## Table of contents

**Opening Ceremony**

FOR A NATURE- AND PEOPLE-POSITIVE FUTURE – BALANCING NATURE, ECONOMY AND SOCIETY, FROM THE BOTTOM UP .......................... 34

**Plenary Monday afternoon**

RE-IMAGINING THE LAWS OF NATURE ........................................ 35
NATURE CONSERVATION WITHIN AGRIBUSINESS: TOOLS, CHALLENGES AND OPPORTUNITIES ............................. 35

**Plenary Tuesday morning**

EIGHT YEARS OF (IN)ACTION TOWARDS THE ATTAINMENT OF THE BIODIVERSITY SDG ......................................................... 37
TOWARDS TRANSDISCIPLINARY CONSERVATION: PARADIGMS, PRACTICES AND PARTNERS ........................................ 37

**Plenary Tuesday afternoon**

INVESTIGATING AND COMMUNICATING CLIMATE CHANGE IMPACTS ON ECOSYSTEM FUNCTION .............................................. 39
FEEL THE FACTS: BRIDGING THE IMAGINATION GAP IN SCIENCE COMMUNICATION WITH ART .............................................. 39

**Plenary Wednesday morning**

IMPACTS OF CONSERVATION AND RESTORATION MEASURES ON DEVELOPMENT AND WELFARE ........................................ 40
THE TIMESCALES OF CLIMATE CHANGE AND THE CHALLENGE FOR GLOBAL BIODIVERSITY ............................................ 40
Plenary Thursday morning

THE TREE OF LIFE AS A FOUNDATION FOR BASIC AND APPLIED RESEARCH .............................................. 42
CONSULTING AND CO-CREATING WITH MOTHER NATURE FOR POSITIVE TRANSFORMATION ................. 42

Advancing our understanding of freshwater ecosystems in the face of anthropogenic change: going beyond biodiversity 44

MEASURING AQUATIC ENVIRONMENTS: UPSCALING SPATIAL RESOLUTION OF BIOTIC INDEX .................. 44
BEYOND RICHNESS DECREASE: THE GLOBAL HUMAN IMPACT ON FRESHWATER COMMUNITIES ................. 44
MULTIPLE STRESS REDUCES THE ADVANTAGE OF PESTICIDE ADAPTATION ........................................... 45
BENEFITS AND ADVERSE IMPACTS OF WETLAND RESTORATION FOR SPECIES REINTRODUCTION .............. 45
FUNCTIONAL DIVERSITY OF FRESHWATER FISH IN THE FACE OF CLIMATE CHANGE ............................... 46
IMPACTS OF EUROPEAN POND TURTLE REINTRODUCTION ON WETLAND FOOD WEBS ............................. 47
DEVELOPMENT OF NEW METHODS TO STUDY GROUNDWATER ECOSYSTEMS IN SWITZERLAND .................. 48
PHYTOPLANKTTONIC DIVERSITY AND TROPHIC LEVELS OF PONDS IN BERTOUA (CAMEROON) ................. 49
WATER CREDITS METHODOLOGY: HYDROLOGICAL REGULATION AND BIODIVERSITY CONSERVATION .......... 49
PREDICTING THE COMBINED EFFECTS OF MULTIPLE STRESSORS AND STRESS ADAPTATION .................... 50

Biodiversity and energy transition at the crossroads 51

DOES THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS NEED TO TRANSITION TOO? ......................... 51
Biodiversity impacts of different renewable energy scenarios in Norway ..................................................... 51
CULTURAL ECOSYSTEM SERVICES IN A RESTORED LIMESTONE QUARRY IN MOMBASA, KENYA .......... 52
THE ENERGY TRANSITION AND MOVING TOWARD NATURE POSITIVE MINING ................................... 53
DAM INDUCED SOCIOECOLOGICAL FRAGMENTATION IN THE HIMALAYA, A BIODIVERSITY HOTSPOT .......... 53
QUANTIFYING BIODIVERSITY IMPACTS OF THE NORWEGIAN ENERGY SYSTEM .................................... 54
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity and the Leave No One Behind: Harnessing Opportunities for Inclusive development</td>
<td>55</td>
</tr>
<tr>
<td>ROLE OF BIODIVERSITY IN SOCIOECONOMIC DEVELOPMENT IN MOROCCO</td>
<td>55</td>
</tr>
<tr>
<td>GENE BANKING FOR CONSERVATION AND UTILIZATION OF AGROBiodiversity IN GEORGIA</td>
<td>55</td>
</tr>
<tr>
<td>MULTIGENERATIONAL DIFFERENCES IN HARVESTING OF WILD EDIBLES IN SOUTH CAUCASUS</td>
<td>55</td>
</tr>
<tr>
<td>PROMISES AND RISKS OF “LEAVING NO ONE BEHIND” IN A FRAGILE BIODIVERSITY CORRIDOR</td>
<td>56</td>
</tr>
<tr>
<td>SOCIAL SOLIDARITY ECONOMY AS AFRICAN AGENTS FOR BIODIVERSITY CONSERVATION</td>
<td>57</td>
</tr>
<tr>
<td>SOCIAL ASSESSMENT TO IMPROVE UNDERSTANDING OF PROTECTED AREAS: LESSONS FROM SAPO</td>
<td>58</td>
</tr>
<tr>
<td>ECO-EMPOWERMENT AND YOUTH-LED DIALOGUE FOR COMMUNITY RESILIENCE</td>
<td>58</td>
</tr>
<tr>
<td>AGROBIODIVERSITY CHARACTERIZATION OF TARO FARMS AS LIVELIHOOD FOR RURAL AREAS</td>
<td>59</td>
</tr>
<tr>
<td>Biodiversity Finance for a Nature Positive Future: Innovations, Challenges, and Opportunities &amp; Sustainable Finance and Biodiversity</td>
<td>61</td>
</tr>
<tr>
<td>LEVERAGING THE BIODIVERSITY INTACTNESS INDEX (BII) WITHIN THE TNFD FRAMEWORK</td>
<td>61</td>
</tr>
<tr>
<td>SAVING SCOTLAND’S RAINFOREST WITH NATURAL CAPITAL FINANCE WITH SO MANY PARTNERS?</td>
<td>61</td>
</tr>
<tr>
<td>OPPORTUNITIES AND BARRIERS TO ACHIEVING ENVIRONMENTALLY SUSTAINABLE INVESTMENTS</td>
<td>62</td>
</tr>
<tr>
<td>ADAPTING MEASUREMENTS AND MONITORING TOOLS FOR TANGIBLE BIODIVERSITY GAINS</td>
<td>63</td>
</tr>
<tr>
<td>COMMUNITIES AND NATURE MARKETS: JUST PARTNERSHIPS FOR BIODIVERSITY CREDITS</td>
<td>63</td>
</tr>
<tr>
<td>SUBNATIONAL ENDOWMENT FUND FOR NATURE AND CLIMATE: MACROFINANCIAL, FISCAL LINKS</td>
<td>64</td>
</tr>
<tr>
<td>DESIGNING A BIODIVERSITY FINANCE DECISION SUPPORT SYSTEM</td>
<td>64</td>
</tr>
<tr>
<td>BIODIVERSITY STEWARDSHIP UNITS TO REWARD CONSERVATION BY FOREST STEWARDS</td>
<td>65</td>
</tr>
<tr>
<td>THE MACRO-CRITICALITY OF NATURE FOR FINANCE</td>
<td>66</td>
</tr>
<tr>
<td>MEASURING BIODIVERSITY FOR THE PURPOSES OF FINANCING CONSERVATION</td>
<td>66</td>
</tr>
<tr>
<td>NAVIGATING NATURE AND CLIMATE RISK: INTEGRATED FRAMEWORK FOR ECONOMIC ASSESSMENT</td>
<td>67</td>
</tr>
<tr>
<td>DEFORESTATION AND BIODIVERSITY RISKS IN AGRICULTURAL COMMODITY FINANCE</td>
<td>67</td>
</tr>
</tbody>
</table>
Biodiversity Finance for a Nature Positive Future: Innovations, Challenges, and Opportunities & Sustainable Finance and Biodiversity

NEW GREEN SHOOTS: EMERGING TRENDS IN NATURE AND SUSTAINABLE FINANCE ........................................ 69
BLUE CARBON FINANCE: COMMUNITY PERCEPTIONS AND SOCIOECONOMIC IMPACT IN KENYA ....................... 69
IDENTIFYING PRIORITY AREAS FOR BLUE CARBON FINANCE DEVELOPMENT IN KENYA .......................... 70

Biodiversity in environmental law – From international frameworks and national legislation to the enforcement of biodiversity through environmental litigation

INTEGRATING PLURALITY IN BIODIVERSITY OFFSETTING AND ALTERNATIVE CONSERVATION ............................ 71
IMPACTS OF LIBERIA’S LAND RIGHTS ACT (LRA) ON BIODIVERSITY CONSERVATION ........................................ 71
MAINSTREAMING REVISITED: HOW SHOULD BIODIVERSITY STRATEGIES STILL HELP US? ............................... 72
LIVING WITH THE INCOHERENT: SILOISM AS CHALLENGE FOR RESTORATION POLICIES ................................. 73
HOW IS BIODIVERSITY ASSESSED AND MONITORED IN EUROPEAN SEAS? - A LITERATURE MAP ..................... 73
BRAZIL’S PATHWAY TO ACHIEVE NET ZERO EMISSIONS WHILE SAFE-GUARDING BIODIVERSITY .......................... 74
HOW THE STATE REDUCES ATTRITION AT THE MEGA BIO-DIVERSE ATEWA FOREST IN GHANA ..................... 74
CHALLENGES IN SWISS BIODIVERSITY GOVERNANCE: THE STAKEHOLDERS’ PERSPECTIVE .......................... 75
RESPONSIBILITY AND TRANSPARENCY IN THE KMGBF: THE SWISS PERSPECTIVE ................................. 76

Biodiversity interactions with earth system processes & Functional diversity in space and time: measurements, models and experiments to advance trait-based ecology

MODELING LAND USE IMPACTS ON PLANT FUNCTIONAL DIVERSITY IN EUROPEAN BIOREGIONS ......................... 77
FUNCTIONAL TRAITS CONTRIBUTING TO COMMUNITY RESPONSES TO NUTRIENT ENRICHMENTS ....................... 77
PHYTOPLANKTON SIZE AND SHAPE ATTRACTOR DYNAMICS OVER ENVIRONMENTAL GRADIENTS ...................... 78
ACUTE VULNERABILITY OF THE GLOBAL SHARK & RAY FUNCTIONAL DIVERSITY ............................................. 79
NATURAL FOREST REGROWTH FOR MITIGATION AND BIODIVERSITY RECOVERY IN PERU ............................. 79
LINKING SPECTRO-FUNCTIONAL VARIABILITY AND AQUATIC PLANT DIVERSITY ........................................... 93

Biodiversity loss and inequality: an interconnected crisis 95
EFFECTS OF ENVIRONMENTAL AND SOCIAL LANDSCAPE ON RAINFOR-
EST FUNCTIONAL INTEGRITY ........................................ 95
ASSESSING ECOCIDE IMPACTS FOR DEVELOPING A CONSERVATION
STRATEGY IN UKRAINE .......................................... 95
POPE FRANCIS’ LAUDATE DEUM: INTEGRAL ECOLOGY AS BIOSPHERIC
SOLIDARITY ................................................................. 96
GALLIFORMES IN ETHIOPIA: POPULATION STATUS AND CONSERVATION
THREATS ....................................................................... 97
UNVEILING VIEWS ON BIODIVERSITY: EDUCATIONAL FRAMEWORKS IN
BRAZIL AND THE US .................................................. 97
ASSESSING INDIGENOUS PEOPLES’ PARTICIPATION IN JOINT FOREST
MANAGEMENT IN INDIA .............................................. 98

Biodiversity values and governance 99
LOCAL GOVERNMENT ROLE IN PROMOTING CIRCULAR ECONOMY-
DRIVEN SOLIDWASTE MANAGEMENT .............................. 99
GOVERNANCE OF HUMAN-WILDLIFE INTERACTIONS IN PERI-URBAN
LANDSCAPES .................................................................. 99
WILD CONVERSATION: READING PUBLIC SENTIMENT TOWARDS RE-
TURNING WILDLIFE IN EUROPE .................................... 100
GOVERNING HYBRIDS: A CASE STUDY OF TROUT CONSERVATION IN
WESTERN NORTH AMERICA ............................................ 100
VALUES AS LEVERAGE POINTS FOR TRANSFORMATIVE CHANGE OF
WETLANDS ...................................................................... 101
BIODIVERSITY VALUES OF THE SWISS PUBLIC ...................... 102
INVOLVING NON-HUMAN STAKEHOLDERS IN WETLAND MANAGEMENT:
HURDLES AND PERSPECTIVES ...................................... 102
PUBLIC PREFERENCES FOR BIODIVERSITY GOVERNANCE IN SWITZER-
LAND ......................................................................... 103

Biodiversity, Biomimicry & Bio-inspired Technology: Mutualisms for Innovation &
Restoration 104
BIOINSPIRATION FROM BATS FOR AUTONOMY IN COMPLEX NATURAL
ENVIRONMENTS .............................................................. 104
PLACE-BASED BIOMIMICRY FUTURES FOR SUSTAINABLE WELLBEING . . 104
BIOMIMICRY AS AN INTERDISCIPLINARY FRAMEWORK FOR BIODIVER-
SITY CONSERVATION .................................................. 105
Biodiversity, Biomimicry & Bio-inspired Technology: Mutualisms for Innovation & Restoration

106

Extracting Engineering Knowledge from Borneo’s Biodiversity

106

Biological invasions: from impacts to solutions - lessons from the IPBES-IAS assessment

107

Urban Forests Threatened by Invasive Species in a Biodiversity Hotspot

107

Climate Change May Reduce Invasion Risk in Southern Africa

107

Coordination and Consistency Needed in US State Invasive Species Policies

108

Population Genomics of a Cosmopolitan Weed

108

Invasion History and Land-use Shape Prevalence of Aliens in Local Assemblages

109

IPBES Thematic Assessment Report on Invasive Alien Species and Their Control

110

Global Summary of Alien Species Impacts: IPBES Report and Where to Go From There

110

Automated Flagging of Potential Alien Occurrences at the Global Database Scale

111

Managing Biological Invasions in the Face of Future Uncertainties

111

Topical Invaders May Restore Lost Ecosystem Functions in Climate Change Hotspots

112

Insularity and Trophic Level Shape Negative, But Not Positive, Impacts of Aliens

113

Global Economic Costs of Biological Invasions

113

IPBES -IAS Assessment - Implications for Countries in Asia

114

The Biogeography and Macroecology of Biological Invasions in the Anthropocene

114

Biological invasions: from impacts to solutions – lessons from the IPBES-IAS assessment

116

Iconnect - Integrative Conyza Network for Contemporary Trait Evolution

116

Perceptions and Realities Post Regulation of IAS Management in Europe

116

Adaptive Ponds for Mitigating Effects of Invasive Crayfish in Western Europe

117

Risk Assessment of Invasive Borer Beetle Impacts on Biodiversity in South Africa

118
RANKING PRIORITY INVASIVE SPECIES IN A TOURIST LOCATION OF WESTERN GHATS, INDIA ............................................................. 118

Bridging scales in soil biodiversity–ecosystem functioning relationships 120
ORGANIC FERTILIZERS IMPROVE SOIL MULTIFUNCTIONALITY IN SUGARCANES AGROECOSYSTEMS ........................................ 120
ENERGY DISTRIBUTION IN SOIL FOOD WEBS OF TEMPERATE AND TROPICAL FORESTS ..................................................... 120
ENERGY FLUXES AND SOIL BIODIVERSITY – AMINO ACID ISOTOPES OPEN UP NEW FRONTIERS ....................................... 121
SOIL METHANOTROPHIC DIVERSITY AFFECTS SOIL-ATMOSPHERE METHANE FLUXES ......................................................... 122
HOW MICROBIAL AND INVERTEBRATE ACTIVITIES SHAPE ALPINE SOIL RESPIRATION .......................................................... 122
SOIL BIODIVERSITY IN PROTECTED, NEAR-NATURAL FORESTS ........ 123
RESTORING SOIL BIODIVERSITY AND FUNCTION THROUGH REWILDING 123
GROUNDCOVER BUFERS THE EFFECT OF CLIMATE CHANGE ON SOIL BIODIVERSITY IN DRYLANDS ............................................ 124
SOIL BIODIVERSITY, PESTICIDES AND ECOSYSTEM FUNCTIONING .... 124
EFFECTS OF URBAN LAND USE ON SOIL FOOD WEB STRUCTURE .... 125

Chemical pollution as a driver of biodiversity decline: data, concepts and policy options127
BIOTRANSFORMATION AS AN INDICATOR OF SPECIES SENSITIVITY TO CHEMICAL POLLUTION .................................................. 127
FICTION AND REALITY IN PESTICIDE RISK ASSESSMENT ..................... 127
INTEGRATING BIODIVERSITY INTO PATHS TO ATTAIN SAFE AND SUSTAINABLE CHEMICAL USE .................................................. 128
ENVIRONMENTAL IMPACTS OF CHEMICALS – BEYOND THE PLANETARY GUARDRAILS? ............................................................. 128
A CRITICAL REVIEW OF EU POLICIES TO PROTECT BIODIVERSITY FROM CHEMICAL POLLUTION ........................................ 129

Closing the social-ecological loop: from principles to practice 131
URGENT NEED TO IMPLEMENT SCIENCE-BASED POLICY TARGETS FOR MARINE BIODIVERSITY .................................................. 131
USING PEER-JUDGEMENT TO EVALUATE SUSTAINABILITY OF HERDING PRACTICES IN MONGOLIA ........................................ 131
UNFOLDING EVIDENCE OF TRANSFORMATIONAL CAPACITIES IN SOCIAL-ECOLOGICAL SYSTEMS ......................................... 132
EFFECTS OF CITIZEN PARTICIPATION ON LOCALS’ MENTAL MODELS TO FOSTER BIODIVERSITY ................................................. 133
INTRODUCING A CLOSING THE LOOP MODEL-TRACKING GREEN COCOA FRAMEWORK FROM GHANA ............................... 133

8
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving Indigenous Australian Knowledges into Natural Resource Management</td>
<td>134</td>
</tr>
<tr>
<td>Improving the Flow from Biodiversity Data to Policy</td>
<td>135</td>
</tr>
<tr>
<td>Building Topical Networks to Ratchet Up EU Biodiversity Commitments</td>
<td>135</td>
</tr>
<tr>
<td>Nisba Framework for Just, Ecological and Transformative Urban Design</td>
<td>136</td>
</tr>
</tbody>
</table>

Combining social, economic and ecological viewpoints in nature's contributions to people (NCP) assessments

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity and Supply of Material NCP in Mount. Kilimanjaro - Tanzania</td>
<td>137</td>
</tr>
<tr>
<td>Combining Social, Ecological and Economic Data to Monitor NCP in Canada</td>
<td>137</td>
</tr>
<tr>
<td>Comparing Results from Mixed Methods to Reveal Social Values in a Swiss Park</td>
<td>137</td>
</tr>
<tr>
<td>Characterizing Generalized and Specialized Nature's Contributions to People</td>
<td>138</td>
</tr>
<tr>
<td>Combining Various Viewpoints in NCP Assessments – The Valpar.ch Project</td>
<td>138</td>
</tr>
<tr>
<td>Lessons from Co-Developing a Multidimensional Biodiversity Index (MBI) for Kenya</td>
<td>139</td>
</tr>
</tbody>
</table>

Conservation science, policy and diplomacy- Notes from the trenches of transdisciplinary research

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensconet: The European Native Seed Conservation Network</td>
<td>141</td>
</tr>
<tr>
<td>Participatory Monitoring Supports Biodiversity Goals in Urban Areas</td>
<td>141</td>
</tr>
<tr>
<td>The Potential of Privately Managed Spaces for Urban Habitat Connectivity</td>
<td>141</td>
</tr>
</tbody>
</table>

Conservation science, policy and diplomacy: Notes from the trenches of transdisciplinary research

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translational Centre Biodiversity Conservation: Connecting Research and Practice</td>
<td>143</td>
</tr>
<tr>
<td>From Knowledge to Impact: Understanding How to Leverage Transformative Change</td>
<td>143</td>
</tr>
<tr>
<td>The Role of Creative Translation in Systems Transition Design</td>
<td>143</td>
</tr>
<tr>
<td>Assessing Use of Global Science-Policy Product in National Biodiversity Policies</td>
<td>144</td>
</tr>
<tr>
<td>Researchers Collaborating with Global Policymakers in International Geneva</td>
<td>145</td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>SUPPORTING CITIES PROGRESS TOWARDS BIODIVERSITY GOALS WITH URBAN LIVING LABS</td>
<td>146</td>
</tr>
<tr>
<td>Converting biodiversity knowledge into actionable knowledge: A glimpse into the new Biodiversity Knowledge governance in Europe</td>
<td>147</td>
</tr>
<tr>
<td>THE FAST EVOLVING LANDSCAPE OF THE BIODIVERSITY KNOWLEDGE GOVERNANCE IN EUROPE</td>
<td>147</td>
</tr>
<tr>
<td>INCLUSIVE AND FUNCTIONAL SCIENCE SERVICE FOR BIODIVERSITY</td>
<td>147</td>
</tr>
<tr>
<td>REFLECTIONS ON BIODIVERSITY KNOWLEDGE GOVERNANCE IN EUROPE</td>
<td>148</td>
</tr>
<tr>
<td>SCIENCE-BASED POLICY SUPPORT AT THE KNOWLEDGE CENTRE FOR BIODIVERSITY</td>
<td>148</td>
</tr>
<tr>
<td>EKLIPSE AND THE EU SCIENCE-POLICY INTERFACE LANDSCAPE</td>
<td>149</td>
</tr>
<tr>
<td>BIODIVERSA+ STRENGTHENING COORDINATION OF BIODIVERSITY MONITORING ACROSS EUROPE</td>
<td>149</td>
</tr>
<tr>
<td>Converting biodiversity knowledge into actionable knowledge: A glimpse into the new Biodiversity Knowledge governance in Europe (by invitation only)</td>
<td>151</td>
</tr>
<tr>
<td>THE EKLIPSE SCIENCE-POLICY PROCESS: BIODIVERSITY AND PANDEMICS AS A CASE STUDY</td>
<td>151</td>
</tr>
<tr>
<td>Coordinated Arctic biodiversity monitoring for informed decision-making</td>
<td>152</td>
</tr>
<tr>
<td>ARCTIC BENTHOS DIVERSITY: PATTERN AND DRIVERS OF ECOLOGICAL CHANGE</td>
<td>152</td>
</tr>
<tr>
<td>SYNTHESIS OF ARCTIC FRESHWATER BIODIVERSITY AND ECOLOGICAL CHANGE</td>
<td>152</td>
</tr>
<tr>
<td>A 20-YEAR PERSPECTIVE ON THE CBMP</td>
<td>153</td>
</tr>
<tr>
<td>CBMP MARINE: KEY FINDINGS, ADVICE AND FOLLOW-UP</td>
<td>154</td>
</tr>
<tr>
<td>CBMP TERRESTRIAL: KEY FINDINGS, ADVICE AND FOLLOW-UP</td>
<td>154</td>
</tr>
<tr>
<td>CBMP COASTAL: ASSESSING BIODIVERSITY USING CO-PRODUCTION</td>
<td>155</td>
</tr>
<tr>
<td>BEYOND THE SAFBR – FUTURE NEEDS FOR ARCTIC FRESHWATER MONITORING</td>
<td>155</td>
</tr>
<tr>
<td>BEAVER IN THE TUNDRA: BIODIVERSITY, FOOD WEBS, AND CONTAMINANTS</td>
<td>156</td>
</tr>
<tr>
<td>Data4Nature: how development banks can share open data to support the Global Biodiversity Framework</td>
<td>158</td>
</tr>
<tr>
<td>THE DATA4NATURE INITIATIVE</td>
<td>158</td>
</tr>
<tr>
<td>GENDIB: A NATIONAL DATABASE ON GENETIC DIVERSITY IN POPULATIONS OF WILD SPECIES</td>
<td>158</td>
</tr>
<tr>
<td>USING A.I. FOR A BETTER UNDERSTANDING OF COMPLEXITY IN ECOSYSTEMS HEALTH</td>
<td>159</td>
</tr>
<tr>
<td>SIB COLOMBIA: ENGAGING THE BUSINESS SECTOR FOR DATA MOBILIZATION</td>
<td>160</td>
</tr>
</tbody>
</table>
EMBEDDING OPEN DATA SHARING PRACTICES ACROSS PROJECTS - EBRD 160
DATA4NATURE: THE CONSULTANT’S PERSPECTIVE ............................... 161
OPEN DATA FOR BIODIVERSITY IN CAMBODIA ................................. 161

Digital Twin applications to foster actions for biodiversity conservation 163
BRIDGING THE GAP: DIGITAL TWINS AND SOCIAL INNOVATION IN COASTAL COMMUNITIES ................................................................. 163
DIGITAL TWIN TECHNOLOGIES FOR SUSTAINABILITY IN IRISH HORTICULTURE FARMING ................................................................. 163
THE POWER OF DIGITAL TWINS: REAL-TIME EVIDENCE-BASED BIODIVERSITY CONSERVATION ................................................................. 164
ADAPTING THE DIGITAL TWIN PARADIGM TO THE REQUIREMENTS OF BIODIVERSITY ................................................................. 164
LTER-LIFE: DEVELOPING DIGITAL TWINS OF ECOSYSTEMS IN A CHANGING WORLD ................................................................. 165
COMBINE BIODIVERSITY KNOWLEDGE IN DIGITAL TWIN APPLICATIONS FOR NOVEL INSIGHTS ................................................................. 166
DESIGN FRAMEWORK FOR DYNAMIC DATA-DRIVEN DIGITAL TWINS IN ECOLOGY ................................................................. 166
A DIGITAL TWIN OF GRASSLAND ECOSYSTEMS ........................................ 167
A COMMON TOOL FOR ESSENTIAL BIODIVERSITY VARIABLES FROM MARINE PLANKTON DATA ................................................................. 167
DIGITAL TWINS - POTENTIALS AND CHALLENGES IN THE CONTEXT OF HONEY BEE VITALITY ................................................................. 168
DIGITAL TWIN EMPOWERED BIODIVERSITY CONSERVATION: SUSTAINABLE FOREST MANAGEMENT ................................................................. 169
FAIR DATA AND MODELS IN BIODT: POWERING BIODIVERSITY DIGITAL TWINS ................................................................. 169

Effects of biodiversity on climate- micro and macro scale 171
POLLUTION AND CARBON REDUCTION CONTRIBUTES TO ORGANISMS DIVERSITY CONSERVATION ................................................................. 171
SHORT-TERM MULTIPLE RESOURCE ADDITIONS REDUCE SOIL FUNGAL DIVERSITY IN STEPPE ................................................................. 171

Effects of biodiversity on climate: micro and macro scale 173
MICROCLIMATIC NICHES PREDICT LONG-TERM SURVIVAL TRENDS OF HIMALAYAN BIRDS ................................................................. 173
FEEDBACK LOOPS BETWEEN BIODIVERSITY AND MICROCLIMATE AT FOREST EDGES ................................................................. 173
A NEW OBSERVATIONAL STRATEGY FOR MONITORING THERMAL FLUXES ACROSS FORESTS TYPES ................................................................. 174
THE INFLUENCE OF NATURE FUTURES BIODIVERSITY SCENARIOS ON REGIONAL CLIMATE ........................................ 174
TREE DIVERSITY INCREASES FOREST TEMPERATURE BUFFERING .... 175

Enabling, Assessing, and Scaling the Value of Native Pollination for Global Prosperity177
PREDICTING WILLINGNESS TO PAY FOR BIRD AND MAMMAL SPECIES 177
ALTERNATIVE BIODIVERSITY METRICS IMPACT SPATIAL DISTRIBUTION OF INVESTMENTS .......................... 177
HETEROTRIGONA ERYTHOGASTRA (CAMERON, 1902) NEW DISTRIBUTION RECORDS IN THAILAND .................. 178
CHINESE STINGLESS BEE HONEYS: QUALITY STANDARDS VIA PHYSICO-CHEMICAL PARAMETERS .................. 179

Enhancing Urban Biodiversity through Blue-Green Infrastructure: A Multidisciplinary Approach 180
Biodiversity Conservation: Toward Collaborative Management of Blue-Green Areas .......................... 180
Advancing Urban Resilience: A Science-Design Loop for Blue-Green Infrastructure .......................... 180
Unveiling Urban Aquatic-Terrestrial Arthropod Community Structures with EDNA .................. 181
Conserving Urban Biodiversity: Waterbody Rejuvenation Harit Pond Noida, India .......................... 182
Planning for Diversity: Nature-Friendly Standards in Local Land Use Regulations .......................... 182
The Role of Urban Mini-Forest: Shaping Avian Diversity, Harit UPVan Sorkha India .......................... 183
Considering a Range of Criteria for Sustainable Roofs: PV, Green Roofs, or Both? .......................... 183
Urban Biodiversity Trends Under Scenarios of Climate Change and Urbanisation .......................... 184
Intentional Multifunctionality of Urban Green Infrastructure ................................................................. 185
Swiss Urban Habitat Mapping Using Lidar Point Clouds and Airborne Imagery .......................... 185
Complementing 30X30: Towards Sustainable Coexistence in the Remaining 70% .......................... 186

Genomic solutions for biodiversity conservation: translating cutting-edge research into action 187
Using a Genomic Approach to Inform Assisted Gene Flow in Araucaria Araucana .................................. 187
GENOMICS FOR SUSTAINABLE AGRO-DIVERSITY FROM FERTILE CRESCENT ........................................... 187
ECOLOGICAL DISTURBANCE REDUCES GENOMIC DIVERSITY IN ALPINE WHITEFISH RADIATION .......................... 188
USING ENVIRONMENTAL NUCLEIC ACIDS (ENA) TO ASSESS ENVIRONMENTAL HEALTH ........................................ 189
USING GENOMICS TO PREDICT ADAPTATION TO CLIMATE CHANGE ........................................ 189
ISOPHYA RIZEENSIS: ENVIRONMENTAL ADAPTATIONS AND GENETIC CORRELATIONS ........................................ 190
ADVANCED GENOMIC BIOMONITORING OF LENTIC WATERS WITH PASSIVE EDNA SAMPLING ....................... 191
REVEALING THE CASCADE OF PESTICIDE EFFECTS FROM GENE TO COMMUNITY ........................................ 191
CLIMATE GENOMICS TO SUPPORT FISHERIES MANAGEMENT IN THE SOUTHERN OCEAN ........................................ 192
GENETICS OF BROWN BEARS INFORMS ADAPTATION TO HUMAN-DOMINATED LANDSCAPES ............................... 193
GENOMIC MONITORING TOOLS FOR POLLINATOR BIODIVERSITY CONSERVATION ........................................ 193
CONSERVATION GENOMICS OF ANODONTA FRESHWATER MUSSELS IN SWITZERLAND .................................... 194
ARTHROPOD GENOMICS BIODIVERSITY: MOLTING DYNAMICS IN CHANGING ENVIRONMENTS ............................... 195
THE CONSERVATION OF FOREST GENETIC RESOURCES THROUGH GENETIC DIVERSITY ANALYSIS ............................ 196
GENOMIC INSIGHTS INTO THE DECLINE AND RESILIENCE OF GRAYLING IN SWITZERLAND ........................................ 196
A RAPID ISOThermal PLANT DNA IDENTIFICATION PROTOCOL USING MICRONEEDLE PATCHES ............................... 197
AN EASY-TO-USE TOOLKIT FOR MANAGERS USING GENOMICS IN BIODIVERSITY CONSERVATION ....................... 197
SIMULATIONS FOR MANAGEMENT DECISIONS: THE CASE OF THE ALPINE IBEX ........................................ 198
EPiGENETIC SEX IDENTIFICATION IN ALDABRA GIANT TORTOISES ........................................ 199
DEVELOPMENT AND UTILIZATION OF IN-SITU CONSERVATION METRICS ........................................ 199
RESILIENT GENOMES, SUSTAINABLE ECOSYSTEMS: INSIGHTS FROM THE IBERIAN HARE ........................................ 200
CAN CONSERVATION GENOMICS GUIDE SPECIES RECOVERY? ........................................ 201
EXPLOITATION OF SOYBEAN GENETIC DIVERSITY FOR ITS IMPROVEMENT ........................................ 201
MONITORING GENETIC DIVERSITY: A GENOMICS-BASED PILOT STUDY FOR SWITZERLAND ............................... 202
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance in protected areas and local livelihoods</td>
<td>203</td>
</tr>
<tr>
<td>HOW HUMAN-ELEPHANT RELATIONS ARE SHAPED: A CASE STUDY IN XISHUANGBANNA, CHINA</td>
<td></td>
</tr>
<tr>
<td>UNLOCKING OECM POTENTIAL WITH INCLUSIVE GOVERNANCE: A FRESH APPROACH FOR NEPAL</td>
<td></td>
</tr>
<tr>
<td>RURAL TOURISM, COMMUNITIES AND TERRITORY: OPPORTUNITIES TO FACE CLIMATE CHANGE</td>
<td>204</td>
</tr>
<tr>
<td>ECOCENTRIC GOVERNANCE IN ACTION</td>
<td></td>
</tr>
<tr>
<td>IMPACT OF INSTITUTIONAL REFORM ON THE MANAGEMENT EFFICIENCY OF NNR-RAA</td>
<td>205</td>
</tr>
<tr>
<td>AREA-BASED BIODIVERSITY CONSERVATION AND ITS' CONSEQUENCE</td>
<td>206</td>
</tr>
<tr>
<td>TRADE-OFFS BETWEEN LOCAL, REGIONAL &amp; NATIONAL PROTECTED AREA PRIORITISATIONS</td>
<td></td>
</tr>
<tr>
<td>Green and brown food webs &amp; Understanding biodiversity and ecosystem functioning across ecosystem boundaries</td>
<td>208</td>
</tr>
<tr>
<td>STRANGE TIMES IN THE NORTH SEA: MARINE HEATWAVES AND FOOD WEB INTERACTIONS</td>
<td>208</td>
</tr>
<tr>
<td>CAN ARTIFICIAL FLOODS RESTORE CROSS-ECOSYSTEM LINKAGES?</td>
<td></td>
</tr>
<tr>
<td>RIPARIAN FORESTS SHAPE TROPHIC INTERACTIONS IN DETRITAL STREAM FOOD WEBS</td>
<td>209</td>
</tr>
<tr>
<td>QUANTIFYING SEASONALITY OF META-ECOSYSTEM FLUXES IN TEMPERATE ECOSYSTEMS</td>
<td>210</td>
</tr>
<tr>
<td>SHIFTS IN MICROBIAL DIVERSITY AND FUNCTIONS DURING CATCHMENT SUCCESSION</td>
<td>210</td>
</tr>
<tr>
<td>BEAVER ENGINEERED HABITATS LINK LAND-WATER ECOSYSTEMS</td>
<td>211</td>
</tr>
<tr>
<td>CHANGE IN FISH FEEDING GUILDS ACROSS MARINE ECOSYSTEMS</td>
<td>212</td>
</tr>
<tr>
<td>RIPARIAN ZONES: KEY-ELEMENTS FOR TERRESTRIAL &amp; FRESHWATER BIODIVERSITY</td>
<td>212</td>
</tr>
<tr>
<td>CROSS-BORDER DIVERSITY AND BIOMASS: PHYTOPLANKTON DYNAMICS IN THE WADDEN SEA</td>
<td>213</td>
</tr>
<tr>
<td>INVASIVE SPECIES DRIVE CROSS-ECOSYSTEM EFFECTS WORLDWIDE</td>
<td>214</td>
</tr>
<tr>
<td>MULTIPLE STRESSOR EFFECTS ON STREAM BENTHIC COMMUNITIES, FOOD WEBS AND PROCESSES</td>
<td>214</td>
</tr>
<tr>
<td>TERRESTRIAL LAND COVER SHAPES FISH DIVERSITY IN MAJOR SUBTROPICAL RIVERS</td>
<td>215</td>
</tr>
<tr>
<td>WARMING UNDERPINS COMMUNITY TURNOVER IN FRESHWATER AND TERRESTRIAL COMMUNITIES</td>
<td>216</td>
</tr>
<tr>
<td>EFFECTS OF DIVERSITY AND WARMING ON LEAF LITTER DECOMPOSITION IN MESOCOSMS</td>
<td>216</td>
</tr>
</tbody>
</table>
Green and brown food webs & Understanding biodiversity and ecosystem functioning across ecosystem boundaries

THE SYMBIOSIS OF ECOSYSTEMS IN THE SANTA MARIA WATERSHED

SPLITTING UP E-DNA: OPPORTUNITIES FOR A MORE RELIABLE BIODIVERSITY MONITORING

CONSERVING ORINOQUIA: A DYNAMIC MOSAIC OF ECOSYSTEM MANAGEMENT

THREATENED BIRDS IN SAUDI ARABIA: THEIR CONSERVATION REQUIREMENTS

How to balance biodiversity and forest management?

MANAGING FORESTS TOWARDS BIODIVERSITY OR NET ZERO GOALS? A SWISS CASE STUDY

USING BIODIVERSITY TO IMPROVE FOREST MANAGEMENT

REVIVING PEDUNCULATE OAK: CLIMATE-CHANGE INDUCED FOREST MORTALITY AS NEW CHANCE?

FOREST ASSOCIATED FRESHWATER ORGANISMS THE SCALE OF THE CONTINENTOUS US

GLOBAL IMPACTS OF FOREST MANAGEMENT AND RESTORATION ON BIODIVERSITY OVER TIME

BIODIVERSITY IN BARK BEETLE-DISTURBED MOUNTAIN PROTECTIVE FORESTS

A BIODIVERSITY INDEX TO ASSESS THE SPATIAL CONNECTIVITY OF HABITAT TREES

SPIDER COMMUNITIES AS INDICATORS OF LAND-USE CHANGE IN GHANA

OPTIMAL CONTROL STRATEGIES FOR MITIGATING BARK BEETLE OUTBREAKS

Insights from the past for a better future

ASSESSING THE RISING ECOSYSTEM NOVELTY OF THE ANTHROPOCENE BIOSPHERE

HIGH-PRECISION MAMMAL MASS FROM SKELETAL REMAINS USING FUTRES ONTOLOGY DATABASE

UNRAVELING THE ROLE OF TEMPERATURE IN NEOSELACHIAN EXTINCTION EVENTS

RECONSTRUCTING HISTORICAL FISH RECORDS IN LAKES USING SEDIMENTARY DNA

ORDINATION OF EURASIAN MAMMAL COMMUNITY STRUCTURES PAST, PRESENT AND FUTURED FUTURE

ALIGNING PALEOBIOLOGY RESEARCH WITH CONSERVATION PRIORITIES: A SHARK PERSPECTIVE

FOSSIL ASSEMBLAGES SHOW NO TEMPORAL TRENDS IN LOCAL SPECIES RICHNESS
MODELING THE PAST PRESENT AND FUTURE OF BIODIVERSITY USING AI

CLIMATE CHANGE IS AN IMPORTANT PREDICTOR OF EXTINCTION RISK
ON LONG TIMESCALES .................................................. 232

PAST AND FUTURE GLOBAL DIVERSITY LOSS FROM ANTHROPOGENIC
BIRD EXTINCTIONS ..................................................... 233

THE MULTIFACETED NATURE OF THE AFRICAN MEGAHERBIVORES DE-
CLINE ................................................................. 233

OCEANIC FISH COMMUNITY ECOLOGICAL AND EVOLUTIONARY DYNAM-
ICS IN A HOTHOUSE WORLD ........................................ 234

UNDERSTANDING HOW PALEOENVIRONMENTAL UNCERTAINTY AF-
FECTS ECO-EVOLUTIONARY MODELS ............................ 235

BIODIVERSITY BIOMASS INTERACTIONS IN LEADING AND TRAILING BO-
REAL FOREST EDGES ................................................ 235

POLAR ECOSYSTEMS EVOLUTION: INSIGHTS FROM THE ORDOVICIAN OF
MOROCCO AND FRANCE .............................................. 236

DROUGHT, FIRE AND EXTINCTION IN THE LATEST PLEISTOCENE, CAL-
IFORNIA, USA ........................................................... 236

AGE-DEPENDENT EXTINCTION IN MODERN SHARKS, RAYS AND SKATES
(NEOSELACHII) ......................................................... 237

PAST CLIMATE ANALOGUES TO UNRAVEL FUTURE: INSIGHT FROM THE
FORAMINIFERAL RECORD ............................................. 238

PAST RECORDS DEFINE SPECIES RECOVERY BASELINES AND IMPROVE
FUTURE PROJECTIONS ................................................ 239

ESTIMATING EXTINCTION VULNERABILITY USING INTRINSIC RISK AND
CURRENT THREATS ................................................... 239

Insights from the past for a better future ........................................... 241

HARNESSING HISTORICAL DATA SOURCES FOR THE CONSERVATION OF
AFRICAN BIRDS ........................................................ 241

UNDERSTANDING BIODIVERSITY OF ANCIENT ECOSYSTEMS THROUGH
DECAY EXPERIMENTS ................................................. 241

MOULTING IN ARTHROPODS: FROM DEEP TIME TO THE PRESENT DAY . 242

THE MIDDLE TRIASSIC ECOSYSTEMS AS A LABORATORY FOR MARINE
FOOD WEB RESEARCH ................................................ 242

CANOPY RESPONSE TO GREENHOUSE WARMING AT THE PALEOCENE-
EOCENE THERMAL MAXIMUM ...................................... 243

EVALUATING SPECIES' POTENTIAL TO PERSIST AND DIVERSIFY USING
THE SHARK PHYLOGENY ............................................. 244

THE EVOLUTION OF GIGANTISM IN THE OCEANS: FROM BALEEN
WHALES TO WHALE SHARKS ....................................... 244
Integrating earth observations and biological tools in ecology and evolution to co-generate knowledge towards meeting the Kunming-Montreal Global Biodiversity Framework targets

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>246</td>
</tr>
<tr>
<td>A GLOBAL HORIZON SCAN OF EMERGING INNOVATIONS IN ANIMAL MOVEMENT ECOLOGY</td>
</tr>
<tr>
<td>21ST-CENTURY MAMMAL EXTINCTION RATES EXCEED 10 E/MSY IN ALL ECOREGIONS</td>
</tr>
<tr>
<td>COMPARING SPECIES RICHNESS AND INTACTNESS BIODIVERSITY FOOTPRINT INDICATORS</td>
</tr>
<tr>
<td>WHERE TO CONSERVE AND USE MARULA TREE SUBSPECIES TO RESTORE GLOBAL DRYLANDS?</td>
</tr>
<tr>
<td>PLANT TRAIT-BASED METHODS TO MAP FOREST BIODIVERSITY FROM OPTICAL IMAGERY</td>
</tr>
<tr>
<td>BIOSCAPE: EARLY RESULTS FROM THE BIODIVERSITY SURVEY OF THE CAPE</td>
</tr>
<tr>
<td>GALAXY PLATFORM FOR DATA PROCESSING AND ANALYSIS ACROSS ENVIRONMENTAL SCIENCES</td>
</tr>
<tr>
<td>SCIENCE BASED APPROACHES FOR CONSERVATION PRIORITISATION AND TARGET SETTING</td>
</tr>
<tr>
<td>EXPLORING ARBOREALITY RELATION TO GLOBAL FORESTS STRUCTURE FROM SPACE</td>
</tr>
<tr>
<td>TRAIT-BASED METHOD TO MONITORING GRASSLAND SPECIES DIVERSITY USING UAV DATA</td>
</tr>
<tr>
<td>ESA ROADMAP FOR ADVANCING EO IN BIODIVERSITY SCIENCE AND MONITORING</td>
</tr>
<tr>
<td>REMOTE SENSING OF BIODIVERSITY ACROSS SPATIAL AND ORGANIS-MAL SCALES</td>
</tr>
<tr>
<td>HARNESSING AI AND REMOTE SENSING TO FOSTER HIGH RESOLUTION HABITAT MAPPING</td>
</tr>
<tr>
<td>NASA-USAID SERVIR: CO-DEVELOPING EO SERVICES FOR IMPROVED ECOSYSTEM MANAGEMENT</td>
</tr>
<tr>
<td>MONITORING AND MANAGING THE SPATIAL GENETICS OF PLANT COMMUNITIES</td>
</tr>
</tbody>
</table>

Integrating mountains in the Kunming-Montreal Global Biodiversity Framework: monitoring, research, and engagement in regional and global policy processes

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>256</td>
</tr>
<tr>
<td>TARGET 6 OF THE GBF IN MOUNTAINS: THE IPBES INVASIVE ALIEN SPECIES ASSESSMENT</td>
</tr>
<tr>
<td>CLIMATE CHANGE AND TRADITIONAL AGROBIODIVERSITY IN HIMALAYA: WOMEN'S PERCEPTION</td>
</tr>
<tr>
<td>HARNESSING KUNMING-MONTREAL GBF MECHANISMS TO ELEVATE MOUNTAIN BIODIVERSITY</td>
</tr>
</tbody>
</table>
UNDERSTANDING PAST AND PRESENT MOUNTAIN BIODIVERSITY TO NAVIGATE THE FUTURE ........................................... 258
MOUNTAIN BIODIVERSITY IN POLICY PROCESSES: MONITORING, RESEARCH, AND REPORTING ........................................... 258

Knowledge gaps and research avenues to leverage Nature-based Solutions (NbS) as a tool to mitigate and adapt to climate change 260
RETROFITTING URBAN NATURE-BASED SOLUTIONS FOR BIODIVERSITY AND PERMEABILITY ........................................... 260
URBAN GREEN SPACE MANAGEMENT, GIS MAPPING OF URBAN BIODIVERSITY ON GREEN ROOFS ........................................... 260
CAN THE SELECTION OF CLIMATE-RESILIENT OAK SEED SOURCES CONTRIBUTE TO NbS? ........................................... 261
NbS: UNDERSTANDING ACTOR POSSIBILITIES IN HISTORICALLY SCALED SYSTEMS ........................................... 262
MICROBIAL RESISTANCE AND RESILIENCE TO DROUGHT IN CONTRASTING CROPPING SYSTEMS ........................................... 262
NATURE-BASED SOLUTIONS AND JUSTICE: WHAT NEXT AND FOR WHOM? 263
DIVERSE FORESTS AS NbS FOR CLIMATE CHANGE MITIGATION AND Ecosystem services ........................................... 264
LAND COVER AND PRECIPITATION SEASONALITY PREDICT SOIL MICROBIAL TRAITS ........................................... 264
USING CLIMATE-READY NATURE-BASED SOLUTIONS TO SAFEGUARD MARINE BIODIVERSITY ........................................... 265
PROTECTING INDIGENOUS LIVELIHOOD IN THE AMIDST OF CLIMATE CHANGE IN TANZANIA ........................................... 266
THE ROLE OF RENEWABLE ENERGIES IN AZERBAIJAN ........................................... 266
THE ITALIAN NATIONAL BIODIVERSITY FUTURE CENTER CONTRIBUTION TO NbS ........................................... 267
NATURE, CLIMATE, HUMAN SOCIETY - COUPLED SYSTEMS IN MULTIPLE CRISIS ........................................... 268

Learning from existing national approaches to monitoring changes in forest biodiversity worldwide to increase their effectiveness 269
BIODIVERSITY IN FINLAND ........................................... 269
NATIONAL BIODIVERSITY MONITORING IN FORESTS (NABIOWALD), A INITIATIVE IN GERMANY ........................................... 269
OVER 30 YEARS OF SOIL BIODIVERSITY MONITORING IN GERMANY – TRENDS AND DRIVERS ........................................... 270
FOREST ASSESSMENT FROM A NATURE CONSERVATION PERSPECTIVE USING REMOTE SENSING ........................................... 271
TOWARD COLLABORATIVE PROTECTED AREA MANAGEMENT: LESSONS FROM SAPO NATIONAL PARK ........................................... 271
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigating artificial light at night (ALAN) for biodiversity and human well-being:</td>
<td>273</td>
</tr>
<tr>
<td>state-of-the-art and future avenues</td>
<td></td>
</tr>
<tr>
<td>SBB REDUCES LIGHT EMISSIONS AT ITS RAILWAY STATIONS</td>
<td></td>
</tr>
<tr>
<td>IMPACTS OF COMBINED STREETLIGHT PROPERTIES ON NOCTURNAL FLIGHT-ACTIVE INSECTS</td>
<td>273</td>
</tr>
<tr>
<td>RESPONSES OF NOCTURNAL INSECTS AND BATS TO SHORT-TERM EXPOSURE OF LIGHT AND DARK</td>
<td>274</td>
</tr>
<tr>
<td>IMPACT OF ARTIFICIAL LIGHT COLOUR ON STRESS, WELLBEING AND THE FEELING OF SAFETY</td>
<td>274</td>
</tr>
<tr>
<td>TOWARDS SUSTAINABLE LIGHTING ALONG FRESHWATER ECOSYSTEMS</td>
<td>275</td>
</tr>
<tr>
<td>INVESTIGATING THE EFFECTS OF ROAD LIGHTING ON FLYING INSECTS IN NORWAY</td>
<td>276</td>
</tr>
<tr>
<td>Modelling biodiversity and ecosystem services (BES) loss scenarios to advance resilience (BES micro-scenarios)</td>
<td>277</td>
</tr>
<tr>
<td>GLOBAL RESPONSES IN BIODIVERSITY AND ECOSYSTEM SERVICES TO LAND USE CHANGE</td>
<td>277</td>
</tr>
<tr>
<td>ASSESSMENT OF FUTURE LAND USE AND CLIMATE RISKS FOR BIODIVERSITY IN EUROPE</td>
<td>277</td>
</tr>
<tr>
<td>NORMATIVE SCENARIOS OF LANDSCAPE CHANGE FOR NATURE-POSITIVE FUTURES IN PERU</td>
<td>278</td>
</tr>
<tr>
<td>CLIMATE CROSSROADS: FUTURES FOR PEOPLE &amp; NATURE IN CENTRAL BELIZE</td>
<td>278</td>
</tr>
<tr>
<td>A NATURE-BASED SOLUTIONS FRAMEWORK FOR MANAGING NATURAL CATASTROPHE RISKS</td>
<td>279</td>
</tr>
<tr>
<td>Models and scenarios for biodiversity &amp; NCP at regional to global scales</td>
<td>280</td>
</tr>
<tr>
<td>BAYESIAN MODELING FOR STRATEGIC BLUE, GREEN, AND GRAY INFRASTRUCTURE PLANNING</td>
<td>280</td>
</tr>
<tr>
<td>ADVANCING THE IMPACT OF FUTURE SCENARIOS BY INTEGRATING PSYCHOLOGICAL PRINCIPLES</td>
<td>280</td>
</tr>
<tr>
<td>FUTURE FOOD SYSTEMS COMPATIBLE WITH AGRICULTURAL BOUNDARIES FOR BIODIVERSITY</td>
<td>281</td>
</tr>
<tr>
<td>MODEL OF CARBON-NEUTRALITY TRAJECTORY COMPATIBLE WITH BIODIVERSITY, IN ARGENTINA</td>
<td>282</td>
</tr>
<tr>
<td>MAPPING POLLINATION DEMAND AND SUPPLY GLOBALLY</td>
<td>282</td>
</tr>
<tr>
<td>MODELING BIODIVERSITY LOSSES TO THE PRESENT IN SOUTH AMERICA AND AFRICA</td>
<td>283</td>
</tr>
<tr>
<td>ATTRIBUTING FUTURE BIODIVERSITY CHANGE TO PROCESSES AND DRIVERS IN THE ALPS</td>
<td>283</td>
</tr>
<tr>
<td>FUTURE GLOBAL CHANGE IMPACTS ON EUROPEAN INVERTEBRATE GROUPS AND ASSOCIATED NCP</td>
<td>284</td>
</tr>
</tbody>
</table>
KESHO: A PARTICIPATORY LAND USE MODEL APPLIED NATIONALLY TO LOCALLY ................................................................. 299
EBVS AND EESVS FOR BIODIVERSITY CONSERVATION AND SUSTAINABLE DEVELOPMENT GOALS ........................................... 299
A MATHEMATICAL PERSPECTIVE ON THE SHARING OF BIODIVERSITY-RELATED MODELS .............................................. 300
EVALUATING THE IMPACTS OF DIFFERENT FUTURE SCENARIOS ON NCP IN SWITZERLAND ................................................. 300

Nature conservation to mitigate biodiversity loss and climate crises 302
EMPOWERING MPAS: A GLOBAL REPOSITORY OF CLIMATE CHANGE ADAPTATION ACTIONS .............................................. 302
COMMUNITY-BASED CONSERVATION AIDS CLIMATE RESILIENCE IN MOUNTAIN COMMUNITIES ........................................ 302
KOSOVO’S PROTECTED AREAS AND ANTHROPOGENIC PRESSURES .... 303
A CENTURY OF REWILDING: IMPACTS ON MOUNTAIN PLANT COMMUNITIES .............................................................. 304
HOW CAN REINTRODUCTIONS OF THREATENED SPECIES MITIGATE BIODIVERSITY LOSS? .................................................. 304
NORMATIVE SCENARIOS FOR EFFECTIVELY MITIGATING BIODIVERSITY LOSS ................................................................. 305
BRINGING AQUATIC FUNGI INTO CONSERVATION: THE BIODIVERSA+ PROJECT FUNACTION .............................................. 306
ENHANCING BIODIVERSITY-INCLUSIVE EIA FOR SUSTAINABLE DEVELOPMENT ........................................................................ 307
WHERE TO RESTORE NATURE TO MAXIMIZE SYNERGIES? .......... 307
OPPORTUNITIES AND CHALLENGES TO CO-MANAGEMENT IN A BIODIVERSITY HOTSPOT .................................................. 308
IMPLICATIONS OF HUMAN LAND COVER CHANGE IN PROTECTED AREAS FOR THE 30X30 TARGET ........................................... 308
QUANTIFYING THE RISK AND THREAT OF Paddock TO TERRESTRIAL ECOSYSTEMS ......................................................... 309
BROADENING AREA-BASED CONSERVATION TO SAFEGUARD HUMAN WELLBEING AND BIODIVERSITY .................................... 309
PLANGEA WEB: DECISION SUPPORT PLATFORM TO ECOSYSTEM CONSERVATION AND RESTORATION ................................. 310
CONTRIBUTION TO THE CONSERVATION OF FUNGAL DIVERSITY IN BENIN ................................................................. 311
NATURE BASED SOLUTIONS FOR CONSERVATION OF MT ELGON FOREST ECOSYSTEM ...................................................... 311
LONG-TERM REWILDING ENHANCES GRASSLAND BIODIVERSITY COMPARED TO ALPINE PASTURES ........................................ 312
CLIMATE CHANGE VULNERABILITY OF WESTERN PALEARCTIC BIODIVERSITY HOTSPOTS .................................................. 313
A CENTURY OF REWILDING AFFECTS MOUNTAIN BIODIVERSITY AT DIFFERENT SPATIAL SCALES .......................................................... 313
DIALOGUE WITH LANDOWNERS A KEY TO SPECIES CONSERVATION ... 314
PLANT DIVERSITY OF THE PROTECTED STEPPE AREAS: A CASE STUDY IN EAST UKRAINE ............................................................... 314
HUMAN-WILDLIFE COEXISTENCE: TRACKING ANIMALS DURING PANDEMIC LOCKDOWNS .......................................................... 315
A PROVINCE-LEVEL SPECIES PROTECTION INDEX TO ASSESS CONSERVATION AREA EFFICACY .................................................. 316

Nature-Based Solutions for Reinforced Disaster Risk Management 317
RESILIENCE ACTION PLAN FOR SANTA MARIA WATERSHED ........... 317
THE ROLE OF NATURAL INFRASTRUCTURE IN DISASTER RISK MITIGATION ................................................................. 317
EVERY CLOUD HAS A SILVER LINING: EMBRACING THE REALITY OF CLIMATE CHANGE ...................................................... 318
NBS IN WATER CREDITS A SOLUTION FOR DISASTER RISK MANAGEMENT: 318
ADOPTION OF BIOFORTIFIED WHEAT TO MITIGATE THE EFFECT OF CLIMATE CHANGE ......................................................... 319
NATURE-BASED SOLUTIONS FOR COASTAL RESILIENCY: CASE STUDIES FROM CANADA .......................................................... 320
Biodiversity and Climate Change Over Enkangala Escarpment of South Africa ................................................................. 320
SOYBEAN: A NATURAL SOLUTION TO MITIGATE CLIMATE CHANGE, AND ENSURE FOOD SECURITY .................................................. 321

Navigating the social and political dimensions of biodiversity data 323
HUMAN-WOLF DYNAMICS THROUGH MULTISPECIES ETHNOGRAPHY AND SPATIO-TEMPORAL DATA ...................................... 323
QUANTIFYING BIAS AGAINST INTRODUCED SPECIES IN THE SCIENTIFIC LITERATURE .......................................................... 323
CAMBIO: TRANSFORMATIVE CHANGE FOR BIODIVERSITY MONITORING IN LATIN AMERICA .................................................. 324
Biodiversity Data Across Borders .................................................... 325

Old gaps and new solutions for global biodiversity monitoring and decision-support 326
QUANTIFYING THE VALUE OF INFORMATION IN MARINE CONSERVATION MANAGEMENT .................................................. 326
IDENTIFYING KNOWLEDGE GAPS WITH ADJACENCY MATRICES: THE CASE OF GBF .............................................................. 326
MONITORING AERIAL BIOMASS AT YOUR FINGERTIPS .................. 327
BIOMONDO - EARTH OBSERVATION SUPPORTED MONITORING OF FRESHWATER BIODIVERSITY .................................................. 328

22
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toward Decision-Relevant Information to Achieve the 2030 Biodiversity Goals</td>
<td>328</td>
</tr>
<tr>
<td>An Active Learning Based Monitoring Strategy for Biodiversity and Conservation</td>
<td>329</td>
</tr>
<tr>
<td>Understanding Biodiversity Responses to River Drying Across Europe</td>
<td>330</td>
</tr>
<tr>
<td>Innovative Participatory Bioacoustic Monitoring in Colombian Ecosystems</td>
<td>331</td>
</tr>
<tr>
<td>Biodiversity Monitoring for Effective Agricultural Policy and Transformation</td>
<td>331</td>
</tr>
<tr>
<td>French Biodiversity E-Infrastructure: From EBV Operationalization Pilot to GBIOS</td>
<td>332</td>
</tr>
<tr>
<td>Optimising Monitoring Approaches for Biodiversity Recovery</td>
<td>333</td>
</tr>
<tr>
<td>Realising the Potential of AI-Assisted Cameras for Global Monitoring of Insects</td>
<td>333</td>
</tr>
<tr>
<td>Citizen Science Enabled Monitoring of Avian Trends and Distributions</td>
<td>334</td>
</tr>
<tr>
<td>Advancing Insect Monitoring through Camera Traps and Artificial Intelligence</td>
<td>335</td>
</tr>
<tr>
<td>Combining Remote Sensing and Citizen Science Data to Derive Forest Biodiversity</td>
<td>335</td>
</tr>
<tr>
<td>From Global Goals to National Actions Using the RED to GREEN Framework</td>
<td>336</td>
</tr>
<tr>
<td>Capturing Gaps and Biases to Support Prioritized Biodiversity Data Mobilization</td>
<td>336</td>
</tr>
<tr>
<td>Blind Spots and Overlaps: Portrait of Biodiversity Indicators in Time and Space</td>
<td>337</td>
</tr>
<tr>
<td>Bridging Monitoring and Decision Support for Range Expanding Species</td>
<td>337</td>
</tr>
<tr>
<td>Mobilization and Cross-Scale Data Integration Towards Butterfly EBV</td>
<td>338</td>
</tr>
<tr>
<td>A Taxonomic Resolution API for All Taxa</td>
<td>339</td>
</tr>
<tr>
<td>Addressing Taxonomic Concept Uncertainty in Global Biodiversity Databases</td>
<td>340</td>
</tr>
<tr>
<td>Biodiversity Knowledge for Antarctic Environmental Conservation</td>
<td>340</td>
</tr>
<tr>
<td>Tailoring Models and Indicators to Navigate Climate Change and Data Gaps</td>
<td>341</td>
</tr>
</tbody>
</table>

**Opening up and preparing scientific publications for the chatGPT-age**

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature Workflows in IPBES - How They Would Profit from Enriched Publications</td>
<td>342</td>
</tr>
<tr>
<td>Development in Publishing Biodiversity</td>
<td>342</td>
</tr>
</tbody>
</table>

23
MACHINE LEARNING FOR COLLECTION OF ARTHROPOD ORGANISMAL AND ECOLOGICAL TRAITS .................................................. 343
HOW DO WE GET THERE? A 7* SCHEME OF GETTING “OPEN FAIR PUBLICATIONS” .......................................................... 344
SEMANTICALLY ENRICHED PUBLICATIONS - THE WHAT, HOW AND HOW IT CHANGES RESEARCH ................................................. 344
WHERE ARE WE TODAY IN REGARD TO FINDING, ACCESSING AND MINING LITERATURE? .......................................................... 345

Paradigm shift in agro-ecology: from patch-scale conservation measures to designing biodiversity-friendly landscapes 346
A MULTI-SCALE PERSPECTIVE OF BIODIVERSITY ENRICHMENT IN OIL PALM LANDSCAPES ................................................ 346
INSECT DECLINE – EVALUATION OF POTENTIAL DRIVERS OF A COMPLEX PHENOMENON ......................................................... 346
MODELLING TRADE-OFFS WHEN SCALING BIODIVERSITY-FRIENDLY FOOD PRODUCTION SYSTEMS ........................................... 347
FROM STEWARDSHIP TO PARTNERSHIP: SWISS ALPINE FARMERS’ RELATIONSHIPS TO NATURE .................................................... 348
RUBBER-AGROFORESTRY SAFEGUARDING FOOD SECURITY AND INCREASING WILDLIFE DIVERSITY ........................................... 348
MONITORING POLLINATORS IN AGRICULTURAL LANDSCAPES IN NORWAY .............................................................. 349
BIOTIC RESISTANCE OUTWEIGHS FACILITATED SPREAD OF GLOBAL CHANGE WINNERS ...................................................... 349
HABITAT SPATIAL HETEROGENEITY INFLUENCES FARMLAND BIRD ABUNDANCE AND DIVERSITY .......................................... 350
HYPER SPECTRAL BIOINDICATORS REVEAL FLORAL POLLINATION STATUS .................................................................................. 351
RED-LISTED PLANTS PERSISTING IN THE AGRICULTURAL LANDSCAPE .............................................................. 351
ORGANIC AND CONVENTIONAL VINEYARD MANAGEMENT EFFECTS ON SOIL FAUNA DIVERSITY .................................................. 352
RIPARIAN ITAUKÉI: A TROPICAL SOLUTION TO AGRO-WETLAND WARFARE ........................................................................ 352
VEGETATION CHANGES IN NORWEGIAN GRASSLANDS ARE BAD NEWS FOR POLLINATING INSECTS ............................................. 353
PADDY RICE: A WIN-WIN FOR BIODIVERSITY AND AGRICULTURE .................................................................................... 354
SOIL PROPERTIES OF DIFFERENT AGROECOSYSTEMS HAVE DIFFERENT EFFECTS ON SOIL FAUNA .................................................. 354

Philosophies of biodiversity conservation 356
CONSERVING BIODIVERSITY THROUGH EATING: IS THERE A CASE FOR VEGANISM? ............................................................... 356
SHOULD NON-HUMAN ORGANISMS HAVE A RIGHT TO A LIVABLE LOCALITY? ................................................................. 356
THREE DIMENSIONS OF URGENCY ......................................................... 357
VALUING NATURE IN THE BIODIVERSITY OF CULTURED LANDSCAPES . 357
BRINGING PHILOSOPHY INTO RELATIONAL VALUE INTERVIEWS WITH BIRDWATCHERS .................................................. 358
HUMAN PRESENCE IN ECOSYSTEMS: A CONCEPTUAL REVIEW OF ENVIRONMENTAL ETHICS ............................................. 358
SUSTAINABILITY AND HABITAT RIGHTS ................................................. 359
CONSERVATION GENETICS, ETHICS, AND QUESTIONS OF PURITY ...... 359
ON THE ROLE OF AESTHETICS FOR BIODIVERSITY CONSERVATION AND SUSTAINABILITY ......................................................... 360
THE SYMBIOcene AS A TRANSFORMATIVE VISION ............................... 361
NARRATIVE ETHICS FOR REWILDING ..................................................... 361
WHY BIODIVERSITY ETHICS? ................................................................. 362
ECOLOGICAL SELVES AND RELATIONAL VALUES: POTENTIAL FOR AN ONTOLOGICAL SHIFT? ............................................... 362

Plant-consumer interactions in a changing world 364
NOVEL PERSPECTIVES ON CONSUMER RESOURCE INTERACTIONS ...... 364
THE EFFECT OF CLIMATE CHANGE ON COMMUNITY DYNAMICS ALONG ELEVATION GRADIENTS ................................................. 364
CHANGING WORLD, CHANGING BIODIVERSITY: IMPLICATIONS FOR A CULTIVATED PLANET ..................................................... 365
GLOBAL CHANGE EFFECTS ON FEEDBACKS BETWEEN PLANT AND CONSUMER COMMUNITIES .................................................. 365
AN AUTOMATED PIPELINE FOR ASSESSING LEAF-ASSOCIATED INTERACTIONS AND LEAF TRAITS ................................. 366

Practicing critical social theory to achieve paradigm-shifting just transformations 367
TO LOOK AND TO ACT “OTHERWISE”: REFLECTING ON CRITICAL SOCIAL THEORY AND VALUE ................................................................. 367
TRANSFORMING HUMAN-NATURE RELATIONS BY REVISIBILIZING, NOT RECONNECTING ..................................................... 367
AN INCOHERENT CONVERGENCE SCIENCE - DIVERSE ECONOMIES, CRISSES AND BETTER FUTURES ................................. 368
COMMUNITIES OF PURPOSE FOR DEEP TRANSFORMATION IN BIODIVERSITY GOVERNANCE .................................................. 369
NATURE-BASED SOLUTIONS IN THE ANTHROPOcene: A TRANSDISCIPLINARY PERSPECTIVE ..................................................... 369
THE ROLE OF NON-STATE ACTORS IN IMPLEMENTING THE GLOBAL BIODIVERSITY FRAMEWORK ............................................ 370
THE PERSONAL SPHERE OF TRANSFORMATIVE CHANGE IN RESEARCHERS AND STAKEHOLDERS ................................................. 371

Protecting and Monitoring genetic diversity
IMPLEMENTATION OF CBD GBF GENETIC DIVERSITY INDICATORS IN NINE COUNTRIES ......................................................... 372
A FRAMEWORK FOR IDENTIFYING ESUS TO SUPPORT POTENTIAL INCLUSION IN THE REDLIST ........................................... 372
EVALUATING MOLECULAR TOOLS IN THE CONSERVATION OF AFRICAN RHINOCEROS ...................................................... 373
A GLOBAL META-ANALYSIS OF GENETIC CHANGE IN NATURAL POPULATIONS ................................................................. 374
MONITORING GENETIC DIVERSITY WITH DNA- AND PROXY-BASED INDICATORS IN SWEDEN ................................................... 374
MONITOR INDICATORS OF GENETIC DIVERSITY FROM SPACE USING EARTH OBSERVATION DATA .................................................. 375

Quantifying plant genetic diversity with spectroscopy
ASSOCIATION OF LEAF SPECTRAL VARIATION WITH FUNCTIONAL GENETIC VARIANTS ............................................................ 377
INTRASPECIFIC VARIATION OF BEECH SEEDLINGS’ RESPONSES TO DROUGHT ................................................................. 377
REMOTE SENSING INSIGHTS INTO EUROPEAN AND ORIENTAL BEECH SUBSPECIES .......................................................... 378
FROM DRONES TO SATELLITES: UNVEILING PHYLOGENETIC DIVERSITY VIA SPECTRAL SPECIES ........................................... 379
SPECTRAL PHYLOGEOGRAPHY IN LIVE OAKS ACROSS THE TROPICAL-TEMPERATE DIVIDE ................................................. 379

Recent changes and future challenges in alpine biodiversity
GLACIER FOREFIELD SUCCESSION IN THE NORTHERN LIMESTONE ALPS: SAME, BUT DIFFERENT ............................................ 381
WILL MICROREFUGIA SAFEGUARD ALPINE PLANT DIVERSITY IN A WARMING WORLD? ......................................................... 381
SPECIES MICROHABITAT PREFERENCES INDICATE DIFFERENT RANGE EXPANSION LIKELIHOODS .............................................. 382
GLOBAL RESPONSES OF RIVER DIATOM COMMUNITIES TO DECLINING GLACIER COVER ..................................................... 382
SNOW AVALANCHE IMPACTS ON MOUNTAIN UNGULATE POPULATION ECOLOGY AND BIODIVERSITY .......................................... 383
CHANGES ON PLANT SPECIES DIVERSITY AFTER 15 YRS. IN THE ANDES OF CENTRAL CHILE ................................................... 384
BIOGEOGRAPHIC IMPACT OF CLIMATE CHANGE IN THE HIMALAYAS: A MODELLING APPROACH ................................. 384
RELATING VEGETATION CHARACTERISTICS TO CARBON STOCKS IN ALPINE TOPSOILS ........................................ 385
ALPINE SPECIES LOSS INDUCED BY FOREST-LINE UPWARD SHIFT .... 386
VEGETATION CHANGES AT HIGH-ELEVATION HIGH-LATITUDE MOUNTAIN 386
FLOW INTERMITTENCY AFFECTS MACROINVERTEBRATE COMMUNITIES IN ALPINE CATCHMENTS .......................... 387

Reflections, Intersections & Connections – Dialogues and collaborations between art, science and society. 389
IDEAS FOR SUSTAINABLE FUTURE COME TRUE - ECOFICTION FOR EARTH NEIGHBORHOOD ................................. 389
THE UNDERWATER SOUNDSCAPES OF HIGH-ALPINE PONDS AND LAKES 389
POETRY AS A TRANSTEMPORAL AND TRANS-EXISTENTIAL ODE TO THE PRACTICE OF DIVERSITY ............................ 390
MAD MAPLE FROM THE SOUNDS OF NATURE TO THE NATURE OF SOUNDS 390
CREATIVE MOUNTAINS: INNOVATIVE APPROACHES FOR PROMOTION OF REMOTE RURAL AREAS ............................... 391
GENERAL AND LOCAL PERCEPTION OF WETLANDS BASED ON AI IMAGES SEMIOTIC ANALYSIS ............................... 392
UNDERCURRENTS: COMMUNITY ART, INDIGENOUS CULTURAL HERITAGE AND OCEAN GOVERNANCE ....................... 392
THE ARTS APPROACH TO SUSTAINABILITY: UNDERSTANDING ESSENTIAL MECHANISMS ........................................ 393
CO-HABITATIONS: SHAPING THE CITY OF TOMORROW BY EMBRACING CO-EXISTENCE TODAY ................................. 393
IMAGINARIES OF POSSIBLE FUTURES: FIRST-PERSON ECOLOGY IN ART/SCIENCE PRACTICE ................................. 394
SENSATIONAL NOCTURNAL ECOCLOGIES; ANTHROPOGENIC NOISE AND NOCTURNAL ECOCLOGIES .............................. 395
SOIL ASSEMBLY - LIVING PEDAGOGIES, SOIL ECOCLOGIES, FOOD PERMACIRCULARITIES .......................... 396
HOMO PHOTOSYNTHETICUS - A (SPECULATIVE) JOURNEY ON HOW TO BECOME AUTOTROPH ................................. 396
BIOMIMICRY OF CONCEPTS ...................................................... 397
#MOSEVIS: PAINT, MUSIC AND AN UNDEAD BOG BODY – A NARRATIVE OUTREACH EXAMPLE ............................. 398
AGRICULTURAL BECOMINGS IN THEATER .............................. 398
Reflections, Intersections & Connections – Showcases of art-based expressions of nature-human relationships towards sustainable futures

ARCTIC UMWELT: SPECULATIVE ARTEFACTS FOR A MORE-TAN-HUMAN FUTURE

WILDLIFE, WATTS & WIRES: CAN YOU “SOLVE” THE ENERGY AND BIO-DIVERSITY CRISIS?

EXPERIMENTAL ECOLOGY: ART + SCIENCE IN DIALOGUE

Satellite observations for a deeper understanding of biodiversity-climate feedbacks: progress and challenges

SEASONAL WARMING AND GLOBAL LAND SURFACE PHENOLOGY

MAPPING GRASSLAND BIODIVERSITY USING ABIOTIC ENVIRONMENT AND REMOTE SENSING

LINKS BETWEEN SATELLITE-DERIVED FOREST HEALTH ANOMALIES AND BIODIVERSITY

SATELLITE OBSERVATIONS TO MONITOR MARINE BIODIVERSITY IN A CHANGING CLIMATE

USING SATELLITE DATA TO UNDERSTAND BIODIVERSITY-CLIMATE DYNAMICS

Satellite observations for a deeper understanding of biodiversity-climate feedbacks: progress and challenges

ECOSYSTEM INTEGRITY-TOOL FOR MONITORING BIO-& GEODIVERSITY BY RS & TRAITS

TESTING THE POTENTIAL OF COPERNICUS PRODUCTS FOR ENVIRONMENTAL MONITORING

BIRDS HAVE LIMITED THEIR CLIMATE CHANGE EXPOSURE USING RANGE REDISTRIBUTIONS

MONITORING DISTURBANCE IMPACTS ON TEMPERATE FOREST PRODUCTIVITY

Species distribution models for spatial prioritization of biodiversity conservation

MACHINE LEARNING-BASED PREDICTION OF POTENTIAL SNOW LEOPARD HABITAT IN NEPAL

A MULTITAXA CONSERVATION PLAN FOR BIODIVERSITY AND CLIMATE CHANGE IN SWITZERLAND

THE CURRENT AND FUTURE DISTRIBUTION OF DRACAENA OMBET UNDER CLIMATE CHANGE

CONSERVATION PLANNING IN SWITZERLAND TO PRESERVE BIODIVERSITY IN EUROPE

USE SDM TO MAP NCP: A NEW PATHWAY TO LINK SPECIES WITH NCP TO HELP CONSERVATION
INCORPORATING PATCH AREA EFFECTS INTO SPECIES DISTRIBUTION MODELS ........................................ 412
MEETING TERRESTRIAL AND MARINE BIODIVERSITY 2030 TARGETS UNDER CLIMATE CHANGE .................. 413
REDEFINING THE FUNDAMENTAL NICHES OF ANIMALS FOR SPATIAL CONSERVATION ............................... 413
PRIORITY AREAS FOR BIODIVERSITY CONSERVATION IN THE CONTEXT OF GLOBAL CHANGE ..................... 414
ENHANCING PERFORMANCE OF SDMs FOR FOREST TAXA WITH HIGH RESOLUTION SOIL MAPs .................. 414
DISENTANGLING OBSERVATION BIASES FOR SPECIES DISTRIBUTION MODELING ................................. 415
WHAT A Cliché: THE IMPACT OF SPATIAL BIAS ON MODELLING SPECIES DISTRIBUTIONS ....................... 416
CARNIVORES OF ARABIA: CONSERVATION CHALLENGES AND OPPORTUNITIES ......................................... 416
SPECIES DISTRIBUTION PREDICTION OPTIMIZATION TO INTEGRATE INTO URBAN PLANNING ...................... 417
LINKING TRAITS TO SPECIES PREDICTIONS: THE KEY TO PLANT COMMUNITY CONSERVATION! ............... 418
TOWARDS HIGH SPATIAL RESOLUTION AND DYNAMICS IN SPECIES DISTRIBUTION MODELING ................ 418
CLIMATE CHANGE DISRUPTS THE ECOLOGICAL NETWORK OF ANATOLIAN BROWN BEARS ......................... 419
SPATIAL RESOLUTION IMPACTS PLANT RESPONSES TO CLIMATE CHANGE ............................................. 420
HIERARCHICAL SPECIES DISTRIBUTION MODELS FOR INVASIVE SPECIES ............................................. 420
COMBINING COMPLEMENTARITY AND CONNECTIVITY IN BIODIVERSITY CONSERVATION DESIGN .................... 421
IDENTIFYING SITES TO COMPLEMENT THE CURRENT NETWORK OF PROTECTED AREAS IN CHILE ................ 421
MARINE PLANKTON BIODIVERSITY ESTIMATES FROM MULTIPLE DATA SOURCES AND TYPES .................... 422
PLANTAGO LANCEOLATA DISPLAYS SLOWER LIFE CYCLES UNDER LOW HABITAT SUITABILITY ....................... 423
AN IMPROVED FRAMEWORK FOR ASSESSING THE EX-SITU CONSERVATION STATUS OF PLANTS ............... 423
SPATIO-TEMPORAL SPECIES DISTRIBUTION MODELLING TO ASSESS BIODIVERSITY CHANGE ....................... 424
FILTERING SURVEY RECORDS FROM PRESENCE-ONLY DATA CAN IMPROVE THE ACCURACY OF SDM ............... 424
AI-DRIVEN CONSERVATION: PROTECTING GLOBAL SHARK DIVERSITY WITH CAPTAIN ............................ 425
PROJECTING THE EFFECTS OF CLIMATE AND LAND-COVER CHANGE ON SWISS BIODIVERSITY .......................................................... 426
EXPLAINABLE DEEP SPECIES DISTRIBUTION MODELS .................. 426
FACILITATING EXPERT REVIEW OF SDM PREDICTIONS ................. 427
EVALUATING SPECIES DISTRIBUTION MODEL THROUGH LATITUDINAL AND GENETIC CLUSTERING ........................................ 428

Sustainable development in the forest-dependent communities: forest role, livelihoods, biodiversity, cultural-spiritual values, and life quality 429
RELIGIOUS AND CULTURAL VALUES OF BIODIVERSITY CONSERVATION IN NEPAL ............................................................. 429
STINGLESS BEE CONSERVATION EFFORTS IN MALAYSIA .............. 429
ANCESTRAL PHILOSOPHY ALLI KAWSAY (BUEN VIVIR) IN INDIGENOUS MOVEMENTS COLOMBIA .................................................. 430
CONSERVATION WORKS: MODEL FOR CONSERVATION & WELLBEING IN LIBERIA ................................................................. 430
BRAZILIAN SOCIO-BIODIVERSITY PRODUCTS AS A TOOL TO THE STANDING FOREST .............................................................. 431
LIVELIHOOD DEPENDENCE ON MANGROVE ECOSYSTEM: CASE STUDY LAMU COUNTY, KENYA ................................................ 432
SUSTAINABLE DEVELOPMENT OF MOUNTAIN ECOSYSTEMS IN THE 2030 AGENDA, SDG 15 ...................................................... 432
COMMUNAL FORESTS IBERIAN: ROLE OF COMMUNITIES IN THE BIODIVERSITY CONSERVATION .............................................. 433

Tapping into alternative knowledge systems to transform biodiversity and conservation management 434
TRANSFORMING OCEAN DECISION-MAKING THROUGH INTUITIVE INTERSPECIES COMMUNICATION ...................................... 434
MEANINGFUL DIALOGUE ACROSS SPECIES - HOW ANIMAL COMMUNICATORS UNDERSTAND ANIMALS ................................. 434
LOCAL LEARNING FOR SUSTAINABLY UTILIZING WILD EDIBLE PLANTS FROM CHHATTISGARH .................................................. 435
INTUITIVE INTERSPECIES COMMUNICATION AS A METHOD FOR LAND MANAGEMENT .......................................................... 435
TREE PERSPECTIVES: APPROACHES AND VOICES FOR BIODIVERSITY STEWARDSHIP .......................................................... 436

The Earth Metabolome Initiative 437
OCEAN METABOLOMICS FOR MARINE CHEMICAL ECOLOGY AND DRUG DISCOVERY RESEARCH ........................................ 437
GENOMIC DATA PRODUCTION SYSTEMS TO CATALOGUE AND EXPLORE EUKARYOTIC BIODIVERSITY .................................... 437
### MOLECULAR FEATURES OF PUSH-PULL INTERCROPPING SYSTEMS IN EAST AFRICA

- 438

### THE EARTH BIOGENOME PROJECT: PROGRESS ON BIOLOGY'S MOONSHOT

- 439

### Towards a global assessment of mountain biodiversity

- 440

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOUNTAIN AQUACULTURE IN NEPAL</td>
<td>440</td>
</tr>
<tr>
<td>HOW CUSHION PLANT COMMUNITIES STRUCTURE HIGH ALPINE BIODIVERSITY</td>
<td>440</td>
</tr>
<tr>
<td>DEVELOPING A KNOWLEDGE BASE FOR A GLOBAL ASSESSMENT OF MOUNTAIN BIODIVERSITY</td>
<td>440</td>
</tr>
<tr>
<td>MOLECULES TO MODELS: EFFECTS OF GLACIER RETREAT ON MOUNTAIN RIVER ECOSYSTEMS</td>
<td>441</td>
</tr>
<tr>
<td>HIMALAYAN RIVER BIODIVERSITY: LONG-TERM CHANGES VERSUS SEASONAL VARIABILITY</td>
<td>442</td>
</tr>
<tr>
<td>A COMPREHENSIVE WORKFLOW FOR A GLOBAL ALPINE BIODIVERSITY INVENTORY</td>
<td>442</td>
</tr>
<tr>
<td>GLOBAL MOUNTAIN RESEARCH INITIATIVES - MIREN &amp; GLORIA - MEET UP AT TREELINE</td>
<td>443</td>
</tr>
<tr>
<td>HABITAT MONITORING IN AN ALPINE NATIONAL PARK USING MULTISOURCE REMOTE SENSING</td>
<td>444</td>
</tr>
<tr>
<td>LEARNING MORE FROM CITIZEN-SCIENCE DATA ON PLANT BIODIVERSITY</td>
<td>445</td>
</tr>
<tr>
<td>A MONITORING SCHEME IN AN ALPINE REGION: BIODIVERSITY MONITORING SOUTH TYROL</td>
<td>446</td>
</tr>
<tr>
<td>ASSESSING THE DYNAMICS OF VEGETATION AT THE ALPINE ECOTONE</td>
<td>446</td>
</tr>
<tr>
<td>BIODIVERSITY IN MOUNTAIN SOILS ABOVE THE TREELINE: WHAT WE KNOW SO FAR</td>
<td>447</td>
</tr>
<tr>
<td>MONITORING MOUNTAIN BIODIVERSITY ACROSS BIOME BOUNDARIES UNDER CLIMATE CHANGE</td>
<td>448</td>
</tr>
<tr>
<td>DOCUMENTING ELEVATOR TO EXTINCTION IN AN IMPERILED AFROTROPICAL ALPINE HOTSPOT</td>
<td>448</td>
</tr>
</tbody>
</table>

### Tropical forest patches: spatio-temporal dynamics, sustainable use and conservation

- 450

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUANTIFYING 22 YEARS OF ANNUAL CHANGE IN VERY SMALL WEST AFRICAN FOREST PATCHES</td>
<td>450</td>
</tr>
<tr>
<td>SIMULATING SELECTIVE LOGGING WITH A FLEXIBLE TRAIT-BASED DGVM</td>
<td>450</td>
</tr>
<tr>
<td>FOREST FRAGMENTATION IMPACTS STRUCTURAL COMPLEXITY IN TROPICAL FOREST PATCHES</td>
<td>451</td>
</tr>
<tr>
<td>CURBING ILLEGAL LOGGING PATTERNS USING SOUND-BASED DETECTION TECHNIQUES</td>
<td>451</td>
</tr>
<tr>
<td>RECONCILING STAKEHOLDER PERSPECTIVES WITH SPATIOTEMPORAL DYNAMICS OF FORESTS</td>
<td>452</td>
</tr>
<tr>
<td>UNDERSTANDING THE SURVIVAL OF FOREST TREES FROM A LANDSCAPE PERSPECTIVE</td>
<td>453</td>
</tr>
</tbody>
</table>

31
WHAT FUTURE FOR FOREST PATCHES, MITIGATION, BIODIVERSITY AND LIVELIHOODS?

VIDEO DOCUMENTATION FROM FIELD RESEARCH IN FOREST PATCHES OF WEST AFRICA

FOREST PATCHES DYNAMICS IN WEST AFRICA: SPATIAL DRIVERS AND FUTURE SCENARIOS

COMMUNITY-BASED BIODIVERSITY MONITORING IN THE COLOMBIAN PACIFIC

MAPPING TROPICAL FOREST LOSS BASED ON IK TO HALT AND REVERSE FOREST DEGRADATION

GROUND-LED FOREST CARBON MEASUREMENT: COUNTING TREES TO UNDERSTAND THE FOREST

Understanding the role and destiny of Arctic Biodiversity in a changing world

DO ARCTIC LICHENS ACCLIMATISE OR EXPERIENCE BLEACHING AS A RESPONSE TO WARMING?

FACE-IT: DEVELOPING ADAPTIVE CO-MANAGEMENT OF ARCTIC FJORDS IN TRANSITION

MARINE UNDERWATER VEGETATION – A HARBINGER OF ARCTIC CHANGE?

BIODIVERSITY CHANGES OF SEAWEED-ASSOCIATED FAUNA IN KONGS-FJORDEN, SVALBARD

FEEDING OF SEA URCHINS ON ARCTIC MACROALGAE ASSOCIATIONS CHANGING WITH DEPTH

PLANT DIVERSITY DYNAMICS OVER SPACE AND TIME IN A WARMING ARCTIC

AREA-BASED CONSERVATION: SAFEGUARDING BIODIVERSITY IN A RAPIDLY CHANGING ARCTIC

IMPACTS OF GLACIAL RETREAT ON FJORD’S BIODIVERSITY IN GREENLAND

BETA DIVERSITY OF RODENTS AND SHREWS IN THE CENTRAL EUROPEAN TAIGA

GLOBAL CHANGE EFFECTS ON THE DIVERSITY-STABILITY RELATIONSHIP IN THE TUNDRA

USING REMOTE SENSING DATA IN ARCTIC TUNDRA CONSERVATION PLANNING

EDNA AND DRONES ENABLE RAPID ESTIMATES OF PLANT DIVERSITY IN ARCTIC LANDSCAPES

HIDDEN DIVERSITY AS THE SOURCE OF BIODIVERSITY AND TRAIT CHANGE IN THE TUNDRA

INTERNATIONAL POLAR YEAR - OPPORTUNITY FOR COORDINATED BIODIVERSITY ASSESSMENTS
ALIEN SPECIES IN THE NORTHEAST OF YAMAL AND THEIR INVASIVE POTENTIAL ................................................................. 466

Unleashing the Power of Blockchain, IoT, and eDNA to Create a Paradigm Shift for Global Biodiversity Monitoring Systems 468

A DEEP LINK BETWEEN BIODIVERSITY RESTORATION AND THE DIGITAL ECONOMY ......................................................... 468

SELECTIVE DISCLOSURE OF ECOLOGICAL DATA ON BLOCKCHAIN .......................... 468

BLOCKCHAIN FOR MONITORING BIODIVERSITY IN PAYMENTS FOR ECOSYSTEM SERVICES? ................................................. 469

COMMUNITY-LED FOREST CONSERVATION: CONSERVATION BASIC INCOME TO SCALE DMRV .............................................. 469

ENVIRONMENTAL DNA AS A TOOL FOR ESTABLISHING BIODIVERSITY BASELINES IN LIBERIA .............................................. 470

BLOCKCHAIN, INTERNET OF THINGS AND ENVIRONMENTAL DNA FOR BIODIVERSITY MONITORING ........................................ 470
FOR A NATURE- AND PEOPLE-POSITIVE FUTURE – BALANCING NATURE, ECONOMY AND SOCIETY, FROM THE BOTTOM UP

Plenary Presentation

D. Obura  

1Founding Director of CORDIO East Africa, Chair of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), Mombasa, Kenya

IPBES’s conceptual framework presents a hypothesis on deconstructing the relationships between nature, economy and society in the sustainable development framework. With the ongoing intensification of biodiversity decline, climate change and other interacting crises humanity has not succeeded in meeting biodiversity or sustainability targets. New aspirations to halt and reverse these trends were adopted in the Global Biodiversity Framework in December 2022. While conservation and restoration actions are fundamentally necessary, they are not sufficient, and this talk focuses on the two sets of actions that need transformative attention in coming years: a) bending and reversing the drivers of biodiversity decline, which requires primary focus on indirect drivers in particular overconsumption, and b) redressing inequalities. Both entail specific responsibilities and actions, by those who over-consume, and for those who under-consume, and can produce positive outcomes for nature and people. Focusing on healthy and sufficient nature at square kilometre scales provides one tangible pathway to address drivers and inequalities, through providing tangible opportunities to restore financial capital into natural capital, and balance the interactions between nature, economy and society for a sustainable (safe and just) future.
Plenary Monday afternoon

RE-IMAGINING THE LAWS OF NATURE

Plenary Presentation

*M. Lim* 1

1Singapore Management University, Yong Pung How School of Law, Singapore, Singapore

Maria Ojala (2017) defines hope to include ‘active coping in the face of hardship’. With the very real hardship of global extinction, I argue that form is as important as content when exploring active coping amidst planetary scale social-ecological upheaval. Blurring the lines of form and content enables plural worldviews and understandings of natural worlds. The sheer existence of our more-than-human kin is disappearing on our watch. The IPBES Values Assessment attributes this unprecedented global biodiversity loss to the prioritisation of instrumental values. In other words, dominant worldviews, which emphasise nature’s use and its usefulness to humans, are a fundamental underlying driver of the catastrophic loss of nature. Creative forms of expression present an important means of engaging emotionally with nature’s intrinsic and relational values. Dominant legal systems, however, largely reflect and entrench dominant value systems which foreground the instrumental values of nature. Current laws mostly focus on safeguarding individual rights and property - and by extension the values of nature that can be easily traded in markets. I contemplate what it would mean to rewrite legal systems with the more-than-human. I consider how storying with nature may allow the re-imagination of law. Creative writing, as a methodology in legal scholarship (and other disciplines), could contribute to the realisation of hopeful futures and the normalisation of human-nature relations.

NATURE CONSERVATION WITHIN AGROBUSINESS: TOOLS, CHALLENGES AND OPPORTUNITIES

Plenary Presentation

*P. Durán* 1

1Universidad Austral de Chile, Institute of Ecology and Biodiversity & Wine, Los Ríos, Chile

There is a growing awareness and receptivity within the agrobusiness sector to incorporate biodiversity conservation and ecosystem services into decision-making and practices. Yet the realities of such incorporation are complex - both technically and practically. From a technical perspective, challenges range from promoting a common understanding of the positive role that nature plays in business to quantifying nature components and adapting production models to ensure conservation outcomes. From a practical perspective, challenges involve from
integrating diverse backgrounds through an effective knowledge co-production process to navigating strong power dynamics. In addition, as these technical and practical challenges are specific to each socio-ecological context, this may require the engagement and collaboration of diverse actors such as executives, academics, NGOs and government representatives. In this plenary, I will discuss such challenges, and suggest their corresponding solutions, when promoting the integration of biodiversity conservation and ecosystem services within agribusiness. I will illustrate and contrast this by presenting two case studies with different characteristics: the global soybean market and the local production of Chilean wine. Finally, I will outline how a new tool, the IPBES Nature Futures Framework, may help to overcome some of the stated technical and practical challenges.
Plenary Tuesday morning

EIGHT YEARS OF (IN)ACTION TOWARDS THE ATTAINMENT OF THE BIODIVERSITY SDG

Plenary Presentation

G. Nhamo 1

1University of South Africa, Exxaro Chair in Climate and Sustainability Transitions, Pretoria, South Africa

The United Nations’s 2030 Agenda for Sustainable Development established a global developmental pathway pivoting on 17 inter-linked Sustainable Development Goals (SDGs). Among these SDGs is SDG 15 that focuses on protecting, restoring and promoting the sustainable use of terrestrial ecosystems, sustainably managing the forests, combating desertification, and halting and reversing land degradation and biodiversity loss. However, eight years down the road to the year 2030, there are more questions asked, than answers being provided as to whether global governments are on course to attaining some of the targets and indicators spelt out in the 2030 Agenda regarding SDG 15. Drawing from the PRISMA framework, the work paints a picture of limited progress. Critical and significant action has been lacking, retarded by the diversion of resources towards the global COVID-19 pandemic, political instability, and the known and persistent climate change crisis. While it is important to note some default recovery from biodiversity loss in selected protected areas due to the global COVID-19 hard lockdowns, that progress remains temporary and limited. To this effect, the paper encourages the planned scaling up of efforts to move from rhetoric to action in the implementation of SDG 15, and other SDGs including SDG 7 (Sustainable Energy), SDG 12 (Sustainable Consumption and Production), SDG 13 (Climate Action), SDG 14 (Life Under Water), SDG 16 (Peace and Security), and SDG 17 (Partnerships).

TOWARDS TRANSDISCIPLINARY CONSERVATION: PARADIGMS, PRACTICES AND PARTNERS

Plenary Presentation

R. White 1

1University of St Andrews, School of Geography and Sustainable Development, St Andrews, United Kingdom

Biodiversity loss is mainly caused by people; acting directly or indirectly, individually or in groups, often in corporate, professional or policy making capacities. Conservation is thus a social and political as well as an ecological project. To understand and redress such losses, we
need not only science and strategies, but also: a paradigm change in the way we theorise biodiversity conservation; adapted practices; and new partners with whom we can work. The aim of this paper, drawing on empirical case studies, is to outline this holistic approach for biodiversity conservation. First, care for nature is required, including resolving ‘nature deficit disorder’ in young people, respecting Indigenous ontologies and re-establishing nature connectedness in corporate and regulatory leaders. Second, we must share learning in and for nature, using interdisciplinarity and epistemological plurality, co-designing practices with non-academics and recognising different cultures and contexts. Third, it needs to be determined who will bear the costs of environmental damage, nature restoration and local livelihood consequences. Systems of environmental governance are likely to include more community governance, regulatory frameworks and adjusted finance, possibly including biodiversity credits and environmental philanthropy. This care, share, bear model requires a holistic, transdisciplinary approach for biodiversity that also releases wider sustainability benefits.
Plenary Tuesday afternoon

INVESTIGATING AND COMMUNICATING CLIMATE CHANGE IMPACTS ON ECOSYSTEM FUNCTION

Plenary Presentation

_E. Sayer_ ¹,²

¹Ulm University, Institute of Botany, Ulm, Germany, ²Lancaster University, Lancaster Environment Centre, Lancaster, United Kingdom

The impacts of climate change on the biodiversity and functioning of ecosystems can manifest over multiple spatial and temporal scales and involve complex interactions among species and between organisms and the abiotic environment. The level of complexity and often abstract nature of climate change impacts not only makes research challenging, but also hampers scientists’ efforts to communicate the urgency of action to the public. Here, I present some surprising results from the world’s longest-running climate change experiment and discuss the importance of engaging the public with research into biodiversity loss and climate change.

FEEL THE FACTS: BRIDGING THE IMAGINATION GAP IN SCIENCE COMMUNICATION WITH ART

Plenary Presentation

_T. Biersteker_ ¹

¹Artist, Amsterdam, Netherlands

In an era overwhelmed by climate crisis and misinformation, Thijs Biersteker, artist and founder of the Woven Foundation, presents a compelling vision for transforming environmental science communication into art installations that make you feel the facts. Biersteker illustrates how art’s emotive power can transcend scientific complexity, making climate facts relatable, personal and actionable. By using climate science data from top scientists around the world to create his immersive artworks, he demonstrates the untapped potential of creative collaborations to spark cultural change and foster a deeper public understanding of environmental issues. His speech explores innovative art installations that convey scientific data vividly, making the invisible impacts of climate change visible and tangible. Biersteker argues that our climate crisis and biodiversity crisis are both an imagination crisis stifling societal change, art becomes not just a tool, but a necessity in engaging the global community, rekindling hope, and driving the urgent action required to safeguard our planet’s future, he will explain and explore how we can turn facts into acts.
Plenary Wednesday morning

IMPACTS OF CONSERVATION AND RESTORATION MEASURES ON DEVELOPMENT AND WELFARE

Plenary Presentation

R. Pandit

1University of Western Australia, Perth, Australia

Biodiversity loss, climate change, and land degradation are the triple environmental challenges faced by the humanity today. Ignoring these environmental challenges in the pursuit of economic growth is not an option. Concerted and urgent efforts at scale that match with the gravity of the challenges are needed from both public and private sectors to sustainably develop or to improve human wellbeing. Within this backdrop, this talk focuses on impacts of conservation and forest restoration measures on development outcomes. Primary focus is on impact of protected areas and/or introduction of specific conservation policy/intervention on household welfare or income based on a meta-analysis of relevant studies. Empirical evidence from a set of selected case studies will be highlighted. The secondary focus of the talk is on restoration measures to halt land degradation. Common ways to halt land degradation will be highlighted based on findings of land degradation assessment of the IPBES, and then a specific focus on community forestry policy and resultant forest restoration in Nepal will be discussed as a case study of successful land (forest) restoration. In presenting the impacts of conservation and restoration measures on development, household welfare, and environmental/biodiversity conservation, emerging challenges and opportunities will also be highlighted to develop strategies and to guide future course of actions.

THE TIMESCALES OF CLIMATE CHANGE AND THE CHALLENGE FOR GLOBAL BIODIVERSITY

Plenary Presentation

D.P. Schrag

1Harvard University, Department of Earth and Planetary Sciences, Cambridge, United States

Climate change’s multiple timescales create profound challenges for global biodiversity conservation. Over half of the CO2 from fossil fuels remains in the atmosphere for a thousand years, with 20% persisting for tens of thousands of years. Thus, even if emissions cease, impacts like sea level rise from ice melt will continue. The most sobering timescale is the decarbonization of the global energy system. Despite political goals for “net-zero” emissions by mid-century, the
actual timescale is likely longer due to technological and economic obstacles. Clean energy development in the developing world lags behind the Paris Agreement targets. The gap between political will and financial investment suggests a prolonged decarbonization process, increasing climate impacts on biodiversity and stressing ecosystems. Another challenge is the expanding land footprint required for the clean energy transition. Shifting from fossil fuels to renewable energy demands more land for biofuels and renewable installations, further pressured by climate change impacts on food production. Addressing these challenges requires aggressive conservation strategies focusing on habitat destruction drivers rather than solely on land conservation. Biofuels, especially from woody feedstocks, could help decarbonize transportation if integrated with conservation efforts. Finally, solar geoengineering may significantly contribute to biodiversity protection but raises substantial governance and risk concerns.
Plenary Thursday morning

THE TREE OF LIFE AS A FOUNDATION FOR BASIC AND APPLIED RESEARCH

Plenary Presentation

J. Pinto-Ledezma ¹

¹University of Minnesota, Department of Ecology, Evolution & Behavior, St. Paul, United States

The variety of life on Earth—also known as Biodiversity—represents the cumulative product of billions of years of evolution. However, biodiversity, in its multiple dimensions, is not constant across space nor over time; as such, the study and understanding of its variation has been challenging. Organisms are related to each other to different extents through ancestor-descendant relationships; these relationships are depicted in the Tree of Life (ToL) and provide a unifying framework for basic and applied issues. In this presentation, I will show results from our studies using the ToL to understand the geographical variation in biodiversity and the potential of remote sensing products to detect different levels of biological organization—from species to lineages to communities. I will then explore an alternative for informing biodiversity conservation using the ToL. In doing so, I will describe how focusing on identifying unique branches within the Tree of Life can help us to address eco-evolutionary and conservation questions.

CONSULTING AND CO-CREATING WITH MOTHER NATURE FOR POSITIVE TRANSFORMATION

Plenary Presentation

W.J. Worsthorne ¹

¹Animal Talk Africa, Sunvalley, South Africa

Over the last 20 years, Wynter has been practicing Intuitive Interspecies Communication (IIC) and demonstrating how it can assist human beings in understanding the needs of the other beings on this planet. Communication between all species is not only possible but crucial. Wynter explores the possibilities of creating positive change by working directly with all stakeholders. When we view Mother Nature not just as another stakeholder but as an expert in the needs of Nature, we can collaborate with her to achieve transformation for harmonious coexistence between the human species and all others. A few examples that Wynter shares include how communicating with baboons restored peace in their relationship with human neighbours and how an awareness of an elephant’s needs, coupled with a shift in human perception, led to a peaceful resolution in a private reserve. Nature not only listens to humans...
but responds clearly and concisely. This presentation will illustrate how, by transforming our way of thinking and interacting with the natural world, we can positively influence life on Earth, repairing, regenerating, and rebalancing to correct past mistakes. Protecting biodiversity has posed a daunting challenge, often leaving us feeling hopeless. Nature demonstrates that by acting in service to her, we can overcome this challenge with grace, beauty, and, above all, love.
Advancing our understanding of freshwater ecosystems in the face of anthropogenic change: going beyond biodiversity

MEASURING AQUATIC ENVIRONMENTS: UPSCALING SPATIAL RESOLUTION OF BIOTIC INDEX

Oral Presentation

R. Blackman1, L. Carraro1, F. Keck1, F. Altermatt1

1University of Zurich, Department of Evolutionary Biology and Environmental Studies, Zurich, Switzerland

Aquatic macroinvertebrates are a diverse and ecologically relevant organismal group, yet strongly affected by anthropogenic activities. As many of these taxa are highly sensitive to environmental change, they are a particularly good early warning systems of human-induced change, thus leading to their intense monitoring. In aquatic ecosystems there are a plethora of biotic monitoring or biomonitoring approaches with more than 300 assessment methods reported for freshwater taxa alone. Ultimately, monitoring of aquatic macroinvertebrates is used to calculate ecological indices describing the state of aquatic systems. Many of the methods and indices used, respectively, are not only hard to compare, but especially difficult to scale in time and space. Novel DNA-based approaches to measure the state and change of aquatic environments now offer unprecedented opportunities, also for possible integration towards commonly applicable indices. Here, we move beyond traditional point based biotic indices with a proof of concept for spatially upscaling ecological indices based on environmental DNA, demonstrating how integration of these novel molecular approaches with hydrological models allows an accurate evaluation at the catchment scale.

BEYOND RICHNESS DECREASE: THE GLOBAL HUMAN IMPACT ON FRESHWATER COMMUNITIES

Poster Presentation

F. Keck1, T. Peller1, R. Alther1, C. Barouillet2, R. Blackman1, É. Capo3, T. Chonova4, M. Couton1, L. Fehringer5, D. Kirschner1, M. Knüsel1, L. Muneret6, R. Oester7, K. Tapolczai8, H. Zhang4, F. Altermatt1

1Eawag, Department of Aquatic Ecology, Dübendorf, Switzerland, 2INRAE, Université Savoie Mont Blanc, CARRETEL, Thonon-les-Bains, France, 3Umeå University, Department of Ecology and Environmental Science, Umeå, Sweden, 4Eawag, Department of Environmental Chemistry, Dübendorf, Switzerland, 5University of Vic - Central University of Catalonia, GEA Aquatic Ecology Group, Vic, Spain, 6INRAE, Université Paris-Saclay, AgroParisTech, UMR Agronomie, Paris, France, 7University of Applied Sciences and Arts of Southern Switzerland,
Institute of Microbiology, Mendrisio, Switzerland, HUN-REN Balaton Limnological Research Institute, Tihany, Hungary

The world is facing an unprecedented decline of biodiversity due to anthropogenic activities. However, despite a large number of studies and data available, the effects of global change on community composition across space (beta-diversity) in natural communities remains unclear. There is a real need for synthesis to generalize these results on a large scale. To address this, we conducted an ambitious and comprehensive meta-analysis to measure the magnitude of beta-diversity changes under anthropogenic pressure and to understand how these changes relate to different types of human activities. Summarizing the results from more than 2000 studies, our meta-analysis sheds new light on the impact of human activities on beta-diversity across ecosystems. This presentation will focus on freshwater ecosystems and on the pressures specific to these particularly vulnerable environments. We will show how beyond the loss of local diversity, communities shift in their composition and homogeneity across space, and how alterations in biodiversity vary in both direction and magnitude, contingent on the specific pressures, the type of organisms under scrutiny, and the scales of observation.

MULTIPLE STRESS REDUCES THE ADVANTAGE OF PESTICIDE ADAPTATION

Poster Presentation

A. Siddique 1, N. Shahid1, M. Liess1

1Helmholtz center for Environmental Research-UFZ, System Ecotoxicology, Leipzig, Germany

Under global change scenarios, multistress conditions may occur regularly and require adaptation. However, the adaptation to one stressor might be associated with the increased sensitivity to another stressor. Here, we investigated the ecological consequences of such trade-off under multiple stress. We compared the pesticide tolerance of the crustacean Gammarus pulex from agricultural streams with populations from reference streams. Under optimum temperature, G. pulex from agricultural streams were considerably more tolerant to pesticides as compared to the reference populations. After experimental pre-exposure to very low concentration (LC50/1000), only reference populations showed increased pesticide tolerance. Moreover, agricultural populations were more sensitive to elevated temperature alone due to the hypothesized fitness cost of adaptation. However, both reference and agricultural populations showed a similar tolerance to the combined stress of pesticides and warming due to stronger synergistic effects in adapted populations. As a result, pesticide adaptation loses its advantage. The combined effect was predicted well using the stress addition model, developed for predicting the synergistic interaction of independent stressors. We conclude that under multistress conditions, adaptation to pesticides reduces the general stress capacity of individuals and trade-off processes increase the sensitivity to additional stressors.
BENEFITS AND ADVERSE IMPACTS OF WETLAND RESTORATION FOR SPECIES REINTRODUCTION

Poster Presentation

**J.-Y. Georges** ¹, A. Ceirans², I. Combroux³, C. Grac⁴, O. Marushchak⁵, U. Meissner⁶, J. Meka⁷, O. Nekrasova⁸, M. Pupins², L. Razafindralay⁹, K.A.E. van der Zon¹⁰, A. Skute², K. Theissinger⁷

¹Université de Strasbourg, CNRS, IPHC UMR 7178, Strasbourg, France, ²Daugavpils University, Department of Ecology, Institute of Life Sciences and Technologies, Daugavpils, Latvia, ³Université de Strasbourg, CNRS, LIVE UMR 7362, Strasbourg, France, ⁴ENGEES, Strasbourg, France, ⁵I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Department of Animal Monitoring and Conservation, Kyiv, Ukraine, ⁶Kreisverwaltung Germersheim, District Administration Germersheim, Department for Environment and Agriculture, Germersheim, Germany, ⁷Senckenberg Nature Research Institute, LOEWE Center for Translational Biodiversity Genomics, Frankfurt am Main, Germany, ⁸Université de Strasbourg, CNRS, IPHC, UMR 7178, Strasbourg, France, ⁹Collectivité Européenne d’Alsace, Direction de l’Environnement et de l’Agriculture, Service Environnement et Territoires, Strasbourg, France, ¹⁰Université de Strasbourg, CNRS, LIVE, UMR 7362, Strasbourg, France

Wetlands belong to the richest ecosystems in terms of biodiversity and biomass, and to the most valuable socio-ecosystems thanks to the ecosystem services they offer. Yet, globally freshwater ecosystems are among the most threatened: wetland surface area has decreased by 90% since the 1700s, bringing freshwater biodiversity to dramatic decline while being increasingly threatened by invasive species. Habitat restoration is considered as nature-based solution for limiting biodiversity erosion. Yet its actual efficiency is poorly assessed. In our project Emys-R (www.emysr.cnrs.fr) we assess the relevance of wetland restoration in favour of the endangered European pond turtle reintroduction and associated biodiversity in Europe. Here we compared the management of two wetlands (French-German Neu Woerr and Latvian Sitas Lake area) restored and/or newly created prior the turtle reintroductions. We show that recreating connectivity between ponds benefits the settlement and dispersion of the European pond turtle, but also non-targeted species such as alien invasive turtles and crayfish (FR-DE) and predatory fish (LV), with adverse impacts on the ecosystems. We also show that maintaining geographically isolated ponds limits the negative impacts of invasive species on native biodiversity. Our study highlights the prime importance of a global assessment of both the ecological context and the long-term conservation goals prior any, highly expensive and time-consuming, wetland restoration.
FUNCTIONAL DIVERSITY OF FRESHWATER FISH IN THE FACE OF CLIMATE CHANGE

Oral Presentation

L. Scherer 1, H.A. Boom1, V. Barbarossa1, P.M. van Bodegom1

1Leiden University, Institute of Environmental Sciences (CML), Leiden, Netherlands

Climate change is one of the key threats to freshwater ecosystems. Previous studies about freshwater biodiversity responses to climate change mainly focussed on species richness, falling short of biodiversity’s multidimensional complexity and being loosely linked to ecosystem functioning. Here, we assessed climate change threats to the global functional diversity of freshwater fish, considering three complementary facets: functional richness, evenness, and divergence. Climate change was represented by changes in streamflow and water temperature extremes at four warming levels (1.5°C-4.5°C). Given the large-scale and prospective assessment, we followed a computational approach. We considered 11,425 riverine fish species characterized by four morphological and physiological traits covering multiple ecological functions. Fish functional diversity responses to climate change strongly varied spatially. 6-25% of the locations worldwide face a complete loss of functional diversity, depending on the warming level and dispersal assumption. The three functional diversity facets are not always aligned. Functional richness might sometimes show a delayed response, and functional evenness and divergence might sometimes (temporarily) increase. The contrasting patterns show the complementarity among the three facets and their added value compared to species richness. As climate change progresses, threats to freshwater ecosystems accelerate, making early mitigation critically important.

IMPACTS OF EUROPEAN POND TURTLE REINTRODUCTION ON WETLAND FOOD WEBS

Oral Presentation

K. Theissinger1, J. Meka 2, C. Grac3, F. Labat4, K.A.E. van der Zon5, A. Meyer6, J.-Y. Georges7

1Justus Liebig University Giessen, Institute for Insect Biotechnology, Giessen, Germany, 2Senckenberg Nature Research Institute, LOEWE Center for Translational Biodiversity Genomics, Frankfurt, Germany, 3National School for Water and Environmental Engineering, ENGEES, Strasbourg, France, 4AQUABIO, Clermont-Ferrand, France, 5Université de Strasbourg, CNRS, LIVE UMR 7362, Strasbourg, France, 6EABX, INRAE, Cestas, France, 7Université de Strasbourg, CNRS, IPHC UMR 7178, Strasbourg, France

The impacts of species reintroductions on ecosystems are poorly reported, especially in terms of ecosystem functioning. Within the Emys-R project (www.emysr.cnrs.fr) we characterized the diet of captive-bred European pond turtles (Emys orbicularis) after release in the wild in
the Neu Woerr area (French-German border, Upper Rhine Valley) to assess the consequences of reintroduction on trophic food webs. For this, eDNA metabarcoding was implemented on Emys fecal samples, while the temporal trends of macroinvertebrate communities (Emys’ main prey) were monitored throughout successive releases over 5 years. Fecal eDNA analyses revealed that released captive-bred turtles exhibited a highly diversified diet (insects, gastropods, amphibians and plants). Importantly, turtles showed a preference for prey with relatively large body size and high longevity (Odonata, Coleoptera and Hemiptera), thus operating at the highest trophic levels in the ecosystem, with larger turtles potentially feeding on larger prey. Yet, the successive releases of turtles have not impacted the macroinvertebrate community throughout time. We demonstrate that captive-breeding, where turtles feed on artificial pellets, does not compromise their predatory skills once released in the wild. We discuss our findings in light of the opportunistic feeding behavior of the European pond turtle and show the relevance of such conservation initiatives benefiting local biodiversity without jeopardizing existing ecosystems.

**DEVELOPMENT OF NEW METHODS TO STUDY GROUNDWATER ECOSYSTEMS IN SWITZERLAND**

Oral Presentation

*M. Couton* ¹, M. Knüssel¹, S. Hürlemann¹, N. Locher¹, A. Studer¹, R. Alther², F. Altermatt²

¹Eawag, Aquatic Ecology Department, Dübendorf, Switzerland, ²University of Zürich, Department of Evolutionary Biology and Environmental Studies, Zürich, Switzerland

Groundwater is the largest type of freshwater ecosystem, yet one of the least explored habitats on earth. This is mainly related to the difficulty of accessing groundwater, but also because the scarcity of organisms requires extensive sampling effort. We overcame this in a two-fold approach. Firstly, we used citizen science with an extensive sampling of organisms in drinking water wells by water providers, followed by DNA barcoding. Secondly, we complemented it with water sampling and environmental DNA (eDNA) metabarcoding. We evaluated the possibility of combining these two approaches for gaining insights into the diversity of organisms living in aquifers, with a particular focus on amphipods. We sampled 20 drinking water wells in Switzerland. Although eDNA was not as efficient as citizen science for detecting groundwater amphipods, the combination of both methods allowed us to reveal the distinct diversity associated to the different amphipod species identified. We also found a correlation between amphipod abundance and total biodiversity at each site, suggesting that amphipods could be used as bioindicators to evaluate the status of groundwater ecosystems. Finally, the lack of genetic references in public databases for groundwater organisms prevented us to assign a taxonomic name to most of our metabarcoding dataset. Yet, using a taxonomy-free approach allowed us to identify different biodiversity patterns related to the surface land-use and the type of aquifer sampled.
PHYTOPLANKTONIC DIVERSITY AND TROPHIC LEVELS OF PONDS IN BERTOUA (CAMEROON)

Oral Presentation

J. Kengne Tenkeu 1, S.H. Zebaze Togouet1

1University of Yaounde 1, Department of animals biology and physiology, Yaounde, Cameroon

A study of some ponds in the city of Bertoua was carried out from March 2016 to April 2017 with monthly sampling, at the surface by direct sampling and at depth with a Van Dorn bottle. Physicochemical analyses were carried out using standard methods and phytoplankton analysis using the Utermöhl method. The abiotic variables of the ponds show anthropisation with high temperatures (> 23°C), low transparency (< 100 cm) despite the shallow depth (< 170 cm), average oxygenation (> 50%) with hypoxia (< 35%) in the rainy season, high mineralisation, high levels of nutrients, organic matter and photosynthetic pigments (> 30 µg/L) with nitrogen as the limiting factor of eutrophication. These characteristics classify these hydrosystems as hypereutrophic ponds. The biotic variables show that the Cote d’Azur pond (159 species) is the most diverse, followed by Mopa (147 species), Ngaikada (143 species), Mokolo (138 species) and Kpokolota (136 species) ponds. Diatoms dominate in the Mopa (53%) and Ngaikada (43%) ponds. Euglenophyceae in Cote d’Azur (32%) and Kpokolota (32%) ponds and Chlorophyceae in Mokolo pond (46%). These phytoplankton organisms with high biomasses are fairly diverse, but not in equilibrium because of the dominance of a few saprophilous and pollutant species (Azpeitia africana, Stauroeis Phoenicenteron, Eresmophphaera gigas, Microcystis aeruginosa and Aphanocapsa incerta). Restoration should control the flow of nitrogen compounds to manage the phytoplankton blooms responsible of eutrophication.

WATER CREDITS METHODOLOGY: HYDROLOGICAL REGULATION AND BIODIVERSITY CONSERVATION

Poster Presentation

M.F. Wilches Fonseca 1

1Cataruben Fundation, Water Department, Yopal, Colombia

This presentation introduces the ‘Water Credits’ methodology for measuring and certifying the additionality in water regulation, quantified in cubic meters per year, stemming from implementation activities such as restoration with native species, reforestation in agroecosystems, and conservation of terrestrial and aquatic ecosystems. These credits are key financial tools for preserving natural coverages, offering a variety of ecosystem services and directly benefiting the conservation of aquatic biodiversity by stabilizing and regulating water flows, advantageous for the biological communities in water bodies. Its efficacy is evident in preventing droughts and floods and maintaining the minimum environmental flow in lotic and lentic hydrological
systems. The application of this methodology in pilot projects in Colombian territory for its validation will be highlighted. The proposed methodology provides a precise quantification of the additionality in water regulation, encouraging businesses to invest in future water security. This investment allows companies to offset their water footprint and invest in the hydrological sustainability of their watershed, creating a positive and tangible impact on biodiversity and water resources.

PREDICTING THE COMBINED EFFECTS OF MULTIPLE STRESSORS AND STRESS ADAPTATION

Oral Presentation

N. Shahid¹, A. Siddique¹, M. Liess¹

¹Helmholtz Center for Environmental Research - UFZ, Department of System-Ecotoxicology, Leipzig, Germany

Global change confronts aquatic organisms with multiple stressors causing synergistic effects. Persistent stress, however, leads to adaptation and related trade-offs. The question arises: How can the combined effects of these contradictory processes be predicted? Here we show that pesticide-adapted Gammarus pulex from agricultural streams were more tolerant to pesticides (clothianidin, prochloraz) than non-adapted populations. However, joint exposure to pesticide mixture and temperature stress led to synergistic interactions, and the combined effects were stronger in adapted populations. We hypothesise that the pesticide adaptation increases sensitivity to the combined stress. We predicted synergistic interactions between two pesticides, three temperature levels, and the adaptation factor using the Stress Addition Model (SAM). We conclude that the effects of multiple stressors including adaptation trade-offs act synergistically and SAM can quantify their joint effects.
Biodiversity and energy transition at the crossroads

DOES THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS NEED TO TRANSITION TOO?

Oral Presentation

F. Cáceres

1University of Calgary, School of Public Policy, Extractive Resource Governance Program, Calgary, Canada

Traditional EIAs for O&G projects in developing countries are too focused on specific impacts that do not always cover the needs of biodiversity. Base line studies, monitoring and auditing, are done at the community level only. Particularities at the population level are rarely taken into account. Impacts on biodiversity are not well assessed, in most of the cases; and there are many controversial methodological issues. Differently from how O&G projects are done, the life cycle of renewable energy (hydro, solar, wind, geothermal, H2) projects requires another approach. The need of critical minerals make these projects to be associated to mining, which can occur in different jurisdictions. Also, environmental aspects and impacts, such as deforestation, change of conditions in natural ecosystems, land/water utilization coverage and direct impacts of operations on flora and fauna, still need to be addressed. This study, based on a review of Ecuador projects, presents a novel approach to EIA. Biodiversity conservation efforts and the consideration of a territory based approach, should be integrated in the energy transition process, particularly combining EIA concepts and methodologies with the territory development plans, including natural protected areas in the process. The role of governments and public policy for a more structured environmental management plan for the jurisdiction, must be enhanced in order to make biodiversity conservation and energy transition compatible.

BIODIVERSITY IMPACTS OF DIFFERENT RENEWABLE ENERGY SCENARIOS IN NORWAY

Poster Presentation

J. Borgelt1, D. Gilad1, R. May2, F. Verones1

1Norwegian University of Science and Technology, Trondheim, Norway, 2Norwegian Institute for Nature Research, Trondheim, Norway

In light of the global push for sustainable energy, it is crucial to assess the potential impact on biodiversity across diverse renewable energy pathways. This study employs a multifaceted approach, integrating ecological assessments, environmental modeling, and scenario analyses to quantify and compare the biodiversity implications of hydropower, wind, and solar energy
expansion, along with powerline network upgrades in Norway. Our investigation focuses on species diversity concerns, utilizing advanced modeling techniques to offer a nuanced understanding of how each renewable energy scenario may affect biodiversity. The chosen scenarios represent feasible options for expanding renewable energy generation in Norway, considering different spatial locations and production technologies. The findings stress the need to bridge the gap between renewable energy development and biodiversity conservation. They underscore the importance of a balanced and informed approach to sustainable energy transitions. Leveraging advanced modeling and data-driven methodologies, our aim is to provide valuable insights for policymakers, environmental practitioners, and stakeholders. This fosters a holistic perspective aligning renewable energy expansion with the imperative of preserving global biodiversity. Anticipated to significantly contribute to informed decision-making, this research guides strategic planning for a sustainable and biodiverse future.

CULTURAL ECOSYSTEM SERVICES IN A RESTORED LIMESTONE QUARRY IN MOMBASA, KENYA

Oral Presentation

A. Musando\textsuperscript{1}, F. Caceres\textsuperscript{2}

\textsuperscript{1}Lafarge Eco Systems. Bamburi Cement Plc., Restoration, Education and Ecosystems, Mombasa, Kenya, \textsuperscript{2}University of Calgary, Extractive Resource Governance Program/School of Public Policy, Alberta, Canada

Mining will increase with the energy transition all around the world. Mining operations leave behind quarries with inhospitable conditions. In Africa, where mining is concentrated, civil society and communities are engaging in activism for environmental responsibility. In Kenya, structures and equipment left at abandoned quarries are dangerous. This study sought to elucidate cultural ecosystem services (CES) in expansive areas exploited for mining and ecologically restored to ecosystems. Restoration in the Bamburi quarries started in 1971. In recent years, the restoration is being sustained through resource allocation, enabling policies and guidelines, for mine closure and land use. Data and records were collected covering periods from 2014 to 2018. Results show that over 566 hectares are now under various land use with 56.51\% of quarry having been restored. The site attracted over 181,000 visitors annually with an average annual revenue of 330,745 US$ from CES. The resulting ecosystem is a unique showcase model for sustainable mine closure. Ecological restoration of mine wastelands can create socio-economic opportunities for sustainable cultural ecosystem services. The study demonstrates that with suitable environmental and policy interventions, mining and cultural ecosystem services could be compatible. Findings call for action by governments to promote restoration, biodiversity and sustainable land use as best practice in Environmental Social Governance (ESG).
THE ENERGY TRANSITION AND MOVING TOWARD NATURE POSITIVE MINING

Oral Presentation

R. Victurine ¹, H. Rainey²

¹Wildlife Conservation Society, Bronx, United States, ²Wildlife Conservation Society, Cambridge, United Kingdom

The energy transition, while providing opportunities for achieving emission reductions may also contribute to significant biodiversity degradation and loss associated with the boom in critical mineral extraction. Under a business-as-usual scenario the drive to meet increasing market demand for raw materials will lead to significant and perverse degradation of areas critical for both biodiversity, as well as for mitigating climate impacts, thereby further widening the gap to achieving Net Zero goals. In response to the 2022 Global Biodiversity Framework (GBF) and the overarching Nature Positive goal established as part of that process, we are developing a nature positive model to guide footprint-based industries involved in the extraction of critical minerals to both reduce and enhance their contributions to biodiversity and the protection of ecosystem services. If adopted, and implemented correctly, in the right scenarios, companies have the potential to generate regional landscape-level Nature Positive outcomes, benefiting both biodiversity and local communities. To be successful in the long term, the model does require significant transformation in the economic and governance systems in which extractive companies operate. This needs to be the focus of more research and political discourse and the solution is essential to achieving the objectives of the GBF.

DAM INDUCED SOCIOECOLOGICAL FRAGMENTATION IN THE HIMALAYA, A BIODIVERSITY HOTSPOT

Oral Presentation

G. Gupta ¹, I. Jones¹

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Climate change and biodiversity loss are two pressing global challenges. However, as global energy demand continues to increase, countries face significant challenges to decarbonisation and reaching ‘net zero’ due to trade-offs between renewable energy generation and biodiversity conservation. For example, hydropower generates renewable energy, but has significant consequences for biodiversity and communities and despite having such deleterious impacts on communities and biodiversity, dams have become a pervasive feature across the globe and India is no exception. India with world’s highest population is the third-largest energy consuming country, with increasing energy demands largely met by coal, oil, and solid biomass, making India the third largest emitter of carbon dioxide. The Greater Himalayan Region of India has abundant rivers and ideal topography to potentially harness the available natural resources
for hydropower generation, with 292 dams proposed for construction in the region. Here I will explore dual dam-induced ecological and socio-cultural fragmentation in the context of the Greater Himalayan Region in India, a hotspot for biodiversity and indigenous communities. To illustrate this concept, I will use two case studies: (1) Tehri Dam, commissioned in 2006 and (2) Arunachal Pradesh, a biodiversity hotspot and land of several indigenous groups with 42 dams billed for construction in the coming decade.

QUANTIFYING BIODIVERSITY IMPACTS OF THE NORWEGIAN ENERGY SYSTEM

Oral Presentation

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1Norwegian University of Science and Technology - NTNU, Trondheim, Norway, 2Norwegian Institute for Nature Research - NINA, Trondheim, Norway

Norway is ambitiously aiming to become climate-neutral by 2030. Despite most Norwegian electricity already originating from renewables, the country is committed to expanding its renewable capacity: upgrading hydropower plants, establishing wind and solar farms, and developing the electric grid. This presents challenges as the construction of energy infrastructure affects biodiversity by fragmenting and altering habitats, acting as barriers to animal movement, and posing risks of collision and electrocution. A comprehensive framework is crucial to understanding the balance of energy production and nature preservation. Life Cycle Assessment is suitable for comparing multiple impacts, revealing trade-offs, and identifying actions to mitigate environmental impacts effectively. We present the first system-wide analysis of biodiversity impacts associated with electricity production and transmission in Norway. We harmonised existing Life Cycle Impact Assessment models, quantifying key biodiversity impacts of hydropower, wind power, and power lines. By integrating these models, we can assess which impacts contribute the most pressure on biodiversity, identify species groups vulnerable to the expansion of energy systems, and pinpoint areas where new infrastructure may threaten species richness. We argue that adopting a holistic approach is essential to minimise biodiversity impacts during electricity system expansion, guiding decision-making towards a sustainable energy transition.
Biodiversity and the Leave No One Behind: Harnessing Opportunities for Inclusive development

ROLE OF BIODIVERSITY IN SOCIOECONOMIC DEVELOPMENT IN MOROCCO

Oral Presentation

M.S. Taleb

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Located at the northwest corner of the African continent between 21 ° and 36 ° north latitude and between the 1st and the 17th degree of west longitude, Morocco with a total area of 715,000 km² enjoys a privileged position with a coastline of 3 446 km long opening to the Mediterranean and the Atlantic Ocean. Morocco is characterized by an important genetic diversity represented by a rich and varied flora with 5211 species and subspecies and many natural ecosystems. This biodiversity and these ecosystems provide a great diversity of goods and services that ensure the survival of local populations and also play an important role in the socio-economic development of the country. This biodiversity and ecosystems are currently subject to many pressures: overgrazing and deforestation, climate change, including increased drought, urbanization and forest fire. This presentation will be focused on the current state of biodiversity and ecosystem services, on the different pressures (grazing, timber harvest, harvesting of medicinal and aromatic plants, charcoal making…) and the efforts constructed by Morocco to conserve and sustainably manage biodiversity. Keywords: Morocco, biodiversity, ecosystem, services, development, conservation.

GENE BANKING FOR CONSERVATION AND UTILIZATION OF AGROBIODIVERSITY IN GEORGIA

Oral Presentation

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1DesertNET International, Chair, Montpellier, France, 2Association for Farmers Rights Defense, AFRD, Executive Director, Tbilisi, Georgia

It’s obvious that current climate change is playing an increasingly important role in the decline of biodiversity, especially Agrobiodiversity. Climate change has altered also marine, terrestrial, and freshwater ecosystems in Georgia because of water pollution, overfishing, Nano plastic and the use of pesticides and different agrochemicals by Farmers and Large Agro Industries. It has caused the loss of local species, increased diseases, and driven mass mortality of plants, animals, and aquacultures resulting in the first climate-driven extinctions. Thus far, in Georgia, we have created just simple on-farm and in-farm, in-situ Gene bank conservation sites for
farmers conserved over 35 indigenous farmer varieties of seeds, and established 8 community gene banks and allied conservation associations. Within these Gene Banks has conducted training programs for collecting, keeping and storing the Seeds and it has also documented the indigenous knowledge of farmers on the methods of selection, cultivation, and use of their crops, including rural youth and women’s knowledge in seed preservation, exchange and movement.

MULTIGENERATIONAL DIFFERENCES IN HARVESTING OF WILD EDIBLES IN SOUTH CAUCASUS

Oral Presentation

A. Faruk1, A. Nersesyan2, A. Papikyan2, S. Galstyan2, E. Hakobyan2, T. Barblishvili3, T. Mikatadze-Pantsulaia3, T. Darchidze3, M. Kuchukhidze4, N. Kereselidze5, D. Kikodze5, I. Willey6, P. Ryan7, E. Breman1

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Ecosystem services are underpinned by biodiversity, which is rapidly eroding globally, threatening rural livelihoods and culture. Examining the uses of wild edible plants (WEPs) that are important to rural communities gives insight into the value of a biodiverse landscape to local communities. Here, the importance of considering age groups in future ethnobotanical and conservation studies is highlighted, as this can enhance our understanding on the dependence of use within a landscape, informing more inclusive conservation actions. Ecosystem services are underpinned by biodiversity, which is rapidly eroding globally, threatening rural livelihoods and culture. Examining the uses of wild edible plants (WEPs) that are important to rural communities gives insight into the value of a biodiverse landscape to local communities. Here, the importance of considering age groups in future ethnobotanical and conservation studies is highlighted, as this can enhance our understanding on the dependence of use within a landscape, informing more inclusive conservation actions. We investigated the patterns of use for wild edible fruits and nuts in the South Caucasus, focusing on multigenerational differences in harvesting patterns, diversity and use through semi-structured interviews in Armenia and Georgia. We found that foraging activities within South Caucasus’ communities remains active; however, the use of WEP is not uniform within and across different communities.

PROMISES AND RISKS OF “LEAVING NO ONE BEHIND” IN A FRAGILE BIODIVERSITY CORRIDOR

Oral Presentation
The involvement of non-state actors in the 2030 Agenda for sustainable development has been popularized as among the most critical in “leaving no one behind”. Specifically, the engagement of private sector actors with indigenous peoples in realms traditionally “reserved” for governments, e.g. forest biodiversity conservation, presents opportunities for inclusivity and real socio-economic results when market-based options are applied. In Kenya’s fragile Kasigau wildlife corridor of the Tsavo ecosystem, dryland forest communities have partnered with private sector actors in conserving threatened biodiversity for over a decade under the Reducing Emissions from Deforestation and Forest Degradation (REDD+) framework. Here, we explore progress in achieving biodiversity conservation under REDD+ in a threatened wildlife corridor using a needs-based approach, including High Conservation Values preservation, governance, poverty eradication and access to education. We explore the risks posed to projects and livelihoods by ideological differences in strategies, systems and standards, market fluctuations and attacks from market naysayers. We conclude that, despite general consensus that we are lagging behind towards achieving the 2030 Agenda, the Kasigau corridor case study illustrates a microcosm of what is possible where benefits outweigh the risks, in a setting where social and biodiversity outcomes are real, verifiable and long-term, while risks are mostly notional and short-term.

**SOCIAL SOLIDARITY ECONOMY AS AFRICAN AGENTS FOR BIODIVERSITY CONSERVATION**

Oral Presentation

**A.A. Akanji**

In this paper, the basic argument is that the social solidarity economy (SSE): co-operatives, mutual, self-help societies etc. hold great potential for sustainable development, in the instant case, biodiversity conservation. This is the case with many states of the global-north. However, African SSE has been less explored within the framework of sustainability programme. To evaluate the problem, relevant literature were reviewed, and some stakeholders were interviewed. The following are some results: (a) the United Nations (UN), and International Labour Organisation (ILO) recognise SSE as important mechanism for biodiversity conservation and sustainable development; (b) UN and ILO identified the following principles and values as core ethics of the SSE: mutual aid, primacy of people and social purpose over capital, care for people and planet, equality and fairness; (c) optimising the potentials of SSE requires supportive legal and policy frameworks; (d) legal and policy frameworks on SSE in Africa is
at their infancy, hence the potential of African SSE is currently sub-optimally utilised. Thus, with Nigeria as the primary research locale, legal and policy frameworks on SSE were reviewed in accordance with UN and ILO requirements. Some un-alignments were observed, and remedial were accordingly proffered. The aim was to properly situate African SSE for biodiversity conversation.

Keywords: Biodiversity conservation, Legal review, Policy development, Social Solidarity Economy.

SOCIAL ASSESSMENT TO IMPROVE UNDERSTANDING OF PROTECTED AREAS: LESSONS FROM SAPO

Poster Presentation

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Rural communities in tropical countries rely on the forest for their livelihood and socio-cultural activities. This relationship is sometimes judged to cause degradation, with environmental protectionists advocating excluding communities from forests. However, the view that rural communities will always negatively affect the environment has become increasingly contested. To address this issue, creating protected areas (PA) as part of a package of integrated conservation and development has been touted as an essential strategy to advance sustainability. In Liberia, which contains the largest remaining portion of the globally significant Upper Guinean Forest Ecosystem, creating a PA network is a central strategy of efforts to protect biodiversity and enhance economic growth. When this is factored with the negative impact that communities might face due to PAs, there is the need to contextualise the experience of people living on the fringe of these areas. Containing 1,804 km2 of lowland tropical rainforest, Sapo National Park (SNP), established in 1983 by military decree, is Liberia’s largest and oldest PA. Using the Social Assessment of Protected Areas methodology, the impact of SNP on the livelihood of fringe communities was assessed to understand how it affects the perception of local communities about the PA. We demonstrate the importance of this exercise in generating information to improve the management of PAs with implications for the well-being of local communities.

ECO-EMPOWERMENT AND YOUTH-LED DIALOGUE FOR COMMUNITY RESILIENCE

Oral Presentation

**A.T. Oo** ¹

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The Greater Mekong subregion countries are at high risk of environmental conflict and suffering from the negative impact of climate change. Climate change as an eco-anxiety phenomenon causes psychological effects on indigenous. As climate-related problems grow, communities are experiencing eco-anxiety for their food security and livelihoods. As the climate crisis worsens, young people may face the most profound impact of climate and environmental challenges on their lives, livelihood, and economic opportunities; as negative effects on the youth employment crisis during the pandemic situation. The project aims to foster collaboration across Greater Mekong countries by initiating an “Eco-Charge Mekong Hub” to follow up the youth center training program- access to profitable, safe, and sustainable livelihoods and employment. Eco-resilience solutions through eco-empowering strategies by addressing the impacts of Ecosystem-Based Adaptation to reduce vulnerability and make holistic approaches for empowering target households, especially the youth generation, then developed pieces of training module on mainstreaming gender equality and social inclusion, gender-responsible anticipatory action. “Activities for Youth-led Mangrove Reforestation Initiative” strengthen natural barriers and protection of coastal communities. Promoting sustainable farming techniques, and climate-smart agriculture improves agricultural practices and productivity.

AGROBIODIVERSITY CHARACTERIZATION OF TARO FARMS AS LIVELIHOOD FOR RURAL AREAS

Poster Presentation

V. Foronda1, A. Del Rosario1, S. Aekbal Salleh2

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Taro is a widely cultivated crop in the tropics, like the Philippines, with diverse agro-physical conditions. The investigation focuses on geo-tagging of taro farms in four municipalities of Camarines Sur, Philippines, and determine its biophysical characteristics. The farm’s coordinates were established using GPS application, and questionnaire was crafted to gather primary data. 211 taro farms were located in the four municipalities. Several taro cultivars (farmer selections) were identified across farms. Farmers prefer to plant taro suckers, with a common planting distance of 0.30 m x 0.50 m, and planted in bed-type layout design. Most farms have clay loam soils. Farmers normally don’t conduct soil analysis, but apply fertilizers to improve crop yield. Weeds are controlled by hand-weeding, and insect pest management is done manually and chemically. Taro are usually harvested for leaves and corms, and kept in an open-type storehouse for drying and storing. Aside from household food or domestic use, farmers grow taro as an enterprise. Both genders are actively involved in taro farming, but female taro farmers outnumber the males. The study recommends the provision of training, financial and technical assistance to promote taro production technologies towards increasing
farm productivity and enhancing the farmer’s knowledge on taro value-adding techniques for profit and for better food sustainability.
Biodiversity Finance for a Nature Positive Future: Innovations, Challenges, and Opportunities & Sustainable Finance and Biodiversity

LEVERAGING THE BIODIVERSITY INTACTNESS INDEX (BII) WITHIN THE TNFD FRAMEWORK

Oral Presentation

G. Thomas

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As the urgency to address biodiversity loss intensifies, stakeholders are increasingly acknowledging the need to incorporate nature-related considerations into their decision-making. The Taskforce on Nature-related Financial Disclosures (TNFD) Framework, with the Locate Evaluate Assess Prepare (LEAP) approach at its centre, plays a focal role in guiding businesses on how to evaluate their dependencies and impacts on nature. Nature-positive decision-making and sustainable investments require actors to be able to compare the impacts on biodiversity resulting from different choices. The Biodiversity Intactness Index (BII) stands as a prominent model-based indicator of ecosystem integrity, providing valuable insights into the state of nature at high spatiotemporal resolution. By incorporating Earth observation data into the PREDICTS database of primary biodiversity data from peer-reviewed studies from 50,000 sites worldwide, the BII calculation leverages advanced machine learning and statistical algorithms. We will present case studies showing how BII can be used with each of the four components of LEAP. The BII’s ability to operate at various spatial scales and aggregate benefits makes it inherently aligned with global targets and policies. By leveraging the BII within the TNFD and LEAP frameworks, businesses can move towards a more sustainable and accountable future, where biodiversity management is central to corporate stewardship and decision-making processes.

SAVING SCOTLAND’S RAINFOREST WITH NATURAL CAPITAL FINANCE WITH SO MANY PARTNERS?

Oral Presentation

H. Rudman

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Scotland’s rainforest lies in a zone along its west coast - in total 18,500km2 - or about 23% of Scotland’s land area. However, within this area there is only about 30,000ha of core rainforest remaining, in small fragments, which are highly threatened by invasive non-native species,
high herbivore levels and other threats. The Alliance for Scotland’s Rainforest - an adhocracy of 27 partner organisations, aims to restore all of Scotland’s rainforest by 2045, linking up existing areas and doubling its size, playing a significant role within the Scottish Government’s national net zero commitment by 2045 and interim 75% target for 2030. The Alliance for Scotland’s Rainforest (ASR) has identified a funding gap of £500m to achieve its aim of ecological restoration of Scotland’s rainforest by 2045. Current models of funding provide neither the scale nor longevity to suit the project delivery or outcomes. Private finance through impact investment and sale of ecosystem services will likely be an important part of the solution. ASR have secured four landscape-scale projects, and identified a pipeline of at least nine future potential projects. ASR cannot progress these at the rate needed without a new finance model suitable for multiple projects across different organisations and landholdings. This case study will explain how the ASR has developed an accessible, scalable and transparent investment model to channel funding into rainforest restoration in Scotland.

OPPORTUNITIES AND BARRIERS TO ACHIEVING ENVIRONMENTALLY SUSTAINABLE INVESTMENTS

Oral Presentation

B. Crona ¹

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There is growing recognition among investors of the interdependence between responsible corporate behaviour and long-term financial viability. This growing interest in sustainability is encouraging, but discernible shifts in corporate practice are limited and trends documenting the state of biodiversity are alarming. Scholarly work on the financial sector abounds, but systems approaches to understanding and analysing its role in driving a sustainability transition are scarce. Yet, a systems perspective is useful for two reasons. First, it helps identify levers of change – system pressure points where implementation of change can result in a disproportionately large effect. Levers for change are the influence mechanisms available to financial actors with different mandates. Second, it allows for identification of how different parts of the system mutually amplify each other’s actions, or conversely, how practices counteract, and thus block, the ambitions of others. The systems framing allows us to bring together the large, but often disparate, scholarship on diverse financial market actors and investment strategies and allows us to show the opportunities that open up to more strategically pursue sustainability in financial practices when we identify how these strategies can complement and amplify each other to jointly unlock the dual potential of sustainable investments: reduce harm and do good by funnelling capital to corporate models that restore and regenerate the biosphere.
ADAPTING MEASUREMENTS AND MONITORING TOOLS FOR TANGIBLE BIODIVERSITY GAINS

Oral Presentation

S. Raithel

1Fauna & Flora International, Cambridge, United Kingdom

Biodiversity, defined as “the variability among living organisms”, is highly complex and highly varied across the globe. Unlike carbon, there is no single universal measure of biodiversity. As biodiversity enhancement both through net gain and nature positive mechanisms for private sector becomes standard, lies the challenge to demonstrate this progress across varied ecosystems. As new nature related reporting requirements are launched, corporations grasp the challenge of measuring their biodiversity footprint. Large scale development sectors are considered to be better prepared to report biodiversity footprints and impacts due to regulatory compliance mechanisms, such as Environmental Impact Assessments. Yet, it is commonly found that these baselines do not provide appropriate data to robustly quantify and assess condition of biodiversity, especially overtime, limiting commitments to protecting and conserving biodiversity. Quantified improvement in ecological outcomes is essential if offsets, nature-based solutions, and biodiversity credits, among others are to be pragmatic means of achieving global goals. In this presentation, new data metrics and visual dashboards will be presented that can inform mining operation actions, corporate decision making, as well as, mobilize resources for local biodiversity conservation to contribute to a nature positive future. Research, corporate policy, national policy and local level actions must be aligned to achieve this ambitious target.

COMMUNITIES AND NATURE MARKETS: JUST PARTNERSHIPS FOR BIODIVERSITY CREDITS

Oral Presentation

J. Smith, L. Alhassan

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Biodiversity credits have been proposed, and are increasingly being piloted, as a market-based mechanism to help halt and reverse the loss of global biodiversity. Indigenous Peoples (IPs) and Local Communities (LCs) are on the frontline of protecting and maintaining the world’s biodiversity: Indigenous Peoples in particular make up less than 5% of the world’s population, manage less than half of terrestrial landscapes and a third of inland waters, yet they have succeeded in protecting 80% of our global biodiversity. When it comes to the development of new markets for biodiversity credits, IPs and LCs are clear key stakeholders without whom a market should not progress. The conference paper builds on a global discussion paper published
by the Biodiversity Credit Alliance (BCA) https://www.biodiversitycreditalliance.org and focuses on the specific context of southern Africa. It unpacks the specific context of how IPs and LCs are defined regionally, how conservation activities take place on different forms of land tenure, and the relevance of this for defining just and viable biodiversity credit partnerships in the region. The findings are based on qualitative research including interviews with experts, officials and stakeholders from the region. The contribution is innovative as this topic has been explored at a global level and in some Latin America countries, but not yet in southern Africa which holds considerably valuable global biodiversity assets.

SUBNATIONAL ENDOWMENT FUND FOR NATURE AND CLIMATE: MACROFINANCIAL, FISCAL LINKS

Oral Presentation

S. Mumbunan

1University of Indonesia, Center for Climate and Sustainable Finance, Institute for Sustainable Earth and Resources, Depok, Indonesia

This paper explores a permanent, subnational endowment fund for climate change and sustainability outcomes from a macrofinancial and fiscal standpoint. A mix of jurisdictional mandates and policy objectives specifies fiscal rules for the long-term management of the fund’s principal and return. This contribution expands on the macrofinancial framework of a sovereign wealth fund and provides links to fiscal relations. It then applies these to a prospective subnational endowment fund for provinces in Indonesia’s Papua, which host one of the world’s biggest tropical rainforest regions and significant biodiversity hotspots. It covers three main topics. (i) Macrofinancial and fiscal features. It discusses structural fiscal balance in light of nominal production that depends on volatile extractive (fossil fuel and mining) commodities and impending liabilities impacted by stranding assets. It addresses possibilities to incorporate nature’s contribution to people (NCP), e.g. tropical peatland carbon stocks and marine biodiversity, into nominal production. (ii) Fiscal and financing capacities. These components are illustrated by transformative policies such as ecological fiscal transfers and sustainability-linked debt financing. (iii) Policy relevance. Limitations of fiscal elements, notably the use of fiscal capacity, in addressing climate and sustainability intended outcomes are discussed in light of the decentralized fiscal relations and Papua’s special autonomy.

DESIGNING A BIODIVERSITY FINANCE DECISION SUPPORT SYSTEM

Oral Presentation

C. Brewster, L. Powell

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This paper will present the design considerations for constructing a decisions support system for mainstream finance to invest in nature based solutions focusing on the protection or enhancement of biodiversity. In the context of a large scale EC funded project, BIOFIN, we outline our approach to a nature based solutions dashboard enabling risk scoring of biodiversity investments. Our approach involves the integration of a variety of data sources, together with assessing the accuracy and trustworthiness of such data. We argue that effective data management depends on provenance and transparency which necessitate the adoption of the FAIR data principles for biodiversity related data. For such an approach to work a coherent consistent and widely adopted data standard must be adopted. Equally important are the governance rules around data collection to ensure to ensure transparency, accuracy and trust. We will present our initial work on developing a risk analysis and underwriting engine for evaluating the risk and return on a specific investment. This risk analysis engine is integrated in our overall dashboard and decision support tool to enable stakeholder to derive trusted insights into biodiversity initiatives.

**BIODIVERSITY STEWARDSHIP UNITS TO REWARD CONSERVATION BY FOREST STEWARDS**

Oral Presentation

*M. Githiru*¹, H. Dublin², L. Martinez-Inigo¹, Y. Githiora¹

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Sustainable and equitable finance is needed at scale to stem or reverse global biodiversity loss. The Global Biodiversity Framework (GBF) emphasizes the role of private finance and that of indigenous peoples and local communities (IPLCs), who play a key role in protecting the world’s biodiversity. Biodiversity credits markets designed to achieve nature-positive contributions are a promising avenue to finance conservation of high-value ecosystems. We present the Biodiversity Stewardship Units (BDSUs) concept, a novel market-based tool to reward local stewards of biodiversity in customary lands with low deforestation risk. Such lands may be restricted from both avoided conversion or biodiversity credits frameworks requiring additionality or uplift from a baseline. Eligibility of customary lands to participate under this methodology will be based on meeting a pre-set historical deforestation and degradation threshold, assessed through current forest extent and biomass stocks. For eligible areas, species richness and composition of selected taxonomic groups will be compared to a list of expected forest indicator species for each taxon. This will be used to compute a biodiversity intactness score that will form the basis for calculating biodiversity units for the eligible land area. BDSUs represent a promising financing mechanism that will neither be used as offsets nor require additionality, thereby placing IPLCs at the centre of conservation of intact landscapes.
THE MACRO-CRITICALITY OF NATURE FOR FINANCE

Oral Presentation

N. Ranger¹, J. Alvarez¹, A. Freeman¹, T. Harwood¹, M. Obersteiner¹, E. Paulus¹, J. Sabuco¹

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The erosion of natural capital linked with biodiversity loss and environmental degradation generates significant and long-term risks to society and therefore financial institutions (FIs), from increasing the risk and impacts of pandemics, floods and droughts, to undermining water quality and supplies, damaging agricultural production and creating risks to human health. These risks are not priced into financial markets and are not accounted for in the scenarios used by financial institutions, Central Banks and supervisors to date for prudential risk management, leaving the financial system exposed to potential systemic risks. The under-pricing of this risk also means that the way capital is allocated in the economy is not most efficient, with finance flowing to activities that generate risk. Better measurement and pricing of these risks is essential for financial resilience and underpins the transition to a nature-positive future. The main objective of this paper is to draw upon the science and economics of nature to help develop the scenario approaches for nature-related financial risks needed to assess the macro-criticality of nature for financial institutions, and couple this with a preliminary assessment of the relative scale of risks across countries. Our focus is on physical nature-related financial risks; that is, those associated with physical changes in nature and the ecosystem services it generates for our societies and economies.

MEASURING Biodiversity FOR THE PURPOSES OF Financing CONSERVATION

Oral Presentation

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For finance, biodiversity must be expressed as a single number that allows change in biodiversity over time to be measured by subtraction. For offsetting and some financial purposes, biodiversity differences between sites are needed. Achieving a single number for such a multifaceted concept is very challenging; a promising approach is to use a basket of metrics, somewhat similar to the basket of goods for measuring inflation. Since the Wallacea Trust coined this approach in 2021, several such measures have appeared, some of which I discuss. Other needs include granularity, repeatability, auditability and efficiency. In operationalising a biodiversity measure, key issues are quality control, transparency, handling uncertainty in measures and estimates, leakage, additionality and the directness of the measure. The counterfactual (e.g. what change would have happened without a given intervention) is particularly important.
for avoided loss measures. A measure is direct when it measures biodiversity directly, rather than via proxies. This leads to the question of whether payments for biodiversity (e.g. biodiversity credits) should be for actions (e.g. appropriate management interventions) or for results (measured biodiversity gain or avoided loss). I try to make sense of these issues via a theory of change approach; this dovetails with my roles in the Biodiversity Credit Alliance, the World Economic Forum Biodiversity Credit Working Group and the Biodiversity Futures Initiative.

**NAVIGATING NATURE AND CLIMATE RISK: INTEGRATED FRAMEWORK FOR ECONOMIC ASSESSMENT**

Oral Presentation

M. Stevanovic¹, P.J. von Jeetze ¹, J.A. Johnson², A. Ceglar³, A. Popp¹⁴

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Biodiversity loss and ecosystem service (ES) degradation can pose substantial threats to financial stability and the broader economy. Despite evidence of ongoing ES degradation, methodological and data challenges hinder a detailed assessment of financial risk, limiting our understanding of the linkages between the economy and ES. We introduce a nuanced approach to grasp the emerging financial risk of ES change, using the LPLmL-MAgPIE-SEALS modeling framework to assess physical, transition and financial risk, considering feedbacks from climate change, land use, and degrading ES. Focused mainly on the EU, we also assess global linkages of ES loss. The framework includes climate-sensitive gridded biophysical data within a land-system model, with landuse patterns downscaled to derive fine-scale changes in ES supply and associated effects on agricultural production. Scenarios, building on the existing NGFS framework, range from a degraded world without policy interventions to an integrated climate-nature scenario with ambitious policies to mitigate both climate and ES change. Results show diverging biodiversity responses based on varying climate and nature policy ambition, emphasizing the need to extend biodiversity safeguarding beyond exclusive reliance on climate mitigation policies. Financial risk is assessed by analyzing sectoral dependencies on various ES, laying the basis for a comprehensive framework to inform decision-making amid emerging climate and nature-related risk.

**DEFORESTATION AND BIODIVERSITY RISKS IN AGRICULTURAL COMMODITY FINANCE**

Oral Presentation
The international commodity trade is highly reliant on finance. With over 90% of forest loss in the tropics linked to the expansion of agricultural commodities, an ability to assess the impacts of these commodities on forests is thus fundamental for assessing the risk of negative environmental consequences of investments. The requirement to remove deforestation and biodiversity loss from supply chains is now also increasingly mandatory for private entities, formalised through regulatory frameworks such as the European Deforestation Regulation and similar legislative initiatives in the UK. Going forward, the finance sector will thus need to carefully assess the environmental risks associated with individual commodities, regions and supply chain actors. However, this is challenging. For most commodities global production maps are lacking. Hence, their origins and local impacts cannot be assessed. In addition, for a wide range of commodities supply chains are largely opaque. Here we summarise recent scientific advances for mapping and monitoring the impacts of commodities. Following a broad overview of the challenges and of key scientific gaps, we show an example of overcoming some of these issues in the case of rubber. We also emphasise the critical role of co-design with stakeholders, and the importance of considering equity as top-down financial and policy regulation may risk marginalising smaller producers or countries with less developed forest monitoring systems.
Biodiversity Finance for a Nature Positive Future: Innovations, Challenges, and Opportunities & Sustainable Finance and Biodiversity

NEW GREEN SHOOTS: EMERGING TRENDS IN NATURE AND SUSTAINABLE FINANCE

Poster Presentation

**J. Smith** ¹, **L. Alhassan**¹

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Nature is an emerging issue within the sustainable finance space, which has been considerably encouraged by the agreement on the Kunming-Montreal Global Biodiversity Agreement. The conference paper is based on an annual series presented from 2021-2024 by the United Nations Environment Finance Initiative, Principles for Responsible Investment and other partners, complemented by in-depth interviews with key actors from banks, investors, project developers and other. The paper documents important trends in- How the market for nature-related impact products is evolving- What are the most anticipated innovations in structuring, de-risking and other that have the most potential to unlock more finance for nature and nature’s stewards including Indigenous Peoples and Local Communities

- Opportunities linked to hot themes such as sovereign debt, food systems, technology, and in secondary markets- Market integrity and avoiding greenwashing, market standards and developments in more harmonised Key Performance Indicators (KPIs), Monitoring, Reporting and Verification (MRV) and safeguards- The relevance of international processes such as the UK-France International Panel on Biocredits in market scaling

The scope of the paper is global but geographically focuses on those markets where sustainable finance is being supplied as well as the locations where conservation and restoration finance need to reach. Marine, coastal, freshwater and terrestrial ecosystems will be highlighted.

BLUE CARBON FINANCE: COMMUNITY PERCEPTIONS AND SOCIOECONOMIC IMPACT IN KENYA

Poster Presentation

**S. Sithole** ¹,², **M. Owour**¹,²

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Coastal ecosystems such as mangroves, seagrass beds, and salt marsh provide ecosystem services to mitigate climate change. The stored carbon is called blue carbon. As attention grows towards developing strategies to incorporate blue carbon into policies, it is important to take into consideration how such projects and policies affect the lives of communities most involved. Community involvement is pivotal for project success, requiring active engagement and acceptance. This study aims to investigate community perceptions and social consideration of blue carbon finance projects. The primary focus is on Kenyan coastal communities in Lamu, where blue carbon initiatives play a vital role in climate change mitigation. This study will delve into the dynamics of these initiatives, examining community perceptions and socioeconomic impacts. It aims to inform the design, implementation, and optimization of similar projects globally. This study uses a mixed-methods approach, combining qualitative interviews, surveys, and complemented by the analysis of environmental and financial data related to blue carbon projects ecological assessments. It seeks to contribute insights to the discourse on blue carbon finance, offering evidence-based recommendations for policymakers, conservationists, and development agencies to ensure the success and sustainability of blue carbon initiatives in Kenyan coastal communities and beyond.

IDENTIFYING PRIORITY AREAS FOR BLUE CARBON FINANCE DEVELOPMENT IN KENYA

Poster Presentation

S. Sithole 1,2,3, M. Owour1,2

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Seagrasses store large amounts of carbon and mitigate climate. Despite their crucial role, they face alarming global declines. Seagrass distribution maps and carbon storage capacity research is still scarce. This study aims to fill this gap by mapping the spatial distribution and sequestration potential of seagrasses in Lamu, Kenya to develop sustainable income for conservation. Using high spatial resolution images and in-situ sampling, this study uses the InVEST Coastal Blue Carbon model to map and assess the capacity for seagrasses to store and sequester carbon under different plausible future scenarios. We further estimate the potential revenue from seagrass carbon sequestration using New Present Value analysis. The study aims to determine the financial viability of blue carbon conservation projects, providing insights for policymakers and stakeholders.
Biodiversity in environmental law – From international frameworks and national legislation to the enforcement of biodiversity through environmental litigation

INTEGRATING PLURALITY IN BIODIVERSITY OFFSETTING AND ALTERNATIVE CONSERVATION

Oral Presentation

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Biodiversity offsetting (BO) and No Net Loss policies have been developed internationally primarily by natural scientists and mainstreamed through the GBF of the CBD and EU Biodiversity Strategies. As these policies are adapted and implemented locally through national or regional regulatory frameworks, they often fail to allow room for local socio-ecological sensitivity and ontological plurality. Similarly, many locally emerged approaches to conservation, such as the promotion of the Rights of Nature by indigenous communities, need to become formalised through prevailing legal institutions for their rights to become enforceable. Hence, environmental policy and law becomes the node where diverse values and worldviews meet, yet it often remains rigid and bias towards what can be called the modern ontology (Blaser 2013). This paper explores local consequences of BO schemes and shows how local indigenous communities can offer alternative, more context sensitive approaches in conservation. Within two case studies impacting indigenous communities, the Sakatti mine in Finland and the Cerrejón mine in Colombia, the ontological dimension of the politics of BO is scrutinized. We consider if and how BO as set in law can be interpreted through a more relational ontology. Additionally, we analyse what strategies existing legal frameworks in Finland and Colombia provide or exclude for advancing alternative conservation measures.

IMPACTS OF LIBERIA’S LAND RIGHTS ACT (LRA) ON BIODIVERSITY CONSERVATION

Oral Presentation

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Liberia contains more than 40% of the remaining Upper Guinean Forest Ecosystem, a global biodiversity hotspot. In 2006, the government committed to maintaining at least 30% of its forest through the Forest Reform Law. This is to be achieved without sacrificing economic
growth. At the heart of this commitment is the creation of a network of protected areas. Since the passage of the law, 3 new protected areas were added to the existing two gazetted PAs. The creation of these PAs came at a cost to local communities as it has restricted their use of these areas. In 2018 the government passed the LRA granting automatic ownership right to local communities over customary land across the country, including in areas recognized as important to biodiversity. Under Conservation Works (CW), a USAID-funded project, we assessed the impacts of the LRA on the full implementation of the Forestry Reform Law, the National wildlife Conservation & Protected Area Management Law, and the Environmental Protection & Management Law. We demonstrate that the system and approach for establishing new protected areas must change to conform with the requirement of the LRA. Governance and management of customary land, including protected areas, must now be carried out with consent and involvement of communities. We highlight the need for the development of new policies and systems to conform to the Land Rights Act. We show how CW is working with the government to protect people and biodiversity.

MAINSTREAMING REVISITED: HOW SHOULD BIODIVERSITY STRATEGIES STILL HELP US?

Oral Presentation

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1Helmholtz-Centre for Environmental Research - UFZ, Leipzig, Germany

Drivers for biodiversity loss are largely regulated by policies in non-environmental sectors. In the face of increasingly unequal power relations between public and private actors, environmental policies have witnessed an on-going trend towards collaborative, soft instruments. For embedding global biodiversity targets into national action, the CBD proposes national biodiversity strategies and action plans (NBSAPs) as the central instrument to guide implementation. However, despite this international mandate, these instruments struggle to establish long-lasting collaborative relationships with sector stakeholders and among different political levels. In our presentation we combine the findings of eight case studies from the Global North and South providing insights into the successes and failures of NBSAP implementation. Based on a data set of 179 semi-structured interviews, from eight countries, covering experiences of government representatives, NGOs, academia and others, we reveal central leverage points for the future design of this instrument. We identify the joint planning, consequent policy revision and adaptive learning as central policy mechanisms, which need to be embedded into future NBSAP processes. By highlighting these mechanisms under both a practical and theoretical lens, we provide guidance for avoiding repetitive goal setting without paths towards implementation on a global and national level.
LIVING WITH THE INCOHERENT: SILOISM AS CHALLENGE FOR RESTORATION POLICIES

Poster Presentation

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Siloism and fragmentation are omnipresent challenges in modern public administrations. Driven by the increasing complexity of environmental problems, public authorities are being pushed towards ever greater specialization of individual organizational units. While this specialization makes political sense as it concentrates expertise and provides a clear target for lobbying clients, it also creates challenges for implementing cross-cutting issues. At the example of the joint implementation of the water framework directive and the habitats directive on the sub-national level in Germany, we analyse how river restoration projects are hampered by the fragmentation of public administrative structures. Based on a multi-stage consultation process of public agents, NGOs, planning officers and area managers, we identify not only practical hurdles and levers, but also link these to underlying institutional structures. Thus, we argue that the reasons for the failure of many projects lie only to a limited extent in practical hurdles like missing resources, information or experience, but instead more fundamentally in the administrative culture. The fragmentation of administrative structures keeps both individual agents as well as organisational units away from comprehensive collaboration, undermining the implementation of cross-cutting European policies on the ground.

HOW IS BIODIVERSITY ASSESSED AND MONITORED IN EUROPEAN SEAS? - A LITERATURE MAP

Poster Presentation

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Climate change and anthropogenic disturbances are precedingly impacting natural marine ecosystems and the biodiversity that they preserve. Assessing and monitoring the status and trends in biodiversity changes is the most effective way of bringing the urgency of the conservation of these ecosystems to policymakers and regulators directly in charge of implementing sustainable development. Nevertheless, the landscape of international, regional, national, and sub-national biodiversity assessment frameworks is complex with many different approaches and tools in use for assessing biodiversity. This systematic literature map aims to present
a structured overview of the applied frameworks including the spatial and temporal resolution of biodiversity monitoring. Additionally, we identify gaps in the coverage of biodiversity assessment in terms of ecosystem components (i.e., organism group) or regions in European waters. This review ultimately helps to understand the differences in assessment and monitoring strategies, and to build the base for identifying potentials for further development and harmonizing strategies in biodiversity assessment and monitoring across Europe.

BRAZIL’S PATHWAY TO ACHIEVE NET ZERO EMISSIONS WHILE SAFEGUARDING BIODIVERSITY

Poster Presentation

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Nature based Solutions (NbS) bring essential commitments to protect our planet, but this ambition is rarely supported by robust policies. Although Brazil has pledged to restore 12 million hectares and offset emissions, it has failed to implement its environmental policies. This work assesses outcomes in compliance levels to national policies by 2050: i) baseline scenario, ii) legal enforcement scenario, and iii) NbS plus scenario. They combine quotas for NbS or engineering technologies, weighing contributions from the land use and energy sectors. The impacts were evaluated on three metric sets by PLANGEA: i) net carbon sequestration; ii) species extinction debt, ecosystems integrity, and ecoregions vulnerability; and iii) land opportunity cost and restoration implementation cost. Conservation has the greatest contribution in achieving net zero emissions while safeguarding biodiversity. Although full implementation of the Forest Code would protect millions hectares of native vegetation, only halting the illegal and legal deforestation should ensure biodiversity conservation. Amazon biodiversity should be protected by combating illegal deforestation, but the biodiversity in Cerrado will only be preserved with a zero deforestation policy. It would avoid higher monetary expenditure on energy sector infrastructures while protecting nature. Brazil must incorporate biodiversity targets into its commitments, reflecting the consistent transformation in environmental governance.

HOW THE STATE REDUCES ATTRITION AT THE MEGA BIO-DIVERSE ATEWA FOREST IN GHANA

Poster Presentation
Global environmental laws have multiple strands and includes UNCBD, CITES, Ramsar Convention on Water fowls and others and these are binding on state parties who are signatories. The mandates are broad with administrative powers and responsibilities whereas liabilities and failures have its own consequences. To help in the political and governance of forests, state parties have enacted laws and protocols to enforce and to protect the natural resource from biodiversity loss, climate change and destruction of the ecosystem. In managing its natural resources Ghana have promulgated several laws for example Forest and Wildlife laws,1995. The Atewa Range Forest Reserve (AFFR) is strategically and sensitive ecological landscape in Ghana Protected areas constitute one of the viable tools that countries like Ghana can count on for securing and conserving environmental, social and economic capital. It is recognized as a Globally Significant Biodiversity resource area with rare fauna and flora. Fundamentally, the state has to use its coercive powers to protect all terrestrial, marine and internal water bodies from harmful practices and pollution. The state has to enforce the laws to deter illegal mining, harvesting of non timber forest products, illegal farming and deforestation through illegal felling of trees in the ARFR. Invariably the government has earmarked the ARFR for commercial mining prospecting. The impact on plants and animal species would be dire.

CHALLENGES IN SWISS BIODIVERSITY GOVERNANCE: THE STAKEHOLDERS’ PERSPECTIVE

Poster Presentation

N. Zumbühl, K. Bussmann-Charran, E. Lieberherr, R. Pärli, S. Richman

Despite its political commitment at the national and international level, Switzerland is still confronted with an ongoing loss of biodiversity. One factor seriously impeding the ability to cope with the loss is insufficient exchange of existing knowledge between science and practice. Syntheses of scientific findings specifically tailored to and co-created with stakeholders could lead to an increased knowledge transfer. Specifically, this could help stakeholders confronted with large amounts of information to identify and assess the effectiveness of different management options; ultimately leading to a higher uptake of effective measures on biodiversity conservation in practice. The recently established Translational Centre Biodiversity Conservation (TCBC) addresses this science-practice knowledge transfer. The TCBC does so by identifying the most pressing questions for Swiss stakeholders working in biodiversity
conservation and then providing related syntheses products. Using a transdisciplinary and participatory approach, we conduct a horizon scan among stakeholders to identify hot topics for syntheses. Then we create working groups integrating experts from science and practice to co-produce syntheses on the topics identified. We will present results from the horizon scan and from the working groups on questions related to policy and governance aspects for syntheses on biodiversity conservation topics as perceived by Swiss stakeholders involved in biodiversity management.

RESPONSIBILITY AND TRANSPARENCY IN THE KMGBF: THE SWISS PERSPECTIVE

Oral Presentation

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Starting with the legal status of multilateral environmental agreements, in particular the CBD and the KM-GBF, this contribution will then present the Swiss perspective on the international negotiation process for a planning, monitoring, reporting and review mechanism. This new mechanism for the KM-GBF was one of the priorities of Switzerland, in order to avoid the shortcomings of the Aichi targets, which mostly couldn’t be achieved. Negotiations on this issue have been difficult and are not yet completely achieved. However, Parties were able to agree on main elements for such a mechanism within the KM-GBF and in decision CBD15/6. The details of the review mechanism still need to be developed and will be the subject of debate at COP-16. The main specific positions of Switzerland on this issue will be discussed. The Bern Process on synergies among relevant MEAs, will be introduced as well, due to the interdependencies with the mechanism. The second part focuses on implementing the KM-GBF, examining the Swiss NBSAP and its adaptation in accordance with the requirements of the new planning mechanism. It will also be the opportunity to discuss about challenges which the implementation entails. Finally, a few comparisons with other existing mechanisms within other MEAs should enable us to get a comprehensive picture and lead us to some prospective conclusions on the future of international biodiversity policy and governance.
Biodiversity interactions with earth system processes & Functional diversity in space and time: measurements, models and experiments to advance trait-based ecology

MODELING LAND USE IMPACTS ON PLANT FUNCTIONAL DIVERSITY IN EUROPEAN BIOREGIONS

Oral Presentation

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Functional diversity is a crucial component of ecosystem health, offering key insights into how human activities affect biodiversity. Land use is a primary driver of global biodiversity loss, making it essential to understand its large-scale impact. To do that, we explored how land use affects plant functional diversity in various European bioregions. Our methodology integrated data on species occurrence (sPlot and European Vegetation Archive) and their traits (TRY) with spatial information on land use and potential natural vegetation. Using three functional diversity metrics (functional richness, evenness, and divergence), we evaluated the consequences of land use. Our results consistently demonstrated that the shift from natural vegetation to human-modified landscapes reduces functional richness, increases evenness, and decreases divergence, with the most pronounced impact observed on functional richness. These findings underscore the significant role of land use in shaping ecosystem functional diversity, especially in diminishing functional richness, potentially undermining ecosystem resilience. Further research is essential to unravel the intricate relationship between these effects on functional diversity and their implications in other biodiversity indicators (e.g., species richness, mean species abundance), advancing our comprehension of the interplay between land use, biodiversity, and ecosystem functionality.

FUNCTIONAL TRAITS CONTRIBUTING TO COMMUNITY RESPONSES TO NUTRIENT ENRICHMENTS

Oral Presentation

E. Hersch-Green ¹

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Environmental nitrogen (N) and phosphorus (P) enrichment often results in increased plant community productivity but decreased biodiversity but whether certain functional traits contribute to these patterns remains unclear. Recent studies indicate that plant genome size (GS) might contribute by mediating trade-offs between NP investments into growth versus cell synthesis (which are expected to be higher for larger GS as they have more nucleic acids and larger cells) that would favor small GS plants under NP ambient conditions. However, it is unclear whether cellular NP investment increases with GS and if trade-offs between metabolic processes and GS depend upon nutrients. We collected GS, cellular nutrient, photosynthetic capacity (Amax) and water use efficiency (WUE) data from >500 grasses and forbs from six grassland sites (spanning a north-south gradient in the US) in which nutrient amounts are experimentally modified (NutNet; https://nutnet.org). For both forbs and grasses, cellular NP investments increased with GS and WUE values were higher under NP enrichments and at dryer sites. Furthermore, larger GS grasses only had lower Amax values at cooler sites and higher WUE values at dryer sites. Our results suggest that GS and WUE may be key functional traits contributing to observed growth and biodiversity responses to nutrient additions although their importance may also vary among plant category type and the prevailing climatic factors.

PHYTOPLANKTON SIZE AND SHAPE ATTRACTOR DYNAMICS OVER ENVIRONMENTAL GRADIENTS

Oral Presentation

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An attractor is the endstate towards which a current state variable is moving; it is dynamic and dependent on the instantaneous environmental context. Traits respond to environmental gradients, within and between populations, due to physiological, ecological and evolutionary processes to match the local environmental optimum which maximizes the overall system performance. Studying how trait attractors shift over environmental gradients is mandatory to understand and predict the effects of environmental changes on biodiversity, and its consequences for ecosystem processes. Here we study two important traits for phytoplankton communities (size and shape), which are at the base of a trade-off between productivity, resource competition and grazing resistance, as a function of environmental changes in resources, temperature driven water physics, and abundance of natural enemies. We model the rate of change in traits at the hourly scale using high frequency plankton imaging data from a eutrophic lake, collected for 5 years, using non-parametric machine learning methods. We find that attractors of trait time-series at the community level vary nonlinearly with interacting temperature, nutrients and abundance of grazers. Our approach also allows us to identify when (in time or parameter space) a system is characterized by multiple attractors. This has
implications for predicting changes in trait distributions from natural communities subjected to a fluctuating or shifting environment.

ACUTE VULNERABILITY OF THE GLOBAL SHARK & RAY FUNCTIONAL DIVERSITY

Oral Presentation

C. Pimiento¹, C. Albouy², D. Silvestro³, T. Mouton⁴, L. Velez⁴, D. Mouillot⁴, A. Judah⁵, F. Leprieur⁴, J. Griffin ⁶

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Elasmobranchs (sharks rays and skates) are among the most threatened marine vertebrates, yet their global functional diversity remains largely unknown. Here, we use a trait dataset of >1,000 species to assess elasmobranch functional diversity and compare it against other biodiversity facets, to identify species- and spatial- conservation priorities. We show that threatened species encompass the full extent of functional space and disproportionately include functionally distinct species. Applying the conservation metric FUSE (Functionally Unique, Specialised, and Endangered) reveals that most top-ranking species differ from the top Evolutionarily Distinct and Globally Endangered (EDGE) list. Spatial analyses further show that elasmobranch functional richness is particularly concentrated along the continental shelf and oceanic islands, with 18 distinguishable hotspots. These newly identified hotspots only marginally overlap with those of other biodiversity facets, reflecting a distinct spatial fingerprint of functional diversity. Functional, taxonomic, and phylogenetic diversity, together with fishing pressure, all converge along the coast of China, which emerges as a critical frontier in elasmobranch conservation. Meanwhile, several components of elasmobranch functional diversity fall in high seas and/or outside the global network of marine protected areas. Overall, our results highlight acute vulnerability of the world’s sharks and rays' functional diversity.

NATURAL FOREST REGROWTH FOR MITIGATION AND BIODIVERSITY RECOVERY IN PERU

Oral Presentation

S. Bereswill ¹, E.G. Urquiaga Flores², W. von Bloh¹, M. Billing¹, B. Sakschewski¹, T. Boza², N. Salinas², E. Cosio², K. Thonicke¹

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Natural regeneration (NR) of disturbed and degraded forests is a central conservation target to reverse biodiversity loss and mitigate climate change. The success of NR under climate change is contingent upon identifying suitable locations where forests can regrow and persist in the future. We employ the flexible trait-based Dynamic Global Vegetation Model LPJmL-FIT (Lund-Potsdam-Jena managed Land – Flexible Individual Traits), a model that combines vegetation processes and functional diversity, to project future trajectories of NR under a range of climate change scenarios. Our study targets Peru, a country facing major challenges due to climate change, with its Andean forests at risk to both the effects of climate change and human activities, such as logging and fire. We first validate modelled biomass, functional trait composition, water and carbon fluxes with data from forest plots, trait databases and flux towers. We then simulate the recovery of biomass and functional diversity of Peru’s forests until the end of the 21st century and assess the effect of climate change and disturbances on forest recovery. We identify regions with high recovery potential and analyse their vulnerability to climate change and disturbance. Our findings can help decision-makers prioritize areas for natural forest regeneration and develop strategies to protect recovering forests, but also stress the importance of protecting intact natural forests to achieve the GBF 30x30 target.

BIODIVERSITY DYNAMICS AND LAND-USE INTENSIFICATION IN SWISS GRASSLANDS

Oral Presentation

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In Switzerland, traditionally managed grasslands are part of the Alps’ cultural landscape. Lowland grassland management has intensified in the second half of the last century, decreasing biodiversity, and altering species assemblages towards homogenous communities. Contrary to the general perception that grasslands in mountainous regions are still traditionally managed, recent study indicate that land-use intensification is also increasing there. However, this process received only little attention, and parallels what has happened in the lowlands in the past. We assess the increase in land-use intensification, and its effect on biodiversity, using data from Swiss national diversity monitoring programs collected over the past two decades. We quantify land-use changes using shifts in vegetation related to mowing frequency, light tolerance and nutrient content. Using linear models and structural equation models, we then link this change to functional composition shifts, and to changes in alpha and beta-diversity along altitude and other environmental gradients. The first results indicate that vegetation alpha diversity tended to increase in the last 20 years, however this effect was linked with a homogenisation of grassland communities. The final results of this ongoing project will enable us to get a clearer picture of potential regional specificities in land-use effects and in the response of different taxa, and will help orientate conservation policies in the Swiss Alps.
ECOSYSTEM BASED MANAGEMENT ANALYSIS FRAMEWORK TO ASSESS THE BIODIVERSITY

Oral Presentation

**V. Schrameyer** ¹, L.O. Mortensen¹

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In recent years, the global focus on marine biodiversity decline has intensified, prompting initiatives adverse and harness the trend. While current management often concentrates on species richness, a broader understanding is needed, encompassing functional diversity and its impact on ecosystem services. This study aimed to develop a comprehensive framework by analyzing long-term monitoring data from the North Sea seabed. The approach involved combining standard taxonomic and functional indicators with Ecological Network Analysis. Reference stations were incorporated, generating an Ecosystem Score as an overall measure of ecosystem biodiversity. This score is a valuable tool for marine operators and managers, offering a clear indicator of the effectiveness of biodiversity efforts. Emphasizing functional diversity recognizes the roles and interactions of species within ecosystems, crucial for assessing the provision of ecosystem services and, consequently, human well-being. The study’s innovative aspect lies in its predictive modeling of spatio-temporal changes in biodiversity, providing insights for proactive management strategies. In summary, this research introduces a practical framework for assessing and predicting marine ecosystem biodiversity, contributing significantly to global conservation and sustainable management efforts.

WARMING AND RESOURCE LIMITATION EFFECTS ON PHYTOPLANKTON METABOLISM AND GROWTH

Oral Presentation

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Higher temperatures due to climate change are predicted to increase thermal stratification in temperate lakes, resulting in resource-limited surface waters. This could have great impact on phytoplankton ecological processes such as population growth, species distributions and community composition. While temperature-resource interactions are documented, we lack a mechanistic understanding of their basis. In this study, we explore the effects of temperature in combination with nitrogen, phosphorous and light limitation on the metabolism of phytoplankton while also monitoring individual- and population-level responses to these abiotic factors. We studied phytoplankton species belonging to three functional groups: green algae, diatoms and cyanobacteria. Using a novel methodology, direct-infusion high resolution mass spectrometry, we monitored metabolic responses to these environmental factors. We found
that temperature and resource-availability have interactive effects on the growth rates of all species. Though the nature of the interaction depends on the species, resource limitation often decreased the sensitivity of growth rates to temperature. We observed substantial changes in phytoplankton metabolism in response to resource type, and we explore key metabolic pathways, including photosynthesis, respiration and stress responses. We discuss how the temperature and resource-sensitivities of these various metabolic pathways scale up to individual and population-level responses.

APEX PREDATORS AND BIODIVERSITY, SIKHOTE-ALIN, RF: NETWORK ONTOLOGY

Oral Presentation

V. Bocharnikov\textsuperscript{1}, A. Trufanov\textsuperscript{2}

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Introduction: Southeastern Sikhote-Alin Mountains (Primorskiy Krai), RF represents the region not depleted severely with its wildlife, however, a gradual loss of biodiversity can be observed here. The key specie of the regional nature with no doubt is Amur tiger (Panthera tigris altaica). This apex predator is a unique one in terms of environmental significance. Negative impact of human activity on biodiversity forms factors jeopardizing all the species and Amur tiger mostly.

Method: Network scope makes the problem more transparent by comparison of network topological parameters with really observed and fixed processes and phenomena. This scope allows one to use objective measures, metrics and indicators to assess the state of sustainability of natural systems in general and its specific elements in particular.

Findings: Network-based ecological and geographical studies of Amur tiger existence exposed to diverse threats is proposed and discussed. The research includes networkalization (converting into networks) of Amur tiger habitats, those of ungulates, landscapes of natural patches and those of land use, roads, settlements, and hunting grounds as well. Exploring structural traits of the multifaceted networks in multilayered format promotes to relate those with ecosystem functions and vulnerabilities, and detect processes which endanger to biodiversity. Fragmentations of landscapes driven by natural, technogenic or anthropogenic causes are in the focus of special attention.

TRY - PLANT TRAIT DATABASE

Oral Presentation

J. Kattge\textsuperscript{1,2}, G. Bönisch\textsuperscript{1}, C. Wirth\textsuperscript{3,2,1}, S. Díaz\textsuperscript{4}, S. Lavorel\textsuperscript{5}, I.C. Prentice\textsuperscript{6}, P. Leadley\textsuperscript{7}, F. Schneider\textsuperscript{8}
Plant traits - morphological, anatomical, biochemical, physiological or phenological features measurable at the level of individuals or their component organs or tissues - reflect the outcome of evolutionary and community assembly processes responding to abiotic and biotic environmental constraints. Measurements of plant traits and trait syndromes (consistent associations of plant traits) are valuable observations for various applications from ecology to Earth system sciences. In 2007 the TRY database project (https://www.trydb.org/) was initiated to improve the empirical basis for trait-based ecological studies, trying to bring together the different plant trait datasets worldwide. As a result, the TRY Plant Trait Database has constantly been growing and has accomplished unprecedented coverage. Since 2015 the data are publicly available, since 2019 under a CC BY license. TRY currently serves about 5000 requests per year and trait data via TRY have contributed to about 550 publications we know of. This presentation will highlight some applications using trait data via TRY and provide an update on recent and upcoming developments in the context of the TRY initiative, i.e. the recently released new version of the TRY database (version 6), the improved data integration workflow for TRY version 7, and the ‘rtry’ R package to support preprocessing of trait data retrieved from the TRY database.

MACROINVERTEBRATE COMMUNITIES IN AN AFROMONTANE RIVER ECOSYSTEM, MALAWI, AFRICA

Oral Presentation

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The Ruo River is an Afromontane ecosystem located in the South of Malawi, Mulanje, in conditions like those of pure environmental integrity but with limited data on macroinvertebrate communities. This study examined impacts of river flow regimes on macroinvertebrate communities in the Ruo river in the upper, middle, and lower reaches using three diverse biotopes: gravel sand and mud (GSM), stone, and vegetation, defining reference conditions to which modified systems can be monitored. Our study systematically identified and quantified macroinvertebrate families within the river reaches, providing clear insights into their ecological roles and distribution patterns. By integrating biomonitoring principles, our findings contribute to the broader discourse on the diversity of macroinvertebrate communities and their
role as bioindicators in water resource management in Afromontane regions of Southern Africa. Significant variations in macroinvertebrate community composition, diversity and distribution were observed among biotopes, emphasizing the importance of considering biotope-specific dynamics. This research underscores the potential of macroinvertebrates as powerful indicators for monitoring and conserving water resources. This study advances biomonitoring practices and can inform sustainable freshwater ecosystem management strategies in Afromontane regions, shedding light on the complex relationships between biotopes, macroinvertebrates, and ecosystem health.

**SPECIES AND FUNCTIONAL DIVERSITY ESTIMATION OF FOREST AND GRASSLAND**

Oral Presentation

Y. Zeng ¹, Z. Zheng¹, C. Xu¹, Y. Zhao², D. Zhao¹, X. Li¹, P. Zhao¹

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Accurate and effective monitoring of plant species and functional diversity in forest and grassland by remote sensing is essential for maintaining the sustainability of ecosystem service and function. For forest diversity estimation, we developed a clustering-based approach to estimate forest species diversity based on tree variations in biochemical and structural properties, using airborne imaging spectroscopy and LiDAR data. We also estimated forest functional diversity based on multi-dimensional traits, which provided the capacity to conduct individual level trait-based ecology with wall-to-wall data. We further clarified the effect of scales on functional diversity monitoring from individual trees to communities. For grassland diversity estimation, we eliminated the soil effects on spectral diversity indices to improve the accuracy of grassland species diversity estimation. Furthermore, considering the differences between grassland species in the structural traits, we developed a canopy height correction model based on scan angle to compensate for the height information loss. Based on the variations in biochemical and structural traits, we also estimated the grassland functional diversity and explored its relationship with the species diversity. The works mentioned above are supported by 7 publications.

**REVEALING TRAIT-BASED MACROECOLOGICAL DYNAMICS TO UNDERSTAND BIODIVERSITY SHIFTS**

Oral Presentation

P. Gauzere ¹, C. Violle², F. Schrod³, L. Santini⁴, W. Thuiller¹

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The ongoing biodiversity crisis presents a complex challenge for ecological sciences. Beyond the consensus about decline in biodiversity, apparent discrepancies in reported diversity trends are debated. These discrepancies are mainly linked to differences in scales of analyses, but also to data and method used. We argue that integrating macroecology theory with temporal and trait-based perspectives can provide fundamental insights on ongoing biodiversity changes and resolve apparent discrepancies on biodiversity trends. First, considering temporal changes in macroecological patterns such as species area relationships and distance decay of similarity can reconcile and synthesize conflicting outcomes in biodiversity observations. Second, macroecology theory allows to link change in macroecological patterns to more fundamental biodiversity components (total number of individuals, species abundance distribution, spatial aggregation). Third, coupling these patterns with species traits can enhance our understanding of how human activities impact biological diversity over time. The holistic approach proposed here can be used to attribute human-driven changes to biodiversity shifts via changes in fundamental biodiversity components. This framework facilitates a deeper comprehension of the fundamental levers driving diversity changes across scales, and how human activities drive current biodiversity changes.

MORE TREES – LESS BIODIVERSITY? – EFFECTS OF WOODY ENCROACHMENT ON BIODIVERSITY

Oral Presentation

J.R. Shipley\textsuperscript{1}, E.R. Frei\textsuperscript{1}, A. Bergamini\textsuperscript{2}, C. Ginzler\textsuperscript{2}, T. MoreTrees-Consortium\textsuperscript{2}, C. Rixen\textsuperscript{1}

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Climate change and transformations in land use are key drivers of biodiversity loss, presenting a substantial challenge for current policy and conservation efforts. The abandonment of agricultural activities results in woody encroachment, converting species rich mosaic habitats like dry meadows and fens into expanding forested areas. These habitats, which are particularly important for biodiversity conservation in Switzerland, face imminent threats. Woody vegetation encroachment not only alters habitat structure but also can drive declines in vascular plant species due to associated effects, such as increased shading or altered competition. Our research addresses this complex relationship by integrating 1m-resolution vegetation height data across Switzerland, as a proxy for woody encroachment, with a comprehensive dataset comprising over 4,000 vegetation surveys from the WBS monitoring in Switzerland. We find that although the greatest increases of woody shrub encroachment are occurring along the
southern Alps, it is also occurring in habitats in the central and northern Alps at a slower pace. We found this has significant consequences on habitats of conservation concern, where plant species diversity decreases even at the initial stages of encroachment. By analyzing the drivers and consequences of agricultural abandonment, our project aims to offer scientific insights for mitigating the adverse impacts on species and functional diversity associated with land use changes.

THE ROLE OF SCALE AND ENVIRONMENTAL VARIABILITY IN FUNCTIONAL DIVERSITY PATTERNS

Oral Presentation

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Disentangling community assembly rules is an important topic in Ecology. Many studies seek to distinguish biotic from abiotic processes through the “filtering framework”, which characterise community assembly as a sequence of filters. Yet, this framework faces conceptual challenges. First, it assumes distinct diversity patterns for each filter, even though abiotic conditions and competitive exclusion may produce indistinguishable outcomes. Second, it overlooks the effects of microenvironmental heterogeneity. Third, it struggles to delineate the relevant spatial extent of species interactions and resulting diversity patterns. Here, we test the interplay of these three conceptual axes on the resulting patterns of functional diversity using a theoretical model. Our results show how the observed patterns depend on the interplay between environmental heterogeneity, the dominant filter(s) at play, and both the scales of observation and biotic interactions. We then identify the limits within which the filtering framework remains relevant for inferring community assembly rules. We then explore new ways to extend these limits by adding the spatial dimension to our analysis.

REPRODUCTIVE EFFORT OF UNISEXUAL AND BISEXUAL ROCK LIZARDS (GENUS DAREVSKIA)

Oral Presentation

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We compared the life history components of small and large-bodied unisexual and bisexual Caucasian rock lizard species. Research objectives were to determine whether reproductive mode, female body size, altitude and landscape of the habitat, or interaction of these factors
determine the relative investment of energy into a single reproduction, number, and relative size of eggs. The research revealed the differences between two parthenogenetic species and their paternal bisexual lizards. However, the pattern did not coincide for the two studied lineages i.e., parthenogenetic D. armeniaca invests relatively more resources into reproduction than its paternal D. valentini. Simultaneously, reproductive effort of parthenogenetic D. dahli did not differ from its paternal D. portschinskii. Instead, D. dahli tended to produce more but lighter eggs than D. portschinskii. In both cases, the parthenogenetic form tended to follow a r-reproductive strategy, typical for lizards occupying less stable environments. However, other interspecific differences such as body size or evolutionary distance shade these differences and determine the pattern of divergence between a parthenogen and its bisexual relative. In particular, smaller body size constraints increased the reproductive effort, and parthenogenetic species shifted to a balance between egg size and number rather than between resources invested into a single reproduction event and the probability of surviving until the next season.

ESTIMATING AQUATIC PLANT DIVERSITY USING SPECTRAL AND PHYLOGENETIC METRICS

Oral Presentation

P. Villa1, R. Bolpagni2, M.B. Castellani3, A. Coppi4, A. Dalla Vecchia2, L. Lastrucci5, E. Piaser1

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As aquatic ecosystems are threatened globally, the conservation of aquatic plant diversity is becoming a priority. In the last decade, remote sensing and phylogenetics have opened up new ways of measuring biodiversity, and linking spectral and phylogenetic features to characterise plant communities can further advance this issue. In this study, we explored the use of phylogenetic features derived from a fully resolved supertree of spectral features extracted from centimetre resolution hyperspectral images collected by a drone to estimate functional diversity (richness, divergence, and evenness) using non-linear parametric and machine learning models within communities of floating hydrophytes and helophytes sampled across a trophic gradient. Our results show that all three functional diversity metrics can be estimated from spectral features using machine learning models (Random Forest; R2=0.89-0.91), while parametric models perform worse (GAMs; R2=0.35-0.79), especially for community evenness. Merging phylogenetic and spectral features improves modelling performance for all diversity metrics (R2=0.91-0.97) using machine learning, but only benefits community evenness estimation when GAMs are used. Combining imaging spectroscopy and phylogenetic analysis can provide a quantitative means of capturing variability in macrophyte communities across scales.
and gradients, to the benefit of aquatic ecologists focusing on the study and monitoring of biodiversity and related processes.

**ON THE LINK BETWEEN FUNCTIONAL AND SPECTRAL DIVERSITY FOR GRASSLAND MONITORING**

Oral Presentation

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Covering 30-40% of the terrestrial surface, grasslands provide vital ecosystem services such as biodiversity or carbon sequestration. Threatened by biodiversity loss, effective monitoring on large scales is crucial. Remote sensing is key for assessing grassland biodiversity via deriving vegetation patterns, species composition, and ecosystem health. The spectral variation hypothesis (SVH) proposes a link between pixel-to-pixel spectral variation and species diversity in remote sensing. The spectral signal of a plant community is determined by its biochemical and functional traits. However, the transferability of the SVH across ecosystems, seasons, and spatial resolutions is unclear. This study combines field data, spatial species distribution simulations, and radiative transfer models to generate artificial community-specific reflectance patterns. Using these, we analysed the SVH in 3 temperate grassland types, across seasons, and different spatial resolutions. We found ambiguous relationships between spectral variation and plant diversity. Correlations and (diversity-) index performance varied, with spatial resolution driving spectral diversity. The study highlights the context-dependency of the SVH, suggesting its value for specific ecosystems rather than universal applicability.

**FOREST FUNCTIONAL DIVERSITY MEDIATES CARBON STORAGE AND PRODUCTIVITY**

Oral Presentation

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Spatially explicit data on plant functional traits and diversity are critical for understanding biodiversity effects on ecosystem processes and functions. In this study, we derived per-pixel community-level functional traits (community-weighted means, CWMs) by combining Sentinel-2 imagery and LiDAR data, which correlated well with in-situ plot-level trait measurements. The remotely-sensed traits were then used to build trait space to estimate functional diversity (FD) indices over the study area. We further investigated the influence of single-trait CWMs,
multi-trait FD indices and environmental variables on ecosystem carbon stocks (aboveground biomass, AGB) and primary productivity (kNDVI) in a species-rich subtropical mountainous forest. We found CWMs of all measured morphological (H95, LAI, FHD) and physiological traits (chlorophyll, SLA, EWT) were significant predictors of AGB and kNDVI, as suggested by the mass-ratio hypothesis. Morphological FD indices were also important predictors of AGB and kNDVI, indicating the effects of complementarity in crown architectures. The best-fit multiple regression models showed that morphological traits together with radiation, elevation, physiological traits and morphological richness explained 50.2%, 77.9% and 82.9% variation in AGB at 30-, 100- and 250-m scales, respectively. Our work highlights the potential of using remotely-sensed functional traits to assess diversity-productivity relationships across large, contiguous areas.

EFFECTS OF PHYTOPLANKTON DOMINANCE SHIFTS ON MARINE CARBON FLUXES

Oral Presentation

A.M. Lewandowska¹, P. Hedberg¹, M. Brunberg¹, C. Uth¹, N.-X. Geilfus¹

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Phytoplankton traits, such as carbon uptake and mixotrophy, influence marine carbon cycle with implications for carbon dioxide (CO2) and methane (CH4) emissions through respiration and methanogenesis. Based on experiments and carbon flux measurements in the sea, we show the effects of dominance changes in marine phytoplankton communities on two coastal ecosystem processes: carbon accumulation and emissions of CO2 and CH4 to the atmosphere. Although in the lab we saw significant differences in the potential carbon accumulation and emission between species, environmental factors such as temperature and salinity had a strong impact on carbon fluxes. Our results elucidate the importance of anthropogenic climate change for carbon sequestration and greenhouse gas emissions by plankton communities, where both keystone species and biodiversity play a role.

GRASSLAND BIODIVERSITY AMELIORATES THE MICROCLIMATE OF HERB SPECIES

Oral Presentation

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The intensification of climate extremes and interactions with biodiversity loss are noteworthy scientific challenges with potentially negative impacts on our society. Yet, the functioning of ecosystems may regulate the impacts of climate extremes. Biodiversity is often reported to enhance ecosystem functioning via changes in compositional, functional diversity, and structural diversity. However, a precise measurement of how biodiversity ameliorates plant communities’ microclimate via functional traits under climate extremes has yet to be fully understood. Here, we measured the leaf angle distribution of three different herb species using machine learning techniques from terrestrial laser scanning (TLS) in a grassland diversity experiment. We identified leaf angle changes as an ecophysiological response to natural variations in climate conditions throughout the growing season, including an extreme drought and hot summer. Leaf temperature and drought index assessed the covariate effects of biodiversity facets (e.g., species richness, functional diversity (FDIs), and functional identity (CWM)) on herbs leaf angle distribution. The results show that functional identity and functional diversity positively and significantly affect the leaf angle distribution of herb species in more diverse communities. Therefore, there is strong evidence that biodiversity affects leaf angle distributions and shows a promising basis for further studies.

FEEDBACKS BETWEEN BIODIVERSITY AND BIOGEOCHEMICAL CYCLES IN THE AMAZON AND AFRICAN BIOMES

Oral Presentation

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Understanding the feedback of biodiversity on biogeochemical cycles is fundamental but still seldom considered. Higher functional diversity seems to predict ecosystem function, carbon dynamics and water exchange and functional diversity is also a response to how biogeochemical cycles affect evolutionary processes, community assemblage and ecosystem resilience. Moving forward we need better and more detailed analyses of these interactions, which can be achieved by integrating observations with models. Here we present two examples of such integration by examining the role of plant traits in water and carbon cycles in tropical systems in the Amazon and more generally for all biomes of sub Saharan Africa. We find that plant traits correlate with different water process parameters over the Amazon, and plant traits might have a stronger regulatory effect when water processes parameters are at the extreme of their values. In the biomes of sub Saharan Africa, we find that changes in traits assemblies due to human extraction can have a strong impacts on carbon storage and the rebound of ecosystems to the effect of sorting biodiversity. These examples show that strong mediating effects on ecosystem processes and biogeochemical cycles by biodiversity need to be further understood so that conservation and existence function and services can be sustainable maintained.
Biodiversity interactions with earth system processes & Functional diversity in space and time: measurements, models and experiments to advance trait-based ecology

EFFECT OF CLIMATE CHANGE ON SOIL MICROORGANISMS BIODIVERSITY

Poster Presentation

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In the aspect of global environmental problems, climate change and its impact on the functioning of the soil microbiocenoses problems has considerable researchers attention. Our research has shown that the amount of carbon dioxide released is closely related to a combination of different combinations: temperature – humidity, and the rate of CO2 production depends more on temperature than on humidity. The results of the model experiment showed that the temperature range of 5-25°C had a different impact on the ecophysiological diversity of microorganisms. The best conditions for the development of soil microorganisms were formed at an air temperature of 15°C, and the least favorable at 5°C and 25°C. Determination of the influence of such a factor as soil moisture level on microbial and biochemical activity in the soil showed that the optimal moisture content in the soil is about 20% full moisture content. It was found that the increase in temperature has a greater negative impact on microbial productivity in the soil, and the presence of moisture has a positive effect on the development of microorganisms. Due to the correlation and regression analysis of the modeled studies, a reliable relationship between the content of microbial biomass and hydrothermal conditions was established. Due to the correlation-regression analysis of the studies, a reliable relationship was established between the content of microbial biomass and hydrothermal conditions.

ECOLOGICAL IMPACTS OF TEMPERATURE OVERSHOOT: PLANNING FOR THE JOURNEY AHEAD

Poster Presentation

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Insufficient action to curb greenhouse gas emissions is increasing the relevance of temperature overshoot (TO) scenarios. TO entails surpassing a specified global warming level (e.g. 1.5°C) followed by a return to or below that level, achieved through human-enhanced CO2 removal
(CDR) from the atmosphere. Despite the increasing relevance, the ecological impacts of TO remain poorly understood. We reviewed the existing knowledge on risks from TO to understand the nature of these risks, identify knowledge gaps, and explore how ecologists can address them. We identified five key characteristics of risks associated with TO:

TO may cause irreversible or long-lasting effects (e.g. extinctions, tipping points);

Risks arrive quickly but decrease slowly;

Ecological changes during the warming phase can differ from those during the cooling phase;

Further cooling may be needed to fully reverse risks/impacts;

CDR may threaten biodiversity due to massive land-use changes.

We argue that the limited number of TO scenarios available hinders a more comprehensive assessment of these characteristics. A thorough understanding of TO impacts requires more global climate models simulating a range of scenarios varying in duration, magnitude, and CDR strategies, along with an integrated assessment of risks from large-scale CDR. Ecological research should shift from assessments of single snapshots (e.g. 2100) to projections that include a temporal perspective spanning the full duration of TO and beyond.

EXPLORING PLANT ASSEMBLY IN URBAN GREEN SPACES: A TRAIT-BASED MODELLING APPROACH

Poster Presentation

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With most of the global population now residing in urban areas, the rapid expansion of these environments has led to adverse effects such as biodiversity loss, air pollution and urban heat islands. Urban green spaces (UGS) are increasingly recognized as effective countermeasures against the negative impacts of urbanization. Although plants play a key role in UGS, the mechanisms guiding plant community assembly remain unclear. Using a trait-based approach, we test the potential of various machine learning algorithms to model plant community assembly in UGS and predict the ecological and human benefits that can be realized from UGS. Unlike existing trait-based community assembly models, our model integrates both environmental and human filters to account for the importance of human preferences and decision-making on plant assembly in cities. Trained on species presence data from five different UGS types across three Swiss cities, our model considers traits ranging from commonly used ecological traits, such as plant height, to those more pertinent from a social perspective, such as cultural importance. By acknowledging human filters as crucial determinants of plant assembly, this
novel approach will enhance our understanding of the dynamics between humans, the environment and plant communities in urban settings. We explore the potential of our model as a tool for UGS stakeholders to advise on sustainable planning amid rapid anthropogenic change and the biodiversity crisis.

**FUTURE PROJECTIONS OF FUNCTIONAL DIVERSITY OF NATURAL FORESTS ON A GLOBAL SCALE**

Poster Presentation

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Forest ecosystems are facing increasing pressure as a result of anthropogenic climate change. Dynamic global vegetation models (DGVMs) aim to simulate plant distributions and can be used to better understand vegetation changes in reaction to climate change. Over the past decades, DGVMs have been improved by including approaches from plant economics and functional trait ecology resulting in a better representation of functional trait diversity in those kinds of models. The range of applications of these models is manifold, in particular allowing us to investigate the interplay of plant traits, ecosystem functions and functional diversity under climate change. Here, we show future simulations of functional diversity of natural forests on a global scale using the state-of-the-art flexible trait-based model LPJmL-FIT (Lund-Potsdam-Jena managed Lands – Flexible Individual Traits). We run simulations for three climate change scenarios until the end of the century and assess the functional diversity in a set of different functional diversity indices (e.g. functional richness, functional evenness, functional divergence). Our results show how functional diversity of natural forests change under climate change on a global scale. Thereby, we identify potential future hotspots of forest functional diversity. Billing, M., Thonicke, K., Sakschewski, B., von Bloh, W. & Walz, A. Future tree survival in European forests depends on understorey tree diversity. Sci. Rep. 12, 1–12 (2022).

**LINKING SPECTRO-FUNCTIONAL VARIABILITY AND AQUATIC PLANT DIVERSITY**

Poster Presentation

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Due to their morpho-physiological peculiarities and wide phenotypic plasticity, aquatic plants - or macrophytes - occupy the extremes of the global spectrum of vegetation forms. Such heterogeneity results in contrasting patterns of diversity along ecological and geographical gradients. As a high-throughput technique, imaging spectroscopy is a feasible and efficient option for assessing plant functional diversity based on spectral proxies directly related to morphological and biochemical traits, which we define as spectro-functional traits. In this study, we used airborne hyperspectral data to assess inter- and intra-specific spectral diversity of floating and emergent macrophyte species in shallow freshwater systems in Italy, Hungary and Lithuania. Our results show that inter-site variability (including latitudinal and seasonal differences) modulates leaf structure and pigment balance. Furthermore, intraspecific variability accounts for a significant fraction of the total diversity in photophysiology and pigments (>20% of total diversity), and even more for density/biomass (LAI), about 50% of total diversity. Remotely sensed maps of spectro-functional macrophyte traits can capture fine-scale variability, between and within species, that would be difficult to detect from point measurements: a powerful addition to the technical toolbox in the hands of functional ecologists focusing on aquatic plants and biogeochemical processes they mediate.
Biodiversity loss and inequality: an interconnected crisis

EFFECTS OF ENVIRONMENTAL AND SOCIAL LANDSCAPE ON RAINFOREST FUNCTIONAL INTEGRITY

Oral Presentation

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Spread over developing countries of South America, Africa and Asia, the rainforests are fundamental to global hydrological cycles and for providing animal protein to half a billion people, among other ecosystem services. Its overexploitation destabilizes an important resource base for local populations as defaunation leads to wildlife population extirpations and decreases in local abundance. Ungulates are key species, vulnerable to the processes of land use change and poaching, while also playing a key role in ecosystem function and local communities nutrition. Thus, their densities can be used as indicators of ecosystem functional integrity. In our study we modeled the effects of the environmental and social landscapes on ungulate density throughout the rainforest’s global cover in order to identify and quantify drivers associated with human impacts on the fauna. We based our analyses on structural equation models and on traditional linear models and on mixed models. Our results indicate a strong and negative relationship between forest integrity and socioeconomic development. It is similar to what was found in studies that evaluated the relationship between socioeconomic indicators and deforestation rates and poaching intensity. In this sense we conclude that biodiversity conservation will not come automatically with socioeconomic development. Thus, to keep rainforests functional integrity, socioeconomic development policies should be associated with environmental policies. Funding by FAPESP 2015/25742-5 and 2024/01529-0

ASSESSING ECOCIDE IMPACTS FOR DEVELOPING A CONSERVATION STRATEGY IN UKRAINE

Oral Presentation

O. Nekrasova¹, O. Marushchak², K. Redinov³, M. Pupins⁴, A. Čeirāns⁴, A. Skute⁴, V. Tytar², I. Moysiyenko⁵, K. Theissinger⁶, J.Y. Georges¹

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Beside the human tragedy of Russian full-scale invasion of Ukraine, there is colossal environmental damage with long-term consequences on biodiversity and ecosystems, with evidence of ecocide, i.e. deliberate destruction of nature. To date, the Ukrainian Ministry in charge of the Environment has listed 2500 military acts having environmental impacts, with associated costs of ~50 billion €. The ruining of the Kakhovka dam is the most severe act of ecocide committed by Russia so far, with ~18 km³ of water flooding the Lower Dnipro National Park (80,000 ha of protected areas with rare species) and natural complexes on the banks of the Dnieper-Buzky estuary, including the Volizhyn forest (Kinburn Spit). Due to their low mobility and dependency on both terrestrial and aquatic environments, reptiles are expected to be most impacted by such ecocide. Using GIS-modeling we identified the most promising territories for the endangered turtle Emys orbicularis and snakes Coronella austriaca and Elaphe sauromates in the mid-southern part of Ukraine. We highlight areas along the Black Sea coast (especially Kinburn Spit) and the lower reaches of Dnieper as major areas for the conservation of these species. Yet, the depletion of key biotopes for these species and associated biodiversity may dramatically impact the ecology of the entire Black Sea region with potential major ecological consequences. We thank the projects EMYS-R (www.emysr.cnrs.fr), Nr.lzp-2021/1-0247 and PAUSE programme.

POPE FRANCIS’ LAUDATE DEUM: INTEGRAL ECOLOGY AS BIOSPHERIC SOLIDARITY

Poster Presentation

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Pope Francis’s text Laudato Si’: On Care for our common Home (LS) came out 8 years ago. LS was well received – although unevenly – among Catholics around the world and received attention from many others. LS firmly situated environmental concerns within the body of Catholic Social Teaching – a body of theological, sociological and scientific analyses and principles about how Christian faith relates to social and ecological issues. Laudate Deum (LD) was published in 2023, focused directly on the climate crisis in the run-up to COP 28. Pope Francis says the situation is increasingly urgent. In LS, Francis called for “ecological conversion” and a “cultural revolution.” One of the key concepts for this is what he called an integral ecology. Relatively undefined in LS, LD gives more detail, culminating in what I have called “biospheric solidarity.” Building on his writing on human solidarity, he appears to extend solidarity to other-than-human creatures, emphasizing that “we do not look at the world from without but from within.” This is consistent with other research to examine on what religions may contribute to global ecological politics. They articulate a “cosmos-politics” beyond the technical policy dimensions, that all creatures of creation are to be part of the moral, and therefore political, consideration. Since documents like LS and LD are addressed...
to “all people of goodwill”, they are cultural resources in the societal transformations that are ecologically required.

**GALLIFORMES IN ETHIOPIA: POPULATION STATUS AND CONSERVATION THREATS**

Oral Presentation

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Galliformes are among the most recognized and predominantly hunted groups of birds in Ethiopia comprising about 16 species including three endemic Francolin species. Nonetheless, they received less research attention and conservation efforts. Consequently, there is a need to study Galliformes ecology and behaviours. Hence, the present study aimed to assess the species composition, population status, public knowledge, and threats to Galliformes in southwestern Ethiopia. Data were collected from January 2018 - December 2020. A line transects and point count survey were employed to collect data. Timed species counting and encounter rates were used to estimate species composition and relative abundance of Galliformes. Three Galliform species: Clapperton’s Francolin (P. clappertoni), Helmeted Guineafowl (N. melanogris), and Stone Partridge (P. petrosus), were recorded in the area. The Helmeted Guineafowl, were abundant (66.83%), Clapperton’s Francolin was common (30.14%), and Stone Partridge was a frequent (3.03%) species. Local communities perceived Galliformes as sources of food consumption, income, and foster-rearing and medical practices. Habitat destruction and loss, agrochemicals, and illegal hunting and egg collection were the major threats affecting Galliformes and their habitats. Further research and community-based conservation interventions are, therefore, essential to thoroughly monitor the population trends of Galliformes and maintain their habitats in the region.

**UNVEILING VIEWS ON BIODIVERSITY: EDUCATIONAL FRAMEWORKS IN BRAZIL AND THE US**

Poster Presentation

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Curriculum standards have traditionally been molded by the historical, educational philosophy, and societal contexts unique to each country. This comparative study explores the perspectives on biodiversity within the educational frameworks of Rio de Janeiro, Brazil, and New York, United States. Brazil holds many of the planet’s most diverse ecosystems, underscoring the
importance of integrating this richness into local curricula. Such integration not only aids in ecosystem preservation but also fosters community involvement in consequential decision-making processes. Contrastingly, the United States has historically emphasized scientific and STEM-centric objectives, aligning with its enduring interest in cultivating a robust science workforce. An in-depth analysis of national and regional educational standards, juxtaposed with Brazil’s, promises to elucidate the educational and societal disparities between these two contexts, each intricately linked to their respective economic landscapes. This exploration seeks to uncover the educational approaches toward biodiversity and the societal fabric and economic underpinnings shaping these distinctive perspectives. By scrutinizing these differing paradigms, this study contributes to a nuanced understanding of how education intertwines with environmental consciousness and economic agendas in diverse global contexts.

ASSESSING INDIGENOUS PEOPLES’ PARTICIPATION IN JOINT FOREST MANAGEMENT IN INDIA

Oral Presentation

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Maintaining and improving forest cover has become critical for the countries to meet environmental goals. Studies have shown that involving Indigenous communities in forest management can solve forest management problems and contribute to livelihood security. However, the inclusion of all Indigenous communities mainly in policy design and decision-making has proved to be a daunting task for a diverse country like India due to the complex institutional setting and socio-political scenario. The present study assesses the level and nature of participation of Indigenous communities in JFM programmes in India, using a new framework developed based on participation theories. Our study reveals that JFM in India failed to achieve the active participation of Indigenous peoples and wherever participation was achieved it was passive. Indigenous peoples were involved only as labour support during the implementation phase, with minimal incentives. It was also observed that the initial enthusiasm often fades into long-term management plans with irregular and inadequate incentive support, which also fails to achieve the stated goal of livelihood improvement of forest-dependent communities. While all policies emphasise the importance of indigenous peoples and their knowledge, JFM in India has failed to integrate them in the process. This study also formulates a set of recommendations based on Indigenous peoples’ perceptions to ensure the active participation of Indigenous communities in JFM.
Biodiversity values and governance

LOCAL GOVERNMENT ROLE IN PROMOTING CIRCULAR ECONOMY-DRIVEN SOLIDWASTE MANAGEMENT

Poster Presentation

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Blue Waste, referring to waste generated in marine and coastal space, has emerged as a global concern due to its detrimental effects on the ocean and human health. As a global concern, it requires an effective management strategy. While the role of local governments on waste management on terrestrial and urban areas received increasing attention in recent decades, its literature on marine and coastal ecosystems is largely unavailable. Hence, this study will be conducted to understand and uncover the role of the county government in promoting sustainable marine ecosystems with primary focus on governance system relating to guidelines on coastal waste management. The study will include a range of three (3) diverse specific objectives; to examine the current status of blue waste management practices in Mombasa, Kenya, to identify the challenges and barriers faced by the local government in implementing circular economy strategies for blue waste management and, to provide insights into the potential economic, social, and environmental benefits of adopting circular economy strategies for blue waste management in Mombasa county, Kenya. The qualitative research presented will be based on data obtained via literature review, Focus Group Discussion and via key informant interviews. Qualitative data obtained will be transcribed, coded and interpreted onto a cluster result matrix and software be used to analyse and interpret the data.

GOVERNANCE OF HUMAN-WILDLIFE INTERACTIONS IN PERI-URBAN LANDSCAPES

Oral Presentation

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Urbanisation is a global phenomenon that changes land uses and habitats. This trend of urbanisation lead to increasing human-wildlife interactions especially at urban peripheries where land uses are mixed between urban and rural areas. In these peri-urban landscapes, different types of human-wildlife interactions can occur. In many scientifically documented cases, scientists are focusing on negative interactions. Furthermore, research about appropriate policy instruments for managing human-wildlife interactions is rare. This study focused on
case studies and their characteristics from around the world on positive, neutral, or negative interactions between humans and wildlife at local level. In addition, influencing factors of human-wildlife interactions and policy instruments for managing human-wildlife interactions in peri-urban landscapes were addressed. An online survey was conducted with international experts working in this field. The results showed that various species were involved in human-wildlife interactions in peri-urban landscapes worldwide, with mammals as being the most common taxon. It can be highlighted that a policy mix consisting mainly of social and cultural instruments, in combination with legal and regulatory instruments can be suggested to address human-wildlife interactions in peri-urban landscapes.

WILD CONVERSATION: READING PUBLIC SENTIMENT TOWARDS RETURNING WILDLIFE IN EUROPE

Oral Presentation

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Across Europe previously locally extinct species are returning through a combination of recolonization and reintroduction. As vividly illustrated by the controversy associated with wolves in Switzerland, some species evoke conflicting views, while others e.g. beavers, appear to be the subject of much less attention. Discourses about rewilding vary across both species and locations, and may have important consequences. Diverging biodiversity values associated with individual species contribute to debates about how nature should coexist. They are often associated with differing interest groups, and are partially reflected in news media. We aim to understand the potential differences in public sentiments towards the return of European wildlife. We focus on sentiments of a selection of “unruly animals” in several culturally and geographically distinct European case studies and use a multi-scalar approach to text analysis. First, we apply natural language processing to computationally perform sentiment analysis for a variety of species – e.g. wolf, beaver and badger - on news media corpora. Second, we conduct qualitative aspect sentiment analysis on dominant sentiments among case studies and species. By understanding sentiments of species and the discourses that evolve around them, and integrating this knowledge into e.g. landscape policy, existing societal friction towards specific species could be reduced, increasing the likelihood of successful conservation interventions.

GOVERNING HYBRIDS: A CASE STUDY OF TROUT CONSERVATION IN WESTERN NORTH AMERICA

Poster Presentation
Advances in genetics and genomics are raising new questions for biodiversity conservation, particularly around the governance of hybrid populations. Climate change can accelerate hybridization by increasing interactions between native and non-native species. In the U.S. and Canadian Rocky Mountains, introgressive hybridization with rainbow trout (O. mykiss) is considered an existential threat to native cutthroat trout (O. clarkii). This research draws on policy and document analysis and interviews with fisheries managers and conservationists to examine how hybridization is addressed in environmental decision-making. We find that thresholds for genetic purity are a frequently implemented strategy to govern hybrid trout. These thresholds aim to distinguish populations with conservation value from populations that pose a threat, but the specific thresholds implemented differ among agencies and scales of management. For example, the U.S. Fish and Wildlife Service used a threshold of 80% (i.e. less than 20% of genes from other species) in evaluating westslope cutthroat trout for listing under the Endangered Species Act. In contrast, the Committee on the Status of Endangered Wildlife in Canada adopted a stricter threshold of 99% purity (<1% introgression) for the same species, which resulted in a vastly different assessment of extinction risk. The use of genetic thresholds has significant material effects on conservation, even as specific thresholds are not universally accepted.

VALUES AS LEVERAGE POINTS FOR TRANSFORMATIVE CHANGE OF WETLANDS

Oral Presentation

P. Romaniuk 1, J.-Y. Georges 2

Wetlands are biodiversity-rich, multiple-service providing socio-ecosystems (SES), yet fast disappearing due to increasing anthropopressure. Research shows that values (core beliefs and judgements) profoundly affect individual and collective behaviour. The leverage points (places in a system where small intervention can produce systemic change) approach underline the transformational potential of values. Therefore, increasing “value-based” governance and conservation may foster the sustainability of wetland SES. We go beyond existing participatory governance models by proposing ways of practically integrating the leverage points approach, with a particular focus on values, into adaptive governance practice. This proposal, based on action-oriented participatory research - Emys-R (www.emysr.cnrs.fr) provides a comparative analysis of three Natura 2000 wetland SES: Woerr (France), Neuburg am Rhein (Germany) and Silene (Latvia). Based on an original SES and Leverage Points approach combined with IPBES’
Nature Futures Framework, we provide1) a transdisciplinary analysis of potentially transformative leverage points, leading to2) a transformative governance model for the co-existence of humans and non-humans on wetlands and3) suggest that conservation initiatives in favour of the protected Emy's orbicularis - European pond turtle (present on all study sites) may promote the engagement of people in conservation efforts, provided developing value-based rationale to engage.

**BIODIVERSITY VALUES OF THE SWISS PUBLIC**

Oral Presentation

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This study explores biodiversity values amongst Swiss population. Understanding of the plural values of biodiversity can help to disentangle the complex relationships that humans establish with nature, which play a key role in shaping environmental decisions. The study builds on the Value Landscapes Approach (Schulz et al., 2018) and the IPBES (Balvanera et al., 2022) values assessment framework to understand people’s values regarding biodiversity and their preferences in relation to what constitutes good biodiversity governance. We implemented a nationwide representative online survey targeting 1800 Swiss citizens (over 18 years of age). Results of the survey help to identify biodiversity values that are latent amongst Swiss population, as well as groups of the general population bearing distinctive value types, such as instrumental, intrinsic and/or relational. Results also help to elucidate whether and how personal values relate to different perspectives on biodiversity conservation governance.

**INVOLVING NON-HUMAN STAKEHOLDERS IN WETLAND MANAGEMENT: HURDLES AND PERSPECTIVES**

Poster Presentation

*Y. Meinard*¹, *J.-Y. Georges*², *P. Romaniuk* ³

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Recent years have seen changes in environmental management practices, which have consisted in increasingly involving stakeholders in decision-making. However, this increased inclusion has left aside a whole category of stakeholders whose wellbeing, and even very existence, is at stake in environmental decisions: individuals and populations of non-human species. The main reason underlying this exclusion is that, as opposed to humans, non-humans can...
neither speak nor vote in collective deliberations and discussions. Here we explore options to overcome this difficulty and thereby include non-humans in environmental decision-making, in the case of wetland management. Three main approaches are compared in terms of relative strengths and weaknesses: i) Empathy consists in striving to take non-human pain and pleasure into account when deciding between alternative courses of action; ii) Interest-based inclusion generalizes the empathic approach by including non-human interests that cannot easily be understood as pain and pleasure, such as the wellbeing of non-sentient beings; iii) “Tentative representation”, which refers to attempts, by human stakeholders, to act as representatives of non-human entities. Using concrete examples in wetland conservation, including our project Emys-R (www.emysr.cnrs.fr), we argue that tentative representation is the most promising and practical approach, and we outline operational reforms needed to institutionalize it in wetland management practice.

PUBLIC PREFERENCES FOR BIODIVERSITY GOVERNANCE IN SWITZERLAND

Oral Presentation

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Given the increasing biodiversity loss in many countries across the world, it is high time to devise public policies to protect and enhance biodiversity. In democratic countries, public acceptability of these policies is crucial, given that policymakers will be reluctant to adopt policy instruments that are not supported by their electorate. However, evidence on public opinion regarding biodiversity policy in general, and regarding specific policy instruments in particular is still scarce. This paper reports the results of a conjoint experiment embedded in a population survey conducted on a representative sample of roughly 1000 inhabitants in Switzerland. Designed to gauge citizens’ (latent) preferences regarding a range of goals, processes and measures related to biodiversity policy, the paper sheds new light on the public acceptability of a variety of policy instruments in this field. In addition, the paper will use subgroup analysis to better understand the factors related to such acceptability, in particular the influence of varying degrees of consciousness regarding the state of biodiversity in Switzerland.
Biodiversity, Biomimicry & Bio-inspired Technology: Mutualisms for Innovation & Restoration

BIOINSPIRATION FROM BATS FOR AUTONOMY IN COMPLEX NATURAL ENVIRONMENTS

Oral Presentation

R. Müller

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Autonomy in complex natural environments, i.e., systems that can accomplish tasks in outdoor settings by themselves, could bring the full force of automation to a number of critical societal challenges. Examples are the production of food and renewable natural resources, environmental monitoring and cleanup, as well as national security. One of the main reasons why successful operation of autonomous systems has been limited to highly controlled indoor environments so far is that the complexity of natural environments still overwhelms technical capabilities for the interpretation of sensory inputs. Predatory animals with mobility in three dimensions, such as certain bat species that are able to hunt their prey on the wing in dense vegetation, provide a model system for how to solve the problems associated with autonomy in complex natural environments. In addition, bats display a degree of parsimony in sensing and sensory signal processing that is not found in their man-made peers, since the animals rely on just two ultrasonic echo trains received at their ears as the sole source of information about their environments. Furthermore, these echo trains are processed with brains that typically have less than one gram of mass. This is in stark contrast to “big data” sensing approaches such as stereo-vision or lidar that dominate the engineering of autonomous systems. Hence, taking inspiration from bats could result in systems that are more capable and efficient at the same time.

PLACE-BASED BIOMIMICRY FUTURES FOR SUSTAINABLE WELLBEING

Oral Presentation

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The enormity of the ecological crisis facing humanity requires a transformation in the goal of our socio-economic system. Not only do the current dominant neo-liberal ideas of sustainable development perpetuate harm to the more-than-human world by prioritising economic growth, they have also significantly decreased human wellbeing. Research in the domains of alternative economics, sustainable wellbeing and sustainability transformations offer examples
of wellbeing-centered sustainability frameworks, in which place-based approaches incorporating local ecological knowledge are an emerging theme. Biomimicry has been rarely applied to exploring local strategies for sustainable wellbeing, but has the potential to inspire multispecies solutions to living well in place. This presentation describes how biomimicry strategies from the boreal forest biome are being used to inspire and design regional development projects for sustainable wellbeing in South-Eastern Finland.

BIOMIMICRY AS AN INTERDISCIPLINARY FRAMEWORK FOR BIODIVERSITY CONSERVATION

Oral Presentation

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Exploring the valuation of biodiversity in economic systems, we investigate how biomimicry—a field at the nexus of social, economic, and technological innovation inspired by nature—can enhance interdisciplinary competencies and drive real-world problem-solving for sustainable urban development. Our study considers infrastructure projects where nature-inspired design interventions directly benefit resiliency and ecological conservation outcomes as cases of successful interdisciplinary innovation. This research addresses how knowledge workers in the life sciences can extend their impact beyond traditional disciplines, particularly through biomimicry. Like ribosomes translating genetic information, biomimics transform research from the life sciences into practical application. By applying the principles of biomimicry as highly localized, place-based research to support infrastructure projects, biomimicry enables nature-inspired strategies for innovations. This approach at once facilitates the translation of specialized scientific insights into relatable knowledge for diverse applications, a key aspect of interdisciplinarity, while delivering sustainable impacts. This research builds upon the justifications for biodiversity in ecosystem services by emphasizing the importance of each species as a source of natural capital offering strategies for innovation and interdisciplinarity.
Bioinspiration is an approach to gain new insights for engineering from the study of biological model systems that has already been validated by an impressive number of success stories. However, in each of these cases, the respective biological model has been evaluated as sources of inspiration one species at a time. In contrast to this, a comparative method that relies on interspecies differences as clues has been a standard approach in the study of biological function for a long time. For bioinspiration, biodiversity could not only widen the number of model systems and hence the chance of discovering principles of engineering value, but could provide critical information on how common functional principles can be adapted to different uses. Borneo’s diverse flying and gliding animals are outcomes of an evolutionary experiment that has been driven by the vertical habitats of its tall, expansive rainforests. To take advantage of this unique biodiversity, a flight tunnel instrumented with 50 high-speed video cameras and 28 ultrasonic microphones has been installed on the campus of the University of Brunei. The setup is currently being used to collect large volumes of data on the flight kinematics and biosonar pulses of bats to understand how these animals are able to control a highly complex flight apparatus based on information conveyed by just two trains of biosonar echoes. AI methods to analyze and compare the complexity across species are currently under development.
Biological invasions: from impacts to solutions - lessons from the IPBES-IAS assessment

URBAN FORESTS THREATENED BY INVASIVE SPECIES IN A BIODIVERSITY HOTSPOT

Oral Presentation

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The growth in urban populations, globally, results in loss of vegetation and biodiversity, compounded by the introduction of invasive species. The invasive beetle, Polyphagous Shot Hole Borer (PSHB), *Euwallacea fornicatus*, poses a threat to urban forests and biodiversity in many countries. Urban forests, which represents green infrastructure, provides significant benefits to society, including social cohesion, temperature regulation, carbon sequestration and flood attenuation. Study sites located in the critically important Maputaland-Pondoland-Albany biodiversity hotspot, along the east coast of South Africa, were sampled, to determine the extent of invasion by PSHB. This study aimed to demonstrate the potential loss of urban ecosystem services and ecological function, threatening urban ecological resilience in cities due to PSHB invasion. Study sites included botanic gardens, residential estates and a coastal forest estate. Using a purposive sampling protocol, trees were sampled for beetle entry holes and known symptoms of infestation, providing baseline data. Tree species susceptible to infestation were identified at each site. The results indicate that the coastal forest ecosystem and residential estates are facing a more serious threat than botanic gardens. Stakeholder collaboration is essential in monitoring and effective management interventions against the threat of PSHB, due to the high variability in infestation patterns and host species in South Africa.

CLIMATE CHANGE MAY REDUCE INVASION RISK IN SOUTHERN AFRICA

Oral Presentation

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Alien species can have profound impacts on biodiversity and ecosystem functioning. Therefore, it is crucial to assess which species among the presently cultivated alien flora have the potential to escape into the wild and become naturalized. While climate change has been known to facilitate the naturalization of many alien plant species in temperate regions, its
effects in (sub)tropical areas is insufficiently known. Here, we used species distribution models to evaluate the current and future naturalization risk of 1,527 cultivated alien plants in 10 countries of Southern Africa. We assessed changes in climatic suitability across the different biomes. Moreover, we assessed whether climatic suitability for cultivated alien plants varied with their naturalization status and native origin. Our findings reveal that a substantial proportion (53.9%) of these species is projected to lack suitable climatic conditions. Currently, 10.0% of Southern Africa is identified as an invasion hotspot. This percentage is expected to decrease slightly to 7.1% under moderate future climate change and shrink considerably to 2.0% under the worst-case scenario. This decline in climatic suitability is observed across most native origins, particularly under the worst-case climate change scenario. Our findings indicate that climate change is likely to have an opposing effect on the naturalization of currently cultivated average plants in (sub)tropical Southern Africa compared to colder regions.

COORDINATION AND CONSISTENCY NEEDED IN US STATE INVASIVE SPECIES POLICIES

Oral Presentation

**J. Barney**

1, E. Reed1, S. Cathey¹, C. Braswell¹, P. Agarwal¹, B. Brown¹, A. Heminger¹, A. Kianmehr¹, S. Salom¹, T. Schenk¹, G. Sharma¹, D. Haak¹

1Virginia Tech, Blacksburg, United States

Invasive species critically threaten economies, native biodiversity, ecosystem function, and human and animal health. A strong regulatory framework is key to mitigating the threat of current invasive species and preventing new damaging introductions. However, the United States lacks meaningful federal laws and regulations on invasive species, leaving it to individual states. We reviewed all invasive species related laws and regulations for 21 eastern US states to evaluate their taxonomic, pathway, and habitat coverage. We identified 706 policy chapters covering 1200 unique species, of which 523 were identified as introduced/invasive. Policies covering plants and vertebrates outnumbered ones covering invertebrates, and varied among states. Policies covering terrestrial habitats outnumbered aquatic ones, though it was more balanced in coastal states. Overall there was little overlap or consistency among adjacent states. We encourage states to coordinate efforts at the regional level to better address invasive species issues.

POPULATION GENOMICS OF A COSMOPOLITAN WEED

Oral Presentation

**M. Lucas**

1, I. Hensen¹, C. Barratt², W. Durka³, D. Nagy¹, R. Onstein⁴, C. Rosche¹

108
Understanding genetic mechanisms of adaptation is crucial for predicting plant responses to global environmental changes. High throughput data facilitate landscape genomic approaches to infer how dispersal is controlled by adaptive vs. non-adaptive drivers of gene flow. Invasive plant species are suitable study models because non-native populations are often prone to rapid genomic changes as a result of colonizing a novel range. We explore the genomic structure of 109 native and 183 non-native populations Conyza canadensis using ddRADseq. C. canadensis is an interesting model to investigate global gene dispersal because it is a successful invader with a cosmopolitan distribution and an economically significant agricultural weed. We test the hypothesis that an interplay between environmental gradients and non-adaptive, demographic processes dictates the global genomic structure of C. canadensis. Results suggest that high selfing rates determine global genomic structure and a strong pronounced differentiation between populations. Partial Mantel tests showed a significant correlation between genetic distances and spatial and climatic distances of the populations. And clustering analysis using admixture coefficients shed light on how population history dictates biotic interactions across large spatio-environmental scales. Future analyses at WBF2024 will include gene flow to illustrate the magnitude of relative migration rates and the clustering of similar sampled areas.

INVASION HISTORY AND LAND-USE SHAPE PREVALENCE OF ALIENS IN LOCAL ASSEMBLAGES

Oral Presentation

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The ecological effects of non-native species emerge from their establishment in local assemblages. However, the rates by which non-natives spread across assemblages, and the factors which affect this rate, have hardly been comprehensively studied, yet. Here, we combine five different databases in a global-scale analysis on how the incidence and proportion of non-native birds, mammals and vascular plants in local assemblages depend on the mean residence time of non-natives in a region, and whether this relationship varies between assemblages under different types of land use. We found that the local incidence of non-native species is higher in regions with longer mean residence times. Among land-use types, the incidence starts to rise in urban and cropland assemblages first, and latest in primary vegetation, with a difference of several decades. Even after 150 years, the rise of incidence levels off only in case of birds and mammals in land use types other than primary vegetation. Effects of residence time on non-native proportions are only significant in case of mammals within the time frame covered. We conclude that the continental exchange of biota needs more than a century to trickle
through to the local scale, and even longer in primary vegetation and for vascular plants. As a consequence, local assemblages will likely accumulate non-native species over the entire 21st century, even in the absence of new introductions.

**IPBES THEMATIC ASSESSMENT REPORT ON INVASIVE ALIEN SPECIES AND THEIR CONTROL**

Oral Presentation

*H.E. Roy*¹, A. Pauchard², P. Stoett³, T. Renard Truong⁴

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The IPBES Thematic Assessment of Invasive Alien Species and their Control was accepted and the summary for policymakers was approved by 143 governments at the 10th session of the IPBES Plenary in September 2023. This landmark publication is the first comprehensive global assessment of invasive alien species and is the result of four years of work by 86 experts from 49 countries. The assessment includes detailed review of 13,000 references and data and information from various knowledge and value systems including Indigenous and local knowledge. The six chapters, which underpin the summary for policymakers, cover current status and trends of invasive alien species, their impacts, drivers, management, and policy options to address the challenges they pose. The Thematic Assessment of Invasive Alien Species and their Control highlights the major and rapidly growing threat that invasive alien species pose to biodiversity, ecosystems and human well-being. Not all alien species become invasive – invasive alien species are the subset of alien species that are known to have become established and spread, which cause negative impacts on nature and often also on people. More than 37,000 alien species have been introduced around the world and 3,500 of these are considered to be invasive with negative impacts on nature and also, in some cases, people. Encouragingly, future biological invasions can be prevented and management of invasive alien species is achievable.

**GLOBAL SUMMARY OF ALIEN SPECIES IMPACTS: IPBES REPORT AND WHERE TO GO FROM THERE**

Oral Presentation

*S. Bacher*¹

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The presentation summarises the impacts of invasive alien species on nature, nature’s contributions to people, and good quality of life, as defined in the conceptual framework of the
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). It will address the following questions: Which native taxa, nature’s contributions to people and components of good quality of life are most negatively and positively impacted by invasive alien species? Which units of analysis and regions are most negatively and positively impacted by invasive alien species? How many and which invasive alien species caused local and global extinctions and which native species and taxonomic groups are affected? What are the global monetary costs of invasive alien species? How do people, including Indigenous Peoples and local communities, assess the magnitude of impacts of invasive alien species? What are our knowledge gaps and biases in the type and distribution of impacts across taxa, regions, units of analysis?

AUTOMATED FLAGGING OF POTENTIAL ALIEN OCCURRENCES AT THE GLOBAL DATABASE SCALE

Oral Presentation

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Global databases of biodiversity observations such as GBIF are key resources for the monitoring of biodiversity change, including the introduction and spread of invasive and alien species. While numerous single and multi-species studies have used database observations to track invasions, global occurrence data have not yet been mobilized to detect alien occurrence records at the scale of major species groups (e.g., all mammals). We present a computationally as well as taxonomically scalable system for the flagging of potentially alien occurrence records, which is designed to predict individual occurrence alien statuses across thousands of species in biodiversity databases. Our system integrates species occurrences from GBIF with global species taxonomies, expert range maps, and national checklists of alien species (GRIIS). Predictions are based on the occurrence record distance to native range map, but additionally consider the dispersal ability of a species as informed by species traits. We show preliminary results from the workflow, identifying alien occurrences across major terrestrial vertebrate groups, and explore the concurrence of automatically flagged alien occurrences with documented distributions of alien occurrences and expert datasets such as GRIIS. We share perspectives of the role of automated alien occurrence alert systems, in conjunction with expert validation, within global alien species monitoring efforts.

MANAGING BIOLOGICAL INVASIONS IN THE FACE OF FUTURE UNCERTAINTIES

Oral Presentation
The future trajectories of biological invasions are highly uncertain, influenced by a multitude of socio-ecological drivers. Employing a scenario-based approach, we explored potential management options for invasive species in Europe. Initially, we formulated a comprehensive strategy comprising 19 objectives related to invasive alien species issues that extend beyond mere management considerations. We examined the strengths and weaknesses of each objective across various scenarios, proposing recommendations to enhance its overall applicability. Our analysis identified four interrelated recommendations that should form the foundation of any long-term strategy for managing biological invasions: (i) establishment of a European biosecurity regime, (ii) implementation of a dedicated communication strategy, (iii) adoption of data standardization and management tools, and (iv) creation of a monitoring and assessment system. Finally, we evaluated the feasibility of the management strategy, revealing varying degrees of challenge under different scenarios. High levels of technological development, increased public environmental awareness, and the effectiveness of IAS policies emerged as factors facilitating the implementation of the management strategy. Together, our findings suggest that it is time for a new management of biological invasions based on a more integrative approach across socio-economic sectors and countries.

TOPICAL INVADERS MAY RESTORE LOST ECOSYSTEM FUNCTIONS IN CLIMATE CHANGE HOTSPOTS

Oral Presentation

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Climate change and bioinvasions cause major shifts in ecosystems’ biodiversity that can dramatically alter their functions and services. In ocean-warming hotspots, where important, thermally sensitive, native species reduce in abundance and even are at risk of extirpations, thermophilic invaders with similar traits might partially or fully offset that loss. The Levant basin in the Mediterranean Sea is a ‘natural lab’ for testing this hypothesis. On shallow reefs in the region, invasive rabbitfish turn lush macroalgal communities to turf barrens, but many alien seaweeds increasingly dominate large reef areas. To understand if these biodiversity changes shift or maintain ecosystem functioning and services, we tested: (1) The thermal vulnerability of several ecologically-important native and alien seaweeds; (2) the seasonal abundance of one endemic and two alien seaweeds; and (3) their metabolic rates and inorganic carbon uptake. We found that: (a) the endemic seaweed had a significantly lower optimal photosynthetic temperature; (b) the cover and biomass of the endemic seaweed peaked in late winter-spring while
they were high year-round in the aliens; (c) the calculated annual carbon uptake is higher for
the aliens. These findings suggest that Blue Carbon potential of reefs might be maintained,
despite the likely loss of important natives, suggesting that tropical aliens may function as
nature-based solutions in ocean warming hotspots.

**INSULARITY AND TROPHIC LEVEL SHAPE NEGATIVE, BUT NOT POSITIVE, IMPACTS OF ALIENS**

Oral Presentation

*Z. Bescond–Michel*¹, *S. Bacher*¹, *G. Vimercati*¹

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Alien species have various environmental impacts worldwide. Negative impacts have received
considerable attention, as impactful alien species, named invasive, are regarded as a main
driver of native biodiversity loss. Alien species can also have positive impacts on biodiversity,
e.g., through food provision or dispersal facilitation, but such impacts have never been sys-
tematically examined. We apply the IUCN EICAT framework and its complementary version,
EICAT+, to quantify number and magnitude of negative and positive impacts of alien ungu-
lates globally. By categorizing impact magnitude into two levels of strength (weak and strong),
we also ask whether impacts are stronger on islands and species positioned higher in the trophic
chain. Out of the 66 alien ungulates species, 29 have been found to cause impacts, for a total of
2,131 impact observations, which mostly concern negative impacts (1,644). Insular biodiversity
faces stronger impacts from alien ungulates compared to mainland areas, although this trend
is significant only for negative impacts. Higher trophic level species (secondary consumers)
exhibit stronger negative impacts compared to those at lower levels (primary consumers and
producers). Conversely, trophic position does not influence the magnitude of positive impacts.
The combined use of EICAT/+ enabled us to conduct a standardized bidirectional impact
assessment that had never been attempted before, providing novel insights for biodiversity
conservation.

**GLOBAL ECONOMIC COSTS OF BIOLOGICAL INVASIONS**

Oral Presentation

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In addition to biodiversity loss, biological invasions are responsible for substantial losses of
goods, services and production capacity as well as monetary expenditures for their manage-
ment. Until recently, a reliable global synthesis of the economic costs of invasive alien species
had been lacking, despite being required for research and management. We have now addressed this problem by producing the first database of economic costs of biological invasions. InvCost is a global, comprehensive, and easily updatable compilation of the recorded monetary impacts of invasions worldwide to human society. We found that biological invasions costs since 1970 are shockingly high, with an annual average cost of several hundred billion of US$. In addition, these staggering economic costs have shown a regular increase estimated as 4-fold per decade, with no sign of slowing down. They also are very heterogeneously distributed by countries, with poorer countries disproportionately impacted. Yet, these costs are still massively underestimated and under-reported. This financial burden of invasions is widely, but unevenly, distributed at regional and taxonomic scales. Our pioneering study is a compelling call for international policy agreements for the coming decades and the necessity of improving research on the consequences of biological invasions.

IPBES -IAS ASSESSMENT - IMPLICATIONS FOR COUNTRIES IN ASIA

Oral Presentation

S. Kavileveettil

Kerala Forest Research Institute, Thrissur, India

The IPBES Report on invasive alien species (IAS) underlines the importance of dedicated policies and their scrupulous implementation for the successful management of IAS. It also calls for a context-specific integrated governance approach and sustained strategic actions in collaboration with all concerned. However, despite increased awareness, several countries in Asia still lack an IAS-specific national legislation and action plan to address IAS threats. Wherever certain regulations are in force, patchy enforcement weakens prevention and management. Also, biosecurity regulations of several Asian countries need updating. Above all, lack of cooperation, conflicting interests, unavailability of relevant data, scarcity of resources, poor public awareness, inadequate capacity and capability and poor stakeholder involvement are hurdles to successful management of IAS in Asia, as discussed in the IPBES Report. The Report emphasizes that prevention of invasion is the best option for IAS management. If it fails, eradication, containment and control are the other main options. However, species-based management involving physical and chemical methods is the norm followed in most of the Asian countries. Biological control is uncommon. Surveillance for IAS, restoration of sites after successful IAS management are challenging due to lack of resources. Gaps in data on invasive alien invertebrates, microbes, fungi and marine organisms impede management of these species in Asia.

THE BIOGEOGRAPHY AND MACROECOLOGY OF BIOLOGICAL INVASIONS IN THE ANTHROPOCENE

Oral Presentation
Biological invasions have become a defining feature of global environmental change. However, the patterns and underlying factors that determine variation in invasions world-wide are still insufficiently understood. Similarly, future trajectories of biological invasions and the consequences for biodiversity conservation are not fully appreciated. Progress in data availability, supplemented by new tools for data integration and analyses have facilitated the compilation of comprehensive databases of world-wide alien species distributions such as GloNAF (https://glonaf.org/) for vascular plants. Similarly, the compilation of the Alien Species First Record-database provides a backbone for analysing spatio-temporal patterns of alien species accumulation. Further, data on human pressures, on the exchange routes of goods and people, and on a wide range of environmental factors have increasingly become available. Combined, these novel data sources have substantially advanced the understanding of the macroecology and biogeography of biological invasions. Here, we will synthesize new key insights into global patterns and drivers of biological invasions. We will highlight likely future trajectories of biological invasions, discuss main gaps of scientific knowledge, and identify new avenues to improve the understanding of alien species spread and impacts. Finally, we will discuss priority questions for biogeography and biodiversity conservation related to biological invasions.
Biological invasions: from impacts to solutions – lessons from the IPBES-IAS assessment

ICONNECT - INTEGRATIVE CONYZA NETWORK FOR CONTEMPORARY TRAIT EVOLUTION

Poster Presentation

C. Rosche¹, M. Lucas ¹, D. Nagy¹, R. Callaway², Y. Lekberg³, W. Durka⁴, N. van Dam⁵, C. Barrat⁶, R. Onstein⁷, M. Shah⁸, H. Uthe⁶, S. Döll⁶, Y. Pöschl-Grau⁶, A. Weinhold⁶, I. Hensen¹

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Rapid evolution is a common occurrence in plant invasions. However, our understanding is limited because most studies underestimate among-population variation (APV) within native and non-native ranges and do not disentangle how population histories drive APV. Furthermore, integrative frameworks of APV-focused research are lacking but could help identify molecular mechanisms of rapid evolution. We here present the integrative network iCONNECT, an open collaboration of researchers who sampled Conyza canadensis populations and researchers who investigate APV in their particular research field. The first study will be a greenhouse experiment with 120 native and 150 non-native C. canadensis populations in a competition × drought treatment. For all populations we collected field data as proxies for population history in terms of plant competitive regime, drought regime, and fungal interactions in the rhizosphere. The samples will be analyzed in a coherent manner for phenotypic, eco-metabolomic, root-fungal interactions, and population genomics. Our experiments will shed light on the principles of rapid evolution by exploring how population history dictates biotic interactions across large spatio-environmental scales. Moreover, studying correlations between the investigated APVs may unravel how belowground mechanisms determine competitive ability and may identify metabolites and genomic regions that are associated with competitive ability and root-fungi interactions.

PERCEPTIONS AND REALITIES POST REGULATION OF IAS MANAGEMENT IN EUROPE

Poster Presentation

Q. Canelles Trabal¹, C. Garcia Lozano¹, B. Leung², N. Roura-Pascual ¹

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Biological invasions stand as a critical threat to biodiversity and ecosystem stability, profoundly impacting the economies and societies of host nations. Addressing these challenges, international directives like EU regulation 1143/2014 mandate detailed reporting of Invasive Alien Species (IAS) and their management strategies. This study undertakes a thorough evaluation of IAS management policies in Europe post-regulation implementation. Surveys conducted among 1941 biodiversity managers from 25 European countries (19 EU members) shed light on the perceived application and effectiveness of management strategies since 2015. Analysis encompassed pre- and post-2015 IAS detections, country-specific legislations, and socioeconomic-environmental factors. Findings underscore disparities in policy implementation, with economically advanced countries adopting a more extensive array of measures. Despite an overall rise in IAS post-2015, countries with robust management exhibit a mitigated trend. Notably, past invasion rates correlate with future vulnerability. This groundbreaking study highlights effective policy implementation amid the challenge posed by a growing influx of new invasions.

Non-indigenous crayfishes are spreading through Europe’s aquatic systems and cause concern. The invasive burrowing crayfish Faxonius immunis, first observed in the Upper Rhine Valley in 1993 disperses along the river catchment. In small standing waters the populations can attain very high densities, cause the disappearance of macrophytes, turn the pond into a turbid water alternative state and pose a threat to amphibians and macroinvertebrates. As part of a project to restore habitats for herpetofauna in the Upper Rhine Valley a pond network was created in the Neuburg-Woerr area between 2011 and 2015. After the first promising colonisation by local macrophytes, macroinvertebrates, and amphibians, most of the ponds were invaded by Faxonius immunis. Most invaded ponds shifted into a turbid state lacking macrophytes. To manage the effects of the invasive alien crayfish the bottom sediment was covered by gravel in one of the ponds. The gravel was intended to impede the harmful digging of the crayfish and mitigate its deleterious ecosystem effects. In this first pond gravelled one year ago Faxonius immunis has not established a stable population yet whereas macrophyte
and macroinvertebrate communities are slightly recovering. Limiting the spread of invasive crayfish is a current issue but quite impossible. This collaborative adaptive management between site managers and scientists could be a part of the solution. This experiment is a part of project Emys-R (www.emysr.cnrs.fr).

RISK ASSESSMENT OF INVASIVE BORER BEETLE IMPACTS ON BIODIVERSITY IN SOUTH AFRICA

Poster Presentation

I.H. Govender ¹, N. Manci¹

¹Durban University of Technology, Department of Horticulture, Durban, South Africa

The Ambrosia beetle, Polyphagous Shot Hole Borer (PSHB), Euwallacea fornicatus, is a significant threat to trees nationally in South Africa (SA). The extent of the consequences of this invasive species varies within the country, devastating natural vegetation, orchards, street trees and urban green spaces. PSHB has infested eight of the nine provinces in SA, transforming considerable areas of urban landscapes and impacting on ecosystem services. The drivers of this invasion varies in the different provinces, and is proving challenging to management of the infestation. This study presents the application of a framework incorporating Bayesian Networks (BN) to determine the possible drivers of PSHB infestation and their provincial differences in contribution to the threats posed to biodiversity. The BN risk model is suitable to assess risks to biodiversity, as it has been applied to various ecosystems globally, incorporating multiple drivers to determine the risks to critical management objectives. BNs produce risk profiles which would indicate the probability of different categories of risks (zero, low, moderate, high), based on the relative contribution of different drivers in the ecosystem. Ongoing monitoring of infestations nationally will contribute to reducing uncertainty in the model, to provide improved risk profiles. Sensitivity analysis will indicate the critical drivers in each province and guide decision-making in managing PSHB infestations.

RANKING PRIORITY INVASIVE SPECIES IN A TOURIST LOCATION OF WESTERN GHATS, INDIA

Poster Presentation

K. M Nair ¹, T.V. Sajeev²

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Athirapilly, located in central Kerala in the Southern Western Ghats of India, is a must-see site that offers a lusty flow of waterfall with nearby trees and the presence of endemic faunal species. According to the most recent tourism statistics published by the State Tourism
Department of Kerala, Athirapilly received 2,11,275 domestic and 3241 foreign visitors. A recent invasive plant survey conducted in and around waterfalls recorded the presence of twenty-two invasive alien plants. Since managing them simultaneously is not feasible, risk was assessed using a modified protocol of the Generic Impact Scoring System (GISS), which relies on field data rather than on published evidence as that of classical GISS. The protocol is designed to quantify the environmental and socioeconomic impacts of alien species by a score on a scale of six, with zero representing no influence and five representing the greatest impact. The total score calculated for a maximum of 60 will be divided into three categories: highest, medium and low impact species. Based on this, the current study ranked four high-risk, eight medium-impact, and ten medium-impact species as less likely to cause damage. By implementing appropriate procedures, starting with the most prioritized species identified from the assessment and information exchange among the necessary stakeholders, the results can subsequently be employed for management activities.
Bridging scales in soil biodiversity–ecosystem functioning relationships

ORGANIC FERTILIZERS IMPROVE SOIL MULTIFUNCTIONALITY IN SUGARCANE AGROECOSYSTEMS

Poster Presentation

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Maintaining and improving ecosystem services in agroecosystems is essential to ensure sustainable food security. We study how long-term fertilization practices shape soil capacity to provide multiple services, by comparing multifunctionality (MFI) of sugarcane soils in three experimental fields located in Réunion, respectively corresponding to nitisol, cambisol and andosol. MFI was investigated using 9 functional indicators of nutrient availability, carbon transformation and soil structure maintenance. Our results showed the consistency of fertilizers effect on MFI across soil types. Filter mud and green waste compost significantly enhanced MFI, nutrient availability, carbon transformation and soil structure (until ca. 60%, 195%, 67% and 33%, respectively) compared to mineral fertilization, while pig manure, poultry litter, sewage sludge did not. MFI variation was related to the quantity of organic matter input more than to their quality (C/N). Organic fertilization practices allowed an increasing in soil MFI index, mainly through functions related with carbon transformation and nutrient availability. Soil properties could only slightly explain MFI variation, which suggests that there are other key drivers to investigate. Our study validated the high potential of organic fertilization to improve cultivated sugarcane soils provided ecosystem services, while highlighting the need for further studies on the biological component of soil fertility.

ENERGY DISTRIBUTION IN SOIL FOOD WEBS OF TEMPERATE AND TROPICAL FORESTS

Oral Presentation

A. Potapov, I. Semenyuk, S. Bluhm, V. Krashevskaya, A. Kudrin, V. Migunova, M.M. Pollierer, O. Rosanova, A. Zuev, S. Scheu, A. Tiunov

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Soil hosts most of Earth’s biodiversity and supports terrestrial energy flux. The structure and functioning of soil food webs were described for specific ecosystems, but their variation across large environmental gradients remains unknown. Here, we use the energy flux approach to explore generic patterns in biomass and energy distribution across micro-, meso- and macrofauna in forest ecosystems spanning from southern taiga forests to tropical rainforests. Tropical soil food webs had either larger (monsoon) or smaller (rainforest) animal biomasses than temperate ones, but had consistently higher energy flux, higher relative biomass of large organisms, and distinct energy distribution. Specifically, tropical soil food webs had proportionally higher predation rates (31 vs 18-27% of the total energy flux) and relied more on the plant energy channel (21 vs 10%), but less on the bacterial (5 vs 9-18%) and litter energy channels (14 vs 18-32%), than temperate soil food webs. Earthworm dominance in temperate mixed broadleaved forests was associated with prevalence of detrital energy channels (litter, soil and deadwood consumption), and estimated decreases in predation (-32% decrease) and fungivory (-43%) in comparison to southern taiga and beech forests. Our study shows functional consequences of global taxonomic turnover in soil animal communities, summarising potential animal effects on related soil functions in different biomes.

ENERGY FLUXES AND SOIL BIODIVERSITY – AMINO ACID ISOTOPES OPEN UP NEW FRONTIERS

Oral Presentation

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Biodiversity in soils is associated with a high functional diversity that is hard to capture. Energy fluxes through food webs and associated functions can be used to link biodiversity to ecosystem functions and thereby account for both changes in community composition and species trophic niches caused by e.g., land-use or climate change. Traditional methods such as bulk isotope and fatty acid analyses allow to capture trophic niches and basal resources, but are associated with baseline problems and lack of quantification. Compound-specific isotope analysis (CSIA) of carbon and nitrogen in amino acids, a new and promising method for analysing trophic interactions in soil food webs, provides more quantitative and baseline-independent measures of trophic positions and basal resources. Here, for the first time, we relate changes in group-level energy fluxes and trophic positions, as derived from CSIA of amino acids, to changes in biodiversity along a gradient of forest management intensity in three landscapes in Germany. We analysed a broad range of taxonomic groups including mesofauna (Collembola, Oribatida, Gamasida) and macrofauna (Lumbricidae, Diplopoda, Isopoda, Chilopoda). Using biomass-weighted ordinations of species distributions within taxonomic groups, we identified the main taxa responsible for shifts in energy fluxes and functions (potential ‘indicator taxa’).
This approach opens up new frontiers for tracking shifts in soil functional diversity in the future.

**SOIL METHANOTROPHIC DIVERSITY AFFECTS SOIL-ATMOSPHERE METHANE FLUXES**

Oral Presentation

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The functional role of microbial diversity for biogeochemical processes is not well understood to date. Methanotrophic bacteria play a key role in Earth’s CH4 cycle by removing atmospheric CH4 and reducing emissions from methanogenesis in wetlands and landfills. Here, we studied effects of methanotrophic diversity by two complementary approaches: de novo assembly of communities from isolates and erosion of existing diversity from diverse natural communities. We assessed the communities’ functioning by gas chromatography and trajectories in their size and composition by qPCR and Illumina-sequencing of pmoA and 16S gene fragments. In all investigated systems, net CH4 consumption decreased as community members were lost, independent of total community size. Studying variation among the specific strain mixtures, we found that interactions among strains were positive or neutral but never negative, and that competitive hierarchies among strains were transitive. However, the structural and function traits of community members we collected did not explain the observed diversity effects. The strains that performed best also varied with environmental conditions, suggesting that a high biodiversity is important for maintaining methanotrophic functioning as environmental conditions fluctuate over time. The effects we found resemble the ones for higher organisms, suggesting that BEF-relationships are universal across taxa and spatial scales.

**HOW MICROBIAL AND INVERTEBRATE ACTIVITIES SHAPE ALPINE SOIL RESPIRATION**

Poster Presentation

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Belowground production of CO2 has been suggested to be highly responsive to climate change, but there are large uncertainties as to the role of soil organisms involved in the mineralization of soil organic matter and subsequent CO2 release. Combining field observations across grassland
ecosystems in the Central Alps with manipulative incubation experiments, we investigated
the role of microbial and invertebrate activities in shaping soil respiration under different
environmental conditions. We measured soil CO2 release jointly with the soil functional profile
based on targeted microorganisms’ intracellular DNA fractions, which contained information
about the active organisms in soil. First results indicate distinct effects of soil invertebrates
on microbial communities with cascading consequences for soil CO2 emissions, which were
particularly pronounced under weather extremes.

SOIL BIODIVERSITY IN PROTECTED, NEAR-NATURAL FORESTS

Poster Presentation

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Soil biodiversity is immense and includes a large taxonomic diversity of organisms, many of
which are still unknown. The main limitations in the study of soil organisms are their physical
inaccessibility, partly due to the complex spatial structure of the soil matrix, and a lack of
taxonomic knowledge. Thus, soil biodiversity remains poorly understood despite its central
role in many essential soil processes such as nutrient cycling and carbon sequestration. There
is a huge need for more data on soil biodiversity, particularly covering all taxa from microbes to
invertebrates, which is currently largely lacking. We conducted a study to assess the diversity
of soil microbes and invertebrates at forest sites in nine countries in and around Europe. We
used pitfall traps, soil cores and eDNA samples to (1) get an overview of soil biodiversity
in different forest types and (2) compare traditional morphological species identification with
results from eDNA analyses. Here we present the results of the first sampling effort in spring
2023.

RESTORING SOIL BIODIVERSITY AND FUNCTION THROUGH REWILDING

Oral Presentation

J. Stewart 1, N. Machado de Lima1, R. West2, R. Kingsford1

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Rewilding is a tool that offers a trophic approach to restoring ecosystem function. However
its effectiveness on restoring soil biodiversity and function is under represented in research.
Above-below ground interactions are known to be of importance at an ecosystem level, but
few studies have measured the response of soil biodiversity to above ground restoration. We
compared restoration strategies in an Australian drylands system to quantify if rewilding
reinstated greater soil functionality than passive strategies, using soil bacteria, fungi, and invertebrate communities as indicators of function. This response was measured over 4 years, across different habitat types, and included the reintroduction of 4 locally extinct mammals, some not seen in the region for over 100 years. Here we present the importance in understanding soil function and community structure rather than traditional diversity metrics alone, with rewilding sites having higher soil functional diversity, despite similar species diversity. Further we found a habitat specific response to treatments, highlighting the need for considering landscape heterogeneity in restoration and management. Our study suggests that rewilding has great potential for restoring drylands and that soil biodiversity can be a useful tool for monitoring restoration success.

GROUNDCOVER BUFFERS THE EFFECT OF CLIMATE CHANGE ON SOIL BIODIVERSITY IN DRYLANDS

Poster Presentation

**J. Stewart** 1, N. Machado de Lima1, M. Muñoz-Rojas2, R. Kingsford1

1University of New South Wales, Centre for Ecosystem Science, Kensington, Australia, 2University of Seville, Department of Plant Biology and Ecology, Seville, Spain

Soil is shown to drive up to 80% of ecosystem function in drylands. However these systems are particularly vulnerable to the impact of climate change over longer and more severe dry periods. A recent global study showed that there was a large discrepancy between air temperature and soil temperature with variances of up to 10 degrees depending on ground cover and soil moisture. Groundcover increases soil moisture and decreases soil temperature, and vegetation types have shown significant differences in their impact on soil respiration and biodiversity. Understanding the correlation of groundcover and soil microbial diversity under climate change conditions is needed to better manage these ecosystems. Empirical studies identifying soil microbial taxa that are tolerant to harsh climate conditions, and that are capable to support soil functions (e.g. nutrient cycling) under climate change are needed. Furthermore, understanding how groundcover might buffer the impacts of climate change on soil functionality could enable targeted management for facilitating ecosystem resilience and resistance to climate change. Using results from a field study, this presentation will aim to address three important scientific questions, (i) how will climate change impact the soil microbial communities in Australian dryland soils, (ii) does this response vary with groundcover type, (iii) how can we improve drylands soil conservation under climate change?

SOIL BIODIVERSITY, PESTICIDES AND ECOSYSTEM FUNCTIONING

Oral Presentation

**F. Romero** 1, M. van der Heijden2,3

124
Soils are highly diverse. Over 50% of all species have been estimated to live in soil or complete a part of their life cycle belowground. Soils not only harbour a significant fraction of biodiversity, but also are important for ecosystem performance. In a recent study, using over 588 sites across 27 European countries, we observed that soil health is positively linked to plant productivity. Moreover, soils are increasingly under stress and the impact of a wide range of soil stresses, including pesticides, on soil biodiversity and soil functioning are still poorly understood. Here we demonstrate that pesticides influence a wide range of soil organisms. We observed that the application of pesticides reduces the abundance of beneficial mycorrhizal fungi in 60 Swiss arable fields. Moreover, using soils from over 210 cereal fields and grasslands in Europe, we observed that fungicides reduce the ability of mycorrhizal fungi to deliver nutrients to their host plants. We also observed that a range of bacteria and fungi, including known pesticide degraders, benefit from pesticides (in terms of enhanced abundance in microbial communities). Using large scale data of a soil monitoring project of the European Union (LUCAS), we present new results and assess the influence of pesticides on a wide range of soil biota. Overall, our work points to the pivotal role of soil biodiversity for ecosystem functioning and it demonstrates that soil stresses such as pesticides impact soil life.

EFFECTS OF URBAN LAND USE ON SOIL FOOD WEB STRUCTURE

Poster Presentation

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Soil fauna is an essential component of biodiversity and plays a vital role in the maintenance of ecosystem functions. Rapid urban expansion has converted large areas of natural habitat into managed systems, posing a potential threat to soil fauna communities and their ecological functioning. Most of studies on urban soil fauna focused on diversity, while the distinctions in food web structure between urban greenspaces and natural systems are largely unknown. Here, we utilized stable isotopes (15N, 13C) analysis to examine the structure of soil animal food webs across different types of urban greenspaces and natural systems. We hypothesized that urban greenspaces reduce the biomass of soil faunal communities, consequentially leading to simplification of soil food web structures compared to forests. However, our results did not show a significant difference in the overall biomass of soil fauna between urban greenspaces and forests, mainly due to the various responses of biomass to system types between different groups of soil fauna. Furthermore, the analysis of multidimensional isotopic metrics did not indicate a lower trophic complexity in urban greenspaces. Notably, the range of Δ15N values was found to be higher in urban woodlands, suggesting a greater number of trophic transfers and/or vertical diversity than in natural forests. Overall, these results suggested that urban
greenspaces do not reduce and may even increase the trophic complexity of soil animal food webs.
BIOTRANSFORMATION AS AN INDICATOR OF SPECIES SENSITIVITY TO CHEMICAL POLLUTION

Oral Presentation

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Whether aquatic species cope with chemical exposure depends on their ability to display mechanisms of defense. Among these mechanisms, biotransformation processes are key in supporting detoxification and the elimination of xenobiotics. However, such processes are likely to vary among species due to factors related to gene conservation and inducibility. In the present study, fish species that are representatives of Swiss biodiversity were collected in watercourses with different levels of pollution and surrounded by different land use. Comparative assessments were conducted to assess species-specific biotransformation ability through measurements of enzymatic activity and biotransformation rates of different micro-pollutants. Among the evaluated species, brown trout (Salmo trutta) presented the highest activity for enzymes considered gold-standard biomarkers of biotransformation, particularly in sites with high levels of anthropogenic influence. However, the pumpkinseed (Lepomis gibbosus), an invasive species from North America, displayed the highest biotransformation rates for micro-pollutants. For bottom-dwelling species, like the European bullhead (Cottus gobio) and common barbel (Barbus barbus), enzymatic activity and micro-pollutant biotransformation displayed the lowest levels. These observations underline major species sensitivity differences towards chemical exposure and highlight the influence of pollution in potentially altering biodiversity in aquatic ecosystems.

FICTION AND REALITY IN PESTICIDE RISK ASSESSMENT

Oral Presentation

M. Liess ¹,²

¹UFZ - Helmholtz Centre for Environmental Research, System-Ecotoxicology, Leipzig, Germany, ²RWTH Aachen University, Germany, Institute of Ecology & Computational Life Science, Aachen, Germany

The global decline in biodiversity is due to a variety of anthropogenic stressors. This underlines the increasing urgency of action. Plant protection products play a decisive role in the relevant stress factors. In response to this, ever higher targets are being proclaimed in environmental
legislation, such as the EU’s Green Deal. However, some of these targets are excessive and scientifically contradictory. For example, reducing use by 50% and reducing risk by 50% are incompatible, given that toxicants generally exhibit logarithmic effects. In addition, there are a number of fundamental flaws in the current regulatory risk assessment process. There is often a lack of validation of predictions at the ecosystem level, and ecotoxicological predictive models fail to consider relevant factors such as latent effects, culmination and synergistic interactions of stressors. Realistic biodiversity conservation objectives and risk assessment that can achieve improvements in biodiversity are therefore needed and outlined within the presentation.

INTEGRATING BIODIVERSITY INTO PATHS TO ATTAIN SAFE AND SUSTAINABLE CHEMICAL USE

Oral Presentation

K. Groh

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Chemical pollution has been generally recognized as one of the major drivers of biodiversity loss worldwide. However, the incompleteness of scientific understanding on this topic appears to delay implementation of this knowledge in practice, e.g., finding a way to integrate biodiversity measures into the design of strategies to attain safe and sustainable chemical economy. The challenges to be overcome include, for example, the need to (i) develop efficient approaches that allow disentangling individual contributions of chemical stressors and other drivers; (ii) identify chemicals or chemical groups with potential to deliver significant benefits for biodiversity protection if addressed by industry or policy efforts (Mueller et al. 2023, DOI 10.1039/D2VA00257D); and (iii) identify and standardize biodiversity metrics that are both comprehensive and practicable, so as to allow their broad use by companies to evaluate their operations or by policymakers to prioritize biodiversity protection actions or assess their efficiency. My talk will describe the approaches that could be taken to help develop workable solutions to these challenges, such as the design of interdisciplinary studies that can improve mechanistic understanding and enhance our capacity to predict chemical impacts on biodiversity; contributions to policy negotiation processes, on the example of Kunming-Montreal Global Biodiversity Framework; and pursuit of nature-positive objectives in the chemical industry sector.

ENVIRONMENTAL IMPACTS OF CHEMICALS – BEYOND THE PLANETARY GUARDRAILS?

Oral Presentation

H. Hollert 1,2,3, F. Sylvester1, S. Johann1

128
Potent stressors such as degradation of habitats, introduction of non-indigenous species, and climate change pose an unprecedented threat to the integrity of ecosystems and biodiversity on our planet. In the last decades, chemical risks have mounted alarmingly following an unabated increase of the global production and release of chemicals into the environment. Recently, Persson and colleagues quantified for the first time the planetary boundary for novel entities, showing that humanity is already outside the safe operating space for novel entities (Persson et al. 2022, Environmental Science & Technology, DOI 10.1021/acs.est.1c04158). Soon afterwards, scientists highlighted the potentially massive link between biodiversity loss and chemical pollution, and the fact that both phenomena have often been studied within sub-disciplines but rarely considered jointly and across sub-disciplines (Grohe et al. 2022, ES&T, DOI 10.1021/acs.est.1c08399; Sigmund et al. 2023, Global Change Biology, DOI 10.1111/gcb.16689; Sylvester et al. 2023, Nature Ecology & Evolution, DOI 10.1038/s41559-023-02117-6). In this talk, the impact of chemicals from the perspective of planetary boundaries and biodiversity crisis will be discussed. Furthermore, this talk will introduce the RobustNature Excellence initiative, a scientific consortium to investigate the impact of chemical pollution and, more generally, of novel entities on the decline of biodiversity from an inter- and transdisciplinary perspective.

A CRITICAL REVIEW OF EU POLICIES TO PROTECT BIODIVERSITY FROM CHEMICAL POLLUTION

Oral Presentation

T. Backhaus 1

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The European Union is a major hub for the production and use of chemicals, and chemicals are continuously emitted into the environment during production, transport, use and disposal. It is therefore not surprising that dozens or even hundreds of different anthropogenic chemicals can be found in every corner of the environment and within all living organisms. These chemicals originate from diverse uses, as pesticides, biocides, pharmaceuticals and as general industrial chemicals. Several regulatory frameworks have been put in place to protect the environment from chemical exposure, from prospective frameworks such as REACH or the Pesticide Regulation to retrospective frameworks such as the Water Framework Directive. Nevertheless, European biodiversity continues to decline at an alarming rate with chemical pollution frequently identified as a contributing factor. In this presentation, I will first critically review European chemical regulation and its environmental protection goals, with a focus on biodiversity protection. I will then assess the adequacy of recent policy initiatives, including the Green Deal and its Chemicals Strategy for Sustainability, alongside the EU Biodiversity
Strategy, in mitigating the adverse effects of chemical pollution on biodiversity. Finally, I will discuss research needs, in order to better understand the interlinkage between chemical pollution and biodiversity loss. The presentation will conclude with an exploration of suitable policy options.
Closing the social-ecological loop: from principles to practice

URGENT NEED TO IMPLEMENT SCIENCE-BASED POLICY TARGETS FOR MARINE BIODIVERSITY

Oral Presentation

**J.-C. Dajka**¹, A.K. Eilrich², A. Franke¹, B. Halpern³, K. Peters¹, B. Snow⁴, A. Lombard⁵, U. Jacob¹, S. Laakmann¹, A. Luhede¹, H. Hillebrand¹

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Progress toward the 2050 “living in harmony with nature” vision outlined by the Global Biodiversity Framework (GBF) is currently insufficient. Governments’ inability to harmonise their national targets with global ones, attributed to a perceived science-policy gap, is a primary obstacle. Our systematic literature review addressed this gap, focusing on the influence of marine biodiversity research on policy targets during the United Nations Decade on Biodiversity (2010-2020) and beyond. Results reveal solid alignment between marine biodiversity research and policy in both pre- and post-2020 policy targets. We see sufficient evidence to back their scientific quality and cannot confirm an inherent science-policy gap. Our study highlights the potential to even bridge this gap, with significant progress from pre-2020 to post-2020 targets. Now, it is on national governments to align their targets with these global benchmarks. Our research underscores the need for better understanding of national governance practices to protect marine biodiversity.

USING PEER-JUDGEMENT TO EVALUATE SUSTAINABILITY OF HERDING PRACTICES IN MONGOLIA

Poster Presentation

**K. Batpurev**¹, D.S. Sinclair¹, D.C. Liu¹

¹Arthur Rylah Institute for Environmental Research, Department of Environment, Energy and Climate Action, Heidelberg, Australia

Certification schemes for agricultural products aim to incentivise sustainable land management. To be credible, they need robust metrics to assess the practices of producers. We demonstrate a new approach for assessing practice, which is explicitly representative of stakeholders, transparent and repeatable. We apply it to nomadic pastoralism in Mongolia, where livestock
overgrazing is of major environmental concern. Our approach uses judgements from stakeholders about the sustainability of hypothetical but realistic herding scenarios. From these data, we created Random Forest models to predict sustainability scores, which can be applied to assess the actual practices of any herder. We explore differences between assessment models created from two judgement datasets representing stakeholders in different ways: the first using free judgement from producers, the second using judgements from the same producers that also conform to the predetermined ecological sustainability requirements by the certifier. Differences reveal a perception gap between consumers and producers, that any certification scheme must negotiate. With this study we reveal the self-interest bias that is present when producers determine what is sustainable, when the concept is tied up with their livelihood. We promote involving producers with certification scheme design as a socially acceptable and democratic approach, but we show that a compromise must be drawn to ensure ecological sustainability.

UNFOLDING EVIDENCE OF TRANSFORMATIONAL CAPACITIES IN SOCIAL-ECOLOGICAL SYSTEMS

Poster Presentation

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Coping with global change requires social-ecological systems (SES) to fundamentally change structure and build alternatives to develop along new pathways. Helping to steer such fundamental SES changes requires an understanding of transformational capacities of SES, thus a way to identify capacities to reconfigure human-environmental relationships. This encompasses exploring dynamics and processes in SES interactions, such as e.g. shifts in agency or cultural norms. SES networks have shown high potential to allow conceptualizing, operationalizing, and analyzing complex interdependencies between social and ecological systems. We analyzed three case studies of SES in mountainous areas characterized by different contexts and having implemented different nature-based solutions (NbS), ranging from the management of human-wildlife coexistence (Italy) to the conversion of agropastoral systems in tropical mountains (Peru) and the repurposing of alpine cultivations (Switzerland). In a first step, we worked with practitioners to build SES networks for the three projects using participatory cognitive mapping methods. We then identified context-independent network motifs and network indicators, which help characterize complex SES in terms of their capacities to transform into another persistent state by restructuring their system components. We will use the results to co-design effective Theory of Change (ToC) with stakeholders in projects supported by the Wyss Academy for Nature.
EFFECTS OF CITIZEN PARTICIPATION ON LOCALS’ MENTAL MODELS TO FOSTER BIODIVERSITY

Oral Presentation

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River restoration is an important measure for promoting biodiversity. According to recent research, Swiss residents are largely in favour of such measures. Despite this, concrete projects often meet with resistance during their implementation. Evidence suggests that this resistance emerge to a critical cause out of lay people’s limited understanding of the importance of natural watercourses for enhancing local biodiversity. Research on social learning on a stakeholder level suggests that interactive involvement potentially improves participants’ shared understanding of the river ecosystem and thus has a positive effect on their local support for restoration. We assume that this effect can also be achieved in the wider public. This study tests these assumptions in two case studies in Switzerland using a quasi-experimental panel analysis design. More specific, groups of respondents are assigned to interventions (e.g., workshops) related to restoration planning. These interventions take place between two repeated quantitative surveys. To test the effect of the interventions, we work with a mental model approach. In our talk, we will showcase the mental models of residents’ understanding of biodiversity elicited from the baseline survey. Based on this starting point, we share findings on the effects of the participatory interventions on participants’ mental models and, in a further step, on their willingness to support implementations of river restoration.

INTRODUCING A CLOSING THE LOOP MODEL-TRACKING GREEN COCOA FRAMEWORK FROM GHANA

Poster Presentation

*E. Amankwah* 1

1Center for Environmental Governance (CEGO), Research, Legon Accra, Ghana

Ghana is the second largest cocoa producer in the world, Cocoa as a smallholder commodity crop has identified volunteers who seek the interests of smallholder farmers as they comply with voluntary sustainability standards agencies. Consumers who consume ethically produced, eco-labelled chocolates and cocoa products should develop an interest to visit cocoa production sites in Ghana to help improve the livelihoods of cocoa producers and communities. The methodology for this paper are from literature review, secondary sources, opinion leaders, practice and observation. Cocoa supply chain emanates from social - ecological scenarios and backgrounds that enhances the benefits from conservation and sustainable use by offering the producers rewards through the payment of environmental services, other incentives and
marketing opportunities. “Tracking Green Cocoa Framework” as a business model promotes biodiversity conservation and rural development to transform the lives of smallholder producers. This initiative focuses on cocoa ecosystems, zero deforestation and provision of ecosystem services for greater impacts on responsible tourism destinations. Rewards of monetary and other benefits could bring significant changes to host communities and contribute in achieving the Sustainable Development Goals (SDGs). Ghana showcases responsible tourism destination for global consumers of chocolate and should bring hope for smallholder producers of sustainable cocoa.

WEAVING INDIGENOUS AUSTRALIAN KNOWLEDGES INTO NATURAL RESOURCE MANAGEMENT

Oral Presentation

R.M. Thompson¹, L.P. Duncan², M. Ella-Duncan³

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The principle of integrating Traditional Indigenous Knowledge into management of natural capital is now well established. The reasons for this include; improving the knowledge base for making decisions, ensuring that policy outcomes are resilient and equitable and providing opportunities for indigenous people to actively participate in management. In Australia the development of a Natural Repair Market in terrestrial ecosystems, and the broadening of water reform to include Indigenous values provides an opportunity to genuine incorporate Indigenous knowledge in decision making. Based on our collective experience we describe how this might be achieved focussing on a series of challenges

Making Western scientific paradigms more open to cultural knowledge.

The challenges in determining and quantifying cultural values in an ethical way with operational relevance.

The need for appropriate resources to support two-way exchange of knowledge.

Using the emerging science of cultural water allocations within the Murray Darling Basin in south-eastern Australia we describe the ways in which these challenges may be addressed in a real world scenario. We explain the utility of a ‘two-eyed seeing’ construct for combining knowledge systems, pitfalls and opportunities for recording and applying indigenous knowledge and the critical need for culturally appropriate communication to empower indigenous peoples to participate in knowledge exchange as equal partners.
IMPROVING THE FLOW FROM BIODIVERSITY DATA TO POLICY

Oral Presentation

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To achieve the Global Biodiversity Targets, we need a seamless and continuous flow of biodiversity data and knowledge to inform policy. Scientists need means to automate the analysis of huge amount of heterogeneous, while decision makers need up-to-date information to evaluate policy options. Effective biodiversity monitoring, alongside advanced modeling techniques and computing tools, is essential for synthesizing knowledge within timescales that are relevant policy. The B-cubed project aims to streamline biodiversity data management and analysis by utilizing data cubes to enhance access and compatibility across heterogeneous datasets. This project provides tools for generating models and indicators that track biodiversity change, and shared workflows to ensure consistent replication. To develop applicable models and indicators, a biodiversity policy landscape analysis is underway. We are reviewing existing policy and reporting needs by consulting with stakeholders throughout the data life cycle (collectors, researchers, policy makers) in multilateral organizations and regional initiatives. This analysis identifies challenges in data flows and analysis, such as data availability, integration, and bottlenecks in applying indicators, while also identifying missing indicators. The results of this landscape analysis will be presented alongside case studies showcasing the co-development of practical, meaningful, and actionable tools for biodiversity monitoring and reporting.

BUILDING TOPICAL NETWORKS TO RATCHET UP EU BIODIVERSITY COMMITMENTS

Oral Presentation

M. Vandewalle 1, U. Jacob2, J. Young3

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BioAgora is the EU project developing the new Science Service for Biodiversity aiming at ratcheting up the implementation of the EU Biodiversity commitments. One key function of the Science Service is to develop topical networks that support the implementation of EU biodiversity commitments (starting with the EU Biodiversity Strategy 2030). A topical network is understood here as the network of a broad range of actors who hold an expertise in a particular topic which is directly or indirectly relevant to the implementation of EU biodiversity commitments. Members of a topical network range from knowledge holders to
knowledge users, and can include scientists, policy makers, practitioners, NGOs, businesses, citizen scientists and any other relevant social actors. Topical networks will be provided with a two-way platform through the Science Service and will be on the front line to support other functions of the Science Service, e.g. answering policy relevant requests, supporting research prioritization and horizon scanning, etc. This talk will present the work done to develop some topical networks, such as the pilot cases on Marine Biodiversity and the one Transformative Change.

NISBA FRAMEWORK FOR JUST, ECOLOGICAL AND TRANSFORMATIVE URBAN DESIGN

Oral Presentation

N. Puskás

1UCL, London, United Kingdom

A novel methodological framework was developed to facilitate the creation of collaborative infrastructures employing nature-based solutions. Via a holistic and transdisciplinary approach, it brings together multiple key stakeholder groups on the local scale to co-design and co-create tangible and intangible outputs that are tailored to the local microclimatic conditions as well as sociocultural context whilst responding to the most urgent challenges, needs and aspirations. The Nisba is able to translate the global-scale grand challenges to the local scale, thus addressing overarching issues via local actions, crucially with people’s participation that creates a genuine sense of ownership, contributing to long-term sustainability and maintenance. The Nisba was tested and refined via design loops to develop its final version, presented here. It will be introduced via the two case studies where it was tested: Budapest and Beirut. Results, lessons learnt and future recommendations will be shared that contribute to informing policymaking and development with empirical findings. These insights are valuable for policymakers and governance as well as the scientific and practitioner communities who are interested in conducting transdisciplinary projects that bring together ecological urban planning and development (including e.g. biodiversity conservation, renaturing the city) with a more just, inclusive and diverse facilitation of people’s participation.
Combining social, economic and ecological viewpoints in nature’s contributions to people (NCP) assessments

BIODIVERSITY AND SUPPLY OF MATERIAL NCP IN MOUNT. KILIMANJARO - TANZANIA

Oral Presentation

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Mountain ecosystems provide essential Nature Contribution to People (NCP) especially material ones, contributing to well-being of people living in and around them. Biodiversity has been a key attribute in promoting ecosystem functions and services. Human activities benefiting from ecosystems can in danger both ecosystems and its biodiversity, potentially exposing societal well-being at risk. Understanding how biodiversity underpins material NCP is crucial. In this study we explored the relationships between timber and energy supply and biodiversity components across climate and land use gradients on Mount Kilimanjaro. Results reveal complex interplays, with species richness, functional richness, and functional composition influencing timber and charcoal supply. Climate indirectly affects resource quantity, while land use types impact resource availability, directly and indirectly mediated through different biodiversity components. Fire wood supply, however, seems influenced by factors beyond biodiversity. The study emphasizes the need for nuanced conservation and management strategies, considering biodiversity, climate, and human activities, and highlights the importance of trait-based analyses for accurate predictions and sustainable resource management. Future research could explore genetic diversity, socio-economic factors, and local community dynamics to enhance conservation efforts and ensure the well-being of both ecosystems and local populations in Kilimanjaro.

COMBINING SOCIAL, ECOLOGICAL AND ECONOMIC DATA TO MONITOR NCP IN CANADA

Oral Presentation

*F. Affinito* 1, P. Rodriguez2, A. Schwantes2, C. Firkowski2, M.-J. Fortin2, A. Gonzalez1

1McGill University, Montreal, Canada, 2University of Toronto, Toronto, Canada

How to monitor nature’s contributions to people (NCP) and assess their long-term sustainability is an open research area. A challenge for monitoring NCP is understanding the multi-scale effects of natural and anthropogenic drivers on the social-ecological processes mediating NCP.
A pan-Canadian research network, ResNet, was formed to support Canada’s capacity to monitor, model, and manage the NCP of its land- and sea-scapes. Here, we provide an overview of the main research findings of the team focused on monitoring NCP. We proposed a detection and attribution framework based on essential ecosystem service variables, a set of six classes of variables spanning social, ecological, and economic data, necessary to understand NCP proposed by GEO BON. The framework assesses spatio-temporal change and explicitly estimates changes in the magnitude and direction of NCP trends across scales. Our approach coupled flexible analytical tools (e.g. Bayesian belief networks, intervention analysis) with a range of datasets capturing the ecological and social dynamics of the system. Our team assessed trends in multiple NCP (air quality, fisheries, carbon storage, wildlife viewing, recreation, and maple syrup production) to understand how monitoring can detect change and attribute causes to guide management. We conclude with lessons learnt and highlight some of the challenges and solutions required to monitor change in NCP to guide action and ensure their sustainability in Canada and abroad.

COMPARING RESULTS FROM MIXED METHODS TO REVEAL SOCIAL VALUES IN A SWISS PARK

Oral Presentation

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We studied perceptions, discourses, and social values in a Regional Nature Park in Switzerland. Using four social research methods (media analysis, survey with micro-narratives, go-along interviews, and focus groups), and adapting a triangulation protocol and systematic process from the health sciences, we aimed to understand how the wolf (Canis lupus) was valued and perceived. Wolf perceptions and discourses showed in three of the four methods, with differences in prominence and feelings attached. We identified a “social value silence” of the wolf when compared to other topics, and “wolf fatigue” points to the fundamental changes required to address social aspects in wolf management, conservation, and policy development. Our findings also point to the need of using mixed methods for disclosing and identifying social values and perceptions on sensitive topics that otherwise may be concealed or magnified by a singular method.

CHARACTERIZING GENERALIZED AND SPECIALIZED NATURE’S CONTRIBUTIONS TO PEOPLE

Oral Presentation
M.E. Degano 1, N.-R. Kinabo1, T. Müller1, U. Arbieu2

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Biodiversity is assumed to be critical for the supply of Nature’s Contributions to People (NCP) yet limited evidence links the various entities of nature (EN) to non-material NCP. To date, the relatively coarse indicators measuring NCP do not address the uncertainty related to whether non-material NCP rely on few or an array of EN across the landscape. To fill this knowledge gap, ecological networks can be used to quantify NCP reliance on EN and characterize NCP as generalized or specialized. We used Twitter data (currently ‘X’) looking at tourists’ perceived EN and non-material NCP at Mount Kilimanjaro, Tanzania. We measured degree of complementary specialization (d’) and defined a gradient of NCP specialization. Four out of the 15 non-material NCP experienced by tourists showed specialized associations with exclusive EN. For instance, Learning had exclusive associations with atmospheric and geological features in the summit. On the contrary, we found three non-material NCP which showed generalized associations with a wide array of EN such as Recreation. The remaining non-material NCP had varying tendencies towards either specialized or generalized associations such as Creativity & Inspiration and Aesthetic Experiences, respectively. Leveraging ecological network concepts into socio-ecological systems is a promising venue to incorporate people’s pluralistic perspectives towards nature, and develop more tailored indicators to understand and manage NCP supply.

COMBINING VARIOUS VIEWPOINTS IN NCP ASSESSMENTS – THE VALPAR.CH PROJECT

Oral Presentation

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Among different types – intrinsic, instrumental, relational – of values of nature, IPBES emphasises the relational ones through the concept of nature’s contributions to people (NCP). Assessing the contributions of nature to people needs the use of indicators whose choice is not an easy task. The project ValPar.CH (https://valpar.ch/) aims at studying the values of ecological infrastructure (EI) in Switzerland. Different viewpoints were confronted in the process of NCP’s assessment. The ecological and economic values of nature may be expressed through numerical indicators (e.g. number of species per ha; monetary value of a specific NCP). They are mainly supply-oriented. Moreover, ecological indicators may be represented cartographically, which makes them easily comparable. The social values of nature cannot be
addressed with the same type of indicators. Being mainly relational, social values are much more related to peoples’ worldviews than ecological and economic ones, and it is difficult to address them with numerical indicators and cartographic representations. Moreover, the work has emphasised that indicators are not neutral and are socially-constructed, that their choice is largely guided by data availability and that it is difficult to integrate social values of nature with ecological and economic ones in a unique indicator framework. In our contribution we aim at presenting how to deal with these issues to provide an overall picture of different values and viewpoints.

LESSONS FROM CO-DEVELOPING A MULTIDIMENSIONAL BIODIVERSITY INDEX (MBI) FOR KENYA

Oral Presentation

O.H. Gandhi\(^1\,2\), L. Waruingi\(^1\), D.A. Odhiambo\(^2\), Y. Githiora\(^3\)

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Developing a Multidimensional Biodiversity Index (MBI) is key in measuring a country’s performance on achieving key biodiversity public health objectives within a particular socio-ecological context. It accounts for the state of biodiversity and its contributions to people. This pilot study seeks to explore challenges and opportunities of combining diverse stakeholders’ perspectives on developing a nationally-determined index framework (NDIF) for Kenya. The study shall apply rapid desktop review and mapping of explicitly biodiversity-linked SDGs and national targets, alongside the global biodiversity goals and targets. Online survey tool shall be used to understand the policy demands and needs of stakeholders on MBI. Stakeholder dialogues and consultations will be key in understanding biodiversity public health concepts, proposed MBI framework and its adaptation to the country’s context, and data issues for Kenya’s NDIF. These will lead to a repository of lessons from co-developing NDIF for Kenya and opportunities for the uptake of MBI in the Kenya – Tanzania transboundary landscape. The results, challenges, opportunities and best practices identified will contribute to the technical and conceptual field of co-developing a robust MBI national assessment methodology for various countries. It will also facilitate a learning process for implementing country-specific NDIF in the African Futures Savannah by balancing biodiversity and human development priorities.
Conservation science, policy and diplomacy- Notes from the trenches of transdisciplinary research

ENSCONET: THE EUROPEAN NATIVE SEED CONSERVATION NETWORK

Poster Presentation

A. Faruk ¹, E.m. 2020 to 2025²

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The ENSCONET Consortium was set-up following the completion of the EU-funded project (ENSCONET) in 2009. As of March 2021, the membership is represented by 33 institutions from 18 countries. Despite the challenges posed by the pandemic, the Consortium members met virtually for a general meeting (January 2021) to review past activities. So far, the collective efforts of the group have led to ~56% of the European flora to be conserved ex situ (GSPC 8a), with 39% of these threatened species (GSPC 8b) and 70% representing economically important species (GSPC 9). The increasing importance of the digital space brought about by the pandemic has spurred the group to prioritize the following in the coming years:

- Strengthening communication of the network through the ENSCONET website;
- Collate and maintain an open access seed database of European species (ENSCOBASE);
- Promoting seed research activities and the exchange of seed conservation related knowledge, best practices and experiences;
- Engage with policy makers, conservationists and practitioners to ensure seed conservation remains key to overall biodiversity conservation action.

PARTICIPATORY MONITORING SUPPORTS BIODIVERSITY GOALS IN URBAN AREAS

Poster Presentation

S. Masseraz ¹, C. Krug¹, G. Schaepman-Strub¹, J. Oehri¹

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Zurich aligns itself with the Kunming-Montreal Global Biodiversity Framework, pledging commitment to biodiversity and climate mitigation. However, 60% of Zurich’s area lacks public monitoring, and the status of biodiversity and nature’s contributions to people in these privately managed spaces is not well known. Specifically, it is unclear how private landowners’ attitudes and management affect species diversity and ecosystem characteristics. Therefore,
we use a living lab approach to co-create an initial assessment of the status of biodiversity and nature’s contributions to people in private spaces and investigate their dependency on landowner values, perceptions and management practices. In our study, we link open-access biodiversity data (GBIF) to environmental, socio-economic and -cultural factors across the municipality of Zurich and select a representative set of private land demonstrator sites that we involve in a participatory mapping initiative. In this initiative, we collaboratively identify diversity of selected taxa, as well as landowner values, perceptions and management practices using on-site and mailback surveys. We expect that private landowner involvement and sensitization complements and enhances municipal biodiversity monitoring and fosters acceptance of biodiversity-friendly practices. Collaborating with private landowners is indispensable for attaining Zurich’s biodiversity goals, making our research pivotal for their achievement.

THE POTENTIAL OF PRIVATELY MANAGED SPACES FOR URBAN HABITAT CONNECTIVITY

Poster Presentation

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Zurich aligns with the Kunming-Montreal Global Biodiversity Framework, pledging commitment to safeguard habitat connectivity for biodiversity. However, 60% of Zurich’s area is privately managed, and the contribution to habitat connectivity of these areas, and how they depend on landowners’ attitudes and management is not well known. Therefore, we use a living lab approach to co-create a baseline of private land contributions to urban habitat availability and connectivity and assess their dependency on landowner values and management. Specifically, we combine a recently developed habitat classification (Price et al. 2021) with cadastre information to map habitat of selected species as well as habitat connectivity across Zurich to assess the relative contributions of private and public spaces. Using a representative set of private land demonstrator sites we collaboratively assess landowner’s current management practices and their willingness to improve habitat quality using on-site and mailback surveys. We expect that privately managed spaces can significantly contribute to improving habitat connectivity for various taxa across Zurich, highlighting the potential of engaging private landowners to achieve global biodiversity goals in urban areas.
Conservation science, policy and diplomacy: Notes from the trenches of transdisciplinary research

TRANSLATIONAL CENTRE BIODIVERSITY CONSERVATION: CONNECTING RESEARCH AND PRACTICE

Oral Presentation

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Society faces a pressing challenge in preserving biodiversity and its associated benefits. Biodiversity conservation is challenged not always by a lack of research but often by the absence of concise, stakeholder-specific synthesis of scientific findings. Stakeholders, seeking information for planning or decision-making, lack the time to sift through scientific evidence. The recently established Translational Centre for Biodiversity Conservation in Switzerland is addressing these issues. The Centre’s mission involves creating working groups that bring together researchers with stakeholders from practice and policy. These groups jointly develop synthesis materials in various forms, and offer guidance on topics where research findings or practical expertise are already available but a comprehensive overview is lacking. The Centre adheres to a transdisciplinary and participatory approach, which has already guided the selection of working group topics, to ensure they are closely aligned with the preferences and requirements of stakeholders. The ultimate objective is to foster collaboration and strengthen communication channels among practice, policy, and research within Switzerland’s biodiversity and conservation landscape. In this talk, we will share insights gained during Centre’s inaugural year, with a focus on the needs-based selection of our working group topics, the establishment and operation of working groups, and the development of pertinent synthesis materials.

FROM KNOWLEDGE TO IMPACT: UNDERSTANDING HOW TO LEVERAGE TRANSFORMATIVE CHANGE

Oral Presentation

C. Hill\textsuperscript{1}, A. R. Carrasco\textsuperscript{2}, F. Akinyemi\textsuperscript{3}, V. Bruckman\textsuperscript{4}, B. Ekberzade\textsuperscript{5}, A. Sofo\textsuperscript{6}, A. Larsen\textsuperscript{7}, A. Izdebski\textsuperscript{8}

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Despite global awareness, biological diversity continues to decline at an alarming rate. Science holds a pivotal role in discerning potential trajectories of change that benefit biodiversity, and the notion of transformative change for biodiversity is gaining attention in both political and scientific spheres. While research and impact assessments on biodiversity loss are being researched, knowledge alone is not enough to solve the biodiversity crisis. For the knowledge created to be useful in tackling the current decline, it must involve a wide range of scientific disciplines as well as non-academic stakeholders that can provide important perspectives that can increase the research’s applicability and uptake. Furthermore, for transdisciplinary science advice to be transformative, it needs to be relevant, clear, timely, and accessible to the policymakers who determine the priorities, biodiversity targets, and their implementation. It is therefore vital that scientists working in transdisciplinary teams understand the information needs of policymakers and the policy landscape in which they operate. In this presentation, we will highlight the need for the scientific community to fundamentally transform how it conducts and communicates research using examples from our engagement with the EU Nature Restoration Law. We will provide practical examples that outline how other scientific communities can support similar initiatives that aim to support evidence-informed policymaking.

THE ROLE OF CREATIVE TRANSLATION IN SYSTEMS TRANSITION DESIGN

Oral Presentation

I. Wang

Independent (irinavw.xyz), North Vancouver, Canada

As a transition designer working at the intersection of existential risk and structural injustice, each collaboration is inherently transdisciplinary; actors and stakeholders across complex systems are from a diverse range of sectors, professions, ethnicities, lived experiences. My recent work about Arctic climate change with the CHARTER project involved natural scientists, social scientists, reindeer herders, Indigenous populations, Finnish government officials, EU policymakers, fellow designers, and global readers both within and beyond the scientific community. In past projects, I’ve worked among/between multinational corporations in the private sector like Hyundai, artistic communities like RISD, academic departments like Harvard Medical School, shrinking native communities in places like St. Paul Island, activist campaigns like Global Zero, and intergovernmental organizations like the United Nations as they attempt to jointly address global issues. My collaborators’ references are as varied as their ways of knowing, so catalyzing strategic transformation requires a hefty amount of translation between groups.
and individuals. In this session, I’d like to speak about the different types of translation I encounter and apply in my work as a designer-researcher—sometimes it’s linguistic, but most often it’s sociocultural, emotional, and power-coded translation that draws on my background as a designer, which is rooted in both visual communication and object-based activation.

**ASSESSING USE OF GLOBAL SCIENCE-POLICY PRODUCT IN NATIONAL BIODIVERSITY POLICIES**

Oral Presentation

*D. Lham*¹, P.D.R. Holderegger², D.C. Bardier³, P.D.M. Fischer¹

¹Swiss Federal Institute for Aquatic Science and Technology, Department of Environmental Social Sciences, Dübendorf, Switzerland, ²Swiss Federal Institute for Forest, Snow and Landscape Research, Biodiversity and Conservation Biology, Birmensdorf, Switzerland, ³Universidad de la Republica, Departamento de Modelización Estadística de Datos e Inteligencia Artificial (Media), Centro Universitario Regional Este, Rocha, Uruguay

Biodiversity loss is occurring at an alarming rate, despite ongoing conservation efforts. To strengthen these efforts & effectively address the key drivers of biodiversity decline, it is imperative that biodiversity policy making is grounded in science-policy products. Globally, the countries are in the midst of revising their National Biodiversity Strategies and Action Plans (NBSAPs) in line with global biodiversity commitments. In view of the importance of global science-policy products in biodiversity policy making, we evaluated the extent to which the Summary for Policymakers of the Global Assessment of Biodiversity and Ecosystem Services of 2019 by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services has been integrated into the NBSAPs. To assess the use of the SPM, we conducted an online survey amongst the national focals of the UN Convention on Biological Diversity and Subsidiary Body on Science Technical and Technological Advice as well as the national coordinators of respective countries’ NBSAPs. The findings shed light on the effectiveness of global science-policy products in influencing national biodiversity strategies, thereby contributing to global biodiversity conservation efforts. In addition, the results provide insights into potential improvements needed to strengthen the coordination between global biodiversity assessments and national conservation strategies.

**RESEARCHERS COLLABORATING WITH GLOBAL POLICYMAKERS IN INTERNATIONAL GENEVA**

Oral Presentation

*M. Rann Andriamahefazafy*¹

¹Geneva Science-Policy Interface, University of Geneva, Geneva, Switzerland
Transdisciplinarity is increasingly required from research funding agencies. The involvement of various stakeholders from policymakers to private sectors and the public is encouraged in research grants. This applies to biodiversity research and other subjects linked to global societal challenges. To remain ‘competitive’ in the research field, researchers embrace these approaches of working together and often learn, while doing, what works or not. This presentation focuses on transdisciplinary collaboration between researchers and global policymakers from the International Geneva ecosystem. It will briefly frame the role of science in global policy and unpack the difference between science and global policy which often are the source of the challenges of working together between researchers and policymakers. It also shares some experience of the Impact Collaboration Programme (ICP) of the Geneva Science-Policy Interface which aims to support collaboration between researchers and global policymakers. The ICP has supported such collaboration for five years. While working on different thematics, project holders often face similar challenges in working together. In this talk, these challenges will be discussed along with the strategies adopted by project partners to overcome them. Input from the audience will also be sought to explore similarities and potential common lessons learnt.

SUPPORTING CITIES PROGRESS TOWARDS BIODIVERSITY GOALS WITH URBAN LIVING LABS

Oral Presentation

J. Oehri 1, C. Krug1, G. Schaepman-Strub1

1University of Zurich, Department of Evolutionary Biology and Environmental Studies, Zurich, Switzerland

Urban areas are key political arenas for transformative change needed to address today’s social-ecological challenges and achieve the goals of the Kunming-Montreal Global Biodiversity Framework of the Convention on Biological Diversity. To promote progress towards these goals, we use a transdisciplinary living lab approach based in Zurich, where we combine (virtual) student exchanges, workshops and participatory research methods to co-create the knowledge, tools and solutions for cities in which biodiversity and humans thrive. Specifically, we work together with international partners in Montreal, Canada, as well as early career researchers, senior experts, public decision-makers and private landowners in Zurich to investigate the potential of participatory monitoring and the role of privately managed spaces for supporting biodiversity goals in urban areas. Our results indicate that privately managed spaces significantly contribute to habitat connectivity for biodiversity, as well as climate change mitigation in Zurich. Further, we identify the social-ecological benefits of participatory monitoring and find a trans-sectoral dialogue as provided by the living lab useful for the translation of global targets to a local context. By comparing these results to outcomes in Montreal, we establish guidelines for living labs and decision-making that facilitate sustainable outcomes for biodiversity and people in urban areas, potentially beyond Zurich and Montreal.
Converting biodiversity knowledge into actionable knowledge: A glimpse into the new Biodiversity Knowledge governance in Europe

THE FAST EVOLVING LANDSCAPE OF THE BIODIVERSITY KNOWLEDGE GOVERNANCE IN EUROPE

Oral Presentation


1Helmholtz Centre for Environmental Research - UFZ, Department of Conservation Biology & Social-Ecological Systems, Leipzig, Germany, 2INRAE, Dijon, France, 3SYKE (Finnish Center for the Environment), Helsinki, Finland, 4European Commission, Joint Research Centre, Ispra, Italy, 5Helmholtz Institute for Functional Marine Biodiversity (HIFMB), Oldenburg, Germany, 6University of Stirling, Stirling, United Kingdom, 7Bridging for Sustainability (B4SD), Clavier, Belgium

The presentation will introduce the fast evolving science-policy interface landscape dealing with biodiversity in Europe. After a short introduction on the overall landscape, a series of fast talks will briefly present new projects mandated by the European Commission to be setting up EU support mechanisms to Commission Services, CBD, IPBES & IPCC. The talk will end with shortly introducing the actors and mechanisms at the interface which will be presented in depth in the session.

INCLUSIVE AND FUNCTIONAL SCIENCE SERVICE FOR BIODIVERSITY

Oral Presentation

M. Vandewalle1, J. Young2, K. Korhonen-Kurki3, K. Vierikko3, J. Narhi3, A. Schmidt1

1Helmholtz Centre for Environmental Research - UFZ, Department of Conservation Biology & Social-Ecological Systems, Leipzig, Germany, 2INRAE, Dijon, France, 3SYKE (Finnish Center for the Environment), Helsinki, Finland

The talk will start with a synopsis of the work done in past EU projects on the identification of key functions to improve the Science-Policy interface for Biodiversity in Europe and will end with a more in-depth presentation of BioAgora, an ongoing EU Horizon Europe project mandated to set up the Science Service for Biodiversity. The Science Service for Biodiversity is meant to be built on and co-developed with the existing actors at the interface and for this purpose BioAgora goes beyond the state of the art by co-creating new ways of bridging the gap between science, practice, society and policy. BioAgora project runs until June 2027 and this talk will present the on-going work and lessons learned of testing key identified functions...
to better connect biodiversity knowledge and research results to the needs of environmental policy.

REFLECTIONS ON BIODIVERSITY KNOWLEDGE GOVERNANCE IN EUROPE

Oral Presentation

S. van den Hove 1

1Bridging for Sustainability, Pailhe, Belgium

The talk will reflect on the institutional science-policy interface landscape and on the role of more coordinated European science-policy-society interfaces in the face of global crises in our socio-ecological systems. The talk will open the discussion on challenges and opportunities which the fast evolving science-policy interface landscape is offering in Europe to both scientists/knowledge holders and policy makers to make a difference for Biodiversity and transformations towards sustainability.

SCIENCE-BASED POLICY SUPPORT AT THE KNOWLEDGE CENTRE FOR BIODIVERSITY

Oral Presentation

P. Vasilakopoulos 1, C. Liquete1, G. Dubois1

1European Commission, Joint Research Centre (JRC), Ispra, Italy

The EU Biodiversity Strategy for 2030 outlines an ambitious plan to protect and restore biodiversity in Europe and beyond. It also aims to establish an enhanced biodiversity governance framework capable of steering the implementation of EU biodiversity commitments at both national and international levels. In particular, to enhance the knowledge governance, the Biodiversity Strategy established back in 2020 a Knowledge Centre for Biodiversity (KCBD) to strengthen and simplify the science-policy interface. Since then, the KCBD has been developing tasks around:- Documenting, tracking and monitoring progress in the implementation of the EU 2030 Biodiversity Strategy and the Global Biodiversity Framework;- Knowledge synthesis and management on cross-sectoral topics related to biodiversity;- Direct policy support underpinning science-policy interfaces or orchestrating ad-hoc replies to priority policy needs.

All these actions could benefit from the input of the broader scientific community. This presentation will explain some of the policy processes to the scientific community and open the door for collaborations, especially related to the identification of policy-relevant indicators and to the responses to technical policy requests. This session should help us better orchestrate and channel biodiversity knowledge from science into biodiversity policies.
EKLIPSE AND THE EU SCIENCE-POLICY INTERFACE LANDSCAPE

Oral Presentation

_U. Jacob_¹, M. Vandewalle², N. Bunnefeld³

¹University of Oldenburg, Oldenburg, Germany, ²Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany, ³University of Stirling, Stirling, United Kingdom

Eklipse was created in 2016 to help governments, institutions, businesses and NGOs make better-informed decisions when it comes to biodiversity in Europe. Eklipse is recognised by the European Commission as a key European science-policy platform for brokering knowledge for policy-makers (e.g see EU publication on Science Service). Since 2016, Eklipse answered requests on a vast range of topics related to biodiversity and ecosystem services - often on contentious policy-relevant issues- by synthesizing the best available knowledge to facilitate actionable policy recommendations. To reach this goal, Eklipse uses a proven and robust process that responds to the evidence needs of requesters by ensuring tailor-made outreach of results to knowledge requesters and society more broadly. The process of knowledge synthesis is a crucial element of any science policy interface. Eklipse's Method Expert Group (MEG) has identified and described 21 different methods to synthesize the different types of knowledge needs requested. On this basis, Eklipse identifies and tailors a set of methods for each specific request from policy makers and societal actors. The talk will demonstrate the innovative and robust Eklipse approach and how it supports and contributes to the fast evolving EU Science-Policy Interface landscape to enable transformative change.

BIODIVERSA+ STRENGTHENING COORDINATION OF BIODIVERSITY MONITORING ACROSS EUROPE

Oral Presentation

_P. Vihervaara_¹, C. Mandon², I. Kallajoki¹, A. Lipsanen¹, G. Body³, M. Basillé³, M. Naeslund⁴, M. Silva del Pozo³, A. Basset⁵, S. Onen Tarantini⁵, L. Brotons⁶, C. Phanis⁷, R. Hendriks⁸, M. Bresadola⁹, T. Hoye¹⁰, S. Germann¹¹, M. Tannerfeldt¹², R. Sodtke¹³

¹Finnish Environment Institute, Helsinki, Finland, ²FRB, Paris, France, ³OFB, Paris, France, ⁴SEPA, Stockholm, Sweden, ⁵MUR, Salento, Italy, ⁶CREAF, Barcelona, Spain, ⁷CPI, Nicosia, Cyprus, ⁸LNV, Amsterdam, Netherlands, ⁹ERAC, Trento, Italy, ¹⁰University Arhus, Arhus, Denmark, ¹¹ANR, Paris, France, ¹²FORMAS, Stockholm, Sweden, ¹³DLR, Berlin, Germany

Gathering 80 research programmers and funders and environmental policy actors from 40 European and associated countries, Biodiversa+ (2021-2028) works on five objectives: 1) plan and support research and innovation on biodiversity; 2) set up a network of harmonised schemes to improve monitoring of biodiversity, building on existing national/regional schemes and the work of EuropaBON (i.e. testing/ operationalizing relevant outcomes in different contexts
and countries); 3) contribute to deploying Nature-based Solutions and valuation of biodiversity in the private sector; 4) ensure efficient science-based support for policy-making; and 5) strengthen the relevance and impact of pan-European research on biodiversity in a global context. Related to the second objective, Biodiversa+ aims to establish a transnational network of national biodiversity monitoring schemes addressing co-defined priorities, efficiently informing the policy arena. Building on national monitoring schemes and setting up new schemes, this will contribute to improving monitoring of biodiversity in Europe. To reach this goal, Biodiversa+ has joined forces with EuropaBON, JRC, EEA, and GBIF in delineating a strategic framework that defines a common vision for biodiversity monitoring across Europe, as well as the major steps to reach it. An overview of the outcomes of Biodiversa+ activities during the first two years, as well as plans for strengthening the coordination during 2024-2025 will be presented.
Converting biodiversity knowledge into actionable knowledge: A glimpse into the new Biodiversity Knowledge governance in Europe (by invitation only)

THE EKLIPSE SCIENCE-POLICY PROCESS: BIODIVERSITY AND PANDEMICS AS A CASE STUDY

Poster Presentation

N. Bunnefeld ⁰¹, M. Vandewalle ²

¹University of Stirling, Stirling, United Kingdom, ²Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany

The Eklipse process on biodiversity and pandemics outlined recommendations for science policy regarding biodiversity and pandemics that need to be implemented in order to develop broader transformative policies for human, animal, and ecosystem health. In particular, the process focused on policies to support and promote research needed to better prevent and manage spillover events in which pathogens originating in wildlife cause disease outbreaks or even pandemics in humans or large-scale disease events in domesticated animals (panzootics). The process formulated recommendations for shaping a strategic research agenda on biodiversity and pandemics. These recommendations address the critical interlinkages between relevant sectors and stakeholders via targeted transdisciplinary research to make future actions more effective. The recommendations call for moving beyond incremental changes to science policy and bringing about transformative change to how research is carried out, organised, and financed. Only in this way will science itself deliver the knowledge and insights needed to develop policies that will help transform human animal and ecosystem health, avoiding the accumulation of problems generated by the still widespread business as usual approach to both research and broader policymaking.
Coordinated Arctic biodiversity monitoring for informed decision-making

ARCTIC BENTHOS DIVERSITY: PATTERN AND DRIVERS OF ECOLOGICAL CHANGE

Poster Presentation

*J. Culp*¹, *W. Goedkoop*², *J. Lento*³

¹Wilfrid Laurier University, Waterloo, Canada, ²Swedish University of Agricultural Sciences, Aquatic Sciences and Assessment, Uppsala, Sweden, ³University of New Brunswick, Canadian Rivers Institute and Department of Biology, Fredericton, Canada

Freshwater biodiversity is under threat as climate change is having dramatic effects on Arctic freshwater ecosystems through changes to the abiotic template, for example via permafrost thaw, warming temperatures, and brownification. The Arctic Council’s Freshwater Circumpolar Biodiversity Monitoring Program compiled and analyzed a database of more than 9000 sites allowing the completion of the first assessment of biodiversity status and trends in these systems. Alpha diversity of the benthos was lowest at high latitudes and constrained primarily by temperature and spatial connectivity. Beta diversity showed high variability among ecoregions for most organism groups with a high degree of dissimilarity within many ecoregions illustrating the uniqueness of these communities. Northward range expansion of taxa into Arctic regions represents a pressure that may lead to large changes in freshwater ecosystem state, to increased competition for cold-stenothermic and cold-adapted species, and ultimately to the irreversible extinction of unique Arctic flora and fauna. Unfortunately, monitoring of biodiversity change in Arctic freshwaters is currently inadequate, making it difficult, if not impossible, to predict changes in ecosystem services. Arctic countries should develop an intensified, long-term monitoring program with routine reporting. Such an approach will allow detection of long-term changes in water quality, biodiversity and ecosystem services of Arctic freshwaters.

SYNTHESIS OF ARCTIC FRESHWATER BIODIVERSITY AND ECOLOGICAL CHANGE

Oral Presentation

*J. Lento*¹, *J. Culp*², *W. Goedkoop*³

¹University of New Brunswick, Canadian Rivers Institute and Department of Biology, Fredericton, Canada, ²Wilfrid Laurier University, Cold Regions Research Centre, Waterloo, Canada, ³Swedish University of Agricultural Sciences, Department of Aquatic Sciences and Assessment, Uppsala, Sweden
The freshwater group of the Circumpolar Biodiversity Monitoring Program (CBMP-Freshwater) conducted the first circumpolar assessment of Arctic freshwater biodiversity. Working with scientists from all Arctic countries, CBMP-Freshwater created a database of biodiversity data and supporting abiotic data for lakes and rivers from across the circumpolar region and assessed spatial and temporal trends of alpha and beta diversity to establish baselines upon which future monitoring efforts can be built. The circumpolar assessments for benthic diatoms, macrophytes, plankton, benthic invertebrates and fish provide novel analyses of how climate change and associated environmental drivers affect the biodiversity of these organism groups. In this presentation, we synthesize knowledge on alpha and beta diversity in Arctic freshwaters gained from the regional and circumpolar assessments and summarize the major environmental drivers of biodiversity patterns. As part of this synthesis, we identify spatial patterns and hotspots of biodiversity across organism groups based on rarefied taxonomic data and decompose the components of beta diversity at a regional scale for large parts of the Arctic. As a way forward, we discuss the need for development of coordinated and harmonized long-term circumpolar freshwater monitoring, including the use of new technologies and development of community-based monitoring networks, to build a framework for science communication and decision support.

A 20-YEAR PERSPECTIVE ON THE CBMP

Oral Presentation

T. Christensen 1,2, C. Coon3,2

1 Aarhus University, Roskilde, Denmark, 2 Circumpolar Biodiversity Monitoring Program Co-Chair, Akureyri, Iceland, 3 NOAA, Anchorage, United States

The Arctic Council working group, the Conservation of Arctic Flora and Fauna (CAFF) established the Circumpolar Biodiversity Monitoring Programme (CBMP), an international network of scientists, governments, Indigenous organizations, and conservation groups working to harmonize and integrate efforts to extend and develop monitoring and assessment of the Arctic’s biodiversity. Its relevance stretches beyond the Arctic to a broad range of regional and global initiatives and agreements. This presentation describes the process and approach taken in the last two decades to develop and implement the CBMP. It documents challenges encountered, lessons learnt, and solutions, and considers how it has been a model for national, regional, and global monitoring programmes; explores how it has impacted Arctic biodiversity monitoring, assessment, and policy and concludes with observations on key issues and next steps. The following are overarching prerequisites identified in the implementation of the CBMP: effective coordination, sufficient and sustained funding, improved standards and protocols, co-production of knowledge and equitable involvement of IK approaches, data management to facilitating regional analysis and comparisons, communication and outreach to raising awareness and engagement in the programme, ensuring resources to engage in international fora to ensuring programme implementation.
CBMP MARINE: KEY FINDINGS, ADVICE AND FOLLOW-UP

Poster Presentation

S.H. Ólafsdóttir1,2, Ø. Leiknes3,2, C. Price 4

1Marine and Freshwater Research Institute, Reykjavik, Iceland, 2Circumpolar Biodiversity Monitoring Program Marine co-lead, Akureyri, Iceland, 3Norwegian Environment Agency, Trondheim, Norway, 4Conservation of Arctic Flora and Fauna (CAFF) International Secretariat, Akureyri, Iceland

The State of the Arctic Marine Biodiversity Report (SAMBR), is a product of the Circumpolar Biodiversity Monitoring Program (CBMP) of the Arctic Council’s Conservation of Arctic Flora and Fauna (CAFF) Working Group. The SAMBR is a synthesis of the state of knowledge about biodiversity in Arctic marine ecosystems, detectable changes, and important gaps in our ability to assess state and trends in biodiversity across six Focal Ecosystem Components (FECs): sea ice biota, plankton, benthos, marine fishes, seabirds and marine mammals. By compiling available information, this report and its subsequent updates, provides an important step to identify knowledge gaps in circumpolar biodiversity monitoring efforts for key targets of monitoring. This presentation will provide an overview of the current state of knowledge and trends in marine FECs as well as current biodiversity monitoring efforts across the Arctic on marine FECs and advice for monitoring efforts. The presentation will conclude with next steps and products from the CBMP Marine group.

CBMP TERRESTRIAL: KEY FINDINGS, ADVICE AND FOLLOW-UP

Oral Presentation

C. Price1, S.B. Ragnarsdóttir 2,3, J.L. Lawler4,3

1Conservation of Arctic Flora and Fauna (CAFF) International Secretariat, Akureyri, Iceland, 2Icelandic Institute of Natural History, Akureyri, Iceland, 3Circumpolar Biodiversity Monitoring Program Terrestrial co-lead, Akureyri, Iceland, 4National Parks Service, Anchorage, United States

Assessing status and trends of biodiversity and attributing causes is very challenging, particularly in the Arctic. Knowledge is limited for a variety of reasons, such as remoteness, logistics, availability and ecological complexities and variability. The State of the Arctic Terrestrial Biodiversity Report (START) (2021) is a product of the Circumpolar Biodiversity Monitoring Program (CBMP) Terrestrial Group of the Arctic Council’s Conservation of Arctic Flora and Fauna (CAFF) Working Group. The START assessed the status and trends of terrestrial Focal Ecosystem Components (FECs)—including vegetation, arthropods, birds, and mammals—across the Arctic, identify gaps in monitoring coverage towards implementation of the CBMP’s Arctic Terrestrial Biodiversity Monitoring Plan; and provided key findings and advice for monitoring. The assessment has made substantial progress in improving our
understanding of status and trends of Arctic terrestrial biodiversity. The START is based primarily upon published data, from a special issue of Ambio containing 13 articles by more than 180 scientists. This presentation will provide an overview of the current state of knowledge and trends in terrestrial FECs as well as current biodiversity monitoring efforts across the Arctic and advice for improving monitoring efforts. The presentation will conclude with next steps for the CBMP Terrestrial group to move towards comprehensive, integrated, and management-relevant ecosystem-based monitoring.

CBMP COASTAL: ASSESSING BIODIVERSITY USING CO-PRODUCTION

Oral Presentation

C. Price 1, D. McLennan2,3, T. Jones4,3

1 Conservation of Arctic Flora and Fauna (CAFF) International Secretariat, Akureyri, Iceland, 2 Independent, Halifax, Canada, 3 Circumpolar Biodiversity Monitoring Program Coastal co-lead, Akureyri, Iceland, 4 U.S. Fish and Wildlife Service, Anchorage, United States

An international network of coastal experts from scientific and Indigenous Knowledge backgrounds produced the Arctic Coastal Biodiversity Monitoring Plan (Coastal Monitoring Plan) under CAFF’s Circumpolar Biodiversity Monitoring Program (CBMP) to develop a long term, integrated, multi-knowledge and multi-disciplinary, circumpolar monitoring plan informed by science and Indigenous Knowledge (IK), with direct and relevant application for communities, industry, governments and other users. The Coastal Monitoring Plan employs a social-ecological approach to identify, assess and coordinate with existing monitoring capacity and programs to detect, understand, assess and report the state of and trends of targets of monitoring and, identify gaps in present monitoring programs. The program is presently in its implementation phase where circumpolar maps of coastal ecosystems are being developed, and linked to a geo-referenced meta-database of ongoing coastal monitoring programs that could support assessments of coastal biodiversity and identify knowledge gaps in ongoing monitoring. The program places a strong focus on utilizing Indigenous knowledge and worldviews. Building a platform for a co-production of knowledge requires equity to build a plan that has room for the methodologies, evaluation and validation processes of multiple knowledge sources. This presentation will share the development and results of the co-production approach and showcase national implementation efforts.

BEYOND THE SAFBR – FUTURE NEEDS FOR ARCTIC FRESHWATER MONITORING

Oral Presentation

W. Goedkoop 1, J. Lento2, J. Culp3

155
In 2019 CAFF published the State of Arctic Freshwater Biodiversity Report (SAFBR), a unique assessment based on a database of >9000 lake and stream sites. This report provided a baseline for future change, identified major threats, and stressed that Arctic biodiversity holds many unique, cold-adapted species. Cold-adapted species have poor competitive abilities when southern, more warm-adapted species arrive, and northward migrations will therefore be the only way for them to cope with increased warming. North migrations of freshwater species are, however, limited by the continental north slopes and many of the expected changes will therefore be irreversible. This was described as “the conveyor belt to extinction”. To detect this ongoing ecological change in Arctic freshwaters Arctic countries need to intensify their monitoring, combining remote sensing with on-site monitoring on a regional scale, and applying new techniques such as metabarcoding for better quantification of biodiversity and the detection of new and potentially invasive species. Such a circum-Arctic approach would benefit from international agreements that include legally-binding, repeated reporting of the biodiversity and water quality of freshwaters. This monitoring should be co-developed with Indigenous Peoples to ensure interweaving of western science and Indigenous observations. The Arctic Council is the key organisation and dialogue forum to implement such an Arctic observational infrastructure.

BEAVER IN THE TUNDRA: BIODIVERSITY, FOOD WEBS, AND CONTAMINANTS

Poster Presentation

J. Musetta-Lambert¹, M. Mervyn², J. Culp ²

¹Environment and Climate Change Canada, National Hydrology Research Centre, Saskatoon, Canada, ²Wilfrid Laurier University, Department of Biology, Waterloo, Canada

Beaver activity and range expansion is occurring across Arctic tundra biomes in Canada due climate-driven environmental transitions such as increases in air temperature, changing vegetation patterns, and thawing of permafrost. Beavers are considered ecosystem engineers through their wide-ranging influence on restructuring hydrological patterns, biogeochemistry, and biotic food webs. In the western Canadian Arctic, Inuvialuit monitors have observed increasing activity (e.g., in-channel impoundments) of the North American beaver (Castor canadensis) across the many important fish bearing streams. It is known that changes in species distributions and range extents can impact ecosystem resilience, alter biotic structure and function, which influence the health of an ecosystem, and reduce the capacity in which an ecosystem can provide services (e.g., regulate water quality and quantity, fulfill cultural and livelihood needs). It is, therefore, important to understand how beaver activity in the tundra will impact aquatic ecosystems in an already rapidly changing Arctic, including potential concerns related
to biodiversity change, exacerbating permafrost thaw and associated potential for mercury bioaccumulation in aquatic food webs. Here we study instream changes to freshwater biodiversity, food web structure and potential for mercury bioaccumulation across twelve tundra streams at the northernmost range of beavers in the Western Canadian Arctic.
Data4Nature: how development banks can share open data to support the Global Biodiversity Framework

THE DATA4NATURE INITIATIVE

Oral Presentation

A. Rodrigues

1

1GBIF - Global Biodiversity Information Facility, Copenhagen, Denmark

Data4Nature is an initiative to encourage the sharing of biodiversity data generated by development projects through the GBIF network. Development agencies and banks can contribute significantly in enabling open access to a large volume of new biodiversity data through the inclusion of clauses within funder-client contracts that require the sharing of primary biodiversity data through GBIF—the Global Biodiversity Information Facility. Data collected as part of project monitoring of biodiversity impacts is often not shared and remains inaccessible for reuse in robust science and effective biodiversity monitoring. This is especially relevant given that client activities are often in regions that are data-poor and/or have very high levels of biodiversity. GBIF is an intergovernmental organization of member countries and associate organizations that supports the publication of primary biodiversity data - data on where species have been observed or collected and when. The network has now supported the biodiversity data holding institutions in publishing over 2.5 billion occurrence records. As the largest aggregator of primary biodiversity data, GBIF, through the Data4Nature initiative, aims to support increased data flows from development projects, and in this talk will highlight the goals of the initiative in support of the implementation of the Global Biodiversity Framework.

GENDIB: A NATIONAL DATABASE ON GENETIC DIVERSITY IN POPULATIONS OF WILD SPECIES

Poster Presentation

C. Buser

1, B. Dauphin, I. Iosifescu-Enescu

2, A. Gross

3, R. Holderegger

4, E. Kolovou

5, D.M. Leigh

1, R. Meile

6, M. Mosimann

1, G.-K. Plattner

1, C. Rellstab

1, S. Stofer

7, S. Woodcock

2, L. Wotruba

5, F. Gugerli

1

1Swiss Federal Research Institute WSL, Biodiversity & Conservation Biology / Ecological Genetics group, Birmensdorf, Switzerland, 2Swiss Federal Research Institute WSL, Forest Resources & Management / EnviDat, Birmensdorf, Switzerland, 3Swiss Federal Research Institute WSL, Biodiversity & Conservation Biology / SwissFungi, Birmensdorf, Switzerland, 4Swiss Federal Research Institute WSL, Biodiversity & Conservation Biology, Birmensdorf, Switzerland, 5Swiss Federal Research Institute WSL, Forest Resources & Management / GIS
GenDiB aims to link conservation genetics and database knowledge to initiate a new database on genetic diversity in populations of wild species in Switzerland. A first interactive map of existing studies on intraspecific genetic diversity already illustrates the potential of these data, which were previously scattered or even inaccessible. Currently, GenDiB is being developed as a database prototype so that existing datasets can be systematically recorded and newly created datasets including comprehensive metadata can be directly uploaded and archived in a referenceable way. Our vision is that GenDiB will help to secure, process, and centrally archive the already existing treasure trove of data on the genetic diversity of wild species in Switzerland. Thereby, these data will become easily, long-term, and publicly accessible for research, teaching, and, especially, practical nature conservation—not least because such data were largely financed with taxpayers’ money. GenDiB will be a useful tool to get an overview of genetic diversity data in Switzerland, but also to “assess, monitor and ultimately halt the loss of genetic diversity”, as envisaged in the Swiss Biodiversity Strategy. This would make Switzerland the first country to have such a national database. We hope that GenDiB will raise awareness of this gap and inspire other countries to continue compiling georeferenced genetic diversity data and make them publicly available.

**USING A.I. FOR A BETTER UNDERSTANDING OF COMPLEXITY IN ECOSYSTEMS HEALTH**

**Poster Presentation**

**A. Popescu**

**1** AERTH, Zug, Switzerland

I am the Founder of ÆRTH, a growing earth systems science network. We have teamed up with scientists at NASA/JPL, and Arose Space Consortium and have created partnerships with numerous on the ground, environmental research institutes and their researchers in the field of Ocean & Coastal Health and Soil regeneration. To solve our planetary challenges, we need instrumentation that allows us to create a common framework: a shared, comprehensive picture to empower diverse solutions. To do so, we need to strengthen collaboration between national environmental research institutes: ÆRTH has developed an on-the-ground incentive mechanism, to connect and use regularly updating ground truth data. Which in return allows for training of robust machine learning analysis and prediction models on biodiversity health and impact–enhancing remote sensing with context and continuity. Our system will then enable development banks, policy- and change-makers to get science-based insights, allowing for better decision-making with more directed and effective interventions and investment-worthy infrastructure and solutions. I would like to present how we are solving this challenge at ÆRTH, addressing the following: How do we share data to build effective, machine learning-supported
SIB COLOMBIA: ENGAGING THE BUSINESS SECTOR FOR DATA MOBILIZATION

Oral Presentation

R. Ortiz-Gallego

1Sistema de Información sobre Biodiversidad de Colombia, Bogotá, D. C., Colombia

The Colombian Biodiversity Information System (SiB Colombia), as GBIF’s node, has been making efforts over the last five years to promote the integration of the business and finance sectors in mobilizing biodiversity data through their network. As a result, the node has reached 50 organizations and mobilized over 3.5 million records from 338 datasets. These achievements were possible due to an alliance with the National Association of Enterprises - ANDI, aiming to mobilize data from Environmental Impact Assessments, optimize the reporting process of biodiversity data to Environmental Authorities, and close data gaps. Furthermore, the node began enhancing capabilities within the business sector to obtain better-structured data with higher quality. The node launched ‘Corporate Management for Nature,’ a series of training courses on data mobilization funded by GBIF and Geopark S.A.S. Fostering the community by listening to their needs has allowed us to set the roadmap for impactful new products and potential funding. This effort has helped consolidate the Colombian Biodiversity and Development GBIF network in 2023, establishing a long-term alliance with a strong voice at the national level and providing funding to support the node’s activities related to mobilizing and using biodiversity data. The node’s experiences could be helpful for other countries and organizations to guarantee the business sector’s data mobilization to support the Global Biodiversity Framework.

EMBEDDING OPEN DATA SHARING PRACTICES ACROSS PROJECTS - EBRD

Oral Presentation

M. Geck

1European Bank for Reconstruction and Development (EBRD), London, United Kingdom

Multilateral development banks (MDBs) have substantial ability to contribute to global biodiversity data because they regularly perform Environmental and Social Impact Assessments (ESIA) all over the world as part of their financed projects. Better sharing of such data can
enhance understanding of species and ecosystems, and also contribute to international societal goals on nature such as those in the Global Biodiversity Framework. In line with the joint MDB Statement on Nature, People, and Planet, EBRD is committed to mainstreaming nature in its activities. This extends to open sharing of biodiversity data. Following similar efforts from MDBs such as the Agence Française de Développement, EBRD is encouraging its clients and consultants to publish any primary biodiversity data generated during funded projects to the Global Biodiversity Information Facility (GBIF). This follows a comprehensive review of the Bank’s biodiversity data practices conducted with the help of Fauna and Flora International, which concluded that GBIF provides the best platform to share EBRD’s biodiversity data in a standardised, centralised, and accessible manner. In collaboration with GBIF and other development banks, EBRD is instituting a process for its clients and consultants to share their biodiversity data with GBIF. This presentation will reflect on the process to date, share lessons learned, address challenges, and explore future areas of collaboration.

DATA4NATURE: THE CONSULTANT’S PERSPECTIVE

Oral Presentation

_C. Elleboode_ 1

1Biotope, Mèze, France

Development agencies and banks can contribute significantly in enabling open access to a large volume of new biodiversity data through the inclusion of clauses within funder-client contracts that require the sharing of primary biodiversity data through GBIF—the Global Biodiversity Information Facility. Typically, data collection and standardisation will not be done by the client themselves but often through sub-contractors who will be on the front line of these new clauses, which for sub-contractors provides them with opportunities and challenges as they see shifts from traditional ways of working. Biotope brings together the largest team of biodiversity consultants and ecologists at the European level to offer nature related consulting. It includes the support to economic sectors in reducing their impacts and increasing their commitments to biodiversity and climate, the design of public policies as well as nature conservation and restoration projects, training for businesses, governments and NGOs. A key part of our work are environmental studies that include data collection for fauna, flora, and landscape diagnostic missions for the obtention of environmental permits to carry out development projects. New changes in funder-client contracts would directly affect our way of work and the talk aims to showcase, from the consultant’s perspective, what some of the opportunities and challenges are for us and more broadly for environmental consultancies as Data4Nature matures.

OPEN DATA FOR BIODIVERSITY IN CAMBODIA

Oral Presentation
Access to biodiversity and natural resource data is vital for informing the public, particularly community-based organizations. Open data empowers communities, enabling them to enhance biodiversity protection and actively engage in preserving natural resources. During environmental impact assessment (EIA) data collection, valuable information for biodiversity monitoring is gathered. However, government and environmental impact assessment firms often assert that these reports are confidential and cannot be shared without permission from the project owner or developer. Contracts for investment projects in extractive industries, economic land concessions, and other development sectors around biodiversity areas aren’t publicly available. This poses a significant hurdle for stakeholders, including researchers, community-based organizations, civil society groups, and environmental activists seeking involvement in biodiversity protection and monitoring development projects. Open Development Cambodia (https://opendevelopmentcambodia.net/) website aims to openly publish EIA reports, resource management datasets, and project details. This paper emphasizes the essential role of open data in providing evidence-based information for stakeholders and conservation groups to advocate and stay informed about biodiversity progress and issues in Cambodia.
Digital Twin applications to foster actions for biodiversity conservation

BRIDGING THE GAP: DIGITAL TWINS AND SOCIAL INNOVATION IN COASTAL COMMUNITIES

Oral Presentation
N.V.S.R. Nalakurthi¹, M. Raji¹, B.E. Lazarus ¹, S. Gharbia¹

¹Atlantic Technological University Sligo, Environmental Sciences, Sligo, Ireland

Coastal communities that are susceptible to climate change impacts like rising sea levels and extreme weather events, face multifaceted challenges. These communities heavily rely on industries such as fishing and tourism, which are sensitive to environmental shifts. Furthermore, remote coastal areas often struggle with limited access to vital services, triggering migration. Addressing climate-related disasters and reinforce the resilience is the primary target for policymakers. However, equally essential are challenges tackling social challenges like housing, healthcare, education, tourism, employment, and resource management. While, community involvement in policy-development and adoption of sustainable practices are vital. Digital-twin, typically used for environmental factors, emerge as a dynamic platform for monitoring and simulating scenarios. Utilisation of this technology for social innovation provides insights into community challenges for decision-making. Integrating digital-twins with social-innovation promotes knowledge sharing, and community-driven solutions with practical applications. The present study showcases the digital-twin platform ‘EmpowerCoast’ that is currently under development for the Transition Coastal Labs (TCLs) within the EmpowerUS project. The platform demonstrates its capabilities with the case studies Træna, Norway and Cap De Crues, Spain that shows the application of digital twin for the positive social transition.

DIGITAL TWIN TECHNOLOGIES FOR SUSTAINABILITY IN IRISH HORTICULTURE FARMING

Poster Presentation
N.V.S.R. Nalakurthi¹, I. Anton¹, S. Gharbia¹, F. Otieno ¹

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The Irish agriculture is evolving with growing emphasis on sustainability and efficiency in horticulture/tillage farming. Smart-farming technologies in Irish agriculture landscape, can provide data-driven solutions by using the continuous monitoring systems and has the potential to reduce the Greenhouse Gas Emissions. Additionally, creating a digital twin for Irish smart plant farmers could be an innovative approach to enhancing agricultural practices. Almost 80% of Ireland’s agricultural land was used for grazing, and a substantial portion of this land was
dedicated to cattle and sheep farming. Therefore, the focus within Irish agriculture has been on livestock farming predominantly. However, horticulture, tillage and vegetables farming also play significant roles in Ireland’s agricultural sector and contribute to the country’s economy, food security, biodiversity and climate resilient agriculture. Irish farmers are recognising the smart farming technologies that can enable them to monitor their farms, reducing the pesticides and preparing themselves with for climate-change adaptation. This study explores current state of smart-farming technologies in Ireland, their challenges, and opportunities. Further, emphasizes the significance of digital-twin platform that can help farmers to access data and insights for their farm, and in decision-making. The aim is to pave a way for more sustainable, efficient, and technologically empowered agricultural landscape in Ireland.

THE POWER OF DIGITAL TWINS: REAL-TIME EVIDENCE-BASED BIODIVERSITY CONSERVATION

Oral Presentation

K. de Koning 1, A. Davison1

1Wageningen University, Environmental Systems Analysis Group, Wageningen, Netherlands

Digital twins (DTs) are digital counterparts of real-world systems, represented by models that are continuously updated with data for synchronization with their physical twin. DTs are already widely applied in engineering, and are now also being developed in environmental and health sciences. We present our work on several digital twin prototypes in the biodiversity domain. We illustrate the main concept, design challenges, and utility of DTs. We will do this by providing an example of a fully operational DT of the crane migration, and by discussing work in progress on DTs for three other applications in biodiversity conservation. We discuss the state of the art of biodiversity monitoring technologies and research infrastructures that now allow researchers to develop models that continuously produce forecasts on ecosystems. These models thereby allow us to: (1) monitor biodiversity states and trends in real-time; (2) detect unwanted trends at an early stage; (3) inform decision makers on how to respond; (4) monitor key drivers of biodiversity decline; and (5) identify information gaps from a monitoring perspective as well as from a system understanding point of view. A key feature of DTs is updating with real-time data, which poses new requirements on ecological data and model design. Hence, a smooth adoption will depend on how we address bottlenecks in bringing DTs to life. We will discuss our experiences in developing DTs and highlight our vision on DTs for biodiversity.

ADAPTING THE DIGITAL TWIN PARADIGM TO THE REQUIREMENTS OF BIODIVERSITY

Oral Presentation
The intellectual origin of the concept of digital twins lies in the domain of manufacturing and has become popular in the recent years. While the idea has attracted a variety of communities outside of industry, including the EC’s program “Destination Earth”, the use and application of this technology is not without its challenges. The domain of biodiversity particularly is significantly different when compared to manufacturing industry, as the type of data, its shape, the tasks at hand, the application and goals are quite different. To address this we present a seven step analysis of digital twin design, originating from industry, and we outline the adaptations needed for the concept to be applied to the biodiversity domain. At each step we identify the different components and concepts needed for the construction of a digital twin and present a set of requirements which can assist in creating a structured approach for implementation. Fundamentally, we argue that the concept of digital twins needs to be adapted in order to be of utility in the biodiversity domain, and equally the biodiversity community will need to make certain changes to its data management practices in order to take full advantage of digital twins. We identify a set of challenges, both technical and socio-technical, which can present obstacles for the domain. This paper aims to provide guidance for both scientists and biologists on how to construct digital twins for biodiversity and other natural phenomena.

**LTER-LIFE: DEVELOPING DIGITAL TWINS OF ECOSYSTEMS IN A CHANGING WORLD**

Oral Presentation

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Given the unprecedented rate of global change in climate, land use, and urbanisation it is urgent to understand and predict how ecosystems and biodiversity are impacted by changes in environmental conditions. To forecast how ecosystems will respond to current and future global change, we need to increase the availability of existing environmental long-term datasets, integrate disparate types of ecological data, and create a user-friendly and secure cloud-based digital modelling and simulation platform that can be used to link data to models and scenarios. LTER-LIFE (www.lter-life.nl) is such an infrastructure which will provide scientists with the tools to create Digital Twins of entire ecosystems. We are using an ecosystem-oriented approach, starting with two iconic sites in the Netherlands, the Wadden Sea and the Veluwe.
National Park, for which long-term ecological as well as environmental data have been extensively collected. We are making these data FAIR (by applying meta-data standards, controlled vocabularies, ontologies, and persistent identifiers) and make these available through our Virtual Research Environment (VRE), together with FAIR models, rules of interactions between these assets (i.e., data and models) and tools for scenario studies to explore the effects of in situ local management strategies on biodiversity. LTER-LIFE is an open-source infrastructure and thus will be instrumental world-wide to help bending the curve of biodiversity loss.

COMBINE BIODIVERSITY KNOWLEDGE IN DIGITAL TWIN APPLICATIONS FOR NOVEL INSIGHTS

Poster Presentation

S. Sharma ¹, P.P. Pileggi¹

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Digital Twin applications are making it easier and faster for earth scientists to study and predict natural and man-made processes. In our international collaboration to develop Digital Twin applications for various aspects of biodiversity, the Horizon Europe project BioDT supports two use cases, called Pollenators and Grassminds, amongst others. These two use cases deal with honeybee dynamics in agricultural landscape and grassland management, respectively. Despite some overlap, there is more hidden value to discover by collaborating across different use cases. The power of Digital Twin is that not only can knowledge be shared more efficiently and effectively, but new knowledge can be identified, shared, and more easily integrated between the researchers. In this talk, we present our findings of how the latter is usually done, and what Digital Twin application integration functionality could be used to bring novel insights.

DESIGN FRAMEWORK FOR DYNAMIC DATA-DRIVEN DIGITAL TWINS IN ECOTOLOGY

Oral Presentation

T. Khan ¹

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Ecological research has witnessed a remarkable evolution over the years, driven by technological advancements and the growing awareness of biodiversity issues. However, traditional approaches often rely on fixed models and observational data, which, while informative, fall short of capturing the dynamic, interconnected, and responsive nature of ecosystems. In this dynamic landscape, Digital Twins offer a promising shift. Legacy ecological modelling and simulation code typically only support static workflows. Users can interact with the running code
to terminate a run when input data and parameter files have been produced in advance and are read by the code at startup. If data re-integration is necessary, it is typically done manually using static, sanitised input files produced from data sources to interact with observation systems, data archives, and experiments. This presents a challenge in using legacy ecological models and simulations in Digital Twins. This session will present a system design framework for Digital Twins in Ecology, by introducing some common components that fuse models and data in order to facilitate the analysis and prediction of physical phenomena. The framework is based on the Dynamic Data Driven Application Systems (DDDAS) paradigm. DDDAS and Digital Twins are a natural pairing as DDDAS incorporates additional data into an executing Digital Twin, and in reverse, enhance a Digital Twin to dynamically steer the decision on its physical asset.

**A DIGITAL TWIN OF GRASSLAND ECOSYSTEMS**

Oral Presentation

**F. Taubert**¹, T. Banitz¹

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Grasslands cover 20-40% of Earth’s land and provide important ecosystem functions. While grassland productivity matters for fodder or bioenergy supply, biodiversity is also relevant, e.g. for stability and for support of animal species, such as pollinators. Hence, the relations between these functions, and their responses to climate and land use change, need to be well understood to promote adequate human action. We develop a prototype digital twin of grassland ecosystems that allows comprehensive investigation of grassland dynamics under various environmental and management conditions. Our approach facilitates frequent interplay between real-world ecosystems and their digital counterparts. The process-based model Grassmind lets us simulate how individual plants of different species compete for light, space and other resources as they establish, grow and die. These dynamics are driven by weather conditions, soil properties and management. Therefore, the digital twin infrastructure includes access to and pre-processing of open data on these drivers so that realistic present and future scenarios can be simulated and predictions of grassland biodiversity and productivity made for different locations. Grassland observation data are integrated to validate and improve model results. End-users can explore the digital twin through a graphical interface, provide feedback or their own data to be taken into account, and gain valuable scientific insight for use in policy or management.

**A COMMON TOOL FOR ESSENTIAL BIODIVERSITY VARIABLES FROM MARINE PLANKTON DATA**

Oral Presentation
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ETH Zürich, Institute of Biogeochemistry and Pollutant, Zurich, Switzerland

In recent years, the volume and accessibility of marine plankton observations have experienced significant growth across various taxa and data types, encompassing traditional microscopy and net observations, quantitative imaging, and omics datasets. In parallel, while numerous online repositories now provide open access to such datasets, they are associated with diverse statistical tools, metadata, taxonomic classification, and quality flags. This limits the ability to extrapolate plankton biogeography in space and time across data sources and sampling methods, and our understanding of plankton ecosystem structure and functioning at the macroecological scale. Building upon a European initiatives such as EMODnet and ELIXIR, and already existing methods for the extrapolation of heterogeneous, scarce, and biased occurrence, biomass, and omics field observations, we introduce a standardized and flexible framework for marine habitat modelling across data types and sources. This framework serves as a foundation for the consistent generation of Essential Ocean Variables (EOVs) and Essential Biodiversity Variables (EBVs) with periodic updates. It carries the potential to significantly advance our comprehension and effective management of marine ecosystems. This framework provides an unprecedented opportunity to foster collaborations in the field of marine science, sustainable ecological practices, and, ultimately, contribute to the preservation of global marine biodiversity.

DIGITAL TWINS - POTENTIALS AND CHALLENGES IN THE CONTEXT OF HONEY BEE VITALITY

Oral Presentation

J. Groeneveld, T. Martinovic, T. Rossi, V. Grimm

Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany, IT4Innovations, VSB - Technical University of Ostrava, Ostrava, Czech Republic, CSC - IT Center for Science Ltd, Espoo, Finland

Digital twins (DTs) are a virtual representation of real-world entities and processes that are regularly updated with data from their real-world counterparts and trigger control inputs in the real-world system. While originally developed for engineered systems, DTs are increasingly being discussed for ecological systems. One example are pollinators such as honey bees (Apis mellifera), which are exposed to multiple stressors such as pesticides, disease and land-use change. It is therefore a long-standing goal to develop a robust understanding of how multiple stressors affect the vitality of insect pollinators. We discuss the opportunities and challenges of applying the DT approach to honey bees using the BEEHAVE honey bee colony model. While there is a high potential to update the colony model with automatically measured data from real colonies (e.g. colony weight, flight activity), it remains challenging to implement real-time control measures from the model into the physical world. However, it has recently been
suggested that the feedback from the DT is more likely to influence the domain knowledge of the stakeholder community and thereby stimulate, potentially delayed, changes in management regimes. Nevertheless, an important positive side-effect of the development of DTs is the improvement of model-data interaction.

**DIGITAL TWIN EMPOWERED BIODIVERSITY CONSERVATION: SUSTAINABLE FOREST MANAGEMENT**

Oral Presentation

*B. Afsar*¹, M. Versluijs², K. Eyvindson³, O. Ovaskainen¹

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In our rapidly advancing digital era, biodiversity loss poses a significant environmental challenge. Recognizing the critical role of biodiversity and ecosystems in societal well-being, we advocate for sustainable forest management. Utilizing a forest digital twin, we predict forest and biodiversity dynamics under various management strategies and climate change scenarios. The LANDIS-II forest simulator creates virtual representations of Finnish forests, while Hierarchical Modeling of Species Communities (HMSC) develops biodiversity models. Integrated simulations and models predict future environmental conditions and assess how biodiversity responds to management options. This holistic forest digital twin promotes sustainable management with an acceptable level of accuracy and reliability. To showcase practical benefits, we propose a digital twin application utilizing EuroHPC LUMI for decision support through interactive multiobjective optimization. This empowers stakeholders and decision makers (e.g., government and ministry representatives and state-owned companies) to identify optimal forest management strategies, considering ecological, social, and economic objectives under diverse climate scenarios. Our initiative underscores the potential of digital twins as actionable tools, guiding effective and adaptable biodiversity conservation measures and facilitating a transformative journey toward sustainability.

**FAIR DATA AND MODELS IN BIODT: POWERING BIODIVERSITY DIGITAL TWINS**

Oral Presentation

*S. Islam*¹, J. Lopez Gordillo¹, H. Koivula²

¹Naturalis Biodiversity Center, Leiden, Netherlands, ²CSC - IT Services for Science Ltd., Espoo, Finland
Digital twins are revolutionising the utilisation of research data, presenting a transformative tool for biodiversity monitoring and conservation decision-making. This presentation introduces the EU-funded BioDT project (2022-2025), dedicated to developing prototypes that seamlessly integrate diverse datasets, models, high-performance computing, and expert domain knowledge. These prototypes empower predictive capabilities, facilitate rigorous testing of model performance, and provide decision support for critical biodiversity issues. The BioDT project exemplifies the application of FAIR principles and FAIR Digital Objects in constructing prototype Digital Twins, fostering collaboration, and ensuring data and model interoperability across various research infrastructures (DiSSCo, eLTER, GBIF, and LifeWatch). This collective effort signifies a pivotal step towards unlocking the full potential of Digital Twins in biodiversity research. In alignment with the Destination Earth initiative, a collective European goal, interoperability takes centre stage. Numerous digital twin projects, also including the Green Deal Data Space and other similar initiatives, recognise the importance of collaboration in achieving shared objectives. The collaborative spirit inherent in these initiatives emphasises the broader impact of Digital Twins, setting the stage for an integrated and collective approach to advancing biodiversity research and conservation decision-making.
Effects of biodiversity on climate- micro and macro scale

POLLUTION AND CARBON REDUCTION CONTRIBUTES TO ORGANISMS DIVERSITY CONSERVATION

Poster Presentation

L. Hong 1

1Nanjing Institute of Environmental Sciences, MEE, Nanjing, China

The global warming will be the biggest driver of biodiversity loss. The COP15 emphasized that the close relationship between the responding to climate change and biodiversity conservation, call for attention between the coordination and promotion. The Second Assessment Report of IPCC (1996) pointed out that reduction of pollution and carbon emissions is beneficial for biodiversity conservation. China is positively taking the spirit and concept of “a community of life for man and nature” to promote climate change mitigation and biodiversity collaboratively. In 2022, the Ministry of Ecology and Environment and six additional departments jointly issued the “Implementation Plan for Collaborative Efficiency Enhancement of Pollution Reduction and Carbon Reduction”. Based on this, we conducted a study of a large number of collaborative action cases for pollution and carbon reduction that have been undertaken in China. We have found that the “small collaboration” of implementing coordinated actions to reduce pollution and carbon emissions is an essential means for promoting multi-objective governance of ecological environments as climate change mitigation and biodiversity protection, which is also of great significance for jointly promoting the “great synergy” of combat climate change and biodiversity protection.

SHORT-TERM MULTIPLE RESOURCE ADDITIONS REDUCE SOIL FUNGAL DIVERSITY IN STEPPE

Poster Presentation

J. Tian 1, Y. Bai2

1Institute of Botany, Chinese Academy of Sciences, Beijing, China, 2Institute of Botany, Chinese Academy of Sciences, Beijing, China

Although many studies have shown that eutrophication is a major threat to plant biodiversity in grasslands through reducing niche dimensionality, it remains largely unclear how multiple resource enrichment impacts soil microbial diversity. Here we examined the effects of nitrogen (N), phosphorous (P), rainfall (W), and snowfall (S) addition on bacterial and fungal diversity based on a three-year field manipulation experiment in semi-arid steppe. Nutrient and water additions decreased fungal diversity rather than bacterial diversity. The magnitude of change in fungal and bacterial diversity was mainly determined by both the resource identity
and the synergistic (for fungal diversity) or antagonistic (for bacterial diversity) interactions between concurrent nutrient and water. Fungal communities exhibited a narrower environmental threshold than bacterial communities, and the increment of relative abundance of a major fungal ecological cluster (Module 1) with resource addition was also responsible for reductions in fungal diversity. Moreover, for both fungal and bacterial communities, elevated resource supply intensified species interactions (measured as \(|\text{negative}|: \text{positive}\)), resulting changes in their diversity. Our findings highlight the important roles of nutrient identity and niche dimensionality in determining fungal and bacterial responses to eutrophication in grassland ecosystems.
Effects of biodiversity on climate: micro and macro scale

MICROCLIMATIC NICHES PREDICT LONG-TERM SURVIVAL TRENDS OF HIMALAYAN BIRDS

Oral Presentation


1Indian Institute of Science, Centre for Ecological Sciences, Bangalore, India, 2University of Texas, Arlington, United States

The synergistic impacts of climate change and habitat degradation threaten tropical species worldwide. However, how species’ abiotic microclimatic niches affect their demographic vital rates and phenotypic changes under anthropogenic change remains poorly understood. Using a 13-year mark-recapture dataset from primary and selectively logged forest in the Eastern Himalayas, we investigated how temperature-humidity microclimatic niche characteristics predicted body mass and survival trends in understorey insectivorous birds over time in each habitat. Our results show that logged forest is hotter and drier than primary forest, and the arthropod community shows dramatic shifts in composition upon selective logging. In understorey insectivores, the degree of dissimilarity between species-specific primary and logged forest niches was strongly and negatively correlated with survival and body mass trends in logged forests. Here, we show that microclimatic niche shifts in response to anthropogenic habitat modification can impact demographic vital rates and body conditions crucial for population persistence. This work has the potential to inform prompt, targeted conservation efforts toward species that are the most threatened in a warmer and more degraded world.

FEEDBACK LOOPS BETWEEN BIODIVERSITY AND MICROCLIMATE AT FOREST EDGES

Oral Presentation

C. Banks-Leite

1Imperial College London, Life Sciences, Ascot, United Kingdom

Edge effects between tropical forested and non-forested habitats have been extensively studied but seldomly we have information on microclimate, plant and animal communities from the same sites to obtain a holistic picture of feedback loops between abiotic and biotic components. In this talk, I will draw on my research in the Atlantic Forest of Brazil, a biodiversity hotspot, to show that forests edges are significantly hotter, drier and more exposed to wind than forest interiors. This dramatic change in microclimatic conditions triggers important shifts in plant communities, leading to up to 80% loss in species of epiphytes, as well as lower recruitment,
and increased turnover rates from climax to early-successional species (i.e., secondarisation, where pristine forest edges resemble secondary forests). Animal communities are also directly impacted by microclimate. I will show that some species of birds avoid using forest edges, leading to compositional changes in the bird community akin to secondarisation in the plant community. The overall consequences of these compositional changes is that the ecosystem functions species perform at forest edges are different to those at forest interiors, which leads to further changes in vegetation structure and therefore altered microclimate.

A NEW OBSERVATIONAL STRATEGY FOR MONITORING THERMAL FLUXES ACROSS FORESTS TYPES

Oral Presentation

J.S. Adams¹, A. Damm¹-², K. Naegeli¹

¹University of Zurich, Department of Geography, Zürich, Switzerland, ²Eawag, Zurich, Switzerland

Land surface temperature (LST) is a critical parameter in forest ecosystems, linked to sensible and latent heat fluxes. The thermal regime over forests is driven by processes of evapotranspiration and water- and heat transfer between soil, atmosphere and vegetation. Highly resolved spatiotemporal observations of LST can shed light on these processes, their relationship with micro- and macroclimate, and are sensitive proxies for forest resilience to climate extremes. This contribution presents a new ground observation set-up to monitor LST over two Swiss forests (mixed and coniferous), which have been priority sites for measuring forest gas exchange, environmental stress responses and biodiversity over many years. This instrumentation will include high-precision spatially resolved LST derived from thermal cameras complemented by pointing radiometers, offering the possibility to disaggregate spatiotemporal distributions of fluxes, and forest type-specific responses to climate change at fine scale. The new set-up will accelerate scientific activities aiming to a) monitor, model and better understand forest water and energy exchange at local scale over different forest types, b) develop a thematic validation site for upcoming high-resolution satellite missions (e.g. TRISHNA, FLEX) that observe LST and ecosystem stress products, and c) integrate with additional eddy flux and spectroscopy observations to provide a holistic observational strategy of monitoring forest energy balance.

THE INFLUENCE OF NATURE FUTURES BIODIVERSITY SCENARIOS ON REGIONAL CLIMATE

Oral Presentation

D.N. Karger¹, H. Brueelheide², M. Chytrý³, T. Hickler⁴, C. Queiroz⁵, S.I. Seneviratne⁶, W. Thuiller⁷, T. Anders⁴, V. Boussange¹, I. Axmanová³, E.L. Davin⁸, J. Divíšek³, M. Gueguen⁷, S. Kambach², I. Knollová³, Z.
Optimizing climate change mitigation efforts without compromising biodiversity conservation poses a significant challenge in addressing global change. To provide scenarios on how biodiversity can be protected, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) initiated the Nature Futures Framework (NFF). These scenarios are associated with modifications in landscape composition and management, with related consequences for biodiversity, ecosystem services, and, furthermore, regional climate. Here, we present how different scenarios in Nature’s Futures can influence plant biodiversity and regional climate by utilizing the coupled land surface-atmosphere regional climate model, COSMO-CLM2. Our approach involved running COSMO-CLM2 simulations for Europe, utilizing spatial land cover scenarios derived from the Nature’s Futures Framework, which were further enriched with data from biodiversity inventories and habitat distributions sourced from EUNIS (European nature information system) and EVA (European Vegetation Archive). By offering a comprehensive examination of how specific Nature’s Futures scenarios can shape regional climate evolution and biodiversity, we provide an overview of how different strategies of biodiversity protection can influence climate, and how mitigation strategies could be optimized to counteract the impacts of global change.

TREE DIVERSITY INCREASES FOREST TEMPERATURE BUFFERING

Oral Presentation


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The increasing frequency and intensity of extreme climate events make ecosystem function stability a crucial objective for forest management. An important, but often neglected forest function is the buffering of temperature extremes, that is, the cooling of hot and insulation against cold macroclimate temperatures below the tree canopy. This temperature buffering may be increased by tree diversity and may itself maintain the biodiversity of other organisms, for instance, by providing microclimate refugia. However, the effect of tree diversity on temperature buffering is largely unexplored. Here, we show that tree species richness consistently increases forest temperature buffering (i.e. temporal stability of temperatures) across daily, monthly, and annual time scales in a large-scale forest diversity experiment covering a species richness gradient of 1 to 24 tree species. By disentangling the ecosystem characteristics responsible for the buffering effect, we show that species richness effects are mediated by vegetation density and structural diversity, assessed as leaf area index and stand structural complexity index, respectively. Our results demonstrate that forests with high tree diversity have a stronger buffering effect on temperature fluctuations than forests with low tree diversity. Safeguarding and planting diverse forests may thus protect below-canopy communities and functions against global warming and climate extremes by promoting temperature buffering.
Enabling, Assessing, and Scaling the Value of Native Pollination for Global Prosperity

PREDICTING WILLINGNESS TO PAY FOR BIRD AND MAMMAL SPECIES

Poster Presentation

M. Broekman, J. Hilbers, M. Huijbregts, K. Kuipers, A. Schipper

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Human activities often negatively affect wildlife species. When designing relevant policy actions in relation to these activities, it is important to account for the value of the affected species, as species can have several values to humans, including use values (e.g., viewing the species) and non-use values (e.g., existence value). A common indicator for expressing the values of wildlife species is the willingness to pay (WTP), typically understood as the amount individuals are willing to spend to protect a species or increase its abundance. However, WTP has currently been estimated for a limited number of species and regions, precluding its application in global scenario and modelling frameworks that assess the environmental and economic impacts of different policy options. In this study, we collected all published WTP values of birds and mammals and derived meta-regression models that relate WTP with several region- and species-specific characteristics. These models enable us to predict WTP values (as well as the corresponding uncertainty), for every extant bird and mammal species. Linking species-specific WTP estimates to changes in species abundance related to human activities is an important step towards the integration of biodiversity considerations into economic decisions.

ALTERNATIVE BIODIVERSITY METRICS IMPACT SPATIAL DISTRIBUTION OF INVESTMENTS

Oral Presentation

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Through the Kunming-Montreal Global Biodiversity Framework, governments seek to plug the finance gaps in nature conservation with private investments to deliver efficient and equitable biodiversity conservation. Biodiversity markets rely on a metric to provide reliable and accurate information in a well-functioning market. Reviews of suggested biodiversity metrics have highlighted differences in the methods to measure habitat, species and genetic diversity,
but it remains unknown whether the different metrics could potentially deliver geographically similar incentives for investments in conservation in Britain. This is important because each metric may incentivise investment funding differently for biodiversity potentially leading to unintended consequences in biodiversity outcomes from applying different metrics. The metrics cover Defra’s Biodiversity Metric with Plan Vivo’s methodology, a conservation prioritisation metric and a rarity-weighted richness metric. Results show that metrics that use rarity will favour investment into the north and the west of Britain; in contrast, metrics that measure abundance incentivise investment into the south and east. The large differences we find in spatial incentives for investment from the use of different metrics contrast with the expectation that biodiversity goals require targeted action in specific areas, suggesting careful choice of metric is essential if biodiversity markets are to deliver the biodiversity gains envisaged.

HETEROTRIGONA ERYTHOGASTRA (CAMERON, 1902) NEW DISTRIBUTION RECORDS IN THAILAND

Poster Presentation

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Forty stingless bees are widely distributed in Thailand, there are 40 species were recorded in twelve genera including Geniotrigona, Heterotrigona, Homotrigona, Lepidotrigona, Lisotrigonon, Lophotrigona, Odontotrigona, Parotrigona, Sundatrigona, Tetragonilla, Tetragonula, and Tetrigena. Stingless bees belonging to Heterotrigona spp. are widely distributed in southern Thailand and they are difficult to distinguish. Very few records of Heterotrigona erythogastra (Cameron, 1902) were subsequently made, and our knowledge about this secretive skink and its geographical distribution remains minimal. Currently, the species is known to exist in only four countries: Thailand, Malaysia, Philippines, and Indonesia. The newly recorded localities for H. erythogastra in southeastern regions of Thailand are presented, which represent the first sightings for Yala province. However, it has not been reported in the western, central, northern, and northeastern portions of the country. The species is distinguished by the combination of the following features: Head, clypeus, base and apex of scape, pedicel frontally black; mandibles black; bristles on vertex and black. Mesosoma dark reddish, tegulae black, scutellum and propodeum black, wings reddish brown, legs black, and pre-tarsi dark reddish. The entrance tube of H. erythogastra nest showed a morning glory flower shape and white color that colony inside the hole of a life tree (Balakata baccata (Roxb.) Esser ) in the forest.
CHINESE STINGLESS BEE HONEYS: QUALITY STANDARDS VIA PHYSICOCHEMICAL PARAMETERS

Oral Presentation

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Stingless bees (Hymenoptera, Apidae, Meliponini) play a critical ecological role with neglected economic benefits. Due to its characteristic sweet and sour taste, medicinal value, as well as its low annual production, stingless bee honey (SBH) has a relative higher market price than the Apis mellifera honeys. Therefore, the new rise of Meliponiculture might contribute to rural revitalization in many tropical and subtropical countries. Researches relating to the chemical composition and psychical parameters of Chinese SBH is still scant, and there is an urgent need to establish Chinese quality standards for the SBH. From 2019-2023, we systematically collected a total of 104 SBH samples of 4 provinces from 5 stingless bee species of China and testing honey physicochemical indicators. We have shown that the physical and chemical properties of Chinese SBH depend not only on the species, but also on the year, location, nectar sources and harvest time. Most of the physicochemical parameters of Chinese SBH are comparable to those of SBH from other counties. Notably, Chinese SBH had a relative low level of 5-hydroxymethylfurfural (0 ~ 9.64 mg/kg) and sucrose (0 ~ 0.43 g/100g), while no diastase activity was detected in all of these samples. In addition, trehalulose, a recent identified qualitative component, in the SBH range from 4.26 to 37.65 g/100g. These data provide basic product characteristics of the Chinese SBH which enables the establishment of relevant SBH standards in China.
Enhancing Urban Biodiversity through Blue-Green Infrastructure: A Multidisciplinary Approach

BIODIVERSITY CONSERVATION: TOWARD COLLABORATIVE MANAGEMENT OF BLUE-GREEN AREAS

Oral Presentation

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Maintaining ecological connectivity is crucial for biodiversity, yet effectively managing interconnected areas through actor collaboration is challenging. This study examines actor collaboration through social-ecological fit in interconnected aquatic “blue” and terrestrial “green” areas, encompassing natural and semi-natural elements, in human dominated landscapes. Combining species distribution models and connectivity analyses focused on declining amphibians and survey data on actors’ area management and collaboration within interconnected areas, we create a spatially explicit social-ecological network that we analyze using network models. Results emphasize that different ecological dependencies shape actor interactions differently. Collaboration is observed in interconnected rural blue-green areas, whereas urban blue-green areas lack collaboration, with minor water bodies and urban green spaces at the network’s core but plagued by social-ecological misfit. Strengthening collaboration in these areas is essential to prevent further ecological network degradation. Incorporating a spatially explicit social-ecological perspective covering diverse blue and green areas guides targeted interventions, fosters the development of effective conservation policy, and facilitates the sustainable planning and implementation of blue-green infrastructure in support of biodiversity.

ADVANCING URBAN RESILIENCE: A SCIENCE-DESIGN LOOP FOR BLUE-GREEN INFRASTRUCTURE

Oral Presentation

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Urban landscapes face the dual imperative of sustainability and resilience, demanding innovative solutions to sustain ecosystem services, often reliant on biodiversity. Our study follows a roadmap for designing blue-green infrastructures in cities, emphasizing an intensive transdisciplinary dialogue—a science-design loop—fostered through collaboration among landscape designers, scientists, and stakeholders. The process entails a dynamic exchange where designers link models, ecological knowledge, as well as stakeholder input, to craft well-informed designs tailored to the intricate challenges of urban environments. This approach is applied in a case study in Antananarivo, where the focus lies on enhancing flood resilience and ecosystem services through blue-green infrastructures. Our science-design loop is an iterative process that cultivates a solution-driven approach from designers, harnesses the problem-solving skills of scientists, and integrates the preferences of end-users. The resulting landscape design proposal embodies a balanced and informed approach to creating blue-green resilient urban landscapes. This research underscores the pivotal role of multidisciplinary collaboration in navigating the complexities of urban transformation towards sustainability and resilience. It also emphasizes the fundamental necessity of incorporating stakeholders’ perceptions and preferences for the establishment of a legitimate design.

UNVEILING URBAN AQUATIC-TERRESTRIAL ARTHROPOD COMMUNITY STRUCTURES WITH EDNA

Oral Presentation

K. Perrelet1, L. Cook2, F. Altermatt3, M. Moretti4

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As a response to the changes in energy and water cycles caused by urbanization, blue-green infrastructure (BGI), like ponds and parks, is typically implemented to meet engineering targets, such as managing stormwater and mitigating heat. However, there is an increasing demand for BGI to serve multiple roles, including urban biodiversity conservation. Nevertheless, designing BGI that effectively safeguards aquatic and terrestrial arthropods, which are highly vulnerable to urbanization due to their specific life cycle needs and limited mobility, remains a challenge. We used environmental DNA (eDNA) metabarcoding to assess arthropods communities in 54 paired aquatic and terrestrial sites in the city of Zürich, Switzerland. We found that factors, such as vegetation structure and vegetation cover at the local scale shape aquatic and terrestrial arthropod communities. However, these communities displayed different patterns of richness and species turnover, indicating distinct responses to the different local environmental conditions. Furthermore, with the increase of the impervious surface at the landscape scale, both communities showed signs of decoupling, indicating a weakening of interactions between aquatic and terrestrial environments associated with urbanization. We further discuss the potential and limitations of eDNA metabarcoding in urban settings, and implications for designing and managing multifunctional BGI to address engineering and ecological needs.
CONSERVING URBAN BIODIVERSITY: WATERBODY REJUVENATION
HARIT POND NOIDA, INDIA

Poster Presentation

R.K. Sharma 1, S. Basu1, N. Pundhir2

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Urban lakes and water structures collectively known as wetlands are crucial parts of the urban ecosystem. Indian wetlands occupy an area of 15.3 million hectares and cover about 4.7% of the country’s total geographical area. There are studies of the decline in urban biodiversity and abundance across urban wetlands due to rapid urbanization, the loss of natural habitats, and the increase in invasive species. In this study, we present baseline inventory from the various urban taxa from one of the urban water structures, restored through ecological processes to enhance the urban biodiversity in Noida, a densely populated city. To create baseline information on biodiversity, we did regular field surveys from April 2023 until October 2023 at Police Line Harit Pond in the Gautam-Buddha Nagar district of Delhi NCR. The total sampled area is 1.5 hectares where we found 16, 5, 10, 2, 2, and 40 species of butterflies, arthropods, damsel and dragonflies, birds, and mammals respectively, and in total 75 species sharing their spaces in the restored and rejuvenated waterbody. This diverse urban biodiversity inventory associated with the ecological process of rejuvenation of water structures in urban setup may further support policymakers, urban planners, managers, researchers, and various stakeholders to understand the ecological importance of satellite wetlands in designing, decision-making, and city planning, especially for emerging cities in the future.

PLANNING FOR DIVERSITY: NATURE-FRIENDLY STANDARDS IN LOCAL LAND USE REGULATIONS

Oral Presentation

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Spatial planning is widely recognized as an important lever for strengthening biodiversity. Recently, research and policy makers have proposed new planning standards to improve biodiversity in built-up areas. More and more cities are including nature-friendly standards in their planning principles, such as minimum ratios for green spaces, tree protection or flat roof greening. Nevertheless, many municipal land use plans still contain hardly any quantitative or qualitative standards for the protection and promotion of biodiversity in urban areas. Creating space for nature is a challenge for municipal policy, as there are many competing demands for utilization in a limited space. We therefore need to better understand what promotes or
hinders the integration of biodiversity standards into municipal planning. Using the example of medium-sized Swiss municipalities, we analyze whether and how biodiversity-friendly standards are integrated into the revision of building and zoning regulations and, if not, for what reasons. To clarify these questions, we choose a qualitative approach and analyze the revision process of the building and zoning regulations by means of interviews and document analysis. We propose an analytical framework that encompasses the policy process including stakeholder involvement, actor’s behavior and attitudes. We provide insights into first case studies.

THE ROLE OF URBAN MINI-FOREST: SHAPING AVIAN DIVERSITY, HARIT UPVAN SORKHA INDIA

Poster Presentation

**R.K. Sharma** ¹

¹HCL Foundation, Harit, Noida, India

The avifauna is one of the key indicators to measure the ecological balance, especially in urban landscapes. There are studies on the decline of urban biodiversity and abundance across urban setups due to rapid urbanization and the loss of natural habitats. In this study, we are representing the baseline inventory of birds from one of the mini-urban forests, that has been created with ecological interventions to enhance urban biodiversity in Noida, a densely populated city. To create the baseline information on avifauna, we did regular field surveys till September 2023 in Harit Upvan Sorkha- a mini-urban forest in the Gautam-Buddha Nagar district of Delhi NCR. The total sampled area is 4.5 hectares where we found 77 bird species from 30 families belonging to 16 orders sharing their spaces in 3 macro habitats viz. Open-shrub land, Dense woody patches, and Waterbody (rainwater harvesting structures). This avifauna inventory associated with habitats may further support policymakers, urban planners, managers, researchers, and various stakeholders to understand the ecological importance of mini-urban forests in designing, decision-making, and city planning, especially for emerging cities to achieve the goal of 30 by 30.

CONSIDERING A RANGE OF CRITERIA FOR SUSTAINABLE ROOFS: PV, GREEN ROOFS, OR BOTH?

Poster Presentation

**B. Maurer**¹, **J. Lienert**², **L. Cook** ¹

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Flat roofs can employ a range of technologies to improve sustainability, such as photovoltaic (PV) panels, green roofs, cool roofs, or a combination of these options. Yet, weighing the
benefits, such as biodiversity enhancement, urban cooling, and runoff reduction, with the costs, is complex, especially when different stakeholders are involved. Decision analysis techniques, such as multi-criteria decision analysis (MCDA), can be used to systematically evaluate a diverse range of rooftop options to assess trade-offs in a quantitative way and avoid decision biases. This study offers a holistic comparison of different roof types, considering stakeholder preferences and uncertainty using MCDA. Ten flat roof options are compared, including black, gravel, cool, extensive green and semi-intensive green roofs, each with or without a rooftop PV installation, for several objectives, including habitat diversity, event runoff, heat mitigation, CO2 mitigation, among others. Performance is evaluated using building energy simulation, hydrologic modeling, and literature research. Despite considerable uncertainty, extensive and semi-intensive green roofs with PV are recommended as relatively robust best-performing options.

**URBAN BIODIVERSITY TRENDS UNDER SCENARIOS OF CLIMATE CHANGE AND URBANISATION**

Oral Presentation

*A. Dietzel* ¹, M. Moretti², A. Hersperger³, L. Cook¹

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Urban biodiversity faces escalating threats from simultaneous changes in land use and climate. Robust, actionable predictions of the present and future distribution of plant and animal species are needed to devise effective mitigation measures like interconnected systems of urban Blue-Green Infrastructure, such as green roofs, water bodies and green spaces. Such predictions must account for the combined impact of climate change and urbanisation, interactions between them, and for uncertainties in species’ ecology and human decision-making, both at the local and global scale. Here we examine trends in the future distribution of more than a hundred species of amphibians, birds, butterflies, dragonflies and grasshoppers under future scenarios of urbanisation and climate change. We combine a big data approach with a covariate selection routine (> 100 covariates), ensemble species distribution modelling (five algorithms), and different scenarios of climate change (three representative concentration pathways and four global climate models) and urbanisation (four scenarios along axes of development restrictions and investment in green space quality) to discern and quantify key sources of uncertainty in our projections. Our results demonstrate the pivotal role of urban Blue-Green Infrastructure in mitigating threats to urban biodiversity. We discuss the need for reliable high-resolution climate data to predict future patterns in biodiversity.
INTENTIONAL MULTIFUNCTIONALITY OF URBAN GREEN INFRASTRUCTURE

Oral Presentation

B. Wadzuk ¹, L. Cook², M. Moretti³, K. Good¹, V. Smith¹, P. Kremer¹, R. Traver¹

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Multifunctional Green Infrastructure (GI) has been researched for decades, yet its holistic implementation in the built environment remains elusive. GI are often built for a single purpose, with the remaining ecosystem services (multifunctionality) assumed to passively occur. Ample literature states that collaboration is needed across research and stakeholder silos to remedy this problem; however, there is little actionable guidance on how to facilitate this. The goal of this study is to provide specific guidance on the aspects that could be jointly considered between GI planning, design, and construction entities, where the academic literature stands on these aspects, and what remains to be addressed. We compiled 15 GI elements (e.g., green roofs) and 15 objectives (e.g., biodiversity) as a suite of aspects that can be intentionally and holistically considered in the planning and design process, i.e., before implementation. Based on a systematic literature review, it is clear that discussion of “engineered” GI remains siloed with water related objectives, while more “natural” GI are more often linked to biodiversity and human well-being. Further coordination across researchers and stakeholders is needed; however, we caution that evaluating too many options before implementation may impede decision-making and lead to a paradox of choice. This may be overcome by first assessing for multifunctionality, and in the short-term, by following principles of adaptive design.

SWISS URBAN HABITAT MAPPING USING LIDAR POINT CLOUDS AND AIRBORNE IMAGERY

Poster Presentation

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This presentation demonstrates a comprehensive methodology for mapping urban habitat types in the Swiss landscape, utilizing LiDAR technology and 4-bands airborne imagery. With the view to enhancing urban biodiversity through blue-green infrastructure, our study employs advanced spatial techniques, including Object-Based Image Analysis (OBIA), to classify and analyze the diverse habitat types within the urban environment. LiDAR point clouds provide a detailed representation of the 3D structure of urban vegetation, enhancing our ability to discern and categorize different habitat types. Coupled with airborne imagery, the data facilitate a precise mapping of the urban landscape, capturing the relationship between built
structures, green spaces, and water bodies in Switzerland. The application of OBIA, supported by the expert knowledge and machine learning algorithms, ensures accurate identification and classification of habitat features. Our findings contribute valuable insights into the distribution of urban habitat types, emphasizing their significance for biodiversity conservation within the Swiss context. This presentation is relevant for urban planners, ecologists, and policymakers seeking to implement effective strategies for biodiversity preservation within the specific geographic and environmental context of Swiss cities, as well as for professionals interested in leveraging advanced technologies for urban biodiversity mapping and sustainable urban development.

**COMPLEMENTING 30X30: TOWARDS SUSTAINABLE COEXISTENCE IN THE REMAINING 70%**

**Poster Presentation**

*C. Rutz* ¹

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To tackle the biodiversity crisis, the international community has agreed to protect 30% of the planet’s surface by 2030. But, what will happen with the remaining 70%? Without immediate action, these unprotected areas will be committed to highly destructive transformation, to satisfy humanity’s need for space and resources. We must urgently intensify efforts to develop environmental planning strategies that promote sustainable human-wildlife coexistence. Disruptive innovation is hindered, however, by our limited understanding of how animals’ movements and behaviour are affected by land modification and human disturbance. The method of choice for filling this glaring knowledge gap is ‘bio-logging’, the use of cutting-edge wildlife wearables for remotely recording high-resolution tracking data. Here, I present my vision for the Urban Exploration Project - a ground-breaking effort to track ~10,000 animals across gradients of urbanization worldwide. Using an innovative Global North-Global South partnering scheme, the initiative aspires to build an inclusive, well-resourced network of collaborating field teams and stakeholders. The Urban Exploration Project promises to drive innovation in environmental planning and conservation management, inform policy making, nurture public goodwill, and ultimately, reveal new pathways for building a future where humans and wildlife can coexist. We must not write-off the unprotected 70% of our precious planet.
Genomic solutions for biodiversity conservation: translating cutting-edge research into action

USING A GENOMIC APPROACH TO INFORM ASSISTED GENE FLOW IN ARAUCARIA ARaucANA

Oral Presentation

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Given the steady decline in the genetic health of tree species populations as adaptation is being outpaced by the speed of human-induced climate change, forest management measures are urgently required. In this context, human translocation of pre-adapted genotypes from source natural populations whose current climatic conditions are similar to those that natural recipient populations will experience in the future, the so-called Assisted Gene Flow (AGF), has the potential to reduce the risk of maladaptation and to make more resilient communities. Here, we introduce a metric we call the Mean Offset Ratio (MOR), which is a population pre-adaptation metric useful for AGF as it aims to increase adaptive genetic variation and decrease the risk of maladaptation of recipient populations. We applied the MOR metric for the iconic South American conifer Araucaria araucana, which is currently in the spotlight due to observed dieback and mortality because of global warming. Our findings suggest that, considering a moderate climate change scenario for year 2070, AGF for A. araucana appears to be context dependent. Populations having the highest risk of maladaptation in the southern Andean piedmonts could benefit from the introduction of genotypes coming from the northern higher elevation Andean populations, which are at lowest risk of maladaptation. For the Coastal metapopulation, no translocation possibilities were observed, both as source and recipient populations.

GENOMICS FOR SUSTAINABLE AGRO-DIVERSITY FROM FERTILE CRESCENT

Poster Presentation

F.S. Baloch1, M.A. Nadeem1, C. Kurt2

187
Core Area within the Fertile crescent was proposed by the Lev-Yadun based on the theme that wild einkorn and emmer from this area shows highest genetic resemblance with domesticated wheat than anywhere else and other founder crops and their wild relatives such as chick pea, lentil, barley, rye are restricted to the region of Southeast Turkey, which include Karacadağ mountain range. In the last few decades, due to heavy industrialization, urbanization, tourism activities and climate change, there is a serious threat of the disappearance of such natural resources. To stem this loss of genetic variation, conservation and reconnaissance of existing biodiversity are fundamental. We had characterized the huge germplasm of triticum species, chickpea, lentil, bean, peanut, sugar cane, Laurus nobilis, pear millet, sorghum, sesame, maize, tomato, dactylus glomerata, Cephalaria. etc using 10-000s of SNPs generated by GBS and identified novel alleles/QTLs from some traits. Some QTLs/alleles have been validated and are being used for genomic selection for biotic and abiotic stress. We are developing strategies how this big data covering the whole genome sequencing can be potentially used for conservation of precious germplasm from their area of diversity. I will provide examples about the use of sequencing data for diversity assessment and their use for developing conservation strategies and how novel QTLs/alleles identified from these precious sources could be used for food security.

ECOLOGICAL DISTURBANCE REDUCES GENOMIC DIVERSITY IN ALPINE WHITEFISH RADIATION

Oral Presentation

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Genomic diversity reflects the adaptive potential of populations and impacts the extinction risk of species. As empirical data on genomic diversity of populations before environmental perturbations are rare our understanding on the impact of perturbation on diversity is limited. We assessed genomic diversity utilising whole-genome resequencing data of contemporary and historical scale samples for all four species of the Lake Constance Alpine whitefish radiation. Our data covers a period of strong but transient anthropogenic environmental change and permits to track changes in genomic diversity over time. Genomic diversity declined during the period of anthropogenic disturbance between 18-30%, depending on the species. Interspecific allele frequency differences at loci located in potentially ecologically relevant genes were homogenized over time. This suggests that during ecological disturbance genome wide genetic variation and also differentiation that evolved in the process of adaptation to alternative ecologies between species declined. These observations demonstrate the sensitivity of biodiversity...
in evolutionary young adaptive radiations towards environmental disturbance. Natural history collections are instrumental for the assessment of genomic consequences of anthropogenic environmental change and enable us to document biodiversity loss against the shifting baseline syndrome and advance our understanding of the needs for efficient biodiversity conservation.

**USING ENVIRONMENTAL NUCLEIC ACIDS (ENA) TO ASSESS ENVIRONMENTAL HEALTH**

Oral Presentation

*M. Cristescu*<sup>1</sup>

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While environmental DNA (eDNA) is increasingly used for biomonitoring, the use of environmental RNA (eRNA) is lagging behind. This can come across as surprising given that RNA provides the additional layer of functional information, beyond species detection. It is well known that actively transcribed genes can reflect the health of organisms. However, current methods of evaluating gene responses are often species specific, invasive, and impractical to apply at a community or ecosystem level. Safeguarding biodiversity under severe stress requires information on the physiological responses of populations because such responses can be detected before major shifts in species assemblages and ecosystem destabilization happen. Thus, my research group develops methods for harnessing functional information from eRNA. In a microcosm experiment conducted on the microcrustacean Daphnia, we identified 3941 genes directly from the water (after the removal of organisms). We identified 42 genes as differentially expressed in response to heat stress. Of these, 62% were also differentially expressed in organismal RNA and exhibited similar levels of relative expression and similar direction (up or down regulation) in both RNA types. In this pioneering study we demonstrated that transcriptomic profiling based on eRNA can reveal not only the community assemblage but also the health status of diverse communities of organisms, with broad implications for biodiversity and conservation studies.

**USING GENOMICS TO PREDICT ADAPTATION TO CLIMATE CHANGE**

Oral Presentation

*M.S. Ferreira*<sup>1</sup>, *T.J. Thurman*<sup>2</sup>, *M.R. Jones*<sup>2</sup>, *L. Farelo*<sup>3</sup>, *A.V. Kumar*<sup>4</sup>, *S.M.E. Mortimer*<sup>2</sup>, *J.R. Demboski*<sup>5</sup>, *L.S. Mills*<sup>6</sup>, *P.C. Alves*<sup>1</sup>, *J.M. Good*<sup>7</sup>, *J. Melo-Ferreira*<sup>1</sup>

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Dissecting how natural populations adapt to changing environments is central to understand how species can persist despite rapid global climate change. Adaptive genetic variation is one key ingredient to enable species survival in the future. However, this knowledge has yet rarely been used to inform conservation decisions. Here, we use the white-tailed jackrabbit as case study to show how studying the genetic determinants of fitness-related traits can be used to predict the probability for evolutionary rescue facing climate change (Ferreira et al. 2023, Science, 379:1238-1242). This declining species undergoes seasonal pelage colour moults, from summer-brown to various shades in the winter, from fully white to brown. The winter colour variation is spatially correlated with snow cover, and thus governed by environmental selection for camouflage. This pressure will shift towards favouring winter brown coats in the future given predicted snow cover declines. Using whole genome sequencing we show that colour variation is determined by interactions between three pigmentation genes. Using this knowledge, our predictive models show that low frequencies of winter-brown alleles suffice to enable future evolutionary rescue. Yet, our predictions suggest that absence of adaptive alleles could bring populations to extinction, which can be avoided by monitoring adaptive variation and promoting population connectivity. This work underscores the key role of genomics in conservation action.

ISOPHYA RIZEENSIS: ENVIRONMENTAL ADAPTATIONS AND GENETIC CORRELATIONS

Poster Presentation

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Our study delves into the genetic adaptations of Isophya rizeensis bush crickets, revealing their survival strategies in changing environments. These crickets thrive across a wide altitudinal range, displaying distinct dorsal coloration and body size patterns linked to temperature and precipitation. We examined populations from 350 to 2500 meters in the Fırtına Valley, analyzing genome-wide polymorphisms in 96 individuals. Our findings are striking: Principal Component Analysis (PCA) identified 72 key genetic loci driving adaptations along altitudinal gradients, while Discriminant Analysis of Principal Components (DAPC) revealed 138 loci differentiating cricket populations. Notably, negative inbreeding coefficients suggest extensive heterozygosity, reflecting rich genetic diversity. Furthermore, we found that this diversity between individuals is highly correlated with their geographic distances (IBD) and with elevation. Future research aims to pinpoint specific genes influencing size and color adaptations
and explore Genotype-Environment Association (GEA). Our work enhances our understanding of genetic mechanisms in rapidly evolving ectotherms and their ability to adapt to changing environments, contributing to biodiversity research.

ADVANCED GENOMIC BIOMONITORING OF LENTIC WATERS WITH PASSIVE EDNA SAMPLING

Oral Presentation

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Wetland ecosystems host immense biodiversity, including high numbers of endangered and cryptic species. Yet, the often-neglected lentic biodiversity suffers from severe wetland surface area loss. Extensive wetland renaturation efforts are performed to establish stable ecosystems providing suitable habitats for limnic species. However, assessing the restoration efforts is difficult due to time-consuming, expert-based taxonomic identification. In the Emys-R project (www.emysr.cnrs.fr), we investigate a cutting-edge approach of advanced genomic biomonitoring of wetlands to detect entire lentic macro-communities within one workflow. We compare passive eDNA sampling as a potentially efficient alternative to standard active filtration usually applied in lotic waters. In combination with multiplex metabarcoding we target several eukaryotic groups (plants, invertebrates and vertebrates) to develop a workflow for a time-saving, low-cost and reliable biodiversity assessment of lentic ecosystems. Our pending results will enable an easy detection of freshwater communities to assess restoration efforts, perform routine genomic biomonitoring, detect rare or invasive species and initiate the appropriate management measures at an early stage. Our approach can thus contribute to an advanced freshwater conservation management.

REVEALING THE CASCADE OF PESTICIDE EFFECTS FROM GENE TO COMMUNITY

Oral Presentation

**A. Siddique¹**, N. Shahid¹, M. Liess¹

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Global pesticide exposure in agriculture leads to biodiversity loss, even at concentrations below the legal limits. The mechanisms by which the effects of toxicants act at such low concentrations
are still unclear, particularly in relation to their propagation across the different biological levels. In this study, we demonstrate, for the first time, a cascade of effects from the gene to the community level. At the gene level, agricultural pesticide exposure resulted in reduced genetic diversity of field-collected Gammarus pulex, a dominant freshwater crustacean. Additionally, we identified alleles associated with adaptations to pesticide contamination. At the individual level, this genetic adaptation to pesticides was linked to a lower per capita growth rate, indicating related fitness costs. At the ecosystem level, we observed a decline in the overall number and abundance of macroinvertebrate species that are susceptible to pesticides while competing with gammarids. The resulting reduction in interspecific competition provided an advantage for pesticide-adapted G. pulex to dominate macroinvertebrate communities in contaminated areas, despite their reduced fitness due to adaptation. These processes demonstrate the complex cascade of effects, and also illustrate the resilience and adaptability of biological systems across organisational levels to meet the challenges of a changing environment.

CLIMATE GENOMICS TO SUPPORT FISHERIES MANAGEMENT IN THE SOUTHERN OCEAN

Oral Presentation

**J.A. Caccavo** ¹, M. Gehlen¹, F. d’Ovidio²

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Antarctica is experiencing climate change impacts at a rapid clip, resulting in warming trends and increased environmental variability. The conservation of Antarctic ecosystems and vulnerable species requires the integration of climate change impacts into management strategies and predictions. Antarctic toothfish are a commercially exploited top predator in the Southern Ocean, whose early-life stages are vulnerable to the environmental perturbations caused by climate change due to their strong association with sea ice and life history connectivity via regional circulation. We use whole-genome resequencing from circumpolar distributions of toothfish to identify local adaptation and genetic structure on the population level. Using genotype-environment association (GEA), we identify the key environmental variables driving adaptation in toothfish, as well as the populations subject to the greatest adaptive pressure. The outputs of the GEA will be combined with particle simulations to build a genetically-informed species distribution model (gSDM) for Antarctic toothfish, informing connectivity and extrapolating zones of adaptive pressure to unsampled parts of the toothfish distribution, both on present and future time scales. In addition to delivering an innovative cross-disciplinary approach to studying the ecological impacts of climate change, we provide critical data to inform the long-term management of the Antarctic toothfish fishery, and Southern Ocean ecosystems as a whole.
GENETICS OF BROWN BEARS INFORMS ADAPTATION TO HUMAN-DOMINATED LANDSCAPES

Oral Presentation

M.Ç. Kemahlı Aytekin, Ç.H. Şekercioğlu, İ.K. Sağlam

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Large carnivores are known for altering life-history strategies in response to environmental change. In eastern Türkiye, the availability of an open city dump has led to the emergence of sedentary and migratory bears which differ in their usage of human food sources. Understanding the genetic processes that have created these behavioral differences is crucial for predicting how anthropogenic pressures will affect wild carnivores in the future. We investigated the adaptive and genomic processes responsible for the two life-history strategies using genome sampling from captured bears in eastern Türkiye inserted with radio collars. We found that this population is highly differentiated and isolated from other world populations but contains high genetic diversity. We also determined several genomic regions and distinct genotypes associated with sedentary and migratory behavior. Outlier loci were associated with a number of transcript modifiers, including CCRL2, a gene that regulates immune response. Polygenic discrimination studies revealed 464 SNPs that actively discriminate between sedentary and migratory bears. Functionally, these 464 SNPs were associated with 514 genes that are highly represented in pathways regulating sensory and chemical stimuli to smell. These results provide insight into the genetics of adaptation of large carnivores to anthropogenic environmental change and will be critical for establishing new sustainable conservation strategies.

GENOMIC MONITORING TOOLS FOR POLLINATOR BIODIVERSITY CONSERVATION

Oral Presentation


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Over the past century, human activities have profoundly impacted Earth’s ecosystems, leading to a severe biodiversity crisis. Insect pollinators are crucial for the pollination of flowering plants and the production of human-consumed crops and are experiencing significant declines in diversity, density, and distribution. Monitoring the genetic diversity within pollinator species, which ultimately determines their adaptive capacity, is a crucial element of biodiversity conservation. Integrated within the Biodiversity Genomics Europe project (https://biodiversitygenomics.eu), this study focuses on model species from three pollinator groups - butterflies (Maniola jurtina), hoverflies (Syritta pipiens), and bumblebees (Bombus terrestris) - to develop intraspecific genomic monitoring tools. Populations across Europe were sampled, and whole-genome resequencing data will be analysed based on high-quality reference genomes for the model species. Population genomics will characterize the fine-scale genetic landscape of the species across Europe, and identify signals of adaptation across the diversity of European biomes and urban environments. This work will create reduced genomic representation toolkits for monitoring intraspecific genetic diversity, supporting the development of conservation strategies to protect this important group of organisms. It will also showcase the accessibility of these tools for broader application across pollinator species.

CONSERVATION GENOMICS OF ANODONTA FRESHWATER MUSSELS IN SWITZERLAND

Oral Presentation

J. Conrads¹, E. Faust², M. Giulio¹, G. Halstead-Nussloch³, P.G.D. Feulner², A.A.-T. Weber ¹

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Freshwater mussels (Unionidae) provide important ecosystem services. However, they are declining worldwide due to the combined effects of habitat degradation and destruction, climate change, pollution and invasive species. In Switzerland, there are three species of the genus Anodonta, the widespread A. anatina and A. cygnea, and A. exulcerata that is restricted to the southern part of the Alps. This study aimed to evaluate the vulnerability of Anodonta
populations and their metapopulation structure in Switzerland. Here we present a de novo reference genome for the duck mussel *A. anatina*, the first reference genome of the *Anodonta* genus. The assembly, based on PacBio HiFi data, is 2.84 Gb large and relatively complete (BUSCO score metazoa: C:91%, F:8%, M:1%) despite being fragmented (33,946 contigs). We then conducted a field campaign and collected non-lethally tissue samples of 423 *Anodonta* mussels (252 *A. anatina*, 153 *A. cygnea* and 18 *A. exulcerata*) from 32 populations occurring in lakes, ponds, rivers and streams. Our population genomic approach revealed strong genetic structure and low levels of connectivity among populations of the same species, as well as contrasting levels of genetic diversity among populations and species. Our study, informing about the vulnerability status of these three species, is particularly relevant in the context of the ongoing update of the Swiss mollusc IUCN red list and has therefore direct implications for management and conservation.

**ARTHROPOD GENOMIC BIODIVERSITY: MOULTING DYNAMICS IN CHANGING ENVIRONMENTS**

Poster Presentation

G. Campli ¹, R.M. Waterhouse²

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The record for species diversity is unarguably held by Arthropoda, a group comprising insects, crustaceans, centipedes, and spiders. Having one million described species, arthropods greatly impact planet health, playing key roles in virtually all ecosystems and representing ecological indicators, pollinators, and dietary resources. Behind their diversity is the shared presence of a modular exoskeleton, providing protection and opportunities for specialisations influencing their ecology. All arthropods need to undergo moulting, by periodically renewing the exoskeleton to allow tissues to grow and enabling larval stages and adults to occupy different ecological niches. In the light of dramatic arthropod declines, we seek to better understand a process fundamental for their biodiversity, a stressful yet essential act of development, which exposes animals to high mortality risk and to increased sensitivity to rising temperatures and global climate change. We take advantage of a large, high-quality dataset from whole-genome sequencing to investigate functional repertoire diversity. We characterise signatures of taxonomically and developmentally distinct lineages, through identification of variations in gene copy number and quantification of gene family dynamics. Our work provides the basis for comprehensive and systematic analyses to shed light on mechanisms of arthropod diversity beyond model species, to bridge arthropod development and ecology and inform conservation efforts.
THE CONSERVATION OF FOREST GENETIC RESOURCES THROUGH GENETIC DIVERSITY ANALYSIS

Poster Presentation

J.-H. Kim\textsuperscript{1}, J.H. Song\textsuperscript{1}, K.-S. Woo\textsuperscript{1}

\textsuperscript{1}National Institute of Forest Science, Forest Bioinformation Division, Suwon, Korea, Republic of Korea

Forest genetic resource reserves (FGRR) are essential zones within forests that require protection or management for the preservation of genetic diversity among plants or species, as well as forest ecosystems. To conserve the genetic diversity of forest species, the selection of target species is conducted, followed by an analysis of the genetic diversity within these target species, their intergroup relationships, and genetic structures. Genetic diversity analysis aims to confirm the variation within the entire population of target species by including as many groups as possible. Molecular markers such as microsatellite (SSR) markers are utilized for genetic diversity analysis, prioritizing groups with high genetic diversity. The next step involves conducting an analysis of intergroup relationships and genetic structures. During this process, priority is given to the conservation of a broader range of genetic variations by excluding groups that are closely related, even if they possess high genetic diversity. To designate the final candidate FGRR, ownership status is initially verified. Priority is given to designating new areas that are not state-owned or existing protected zones. Finally, the management criteria of the designated FGRR are presented for the maintenance of genetic diversity through an analysis of effective population size and spatial autocorrelation.

GENOMIC INSIGHTS INTO THE DECLINE AND RESILIENCE OF GRAYLING IN SWITZERLAND

Oral Presentation

E. Faust\textsuperscript{1}, J. Brodersen\textsuperscript{1}, A. Anh-Thu Weber\textsuperscript{2}, P. Feulner\textsuperscript{1}

\textsuperscript{1}Swiss Federal Institute of Aquatic Science and Technology (Eawag), Department of Fish Ecology and Evolution, Kastanienbaum, Switzerland, \textsuperscript{2}Swiss Federal Institute of Aquatic Science and Technology (Eawag), Department of Aquatic Ecology, Dübendorf, Switzerland

Biodiversity loss is an ongoing planetary crisis with far-reaching consequences for ecosystems and human society as a whole. Genomic data is pivotal in preserving biodiversity, identifying at-risk populations and understanding neutral and adaptive diversity. There is an urgent need to develop well-described procedures and simplified analytical pipelines. Here we focus on the European grayling (Thymallus thymallus) to develop a conservation genomics framework in freshwater. The specific habitat requirements across the graylings’ life stages have made it an important biological indicator species for riverine ecosystems. Unfortunately, this also makes the species very vulnerable, which has declined in many parts of its distribution. Here
we conduct the first whole-genome population genomics study of grayling using resequencing data of >200 fish from the four Swiss river basins. Results revealed clear divergence both between and within river catchments as well as signs of inbreeding, influenced by human-led translocations and natural spatiotemporal variation. Interestingly, contemporary hatchery fish significantly diverged from their wild counterparts. Overall, we show how genome-wide data can be effectively used within freshwater conservation frameworks despite a history of anthropogenic influence. Engaging with local stakeholders, our research aims to highlight the relevance of genomic insights for conservation management.

A RAPID ISORTHermal PLANT DNA IDENTIFICATION PROTOCOL USING MICRONEEDLE PATCHES

Oral Presentation

N. Adam¹, J. Selz¹, C.H.M. Alers¹, L.E. Wilhelm¹, M.E. Wettstein¹, T.C.R. Cañellas Rey De Vinas¹, S. Buerki², S.J. Maerkl¹

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Biodiversity identification and monitoring are the cornerstones of effective conservation strategies; however, the rate of ecosystem degradation has outpaced the time required for classical identification approaches. To address this race against time, we developed a novel isothermal pipeline to perform nanopore sequencing analysis in the field based on rapid gDNA extractions using microneedle patches. To validate the protocol, two sets of DNA analyses were performed on a wide range of species spanning different leaf anatomies and phylogenetic lineages: (i) fresh leaves were punched with custom microneedle patches to recover genomic DNA, or (ii) QIAGEN DNA extractions. Three plastid (matK, rbcL, trnH-psbA) and one nuclear ribosomal (ITS) DNA regions were amplified and prepared for sequencing (i) by recombinase polymerase amplification or (ii) by polymerase chain reaction and sequenced using nanopore technology. Both methods lead to the same plant identification by yielding the same DNA sequences. The proposed technique reduces extraction to 1 minute, and isothermal amplification reduces the process to 30 minutes, while minimizing manual handling and equipment needs. Our significantly faster and simpler method represents a transformative change in DNA extraction and field nanopore sequencing for botanical applications. Its adaptability to diverse plant species and compatibility with nanopore sequencing underscore its potential to advance both research and conservation efforts.

AN EASY-TO-USE TOOLKIT FOR MANAGERS USING GENOMICS IN BIODIVERSITY CONSERVATION

Oral Presentation
Once considered a “nice to have”, genomic data is fast becoming an essential item for informing and managing biodiversity conservation. Over the past decade, the development of genetic and genomic tools for conservation management have come forward in leaps and bounds. However, due to the complexity of the field, using genomic data for decision-making and monitoring remains beyond the reach of most managers and conservation biologists. The Threatened Species Initiative (TSI) was launched in May 2020 and is a program designed to generate genomic resources for Australia’s threatened species. Critical to the project is not only the generation of reference genomes and population genomic data but an online conservation hub for conservation managers. The hub is a “one stop shop” from collecting samples to generating and analysing genomic data, to an easily interpretable genetic management report using the genetic EBVs. The TSI biodiversity portal is a point and click web interface where you can pull in and align the raw sequence data, select the population genetic information you need for management decisions, and the system will run the analysis for you and produce a standardised report. In addition, there are training modules, short (10-15min) Youtube videos on everything from conservation genetics to genome assembly. We will present the current toolkit and provide case study examples for how it is being used to inform management decisions of Australia’s threatened species.

SIMULATIONS FOR MANAGEMENT DECISIONS: THE CASE OF THE ALPINE IBEX

Oral Presentation

I. Biebach 1, L. Keller1

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With an increasing number of extirpated, small, or fragmented populations in the wild, conservation translocations to reinforce genetically impoverished populations or reintroductions to formerly occupied habitat are becoming essential tools in biodiversity conservation and restoration. In the XIX century, Alpine ibex were restricted to only one surviving population in the Gran Paradiso region in Northern Italy. Over the past 100 years, successful reintroductions brought the Alpine ibex back to nearly all of its former habitat in the Alps. In a study that covered most Alpine ibex populations across the Alps, we found low genome-wide diversity and high inbreeding levels, and substantial effects of inbreeding on population growth rates. These results suggest that populations with high levels of inbreeding would likely benefit from...
reinforcements. To inform management decisions, we created a detailed genomic data set and combined it with life history data in individual-based simulations to predict the genetic outcome of reinforcements and reintroductions. We compared these predictions to empirical data from a recent conservation reinforcement in the Swiss Alps by estimating the extent of successful gene flow one generation after the translocation.

**EPIGENETIC SEX IDENTIFICATION IN ALDABRA GIANT TORTOISES**

Poster Presentation

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Wildlife conservation is at a critical juncture, with numerous animal species facing the threat of extinction due to human-made environmental factors. While genomics has advanced our understanding of neutral genetic diversity and long-term adaptive responses in endangered taxa, wildlife epigenetics, particularly in non-model species, remains understudied due to a scarcity of essential genomic tools. Aldabra giant tortoises, among the last two global giant tortoise species, face threats posed by climate change-induced sea level rise. Despite they show temperature-dependent sex determination, the molecular basis remains elusive. Using Oxford Nanopore sequencing, we conducted whole-genome DNA methylation profiling in over 50 Aldabra giants to identify differentially methylated regions. Our goal is to pinpoint epigenetic biomarkers for efficient sex identification in the wild, aiding captive colony management and ensuring the future viability of rewilded populations of this iconic reptile species.

**DEVELOPMENT AND UTILIZATION OF IN-SITU CONSERVATION METRICS**

Poster Presentation

*J.-H. Kim*¹, H.-K. Nam¹, K.-S. Woo¹, J.H. Song¹

¹National Institute of Forest Science, Forest Bioinformation Division, Suwon, Korea, Republic of

To minimize the subjective judgment of researchers in selecting forest genetic resource reserves, specific indicators for in-situ conservation were derived, and respective weights were applied to each indicator to select candidate sites for forest genetic resource protection, particularly focusing on Korean Stewartia (Stewartia koreana Nakai ex Rehder). The results showed that sub-indicators like genetic diversity (0.320) and rare genes (0.320) were equally prioritized within the genetic factors. As for ecological factors, species diversity (0.351) was the highest, connectivity (0.184) was the lowest. Among threats, climate change (0.291) held the highest weight, followed by development pressure (0.235), invasive species (0.181). For socio-economic
factors, the weights for landscape value were 0.361, followed closely by forest product harvesting (0.320), and forest cultural resources (0.319). Upon applying the detailed conservation indicators to six populations of Korean stewartia, the Bulmosan population exhibited the highest values within genetic factors, while the Unjangsan population scored highest in ecological factors, the Baegunsan population in threats, and the Unjangsan population again in socio-economic factors. Combining these three factors resulted in the Unjangsan population displaying the highest overall value, suggesting its designation as a forest genetic resource reserve.

RESILIENT GENOMES, SUSTAINABLE ECOSYSTEMS: INSIGHTS FROM THE IBERIAN HARE

Poster Presentation

J.P. Marques\textsuperscript{1,2}, B. Cardoso\textsuperscript{1,3,4}, J. Queirós\textsuperscript{1,2}, N. Santos\textsuperscript{1,2}, L. Farelo\textsuperscript{1,2}, J. Pinto\textsuperscript{1,2}, P. Esteves\textsuperscript{1,2,4}, F. Ballesteros\textsuperscript{5}, P. Acevedo\textsuperscript{3}, C. Gortazar\textsuperscript{3}, J. Pohjoismäki\textsuperscript{6}, J. Melo-Ferreira\textsuperscript{1,2,4}, P.C. Alves\textsuperscript{1,4,7}

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The Iberian hare (Lepus granatensis) plays a crucial role in the delicate balance of ecosystems and is an important game species in Iberia. Recent myxomatosis outbreaks has threatened the species’ persistence, causing high mortalities due to the Myxoma virus’ host jump from coexisting wild European rabbits. Our case study, developed in the frame of the Biodiversity Genomics Europe (BGE) and the European Reference Genome Atlas (ERGA) initiative, aims at unravelling genetic factors influencing the Iberian hare susceptibility and resistance to myxomatosis. Using cutting-edge genomic tools, our research aims to inform disease control, species conservation and management. The Iberian hare reference genome, a product of ERGA’s effort, serves as the foundation for our investigation. WGS data analysis will allow understanding how genetic diversity shaped resistance. In this BGE study, we analyse Myxoma virus-killed hares and those resisting the disease (with antibodies but without disease), using genome scans to identify candidate genes underlying susceptibility and resistance, to develop future intraspecific monitoring tools. Further analyses of unaffected neighbouring species will contribute to complete our understanding of myxomatosis resistance architecture. This work showcases the impact of ERGA and BGE in advancing genomic tools for biodiversity management, and how
cutting-edge genomic tools can provide essential tools to mitigate and control the spread of wildlife diseases.

**CAN CONSERVATION GENOMICS GUIDE SPECIES RECOVERY?**

Oral Presentation

*U. Ramakrishnan* ¹

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Despite international and national conservation legislation in the 1970’s, habitat loss and fragmentation continues, endangering species. While many species continue to decline, others are recovering, like wolves in Europe, and tigers in India. Technologies to sequence DNA were developed in the late 1970’s. More recently, the ability to sequence several genomes relatively inexpensively has resulted in an explosive amount of genetic sampling and monitoring. But how can genomic data aid conservation? Over nearly two decades, I have studied conservation genetics in the Indian subcontinent. Our research has identified isolated populations and connected landscapes, and factors that allow tiger movement and connectivity. We have identified mutations responsible for rare phenotypes like the black tiger, and highlighted inbred populations. We strive to translate the implications of our work to management and action for conservation. Further, we use genomic approaches to investigate multi-species connectivity, enhance understanding of at-risk populations, and better understand species biology for several endangered species including vultures, elephants, Dhole, Gaur and Sambar. In this talk, I will present these case studies, but also propose a way forward by which genomics can be better integrated into conservation action for endangered species.

**EXPLOITATION OF SOYBEAN GENETIC DIVERSITY FOR ITS IMPROVEMENT**

Poster Presentation

*Z. Ahmed* ¹, *R. Maqbool*¹, *F.S. Awan*², *R. Rehman*¹, *A.I. Khan*¹

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Soybean is a nutrient rich crop that offers a sustainable source of dietary protein and edible oil. Identifying the relationship between various genetic resources and the estimation of genetic diversity is very important in crop improvement strategies. With increasing human population and demand of soybean, it is necessary to evolve new varieties of soybean with higher yields, better nutritional quality, and resistance to stresses. This necessitates the use of genetic diversity and variability existing throughout the world. Unfortunately, breeding
has eroded very useful genetic variation present in soybean due to use of parents with same
genetic origin. In soybean, there are many wild species possessing genes for desired traits like
high yield, resistance to biotic and biotic factors. This genetic variation present in the wild
germplasm needs to be exploited using different techniques for developing improved soybeans.
Unfortunately, wild species of soybean have not yet been so largely explored and exploited.
There is need to identify the wild species and their accessions as source of genes for traits
conferring better nutritional quality and resistance to various stresses.

MONITORING GENETIC DIVERSITY: A GENOMICS-BASED PILOT STUDY
FOR SWITZERLAND

Oral Presentation

M.C. Fischer 1, O. Reutimann1, G. Ulrich1, K. Clivaz1, J.N. Tschan1, N. Zemp2, F. Gugerli3, R. Holderegger3, A. Widmer1

1ETH Zurich, Institute of Integrative Biology (IBZ), Zurich, Switzerland, 2ETH Zurich, Genetic Diversity Centre (GDC), Zurich, Switzerland, 3Swiss Federal Research Institute WSL, Birmensdorf, Switzerland

Genetic diversity is the raw material of evolution and is essential for species to adapt to
changing environments. To date, systematic monitoring of genetic diversity on a national scale
has rarely been undertaken. We have initiated a pilot study on genetic diversity monitoring
in Switzerland, with the aim of assessing genetic diversity indicators for five animal and plant
species, thereby gaining the practical experience necessary for setting up a genomics-based
monitoring programme. The five selected species occur in habitats of national importance
or in anthropogenically modified landscapes. We de novo assembled their reference genomes,
sampled >1,200 individuals across all biogeographic regions in Switzerland, and re-sequenced
their full genomes. For two species, we used a museomic approach to go back up to 200
years into the past. Together, these data enable detailed conservation-relevant analyses, not
only of genetic diversity, but also of runs of homozygosity (ROH) and estimates of effective
population size (Ne), and provide unprecedented insights into temporal changes in genetic
diversity in natural populations. With the experience gained, it is now possible to monitor
genetic diversity at a national scale. An ongoing challenge is to develop scientifically sound
but intuitive indicators, which can be effectively communicated to relevant authorities and
stakeholders for implementation in conservation management.
Governance in protected areas and local livelihoods

HOW HUMAN-ELEPHANT RELATIONS ARE SHAPED: A CASE STUDY IN XISHUANGBANNA, CHINA

Oral Presentation

F. Ba, X. Li, Y. Zhang, W. Shi, P. Zhang

1China Agricultural University, Beijing, China, 2Renmin University of China, School of Agricultural Economics and Rural Development, Beijing, China, 3Humboldt University of Berlin, Berlin, Germany

The conservation of nature is of paramount importance for preserving biodiversity. However, it can also give rise to conflicts and challenges for communities dependent on natural resources. In this paper, we focus on the issue of Human-Elephant conflict (HEC) in Xishuangbanna National Nature Reserve, China, and investigate the causal linkages between governance systems and HEC. Our research presents a comprehensive case study of a village located within the Xishuangbanna National Nature Reserve, delving into the intricate dynamics of human-elephant relationships spanning a three-decade period. Drawing on the integrated governance (IG) theory and actor-centered power (ACP) perspectives, we analyze the influence and interaction of three policy systems—Asian elephant conservation policy, agricultural development policy, and forestry policy—on the governance of HECs. Through our examination of power dynamics among multiple actors involved in policy formulation and those affected by policies, we aim to identify the driving forces influencing governance performance. We have identified noteworthy patterns of synergy and conflicting interests among agricultural, forestry, and elephant conservation policies, which have evolved at different stages of governance. The interplay between these policy systems significantly influences the habitat of wild elephants, the land-use patterns of adjacent communities, and the livelihood strategies adopted by local farmers.

UNLOCKING OECM POTENTIAL WITH INCLUSIVE GOVERNANCE: A FRESH APPROACH FOR NEPAL

Poster Presentation

K.P. Acharya

1Conservation Nepal, Kathmandu, Nepal

Nepal has achieved notable success in biodiversity conservation, primarily via its protected areas, which encompass 23.6% of the country’s land. Conservation is currently governed through three mechanisms: government-managed, community-managed, and non-governmental organizations. These governance systems have evolved and contributed significantly to conservation.
However, the adoption of Target 3 has introduced Other Effective Area-based Conservation Measures (OECMs) as a vital addition to conservation landscape. OECMs expand the conservation scope beyond traditional protected areas, necessitating innovative governance approaches to maximize their potential. The research underscores the pressing need for a new governance mechanism. Drawing from the invaluable lessons, experiences of the past and field consultations, it becomes evident that this new governing framework is essential to unlock the full potential of OECMs. Such a mechanism holds the key to ensuring that OECMs fulfill their fundamental role in advancing biodiversity conservation and sustainable development. Moreover, it promises inclusivity, where diverse stakeholders, spanning from local communities to governmental bodies and NGOs, actively participate in shaping the conservation landscape of Nepal. In doing so, it reinforces the core principles of equity, social justice, and collaborative action, all of which are essential for safeguarding Nepal’s rich biodiversity and securing a sustainable future.

RURAL TOURISM, COMMUNITIES AND TERRITORY: OPPORTUNITIES TO FACE CLIMATE CHANGE

Oral Presentation

G. Pérez

Technological Metropolitan University, Faculty of Economics and Administration, Santiago, Chile

Rural tourism is characterized by the active participation of local communities and a closer relationship with ecological systems. Usually, this tourism activity is generated near or within protected areas, where different dimensions present in local spaces interact: tourism resources, local knowledge, cultural heritage and development expectations. However, this tourism offer has not managed to incorporate sustainable practices that allow the construction of tourism products and a story that contribute to the restoration of ecosystems, building better response mechanisms in the face of climate change. One of the recurring situations points to gaps in the construction of governance, given that local communities require efforts from public institutions, companies, academia and other actors in the territory to generate better mechanisms for sustainability, climate action and restoration activities of the ecological systems with which they are related. Considering this background, we seek to analyze how to strengthen the actions of local communities to incorporate ecosystem restoration activities into their tourism offerings and generate stories that allow the construction of local development initiatives and enable better coordination between public and private actors and academia.

ECOCENTRIC GOVERNANCE IN ACTION

Oral Presentation
**L. Tucker**

Global White Lion Protection Trust, Hoedspruit, South Africa

The ASSEGAIA (Alliance for the Sacred Sites of Earth Gaia) Declaration, representing a critical shift in Earth governance, was launched at Davos BlockBase during the 2020 World Economic Forum. The Declaration calls on governments, institutions, and private sector companies to move from their egocentric (anthropocentric) approach to an ecocentric model, placing the regeneration of a living Earth at the center of all decisions. This model integrates core Indigenous Knowledge Systems with modern science, to offer an effective template for biodiversity restoration. Like a body’s vital organs, Sacred Natural Sites support the health of the whole organism (Gaia). The heart of the site must be a “No-Go Zone”, allowing biodiversity to flourish with minimal human interface. Surrounding the heart, “Thrive Zones” provide ecologically sensitive, livelihood-supporting activities; eg agroecology, eco-education, nature trails, interpretive and cultural heritage centers. Leading conservationist and founder of the Global White Lion Protection Trust, Linda Tucker, will speak into this model’s application to restore the biodiversity of wildlife alongside the cultural diversity of human life. The White Lion Heartlands, an ancient African Sacred Site in a UNESCO Biosphere, is one of ASSEGAIA’s founding Sacred Natural Sites, demonstrating the efficacy of the model. Linda will share firsthand knowledge and experience from a frontline conservation project that has put Nature first for over 20 years.

**IMPACT OF INSTITUTIONAL REFORM ON THE MANAGEMENT EFFICIENCY OF NNR-RAA**

Oral Presentation

**H. Liu**

1Renmin University of China, School of Agricultural Economics and Rural Development, Beijing, China

A national institution reform was carried out in China in 2018, in order to establish a unified protected area management system to improve the management efficiency. However, as a niche type of protected area, the National Natural Reserve for Rare Aquatic Animals (NNR-RAA) benefit limitedly from the reform, and even face new obstacles to its daily management. This paper focuses on the problems of NNR-RAA in the institutional reform and explores the reasons for the barriers. This study employed qualitative research method and examined the impacts of the institutional reform on the NNR-RAA in the Yellow River Basin through face-to-face interviews with management agency. We found that the institutional reform has hindered the improvement of the management efficiency of the NNR-RAA in the short term. In terms of function, the NNR-RAA have not yet adapted to the transformation of the management system, and the inclusion of new functions has affected the fulfillment of the original functions. In terms of concept, the authority and local people of different types of protected area have
different concept of conservation, and the passive conservation concept negatively affected the management efficiency of NNR-ARR. Moreover, the performance audit by the forestry and grassland system is not fully applicable to the aquatic system, which leads to a low score in performance, and further limiting on the allocation of funds and projects.

AREA-BASED BIODIVERSITY CONSERVATION AND ITS’ CONSEQUENCE

Poster Presentation

R. Wu

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The establishment of protected areas represents a potential solution to biodiversity crisis. However, the delineation of some protected areas in China is not entirely based on the scientific principles of biodiversity conservation. It has resulted in a series of impacts on the subsequent management of protected areas and the livelihoods of local communities. Therefore, this study conducted an in-depth qualitative investigation of the local communities in the Gahai Zecha National Nature Reserve in Gansu Province, building upon semi-structured interviews and employing a social-ecological system framework for analysis. The research reveals that the irrational allocation of protected area boundaries is a policy-led result. A larger area could be more easily promoted to a national-level protected area, further attracting more funding. Consequently, this led to challenges in protected area management and livelihoods of local residents, including the inefficient utilization of grassland resources, increased costs associated with the approval process and supervision of infrastructure development within the protected area, and negative feedback resulting from the escalating conflicts between the management bureau and the local residents. The study also discusses a series of measures adopted by the management agency to address the challenges caused by irrational area design. Overall, this research underscores the importance of a science-based approach to biodiversity conservation.

TRADE-OFFS BETWEEN LOCAL, REGIONAL & NATIONAL PROTECTED AREA PRIORITISATIONS

Oral Presentation

K. Dhanjal-Adams, E. Nic Lughadha, D. Silvestro, A. Antonelli

1Kew Royal Botanic Gardens, Millenium Seedbank Partnership, Haywards Heath, United Kingdom, 2Kew Royal Botanic Gardens, Herbarium, Richmond, United Kingdom, 3University of Fribourg, Biology, Fribourg, Switzerland
Species do not follow political boundaries. Yet, these boundaries shape biodiversity protection. Many conservation goals are agreed internationally, planned nationally, and implemented locally. Here, we use the reinforcement learning software CAPTAIN to investigate trade-offs between plans developed at national, provincial, regional, district, and commune levels, through a case study of endemic trees of Madagascar. We also investigate how splitting budgets between administrations might impact protected area patterns, whether split equally between administrations, or by human population size, by area or by biodiversity. We find that at smaller scales, protected area networks become more connected, with a larger number of smaller patches, but stronger edge effects. Despite these changes in protected area spatial patterns, 91.1–97.8% of species are consistently protected at all administrative levels except commune – whether administrations share budgets equally, by human population size, by area or by biodiversity. It is therefore possible to achieve similar conservation targets locally as nationally with the same budget. At commune level, allocating protection by species number safeguards 92.1% of species compared to 4.6–56% under other scenarios. Strategic investment can therefore enhance biodiversity protection at smaller scales, while empowering local communities to develop conservation plans that work for them.
Green and brown food webs & Understanding biodiversity and ecosystem functioning across ecosystem boundaries

STRANGE TIMES IN THE NORTH SEA: MARINE HEATWAVES AND FOOD WEB INTERACTIONS

Oral Presentation

**E. Puccinelli** ¹, G. Aarts², S. Brasseur², E. Couce³, G. Engelhard³, P. Hovenkamp⁴, E. Immler¹, L. Kleine Schaars¹, M. Leopold², D. van Oevelen⁴, B. Parmentier⁴, M.A. Peck¹, J. Pinnegar³, A. Tramper⁴, R. Witbaard⁴, K. Camphuysen¹

¹Royal Netherland Institute for Sea Research, Coastal Systems, Den Hoorn, Netherlands, ²Wageningen Marine Research, Den Helder, Netherlands, ³Centre for Environment Fisheries & Aquaculture Sciences (Cefas), Lowestoft, United Kingdom, ⁴Royal Netherlands Institute for Sea Research - NIOZ, Estuary and Delta Systems, Yerseke, Netherlands

The Dogger Bank is a biodiversity hotspot in the North Sea characterized by complex food web interactions including seabirds and seals foraging from land-based colonies. The North Sea is subjected to increasing anthropogenic pressures from oil and gas extraction, renewable energy, shipping, and climate change. We provide a multi-national collaborative case study of how multiple factors may synergistically influence the biodiversity and ecosystem functioning in regional seas. A multidisciplinary cruise conducted under the EU-ACTNOW programme made synoptic measurements throughout the food web, from plankton to fish, mammals, and seabirds. Measurements made during the cruise and telemetry data from land-based predators, including various seabirds and seals, were combined to focus our research on the most productive and heavily used offshore foraging grounds. The cruise co-occurred with the most intense marine heatwave ever recorded in the NE Atlantic. Such extreme seawater temperatures were reflected in changes in in-water physical and biological features including limited plankton production, unexpected distributions of fish, and major anomalies in species interactions and patterns in spatial foraging of top predators. We will showcase the benefits of such an holistic view in terms of forecasting how land-based predators may be influenced by anthropogenic pressures impacting offshore marine habitats.

CAN ARTIFICIAL FLOODS RESTORE CROSS-ECOSYSTEM LINKAGES?

Oral Presentation

**C. Kowarik** ¹, C.T. Robinson¹

¹Eawag (Swiss Federal Institute of Aquatic Science and Technology), Aquatic Ecology, Düben-dorf, Switzerland
Aquatic and terrestrial ecosystems are tightly coupled, with floods playing a crucial role in resetting ecosystems and maintaining biodiversity and ecosystem function. However, the use of streams for hydropower production involves keeping a constant residual flow below dams. The missing flow variability has a strong ecological impact, often leading to a dominance of non-emergent invertebrates. Artificial floods are used as a means to mitigate some of these effects and restore ecosystem integrity. This study investigated the effect of artificial floods on resource subsidies from aquatic to terrestrial systems. We compared the nutritional quality (fatty acid content) of periphyton over time following a flood event with a system maintained at a constant residual flow. We also assessed the export of nutrients by emergent aquatic insects. Our findings revealed that following the flood, periphyton biomass and insect emergence were reduced, however both recovered within a few weeks. We also observed higher stonefly emergence, an important subsidy pathway, in the system with a flood program. The results suggest that artificial floods can effectively reset ecosystems and promote connectivity to adjacent terrestrial areas by influencing nutrient quality at the base of the aquatic food chain and biomass export by emergent insects. These findings emphasize the significance of incorporating flood programs into stream management strategies to improve ecosystem integrity of riverscapes.

RIPARIAN FORESTS SHAPE TROPHIC INTERACTIONS IN DETRITAL STREAM FOOD WEBS

Oral Presentation

R. Oester 1, F. Altermatt 2, A. Bruder 1

1SUPSI, Institute of Microbiology, Mendrisio, Switzerland, 2EAWAG, Department of Aquatic Ecology, Dübendorf, Switzerland

Freshwater and terrestrial biodiversity is linked through resource flows. For example, subsidies from the riparian vegetation form the base of food webs in small streams. On the one hand, the riparian vegetation mediates the timing, quality and quantity of plant material that falls into streams, on the other hand, shading influences in-stream primary production. While detritus can contribute to stability of ecosystem functions and to high consumer biodiversity, it is often nutrient poor and of low nutritional quality. Despite the key role of detritivores in these food webs, consequences of altered resource availability and riparian vegetation type on their trophic strategies are largely unknown. Therefore, we experimentally tested direct and indirect effects of riparian vegetation type on trophic interactions and dietary imbalances of detritivores. We used stoichiometric and isotopic differences between consumers and resources as functional measures of trophic link strength. Our results show that the lack – compared to the presence – of riparian forests directly affected both stoichiometric and isotopic differences in detrital food webs, yet with diverging patterns between resources and consumers, ultimately leading to aquatic-terrestrial decoupling. Consequently, our findings demonstrate that riparian forests
are essential for aquatic food webs by influencing both organisms and trophic interactions networks.

QUANTIFYING SEASONALITY OF META-ECOSYSTEM FLUXES IN TEMPERATE ECOSYSTEMS

Oral Presentation

E. Cereghetti¹, T. Peller¹, S. Käser², I. Gounand³, F. Altermatt¹

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Forests and streams are very different ecosystems and yet they are tightly coupled by flows of materials and organisms. Plant litter in particular has been recognized as a fundamental subsidy to freshwater ecosystems, which in turn, process large amounts of detritus worldwide, maintaining the cycling of nutrients and carbon across ecosystems. The meta-ecosystem framework was conceptualized to advance our understanding of the ecological significance of such flows, however, much of the understanding derived from this framework overlooks temporal dynamics and assumes flows to be constant across time. Most ecosystems possess strong phenological signatures, especially in highly seasonal climates, and temporally-resolved quantifications of these flows are strongly needed. Here, we conducted a 14 month long investigation at two small-forested stream catchments. We investigated vertical inputs, lateral transport (forest to stream), potential downstream transport (via water discharge) and in-stream and forest-floor decomposition of leaf litter. We observed distinct seasonal patterns of resource flows and processing rates of detritus, and consider how these are interlinked across time. Our findings suggest that we urgently need to address the temporal dimension of meta-ecosystem dynamics, so that we might recognize and mitigate the consequences of global change on the functioning of ecosystems.

SHIFTS IN MICROBIAL DIVERSITY AND FUNCTIONS DURING CATCHMENT SUCCESSION

Oral Presentation

J. Schreckinger¹, M. Mutz², L. Gerull², M. Gessner³, A. Frossard ⁴

¹University of Koblenz and Landau, Mainz, Germany, ²Brandenburg University of Technology Cottbus-Senftenberg, Cottbus, Germany, ³Leibniz Institute of Freshwater Ecology, Berlin, Germany, ⁴Swiss Federal Research Institute WSL, Birmensdorf, Switzerland
Landscape resets, rebuilt after complete land-use destruction, are opportunities to gain fundamental knowledge on changes of biodiversity and ecosystem functions during ecosystem primary succession. To assess changes in the structure and functions of microbial communities in ephemeral stream sediments and adjacent soils over 10 years of early-ecosystem development, we took advantage of a newly-created 6-ha experimental catchment. Since its construction, the catchment has developed in undisturbed conditions undergoing significant transformations in geomorphology, hydrology, and vegetation cover. Our results reveal that catchment development significantly changed sediment and soil microbial community structure and functions. Initially dominated by autotrophic cyanobacteria, the bacterial community was predominantly heterotroph 10 years later, accompanied by a rise in microbial respiration and extracellular enzyme activities. Microbial functions showed intensified seasonal patterns, which were less pronounced for the microbial community structure. However, microbial diversity and functions, which were largely decoupled at the early successional stage, became more tightly linked along with catchment development. Overall, a decade of catchment development enhanced spatial heterogeneity of microbial community and functioning, intensifying differences between ephemeral stream sediments and adjacent soils.

**BEAVER ENGINEERED HABITATS LINK LAND-WATER ECOSYSTEMS**

Oral Presentation


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Conservation action for freshwater biodiversity is needed due to losses in habitat area and quality. Restoration of freshwater habitats is challenging because it is costly to recreate natural dynamics. Ecosystem engineering by beavers could support these restoration efforts and restore land-water ecosystem linkages. Construction and foraging activities of beavers create mosaic-like habitats, which have been documented to increase local biodiversity. However, effects on terrestrial and communities at the land-water boundary are largely unknown. Our research is designed to explore the potential of beavers as conservation agents at the land-water boundary. We hypothesise that beaver activities change biodiversity patterns in aquatic and terrestrial communities, increasing overall landscape diversity while providing resource hotspots for other organisms. Our results suggest context-dependent effects on different species communities and ecosystems. For instance, while fish and bat communities showed higher abundance and species
richness in most beaver-engineered systems, arthropods showed a more complex response. Further statistical analysis helps to understand these responses in contexts like human influence and the potential for biodiversity conservation with beaver activities. The results of this study can provide a baseline for future evidence-based aquatic ecosystem conservation while deepening the understanding of beaver-engineered land-water ecosystem processes.

CHANGE IN FISH FEEDING GUILDS ACROSS MARINE ECOSYSTEMS

Oral Presentation

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International efforts to assess the status of marine ecosystems have been hampered by insufficient observations of food web interactions across many species, their various life stages, and geographic ranges. Hence, we collated data from multiple databases of fish stomach contents from samples taken across the North Atlantic and Arctic Oceans containing 944,129 stomach samples from larvae to adults, with 14,196 unique interactions between 227 predator species and 2158 prey taxa. We use these data to develop a data-driven, reproducible approach to classifying broad functional feeding guilds and then apply these to fish survey data from the Greater North Sea, Celtic Seas, Bay of Biscay, Iberian Coast, and the wider Atlantic between 1997-2020 to reveal spatial and temporal changes in ecosystem structure and functioning. Our aim was twofold, to generate empirical estimates of fish feeding traits that could help improve understanding of changes in marine ecosystem structure and functioning; and to achieve international consensus for an approach to assessing feeding guilds across ecosystems within the OSPAR Maritime Area in a way that can be readily extended to other areas (e.g., Northeast US continental shelf) and organisms (e.g., invertebrates and mammals).

RIPARIAN ZONES: KEY-ELEMENTS FOR TERRESTRIAL & FRESHWATER BIODIVERSITY

Oral Presentation

R. Schinegger ¹, G. Gruber¹, U. Laa², C. Seliger³

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Riparian zones represent important transitional areas between land and freshwater ecosystems which provide a multitude of ecosystem services and support the objectives of several European directives and policy initiatives (e.g., Biodiversity Strategy (BS), Water Framework Directive, Habitats and Birds Directive). Due to multiple anthropogenic uses, they are often highly impacted and restricted in terms of their expansion and dynamics. Based on the BS, more than 25,000 km of free-flowing rivers and their linked floodplains and wetlands have to be connected and restored by 2030. To reach that goal, strategies for prioritization, restoration and conservation are needed. Within the Horizon Europe project “NaturaConnect”, we combine spatial data from River Basin Management Plans, Copernicus riparian zones and land-use data, IUCN red lists & biodiversity data, protected areas and floodplains in a GIS-based modelling approach for the Danube-Carpathian region. With an integrative analysis, we identify multiple human stressors, biodiversity values and current conservation status of actual and potential riparian zones and their biological assets. The detailed assessment can support the formulation of restoration activities to target BS goals better and serves the protection of both freshwater and terrestrial biodiversity by contributing to secure an ecological network of green and blue infrastructures with vital ecosystems across Europe.

**CROSS-BORDER DIVERSITY AND BIOMASS: PHYTOPLANKTON DYNAMICS IN THE WADDEN SEA**

Oral Presentation

**J. Antonucci di Carvalho** $^{1,2}$, **L. Rönn**$^3$, **T. Prins**$^4$, **H. Hillebrand**$^{5,6,2}$

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Our study addresses critical aspects of biodiversity and ecosystem functioning across ecosystem boundaries, focusing on coastal marine ecosystems. We analyzed long-term monitoring datasets from German and Dutch coastal stations, integrating species biomass information to assess phytoplankton community changes in the Wadden Sea. Our findings reveal a decrease in biodiversity, measured as the number of species and the effective number of species, in Dutch stations over the past two decades, coupled with an increase in biomass. This indicates a trend towards fewer species becoming more dominant. In contrast, German stations did not exhibit significant changes in biodiversity or biomass. Despite some cross-border differences, shifts in community composition and relative abundance were consistent, underscoring the importance of harmonized monitoring programs and multi-metric approaches in detecting environmental changes. Our research highlights the dynamic nature of ecosystem linkages and their implications for biodiversity conservation and ecosystem management strategies.
INVASIVE SPECIES DRIVE CROSS-ECOSYSTEM EFFECTS WORLDWIDE

Oral Presentation

T. Peller 1,2, F. Altermatt 1,2

1University of Zurich, Zurich, Switzerland, 2Eawag: Swiss Federal Institute of Aquatic Science and Technology, Dubendorf, Switzerland

Invasive species are pervasive around the world and have profound impacts on the ecosystem they invade. Invasive species, however, can also have impacts beyond the ecosystem they invade by altering the flow of non-living materials (e.g., nutrients, chemicals) or movement of organisms across the boundaries of the invaded ecosystem. Cross-ecosystem interactions via spatial flows are ubiquitous in nature, for example, connecting forests and lakes, grasslands and rivers, and coral reefs and the deep ocean. Yet, we have a limited understanding of the cross-ecosystem impacts invasive species drive relative to their local effects. By synthesizing emerging evidence, we demonstrate the cross-ecosystem impacts of invasive species as a ubiquitous phenomenon influencing biodiversity and ecosystem functioning around the world. We identify three primary pathways by which invasive species have cross-ecosystem effects: firstly, by altering the magnitude of spatial flows across the boundaries of invaded ecosystems, secondly by altering the quality of spatial flows, and thirdly by introducing novel spatial flows. Ultimately, the strong impacts invasive species can drive across ecosystem boundaries suggests the need for a paradigm shift in how we study and manage invasive species around the world, expanding from a local to a cross-ecosystem perspective.

MULTIPLE STRESSOR EFFECTS ON STREAM BENTHIC COMMUNITIES, FOOD WEBS AND PROCESSES

Oral Presentation

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Environmental change results in multiple stressors acting simultaneously to affect stream communities, food-webs, and ecosystem functioning. We examined the single and interactive effects of four common agricultural stressors on a New Zealand stream food-web: nutrient enrichment, deposited fine sediment, flow velocity reduction, and a nitrification inhibitor. Our experimental setup with 128 stream-fed outdoor channels allowed natural colonisation by benthic organisms from a nearby stream and independent stressor manipulations. We studied responses of the brown (decomposition of two distinct litter species, FPOM, fungi, and shredders) and green
(algae and grazers) compartments of the benthic food web. Although additive stressor effects dominated community and ecosystem responses, some stressor interactions were relevant. Slower flow velocity reduced deciduous litter decomposition, fungal biomass, and algal biomass. Deposited sediment reduced algal and invertebrate biomass but accelerated evergreen litter decomposition. The food-web perspective in our analyses revealed unexpected resource pathways and stressor interactions. Fine sediment and flow reduction showed strongest additive effects on several organism groups and processes and were also relevant for shifts in trophic links in the food web. Our findings emphasize the relevance of these stressors and of a food-web perspective for the management of stressors in small streams.

TERRESTRIAL LAND COVER SHAPES FISH DIVERSITY IN MAJOR SUBTROPICAL RIVERS

Oral Presentation


University of Zurich, Zürich, Switzerland, EAWAG, Dübendorf, Switzerland, Chiang Mai University, Chiang Mai, Thailand, Research Institute on Terrestrial Ecosystems (IRET), Lecce, Italy, The Freshwater Biological Association, Cumbria, United Kingdom, University of the Highlands and Islands, Inverness, United Kingdom, ETH Zürich, Zürich, Switzerland, WSL, Birmensdorf, Switzerland

Freshwater biodiversity is critically affected by human modifications of terrestrial land use and land cover (LULC). Yet, knowledge of the spatial extent and magnitude of LULC-aquatic biodiversity linkages is still surprisingly limited, impeding the implementation of optimal management strategies. Here, we compiled fish diversity data across a 160,000-km² subtropical river catchment in Thailand characterized by exceptional biodiversity yet intense anthropogenic alterations, and attributed fish species richness and community composition to contemporary terrestrial LULC across the catchment. We estimated a spatial range of LULC effects extending up to about 20 km upstream from sampling sites, and explained nearly 60 % of the variance in the observed species richness, associated with major LULC categories including croplands, forest, and urban areas. We find that integrating both spatial range and magnitudes of LULC effects is needed to accurately predict fish species richness. Further, projected LULC changes showcase future gains and losses of fish species richness across the river network and offer a scalable basis for riverine biodiversity conservation and land management, allowing for potential mitigation of biodiversity loss in highly diverse yet data-deficient tropical to sub-tropical riverine habitats.
WARMING UNDERPINS COMMUNITY TURNOVER IN FRESHWATER AND TERRESTRIAL COMMUNITIES

Oral Presentation

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Rising temperatures are leading to increased presence of warm-affinity species in ecosystems, known as thermophilisation. However, factors influencing variation in thermophilisation rates among taxa and ecosystems, particularly freshwater communities with high diversity and high population decline, remain unclear. We analysed compositional change over time in 7,123 freshwater and 6,201 terrestrial mostly temperate communities from multiple taxonomic groups. Overall, temperature change was positively linked to thermophilisation in both realms. Extirpated species had lower thermal affinities in terrestrial communities but higher affinities in freshwater communities compared to those persisting over time. Temperature change’s impact on thermophilisation varies with community body size, thermal niche breadth, species richness and baseline temperature; these interactive effects were idiosyncratic in the direction and magnitude of their impacts on thermophilisation, both across realms and taxonomic groups. While our findings emphasize the challenges in predicting the consequences of temperature change across communities, conservation strategies should consider these variable responses when attempting to mitigate climate-induced biodiversity loss.

EFFECTS OF DIVERSITY AND WARMING ON LEAF LITTER DECOMPOSITION IN MESOCOSMS

Oral Presentation

B. Drost ¹, M. Ilic¹, C. Schubert², M. Gossner¹

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The interactions between horizontal and vertical diversity on ecosystem functioning and the effects of a warming climate in different habitats remain unclear. An ecosystem function that can be measured both in aquatic and terrestrial habitats is leaf litter decomposition, as leaves from trees are also a common resource in aquatic habitats. In order to test these diversity effects, a controlled mesocosm experiment was carried out concerning leaf litter decomposition. The mesocosms were either aquatic or terrestrial on with ambient or increased temperature and contained leaf litter from beech (Fagus sylvatica), oak (Quercus robur), alder (Alnus glutinosa) or all three mixed. Moreover, either no invertebrates, one species (aquatic: Gammarus fossarum, Asellus aquaticus or Planorbis planorbis; terrestrial: Porcellio scaber, Oniscus asellus or Discus rotundatus) or three species were added. Lastly, a subset of the mesocosms with oak leaf litter was not inoculated with fungi, while all other mesocosm were inoculated. In
total, there were 100 different treatments, which were replicated 5 times. The outcome of this experiment can lead to valuable insights about how diversity and climate change and their interactions can influence leaf litter decomposition.
Green and brown food webs & Understanding biodiversity and ecosystem functioning across ecosystem boundaries

THE SYMBIOSIS OF ECOSYSTEMS IN THE SANTA MARIA WATERSHED

Poster Presentation

A. Pascual

1Fundación CoMunidad, Director, Panama, Panama

The Santa Maria Watershed, has an extension a territory occupies a total area of 3326 km², with a length total of 168 km, representing 4.56% of the land of Panama. It is located between the provinces of Veraguas, Herrera, Cocle and the indigenous region of Ngäbe Bugle, identified as one of the country’s priority catchments it represents a water source for more than 200,000 people living in 15 Local Governments. The water that’s flow in the system of rivers of Santa Maria Watershed, is generated by physical, chemical and biological characteristics from mountain, grassland and wetland ecosystems, from the source of the river in the upper part, passing through the urban centers and until it drains into the sea, there are multiple landscapes that intervene, are linked and depend of each biome for work together. The complex forests that shape the Santa Maria Watershed are a network diverse ecosystem which are categorized within six protected areas of Panama: Santa Fe National Park, La Yeguada Forest Reserve, Alto Guarumo Forest Reserve, and Sarigua National Park, Mangrove of Cenegon and Multiple use space of las Macanas Swamp, covering a total of more than 89 thousand hectares. Fundación CoMunidad, Non-Government Organization, based in Panama, has been researching since 2017 and 2022 we began the implementation of the project Resilience Action Plan for Santa Maria Watershed, that linkages between the ecosystems, water and people on the region adopting an integrated approach.

SPLITTING UP E-DNA: OPPORTUNITIES FOR A MORE RELIABLE BIODIVERSITY MONITORING

Poster Presentation

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The analysis of environmental DNA (eDNA) revolutionizes biodiversity monitoring by assessing organismic diversity at unprecedented large scale and taxonomic detail. However, spatially and temporally correct allocation of data is still challenging, eventually leading to false positive results. In my research, I am investigating the utility of separating environmental DNA into extracellular (exDNA) and intracellular (iDNA) fractions for enhanced ecological
insights. As both fractions can experience differential persistence in the environment, they bear individual information about their spatial and temporal origin. By subjecting samples to sequential washings, exDNA and iDNA are separated and subject to DNA extraction and downstream analyses. The easy and convenient approach has the potential to deepen sampling, reduce false-positive detections in eDNA monitoring and potentially reveal microbial activity and physiological state. Most importantly, we argue that it may also help in distinguishing autochthonous from allochthonous DNA by introducing the four-scenario concept that categorizes sampling sites based on environmental conditions determining differential persistence of eDNA fractions.

**CONSERVING ORINOQUIA: A DYNAMIC MOSAIC OF ECOSYSTEM MANAGEMENT**

Poster Presentation

*E.A. Hincapie Peñaloza* ¹

¹Cataruben Foundation, Biodiversity, Yopal, Colombia

In this study, we explore the connectivity of different ecosystems within the macro-basin of Orinoquia. Our focus is on 545,117 hectares of different ecological landscapes in this region, with an emphasis on the management of private lands. The comprehensive approach includes several initiatives: the Paramuno Initiative targets moorland and high mountain ecosystems on 120,000 hectares; the CO2Bio projects address 217,701 hectares in floodplain savannas, piedmont and gallery forests; and the combined efforts of ORINOCO2 and CultivO2 are dedicated to managing 207,416 hectares in savannah and agroforestry systems. These initiatives are notable for engaging private landowners in ecosystem management, who play a critical role in the region’s conservation efforts. Our approach illustrates the interconnected effects of conservation activities in different ecosystems, such as the influence of peatland conservation on floodplain savannas and gallery forests. The study highlights the critical flow of materials and organisms between these ecosystems, emphasizing their impact on biodiversity and ecosystem functioning. We address the challenges of transboundary ecosystem conservation and propose recommendations to improve conservation practices across ecosystem boundaries. The need for a holistic, multidisciplinary approach to conserve ecosystem linkages and manage spatial cascades of disturbance is emphasized, advocating for collaborative and joint action.

**THREATENED BIRDS IN SAUDI ARABIA: THEIR CONSERVATION REQUIREMENTS**

Poster Presentation

*M.Z. Islam* ¹

¹Saudi ARAMCO, Env. Biodiversity Division, Dhahran, Saudi Arabia
Saudi Aramco has an important role to play in protecting birds in Saudi Arabia, where over 550 species have been recorded and 362 have had their global population trend confidently assessed in a book called ‘Birds of Saudi Arabia’ published by Saudi Aramco in 2020. Portentously, 52 of all species are declining 19 species are considered globally threatened, and 24 are near-threatened. Two of these species are Critically Endangered, namely Sociable Lapwing occurs at several places and Slender-billed Curlew has not been recorded in the last 30 years. Considerably, one of the most threatened species is the Asir Magpie endemic to the south-western highlands (Asir mountains) and to get more ecological details, Saudi Aramco supported research on it that would help in managing the remaining dwindling population and its fragmented habitats. Four species may already be extinct within the country, namely the Arabian Bustard, Bateleur, Bearded Vulture, and Northern Bald Ibis. In line with Vision 2030, Saudi Aramco’s overarching Biodiversity Protection Policies include the promotion of habitat and species conservation where birds are protected from an array of threats present in the wider landscape. Saudi Aramco conserves threatened and unique avifauna through its conservation policies by implementing effective conservation measures and raising public awareness, establishing Biodiversity Protected Areas (BPAs) to ensure the survival of threatened birds and keeping the common birds common.
How to balance biodiversity and forest management?

MANAGING FORESTS TOWARDS BIODIVERSITY OR NET ZERO GOALS? A SWISS CASE STUDY

Poster Presentation

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Switzerland has an ambitious 2050 “net-zero carbon” law that requires drastic CO2 emission reductions. The Swiss construction sector accounts for (directly and indirectly) around 40% of national CO2 emissions. Timber engineering and construction have a great potential to reduce these emissions by sequestering carbon in productive forests, storing it in long-lived buildings, and thus substituting carbon-intensive materials (e.g., concrete, steel), and by reducing energy-related emissions in the built environment. However, this requires a different forest management, which may have consequences for forest biodiversity. Within the MainWood project, we develop projections of forest growth and wood production in Switzerland under anticipated climate change and for four forest management scenarios, ranging from a focus on high biodiversity to high wood production. Using the dynamic process-based model ForClim, we assess the tree species’ climate suitability and growth dynamics and quantify the effect of these scenarios on wood production by species and assortment. For all scenarios, C sequestration as well as the simulated effects on other ecosystem goods and services such as biodiversity are assessed. We evaluate the trade-offs associated with different forest cover, forest management, and wood production strategies. Focusing on specific case study regions in Switzerland, these results are discussed with a variety of stakeholders to assess preferences with respect to trade-offs.

USING BIODIVERSITY TO IMPROVE FOREST MANAGEMENT

Oral Presentation

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The idea of a tradeoff between goals of production and conservation in managed ecosystems including forests has dominated science and application for a long time and is still prevalent in many places. However, experimental and empirical work carried out over the past decades, first in grassland and now more and more often in forest ecosystems, shows that the tradeoff idea does not generally apply and in many cases balancing biodiversity and management can lead
to win-win situations. To demonstrate this, I will review results spanning the range from forest biodiversity experiments to comparative studies across global forests. Mechanisms underlying the observed positive relationships between biodiversity and ecosystem functions in forests include functional complementary between species (division of labor in resource uptake and defense), dominance effects, and multi-trophic diversity. Knowledge about these mechanisms may be used to select promising species mixtures for afforestation. In addition, mixtures should be planted choosing genotypes with high mixture performance within species.

REVIVING PEDUNCULATE OAK: CLIMATE-CHANGE INDUCED FOREST MORTALITY AS NEW CHANCE?

Oral Presentation

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The light-demanding regeneration of Pedunculate Oak (Quercus robur L.), a key species for forest biodiversity in Central Europe, is currently hampered by homogenized environmental conditions in dense forests. The prevailing high tree mortality under climate extremes may change this situation. Using a meliorated floodplain forest as model system, our project investigates how recent canopy mortality may support management approaches for oak regeneration and how these influence understorey and soil microclimate. For two years, we measured microclimatic air and soil conditions and monitored the development of planted oaks along gradients of over- and understorey tree density resulting from a combination of (single-)tree mortality and management interventions (cuttings up to 0.7 ha). Higher openness in over- and understorey increased mean soil moisture and temperature fluctuation. The monthly mean differences between cuttings and closed forest peaked in the dry summer 2022 with 12.6 % volumetric soil moisture, 2.3 °C soil temperature and 1.9 °C air temperature. Thinning the understorey enhanced oak growth and vitality, especially under high overstorey mortality, indicating improved light and microclimatic conditions compared to unthinned forest or cuttings. The results provide insights into the dynamics of a floodplain forest and support the development of evidence-based nature conservation strategies as complementary measures to a hydrological revitalization to promote Q. robur.

FOREST ASSOCIATED FRESHWATER ORGANISMS THE SCALE OF THE CONTERMINOUS US

Poster Presentation

G. Bury 1, R. Flitcroft 2
Freshwater aquatic biodiversity is vulnerable to, and highly affected by, human activities. Freshwater aquatic biodiversity varies at local, regional, and national extents in response to geologic history, ecogeomorphic conditions, and upland vegetation composition. Accurate analysis of biodiversity vulnerability and potential resilience of aquatic species to landscape-scale change requires continuous spatially explicit datasets. Here, we focused on forest distribution and forest-associated freshwater taxa. Forests are a key large-scale vegetation community which respond to anthropogenic impacts such as timber harvest, wildfire management, and climate change. There are few studies that use large datasets to determine forest association of freshwater aquatic biodiversity. We used HUC8 scale ranges of all native species of aquatic-dependent fish, amphibians, reptiles, mussels, and crayfish, and determined their co-occurrence with forested areas. In the conterminous United States, areas of high aquatic biodiversity and forest association are clustered in the southeast and along the northern coasts. Aquatic organisms associated with low-forested areas are found primarily in the southwestern and central plains. The patterns caused by forest management will have important implications for long term persistence of freshwater biodiversity, especially as both animals and habitats interact with climate change.

GLOBAL IMPACTS OF FOREST MANAGEMENT AND RESTORATION ON BIODIVERSITY OVER TIME

Oral Presentation

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Sustainable forest management and restoration could mitigate impacts of forestry and degradation on biodiversity outside of protected areas. Yet, little is known about recovery times nor the vegetation structural properties underlying impacts on biodiversity. Through an expansion of three meta-analysis-based global databases with data on forest management, time since impact and vegetation structure, we aim to better understand effects of 11 management and restoration systems on animal biodiversity, expressed in three biodiversity indicators. In line with previous studies, we show that biodiversity values for selective logging are closest to those of undisturbed forests, whereas those of plantations are furthest away. We found variable values across biodiversity indicators for agroforestry. Effects of selective logging on biodiversity remain stable over 50 years. Biodiversity in clear cutting systems is relatively high following harvest, after which it declines and rises again between 30 to 70 years. Agroforestry systems display a gradual biodiversity increase between 0 and 30 years following establishment. Biodiversity variations within management systems may relate to vegetation structure, with positive effects of basal area in plantation systems and tree diversity in restoration systems.
Our results highlight the need to consider temporal and vegetation structural effects to prevent under- or over-estimations of biodiversity effects of forest management and restoration.

BIODIVERSITY IN BARK BEETLE-DISTURBED MOUNTAIN PROTECTIVE FORESTS

Oral Presentation

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Mountain forests host part of the Earth’s terrestrial biodiversity but are subject to increasing disturbances. The amplification and possible interconnection of forthcoming disturbances underscore a fundamental requirement to better understand the effects of disturbances and related management on suitable habitats for forest biodiversity. Here, we examined the impact of European spruce bark beetle disturbance and subsequent management on the occurrence and diversity of tree-related microhabitats in spruce-dominated mountain protective forests in the canton of the Grisons in Switzerland. Tree-related microhabitats were documented in circular plots with a radius of 12.62 metres. These plots were situated within areas influenced by bark beetle disturbance, as well as in neighbouring undisturbed areas. Our results show a higher prevalence of tree-related microhabitats within disturbed areas in comparison to undisturbed sites (with 82 and 42 microhabitats on average, respectively). Galleries, holes, and bark loss were mainly observed within areas affected by bark beetle disturbance. A specific example is the “bark shelter”, a microhabitat primarily attributed to the presence of dead trees following bark beetle infestations. It is an important microhabitat for bats, providing them a place to rest and mate. Thus, the bark beetle disturbance created tree-related microhabitats, consequently enhancing the availability of suitable habitats for forest biodiversity.

A BIODIVERSITY INDEX TO ASSESS THE SPATIAL CONNECTIVITY OF HABITAT TREES

Oral Presentation

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Forests are among the most complex ecosystems on Earth and provide a multitude of goods and services to society. Anthropogenic pressure and climate change compromise their integrity, leading to forest depletion. To balance multiple ecosystem services, especially timber production and biodiversity conservation, old-growth forest structures have assumed an increasing role, particularly Tree-related Microhabitats. Although numerous studies have been conducted on Tree-related Microhabitats and habitat trees, the influence of their spatial distribution within forest stands is still poorly explored. This study aims to introduce the TreMs Spatial Index (TSI), a new biodiversity index based on the spatial distribution of both Tree-related Microhabitats and habitat trees. The TSI is composed of three ratios: i) frequency of habitat trees and trees; ii) observed TreM richness and total number of TreMs according to a hierarchical classification; and iii) ratio between the average distance of all trees and the average distance of habitat trees. The index was tested in several forest types across Europe through the EU marteloscopes network. The index results versatile, truthful, and very easy to implement in whatever forest type. In addition, providing significant insights into the spatial connectivity of habitat trees, the Index can support forest managers to optimize the integration of biodiversity within silvicultural practices.

SPIDER COMMUNITIES AS INDICATORS OF LAND-USE CHANGE IN GHANA

Oral Presentation

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Forest conversion is particularly acute in West Africa and causes losses of about 3.4 million ha yearly. Ghana has an estimated 9.17 million ha of rainforest; However, forest resources are lost faster than in other developing countries, with threats through agriculture, logging, infrastructure development, and mining. Spiders are valuable indicators for rehabilitation success in forests and successfully facilitate by regulating insect pests often associated with agricultural or disturbed ecosystems. We evaluated the taxonomic diversity of ground-dwelling spiders across a habitat gradient ranging from the primary forest (Asukese forest reserve) to agroforestry plantation (Bosomkese) and restored forest (Tain II restoration area) in the Ahafo region of Ghana to understand their structural complexity as indicators of overall arthropod diversity. Of the twenty-three (23) families sampled, Lycosidae, Zodariidae, Ctenidae, and Salticidae, respectively, made up the bulk of the spiders. Spider abundance and diversity increased with undisturbed forests. This can indicate that land-use affects ground-dwelling spiders and, subsequently, all arthropod diversity. And restoration activities can speed up the
rate of recolonization and regeneration. The propose further sampling of higher and canopy-
dwelling spiders to make appropriate conclusions on the effects of land-use on spiders and
hence other arthropods.

OPTIMAL CONTROL STRATEGIES FOR MITIGATING BARK BEETLE
OUTBREAKS

Poster Presentation

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Bark beetle outbreaks threaten coniferous forests, causing economic damage and potential loss
of ecosystem services. While previous theoretical research has extensively explored outbreak
dynamics, relatively little attention has been given towards identifying optimal management
actions to mitigate their impacts. We address this gap by utilising optimal control theory to
devise effective strategies for controlling bark beetle outbreaks. Expanding a model by Krivan
et al. 2016, we incorporate various bark beetle control and outbreak management approaches
and evaluate their efficacy individually and in combination, determining the optimal balance
between active and preventive management. Additionally, we introduce the inclusion of a non-
susceptible tree species to enhance the forest stand’s overall resilience against beetle attacks
in the long term. For our case study, we consider a forest consisting mainly of Norway spruce,
Picea abies, susceptible to the European spruce bark beetle (Ips typographus). Our findings
provide insights into the most effective approaches for mitigating and controlling bark beetle
outbreaks. The methods presented contribute to informed decision-making and can be a
complementing tool to enable stakeholders to make proactive and sustainable management
decisions.
Insights from the past for a better future

ASSESSING THE RISING ECOSYSTEM NOVELTY OF THE ANTHROPOCENE BIOSPHERE

Oral Presentation

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The concept of novel ecosystems has been discussed for more than a decade to describe ecosystems that have an altered species composition and function, such that the community has crossed a threshold forbidding a return to its historical state. While spatial and temporal community compositional change has been well studied, classifying modern novel ecosystems tend to classify novelty based on a static baseline. Given that the abiotic and biotic drivers of novelty are in a state of rapid change, reaching levels unprecedented within the last hundred thousand to million years, defining such a threshold requires additional thought. In this study we explore how novelty can be defined in an environment undergoing global change. We assess the degree to which a modern ecosystem is novel using measures of non-native plant species (invasion) and extirpated mammal species (defaunation). We then map the temporal variation in key climate variables, comparing the natural variation experienced by a site over the last 800,000 years to modern and near-future conditions, as well as the change in human-associated drivers. By comparing these indicators, we can examine how the potential transition of a system to a novel state is affected by both the history of an area and the choice of temporal baseline. Finally, we suggest pathways through which the emergence and spread of novelty can be further explored, understood, and managed beyond the perspective we offer here.

HIGH-PRECISION MAMMAL MASS FROM SKELETAL REMAINS USING FUTRES ONTOLOGY DATABASE

Oral Presentation

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FuTRES (Functional Trait Resource for Environmental Studies), an ontology-based data repository, stores and retrieves vertebrate trait data, aiding research in conservation biology and paleobiology. By enabling the exploration of trait distributions across species, space, and time, it empowers scientists to address process-based inquiries. This knowledge store, akin to GenBank for genetic data, offers standardized trait data at the individual specimen level, enhancing the discoverability of new observations. To illustrate new approaches enabled by FuTRES, we developed transfer functions for precise body mass estimation in mammals using common dental and skeletal measurements. Traditionally, such analyses were limited to a few dozen specimens, but FuTRES leverages a dataset of over 2 million observations. By applying transfer functions to approximately 200 Otospermophilus beecheyi individuals and utilizing body length data from 10,000 more in the VertNet database, we have significantly reduced uncertainty in body mass estimates. This boosts our ability to predict body mass distributions in ancient ecosystems, a crucial factor in assessing anthropogenic impacts on Earth’s biosphere and emergent ecosystem properties. FuTRES plays a pivotal role in advancing our understanding of these ecological dynamics.

UNRAVELING THE ROLE OF TEMPERATURE IN NEOSELACHIAN EXTINCTION EVENTS

Oral Presentation

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Neoselachians (comprising modern sharks, rays, and skates) make up one of the most ecologically diverse marine vertebrate lineages in modern oceans. However, causes and mechanisms of extinction events during their long evolutionary history are poorly constrained. Following recent calls in Palaeontology for the application of causal inference approaches to the fossil record, we applied a Bayesian causal inference model within a structural equation modelling framework to a novel compilation of fossil neoselachian occurrences, aiming to move beyond documenting patterns towards processes of extinction. We show that the severity of extinction in neoselachians is strongly tied to global temperatures. Specifically, we found extinction risk to increase as global temperatures decrease, with extinction risk being 66% higher during hypothermals than during periods of substantial warming. This negative temperature-extinction relationship was consistent for 150 million years and across various temporal and taxonomic scales and can be linked to metabolic strategies of individual species. We additionally find that species highly susceptible to temperature changes in the geological past are less at risk of extinction in modern oceans based on the IUCN Red List. We therefore provide a particularly
compelling example of unbiased extinction processes inferred from the fossil record that can be informative for modern conservation efforts.

RECONSTRUCTING HISTORICAL FISH RECORDS IN LAKES USING SEDIMENTARY DNA

Oral Presentation

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The recovery of DNA preserved in the sediment of aquatic systems (sedDNA) has provided short-term and long-term data on biological groups (e.g., bacteria, phytoplankton, zooplankton, and fishes) and has advanced our understanding of how environmental changes have affected aquatic communities. Here, we demonstrate the use of fish sedDNA from lake sediment cores in reconstructing the history of fish occurrence in five lakes within the Oil Sands region in Alberta, Canada. A general fish and eight targeted qPCR-based eDNA assays for freshwater fish species (cisco, lake whitefish, northern pike, chain pickerel, burbot, rainbow trout, lake trout, and walleye) were rigorously designed and validated. With these tools in hand, we detected sedDNA from several fish species in sediment cores spanning over a century, which aligned with conventional fish surveys, Indigenous Knowledge, and historical records of human-mediated introductions. The use of fish sedDNA provided greater temporal resolution into the historical fish faunal records, bridging the knowledge gap that spanned from 100- to 150-year-old data. The present study also allowed documentation of human-mediated introductions of fish populations to the examined lakes. These findings can be used to refine native freshwater fish ranges and clarify the influence of human-mediated introductions on fish diversity in lakes, providing essential baseline data for conservation management and environmental impact assessments.

ORDINATION OF EURASIAN MAMMAL COMMUNITY STRUCTURES PAST, PRESENT AND FUTURED FUTURE

Oral Presentation

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Contemporary extinctions are driving the loss of functional diversity in modern communities relative to faunas pre-dating human impacts. We quantify differences in community composition between today’s terrestrial mammal faunas and fossil sites from the last 2.6 million years in order to identify where extinctions result in communities without historic functional analogs. Such differences may be driven by sampling biases in the fossil record, human-driven extinctions, and climate change. We evaluate each of these drivers of change in community structure; first, by quantifying size- and diet-biases in the fossil record at Eurasian sites in the NOW database of fossil mammals. Next, we employ Generalized Linear Latent Variable Models to create 2-dimensional ecospaces based on mammalian body masses and diets within communities derived, for modern samples, from the PHYLACINE and Eco-ISEA3H databases. These ecospaces visualize the magnitude of community structure change caused by Late Pleistocene extinctions and the geography of where future communities with projected extinctions will result in non-analog trait structures. Finally, we employ ecometric models relating modern mammal body mass distributions to climate, which have been developed for paleoclimate reconstructions. We instead apply these models to projected future climate change, yielding spatially-explicit estimates of community changes that could track existing trait-environment relationships.

ALIGNING PALEOBIOLOGY RESEARCH WITH CONSERVATION PRIORITIES: A SHARK PERSPECTIVE

Oral Presentation

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Humans have dramatically transformed ecosystems over the previous millennia and are causing a mass extinction comparable with the other five that shaped the history of life. Conservation actions to halt extinctions are however somewhat limited because they are based on short-term trends. Conservation paleobiology is an emerging field that uses geohistorical records to offer a long-term perspective on biodiversity changes in the face of human impacts. However, the on-the-ground contributions of paleobiology to conservation outcomes are still developing. Here, we present an overview of directions in which conservation paleobiology research could progress to aid conservation in the coming decades using elasmobranchs (sharks, rays, and skates), a highly threatened group with a rich fossil record, as a model. Four research topics emerged that align paleobiological research agendas with open questions in conservation: 1) baselines, 2) ecological roles, 3) threats, and 4) conservation priorities. We explore how a new dataset on elasmobranch fossil occurrences can aid conservation priorities (theme 4) by using a deep learning approach to test the extent to which species’ longevity (i.e. time from origination) can be used to predict the IUCN extinction risk status of species. Our work
highlights opportunities to apply the fossil record to conservation, with our new analyses having the potential to complement current conservation schemes.

FOSSIL ASSEMBLAGES SHOW NO TEMPORAL TREND IN LOCAL SPECIES RICHNESS

Oral Presentation

**M.C. Rillo**¹, M.T.C. Sugawara², D.V. de Latorre³, A. Tomašových⁴, A. Penny⁵, E. Dowding⁶, E.E. Saupe⁷, S. Finnegan⁸, P. Hull⁹, & BioDeepTime Project⁶

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Although humans are undoubtedly degrading biodiversity globally, analyses of neoecological (i.e., modern) assemblage time series consistently detect no systematic trend in temporal alpha diversity (e.g., species richness) within local communities. These time series, however, typically span only several decades, raising the question of whether this pattern is a result of the inevitable short time scale of neoecological observation. Using the recently published BioDeepTime database, we analysed 1,756 paleontological assemblage time series spanning the last 97 million years to investigate how local diversity is changing over deep time. We quantified patterns of temporal alpha diversity using Hill numbers, coverage-based sample standardisation, and time series models typically used for trait evolution. We find that fossil assemblages do not show a temporal trend in alpha diversity. Most fossil diversity trajectories fluctuate around their mean richness through time, which is consistent with either constant or random models of evolution. Temporal scaling of the time series (temporal extent and average time-step) do not seem to explain the support for the different models. Our results suggest that richness trajectories alone are insufficient to quantify local trends in biodiversity change in deep time. Other dimensions of biodiversity, such as compositional change and evenness, are necessary to fully grasp past, and future, biodiversity change.

MODELING THE PAST PRESENT AND FUTURE OF BIODIVERSITY USING AI

Oral Presentation
Throughout the long evolutionary history of life, species of all kingdoms have undergone staggering diversification and faced countless environmental changes and extinction events. Yet today, with over a million species threatened with extinction, biodiversity is facing unprecedented challenges, urging the need for conservation policies that maximize its protection and sustain its manifold contributions to people. Here I present a suite of new methods aimed to quantify biodiversity and help guiding conservation efforts using artificial intelligence. Specifically, I will present deep learning models to estimate spatial patterns of species richness today and to model the evolution of biodiversity through time using fossil data. I will showcase the use of machine learning models to evaluate the extinction risk across thousands of species, complementing the Red List compiled by the International Union for Conservation of Nature (IUCN). Finally I will present a reinforcement learning framework to guide conservation efforts and predict the outcomes of different implementations of the 30 by 30 biodiversity framework. Artificial intelligence holds great promise for improving our understanding of the evolutionary dynamics shaping biodiversity patterns and for optimizing conservation efforts in a rapidly changing and resource-limited world.

Climate Change is an Important Predictor of Extinction Risk on Long Timescales

Oral Presentation

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Anthropogenic climate change is occurring at an unprecedented rate, and the magnitude of that change is expected to rival levels that characterize Earth’s largest extinction events. The fossil record provides the unique opportunity to robustly test the interplay between extrinsic and intrinsic drivers of extinction under extreme climate change scenarios. We present the first integrated approach examining the role of potential intrinsic and extrinsic drivers in mediating extinction risk over the past 485 million years using state-of-the-art climate models to reconstruct physiological traits and localized climate change. We found that geographic range size, body size, realized thermal preference, realized niche breadth, and the magnitude of climate change are all necessary to predict extinction risk for taxa. Our results suggest that taxa previously identified as extinction resistant may still succumb to extinction if the magnitude of climate change is great enough.
PAST AND FUTURE GLOBAL DIVERSITY LOSS FROM ANTHROPOGENIC BIRD EXTINCTIONS

Oral Presentation

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Understanding how extinction has occurred in the recent past is crucial to identify the main drivers of this process and design effective conservation practices to minimize global biodiversity loss. Here we quantify all known bird extinctions related to human impacts, since the Late Pleistocene (130,000 years ago), including species only known from fossil material. We then project future extinctions and quantify the changes in functional and phylogenetic diversity caused by avian extinctions in different periods of time. We show that at least \(~600\) bird species have gone extinct, \(80\%\) of which are island endemics. These extinctions have caused a disproportionate loss of the global avian functional space along with \(~3.3\) billion years of unique evolutionary history. Despite the dramatic magnitude of these numbers, these represent very conservative estimates. By employing inference techniques, we quantify how many species might have gone extinct ‘undiscovered’ (not yet discovered or left no trace), and show that at least \(~1,300 – 1,500\) bird species (\(~12\%\) of the current diversity) have been lost. Projected future extinctions indicate a comparable loss of avian functional diversity within the coming centuries alone. These results highlight the dire consequences of the current biodiversity crisis and the urgent need to identify the ecological functions being lost due to species extinction.

THE MULTIFACETED NATURE OF THE AFRICAN MEGAHERBIVORES DECLINE

Oral Presentation

J.L. Cantalapiedra\textsuperscript{1}, I.A. Lazagabaster\textsuperscript{2}, F. Blanco\textsuperscript{3}, F. Bibi\textsuperscript{4}, M. Ríos\textsuperscript{5}, B. Mennecart\textsuperscript{6}, J. Saarinen\textsuperscript{7}, T. Hauffe\textsuperscript{8}, D. Silvestro\textsuperscript{3}, O. Sanisidro\textsuperscript{9}

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Diversity crises are complex events where abiotic and biotic factors typically intertwine to render the patterns observed in the fossil record. Using uni-variable approaches to investigate such events likely yields biased perspectives on the mechanisms driving diversity collapses. In
the examination of the Plio-Pleistocene decline of the megaherbivores, the exclusive emphasis on the extinction selectivity linked to a sole trait (i.e. body mass) may have impeded a thorough understanding of both the ecological processes and the precise timing of this event. We reread the fossil record of African herbivores, and use diversification models based on neural networks to tease apart the contribution of environmental change, body mass and phylogeny. Disparate speciation potential was more decisive than lineage-specific extinction at reshaping African herbivore faunas. Species proliferation shows a clear phylogenetic signal, and is suppressed in lineages of larger mass, especially as atmospheric CO2 concentrations (pCO2) decreased (a trend linked to the expansion of C4-route plants). Extinction patterns are mainly shaped by decreasing pCO2, with small-size lineages showing substantially higher extinction acceleration. Our findings underscore that diversity crises and turnover events involve not only changing extinction risks but critical interplays between environmental disruptions and speciation potential.

**OCEANIC FISH COMMUNITY ECOLOGICAL AND EVOLUTIONARY DYNAMICS IN A HOTHOUSE WORLD**

Oral Presentation

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The open ocean and deep-sea habitat is estimated to contain ~90% of fish biomass in the modern ocean, yet the ecological and evolutionary dynamics of the these ecosystems are poorly understood, as monitoring efforts are challenging in the vast and remote open ocean. The deep-sea sedimentary record provides a unique, high-resolution record of open ocean ecosystems in deep time, combining environmental conditions reconstructed from geochemical proxies with a robust microfossil record that includes representatives from primary producers up to consumers. Here we investigate the ecological and evolutionary dynamics of fish communities from the Late Cretaceous, across the Cretaceous-Paleogene (K/Pg) mass extinction, and during the intervals of extreme warmth of the Early Eocene, leveraging the microfossil ichthyonolith (fish tooth and shark scale) record in deep-sea sediments. We find that fish and shark community productivity – the abundance of fish and sharks in the ocean through time – is temporally decoupled from fish diversity dynamics, with intervals of high speciation distinct from intervals of high abundance. Further, we find that while overall extinction across the K/Pg event was low, stable Cretaceous fish communities were significantly disrupted at the mass extinction, only stabilizing again during extreme greenhouse conditions. Overall, this suggests that open ocean fish communities are able to adapt to significant environmental disruption on geologic timescales.
UNDERSTANDING HOW PALEOENVIRONMENTAL UNCERTAINTY AFFECTS ECO-EVOLUTIONARY MODELS

Oral Presentation

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Spatially explicit eco-evolutionary models have provided a powerful tool to understand the relationship between contemporary biodiversity patterns and past geologic and climatic events. The dynamic behaviour studied within these models depends upon user-defined landscapes and environmental parameters that underpin the accuracy of the simulations (Eyres et al. 2021). The newly developed general engine for eco-evolutionary simulations (gen3sis) offers a modular framework to study the relationship between geologic, biologic, and environmental drivers on species-level processes (Hagen et al. 2021), potentially allowing for mechanistic inferences on how contemporary biodiversity patterns may change due to anthropogenic climate change. This project set out to constrain the uncertainty between alternative paleoenvironmental landscapes and simulation outputs, recognizing the importance of accurate paleoclimate reconstructions for simulation models. This was accomplished by comparing simulations initialized using case study paleoenvironmental landscapes released within gen3sis to an alternative landscape developed from the HadCM3 family of climate models (Valdes et al. 2017). Quantifying uncertainty between simulation outputs could then be used to understand the impact of alternative paleoclimate reconstructions on model outcomes. Understanding this uncertainty is crucial if eco-evolutionary processes are to be inferred from gen3sis simulations.

BIODIVERSITY BIOMASS INTERACTIONS IN LEADING AND TRAILING BOREAL FOREST EDGES

Oral Presentation

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Anthropogenic climate change is causing global changes in the biosphere. Future biome shifts, such as the expansion and retraction of boreal forests, are undisputed and will lead to changes in biodiversity. The direction and magnitude of these changes are often uncertain. Additionally, an asymmetry in the speeds of forest expansion and retraction could cause diverse interactions of biodiversity and biomass at the different biome boundaries. Even though boreal forests are already changing, the short length of modern observations impedes conclusions to be drawn from recent data. Using a novel harmonized pollen data set, LegacyPollen2.0, we investigate the relationship between biomass and biodiversity in the boreal forest biome during the Holocene. We make use of reconstructed forest cover to infer past biomass and connect it to compositional information to unravel the relationships between biomass, biodiversity, and
forest cover trajectories and uncover whether an asymmetry between interactions at leading and trailing edges exists. Improving this understanding of past dynamics will aid predictions of future changes in boreal forest biodiversity and help increase awareness of potential extinction debts or opportunities for increasing biodiversity through conservation and management.

POLAR ECOSYSTEMS EVOLUTION: INSIGHTS FROM THE ORDOVICIAN OF MOROCCO AND FRANCE

Oral Presentation

G.J-M Potin¹, F. Saleh¹, L. Lustri¹, P. Gueriau¹, J. Pople¹, A.C. Daley¹

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Exceptional fossil preservation enhances our understanding of ancient ecosystems by providing a record of soft-bodied organisms lacking a biomineralized structure. Sites containing such fossils offer valuable insights into past animal ecosystems, particularly during the Cambrian and the Ordovician, (~500 million years ago), when most modern animal phyla appeared and diversified. However, a significant challenge arises as most of these preservation sites are associated with paleotropical and temperate ecosystems, leaving a notable gap in our knowledge regarding past polar regions. Addressing this knowledge gap is crucial for comprehending the evolution of animal life on Earth, especially since the Early Ordovician was characterized by elevated temperatures, warmer than those experienced today, with little to no ice at the poles. This study explores two recently discovered Early Ordovician fossil sites with soft-tissue preservation located in Morocco and France, both previously situated on the margin of the Gondwana continent within the paleopolar circle. The Moroccan site reveals an exceptionally diverse assemblage of marine animals, showcasing numerous biotic interactions. The French site exhibits a diverse assemblage dominated by sponges, arthropods, and algae. Through the examination of these ancient communities, this research delves into their ecological aspects, contributing to a coherent understanding of how animals adapted to warm environmental conditions in deep times.

DROUGHT, FIRE AND EXTINCTION IN THE LATEST PLEISTOCENE, CALIFORNIA, USA

Oral Presentation

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Late Pleistocene faunas preserved in the asphaltic traps at Rancho La Brea, Los Angeles, CA, record the extinction of the North American megafauna in Southern California. We obtained 172 new radiocarbon dates for eight megafaunal taxa spanning ~16 to 10 ka. Seven species of extinct megafauna disappeared by 12.9 ka, prior to the onset of the Younger Dryas. Beginning ~14 ka, herbivore populations began to decline with browsers disappearing first. From 13.25-13.0 ka, a precipitous decline of all megafauna occurred, resulting in complete extirpation/extinction by 12.9 ka. Sedimentological, geochemical, pollen and charcoal records from nearby Lake Elsinore provide key insights about climatic shifts and the impacts of warming and drying on vegetation and fire of the region. These data, in combination with estimates of human demographic growth based on radiocarbon dates from continental archeological records, provide an unrivaled record spanning the event. Pollen data show decreased tree cover and increase in xeric plant taxa concurrent with the herbivore decline. The precipitous decline and disappearance of all megafauna species coincided with rapid warming, a severe drought ~250 years in duration, and a dramatic spike in wildfire activity. Time series modeling implicates large-scale fires as the primary cause of the extinctions; we argue that the catalyst of this state shift was mounting human impacts and fire ignitions in a drying, warming and increasingly fire-prone ecosystem.

AGE-DEPENDENT EXTINCTION IN MODERN SHARKS, RAYS AND SKATES (NEOSELACHII)

Oral Presentation

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Are ancient taxa more or less likely to survive than those newly emerged? Determining the role of age (i.e. time elapsed since origination) in extinction risk can provide key insights
for the understanding biodiversity patterns. However, our current knowledge remains inconclusive. While past studies have proposed that age determines extinction in some lineages, others have found no evidence for age-dependancy. Here, we assess age-dependant extinction in neoselachians (modern sharks, rays and skates and their extinct relatives) using a novel neural network model and an unprecedented dataset of fossil occurrences spanning the last 145 Myr. We found evidence of age-dependant extinction through time, with young species consistently being more likely to go extinct regardless of the extinction magnitude and timing. Extinction probability were higher during the first 0.5 Myr from origination, and gradually decreased as species aged. Overall, the identification of age as one of the mechanisms of extinction selectivity intrinsic to neoselachians provides novel insights into the evolutionary history of a group that is highly threatened today.

PAST CLIMATE ANALOGUES TO UNRAVEL FUTURE: INSIGHT FROM THE FORAMINIFERAL RECORD

Oral Presentation

R. D’Onofrio 1, S. Armeli Minicante1, F. Boscolo Galazzo2, L. Capotondi3, L. Consorti4, E. Di Russo1, L. Ferraro5, G. Filippi6, L. Giordano5, L. Giusberti7, V. Luciani6, G. Margaritelli8, S. Sigismondi6

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The long-term ecosystem dynamic and resilience during past climatic events showing similarities with present climate changes (global warming, deoxygenation, ocean acidification), recently gained significant attention in science, politics and society. Foraminifera are marine protists abundant in the fossil record and highly sensitive to the chemical, physical and trophic variations of the seawater, thus representing a key group to infer the link between climate and biotic response. Here we present a variety of case studies recording major assemblage changes across crucial paleoclimatic warming events in Earth history. By combining geochemical proxies and micropaleontological data it is possible to build a comprehensive scenario of the paleoecological, paleoceanographic and paleoenvironmental changes occurred across the selected paleoclimatic events. Our outcomes provide essential information about the impact and rates of pronounced warming on foraminiferal communities and related carbonate production, to decipher possible future implications on the biogeochemical cycle. These data are relevant to quantify biodiversity loss and to develop appropriate conservation measures. Last
but not the least, the available data will allow us to contribute to the development of the European Research Infrastructure DiSSCo (Distributed System of Scientific Collections), making information accessible and thus enhancing the role of foraminiferal records.

PAST RECORDS DEFINE SPECIES RECOVERY BASELINES AND IMPROVE FUTURE PROJECTIONS

Oral Presentation

**J. Hansford**\(^1\), E. Saupe\(^2\), S. Turvey\(^1\), B. Li\(^3\), M. Grace\(^4\), H. Ma\(^1\), I-T. Tu\(^5\), G. Varnham\(^6\), P. Mannion\(^6\)

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Ecological Niche Models (ENMs), crucial in conservation planning, typically depend on recent data (50 years old). However, given that current species’ distributions likely reflect long-term anthropogenic disturbances, use of only recent data is likely to lead to misunderstood niches and erroneous conservation directions. The IUCN Green Status of Species has set a pre-industrial baseline to define recovery objectives, for which we present the first example in the development of a workflow: incorporating archival, zooarchaeological, and fossil remains of the Critically Endangered Chinese alligator into ENMs. Presently, the Chinese alligator’s distribution is constrained to a single province in China; however, older archives record a broader past distribution. As this rich record spans the mid-Holocene to the present day, we applied multi-temporal calibration of the ENM to account for climate and range shifts. This augmented past range significantly improves the accuracy of our predictive ENMs, including projections under future climate scenarios, through improving spatial and niche completeness. Moreover, it helps mitigate a common pitfall associated with ENMs, especially with range-retracted species: a tendency to overfit when data representing niche completeness are sparse. Our findings underscore the importance of leveraging past archives in developing species baselines and the need to consider the dynamic nature of species distributions in defining conservation objectives.

ESTIMATING EXTINCTION VULNERABILITY USING INTRINSIC RISK AND CURRENT THREATS

Oral Presentation

**P. Harnik** \(^1\)

\(^1\)
Efforts to assess the conservation status of extant species are limited by the availability of population timeseries, with many marine and non-target species consequently classified as data deficient. Analysis of extinction dynamics in the fossil record can potentially mitigate this issue by documenting how related taxa, and taxa with similar characteristics, fared during past intervals of environmental change. Drawing upon case studies of several marine clades, including bivalve mollusks, corals, and sharks, I will review how paleontological data can i) ground truth criteria currently used in conservation assessment, ii) identify additional criteria that could be incorporated into future assessments, and iii) provide intrinsic risk estimates for extant taxa when combined with modern data. Using paleontological models of intrinsic risk to estimate the vulnerabilities of extant taxa, however, requires an understanding of how intrinsic risk interacts with current biodiversity threats. This understanding is currently incomplete, and is distorted by uneven sampling; current risk is better understood for exploited species whereas past risk is better understood for non-target taxa. I will conclude by outlining directions for future research that focus on assessing the relative contribution of intrinsic risk to current vulnerability, and consequently the contribution of the deep-time fossil record to global conservation.
Insights from the past for a better future

HARNESSING HISTORICAL DATA SOURCES FOR THE CONSERVATION OF AFRICAN BIRDS

Poster Presentation

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Species conservation has long focused on preventing human-driven extinctions. Measurement of changes to species extinction risk in the past few decades have relied upon utilisation of vast data repositories, such as GBIF. Although these tools are critical in facilitating modern conservation efforts, they possess strong limitations concerning spatial and temporal coverage which limits their potential for analysis of species distributional change by obfuscating true baseline conditions. Historical data, spanning diverse repositories such as atlas collections, field notes, and literature records, offer invaluable insights into past avian distributions, behaviours, and ecological dynamics. Here we leverage previously undigitised historical data sources in order to discern baselines and track range changes. Rapid, accurate, and repeatable data derivation from atlas-style sources has been achieved through the use of advanced computer vision approaches. These approaches can both detect data points and classify them in an unsupervised learning environment, thereby rapidly accelerating historical data tabulation. The historical context provides a nuanced understanding of how human activities, climate change, and habitat alteration have shaped avian communities over time. It will allow for an effective pursuit of avian conservation strategies across sub-Saharan Africa as both direct human footprint, and wider anthropogenically-induced climate change increase in their impact.

UNDERSTANDING BIODIVERSITY OF ANCIENT ECOSYSTEMS THROUGH DECAY EXPERIMENTS

Poster Presentation

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Studying the biodiversity of past ecosystems is important for understanding evolution. The fossil record, although essential, is biased towards hard tissues such as bones and shells, while soft tissues such as the body walls of arthropods, annelids, and cnidarians are rarely preserved. To better understand the preservation potential of biodiversity, decay experiments are conducted under controlled laboratory conditions to constrain the factors involved in the early stages of fossilization. Abiotic factors in the environment, such as the present sediment, can influence the preservation potential of biological tissues after the death of an organism.
However, the specific role of sediments on dead and decaying animals is largely unexplored. Here, we investigate the decay of marine shrimps deposited on three different clay substrates. Our results show that kaolinite reduces bacterial diversity in comparison to other sediments. In this study, kaolinite is the only clay to aid the mineralization of soft tissues, stabilizing their morphology over geological times. Therefore, through this dual role, kaolinite likely favors soft-tissue preservation in ancient ecosystems. The absence of kaolinite from a certain fossiliferous site might mean a lower fidelity of preservation and a biased understanding of paleodiversity.

MOULTING IN ARTHROPODS: FROM DEEP TIME TO THE PRESENT DAY

Poster Presentation

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Moulting, the process through which arthropods shed their old exoskeleton to allow for growth, metamorphosis and repair, is important for gaining insight into their vast diversity. Moulting is a physiologically and morphologically demanding process, making arthropods exceptionally vulnerable during this phase. Understanding how moulting patterns have evolved across major arthropod groups and over time can provide invaluable insight into this behaviour. Fossil evidence of moulting, dating as far back as the early Cambrian, offers information into various aspects of this process. For example, through fossils, we can deduce the location of the opening through which arthropods exited the exoskeleton and the behaviours they used to do so, the number of times they moulted, and the morphological changes that occurred between moultst. We present an exploration of new methodologies to differentiate moultst and carcasses in a Cretaceous freshwater decapod. We also present a collaborative effort to build a multidisciplinary database integrating genomic, developmental, and paleontological data on arthropod moulting, here with a focus on the latter. Through this work, we can synthesise this information and explore associations with broad-scale evolution and development of global environments, to gain a better understanding of how diversity in moulting behaviour is connected with ecological settings.

THE MIDDLE TRIASSIC ECOSYSTEMS AS A LABORATORY FOR MARINE FOOD WEB RESEARCH

Poster Presentation

A. Torchet¹, J. Shaw², T. Scheyer³
Food webs are among the most crucial and challenging subjects of study in ecology. The current biodiversity crisis make the study of food webs, past and present, even more pressing. The Middle Triassic period represent a crucial point between the Permian Mass Extinction event and the modern marine ecosystems. The Monte San Giorgio (MSG) lagerstätte near Meride (Canton Ticino, Switzerland) represents a central fossil Lagerstätte featuring a complex community made of marine reptiles, fishes and invertebrates. Here, we use some newly produced data on the trophic networks of the Monte San Giorgio fauna to present a complete ecological profile of the MSG animals and we use these results to propose keys of reflection on how to better predict food web reactions to environmental crisis.

**CANOPY RESPONSE TO GREENHOUSE WARMING AT THE PALEOCENE-EOCENE THERMAL MAXIMUM**

Poster Presentation

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In a rapidly warming world, the response of vegetation—its composition and structure—critically impacts terrestrial processes, biodiversity, ecosystem function, and food security. Uncertainty remains about how anthropogenic carbon emissions and attendant warming will impact forest ecosystems and carbon reservoirs in the future. To better understand these processes, we track forest canopy density and plant compositional change in fossil forests of south-central Wyoming, USA, through the Paleocene-Eocene Thermal Maximum (PETM). The PETM was an interval of abrupt global warming 56 million years ago brought on by exogenic carbon emissions approaching that of modern anthropogenic emissions. We quantify Leaf Area Index (LAI) using a new proxy from leaf epidermal cell morphology, and floral composition using pollen. Forest canopies opened abruptly at onset of PETM warming and shifted from angiosperm to fern and palm dominance. On average, PETM forests are 37% more open than late Paleocene forests and 50% more open than early Eocene forests. The opening of vegetation during the PETM increased erosion and altered stream hydrology. These patterns suggest continental-scale changes in plant communities caused landscape destabilization, and have broader implications for multi-millennial scale hydrologic and carbon cycle feedbacks in the climate system. Counter to carbon fertilization hypotheses, we show that high atmospheric CO2 can negatively effect terrestrial primary production.
EVALUATING SPECIES' POTENTIAL TO PERSIST AND DIVERSIFY USING THE SHARK PHYLOGENY

Poster Presentation

*L. Williams*¹, C. Pimiento¹, D. Silvestro², W. Allen¹

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For over 400 million years, sharks have exhibited remarkable adaptability and resilience, establishing themselves as one of the most ecologically diverse groups of marine animals. Nevertheless, present-day pressures such as overfishing, habitat loss, and climate change pose significant threats to the survival of modern shark species. This has led to the latest International Union for Conservation of Nature (IUCN) report estimating that over one-third of shark species are threatened with extinction. By creating a comprehensive phylogeny and trait dataset of all living and extinct shark species, we aim to investigate how traits rooted in deep time can be used to assess the potential for modern shark species to persist and diversify. This involves using photo-recognition and machine-learning models to infer trait data for extinct shark species based on their abundant fossil record of teeth. Using these traits we can create the first time-scaled total shark phylogenetic tree and model how vital biodiversity metrics have changed throughout the evolutionary history of sharks. We will also investigate how species' age influences shark speciation and survival potential, using the past to predict the future. Utilising these cutting-edge methods that integrate paleontological and genomic data with advanced analytical techniques will provide critical insights that can help inform conservation and management efforts in the future.

THE EVOLUTION OF GIGANTISM IN THE OCEANS: FROM BALEEN WHALES TO WHALE SHARKS

Poster Presentation

*C. Prieul*¹, D. Silvestro², W. Allen¹, C. Pimiento¹,³

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The specialisation for filter-feeding has converged in distantly related marine clades such as marine mammals and sharks. Interestingly, in these clades, the evolution of filter feeding is related with the attainment of gigantism. This emergence of gigantism appeared after ancestrally predatory species had already shifted to planktivory, taking advantage of bursts in ocean productivity. However, while sharks did not evolve sophisticated anatomical structures as their gills provided the necessary structures to sieve the water column, mysticetes went through an anatomical revolution and evolved baleens from toothed ancestors. This extraordinary transformation gave rise to the largest extant animal on Earth, the blue whale. Whilst
filter-feeding sharks are themselves gigantic, they failed to reach such enormous sizes. Despite their modest size, it can be argued they have a longer evolutionary history. Indeed, the whale shark first evolved in the Oligocene (23-34 Ma) whereas the blue whale evolved in the Pliocene (2-3 Ma). We propose to explore the evolutionary pathways that shark and mysticetes took to converge in filter feeding. We aim to answer the following questions: Is the emergence of baleens responsible for the attainment of super gigantism in mysticetes compared to elasmobranchii? What role does thermoregulation play in the convergence of filter-feeding? What are the evolutionary constraints in evolving super gigantism in filter feeders?
Integrating earth observations and biological tools in ecology and evolution to cogenerate knowledge towards meeting the Kunming-Montreal Global Biodiversity Framework targets

A GLOBAL HORIZON SCAN OF EMERGING INNOVATIONS IN ANIMAL MOVEMENT ECOLOGY

Oral Presentation

T. Speaker¹, S. O’Donnell², S. Beery³, S. Davidson⁴, R. Kays⁵, C. Rutz⁶, J. Solomon⁷

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Continuing improvements in animal-borne bio-logging technologies, accompanying high-resolution, remotely sensed environmental data, and analytical developments in movement modeling have opened up paradigm-shifting opportunities in animal movement ecology. However, significant potential remains untapped, including innovations that would enable researchers to discover drivers and predict consequences of movements and even to leverage animals as planetary sensors themselves through near-real-time, fine-scale observations, providing unprecedented insights into the natural world and built environment. While many have called for interdisciplinary collaborations to catalyze the technological and methodological advances underpinning continued progress, no comprehensive, stakeholder community-sourced agenda has been set to guide such interactions or direct resources to enable them. Here we present findings from the first global horizon scan of animal movement ecology, in which 38 leading experts identified and iteratively prioritized 30 emerging engineering, analytical, and coordination innovations in the space for the next two decades. Harnessed effectively, these innovations and the efforts they unlock stand to contribute significantly to advancing and monitoring progress on internationally agreed-upon priorities such as the Montreal-Kunming Global Biodiversity Framework targets and the UN Sustainable Development Goals.

21ST-CENTURY MAMMAL EXTINCTION RATES EXCEED 10 E/MSY IN ALL ECOREGIONS

Poster Presentation

K. Kuipers¹, S. Marquardt¹, S. Sim², A. Schipper¹, M. Huijbregts¹
The planetary boundary for species extinctions is 10 extinctions per million-species years (E/MSY). This means that of the ~6,000 mammals, no more than six species should go extinct within 100 years to safeguard Holocene biodiversity. However, recent extinction rates surpass this boundary, reflecting a 6th mass extinction. In response, the first goal of the Kunming-Montreal Global Biodiversity Framework (GBF) is to reduce species extinction rates tenfold by 2050. To evaluate progress towards and identify strategies to meet this goal, we need to understand the effects of human pressures and interventions on extinction rates. This requires projections of species extinctions as a result of current activities, quantifying the expected timing of extinctions as a product of elevated extinction risks. However, extinction rates have so far been quantified based on past extinctions and without considering an explicit link with human drivers, meaning that they do not reflect extinctions due to current activities and that they cannot be used to support reaching the first GBF goal. We estimate prospective mammal extinction rates due to land use, the largest driver of biodiversity loss globally. We estimate global population sizes of 5,467 mammal species and implement this in an extinction dynamics model rooted in neutral theory to estimate global extinction dynamics. Preliminary results suggest that mammal extinction rates exceed 10 E/MSY in all terrestrial ecoregions.

COMPARING SPECIES RICHNESS AND INTACTNESS BIODIVERSITY FOOTPRINT INDICATORS

Poster Presentation

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The Kunming-Montreal Global Biodiversity Framework (GBF) promotes the reduction of consumption footprints via the monitoring of company and product impacts on biodiversity and providing this information to consumers (GBF targets 15-16). Two commonly used biodiversity production and consumption footprint indicators are the potentially disappeared fraction of species (PDF), an indicator for species loss, and the mean species abundance (MSA), an indicator for ecosystem intactness. Although PDF and MSA address different components of biodiversity, they are also related because species extinctions will also cause loss in MSA. However, the degree of his relationship has not yet been studied. This means that it is unclear to what extent PDF and MSA are complementary indicators revealing distinct patterns of biodiversity loss, or whether one serves as a proxy for the other. We evaluate the relationship between PDF and loss of MSA. We compile 2,062,483 empirical pairwise comparisons of individual species abundance in impacted and (natural) reference conditions from various
databases to calculate 19,891 PDF and MSA measures and to explore the PDF-MSA relationship. Preliminary results indicate that there is a strong correlation between PDF and MSA, but that MSA can serve as an early indicator of biodiversity impacts not captured by PDF, especially in communities characterised by high interspecies variability in responses to environmental change.

WHERE TO CONSERVE AND USE MARULA TREE SUBSPECIES TO RESTORE GLOBAL DRYLANDS?

Oral Presentation

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Land degradation is currently a global challenge hampering the achievement of sustainable development goals. Currently, more than 2 billion hectares of land worldwide are degraded and need to be restored. Marula, Sclerocarya birrea (S. birrea) (A. Rich.) Horchst, is a drought-tolerant and multipurpose tree native to Africa, currently in decline. S. birrea has been used to restore drylands in Sahel region and introduced outside Africa as a pilot towards commercial cultivation. However, it is unclear where its subspecies can survive beyond Africa. We predict and quantify suitable areas for S. birrea subspecies under the current and future climates, globally. Areas were modeled and predicted using MaxEnt algorithm and occurrence data from Africa, climatic and topographical environmental variables, and the Max Planck Institute for Meteorology and Hadley Climate Center’s Earth Systems Models under shared socio-economic pathways (SSPs), SSP3-7.0, for the year 2050 and 2080. Results show that currently suitable areas for S. birrea and its subspecies exist in all continents except Europe and Antarctica, occupying 3,751,057-24,632,452 km² of earth’s landmass in 54-107 countries, predominantly in climatic conditions ranging from desert tropical to temperate humid. Under future climates, the areas will retract by 64-100%, shifting to high latitudes and being limited to tropical desert-to-desert temperate, Mediterranean warm global biomes, and some regions of Eastern Europe.

PLANT TRAIT-BASED METHODS TO MAP FOREST BIODIVERSITY FROM OPTICAL IMAGERY

Oral Presentation

J.-B. Feret ¹

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Remotely sensed assessment of forest biodiversity can be obtained from the measurement of the spatial heterogeneity of a set of optically effective plant properties (optical traits) derived
from statistical methods (e.g. spectral transformation, machine learning or spectral indices) or physical methods (e.g. physical model inversion) applied to optical imagery. The set of optical traits accessible from optical data varies with sensor characteristics: new imaging spectroscopy missions expand the range of variables for which quantitative assessment is possible compared to multispectral imagery. We introduce a framework taking advantage of physical modelling to assess a set of vegetation traits then used to feed remotely sensed diversity mapping techniques in the context of forest ecosystems. This approach intends to explicitly account for vegetation traits related to structural, compositional and functional properties when computing diversity metrics. To illustrate it, we used the model PROSAIL to assess Leaf Area Index, leaf chlorophyll content, equivalent water thickness and leaf mass per area from imaging spectroscopy. BiodivMapR was then used to compute various diversity metrics from these vegetation biophysical properties, including \( - \) and \( - \)-diversity metrics usually obtained from species inventories in ecological applications. We illustrate this framework with various optical sensors, including airborne and spaceborne imaging spectroscopy, and discuss current limitations.

**BIOSCAPE: EARLY RESULTS FROM THE BIODIVERSITY SURVEY OF THE CAPE**

Oral Presentation

A. Wilson\(^1\), E. Hestir\(^2\), J. Slingsby\(^3\), A. Cardoso\(^4\), C. Forbes\(^4\)

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The Biodiversity Survey of the Cape (BioSCape) is an international research project in the Greater Cape Floristic Region (GCFR) of South Africa. The domain covers two global biodiversity hotspots, with the richest temperate flora and the third-highest marine endemism in the world. The project will link satellite, airborne, and field data to improve our understanding of the region’s biodiversity and nature’s contributions to people. In other words, BioSCape will help scientists understand where biodiversity is, what it is doing, and why it matters. In late 2023, we collected airborne UVSWIR and TIR imaging spectroscopy and waveform lidar data over terrestrial and aquatic targets using four NASA instruments: Airborne Visible Infrared Imaging Spectrometer-Next Generation (AVIRIS-NG), Portable Remote Imaging Spectrometer (PRISM), Hyperspectral Thermal Emission Spectrometer (HyTES), and Land-Vegetation and Ice Sensor (LVIS). The team also conducted extensive fieldwork to capture several dimensions of biodiversity. The dataset is unprecedented in its instrument combination and level of detail, with nearly complete coverage of the electromagnetic spectrum at ~5m resolution and coincident full-waveform lidar acquisitions. We present early results from the project, emphasizing the integration of field data with remote sensing. All BioSCape data will be publicly accessible to help address the information and decision-support needs of stakeholders in the region and internationally.
GALAXY PLATFORM FOR DATA PROCESSING AND ANALYSIS ACROSS ENVIRONMENTAL SCIENCES

Oral Presentation

M. Jossé¹, J. Detoc², Y. Le Bras³, A. Nekrutenko⁴, B. Grüning⁵

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The European FAIR-EASE project addresses the challenges associated with data accessibility and promotes integrated usage by establishing connections through out all environmental sciences disciplines. Its main goal is to facilitate integration and data processing for multidisciplinary projects across various domains, aligning with the broader strategy of the European Open Cloud for Science (EOSC). It specifically focuses on the following domains:

Coastal water dynamics
Ocean bio-geochemical
Marine omics
Volcano activities
Land degradation assessment

To achieve its objectives, the project collaborates closely with the French Biodiversity E-infrastructure on the open source Galaxy platform. By addressing these subjects, the project aims to enhance the Galaxy platform with numerous and widely used Earth observation datasets, along with dedicated tools for their processing. This proposed session will highlight the implementation of the Galaxy platform as a powerful tool to unite Earth observations datasets and processing. Galaxy’s design facilitates data management through sharing and publishing results, workflows, and visualizations, ensuring reproducibility by capturing essential information for repeating and understanding data analyses. The session will also showcase practical examples, including a workflow addressing land degradation through the processing of satellite remote sensing data, providing valuable insights into biodiversity indicators and vegetation well-being.

SCIENCE BASED APPROACHES FOR CONSERVATION PRIORITISATION AND TARGET SETTING

Poster Presentation

A. Hughes ¹
Globally we are beginning to realise the need for policies built on evidence, and for environmental policy that entails science-based policy. Yet, any analysis is only as good as the data used to conduct it, thus understanding the limitations and assumptions in environmental data is crucial to ensuring it’s sensible and effective use. However, guiding sensible use and providing more robust solutions is key, thus building from this we provide recommendations to help guide sensible and effective use and interpretation of data, frameworks to enable more effective use of data within its sensible limits, and better approaches for the generation of further data to aid the development of effective conservation, policy and management. Furthermore, we explore how targets can be optimise for climate and biodiversity goals, as well as exploring different approaches to enable provision of ecosystem services in synthesis with wider policy goals. We also demonstrate how data can be sensitively analysed and applied to help create better and more sensitive environmental targets, and can also help align, such as ecological conservation redline policy and to maximise the synergies between climate and biodiversity targets. Finally we highlight priorities ahead for both research, and spatial targets, as well as discussing short and longterm solutions as we fill knowledge gaps and develop more accurate model approaches.

EXPLORING ARBOREALITY RELATION TO GLOBAL FORESTS STRUCTURE FROM SPACE

Oral Presentation

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Biodiversity is rapidly declining at an alarming pace and this trend is expected to continue unless transformative changes are implemented within the global socio-economic system. The Convention on Biological Diversity has introduced the Kunming-Montreal Global Biodiversity Framework to establish goals and targets for 2020-2030. Among these, Target 4 aims to halt the extinction of known threatened species. Many arboreal species worldwide are known to be threatened, as they are disproportionately affected by human activities that lead to habitat loss, forest fragmentation, and forest degradation. To gain a comprehensive understanding of the distribution of arboreal species in forested environments, information on vegetation structure is crucial. NASA’s GEDI (Global Ecosystem Dynamics Investigation Lidar) has been specifically designed to measure the vertical structure of forests, producing space derived high resolution laser ranging observations of the 3D structure of the Earth. We show that arboreal species require specific forest structure to thrive, highlighting the need to conserve a diversity of habitat matching the very specific diversity of requirements of arboreal species.
TRAIT-BASED METHOD TO MONITORING GRASSLAND SPECIES DIVERSITY USING UAV DATA

Oral Presentation

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Accurate and effective monitoring of grassland species diversity through remote sensing holds significant importance for sustaining the productivity and ecosystem services of grassland. Considering the impact of the complex canopy structure in some grassland types, the application of the spectral variation hypothesis is limited. Therefore, we propose an approach for estimating species diversity based on trait combinations by remote sensing. Utilizing unmanned aerial vehicle (UAV) hyperspectral and lidar data, we accurately estimate the biochemical and structural traits of grassland. We further identify the optimal trait combinations which can effectively distinguish the majority of species. By employing the adaptive fuzzy C-clustering algorithm, we achieve grassland species diversity estimation and accuracy assessment at both leaf and pixel scales. Results indicate that, for grasslands with complex canopy structure, our trait-based clustering algorithm outperforms the methods based on spectral diversity indices, achieving higher monitoring accuracy. The introduction of structural traits effectively enhances the accuracy of trait-based species diversity estimation. Additionally, the flowering status and proportional representation of species also influence the accuracy of species diversity monitoring. This study provides a comprehensive and precise method for monitoring grassland ecosystems, demonstrating its potential significance in the field of global biodiversity.

ESA ROADMAP FOR ADVANCING EO IN BIODIVERSITY SCIENCE AND MONITORING

Oral Presentation

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1European Space Agency, Directorate of Earth Observations, Frascati, Italy

Despite growing awareness that sustainable development cannot be achieved without adequate attention to the safeguard of biodiversity, the world is still experiencing massive degradation of terrestrial, freshwater and marine ecosystems. Recognising that this decline is likely to continue under business-as-usual scenarios, the CBD adopted the Kunming-Montreal Global Biodiversity Framework as an ambitious transformative plan aimed at stabilising biodiversity loss by 2030. As the biodiversity cornerstone of the European Green Deal, the EU Biodiversity Strategy for 2030 aims to put Europe’s biodiversity on the path to recovery. Regular assessment of the state and changes of biodiversity requires scientific cooperation in the collection,
production, analysis and dissemination of biodiversity data. The emergence of government-funded satellite missions, with open and free data policies and long-term continuity of observations, such as the European Copernicus programme, offers an unprecedented ensemble of satellite observations which, together with field measurements, enable the development of effective biodiversity monitoring systems. The combined use of different data sources paves the way for more effective use of EO in the functional and structural characterisation of ecosystems and their components. We will present the ESA roadmap in advancing the use of Earth Observation in Biodiversity Science and Monitoring.

REMOTE SENSING OF BIODIVERSITY ACROSS SPATIAL AND ORGANISMAL SCALES

Oral Presentation

A.K. Schweiger

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Remote sensing provides the only way to monitor Earth’s biodiversity continuously and repeatedly across large spatial extents. With space agencies investing in sensor fleets specifically designed to monitor and assess biodiversity and ecosystem health, we have now, for the first time, the opportunity to design global monitoring systems to detect early signs of ecosystem change. Given the urgency to halt biodiversity loss, it is more important than ever to understand which aspects of biodiversity satellite systems can track. This requires the integration of theory and methods from ecology and remote sensing across spatial, temporal, and biological scales. In this talk, I will present examples of how data from already existing ecological monitoring networks can be used to develop methods for space-borne assessments of plant diversity and the diversity of other organism groups.

HARNESSING AI AND REMOTE SENSING TO FOSTER HIGH RESOLUTION HABITAT MAPPING

Poster Presentation

S. Si-Moussi, S. Hennekens, S. Mücher, W. Thuiller

1LECA CNRS, Gières, France, 2WUR, Wageningen, Netherlands, 3Wageningen Environmental Research (WENR), Wageningen, Netherlands, 4CNRS, Gières, France

Habitats emerge from a complex of abiotic factors and biophysical elements that support biodiversity. Accurate habitat mapping is essential, especially with refined thematic definitions that can distinguish specific habitats. In this study, we leverage recent remote sensing products and advanced machine and deep-learning techniques to predict habitats at high resolution in
Europe. We modeled habitat classes based on climate, terrain, hydrology, soil predictors, and incorporated ecosystem descriptors from high-resolution remote sensing products. Using deep learning algorithms, we explored the extraction of additional features from raw multi-spectral images. We evaluated various classification strategies, including binary, multi-class, and hierarchical approaches, each varying in their constraints on habitat co-occurrence. Our results revealed distinct recall and precision trade-offs with different classification strategies. The integration of remote sensing-based predictors significantly improved the overall predictability of habitat models, with varying impacts across habitat classes. Additionally, the inclusion of multi-spectral images enhanced the recall of most habitats, emphasizing the importance of spatial landscape structure for habitat suitability. In conclusion, we advocate the use of high-resolution remote sensing imagery alongside AI for habitat mapping at large extents.

**NASA-USAID SERVIR: CO-DEVELOPING EO SERVICES FOR IMPROVED ECOSYSTEM MANAGEMENT**

*Poster Presentation*

**K. Herndon** 1,2, **E. Cherrington**1,2, **D. Irwin**1,3

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SERVIR, a joint program between the National Aeronautics and Space Agency (NASA) and the United States Agency for International Development (USAID), partners with leading geospatial organizations around the globe to use remote sensing and geospatial technology to address environmental challenges related to ecosystems and carbon management, weather and climate resilience, water security, air quality and health, and agriculture and food security. Through an extensive co-development process, SERVIR hubs in Latin America, Asia, and Africa work with regional and local stakeholders to develop EO-based services that provide improved information to empower decision makers. Here we present four examples where remote sensing was used to develop comprehensive services that address ecosystem management challenges related to gold mining in Peru, charcoal production in Ghana, protected area compliance in Guatemala, and coastal ecosystem restoration in Guyana. These services demonstrate an approach to monitoring ecosystem change that can serve as tangible models for evaluating progress towards the Montreal-Kunming Global Biodiversity Framework targets.

**MONITORING AND MANAGING THE SPATIAL GENETICS OF PLANT COMMUNITIES**

*Oral Presentation*

**M.C. Schuman** 1, and the Spatial Genetics Group

254
The Spatial Genetics group at the University of Zurich studies why plants are different, where it matters for ecology and for people. Genetics studies the relationships of what we inherit (our genetic material), where we are (our environment), what we do (our traits), and what we can become (our potential) - both for individuals and for groups (populations and species). We study spatial distributions of genetic variation in plants, some of Nature’s master chemists, and the consequences for living things that need plants to survive - which is most life on Earth, including us. To do so, we take an interdisciplinary approach that includes “brute-force” georeferenced sample harvesting, genetic sequencing, bioinformatics, and analyses of different traits, and incorporates remote sensing (optical spectroscopy, structure-for-motion, LiDAR), statistical modelling and machine learning. I will present insights gained from integrating these approaches in the study of genetic variation in common beech trees, which dominate forests across much of Europe that have an uncertain future under global change. I will also show how incorporating research on a completely different model system from molecular and chemical ecology, the wild tobacco plant Nicotiana attenuata, can support novel insights in other plant systems, including beech forests.
Integrating mountains in the Kunming-Montreal Global Biodiversity Framework: monitoring, research, and engagement in regional and global policy processes

TARGET 6 OF THE GBF IN MOUNTAINS: THE IPBES INVASIVE ALIEN SPECIES ASSESSMENT

Oral Presentation

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The recently adopted Kunming-Montreal Global Biodiversity Framework, and specifically its Target 6, calls for strong actions to halt biological invasions: “Eliminate, minimize, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing pathways of the introduction of alien species, preventing the introduction and establishment of priority invasive alien species, reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 per cent by 2030, and eradicating or controlling invasive alien species, especially in priority sites, such as islands.” Mountains have for long been seen as relatively resistant to biological invasions. However, evidence has proven that even the highest mountain ecosystems are being affected by invasions of plants, animal, and microorganisms. The Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has been approved by more than 140 member States at their 10th Plenary session in September 2023, in Bonn, Germany. Our aim is to showcase the main results of the IPBES report, specifically for mountain ecosystems, and how that information can be used to achieve Target 6 both in terms of management of biological invasions but also for better policies at local and international scales.

CLIMATE CHANGE AND TRADITIONAL AGROBIODIVERSITY IN HIMALAYA: WOMEN’S PERCEPTION

Oral Presentation

P.C. Tiwari\(^1\)
The work aims to assess impact of climate change on diversity of traditional high-value food crops in Himalaya primarily through the interpretation of women’s perception with a case illustration of Kumaon Himalaya, India. The study adopted empirical methods to interpret relationship among various research parameters. Fifty villages located in varying agroclimatic transacts were studied through field observations, mapping and documentation, interviews with women, focussed group discussion and key informant interviews. The results indicated a sharp rise in annual mean temperature, decline in rainfall, decrease in rainy days and a significant increase in the events of high-intensity rainfall and drought. These changes have reduced the variety of native cereals (25%), millets (71%) and pulses (65%), decreased cropping strength by 15% and declined the productivity of traditional crops by 35% over past the decades. Given this, the different villages are facing food deficits ranging between 47% to 69% increasing the proportion of food-insecure population, particularly the poor and weaker sections of society by 12.75%. It is therefore highly imperative to evolve a community-centric agrobiodiversity management framework at watershed level involving women, local institutions, government agencies, private enterprises, non-government organizations and civil society organizations to preserve the diversity of traditional high-value food crops in the densely populated Himalayan mountains.

HARNESSING KUNMING-MONTREAL GBF MECHANISMS TO ELEVATE MOUNTAIN BIODIVERSITY

Oral Presentation

M. Jurek¹, G. Schmoeker ¹

¹United Nations Environment Programme, Vienna, Austria

Mountains, as vital contributors to global biodiversity, require comprehensive integration into science-policy processes including that of the Kunming-Montreal Global Biodiversity Framework (KM-GBF) to protect their invaluable ecosystem services and to safeguard them for the wildlife and people who depend on them. Mechanisms such as the Convention on Biological Diversity (CBD) Programme of Work on Mountain Biodiversity are crucial to ensure the full implementation of the KM-GBF targets and goals. Recent CBD COP and SBSTTA decisions highlight the pivotal role of the Programmes of Work in providing Member States with a pathway to meet commitments by 2030. This presentation will look at examples on how the United Nations Environment Programme, working together with the CBD Secretariat, science, regional organisations, governments and others is enhancing engagement on science-policy dialogue for mountain biodiversity such as at multilateral events including CBD COP and SBSTTA. With confirmed political support from countries around the globe on further upcoming processes surrounding the Programme of Work on Mountain Biodiversity, further science-policy exchanges are critical for supporting the KM-GBF and further elevating the profile of mountain biodiversity.
UNDERSTANDING PAST AND PRESENT MOUNTAIN BIODIVERSITY TO NAVIGATE THE FUTURE

Oral Presentation

R. Marchant 1

1University of York, York, United Kingdom

Mountains play a fundamental role in shaping regional and continental-scale climates, underpin global processes, are a source to all major river systems and support unique, and highly diverse and threatened, ecosystems. Mountains cover only ~25% of the world’s total continental land surface yet are home to more than 85% of the world’s amphibians, birds, and mammals, many of which are entirely restricted to mountains. This amazing diversity is mirrored by high levels of endemism and beta diversity at genetic, species, and ecosystem scales as well as being culturally diverse and of economic importance; directly supporting communities through the provision of a diverse range of ecosystem services. Despite this importance, high altitude areas are not adequately protected - some 2500 Key Biodiversity Areas in mountains remain entirely unprotected. We must identify priorities for new ways to understand, value, protect and conserve mountains and take novel interdisciplinary approach that combines temporally and spatially diverse datasets we can craft a better future. Understanding how Mountain environments, and the benefits people obtain from them, have changed, and are changing. To overcome these complex and wicked challenges we must apply a novel combination of tools and data sets to navigate the challenges by integrating biodiversity and climate change agendas to allow us to better support biodiversity conservation in times of rapidly changing climates.

MOUNTAIN BIODIVERSITY IN POLICY PROCESSES: MONITORING, RESEARCH, AND REPORTING

Oral Presentation

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The importance of mountain biodiversity protection and sustainable management are undisputed. With SDG indicator 15.4.1 on the coverage by protected areas of important sites for mountain biodiversity and new targets agreed upon in the Kunming-Montreal Global Biodiversity Framework, opportunities exist for meaningful reporting on mountain biodiversity and for countries to take on their responsibilities in safeguarding their mountains’ natural capital. In providing SDG indicator 15.4.1 for individual mountain ranges, we show that national-level indicators of mountain biodiversity protection provide little information at conservation-relevant
scales and that reporting at subnational level is critical for sustainably managing mountain ecosystems and for stakeholder engagement into mountain biodiversity safeguard. However, based on national and global datasets of mountain biodiversity monitoring efforts, mapped onto the most recent GMBA mountain inventory, we show that major gaps exist in the data available for detecting, attributing, and addressing changes in biodiversity and for reliable reporting. Using ongoing synthesis work, we further show that major research gaps undermine our ability to understand and predict the evolution of mountain species and ecosystems. We argue that reliable reporting on global biodiversity-related targets at scale are not realistic unless we improve research in and spatiotemporal monitoring of mountain ecosystems.
Knowledge gaps and research avenues to leverage Nature-based Solutions (NbS) as a tool to mitigate and adapt to climate change

RETFITTING URBAN NATURE-BASED SOLUTIONS FOR BIODIVERSITY AND PERMEABILITY

Oral Presentation

T. Wild

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The role of more biodiverse nature-based solutions is under-researched and undervalued (Ak-oumianaki and Pakeman, 2023) especially in cities. Understanding potential synergies and trade-offs between biodiversity and other ecosystem services is fraught with difficulties in urban areas, confounded also by complexities around issues of scale. Whereas biodiversity impacts can be considered at a range of scales, some ecosystem services e.g. regulatory aspects such as catchment management of urban water, can only be meaningfully considered at wider (e.g. city) scales. However, opportunities do exist to understand and optimise synergies realised through implementing urban nature-based solutions, including climate change adaptation benefits and habitat creation. We report findings of field-based monitoring and spatial analysis of urban NBS benefits for biodiversity at the city-regional scale for three large (capital) cities alongside win-win opportunities to enhance permeability of developed areas. Potential synergies with other positive impacts such as local access to nature including in socio-economically deprived districts are explored.

URBAN GREEN SPACE MANAGEMENT, GIS MAPPING OF URBAN BIODIVERSITY ON GREEN ROOFS

Oral Presentation

R.J.N. Al-Hmoud, P.D.K. Tielbörger

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Urban expansion contributes to the degradation of green spaces and harms biodiversity. This needs to be changed. Green space management includes the enhancement of green space quantity, quality, and accessibility, but this can be hard to achieve in densely built areas. Nature-based solutions, such as Green Roofs (GR), can be implemented on existing roofs. GR can support biodiversity and provide new habitats for a range of species. GR, or what is so-called Hortiterture, advocates planning future cities closer to nature. Yet, the added value of GR is still debated, especially in countries where GR is uncommon. We use Amman, one of the least

260
‘green’ cities worldwide, as a test case for GR benefits (i.e., biodiversity protection). Green space is about 2.5 m² per capita, and consequently, urban biodiversity is very low. We evaluate the potential of urban GR (roofs and balconies) as a function of geographical, managerial, and socio-economic aspects. Specifically, we study the impact of size and isolation, as well as the distance to noise and pollution on biodiversity. We predict that biodiversity is largest in large and less isolated areas and areas less affected by noise and pollution. Currently, we study 14 green & 10 conventional roofs. Birds are recorded using camera traps. Surroundings are analyzed using GIS. A suitability GR map will be created to maximize biodiversity gains.

CAN THE SELECTION OF CLIMATE-RESILIENT OAK SEED SOURCES CONTRIBUTE TO NBS?

Oral Presentation

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Oak trees are vital to nature-based solutions (NbS) aimed at mitigating climate change effects in forests. Yet due to the magnitude of ongoing climatic changes, many oak stands may be maladapted to their new climatic niches, jeopardising their NbS contributions. Understanding adaptive traits and the genes that confer climate resilience, is thus essential for the development and implementation of management strategies that directly support oaks, such as assisted gene flow. Successful assisted gene flow starts with the identification of suitable seed sources. In the ACORN project, we studied three (Quercus robur, Q. pubescens, and Q. petraea) commercially important and widely spread oak species, to identify sources that can cope with ongoing climate change. Focusing specifically on drought adaptation, three common gardens were established in Turkey, Switzerland, and Austria. Provenances were chosen from both distributional and local environmental extremes. Traits related to growth and water usage efficiency were characterised. Trait data showed very few disparities between provenances originating from local environmental extremes compared to those originating from continental extremes. This data is now being summarised to provide assisted gene flow guidelines for oaks for foresters. In summary: the analysis of genes and traits in resilient white oaks on a continental scale delivers valuable information for forest conservation and management, serving as essential criteria for NbS.
NBS: UNDERSTANDING ACTOR POSSIBILITIES IN HISTORICALLY SCALED SYSTEMS

Oral Presentation

E.C.H. Keskitalo, M. Pettersson, S. Rybråten, B. Hoffmann, K. Hendriksen

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Nature-based solutions have recently become a focus in relation to ecosystem management. However, the concept can also be questioned as it relates relatively strongly to an urban basis. This paper discusses adaptations in the cases of both land- and water based management in rural areas. Drawing upon cases in forest management in Sweden and fishing in northern Norway and Greenland, the paper shows that nature-based solutions may not always be a relevant concept to distinguish solutions from each other. Instead, the possibilities to implement solutions depend on amongst other the extent to which political decision making and incentivization of them is possible within the present systems.

MICROBIAL RESISTANCE AND RESILIENCE TO DROUGHT IN CONTRASTING CROPPING SYSTEMS

Oral Presentation


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Soil biodiversity is key for soil functioning and crop growth, but these functions are threatened by climate change. Cropping practices that promote soil biodiversity and increase the capacity to buffer against climate change stressors need to be identified. The BiodivERsA project MICROSERVICES aims to understand and predict climate change impacts on soil biodiversity.
in European cropping systems, and to elucidate the potential of cropping practices to increase the resilience of soil biodiversity towards climate change. As part of MICROSERVICES, an on-field drought simulation experiment was conducted in the DOK long-term field trial comparing different organic and conventional cropping systems since 1978. The drought response of soil biodiversity and its recovery was assessed. Drought altered soil biodiversity, affecting fungi more strongly than prokaryotes. Microbial communities associated with the crop (rhizosphere and root) were more strongly affected by drought than in the bulk soil. Yet, there was no indication that organic fertilization in organic or conventional systems or reduced pesticide application in organic systems could enhance resistance and resilience of soil biodiversity to drought. This study indicates that cropping systems considered to promote soil biodiversity might not be able to mitigate the impact of severe drought on soil biodiversity and alternative regenerative practices should be included to enhance climate change resilience of cropping systems.

NATURE-BASED SOLUTIONS AND JUSTICE: WHAT NEXT AND FOR WHOM?

Oral Presentation

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With the increased adoption of nature-based solutions (NbS) as a socio-ecological transformation to address grand societal challenges simultaneously, also questions of justice have become pertinent. Most of the existing NbS applications consider questions of social justice (e.g. vulnerable groups) and procedural aspects (e.g. co-creation), or focus on distributional aspects of environmental benefits mainly. However, initial research mapping the scope of NbS suggest that overall environmental justice is only considered peripherally, mostly focused on specific applications. The presentation shares insights into how justice concepts are adopted interchangeably, mainly to the extent they help frame how NbS address a defined societal challenge (e.g. climate justice). It argues for a more comprehensive debate on the role of environmental justice aspects for NbS activation. This refers to justice considerations in relation to non-human species, and the shift from a mere analytical perspective to more normative questions. The presentation will end by suggesting how future research can test normative theories, especially on how value systems impact conflicts between climate change and biodiversity objectives. This also regards the empirical testing of how power dynamics are played out in framing NbS narratives, especially in relation to climate change mitigation and adaptation but also in relation to the adoption of a human-centric perspective versus ecological justice considerations.
DIVERSE FORESTS AS NBS FOR CLIMATE CHANGE MITIGATION AND ECOSYSTEM SERVICES

Oral Presentation

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Rewilding and increasing the global tree cover is a prerogative measure to tackle climate change and restore ecosystem services. Planting mixed-species forests would add value to both challenges as they commonly exhibit higher multifunctionality, resilience to disturbances, and biodiversity than monocultures. Their inherent properties vouch for their viability as a nature-based solution to mitigate and adapt planted forests to climate change, restore degraded land, and maintain or enhance ecosystem functions and services. However, predicting optimal species combinations remains elusive. More research is needed to empirically determine which species combinations work best together and in what conditions. There is also a gap in our understanding of how to simplify the management of these forests, especially as species and structural diversity increase the operational complexity of the management, deterring forest managers from adopting such systems. Addressing these knowledge gaps demands research tailored to understand species combinations and management practices that maximize multifunctionality and resilience. In this talk, we will pinpoint the most prominent research avenues to leverage mixed-species forests as nature-based solutions to mitigate climate change, corroborated by the research emerging from TreeDivNet, the largest global consortium on tree diversity experiments, and explore the translation of this scientific knowledge into actionable management guidelines.

LAND COVER AND PRECIPITATION SEASONALITY PREDICT SOIL MICROBIAL TRAITS

Poster Presentation

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Microorganisms are key players in soil carbon (C) cycling, yet investigations of microbial communities remain descriptive and their role in ecosystem functioning under future climate change elusive. To overcome these limitations, we developed a workflow to predict bacterial
phenotypic traits from marker gene sequencing data and identified environmental drivers of bacterial trait distributions in a large transcontinental dataset from soils across Greenland, Europe and South Africa. Interestingly, land cover and precipitation seasonality were key predictors of bacterial traits such as doubling time, genome size, sporulation, motility and cell size and were more important than established drivers of soil microbial community structures such as pH. Particularly bacteria from South African soils with high precipitation seasonality harbored a distinct trait profile characterized by small genomes, short doubling time, high 16S rRNA gene copy numbers, sporulation and motility. We propose that these trait combinations constitute an adaptation to extreme drought periods, allowing to survive in a resting stage and optimizing high growth rates under short periods with available water. Overall, we demonstrate an efficient approach to derive ecologically interpretable information from marker gene sequencing data. Our workflow allows to empirically validate bacterial mechanisms in trait-based biogeochemical models and thus to improve predictions of microbial C feedbacks under climate change.

**USING CLIMATE-READY NATURE-BASED SOLUTIONS TO SAFEGUARD MARINE BIODIVERSITY**

Oral Presentation

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Implementing Nature-based Solutions (NbS) such as habitat restoration and conservation (protection) is challenging in marine systems for a number of reasons including that these areas are multi-use and that benefits (increases in ecosystem services) from NbS may only accrue after many years to decades. Furthermore, planning these types of interventions to safeguard or rebuild biodiversity needs to be done hand-in-hand with other sectors that rely on living marine resources such as small- and large-scale fisheries and aquaculture. Finally, the ecological impacts of climate change pose a threat to the successful implementation of long-term efforts to restore and protect marine habitats. This presentation highlights several case studies from the multi-national EU project FutureMARES working at the climate-biodiversity-NbS nexus. The presentation highlights recent advancements in tools (risk assessments, measurement techniques, advanced spatially-explicit models) and knowledge needed to support NbS implementation in marine habitats in a future climate. Case Studies at large spatial scales (e.g. Mediterranean Sea, North Sea) simulate food-web responses to scenarios of changes in climate x NbS x fishing. Case Studies at smaller, local scales in northern and southern European regional seas highlight knowledge gained on habitat-forming plants (seagrasses, seaweeds) and animals (shellfish and other biogenic reefs) to support climate-ready implementation of NbS.
PROTECTING INDIGENOUS LIVELIHOOD IN THE AMIDST OF CLIMATE CHANGE IN TANZANIA

Poster Presentation

E. Mwanga ¹

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For a long period, indigenous people from different parts of the world have been victims of political and economic marginalization. They have also been facing loss of their land and resources, human rights violations, discrimination and unemployment. These problems are mainly contributed by the fact that; the indigenous peoples’ livelihood depends largely on the ecosystem. Thus to protect the indigenous peoples' livelihood and rights, various measures are being implemented at the international and national level. These measures include adopting policy and legal instruments that address the specific concerns of indigenous peoples. However, the problem of climate change which exacerbates the problems faced by indigenous communities, implies that more legal and policy measures are needed to ensure that their livelihood is protected. Thus, this paper uses Tanzania to demonstrate the extent indigenous peoples’ concerns are addressed in the legal and policy frameworks for climate change. The paper argues that the policy and legal measures employed by Tanzania to address the problem of climate change do not consider the specific circumstances of the indigenous people. As such it is pertinent to revisit these measures in order to ensure that indigenous peoples’ livelihood is protected and guaranteed.

THE ROLE OF RENEWABLE ENERGIES IN AZERBAIJAN

Poster Presentation

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This research starts by summarizing Azerbaijan’s climate targets and the current status of greenhouse gas (GHG) emissions in the country. Then, the article analyses the potential for RES, such as solar, wind, and geothermal, in Azerbaijan and the benefits they can provide for reducing GHG emissions. Azerbaijan is a historic exporter of oil and gas, but it has also committed to reducing its greenhouse gas emissions by 35% by 2030 and 40% by 2050 compared to 1990 levels. To achieve these goals, the country has recognized the value of diversifying its economy, increasing energy efficiency, and supporting the growth of renewable energy sources. Azerbaijan has a significant untapped potential for renewable energy, especially in solar, wind, hydro, biomass, and geothermal resources. RES can play a critical role in helping Azerbaijan achieve its climate targets and reduce its dependence on fossil fuels. Promoting the growth of RES in Azerbaijan requires a comprehensive policy framework, increased investment, and international collaboration. To achieve the set goal, we evaluated the database of specific
meteorological measuring devices and satellite observation points. By integrating this data with the Geo-information System (GIS) using the Analytic Hierarchy Process method, we investigated climate change and the role of renewable energy in combating it. As a result, ways to preserve the 0.8°C average temperature increase in our country have been determined.

THE ITALIAN NATIONAL BIODIVERSITY FUTURE CENTER CONTRIBUTION TO NBS

Oral Presentation


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The Next Generation EU has been instrumental for Italy’s launch of the National Biodiversity Future Center (NBFC), addressing biodiversity loss and its nexus with global change. The NBFC focuses on advancing knowledge and tools for conservation, monitoring, restoration, and biodiversity valorization. Ongoing NBFC activities include a national biodiversity and ecosystem services platform, offering tools for researchers, land planners, and practitioners. The platform simulates the effects of land use changes, advocating for its potential to accelerate large-scale rewilding and Nature-based Solutions (NbS), implementation, thus supporting the EU Nature Restoration Law nationally. A catalogue of NbS case studies and an NbS design supporting tool are included in the platform. The platform’s application extends to 12 Broad Area Sites (BAS), where a multi-taxa monitoring network is established along community richness, climatic, and disturbance gradients, also including NbS case studies. In situ measurements and remote sensing are used to deepen our understanding on the biodiversity
and ecosystem function relationships, by identifying the species combinations and environmental contexts where mixed ecosystems yield higher-than-expected services. In summary, NBFC activities hold promise for advancing our understanding of biodiversity and ecosystem services’ dynamics, also in connection with NbS implementation.

NATURE, CLIMATE, HUMAN SOCIETY - COUPLED SYSTEMS IN MULTIPLE CRISES

Oral Presentation

H.-O. Pörtner

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Climate, biodiversity, and societal challenges are intertwined but are often treated as singular problems. Solutions exist with co-benefits across sectors. In intact and functional ecosystems, nature is efficient at carbon capture (by photosynthesis) and sequestration (long-term removal from the carbon cycle), provided that warming is limited to 1.5 °C or better below through ambitious emissions reductions. Strengthening the biosphere on land, in freshwater, and in the ocean will support climate change mitigation, adaptation, biodiversity, human well-being, and livelihoods. Mounting scientific evidence points to the need to prioritize the protection of remaining undamaged carbon- and species-rich environments and to implement targeted restoration projects, with attention to effectively sustaining biodiversity and fairly distributed societal co-benefits. Three critical objectives for future spatial planning include a habitable climate, self-sustaining biodiversity, and sustained provisioning of nature’s contributions to people to support development and a good quality of life for all. Coordinated efforts among science and policy can identify and help navigate development pathways toward climate resilience for both human society and biodiversity.
Learning from existing national approaches to monitoring changes in forest biodiversity worldwide to increase their effectiveness

BIODIVERSITY IN FINLAND

Oral Presentation

A. Hyytiä ¹

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Ecological sustainability is strengthened by protecting biodiversity and the factors influencing the functioning of ecosystems. Forests host a major share of Finland’s biodiversity. Both conservation areas and nature management in commercial forests are needed to protect biodiversity. In relative terms, Finland is the most forested country in Europe. The Forest Act provides the baseline for the preservation of biodiversity, including provisions on the protection of habitats of special importance. Protecting biodiversity is thus a central part of sustainable management and use of forests. Actions promoting the diversity of forests are defined in several strategies and programmes. A process to prepare a new National Biodiversity Strategy and an action plan to 2030 related to this is currently underway. In addition to national objectives, the strategy takes into account the objectives of the UN Convention on Biological Diversity and the new EU Biodiversity Strategy. The strategy will enhance the protection of biodiversity and promote the restoration of degraded ecosystems. In addition, methods to measure the actions and their impacts will be developed. The strategy and action plan will be linked to the objectives set internationally and within the EU. The aim of the strategy is to halt the loss of biodiversity by 2030 and turn the trend towards recovery by 2035.

NATIONAL BIODIVERSITY MONITORING IN FORESTS (NABIOWALD), A INITIATIVE IN GERMANY

Oral Presentation

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The status and future development of biodiversity in German forests cannot be sufficiently determined by the already existing national monitoring programs. NaBioWald aims to close this gap by providing comprehensive and representative information on biodiversity. NaBioWald is intended to provide an important basis for biodiversity-oriented forest management, to support the forest and nature conservation policies of the federal and state governments, and to contribute to the fulfilment of national and international reporting obligations. A working group consisting of representatives of federal and state institutions in the field of forestry and nature conservation is currently working on a monitoring concept with the involvement of experts. One focus is on the influences of forest management, climate, air pollution and pesticides on biodiversity. Existing, Germany-wide (forest) surveys are to be supplemented with additional surveys and interfaces to ongoing and developing biodiversity monitoring programs are to be created. Due to the manifold anthropogenic influences, as well as the complexity of the topic and the effort of monitoring, a division of work and tasks of many different actors from science, administration, forestry and nature conservation on federal and state level is required. A draft concept is to be discussed and presented as a final draft to politicians for a decision on implementation. We present the current state of work and the further process of NaBioWald.

OVER 30 YEARS OF SOIL BIODIVERSITY MONITORING IN GERMANY – TRENDS AND DRIVERS

Oral Presentation

C. Ristok\textsuperscript{1,2}, K. Paschke\textsuperscript{3}, N. Eisenhauer\textsuperscript{1,2}

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The decline in biodiversity in conjunction with global change poses a threat to human well-being. Soils are home to c. 60\% of species on earth but our knowledge of soil biodiversity change and its drivers is limited. Long-term monitoring data are needed but are scarce or have not yet been analyzed. Here, we present analyses of over 30 years of soil biodiversity monitoring in Germany. In c. 800 plots, physico-chemical and biological parameters of soils have been monitored, partly since 1985. These plots were established in three major land-use types, i.e., forest, agriculture, and grassland, and are monitored in set intervals every few years. We have aggregated and harmonized all data and used time-series and meta-analytical tools to statistically analyze the data. We show how earthworm diversity, soil microbial biomass, and organic carbon changed over time. In addition, we link changes in these soil biodiversity variables to important drivers, such as soil pH, nutrients, and pollution. We are able to show how these drivers interact with land-use type. Lastly, we present a statistical approach to
deal with heterogeneous monitoring data. Taken together, we present the first time-series of soil biodiversity change for Germany and make a case for the importance of soil monitoring. Furthermore, we show how our results can inform assessments on the state and change of biodiversity, potentially resulting in policies to protect and restore soil biodiversity.

FOREST ASSESSMENT FROM A NATURE CONSERVATION PERSPECTIVE USING REMOTE SENSING

Oral Presentation

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Remote sensing allows capturing area-wide and spatially high-resolution forest information. Forest characteristics on tree species diversity and structural features are in particular valuable to assess forests from a nature conservation perspective. Here, we present a tree species classification map of Germany based on Sentinel-2 satellite data, showing the main tree species pine, spruce, Douglas fir, fir, larch, oak and beech and less dominant tree species maple, alder, ash, birch as well as two mixed broadleaf classes. The classification was carried out independently in three landscape regions of Germany – Northern-Lowlands, Central- and Southern-Uplands - to take into account differences in phenological developments. The overall accuracy of the map is around 84%. The classification map is used to compare species composition in forest areas with the ‘potential natural vegetation’ (PNV). Based on this, our nature conservation assessment of forest areas includes the degree of naturalness in tree species composition and forest structure parameters derived from tree canopy height models. Additional high resolution (1 meter) data on canopy height is currently pre-processed and analysed to apply our approach country-wide. We aim to compare tree species diversity with tree height variations and other structural parameters to investigate whether other remote sensing criteria related to habitat quality, ecological stability and ecological function can be included in our assessment.

TOWARD COLLABORATIVE PROTECTED AREA MANAGEMENT: LESSONS FROM SAPO NATIONAL PARK

Oral Presentation

M. H Narayana1, S. P Kewllain2, M. Varney1, M. Molokwu-Odozi1

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271
Liberia is home to the largest remaining forest blocks of the Upper Guinean Rainforest ecosystem in West Africa, one of the world’s most threatened terrestrial ecoregions. A global biodiversity hotspot, Liberia’s forest is divided into two major blocks in the southeast and northwest. The forests contain diverse ecological communities with impressive faunal and floral diversity and a high rate of endemism. Sapo National Park, established in 1983, covers 1,804 km² and is Liberia’s largest and oldest protected area. The park is part of the transboundary Taï-Grebo-Krahm-Sapo Forest Landscape, the world’s fourth largest block of tropical rainforest. Since the establishment of SNP, there have been many periods of conflict between the management and the communities due to the contestation of the park’s boundary, which was expanded in 2003. The associated restriction to resources and competing land use interests (e.g., artisanal gold mining, hunting, commercial logging) have created resentment from local communities. In recent years, efforts have been made by the government and its conservation partners to foster positive relationships between the communities and the park management. We present the result of using strategies centred on a rights-based approach like developing a good park neighbour policy and working with traditional leaders to build partnerships and maintain good relationships between the people and the institutions that reside, manage and utilise the Sapo Landscape.
Mitigating artificial light at night (ALAN) for biodiversity and human well-being: state-of-the-art and future avenues

SBB REDUCES LIGHT EMISSIONS AT ITS RAILWAY STATIONS

Oral Presentation

A. Heller 1

1SBB Infrastructure, Bern, Switzerland

To ensure the safety and well-being of customers and employees, Swiss Federal Railways (SBB) also illuminates its stations in the evening and at night. At the same time, artificial light can have a negative impact on people, flora and fauna. In recent years, SBB has made some progress in reducing light pollution. With the reduction of the light colour temperature, it reduces it further. There is a need for action in the commercial lighting, the luminosity and the implementation of the regulations.

IMPACTS OF COMBINED STREETLIGHT PROPERTIES ON NOCTURNAL FLIGHT-ACTIVE INSECTS

Oral Presentation

N. van Koppenhagen 1, M. Gossner1, J. Haller2, J. Kappeler1, J. Bolliger1

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Streetlights are an essential component of artificial light at night (ALAN), which has been shown to have significant ecological impacts. However, the specific interactions between different LED properties, such as color temperature, dimmability, and luminaire shape, have not been widely studied. To address this gap, we conducted a comprehensive three-year experiment from 2021 to 2023, assessing the individual and interacting effects of three LED color temperatures (2200K, 3000K, 4000K), four light intensities (10%, 25%, 50%, and 100%), and two LED luminaire shapes (with and without diffusor) on the abundance of nocturnal flight-active insects. To examine this, we set up plots for 14 LED street light treatments and two control dark plots at three Swiss forest sites. We used automated flight-interception traps mounted on the streetlights to monitor insect abundance. Our objective was to gain a better understanding of the impacts of ALAN on flight-active insects as a function of different LED properties and to determine whether specific LED property interactions can amplify or mitigate negative effects of ALAN on insects. By investigating the impacts of LED luminaires over multiple years, we aimed to achieve a better understanding of the longer-term effects of different street lighting properties on flight-active insects. Keywords: ALAN, artificial light
RESPONSES OF NOCTURNAL NSECTS AND BATS TO SHORT-TERM EXPOSURE OF LIGHT AND DARK

Oral Presentation

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Artificial light at night (ALAN) has been identified as one of the main causes of biodiversity decline. In this experiment, we improve the mechanistic understanding of the direct effects of ALAN on ecology. We compare long-term with short-term response patterns of flying insects and bats to light exposure and determine the short-term dynamics and resilience of ecological systems. Flying insects and bats were sampled during two field seasons (2021, 2022) at three sites in Switzerland. The sites contained 14 LED streetlights with different light treatments (three LED colors: 2000K, 3000K, 4000K), two luminaire shapes (focused, diffuse) and two dimming levels (full light and dimmed to 50%) as well as two dark controls. The short-term responses were determined by alternating between light and dark for one week - during one week in the middle of the sampling period, the streetlights were switched off. Response patterns were examined by comparing insect abundance and bat activity in the dark week with that in the adjacent weeks with the lights on. We were able to show that nocturnal flying insects responded immediately to the lights being switched on and off, regardless of the type of lighting.

IMPACT OF ARTIFICIAL LIGHT COLOUR ON STRESS, WELLBEING AND THE FEELING OF SAFETY

Oral Presentation

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Artificial light is omnipresent in the landscape. Artificial lights have a strong impact on sustainable development, both through their high energy consumption and through their increasingly recognised impact on public health. As streetlamps are modernised, focus tend to
lie on improving their energy efficiency. Yet more energy-efficient streetlamps often have different colours than the older generations of lights, colours which could reduce wellbeing and the feeling of safety. Finding out how to optimise streetlamp colours to best balance their energy consumption with their impact on wellbeing and the feeling of safety is critical. We conducted a field experiment combining biological measurements with self-reports to assess the effect of three different light colours on stress, wellbeing and the feeling of safety in a typical village centre in Switzerland. 76 participants were exposed to streetlamps of either 2700K, 4000K or 6500K for a 20-minutes stay in three different streets, with each light colour being used alternatively in each street. Stress and well-being were measured pre- and post-exposure, with salivary cortisol and the PANAS scale respectively. The feeling of safety was assessed post-exposure based on a version of the perceived personal danger scale adapted to be used in the context of artificial light. Thanks to a unique experimental setup, we will provide applicable evidence to balance energy reduction measures with the needs of the population.

TOWARDS SUSTAINABLE LIGHTING ALONG FRESHWATER ECOSYSTEMS

Oral Presentation

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Artificial light at night (ALAN) is increasingly recognized as a major driver of global environmental change. Since emissions are rapidly growing and half of the human population lives within 3 km of a surface freshwater body, rivers and lakes are ever more exposed to light pollution worldwide. Although freshwaters are hotspots for biodiversity and crucial for human well-being, only a small proportion of studies conducted on ALAN focus on freshwater ecosystems. But the effects of light pollution on freshwaters are far-reaching and affect all levels of biodiversity. Thus, alleviating light pollution requires innovative concepts that include the protection of biodiversity and ecosystems as an explicit objective. With some progress in developing sustainable lighting concepts, the importance of reducing light pollution has indeed been increasingly recognized. However, despite evidence of effective and readily available mitigation strategies (e.g. light orientation, shielding, scaling of light levels to the intended use, spectral tuning), little attention has been given to measures that specifically address light pollution of inland waters and surrounding land. This presentation summarizes the effects of ALAN on freshwater biodiversity and ecosystems, and highlights innovative lighting concepts, strategies and specific measures to improve the protection of freshwater biodiversity and ecosystems from ALAN without foregoing the benefits of nocturnal lighting for humans.
INVESTIGATING THE EFFECTS OF ROAD LIGHTING ON FLYING INSECTS IN NORWAY

Oral Presentation

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While road lighting systems presumably contribute to the safety of motorists and pedestrians, their ecological consequences remain poorly understood. Recent research has shown that light pollution is a major driver of declines in global insect populations and only few studies of the effects of road lighting under arctic and sub-arctic conditions have been performed. Our research combines field surveys and DNA metabarcoding to identify and quantify changes in insect species composition and abundance in illuminated versus non-illuminated environments. Insects were collected over four registration periods throughout the growing season using 24 window traps distributed over two study areas, one illuminated by LED road lighting systems, the other without lighting. At each trap location, average light flux and the intensity of the sources were measured. We also use GIS-based spatial analyses to examine the visibility of road lighting across the landscape. We present preliminary findings from the first year of data collection and discuss the impact of seasonality, distance to the illuminated road, vegetation, weather conditions and natural light-variations. Finally, we discuss the potential of different practical and technical solutions that may reduce the negative impacts on insects. Understanding the ecological implications of road lighting on insects is crucial for balancing the benefits of human infrastructure with the preservation of biodiversity.
Modelling biodiversity and ecosystem services (BES) loss scenarios to advance resilience (BES micro-scenarios)

GLOBAL RESPONSES IN BIODIVERSITY AND ECOSYSTEM SERVICES TO LAND USE CHANGE

Oral Presentation

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Maintaining biodiversity and the ecosystem services it supports is critical to human-wellbeing over the next century. However, we lack specific knowledge of the shape and speed of the responses of biodiversity and ecosystem services to global change drivers across wider scales. Land use change, given its wide-ranging direct and indirect impacts on biodiversity and ecosystem services, through replacement, degradation, and fragmentation, is a particularly important driver. Here, we use space-for-time substitution to model the relationship of land use change to 19 indicators of biodiversity and ecosystem services across global mountain, island and delta systems. We then apply SSP scenario projections to our model to estimate the impact of future land use change on biodiversity and ecosystem services in each system. We find positive relationships (for material ecosystem services) and negative relationships (for biodiversity and non-material ecosystem properties and services) as land use change increases, but at relatively low levels of land use change, these relationships can decouple: weakening or reversing. This decoupling suggests that these systems then depend on imports of ecosystem services from elsewhere to support their persistence, and can complicate management and reduce future options. Different future scenarios can augment (‘business as usual’) or diminish (‘sustainability’) the number of systems which display decoupling.

ASSESSMENT OF FUTURE LAND USE AND CLIMATE RISKS FOR BIODIVERSITY IN EUROPE

Oral Presentation

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Accelerating global change raises concerns about how the Earth ecosystems will change in the coming decades. While policy making commonly includes risk assessments based on climatic and socio-economic scenarios, we are still missing sufficiently fine grained approaches to address the coupled impact of land use and climate change on biodiversity. We develop a series of scenarios for Europe that represent alternative developments consistent with its diversity of
societal ambitions, in the context of ongoing climate change. We expand on previous work by considering a range of doom-gloom scenarios, and pathways to protect biodiversity within these. In doing so, we estimate biodiversity loss and change between current and potential climate and land use scenarios. The assessment will indicate the compound risks of climate and land use change for biodiversity, but also the inherent trade-offs between different species and the distribution of biodiversity values across Europe. Different pathways towards more sustainable management will be discussed to indicate the extent to which biodiversity policies can respond to these risks.

NORMATIVE SCENARIOS OF LANDSCAPE CHANGE FOR NATURE-POSITIVE FUTURES IN PERU

Oral Presentation

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SwissReAccording to the Global Climate Risk Index, Peru is one of the worst impacted countries by climatic change, and under projected business-as-usual trends, this will be exacerbated. As a response, alternative future scenarios, centered around normative visions of positive outcomes for nature and society, are needed to mobilize decision-makers towards transformative change. Our research builds upon a methodology, successfully applied in Switzerland, to operationalize the IPBES Nature Futures Framework to model normative scenarios of landscape change and the concurrent impacts on biodiversity and ecosystem services in Peru until 2060. Scenario narratives are devised through a participatory process with local stakeholders, linking global SSP/RCPs with national political processes and incorporating regional perspectives. The narratives are instantiated in a spatially explicit model of land use and land cover change (LULCC) with scenario specific realizations of biophysical and socio-economic drivers as well as interventions representing policy changes (e.g. the establishment of nature protection areas) and system shocks (e.g. market fluctuations affecting agricultural activities). The results of LULCC simulations are subsequently used as input for models of ecosystem service provision and habitat suitability for priority species with spatio-temporal predictions summarized qualitatively in terms of economic impacts for sectors of interest to policy makers and communities.

CLIMATE CROSSROADS: FUTURES FOR PEOPLE & NATURE IN CENTRAL BELIZE

Oral Presentation

J.L. Snaddon, I. Chan, R. Holland, K. Peh, P. Imbach

278
Changing climate patterns will alter the state of the environment and therefore affect our livelihoods, well-being, and quality of life. Understanding what impacts will occur and where can help in charting strategies for adapting to these changes. Scenarios and models developed to assess such changes often remain at global and regional scales that do not adequately represent and translate local scale impacts that are important for local community adaptation and mitigation. To address this gap, this study evaluates changes in nature’s contributions to people within a local landscape in Central Belize, incorporating emerging scenarios such as the Nature Futures Framework. The study is novel in exploring ways to operationalize the framework within a local setting, given certain data challenges, to produce results that are locally relevant, digestible, and reproducible. Importantly, the project underscores the importance of community engagement and finding ways to incorporate community knowledge in scenario and model development.

A NATURE-BASED SOLUTIONS FRAMEWORK FOR MANAGING NATURAL CATASTROPHE RISKS

Oral Presentation

V. Dib¹, E. Lacerda¹, S. Manes¹, J. Niemeyer¹, L.G. Oliveira¹, F. Resende¹, J. Venegas¹, F. Gomes¹, J. Almeida-Rocha¹, R. Loyola¹

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Biodiversity and ecosystem services (BES) are essential for addressing global change drivers. We are developing a framework to guide decision-making on how to mitigate natural catastrophe risks (e.g., floods, and inundations) through nature-based solutions (NbS), specifically the recovery of deforested and degraded lands. We modelled baseline, pessimistic, and optimistic scenarios of land use and climate change across multiple temporal scales (present, 2030, 2040, and 2050) to assess their impacts on the coastal protection, erosion control, and inland flood control in urban, rural, and coastal environments, as well as on biodiversity conservation (i.e., the extinction risk of endemic and endangered fauna and flora species) and socio-economic aspects (i.e., a social vulnerability index). By comparing scenario impacts over time, priority areas to optimise BES, hotspots of BES loss, and trade-offs between the provision of different BES are being identified. To illustrate our approach, we applied the framework to the state of Rio de Janeiro, Brazil, a region of great national economic importance that is very vulnerable to natural catastrophes located in a global biodiversity hotspot, the Atlantic Forest biome. The framework is replicable to other contexts, supporting stakeholders’ decision-making to ensure the avoidance and mitigation of natural catastrophes’ risks.
Models and scenarios for biodiversity & NCP at regional to global scales

BAYESIAN MODELING FOR STRATEGIC BLUE, GREEN, AND GRAY INFRASTRUCTURE PLANNING

Oral Presentation

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Urban areas grapple with dual challenges—rapid urbanization and mounting climate change impacts—resulting in economic losses, social insecurity, and well-being threats. Nature-based Solutions (NbS) and Gray Infrastructure (GrA) offer strategic routes to achieving Sustainable Development Goals. Cities confront complex decisions in green infrastructure investments, particularly in stormwater management and extreme heat domains. This research project aims to develop a decision-support tool for stakeholders and communities to strategically plan climate-resilient green infrastructure. We present a Bayesian Network model that facilitates citywide spatial planning, followed by suitable assessments at smaller scales. What distinguishes our model is its utilization of multidimensional data, encompassing geographic, climatic, demographic, and socio-economic factors. This approach provides cities with a robust framework for making well-informed investments amid climate change and urban expansion. By addressing stormwater management and extreme heat, our model contributes to achieving SDGs such as sustainable cities (11) and climate action (13). Our research advances the understanding of planning and implementing infrastructure solutions that mitigate environmental risks while ensuring economic sustainability. By integrating diverse aspects into the decision-making process, our study promotes green infrastructure investments that create resilient, sustainable, and livable cities.

ADVANCING THE IMPACT OF FUTURE SCENARIOS BY INTEGRATING PSYCHOLOGICAL PRINCIPLES

Oral Presentation

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Engaging with the future to make better decisions in the present is key for sustainable development and climate change responses. In this conceptual paper, we suggest a scenario building approach that connects psychological principles of future thinking with future scenario development in order to advance the impact of scenarios. Future scenario work currently does not sufficiently consider processes of human communication, emotion, cognition and has only begun to focus on people’s local contexts in recent years. We argue that more understanding of psychological processes, such as cognitive biases and heuristics, as well as psychological distance, which typically occur in future thinking, can improve the impact of scenarios. Specifically, we provide a psychological basis for systematically integrating emotion-evoking aspects into future scenario development, using tailored narratives and visuals to make content tangible and meaningful for a broad spectrum of audiences, and adapting content temporally, spatially, and linguistically to audiences, in combination with inclusive and creative co-creation of scenarios and sustainable solutions. We explain why this approach has the potential to overcome some recognised cognitive biases hampering scenario impact and intended sustainable change processes, and can therefore support the co-development of sustainable and inclusive policies and solutions that empower and connect individuals, communities, and decision makers.

**FUTURE FOOD SYSTEMS COMPATIBLE WITH AGRICULTURAL BOUNDARIES FOR BIODIVERSITY**

Oral Presentation

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Agriculture is the main driver of the rapid collapse of biodiversity, upon which all life on Earth, including agricultural production, depends. While the potential to expand and improve natural habitats for biodiversity conservation has been widely explored in large-scale scenarios of agricultural systems, the critical role of agricultural landscapes’ management on halting the loss of biodiversity remains unexplored at this scale. The aim of this study is precisely to fill this literature gap by proposing an exploratory scenario that evaluates a global agri-food system compatible with biodiversity conservation within and across farmlands, and minimize agriculture’s far-reaching impacts on biodiversity. First, based on a literature review, we identified the main biodiversity pressures stemming from agriculture: land-use change, contribution to climate change, water withdrawal, pesticide pollution, nutrient (nitrogen and phosphorus) pollution, and landscape and farm-scale simplification (of croplands and pastures). Second, for each one, we proposed a critical boundary which negative impacts on biodiversity are minimized or positive effects arise. Third we developed a global biophysical mass-balance model to assess some characteristics of food systems compatible with these critical boundaries, especially food production reallocation, links between the animal and the plant sector and diets.
MODEL OF CARBON-NEUTRALITY TRAJECTORY COMPATIBLE WITH BIODIVERSITY, IN ARGENTINA

Oral Presentation

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Argentina has committed to achieving carbon neutrality by 2050. We are modelling alternative trajectories for Argentina with the conviction that global goals cannot come at the expense of national sustainability ambitions. Our objective was to correct the trajectory of carbon neutrality with biodiversity conservation objectives of tetrapods threatened with extinction. The spatially explicit versions of the trend trajectories (or same land use transition trends as in the last two decades) and the carbon-neutrality trajectory (distribution of land uses compatible with neutral emissions) were superimposed on the habitat area of all the threatened tetrapod species in Argentina. We found that the carbon neutrality trajectory of the model was better than the trend, but still with unsatisfactory compatibility with the proposed conservation goals in biodiversity, so we carried out a correction of the carbon-neutrality trajectory maximizing benefits for biodiversity. Our results show a map that represents the carbon-neutrality compatible trajectory, compared to the carbon neutrality and trend trajectory in which the consequences of each trajectory on the conservation of biodiversity are quantified in hectares gained and lost for each species. These results are part of a more comprehensive project to build a land use system compatible with climate, nature, and society goals for Argentina. They serve as a decision-making tool in territorial planning and just and sustainable transition.

MAPPING POLLINATION DEMAND AND SUPPLY GLOBALLY

Oral Presentation

L. Vezzani¹, A. Schipper¹, A. Marques¹

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Among the ecosystem services (ES) of major interest in agroecosystems, pollination has received a lot of attention. The presence of pollinator-rich communities is known to be influenced by many variables, such as nesting and floral resource availability and diversity, climate conditions, and agrochemicals application. Knowledge gaps still exist regarding global levels and distributions of pollination supply, as well as links between pollination supply and demand. Existing global pollination models are often based on limited empirical data or contain highly simplified yield-pollination relationships. We aim to build a global pollination model that estimates pollinator abundances and translates them into ES delivery by confronting the
potential supply of pollination with the presence of pollinator-dependent crops (the pollination
demand). We envision a model that accounts for multiple environmental variables expected
to influence pollinator abundance, such as edge density, amount of natural vegetation cover,
chemical inputs, and crop diversity. To translate pollinator abundance into ES delivery, we
develop yield functions for different crops that will allow the global mapping of pollination de-
delivery. Our model could shed light on regions experiencing pollination shortfalls and increase
the knowledge base necessary for developing future food security and biodiversity policies that
aim towards agroecosystems in harmony with nature.

MODELING BIODIVERSITY LOSSES TO THE PRESENT IN SOUTH
AMERICA AND AFRICA

Oral Presentation

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Biodiversity faces significant threats from human-induced land-use and climate changes. Un-
derstanding these impacts is essential for devising effective conservation planning. Here, we
assess biodiversity losses in South America and Africa due to land-use changes. To do so, we
integrate a series of biophysical variables to model the native vegetation distribution repre-
sentative of the beginning of Holocene in South America and Africa. Then we model for the
continents the current species richness, endemicity and beta-diversity based on the present
land-use, biophysical variables, and species occurrence database. The model also includes the
sampling effort aimed to minimize sampling bias and collection gaps. To infer the biodiversity
of the past, the same model is applied by switching the vegetation map with the one of the
Holocene. Finally, we subtract the current values for the biodiversity metrics from those of the
Holocene to estimate losses. By identifying regions of high priority for conservation but are
experiencing significant change and declines in biodiversity, our study contributes to directing
conservation actions in regions of biodiversity hotspots.

ATTRIBUTING FUTURE BIODIVERSITY CHANGE TO PROCESSES AND
DRIVERS IN THE ALPS

Oral Presentation

A. Thomas 1, M. Gueguen1, Y. Dou2, J. Renaud1, M. Chytry3, W. Thuiller1

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Understanding and projecting biodiversity responses to land use and climate change is an urgent priority in global and European conservation, especially in sensitive, species-rich mountain environments. Recent calls for standard empirical frameworks for detection and attribution of biodiversity change such as Gonzalez et al. (2023) reflect this priority. However, these approaches emphasize drivers of change such as climate patterns, neglecting the underlying ecological processes that link drivers to biodiversity shifts. Process-based models of biodiversity dynamics are poised to fill this gap, integrating observed biodiversity patterns, climate and land use drivers, and ecological processes such as biotic interactions and demography. Importantly, models also allow projection of biodiversity shifts under future scenarios of climate and land use change. Our study uses a process-based vegetation model, FATE-HD, to disentangle the effect of anthropogenic drivers and biotic interactions on future biodiversity change in the Alps. Using novel land use scenarios from the IPBES Nature Futures Framework, we demonstrate that while climate change is a driver of vegetation dynamics in the Alps, its effects are long-term and slower than those of land use changes. Plant-plant interactions have marked effects on the Essential Biodiversity Variables monitored. We conclude by advocating better uptake of process-based models together with adaptive land use scenarios to safeguard biodiversity.

FUTURE GLOBAL CHANGE IMPACTS ON EUROPEAN INVERTEBRATE GROUPS AND ASSOCIATED NCP

Oral Presentation

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Invertebrates provide key nature contributions to people (NCP), such as pollination, decomposition and pest control. Recent climate change and land-use intensification have already affected their distributions and diversity worldwide. It is thus of prime importance to quantify how future changes will affect invertebrates under different climate and land-use change scenarios. Identifying invertebrate trophic groups that are most sensitive to specific drivers of change can help us anticipate threats to corresponding NCP. However, studies predicting the impact of climate change on invertebrate distributions have been limited in taxonomic scope, spatial resolution and land-use change is rarely considered. Here, combining ensemble machine learning models to state-of-the-art scenarios of climate change, land-use conversion and intensification, we predict shifts in invertebrate distributions across Europe over a broad range of taxa, including predators, herbivores, pollinators and detritivores. We also investigate how positive change scenarios based on the Nature Futures Framework (NFF) can assist in mitigating range loss. On average, we find larger changes in species distributions under climate-change compared to land-use change scenarios, while interactions between climate and land use could negatively impact invertebrates. Yet invertebrate groups differ in their sensitivity
to drivers of change. Importantly, we show that under NFF narratives, impacts might be strongly reduced.

GLOBAL SCENARIOS: EFFECTIVENESS OF BIODIVERSITY AND CLIMATE CHANGE INTERVENTIONS

Oral Presentation

C. Neumann ¹, R. Alkemade², D. van Vuuren³, R. Seppelt¹


The importance of and need for transformative solutions to achieve a more sustainable future is growing. Designing policy interventions that address multiple challenges of the Anthropocene is challenging. For example, climate change and biodiversity loss are closely linked issues, increasing the likelihood of trade-offs arising from single-focus measures. We have developed a comprehensive database of state-of-the-art global target-seeking and policy-screening scenarios that simulate impacts on either biodiversity, climate change or both. The database includes information on the scenarios’ underlying qualitative and quantitative assumptions, the interventions applied and their impacts. Based on the database, we synthesize trade-offs and synergies for intervention combinations, scenario archetypes and their impacts on biodiversity and climate change. This provides the basis for identifying promising combinations of interventions that have the least trade-offs and the most synergies for biodiversity and climate change. For example, the analysis shows that lifestyle changes combined with conservation measures offer larger potentials for multiple synergies than more sectoral approaches. Conversely, technological solutions to mitigate climate change (e.g. in the building or energy sector) may have negative impacts on biodiversity. Our findings can identify combinations of interventions that can promote transformative change and contribute to the development of future scenarios.

CONNECTING THE DOTS: USING AGENT-BASED MODELS TO LINK HABITATS AND BIODIVERSITY

Oral Presentation

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Connectivity of habitats plays a significant role in maintaining healthy marine ecosystems by providing a key mechanism for the dispersal and recruitment of species. The biodiversity of
an ecosystem has often been linked to the number of connections the ecosystem has to the broader regional area. With the current ecological status of the world’s oceans, there is an increased risk that habitat connectivity will be disrupted, which can result in negative effects upon biodiversity and disrupted ecosystems. To support decisionmakers in managing their biodiversity footprint, we have developed an approach using agent-based modelling coupled with ecological modelling together with local and regional developed hydrodynamic models (Hansen et al. 2015) to assess the connectivity of local and regional areas. This allows to model how entities (such as species), proxies (such functional traits), or concepts (such as biodiversity), of a local area is linked to other areas both locally and regionally. By coupling observational data on biodiversity with hydrodynamic and static information through general additive models and machine learning algorithms spatial distribution of biodiversity can be mapped. The coupling of the two approaches allows for predicting the spatio-temporal distribution of ecosystem connectivity in terms of biodiversity and enables quantitative assessments on how biodiversity will change in time and space.

ROOM FOR MANOEUVRE - MODELLING THREE PATHWAYS USING THE NATURE FUTURES FRAMEWORK

Oral Presentation

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Land use, climate change and biodiversity outcomes are inherently intertwined. Integrated assessment models allow us to better understand these interconnected dynamics and to explore pathways towards sustainability goals using different scenarios. We used the Nature Futures Framework to develop three different narratives, each reflecting different values perspectives, towards positive biodiversity outcomes. These narratives were translated into global scenarios that we simulated using the IMAGE-GLOBIO modelling framework. The three scenarios differed in terms of lifestyle (i.e. diet and food waste), degrees and types of nature protection, economic development and urban planning. We assess the changes in land use and biodiversity outcomes over time (2020-2100) and by using a business-as-usual SSP2 scenario as a counterfactual. Our results show that all three scenarios lead to positive biodiversity outcomes when compared to the SSP2 scenario. Yet, an improvement in biodiversity outcomes by the end of the century can only be achieved when far-reaching climate change mitigation measures are taken in the non-land use sector as well. Our findings reveal how different values of nature yield different nature and biodiversity outcomes. Furthermore, our study shows the implications of different long-term land use trajectories on biodiversity, offering insights into drivers of these trajectories and the trade-offs and synergies between conservation goals and climate change mitigation.
PERFORMANCE OF TERRESTRIAL PROTECTED AREAS UNDER THE NATURE FUTURES PRISM

Oral Presentation

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This presentation provides a spatio-temporal analysis of essential variables on biodiversity, ecosystems, and ecosystem services between 2000 and 2015/18 across different categories of protected areas and indigenous land. The analysis uses the Nature Futures Framework and maps protected areas onto the three nature value perspectives of the framework. We assign strictly protected areas (IUCN I-III) to Nature for Nature (NN, appreciating intrinsic values of nature), protected areas for conservation or sustainable use (IUCN IV and VI) to Nature for Society (NS, utilitarian values), and protected areas on the cultural landscape (IUCN V) and the indigenous land to Nature as Culture (NC, relational values). We assess how the state of biodiversity, ecosystems, and ecosystem services were in 2000 and how they changed by 2015 or 2018 in these areas compared to the areas without protection (Status Quo). We compare the performance of Nature Future protection regimes across the four IPBES region at the national scale. We find that nature and its services to people are at its best state and conserved the most in the NN regime, then NS and NC regimes, then the worst in the Status Quo. There are however heterogeneous patterns at finer scales across the regions. The study highlights the importance of regular evaluation of protected areas on its effectiveness and recommends the integration of diverse roles, values and benefits of nature in the CBD Post-2020 Global Biodiversity Framework.

PATHWAYS TO SECURE INDIA’S BIODIVERSITY AND LAND-USE FUTURE

Oral Presentation

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In India, most of terrestrial biodiversity reside in the forests, as other habitats are losing their natural state due to exceeding population pressures. We use the FABLE calculator to look at changing dynamics of food and land-use systems over the years and track biodiversity conservation till 2050. The calculator is an excel based tool that enables an assessment of alternative pathways of agriculture, food and land-use (AFOLU) sector (Mosnier et al., 2023).
We create two pathways to compare India’s future trajectories, incorporating commitments such as the Bonn Challenge (26Mha afforestation by 2030), dietary recommendations by National Institute of Nutrition, etc. Biodiversity conservation is examined through land cover that supports biodiversity like forest cover and other lands where natural vegetation flourish. In the Business-as-Usual pathway, this land cover share is only 23% by 2050, whereas, in a sustainable transformation pathway that includes other policy commitments, this share increases to 57%, suggesting synergies with the AFOLU sector transformation. With future diet changes and improved crop productivity, our results indicate a nearly 35% decrease in cropland requirement by 2050 compared to 2020. These projections take into account the rising population and our results demonstrate the use of novel scientific methods to generate policy pathways for a country to meet its biodiversity commitments while at the same time ensuring its population’s food security.

CONTRASTING PATHWAYS FOR TRANSFORMATIVE CHANGE WITHIN EU BIOMASS VALUE CHAINS

Oral Presentation

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Humanity faces significant environmental challenges: a rapidly changing climate, severe declines in biodiversity and nature’s contribution to people and other essential facets of sustainable development. To tackle these challenges and move towards a more just and sustainable future, science points towards the need for transformative change, i.e., fundamental, systemwide changes across technological, economic and social dimensions. Here, we develop and explore pathways of transformative change for biodiversity, climate and people with a focus on EU biomass value chains. We draw on the narratives of the newly emerging Sustainable Development Pathways (SDP) and the Nature Futures Framework (NFF). We enrich these narratives with environmental justice considerations and tailor them towards the EU within a global context, focusing on biomass value chains. We then suggest downscaling global and regional sustainability targets as a tool to explore how contributions to achieving such transformative change can be shared among geographies, economic sectors, or actors. Contrasting different principles of distributional justice aligned with their underlying world views enables us to highlight how burden and benefit sharing might differ across pathways. We apply this, e.g., to targets around the intensity of agricultural production and the consumption footprints of agricultural products. This work offers a discussion space to explore alternative routes to the needed transformative change.
BENDING THE CURVE OF BIODIVERSITY LOSS REQUIRES A SATNAV FOR NATURE

Oral Presentation

A. Purvis

1Natural History Museum, Biodiversity Futures Lab, London, United Kingdom

Models and scenarios have vital roles to play if the world is to bend the curve of biodiversity loss, but these roles are only implicit in the Global Biodiversity Framework. Of particular concern, none of the framework’s headline indicators could discern any change in biodiversity trajectories by 2030. Meeting any biodiversity targets efficiently requires a ‘sat-nav’ for nature, built on (1) models that allow comparison of the future consequences of making alternative near-term choices, and (2) rapid feedback from monitoring to enable course corrections and model improvements. The same elements are needed by organisations wishing to be nature-positive. Making the importance of models and scenarios explicit in the Global Biodiversity Monitoring Framework (to be negotiated at COP16) would obviously help, but many challenges remain. Some are purely scientific; e.g., developing climate models were able to use rich time series from the instrumental record and proxies, but no comparable data are available for biodiversity models. Other obstacles, such as the lack of a Biodiversity Model Intercomparison Program analogous to CMIP for climate models, could be overcome relatively rapidly with funding. The cultures within biodiversity science and science-policy have themselves thrown up some obstacles, such as a leaky pipe for data and disincentives for improving indicators, which also need to be resolved if we are to maximise the chances of bending the curve of biodiversity loss.

GLOBAL SCENARIOS FOR BENDING THE CURVE OF BIODIVERSITY LOSS: A MAPPING REVIEW

Oral Presentation

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Scenario analysis is a systematic way of projecting long-term developments and can be used to examine how alternative future pathways and policy choices could affect biodiversity. As part of the Convention on Biological Diversity (CBD), countries have agreed to halt, or even reverse, biodiversity loss. However, it is not clear under which integrated strategies these objectives can be met. With this review we examine the literature on modelled global scenarios halting or reversing declines in biodiversity. We identify the most relevant findings, common methods used, and important research gaps, through a systematic mapping method. We developed a search strategy to identify relevant articles and screened the resulting comprehensive body
of literature (documents n=3,224), of which we selected 54 papers that met our inclusion criteria (global, ambitious, quantitative). Out of the 54 studies, only 4 scenarios aim to reverse biodiversity declines, while the rest focus on halting further loss. In addition, we compare the impact of multiple drivers of loss on biodiversity metrics, and the proposed response strategies. We argue that, given the few existing scenarios that aim to reverse trends while taking multiple drivers into account, additional effort should focus on improving scenarios that outline appropriate future pathways for the reversal of biodiversity loss, strengthening the alignment of their response strategies with existing policies, and assessing their feasibility.

INTRODUCING A JUSTICE FRAMEWORK FOR BIODIVERSITY MODELLING AND SCENARIO DESIGN

Oral Presentation

C. Wong 1, T. Schinko1, D. Leclere2, L. Novak3, T. Kastner3

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Biodiversity research and policy exists at a nexus of political, economic and social debates over land and resource use and the allocation of the derived benefits. In this context, understanding different perceptions of justice around interventions to improve biodiversity has two key benefits. Firstly, to avoid creating greater injustice via biodiversity policy such as the mistakes of traditional “fortress” conservation, the strict removal of economic activities from areas of natural beauty and high or unique biodiversity, that occurred in the 1960s and 1970s in sub-Saharan Africa that led to injustices for local peoples including forced eviction and denial of rights of passage for migratory routes. And, secondly, to improve the viability of policy pathways because the perceived fairness of these policies is key to their acceptability so that justice can be used as a leverage point to increase the sustainability of interventions. In this session, we will introduce the justice framework and explore how different forms and patterns of justice exist in current biodiversity research. Then we will demonstrate how the justice framework is being currently used to design transformative biodiversity pathways in the Horizon Europe Rainforest project.

RESTORING MARINE BIODIVERSITY WITH NATURE-BASED SOLUTIONS IN A CHANGING CLIMATE

Oral Presentation


290
Tomczak\textsuperscript{6}, L. van Duren\textsuperscript{7}, L. Vilmin\textsuperscript{7}, J. Pinnegar\textsuperscript{1}, M. Peck\textsuperscript{8}, T. Kristiansen\textsuperscript{9}, M. Butenschön\textsuperscript{10}

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Marine ecosystems support a large proportion of global biodiversity, help regulate the climate, and contribute directly to worldwide food security. However, marine biodiversity is under threat from human activities and climate change, which may jeopardize the success of Nature-based Solutions (NbS - conservation and restoration actions) to safeguard biodiversity contributions to people. Three scenarios of change, given Shared Socioeconomic Pathways ‘Global Sustainability’, ‘National Enterprise’ and ‘World Markets’), were developed based on IPCC SSP1, SSP3 and SSP5. Within these scenarios, the potential change in biodiversity and fisheries yields were modelled following the implementation of marine protected areas and the restoration of habitat-forming species. Statistically downscaled Earth System Model projections (including temperature, salinity, oxygen, pH and primary production) were used to drive spatio-temporal Marine Ecosystem Models (using Ecopath with Ecosim) for regional seas (North Sea, Baltic Sea, Bay of Biscay and the Western Mediterranean Sea), and sub-regions (Local Baltic Sea, North-western Mediterranean Sea and the Portuguese Shelf). Our results improve understanding of climate change impacts, and how NbS can increase the potential for climate change adaptation and mitigation of marine ecosystems, and strongly contribute to upcoming national-, EU- and global-level reports, policies and interventions.

\textbf{DEGROWTH SCENARIOS FOR BIODIVERSITY? SOME KEY METHODOLOGICAL STEPS}

Oral Presentation

I. Otero\textsuperscript{1}, S. Rigal\textsuperscript{2}, L. Pereira\textsuperscript{3}, H. Kim\textsuperscript{4}, G. Gamboa\textsuperscript{5}, E. Tello\textsuperscript{6}, A. Grêt-Regamey\textsuperscript{7}

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Studies show that economic growth contributes substantially to biodiversity loss and that, after a certain threshold, it does not contribute to wellbeing. Thus, when developing biodiversity scenarios, considering societal futures where economic growth is not a pre-condition requires special attention. However, degrowth scenarios have not been explored for biodiversity conservation and human wellbeing. Here we explain how the Nature Futures Framework and other approaches could be used to generate degrowth scenarios for biodiversity, NCP and Good Quality of Life (GQL). We present key methodological steps, including: producing degrowth visions for high-income countries; identifying leverage points and imagining degrowth pathways; identifying key social-ecological feedbacks; and modelling biodiversity, NCP and GQL along degrowth scenarios. Our proposal is framed within current theoretical, empirical, and modelling work as well as within efforts to improve scenario development across the biodiversity and climate communities. To develop degrowth scenarios for biodiversity, NCP and GQL, we call for collaboration across natural and social sciences, quantitative and qualitative approaches, and northern and southern perspectives. This collaboration could lead to a community of practice that tests and improves the degrowth scenarios in national and international science-policy interfaces as they set out to achieve the CBD 2050 vision of living in harmony with nature.

FORECASTING TERRESTRIAL FOOD WEBS AND NCP IN CLIMATE AND LAND USE CHANGES

Oral Presentation

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Ambitious biodiversity and environmental targets have been set at both international and regional levels, notably under the Convention on Biological Diversity’s (CBD) post-2020 targets, and the European Union’s Green Deal. In the NaturaConnect project, we aim at understanding how future climate and land use changes will impact vertebrate species and diversity while accounting for their trophic interactions and dispersal abilities, and how will this affect associated NCP like pest control. First, we harnessed biological data, climate scenarios and then mapped the European landscape changes required to ensure that land based environmental targets can be met under different socio-economic and climate change scenarios. Subsequently, we developed an innovative trophic species distribution model that incorporates trophic interactions between species. Using this model, we projected vertebrate trophic networks and associated metrics across Europe, considering a range of climate and land use change scenarios for the years 2050 and 2080. By implementing a range of plausible futures following three primary perspectives that capture people’s relations to nature, we show how vertebrate
species distributions, interactions, and overall local network properties could be maintained or threatened in function of different positive scenarios.

**BIODIVERSITY AND CLIMATE OUTCOMES UNDER INTERNATIONAL TRADE FUTURES**

Oral Presentation

*F. d’Albertas*¹, B. Pavani¹, J. Krieger¹, E. Lacerda¹, R. Capelão¹, L. Oliveira¹, D. Rocha¹, G. Duarte¹, J. Vicentin¹, S. Oliveira¹, D. Leclère², R. Loyola¹

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International trade addresses the agricultural production disparities among nations and tackles food safety challenges. However, the agricultural expansion and flow of products between countries pose significant threats to biodiversity conservation and climate change. To confront these pressing issues, we used scenario modelling to project outcomes by 2050 assessing how international trade could pave the way towards an adaptation strategy to achieve agricultural demands while conserving nature. Although trade expansion scenarios negatively impacted biodiversity and released more carbon than business-as-usual projections, capping the trade of commodities and forcing localised production did not improve biodiversity outcomes. Latin American countries make a strong case because they disproportionately suffered the consequences of trade expansion. On the other hand, in Latin America, expanding protected areas and restoring degraded land offset the negative impacts of trade on biodiversity and carbon emissions at the global level. We recommend a mix of trade liberalisation facilitation policies joined with ambitious conservation and restoration initiatives. Our findings can provide novel insights to support policymaking, highlighting the balance of trade benefits with the need to protect biodiversity and mitigate climate change.

**SCENARIOS AND MODELS FOR BIOLOGICAL INVASIONS: A STATUS QUO SYNTHESIS**

Oral Presentation

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Biological invasions – a process describing the human-induced redistribution of species beyond their native range – is a signature of the Anthropocene driving biodiversity loss and the homogenization of biotic communities worldwide. This phenomenon is (partly) responsible for 60%
of global extinctions of native species, causes severe economic damage estimated at US$ 423 billion annually and severe impacts on human livelihoods. Despite this importance scenarios of biodiversity, ecosystem services, and human well-being currently do not include biological invasions. The IPBES Global Assessment found a staggering overrepresentation of climate change (708 scenarios) and land-use change (161) as drivers in existing scenarios, while biological invasions were particularly strongly underrepresented (14). This near absence of biological invasions in biodiversity scenarios has also been highlighted elsewhere in the literature. As part of the IPBES assessment on Invasive Alien Species, we conducted a comprehensive literature review of the invasion science literature body to identify publications dealing with qualitative and quantitative scenarios and models of biological invasions exploring the following questions:

What is the status quo of the scientific literature on scenarios and models of biological invasions?

How well does the literature cover different types of models and scenarios?

Do existing scenarios and models address Good Quality of Life and Nature’s Contributions to People?
Models and scenarios for biodiversity & NCP at regional to global scales

SCENARIO MODELLING HUMAN–NATURAL SYSTEMS INTERACTIONS TOWARDS THE SDG

Poster Presentation

D. Yu

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The United Nations Sustainable Development Goals (SDGs) have a profound impact on human well-being and environmental sustainability on a global scale. Scenario modelling plays an important role in supporting the interaction of human and natural systems to achieve the SDGs. It provides the scientific basis for quantifying the SDGs and identifies synergies and trade-offs by considering the interactions between the goals and the actions needed to achieve them. The ability of scenario simulations to deal with complexity is invaluable for scientists, policymakers, managers, and practitioners to develop meaningful policies, improve sustainability, and make more informed decisions. However, our systematic review based on a large number of case studies, found that scenario simulations is currently not delivering on its promise to ensure good implementation of the SDGs and provides limited SDGs information. In the future, it is necessary to strengthen the capability of scenario modeling under human-nature coupling system in combination with the SDGs, and systematically carry out theoretical research and practical application of scenario simulation under human-nature coupling system for different types of communities around the world.

MODELLING MARINE CLIMATE-FISHERY-CONSERVATION SCENARIOS IN SOUTHERN AFRICA

Poster Presentation

L. Shannon, K. Ortega-Cisneros, S. Grusd, D. Anderson

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A suite of Southern African marine ecosystem models has been developed to provide insights into potential implications and interactions between ocean users including humans and biodiversity. In this contribution, we run SSP and hypothetical nature-positive conservation scenarios for several different Southern African marine ecosystems to explore the implications of modelled biodiversity management scenarios under different climatic conditions. Uniqueness (ecosystem-specificity) and regional (Southern African) patterns of climate-user interactions
are examined by means of modelled indicators of marine NCPs, composition of marine community assemblages and overall food web dynamics. This work aims to highlight marine ecosystem modelling research in support of marine ecosystem sustainability in Southern Africa.

STOCHASTIC PROCESSES IN ECOLOGY: FROM FOOD WEBS TO LANDSCAPES

Poster Presentation

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A primary goal of sustainability research is to understand how biological diversity can be described across different level of ecological organisation. In this talk, I will present a theoretical framework to describe biotic interactions, emphasising their stochastic nature. Within this framework, we revisit the derivation of some biodiversity models, highlighting their common assumptions and proposing methods to infer parameters from data. In the second part of the talk, I will extend the stochastic approach to explicitly include spatial dynamics. Using methods of network theory, we can study the relationship between changes in landscape connectivity and biodiversity dynamics at local and regional scales, contrasting predictions about species richness between static landscapes and dynamic landscapes. Our results show that local and regional biodiversity can increase simultaneously in dynamic landscapes characterized by periodic connectivity. Extending metacommunity theory, by including fluctuations in landscape connectivity, can thus be used to provide new testable scenarios about species diversity across different spatiotemporal scales. I will conclude showing how this simple approach can be used to inform more sophisticated models of biodiversity and ecosystem services. 


UNDERSTANDING AND PREDICTING RECENT GLOBAL VERTEBRATE ABUNDANCE CHANGE

Poster Presentation

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We urgently need to bend the curve of biodiversity loss. Recent models of vertebrate abundance trends have highlighted delayed, negative responses to the combined impacts of land-conversion and climate warming, and immediate negative consequences of direct exploitation. In contrast, conservation interventions such as protected areas and targeted management are found to improve population trends. In addition to identifying the drivers of ecological declines and implementing conservation actions that work, we must accurately track progress towards specific biodiversity goals, such as increasing ‘the abundance of native wild species’. Although the use of empirical data may be preferable, many nations lack abundance time-series, limiting our ability to monitor a fundamental component of biodiversity change. Using the above-described models and global environmental data products, we project spatially explicit relative abundance indices for birds and mammals between 1950 and 2014. Our predicted indices suggest recent declines exceeding those in the empirical data, largely attributable to different distributions of driver pressures between monitored populations and the global terrestrial surface. We present these predicted indices as prototypes, whereby further development can incorporate additional drivers and ecological complexity to improve predictive performance and produce an urgently needed ‘leading’ indicator of abundance at local, national and global scales.

IMPACT OF CLIMATE CHANGE ON INSECT POLLINATORS AND POLLINATION SERVICE

Poster Presentation

S. Stöckli¹,², N. Kuelling², A. Lehmann², A. Adde³, A. Guisan⁴,³

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Within the NCCS programme «Decision Support for Dealing with Climate Change in Switzerland» (NCCS-Impacts) actionable climate services for the environment, economy and society will be developed from 2022 to 2025. The aim of the project «Impacts of climate change on ecosystem services in Switzerland» is to describe the projected changes in ecosystem services and functions caused by climate change for the forest, agriculture and aquatic ecosystems. The presentation will focus on the impact of climate change on insect pollinators and pollination ecosystem services (ESS) in Switzerland up to 2050 as one of the most important nature’s contributions to people (NCP) and additionally related to other NCP’s such as agricultural production. We will demonstrate how we model high resolution potential for pollination ESS using a hierarchical framework at local scale considering relative pollinator species abundance, habitat indices related to floral resources and nesting habitat, pollination related species traits and pollination dependent crops. For future ESS projections we use the CH2018 climate scenarios that are based on socioeconomic mitigation pathways. A co-creation process supported
the development of user-centered indicators for climate services. Our results will assist farmers to plan adaptation measures efficiently or decision makers to prioritize investments and evaluations. The findings will be integrated in a digital open-access dashboard on the NCCS web portal.

CONNECTIVITY SHAPES MIGRATORY SPECIES RESILIENCE TO HABITAT LOSS

Poster Presentation

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Migratory species are declining at greater rates than non-migratory species due to changes in habitat availability. Migrants rely on multiple connected sites to complete their lifecycles, making connectivity an important aspect to consider for conservation planning. However, very little about how different patterns of connectivity influence population sensitivity to stressors such as habitat change or loss. To this end, we categorised ‘real-world’ migratory networks into eight broad types based on their connectivity patterns and used a graph theoretic approach to quantify their vulnerability to habitat loss and degradation. Our results showed that networks differed in how many sites could be lost before population collapse, and this was mainly dependent on their connectivity pattern. Surprisingly, we also found that low levels of habitat degradation across all sites caused greater and more rapid population declines than the loss of entire sites. Our results highlight how conservation strategies should not only account for connectivity, but also connectivity patterns and network architecture when conserving declining populations of migratory species.

DIVERSE WAYS TO COMMUNICATE SCIENCE TO HARD TO REACH COMMUNITIES

Poster Presentation

R. Marchant ¹, O. Wilson¹, C. Lyon¹

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Publicly funded global science community has a responsibility to communicate and engage with as wide a body of people as possible. Through photography, painting, short films, dance, 3-D printed models and sculpture, researchers and artists provoke us to think deeply and critically about urgently relevant topics such as climate justice, adaptation, challenges of living with the future. We present experiences from creating short films, art, dance and 3d models of pollen grains and how these different media have engaged with a wider audience. We have worked
with an artist to transform the climate model perspective of long term earth system pasts and futures to envisage what the world will be like in 2500. On the issues of futures, we have used a cartoon film to showcase how future scenarios can be able to navigate conservation and development challenges through the lens of land. In addition, we have been bringing the microscopic world to life. Pollen grains reveal ancient histories, solve crimes, deliver vaccines, hold together ecosystems, and help feed us all. Interpretation boards with 3D pollen models, primary school workshops, and a free public lecture have all connected to hundreds of thousands of visitors have learned about pollen, the research which surrounds it, and ways to help pollinators. These models are also being used to engage with indigenous cultures in Brazil and ensure their voice is being included in reconstructing past ecosystem histories.

KESHO: A PARTICIPATORY LAND USE MODEL APPLIED NATIONALLY TO LOCALLY

Poster Presentation

**R. Marchant** ¹, J. Thorn², C. Capitani³, R. Kariuki⁴, P. Pusingha¹, R. Newmann¹, R. Han¹

¹University of York, York, United Kingdom, ²St Andrews, St Andrews, United Kingdom, ³JRC, Ispra, Italy, ⁴University of Arizona, Phoenix, United States

Ecosystems play a fundamental role in shaping regional and continental-scale climates, underpin global processes, and support unique, and often highly biodiverse and threatened regions of the world. This amazing functioning is especially so in the tropics; where ecosystems directly support communities through the provision of a diverse range of ecosystem services such as agriculture, tourism, and water regulation. To overcome complex climate and development challenges we must apply a novel combination of tools and data sets to navigate the challenges. Participatory scenario approaches can co-create credible and innovative scenarios that integrate science-based knowledge and data with local wisdoms to enable local, national and international decision makers to envision a future where space for wildlife, biodiversity is maintained, and appropriate adaptation strategies to be realised. By taking a novel interdisciplinary approach that combines temporally and spatially diverse datasets we can craft a better future. KESHO is a participatory land use tool applied to multiple landscapes and issues from charting carbon futures in Tanzania to looking at the interaction of coffee, biodiversity and livelihoods at 20km sq in the Jimma highlands, from looking at green urban infrastructure to forest futures in northern Thailand.

EBVS AND EESVS FOR BIODIVERSITY CONSERVATION AND SUSTAINABLE DEVELOPMENT GOALS

Poster Presentation
As nations design a framework and a process for implementing the new goals and targets set by the Convention on Biological Diversity (CBD), the question on how to report on the successes and failures of policy implementation is becoming more salient. In this paper, we demonstrate the potential role of Essential Biodiversity Variables (EBVs), Essential Ecosystem Services Variables (EESV) and their derived indicators in monitoring, planning, and implementing multiscale policy frameworks across spatial scales. We first introduce the EBVs and EESVs and then analyze their role in the UN CBD Global Biodiversity Framework, the Systems of Environmental Economic Accounting, Sustainable Development Goals, and the Intergovernmental Platform on Biodiversity and Ecosystem Services. We illustrate how the EBVs and EESVs can be used across scales via application cases. We also discuss the use of EBVs and EESVs in scenarios and modelling for strategic policy planning. This paper presents the values of the Essential Variables in implementing biodiversity conservation and sustainable development goals, optimizing the integrative use of scientific, policy, and data frameworks and scalable and repeatable workflows from primary data to indicators.

A MATHEMATICAL PERSPECTIVE ON THE SHARING OF BIODIVERSITY-RELATED MODELS

Poster Presentation

D. Mietchen

Biodiversity-related sciences - from metabolomics to traits to invasions to systems biology and ecosystem dynamics - are among a broad range of research fields that make increasing use of mathematical and computational models. There is, however, room for improvement in terms of how models and scenarios for biodiversity and NCP are being shared, both within the field and with other fields, including mathematical and computational ones. This contribution will outline challenges, opportunities and common practices in the sharing of mathematical and computational models and highlight how they translate to biodiversity and NCP contexts at different biogeographic scales, levels of biological organization or socio-economic factors. Special emphasis will be put on the discoverability, reproducibility and reusability of biodiversity-related models and on how the sharing of such models can both benefit from and contribute to research in mathematical, computational and other fields.

EVALUATING THE IMPACTS OF DIFFERENT FUTURE SCENARIOS ON NCP IN SWITZERLAND

Poster Presentation
The combined effects of human development, land-use, and climate change enhance the pressures on ecosystem equilibrium. In Switzerland, ongoing land use and climate changes are shaping the landscape and the species living in it, and these changes are expected to continue. Understanding the relationship between these drivers of change and nature’s contributions to people (NCP) is necessary to mitigate potential adverse effects for both humans and biodiversity. Despite the urgency, comprehensive national-level studies analyzing the evolution of NCP distribution remain scarce. Here, we address this lack by evaluating the consequences of climate and land use changes on ten NCP indicators for Switzerland. Leveraging the most recent climate and land use projections, our assessment spans current and projected NCP supply through five distinct future scenarios, encompassing exploratory and normative perspectives across different future time steps. We compared the spatial distribution and temporal dynamics of NCP in Switzerland and explored the expected effect of different development and climate scenarios on NCP supply. This work is a valuable resource to understand the potential evolution of NCPs in Switzerland and to offer guidance for decision-making processes towards a desirable future.
Nature conservation to mitigate biodiversity loss and climate crises

EMPOWERING MPAS: A GLOBAL REPOSITORY OF CLIMATE CHANGE ADAPTATION ACTIONS

Oral Presentation

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Marine Protected Areas (MPAs) serve as crucial tools for conserving marine biodiversity. As climate change continues to pose significant threats to marine ecosystems, it is imperative to assess and implement effective operational actions within MPAs. We will present a comprehensive analysis of operational actions already in practice across diverse MPAs worldwide, designed to combat, mitigate, and adapt to climate change impacts. To facilitate efficient knowledge dissemination and empower MPA managers, an open-sourced database has been meticulously developed. This database serves as a valuable repository, compiling a diverse array of climate change actions being implemented within MPAs globally. By collating and categorizing these actions, the database provides a toolkit for managers, enabling them to tailor strategies according to their specific vulnerabilities. Through this in-depth exploration of successful operational actions and strategies, we aim to enhance the collective understanding of climate change adaptation within MPAs. By facilitating access to this knowledge repository, it is anticipated that MPA managers will be better equipped to make informed decisions and implement effective measures, ultimately contributing to the resilience and sustainability of our marine ecosystems in the face of climate change.

COMMUNITY-BASED CONSERVATION AIDS CLIMATE RESILIENCE IN MOUNTAIN COMMUNITIES

Oral Presentation

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The role of community-based conservation (CBC) and natural resource management (CBNRM) in ecosystem protection and socioeconomic enhancement has received considerable attention, but their contribution to climate adaptation in vulnerable areas remains unexplored. Using a mixed-method case study approach, this study compares two sites (Khyber and Khudaababad)
in northern Pakistan with comparable socioeconomic features but varying levels of effectiveness of CBC/CBNRM programs. The CBC in Khyber initiated in 1997 is still active while CBC in Khudaabad initiated in 2002 was inactive until 2017. Data was gathered through household surveys (n=220, 110 at each site), key informant interviews (n=4 office-bearers of community-based organizations at each site), and document review. In comparison to Khudaabad, the findings revealed that local communities in Khyber exhibit greater climate resilience due to proactive governance, improved farming practices, efficient energy options, credit access, health insurance, hazard response and climate knowledge. The study concludes that CBC/CBNRM contributes to building climate resilience among vulnerable mountain communities by strengthening social and ecological systems. It recommends integrating climate adaptation and mitigation into existing CBC/CBNRM programs rather than standalone measures to enhance vulnerable communities’ climate resilience.

**KOSOVO’S PROTECTED AREAS AND ANTHROPOGENIC PRESSURES**

Poster Presentation

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The last two decades have emphasized ecosystem degradation in Kosovo, which indicates the sheer magnitude of anthropogenic pressure on natural ecosystems. The main anthropogenic pressures in the protected areas (PA) are land exploitation quarries, riverbed aggregate exploitation, agricultural land beyond its capacity, deforestation, and habitat loss. Thus, the total number of PAs in Kosovo is 248, which covers an area of 126,023.2 ha, or 11.5% of Kosovo’s area.

Challenges: Despite the constant rise in the number and size of PAs, efficient administration of PAs and the prevention of unlawful activities in these areas remain a challenge for Kosovo institutions. There are still PAs with special protection status that lack competent management authorities. The absence of spatial, managerial, and regulatory plans in some of these places is also regarded as a challenge. The unplanned construction, especially in the two biggest PAs, the National Parks “Bjeshket e Nemuna” and “Sharr Mountains,” which cover 94% of all PAs in Kosovo, is the biggest challenge to date.

Solutions: higher priority from the government for the conservation of PAs as well as their expansion. The establishment of management bodies for PAs, the acceleration of procedures to declare new PAs, and raising citizen awareness of PAs and their value. Most importantly, Kosovo needs to sign and ratify all the relevant international conventions in the fields of nature conservation and environmental protection.
A CENTURY OF REWILDING: IMPACTS ON MOUNTAIN PLANT COMMUNITIES

Oral Presentation

**R.S. von Büren** ¹, M. Schütz², C. Rixen³, S. Rumpf⁴, S. Wipf¹

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Rewilding is a conservation approach that aims at restoring human-dominated ecosystems into their natural state by re-establishing keystone species and habitat connectivity. It promotes trophic cascades, ecosystem services, and resilience against environmental changes with the goal of halting biodiversity loss and habitat degradation. In 1914, a unique “rewilding experiment” was initiated in the Central European Alps by the creation of the Swiss National Park, where any human use is banned and human presence is restricted to a network of trails. To monitor the expected natural succession from grassland into secondary natural forest, 130 permanent vegetation plots were set up from 1917 on and re-surveyed on average every 7 years until today. Annual observations revealed that red deer populations re-established and exponentially increased since the establishment of the park until the 1980s, and then remained relatively stable. The return of this keystone species suppressed forest succession, increased plant species richness, and the influence of deer grazing counteracted global change effects on plant communities by impeding the increase of thermophilic, nitrophilic and competitive species. Our results suggest that restored biotic interactions have the potential to overrule the effects of global change on plant communities in the long run. Moreover, our contiguous, very long-term time series allows us to explore the particularly slow vegetation shifts in mountain ecosystems.

HOW CAN REINTRODUCTIONS OF THREATENED SPECIES MITIGATE BIODIVERSITY LOSS?

Oral Presentation

**J. Meka** ¹, O. Marushchak², O. Nekrasova³, M. Pupins⁴, A. Škute⁴, K. Theissinger¹, **J.-Y. Georges** ³

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The reintroduction of threatened species is considered a nature-based solution to limit human-induced biodiversity loss and conserve ecosystem services. The European pond turtle (Emys
orbicularis) is the reptile that has suffered the most dramatic decline in Europe due to wetland collapse since the 18th century. The species has benefited from numerous reintroduction initiatives throughout Europe, but the actual efficiency of all these conservation actions has never been assessed. Based on an exhaustive literature review, interviews of stakeholders engaged in past and present Emys reintroduction initiatives, and original field data from our project Emys-R in France, Germany and Latvia (www.emysr.cnrs.fr), we identified a set of most effective settings and protocols for successful reintroduction or restocking of endangered populations of Emys. The results show the interdependency of ecological, economic and social levers, providing insights for best practices to ensure survival, dispersal, reproduction, and population growth as indicators of the success of releasing captive-bred Emys in the wild. This highlights the relevance of conservation actions focusing on umbrella species such as Emys, since they also benefit associated biodiversity, e.g. threatened amphibians. This knowledge will mitigate biodiversity loss through species reintroduction by enabling decision-makers to implement scientific findings in conservation actions.

NORMATIVE SCENARIOS FOR EFFECTIVELY MITIGATING BIODIVERSITY LOSS

Oral Presentation

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Extrapolating the impact of global change trends has led to alarming predictions of biodiversity loss. While such scenarios serve as stark warnings, they provide little guidance for averting the undesirable futures they predict. By contrast, normative scenarios, emphasizing positive outcomes for nature and society, allow for rethinking existing strategies and the possibilities for transformative change. In this contribution, we demonstrate the use of normative scenarios to identify protected areas to effectively mitigate biodiversity loss. We utilize the IPBES Nature Future Framework to create five scenarios, intended to support policy-makers in designing and managing a functioning ecological infrastructure for Switzerland. These scenarios are operationalized through quantitative modelling to explore spatial-temporal impacts on biodiversity and ecosystem services until 2060. Our results show that managing the landscape under normative goals, such as a ‘Nature for nature’ or ‘Nature for Culture’ perspective, can strongly improve landscape cohesion in protected areas as compared to business-as-usual predictions. Furthermore, we demonstrate that selecting sites for protected areas should consider their added value for the provision of ecosystem services, as this led to better results than focusing on their value for biodiversity alone. Such positive outcomes not only help identify strategies reverting current trends but allow mobilizing public support through positive messages.
BRINGING AQUATIC FUNGI INTO CONSERVATION: THE BIODIVERSA+ PROJECT FUNACTION

Poster Presentation

I. Fernandes 1,2,3, M. Bohm4, A. Bruder5,6, C. Canteiro4, S. Costa1,2, E.M. Eckert7, E. Ferrari7, D. Fontaneto7, L. Ganzert8, L. Garzoli7, D. Graça1,2, H.-P. Grossart8,9, V. Kisand10, K. Panksep11,10, O.V. Pettersson12, S. Pinnow8, V. Prins10, A. Retter8, D. Romero-Mujalli5, R. Sousa1,2, L. Tedersoo13, J. Anderson14

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Freshwater habitats harbour a rich biodiversity, provide essential ecological services, and are vitally important for human health, culture, recreation, and economy. Aquatic fungi (AF) are ecologically diverse organisms (decomposers, endophytes, symbionts, predators, parasites, pathogens), and influence food web dynamics and ecosystem functioning through interactions with all trophic levels. Huge efforts to document and protect biodiversity are underway across Europe (e.g. EU Biodiversity Strategy for 2030, European Green Deal). Yet, until now, AF contributing to the health and resilience of freshwater ecosystems are entirely neglected in all major conservation plans or policies. Further, the efficacy of existing protection schemes for preserving this important biodiversity component in freshwaters has not been evaluated. FUNACTION is, for the first time, building knowledge about the taxonomic, phylogenetic and functional diversity of AF to develop strategies for their conservation at large spatial scales, i.e. Pan European. In particular, FUNACTION aims at 1) producing the knowledge base needed for AF-aware conservation actions, 2) translating that knowledge into conservation planning and monitoring tools for AF in collaboration with stakeholders, and 3) increasing awareness about AF and the role they play in our freshwater ecosystems. We prioritise engagement with stakeholders to produce a useful scientific basis for effective implementation of conservation actions.
ENHANCING BIODIVERSITY-INCLUSIVE EIA FOR SUSTAINABLE DEVELOPMENT

Poster Presentation

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Amidst the escalating biodiversity loss catalysed by global development projects, this study delves into the intricate relationship between human well-being and natural systems. Focusing on pivotal sectors such as transportation, renewable energy and extractives, it underscores the pressing need to seamlessly integrate biodiversity considerations into development practices. The Environmental and Social Impact Assessment (ESIA) process, a key element in this integration, is critically examined for its effectiveness in mainstreaming biodiversity. Despite fervent calls from entities like the Convention on Biological Diversity (CBD), a nuanced understanding of how EIA significantly contributes to positive biodiversity outcomes remains elusive. With a specific focus on low-income countries, the study aims to unravel the complexities hindering favourable biodiversity impacts within the current EIA framework. By scrutinizing challenges and proposing actionable changes, it seeks to position EIA not merely as a regulatory hurdle but as a potent tool for steering sustainable economic growth and transformation. This research contributes to the broader discourse on leveraging EIA to catalyse biodiversity conservation within the intricate tapestry of global development.

WHERE TO RESTORE NATURE TO MAXIMIZE SYNERGIES?

Oral Presentation

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Biodiversity protection and reforestation for climate mitigation are two of the most pressing challenges of our time. However, navigating the complex interplay of biodiversity restoration, carbon sequestration, and food security within the constraints of limited land presents a significant challenge for decision-makers. In this study, we investigate the synergies and trade-offs between biodiversity restoration, carbon sequestration and food security across the land area of Great Britain at a 500m resolution, employing a multi-criteria optimization with changing priority weightings and changing budgets. This allows for a comprehensive exploration of potential land conversions between arable land, pasture for livestock, reforestation, and habitat restoration without predefined allocation rules. Our results demonstrate the feasibility of achieving climate and biodiversity targets in GB without compromising food production, contingent upon careful selection of land conversions. However, we found that effective conversions that enhance biodiversity and carbon sequestration without compromising food production are
limited to a minority of scenarios. Prioritizing these conversions is crucial for achieving substantial improvements within a limited budget of land conversions. The study concludes with recommendations for specific areas and land uses that should be prioritized in future policies, offering practical insights for sustainable land management and informed decision-making.

**OPPORTUNITIES AND CHALLENGES TO CO-MANAGEMENT IN A BIODIVERSITY HOTSPOT**

Oral Presentation

*S.P. Kerwillain* †, M. Garbo‡

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Tropical rainforests are the focus of actions addressing climate change and reversing biodiversity loss. With more than 60% of its terrestrial area covered by forest, Liberia is the most forested country in the Upper Guinean Forest Ecosystem of West Africa, a biodiversity hotspot. The forest contains distinctive flora and fauna and diverse ecological communities that provide refuge to several rare and endemic species and valuable timber and mineral resources. However, pressure from commercial and subsistence activities threatens the health of the forest. As part of its approach to forest management, the government has committed to setting aside 30% of its forest estate for conservation. Protected Areas (PA) remain at the heart of this strategy. Still, there is recognition that areas outside of the PA network remain valuable for biodiversity conservation and interventions to address climate change. Initially tilted toward a top-down government-centric approach that excluded local communities, the government and her conservation partners have moved toward an approach that centres the involvement of rural communities. This has been necessitated by more appreciation of the social nature of forest management and the passage in 2018 of a land rights law recognising customary ownership of land, including forests. I investigate the feasibility of collaborative management as a viable approach to sustainable forest management in a country where poverty overlaps with biodiversity.

**IMPLICATIONS OF HUMAN LAND COVER CHANGE IN PROTECTED AREAS FOR THE 30X30 TARGET**

Oral Presentation

*S. Block* †

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As the world rushes toward protecting 30% of terrestrial and marine habitats by 2030, it is crucial to monitor the effectiveness of existing protected areas. I used high-resolution land cover
maps from the Dynamic World dataset to measure changes in the expanse of croplands and built environments between 2017 and 2022 inside more than 40 thousand terrestrial protected areas in 200 countries. Croplands and buildings covered only 2.9% of the total area protected in 2022, but they were expanding in nearly half (47.6%) of the protected areas analyzed. If these trends continue, by 2030 croplands and buildings will cover more than 5% of area protected in 61 countries, and more than 10% in 32 countries. Anthropogenic land cover (and its dynamics) varies between protected areas with different IUCN categories. On average, croplands and buildings are stable or shrinking in IUCN categories Ia, Ib, and II, but they are growing in categories III to VI. In the average “protected landscape” (IUCN category V) 16.4% of the area was croplands and buildings in 2022, and with current trends this will increase to 17.75% by 2030. Human modification of protected habitats goes beyond conversion to croplands and buildings, so these figures are conservative estimates protected area effectiveness. Still, this analysis can help identify ineffective protected areas and track progress towards the 30x30 conservation target.

QUANTIFYING THE RISK AND THREAT OF PADDD TO TERRESTRIAL ECOSYSTEMS

Poster Presentation

S. Ng¹, H.C. Teo¹, L.P. Koh¹

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Protected Areas (PAs) are under the threat of Protected Area Downgrading, Downsizing and Degazettement (PADDD). Forests within PAs are likely at risk of increased deforestation and degradation after PADDD, yet are ineligible for carbon offsets under the current REDD+ regime. We utilise random forest models to determine the potential carbon emissions due to PADDD in the next five years. It was found that PAs globally are at varying risk of PADDD, which would result in a potential increase in deforestation rates of 1.25% on average, resulting in the potential emissions of 165MtCO2 per year over the next five years. Our model identified size of PA, GDP, control of corruption and temperature as key predictors of PADDD. The deforestation model identified control of corruption, GDP, precipitation and distance to urban centres as key predictors. We identified key areas of conservation priority in the Amazon, Congo Basin and Southeast Asia, but boreal and temperate forests in more affluent regions should not be overlooked. We suggest that reducing risk of PADDD to decrease emissions from such events could be a viable pathway for funding through carbon offsets.

BROADENING AREA-BASED CONSERVATION TO SAFEGUARD HUMAN WELLBEING AND BIODIVERSITY

Oral Presentation
Biodiversity loss affects not only species but also critical ecosystem services, or natural contributions to people (NCPs), that humanity relies on. These critical natural assets rely on healthy ecological communities for their resilient provision of goods and services to local people. Ecological degradation of critical natural assets leaves human communities vulnerable. In this work, we use the Biodiversity Intactness Index (BII) to assess the state of ecological communities between 2000 and 2020 in areas that provided critical natural assets for about 6 billion people. Following the ‘30 by 30’ framework, we select ~30% each country’s land area that presented the highest value of critical natural assets for their closest human community. We evaluated the rate of change of BII in these areas, in the country overall, and in the country’s natural protected areas (PAs). Although BII’s global decline is attenuated in PAs, critical natural assets are losing BII as rapidly as the rest of the world. However, protection makes less difference to BII in critical natural assets than in other PAs. Our results highlight that although PAs are effective in decelerating biodiversity loss, critical natural assets are poorly represented and protected by these PAs. As a result, nature is declining in the most critical areas for ecosystem services, meaning we must rethink area-based conservation to safeguard human wellbeing as well as species.

PLANGEA WEB: DECISION SUPPORT PLATFORM TO ECOSYSTEM CONSERVATION AND RESTORATION

Oral Presentation

B. Pavani¹, P. Branco¹, F. Gomes¹, B. Valle¹, E. Lacerda¹, R. Capelão¹, L. Oliveira¹, D. Rocha¹, J. Krieger¹, F. d’Albertas¹, R. Loyola ¹, B. Strassburg¹

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Ecosystem conservation and restoration efforts are assigned to address the world’s greatest challenges: biodiversity conservation and climate regulation. Meeting these efforts from national and international commitments in priority areas should give gains to nature by less economic costs. PLANGEA Web was developed to facilitate and support the strategic planning of land use under different goals and targets. The decision support platform integrates multiple benefits and costs across all terrestrial ecosystems. In addition to being flexible, it undergoes continuous development to improve its multicriteria optimization to identify priority areas for ecosystem conservation and restoration. The interactive map’s user-friendly interface shows outputs in different scenarios on a national or global scale, making it possible to compare the impacts individually on several metrics. For biodiversity conservation, PLANGEA Web models the species extinction debt, the ecoregions vulnerability and the ecosystems integrity. On climate change mitigation, it quantifies the net carbon sequestration. In addition, the land opportunity cost and the restoration implementation cost also are analysed metrics. This
multicriteria approach reveals biodiversity and climate synergies and trade-offs, incorporating them into economic efficiencies of the planning and policy choice. For detailed information, please visit https://plangea.earth/.

CONTRIBUTION TO THE CONSERVATION OF FUNGAL DIVERSITY IN BENIN

Oral Presentation

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The diversity of fungi in Benin is around 16,842 species, but only around 432 (2.6%) species are known. This study aims to contribute to the documentation of fungal diversity and improvement the conservation of fungi in Benin. Thus, between 2017 and 2022, each year, from June to September every three days, a transect lines of 500m x 10m has been traced in Bassila gallery forest, Koussoucouingou gallery forest, Wari-maro forest reserve and Kota waterfall, in the woodland dominated by ectomycorrhizal trees, Isoberlinia doka Craib & Stapf, I. tomentosa (Harms) Craib & Stapf, Uapaca togoensis Pax, and in the forest galleries dominated by Berlinia grandiflora (Vahl) Hutch, U. guinnensis Müll. Arg., for the fungal sample collection, description and characterization accompanied by local population awareness sessions. At the same time, we did a list of EcM trees in Benin based on the literature. During this period, 11 fungal species have been described as new to science. To contribute to the conservation of fungi and their habitats, 1200 peoples were educated about sustainable conservation of fungi and around 10,000 plants of I. doka and B. grandiflora were produced to reforest degraded fungal habitats. The literature reveals 18 species of symbiosis trees. Our study therefore confirms that many fungal species are being discovered in Benin and that many steps remain to be taken to show the importance of fungi to local populations, environmental defenders and political decision-makers.

NATURE BASED SOLUTIONS FOR CONSERVATION OF MT ELGON FOREST ECOSYSTEM

Oral Presentation

N. Nambande Masayi 1

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Mt. Elgon Forest plays a critical role in the providing essential ecosystem services. The forest faces a great challenge from human activities and climate change. Nature Based Solutions (NbS) have been used in the region because of its multiple benefits, however the effects of this
programs on forest cover is unclear. The study assessed the effects of precipitation and NbS on the size and quality of forest cover between 2013-2023. Climatic data was collected from Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) while data from Landsat and Sentinel images were used to collect data on Land Use Land Cover Change and Normalised Difference Vegetation Index (NDVI). Questionnaires and Key Informant Interview (KI) were used to validate the data. Data was analyzed using ArcGIS Pro and Google Earth Engine. The highest precipitation was experienced between the month of March-May except for the year 2013 and 2020 when the highest amount of precipitation was experienced in the month of September-November. Regression analysis revealed that December February precipitation explains about 43% of the NDVI of the same. There is a strong correlation ($p=0.66$) between rainfall and NDVI. Land under agriculture explains about 51% of the changes in the size of land under forest cover. Areas with established NbS have high forest cover with high NDVI (0.873). Questionnaires established that NbS has played a great role in the increase in forest cover in the region.

LONG-TERM REWILDING ENHANCES GRASSLAND BIODIVERSITY COMPARED TO ALPINE PASTURES

Poster Presentation

C. Rossi $^1$, S. Wipf$^1$

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Management abandonment of high-altitude, unproductive meadows and pastures has been a commonly observed trend in mountain areas in many parts of the world. The abandonment is often simplistically associated with a rapid loss of plant species diversity. However, abandonment followed by rewilding approaches may present opportunities to mitigate this loss or even enhance biodiversity. Here, we investigate the long-term differences in plant diversity between grasslands subject to a century-long rewilding experiment (i.e. the establishment of a wilderness area in the Swiss National Park), and managed grasslands in the adjacent agricultural landscape. We used a combination of plant surveys and optical remote sensing data from drones collected at various pairs of sites, in and outside the park. We found grassland in the park, primarily grazed by red deer and potentially other ungulates, having a higher plant diversity and spectral diversity when compared to similar patches, grazed by livestock in the park surroundings. Spectral diversity showed associations with both plant species richness and plant phylogenetic richness. Moreover, we did not find significant differences in terms of productivity between sites in and outside the park. Our results add to a growing line of evidence that rewilding can benefit plant diversity in grasslands and shed new light on the effect of excluding agricultural grazing practices in mountain areas.
CLIMATE CHANGE VULNERABILITY OF WESTERN PALEARCTIC BIODIVERSITY HOTSPOTS

Oral Presentation

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Anthropogenic climate change significantly threatens biodiversity by shifting species distribution and assemblages. Human land use compounds this threat by fragmenting habitats and reducing connectivity. To address these threats, calls to expand global protection are increasing such as the Kunming-Montreal Biodiversity Framework which aims to conserve at least 30% of the planet by 2030. Achieving this target requires conservation actions on critical biodiversity areas that are not protected effectively. The Western Palearctic biodiversity hotspots host High Biodiversity Importance Ecoregions, most of which are nature-imperiled and under 30% protection. Understanding how these areas will be affected by climate and land use changes is a priority for conservation. Here, we assess the climate change vulnerability of three biodiversity hotspots (the Mediterranean Basin, the Irano-Anatolian, and the Caucasus) in the Western Palearctic. Using a climate-analogs approach with land use changes, we delineate potential climatic shifts and high-risk areas within the hotspots for different emission scenarios by 2100. Our comprehensive assessment examines vulnerability at multiple levels: hotspots, biomes, ecoregions, and key biodiversity areas. We found that climate vulnerability varies across hotspots and ecoregions, and there is an urgent need for additional protection. We provided suggestions for area-based conservation strategies to meet the Kunming-Montreal Biodiversity Framework.

A CENTURY OF REWILDLING AFFECTS MOUNTAIN BIODIVERSITY AT DIFFERENT SPATIAL SCALES

Oral Presentation

S. Wipf 1, R. Haller1, S. Gubler2

1Swiss National Park, Zernez, Switzerland, 2SCNat, Bern, Switzerland

The Swiss National Park was established in 1914 as a strictly protected wilderness area. From its beginning, it was accompanied by intensive research and monitoring of the succession of ecosystems after the cease of human activity. Thus, the Swiss National Park constitutes a century-long, large-scale rewilding experiment. Rewilding as a conservation concept involves three major ecological processes, namely trophic complexity within habitats, spatial connectivity between habitats, and the presence of stochastic natural disturbances (Perino et al. 2019,
Science). By depicting examples from the abundant research accompanying the region’s long-term development, we elucidate how these aspects are contributing to the conservation of biodiversity at the level of species and habitats. Finally, we discuss these drivers of biodiversity in the light of different protection schemes proposed to reach the UN’s “30 by 30” goal.

DIALOGUE WITH LANDOWNERS A KEY TO SPECIES CONSERVATION

Oral Presentation

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Semi-natural grasslands are amongst the most species-rich habitats in Scandinavia and elsewhere in Europe. However, the ecological values of these habitats are threatened, by intensification of agriculture in some areas and by abandonment in others. A key question is whether current measures aiming to protect this biodiversity in Norway are in fact successful. We evaluated, in the field, the condition of 55 localities of semi-natural pastures and hay meadows recorded in the Norwegian nature database, Naturbase. We found that only 20 localities (36%) were receiving the agri-environmental subsidies for which they were all eligible. All but one of the localities receiving the subsidies were in fair to good condition, compared with just 41% of the localities that did not receive subsidies. However, only four of the 16 most valuable localities, those classed as nationally important, received agri-environmental subsidies. Through a questionnaire to landowners, we found that many were not aware of the biodiversity value on their properties. Of 33 respondents, 20 (61%) knew that they had these valuable ecosystems on their property, whilst 13 (39%) did not. Further, twenty respondents were not aware that they were eligible for financial support to maintain their species-rich grasslands. We conclude that to achieve long-term conservation in habitats dependent on management, it is essential to improve dialogue with landowners.

PLANT DIVERSITY OF THE PROTECTED STEPPE AREAS: A CASE STUDY IN EAST UKRAINE

Poster Presentation

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Steppe grasslands are among the most species rich plant communities, at the same time, steppe is one of the most threatened biomes. Plant species richness was studied in the Striltsivskyi Steppe department of the Luhansk Nature Reserve (Luhansk region). It is located on the
southern slopes of the Central Russian Upland, in the north of the steppe zone. From 1984 to 2021, we analyzed about 400 standard relevés (100 m²), a part of which was made on 23 permanent plots. The predominant soil is typical chernozem formed on the flat interfluves and gully slopes. These areas are covered with rich forb-bunchgrass steppes dominated by Stipa zalesskii, S. tirs, Festuca valesiaca. A characteristic feature of the Striltsivskyi Steppe is the wide distribution and dominance of the steppe shrubs Amygdalus nana, Caragana frutex, and Chamaecytisus ruthenicus. There are also fragments of sandy, petrophytic (mainly chalk), and saline steppes growing on the slopes. The average richness over all relevés was 62 species/100 m² (max. 108, min. 28). The maximum values of species richness were recorded in shrub steppes. This type of steppes is the initial stage of steppe overgrowth with woody species in the absence of grazing or mowing, this stage of succession is characterized by the highest species richness. It decreases with continued lack of management. Our study demonstrates the importance of low-intensity land-use for the preservation of biodiversity both at the local and the landscape scale.

HUMAN-WILDLIFE COEXISTENCE: TRACKING ANIMALS DURING PANDEMIC LOCKDOWNS

Oral Presentation

C. Rutz

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Slowing biodiversity loss requires deep mechanistic understanding of how human activities affect wildlife. Despite intense research efforts, a major challenge remains: disentangling the effects of landscape modifications, and the movements of people and vehicles. While these static and dynamic components of human activity are typically confounded, they temporarily became dissociated on a planetary scale during COVID-19 lockdowns, creating an invaluable research opportunity. The COVID-19 Bio-Logging Initiative investigates how animals responded to altered levels of human mobility, using tracking data remotely collected by wildlife wearables (‘bio-loggers’). In a remarkable community-driven effort, this UN-endorsed research consortium of >600 partners amassed >1 billion satellite fixes for ~13,000 tagged animals across ~200 species. Using an inclusive collaboration model, a portfolio of coordinated sub-projects is producing a step change in our understanding of human-wildlife interactions, helping inform conservation-management and environmental-planning decisions under the 30x30 agreement. More generally, this work highlighted, under the most tragic of circumstances, how animal tracking (‘Internet of Animals’) can help fill critical knowledge gaps in our pursuit of sustainable human-wildlife coexistence.
A PROVINCE-LEVEL SPECIES PROTECTION INDEX TO ASSESS
CONSERVATION AREA EFFICACY

Oral Presentation

J. Portmann\textsuperscript{1,2}, J. Wilshire\textsuperscript{1,2}, D. Leng\textsuperscript{1,2}, K. Winner\textsuperscript{1,2}, A. Killion\textsuperscript{1,2}, W. Jetz\textsuperscript{1,2}

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Following the adoption of the Kunming-Montreal Global Biodiversity Framework (GBF) and Target 3—to effectively conserve 30 percent of earth’s land and sea—the question is now where to focus our efforts. The Species Protection Index (SPI) assesses how current and future protected areas and other effective area-based conservation measures achieve the GBF goals of “healthy and resilient populations of all species” and to “reduce extinction rates” by conserving key species habitats and supporting the survival of species populations. The SPI is now available for all states and provinces globally. This higher resolution assessment elucidates subnational trends to inform future conservation efforts and highlights global patterns in the species coverage of conservation areas. In North America, province-level SPI scores are highly variable, spanning nearly the entire range of possible SPI values, whereas western Europe, Australia, northern South America, and southern Africa tended to have more consistent SPI scores. Overall, many more regions had an SPI of 0 than an SPI of 100 in 2023. Identifying these nuances allows local governments to improve their species protection and the national government to develop policies that direct resources to those areas most in need.
Nature-Based Solutions for Reinforced Disaster Risk Management

RESILIENCE ACTION PLAN FOR SANTA MARIA WATERSHED

Oral Presentation

A. Pascual

1Fundación CoMunidad, Director, Panama, Panama

The disasters as hurricanes have been increasing in intensity and frequency in Central America, one of the most vulnerable regions in the planet. Between 3 and 17 November 2020 the region was severe damage cause back-to-back by the tropical storms Eta & Iota. Our project focus in the increase the climate resilience for the people and ecosystems in the upper part in Santa Maria Watershed to improve water security. The nature-based solutions, to enhance the protective functions by the mountain agrifood systems to safeguard their functions as natural buffers and enhance their use for risk reduction to climate change in this key source that provides water to more than 200,000 people in three provinces and a part of the indigenous region. Our action on disasters risk reduction focus in the Nature Based Solution, was implemented in the upper part of Santa Maria Watershed, specifically in Local Government of Santa Fe, Veraguas. To increase climate resilience, we work together with family farmers, coffee, citrus and vegetables producers. The project methodology is development workshops for construction of collective knowledge for face the climate change. The outcomes of the project were identifying the native trees of fruit and timber useful for your own agroforestry systems as green infrastructure and the establishment of local nurseries. Implement living and dead barrier, in farms to conserve the soil, within some of the species that are used are plantain, pineapple and lemongrass.

THE ROLE OF NATURAL INFRASTRUCTURE IN DISASTER RISK MITIGATION

Poster Presentation

M. Obeng Pokua

1University of Education-Winneba, DRID/Political Science, Winneba, Ghana

Natural infrastructure plays a crucial role in disaster risk management, offering sustainable and effective solutions to mitigate the impact of natural disasters. Unlike traditional built infrastructure, natural infrastructure leverages the inherent protective qualities of ecosystems, such as wetlands, forests, and coastal areas, to enhance resilience and reduce vulnerability. This approach aligns with the concept of ecosystem-based adaptation, recognizing the interconnectedness between nature and human well-being. Wetlands act as natural sponges, absorbing...
excess water during floods, while forests serve as barriers against landslides and wildfires. Integrating natural infrastructure into disaster risk management strategies not only enhances the ability of ecosystems to withstand extreme events but also ensures sustainable resource management and biodiversity conservation. This study explores the multifaceted role of natural infrastructure in disaster risk reduction, emphasizing its cost-effectiveness and long-term benefits. By fostering ecosystem health and functionality, natural infrastructure contributes to community resilience, economic stability, and environmental sustainability. Recognizing the value of these ecosystems in disaster risk management is essential for fostering a holistic and adaptive approach to building resilience in the face of an increasingly unpredictable climate and the escalating frequency and intensity of natural disasters.

EVERY CLOUD HAS A SILVER LINING: EMBRACING THE REALITY OF CLIMATE CHANGE

Poster Presentation

M. Obeng Pokuaa 1

1UEW, Winneba, Ghana

It is essential to note that climate change generally poses numerous challenges to agriculture, including altered precipitation patterns, increased frequency of extreme weather events, and shifts in temperature regimes. However, amidst these challenges, certain aspects of climate change can potentially have positive impacts on agriculture. Warmer temperatures in certain regions may extend growing seasons, allowing for increased crop yields and multiple harvests within a year. Additionally, elevated levels of carbon dioxide (CO2) in the atmosphere, a key driver of climate change, can act as a fertilizer for plants, enhancing photosynthesis and potentially boosting agricultural productivity. While acknowledging these potential benefits, it is crucial to approach the relationship between climate change and agriculture with caution, recognizing the inherent uncertainties and the overarching negative impacts that climate change poses to global food security. This abstract highlights the nuanced interplay between climate change and agriculture, emphasizing both potential opportunities and risks. It underscores the need for comprehensive strategies that consider the broader context of climate impacts on agricultural systems and the imperative of sustainable practices to ensure food security in the face of a changing climate.

NBS IN WATER CREDITS A SOLUTION FOR DISASTER RISK MANAGEMENT

Oral Presentation

M.F. Wilches Fonseca 1

1Cataruben Fundation, Water Department, Yopal, Colombia
The ‘Water Credits’ methodology for measuring and certifying the additionality in water regulation, quantified in cubic meters per year, derived from Nature-based Solutions (NbS). These solutions encompass terrestrial ecosystem restoration with native species, reforestation in agroecosystems, conservation of terrestrial and aquatic ecosystems, water harvesting, and land adaptation following keyline contour plowing. Water Credits serve as essential financial tools for restoring natural coverages, providing vital ecosystem services for human activities and biodiversity conservation, thereby stabilizing and regulating water flows. This effectively prevents droughts, floods, and natural disasters linked to hydrological instability and climate change. The effectiveness of Water Credits is evident in mitigating extreme events in lotic and lentic hydrological systems, thereby enhancing the resilience of watersheds against climate change-induced disasters. The methodology’s application in pilot projects across Colombian watersheds in the global south will be emphasized. The methodology enables precise quantification of additionality in water regulation, encouraging businesses to invest in future water security and natural disaster prevention. This investment allows companies to offset their water footprint and invest in the hydrological sustainability of their watershed, creating a positive and tangible impact on the population, productive activities, and water resources.

ADOPTION OF BIOFORTIFIED WHEAT TO MITIGATE THE EFFECT OF CLIMATE CHANGE

Oral Presentation

R. Rehman¹, V. Govindan², Z. Ahmed¹

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In Pakistan 40% children and 48% of pregnant women are Zn deficient with relatively higher proportions in rural setting. There is a dire need to take immediate measures to reduce the adverse effects of climate change on malnutrition by utilizing the biodiversity, disseminating climate resilient, nutritionally enriched wheat as a staple food. CIMMYT develop and disseminate the climate resilient wheat lines to south Asian countries every year including Pakistan. Two CIMMYT trials were conducted during the crop growth period 2020-21 viz. 11th Harvest-Plus Yield Trial (HPYT) and 12th HarvestPlus South Asia Nursery (HPAN) at five locations across Pakistan. 50 elite wheat genotypes in 11th HarvestPlus Yield Trial (HPYT) and 290 genotypes in 12th HarvestPlus South Asia Nursery (HPAN) were tested for yield potential, biotic and abiotic stress tolerance and grain Zn. Genotype x Environment (GxE) testing of 50 best lines in target locations exhibited limited G x E interaction with significant genotypic effect and non-significant G x E interaction effect of entries across all five locations. In all locations, various lines were superior to checks on the basis of yield, Zn and Fe contents and resistance towards biotic and abiotic stresses. Best performing genotypes from 12th HarvestPlus South Asia Nursery (HPAN) were also selected on the basis of mentioned traits for further
multi-locational testing. These genotypes will further be subjected to seed multiplication and varietal release.

**NATURE-BASED SOLUTIONS FOR COASTAL RESILIENCY: CASE STUDIES FROM CANADA**

Oral Presentation

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Boasting the longest coastline in the world, Canada faces significant coastal hazards amid a changing climate. Nature-based Solutions (NbS) are frequently being adopted to improve coastal resilience, while providing numerous co-benefits. This presentation will share coastal NbS case studies from across Canada, including (at minimum):

Robert’s Bay Marsh Expansion, British Columbia, Canada. This project aimed to restore and expand a degraded salt marsh in Western Canada. The project aimed to improve carbon sequestration, provide intertidal habitat, and reduce coastal flood and erosion hazards, amongst other benefits. Construction is scheduled for Summer 2024.

Conway Narrows Vulnerability Assessment, Prince Edward Island, Canada. Conway Narrows is a hotspot for oyster cultivation in Eastern Canada. An extensive barrier island beach-dune system has historically protected the oyster leases from ocean waves and sea ice; however, barrier islands, including this system, are experiencing significant degradation (including erosion and breaches) due to a changing climate. This project involved assessing the vulnerability of the aquaculture leases and the naturally protective barrier island system, in consideration of a changing climate.

The physical, environmental, and socio-economic contexts of each project will be highlighted, as well as study methodology, proposed solutions, and project outcomes. Project insights will provide practical guidance for other projects globally.

**BIODIVERSITY AND CLIMATE CHANGE OVER ENKANGALA ESCARPMENT OF SOUTH AFRICA**

Oral Presentation

*A. Hadisu*
The Enkangala Escarpment is a mountainous area in the eastern part of South Africa, a hotspot for biodiversity but threatened by climate change. Climate change, despite its widely recognized negative consequences, presents unique opportunities for advancing climate modeling capabilities. The evolving climate provides a dynamic environment for scientists and researchers to refine and enhance existing climate models on a fine scale. The use of regional climate models provides opportunities for the validation and calibration of models against real-time observations of changing climatic conditions. The increasing frequency and intensity of extreme weather events allow for more robust testing of model accuracy and predictive capabilities. Moreover, biodiversity studies can benefit from incorporating high-resolution observational data, satellite imagery, and advanced computational methods, resulting in more precise and reliable predictions. The continuous evolution of climate parameters offers a real-world laboratory for refining model parameters and improving simulations of complex climate processes. Additionally, the interdisciplinary nature of climate change encourages collaboration between climate scientists, ecologists, economists, and policymakers. This way of working together lets different datasets and points of view be combined, which makes climate models more accurate and complete, which can help people make decisions based on facts.

SOYBEAN: A NATURAL SOLUTION TO MITIGATE CLIMATE CHANGE, AND ENSURE FOOD SECURITY

Oral Presentation

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The increasing population, diminishing biodiversity, industrialization, and intense agriculture rapidly add to climate change. Pakistan is among those countries that are highly vulnerable to climate change. In the past two decades, many human lives and billions of $US losses occurred due to many catastrophic events including heat waves, unexpected rainfall, and prolonged drought. This has seriously raised concerns about agriculture productivity to feed over 250 million people. To provide natural solutions to these problems, efforts were started to improve crop diversification and enhance productivity by introducing climate-resilient germplasm. For this purpose, 1200 genetically diverse soybean accessions were collected from all over the world through USDA. These lines were tested and bred across different agroecological zones of Pakistan to develop elevated temperatures (<45 °C), drought, and salinity-tolerant high-yielding photoperiod insensitive germplasm. At a commercial scale, our results demonstrated
>25% increased crop productivity, >26% water, and 21% nutrient use efficiencies with the potential to rehabilitate >15 million hectares of deteriorated lands and protect >20 million hectares of already cultivated lands. It was also demonstrated that this crop can provide natural remedies to cure >10 million malnourished children and women in rural areas. Our results also indicated a 33% increase in the income of farmers with small land holdings. Overall this invention has demonstrated a tremendous potential to mitigate climate change, improve socio-economic status, and ensure food security for millions.
Navigating the social and political dimensions of biodiversity data

HUMAN-WOLF DYNAMICS THROUGH MULTISPECIES ETHNOGRAPHY AND SPATIO-TEMPORAL DATA

Oral Presentation

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Biophysical and socio-cultural factors have jointly shaped the recovery of wolves in human-dominated landscapes, yet relatively few studies have assessed the influence of social and ecological landscapes on wildlife distribution through a multispecies ethnographic lens. With the recolonizations of wolves (Canis Lupus) in Europe, including densely human-populated areas like Flanders, exploring the potential for human-wildlife coexistence becomes crucial for understanding the social-ecological causes and consequences of species recovery and making appropriate management recommendations. Here, we investigated how the effects of long-term absence and recent recovery of wolves (re)creates multispecies interactions. We sought to determine whether social and ecological covariates shape the distribution of this ecological and highly political keystone species. We focus on the territory where humans and wolves overlap. By using wildlife monitoring alongside semi-structured interviews and participant observations, we detail how multispecies ethnography can help understanding the social, political, and ecological dimensions of biodiversity data and address biases along these dimensions. We conclude that social-ecological systems thinking, and multispecies ethnography aids in countering the implications of data disparities on conservation decision-making.

QUANTIFYING BIAS AGAINST INTRODUCED SPECIES IN THE SCIENTIFIC LITERATURE

Oral Presentation

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Bias occurs when researchers, knowingly or unwittingly, shape their science to favour specific outcomes. Mission-driven fields, such as conservation and invasion biology, may be particularly prone to such biases because they reflect certain values and worldviews. Here, we provide an extensive catalogue of the ways in which biases against introduced species can potentially appear within scientific publications. We then conducted a bibliographic study to quantify
the prevalence of two common forms of bias within a sample of 63* peer-reviewed studies published in English from 1980 to 2022 with key words pertaining to introduced species. Each paper was scored independently by two readers. We found that 17% of articles show evidence of at least one form of bias against introduced species, and that an additional 20% of articles show negative bias but with weaker evidence. There is no evidence that the frequency of biases has changed with time. *Highly cited articles in our sample are [more likely / not more likely] to be biased than rarely-cited articles. Repeatability of bias scores was moderate, which suggests room for methodological improvement. Greater integration of the social sciences into research projects on introduced species could help ensure that worldviews are stated explicitly and independently of analyses. Policy recommendations should consider multiple worldviews.*analyses ongoing

CAMBIO: TRANSFORMATIVE CHANGE FOR BIODIVERSITY MONITORING IN LATIN AMERICA

Oral Presentation

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Biodiversity is a megacategory that comprises the multiple dimensions of life on earth. As such, estimations of biodiversity trends represent a paramount challenge in the process of selecting what to measure, and how and where it can be measured. Additionally, it is a concept that exists because of its relation to people and not despite it. Local communities have been shaped by the local share of biodiversity that defines their own identity, survival, needs and values. Yet, efforts to halt biodiversity loss (e.g. SDGs, planetary boundaries) focus on few prevailing definitions that result in little long-term success due to the disempowerment of communities that are not able to utilize the tools created outside their reality. Efforts to streamline the need for transformative change for biodiversity have been taken up by the Post-2020 Kunming-Montreal Biodiversity framework. According to it, biodiversity monitoring should aim to facilitate, promote and accelerate transformative change. The question is what such a just framework should look like? To answer this question, we designed the transdisciplinary project named CAMBIO. This project is developed for Latin America, a region recognized as one of the most socially and biologically diverse on the planet. CAMBIO is based on 5 pillars that
integrate the socioecological dimensions of biodiversity: 1) shared values, 2) spatiotemporal scales, 3) biodiversity governance, 4) citizen science and, 5) knowledge infrastructures.

BIODIVERSITY DATA ACROSS BORDERS

Oral Presentation

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While rapidly growing repositories of biodiversity data provide unprecedented insight into ecological patterns at global scales, the application of species observations often belies the reality that the species these data tell us most about is the one they were never intended to include: humans. Biodiversity data trace not only cities and roads but the rise of surveillance technology, shadows of colonial histories, and echoes of contemporary racial and economic disparities. Understanding the histories and human dimensions of biodiversity data is critical to ensuring policy and practice informed by these data don’t exacerbate inequities. This work focuses on disparate and discontinuous data patterns across national borders. We explore how uncorrected socio-political disparities in biodiversity data can impact not only our insights about ecosystem processes but the distributional equity of decisions derived from these data. While statistical models can help identify and control for social and political data disparities, we provide examples of where expertise in social, cultural, and political processes underlying biodiversity data infrastructures might help equitably leverage existing data and inform future monitoring.
Old gaps and new solutions for global biodiversity monitoring and decision-support

**QUANTIFYING THE VALUE OF INFORMATION IN MARINE CONSERVATION MANAGEMENT**

Poster Presentation

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Environmental decision-making is inherently subject to uncertainty. Yet, decisions are often urgent and the question of whether one should take direct action or invest in collecting additional data beforehand is pervasive. To make this trade-off explicit, value of information theory (VOI) offers a powerful decision analytic tool to quantify the expected benefit of resolving uncertainty in a decision context. Although it is mostly used in economic contexts, it can be applied to biodiversity conservation and management. In our approach, we evaluate the expected surplus in resolving uncertainty about the occurrence of harmful algal blooms in the German North Sea coastal waters and the effect on decision-making. We use an adapted dynamic NPPZ model by Chakraborty & Feudel (2014) with two competing phytoplankton consortia (harmful, non-harmful) and regional monitoring data to analyse the prediction accuracy of different indicators. We then evaluate the effect of reducing uncertainty about these indicators (e.g. through monitoring) on management decisions by means of VOI analysis. We see that additional information may lead to an expected welfare gain in our decision context. This approach contributes valuable methodological insights for optimizing the resource allocation between monitoring and management and for improving management strategies in the context of biodiversity conservation. It further emphasizes the importance of considering uncertainty in decision-making processes.

**IDENTIFYING KNOWLEDGE GAPS WITH ADJACENCY MATRICES: THE CASE OF GBF**

Poster Presentation

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The quality and quantity of potentially available data overwhelmingly exceed the contemporary processing capacities of individuals and organizations. Hence, the issue of knowledge gaps, understood as a lack of necessary and sufficient information in a particular field of action, becomes burning. Overcoming this issue is critical for the effectiveness of the program described in Kunming-Montreal Global Biodiversity Framework (GBF). The paper presents an original procedure for aiding the comprehensive identification of knowledge gaps in GBF programming documents. Based on the adjacency matrix approach, the content analysis of relations between concepts used in Kunming-Montreal GBF will be discussed. Attention was paid to explicit and implicit sources of knowledge gaps within Section G (Goals) and Section H (Targets) of GBF. The knowledge gap was operationalized as the lack of information about the links between phenomena represented by a set of concepts included in Kunming-Montreal GBF. Adjacency matrices are used in cognitive mapping studies (Axelrod 1976, 2015; Kosko 1986) and have roots in graph theory. Our results demonstrate the effectiveness of the adjacency matrix approach for identifying knowledge gaps in actions programmed in the GBF. The study is part of the Emys-R project (www.emysr.cnrs.fr).

**MONITORING AERIAL BIOMASS AT YOUR FINGERTIPS**

Oral Presentation

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The airspace is a crucial habitat for aerial biodiversity but remains difficult to monitor. Remote sensing approaches like radar have emerged as important tools for large-scale airspace monitoring and can provide data on Essential Biodiversity Variables (EBV), e.g. by quantifying abundances and distributions (‘Species Populations’) and identifying the timing and routes of migrations (‘Species traits’). There are two major systems of radars – large-scale weather radars and small-scale biological radars. Weather radars provide estimates of aerial biomass at continental scales but are limited to higher altitudes (>200m) and coarse taxonomic information. Small-scale biological radars can simultaneously track and classify individual birds, bats and insects from 3 m above ground and up to several hundred (insects) or thousand meters (birds, bats). Various features measured by radar such as size or shape facilitate the differentiation into species groups. We present data on abundance and temporal movement patterns of insects from Finland to France using a network of biological radars. The EBV framework emphasizes that variables should be repeatedly measured at the same site, and over larger spatial scales and longer time intervals, which a network of biological radars could provide. Understanding the dynamics of biomass exchange through the air will be key to the future
The European Space Agency (ESA) activity “Biodiversity+ Precursors” is a contribution to the joint EC-ESA Earth System Science Initiative to advance ESS and its response to the global challenges. The Precursor BIOMONDO was focused on biodiversity in freshwater ecosystems. Based on analysis of relevant sources for scientific and policy priorities, the main knowledge gaps and challenges in biodiversity monitoring were compared to possibilities from Earth Observation (EO). These findings were the basis for the development of innovative integrated earth science solutions (Pilots) that integrates EO based products, biodiversity modelling (GLOBIO and Delft3 model suites) and in situ data using advanced data science and information technology. The three pilots were focused on eutrophication, heat waves and river fragmentation, and its effect on biodiversity. The generated products were also implemented in a BIOMONDO Biodiversity data cube. In addition, time series of the cube’d data were analysed using Machine Learning (ML) technique and integrated Thematic Ecosystem Change Indices (TECI), e.g., water quality and lake water temperature evolution, were deduced and analysed. Validation of the integrated products was a key task within BIOMONDO, and several biodiversity and policy experts have been consulted. They were also provided access to the novel EO products in the cube via API or the implemented data viewer, a tool for visualisation and easy access to products and data.
The 2030 commitments of the Kunming-Montreal Global Biodiversity Framework have energized governments and businesses worldwide. But an effective and inclusive safeguarding of biodiversity relies on robust information products that support the assessment of biodiversity change and effective conservation decisions. I will provide a brief review of the landscape of global biodiversity monitoring and decision-support, explore key gaps between information products and needs, and highlight select new opportunities. I will also discuss different approaches to measuring progress toward Target 21 of the framework, which aims to ensure that best available data, information, and knowledge are accessible to decision-makers, practitioners, and the public. Finally, I will attempt to provide a framework for our larger session at the Forum and briefly introduce the speakers and their themes.

AN ACTIVE LEARNING BASED MONITORING STRATEGY FOR BIODIVERSITY AND CONSERVATION

Oral Presentation

**K. Winner**\(^1,2\), F. Iannarilli\(^3,1,2\), B. Kellenberger\(^1,2\), S. Sharma\(^1,2\), D. Ellis Soto\(^1,2\), W. Jetz\(^1,2\)

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We propose a novel monitoring strategy using “active learning” methodologies originally developed by the machine learning community for human-in-the-loop learning tasks in computer vision and natural language processing where they proved to be very efficient at optimizing the use of human annotation time. Our approach takes these concepts and reimagines them as a form of model-based, iterative sampling strategies that we show can significantly improve the sampling efficiency of a variety of biodiversity monitoring tasks. At its core, this method considers the quantitative information value of different sampling actions (e.g. different locations to conduct a field survey) with respect to how they would improve expected model performance. In this talk, we will show how this approach can be applied to direct species distribution modeling efforts, first to optimize the spatial distribution of sampling effort, then to jointly optimize for space and species selection in a joint SDM, and finally to optimize model forecasting performance under climate change scenarios. We also demonstrate how this flexible approach can be extended to directly address conservation objectives and how the “information value” component can be extracted from the overall strategy for other uses. Overall, this new framework provides a wide array of potent new ways to inform monitoring activities and which directly and quantitatively bridge the gap from biodiversity monitoring to decision making.
UNDERSTANDING BIODIVERSITY RESPONSES TO RIVER DRYING ACROSS EUROPE

Poster Presentation


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River drying affects more than half of the global river network and drying events are increasing in magnitude, duration and frequency under hydroclimatic change, yet we lack the ability to predict its impacts on aquatic species populations. This study used 13 datasets from across temperate, continental and Mediterranean Europe to model how species populations respond to drying. We found that monitoring missed more than half of the aquatic species estimated to occupy sites within river systems affected by drying, leading to systematic underestimation of the contribution of these systems to freshwater biodiversity. After accounting for this, we estimated a mean loss of 2.5 species per 10% increase in drying event duration. Our assessment of model transferability between datasets highlighted the importance of long-term, species-level monitoring for improving our understanding of biodiversity responses to river drying. Overall, our findings emphasise the need to reform European freshwater monitoring practices to include robust statistical methods that address the inefficiencies of ecological survey techniques, investment to preserve and expand long-term monitoring networks, and the adoption of new survey techniques to facilitate more efficient monitoring of species populations.

330
INNOVATIVE PARTICIPATORY BIOACOUSTIC MONITORING IN COLOMBIAN ECOSYSTEMS

Oral Presentation

E.A. Hincapie Peñaloza

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Traditional biodiversity measurements often fail to comprehensively cover ecological diversity, resulting in significant gaps and biases in our understanding. To address these shortcomings, the Cataruben Foundation’s BioBits project is implementing innovative participatory bioacoustic monitoring systems in various Colombian ecosystems. By integrating community participation with advanced technology, the project enriches biodiversity assessment and conservation efforts. BioBits includes wetland, savanna, Andean high mountain forest and páramo ecosystems. It effectively assesses and mitigates the impacts of human activities such as deforestation and land-use change. The project’s use of participatory bioacoustic monitoring, using machine learning for faunal analysis, has led to significant advances in community engagement. Effective data collection has been achieved on 450 private conservation properties, with plans to double this coverage. Notable achievements include the identification of diverse species, improved logistical standardisation and increased local participation. These methods have proven scalable in diverse environments, including Andean ecosystems, wetlands and savannas, positioning the Colombian case as a globally replicable model. BioBits demonstrates how innovative monitoring strategies can fill gaps in traditional biodiversity knowledge and promote inclusive conservation practices, making a significant contribution to global biodiversity frameworks.

BIODIVERSITY MONITORING FOR EFFECTIVE AGRICULTURAL POLICY AND TRANSFORMATION

Poster Presentation

M. Clausen

1, N. Borchard2, C. Scherber3, A. Kirse3, E. Niephaus3, N. Heitepriem4

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BioMonitor4CAP: ADVANCED BIODIVERSITY MONITORING FOR RESULTS-BASED AND EFFECTIVE AGRICULTURAL POLICY AND TRANSFORMATION

BioMonitor4CAP is a research project aiming to develop advanced biodiversity monitoring to show which agricultural practices and policies work best at conserving farmland biodiversity.
Twenty-three partner organisations from 10 European countries and Peru participate in this project funded through the Horizon Europe research and innovation programme. Agriculture is a significant driver of biodiversity loss in Europe, and current monitoring methods are inadequate for assessing progress towards conservation goals. The BioMonitor4CAP project aims to address this challenge by developing and testing affordable and reliable biodiversity monitoring systems that combine classical indicator systems with technology-driven approaches. By developing predictive response models that recommend appropriate land management practices to improve on-farm biodiversity, these biodiversity monitoring systems ultimately contribute to the project’s goal to successfully implement result-based policies within the Common Agricultural Policy (CAP). The project will collaborate with various stakeholders to evaluate the regional socioeconomic impacts and potential compromises arising from the implementation of the new monitoring systems, particularly from the perspective of rural stakeholders.

FRENCH BIODIVERSITY E-INFRASTRUCTURE: FROM EBV OPERATIONALIZATION PILOT TO GBiOS

Oral Presentation


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The biodiversity needs to build a framework harmonized and interoperable data from raw, heterogeneous and scattered datasets. Such a framework will help observation, measurement and understanding of the spatio-temporal dynamic of biodiversity from local to global scales. One of the most relevant concept to use is Essential Biodiversity Variables (EBV). The EBV concept represents a useful basis for identifying appropriate data to be collated as well as associated analytical workflows for processing it. Thanks to FAIR (Findable, Accessible, Interoperability, Reusable) data and source code implementation, it is possible to make a transparent
assessment of biodiversity by generating reusable biodiversity indicators, and help improving biodiversity monitoring at various scales. Through the BiodiFAIRse GO FAIR implementation network, we established how we can benefit from existing open standards, tools and platforms as the Galaxy platform for code accessibility and Ecological Metadata Language, associated to DataONE and GBIF, for data. We propose through Global Open Science Cloud EBVOSC case study that these implementation choices can help supporting the mission of GEO BON: “Improve the acquisition, coordination and delivery of biodiversity observations and related services to users including decision makers and the scientific community” playing a role in the setup of the Global Biodiversity Observation System (GBiOS) to help reach the needs of the Global Biodiversity Framework.

OPTIMISING MONITORING APPROACHES FOR BIODIVERSITY RECOVERY

Poster Presentation

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Amid the global challenges posed by biodiversity loss and climate change, the emergence of a biodiversity credit market sparks hope. However, a ‘gold standard’ for measuring biodiversity remains elusive, hindering the market’s progress. This talk introduces a framework guided by principles of generalisability, scalability, time-efficiency, and replicability to address the question: “How can we effectively monitor biodiversity recovery within restoration projects?”. We offer insights into several crucial aspects: the selection of taxa for monitoring, suitable data collection methods, biodiversity metrics, and targets for assessing recovery. When considering taxa, should our focus transcend single taxon assessments to encompass the interconnected web of species? If traditional data collection methods fall short, could promising alternatives such as eDNA and acoustic monitoring hold the key to efficient, large-scale monitoring? Biodiversity metrics also hold importance; can species richness, abundance, community composition, or functional metrics capture the dynamic nature of ecosystems undergoing succession? Further, establishing reliable recovery targets is crucial to validating restoration success and quantifying biodiversity shifts over time. How do we consistently define a recovered community, without access to control sites? Join us as we navigate novel monitoring methods, nuanced metrics, and comparative analyses to propose a new standard for biodiversity monitoring.

REALISING THE POTENTIAL OF AI-ASSISTED CAMERAS FOR GLOBAL MONITORING OF INSECTS

Oral Presentation
D.B. Roy 1,2

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There is growing evidence of wholesale declines in insects (van Klink et al. 2020) - ‘death by a thousand cuts’ via a range of environmental pressures such as pollution, habitat loss and climate change (Wagner 2020). Robust monitoring of insects is a priority for action (Luke et al. 2023) due to the vital role they play in all terrestrial ecosystems, e.g. comprising ~80% of all animal life (Stork 2018); providing critical ecosystem service such as pollination, pest control, nutrient cycling, and culture services; highly effective as indicators of wider biodiversity and habitat quality. Monitoring of insects traditionally needs entomologists in the field and high levels of taxonomic expertise; both have proven hard to achieve for many parts of the world. Insect camera systems powered by AI are emerging as a disruptive new technique that offers huge potential for monitoring of insects in a standardised way at the scale required - high temporal precision, non-destructive, verifiable, achievable over large areas and for the long-term. We review progress in applying automated monitoring of insects (AMI) systems in Europe, North America, south-east Asia and Central America - from sensor development and field deployment to workflows for data processing via AI and building image training datasets through citizen science. We propose priorities towards a step-change in automated monitoring of insects, a vital task in the face of rapid biodiversity loss from global threats.

CITIZEN SCIENCE ENABLED MONITORING OF AVIAN TRENDS AND DISTRIBUTIONS

Poster Presentation

F. La Sorte 1,2, J. Cohen1,2, W. Jetz1,2

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Understanding and addressing the global biodiversity crisis requires compiling and processing ecological information from multiple sources. Citizen science programs provide opportunities to support these efforts for many taxa, including birds. A unique feature of one such program, eBird, is that participants have the option to select from predefined geographic locations that are popular and publicly accessible birding destinations (hotspots). The sampling structure of eBird hotspots in comparison with other point-based data sources has not been examined. A total of 300,500 hotspots were designated in eBird from 2002 to 2022 with the best sampled hotspots occurring in North America and Europe and the poorest occurring in Central Africa and Central Asia. A total of 10,410 bird species (ca. 96.9% of total) were recorded at hotspots and the accumulation across years of new species in most regions and seasons was non-asymptotic. In most cases across seasons, years and regions, the completeness of species richness estimates at hotspots were above 90%. The landcover classes sampled by hotspots
displayed strong geographic variation and differed from other data sources with urban areas sampled at higher frequencies. These results provide a context for the informed application of hotspot data in the study of avian diversity trends and dynamics within and across years.

ADVANCING INSECT MONITORING THROUGH CAMERA TRAPS AND ARTIFICIAL INTELLIGENCE

Poster Presentation

R. Künast ¹, S. Meyer¹, P. Mäder²

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Insects and grasslands, renowned for their ecological significance, face unprecedented challenges with documented declines in abundance and diversity, particularly due to land-use intensification. Traditional insect monitoring methods suffer from limitations in spatial and temporal resolution, hindering a comprehensive understanding of the impact of land-use changes on insect communities. The AIforIBM project addresses this gap by leveraging digital monitoring systems employing cameras in conjunction with artificial intelligence (AI)-enabled image recognition. Building on the evolving landscape of AI applications in ecological research, the project focuses on the development and deployment of camera traps for insect identification in field conditions. By combining the advantages of controlled lab environments with the realism of field settings, these traps provide a standardized yet ecologically relevant framework. The integration of AI facilitates the automated analysis of continuous image feeds, enabling high-temporal-resolution insights into insect community dynamics. The AIforIBM project not only aims to advance insect monitoring through the synergistic use of AI and camera traps but also specifically investigates the impact of mowing on insect diversity, serving as a comprehensive example to research the strengths and limitations of AI linked methods to investigate ecological dynamics.

COMBINING REMOTE SENSING AND CITIZEN SCIENCE DATA TO DERIVE FOREST BIODIVERSITY

Oral Presentation

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Despite the increasing threat to essential ecosystem services provided by forests due to the biodiversity and climate crises, robust monitoring of biodiversity has been lacking due to the inaccessibility and heterogeneous formats of valuable data and observations, as well as suitable analysis methods. The goal of this study is, therefore, to integrate the entire repertoire of available geo- and citizen science data to link previously untapped biodiversity information with remote sensing products through methods of Artificial Intelligence (AI) for the spatial derivation of forest communities and ultimately biodiversity. This will be achieved by using AI methods, allowing integration of large data volumes with predictors of different data structures. These properties enable deriving biodiversity properties in forest ecosystem based on remote sensing products in combination with heterogeneous and discrete data. Here we present the concept and first results of the project “iForest”. iForest will build on comprehensive acquisition and analysis of citizen science data (https://www.gbif.org/) and satellite data in concert. Accordingly, we present 1) GBIF data density per forest community and forest growth regions, 2) selection of forest community subsets based on indicator species as provided by GBIF and 3), we finally combine citizen science data with satellite observations to demonstrate the additional value in estimating the extent and quality of biodiversity observed.

FROM GLOBAL GOALS TO NATIONAL ACTIONS USING THE RED TO GREEN FRAMEWORK

Oral Presentation

M.O. Kyrkjeeide, M. Evju, B. Pedersen

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To bend the curve of biodiversity loss, global goals must be translated into national targets and actions. Tools to do this are highly needed, but still scarce. High ambitions are set in the Kunming-Montreal global biodiversity framework with urgent need for implementation nationally. As a first attempt to operationalize national Red Lists by using the criteria of risk assessment as quantifiable objectives, we recently developed the Red to Green framework. The framework allows for a systematic setting of conservation goals, with quantifiable conservation objectives, and identifying conservation actions to achieve these objectives. Through a systematic assessment of knowledge and conservation actions, the framework forms a solid foundation for developing national action plans for biodiversity conservation. We assessed 133 Red Listed species and habitats, and identified knowledge gaps and/or unmanageable threats as large constraints to suggest actions for the most threatened species in Norway. With limited resources, prioritization of species, actions, and spatial units is necessary to produce the greatest conservation benefits. The Red to Green framework forms a solid starting point for prioritization and implementation of conservation actions and reporting on progress, and we demonstrate how by presenting a case-study from Norway.
CAPTURING GAPS AND BIASES TO SUPPORT PRIORITIZED BIODIVERSITY DATA MOBILIZATION

Oral Presentation

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Making progress towards Target 21 of the Kunming-Montreal Global Biodiversity Framework (GBF) will require tools to analyse the completeness of available data across taxonomic, spatial and temporal dimensions, and thereby to direct effort for targeted data mobilization to address gaps and biases. The Global Biodiversity Information Facility (GBIF), along with its sister network the Ocean Biodiversity Information System (OBIS), offer comprehensive and flexible platforms to share and combine primary data on the occurrence of species, derived from a wide variety of sources including specimen collections, structured ecological monitoring programmes, citizen science efforts and a range of emerging technologies such as camera traps, acoustic monitoring, eDNA and others. Analysing the content of such platforms, and the extent to which their completeness improves over time, will therefore form an important component of the GBF monitoring framework with regard to Target 21. The presentation will review different approaches that have been put forward to measure data gaps and biases, assess their complementarity, and provide an update on how this issue is addressed in the proposed headline indicator for Target 21. It will also highlight opportunities to use the outputs of such analysis to direct effort and investment on mobilization of new data through the GBIF and OBIS networks of nodes and data publishers, as well as through training and capacity investment in developing countries.

BLIND SPOTS AND OVERLAPS: PORTRAIT OF BIODIVERSITY INDICATORS IN TIME AND SPACE

Oral Presentation

K. Hébert 1, M. Jousse1, J. Serrano1, L. Pollock1

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A long list of indicators have been proposed to monitor and respond to biodiversity changes as they unfold through time and space, as part of the Global Biodiversity Framework (GBF). Each indicator is best-suited to track biodiversity at certain spatiotemporal scales, and may be less appropriate to detect other dimensions of change. But, it is less clear whether these indicators, when taken together as an ensemble, cover the complete range of potential biodiversity changes. Is our toolbox equipped to be sensitive enough to monitor short to long-term biodiversity change and to inform decisions at the local, subnational, and national level? Are there blind spots that may not be captured by the proposed indicators? To answer these questions, we gathered experts in biodiversity monitoring and decision-making as part of the “Tracking a
Moving Target” workshop during the 2023 GeoBon Global Conference in Montreal, Canada. We asked groups to outline the capacity of biodiversity indicators to detect short-term to long-term changes and over local to subnational and national scales. The consensus highlights blind spots that need to be remedied with new or extended indicators, and highlights redundancies in our measurements of large-scale and medium-term change. Taken together, these outlines form a preliminary portrait of the combined capacity of biodiversity indicators to monitor change and to inform decision-making at different time scales and levels of organisation.

BRIDGING MONITORING AND DECISION SUPPORT FOR RANGE EXPANDING SPECIES

Oral Presentation

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Range expanding species are a critical subset of biodiversity responsible for potential ecosystem resilience under novel climates, but also of significant concern in cases where they negatively impact local communities of species and people. Target 6 of the Global Biodiversity Framework (GBF) relies heavily on evidence for this subset of taxa, with the goal of reducing range expansion of invasive alien species by 50 per cent. Indicators under the Target are also heavily reliant on evidence of population spread. However, gaps in the evidence needed on populations of range expanding species are well established. For example, the overview of information and knowledge gaps produced by the IPBES Assessment of Invasive Alien Species and their Control identifies at least 10 gaps pertaining directly to the need to enhance evidence to estimate and predict species range expansions. The intersection between Target 6 and Target 21 of the GBF - to ensure that the best available data and information are accessible to decision-makers – is therefore clear. Achieving Target 21 for this subset of high priority species will not only deliver the evidence needed for Target 6, but progress towards Target 6 delivers progress against six of the Sustainable Development Goals and contributes to at least seven other GBF Targets. A focus on the core set of information and modeling needs and the integration of data, methods and workflows for these species will therefore deliver widespread benefit.

MOBILIZATION AND CROSS-SCALE DATA INTEGRATION TOWARDS BUTTERFLY EBV

Oral Presentation

S. Pinkert 1,2,3, W. Jetz1,3,4

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Biodiversity research relies heavily on Essential Biodiversity Variables (EBVs) to gain a holistic understanding of species diversity and to design effective conservation strategies. Expert range maps – currently the most common EBV surrogate – are, however, incomplete or missing for most taxa, particularly among plants and invertebrates. Here, we review recent progress in retrieving EBVs for the global butterfly diversity through the mobilization of diverse types of distribution information and approaches that allow generating and updating baseline surrogates of species’ distributions from readily available data. From these data emerge new tools that facilitate expert validation of species’ range maps and threat assessments. We highlight common challenges in integrative biodiversity research, but also present opportunities to leverage the complementarities of underappreciated information in modelling workflows that can help fill a significant knowledge gap. With the most complete assessment of the global butterfly biodiversity that is built on these diverse efforts, we showcase a promising avenue not only for improving taxonomic coverage but also the accuracy and updatability of EBVs. Whereas it is tempting to focus research on taxa with high quality data, we advocate for more inclusive biodiversity assessments, approaches that address the extremely data-poor majority of species as well as encourage explorations informed by modelling and global gap assessments.

A TAXONOMIC RESOLUTION API FOR ALL TAXA

Poster Presentation

J. Wilshire 1,2, J. Portman 1,2, Y. Sica 1,2, K. Ingenloff 1,2, A. Ranipeta 1,2, J. Wiezorek 3, K. Winner 1,2, A. Killion 1,2, W. Jetz 1,2

1Yale University, Department of Ecology and Evolutionary Biology, New Haven, United States, 2Yale University, Center for Biodiversity and Global Change, New Haven, United States, 3University of California, Museum of Vertebrate Zoology, Berkeley, United States

Getting taxonomists to agree on a name is sometimes impossible. We rely on organizations to provide taxonomies which synthesize the expert opinions and scientific evidence into a source of truth for that taxa. However the underlying biodiversity data (and the names attached to these records) lag behind the approved names. For large biodiversity projects matching the old names to the new is known as taxonomic resolution and is essential for ensuring biodiversity data and subsequent analysis are consistent across sources. This is especially true when combining biodiversity data from multiple providers who may not agree on a universal taxonomy. We provide a transparent taxonomic resolution on demand service across all taxa and taxonomies quickly providing name resolutions. Our service also aims to resolve sources of errors, including i.e. spelling mistakes, old synonyms, homonyms, and use of common names. In this talk, we will demonstrate the potential of this service to unlock new avenues of multi-model biodiversity science across a variety of taxa.
ADDRESSING TAXONOMIC CONCEPT UNCERTAINTY IN GLOBAL BIODIVERSITY DATABASES

Poster Presentation

R. Li 1, W. Jetz1

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Databases of species occurrences such as GBIF are increasingly important in global biodiversity monitoring, but the heterogeneity of underlying data sources constrains database usability without flexible methods to resolve conflicts. Taxonomic concept mismatch is one key challenge in which occurrences under the same scientific name differ in name meaning (i.e., circumscription) due to taxonomic revision. Concept mismatches create ambiguity in the taxonomic identity of occurrences, leading to frequent misassignment of stored information. Thus, methods are needed to 1) detect concept mismatches at database scales, and 2) characterize global patterns of concept-mismatch derived taxonomic uncertainty in biodiversity databases. We share a generalizable method for detecting taxonomic concept mismatches in occurrence databases at the scale of major species groups. We created 17 metrics predictive of mismatch, based on spatial/metadata properties of species and their occurrences. We train a logistic regression model predicting taxonomic mismatch status, achieving upwards of 73.5% prediction accuracy. We identify key drivers of mismatch potential, and illustrate the corresponding global patterns of taxonomic concept uncertainty for mammalian species. Methods for flagging species with taxonomic concept mismatch, when integrated into informatics workflows, will facilitate improved documentation of taxonomic uncertainty and more responsible data use from global biodiversity databases.

BIODIVERSITY KNOWLEDGE FOR ANTARCTIC ENVIRONMENTAL CONSERVATION

Oral Presentation

S. Chown1, R. Leihy1,2

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Antarctica is the only continent set aside as a natural reserve devoted to peace and science, with environmental protection mandated through the Protocol on Environmental Protection to the Antarctic Treaty. The continent’s surrounding sub-Antarctic islands enjoy similarly high levels of protection, as does the Southern Ocean under the Convention on the Conservation of Antarctic Marine Living Resources, though with rational use being included in the definition of conservation. The extent to which these legal protections succeed depends on
high-quality biodiversity knowledge, for status and trends of indigenous species, and for the same information with respect to Invasive Alien Species (IAS), along with understanding of the pressures on the region. Yet such information is remarkably fragmentary, and its route into the policy environment less than straightforward. In consequence, whether that best available data, information, and knowledge are accessible to decision-makers, practitioners, and the public for the region is not certain. In this presentation, current progress in resolving these challenges is laid out, including the way in which progress in the Antarctic region may inform and be informed by developments elsewhere. Specific focus is given to the status and trends of species and how decision-makers, practitioners and the public are responding to the development of new data and insights. At times, these responses differ substantially based on identical information.

TAILORING MODELS AND INDICATORS TO NAVIGATE CLIMATE CHANGE AND DATA GAPS

Oral Presentation

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Biodiversity will be increasingly threatened by climate change in the coming decades. How species will respond is highly uncertain even in the best-sampled regions–how poorly sampled species will respond is virtually unknown. Fortunately, uncertainty does not preclude climate change from being used in conservation planning, monitoring and indicator development. In some cases, layering uncertainty can actually have the counterintuitive effect of helping to narrow down the options of where to best protect biodiversity. I highlight such an example for terrestrial vertebrates in Canada, which are highly threatened by rapid climate change and poorly sampled across much of the country. Both solutions for 30x30 and the calculation of biodiversity indicators (e.g. Species Projection Index) can benefit from climate change projections, but only when bias is adequately addressed. In cases of extreme bias, these techniques can also highlight where strategic additional sampling is required to make informed decisions. We argue that climate change should not be left behind in the global efforts to assess biodiversity change.
Opening up and preparing scientific publications for the chatGPT-age

LITERATURE WORKFLOWS IN IPBES - HOW THEY WOULD PROFIT FROM ENRICHED PUBLICATIONS

Oral Presentation

R.M. Krug ¹

¹University of Zurich, Department of Evolutionary Biology and Environmental Studies, Zürich, Switzerland

IPBES (https://www.ipbes.net/) is best known for the assessment reports it produces. To produce these reports, experts synthesize existing, often published, knowledge to provide an overview about a given topic, while also identifying potential knowledge gaps. The main sources for these assessment processes are scientific and peer reviewed articles, but also grey literature, and to a lesser extent, primary data stored in databases. When working with literature, the workflow can be separated into two steps: 1. search 2. analysis

The IPBES technical support unit for data and knowledge recommends using OpenAlex (https://openalex.org/) for literature search, because of the openness of its underlying code and data. Based on our experiences, the results are of better usability than proprietary alternatives. Nevertheless, the search results could be improved by a more open and machine readable and semantically enriched publication of the paper. The (automated) literature analysis depends heavily on the openness and machine readability of the publications. Minimally, publications must comply with Open Access policies but semantically enriched publications (e.g., XML, JATS) are far superior to PDF to support the extraction and identification of evidence (e.g. study site, species, results). In this talk, I will present the basic workflow of literature search and analysis in IPBES and discuss the advantages of open and machine readable publications.

DEVELOPMENT IN PUBLISHING BIODIVERSITY

Oral Presentation

L. Benichou ¹

¹Museum National d’Histoire Naturelle, Science Press, Paris, France

Over the past decade, the academic publishing sector has undergone a number of changes: both in terms of business model, with Open Access, and in terms of technological advances, with the need to comply with the FAIR principles. However, the main mission remains the same as in Linnaeus’ day: to make information stable, reliable and available to the public. The way we choose to publish has a direct impact on the availability of the document, on
the types of users it addresses, on the way they use the information, and on the accessibility and preservation of the information disseminated, now and in the future. Publishing is the art transforming a manuscript into a clearly readable article, easy to find and reuse. Nowadays, the same definition applies, the differences lay in the fact that the publication needs to allow both human- and machine-readability. Within the BiCIKL project, publishing workflows have been improved to optimize annotation and extraction of biodiversity data and ensure the linkage and reuse of high-quality data within the publication. The presentation will showcase the alternative solutions developed by Pensoft, EJT and other journals in partnership with Plazi for publishing advanced, verified and linked FAIR data and allow their immediate reuse, which furthermore, enable bi-directional links between literature and relevant domain databases. The benefit for the journals to switch from a PDF publishing format to an enriched XML will be demonstrated.

MACHINE LEARNING FOR COLLECTION OF ARTHROPOD ORGANISIMAL AND ECOLOGICAL TRAITS

Oral Presentation

_J. Cornelius_¹, H. Detering², O. Lithgow Serrano¹, F. Rinaldi³, R. Waterhouse⁴

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In view of biodiversity declines, the adaptability of arthropods as the most numerous and diverse group of animals, to a multitude of ecological niches is increasingly gaining interest. In recent years, the amount of genomic data on arthropods has steadily increased, enabling the identification of patterns in gene and genome evolution. However, comprehending arthropod successes in adapting to diverse ecosystems necessitates an understanding of links between genomic data and observable phenotypes. This hinges on conducting large-scale quantitative analysis of trait data. In this study, we introduce advanced text mining techniques to analyze and extract relationships between arthropod traits and their values, forming arthropod-trait-value triples, from a broad spectrum of publications. Our methodology adopts a multi-step approach, beginning with the assembling of ontologies and resources for arthropods, traits, and values. This is followed by compiling a literature corpus and generating manual annotations. Subsequently, we implement a Named Entity Recognition and Relation Extraction pipeline to identify and extract relation triples. The final step involves building a database to store our findings and make them publicly accessible. This project represents an initial foray into the large-scale collection of quantitative traits across Arthropoda. It will facilitate future co-interrogation of patterns of genomic evolutionary change with detailed organismal and ecological traits.
HOW DO WE GET THERE? A 7* SCHEME OF GETTING “OPEN FAIR PUBLICATIONS”

Oral Presentation

D. Agosti 1

1Plazi, Bern, Switzerland

Research results are published as scientific articles. They represent an intricate network of citations and facts, representing the existing knowledge, as billions of statements. In biodiversity, this includes a corpus of an estimated 500 million pages. A small but growing part is published in a semantically enhanced open access format, but the overwhelming part is behind multiple barriers, from being print only to closed access portable document formats (PDFs). To make use of the emerging AI tools, this corpus needs to be made available in a machine actionable way. At least part of it has to be curated to serve as training material for AI and machine learning. The steps towards fully machine actionable data will be described in this presentation. Starting with print (), print with metadata (), to scan-based PDF with metadata (), text-based PDF with metadata (**), ASCI – standard structured XML with metadata (****), ASCI – XML with semantic enhancements and metadata (*****), and ending with ASCI – XML with semantic enhancements, attributes and metadata (******). To serve the wider community, the publications have to be open access, infrastructures need to be expanded such as the Biodiversity Literature Repository to allow FAIRizing of data, including specific blocks of text such as taxonomic treatments, recommendations or illustrations, and vocabularies have to be developed and maintained to enable semantic enhancement in cases where they do not exist.

SEMANTICALLY ENRICHED PUBLICATIONS - THE WHAT, HOW AND HOW IT CHANGES RESEARCH

Poster Presentation

R.M. Krug 1, L. Bénichou2, F. Rinaldi3, P. Ruch4, R. Waterhouse4, D. Agosti5

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As Wikipedia states, “[s]emantic publication provides a way for computers to understand the structure and even the meaning of the published information, making information search and data integration more efficient."In other words, it makes literature search and analysis in research and beyond much more efficient and less error prone than analyzing a published pdf.
Especially in the context of automated search and analysis, involving thousands or even millions of papers, this opens the doors for new types of literature analysis. There are already quite a number of publications using semantically enriched publication approaches, including the Biodiversity Data Journal, Zookeys or Nature Conservation. This poster defines some important terms of this topic, illustrates how literature search and analysis workflows can be improved through the availability of semantically enriched formats, and shows examples where this data already exists and is being used. This topic will be discussed in more detail in the session SCICOM_15.1 Opening up and preparing scientific publications for the chatGPT-age.

WHERE ARE WE TODAY IN REGARD TO FINDING, ACCESSING AND MINING LITERATURE?

Oral Presentation

P. Ruch ¹

¹HES-SO & SIB Swiss Institute of Bioinformatics, Text Mining, Carouge, Switzerland

In the course of the BiCIKL project, the SIB Literature Services (SIBiLS) started indexing a larger set of biodiversity-related contents to build a new literature database called “Biodiversity PMC”. In addition to MEDLINE and PubMed Central, SIBiLS is now providing a unique entry point to half a million taxonomic treatments extracted by Plazi, as well as to a growing set of XML native full-text articles from Pensoft and other publishers, e.g. EJT. Further, an original index enable users to search publications’ supplementary data files, including XLS, CSV, MS-Word files or OCR-ized images. The services can be accessed via rich Graphic User Interfaces and an OpenAPI. Text contents are normalized using a large collection of life & health sciences terminologies or ontologies. Of particular interest for the biodiversity communities, SIBiLS contents are normalized using ENVO (Environmental Ontology), ROBI (Relation Ontologies), and taxonomic names are normalized using both the NCBI Taxonomy and the Open Tree of Life, a superset of the Catalogue of Life. The resulting data graph contains 12+ billion normalized descriptors and supports access via keyword search, as well as via an AI-based question answering interface. Finally, all annotations are stored in a large triple store with a SPARQL endpoint. However, the volume of data poses various cutting edge challenges. All data - using JATS and BioC standards - are fully available under CC-BY 4.0 licenses.
Paradigm shift in agro-ecology: from patch-scale conservation measures to designing biodiversity-friendly landscapes

A MULTI-SCALE PERSPECTIVE OF BIODIVERSITY ENRICHMENT IN OIL PALM LANDSCAPES

Oral Presentation

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Biodiversity enrichment in oil palm landscapes is a great sustainability challenge. Establishing tree islands has been proven as a suitable strategy to boost biodiversity and ecosystem functioning at local scale (i.e. patch level). However, the landscape-level processes and factors influencing biological communities within and across patches remain poorly understood. We conducted a multi-scale analysis of the patterns and drivers of plants, arthropods, birds, soil fauna, soil bacteria and soil fungi communities, within 52 experimental tree islands in an oil palm landscape in Sumatra, Indonesia. Our research revealed that both local factors and landscape characteristics influence above- and below-ground diversity. The optimal spatial extent for predicting diversity varied across taxa. Additionally, our results point towards the key role of landscape heterogeneity and soil biota in shaping multi-taxa species composition. Our results provide insights on the complex interactions affecting the assemblages of biological communities at the local and landscape levels. These insights should contribute guiding biodiversity enrichment strategies in oil palm-dominated landscapes.

INSECT DECLINE–EVALUATION OF POTENTIAL DRIVERS OF A COMPLEX PHENOMENON

Poster Presentation

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Insect decline is a complex phenomenon influenced by various causal factors acting at different spatial and temporal scales, affecting different insect groups. Large-scale effects, such as landscape changes, are assumed to be significant drivers, but comprehensive datasets directly
linking factors to insect decline are largely lacking. Here, we provide a detailed analysis of potential drivers of insect decline in Germany over the last decades, where insect biomass has been measured in previous studies. We examined landscape structure, land use changes, grassland management, cropping practices, pesticide use, climate, and light pollution on federal state level in an exemplary region. The results of the analysis suggest that habitat loss, changes in land cover, land use or land-use intensification are factors consistently correlating with declining tendencies in insects in Germany. Especially grassland faced transformation and/or management intensification by dairy farming and bioenergy plant cultivation, leading to a habitat quality degradation for insects. This study represents one of the first comprehensive retrospective investigation of these factors. With this extensive dataset, we can link habitat drivers (landscape changes, agricultural uniformity, loss of fragmented structures) to insect decline trends, in conjunction with various potential causal factors (pesticides, urbanization, nightlight), contributing to a better understanding of insect friendly landscapes.

MODELLING TRADE-OFFS WHEN SCALING BIODIVERSITY-FRIENDLY FOOD PRODUCTION SYSTEMS

Oral Presentation

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While conserving and restoring land to nature is essential to halt biodiversity loss, in many countries pressure on agricultural land is already high and increasing due to population growth, a shift to meat-heavy diets, and demand for national food self-sufficiency. Large-scale agricultural land abandonment is rarely a viable option, so agricultural landscapes need to be managed to provide food and conserve biodiversity in tandem. We developed and applied a module for an integrated food system assessment model, the FABLE Calculator, to explore the effects on food production, biodiversity, and climate goals in 2050, of diversified cropping practices replacing 10%, 50% and 100% of global monocropped land. Effects on yield and biodiversity were estimated from existing systematic reviews. Current practice distribution was estimated from global proxy datasets and adjusted using local agricultural expert knowledge. Preliminary results from one use case (Mexico) show that shifting to biodiversity-friendly practices across 50% of cropland is compatible with providing minimum recommended calories for the population in 2050, with practices targeted mainly to non-cereal crops including coffee, cocoa and banana systems. Shifting practices across 100% of cropland would lead to a shortfall in food supply in the absence of substantial dietary shifts or technical innovations to close yield gaps.
FROM STEWARDSHIP TO PARTNERSHIP: SWISS ALPINE FARMERS’ RELATIONSHIPS TO NATURE

Oral Presentation

M. Chapman 1, A. Deplazes-Zemp2

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Biodiversity friendly farming has often been associated with ‘stewardship’ as a human-nature relationship which involves human care, responsibility and accountability and is thus more sustainable than the alternative of mastership. We show that the consideration of nature in agriculture can go further than stewardship by presenting data from qualitative interviews with Swiss Alpine Farmers indicating that many of them view their relationship with nature as a form of partnership. Drawing on literature of human-nature partnership, we characterize this relationship by 1) bidirectionality –a give and take between nature and humans–, 2) the understanding of nature as a subject rather than an object and 3) interaction with nature that consists of collaboration rather than executing commands. The mountain farmers expressed all of these features in their farming practices and descriptions of their role in nature. A few farmers even saw their role as subordinates to nature, for which we introduced the new human-nature relationship category of “apprenticeship”. We further suggest that the partnership relation between humans and nature is associated with a strong emphasis on relational environmental values, which also emphasize the combination of benefits for people with care for nature. An understanding of farmers’ relational values and relationships to nature can inform more effective biodiversity conservation, facilitating collaboration at the landscape scale.

RUBBER-AGROFORESTRY SAFEGUARDING FOOD SECURITY AND INCREASING WILDLIFE DIVERSITY

Oral Presentation

N. Sutummaawong 1, Y. Thrisurat1, S. Supphawong2

1Kasetsart University, Department of Forest Biology, Faculty of Forestry, Chatujak, Thailand, 2Owner Land, Srinakarine, Thailand

Meanwhile, the majority of southern Thailand’s rainforest has been replaced by a monoculture of rubber plantations. However, the rubber-agroforestry practice of 0.05 square kilometres is located close to the Khao Banthad Wildlife Sanctuary’s buffer zone and is surrounded by monoculture rubber plantations. Since 2010, over 250 species of native, fruit, edible, and medicinal plants have been planted as part of an extensive management effort. The main sources of income are latex, fruits, vegetables, and seedlings, which bring in at least 80–90 USDs daily, or 30,000 USDs a year, which is more than Thailand’s average GDP per capita income of 7449 USDs. Moreover, it was discovered that more wildlife is migrating from the
wildlife sanctuary to this site for food, refuge, and nesting. A survey conducted in 2022–2023 discovered 37 species of mammals, 263 species of birds, 29 species of reptiles, and 53 species of amphibians, including animals that are on the 2021 IUCN Red List as endangered (17), such as Helarctos malayanus, Macaca arctoides, and vulnerable 34, such as Aonyx cinerea and Hemigalus derbyanus. According to the study, more wildlife habitat would be supplied, and farmers will be able to get more income from the produce grown there if the rubber plantation area is managed using a combination of agro-ecology practices. Because if there is only one area like this, there is a possibility that wildlife may also be poached in the middle of a monoculture rubber plantation.

MONITORING POLLINATORS IN AGRICULTURAL LANDSCAPES IN NORWAY

Oral Presentation

W. Fjellstad 1, G. Stokstad1, C. Pedersen, W. Dramstad

1NIBIO - Norwegian Institute of Bioeconomy Research, Department of Landscape Monitoring, Ås, Norway

The Norwegian monitoring programme for agricultural landscapes has been running for 25 years, collecting data on status and change in agricultural landscapes. The programme is based on mapping of a thousand 1 x 1km squares from aerial photographs, with field work to record birds and plants at around 10% of the squares. In 2021, the programme introduced field recording of butterflies and bumblebees along a 1 km transect at ten monitoring squares. In spite of the low number of sites, we found a clear trend between landscape spatial structure and number of pollinators. Both the number of individuals and number of species increased with increasing landscape heterogeneity. This mirrored patterns that have been detected in the monitoring of farmland birds. Much is known about how to improve farming landscapes for pollinators. In Norway, agri-environmental subsidies are available to encourage the management of flowery pollinator zones adjacent to arable land. First, farmers received payment to sow nectar-rich plants such as the non-native Phacelia tanacetifolia in field margins. Then higher subsidy rates were introduced for using seed mixes of regional plant species. The latest development is payment for managing zones adjacent to the crop, typically woodland edges. This saves agricultural soil for food production, whilst expanding the role of farmers in contributing to pollinator-friendly landscapes.

BIOTIC RESISTANCE OUTWEIGHTS FACILITATED SPREAD OF GLOBAL CHANGE WINNERS

Oral Presentation

E. Meier 1, A. Indermaur, E. Knop

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Farmland biodiversity is declining due to several global change drivers, despite considerable financial and practical conservation efforts over the past decades. To improve the effectiveness of conservation efforts, there have been calls for a paradigm shift in farmland conservation, moving from patch-scale conservation efforts to the design of biodiversity-friendly landscapes. However, such biodiversity-friendly landscapes could not only promote species threatened by global change, but also species that benefit from global change, thereby exacerbating the situation for the losers of global change. Conversely, local biotic resistance effects in biodiversity-friendly landscapes that act against the winners of global change may outweigh these facilitating effects. Using data from the Swiss agricultural landscape biodiversity monitoring programme “ALL-EMA” at different time points, we show here that biodiversity-friendly landscapes do indeed facilitate the winners of global change, but also show increased resistance to them, which even outweighs their facilitating effects. Thus, a shift from patch-scale conservation efforts to the creation of biodiversity-friendly landscapes may be appropriate to bend the curve of the biodiversity crisis.

HABITAT SPATIAL HETEROGENEITY INFLUENCES FARMLAND BIRD ABUNDANCE AND DIVERSITY

Oral Presentation

C. Pedersen 1, S.O. Krøgli1

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Over recent decades, farmland bird populations in Europe have markedly declined, attributed to factors like agricultural intensification and land abandonment. This study in Norway explores the correlation between land use and bird species, aiming to understand how spatial heterogeneity and land use diversity affect the richness, abundance, and distribution of farmland birds. The Norwegian monitoring program for agricultural landscapes involves 1 km2 monitoring squares across the country, mapped using detailed aerial photograph-based land use classifications. Within 130 squares, breeding birds are recorded at permanent observation points, enabling us to assess the relationship between land use/cover and farmland birds. Between 2000 and 2023, we saw declining populations and reduced distributions of several farmland bird species within the monitoring squares. Additionally, we found that both spatial heterogeneity of land use and high land type diversity positively influenced farmland birds. This gives important insight on how to design biodiverse agricultural landscapes. Emphasizing the importance of maintaining a spatially heterogeneous agricultural landscape with high land type diversity and natural areas, the study raises concerns about potential negative impacts on bird populations. Continued intensification of agriculture and production of bioenergy leading to reduced heterogeneity and land type diversity may exacerbate the ongoing decline in farmland bird populations.
HYPERSPECTRAL BIOINDICATORS REVEAL FLORAL POLLINATION STATUS

Poster Presentation

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Pollination is critical for ecosystem health and stability, with inadequate pollination frequently limiting yields, seed quality, and reproductive success in plant populations. Agricultural expansion is increasing the demand for pollination services, but this is considered a driver of global insect pollinator declines and is reinforcing pollination deficits. Yet, we do not have the tools to assess pollination at a high resolution and across useful spatial and temporal scales, thus limiting our ability to mitigate pollination deficits, target pollinator conservation, and effectively measure its impacts. I will showcase a novel controlled pollination study which exploits machine learning to identify candidate hyperspectral reflectance bioindicators to accurately predict pollination status and senescence in Oilseed rape flowers. Using our in-situ hyperspectral imaging system to generate time-series floral reflectance profiles, I demonstrate the utility of hyperspectral reflectance for revealing floral ultrastructural and metabolomic changes that are invisible to the naked eye. These findings have the potential to quantify previously unidentifiable pollination deficits in real-time at the landscape scale, with broad applications across crop and non-crop species to inform targeted pollinator conservation.

RED-LISTED PLANTS PERSISTING IN THE AGRICULTURAL LANDSCAPE

Poster Presentation

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Intensification and effectivization of agriculture had many negative effects on species diversity in Norway, as in many other countries. In this process, both content and composition of the agricultural landscape was changed. Many types of habitats were either removed entirely or reduced in size or quality. Agriculture covers only ca 3.5% of Norwegian land area but is geographically widely distributed. The agricultural landscape defined here as agricultural land and a 100-meter-wide buffer, captures 9% of the Norwegian land area. Today, Norway red-lists 4957 species, including 475 vascular plants, 1163 insects and 93 birds. The main driver of decline for nearly 400 species is agricultural-related changes. We analysed the presence of red-listed vascular plant species in the agricultural landscape in five regions with intensively managed agriculture. We explored whether these species are present in these landscapes, and
if so, where. We found a total of 345 unique red-listed vascular plant species apparently still present in the agricultural landscape, with a total of 42977 observations. Observations were recorded on various land-use/cover types, notably on grazed land and forest patches (78%). Our interpretation from this pilot study suggests potential for reestablishment and reversal of decline at least for some species if suitable habitats are reintroduced. It also implies, however, that much caution must be used if agricultural landscapes are subjected to further changes.

ORGANIC AND CONVENTIONAL VINEYARD MANAGEMENT EFFECTS ON SOIL FAUNA DIVERSITY

Oral Presentation

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Viticulture is a valued sector worldwide with an extraordinary socio-economic impact. Numerous factors including soil infertility, pests and diseases threaten vineyards, as their management primarily relies on the use of conventional practices. The transition to organic viticulture and the use of cover crops is arising as an important alternative with numerous benefits, including favouring above-belowground biodiversity and the presence of beneficial soil organisms. The study measured the mechanisms involved in shaping soil arthropod assemblage composition under different vineyard management practices (conventional vs organic), focusing on the role of taxonomic turnover and/or nestedness, and how functional traits respond to vineyard management. The results revealed that organic vineyard management significantly improved the abundances of beetles, and spiders, however it had no significant effects on earthworms. Fynbos/natural ecosystems which were used as reference sites resembled organic vineyards in soil fauna species richness, functional diversity and beta diversity. Practices such as chemical usage, tillage, and low vegetation complexity in the conventionally managed vineyards drove most of the detected low soil fauna diversity. The results highlight the significance of organic management and associated landscape factors for sustaining ecosystem services. Keywords: biodiversity, soil, agriculture, ecosystem, conservation

RIPARIAN ITAUKEI: A TROPICAL SOLUTION TO AGRO-WETLAND WARFARE

Oral Presentation

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The programs of restoration and biomonitoring that build upon commonly held ethnobiological knowledge and cultural values have the greatest opportunity for success in the Pacific Island countries. One such example is the first riparian restoration model for indigenous farmers in Fiji—‘Riparian ITaukei’. As part of the US Forest Service’s Pacific Islands Forest Restoration Initiative Program (PIFRI), a local NbS toolkit integrating biocultural values of the ITaukei agricultural community was developed. Watershed management in Fiji has often been the preserve of lowland forest-non riparian zone approaches. This paper proposes the first model for riparian rehabilitation for Fiji, which intends to support agrobiodiversity without affecting the ecological stability of the riverine systems that drain the agricultural catchments. The ‘Riparian ITaukei’ is a multi-species TEK integrated ‘permasilviculture’ riparian rehabilitation model comprising of a three-zone buffer intended to maximize environmental, economic and social benefits with each zone providing a specific function which includes water quality protection, bank stability, agrobiodiversity, ethnobiodiversity, enhancement of habitat for terrestrial wildlife and aquatic biota, and income generation. This model is designed to expand and complement the recently developed community-based river resource management approach to Fijian watersheds and climate change adaptive solutions centering agricultural community empowerment.

VEGETATION CHANGES IN NORWEGIAN GRASSLANDS ARE BAD NEWS FOR POLLINATING INSECTS

Poster Presentation

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Since 2004, the Norwegian monitoring programme for agricultural landscapes has been monitoring vascular plants in approximately 10 % of the thousand 1 km2 squares in the programme. Within those squares, altogether 569 permanent plots of 64 m2 are placed nearby active farms in grazed or unmanaged grasslands. In the period 2004-2008, all the plots were visited. Within the plots, all vascular plants and some environmental variables were recorded, and species cover abundance of all species were estimated. This was repeated from 2011 to 2018. The plots were classified into four classes: moderately fertilized or moist pastures; overgrown, former agricultural land; cultivated pastures or disturbed grasslands; and semi-natural pastures or grazed rangelands. The species composition within the plots had changed significantly between the periods. The overall trend in the data material was regrowth: Woodland and succession species occurred more frequently in the plots in the second period, while grassland species, i.e. herbs important to bees and bumble bees, had declined. Also, plants indicating a more humid climate occurred more frequently in two vegetation classes. Monitoring programs with long-term field studies are of high importance to detect if biodiversity goals in the agriculture
policy are achieved and if subsidies are working as intended. The results from the monitoring programme show that several measures to restore a more pollinator-friendly landscape should be taken.

**PADDY RICE: A WIN-WIN FOR BIODIVERSITY AND AGRICULTURE**

Oral Presentation

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Wetland biodiversity in Switzerland is continuously declining in connection with the loss of an estimated 90% of wetlands due to land-use change. In addition Switzerland’s average annual temperatures increased by 2.5°C compared to the pre-industrial time, forcing agriculture to rethink the standard cropping practices in the light of climate change. Introducing crops like paddy rice that are better-suited to warmer temperatures can address challenges related to climate change, support food production, and mitigate the ongoing global biodiversity crisis. Since 2017 a group of farmers, with scientific support from Agroscope, have been pioneering the management of ecological paddy rice in lowland parts north of the Swiss Alps. The results of past biodiversity surveys have shown a variety of wetland fauna and flora, among other endangered species, that use paddy rice as habitat. Therefore, these arable landscapes show a considerable potential as biodiversity promotion areas for endangered species, among others dragonflies like the spotted darter (S. depressiusculum). This study investigates the potential and limitations of cultivating paddy rice in Switzerland to promote biodiversity, given the crop’s recent introduction to the region. The impact of crop management practices, including fertilizer application, flooding timing on the species attracted to paddy rice fields is being evaluated and preliminary results of the ongoing research will be presented during the presentation.

**SOIL PROPERTIES OF DIFFERENT AGROECOSYSTEMS HAVE DIFFERENT EFFECTS ON SOIL FAUNA**

Poster Presentation

*E. Mamabolo* 1, *J.S. Pryke*1, *R. Gaigher*1

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The intensification of agricultural management practices has not only been linked to the degradation of important natural resources but also to the fluctuations in the soil environment, which plays an important role in regulating soil fauna biodiversity. This study assessed the status of soil physical and chemical properties and their influence on soil fauna abundance, diversity and assemblage composition in four contrasting land uses. The conventional land use favoured some nutrients, however soil of both the integrated and conservation land uses had physical and chemical properties indicative of good soil quality e.g. low compaction, low C:N ratio and stable aggregates. Soil fauna abundance was more responsive to land use and the soil environment compared to species diversity which did not show significant responses as expected. The analysed data provided an understanding that soil variables which regulate soil nutrient and water dynamics, mainly; the C:N ratio, calcium, magnesium, potassium, phosphorus, aggregate stability, clay, porosity, organic matter, and penetration are the main variables influencing soil fauna in agricultural soils in the study region. The implementation of sustainable soil management practices which improves the physical and chemical status will not only be beneficial for productivity but also for the promotion of important soil fauna and ecosystem services they provide. Keywords: fauna, soil health, environment, soil management, degradation.
Philosophies of biodiversity conservation

CONSERVING BIODIVERSITY THROUGH EATING: IS THERE A CASE FOR VEGANISM?

Oral Presentation

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The purpose of the paper is to look at the linkages between diets, biodiversity, and food system from an ethical angle. Food production and consumption are important drivers of biodiversity loss in two ways: through direct use components of biodiversity as a harvested resource and through the land-use impacts (including pollution and climate change). Since the primary reason for agriculture related clear-cutting is the need for increased feed production and thus to support the animal agriculture, there are indications that a vegan diet is more biodiversity-friendly than average omnivorous diets. We consider critically whether there is a case for veganism in biodiversity conservation. The paper consists of the four sections. First, we identify starting points that instruct the analysis. Second, we describe how the biodiversity concern for animals has historically been resource-motivated. Third, we compare the idea that meat-eating generates sentient animals (the so-called logic of the larder) with the idea that the conservation of (some elements of) biodiversity rests on resourcist ideas (what we call the logic of the ostrich following the survival of the species through its use). These logics are discussed with relation to how they link biodiversity conservation to diets and food ethics, especially in relation to the request of following a vegan diet. And finally, we notify the anecdotal nature of previous research providing a way for a broader, a food-system perspective.

SHOULD NON-HUMAN ORGANISMS HAVE A RIGHT TO A LIVABLE LOCALITY?

Oral Presentation

S. Capisani¹, Y. Rohwer², A. Lee³

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Global environmental change impacts the (im)mobilities of non-human organisms and threatens global biodiversity. We consider a series of cases wherein native habitat is no longer a viable option. In situ conservation and the background normative assumptions that prop it up, are no longer sufficient to address the heterogeneity of mobility issues of nonhuman organisms and fulfill forward-looking conservation obligations in the context of global environmental
change. Assisted migration is a common response to mobility issues; however, the complexity of non-human mobility and forward-looking obligations require a novel normative framework for conservation. By extending a climate-justice based argument regarding human mobilities, we argue for a normative framework based on the right to a livable locality that addresses the widening scope of conservation obligations in a changing world. Our framework preserves some normative commitments to in situ conservation but also questions the importance of standard value assumptions in conservation concerning invasive species, the importance of ecosystem integrity, and fears about unintended consequences of assisted migration. A refocus on a right to livability in conservation means considering in practice the full range of competing values and the correlative risks associated with both interventionist and non-interventionist actions rather than merely focusing on risks arising from individual mobility.

THREE DIMENSIONS OF URGENCY

Oral Presentation

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Conservation interventions such as translocation, intentional hybridization, and even genetic modification are controversial and often criticized as radical and possibly unethical. Conservationists’ views about whether and when interventionist conservation strategies are appropriate are influenced by beliefs about the problem’s level of urgency. But what is urgency? And why does urgency constitute a justification for actions that would otherwise be considered too risky? Talk of urgency is rampant in the field of conservation; however, there has been little philosophical attention to what urgency is and when and why it shifts the justificatory burden for conservation intervention. We identify three dimensions of urgency that affect conservation decision-making. First, there is a temporal dimension: whether the situation is urgent is related to the rate at which undesirable changes are occurring and imminency of undesirable outcomes, along with the time needed to develop and deploy solutions. Second, there is a causal dimension: urgency implies that human agency can causally influence the outcome. Third, there is a value dimension: in conservation, urgency implies moral stakes. By identifying and explicating these three dimensions of urgency, we can help understand why people have divergent views concerning when certain interventions are justified, and we can better identify sources of disagreement about more controversial interventions.

VALUING NATURE IN THE BIODIVERSITY OF CULTURED LANDSCAPES

Oral Presentation

A. Deplazes Zemp 1, A. Michel 2, N. Backhaus 3

357
If we speak of biodiversity conservation in middle Europe, we mostly speak of biodiversity in cultured landscapes. However one might wonder, whether it really makes sense to speak of a protection of nature in case of ecosystems that would not exist without human influence. The presentation will introduce an interdisciplinary approach to address this question, in which the analysis of empirical data (interviews) is combined with a philosophical approach. The interview-data show how local stakeholders in Swiss nature parks often value cultural and natural elements of their environment together. In this combination of culture and nature they experience nature as an active force with which they interact and co-shape the environment. In that sense, active nature is experienced, valued and respected as “an Other” in the cultural landscape. The active and generative force of nature is particularly experienced in biodiversity as an expression of versatility and sophistication in nature.

BRINGING PHILOSOPHY INTO RELATIONAL VALUE INTERVIEWS WITH BIRDWATCHERS

Poster Presentation

R. Zinnenlauf¹, A. Deplazes², M. Chapman³, N. Backhaus¹

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In recent years, the concept of ‘relational value’ became established in the environmental policy and biodiversity conservation discourses. The concept is used to refer to the importance and meaning of nature in human-nature relationships. For our philosophical analysis of relational value, we need a better understanding of the specific characteristics (such as bidirectionality, context-sensitivity and non-substitutability) of this value category. The poster presents our approach to address philosophical questions in the interview and evaluation protocols of an empirical study using qualitative interviews and transect walks with bird-watchers.

HUMAN PRESENCE IN ECOSYSTEMS: A CONCEPTUAL REVIEW OF ENVIRONMENTAL ETHICS

Oral Presentation

T. Kortetmäki¹, G. Cortés-Capano¹

¹University of Jyväskylä, Jyväskylä, Finland
Many nonhuman properties that environmental ethics has sought to define and value (e.g., intactness, authenticity, wildness) are lost or nearly lost by human involvement with ecosystems. Thus, the field has been highly critical towards any human interference with ecosystems even if the intention is to support biodiversity protection. Yet, more recent approaches to environmental ethics have questioned this categorical judgment of human interference and called for more nuanced approaches to examine human-nature relations. Biodiversity conservation and ethics warrant more nuanced understanding about how human presence in ecosystems can be examined from the viewpoint of environmental ethics. Our conceptual review examines how various environmental ethics literature strands define and characterize environments with active human presence. This helps understand the grounds and opportunities for creating more qualitatively nuanced ethics of human land use with biodiversity-concerned perspective. We focus on three literature strands: (1) the traditional strand (the most influential environmental ethics works); (2) ethics literature that speaks of landscapes, agriculture, or urban topics (areas that have active human presence); and (3) ecofeminist literature. This conference paper introduces our preliminary results and discusses their significance for environmental ethics and the ethics of biodiversity conservation.

SUSTAINABILITY AND HABITAT RIGHTS

Oral Presentation

**A. Wienhues**

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In this presentation, I compare how theorising from sustainability and integrating sustainability ex-post in non-anthropocentric theories of just conservation differ from each other. I thereby argue for the former approach by engaging the example of habitat rights as a recent area of philosophical debate which can be understood as contributing to non-anthropocentric accounts of just conservation. In this context, not all non-anthropocentric accounts of justice are as good as others with respect to their theoretical potential to integrate and take seriously the dynamic nature of sustainability. Ultimately this implies that I argue from within a non-anthropocentric perspective against the current dominant animal rights approach in political thought in favour of starting from sustainability.

CONSERVATION GENETICS, ETHICS, AND QUESTIONS OF PURITY

Oral Presentation

**D. Havlick**, C. Biermann

1University of Colorado Colorado Springs, Geography and Environmental Studies, Colorado Springs, United States
Genetic and genomic technologies are reshaping conservation priorities for organisms ranging from American bison (Bison bison) to Galapagos tortoises (Chelonidis spp.). In this paper we critically examine efforts to protect native cutthroat trout (Oncorhynchus clarkii) in the US Rocky Mountains, where genetic analyses have demonstrated that decades of conservation work were dedicated to species misidentified by phenotype. Advances in genetic techniques allow fisheries scientists to distinguish minute degrees of hybridization between species or subspecies of trout, recasting taxonomies and creating new ethical and applied questions about how to accomplish conservation goals. This molecular turn in biodiversity conservation leads to life-or-death decisions for populations deemed too introgressed to warrant protection and can lead to a single-minded focus on genetic purity that may discount other values such as ecological function or human connections to existing fish populations. Even as it emerges as a powerful new tool for protecting biodiversity, conservation genetics can also undermine efforts to protect and connect habitats at a landscape scale and instead prioritize isolating genetically pure populations. This, in turn, may promote a more intensively interventionist form of conservation directed at eradicating hybrids, translocating populations granted genetic value, and normalizing genetic rescue to bolster resilience against changing climate and habitat conditions.

**ON THE ROLE OF AESTHETICS FOR BIODIVERSITY CONSERVATION AND SUSTAINABILITY**

Poster Presentation

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There is a myth that we can put a price on nature and still have a sustainable development. Degrowth suggests that a sustainable economy requires decoupling nature from financial development. This is only possible if we reimagine sustainable futures where human-environment relations are bounded to non-economic values. This talk dwells into the aesthetic values of nature as counterweight to the economic values of nature and biodiversity. Aesthetics is fundamental in most humans’ activities, from artworks, products designs, nature appreciation and scientific practice. By using a decolonial approach to history and philosophy of science combined with case studies of traditional communities in the Global South, this talk explores prospects to conservation and sustainability that is focused on the aesthetics values of human-environment relation. Exploring the potential of aesthetic to the climate emergency debate will foster a paradigmatic shift regarding our relations to nature as to improve scientists’ epistemic tools about biodiversity crisis, planetary health and degrowth.
THE SYMBIOCENE AS A TRANSFORMATIVE VISION

Poster Presentation

T. Heger1,2,3, I. Rügemer3,4, O. Szasz4,5,3

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We live in times of crises and calls for a transformative social-ecological change are voiced increasingly often. The question is, however, how such a transformation could be achieved. The prevailing view is that we are living in an era in which human activities significantly altered planet Earth: the Anthropocene. According to this narrative, humans are a very powerful force, turning the global situation to the worse. It has been argued that this view can cause disillusion and frustration, thus hampering the willingness to change the situation. This has led the philosopher Glenn Albrecht to suggest that what is really needed is a positive vision of an age beyond the Anthropocene, namely the ‘Symbiocene’: A “period in Earth’s history where humans symbiotically reintegrate themselves, emotionally, psychologically and technologically, into nature and natural systems.” (Albrecht, G. 2014, Ecopsychology 6, p.58). With our contribution, we will explore the potential of the concept of a Symbiocene as a transformation vision able to stimulate action. At the core of the concept, we see a call for renewed human-nature relationships. We demonstrate how recent work in philosophy and environmental ethics on relational values could be used to spell out in greater detail what exactly this could mean. Further, we show that the Symbiocene concept aligns well with recent ideas for a nature positive future and calls for moving from sustainability as a goal towards the goal of regeneration.

NARRATIVE ETHICS FOR REWILDING

Oral Presentation

C. Keller1

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To transition from science to action and implement innovative conservation strategies, reflecting on the underlying values and ethical principles is crucial. This will be demonstrated through the discourse on (Re)Wilding. In Charlotte McConaghy’s novel “Once There Were Wolves” (2021), what remains a distant reality in the real world is already implemented in the world of the novel: as part of a project to rewild Scotland, wolves are reintroduced into the Cairngorm Mountains, aiming to restore the forests and biodiversity. The novel explores
both the ecological discourse and the resistance from the local population depending on sheep-farming. The planned contribution examines how this novel portrays rewilding as an innovative conservation strategy for biodiversity and analyzes the environmental ethical arguments it embodies. In a subsequent step, this example will be juxtaposed with other literary and popular scientific narratives on rewilding, analyzing the ethical statements made in each (e.g., Jan Haft’s “Wildnis” (2023) Simone Böcker’s “Rewilding” (2023), Isabella Tree’s “Wilding” (2018)). Through this approach, the contribution aims to highlight the significance of narrative structures in ethically legitimizing conservation strategies.

WHY BIODIVERSITY ETHICS?

Oral Presentation

G. Schepers

1

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In my paper I argue that it takes an own biodiversity ethics besides the ethics of nature. The backdrop for my claim is as follows. Participants in the debate on the ethics of nature – or environmental ethics as it is synonymously called – concern themselves with the question of how to deal with nature. In view of the destructions of nature in the last decades, for example on the grounds of industrialisation, intensive agriculture, and urbanisation, their main question is if we should protect nature. In recent times the discussants have taken another topic into account. They do not only ask any more how we should deal with nature, but they also ask how we should deal with biodiversity now as also biodiversity is increasingly endangered. Against this background I investigate if one can make fruitful arguments from the ethics of nature for the discussion on biodiversity. It becomes apparent that arguments from the ethics of nature are suitable for a justification of the protection of biodiversity only to a limited extent. Thus, if it is our concern to decide how to deal with biodiversity a further ethical analysis is needed. Briefly speaking: It takes an own biodiversity ethics.

ECOLOGICAL SELVES AND RELATIONAL VALUES: POTENTIAL FOR AN ONTOLOGICAL SHIFT?

Oral Presentation

G. Frigo, D. Delorme

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Despite years of debate in both environmental ethics and conservation biology, the distinction between instrumental and intrinsic values remains controversial. Instrumental values have
primarily been associated with extractivist interests, while intrinsic values have essentially been connected to non-human well-being, integrity and stability. The introduction of relational values aims to challenge and transcend this dualistic view of values. However, this third category of values has also been criticized. In this paper we argue for relational values and suggest that they may provide a new paradigm. But, because relational values run the risk of being construed as a mere extension of instrumental values, we argue that relational values are better understood as a distinct category that is essentially related to caring relationships among different living beings. We stress that relational values, like intrinsic ones, have the potential to decenter humans from their perspectives, interests, and needs. Building on previous work in environmental virtue ethics, we argue that the adoption of relational values implies a shift from an atomistic notion of agency to that of an ecological self. One important implication of this broader notion of self is that humans are not the only ecological selves capable of adopting relational values and caring practices. This contribution to the theory of relational values can inform the practical implementation of conservation and policy initiatives.
Plant-consumer interactions in a changing world

NOVEL PERSPECTIVES ON CONSUMER RESOURCE INTERACTIONS

Oral Presentation

G.M. Palamara¹, J.A. Capitan², D. Alonso³

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A primary goal in research in ecology is to understand how macroscopic descriptions of trophic interactions relate to the individual processes that define the consumer-resource interaction in the first place. Despite decades of studies, there is still no clear agreement on the functional forms of the per capita consumption rate of consumers (generally called “functional responses”), not only in community food webs models, but also in simple predator-prey equations. In this talk, I will present a theoretical approach based on the theory of continuous time Markov processes to describe individual feeding interactions, emphasizing their stochastic nature. Within this framework, we revisit the derivation of classical functional responses and suggest extensions of them in multi-resource contexts. More importantly, we highlight the common assumptions underlying all these derivations and propose methods to infer functional response parameter from experiments. I will conclude showing how this novel approach can be used to understand how global change alters plant-consumer interactions. Palamara, G. M., Capitán, J. A., & Alonso, D. (2021). The stochastic nature of functional responses. Entropy, 23(5), 575. Palamara, G. M., Capitán, J. A., & Alonso, D. (2023). The implicit assumptions of classic functional responses and their multi-species extensions. BioRxiv.

THE EFFECT OF CLIMATE CHANGE ON COMMUNITY DYNAMICS ALONG ELEVATION GRADIENTS

Oral Presentation

S. Rasmann¹

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A current significant challenge in ecology involves predicting the responses of communities and ecosystems to global climate change. The impact of global change, beyond directly affecting plant communities and their functioning, it can also modify interactions among species. For example, climate warming may lead to shifts in organism distributions, with varying rates of movement among different species, ultimately causing alterations in the composition and operation of ecological communities. These effects are often overlooked in forecasts regarding the impact of climate change on biodiversity. I will demonstrate that experimental translocations can be utilized to explore the consequences of uneven upslope migration in alpine plants and...
their insect herbivores on community interactions. Subsequently, I will elaborate on how these reorganized trophic interactions will play a crucial role in driving changes in plant communities under anticipated future climate conditions.

**CHANGING WORLD, CHANGING BIODIVERSITY: IMPLICATIONS FOR A CULTIVATED PLANET**

Oral Presentation

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The world around us is changing at fast pace, and correlated drivers abound. We are experiencing climate change, land use change, and biodiversity change at the same time. In this talk, I will showcase a wide range of global change experiments, where climate, land-use, and biodiversity were manipulated in terrestrial ecosystems. I will show how drivers of change affect multitrrophic interactions and resulting process rates, with implications for the services we get from nature, such as yield or product quality in production systems. The talk covers multitrrophic interactions in a range of experiments, covering biodiversity experiments in grassland and forests, climate change experiments manipulating carbon dioxide, drought and temperature, and land-use change experiments manipulating crop rotations or cropping system diversity. The experimental scales range from plot-based field experiments to farm-scale manipulations. I will provide a common framework for analysing cause-effect relationships using multitrrophic network approaches. Finally, I will investigate linkages between global change drivers, multitrrophic interactions and ecosystem services. Ecology is a discipline rooted in observations, let us now turn it into a discipline rooted in experimentation.

**GLOBAL CHANGE EFFECTS ON FEEDBACKS BETWEEN PLANT AND CONSUMER COMMUNITIES**

Oral Presentation

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Global change is altering interactions between plants and their herbivores and pathogens. Understanding changes in these interactions is crucial, as they have important implications for biodiversity conservation and local and global food security. Shifts in plant community characteristics, such as diversity, productivity and functional composition, following global
change, could have large indirect effects on consumer communities. Changes in herbivore and pathogen abundance, diversity and community composition might in turn alter their impact on plants. Global change may therefore alter feedbacks between plants and consumers and these feedbacks could amplify or dampen its effects. Despite long-standing theory on particular aspects of this feedback, we lack a comprehensive picture of how global change indirectly affects consumers by altering plant consumer feedbacks. We synthesize current knowledge of how the productivity, diversity and functional composition of plant communities alter key properties of invertebrate herbivore and pathogen communities, and vice versa. We then use ecological theory to develop a predictive framework to understand how global change will alter feedbacks between plant and consumer communities. We also present examples from experiments testing elements of the feedback. We show that our ability to predict effects of global change requires a holistic perspective, taking into account direct as well as indirect effects, mediated via biotic interactions.

AN AUTOMATED PIPELINE FOR ASSESSING LEAF-ASSOCIATED INTERACTIONS AND LEAF TRAITS

Poster Presentation

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Phytophagous insects are closely associated with morphological and metabolic traits of tree species. For the pedunculate oak (Quercus robur) alone, at least 700 species of phytophages are known to affect the health and development of the leaves and, in some cases, can lead to severe leaf loss and tree death. However, in the absence of methods for standardized detection of such components of tree fitness, the spatial and temporal patterns in the complex interactions between leaf characteristics and phytophages remain largely unknown. Imaging techniques that allow the standardized characterization and automatic analyses of even subtle changes in leaf structure, are of great potential for the development of large-scale monitoring of leaf feeding and infestation. Here, we developed an automated pipeline for the assessment of herbivory, leaf-herbivore interactions and leaf health based on images. Specifically, we propose to adopt AI-based object detection techniques to identify characteristic damages and assess the amount of herbivore as well as pathogen damage. With our approach, we aim to overcome issues of current methods for the assessment of leaf damage and particularly herbivory for leaves with non-entire margins. Through comparisons with manipulated and real test data, we will evaluate the accuracy of our methods. The proposed approach will offer a wide range of applications and facilitate a spatially and temporally fine scaled monitoring of plants and associated biota.
**Practicing critical social theory to achieve paradigm-shifting just transformations**

**TO LOOK AND TO ACT “OTHERWISE”: REFLECTING ON CRITICAL SOCIAL THEORY AND VALUE**

Oral Presentation  
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This presentation reflects on some ways Critical Social Sciences (CSS) can contribute to the theorization and practices of transformative change starting from my use of CSS to engage with recent debates of “values of nature” and my experience of ethnography on the Italian Alps. Value has become a central topic of discussion within conservation but scientific research has mostly accounted for how people assign value to particular natures, neglecting questions about desirable transformations (with the notable exception of IPBES and a few others). In my research with a group of “mountain carers” (farmers and shepherds), I found that the application of critical social theory of value allowed me to go beyond the “accounting” of value diversity and tease out the ways this group organizes their socio-economic and ecological lives around care and solidarity instead of accumulation. This theoretical position casted political light on their value struggle as they tried to enact new ways of being in the world, and revealed the power struggles and dynamics of change carers have embarked on. CSS enabled me to not only analyze power and transformation dynamics but also to look at reality searching for alternatives. Finally, my engagement with CSS led me to embrace an “activist” approach to research, taking part in the groups’ material struggles. This broadened the possibilities of collaboration between me and the community and challenged notions of a “disengaged”, “neutral” science.

**TRANSFORMING HUMAN-NATURE RELATIONS BY REVISIBILIZING, NOT RECONNECTING**

Oral Presentation  
*S. Deutsch* ¹

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One of the main approaches to societal transformation towards sustainability focuses on socioecological relations. Such approaches often emerge from the idea that humans have become disconnected from nature and therefore aim to reconnect them. At the same time, Indigenous peoples’ (holistic) understandings of socioecological relations suggest that disconnection of humans from each other and the rest of nature would mean certain death, and biology supports
this understanding. Here, I use Marxist theory to illuminate the core causes of the perceived human-nature ‘disconnection’ such approaches seek to address. I suggest that it is more helpful to think of human connections with each other and the rest of nature as becoming hidden or rendered invisible by certain economic processes. With this understanding, I then show how such a theorization can be practically applied. Using the design of a workshop for the production of everyday household items as an example, I show how engaging with Marx’s theories on production and alienation led to a different design than without such theories. I thus demonstrate how critical social theory can be integrated into an interdisciplinary project to assist with the assessment of the problem and put such theory into practice. Such an understanding has important implications for achieving the just transformations we aim for.

AN INCOHERENT CONVERGENCE SCIENCE - DIVERSE ECONOMIES, CRISSES AND BETTER FUTURES

Oral Presentation

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This paper introduces a critical approach and calls for a revolutionary convergence science – one with a real hope of generating solutions to our most pressing contemporary crises. This approach emphasizes, in particular, spaces of inclusion for the world’s epistemological and ontological diversity, and the myriad on-the-ground practices that are often belittled and marginalized. Modern scientific research is imbricated with dominant forms of capitalism, which lead to solutions that prioritize and substantially reproduce the status quo. An incoherent convergence, in contrast, encourages the complementarities and synergies across disciplines, epistemologies, and ontologies without requiring one path. This paper draws on empirical evidence from the case of Mora, New Mexico, USA and its recovery from the Hermit’s Peak Calf Canyon Wildfire of 2022 to illustrate the need for approaches to disaster and recovery strategies that work with and for diverse communities and economies. Without interrogating dominant science itself and the solutions it generates, the solutions will force alignment with the logic and values of the dominant economic-political paradigm, and reproduce both the structural violence enacted on diverse communities and the political-economic processes that led to the climate change and the uneven vulnerabilities within it.
COMMUNITIES OF PURPOSE FOR DEEP TRANSFORMATION IN BIODIVERSITY GOVERNANCE

Oral Presentation

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In the wake of IPBES’ report of 2019, transformation has become a major science & policy agenda in biodiversity governance (e.g., Global Biodiversity Framework of 2022). This agenda legitimizes critic of prevailing approaches to sustainable development, and calls for disruptive change. But, paradoxically, it can also strengthen the status quo, for instance, when political institutions and companies use shallow commitments to ‘sustainability transition’ to replenish their exhausted credibility, or, when initiatives for transformation reproduce structural causes of unsustainability (e.g., the nature/culture dualism; faith in linear progress and technological fixes; inequalities between beneficiaries and victims of unsustainable practices). Against this backdrop, we will present a transdisciplinary method that uses critical theories of modernity to debunk shallow ‘transformation talk’ and foster deep transformative change in dysfunctional biodiversity governance contexts. Based on two real-life experiments in the field of Access & Benefit-Sharing, we will show how transdisciplinary ‘communities of purpose’ that integrate critical social sciences can help participants: i.) emancipate cognitively and emotionally from the spell of unsustainable modernization, ii.) elaborate different ways of “seeing the world, being in the world, and doing politics” (Beck 2016: 6), and iii.) devise actionable tools and strategies to ‘terrestrialize’ (Latour 2018) biodiversity governance frameworks.

NATURE-BASED SOLUTIONS IN THE ANTHROPOCENE: A TRANSDISCIPLINARY PERSPECTIVE

Oral Presentation

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The profound transformation of the Earth and its ecosystems within the Anthropocene, have opened a discussion about how to (re)imagine climate action. Nature based Solutions (NbS) are frequently approached as human actions aimed at simultaneously protecting biodiversity, mitigating greenhouse gas emissions, and supporting the implementation of the sustainable
development goals agenda. However, these solutions do not necessarily address longstanding inequalities and uneven power relationships. In this work we use social critical lenses to better understand how nature is framed as part of the solution and how other ways of being and knowing that are typically neglected are perceived. We, a group of Latin American early-career scholars and a young Indigenous, argue that hegemonic narratives on nature - driving current decision-making in environmental and global change policies - are based on hegemonic human-centred worldviews that silence local voices, their ways of knowing and local developmental agendas. Drawing on critical discourse analysis, we examine how NbS are constructed within the framework of the Anthropocene and contrast with Indigenous-based narratives. We also provide insights on how transdisciplinary approach can be a vehicle to build more pluralistic science and so narratives around it. In this session, we want to explore emerging categories and potential applications from our critical analysis of Nbs founded on Indigenous-based narratives.

THE ROLE OF NON-STATE ACTORS IN IMPLEMENTING THE GLOBAL BIODIVERSITY FRAMEWORK

Oral Presentation

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The Global Biodiversity Framework (GBF) to guide global action on nature through 2030, was approved in late 2022. Besides its 23 ambitious targets, the landmark agreement provides new spaces for non-state actors to commit to biodiversity actions through the Action Agenda for Nature and People. Using the current data to scrutinize ongoing efforts at the CBD Action agenda platform, our paper explores the non-state actors’ contribution and the progress they have made to implement the GBF commitments in different local contexts. Our initial findings highlight that the Action Agenda Platform has gradually become a meaningful pillar of the GBF implementation. It serves as a complementary solution to the dichotomous options of top-down vs. bottom-up strategies. The non-state actors have unique capabilities and criticality to change due to their influences across levels of decision-making and biodiversity governance. We posit that the existing literature on global biodiversity governance may misidentify the role of these actors, raising questions on their biodiversity conservation discourses, strategies, and power within the biodiversity conservation governance landscape. We suggest a modal remedy to connect the highly contextualized situations with the global generalization in the biodiversity conservation policy-making process by engaging the non-state actors in locally adapted, inclusive ways for transformative change.
THE PERSONAL SPHERE OF TRANSFORMATIVE CHANGE IN RESEARCHERS AND STAKEHOLDERS

Poster Presentation

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Transformative Change (TC) is essential to conserve and sustainably use nature. The personal sphere of TC – including values and worldviews – contains the most powerful leverage points for TC, but it remains understudied. Here we explore the personal sphere of TC in researchers and non-academic stakeholders working in a research project on nature in Switzerland. Through semi-structured interviews, we analyse their conceptions of nature, whether they think that humans are part of nature, their values of nature, and their worldviews. We also explore whether and how these elements change throughout their biographies. Our results show that contrasting conceptions of nature coexist in the project. The informants consider humans as part of nature but experience personal contradictions when expressing this, and long for connectedness. Their relational values are strongly linked to attempts to reconnect with nature, and coexist with intrinsic and instrumental values. Most of the informants have pluricentric or bio-ecocentric worldviews, but anthropocentric worldviews are also present. We found evidence of TC and activation of leverage points in the personal sphere of some informants. Our findings are a first step towards understanding the potential of the personal sphere of conservationists for TC. We call for research on the interactions across spheres of TC (namely personal, political, and practical) and their outcomes for people and nature across different geographical settings.
Protecting and Monitoring genetic diversity

IMPLEMENTATION OF CBD GFB GENETIC DIVERSITY INDICATORS IN NINE COUNTRIES

Oral Presentation


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The scale of biodiversity loss is daunting. To facilitate effective action, we need to assess biodiversity status and trends quickly and affordably. This includes genetic diversity, the diversity within species that allows adaptation. However, for most species we do not yet have detailed DNA-based studies of within-species’ genetic diversity. One solution to this challenge is to use primarily non-genetic data to calculate genetic “indicators” – simple metrics based on minimum effective population sizes and conserving genetically distinct populations. The indicators are part of the Convention on Biological Diversity COP15 Kunming-Montreal agreement. They build on well-accepted conservation principles. We will present results from applying the indicators in nine countries across 919 species and >5000 populations. Data were obtained from diverse sources, from management reports to citizen science. Results show that although species have lost only a moderate proportion of populations, most extant populations are too small to maintain adaptive capacity long term. We conclude that many populations are on the precipice of rapid genetic erosion, with consequences for their survival – and for society. This is a critical opportunity to protect genetic diversity precisely when species need it the most. Genetic indicators can identify species and populations experiencing genetic erosion, assist in planning interventions, and make genetic concepts approachable to decision makers.
A FRAMEWORK FOR IDENTIFYING ESUS TO SUPPORT POTENTIAL INCLUSION IN THE REDLIST

Oral Presentation

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The IUCN RedList is a global conservation tool, providing threat status labels (e.g. endangered) for species protection. The RedList does not consider genetic diversity loss or protection in any way. This oversight limits global conservation because genetic diversity is fundamental to self-sustaining populations, individual fitness, and population growth rates. Subpopulations - extremely isolated demographically independent units - can receive separate RedList listings. An achievable and rapid route to incorporate genetic diversity into the RedList, is a shift from “subpopulations” to “Evolutionary Significant Units” (ESUs). ESUs are lineages demonstrating limited gene flow within a species that also house unique genetic diversity (e.g. local adaptation). Erroneously combining distinct ESUs in the RedList could drive genetic diversity loss, because extirpation of an ESU can occur silently, with minor impacts on global population trends but extinctions of alleles. Moreover, erroneous merging of ESUs can harm species-level conservation success through incorrect management decisions and falsely inflated population trends. The gold standard for ESU delineation requires genetic and genomic data; however, such data are expensive and any changes to the IUCN RedList cannot introduce barriers (i.e. cost) that limit access. Consequently, we have developed a framework of both genetic and nongenetic indicators to facilitate ESU identification and inclusion into the IUCN Redlist.

EVALUATING MOLECULAR TOOLS IN THE CONSERVATION OF AFRICAN RHINOCEROS

Oral Presentation

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Molecular tools are used for the assessment and monitoring of biodiversity which aid in conservation decisions and management. Recent developments in molecular methods have allowed researchers to analyse species at a genetic and/or genomic level. The level of analysis will depend on the available resources, funding, training, and access to technologies. In some countries/institutions, traditional genetic data such as microsatellites are still utilised in conservation decisions and in others advanced technologies that produce genome data for species are incorporated into management. Genetic/genomic information can answer a variety of research questions at either a higher evolutionary level or at phylogeographic, phylogenetic or
population level. Here I have used African rhinoceros as a case study to illustrate how genetic and genomic information can complement each other in conservation management. Data showed that genome level analysis often identified finer scale patterns that were not observed using traditional markers (mitochondrial DNA or microsatellite data), but the overall patterns of diversity were supported by all marker types. In addition, genomic data provided further information regarding inbreeding and genetic load. Researcher should therefore choose suitable molecular makers according to the question being posed, conservation goals for the species and the available funding.

A GLOBAL META-ANALYSIS OF GENETIC CHANGE IN NATURAL POPULATIONS

Oral Presentation

**C. Grueber**<sup>1</sup>, R. Shaw<sup>2</sup>, K. Farquharson<sup>1</sup>, M. Bruford<sup>3</sup>, D. Coates<sup>4</sup>, C. Elliott<sup>4</sup>, J. Mergeay<sup>5</sup>, K. Ottewell<sup>4</sup>, G. Segelbacher<sup>6</sup>

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To implement strategic methods and targets for preserving biological diversity, we must understand how human actions have impacted the genetic status of species. However, there has to-date been no systematic analysis of the relationships between ecological disturbance and conservation action on intraspecific genetic diversity. This presentation reports progress on an ambitious effort to answer this question via a global meta-analysis of temporal genetic research. We aimed to quantify the empirical patterns that more than three decades of genetic research have produced, as well as identify areas of opportunity. Our search of the peer-reviewed literature returned 80,271 works, which were examined via a combination of text mining and manual screening to return more than 4,000 temporal studies of intraspecific genetic diversity in over 600 species of animals, plants, fungi and other multicellular Eukaryotes. Overall, we found pervasive genetic diversity loss, revealing patterns across terrestrial and marine realms, taxonomic classes, study design choices, and – importantly – variation in the face of ecological threats and conservation interventions. Results strongly endorse the role of genetic monitoring and targeted conservation action for the preservation of species’ resilience. In addition to the Core Team named on this abstract, this research represents collaboration with 48 additional contributors.

MONITORING GENETIC DIVERSITY WITH DNA- AND PROXY-BASED INDICATORS IN SWEDEN

Oral Presentation
Genetic diversity is the basis for evolutionary processes allowing populations to adapt and survive over time. The need for assessing and monitoring this level of biodiversity to assure maintenance of adaptive capacity of populations has long been recognized by scientists and is recently receiving international and national attention in policy implementation and management. Indicators for genetic diversity – i.e., metrics that measure trends in genetic diversity within and among populations of species – have recently been developed. Two basic types of indicators have been developed. First, cost effective and easy to apply proxy-based indicators that do not require DNA-data elaborated for e.g. implementing the Convention on Biological Diversity’s newly adopted Kunming-Montreal Global Biodiversity Framework. Second, DNA-based indicators that require genotyping or sequencing of samples collected from natural populations. Both types of indicators have been developed. First, cost effective and easy to apply proxy-based indicators that do not require DNA-data elaborated for e.g. implementing the Convention on Biological Diversity’s newly adopted Kunming-Montreal Global Biodiversity Framework. Second, DNA-based indicators that require genotyping or sequencing of samples collected from natural populations. Both types of indicators have been applied in Sweden. We find that both types of indicators and the monitoring efforts conducted, provide information that has typically not been available previously. This modifies the conservation situation and management requirements for assessed species. Common species can have genetically distinct subpopulations important to protect for ecosystem resilience. Integrating genetic diversity indicator assessments in national agency work has, however, several challenges that need overcoming and we suggest ways forward.
The genetic variation distributed across the individuals and populations of Earth’s species is essential for their adaptation and persistence in changing environments, and for the maintenance of biodiversity [1, 2]. Its importance is recognized within the monitoring framework of the Global Biodiversity Framework adopted at the 15th Conference of the Parties to the CBD (COP15) [3], which includes a headline indicator on the maintenance of genetic diversity in species populations. Yet despite rapid advances in sequencing technology, it remains laborious and expensive to monitor changes in genetic diversity by repeatedly sampling populations and sequencing their DNA. Fortunately, the COP15 headline indicator and other key indicators of genetic diversity can be assessed based on information about species populations inferred from local knowledge, field surveys, and other sources, and do not necessarily require genetic sequence data [2, 4, 5]. This represents a useful but indirect means of genetic diversity assessment, and additional biodiversity observation data is needed to improve indicator quality [6]. By providing images of the globe, measured frequently across several optical domains, in the form of public data, Earth observation (EO) has high potential to facilitate and advance biodiversity monitoring [7]. However, EO is generally not considered for genetic diversity assessment because genetic information cannot be retrieved easily or directly from satellite observations [8]. Here, we present a framework and show examples for how existing, public data from EO satellites can provide complementary biodiversity observations that could immediately be used to improve monitoring and reporting on indicators of genetic diversity. For example, EO products can directly help countries to locate and delineate species populations and monitor their change over time. We not only show how EO can facilitate genetic diversity monitoring as implemented within the GBF, but also look ahead to potential EO contributions in assessing genetic Essential Biodiversity Variables (EBVs). We call for the advising of Parties on how to use existing EO products for genetic diversity monitoring and for the co-development and dissemination of accessible tools, consistent with the approach proposed for other CBD indicators [7]. We propose that EO should be rapidly integrated into genetic diversity monitoring workflows to accelerate the ongoing development of these indicators while helping Parties fulfill their reporting commitments.
Quantifying plant genetic diversity with spectroscopy

ASSOCIATION OF LEAF SPECTRAL VARIATION WITH FUNCTIONAL GENETIC VARIANTS

Oral Presentation

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Spectroscopy offers novel insights into plant functional and phylogenetic variation, aiding global biodiversity assessments. Exploring the genetic influence on reflectance spectra can enhance biodiversity monitoring and clarify plant responses to environmental shifts. We studied the coyote tobacco, Nicotiana attenuata, using a genetic mapping population to link genetic differences with leaf spectral variations in a natural setting. Analyzing leaf reflectance from 325 genotyped recombinant inbred lines (RILs), we tested three Genome-Wide Association Studies (GWAS) approaches. Introducing the Hierarchical Spectral Clustering with Parallel Analysis (HSC-PA) method, we identified an association between a chromosome 1 locus and the 445-499 nm spectral range, linked to chlorophyll’s blue light absorption, suggesting genetic variation in photosynthetic efficiency. Nearby candidate genes hint at potential mechanisms for these spectral differences. Established spectral indices failed to detect robust genotype associations, while single-wavelength analysis mirrored HSC-PA but lacked statistical power. HSC-PA offers a data-driven yet interpretable method for understanding genetic determinants of spectral variation, paving the way for future plant genetics and remote-sensing research.

INTRASPECIFIC VARIATION OF BEECH SEEDLINGS’ RESPONSES TO DROUGHT

Oral Presentation

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In Europe, climate change is intensifying and increasing the frequency of severe droughts. Beech (Fagus sylvatica L.), a drought-sensitive tree species, faces, therefore, heightened vulnerability during the seedling phase. We assessed the intraspecific diversity of beech regarding drought tolerance. We conducted a common garden experiment with 184 2-year-old beech seedlings grown from seeds from 16 populations across the specie’s range in Europe. We exposed the potted seedlings to two experimentally induced drought periods in June and July 2023 (two weeks each), with the appropriate controls. We used leaf spectroscopy to assess the
intraspecific differences in the response of beech seedlings to the droughts. We derived physiological, biochemical, and structural leaf traits based on spectral indices and the inversion of a PROSPECT-D radiative transfer model. This allowed us to capture a multitude of relevant physiological drought stress responses across beech tree genotypes. The leaf spectra showed a clear signal of drought stress. The provenances showed a similar response to the induced drought treatment but, depending on the leaf spectral index, genotype was also a determinant of drought stress. The constituents derived from the inverse PROSPECT-D model yielded detailed information on beech seedling physiology under drought stress. Further research is needed to bridge leaf-to-canopy spectroscopy, facilitating methodology upscaling for larger nurseries or mature forests.

REMOTE SENSING INSIGHTS INTO EUROPEAN AND ORIENTAL BEECH SUBSPECIES

Oral Presentation

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Differentiating European beech (F. sylvatica ssp. sylvatica) from Oriental beech (F. sylvatica ssp. orientalis) is crucial for ecological management and assisted gene flow. Current methods rely on molecular markers, impractical for widespread monitoring. Our study uses advanced remote sensing to differentiate these subspecies. Employing diverse spectroscopy data and a novel open-source classification system, we identify distinct spectral patterns. Our approach integrates genetic testing, confirming the accuracy of subspecies differentiation via spectroscopy. Phenological differences prove crucial for subspecies identification, supported by in situ observations. Our method, employing spectral indices and machine learning, enhances differentiation accuracy, detectable through satellite imagery across the growing season, validated by field observations. Consistent spectral differences over four years highlight satellite-based sensing’s potential for accurate subspecies differentiation. This study contributes to refining remote sensing for subspecies discrimination, offering insights into ecosystem dynamics, hybridization patterns, and assisted gene flow monitoring in European and Oriental beech forests.
FROM DRONES TO SATELLITES: UNVEILING PHYLOGENETIC DIVERSITY VIA SPECTRAL SPECIES

Oral Presentation

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The spectral species concept, that is the diversity of subunits within the spectral space, has been successfully used as a remote sensing surrogate of plant diversity. While spectral species diversity has been widely used as a proxy for plant taxonomic diversity, we argue that the spectral species concept has the potential for estimating phylogenetic diversity. Growing evidence suggests that plants with similar spectral signatures might have shared evolutionary history. We assessed the ability of spectral species derived from multispectral drone and hyperspectral satellite data to estimate phylogenetic diversity of grasslands located in the Swiss Alps and the U.S. Southern Great Plains. We proposed a novel approach to estimate spectral species from coarse resolution satellite data with 30 m x 30 m pixels at the sub-pixel level; in doing so, we considered the within-pixel variability necessary when working with remotely-sensed data with coarse spatial resolution. For both drone and satellite data, we found stronger associations between spectral species diversity and phylogenetic diversity compared to taxonomic diversity. We also identified several factors affecting the performance of spectral species, including the plot size, the plant community composition and the scale mismatches between remote sensing and in situ data. Our results demonstrate the unique capability of spectral species to estimate plant phylogenetic diversity using drones and forthcoming spaceborne imagers.

SPECTRAL PHYLOGEOGRAPHY IN LIVE OAKS ACROSS THE TROPICAL-TEMPERATE DIVIDE

Oral Presentation

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In heterogeneous landscapes with different environments, it is expected that genetic divergence between populations and local adaptation would be promoted by selection. However, gene flow is a neutral evolutionary force that can influence the extent to which isolation by distance or by environment causes population divergence and genetic structuring. By comparing
the divergence between neutral markers and quantitative traits, we can achieve a broader understanding of how genetic and phenotypic differences arise, how they are related to each other, and how they respond to changing ecological and evolutionary contexts. Here, we investigate whether phenotypic variation (measured using spectral reflectance) and genetic differentiation (nuclear SSR) across the lineage of the seven species in live oaks (Virentes) lineage fits isolation by distance (IBD) or isolation-by adaptation (IBA) frameworks. After comparing PST (phenotypic differentiation)-FST (genetic differentiation) we found that phenotypic variation indicate divergent contributions of potentially adaptive factors in the case of sympatric species where IBA plays a crucial role in maintaining species identity. These processes seem to be relevant for the taxa which are wide distributed across gradients in climate, hydrology and fire, and present a variety of ecologically divergent species that have likely arisen both allopatrically and sympatrically.
Recent changes and future challenges in alpine biodiversity

GLACIER FOREFIELD SUCCESION IN THE NORTHERN LIMESTONE ALPS: SAME, BUT DIFFERENT

Oral Presentation

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Glaciers in the Alps retreated since the end of the Little Ice Age (c. 1855) and leave the newly available (initially barren) ground open for primary succession. While such interesting sites have been studied at least since the 1960ies, especially in the Central and Southern Alps, it seems that there is a knowledge gap from the Northern Limestone Alps. To overcome this knowledge gap, we initiated a long-term monitoring programme at four glacier forefields (Halls-tätter Glacier & Großer Gosau Glacier, Dachstein Range, Austria & Blaueis and Watzmann Glacier, National Park Berchtesgaden Germany), starting in 2016, using a chronosequence approach. While expectedly species richness and frequency increase with the age of the forefields, it seems that the successional speed is much slower than observed at other glacier forefields. This is probably due to the different geology, namely karstic limestone, where newly established soil and nutrients are quickly washed away, as well as (geo)morphological differences, hindering dispersal and colonization processes. We further compare the successional speed as observed from the chronosequences with that of the monitoring period (2017-2023), as well as providing initial results on functional changes in the vegetation during succession.

WILL MICROREFUGIA SAFEGUARD ALPINE PLANT DIVERSITY IN A WARMING WORLD?

Oral Presentation


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Models based on elevational lapse rates of temperature predict severe range loss and mountain top extinctions of alpine plants and consequent depletion of the high-elevation flora. These predictions have been criticised with reference to the rugged alpine terrain which may offer cold microrefugia at each elevation in a warming world. However, to which extent the ability of alpine plants to make use of these microrefugia depends on the size and connectivity or
remaining cold spots is little explored. Here, we combine data from a dense network of vegetation plots on Mt. Schrankogel, Tyrol, with long-term monitoring of the subnival vegetation on the same mountain to show, first, that the current distribution of alpine plants is more strongly determined by the meso- and macro-topography of an alpine landscape than by its fine-scale topographical patterns; and second, that colonization and extinction of microsites are controlled by dispersal limitation at least as much as by habitat suitability over a time span of 20 years. Together, these data suggest that even today many suitable but small and isolated microsites sites in an alpine landscape remain uncolonized. Given that area and connectivity of cold spots will shrink in the future the efficiency of these microrefugia in safeguarding alpine plant diversity should hence not be overestimated.

**SPECIES MICROHABITAT PREFERENCES INDICATE DIFFERENT RANGE EXPANSION LIKELIHOODS**

Oral Presentation

*N.I. Chardon*¹, L. McBurnie¹, K. Goodwin¹, K. Pradhan², J. Hille Ris Lambers³, A. Angert¹

¹University of British Columbia, Vancouver, Canada, ²University of Washington, Seattle, United States, ³ETH Zurich, Zurich, Switzerland

A common, yet untested, assumption in forecasting approaches is that species will shift beyond current range edges into new habitats as they become macroclimatically suitable, even though microhabitat variability could have overriding effects on local population dynamics. We aim to understand the role of microhabitat in range shifts through its impacts on establishment by i) examining microhabitat variability along large macroclimatic gradients, ii) testing which of these microhabitat variables explain plant recruitment and seedling survival, and iii) predicting microhabitat suitability beyond species range limits. We transplanted seeds of 25 montane and alpine species across and beyond their current elevational limits, spanning a broad range of macroclimates. Over five years, we recorded recruitment, survival, and microhabitat characteristics rarely measured in biogeographic studies. We found that only 30% of microhabitat parameters covaried in the expected way with elevation. Moreover, species and life stages responded in contrasting ways to soil biota, soil moisture, temperature, and snow duration. Microhabitat suitability predictions suggest that distribution shifts are likely to be species-specific, as different species have different suitabilities, and availabilities, of microhabitat beyond their present ranges, thus calling into question large-scale macroclimatic projections that will miss such complexities.

**GLOBAL RESPONSES OF RIVER DIATOM COMMUNITIES TO DECLINING GLACIER COVER**

Oral Presentation
Glacial meltwater contributes significantly to habitat heterogeneity in alpine and polar river ecosystems. This leads to high biodiversity regionally as some taxa are adapted to withstand the cold, turbulent, harsh glacial river environment. However, unprecedented glacier retreat in mountain regions globally is threatening freshwater resources and biodiversity. Diatoms form the primary energy source to food webs in rivers above the treeline and their rapid response to shifts in environmental conditions make them good ecological indicators. Despite this, previous research has often overlooked this important component of glacial river ecosystems, and the few comprehensive diatom studies are predominantly from Europe and North America. Our research identifies global-scale responses of diatom communities to declining glacier cover, with new datasets from nine mountain ranges on five continents spanning a latitudinal gradient of 14° to 78°. Diatoms were identified using Illumina NextSeq 18S amplicon sequencing. This talk provides novel insight into the resilience of primary producers to rapid environmental change and highlights the species, regions and thresholds of glacier loss that are of particular concern.

SNOW AVALANCHE IMPACTS ON MOUNTAIN UNGULATE POPULATION ECOLOGY AND BIODIVERSITY

Oral Presentation

K. White 1, E. Hood1, G. Wolken2, E. Peitzsch3, Y. Bühler4, K. Wikstrom Jones2, C. Darimont5

Understanding how snow influences biodiversity in rapidly changing mountain ecosystems is critical. Whereas effects of snow on food availability, energy expenditure, and predation are well documented, we report how avalanches exert major demographic impacts on an ecologically significant mountain ungulate - the coastal Alaskan mountain goat (Oreamnos americanus), and the communities of vertebrates that utilize their remains. Using long-term GPS data and field observations across four populations (421 individuals over 17 years), we show that avalanches caused 23-65% of all mortality. At the population-level, an estimated 8% of mountain goats died annually from avalanches, with up to 22% in severe years. Field observations of carcasses (n = 233) revealed use by all meso- and large carnivore species present in the region during 9 months of the year. Our findings reveal a widespread but previously
undescribed pathway by which snow can elicit major population-level impacts on mountain ungulates with cascading effects on biodiversity, community ecology and scavenger food webs in biomass-poor mountain ecosystems. Human communities are also impacted through linkages with cultural and subsistence traditions related to mountain goats. These findings add to our understanding of how avalanches can influence ecosystems, biodiversity and conservation of alpine environments.

**CHANGES ON PLANT SPECIES DIVERSITY AFTER 15 YRS. IN THE ANDES OF CENTRAL CHILE**

Oral Presentation

*L. Cavieres*¹,², M. Mihoc³

¹Universidad de Concepción, Departamento de Botánica, Concepción, Chile, ²Instituto de Ecología y Biodiversidad-IEB, Concepcion, Chile, ³Universidad de Concepción, Departamento de Botánica, Concepción, Chile

Alpine habitats are those found above the upper limit of tree growth (treeline). Alpine habitats in the Andes of central Chile harbor a rich flora characterized by high endemism levels, and that provide a series of contributions to people such as water cycle regulation, stabilizing slopes, erosion avoidance, etc. However, in recent years this zone has been affected by increases in temperatures and decreases in precipitation. In addition, several exotic plant species have been reported for this zone, but their effects on the native flora and their eventual synergies with climatic changes are unknown. In this study we analyze the changes in richness and cover of native and exotic plant species after 15 years of monitoring along an altitudinal gradient (from the treeline to the upper limit of the vegetation) in the Central Chile Andes (33°S). Additionally, we analyzed the functional characteristics of the species that had increased in abundance during this period (winners) vs those that had decreased (losers). We observed that after 15 years the main changes in species richness occurred in the lower part of the gradient where native species richness decreased whilst exotic species richness increased. Nonetheless, the most notable changes were observed in cover where many native species decreased while most of the exotic species increased. FONDECYT 1211197, ANILLO ACT 210038, FB 210006

**BIOGEOGRAPHIC IMPACT OF CLIMATE CHANGE IN THE HIMALAYAS: A MODELLING APPROACH**

Oral Presentation

*M.E. Timana*¹, A.Ş. Şerban², M.A. Cuentas³
Global evidence shows drastic ecological changes in response to climate change, these being most evident in high mountain vegetation. Studies have shown that the increase in global temperature has induced a spatial upward shift in mountain species distribution associated with ecological responses and spatial displacement to adjacent ecosystems. We apply a Species Distribution Modelling approach using MaxEnt to examine potential future climate change impacts in the spatial distribution of twelve alpine and subalpine plant species which are present in the Himalayan region and surrounding areas. Bioclimatic variables provided by the high-resolution global climate dataset CHELSA and a digital elevation model were projected to the year 2050 using two climate scenarios from the Coupled Model Intercomparison Project Global Climate Models: the Max Planck Institute Earth System Model and the UK Earth System Model version 1, each with two Shared Socio-economic Pathway scenarios: SSP126 and SSP585, to examine the climate change impact in the distribution of the selected species. Preliminary results show either a clear reduction in the range size, and/or changes in their geographic distribution; different degrees of range reduction are detected, including nearly local extinction levels. The study may serve as a guide for the implementation of climate change adaptation programs, the establishment of protected areas, and the conservation of biodiversity in this fragile mountain ecosystem.

RELATING VEGETATION CHARACTERISTICS TO CARBON STOCKS IN ALPINE TOPSOILS

Poster Presentation

M. Zehnder 1,2, A. Udke3, F. Hagedorn3, C. Rixen1, J. Hille Ris Lambers2

1WSL-Institute for Snow and Avalanche Research (SLF), Davos Dorf, Switzerland, 2Swiss Federal Institute of Technology Zurich ETH, Institute of Integrative Biology, Zürich, Switzerland, 3Swiss Federal Institute for Forest Snow and Landscape Research WSL, Birmensdorf, Switzerland

Unmanaged alpine terrain and alpine pastures are rich in soil organic carbon (SOC). While drivers of C stocks in forest soils or temperate grasslands are well-studied, little is known about the distribution of SOC in higher alpine regions above the treeline and its environmental conditions. In general, SOC and alpine vegetation cover decrease with higher elevation. However, mountain ecosystems are characterized by high topographic and climatic heterogeneity, resulting in diverse microhabitats and high variability in SOC and plant life. Hypothesizing that biotic parameters derived from vegetation and its diversity better explain SOC stocks than direct topo-climatic variables alone, we conducted over 120 coupled vegetation- and soil surveys at meteorological stations between 2000 and 3000m across the Swiss Alps. The data was
organized into a path-relation network and subjected to structural equation modelling (SEM) to tease apart direct effects of environmental variables and indirect effects on SOC. Our results suggest that, while SOC stocks decrease with elevation, they are primarily explained by the type and diversity of herbaceous vegetation. Including plant community-weighted indicator values improved the model performance significantly, emphasizing alpine vegetation characteristics as suitable predictors of spatially heterogeneous C stocks above the treeline.

**ALPINE SPECIES LOSS INDUCED BY FOREST-LINE UPWARD SHIFT**

Oral Presentation

*N. Delpouve*¹, *L. Bergès*², *S. Mollier*², *C.B.K. Rathgeber*¹, *S. Chauchard*¹, *N. Leroy*¹, *J.-L. Dupouey*¹

¹Université de Lorraine, AgroParisTech, INRAE, SILVA, Nancy, France, ²INRAE, LESSEM, Saint-Martin-d’Hères, France

Land use abandonment and canopy closure are known to modify biodiversity in open areas. This issue is of great concern in the context of global warming and the decline of mountain pastoralism, leading to a rise of the tree-line in alpine ecosystems. As forests rise, abiotic conditions change and may become unsuitable for alpine species, reducing their habitat. We aim to quantify the effects of forest-line shift on alpine plant biodiversity. We focus on the French Alps, where the forest-line has risen by more than 130 metres since the mid-19th century. We conducted 102 botanical surveys in the tree-line ecotone of the Maurienne Valley (northern Inner French Alps, Savoy), assessing the presence and abundance of all species in plots ranging from ancient dense forest (shown on historical maps), through recent (established between 1850 and 1950) and very recent forest (established after 1950), to current open vegetation. The sites were arranged in triplets along the elevation gradient: pairs of two land use types with a transitional site in between. Species richness was higher in open vegetation and in the transition sites than in ancient dense forest. A temporal lag in the shift in community composition from ancient forest to open vegetation suggests that alpine species can persist for several decades after tree colonisation and canopy closure. This trend may open a window of opportunity for the conservation of alpine patrimonial species despite the rapid expansion of forests.

**VEGETATION CHANGES AT HIGH-ELEVATION HIGH-LATITUDE MOUNTAIN**

Poster Presentation

*I. Kuusisto*¹, *S. Huttunen*¹, *R. Virtanen*², *C. Gonzales-Inca*³
High-latitude arctic environments have been warming at unprecedented rates — and these may have strong impacts on high-elevation cryptogam assemblages with sparse vascular plant cover. We investigated the changes in high latitude-high elevation cryptogam-vascular assemblages under 32 years by resurveying a transect study in 2022, earlier surveyed in 1990 on Mt Ritničohkka, NW Finnish Lapland. We used ordination methods with adonis to detect the possible temporal differences in community structures. To study the responses of individual species we conducted Indicator species analysis. We also calculated weighted Ellenberg’s indicator values for studied plots and studied changes in community qualities. Furthermore, we divided our data into vascular plants, mosses, liverworts and lichens to see how different plant groups respond to temporal and elevational changes. In total, 203 taxa were observed of which 38 were vascular plants and 165 cryptogams. We observed temporal vegetational changes in the composition of plant assemblages. These changes were partly elevation-dependent. For example, the total number of vascular plants increased during the study period and the cover of liverworts increased. The changes were species-specific and more than 10 percent of the species showed significant temporal changes. High latitude-high elevation plant communities are about to reassemble into novel compositions of bryophytes, lichens and vascular plants.

FLOW INTERMITTENCY AFFECTS MACROINVERTEBRATE COMMUNITIES IN ALPINE CATCHMENTS

Poster Presentation

P. Chanut\textsuperscript{1}, T. Datry\textsuperscript{2}, M. Antonetti\textsuperscript{3}, I. Gounand\textsuperscript{4}, M. Doering\textsuperscript{3}, C.T. Robinson\textsuperscript{1}

\textsuperscript{1}Eawag, Duebendorf, Switzerland, \textsuperscript{2}Inrae, UR Riverly, Villeurbanne, France, \textsuperscript{3}ZHAW, Institute of Natural Resource Sciences, Wädenswil, Switzerland, \textsuperscript{4}Sorbonne Université, Institut d’Écologie et des Sciences de l’Environnement de Paris, Paris, France

Flow intermittence is prevalent in glaciated alpine catchments, but with decreasing snow and glacier cover, it is expected to intensify and become more spatially synchronized. Little is known about the ecological effects of drying regimes differing in frequency, duration, timing, and spatial extent. Here, we used modified light sensors to characterize intermittence regimes in 75 alpine streams from 4 glaciated alpine catchments in the Swiss Alps. We also modelled flow intermittence within each of these catchments to derive landscape connectivity metrics. We sampled macroinvertebrate communities and at three dates. We investigated how frequency, duration and timing of drying events as well as habitat features, and the degree of landscape connectivity affect structural and functional aspects of these communities. The analysis is ongoing, and preliminary results suggest taxonomic and functional diversity as well as the abundances of the more sensitive taxa responded negatively to increased intermittence.
Interestingly, early drying in autumn and late summer also had strong effects on communities. Finally, landscape connectivity constrained some of the negative effects of intermittence. Overall, our research suggests that increasing intermittence in alpine catchments may drive significant changes in aquatic biodiversity and that these changes may vary depending on local context such as landscape connectivity and resource availability.
Reflections, Intersections & Connections – Dialogues and collaborations between art, science and society.

IDEAS FOR SUSTAINABLE FUTURE COME TRUE - ECOFICTION FOR EARTH NEIGHBORHOOD

Oral Presentation

K. LaMantia 1

1Earth Neighborhood Productions, Creative Media, Beaverton, United States

Imagining Human systems that meet human needs and enhance urban areas allow for livable cities that support life, work in common for the expansion of wild areas and cooperate regionally to sustain both. Our footprint on the Planet need not be a crushing blow and our relationships with one another and species that surround us, systems that support all and a Planet that welcomes all is possible. What changes first when humans get the message it is time to clean up the human world with respect for all? What goes and what stays in our efforts to create a just and sustainable world and how must we proceed with the world we have today? Who guides us day to day and what principles of right action come into play? In a society where the Rules of the Game are “Have fun and Be Kind” what disappears and what remains? When do armies around the world stop fighting others that are themselves? What are ways to settle on-going wars that have lasted for generations? What brings the joys of creativity to educate, inform and transform? Samples of my work are free, on line at EarthNeighborhood.com for free to anyone who cares, as a model for transformative ideas and systems for positive change. Imagine your own best solutions and answers. They will come true as are many of the concepts, ideas, findings and solutions that have come into existence since these books were written 23 years ago.

THE UNDERWATER SOUNDSCAPES OF HIGH-ALPINE PONDS AND LAKES

Oral Presentation

D. De La Haye 1, C. Robinson2

1Newcastle University, School of Arts and Cultures, Newcastle upon Tyne, United Kingdom, 2Eawag, Aquatic Ecology, Dübendorf, Switzerland

Ecoacoustics is increasingly being used as a tool for studying biodiversity. However, the underwater soundscapes of ponds and lakes remain a mystery to most. This session will introduce these fascinating sounds, using a pioneering creative project based in the Macun region of the Swiss National Park as a case study. It will explore how hydrophone recordings provide more than acoustic documentation and baseline studies; they may help create cultural connections and offer new perspectives of habitats through artistic practice. We will discuss
a new sound work, curated for World Biodiversity Forum, which merges Switzerland’s dual histories as the birthplace of limnology and as a beacon of early Romanticism. Could listening help us rediscover the natural beauty of our freshwater spaces?

POETRY AS A TRANSTEMPORAL AND TRANS-EXISTENTIAL ODE TO THE PRACTICE OF DIVERSITY

Oral Presentation

R. Boswell

1Nelson Mandela University, Institute for Coastal and Marine Research, Port Elizabeth, South Africa

Meditating of the poetry of Jalāl al-Dīn Muḥammad Rūmī, or Rumi, the 13th-century poet, Hanafi faqih, Islamic scholar, Maturidi theologian and Sufi mystic originally from Greater Khorasan in Greater Iran, I have composed poetry that seeks to articulate the complex, often contradictory but still exquisite relationship of humans with the sea. Considering the recently published poems in my third anthology, Between Worlds (2022) as well as poetry from my fourth (in progress) anthology, Lover Brine, I propose that poetry offers a transtemporal and trans-existential experience of the ocean. It is at once a universal and cross-cultural ‘language’ and it offers instantaneous expression of human feeling for nature and with nature. As an art form, poetry can make space for an alternative epistemology of the ocean, one that is removed from neoliberal, ‘rationalistic’ perspectives but is still sensitive to socioeconomic realities. Poetry, I argue, is also valuable because it relies on the articulation of sensory human experience (Laplantine 2015) which permits an openness to the diversity of nature’s agency, logics and its existentialism. Poetry is also transtemporal, it allows, Borges argues, to see the whole universe in an instant. It reminds us that we are not Cartesian beings but holistically crafted, vulnerable, reaching and diverse beings – the kind of diversely located beings we need to perceive, if the complex project of biodiversity conservation and inclusion is to be achieved.

MAD MAPLE FROM THE SOUNDSCS OF NATURE TO THE NATURE OF SOUNDS

Oral Presentation

S. Morfin

1Compagnie Garden, Paris, France

Inspired by the work of Baptiste Morizot, Philippe Descola and Vinciane Despret, Séverine Morfin’s Mad Maple questions our relationship with nature and sound - from the sounds of nature to the nature of sounds. Blending writing and improvisation, Mad Maple takes the form
of suites for viola, guitar, clarinet, and soundtracks. Composed as a fourth voice, these tapes include a montage of forest, glacier and storm sounds. The tapes are played, manipulated, modulated and spatialised in real time and in immersive multicasting in concert, they come to life. Mad Maple’s music is joyful and intensely poetic, even if it is inhabited by concern for the state of the earth (the glacier we hear collapsing has already disappeared). The wind blows with the viola, the birds sing with the clarinet, a glacier converses with the guitar... Thanks to the overlapping of timbres, we no longer know which sound belongs to which. This multiplication and indistinction of sources gives the music a thickness, a gentle density and, paradoxically, a simplicity and obviousness. In Mad Maple, the sounds are all received in the same way, and the four voices merge into a single moving, living body. From the wood of the instrument to the wood of the forest, Mad Maple reconnects us with the natural elements - the wind, the water, the trees. We are part of the whole, these imaginary landscapes seem to say. By reactivating a vibratory relationship with our environment, Mad Maple gives birth to a new world.

CREATIVE MOUNTAINS: INNOVATIVE APPROACHES FOR PROMOTION OF REMOTE RURAL AREAS

Oral Presentation

S. Belova

1 Association for Nature Conservation Machaon International, Poprad, Slovakia

The project „Creative mountains“ brings together innovative approaches and creative people in order to support transnational mobility of bloggers and photographers and to promote the unique natural and cultural heritage of rural mountain areas of Armenia, Georgia and Slovakia. It uses festivals, modern communication channels (bloggers) and digital technologies in order to foster international exchanges, cultural diversity and local development in a sustainable direction. Project activities are designed to promote music, gastronomy, crafts and other forms of intangible and tangible cultural heritage. The project bring new marketing and communication skills to support farmers, musicians, culinary heritage specialists, craft-masters, and contribute to development of sustainable tourism. We achieved success in involving bloggers through contest travedding.com (241 applications from 45 countries, 25 winners) audience reach (2 mln.) and engagement, and created quality content for further promotion of remote mountain regions. Issues of sustainability and environmental aspects are integrated into project. As project actions take part within and near protected areas of international value, we recognize the potential to use cultural activities also for interactive public education and raising of awareness about sustainable development opportunities and challenges and about benefits from the preservation of the unique natural and cultural environment which the project regions possess.
GENERAL AND LOCAL PERCEPTION OF WETLANDS BASED ON AI IMAGES SEMIOTIC ANALYSIS

Oral Presentation

G. Chaberek, M. Karczmarzyk, P. Romaniuk, K. Kasianiuk

1University of Gdańsk, Institute of Human Geography and Spatial Management, Gdańsk, Poland, 2University of Gdańsk, Institute of Pedagogy, Gdańsk, Poland, 3Polish Academy of Sciences, Institute of Philosophy and Sociology, Warsaw, Poland, 4Collegium Civitas, Institute of Political Sciences and International Relations, Warsaw, Poland

Wetlands play a crucial role in preserving biodiversity while ranking among the most endangered ecosystems on the planet. Effective conservation requires the engagement of local communities in pro-environmental behaviours and the cessation of activities negatively impacting these areas. According to the Goal-Directed Behavior Model, behavioural intentions are indirectly shaped by attitudes, subjective norms, perceived behavioural control, and anticipated positive and negative emotions. The study addressed the following research questions: Is the general perception of wetlands represented by the information on the global internet network? If so, how? Does the perception of wetlands differ when asked about specific locations? In the Emys-R project (www.emysr.cnrs.fr), we focus on three sites: Silene (Latvia), Neuburg am Rhein (Germany), and Woerr (France). The concept of “place image” refers to the mental or emotional representation of a particular location or environment. Based on this, an experiment was conducted to answer the above three questions. Artificial intelligence (AI) engines, using Mindjournay and Discord, were asked to draw pictures of wetlands in general. Subsequently, each engine generated three additional images after adding specified locations from the EMYS-R project to every prompt. The perception of wetlands was tested using semiotic and comparative analyses based on AI art.

UNDERCURRENTS: COMMUNITY ART, INDIGENOUS CULTURAL HERITAGE AND OCEAN GOVERNANCE

Oral Presentation

S. Jeffrey, E. Morgera, L. McDonald

1The Glasgow School of Art, School of Innovation and Technology, Glasgow, United Kingdom, 2University of Strathclyde, Strathclyde Centre for Environmental Law and Governance, Glasgow, United Kingdom

Ocean cultural heritage is often overlooked in national and global biodiversity policies and management. Art-based research can provide a transformative way to respectfully engage with Indigenous knowledge, meaningfully connect with unique ocean-human connections, and inform decisions that can ensure biodiversity conservation and sustainable use. In the context of ocean and biodiversity governance, cultural and spiritual connections with the sea
that embody ecosystem custodianship and deep knowledge of species and habitats, including those under extreme threat, should be considered just as important as food security and economic benefit. The One Ocean Hub, a transdisciplinary programme of research connecting marine and social sciences, law and arts for more inclusive and integrated decision-making, has adopted novel approaches to support the integration of Indigenous worldviews into broader debates about ocean stewardship. This paper discusses community-led art projects ranging from film, murals, music and song, to wearable art and tapestry in South Africa, Ghana, Vanuatu, Solomon Islands and Papua New Guinea that explore the profoundly inhabited nature of the ocean, from marine life to spiritual beings and ancestors. The paper concludes by reflecting on the agency of creative practices to influence decision-making processes and legal frameworks in the face of stressors such as over-fishing, climate change, marine pollution and deep-seabed mining.

THE ARTS APPROACH TO SUSTAINABILITY: UNDERSTANDING ESSENTIAL MECHANISMS

Oral Presentation

**O. Szasz** 1,2,3, **I. Rügemer**3,2, **T. Heger**4,3,5

1 Macromedia University of Applied Sciences, Munich, Germany, 2 Culturesphere GmbH, Munich, Germany, 3 Symbio(s)cene e.V., Ottobrunn, Germany, 4 Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany, 5 Technical University of Munich, Restoration Ecology, Freising-Weihenstephan, Germany

Visions are the foundation to action. Taking the correlations between the theories of sensory perception, cognition and creativity as a starting point, this presentation will explore the unique mechanisms of artistic approaches and methods to envision alternative futures and to motivate action through artistic expression. The presentation focuses on deepening comprehension of the underlying principles and approaches that the arts have developed: critical reflection to challenge societal norms and existing structures; artistic expression to provoke thought and influence the evolution of belief systems; fostering imagination to contribute to the redefinition of cultural values and inspire collective action. In essence, the arts show a unique capacity for envisioning sustainable futures for humanity and nature by exploring new paths to evoke powerful emotions, for encouraging the synthesis of disparate concepts and for shaping the trajectory of human development towards a relational and regenerative paradigm. A series of projects showcasing arts and sciences collaborations will be explored and discussed.

CO-HABITATIONS: SHAPING THE CITY OF TOMORROW BY EMBRACING CO-EXISTENCE TODAY

Oral Presentation
The community-based public art project based next to Zurich Main Station, initiated by the WE ARE AIA founder and curator seeks to transform public spaces into hubs for discourse, awareness, and participatory learning. The project won the Climanow Award on Art + Ecology as well as the award Arts for Future from the City of Zurich. The initiative, involving a transdisciplinary team with a landscape architect, researchers, artists, a chef and urban gardening pioneer and an art education practitioner aims to redefine societal layers, including the non-human ecological sphere. The project centers around building a community garden to strengthen local bonds, raise ecological awareness, and highlight the symbiotic relationship between humans and their environment. By fostering transdisciplinary and sustainable practices, the project envisions a circular economy to decarbonize cities, utilizing Wilderplatz as an experimental ground for shared materials and services, blurring lines between individuals in the collaborative construction process. Encouraging active participation and collaboration, as well among school children, the initiative emphasizes shared values through workshops and educational programs. The goal is to address the climate crisis by incorporating traditional building methods into modern solutions, promoting environmental justice, and creating a legacy that values cultural heritage and planetary well-being for a regenerative community.

**IMAGINARIES OF POSSIBLE FUTURES: FIRST-PERSON ECOLOGY IN ART/SCIENCE PRACTICE**

Oral Presentation

**D. Delorme**¹,², D. Ghavami³,⁴

¹University of Lausanne, Institut of Geography and Sustainability, Lausanne, Switzerland, ²The Manufacture - University of Performing Arts of Western Switzerland, Lausanne 16, Switzerland, ³The Manufacture - University of Performing Arts of Western Switzerland, Lausanne, Switzerland, ⁴Theatre Vidy-Lausanne, Lausanne, Switzerland

The “Imaginaries of Possible Futures” cycle is a collaboration between the Théâtre Vidy-Lausanne and the University of Lausanne. Since 2019, three sessions of interdisciplinary collaboration between young sustainability researchers and performing artists have resulted in various performance creations. A fourth will take place next year. Based on a selection from this corpus, we propose to analyze various recurring motifs in the staging of living non-humans and the dramaturgical, epistemological and political questions that arise from such
an art/science dispositive. Based on feedback from participants, we’ll ask how this dispositive fosters a first-person ecology that constitutes a transformative experience that connects knowledge and practice. We’ll show how aesthetic sensations and emotions are mobilized to reconstruct relationships with living beings and contribute to the ecological conversion of our modern Western societies. This presentation is based on a research project underway since 2021 at The Manufacture - University of Performing Arts of Western Switzerland in Lausanne, entitled AVETA (Arts Vivants / Écologie: le Travail des Affects), which aims to map and analyze the proposals of the performing arts in relation to ecological issues on stages in French-speaking Switzerland, starting from the question of the affects mobilized, staged or aroused.

SENSATIONAL NOCTURNAL ECOLOGIES; ANTHROPOGENIC NOISE AND NOCTURNAL ECOLOGIES

Oral Presentation

**T. O’Connell** ¹, **N. White**², **E. Briolat**³

¹University of Reading, Fine Art, Reading, United Kingdom, ²University of Westminster, CREAM - Centre for Research and Education in Art and Media, London, United Kingdom, ³University of Exeter, Centre for Ecology and Conservation, Penryn, United Kingdom

Sensational nocturnal ecologies addresses the ecological impact of anthropogenic noise on biodiverse nocturnal landscapes in Europe (Briolat, Kunc/Schmidt). We focus on the impact of artificial LED light (light emitting diodes) that interfere with multispecies habitats and ecosystems. We draw on artistic and scientific perspectives to propose new public engagement strategies. We will present two elements; 1) an oral presentation drawing on research into moths declines led by artists with scientific reflections; 2) live production of images for a social media campaign during the World Biodiversity Forum to support protection of nocturnal species and habitats. The presentation of nocturnal fieldwork from an urban park by artists Tina O’Connell and Neal White in Amsterdam will link with the insights from Dr Emmanuelle Briolat and the Exeter Visual Ecology team. Together we ask; ‘What is needed to transform scientific insights into attitudinal or behavioural change in nocturnal environments? What can we learn from multisensory research (Eardley) that situates persons with disability gain (including visual impairment and blindness) as co-researchers in visual cultural contexts? We will share our aims for a deeper public understanding of visual ecology and relationships with nocturnal cohabitants to quieten the anthropogenic noise now becoming ‘omnipresent in aquatic and terrestrial ecosystems’. (WHO). Abstract image: [https://nealwhite.org/World-Biodiversity-Forum](https://nealwhite.org/World-Biodiversity-Forum)
SOIL ASSEMBLY - LIVING PEDAGOGIES, SOIL ECOLOGIES, FOOD PERMACIRCULARITIES

Oral Presentation

E. Chardronnet ¹, M. Joseph Vari², P.N. White³, M. Minder⁴, R. Vania⁵, V.M. Dass⁶

¹ART2M, Journalist, Paris, France, ²Rizq Art Initiative, Abudabi, Curator, Dubai, United Arab Emirates, ³University of Westminster, Centre for Research and Education in Arts and Media (CREAM), Middlesex, London, United Kingdom, ⁴hackteria.org, Artist, Zürich, Switzerland, ⁵Srishti Manipal, Institute for Art, Science and Technology, Yelahanka, Bengaluru, India, ⁶Srishti Manipal, Institute of Art, Design and Technology, Yelahanka, Bengaluru, India

Initiated by the Srishti Manipal Institute of Art, Design and Technology (IN), CREAM (Centre for Research and Education in Arts and Media) at the University of Westminster (UK), Makery.info (FR) and the International Hackteria Society (CH), the Assembly is an international gathering. It stands at the intersection of soil ecology, permaculture design, food transition and living pedagogies, and brings together a unique combination of artistic practices, academic research and pedagogy of international significance. The assembly aims to connect with a wider audience to highlight the interventions of creative collectives and artists initiatives around the world, so that new generations of art practitioners can also contribute to the collective regeneration of the degraded landscapes of the Anthropocene. What does Soil Assembly Do? LEVERAGES the power of ‘The Arts’ to create a living pedagogy by affecting people’s hearts, heads and hands. CURATES a global network of creative collectives and individual artists, designers and technologists that are critically engaging with living soils, biodiversity and landscape conservation. SEEDS academia, especially art and design schools across the globe, with critical eco-literacy, so that new generations of art practitioners can contribute to the collective regeneration of the degraded landscapes. SHOWCASES innovative living labs, projects and communities working at the interface of art, science and the environment. www.soilassembly.net

HOMO PHOTOSYNTHETICUS - A (SPECULATIVE) JOURNEY ON HOW TO BECOME AUTOTROPH

Oral Presentation

M. Minder ¹, E. Chardronnet²

¹Independent Artist, hackteria.org, Zürich, Switzerland, ²Art2M, Artist / Journalist, Paris, France

Since 2021, the Homo Photosyntheticus project has been exploring algae as bio-indicators of climate change and their potential in the ecological transitions. The title comes from a speculation in the book ‘Microcosmos’ by biologist Lynn Margulis. Margulis was instrumental in
highlighting the importance of the metabolism of living organisms in the gas balance of the biosphere, thus supporting James Lovelock’s Gaia hypothesis and giving substance to what is now defined as Earth System Science. Margulis’s Homo Photosyntheticus speculation imagines human beings becoming plants, inspired in particular by marine photosymbioses, such as corals, anemones and other animals feeding on the photosynthesis of their algal partners. Inspired by this imaginary evolution towards algae, artists Ewen Chardronnet and Maya Min- der explore algae based applications and promises in the fields of food, medicine, biomaterials, carbon capture and space exploration. With their mobile “media kitchen lab”, the artists have investigated these questions in France, Japan, Switzerland and beyond, using a variety of artistic practices such as film, multimedia, installation, performance, biology or cooking workshops, as mediation tools for speculative and critical thinking, and for opening up audiences to the macro and micro worlds of algae, from global photosynthesis to circular economy. This project is supported by the platform roscosmoe.org, an art research initiative in the field of marine biodiversity.

**BIOMIMICRY OF CONCEPTS**

Oral Presentation

*V. Mariadass*  

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Unlike the practical concern of Biomimicry to design objects and “inventions,” a more fundamental concern of this paper is to explore Biomimicry for conceptualization. Hence, I will engage with The Ground, Below, a solo show at Samukha Gallery, in August 2023 by Ayisha Abraham, and begin with The Big Tree from the assemblage. An old work A Thousand Plateaus by Gilles Deleuze and Felix Guattari popped up in my mind because of the tree and the content meandering under and around the “tree.” It is an outdated text, but the task of this work is not complete. Through Nature, it produces paradigm shifts, concepts, and perspectives: the duo scrambled the quite intact tree structure that has existed for time immemorial. Abraham’s The Big Tree invokes the haunting tree, the video image of a tree, and a geometrical tree. Indeed, it sets up a conversation between the smaller geometrical tree and the looming video image of a large tree, moving and waving and quite oblivious to the geometrical tree. Instead of asking what is mimicked from Nature, my question here is “how” it is mimicked. The “how” illustrates the gaps, limitations, fragmentation, and skewed desires. However, irreconcilable productivity has also emerged which is particularly evident in the Sciences. Perhaps an incomplete and irreconcilable answer directs our attention to Nature and a return to it with further radical shifts in frameworks and perspectives: for the sake of sustainable futures and to mitigate climate change.
# MOSEVIS: PAINT, MUSIC AND AN UNDEAD BOG BODY – A NARRATIVE OUTREACH EXAMPLE

Oral Presentation

**F. Bengtsson** ¹, M. Olsen Kyrkjeeide¹

¹Norwegian Institute of Nature Research, Trondheim, Norway

Peatlands are currently disappearing in favor of using the peat and land for other interests, so we aim to raise public interest in preserving them, their biodiversity and carbon storage values. The project MoseVis blends art, music and science to provoke empathy for and increase knowledge of peatlands. As peatlands are often seen as inhospitable and dangerous to people, finding a connection to people in these ecosystems was a focus point. To this effect we crafted a story with a relatable protagonist. Awakening from a digger excavating the peatland where she is buried, the bog body-like character starts walking around horrified by the ongoing destruction of mires, and by how much peatland has been transformed into agricultural land, lost to infrastructure, or completely urbanised. We tell this story in a music video “Graver du i grava mi” [Digging in my grave], where certain aspects are told visually, and others through music and lyrics by Norwegian composer Ane Marthe Sørlien Holen. The multimedia visuals include video, watercolour/ink illustrations, stop motion and photography. The lyrics mainly revolve around land-use changes for agriculture and roads, and emphasize how excavating peat leads to the release of carbon to the atmosphere, and how this is a problem now and for future society. In connection to the music video we created a website presenting the importance of peatlands and peatmosses. The two parts of the project are linked through the watercolors by Bengtsson.

AGRICULTURAL BECOMINGS IN THEATER

Oral Presentation

**E. Beaufils** ¹

¹Université Paris 8, Theater Studies, Saint Denis, France

This communication is a comparative analysis of three theatrical devices that confront the growth of plants, their peculiarities and the ways in which they can be cultivated. The first, by the Superflux collective, prefigures urban agriculture in an apartment in 2050; the second, by artist-permaculturist Marina Pirot, takes spectators outside to experiment with various anthropo-vegetal relationships; and the third, Plantoon, suggests alternative urban policies. The devices create three different forms of encounters with plants: the first involves material dystopia and sound aesthetics, the second anchors us in the ground here and now, and the third crosses the spaces of the city of Hanover to recognize the resilience of plants with spectators. It is important to analyze these different strategies, which are all multimodal and characterized
by the combination of cognition, care, aesthetics and speculation, in order to increase the impact on spectators.
Reflections, Intersections & Connections – Showcases of art-based expressions of nature-human relationships towards sustainable futures

ARCTIC UMWELT: SPECULATIVE ARTEFACTS FOR A MORE-TAN-HUMAN FUTURE

Poster Presentation

I. Wang

1Independent (irinavw.xyz), North Vancouver, Canada

In communication with the authors of Discursive Design (2018), Scott Klinker aptly describes the practice of critical design as “[trying] on a new set of values embodied in a polemic design proposal. It becomes a way of visualizing how our values may evolve. This type of work is especially important now as our society shifts from the values of an industrial and information age into a new age.” Within these subgenres of discursive, critical, and speculative design, there’s a growing exploration of “more-than-human” scenarios aiming to enrich interspecies understanding and expand the moral circle that shapes boundaries of both individual behavior and societal lawmaking. I consider these intentions crucial for fostering future sustainable stewardship. To contribute to this transdisciplinary conversation around nature-human relationships in the context of my Arctic climate change research with the CHARTER project, I propose a set of speculative tools that temporarily extend the umwelt (i.e. lens of environmental perception specific to a species’ biological capabilities and relevant needs) of various Arctic species into the human perception and sensory experience. For instance—might we regulate shipping activity differently if we experienced underwater noise pollution constantly and viscerally, through a beluga’s bioacoustic adipose tissue mass? Depending on the artefacts’ size and portability, they may be fabricated physically or rendered digitally for display in Davos.

WILDLIFE, WATTS & WIRES: CAN YOU “SOLVE” THE ENERGY AND BIODIVERSITY CRISIS?

Poster Presentation

D. Gilad, J. Borgelt, S. de Visser, M. Dorber, P. Gjedde, F. Verones

1Norwegian University of Science and Technology - NTNU, Trondheim, Norway, 2Norwegian Institute for Nature Research - NINA, Trondheim, Norway

The global expansion of renewables is expected to increase rapidly in the coming decades. However, the construction of new power plants and power lines can alter habitats, disturb wildlife, and impact species richness. How can we effectively communicate the trade-offs between promoting renewable energy and protecting biodiversity to the public? Our approach
is simple: by playing. We developed a board game where players compete against each other while navigating the balance between energy needs and environmental impacts. The game unfolds in a city surrounded by diverse landscapes. Each landscape tile is assigned a biodiversity token, indicating its conservation status. Players can build hydropower, wind power, solar power, or fossil power plants, each with varying electricity production and CO2 emissions. The challenge lies in selecting power systems that meet electricity demands, minimise emissions, and strategically place them to avoid biodiversity impacts. Each round introduces unforeseen events, such as favourable weather conditions boosting solar power output or new climate policies constraining planned constructions. To win the game, players must generate sufficient electricity while minimising CO2 emissions and pressure on biodiversity. “Wildlife, Watts & Wires” offers an engaging and enjoyable experience, providing insights into the complex balance needed to meet rising energy demands while mitigating potential impacts on biodiversity.

EXPERIMENTAL ECOLOGY: ART + SCIENCE IN DIALOGUE

Poster Presentation

*M. Huber*¹, G. Jetzer²

¹WE ARE AIA I Awareness in Art, Zurich, Switzerland, ²Kunstmuseum St. Gallen, Director, St. Gallen, Switzerland

The project Experimental Ecology by Martina Huber and Gianni Jetzer offers a contemporary platform for collaborations between artists and scientists in ecology in the spirit of the famous E.A.T. – Experiments in Art and Technology, an initiative launched in 1967 pairing artists with engineers, thus enabling a new sense of exchange. Five teams develop novel ways to re-think our impact on the biosphere. The encounters and the resulting ideas were first presented in a symposium with workshops in fall 2022 to engage with the public. Their resulting works spearhead new ways to understand our relationship with our environment and are pioneering collaborations between art + science on eye level. The travelling exhibition produced by Kultur Stiftung Basel H. Geiger with 2/3rd of re-used materials was first shown in Basel, accessible to the public for free and through an open access catalog. The project will be shown next at Kunstmuseum St. Gallen from April to November 2024.
Satellite observations for a deeper understanding of 
biodiversity-climate feedbacks: progress and challenges

SEASONAL WARMING AND GLOBAL LAND SURFACE PHENOLOGY

Oral Presentation

J. Lever¹, D. Odermatt², P. D’Odorico³, L.J. Gilarranz², S. Simmis⁴, C. Ginzler³, A. Psomas³, A. Damm⁵, A. Gessler³, Y. Vitasse³

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Emerging evidence suggests that ongoing climate changes not only differ strongly between regions, but also between seasons. The implications of such seasonal differences in global warming for plant phenology, i.e. the timing if key events during the plant seasonal cycle, however, remain largely unknown. Here, we provide a global analysis of the interrelationships between seasonal temperature changes and global land surface phenology using satellite data from the period 2001-2019. More specifically, we determined at +10,000 point locations the annual period of highest correlation between temperature fluctuations and the onset of different phenological stages. We found that, across most of the Northern Hemisphere’s mid and high latitudes, a wide range of these stages, i.e. from the onset of ‘greenup’ to ‘green-down’, correlate strongly with temperature fluctuations during roughly the same period of the year, i.e. up until a few weeks before or after the onset of greenup. We found that warming rates during this period were roughly 1.5-2.5 faster than regional mean annual temperature increases. Our results thus suggest that we are likely to underestimate the impacts of global warming on global landsurface phenology when we fail to take seasonality into account. This is particularly important because limiting increases in global mean annual temperature is the primary objective of global climate policies.

MAPPING GRASSLAND BIODIVERSITY USING ABIOTIC ENVIRONMENT 
AND REMOTE SENSING

Oral Presentation

Y. Zhao¹, Z. Zheng², Y. Wang¹, Y. Bai¹

¹Institute of Botany, Chinese Academy of Sciences, Beijing, China, ²Aerospace Information Research Institute, Chinese Academy of Sciences, Beijing, China

Although global spatial patterns of vascular plant diversity have been well mapped based on environment-diversity relationship, the poor availability of vegetation plot data has caused
large uncertainties in machine learning-based species diversity prediction models, especially in grasslands. Recently multiple remote sensing methods have been developed to directly estimate plant diversity with spectral diversity or related functional traits, phenology, productivity, and habitat heterogeneity. However, it remains controversial whether these satellite remote sensing essential biodiversity variables can improve the predictions of large-scale variation in plant species diversity due to the context dependencies. Using 1609 field plots sampled across the Mongolian Plateau, we modelled and mapped grassland species diversity at 500 m resolution. Our results show that the inclusion of remotely sensed data did not significantly improve the predictive accuracy of grassland species diversity (69%) compared to macro-environmental factors alone (65%). Yet, they individually all predicted approximately 45% of the variation in species diversity. The covariance of remotely sensed habitat heterogeneity, functional traits, spectral diversity, phenology and productivity with water and energy-dominated macroenvironments obscured their effects on diversity patterns. These findings improve our understanding of the interaction of key drivers on predicting grassland species diversity.

LINKS BETWEEN SATELLITE-DERIVED FOREST HEALTH ANOMALIES AND BIODIVERSITY

Oral Presentation

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The Forest Condition Monitor project of the Helmholtz-Centre for Environmental Research aims at making information about national scale forest condition accessible to stakeholders, policy makers and scientists. One of its main components is an area-wide estimation of forest condition anomalies from satellite-based land-surface reflectance measurements. Reflectance patterns differ between healthy and damaged vegetation and are widely used to depict vegetation vitality or anomalies. Here, we used a tree species map with 20 m spatial resolution to extract species-specific reflectance time series of Germany’s tree stands for 2016-2022. The seasonal evolution of these time series serves as reference for the detection of forest condition anomalies. We calculated a similarity metric – further called forest condition anomaly index (FCA) - between each reflectance observation and the respective measurements within the reference time series, also considering the natural temporal deviations caused by phenology. A temporal aggregation of these FCA values allows the generation of a spatially comprehensive map with 20 m spatial resolution, showing patterns related to drought, fire, storm events and bark beetle outbreaks. We compared this map with the Shannon index derived from tree species information to assess potential links between biodiversity and forest disturbances. Here, we present the FCA’s ability to depict forest condition and first results about its relation to biodiversity.
SATELLITE OBSERVATIONS TO MONITOR MARINE BIODIVERSITY IN A CHANGING CLIMATE

Oral Presentation

V. Martinez Vicente 1, S. Sathyendranath1, T. Jackson2,1, D. Clewley1, E. Sullivan1, A. Atkinson1, A. Laurenson1, J. Harding1, D. Raitsos3, S. Darmaraki3, F. Steinmez4, J. Fernandes5, A. Anabiarte5, A. Astarloa5, I. Garcia Baron5, L. Barille6, P. Gernez6, B. Davies6, S. Oiry6, D. Treganos7, A. Pertiwi7, J. Concha8, M. Paganini8, M.-H. Rio8

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Satellite observations assessing and monitoring how the community structure and function of coastal ecosystems will respond to the anthropogenic and natural drivers in a changing climate are needed. We present progress on two projects supported by the European Space Agency (ESA): Biodiversity in the Open Ocean: Mapping, Monitoring and Modelling (BOOMS, https://www.booms-project.org/ ) and Biodiversity of the Coastal Ocean: Monitoring with Earth Observation (BiCOME, https://www.bicome.info/ ). These projects explore satellite ocean colour observations to derive a wide range of Essential Biodiversity Variables (EBV) in intertidal, subtidal and pelagic (coastal and oceanic) ecosystems. Specifically, Sentinel-2 MSI derived remote sensing products have been combined with in situ observations to map seagrass taxa extent in coastal intertidal environments, and then investigated to produce taxa specific phenology. In the open ocean the Ocean Colour climate change initiative (CCI) remote sensing reflectance product has been used in combination with the sea surface temperature CCI derived fronts, to produce a long term time series of seascapes. In this presentation we will evaluate the ecological significance of these seascapes for different trophic levels. These results feed into a roadmap informing the Space Agencies about future algorithms and datasets development needs.

USING SATELLITE DATA TO UNDERSTAND BIODIVERSITY-CLIMATE DYNAMICS

Oral Presentation

P. Bonnet 1, A. Joly2

1CIRAD, BIOS, Montpellier, France, 2Inria, Zenith Team, Montpellier, France

Human activities have an impact on the world’s biodiversity, which needs to be fully understood if we are to effectively mitigate the effects of climate. Recent advances in the storage and management of large volumes of visual and environmental data, particularly satellite data,
and the development of new artificial intelligence models are now making it possible to fill the gaps in our knowledge of species and habitats. Gathered using innovative tools, this increased knowledge can be used to improve land management practices. In the same time, citizen science tools and platforms allow to collect large volumes of field data on biodiversity, but correlation with satellite data remains a challenge. In the context of European projects, we aim to take advantage of these different data sources to promote large-scale biodiversity inventories. Taking advantage of Big Data, the power of participatory science platforms and the latest advances in deep learning model training, we are developing new prototypes for the effective monitoring of plant species and habitats at the European scale. A comprehensive presentation will share the advances made, promoting the widespread adoption of satellite-based approaches to understanding biodiversity-climate dynamics within the scientific community.
Satellite observations for a deeper understanding of biodiversity-climate feedbacks: progress and challenges

ECOSYSTEM INTEGRITY-TOOL FOR MONITORING BIO- & GEODIVERSITY BY RS & TRAITS

Poster Presentation

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One of today’s greatest challenges is to monitor the rapid environmental changes taking place worldwide on both local and large-scale levels. This requires easy-to-use and operational tools and services that can monitor and quantify aspects of changing biodiversity as well as geo-diversity impacts of land use intensification using freely available and global remote sensing data and derive remote sensing-based indicators. Currently, there is no tool or service available for the hybrid (raster and vector) quantification of traits and trait variations, structural, taxonomic or functional indicators into a single “compact-tool-package”. Therefore, this presentation presents the methodological approaches and the indicators implemented in ESIS (Ecosystem Integrity - Remote Sensing / Modelling - Service). ESIS enables remote sensing based indicators to be derived for the quantification of traits and trait variations, structural, taxonomic and functional indicators of vegetation and geodiversity as well as land use intensity. Even though big data have been integrated, ESIS can run on any PC, as the processing and derivation of the indicators have been greatly optimized. The source code is open access and is hosted and maintained at GitLab: https://doi.org/10.5281/zenodo.8116370.

TESTING THE POTENTIAL OF COPERNICUS PRODUCTS FOR ENVIRONMENTAL MONITORING

Poster Presentation

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Europe’s Earth Observation programme for climate and environmental monitoring, Copernicus, provides ready-made thematic layers in the form of High-Resolution Layers (HRL). Examples include Water and Wetness, Small woody features, Grassland and Imperviousness.
These datasets are freely available and comparable across Europe, but are they of high enough quality to be useful in national monitoring? In a collaborative project between Norway and Poland, we tested the accuracy and usefulness of these products for environmental monitoring, either alone or in combination with national data. We identified several challenges, ranging from errors in the data, difficulties finding information needed in the verification work, issues related to definitions and thresholds and the time-lag before data are available. However, the work also highlighted gaps and weaknesses in the national geographic datasets. We conclude that there is a clear need for the CLMS products. We advise caution in using the products until they have been improved but see that they have great potential for future use in environmental monitoring.

BIRDS HAVE LIMITED THEIR CLIMATE CHANGE EXPOSURE USING RANGE REDISTRIBUTIONS

Poster Presentation

J. Cohen 1, W. Jetz1

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Wildlife has been extensively documented moving polewards as climate change accelerates, but it is unknown whether these mass redistributions have successfully conserved environmental niches. Here, we pair tens of millions of bird observations with high-resolution weather data and apply a novel statistical approach to quantify expected climate change exposure, range redistributions, and niche loss among 384 well-sampled North American species. We find extensive northbound redistributions and niche loss over the past 20 years. Although birds moved north at similar rates during winter and summer, they are experiencing ~3.74 °C higher maximum daily winter temperatures and ~1.47 °C increases in summer, alongside smaller changes in productivity and precipitation. However, many species used range redistributions to mitigate the extent of their niche loss, and species that moved furthest north conserved their niches most successfully. Birds mitigated their expected exposure by only ~0.47 °C in winter (11% of expected niche loss), but ~1.16 °C during summer (44%), and may avoid summer warming approaching their thermal limits. Furthermore, hand-wing index, a measure of dispersal ability, was associated with redistributions and niche conservation. Over the past 20 years, range redistributions have only been partially effective at allowing species to mitigate their climate change exposure, and most species are unable to use movement to keep pace with accelerating climate change.

MONITORING DISTURBANCE IMPACTS ON TEMPERATE FOREST PRODUCTIVITY

Poster Presentation
Bark beetle (BB) infestation is one of the most important biotic disturbances in temperate forests in Europe. Extreme weather conditions have caused a surge in BB outbreaks. Climate change will continue to lead more frequent and severe drought events in the future, this will exacerbate the BB infestation, resulting in significant social and economic consequences. Intensification of BB infestation, cause increased tree mortality, reduced forest density, and a decline in biodiversity. This is expected to affect forest net primary productivity (NPP). The main goal of this research is to assess the impact of BB infestation and change in temperature represented by Land Surface Temperature (LST) a proxy of climate change in NPP in Bavaria Forest National Park (BFNP) (Germany). This research studied variation of time series satellite adjusted NPP from LPJ-GUESS. Monthly high-resolution NPP maps were generated by incorporating leaf rea index retrieved from Sentinel-2 data, allowing to study variation in NPP at a local scale. Furthermore, the LST was calculated using Landsat-8 thermal data, while BB infestation data was provided by the BFNP administration. The results of our analysis showed the impact of BB infestation and variation of LST on NPP in temperate forest. We observed a gradual decline in NPP due to BB infestation, finding a negative relationship between NPP and infestation intensity. Our results showed the importance of LST to identify dry periods through NPP dynamics.
Species distribution models for spatial prioritization of biodiversity conservation

MACHINE LEARNING-BASED PREDICTION OF POTENTIAL SNOW LEOPARD HABITAT IN NEPAL

Poster Presentation

G. Puri 1

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Studying and predicting the distribution of elusive species like the Snow leopard is challenging due to their elusive nature, the dynamic nature of ecosystems, and the potential impact of climate change. A study was conducted to assess the current and future habitat suitability of Snow leopards in the Nepalese Himalaya, spanning different time periods (current, 2030s, 2050s, and 2070s), using presence-only data and twelve environmental variables. The study’s model projected a decline in Snow leopard habitat in the future. The primary determinant for habitat selection was Annual Mean Temperature (BIO1), accounting for 80.6% of the model’s importance. Wetness (8.3%), land cover (2.8%), hill shade (2.3%), and precipitation of the driest month (BIO14; 2%) also played significant roles in shaping the Snow leopard’s niche. A suitable habitat should maintain an annual mean temperature within -15°C to 10°C. According to the habitat suitability map, Nepal currently has 16,583.48 km² of highly suitable habitat, 16,583.48 km² of moderately suitable habitat, and 109,784.60 km² of unsuitable habitat for Snow leopards. The model predicted future reductions in suitable habitat to 1,518.38 km² (4.29%) in the 2030s, 1,405.88 km² (3.97%) in the 2050s, and 2,120.89 km² (5.99%) in the 2070s. These findings are crucial for the development of effective landscape-level Snow leopard conservation strategies in Nepal, helping to address the challenges posed by climate change and habitat loss.

A MULTITAXA CONSERVATION PLAN FOR BIODIVERSITY AND CLIMATE CHANGE IN SWITZERLAND

Oral Presentation

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Systematic conservation planning is a quantitative approach to allocate conservation resources and optimize areas with the highest biodiversity. Currently, protected areas in Switzerland
are lagging behind the rest of Europe, with ~12% land area protected (compared to, e.g., 28% in France, 21% in Italy, and 26% on average across the European Union). Approximately half of the natural habitats and one third of species in Switzerland are at risk. Consequently, a conservation plan is needed to ensure the preservation of biodiversity in the face of climate change over the next century. Here, we use the Zonation conservation planning software to explore a set of prioritization portfolios based on biodiversity and climate change. We use species distribution models for ~7000 species across Switzerland under two emissions scenarios and three different time steps to determine hotspots of biodiversity that should be prioritized for the establishment of protected areas. These conservation planning scenarios aim to provide a basis for protected areas management and policy in Switzerland that can be implemented to facilitate meeting the Global Biodiversity Framework target of protecting 30% of the world’s terrestrial area by 2030.

**THE CURRENT AND FUTURE DISTRIBUTION OF DRACAENA OMBET UNDER CLIMATE CHANGE**

Poster Presentation

H. Kassa¹, S. Nimomissa², B. Warkineh², E. Aynekulu ³, W. Oluoch⁴

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Dracaena ombet is one of the trees that can survive a long period of drought, and thus is an important part of desert ecosystems. The species is classified as ‘Endangered’ in the IUCN Red List of Threatened Species. In this study we predicted the potential current and future geographic distribution under two Shared Socioeconomic Pathways. These are SSP2-4.5 and SSP5-8.5 greenhouse gas emission scenarios for the 2050s and 2070s models. The test AUC average values of the simulated training data set based on the dominant environmental variables were 0.989 and the predicted results revealed that the geographical distribution of the predicted model is in high agreement with the actual distribution. Regard to future distribution of this species, the present modeling suggests that there will be range contraction and gain or shift of its partial geographical distributions. Loss of very high suitable habitats would be 42.24% and gain of high suitable habitats of D. ombet is expected to be 10.46% by climate changes on 2070s under SSP5_8.5. The models have predicted that most of the land mass in Ethiopia would be outside of the fundamental niche. Hence, the fate of this species remained highly restricted in narrow portion, especially in pocket and hotspots in northern Ethiopia. Therefore, protecting, maintaining of the population in the existing sites and introducing it to a newly suitable area is crucial for safeguarding the species from extinction.
CONSERVATION PLANNING IN SWITZERLAND TO PRESERVE BIODIVERSITY IN EUROPE

Oral Presentation

Y. Chauvier-Mendes, A. Adde, C. Graham, N. Zimmermann, L. Pellissier, J. Casanelles-Abella, B. Fournier, F. Altermatt

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Switzerland is a key hub of the future EU conservation network due to its central location in the Alps, hosting high elevation ecosystems with enigmatic fauna and flora. Despite this importance, previous European research have highlighted either a severe lack of strict protected areas in the country, or the absence of comprehensive information on how biodiversity, nature contributions to people (NCPs) and adapted conservation planning are distributed. Our research is part of the SPEED2ZERO project, a consortium and Swiss federal project aiming to halve greenhouse gas emissions by 2030 in Switzerland. We here present an overview of how the conservation network of the country may be improved according to expected changes in biodiversity and NCPs in the face of global changes. Although results reasonably vary across taxa group (e.g., vegetation, birds, and insects, >7'000 species), our conservation simulations predicted a larger protection focus on higher elevations and latitudes by 2050, yet with different notions and priorities for aquatic versus terrestrial systems. We explain this trend through biodiversity shifts induced by climate change, and more specifically spatial shifts in NCPs threatening the future availability and access to natural resources in the country. Overall, we highlight that Switzerland, although occupying a modest geographical extent, is expected to keep a central role within Europe to assist species migration and preserve mutual ecosystem services.

USE SDM TO MAP NCP: A NEW PATHWAY TO LINK SPECIES WITH NCP TO HELP CONSERVATION

Oral Presentation

P.-L. Rey, A. Adde, C. Martin, A. Guisan

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Over the last half-century, nature conservation has shifted through several steps from ‘nature for itself’ to ‘nature and people’, corresponding to a new perspective that all species count to
ensure ecosystem functioning, and with them that nature’s contributions to people (NCPs) are effective and maintained. Despite the integration of “Species Distribution Models” to improve conservation decision-making and help projections for sustainable future for species and environment seems endorsed. We have difficulties to propose a common pathway between species and NCP for conservation to achieve some targets from the Global Biodiversity Framework. Here, based on speciesxNCP relationship table (Rey et al. 2023) and N-SDM tool (Adde et al. 2023), we carried out the first spatial prediction of 17 NCPs directly linked to species (i.e. flora and vertebrates; n = 2,066; Rey et al. 2023) developed under current and future climate scenarios (RCP 4.5 and RCP 8.5 for 3 time periods 2020-2049, 2045-2074, 2070-2099; Karger et al. 2017) for a large mountain region of the Swiss Alps. This work illustrates a powerful tool for including NCPs in conservation planning and ending the opposition between NCPs and biodiversity. We prove that SDM combined with NCP can also offer a powerful tool for communications and help to act quickly to achieve the GBF vision for 2050.

INCORPORATING PATCH AREA EFFECTS INTO SPECIES DISTRIBUTION MODELS

Poster Presentation

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Patch area effects (e.g., minimum patch size effects on species occupancy) have been central in the history of ecology and conservation biology. Nevertheless, species distribution models (SDMs) have rarely incorporated patch area effects. This gap is problematic because SDMs are used increasingly often to predict biodiversity change at high resolutions, including resolutions sufficiently high to represent habitat existing in patches of different sizes. To better understand the implications of patch size effects in SDMs, we will model species distributions of habitat specialists species in United States, testing for the importance of the size of the habitat patch in which these species were recorded in moderating their occurrence probability. Specialist species are ideal study systems because they are limited to specific land cover types - wetlands, grassland, cultivated crops, forests... Species are chosen with consideration for the ease of classification of their habitat in spatial land cover data, allowing for robust calculations of the size of the patches in which species were observed. We will model species distributions at a fine scale (tentatively, 100 m resolution) to test the importance of patch area in mediating the probability of occurrence of each model species. We expect that integrating patch area effects has the potential to improve model predictions and to clarify the processes shaping the distribution of species in human dominated landscapes.
MEETING TERRESTRIAL AND MARINE BIODIVERSITY 2030 TARGETS UNDER CLIMATE CHANGE

Oral Presentation

**M. Bastos Araújo**

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One of the key outcomes of the United Nations Biodiversity Conference (COP 15) was the historical pledge to expand the world’s protected-areas coverage up to 30% of all land and sea, known as the 30-30 biodiversity targets. While some regions still require expansion of protected areas to conserve unprotected species and habitats, other territories sample reasonably well their biodiversity. For these regions, the main challenge is to expand protected areas so to ensure the long-term persistence of biodiversity in face of external threats, including climate change. Designing climate-resilient protected areas is a particular problem of spatial conservation planning whereby, in addition to the spatial dimension, the temporal dimension is also considered. We develop a protocol for spatial prioritization to achieve the 30-30 biodiversity targets that combines species distribution modelling with a heuristic approach to identify the minimum set of areas required for species persistence, under climate change, up until the end of the century. We illustrate the framework with two governmental-backed case studies. These case studies assist conservation bodies in identifying conservation-area priorities in the mainland of Portugal and the marine coastal areas of the Azores.

REDEFINING THE FUNDAMENTAL NICHES OF ANIMALS FOR SPATIAL CONSERVATION

Oral Presentation

**J. Matthiopoulos**

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The fundamental niche, the complete set of environments that allow an individual, population, or species to persist is a crucial concept connecting population dynamics, spatial ecology and evolutionary theory, and a prerequisite for predictive ecological models at a time of rapid environmental change. Yet, its properties have eluded quantification, particularly for mobile, cognitively complex organisms. Here, I combine recent mathematical and statistical results linking habitats to population growth, to achieve a quantitative and intuitive understanding of the fundamental niches of animals. I examine how animal mobility and behavior may blur the division between geographical and environmental space and derive a concise mathematical equation for the fundamental niche of animals, demonstrating that fitness parameters can be understood and directly estimated by fitting this model simultaneously to data on population
growth and spatial distributions. I fit this model to a dataset of house sparrow colonies to quantify how a species of selective animals can increase their fitness in heterogeneous environments. The results demonstrate how organisms might buffer themselves from change by bending the boundaries of viable environmental space, and offers a framework for designing optimal habitat interventions to protect biodiversity or obstruct invasive species. I argue that the fundamental niche is a central tool for practical environmental management.

PRIORITY AREAS FOR BIODIVERSITY CONSERVATION IN THE CONTEXT OF GLOBAL CHANGE

Poster Presentation

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Human-driven habitat degradation, climate change and biological invasions are major causes of current species mass extinction. In Europe where wetland surface area has declined by 90% since 1700s, the European pond turtle Emys orbicularis is considered as the reptile that suffered the most dramatic decline. Recently alien turtle species originated from America, Asia and Africa have been widely spread in Europe with high invasion potential threatening native biodiversity. Using field data, open databases and GIS modelling, we mapped present and future distributions, in relation to habitat and climate conditions, of the native European pond turtle and seven alien turtle species, including the red slider painted turtle Trachemys scripta sp. which is listed as one of the 100 worst invasive species in the world. We show that presently T. scripta and Graptemys pseudogeographica exhibit highest ecological flexibility, occupying most habitats suitable for native E. orbicularis with ~45% overlap at the scale of (mainly Western) Europe. By 2050, this overlap will increase, except in Northern and Eastern Europe where E. orbicularis is predicted to expand its range by 700 km, while exotic turtles spread only up to Southwestern Ukraine. We conclude that priority conservation areas for the endangered European pond turtle are Eastern and Northern Europe, where competition risk of invasive turtles are limited. We thank the projects EMYS-R (www.emysr.cnrs.fr), Nr.lzp-2021/1-0247 and PAUSE.

ENHANCING PERFORMANCE OF SDMS FOR FOREST TAXA WITH HIGH RESOLUTION SOIL MAPS

Oral Presentation
In forests, edaphic factors affect species niches and occurrence, due to species-specific preferences to particular soil properties. However, datasets that relate species and reliable soil data across wide geographical areas are rare. Here, we used 25m resolution soil maps for Swiss forests, generated through digital soil mapping (DSM), to improve species distribution models (SDMs) for various forest taxa in Switzerland. We included vascular plants, bryophytes, fungi, and lichens. We seek to identify key soil predictors enhancing SDM accuracy and assessing variability across species using both National Forest Inventory and InfoSpecies occurrence data. We evaluated topo-climatic SDM performance with and without soil predictor variables across the whole Swiss forests, testing varying levels of soil data quality and resolution. We found that digitally mapped soil properties at high-resolution enhance the SDM predictive power. Furthermore, the inclusion of soil is more relevant for species with specific soil preferences. Our results improve the understanding of soil properties’ role in shaping forest taxa distribution, emphasizing the relevance of accurate soil predictors in modelling, with the aim to better inform forest management under environmental change.

DISENTANGLING OBSERVATION BIASES FOR SPECIES DISTRIBUTION MODELING

Oral Presentation

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The growing use of citizen applications to observe species is considerably expanding biodiversity databases. These opportunistic observations, known as presence-only data, are particularly useful for species distribution modeling (SDM) in a wide range of applications, such as biodiversity conservation, especially for deep learning based SDMs, aiming for predictions at large extent and high resolution. However, presence-only data entail severe sampling biases in any species distribution analyses, due to uneven sampling effort across species and geographic locations, stemming from observers’ behaviors. Disentangling these observation biases represents a major challenge towards improving species distribution modeling. Point processes are a useful statistical framework enabling to jointly model most types of biodiversity data, like presence-only, but have never been used with deep SDMs. To solve sampling biases arising in deep SDMs, we designed a simulation setting in order to compare the ability of various point process loss functions for deep SDMs to disentangle complex patterns of sampling biases and species distributions. The simulated point processes, modeling opportunistic and systematic sampling, was defined by virtual species intensity, sampling effort, probability of detection,
and other temporal and observer factors derived from real data. This simulation framework offers a promising opportunity to design appropriate loss functions to disentangle observational biases.

WHAT A CLICHÉ: THE IMPACT OF SPATIAL BIAS ON MODELLING SPECIES DISTRIBUTIONS

Poster Presentation

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Ecological processes are often spatially and temporally structured, potentially leading to autocorrelation either in environmental variables or species distribution data. Because of that, spatially-biased in-situ samples or predictors might affect the outcomes of ecological models used to infer the geographic distribution of species and diversity. There is a vast heterogeneity of methods and approaches to assess and measure spatial bias; this paper aims at addressing the spatial component of data-driven biases in species distribution modelling, and to propose potential solutions to explicitly test and account for them. Our major goal is not to propose methods to remove spatial bias from the modelling procedure, which would be impossible without proper knowledge of all the processes generating it, but rather to propose alternatives to explore and handle it. In particular, we propose and describe three main strategies that may provide a fair account of spatial bias, namely: (i) how to represent spatial bias; (ii) how to simulate null models based on virtual species for testing biogeographical and species distribution hypotheses; and (iii) how to make use of spatial bias - in particular related to sampling effort - as a leverage instead of a hindrance in species distribution modelling. We link these strategies with good practice in accounting for spatial bias in species distribution modelling.

CARNIVORES OF ARABIA: CONSERVATION CHALLENGES AND OPPORTUNITIES

Oral Presentation

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Carnivores, including canids and felids, are key species for conservation efforts worldwide, with particular emphasis on the Arabian Peninsula. However, over the past century, these species have undergone a significant population decline, exemplified by the Arabian Leopard, where only approximately 100 individuals remain in the wild. To assess the potential impact
of projected climate change in the future (2050 & 2070) on carnivore species in the Arabian Peninsula, we employed Species Distribution Models (SDMs). Subsequently, we utilized systematic conservation prioritization to identify optimal sites for reintroduction. Our modeling results indicate that the areas with the highest potential for successful reintroduction are situated in montane habitats along the Red Sea mountains and Sinai region. Conversely, the model predicts a substantial shrinkage (50%) in distribution ranges by 2050. Notably, both the Sand Cat and Arabian Wolf exhibit greater resilience to climate change, with projections predicted an expansion of their ranges in the future. Furthermore, our prioritization model identified three primary sites crucial for conservation actions such as reintroduction, collectively representing approximately 15% of the current distribution. The outcomes of our study furnish conservation managers with essential information for safeguarding carnivores and strategically prioritizing conservation efforts to mitigate the risk of species extinction.

**SPECIES DISTRIBUTION PREDICTION OPTIMIZATION TO INTEGRATE INTO URBAN PLANNING**

Oral Presentation

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In our urbanized world, cities pose threats and opportunities for global biodiversity. The Kunming-Montreal Global Biodiversity Framework calls for biodiversity-inclusive urban planning to enhance native biodiversity and sustainable urbanization, extending conservation beyond natural areas. However, creating effective biodiversity-inclusive urban landscapes is challenging, as planners often lack the needed biodiversity knowledge. Ecologists possess advanced expertise, such as using species distribution models (SDMs) to inform spatial biodiversity prioritization. Yet, standardizing SDMs for urban spatial prioritization requires a sufficient account of the urban social-cultural and anthropogenic drivers. This process has yet to fully engage built environment professionals, who need assistance incorporating species distribution predictions. Achieving transformative change requires translating knowledge into actionable practice. In this research, utilizing the GBIF platform’s birds and butterflies as indicators in Madrid, we aim to assess the significance of the anthropogenic variables in MaxEnt species distribution predictions, explore balanced parameter selections, and outline measures for integrating improved predictions into the planning cycle. Insights from interviews with the built environmental professionals will enrich the study. The results will demonstrate the potential of evidence-based predictions to guide a collaborative biodiversity-inclusive urban future.
LINKING TRAITS TO SPECIES PREDICTIONS: THE KEY TO PLANT COMMUNITY CONSERVATION!

Oral Presentation

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Modelling species communities while considering both single species distributions and trait diversity offers a holistic view of ecosystems, which is key to assess and plan resilient and functional conservation networks. This approach ensures the preservation of not only individual species but also functionally diverse communities. However, how to model diversity facets like community-trait mean and variance remains unclear. Some prefer modelling species distributions and then construct back community-level trait metrics, while others directly model community-level trait metrics but then ignore species level information. Despite pros and cons, these approaches lacked a systematic comparison but also a proper integration into a unified framework. Here, we first introduce a comparative analysis using extensive plant community data in the French Alps, demonstrating that directly modelling community-level metrics is safer and more effective than species-first modelling. We then present a machine learning model combining species distribution models with predicted or observed community-level trait metrics (potentially through satellite data), optimising objectives for both species and community composition. This methodology holds promise for refining our understanding and predictions of plant communities within a conservation framework. Notably, it will be applied on plant communities across Europe in the NaturaConnect project, facilitating the prioritisation of protected areas.

TOWARDS HIGH SPATIAL RESOLUTION AND DYNAMICS IN SPECIES DISTRIBUTION MODELING

Oral Presentation

C. Botella¹, C. Hui², D. Richardson³, B. Deneu¹, D. Marcos⁴, J. Estopinan¹, M. Servajean⁵, T. Larcher⁴, C. Leblanc⁴, P. Bonnet⁶, A. Joly⁴

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A precise knowledge of the spatial distribution of species and their temporal changes are needed in times of fast global changes, in order to anticipate threats on biodiversity, like biological invasions. Predicting the current composition of communities at a fine spatial scale remains particularly difficult. Plus, we lack a methodology combining observational data and causal
processes to anticipate the non-equilibrium dynamics of species. I will show how combining remote sensing data with massive biodiversity observations in dedicated deep learning models has drastically improved the prediction of community composition at fine spatial scales by producing a compact representation of the environment for the prediction of thousands of species. I’ll illustrate the precision achieved in characterizing plant species communities and habitats at European scale. A more causal perspective is needed to gain insights on future species spatial dynamics under global changes. I proposed a Bayesian dynamic model class able to fit species life-history parameters, as demographic and spread rates, to heterogeneous spatio-temporal observations. I used it to reconstruct the past invasion of Plectranthus barbatus in South Africa, revealing the importance of long-distance dispersal. One may identify why a trajectory emerges and its sensitivity to e.g. climate change scenarios or spread rates. An assessment of its potential to predict future spatial dynamics is underway.

CLIMATE CHANGE DISRUPTS THE ECOLOGICAL NETWORK OF ANATOLIAN BROWN BEARS

Poster Presentation

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Human land use that promotes climate change effects on wildlife leads to increased habitat loss for particularly vulnerable groups such as large carnivores. Population viability requires ecological linkages between their core habitats. The brown bear is the largest carnivore living in Türkiye, one of the countries with the highest bear numbers globally. In the current study, the habitat connectivity and climate change effects on the ecological network of brown bears were examined. We identified bears’ movement paths and prioritized critical areas using a combination of least-cost corridor modeling and circuit theory. We mapped a total of 61 current core habitats and 106 linkages in the country. Our analysis showed that the Black Sea and East Anatolia were the regions with the greatest importance for maintaining of landscape-wide connectivity. Considering the area-corrected centrality score, the importance of small patches connecting the Mediterranean to the Black Sea and Marmara in the west of the country and the patches linking the Eastern Anatolia habitat block increased. Barrier mapping showed substantial barriers to the dispersal of brown bears, especially in central Anatolia. The high-significant areas for restoration were scattered across the central Black Sea, Marmara, and Eastern Anatolia regions. Finally, our findings showed that climate change would have a significant disruptive effect on the ecological network of brown bears across Anatolia.
SPATIAL RESOLUTION IMPACTS PLANT RESPONSES TO CLIMATE CHANGE

Oral Presentation

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Understanding how grain size affects our ability to characterize species responses to ongoing climate change is of crucial importance in the context of an increasing awareness for the substantial difference that exists between coarse spatial resolution macroclimatic data sets and the microclimate actually experienced by organisms. Climate change impacts on biodiversity are expected to peak in mountain areas, wherein the differences between macro and microclimates are precisely the largest. Based on a newly generated fine-scale environmental data for the Canary Islands, we compared species distribution patterns of endemic bryophyte species resulting from previous coarse environmental datasets (~1km resolution) and CanaryClim (100m), with a regard to global warming. We found that although no differences in terms of model performances were found between the two datasets, CanaryClim was able to find future potential refugia for species for which the coarser resolution was predicting an extinction in the future. This highlights the crucial role that fine-resolution climate datasets can play in predicting the potential distribution of microrefugia, and further in conservation planning.

HIERARCHICAL SPECIES DISTRIBUTION MODELS FOR INVASIVE SPECIES

Oral Presentation

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Invasive alien species are one of the five major threats to biodiversity loss and cause $435 billion/year of economic damage worldwide. High mountain regions have remained mostly invasion free, but climate change will facilitate future spread of invasive species. Predicting invasions into mountainous areas is therefore essential. This can be accomplished with Species Distribution Models (SDMs), which are staple devices in conservation planning. We present an SDM method specifically designed to predict invasive mountain species using MaxEnt, a popular algorithm that uses presence-only species data combined with background points.
(BPs). We use a new way of sampling BPs stratified randomly in environmental space that has been demonstrated to yield more accurate SDMs by our own previous scientific findings. In addition, we employ a hierarchical approach to prevent niche truncation. The result is a 25m resolution map of areas most likely to be invaded in Switzerland. Our results highlight those areas that are most at risk of invasions and can be used to guide biodiversity conservation.

COMBINING COMPLEMENTARITY AND CONNECTIVITY IN BIODIVERSITY CONSERVATION DESIGN

Oral Presentation

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The legally protected terrestrial and freshwater area needs to be expanded substantially to achieve international targets in biodiversity conservation. To choose additional protected areas (PAs), habitat type and species composition are important aspects to consider. In addition, protected areas (PAs) should be arranged in a well-connected network, because with rapid environmental change species may lose the ability to thrive in one PA and may have to move to another. Here, we jointly optimize PA network design for complementarity and connectivity on the Swiss plateau. We first define clusters of similar habitats by aggregating TypoCH habitat classes into 36 categories based on pH, elevation, and humidity, to optimize connectivity between ecologically similar environments. For each category, we then use high-resolution habitat suitability maps of character species to separately map conservation value in terms of complementarity and in terms of connectedness to the existing network. The first results show a limited overlap between priority areas for connectivity and complementarity, highlighting that single-focus conservation strategies may not adequately capture the interconnected nature of ecosystems across complex landscapes. In conclusion, our optimization of connectivity between similar habitats may offer a more pertinent strategy than approaches emphasizing connectivity across dissimilar habitats in landscape-level biodiversity conservation.

IDENTIFYING SITES TO COMPLEMENT THE CURRENT NETWORK OF PROTECTED AREAS IN CHILE

Oral Presentation

P. Pliscoff¹
Chile’s environmental institutions are in a period of transformation. Creating a new institution (Biodiversity and Protected Areas Service) in 2023 opens up a series of new challenges for conservation planning. Among them is identifying new areas to complement the current protected area network to meet target 3 of the recent Convention on Biological Diversity framework. Target 3 states that at least 30% of terrestrial areas should be protected, and Chile currently has 23% under protection. Despite being close to meeting the target, there is a spatial imbalance, with more than 80% of the current protection concentrated in the southern part of the country, where the greatest concentration of biodiversity and unique biota is not found. For these reasons, there is an urgent need to identify new areas to complement the current network under the criteria of ecosystem representativeness. To address this challenge, we present the results of applying a methodology for identifying climatic refuges at macro and micro scales, combining elements of relief, climate and species distribution models to prioritise areas that meet the criteria of complementarity, representation and connectivity.

MARINE PLANKTON BIODIVERSITY ESTIMATES FROM MULTIPLE DATA SOURCES AND TYPES

Poster Presentation

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Biodiversity is a fundamental aspect of conservation biology and, although still a subject of debate, is often linked to ecosystem properties such as biomass and resilience. Habitat modelling has played a crucial role in identifying biodiversity hotspots for conservation, primarily relying on traditional observation data in the past decades. Nevertheless, the emergence of new sampling methods, such as ’omics in plankton data collections, has expanded the wealth, development, and accessibility of data in marine ecology. In this study, we explore the consistency of marine biodiversity hotspots estimated from traditional field observations versus those based on emergent sampling methods. Specifically, using a global dataset of phytoplankton and zooplankton distribution from traditional methods and emergent omics observations, we applied an ensemble of marine habitat models to infer a range of global biodiversity metrics. By comparing these metrics across different data types and methodologies, we locate regions of consistently high biodiversity, and explored the drivers and dynamics of such biodiversity hotspots for marine plankton ecosystems. This comprehensive examination of biodiversity metrics, encompassing various data sources and types, opens new perspectives for defining marine biodiversity indicators and conservation priorities. Finally, such biodiversity hotspot estimates, consistent across sampling methods, are key to estimate future changes under climate scenarios.
PLANTAGO LANCEOLATA DISPLAYS SLOWER LIFE CYCLES UNDER LOW HABITAT SUITABILITY

Oral Presentation

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Species Distribution Models (SDMs) predict the probability of occurrence of a species as a function of environmental drivers. SDMs can be used to quantify habitat suitability gradients. What exactly can SDM predicted “suitability” indicate for a species, beyond sheer probability of occurrence? For instance, is variance in suitability associated with population processes such as life history strategies? Using 39 populations of the widespread perennial herb P. lanceolata across its native range, we found that life history strategies consistently shifted towards slower strategies in low suitability areas. In high suitability areas, populations displayed faster life cycles, with more births, but also more deaths of individuals each year. Neither fitness nor population density increased with suitability. Importantly, these findings were reliant on the selection of environmental predictors closely related to the ecology of the species. Perspectives for conservation: in addition to distribution, SDMs can provide information on the state of populations, though not always in an intuitive way. In the IUCN categories and criteria, timeframes during which threats and declines can impact a species’ extinction risk are linked to its generation length. This could imply that populations located in harsh climates not only are less likely to occur; they may also be likely to be affected by threats for longer.

AN IMPROVED FRAMEWORK FOR ASSESSING THE EX-SITU CONSERVATION STATUS OF PLANTS

Oral Presentation

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We present an improved framework to assess the ex-situ conservation status of plant species. Our method improves upon prior work in several ways. We improve the way species distribution models are used to predict species ranges by (1) either further constraining or by expanding the predictions based on observations; (2) assuming alternative relationships between species
range size and genetic diversity; (3) considering the geographic and environmental distance between areas sampled in a single metric; and (5) account for samples with unknown geographic origin. We illustrate our method with crop wild relatives from Africa.

**SPATIO-TEMPORAL SPECIES DISTRIBUTION MODELLING TO ASSESS BIODIVERSITY CHANGE**

Oral Presentation

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Understanding biodiversity patterns and change under climate change is crucial for mitigating the global crisis of biodiversity loss and its conservation. Species distribution models (SDMs) are useful tools for this purpose, but they often neglect temporal variability in species distributions. This study aims to incorporate temporal dimension into SDMs and develop Spatio-temporal SDMs to characterize dynamics and trends of change in biodiversity. To do so, we used temporal species data obtained from GBIF as well as time series of climate data obtained from CHELSA. First, we linked species data to corresponding climate variables over time. We then tested two approaches to incorporate temporal data into SDMs. The first approach is based on pooling temporal data into a single dataset and fitting an integrated model, and the second approach uses a moving window over temporal data to fit a separate SDM for each subset of data corresponding to the moving window. We tested different lengths of moving windows including 5, 10, and 20 years to assess the effect of temporal bias. The Spatio-temporal SDMs were used to predict the time series of species distributions for each year and then calculated the temporal trend of changes at the pixel level. Our results revealed that increasing the length of the moving window can partially decrease the effect of temporal bias in data and effectively quantify the trend of changes in biodiversity that can inform conservation efforts.

**FILTERING SURVEY RECORDS FROM PRESENCE-ONLY DATA CAN IMPROVE THE ACCURACY OF SDM**

Oral Presentation

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The most abundant species distribution data are georeferenced records (Presence-Only - PO data). Using PO data to train Species Distribution Models (SDMs) is challenging because it is biased toward areas where there are more observers. Several methods have been proposed to account for spatial sampling bias in SDMs trained with PO data. However, the success of these methods is conditioned on a proper description of the sampling bias. An overlooked issue when accounting for sampling bias in SDMs is caused by the existence of systematic observations in the PO databases. We hypothesise that occurrences from systematic surveys can interfere with the description of the sampling bias and therefore affect the estimations of the species’ distribution. We used a synthetic study case and Integrated SDMs (ISDMs) to test this hypothesis. We show that filtering non-opportunistic records from the PO data can improve the description of sampling bias variability across space and therefore generate more accurate and precise predictions of species distribution when using ISDMs. Filtering survey records produced parameter estimates closer to the values used to simulate the data for both sampling bias and species distribution parameters, resulting in more accurate estimates of species distribution and population size. We advocate incorporating this data filtering approach not only when using ISDMs but whenever using PO data to train SDMs, particularly if spatial sampling bias is accounted for.

**AI-DRIVEN CONSERVATION: PROTECTING GLOBAL SHARK DIVERSITY WITH CAPTAIN**

Poster Presentation

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With 37% of sharks and rays facing extinction, urgent conservation efforts are essential to preserve these critical apex predators and maintain marine ecosystem balance. We used CAPTAIN (Conservation Area Prioritization Through Artificial INtelligence), an advanced machine learning software, to recommend marine protected areas (MPAs) for over 1000 shark species worldwide. The extinction crisis looms large, with potential consequences including disrupted marine food chains and ecological imbalances. Preserving sharks becomes paramount as they play a fundamental role in the health and stability of marine ecosystems, including the protection of coral reefs and mitigation of climate change impacts. CAPTAIN’s cutting-edge algorithms empower precise and data-driven recommendations for MPAs. Through this approach, we identify key regions requiring protection, with Indonesia and the Caribbean emerging as vital habitats and critical breeding grounds for numerous shark species. Despite challenges in heavily fished areas such as the Mediterranean Sea and China, where establishing traditional MPAs may be economically unfeasible, our study highlights the importance of exploring alternative conservation measures and sustainable fishing practices in these regions. The significance
of this research lies in its potential to inform conservation strategies and policy decisions. AI-driven recommendations offer opportunities to protect sharks and preserve marine biodiversity on a global scale.

**PROJECTING THE EFFECTS OF CLIMATE AND LAND-COVER CHANGE ON SWISS BIODIVERSITY**

Oral Presentation

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Climate and land-use/land-cover (LULC) change projections for Switzerland indicate that the country can expect drier summers, increased precipitation, and more artificial land surfaces. Some potential consequences for biodiversity are shifts and contractions in species’ distributions. Species distribution models that incorporate climate and LULC data are valuable tools for projecting and mapping prospective species distributions under future scenarios of environmental and societal change. Currently, Switzerland lacks comprehensive biodiversity projections that account for the cumulative effects of these changes, posing a challenge for guiding effective conservation efforts. Our study aimed to address this gap by evaluating the potential impacts of climate and LULC change on Switzerland’s biodiversity using a state-of-the-art species distribution modelling approach. We quantified the relationship between the baseline climate and LULC conditions and the spatial distribution of species in all taxonomic groups for which sufficient data were available. We projected future species’ habitat suitability for eight future periods using newly developed climate and LULC projections based on five exploratory and normative scenarios. We evaluated percentage changes in suitable areas, geographical shifts, and presented illustrative maps for main taxonomical groups. Our models and maps offer guidance for spatial planning, pinpointing prospective areas for biodiversity conservation.

**EXPLAINABLE DEEP SPECIES DISTRIBUTION MODELS**

Oral Presentation

*B. Kellenberger*¹, D. Marcos², K. Winner¹, W. Jetz¹

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Species distribution models (SDMs) relate observed species occurrence data to environmental conditions and offer a key avenue for understanding and predicting habitat suitability for and whereabouts of species. Recently, promising results from deep learning-based SDMs have emerged; these models are ideally suited for big data and are capable of modelling arbitrarily complex relationships at high accuracy. Beyond high predictive performance, however, SDMs also should ideally be understandable and have a mechanistic underpinning, i.e., reveal which environmental characteristics (or combination thereof) are responsible for a high or low suitability score for a particular species and location. Unfortunately, deep learning models have long been known as “black boxes” and hard to interpret. Here, we present a means to open up the bonnet of deep learning-based SDMs by resorting to the field of explainable AI. Our approach is based on deep gradients and applicable post-hoc to a wide range of deep learning models with minor adjustments. We apply and test our method on a large dataset of 311 mammal species over North America and show that we are able to reliably estimate importance scores for all covariates that make sense regarding the species’ postulated environmental requirements. In essence, we show that with appropriate modifications, deep learning-based SDMs indeed have the potential to offer insights that have mechanistic relevance, are sound, and understandable.

**FACILITATING EXPERT REVIEW OF SDM PREDICTIONS**

Oral Presentation

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As species distribution models (SDMs) have grown in popularity and importance within the ecology and conservation communities, much attention has been given to how to evaluate the predictive performance of the models. However, quantitative evaluation of SDMs (particularly presence-only SDMs) has proven to be an elusive goal that has limited the adoption of SDMs into conservation and planning. Identifying and diagnosing issues with SDMs generally still requires significant taxonomic or regional expertise and is difficult to achieve from statistical analysis alone. To enable a more efficient expert review of SDMs, we developed a model evaluation platform that enables experts to explore and visualize SDMs and their predictions and provide spatially explicit feedback about both the overall quality of each model and what it gets wrong. In this talk, we will present a case study of our SDM evaluations where taxon experts reviewed roughly 4000 high-resolution presence-only SDMs for terrestrial species in North America. From these results, we will describe a new quantitative model evaluation approach focused on model review prioritization and the methods we developed to incorporate feedback into the SDM pipeline. We show how these techniques and our platform have led
to significant improvements in model quality for many species and how they can inform the safe(r) incorporation of SDMs into conservation decision-making.

EVALUATING SPECIES DISTRIBUTION MODEL THROUGH LATITUDINAL AND GENETIC CLUSTERING

Poster Presentation

S. Ansari\textsuperscript{1}, A. Hancock\textsuperscript{1}, Y. Yarkhunova\textsuperscript{1}

\textsuperscript{1}Max Planck Institute for Plant Breeding Research, Köln, Germany

To predict the effects of climate change on biodiversity, it is important to be able to infer the factors that limit a species’ niche accurately. Correlative Species distribution models (SDMs) statistically correlate the location of the species with its environment and are widely used for predicting the fate of the species. Firstly, we create SDMs for Arabidopsis thaliana, a plant model organism, to check which climate variables affect the distribution of the species. Because of the heterogeneity within the species, we divide the dataset into latitudinal and genetic clusters and use a range of algorithms to assess the model performance. This study aims to contribute to a broader understanding of the distribution of A. thaliana and provide insights that are critical for better predicting the species’ responses to the escalating challenges of climate change.
Sustainable development in the forest-dependent communities: forest role, livelihoods, biodiversity, cultural-spiritual values, and life quality

RELIGIOUS AND CULTURAL VALUES OF BIODIVERSITY CONSERVATION IN NEPAL

Oral Presentation

K.P. Acharya

Conservation Nepal, Kathmandu, Nepal

Nepal, nestled in the Himalayas and predominantly Hindu and Buddhist, represents a unique fusion of spirituality and nature. This paper explores into the religious and spiritual values shaping biodiversity conservation, deeply rooted in the nation’s cultural fabric. These values extend to diverse wildlife and flora. Animals like the revered tiger, symbolizing strength and power, the wise elephant, and sacred monkey, embody divine qualities, transcending their biological significance to become spiritual icons. Animal worship during festivals like Dashain and Tihar, highlight this bond, instilling profound respect for these creatures. This study reveals that over 100 plant species play vital roles in socio-cultural festivals within Hindu Brahmin families. These plants are indispensable for initiating religious ceremonies. Specific species are designated for distinct occasions, varying in frequency from daily to occasional. Among them, the sacred basil plant, Tulsi, is a fixture in every household. Nevertheless, socio-cultural and demographic shifts exert substantial influence over the valuation and usage of these species, impacting taxonomic diversity, vegetation composition, and conservation status. This amalgamation of culture and conservation extends beyond conventions. It cultivates a holistic perspective on the interconnectedness of life, emphasizing the nexus between spirituality and the protection of natural heritage, which is integral to sustainable development.

STINGLESS BEE CONSERVATION EFFORTS IN MALAYSIA

Oral Presentation

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At the core of Malaysia’s conservation effort to stingless bee is community engagement, where tailored educational programs and workshops serve as catalysts for raising awareness within local communities. These initiatives not only educate about the vital role of stingless bees
in pollination but also instill a sense of responsibility, transforming communities into active participants in the conservation journey. This dynamic interaction fosters a sustainable coexistence between humans and stingless bees. In parallel, innovation plays a pivotal role, leveraging modern technologies such as mobile applications integrated into SmartHive technology to disseminate information widely. These tools not only enhance outreach but also establish a wider network of bee enthusiasts and advocates, fostering a collective commitment to the preservation of stingless bee habitats. A standout feature of Malaysia’s conservation initiatives is the systematic cataloging of Indo-Malaya stingless bee species in Borneo and Peninsular Malaysia. Collaboration between scientists, local communities, and conservation organizations ensures a comprehensive and inclusive approach. The cataloging efforts yield invaluable insights into the diversity of stingless bee species, aiding in the identification of endangered populations and the formulation of targeted conservation strategies.

ANCESTRAL PHILOSOPHY ALLI KAWSAY (BUEN VIVIR) IN INDIGENOUS MOVEMENTS COLOMBIA

Oral Presentation

A. Vanessa¹, E. Erazo Acosta²

1University Nariño, Pasto, Colombia, 2Indigenous Independiente Researcher, Pasto, Colombia

The purpose of this research is to present the urgency of listening to indigenous epistemologies of Sumak Kawsay (in kichwa language: Buen vivir—Good Living) and also to accompany the care/defense of the biodiversity-rich indigenous territories of the Andean region. As a research question: How is the anthropocene affecting the indigenous territories and with it the threats of the epistemologies of the Sumak Kawsay/Buen vivir? This ethnographic research has been carried in the last 7 years, in Republics of Colombia and Ecuador, in Indigenous Regional Council of Cauca CRIC, and The Indigenous Confederation of Ecuador CONAIE. Theoretical references: epistemology of indigenous communities, indigenous intellectuals. The anthropocene affects considerably the species of flora and fauna, the glaciers, water reserves, páramos understood as places where the water is born for the species. With it the territories Pan Amazonas region of native communities are strongly affected in their cosmovision to know. Due to its high impact in high mountain areas, climate change affects the melting of glaciers, strong droughts, seasonal changes for food production, water shortages and with this the displacement of animals and indigenous people and with it affects their traditions and cosmovisions due to geographical relocation and spatial - socio-cultural changes.

CONSERVATION WORKS: MODEL FOR CONSERVATION & WELLBEING IN LIBERIA

Poster Presentation
Liberia contains more than 40% of the remaining Upper Guinean Forest Ecosystem, a global biodiversity hotspot. In 2006, the government committed to maintaining at least 30% of its forest through legislation. This is to be achieved without sacrificing economic growth. Conservation Works (CW), a five-year USAID-funded project, contributes to the overall national objective of enhancing economic prosperity through biodiversity conservation. The CW cooperative's objective is defined by five strategic approaches: 1) establish new Protected Areas (PAs) and clarify the laws regarding their creation, 2) reinforce the management of existing and new PAs for long-term support to safeguard from anthropogenic threats such as habitat destruction and bushmeat hunting, 3) foster sustainable alternative livelihoods for the thousands of forest-fringe communities in and around PAs, 4) engage with new international and local tourist markets to generate ecotourism opportunities for the area, and 5) integrate One Health initiatives and concepts into government policies to maximize the benefits of PAs. We demonstrate how CW tackles the complex issues related to sustainable natural resource management or more specifically, forest conservation, community ownership of forest resources and the overarching need to ensure compatibility of rural economic expansion and sustainable utilization of forest resources.

BRAZILIAN SOCIO-BIODIVERSITY PRODUCTS AS A TOOL TO THE STANDING FOREST

Oral Presentation

A.P. Barbosa de Almeida

Brazil has the greatest biodiversity of flora and fauna on the planet, divided into six biomes. The scenario of increasing devastation of these forests makes us question how we can use the natural resources and, at the same time, generate products and profit. However, there are people who have been living with this balance for many years. Traditional communities that inhabit Brazilian biomes are essential actors since their livelihoods and traditional knowledge are aligned with vegetation preservation. This context, added to the growing evidence of the business sector in achieving UN’s 2030 Global Goals, generates an opportunity to create chains where raw materials from Brazilian biomes can become bioproducts offered by companies. Eco+ Foundation supports its clients in the creation of these value chains and, for this complex work, the requirements and criteria of global Fair Trade certifications are used as a basis to assess business chains existing gaps. Examples of this work are two projects at Amazon and Cerrado biomes, where the intermediation carried out by the Eco+ Foundation considers: vegetation monitoring; territory mapping and assessment; local partnerships; and assessment of social impact. The creation of chains like these enables the valorization of local communities for
their traditional knowledge, empowering them to continue their important role, and shows how businesses can benefit and learn from their sustainable practices.

**LIVELIHOOD DEPENDENCE ON MANGROVE ECOSYSTEM: CASE STUDY LAMU COUNTY, KENYA**

Oral Presentation

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Mangrove forests are a crucial resource that offers a wide range of benefits to local and global communities. Unfortunately, these forests are facing mounting pressure and demand, leading to the loss and degradation of their habitats. One example of this is in Lamu County, Kenya, where mangroves are endangered due to port expansion, urbanisation plans and heavy utilisation for local household needs. To make well-informed decisions and carry out effective conservation measures, it is vital to comprehend the importance of ecosystem services for people’s livelihood and well-being. This research aims to achieve three objectives: (i) assess the reliance of livelihoods on mangroves in Lamu, (ii) investigate the factors that affect households dependence on mangroves, and (iii) understand the people’s attitudes towards the future of the mangrove forest in Lamu. A household survey was conducted, involving 606 households in seven locations, and the data was analysed using Chi-square and logistic regression to examine household dependence as a function of socioeconomic attributes. Results show the vital role that natural areas play in supporting livelihoods and that socioeconomic factors have a substantial relationship with resource use. More diverse management measures would be more effective in conserving the forest and ensuring the wellbeing of the coastal communities.

**SUSTAINABLE DEVELOPMENT OF MOUNTAIN ECOSYSTEMS IN THE 2030 AGENDA, SDG 15**

Oral Presentation

*I. J. Diaz-Maroto* ¹

¹University of Santiago de Compostela, Department of Agroforestry Engineering, Lugo, Spain

In the Agenda 2030, the role of mountain ecosystems is distinguished in the category Life on Land (Sustainable Development Goals SDG 15), in which objective is to ensure their conservation including biodiversity to enhance the capacity to provide livelihoods that are essential for sustainable development. Forests are a vital component of mountain ecosystems in a lot of areas of the world. Nearly 15% of mountainous land area is covered by forests,
and mountain forests involve 28% of the world’s forests. On the one hand, native forests give more than a fifth of rural households’ livelihoods. Mountain forests can offer ways out of poverty and life quality if forest products are exploited sustainably. Also, they contribute to human welfare well because of functions such as climate and hydrological services. On the other hand, they have high biodiversity and many of them are protected under different ways of protection. Depending on the degree of involvement of local communities, access to forest resources could be limited and trade-offs between conservation and poverty alleviation could be created. Options to ensure local communities benefit from protected areas include ecotourism, sustainable use of non-timber forest products and zoning to include indigenous and community-only use areas where their cultural-spiritual values are respected. Changes in climate requirements could influence disturbances of forest ecosystems because they are a natural element of ecosystem dynamics.

COMMUNAL FORESTS IBERIAN: ROLE OF COMMUNITIES IN THE BIODIVERSITY CONSERVATION

Poster Presentation

I.J. Diaz-Maroto¹, J.A. Lopes²

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The communal forests of NW Iberian are one of the few forms of Germanic property survived the municipal organization of the 19th century. They are indivisible, inalienable, imprescriptible, and unattachable property, and it belongs exclusively to the neighbours. To reach socioeconomic development in a sustainability framework, natural resources and biodiversity conservation are the key. However, the conflicts between property owners’ hinder efforts to sustainable use. The historic conflicts include aspects linked with use resources, forest borders, forest fires, silvicultural treatments, use of water ways, grazing… Despite discrepancies, there are many common traits between Spain and Portugal that could explain the successes and difficulties in managing conflicts. “Baldios” in Portugal and “Montes Veciñais en Man Común” (MVMC) in Galicia play an essential role in the communities’ economy. Due to forestation, and agriculture decline, this role was lost throughout the 20th century. The restoration of democratic regimes returned the commons to the owner communities. The communal forests occupy about 1 million ha, 400,000 in Portugal, mainly in the northern, and 600,000 in Galicia. They are owned by near 3000 communities in Galicia and 1000 in Portugal. The use is mostly forestry, but several factors have produced an underutilization of its potential. Our aim is to open a discussion on the challenges and potential of the commons to achieve sustainable rural development.
Tapping into alternative knowledge systems to transform biodiversity and conservation management

TRANSFORMING OCEAN DECISION-MAKING THROUGH INTUITIVE INTERSPECIES COMMUNICATION

Oral Presentation

L. Shannon 1, W. Worsthorne 2

1Amethyst Independent Facilitation, Cape Town, South Africa, 2AnimalTalk Africa, Wilderness, South Africa

This contribution aims to provide some initial thoughts around potential linkages between an alternative knowledge system (here intuitive interspecies communication) and natural science, in an effort to achieve transformation in ocean decision-making. Here we report on the planning of a pilot phase being explored in Southern Africa. A set of prospective marine case studies has been identified, with a view to exploring a collaborative initiative in support of ocean biodiversity and conservation. A draft plan for an Ocean “Heart Energy Achieving Real Transformation” initiative will be presented as a basis for establishment of an Ocean Transformation Programme that would align well with current global biodiversity efforts. Taking the process further regionally and globally will require the identification of interested potential researchers and intuitive interspecies communication practitioners. A community of practice is proposed and some initial ideas and examples provided to initiate this exciting and new approach.

MEANINGFUL DIALOGUE ACROSS SPECIES - HOW ANIMAL COMMUNICATORS UNDERSTAND ANIMALS

Oral Presentation

V. Hinz 1, M.J. Barrett 1

1University of Saskatchewan, School of Environment and Sustainability, Saskatoon, Canada

Remote intuitive interspecies communication (RIIC) is the experience of a relational exchange between a human and another animal that is, despite its physical absence, experienced as present and relationally engaged. RIIC as practiced by professional animal communicators (ACs) challenges us to consider animals as agents with the communicative capacity and potential to be involved in participatory nature conservation – even from afar while they may be roaming in the wild. Using descriptive phenomenology, this qualitative study followed a multi-stage data collection and analysis process with experienced, professional ACs as they communicated remotely with other animals. In-depth analysis yielded considerable commonalities across the ACs’ reported RIIC experiences, including how ACs make sense of mental,
emotional, sensory and bodily impressions that they discern to originate from an animal. This sense-making process unveils to ACs an animal’s individual character and agency, and assists them in gaining insight into animals’ needs, experiences, perspectives, and the threats they face. This study’s systematic description of AC’s sense-making processes provides crucial baseline knowledge for understanding existing RIIC applications in human-wildlife conflict situations and wildlife rehabilitation, as well as for designing and evaluating RIIC based participatory conservation models. It also challenges us to rethink the limits of current paradigms in human-animal interactions.

LOCAL LEARNING FOR SUSTAINABLY UTILIZING WILD EDIBLE PLANTS FROM CHHATTISGARH

Poster Presentation

A.K. Bundela 1, P.C. Abhilash1

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The Anthropocene has brought forth numerous sustainability issues, food insecurity being the critical issue, further exacerbated by the pandemic. Constrained access to nutritious food underscores the imperative to diversify the global food system. Consequently, there is a critical need to draw insights from tribal communities closely aligned with nature, particularly in leveraging wild edible plants (WEPs). The study was conducted in selected districts of Chhattisgarh (India) with a substantial tribal population, aiming to meticulously document the diversity of WEPs. Furthermore, understanding consumption patterns, perceptions, and market prevalence to elucidate the multifaceted utility of WEPs. The study cataloged 89 WEPs across 52 families with 47% of them being herbs followed by trees (41%), shrubs (7%), and climbers (2%). Leaves, easily accessible and versatile, constituted the primary consumed part, even for medicinal use. Consumption modes included vegetables (primary), raw, stir-fried, processed, and least commonly boiled. Ethnobotanical indices indicated the bio-cultural association of these species among the tribes of Chhattisgarh. Conservation analysis per IUCN criteria revealed 56% lacking data, 42% least concern, 1% near-threatened, and data-deficient species. This knowledge is pivotal for advancing UN-SDGs and securing local food security, emphasizing the need for sustainable practices and systematic knowledge dissemination.

INTUITIVE INTERSPECIES COMMUNICATION AS A METHOD FOR LAND MANAGEMENT

Oral Presentation

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As climate change and environmental destruction continue to progress at a rapid rate, animals are among those most vulnerable to these changes; yet not only do we seldom seek their counsel in addressing issues that impact them, but we also continue to foster an increasing human-nature divide. As many scholars of transdisciplinary backgrounds have noted, humans must strive for a more profound, relational way of knowing and being, particularly alongside animals and other living beings. Professional animal communicators (ACs) are examples of individuals answering this call. They are presently applying the method of intuitive interspecies communication (IIC) to consult with animals, both domestic and wild, on a range of topics. IIC is defined as “detailed, non-verbal and non-physical communication between humans and other animals using a wide range of intuitive capacities” (Barrett, Hinz, Wijngaarden & Lovrod, 2021). Despite this active consultation with animals, it is still unclear how animal communicators are working with wildlife in different environmental contexts. Using case study methods to document two projects, this research illustrates how ACs are engaging with wildlife in 1) conservation and 2) human-animal conflict. Highlighting the groundbreaking work that ACs are conducting as interspecies translators demonstrates the power of engaging with the wisdom and autonomy of animals.

TREE PERSPECTIVES: APPROACHES AND VOICES FOR BIODIVERSITY STEWARDSHIP

Oral Presentation

S. Abbott 1

1University of Regina, Regina, Canada

The vital need to move “from science to action” for effective support of biodiversity and conservation requires expanding western traditions of knowledge-building and application to include other approaches and participant voices. Centred on trees and intuitive interspecies communication (IIC), this talk advocates for holistic inquiry and engagement that respectfully recognize and collaborate with the relational, intentional and communal lives of ecological non-humans. Trees are agentic beings with intelligence, perception and perspectives who respond to and impact their surroundings. As per Mancuso (2019), trees “are extraordinary beings in every respect [who did] not become the primary source of a planet’s life by chance.” They are “biosocial becomings” (Ingold & Pálsson 2011): life–nonhuman or human–that evolves equally and intrinsically through both biological and social influences. IIC with trees gives trees a participatory seat at the biodiversity research and stewardship table, inviting their direct, experiential place-based knowledge of what human actions are (and are not) needed. IIC practices guide, decenter and open us to communication with nonhumans through deep listening, inner quiet, sensory and intuitive awareness, and discernment—cultivating “subtler sensitivities” for “attunements to other sentiences” (Myers 2017) and resonant with Indigenous ways of knowing within interrelational reality (Cajete 2000; Pierrotti 2011) and “kincentric ecology” (Salmón 2000).
The Earth Metabolome Initiative

OCEAN METABOLOMICS FOR MARINE CHEMICAL ECOLOGY AND DRUG DISCOVERY RESEARCH

Oral Presentation

*D. Tasdemir* ¹

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Oceans harbour a unique and indeed the largest biodiversity. Distinct life forms and genetic resources that thrive in the ocean provide not only food, but also many ecosystem services with high value to humans. Small molecule secondary metabolites (marine natural products) on the one hand mediate complex ecological interactions between the organism and its ecosystem; on the other, they are prolific sources of many life-saving human medicines. However, for many different reasons we know very little portion of ocean metabolome. Our group has been using LC-MS/MS based computational untargeted metabolomics (such as molecular networks) coupled with manual and in silico dereplication methods for identifying the global metabolome (and spatial metabolome) of marine organisms (e.g., invertebrates, seagrasses, seaweeds), as well as their associated microbiota as the very first step of marine chemical ecology and discovery efforts. This presentation will highlight our metabolomics-assisted investigations on few marine holobiont models from temperate and extreme environments to shed light to their functions in the Nature, plus how we explore them further, e.g., in anticancer and antibiotic drug discovery research.

GENOMIC DATA PRODUCTION SYSTEMS TO CATALOGUE AND EXPLORE EUKARYOTIC BIODIVERSITY

Oral Presentation

*R. Waterhouse* ¹

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Biodiversity research is an extremely broad field spanning many different scales - from studying a single species to whole ecosystems or even global patterns. It also encompasses many different taxonomic groups - from charismatic megafauna to the innumerable species of arthropods or other so-called “dark taxa” such as fungi. The unifying theme is the recognition that biodiversity is critical for the health of our planet and human activities are causing unprecedented biodiversity declines that threaten the provision of ecosystem services upon which human society depends. Molecular sequencing technologies are increasingly being employed
to support biodiversity research, a key reason being the power they have in overcoming the
taxonomic biases which are inherent in biodiversity observations made by traditional methods.
Increasingly these molecular sequencing technologies are high throughput, with individual field
experiments generating very high volumes of sequence data, of a variety of types. Molecular
sequencing initiatives are producing reference catalogues of genetic and genomic biodiversity,
which need to be connected to biodiversity research infrastructures that are aggregating knowl-
edge from scientific collections, human-made observations, and the literature. As a community,
we have a responsibility to contribute towards ongoing and future global efforts to understand
biodiversity and help mitigate the effects of human-induced changes that threaten healthy
ecosystems.

MOLECULAR FEATURES OF PUSH-PULL INTERCROPPING SYSTEMS IN
EAST AFRICA

Oral Presentation

J. Lang 1, S.E. Ramos1, L. Reichert1, C. Apel2, M. Smohunova1, M.
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The maize-desmodium push-pull system, which employs Desmodium ssp. as a repellent inter-
crop in combination with an attractive border grass, has been shown to significantly increase
maize yields and reduce insect damage in various African countries. However, the underlying
molecular mechanism is still debated, with some studies suggesting that desmodium volatiles
are the driving factor, while others claim purely physical effects of the intercrop. To better un-
derstand the chemical basis of the push-pull effect, we developed an on-site sample extraction
procedure for mass spectrometry-based metabolite analysis and combined it with a pre-existing
method for volatile capturing. We then performed a large-scale volatile and metabolite field
sampling campaign in Kenya, with simultaneous metabolite sampling campaigns in Uganda,
Rwanda, and Ethiopia for international comparability. All metabolite samples were evaluated
using a rapid screening UHPLC-MS method, which showed an increased abundance of two
ion species across all countries. The ions were then identified to belong to two benzoxazi-
noids, which allows further insights into the chemical functionality involved in the push-pull
effect. Furthermore, multiple plant volatiles could be detected that were previously reported
to influence the behaviour of some of the most damaging insect pests in east Africa.
THE EARTH BIOGENOME PROJECT: PROGRESS ON BIOLOGY’S MOONSHOT

Oral Presentation

H. Lewin

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Earth is in the midst of global biodiversity crisis, with species loss at 100 to 1,000-fold above the background extinction rate. Loss of biodiversity threatens vital ecosystems on which humans depend. In response to this crisis, the Earth BioGenome Project (EBP) was launched in 2018. The EBP aims to sequence, catalog, and characterize the genomes of all of Earth’s named plant, animal, and microbial eukaryotic biodiversity; ~1.8 million species. The ultimate aims of the EBP are to create a foundation for revealing the “rules of life” and delineation of the mechanisms of how biological systems evolve under changing environmental conditions. My lecture will present recent progress made by the EBP and the challenges faced in reaching the project’s goals.
Towards a global assessment of mountain biodiversity

MOUNTAIN AQUACULTURE IN NEPAL

Poster Presentation

N. Pokharel 1, K. Ghimire2

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Mountain and high Hill aquaculture in being practiced in Nepal for raising cold water Native as well as exotic species in highly feasible areas. The farmers in Remote Mountain areas are involved in producing Snow trout called ASALA and exotic Rainbow trout. The raising of indigenous fish species is being popular because of its cultural and social values. The preservation of precious and most preferred tasty native species in Mountain in biodiversity conservation is an existing example. This case study is for identifying the present conditions, prospects, and problems faced. Different participatory rapid appraisal tools such as close observation, focused group discussion, field visits, and fisher’s interviews were used to collect relevant information. The study is based on primary information gathered from skilled practitioners. The fishers in the mountain region are not formally trained, skilled and knowledge is being transferred from their ancestors. The major livelihood option is fishing. On an average they earn (7-11 US$) regularly. Issues of mountain aquaculture and fisheries communities are poorly documented. The commercial scale up of native species, in-situ seed production, hatchery management and marketing approach will the best management option for securing biodiversity conversations in Mountain region. So it is too big to ignore locally practiced environmentally-friendly production approach by mountain people for the sake of biodiversity conservation.

HOW CUSHION PLANT COMMUNITIES STRUCTURE HIGH ALPINE BIODIVERSITY

Poster Presentation

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Mountain biotas are unique by their exceptional diversity and level of endemism. Near their tops lies the alpine-nival elevational zone, were extreme temperature variations, high UV radiations and often limited water availability shape one of the harshest environments where life thrives. One of the key features of these ecosystems are alpine cushion plants, whose dense, mat or dome-shaped morphology buffers against the aforementioned environmental
constraints, not only for the sake of the plants themselves, but also for many other organisms they shelter. Cushion plants are thus keystone species to high alpine ecosystems, creating favourable conditions for other organisms by modifying the climatic and other edaphic constraints in their close environment. While they received attention for their facilitative effect on other plants, the role of cushion plants as ecosystem engineer has been overlooked so far. In order to bridge this knowledge gap, the ecosystems created by more than 200 cushion plants from 10 different species sampled in the western Alps were studied by means of environmental DNA and physical measurements on their soils. We thus unveil the way cushion plant traits modify environmental conditions, and how they shape unique communities of organisms. We also shed light on the importance of the local diversity of engineer species as they promote a rich biodiversity in high mountain environments.

DEVELOPING A KNOWLEDGE BASE FOR A GLOBAL ASSESSMENT OF MOUNTAIN BIODIVERSITY

Oral Presentation

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Knowledge and data about mountain biodiversity are steadily increasing. However, no assessment exists yet that taps into this wealth of information to comprehensively report on the status of and trends in mountain biodiversity and in mountain biodiversity research. This is the case even though such an assessment represents the baseline required for formulating mountain-specific targets within the Kunming-Montreal Global Biodiversity Framework and other local to international agendas. The Global Mountain Biodiversity Assessment has the ambition to close this gap with a dual assessment of mountain biodiversity research and of current trends in mountain biodiversity. Methodologically, the former consists in a systematic mapping study with the aim to achieve an overview of mountain biodiversity research and identify research trends and gaps. The latter, in turn, consists in a systematic literature review, with a focus on gathering and synthesising evidence that can be corroborated and evaluated based on the analysis of actual data. Here we present ongoing efforts to develop the mountain biodiversity data and knowledge base that will serve as an input to the assessment. These efforts include the establishment of automatized workstreams to mine global databases, the compilation of spatial and thematic keyword libraries based on discipline-specific vocabularies, thesauri and ontologies, as well as the establishment of expert review processes for validation purposes.
MOLECULES TO MODELS: EFFECTS OF GLACIER RETREAT ON MOUNTAIN RIVER ECOSYSTEMS

Oral Presentation

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Mountain regions are warming rapidly and their unique ecosystems are particularly vulnerable to climate change as geographical distances between mountain ranges largely restrict opportunities for poleward species shifts. Cold-adapted species such as those living in glacier-fed rivers are therefore expected to migrate to higher altitude, but understanding of how ecosystem biodiversity and functioning will respond remains limited. This talk will present results of recent studies in which we have adopted novel techniques for data acquisition and analysis across large-scales, to enhance understanding of how mountain river ecosystems can be expected to change as glaciers recede further. Specifically, it will present results of: (1) a field study spanning six countries/four continents in which we uncovered links between fungal genes, populations and communities, and carbon cycle functions in mountain rivers; (2) model simulations of future river invertebrate biodiversity across the alpine zone of the entire European Alps, at decadal intervals from 2020 to 2100. Together these studies illustrate how ongoing global decreases in glacier cover can be expected to change river biodiversity significantly, with knock-on effects for ecosystem functions such as carbon cycling. However, we unexpectedly find the potential for species refuge areas to persist in some areas, suggesting the need for significant changes in protected area management.

HIMALAYAN RIVER BIODIVERSITY: LONG-TERM CHANGES VERSUS SEASONAL VARIABILITY

Oral Presentation

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The effects of climate change are particularly prominent at high altitudes. Alpine streams experience increasing water- and air temperatures, changes in water sources and hydro-dynamics due to shrinking glaciers, mobilized dissolved organic matter and changes in catchment vegetation. Due to natural spatio-temporal variability, long study periods are needed to detect effects of these changes, but time series or historic ecological data are rare, in particular from low latitude mountain systems. Here we report 30 yr long-term changes compared to short-term seasonal variation in diversity and community composition of algae and macroinvertebrates.
in 12 Himalayan streams along the Langtang Valley in Nepal. The study sites covered an altitudinal gradient from 1600 and 4000 m asl and large differences in stream and catchment properties. Richness of invertebrates decreased equally with altitude in 1992 and 2022, but was higher at most sites in 2022, with several new groups appearing. Seasonal differences in richness were less pronounced. Yet, in terms of community composition, seasonal variability exceeded that of long-term shifts. Further analyses of long-term shifts in richness and community composition at specific sites in relation to stream characteristics and changes in catchment properties over the 30 yr period will contribute to our understanding of how different mountain stream types respond to long-term catchment changes.

A COMPREHENSIVE WORKFLOW FOR A GLOBAL ALPINE BIODIVERSITY INVENTORY

Oral Presentation


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Mountains, and alpine ecosystems in particular, are global hotspots of biodiversity. However, the patterns of biodiversity in alpine areas vary markedly from one mountain region to another, shaped by the evolutionary dynamics and distinct biogeographic histories of each mountain range. Despite its importance, the understanding of these biodiversity patterns is hampered by the scarcity of comprehensive data on alpine species. While global datasets often concentrate on certain taxonomic groups and lack details about species’ elevation ranges or alpine status, regional datasets provide in-depth information but are limited to specific areas and often come in varying data formats. This leads to a significant gap in a unified, open-access and truly global inventory that encompasses various taxonomic groups occurring in alpine environments. To bridge this gap, we introduce a new, R-based workflow resulting in a Global Alpine Biodiversity Dataset, including data on flora, mammals, birds, and reptiles. By integrating and standardizing data from both regional and global sources, this workflow identifies species above the treeline in various mountain regions worldwide. This comprehensive inventory of alpine species will enhance our understanding of biodiversity patterns in mountainous areas and provide a tool for analyzing the factors influencing these patterns.
GLOBAL MOUNTAIN RESEARCH INITIATIVES - MIREN & GLORIA - MEET UP AT TREELINE

Oral Presentation

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We summarize and synthesize emerging insights from MIREN and GLORIA, including additional analyses on species reshuffling around the treeline ecotone. MIREN: Climate change threatens plant diversity in mountains worldwide. Evidence suggests that plant species respond by changing their elevational ranges. The Mountain Invasion Research Network (MIREN) systematically quantifies global patterns of native and non-native species distributions along elevation gradients and shifts arising from interactive effects of climate change and human disturbance. (Haider S et al. 2022). GLORIA: Global evidence suggests that species from lower elevations are colonizing habitats on mountain summits at an accelerating pace, with five times faster rates than half a century ago. Repeated in situ surveys in permanent plots showed a widespread transformation of alpine plant community assemblages toward more warmth-demanding and/or less cold-adapted species. Concurrently to widespread increases in overall species richness, high-elevation plant species have declined in abundance and frequency. Strongly cold-adapted plant species may directly suffer from warmer and longer growing seasons. (Pauli & Hallo 2019). We suggest the treeline ecotone to be the critical observational zone for species reshuffling in mountain environments. Although MIREN and GLORIA permanent plots do not match in location, they jointly provide clues on changing alpine plant community dynamics.

HABITAT MONITORING IN AN ALPINE NATIONAL PARK USING MULTI-SOURCE REMOTE SENSING

Poster Presentation

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Biodiversity is globally at risk due to environmental and anthropogenic changes. Habitats are important indicators of biodiversity and closely linked to the occurrence of species and species communities, while detailed habitat information can serve as sensitive proxy for biodiversity state and dynamics. The Swiss National Park (SNP) in the Engadine was established in 1914, encompasses around 170 km² and is subject to strict process protection (IUCN category Ia). Automated, replicable, and cost-effective analyses of habitat-relevant parameters are needed to study and monitor habitat changes in the entire SNP and its surroundings. We provide a framework for habitat monitoring in the SNP using multi-sensor remote sensing including optical, LiDAR, and SAR to characterize the complex habitats of the SNP and document their changes over time. At the outset, we will focus on the analysis of multi-temporal airborne imaging spectroscopy data whereby an extension of the spatial scope beyond the regional scale is assessed regarding newly emerging spaceborne sensors. The proposed framework provides the opportunity to quantify habitat changes related to rewilding and climate, including natural disturbances and treeline shifts in a setting of minimal human influence, and enriches insights on biodiversity dynamics in such environments.

LEARNING MORE FROM CITIZEN-SCIENCE DATA ON PLANT BIODIVERSITY

Oral Presentation

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In the era of big data, the key challenge for scientific advancement lies in efficiently extracting essential information. We demonstrate that using deep neural networks (DNNs) for multispecies distribution modeling substantially improves inference from ubiquitous citizen-science data. Based on 6.7 million observations, we conducted a joint analysis of the distribution of 2477 plant species and species aggregates in Switzerland, using an ensemble of DNNs, each designed with a distinct cost function. This ensemble outperformed traditional methods in predicting species distributions and, more notably, the composition of plant communities. The approach also enabled the exploration of lesser-known ecological aspects: by factoring in the seasonal variation of observation probabilities, we could estimate flowering phenology; by adjusting predictions to reflect plant cover-abundance we could map dominant tree species nationwide; and by projecting DNNs to future scenarios we could not only estimate changes in observation probability but also in flowering phenology and potential dominance. The effectiveness and adaptability of multispecies DNNs make them a powerful tool for enhancing our understanding of plant distributions and other well-sampled taxa.
A MONITORING SCHEME IN AN ALPINE REGION: BIODIVERSITY MONITORING SOUTH TYROL

Oral Presentation

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The need for long-term regional data on biodiversity population trends has grown rapidly in recent decades. This is particularly true for mountain regions considered global hotspots for biodiversity. In 2019 a permanent biodiversity monitoring program was started in South Tyrol, Italy, as an initiative of the local provincial government. The aim of the Biodiversity Monitoring South Tyrol is to survey species groups which are sensitive to climatic and land use changes. The study sites are distributed evenly over the region and include a representative selection of near-natural habitats, such as high-mountain grasslands, alpine brooks and forests, as well as habitats which have been strongly influenced by humans, such as meadows, vineyards and residential areas. Surveyed groups cover vascular plants, bryophytes, birds, bats and insect groups, such as grasshoppers and butterflies. For the aquatic part of the monitoring, a total of 120 individual areas of running water are being surveyed for water insect larvae. In addition, data on abiotic factors as well as on the surrounding landscape is also being collected. In 2023 the first monitoring period of the terrestrial part was concluded. From 2024 onwards the surveys will be repeated at the same sites. The presentation gives an overview of the project and reveals the findings of the project’s first five years, presenting also the scientific output to date.

ASSESSING THE DYNAMICS OF VEGETATION AT THE ALPINE ECOTONE

Oral Presentation

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As global warming intensifies, mountainous vegetation, particularly above the treeline (i.e., ecotone), is responding rapidly. Continuous monitoring of vegetation within the ecotone is essential for gaining insights into climate change. In this study, we utilized Sentinel-2 data with a 10m resolution to identify the upper elevational limits of treelines and vegetation lines globally, thereby delineating the boundaries of high-mountain ecotones. Building upon this foundation, we conducted a long-term, dynamic monitoring of vegetation within the ecotone, utilizing approximately 40 years of Landsat data. Our mapping of tree and vegetation lines
aligns with established distributions, revealing the highest elevations on the Tibetan Plateau and a gradual decrease towards higher latitudes. Dynamic analysis of vegetation within the ecotone underscores a significant greening trend in high-mountain ecosystems worldwide in response to climate warming. This research establishes a comprehensive framework for monitoring tree and vegetation lines in global high-mountain areas, providing a baseline for assessing vegetation long-term changes in high-mountains in response to climate change.

**BIODIVERSITY IN MOUNTAIN SOILS ABOVE THE TRELINELINE: WHAT WE KNOW SO FAR**

Oral Presentation


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Mountain soils fulfil crucial ecosystem functions, also for the surrounding lowland, but little is known about their soil biota diversity. The working group “Mountain Soil Biodiversity” of the GMBA aims to evaluate its current state of knowledge and identify future research needs. We performed a literature research to collate of available papers focusing on biodiversity in mountain soils above the treeline for cryptogams, microorganisms, and fauna. We assessed the paper densities of eleven alpine regions, and allocated the taxonomic groups within them. Further, we describe what shapes diversity distribution patterns. Alpine soil biodiversity studies are available mainly for Central Asia and Southern & Central Europe (261 and 232 papers, respectively), followed by Northern Europe (71). Therefore, many alpine regions remain widely understudied (e.g. the Andes (26) and the Caucasus (17)). Biodiversity was still high at high elevation, with many specialist taxa that have developed adaptations (e.g. omnivory, life under snow) to cope with the extreme environment. Knowledge on alpine soil biodiversity is still sparse, especially outside Europe and Central Asia. Therefore, we bring more attention to these sensitive habitats, as they are currently threatened by climate and land-use change, but are a relevant livelihood for many people. Our review opens research questions and gives recommendations for policymakers to better understand and preserve alpine soil biodiversity.
MONITORING MOUNTAIN BIODIVERSITY ACROSS BIOME BOUNDARIES UNDER CLIMATE CHANGE

Oral Presentation

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Mountains contain sharp climatic gradients and climate-related biome transitions which make them sensitive to climate change and related changes in species distributions and biodiversity. We review the lessons learned in a large subcontinental field-monitoring study across mountains in four states in the Northeastern U.S. designed to detect early stages of climate-induced species migrations and to investigate climate controls on mountain biodiversity. We surveyed forest plant communities spanning montane temperate (deciduous) to boreal (conifer) forest transition on 12 mountains using 2,580 plots in total (each 1×1 m). We also characterized forest structure, microclimate, soil properties, and tree root colonization by mycorrhizal fungi. We found that tree seedling distributions showed the early stages of upslope migration for boreal conifers (particularly in canopy gaps) but not for temperate deciduous species (regardless of canopy environment). Greater canopy tree mortality in high elevations supported conifer seedling upslope shifts. Tree seedling distributions were related primarily to climate, and secondarily to soil conditions. Diverse tree seedling communities were associated with high diversity of other understory plants, while tree seedlings formed complex interaction networks with other plants and fungi that varied with elevation, suggesting that the entire forest biodiversity needs to be considered when predicting climate effects on mountain ecosystems.

DOCUMENTING ELEVATOR TO EXTINCTION IN AN IMPERILED AFROTROPICAL ALPINE HOTSPOT

Oral Presentation

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Alpine ecosystems in the Afrotropical realm occur in disjunct and fragmented ranges in eastern and southern Africa, totaling only 16,500 km² in extent. They have been classified as “nature imperiled” due to their high level of biodiversity, endemism and extreme vulnerability to climate change and other anthropogenic threats. Most alpine areas are both unprotected and poorly explored biologically. We show how a combination of ecotourism-based citizen science and rapid “BioBlitz” surveys guided by broad specialist knowledge can provide a robust
baseline assessment of biodiversity in one such alpine hotspot bordering Lesotho and South Africa, the Witsieshoek Community Conservation Area. We documented 930 plant and animal species in ten diverse plant and animal taxa along an elevation gradient from 1760 to 3100m and demonstrated the uniqueness of alpine compared to subalpine ecosystems, providing a baseline for future monitoring and assessment. Taxonomic experts and students from ten institutions in three countries participated in six BioBlitz surveys between October 2021 and November 2023. Validated GBIF records provided accurate checklists complementing biodiversity survey data from this project. We advocate an integrated approach for future surveys of mountain biodiversity hotspots, drawing on collaboration across disciplines between museums, herbaria, academic institutions, ecotourism facilities, citizen scientists, traditional and conservation authorities.
Tropical forest patches: spatio-temporal dynamics, sustainable use and conservation

QUANTIFYING 22 YEARS OF ANNUAL CHANGE IN VERY SMALL WEST AFRICAN FOREST PATCHES

Poster Presentation

V. Wingate, G. Curatola Fernandez, C. Ifejika Speranza

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Tropical forests are a fundamental component of the Earth System. In West Africa, tropical forests are being lost to deforestation; the remnant forest patches provide a wealth of ecosystem services including biodiversity, habitat connectivity, yet they are still to be mapped and their dynamics and ecosystem services quantified. Small forest patches are disproportionately impacted by deforestation and fragmentation; such patches present a high probability of disappearing and therefore constitute an important research and conservation priority. Very small forest patches (0.5 – 100 ha) in West Africa have not been widely mapped or catalogued before; hence, this study maps and quantifies their annual forest change for the period 2000-2022, to understand how they are changing. We use the Global Forest Watch tree cover dataset and an object-based method to measure the amount of forest change for individual forest patches outside of protected areas and examined the rate and trend of change. We found that forest patches lying outside of protected areas are present extensively throughout West Africa and identified that the smallest primary forest patches are losing on average almost half of their area and exhibit a significant positive trend in the rate of forest loss. Our results show that forest loss impacts particularly very small forest patches, is taking place at an increasing rate, and was particularly pronounced during the period 2020-2021.

SIMULATING SELECTIVE LOGGING WITH A FLEXIBLE TRAIT-BASED DGVM

Poster Presentation

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Selective logging of commercially valuable trees is widespread in the Amazon rainforest. The practise causes a significant amount of emissions, degrades forests and can be the first step on the pathway to complete deforestation. We analyse the short- and long-term effects of selective logging utilising a newly implemented logging module in the flexible trait-based Dynamic Global Vegetation Model LPJmL-FIT. Selective logging operations are simulated based
on a user-defined wood density range and a stem diameter felling threshold. Logging-induced damage to surrounding trees is considered to increase mortality in selectively logged forest patches. The model was validated with field data from forest disturbance experiments (Para-cou, Tapajós). Different logging intensities were simulated to assess biomass recovery, changes in forest structural composition (age, height), and shifts in functional traits. Forest structure shifted towards a younger and smaller tree community, and biomass recovery was delayed when logging was intense and occurred repeatedly. The newly developed module will allow us to model the impact of climate change on the recovery time of selectively logged forests in the tropical rainforests of the Amazon basin.

FOREST FRAGMENTATION IMPACTS STRUCTURAL COMPLEXITY IN TROPICAL FOREST PATCHES

Oral Presentation

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Tropical forests are cleared worldwide at a high rate. Deforestation largely results in forest fragmentation, leading to ever more and smaller remaining forest patches. These forest patches are often isolated and vulnerable to edge effects and further anthropogenic disturbances, such as logging or fires. The stand structural complexity index (SSCI) is a proven and fast-to-measure proxy for the integrity of a forest, including ecosystem services such as biodiversity, biomass, and local climate regulation. Reduced SSCI leads to several positive feedback loops. For instance, if SSCI and forest canopy cover is reduced, more sunlight and heat penetrate the forest, which influences the vegetation dynamics at the cost of specialized species. Fewer species occupying less spatio-ecological niches lead to reduced resource use efficiency and less structural complexity. We use a terrestrial laser scanner (TLS) to quantify the spatial patterns of structural complexity in forest fragments in West Africa. We show that SSCI increases with distance to the edge. This effect is pronounced in fragmented forest patches. Also, several forest patches are below their potential structural complexity, modeled by Ehbrecht et al. (2021). In view of the continuing forest fragmentation, it is crucial to provide precise ecological data. The SSCI is ideal to quantify the ecological integrity of forest patches and it may help inform where restoration is mostly needed to secure linked ecosystem services.

CURBING ILLEGAL LOGGING PATTERNS USING SOUND-BASED DETECTION TECHNIQUES

Poster Presentation

H. Muchiri1, A. Mwangi2, A. Jedditschka3, F. Gu4, C. Zemp 5, S. Ayankoso4, J. Chepng`eno1, J. Devitt4, S. Kahoro1, D. Kerre1, Z. Muti1, S. Mwongela1, C.
Illegal logging plagues community forests in Kenya, affecting the amount of carbon sequestration and the livelihoods of communities that directly depend on these forests, by straining resources for their household economies. The proposed solution involves deploying Internet of Thing devices that detect sound signals produced by chainsaw and axe, which are popular tools for logging. In case of a positive result, a drone is sent to the site of illicit logging and images are captured for further analysis. The validity of this solution will be certified by measurement and analysis of carbon stocks before, during, and after the period of implementation. This guides in establishing the rate of illegal logging and its contribution to climate variability and change. This study aims to justify a data-driven approach in forest management, where results of data analyses guide decision making processes for climate mitigation and adaptation. The research proposes to publish datasets on environmental sounds, sounds produced by axe and chainsaw, and spatial carbon maps that seek to address current research gaps in sound classification and carbon analysis respectively. Community Forest Associations within these forest-dependent communities are set to directly benefit, by relieving them from active monitoring for illegal logging activities. During deployment, women and youth-led groups will be prioritised to enhance inclusivity in forest management and climate action.

RECONCILING STAKEHOLDER PERSPECTIVES WITH SPATIOTEMPORAL DYNAMICS OF FORESTS

Oral Presentation

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West African tropical forests face growing threats from deforestation and forest degradation, driven by a complex set of social, economic, and political factors. While several studies have explored forest change dynamics, little is known about how stakeholders’ perceptions of this change relate to the spatiotemporal dynamics derived from remote sensing. This knowledge gap limits the design of effective forest conservation policies that consider stakeholder perspectives. To address this, we interviewed diverse stakeholders and examined relationships between their multi-scale narratives of forest change and quantitatively analysed dynamics from remote sensing data. We show where land users’ perceived changes match the spatiotemporal patterns identified from remote sensing data analysis and where they differ. Some changes were more prominent in the narratives, while others were clearer from the remote sensing analysis. We
discuss how such integrated analysis could enable a more holistic understanding of forest trajectories and their potential to build trust, tune policies to on-the-ground realities, maximize compliance and deliver more durable conservation outcomes for these imperilled forests and the dependent livelihoods.

UNDERSTANDING THE SURVIVAL OF FOREST TREES FROM A LANDSCAPE PERSPECTIVE

Poster Presentation

G.A. Agonvonon 1, C. Ifejika Speranza 1

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Effective management of conservation areas, particularly forest ecosystems, has become a critical policy to mitigate the global biodiversity crisis. Trees are key component of forest ecosystems, sustaining diverse plant and animal life as well as human livelihoods. However, various disturbances pose a significant threat to their survival. While several studies have examined the impact of disturbances on individual tree populations, few have investigated their effects on tree communities, especially in community-managed tropical forests that have been fragmented into isolated forest patches. This study employs case studies from eight forest patches across diverse bioclimatic zones in West Africa to explore the relationship between the survival of tree communities and various landscape attributes, encompassing both social and physical aspects. It demonstrates the correlation between landscape attributes, forest disturbances (e.g. wildfires and selective logging), and the sustainable management of tree communities in community-managed tropical forest patches. By understanding the social-ecological factors that influence the functionality of tree communities within forest patches, this research endeavours to inform strategies for their sustainable management, significantly contributing to biodiversity conservation and supporting human livelihoods. Keywords: tree, community, forest, landscape, disturbance, conservation

WHAT FUTURE FOR FOREST PATCHES, MITIGATION, BIODIVERSITY AND LIVELIHOODS?

Oral Presentation

D. Ellison 1

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Greater than 70% of Parties to the UNFCCC’s 2015 Paris Agreement include forests in their Nationally Determined Contributions. Much of this effort is focused on large-scale forest restoration and afforestation projects. But a principal restoration success story in much of West Africa is linked to comparatively smaller-scale efforts. Among these, farmer managed
natural regeneration (FMNR) is frequently considered one of the more successful tools for small scale forest landscape restoration. Thus, that the potential role of forest fragments has not been more thoroughly considered in climate policy frameworks is surprising. Forest patches pepper much of the West African landscape. Yet, little literature considers their role as sources of future carbon sequestration, or their ecosystem service and provisioning benefits. Fragmented forest patches remain important for sustaining livelihoods and communities. But, forest patches are more vulnerable and likely to succumb to demands for land use conversion. Generally not part of any larger framework (e.g., protected areas), such patches are comparatively unregulated (lacking legal or conservation status), and are more likely to suffer degradation. Due to their socio-economic importance, and the role they could play in climate policy, forest patches are of increasing interest to communities facing global and climate pressures related to population growth, rising demand for agricultural products, illegal logging and fuelwood use.

VIDEO DOCUMENTATION FROM FIELD RESEARCH IN FOREST PATCHES OF WEST AFRICA

Poster Presentation

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Fieldwork is a critical component that can determine the success or failure of social-ecological research. We use the medium of a documentary video to illustrate aspects of a six-month field research conducted on nine forest patches in agricultural landscapes of Togo, Benin, Nigeria, and Cameroon. We show qualitative and quantitative methods of data collection, how we worked with local stakeholders and collected ecological data in partly sacred forests. The 15min-video shows practical challenges from the field and how to overcome them, when research objectives are to be achieved under constraining conditions.

FOREST PATCHES DYNAMICS IN WEST AFRICA: SPATIAL DRIVERS AND FUTURE SCENARIOS

Poster Presentation

G. Curatola Fernández 1, V. Wingate1, C. Ifejika Speranza1

1University of Bern, Bern, Switzerland

Fragments of tropical forests in West Africa are disappearing, disrupting essential habitat connections, and leaving agricultural areas deprived of critical ecosystem services. To gain knowledge on the causes of forest fragment loss and persistence, it is necessary to reveal the
spatial patterns and the drivers behind forest fragment change. This would contribute to improving forest management and forest protection strategies. We will apply a land change modelling approach based on an inventory of forest patches for West Africa and different explanatory spatial variables, such as precipitation and temperature anomalies, topography, population density, distance to key spatial features, and fragments connectivity. The results will allow us to unravel the patterns and drivers of changes in the area and the number of forest fragments. Moreover, they will help us to predict different scenarios of change in forest fragments, shedding light on which areas are most likely to change and which to persist.

COMMUNITY-BASED BIODIVERSITY MONITORING IN THE COLOMBIAN PACIFIC

Poster Presentation

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The Chocó Biogeographic Region is one of the most biodiverse areas of Colombia, harbouring many endemic species. Unfortunately, extractive industries and illicit crops are driving local ecosystem change, threatening the little-known fauna from the region. Consequently, we aimed to 1) characterize the species richness of mammals and flightless birds; 2) investigate the impact of human activities on wildlife presence, and 3) integrate the local community. We collected data between December 2021 and July 2022 in 5 REDD+ projects located in 3 departments of Colombia. We adopted a community-based biodiversity monitoring approach, involving 13 local communities. We deployed 25 camera traps in each REDD+ project and sampled at least 60 days. We placed the cameras following a grid or randomly, keeping at least 1km between sampling points. We recorded a total of 28 mammal species and 23 flightless bird species, of which 4 were threatened (EN) and 2 endemics. We found that areas with lower human presence registered the highest camera capture rates. On the contrary, illicit crops registered the lowest activity. Finally, communities could autonomously monitor the fauna from their territories and recognize, value, and disseminate information about it. This facilitated the contribution of local communities to the inter-institutional design of their conservation plans.

MAPPING TROPICAL FOREST LOSS BASED ON IK TO HALT AND REVERSE FOREST DEGRADATION

Oral Presentation

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Every year the world loses enough forest trees to fill Portugal, exacerbating climate change and biodiversity loss, and jeopardizing the livelihoods of indigenous communities. Realizing the importance of protecting the world’s forests and minimizing the risk of deforestation, a number of international agreements including the Glasgow Leaders’ Declaration on Forest and Land Use (2021), and the Kunming-Montreal Global Biodiversity Framework (2022), set out an ambitious goal to halt and reverse forest loss and land degradation by 2030. Although there are several attempts to regenerate forest cover around the world, many of them focus on converting landscapes into large-scale tree plantations rather than natural forests, threatening biodiversity, endangering ecosystem services, and endangering the livelihoods of forest-dependent Indigenous peoples. In this context, based on two case studies from the protected forests in Western Ghats, India we demonstrate how Indigenous Knowledge (IK) can be used to map the changes in tropical forests. Our results show that IK is not only effective for mapping forest types and biodiversity rich areas at the local scale, but can also provide valuable insights into the changing natural ecosystem services and the changes in IK corresponding to forest changes. Therefore, our study highlights the importance of identifying IK at the local scale to achieve the goals of halting and reversing of forest degradation and associated challenges.

GROUND-LED FOREST CARBON MEASUREMENT: COUNTING TREES TO UNDERSTAND THE FOREST

Oral Presentation

T. Franzen

1biodiversityX, Zurich, Switzerland

Traditional methods of measuring basal area in forestry are time-consuming, costly, and require specialized skill. Understanding a forest’s aboveground biomass is crucial for ecosystem assessment, and current applications evolved to carbon credit projects, impact reporting, forestry inventory for private landowners, nature-dependent businesses and governments, wild- fire assessments, and globally harmonized ways of measuring nature targets. The proposed solution innovates on the process of existing forestry science. Starting from Angle Count Sampling methodology, we leverage the tailwinds on remote sensing advancements for high quality canopy height paired with a user-friendly mobile app that empowers all users to conduct ground measurements efficiently without the need for special equipment or experience. In the backend, data is processed deploying AI and Computer Vision, generating biomass and biodiversity insights. This innovation reduces costs, while fostering social inclusion and environmental impact. By simplifying data collection, entry, and analysis, our app streamlines forest mapping efforts, making them more real-time and accessible. biodiversityX aims to lower barriers for biomass measurement, paving the way for breakthroughs in climate-positive decisions and fostering global harmonization in nature measurement.
Understanding the role and destiny of Arctic Biodiversity in a changing world

DO ARCTIC LICHENS ACCLIMATISE OR EXPERIENCE BLEACHING AS A RESPONSE TO WARMING?

Oral Presentation

J. Subrt\textsuperscript{1}, C. Colesie\textsuperscript{1}, K. Newsham\textsuperscript{2}, M. García-Criado\textsuperscript{1}

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Lichens in the Arctic are recognized as extremophiles. However, they also serve as sensitive climatic indicators. Studies have indicated a decline in Arctic lichen abundance due to climate warming and an increase in other plant functional groups. However, most observational studies lack a mechanistic understanding of lichen decline. Moreover, despite their prominent roles in Arctic ecosystems, the extent to which lichens can acclimatise to changing climates over the long term remains poorly understood. My research focuses on investigating the physiological and morphological responses of lichens subjected to experimental warming using the open-top chamber experiment in Ny-Ålesund, Svalbard. This investigation aims to enhance our understanding of the carbon balance of polar lichens under warming conditions and ascertain whether these lichens and their symbionts possess adaptive capabilities or experience physiological degradation. Such degradation may manifest as bleaching, disrupting lichen symbiosis similar to corals, potentially leading to widespread ecosystem collapse. The results indicate that lichens subjected to warming for 10 years physiologically and morphologically deteriorated and did not acclimatise after experiencing warmer conditions. These findings hold significance within the context of the imminent threat posed by climate warming in the Arctic, as well as the potential impact on the biodiversity and ecosystem services provided by lichens.

FACE-IT: DEVELOPING ADAPTIVE CO-MANAGEMENT OF ARCTIC FJORDS IN TRANSITION

Poster Presentation

K. Bischof\textsuperscript{1}, J. Lebel\textsuperscript{2}, S. Jungblut\textsuperscript{1}

\textsuperscript{1}University of Bremen, Marine Botany, Bremen, Germany, \textsuperscript{2}Nordland Research Institute, Svolvaer, Norway

Arctic ice is melting, turning sea-terminated into land-terminated glaciers. This rapid loss of cryosphere is accompanied by biodiversity changes, with likely far-reaching effects on ecosystem functioning in Arctic fjords and related human activities. FACE-IT is an EU-funded Horizon 2020 project, aiming to enable adaptive co-management of social-ecological fjord systems in the
Arctic in the face of rapid biodiversity changes and its consequences. The concept of FACE-IT rests on a comparison of selected Arctic fjord systems at different stage of cryosphere loss in Greenland, Svalbard and Finnmark, Northern Norway. The underlying two-pronged hypothesis is (1) that the biodiversity of Arctic coastal zones is changing in accordance with the rates of cryosphere changes, and (2) that such biodiversity changes affect local communities, food production, livelihoods, fisheries, tourism and other ecosystem services. FACE-IT includes the participation of Arctic stakeholders to ensure that Indigenous and local knowledge, perceptions, and concerns about ongoing changes are taken into account in defining innovative and adaptive co-management approaches towards a more sustainable future. In this way, FACE-IT will deliver significant contributions towards the implementation of the new integrated EU policy for the Arctic as well as the EU missions “Adaptation to Climate Change” and “Restoring our Ocean and Waters by 2030”.

MARINE UNDERWATER VEGETATION – A HARBINGER OF ARCTIC CHANGE?

Oral Presentation

K. Bischof¹, S. Niedzwiedz¹

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Seaweeds act as ecosystem engineers on many polar rocky shore coastlines. The underwater light climate and temperature are the main drivers for their vertical and latitudinal distribution. With temperatures rising globally, an Arctic expansion of temperate seaweed species is expected. Glacial melt might result in newly available substratum for settlement, but also in a deteriorating light climate as consequence of increasing terrestrial run off. Combining data from pan-Arctic time-series of seaweed community structure, underwater light climate in response to glacier influence and species eco-physiology sheds light on the fate of Arctic fjord ecosystem functioning modulated by globally and locally acting drivers of environmental change. We observed reduced light intensities and a changed spectral composition in glacial meltwater plumes, potentially resulting in an upward shift of the lower depth limit of seaweeds, counteracting the predicted biomass increase in the Arctic. Furthermore, we studied temperature-related changes in light-use characteristics in different seaweed species. Ultimately, temperature induced changes in seaweed light-use characteristics might lead to shifts in species composition, at the expense of the rather cold-adapted species. We conclude that the deterioration of the underwater light climate in combination with temperature increase may drive substantial changes of the future Arctic underwater forest.

BIODIVERSITY CHANGES OF SEAWEED-ASSOCIATED FAUNA IN KONGSFJORDEN, SVALBARD

Oral Presentation
The marine physical environment of the Arctic is rapidly changing and entails dramatic decreases in sea-ice and a retreat of glaciers. Especially in coastal areas, this ongoing cryosphere loss has profound effects on shallow subtidal habitats and communities, including shifts in distribution of seaweed biomass and species composition along the depth gradient. The objective of this study was to assess whether and, if so, by how much biomass, total abundance, and taxon composition of the seaweed-associated fauna had changed concomitantly. In Kongsfjorden, Svalbard, the seaweed-associated fauna at Hansneset has been sampled at 2.5, 5, 10, and 15 m in 1996/98, 2012/13, and 2021. Taxonomic composition differed considerably between 1996/98 and 2012/13, while it remained similar to the latter in 2021. Taxonomic composition varied also with depth and this effect was independent on year of observation. The fauna biomass increased with depth between 2.5 and 15 m in 1996/98. Contrarily, it decreased with depth in 2012/13. In 2021, peak biomass was found at 5 m depth, while the remaining depths showed similar values of about 30-50% less. Overall, biomass and abundance of the seaweed-associated fauna increased about twofold, on average, between 2012/13 and 2021, returning to 1996/98 values. While mainly cirripeds caused this increase in biomass, the biomass of bryozoans decreased from 2012/13 to 2021.

**FEEDING OF SEA URCHINS ON ARCTIC MACROALGAE ASSEMBLAGES CHANGING WITH DEPTH**

Poster Presentation

*S. Jungblut 1, M. Brand2, S. Dorschner3, W. Hagen3*

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Glacier retreat in the Arctic and the overall shift from sea- to land-terminating glaciers immensely impacts shallow-water benthic communities, especially in fjords. The underwater light climate changes due to increasing sediment loads and a lower rate of iceberg scouring causes less disturbances in shallow areas. In Kongsfjorden, Svalbard, the majority of kelp species (brown algae) is now found at shallow depths around 2.5 and 5 m, whereas the deeper areas around 10 and 15 m are dominated by red algae. We sampled the dominant grazers, the sea
urchins Strongylocentrotus pallidus and S. droebachiensis, from the different depths as well as the dominant macroalgae in summer 2021. Lipid and fatty acid analyses of gonad tissue revealed similarly high total lipid contents of 20-27 % dry mass as well as similar fatty acid profiles for both species from different depths. Thus, the energy-storing capacities and feeding preferences of sea urchins do not vary with depth and hence different macroalgal assemblages. Sea urchins may migrate routinely up and down rocky bottom slopes while foraging, which leads to similar dietary compositions, even if sampled in different macroalgal assemblages. Furthermore, sea urchin metabolism is complex and lipid storage might be independent from the carbon uptake via the polysaccharides stored in macroalgae. Both conclusions illustrate that Arctic sea urchins are relatively independent from the ongoing changes in the depth distributions of macroalgae.

PLANT DIVERSITY DYNAMICS OVER SPACE AND TIME IN A WARMING ARCTIC

Oral Presentation


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The Arctic is warming four times faster than the global average, and plant communities are responding through shifts in species abundance, composition and distribution. However, the direction and magnitude of local plant diversity changes have not been determined at a pan-Arctic scale. Using a compilation of 42,234 records of 490 vascular plant species from 2,174 plots at 45 study areas across the Arctic, we quantified temporal changes in species richness and composition from repeat surveys between 1981 – 2022, and identified the geographic, climatic and biotic drivers of change. Despite plant species richness being greater at lower latitudes and warmer sites, species richness did not change directionally over time. However, 99% of the plots experienced changes in species abundance, with 66% of plots gaining and/or losing species. Species richness increased most where temperatures had warmed most over time. Shrub expansion was associated with greater species losses and decreasing richness. Yet, Arctic plant communities did not become more similar to each other, suggesting that no biotic homogenisation has occurred thus far. Overall, we found that Arctic plots changed in richness and composition in all possible directions, yet climate and biotic interactions emerged as the main drivers of directional change. Our findings show a variety of diversity trends, which could be precursors of future changes in ecosystem function, wildlife habitats and livelihoods for Arctic people.

AREA-BASED CONSERVATION: SAFEGUARDING BIODIVERSITY IN A RAPIDLY CHANGING ARCTIC

Oral Presentation

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Protected areas have long been viewed as a key element for maintaining and conserving Arctic biodiversity. But as the Arctic warms there are questions of whether its protected areas will be able to adapt quickly enough to maintain their functions in the face of swift change. Strategies in protected areas management and conservation must evolve to meet new realities and challenges. The Arctic Council has long recognised that “the Arctic environment
needs to be protected as a basis for sustainable development, prosperity, lifestyles and human well-being” (Kiruna Declaration 2013). In recent years the Arctic Council has released a range of recommendations and products focused on advancing the protection of large areas of ecologically important Arctic habitats, building upon existing and on-going domestic and international processes, and implementing appropriate measures for their conservation. A coordinated circumpolar approach that responds to rapid change, addresses local concerns and links the Arctic in the wider global context is needed to safeguard Arctic biodiversity and the peoples that depend on it. This presentation will showcase Arctic Council activities on protected areas and other area-based conservation measures to track Arctic progress towards the Global Biodiversity Framework Target 3 of 30 per cent of effectively conserved areas by 2030.

**IMPACTS OF GLACIAL RETREAT ON FJORD’S BIODIVERSITY IN GREENLAND**

Oral Presentation

**V. Marques**, E. Van Der Loo, C. Hassler, S. Jaccard, C. Albouy, K. Deiner, L. Pellissier

1ETH Zurich, Zurich, Switzerland, 2UNIL, Lausanne, Switzerland, 3ETH Zurich, Environmental DNA Group, Department of Environmental Systems Science, Zurich, Switzerland

Accelerated global climate changes disproportionately affect Arctic regions, with fjords serving as crucial intersections of the cryosphere, ocean, and land. Fjords play a vital role in connecting rivers and glaciers to ocean waters and supporting local populations through fisheries. They face transformative impacts from rising temperatures, causing increased meltwater flow and the retreat of tidewater glaciers to land-terminating glaciers. Such transformations lead to potential cascading effects on biodiversity, food webs, and fisheries. Yet, the consequences and associated mechanisms of changing biogeochemical fluxes for biodiversity remain poorly understood. Our study, conducted in two contrasting fjord systems in Southwest Greenland, one tidewater and one land-terminating glacier, used environmental DNA (eDNA) metabarcoding to characterize fish and plankton communities. In-situ measurements of abiotic parameters and nutrient content were obtained using CTD and water sampled from Niskin bottles. By correlating biodiversity change with environmental gradients, we aim to understand the impact of rapid fjord ecosystem changes. Additionally, we explored whether higher-trophic level fish communities are constrained by plankton availability. Our study sheds light on the dynamics of Arctic fjord ecosystems, revealing the cascading impact of climate-induced changes on biodiversity and provides insights to forecast the consequences of rising temperatures on ecosystem functioning.
BETA DIVERSITY OF RODENTS AND SHREWS IN THE CENTRAL EUROPEAN TAIGA

Poster Presentation

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We are studying the spatial organization of micromammalian communities in European middle taiga landscapes for 30 years. The study area is between the Vaga and Northern Dvina rivers on the Ustyansky plateau (130-210 m). The structure and composition of the vegetation and animal population are determined by the ecosystems, by abundance of habitats, by history of the biota formation, and by human impact. Indigenous spruce forests remain in remote places far from villages. The dominant habitats of watersheds are: mosaic of different succession stages of spruce forests, caused by large-scale deforestation; raised bogs; and farm lands. In the floodplains of small rivers there are alder and willow communities, and swamps. We study biodiversity in the summer by standard methods – pitfall traps and trap-lines. Alpha diversity in study area is 13 species of rodents and 7 species of insectivores. Background species in the vast majority of taiga watershed habitats are the bank vole Myodes glareolus and the common shrew Sorex araneus. The root vole Alexandromys oeconomicus joins them in floodplain habitats. There is no permanent population on the monoculture fields. M. glareolus and S. araneus are also dominate in communities of the coniferous-small-leaved forest outliers among the fields. These biotopes are also inhabited by species of southern origin – the common vole Microtus arvalis subterraneus, the striped field mouse Apodemus agrarius, and the harvest mouse Micromys minutus.

GLOBAL CHANGE EFFECTS ON THE DIVERSITY-STABILITY RELATIONSHIP IN THE TUNDRA

Oral Presentation

R. Heim¹, V. Zemlianskii¹, K. Ermokhina², A.R. Team³, J. Assmann¹, F. Pennekamp¹, E. Plekhanova¹, G. Schaepman-Strub¹

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The effect of species diversity on temporal stability is a long-standing question in ecology. Understanding the diversity-stability relationship in tundra ecosystems is crucial due to the pronounced global change impacts. Changes to the stability of the tundra vegetation may have knock-on effects on global warming due to permafrost thaw-related release of greenhouse
Empirical research shows that high species diversity is often linked to high temporal stability through several mechanisms (such as the insurance or portfolio effect of biodiversity). Our study aims to answer:

a) Does species richness of tundra vegetation enhance temporal stability in tundra ecosystems?
b) Does the impact of species richness on temporal stability vary among functional groups?
c) How do temperature and precipitation change affect the relationship between species richness and temporal stability?

To answer these questions, we analyzed the relationship between the temporal stability of productivity (measured by the NDVI) and species richness from > 3000 vegetation surveys from the Russian Arctic Vegetation archive. Since cryptogams are abundant and have a critical function in tundra ecosystems, we hypothesize that they will play a crucial role in stabilizing the ecosystem. First results from our analysis show that lichen diversity predicts temporal stability of NDVI and that precipitation and temperature change impact the relationship between moss diversity and temporal stability of NDVI.

**USING REMOTE SENSING DATA IN ARCTIC TUNDRA CONSERVATION PLANNING**

Poster Presentation

*A. Ludwig*¹, *H. Feihauer*¹

¹Leipzig University, Leipzig, Germany

The advancement of forests and the expansion of economic activities associated with global warming will lead to an displacement of the Arctic tundra. The impact of the expansion of the Arctic tree line and economic changes on the loss of the unique tundra biodiversity and ecosystem functions have not been adequately documented. The SQUEEZE project aims to systematically plan a circumpolar, sustainable, and acceptable network of tundra conservation areas. To address potential land-use conflicts and guide management decisions in nature conservation, feedback from stakeholders and rights-holders is considered. Putative protection areas are envisioned to maintain tundra biodiversity and associated ecosystem services, including permafrost protection, to withstand future warming. As part of SQUEEZE, we plan to capture the current dynamics of the Arctic tree line and the biodiversity of tundra regions using circum-arctic Earth observation data with a spatial resolution finer than 50 m x 50 m. Existing operational EO products are insufficient in quality and temporal and spatial coverage. Therefore, we will create new time series for i) the spatio-temporal dynamics of expanding forest cover in tundra areas, ii) the spectral characterization of functional tundra properties, and iii) an analysis of the spatio-temporal patterns of selected aspects. The project will start in January 2024. In the session, we plan to present the concept and discuss the very first, preliminary results.
EDNA AND DRONES ENABLE RAPID ESTIMATES OF PLANT DIVERSITY IN ARCTIC LANDSCAPES

Oral Presentation

**J.J. Assmann** ¹, D.S. Obrist², E. Cox², G. Varliero³, B. Frey³, G. Schaepman-Strub¹

¹University of Zurich, Zurich, Switzerland, ²Polar Knowledge Canada, Cambridge Bay, Canada, ³Swiss Federal Research Institute WSL, Birmensdorf, Switzerland

Climate change and industrial development are changing the Arctic tundra. However, baseline data of plant diversity are missing for many parts of the biome, especially at higher latitudes and for non-vascular plants. These data-gaps limit our understanding of changes in plant diversity and their drivers, as well as the identification of priority locations for conservation efforts. We developed and tested a new protocol for the rapid assessment of tundra plant species richness at the landscape-scale using environmental DNA (eDNA) and drones. We sampled three 300 m x 300 m landscapes in Nunavut, Canada using a combined systematic and random sampling design. For each landscape, we collected botanical observations and soil samples and acquired multispectral drone imagery. We extracted eDNA from the soil samples and carried out metabarcoding using next generation sequencing. We found that detailed botanical observations were needed to detect rare plant species, but eDNA metabarcoding allowed for the fast detection of a large proportion of the plant richness in the landscapes. Using post-hoc subsampling, we optimised the protocol for short time-windows (3-4 hours) such as those found during helicopter and ship-based campaigns in the high Arctic. Our findings demonstrate the potential for eDNA metabarcoding to accelerate plant diversity surveys in the tundra. The simplicity of the soil sampling may also enable citizen and non-expert collections.

HIDDEN DIVERSITY AS THE SOURCE OF BIODIVERSITY AND TRAIT CHANGE IN THE TUNDRA

Oral Presentation

**G. Daskalova**¹, I. Myers-Smith², C. Rixen³, A. Bjorkman⁴, *M. Garcia Criado* ⁵, J. Assmann⁶

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Tundra plants are responding as the climate continues to warm, with biome-wide shifts in biodiversity and species traits. However, plant surveys often capture scales of only several square metres, leaving many unmonitored species that by chance could be absent in small
plots. This hidden diversity could be the source of future shifts in species richness, plant composition and plant traits. Here, we bring together plot-scale observations of up to 30 years with species pool and topography data to reveal the magnitude of hidden biodiversity in tundra ecosystems and its relationship with long-term shifts in species richness, composition and plant height. We found that across 17 sites representing 39 vegetation types, the magnitude of hidden diversity varied up to 10-fold from four to 80 species, but this variation was poorly explained by latitude, altitude, or topography features. Average plant height was higher outside plots than inside, suggesting that predictions of tundra change based solely on small-scale observations might be underestimating the magnitude of future changes. Quantifying not just plot-scale biodiversity changes but also their landscape context and potential future colonizing species could be the missing link that allows us to scale up observations from just a few square meters to predictions across the tundra biome.

INTERNATIONAL POLAR YEAR - OPPORTUNITY FOR COORDINATED BIODIVERSITY ASSESSMENTS

Oral Presentation

G. Schaepman-Strub

1University of Zurich, Zurich, Switzerland

The Arctic and Antarctic are changing rapidly through amplified warming at the poles, impacting biodiversity and ecosystem functioning, with major feedbacks to the Earth system. In addition to climate, multiple other drivers of change of biodiversity become stronger, such as increasing industrial activity, tourism, wildfires, plastic pollution, and invasive species. In line with these rapid changes, a 5th International Polar Year in 2032-33 has started, only 25 years after the past IPY. The 5th IPY provides a unique platform for coordinated interdisciplinary research efforts, involving polar researchers, knowledge holders, rights holders and stakeholders. With this presentation, we will give an overview of the IPY process and how interested parties can get involved. We will further reflect opportunities towards biodiversity and ecosystem functioning assessment in the Arctic and Antarctic. Finally, we highlight the need for coordinated measurements, data processing, synthesis and data management in order to close major knowledge gaps and feed results of the polar regions back to global biodiversity efforts and efficiently inform policy makers.

ALIEN SPECIES IN THE NORTHEAST OF YAMAL AND THEIR INVASIVE POTENTIAL

Oral Presentation

N. Kadetov, N. Leonova, V. Zemlianskii, V. Borodulina

1MSU, Moscow, Russian Federation, 2UZH, Zurich, Switzerland
Biological invasions are emerging as significant threats to biodiversity, particularly in Arctic regions affected by major climate changes in recent decades. Our group conducted a comprehensive study of flora changes in northeast Yamal from 2011 to 2023. We registered 219 vascular plant species, with 143 native and 76 alien. The share of adventive species detected exceeds 30%, surpassing the 22% estimate for the Russian Arctic sector (Morozova, Tishkov, 2021). Our analysis shows the peak in species diversity occurred during the 2020-2021 growing season, following biological reclamation of disturbed areas. About 40% of adventive species were observed briefly for one or two years only. Notable among these are Nonea pulla, Phacelia tanacetifolia, and seedlings of Armeniaca vulgaris and Cerasus vulgaris. A smaller group, present since the study’s onset, likely emerged through unintentional introduction. Noteworthy among these is Chamaenerion angustifolium, observed almost annually in various habitats, including transformed and natural areas like ravine slopes and lake shallows. The population noted since 2011 has expanded its area by more than 20 times, and the number of shoots has increased by over 40 times.
Unleashing the Power of Blockchain, IoT, and eDNA to Create a Paradigm Shift for Global Biodiversity Monitoring Systems

A DEEP LINK BETWEEN BIODIVERSITY RESTORATION AND THE DIGITAL ECONOMY

Oral Presentation

A. Mazzi

1Head of Partnerships and Field Research at Sovereign Nature Initiative / PhD. Candidate at Wageningen University, School of Social Sciences, Wageningen, Netherlands

The Sovereign Nature Initiative’s DEEP Link technology leverages distributed ledger functionalities to reshape how every-day digital activities can contribute to the long-term financing of biodiversity restoration. With DEEP (Decentralised Ecological Economics Protocol), Sovereign Nature Initiative (SNI) develops a novel approach to utilising biodiversity data produced by conservation organisations (eco-data) to enable a sustainable, resilient and independent funding mechanism for these organisations. SNI operates as a conduit between conservation organisations and the growing digital economy by supplying the technological infrastructure that enables new collaborations. SNI processes the eco-data so that it can become actionable for creating digital assets. The data is linked through a rarity index, allowing the digital assets to be organised alongside the physical rarity of animals. In addition, the ecological impact of sold digital assets is traced through an immersive interface on SNI’s website, ultimately significantly reducing the distance between biodiversity restoration and the digital sphere. We developed PoCs with Web3 and Web2 games, Web3 wallet integrations and with event organisations through eco-data backed NFTs as proof of attendance. We will present how DEEP Link has been implemented in more than 5 proofs of concept over the past 6 months and draw out the conceptual, financial and ethical implications of this work.

SELECTIVE DISCLOSURE OF ECOLOGICAL DATA ON BLOCKCHAIN

Oral Presentation

H. Fiegenbaum, R. Lewis, C. Li

1Leipzig University, Institute for Medical Informatics, Statistics and Epidemiology, Leipzig, Germany, 2Norwegian Institute for Nature Research, Norwegian Institute for Nature Research, Trondheim, Norway, 3University of Bergen, Institution of Informatics, Bergen, Norway

The growing demand for ecological data and biodiversity monitoring brings to the forefront the issues of data standards and governance. If ecological data should be findable, accessible, interoperable, and reusable, utilizing blockchain technology can incentivize FAIR data contributions by providing traceability and security of data, as well as securing control over
data by contributors. In cases of disclosure of impact from organizations and governments, challenges exist in adhering to the FAIR mandate for data while equally protecting data sensitivity. Furthermore, safeguarding sensitive ecological data is essential to prevent misuse. We suggest using blockchain in combination with encryption techniques, such as homomorphic encryption, for these critical use cases as a means to harmonize both requirements by controlling data access and allowing selective disclosure without revealing the raw data itself.

**BLOCKCHAIN FOR MONITORING BIODIVERSITY IN PAYMENTS FOR ECOSYSTEM SERVICES?**

Oral Presentation

*D. Oberhauser*  

1German Federal Ministry for the Environment, Bonn, Germany

Robustly monitoring biodiversity data remains a major obstacle for effective payments for ecosystem services (PES), a key policy instrument to mitigate the biodiversity and climate crises. Blockchain technology can theoretically address this problem by providing a platform for transparent and immutable monitoring of PES outcomes, but thorough assessments of its potential in practice are still rare. This presentation aims to advance the debate and stimulate further research about blockchain for biodiversity monitoring by taking a closer look at the case of blockchain-based payments for forest ecosystem services. First, it revisits the fundamental novelties of the technology that make it suitable as a backbone for monitoring in PES schemes. Second, it presents a proof of concept for a blockchain-based forest PES mechanism that monitors outcomes by linking Ethereum smart contracts to satellite-based forest monitoring. Third, it compares the proof of concept with practical findings from the implementation of the German forest PES programme. The presentation concludes by highlighting research gaps that need to be addressed before blockchain can play a role in operational biodiversity monitoring applications such as PES, including questions of technological improvement as well as of environmental governance. While the conclusions are derived from the specific use case of PES, they are of great relevance for Global Biodiversity Monitoring in general.

**COMMUNITY-LED FOREST CONSERVATION: CONSERVATION BASIC INCOME TO SCALE DMRV**

Oral Presentation

*S. Max*  

1GainForest, Zurich, Switzerland, 2Gainforest, Zurich, Switzerland

Gainforest’s innovative Conservation Basic Income revolutionizes biodiversity conservation by incentivizing local communities through direct eco-payments for their data collection work.
on their restoration and conservation efforts, providing a long-term secure income alternative. Leveraging blockchain for secure, transparent transactions, this method addresses critical data gaps and funding inefficiencies that impede climate and biodiversity action. With tools like decentralized monitoring apps, drones or eDNA, AI for data verification, and Web3 for payment structuring, the Measure-To-Earn technology facilitates robust forest monitoring. Today, our method empowers communities in 8 countries, harnessing grassroots action for global change, demonstrating a sustainable, equitable approach to preserving biodiversity.

ENVIRONMENTAL DNA AS A TOOL FOR ESTABLISHING BIODIVERSITY BASELINES IN LIBERIA

Poster Presentation

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¹Fauna & Flora, Liberia Program, Monrovia, Liberia, ²Ludwig Maximilian University of Munich, Rachel Carson Center for Environment and Society, München, Germany

Liberia has over 40% of the remaining Upper Guinean Forest Ecosystem, a global biodiversity hotspot. These forests are home to exceptional ecological diversity and high endemism of flora and fauna. Most conservation monitoring efforts focus on exotic species like chimpanzees, elephants, and pygmy hippopotamus. Monitoring programs in Liberia utilise the knowledge of communities living near the forests, with field teams mainly composed of those living near the focal area. However, traditional biodiversity monitoring methods (e.g., line transects or camera trap surveys) are expensive, time-consuming, and require high technical supervision. This means that surveys are limited, resulting in a significant gap in biodiversity information across Liberia. Effective conservation programs rely on effectively detecting and understanding the species richness and distribution, especially in the regions at risk from fragmentation, especially outside protected areas – typically not targeted for survey. The eDNA as a biodiversity tool provides an opportunity for a cost-effective rapid detection approach requiring minimum technical supervision to carry out surveys that fill the biodiversity knowledge gap. This method can be an effective and applicable tool for monitoring a wide range of taxa and could inform decision-making for conservation planning. We present the result from our experience using this method for biodiversity monitoring across protected and proposed protected areas.

BLOCKCHAIN, INTERNET OF THINGS AND ENVIRONMENTAL DNA FOR BIODIVERSITY MONITORING

Oral Presentation

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Monitoring data for biodiversity at a global scale stays elusive and underfinanced. This symposium aims to provide a platform for interdisciplinary discussions and knowledge exchange to drive forward the integration of new collaboration tools such as blockchain, environmental DNA (eDNA) and Internet of Things (IoT) to power open data for biodiversity monitoring. In this introduction I will give very basic background on the technologies to be discussed in more depth via their use cases by the presenters of the symposium covering blockchain, IoT and environmental DNA and give some insights into how these technologies can be combined to realize global biodiversity monitoring systems.