GEO BON
Group on Earth Observations
Biodiversity Observation Network

Convention on
Biological Diversity

GEO BON Global Conference

MONITORING BIODIVERSITY FOR ACTION

A whole of society approach for urgent and transformative change

Abstract Booklet

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Contents

Tools and Models to Understand Biodiversity and Carbon Benefits in Data-Limited Landscapes for Decision Support

210002 - Using compositional-turnover modelling to derive greater value from sparse biodiversity observations in data-limited landscapes

Simon Ferrier[1]

[1]CSIRO Environment

Modelling spatial patterns in the distribution of biodiversity across data-limited landscapes can be particularly challenging for highly diverse biological groups (e.g. invertebrates, microbes). A sizable proportion of taxa within such groups are likely to be recorded at an insufficient number of sites to be modelled effectively using more traditional techniques such an species distribution modelling. Many taxa occurring within a landscape of interest may fail to be recorded even once if sampling sites are sparsely distributed relative to the grain of spatial variation in the species composition of communities. Compositional-turnover modelling offers an effective alternative for analysing, and predicting, patterns of biodiversity distribution in such situations. Rather than attempting to model the distribution of individual taxa this approach instead focuses on modelling a collective community-level property of biodiversity - i.e. the dissimilarity in species composition of communities at sampled locations - as a function of environmental differences, and spatial distances, between these locations. Here I will review how one such technique - generalised dissimilarity modelling (GDM) - has been used to address this challenge over recent years, across a range of spatial scales and application domains.

Presentation type

Talk

Affiliation

CSIRO Environment

Session

Tools and Models to Understand Biodiversity and Carbon Benefits in Data-Limited Landscapes for Decision Support

210001 - Measuring biodiversity and carbon where the James Bay Lowlands meet the Boreal Shield

Russ Weeber[1], Frances Stewart[2], Catherine Dieleman[3], Samantha McFarlane[1], Caroline Emilson[4], Jennifer Baltzer[2], Lisa Venier[4], Josie Hughes[5]

[1]Canadian Wildlife Service, Environment and Climate Change Canada, [2]Wilfrid Laurier University, [3]University of Guelph, [4]Canadian Forest Service, Natural Resources Canada, [5]Wildlife and Landscape Science, Environment and Climate Change Canada

Ontario's Far North straddles the world's second largest contiguous peatland and one of the largest unroaded boreal forest regions. The region supports Indigenous people, globally significant soil carbon stores, and intact wildlife communities. Climate change impacts, roads, and mining activity are anticipated. To address a need for baseline information in this unique, important, and understudied area, the Canadian Wildlife Service designed a network of study sites spanning >54,000 km2 and four degrees of latitude along the transition between the Western James Bay Lowlands and the Boreal Shield. Since 2020, approximately 500 sites have been sampled for birds using autonomous recording units. ~100 surface soil cores were collected at a subset of these sites to measure variation in the most vulnerable carbon stocks. In 2022, 232 unbaited wildlife camera traps were added. Soil and leaf samples were collected from ~80 sites to examine soil and phyllosphere biodiversity using metabarcoding. Deep carbon and additional surface vegetation measures will be collected in 2024. Tools for designing efficient stratified sampling networks, automated data collection, and co-located sampling all help increase the information obtained from difficult expensive sampling. Data will be used to identify areas important for carbon storage and wildlife, to provide a baseline for assessing impacts of anticipated resource development and climate change, and to inform future sampling efforts. Data sparsity and high sampling costs increase the importance of assessing uncertainty, iteratively updating models with new information, and working with data users to ensure modeling and data collection efforts meet needs.

Presentation type

Talk

Affiliation

Environment and Climate Change Canada

Session

Tools and Models to Understand Biodiversity and Carbon Benefits in Data-Limited Landscapes for Decision Support

210004 - In search of multi-objective approaches, tools and case studies to protect biodiversity and traditional food security in carbon rich areas

Juan Zuloaga[1], Andrew Gonzalez[1]

[1]McGill University

We will present some examples that might provide local, regional and/or global co-benefits (e.g., promoting global climate stability and biodiversity protection). We also present some details about our workshop, right after the GEO BON conference, among multiple partners aimed to weave multiple knowledge systems in the application of multi-objective approaches and tools in the HJBL and northern landscapes.

Presentation type

Talk

Affiliation

McGill University

Session

Tools and Models to Understand Biodiversity and Carbon Benefits in Data-Limited Landscapes for Decision Support

210005 - Exploring carbon stocks, biodiversity, and Indigenous Knowledge in the Hudson-James Bay Lowlands: a collaborative study

Karen Richardson[1], Laura Dingle Robertson[2], Vicki Sahanatien[3], Calvin Lincez[3], Lori White[2], Jason Duffe[2], Adam Collingwood[1]

[1]Parks Canada, [2]Environment and Climate Change Canada, [3]Mushkegowuk Council

Parks Canada and Environment and Climate Change Canada are working with Indigenous, academic, NGO, and government partners to assess biodiversity and the extent and quantity of carbon stocks and fluxes in wetland, peatland, coastal, and marine ecosystems in the Hudson-James Bay Lowlands and adjacent marine waters. Field-based measurements of carbon stocks and fluxes are complementing new remotely-sensed analysis and classification of wetland and vegetation types to produce the best available modeled estimates of carbon stocks and fluxes in the various ecosystems in this important region. Biodiversity information data mining is complementing remote sensing methods that will allow modelling of biodiversity across these ecosystems as well. Indigenous knowledge of biodiversity will contribute to our understanding of this scientifically data-limited landscape where decisions on protection and development are pending.

Presentation type

Talk

Affiliation

Parks Canada

Session

Tools and Models to Understand Biodiversity and Carbon Benefits in Data-Limited Landscapes for Decision Support

210003 - Cree understanding and knowledge of biodiversity

Vicki Sahanatien[1], Calvin Lincez[1], Tanya Iljas[1], Roxanne Metlin[1], Lawrence Martin[1]

[1]Mushkegowuk Council

The Hudson Bay and James Bay Lowlands are the homelands of the Mushkegowuk Cree. Mushkegowuk Cree have extensive temporal and spatial knowledge of the biodiversity of terrestrial and coastal ecosystems. This presentation will provide an overview of *missaway wahkohtawin* with examples from selected ecosystems and taxa.

Presentation type

Talk

Affiliation

Mushkegowuk Council

Session

Tools and Models to Understand Biodiversity and Carbon Benefits in Data-Limited Landscapes for Decision Support

Tools and Models for Biodiversity Monitoring

170005 - A workflow to evaluate ecosystem restoration impact based on Earth observation datasets

Jasper Van doninck[1], Wieteke Willemen[1], Wietske Bijker[1]

[1]University of Twente - Faculty of Geo-Information Science and Earth Observation

The ability to evaluate the success of ecosystem restoration interventions allows us to learn from past experiences and allocate scarce resources more effectively. Standardized evaluation protocols are therefore of increasing importance for restoration practitioners, governments, funding bodies, and other stakeholders. The availability of long-term, open satellite remote sensing data repositories now enables such standardized evaluation protocols, thereby bypassing some constraints of traditional evaluation approaches such as the difficulty to obtain repeated observations. We present a set of tools to assist ecosystem restoration stakeholders in assessing the effectiveness of interventions. The workflow relies on Earth observation datasets made available through SpatioTemporal Asset Catalogs (STAC). As an example, we evaluate a reforestation initiative using a Before-After-Control-Impact (BACI) design applied on multitemporal Landsat data. BACI is a comparative method that contrasts the temporal trajectory of an evaluation metric within an intervention site with that of environmentally similar control sites, thereby accounting for possible confounding factors. We use a propensity score matching based on several remotely sensed and ancillary covariates to match pixels within restoration sites with several similar control pixels. The BACI approach provides an estimate of the magnitude of the intervention effect in terms of the evaluation metric, as well as an indication of the statistical significance. Because the analysis is performed at the pixel scale, rather than at the site scale, our approach allows to differentiate between intervention success and failure within the same site and gain further insights in the reasons of possible restoration effects.

Presentation type

Talk

Affiliation

University of Twente - Faculty of Geo-Information Science and Earth Observation (ITC)

Session

Tools and Models for Biodiversity Monitoring

170001 - Improving conservation strategies through standardised biodiversity monitoring protocols

Ashley Leedman[1], Sandra Walpole[1], Frances Daniels[1], Amelia Cook[1], Ben Sparrow[2], Sally O'Neill[2], Andrew Tokmakoff[2], Katie Irvine[2], Siddeswara Guru[3], Nicolas Rakotopare[3], Beryl Morris[3]

[1]Australian Department of Climate Change, Energy, the Environment and Energy, [2]TERN Australia, University of Adelaide, [3]TERN Australia, University of Queensland

The Australian Government makes significant investments to improve stewardship of the country's biodiverse environment. Evaluation of such government investments improves our understanding of the effectiveness of natural resource management and mitigation activities. However, because biodiversity data from government-funded natural resource management projects lacks standards, is captured inconsistently and is not interoperable, the Australian Government has partnered with Australia's continental-scale national terrestrial ecosystem observatory, TERN, to develop and encourage uptake of standardised monitoring protocols that generate consistent and reliable data across the projects in which the government invests.

TERN commenced in 2009 and the new protocols build on its established data aggregation systems and well-tested survey protocols. The standardised monitoring protocols will be used to support future government-supported natural resource management programs that benefit the environment, agriculture and communities. In addition, the protocols will be available for use by other environmental land managers and environmental consultants, thus increasing the level of standardised biodiversity monitoring across the country. In addition to the standard protocols, TERN has developed complementary training and education packages for anyone collecting field data to ensure ready access to comprehensive instructions for the suite of standardised collecting protocols and associated web-based applications which allow ecologists, natural resource managers and others in the field to enter data and images and have access to web-based portals to curate and manage data collected. Standardised monitoring protocols allow governments, non-government organisations, stakeholders and the community to better understand and report the performance of conservation strategies as well as informing priorities for future investment.

Presentation type

Talk

Affiliation

TERN Australia, University of Queensland

Session

Tools and Models for Biodiversity Monitoring

1700032 - ClimateMedia - Understanding climate change phenomena and impacts from digital technology and social media

Ana Sofia Vaz[1], Ana Sofia Cardoso[1], Hugo Rebelo[1], Richard Ladle[1], Fernanda Martins[1], Javier Arribas[1], Alípio Jorge[2], João Santos[3], Domingo Alcaraz-Segura[4], Siham Tabik[5]

[1]CIBIO-InBIO Associação BIOPOLIS, [2]Department of Computer Science, Faculty of Science of the University of Porto, [3]Departamento de Física, Universidade de Trás-os-Montes e Alto Douro, [4]Facultad de Ciencias, Universidade de Granada, [5]Departamento de Ciencias de la Computación e Inteligencia Artificial, Universidad de Granada

Climate change is amongst the most striking environmental challenges of modern times, producing major socio-ecological impacts with economic repercussions. More dynamic, automated, and social-oriented observatory systems are needed to tackle climate change in order to consider adequate mitigation and adaptation responses. Online social media data has been seen as an opportunity to get insights on which climate phenomena and impacts people perceive of highest relevance and concern. Concurrently, the information created and shared by social media users may not always align with that from scientific facts and observations, bringing many challenges to climate change political decision-making and actions. Here we present ClimateMedia, an exploratory project that aims to: (1) understand the extent to which climate change phenomena (e.g., extreme weather, wildfires, floods) arereported by social media users, (2) how those users perceive climatic impacts on several social-ecological dimensions (e.g., health, biodiversity, economic production) and, (3) evaluate how divergent/congruent such reports and perceptions from social media users are to the scientific evidence. The project adopts recent technological advances in artificial intelligence algorithms, namely from Natural Language Processing, to explore textual content about climate change from social media data and the scientific literature. By understanding how divergent or aligned social media users' perceptions are from/with scientific facts, outputs from ClimateMedia aim to help practitioners redirecting awareness actions and establish appropriate political goals for the people. Ultimately, ClimateMedia serves as a proof-of-concept determining the feasibility of a future development of a social observatory system of climate change using social media information.

Presentation type

Poster

Affiliation

CIBIO-InBIO Associação BIOPOLIS

Session

Tools and Models for Biodiversity Monitoring

170004 - Optimal sampling of ecological dynamics

Michael Catchen[1], Andrew Gonzalez[1]

[1]McGill University

Ecosystems are inherently dynamic---they change over time. This change is driven by both intrinsic variance in ecological processes and anthropogenic change. Monitoring ecosystems is difficult, in large part because they encompass all of Earth, and people can only collect ecological datasets systematically in a very small subset of places on Earth. This has immense consequences for our ability to estimate the current state of biodiversity on Earth, and for our ability to detect when and how biodiversity is changing, and to attribute that change to particular causes. Therefore we must attempt to ensure our sampling locations/times provide us maximally informative data. In this talk I describe our software 'BiodiversityObservationNetworks.jl' (BONs.jl) is a software package in the Julia language, which provides methods to most efficiently sample ecological processes across landscapes. This package provides several algorithms for spatial and temporal planning of sampling. Through case-studies, we demonstrate how BONs.jl can be used to improve the amount of information provided by a particular sampling location, and show how this can guide sampling design for future observation networks.

Presentation type

Talk

Affiliation

McGill University

Session

Tools and Models for Biodiversity Monitoring

170007 - Continental species distribution and biodiversity predictions depend on modeling grain

Jeremy Cohen[1], Walter Jetz[1]

[1]Yale University

Accurate predictions of species distributions and biodiversity patterns are critical to prevent population declines and biodiversity loss. However, at continental scales, these predictions are often derived from species distribution models (SDMs) fit at coarse spatial grains uninformed by ecological processes. Coarse-grain models may systematically bias predictions of distributions and biodiversity if they are consistently over- or under-estimating area with suitable habitat, and this bias may intensify in regions with heterogenous landscapes or with poor data coverage. We fit presence-absence SDMs characterizing the seasonal distributions of 572 North American bird species across five spatial grains from 1 to 50 km, using observations from the eBird initiative. We find that across seasons, models fit at 1 km performed better under cross-validation than those at coarser scales and more accurately predicted species' presences and absences at local sites. Coarser-grain models consistently under-predicted range area relative to 1 km models, suggesting that coarse-grain estimates of distributions could be missing important habitat. This bias intensified during summer (83% of species) when many birds have smaller 'operational scales' via localized home ranges and greater habitat specificity while breeding. Biases were greatest in heterogenous desert and scrubland regions and lowest in homogenous boreal forest and taiga-dominated regions. When aggregating distributions to produce continental biodiversity predictions, coarse-grain models overpredicted diversity in the west and underpredicted in the great plains, prairie pothole region and boreal/taiga zones. The modern availability of high-performance computing and high-resolution observational and environmental data provides opportunities to improve continental predictions of species distributions and biodiversity.

Presentation type

Talk

Affiliation

Yale University

Session

Tools and Models for Biodiversity Monitoring

170012 - Ecological networks are predictible - now what?

Timothée Poisot[1]

[1]Université de Montréal

Networks of species interactions underpin most ecosystem services at the global scale. Yet, collecting high-quality data on these systems is difficult and costly, and therefore our knowledge of ecological networks is highly biased in time, space, and types of systems that have been described. But recent advances in machine learning led to the realization that networks are relatively straightforward to predict, including in areas with massive data deficiencies. In this talk, I will review some recent advances in the prediction of networks of species interactions, and show how these predictions can map directly onto pressing conservation matters that can enable more integrative BONs. In particular, I will focus on (i) the network-based identification of novel hosts of zoonotic diseases and its possible use in One Health approaches, (ii) the reconstruction of food webs using transfer learning and the use of these predictions to identify high-uncertainty areas that should receive priority sampling, and (iii) the use of network-approaches in designing multi-purpose BONs for non-equilibrium systems with strong environmental forcings.

Presentation type

Talk

Affiliation

Université de Montréal

Session

Tools and Models for Biodiversity Monitoring

170006 - Research in artificial intelligence in the field of marine biodiversity: an unprecedented international scientific challenge

Camille Coux[1], Virginie Barbosa[2], Aurélie Delavaud [1], Olivier Gallibert[2], Yvan Le Bras[3], Olivier Norvez[1, 3]

[1]The French Foundation for Biodiversity Research (FRB), [2]France's national metrology laboratory (LNE), [3]National Museum of Natural History (MNHN)

The AI-Biodiv challenge aims to predict changes in biodiversity and develop reliable indicators. Given the complexity of interactions between ecosystems and the heterogeneity of data, current indicators remain limited in predicting changes in biodiversity, particularly in the marine environment. Furthermore, data structuring remains one of the major obstacles to knowledge of biodiversity. The main objectives are:

- Optimise AI methods to improve research into marine biodiversity,
- Design innovative prediction models and indicators,
- Develop hybrid AI methods to enhance our knowledge of marine environments,
- And will focus on coastal marine biodiversity in the Mediterranean Sea and the Pacific Ocean.

Presentation type

Talk

Affiliation

National Museum of Natural History (MNHN)

Session

Tools and Models for Biodiversity Monitoring

170008 - Using acoustic monitoring to track progress towards Global Biodiversity Framework restoration targets

Carly Batist[1, 2], Marconi Campos-Cerqueira[1, 2], José Wagner Ribeiro[1, 2], Gabriel Augusto Leite[1, 2], Tomaz Nascimento de Melo[1, 2], Kris Harmon[1, 2], Rachel Cohen[3], Rafael Souza[4], Ulrik Ilstedt[5]

[1]Rainforest Connection (RFCx), [2]Arbimon, [3]WeForest, [4]Ipê, [5]Swedish University of Life Sciences (SLU)

The Global Biodiversity Framework (GBF) sets ambitious targets for safeguarding and restoring biodiversity worldwide. The GBF emphasizes the critical importance of restoring degraded land; however, efficient biodiversity monitoring is required to assess the effectiveness of restoration efforts. Passive acoustic monitoring (PAM) combined with machine learning (ML) offers a transformative approach to achieving GBF restoration targets. This is a non-invasive, cost-effective and scalable solution for monitoring biodiversity and supporting evidence-based conservation decision-making. We will describe how we used PAM to assess the effect of restoration on species richness, distribution, and community patterns in critical biodiversity hotspots: Atlantic Forest (Brazil), Sabah (Malaysia), and Hutan Harapan (Indonesia). For each project, we deployed acoustic recorders across different land-cover sites to monitor 174 total species. We used Arbimon's pattern matching tools to automate species detection (with expert verification). We then fit multi-species occupancy models (per project) using a suite of remote sensing variables. We found that, across all projects, restoration sites had a positive effect on species richness. Restored sites in Brazil had a 35% higher species occurrence probability than unrestored sites and in Sabah, restoration sites hosted 2.5x more species than cultivated sites. Across all projects species diversity nearly matched that of primary forests (age of restoration also a factor). These studies offer quantitative evidence of the positive impact that restoration can have on tropical biodiversity across continents. These datasets are now being used to develop and deploy multi-species ML models to further improve biodiversity monitoring in restoration projects.

Presentation type

Talk

Affiliation

Rainforest Connection (RFCx) & Arbimon

Session

Tools and Models for Biodiversity Monitoring

170010 - Efficient integration of large amounts of field survey data: shifting from a state-of-the-art web portal to spreadsheets

Victor Cameron[1, 2]

[1]Université de Sherbrooke, [2]Biodiversité Québec

Ecological data management is an important issue for organizations overseeing the acquisition of biodiversity observations. This challenge is pronounced for the Quebec Biodiversity Observation Network initiative (Biodiversité Québec) which oversees the acquisition of a wide variety of data (abundances, eDNA, acoustics, environmental data, etc.) over the large territory of the province of Quebec (Canada), in a large number of sites (287) and of partners. Web portals and data integration tools such as GBIF's IPT have gained popularity in recent years to meet the data integration and management challenge. Following this trend, Biodiversité Québec has developed a portal allowing its partners to integrate and interact with their data. However, the schema of acquired data must evolve with the needs of field technicians and protocols. In addition, data acquisition requires quality control and interaction interfaces. Finally, the skill level and comfort with web-based tools vary widely between partners, participants, and technicians who manipulate the data. These challenges required from Biodiversité Québec significant efforts to accommodate complex data schemas as well as significant efforts to train partners. Our experience led us to promote the implementation of a spreadsheet-based template system. This system proved to be simpler for our partners to integrate into their processes and easier to maintain for data managers. Our experience of ecological data management has shown that despite web-based visualization tools are effective in communicating and synthesizing data, data management benefits from relying on tools and technologies that can be adapted to evolving needs and users' skill level.

Presentation type

Talk

Affiliation

Université de Sherbrooke

Session

Tools and Models for Biodiversity Monitoring

170009 - Modelling challenges for biodiversity monitoring in Colombia

Susana Rodriguez-Buritica[1], Jose M. Ochoa[1], Natalia Norden[1], Bibiana Gomez[1], Elkin Noguera[1], Lina Sanchez[1]

[1]Natural Resources Research Institute Alexander von Humboldt

Including biodiversity monitoring in decision-making is a challenge for every country, especially for highly biodiverse, resource-limited countries. Scientific developments that smooth all steps of a monitoring cycle are a must in these countries. From data gathering, data integration analyses, and modeling, to scenario planning and science communication. This presentation will introduce and discuss the most pressing challenges Colombia has faced, regarding developing biodiversity monitoring narratives that permeate the political and environmental management arenas. Some of these challenges derived from lags in implementing scientific developments that could ease biodiversity monitoring, analytical challenges derived from data limitation, and some others derived from a mismatch between scientific and non-scientific perceptions around what is needed, what is urgent, and what is important. Modeling approaches have plenty to offer to solve some of these burdens. Still, sometimes analytical developments are considered as isolated problems without considering the context in which they should be implemented. We will present challenges and comprehensive approaches to generate more context-aware narratives around biodiversity monitoring. These challenges had emerged within Humboldt's institute experience as an institute responsible to connect science with public policy in Colombia.

Presentation type

Talk

Affiliation

Natural Resources Research Institute Alexander von Humboldt

Session

Tools and Models for Biodiversity Monitoring

170002 - Open EO tools for terrestrial vegetation and wetland function recovery analysis to support ecosystem and biodiversity restoration projects

Andy Dean[1], V Tang[1], S Zwiep[2], M Birch[2], M Kavlin[2], J Miettinen[3], FM Seifert[4], Nicholas Coops[2]

[1]Hatfield Consultants, [2]Faculty of Forestry, University of British Columbia, [3]VTT Research, [4]European Space Agency

Ecosystem Restoration (ER) is important to help reverse biodiversity loss and is critical to achieve the United Nations (UN) sustainable development agenda, the UN Decade on Ecosystem Restoration (2021–2030), and 30:30 target adopted at the Convention on Biological Diversity COP 15 in Montreal in December 2022.

Effective planning, monitoring, and assessment of ER activities is required to evaluate changes to ecosystem functions and to determine whether ER activities are having the desired impact. The Pioneer Earth Observation apPlications for the Environment (PEOPLE) ER project financed by the European Space Agency is developing a flexible, powerful set of open EO data analytics tools to support the monitoring of key ecosystem parameters and functions as drivers of biodiversity recovery in forested and wetland ecosystems. The PEOPLE-ER Vegetation Recovery and Trends toolset provides methods for high-resolution EO data time-series analysis to enable monitoring of vegetation recovery in forested ecosystems. Using open EO data time-series, users can select from a variety of spectral indices and recovery metrics monitor their trend and trajectory over time, as well as define reference areas or baseline conditions. The PEOPLE-ER Wetland Function Recovery toolset provides an approach for high-resolution Sentinel-1 EO data time series analysis of inundation trends in natural to heavily modified wetland ecosystems. Users can perform data mining and cluster analysis on the time series data to explore hydrologic regimes that drive wetland functions within a landscape. The presentation will introduce the initial release of the PEOPLE-ER tools, and their testing and validation in Canada and Vietnam.

Presentation type

Talk

Affiliation

Hatfield Consultants

Session

Tools and Models for Biodiversity Monitoring

170003 - A new approach to evaluate the impacts of environmental management and governance by using embedded Gaussian processes

Daniel Schoenig[1], Christian Messier[1, 2], Jérôme Dupras[2]

[1]Université du Québec à Montréal, [2]Université du Québec en Outaouais

Environmental decision-making is crucial to maintain nature's contribution to people and align the outcomes of social-ecological systems with goals related to sustainability, biodiversity conservation, and the climate. Successful decision-making depends, in turn, on robust assessments of how management interventions and environmental policies impact environmental outcomes. However, studying causal relationships in geographic space thus typically involves a number of covariates that are related to an environmental outcome and to the presence of a management intervention, a policy instrument, or another system attribute of interest, resulting in spatial confounding. Further challenges are posed by non-linear relationships between important social-ecological factors, as well as by the computational costs of using high-resolution data over large geographic areas. In addition, the effect of a management intervention or policy frequently varies over geographic space. We propose embedded Gaussian processes (EGP) as an approach to causal inference that is designed address these challenges and provide more reliable effect estimates under spatial confounding. According to a simulation study we have conducted, EGP attains (and frequently surpasses) the performance of the best methods so far available, while providing more flexible means of spatial aggregation. To show the capacities of the approach for biodiversity and environmental systems monitoring, we present case studies on how forest outcomes are affected by indigenous tenure and protected areas in the entire Amazon region and Central America, taking into account more than 20 million point observations.

Presentation type

Talk

Affiliation

Université du Québec à Montréal

Session

Tools and Models for Biodiversity Monitoring

170011 - Automated detection and counting of nests of Antarctic shags (Leucocarbo bransfieldensis) using machine learning

Jędrzej Świeżewski[1]

[1]Appsilon

Understanding the population of Antarctic shags is crucial to comprehending the well-being of the overall Antarctic ecosystem, particularly in the face of ongoing disruptions caused by global warming. Antarctic shags have no natural predators and can prey even on demersal fish in a relatively large area. Hence, their reproductive success is a valuable indicator of the abundance of fish in the area, an information hard to obtain otherwise in the context of the Southern Ocean. However, manual nest counting on remote islands, especially in the presence of multiple colonies and species, is a resource-intensive endeavour.I will present results obtained by the team at Appsilon in collaboration with scientists from the Arctowski Polish Antarctic Station in an effort to streamline this process using computer vision. Leveraging the drone data collected by the station, we employed customised, machine learning based, object detection algorithms to produce excellent results in determining the number and location of shags' nests.In this talk I will introduce the problem and the stunning dataset collected by the Arctowski Polish Antarctic Station, before discussing the methods employed and impressive results obtained across the numerous Antarctic islands.The models obtained are robust not only for counting nests in colonies whose historical data the model has been trained on (test-over-time), but also on spatially distinct colonies (test-over-location), as well as, on legacy datasets collected by independent research groups (test-over-source). Hence we obtain a robust method of automated counting of nests of shags in remote regions.

Presentation type

Talk

Affiliation

Appsilon

Session

Tools and Models for Biodiversity Monitoring

1700031 - Optimizing the monitoring of forest ecosystems to increase reforestation success rates and biodiversity implementation on a larger scale

Adrien Pages[1]

[1]MORFO

MORFO has created a method to restore forest ecosystems on a large scale. Monitoring is an essential component of their work and is conducted at three stages: prior to planting, during planting, and after planting. In this presentation, Adrien Pages (MORFO co-founder) will provide an update on MORFO's research and development progress aimed at improving survival rates and accurately tracking the development of a terrain.

Presentation type

Poster

Affiliation

MORFO

Session

Tools and Models for Biodiversity Monitoring

Detection and Attribution of Biodiversity Change

5000032 - Climate change, biodiversity and health nexus: evidence from malaria in Vietnam

Marion Coinon[1], Manh-Hung Nguyen[1]

[1]Toulouse School of Economics, INRAE, University of Toulouse Capitole, Toulouse, France.

This paper documents the complex relationship between biodiversity and a representative zoonotic infectious disease, namely malaria, in a tropical country and provides evidence of synergism with wind-related factors as a proxy for climate change. We combine data on malaria, climatic factors, and biodiversity at the monthly and provincial levels in Vietnam, resulting in a final balanced panel dataset spanning from 2009 to 2019, containing 1,361 observations.

For all analyses, measures of bird abundance were log-transformed and operated in the Shannon index. We chose the Ebird database Managed by the Cornell Lab of Ornithology with the subtraction data only for Vietnam from 2008 to 2018 to match the time frame of disease databases. 720 avian species are observed in the provinces of Vietnam by human observation. The fixed-effects model helps us find the impact of biodiversity on human health through the case of malaria. On average, for all provinces, the diluted effect of biodiversity is 0.45 (CI 95%= 0.23 - 0.67) cases per 100,000 population over time with the presence of 7-day cold wave variables.

Using the exogenous variation in climate and the Shannon biodiversity index in a fixed-effects framework, we find that the wind speed and cold wave significantly increase new cases, but the frequency and intensity of these determinants are decreasing rapidly over time due to global warming. Our results suggest that the synergism of climate change and dilute-effect biodiversity is favorable for reducing malaria incidence.

Presentation type

Poster

Affiliation

University of Strasbourg, France

Session

Detection and Attribution of Biodiversity Change

50006 - Global monitoring for biodiversity: uncertainty, risk and power analyses for trend change detection

Brian Leung[1], Andrew Gonzalez[1]

[1]McGill University

The Kunming-Montreal Global Biodiversity Framework of the UN Convention on Biological Diversity has set ambitious goals to reverse biodiversity declines by 2050. However, we have yet to explicitly evaluate the information needed to reliably detect change in biodiversity trends. We conducted a “biodiversity change power-analysis” for global population trends to evaluate whether improvements resulting from policy and conservation action could be detected with high confidence by 2030. We used the Living Planet Database for population trends and analyzed 62 systems (populations separated into taxonomic groups at the country level) showing very rapid declines. We show that even in these rapidly declining systems, we would detect improvements with high (95%) certainty in only 14 of 62 systems, even if thousands of populations were sampled, and the new policies reduced net declines to zero immediately, on average. This result occurs because our ability to detect change is limited by current uncertainty in our estimates of population trends. To tackle this issue, we propose a risk framework for evaluating biodiversity trends, that considers thresholds for both probability (certainty) and decline magnitude. We also derive the quantitative monitoring effort required given alternative evaluation metrics (e.g., we could obtain >80% power with ~250 populations sampled for 32 of 62 systems, by accepting 70% certainty). Our work will promote needed discussions and important considerations for biodiversity monitoring, which will help ensure that conservation actions are effective.

Presentation type

Talk

Affiliation

McGill University

Session

Detection and Attribution of Biodiversity Change

50004 - A monitoring protocol for conservation decisions

Joseph Bennett[1], Richard Schuster[2], Jeffrey Hanson[1], Jaimie Vincent[1], Jonathan Rhodes[3]

[1]Carleton University, [2]Nature Conservancy of Canada, [3]University of Queensland

Information from biological monitoring is often crucial for informing biodiversity decisions. Monitoring can also help identify previously-unrecognized threats and patterns in ecosystems, and can be used to build evidence, in cases where uncertainty hampers conservation decisions. In addition, monitoring is integral to adaptive management. However, poorly-designed monitoring programs can also waste resources that are essential for direct management, leading to lost conservation opportunities. To help managers choose when and where to monitor efficiently, we describe a method for estimating the benefit of monitoring for conservation decisions. This method incorporates elements of structured decision-making and simplified value of information (VOI) analysis to help determine whether monitoring may be important for making choices regarding direct management. We focus on monitoring for management decisions, while recognizing that monitoring can serve various additional purposes, such as providing baseline ecological information, or providing opportunities to experience or learn about nature. Our method requires only relative certainty regarding the elements being considered in decision problems. As such, it is more immediately applicable than full VOI analysis to many conservation decisions. Is also provides structured guidance that is easily replicable and defensible, where the evidential basis for monitoring decisions is sparse.

Presentation type

Talk

Affiliation

Carleton University

Session

Detection and Attribution of Biodiversity Change

5000031 - Bat sonotype as a novel insight into the congo basin rainforest dynamic

Yoba Alenga[1]

[1]Congolese Youth Biodiversity Network

Tropical forest ecosystems are undergoing an exponential regression of their surface areas with subsequent habitat loss and fragmentation. The effects of such disturbances on bats are quite significant, even leading to a decline in populations. In order to ensure the maintenance of bat populations, it is thus important to preserve their habitats. This involves highlighting preferential habitats but also factors related to their foraging sites.

We have combined acoustic surveys and capture-mark-recapture methods to study relationships between bats and their preferred habitats and also to identify functional role of bats captured or recorded in their habitat. A total of 42 bats were captured, belonging to 13 species, including 5 species of frugivorous bats and 8 insectivorous bats.

Acoustic monitoring revealed the presence of 11 sonotypes namely of the following species: *Chaerephon pumilus*, *Macronycteris gigas*, *Macronycteris vittatus*, *Doryrhina cyclops*, *Rhinolophus fumigatus*, *Neoromicia nana/Scotophilus dinganii*, *Pipistrellus nanulus*, *Pipistrellus rueppellii*, *Nycteris arge*, *Myotis bocagii* and *Glauconycteris superba*.

The type of habitat (primary forest) significantly increases the foraging activity of bats. A medium to high density of the understorey and a medium opening of the canopy have a significant influence on bat activity and call structure. Complementarity of acoustic monitoring and capture is crucial to understand the mechanisms governing aggregation of bats assemblages in order to assess their activity and the ecosystem services they provide.

Presentation type

Poster

Affiliation

Congolese Youth Biodiversity Network

Session

Detection and Attribution of Biodiversity Change

50007 - Monitoring ecological integrity to support ecosystem management in Canadian national parks and park reserves

Lucy Patterson[1], Claude Samson[1], Prabir Roy[1], Sarah Yuckin[1], Sébastien Renard[1]

[1]Parks Canada Agency

Parks Canada monitors biodiversity in protected areas across Canada using a common framework called the ecological integrity monitoring program (EIMP). This program assesses ecological integrity in parks and park reserves and enables prioritization and tracking of management actions to enhance ecosystem integrity. In 2022, the program summarized the status (good, fair, or poor) and trend (improving, stable, or declining) of 117 ecosystems within 42 national parks and park reserves. Of these ecosystems, 60% were in good condition, 22% in fair condition, and 18% in poor condition. The five-year trend of 79% of ecosystems was stable or improving. Observed declines were attributed to a variety of stressors, ranging in scale from global (e.g., climate change) to local (e.g., hyperabundant wildlife). In 2021, Parks Canada invested more than $20M in 70 conservation projects across Canada to contribute to halting and reversing biodiversity loss. Management efforts of 15 projects resulted in measurable progress towards these objectives. To illustrate how the results of the EIMP are integrated in ecosystem management planning process and the conservation of biodiversity, we present a case study on hyperabundant moose in national parks in eastern Canada. We conclude with some future directions of the EIMP, notably an increased emphasis on landscape-scale conservation, climate change adaptation, and weaving Indigenous ways of knowing and science-based knowledge.

Presentation type

Talk

Affiliation

Parks Canada Agency

Session

Detection and Attribution of Biodiversity Change

50001 - Mountain biodiversity: from monitoring to reporting at subnational scale

Mark Snethlage[1, 2], Davnah Urbach[1, 2], Amina Ly[3], Jonas Geschke[4], Noah Diffenbaugh[3], Markus Fischer[4]

[1]Global Mountain Biodiversity Assessment, [2]Centre interdisciplinaire de recherche sur la montagne, University of Lausanne, [3]Stanford University, [4]University of Bern

The importance of mountain biodiversity protection and sustainable management is undisputed. With SDG indicator 15.4.1 on the coverage by protected areas of important sites for mountain biodiversity and with new targets agreed upon in the Kunming-Montreal Global Biodiversity Framework, needs and opportunities exist for meaningful reporting on mountain biodiversity and its role for the sustainable development of mountains and beyond.

In providing SDG indicator 15.4.1 on mountain biodiversity protection 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 the sustainable management of mountain ecosystems and for a meaningful interpretation of national values. However, based on national and global datasets of mountain biodiversity monitoring efforts, which we map onto the ranges of the most recent GMBA mountain inventory, we show that major gaps exist in the data available for reliable reporting. We specifically show that even in mountain countries generally rich in environmental data, gaps in the monitoring of mountain ecosystems are numerous and large - despite extensive *in situ* and remote-sensing work - which undermines our ability to detect rapid changes in biodiversity. The data further indicate opportunities for improving the biogeographical and ecological representativeness of monitoring sites in mountains.

We argue that reliable reporting on global biodiversity-related targets at scale is not realistic unless we achieve improved spatiotemporal monitoring of mountain biodiversity and ecosystems, using *in situ* and remote-sensing approaches in complementary and synergistic ways.

Presentation type

Talk

Affiliation

Global Mountain Biodiversity Assessment

Session

Detection and Attribution of Biodiversity Change

50005 - Towards a unified understanding of personalised bias in biodiversity estimation and conservation

Wenyuan Zhang[1]

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How biodiversity responds to environmental change across time and space is among the most pressing questions facing ecologists. A prerequisite for addressing the question is effective biodiversity estimation. Evidence suggests that a broad array of interactions between individual human observers and nature may bias biodiversity estimates. Such personalized bias, especially when unexplained, can lead to spurious or seemingly contradictory conclusions, which can limit understanding and our ability to transfer findings from ecological studies to conservation practices. Here, we identify knowledge gaps on drivers of personalized bias and discuss the mechanisms by which personalized bias influences biodiversity estimation and conservation as an integrated system. We also outline the multiple dimensionalities of personalized bias at the intersection of spatial and temporal variability. We elucidate the potential of which investigating personalized bias can provide a theoretical framework to account for uncertainties in biodiversity synthesis. We argue that disentangling the effects of personalized bias in biodiversity estimation and conservation is a critical challenge in ecology, essential for augmenting biodiversity understanding and conservation.

Presentation type

Talk

Affiliation

Department of Biology, Quebec Centre for Biodiversity Science, McGill University, 1205 Dr. Penfield Avenue, Montreal, H3A 1B1, Quebec

Session

Detection and Attribution of Biodiversity Change

50002 - The Living Planet Index's ability to capture biodiversity change from uncertain data

Katherine Hébert[1], Dominique Gravel[1]

[1]Université de Sherbrooke

The Living Planet Index (LPI) is a crucial tool to track global biodiversity change, but necessarily sacrifices information to summarize thousands of population trends into a single communicable index. Evaluating when and how this information loss affects the LPI's performance is essential to ensure interpretations of the index reflect the truth as reliably as possible. Here, we evaluated the ability of the LPI to accurately and precisely capture trends of population change from uncertain data. We derived a mathematical analysis of uncertainty propagation in the LPI to track how measurement and process uncertainty may bias estimates of population trends and to measure the overall uncertainty of the LPI. We demonstrated the propagation of uncertainty using simulated scenarios of declining, stable, or growing populations fluctuating independently, synchronously, or asynchronously, to assess the bias and uncertainty of the LPI in each scenario. We found that measurement and process uncertainty consistently pull the index below the expected trend. Importantly, variability in the raw data scales up to draw the index further below the expected trend and to amplify its uncertainty, particularly when populations are small. These findings echo suggestions that a more complete assessment of the variability in population change trends, with particular attention to covarying populations, would enrich the LPI's already critical influence on conservation communication and decisions.

Presentation type

Talk

Affiliation

Université de Sherbrooke

Session

Detection and Attribution of Biodiversity Change

50003 - Integrating spectral and structural remote sensing time series metrics to examine bird habitat

Rachel Kuzmich[1], Ross Hill[2], Paul Treitz[1], Paul Bellamy[3], Shelley Hinsley[4]

[1]Queen's University, [2]Bournemouth University, [3]Royal Society for the Protection of Birds, [4]UK Centre for Ecology and Hydrology

Remote sensing time series have been used to assess changes to land use and land cover, monitor habitat quality, quantity and configuration, characterize the relationship between habitat and ecological indicators like species richness and diversity, and examine habitat availability for species of interest. For this study, we used bird survey, spectral and structural remote sensing data to characterize Chiffchaff (*Phylloscopus collybita*), Chaffinch (*Fringilla coelebs*), Blue Tit (*Cyanistes caeruleus*) and Willow Warbler (*Phylloscopus collybita*) habitat over time across multiple woodlands in Cambridgeshire, United Kingdom. Our goal is to develop habitat occupancy models for these bird species. Metrics derived from airborne laser scanning (ALS) data were used to characterize forest structure. ALS data are particularly useful as bird species occupy three-dimensional spaces and use structural cues to select habitat within woodlands. We used individual band information, derived vegetation indices and habitat maps from spectral data (e.g., Landsat, PlanetScope). Habitat models were developed for each species using Random Forests. Generally, variables derived from ALS data more accurately described habitat than those derived from spectral data. However, this may not be due to the nature of spectral data itself but more a function of spatial and spectral resolution. We also found that habitat models developed with multiple years had higher accuracy and greater transferability over time. Rather than a static representation of habitat, time series spanning multiple years capture structural changes in areas undergoing woodland succession, resulting in modified habitat conditions that bird species subsequently occupy.

Presentation type

Talk

Affiliation

Queen's University

Session

Detection and Attribution of Biodiversity Change

SEEA Ecosystem Accounting and Biodiversity

80003 - The Census of Environment: The use of Earth Observations in the national implementation of the SEEA-EA in Canada

François Soulard[1]

[1]Statistics Canada

The Census of Environment (CoE) is a new (2021) program at Statistics Canada. It represents a pioneering effort to systematically produce or collect, integrate, and disseminate environmental data through a full suite of ecosystems accounts and environmental profile, in order to quantify the relationships between ecosystems, human activities, and socio-economic outcomes. Our vision is to provide a holistic and accurate portrayal of ecosystem health and its dynamic interactions with society. Satellite Earth observations represent a critical data source; however, their use is not without serious challenges. This presentation highlights some of these challenges, and offers possible solution.

Presentation type

Talk

Affiliation

Statistics Canada

Session

SEEA Ecosystem Accounting and Biodiversity

8000032 - Integrations and substitutions linking domestic and international ecosystem services: a case study of Uganda

Haruna Lubega[1], Benard1 Ssenyomo[1], Rose Nabuma[2]

[1]Knowledge Integrated Sustainable Agriculture and Nutrition Agency (KISANA),Uganda,
[2]Makerere University,Kampala,Uganda

Expenditure on ecosystem services seek to support land use practices that develop and/ or preserve the maintenance of ecosystem services to domestic or international community. In Uganda, an internal program of compensation focuses on four ecosystem services namely; preservation of biodiversity, carbon storage, hydrological services, and scenic beauty. Aiming at compensation systems is an intricate concern since it necessitates synthesizing the interconnections and substitutions between the diverse services. The objective of the study is to evaluate the spatial distribution of the four ecosystem services of preservation of biodiversity, carbon storage, hydrological services, and scenic beauty.

The evaluation of the four ecosystem services reflects on the ability of ecosystems to generate a service and the existence of recipients in the spatial area where the service flows. For each ecosystem service, the study distinguished ecological and socio-economic pointers recounting the ability of ecosystems to generate a service and the existence of recipients. Employing unclear judgment, the study plotted ecosystem services at the national scale and diverse spatial declarations. The plots of ecosystem services illustrate diverse key domains for the four ecosystem services. Linkages between services are recognized in a number of sections, whilst a few other sections are typified by substitutions between domestic or international services.

Spatial evaluation of ecosystem services facilitates examining the spatial interconnection or substitutions between ecosystem services and prioritizing local areas with different profiles of service delivery.

Presentation type

Poster

Affiliation

Knowledge Integrated Sustainable Agriculture and Nutrition Agency (KISANA),Uganda

Session

SEEA Ecosystem Accounting and Biodiversity

8000034 - Economic valuation of ecosystem services for indigenous communities of Chitral Valley in the Hindukush range, Pakistan

Uzma Saeed[1], Muhammad Ali Nawaz[2]

[1]Quaid I Azam University, Islamabad, [2]Department of Biological and Environmental Sciences, Qatar University, Doha, Qatar

Understanding montane communities' dependence on ecosystem services (ES) is essential to develop relevant adaptation strategies. The ES in Chitral Valley, in the Hindukush range of Pakistan, provides a unique opportunity to explore this question. This underwork area is increasingly exposed to global climate change and the overexploitation of resources. Hence, this study aimed to identify the ES in this region; and delineate indigenous communities' reliance on ES based on valuation in the Chitral Valley. ES were classified using semi-structured interviews and focus group discussions using CICES (Common International Classification on Ecosystem Services) table and the Total Economic Valuation Framework. Findings show indigenous communities high dependence on the ES. The provisioning ES have 3.7 times higher total economic value than a household's (HH) average income, worth 7272 ± 481.6 USD/HH/yr. Forage for livestock holds the highest value as an ES in the Valley 2219 ± 83 USD per household per year. The sustainable use of ES and climate change adaptation and mitigation have substantial cultural, economic, and ecological benefits for the Hindukush range.

Presentation type

Poster

Affiliation

Quaid I Azam University, Islamabad

Session

SEEA Ecosystem Accounting and Biodiversity

80004 - Valuing and monitoring biodiversity in natural capital accounting frameworks

Albert Ugochukwu[1], Walter Lepore[2], David Castle[2]

[1]University of Saskatchewan, [2]University of Victoria

The Kunming-Montreal Global Biodiversity Framework describes the need for “tools and solutions for implementation and mainstreaming” and Target 21 describes how “best available data, information and knowledge” can be generated and made accessible to “guide equitable governance.” Buxton et al (2021) have considered 50 information needs in six categories for biodiversity conservation in Canada: conservation policy; public support; research for planning and management: monitoring; threat identification: and mobilizing information. We contend that a natural capital accounting (NCA) framework can play a synthetic and structuring role that mobilizes knowledge to action and guides equitable governance. The NCA framework creates an environmental profit and loss account that identifies gains and losses of biodiversity based on their condition (quality), extent (quantity), and value (monetizable and non-monetizable). Drawing on a systematic review of NCAs we will consider how they inform and enhance multi-stakeholder policy choices that promote sustainable development and global economic growth. We explore two themes that have shaped the GBF but need further development in contemporary NCA frameworks. The first is the capacity of NCAs to uptake biodiversity data from scalable biomonitoring technologies, for example the use of DNA barcoding for species identification, study of interactions, and the characterization of ecosystem dynamics. The second is the contribution of Indigenous perspectives on the interdependence of nature, people, society, and the economy. We will assess what further work on NCA frameworks is needed to deepen understanding of transformations occurring in biodiversity and ecosystems and the potential consequences on the environment, sustainability, and human well-being.

Presentation type

Talk

Affiliation

University of Victoria

Session

SEEA Ecosystem Accounting and Biodiversity

80001 - The SEEA Ecosystem Accounting: Opportunities and challenges of Earth Observations

Marc Paganini[1]

[1]European Space Agency (ESA)

In March 2021 the United Nations Statistical Commission adopted the System of Environmental-Economic Accounting (SEEA) Ecosystem Accounting as a new statistical framework to integrate ecosystems and their services into national accounting, and account for biodiversity and ecosystems in national economic planning and policy decision-making. This new internationally agreed statistical framework brings a new paradigm shift in the appreciation and valuation of natural resources, allowing countries to use a common set of rules and methods to track changes in ecosystem assets (e.g. ecosystem extent and conditions) and related flow of services (i.e. ecosystem services), and to link ecosystem information to economic and development activities. The concept of Ecosystem Accounting provides also a new policy framework underpinning the development of ecosystem-related indicators from other international agreements including the CBD Kunming-Montreal Global Biodiversity Framework (GBF). Ecosystem Accounts are inherently spatial accounts, with the implication that they strongly depend on the availability of spatially explicit datasets, including Earth Observations. EO is widely recognized as a major source of information to monitor the extent and condition of ecosystems, and services provided. The advent of dense EO data streams at appropriate scales combined with the emergence of digital technologies offer unprecedented opportunities for countries to monitor the extent and condition of their ecosystems, determine ecosystem services and to use this information in compiling ecosystem accounts. The presentation will introduce the new SEEA Ecosystem Accounting framework and present the relevance and challenges of EO applications in ecosystem accounting.

Presentation type

Talk

Affiliation

European Space Agency (ESA)

Session

SEEA Ecosystem Accounting and Biodiversity

8000035 - Biodiversity Return on Investment (ROI) assessment strengthening agricultural productivity: a case study of Buvuma Island, Uganda

Aloysious Sekitoleko[1], Silver Musitwa[2], Peterson Ekwiri [2]

[1]Grassland Community Initiatives Uganda (GCIU),Masaka,Uganda, [2]Century Environmental Development Agency (CEDA),Jinja,Uganda

Return on Investment on different management alternatives for conserving and strengthening biodiversity in agricultural productivity was conducted. This work was within the framework of the Conservation and Sustainable Management of Belowground Biodiversity project, which strives to enhance awareness, knowledge and understanding of Belowground Biodiversity important to sustain agricultural productivity in tropical land use systems. Integrating conservation in sustainable production systems ensures that agricultural productivity is enhanced, prevents further incursion into natural landscapes, and biodiversity is harnessed and conserved. Economics of on-farm studies help translate technical feasibility into economic feasibility by considering farmers' managerial, farm resource constraints and serves as a decision tool. Data were obtained from on-farm experiments on Legume Nodulating Bacteria (LNB), Mucuna improved fallows, Maize Stover application and Earthworm inoculation conducted in Buvuma Island. Partial budgets and farmer participatory approaches were used to value benefits and costs. The marginal rate of return was calculated to determine which options were dominant relative to farmers' practice, and marginal analysis curves were constructed. Sensitivity analysis enabled to incorporate variability in the analysis. Findings showed that all technologies were advanced with regard to the farmers' practices. However, some were dominated because of the high cost outlays involved and/or small net benefits. Sensitivity analysis indicated that technologies were sensitive to prices and yield variability. Economic viability of sustainable management options that enable farmers to achieve both objectives of increased crop productivity and enhanced conservation of biodiversity in agriculture is important. Availing such a decision support tool is a useful milestone in agro-biological conservation.

Presentation type

Poster

Affiliation

Grassland Community Initiatives Uganda (GCIU)

Session

SEEA Ecosystem Accounting and Biodiversity

8000031 - Maximizing the benefits of watersheds through earned value management (EVM)

Rogers Kisitu[1], Mathew Ssenteza[1], Derrick Kizza[2]

[1]Environmental Conservation and Development Initiatives (ECDI), Mubende, Uganda, [2]Research International Consult Uganda (RICU)- Kampala,Uganda

Well managed watersheds provide valuable services to communities, including the supply, protection and purification of water. Since these natural ecosystem services are always outside the conventional spheres of commercial markets, they are usually undervalued and under protected. With increased anthropogenic outcomes leading to severe effects on watersheds, valuable hydrological services are diminishing, which poses risks to the quality and cost of drinking water and the reliability of water supplies. Ensuring protection of watershed hydrological services requires policies that match integrated water and natural resource use with the provision of crucial natural protection services. The objective of this study is to examine the key attributes of hydrological services and their economic benefits. The study also highlights lessons learned, best practices and recommendations for maximizing the benefit of watershed through earned value management.

Presentation type

Poster

Affiliation

Environmental Conservation and Development Initiatives (ECDI)

Session

SEEA Ecosystem Accounting and Biodiversity

80005 - Essential Biodiversity Variables and Essential Ecosystem Services Variables for post-2020 policy development and implementation

HyeJin Kim[1], Patricia Balbanera[2], Jillian Campbell[3], Rebecca Chaplin-Kramer[4], Matthew Child[5], Simon Ferrier[6], Gary Geller[7], Mike Gill[8], Cornelia Krug[9], Katie Millette[10], Frank Muller-Karger[11], Henrique Pereira[12], Laetitia Navarro[13]

[1]UKCEH, [2]Universidad Nacional Autónoma de México, [3]CBD Secretariat, [4]WWF, [5]South African National Biodiversity Institute, [6]CSIRO, [7]NASA, [8]NatureServe, [9]bioDISCOVERY, [10]GEO BON Secretariat, [11]University of South Florida, [12]iDiv, [13]EBD-CSIC

As nations design a framework for biodiversity monitoring and conservation, the question on how to report on the successes and failures of policy implementation is becoming more salient. Here we show the value/benefits of Essential Variables for biodiversity and ecosystem services and their derived indicators for target tracking, policy planning, and forecasting, across scales. We first introduce Essential Biodiversity Variables (EBVs) and Essential Ecosystem Services Variables (EESV). We analyze the role of EBVs and EESVs in the Global Biodiversity Framework of the Convention on Biological Diversity, the United Nations Systems of Environmental-Economic Accounting, the United Nations Sustainable Development Goals, and the Conceptual Framework of the Intergovernmental Platform on Biodiversity and Ecosystem Services. We then illustrate how EBVs and EESVs are used in national accounts via application cases with repeatable workflows and open methodologies that are co-developed by the national stakeholders. We also discuss the potential of EBVs and EESVs in socioecological systems assessments and future forecasting in informing policy decisions. This paper explores the opportunities and benefits of the EBVs and EESVs for policy development and implementation from local to global scales with emphasis on repeatable workflows from primary data to indicators for decision support.

Presentation type

Talk

Affiliation

UK Centre for Ecology & Hydrology

Session

SEEA Ecosystem Accounting and Biodiversity

80002 - Integrated Natural Capital Accounting (INCA): Implementing the SEEA EA standard in the EU

Mayra Zurbarán Nucci[1]

[1]Joint Research Centre of the European Commission

The Knowledge Innovation Project on Integrated Natural Capital Accounting (INCA) for the EU is a joint undertaking by the European Commission services, including Eurostat, the Joint Research Centre, DG Environment and DG Research and Innovation, and the European Environment Agency. INCA provides the calculation of Ecosystem Accounts for the years 2000, 2006, 2012, 2018, and ongoing work is being carried out for 2021. Furthermore, INCA is fully compliant with the SEEA EA standard that was developed with the support of the European Commission. Specifically, INCA developed an approach to account for Ecosystem Services (ES), which considers the interaction between what ecosystems can provide (ES potential) and the human needs (ES demand). The project demonstrates consistent implementation of Ecosystem Accounts in the EU that ensures comparability and trend analysis. This presentation highlights the experience gained from INCA, the streamlining of the models through the INCA Tool, the use of Earth Observation in the models and challenges.

Presentation type

Talk

Affiliation

Joint Research Centre of the European Commission

Session

SEEA Ecosystem Accounting and Biodiversity

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

1300031 - Challenges and opportunities for mitigating climate change: Cherry-Throated Tanager Conservation Project in the State of Espírito Santo

Jaluzza Araujo[1], Filipe Santos[1], Marcelo Santos[2], Pedro Soares[1]

[1]Institute of Social Sciences of the University of Lisbon, [2]Marcos Daniel Institute

The loss of biodiversity and the ecosystem disturbances as a result of climate change is already a reality. The risk of species disappearance increases when we are faced with restricted biomes threatened by the lack of inspection and adequate public policies for monitoring land use. This is the scenario in which *cherry*-throated *tanager* (Nemosia rourei) finds itself, with only 22 individuals register in the world is a endemic bird to the State of Espírito Santo in Brazil and a critically endangered species. Having the high-altitude Atlantic Forest as its natural habitat, the actions foreseen in the *cherry*-throated *tanager* Conservation program (PCSA) foresee the intensive monitoring of forest conservation as a means of safeguarding the protection of the species and which can be more efficient if done with satellite remote sensing.The use of such technology can still be beneficial for fighting forest fires and managing the reliability of carbon and biodiversity credits. Raising the awareness of the social actors involved is the best path and the development of transversal public policies based on ESG criteria that include monitoring forests with high biodiversity at risk of extinction is an emergency action.

The article seeks to address how satellite monitoring of forests can contribute to the preservation of endangered species and leverage public policies that foster the green economy based on actions under development in the State of Espírito Santo.

Presentation type

Poster

Affiliation

Institute of Social Sciences of the University of Lisbon

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

130002 - Mapping lichen availability and accessibility in the context of caribou winter habitat selection

Leila Yousefizadeh Naeni[1], Jérôme Théau[1], Saeid Homayouni[2], Alexandre Langlois[1], Wenjun Chen[3]

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Terrestrial lichens provide crucial forage, especially during winter for caribou. The distribution and abundance of forage lichens have been shown to influence caribou habitat use patterns and population demography through time. In the winter, caribous often dig, or crater, in the snow to access the forage beneath, the energetic cost of which depends upon the snow's depth and physical characteristics. Icing events encase the vegetation below the snowpack in ice, making it inaccessible to caribou. Thus, a good understanding of lichen availability and accessibility is essential for conserving caribou in northern Canada, and remote sensing techniques can help reach these goals. This study aims to model habitat selection based on the lichen cover map and snow properties and identify how changes in the lichen cover map may affect caribou forage selection. This research focuses on the winter range of two migratory caribou herds north of Quebec. We will assess the potential of a multi-scale lichen cover mapping approach using a combination of in situ vegetation plots and uncrewed aerial vehicle (UAV) imagery collected during the field campaign in 2019 and 2022 and satellite imagery to produce the lichen cover map over a vast area. Afterward, by using the SNOWPACK model spatialization platform (OSSA), the spatiotemporal snowpack characteristics that affect foraging conditions will be simulated. These results will be used to improve the habitat modeling of caribou in their recorded locations. This presentation will cover the preliminary results of lichen cover mapping over the George River Herd winter range.

Presentation type

Talk

Affiliation

University of Sherbrooke

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

130005 - Quantifying the benefitscape and riskscape of the urban canopy under climate change

Sylvia Wood[1], Olivier Tanguy[1], Fanny Maure[1], Annick St-Denis[1], Kyle Martins[1], Noemie Lacroix[1], Tejasvi Hora[1], Andrew Gonzalez[1], Jerome Dupras[1], Christian Messier[1]

[1]Habitat

Cities, and the nature within them, are already experiencing the impacts of climate change. Both people and urban ecosystems are subjected to increasingly extreme weather events and pest outbreaks, putting the quality of life in cities at risk. Many cities have responded with ambitious tree-planting goals, however, such strategies rarely take consider the functional diversity of the urban canopy or adequately match tree traits to local climate hazards.

We develop a methodology to inform the strategic selection of species and plantation sites in cities that meet both social and climate tree planting goals. We test and assess the impact of these strategies on the overall canopy resilience (riskscape) and ecosystem service (ES) provision (benefitscape) across cities in Canada. Specifically, using spatial modeling and forecasting, we compare current business-as-usual (BAU) tree planting strategies with our functional diversity strategy with varying degrees of spatial matching to climate hazards and social criteria. We demonstrate the utility of our approach through a tale of five cities.

Across the cities we find that i) functional-diversity-driven planting strategies increase ecosystem service provision over business-as-usual (BAU) planting for some, but not all services; ii) species selection that is based on functional diversity and tolerance to site-specific climate hazards can dramatically increase the overall tolerance of the canopy to climate hazards, but can result in lower ES provision compared to BAU; and iii) that socio-economic differences in access or exposure to the benefitscape and riskscape of the urban canopy can be lessened through a function-diversity based approach.

Presentation type

Talk

Affiliation

Habitat

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

1300033 - Impact of climate change on biodiversity and ecosystem services in central Uganda

Tonny Kiggundu[1], Badru Kalyesubula[1], Shamim Namale[2], Edward Mutawe[3]

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Biodiversity and ecosystems are under threat from both natural and manmade drivers of change including; poverty, rapid population growth, unplanned urbanization, expansion of informal settlements, industrialization and the impacts of climate change. This study explored the impact of climate change on biodiversity and ecosystem services in central Uganda. The study used secondary data, climatic models, migration, and extinction scenarios to assess the impact of climate change on biodiversity and ecosystem services. Threats to biodiversity and ecosystem services in the region are exacerbated by climate change trends such as changing seasonal patterns, increased temperatures and aridity. Under migration scenarios, plant species that are unable to shift their geographic distributions are at 18% risk of extinction, as the earth continuously becomes hotter, cropping seasons are being altered. Terrestrial species are moving up in elevation at rates 2 times greater than initial estimates. The mean annual temperatures in the region have increased by 0.3^{o}C, having a significant impact on health and agriculture. Rising temperatures have favored the proliferation and breeding of mosquitoes, increasing malaria prevalence. Impacts of climate change like heavy rains, flooding, drought, disease outbreaks and epidemics have had significant implications for agriculture, food security, soil, water resources and land use. The ecosystem services provided by local habitats are vulnerable to loss of protection services provided by wetlands. Impacts of climate change have had serious effects on biodiversity and ecosystem services where by inadequate human capacity, limited research and development programs on climate change have constrained mitigation efforts.

Presentation type

Poster

Affiliation

Organization for Development of Integrated Rural-Urban Community Entities (ODIRUCE)

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

1300032 - Assessing Sudan forest ecosystems' integrity and resilience for biodiversity conservation and climate change mitigation

Nasradeen Gadallah[1, 2], Zoro Bertin[1], Ahmed Siggig[2]

[1]University Felix Houphouet-Boigny, [2]University of Khartoum

Forests globally provide economically essential products and services to humans and actively contribute to the world's environmental stability by preventing soil degradation, trapping carbon-dioxide, protecting 80% of the world's terrestrial biodiversity, and protecting watersheds. Forested ecosystems in Sudan are significant sources of various ecosystem goods and services which support the livelihoods of millions of people in the country. Unfortunately, these forests are overexploited, fragmented by many risks, and their areas continue to be sunk where only 10.3% of the country's landed area of 188.665 Mha is left as forest cover. Climate change, on top of other threats, is posing a real risk to these vital ecological areas, including their provided goods and services. Perhaps, for better preparedness for and coping with the impacts of climate change on forested ecosystems and its subsequent effects on goods and services, knowledge about the levels of integrity and resilience of these ecosystems remains the most crucial step in this path. Furthermore, planning for appropriate management interventions are also relying on understanding the degree of ecosystem resilience to climatic changes drivers as well as the adaption capacity of these ecosystems. Therefore, information on their status and adequacy to conserve biodiversity, mitigate climate change, and sustain the environment are critical to inform science-based policy development to support responsible and accountable land-use planning and decision-making. Thus, this research is aiming to characterize the integrity and capacity of Sudan forests ecosystems, with a view to strengthening the use of forest ecosystems for sustainable development.

Presentation type

Poster

Affiliation

University Felix Houphouet-Boigny

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

1300034 - Using bioacoustics to examine insect phenology and distribution on a latitudinal gradient

Joëlle Spooner[1], Anouk Simard[2], Marc J. Mazerolle[1]

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Biodiversity monitoring programs allow us to detect, understand and measure the impacts of climate change and anthropogenic pressures on ecosystems. In Quebec, a biodiversity monitoring network was established in 2016 by the provincial government. Taxonomically broad monitoring is performed yearly at survey sites across the province by using various sampling methods, such as acoustic recorders targeting Orthoptera (crickets, katydids, grasshoppers), birds, anurans, and bats. Since ectotherms depend on temperatures to complete their life cycle, our project aims to examine Orthoptera phenology as a bio-indicator of change. Using multi-species occupancy models, we investigate whether 9 Orthoptera species modulate their phenology and distribution in response to temperature on a latitudinal gradient. Such gradients can be used as tools to predict and evaluate potential responses to climate change. We found that the distribution of multiple species was limited by mean annual temperature. Our results also suggest that some Orthoptera species extended the length of their calling activity period and delayed their peak of calling activity at sites with high mean annual temperatures compared to low temperatures. Based on these results, we conclude that potential temperature increases could lengthen certain Orthoptera species' calling activity period and maintain or delay their peak of activity. Although multiple studies have found that seasonal activities tend to happen earlier in the season with warming temperatures, we found that phenological shifts are not unidirectional. These findings highlight that it is essential to understand how species adapt to temperature to predict how their phenology could be altered by climate change.

Presentation type

Poster

Affiliation

Université Laval

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

130003 - Trait-based diversity from Sentinel-2 links to drought resilience in temperate forests

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Satellite data offer great potential for addressing the need for continuous spatial and temporal information on biodiversity. Trait-based diversity at the community level, an essential dimension of biodiversity, bears opportunities to monitor and study vegetation in large-scale analyses when derived from satellite data. We present an approach to map and quantify diversity from physiological forest traits related to forest health, stress, and potential productivity, on landscape scales using Sentinel-2 data at 20 m spatial resolution.

Using this approach, we investigate the link between trait diversity maps and an ecosystem function, namely forest resilience to the drought of 2018 in Central Europe. We assess trait diversity at the community level of 1000 km^2 of Swiss temperate mixed forests and analyze the forests' drought response in terms of resistance, recovery, and resilience from 2017 to 2020 for different aggregation levels of richness, divergence, and evenness.

Our results show that forests with higher richness exhibit higher resistance and resilience to drought. Conversely, the relationship of divergence and evenness with resistance was hump-shaped, implying an optimum of these metrics in high-resistance forests. Lastly, forests with low divergence and evenness exhibited high resilience.

Our work explores and confirms the link between trait-based diversity and drought resilience from satellite data, contributes to understanding climate change impacts on forests, and provides the basis for further research on landscape-scale interactions. This paves the way toward large-scale assessment and long-term monitoring of forest diversity using satellite data.

Presentation type

Talk

Affiliation

University of Zurich

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

130001 - An integrated land-surface-phenology monitoring system for Chile: advances on the remote sensing based platform and the Phenocam field network

Roberto O. Chávez[1], Diego Valencia[2], Ignacio Díaz-Hormazábal[2], Jorge Herreros[3], José Lastra[1], Javiera Aguayo[1], Pablo Stuardo[1], Sebastián Bruna[1], Marcela Riquelme-Solar[1]

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Monitoring changes in vegetation phenology using remote sensing is one of the simplest and most efficient way to detect and geographically spatialize the effects of climate change. The increasing temperature of the last decades is altering the Earth vegetation phenological cycles, being the most evident symptom the timing shift of the onset, offset and growing season length. Regional to continental shifts in phenological timing can modify large scale biogeographical patterns affecting biodiversity, forest production, pest dynamics, agriculture and food availability. Several national and international efforts have been made to develop operational remote sensing based phenological monitoring system as well as ground observation networks of time-lapse cameras or “Phenocams”. Particularly in Chile, a 4,000 km long country, an alliance between the Pontificia Universidad Católica de Valparaíso, the National Forest Service Conaf and the Ministery of Environment is impulsing a Chilean **land-surface-phenological monitoring system.** The web-platforms is based on a flexible non-parametric probabilistic algorithm (the “npphen” R package) capable to reconstruct any type of leaf phenology using remote sensing data and to quantify its inter-annual variation by means of percentiles of the reference frequency distribution (RFD). Phenological anomalies with RFD > 0.95 trigger a “red alert” which is displayed on the web application as soon as the satellite data become available. Furthermore, a Phenocam network is under construction with daily RGB photos taken from ten sites (and in expansion) and transmitted via wireless to the central server. In this work, we show preliminary results and discuss future opportunities and challenges.

Presentation type

Talk

Affiliation

Lab. de Geo-información y Percepción Remota, Instituto de Geografía, Pontificia Universidad Católica de Valparaíso

Session

Climate Change as a Driver of Biodiversity and Ecosystem Change – Novel Uses of Satellite Remote Sensing

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250001 - Embracing the megadiversity: Long-Term Ecological Monitoring Programs (PELD) using traditional and e-DNA data

Valeria Tavares[1], Paulo Bobrowiec[1], Leonardo Trevelin [1], Carolina Carvalho[1], Mauricio Watanabe[1], Juliana Teixeira[1], Rafael de Fraga[1], Rafael de Assis[1], Tereza Giannini[1], Alexandre Aleixo[1], Guilherme Oliveira[1]

[1]Instituto Tecnologico Vale

Ecological change may appear instantaneous if considered separate nature interaction portraits. The pollination of a single flower unlocks a cascade of transformations that we seem to be able to predict. However, the dynamics of ecological transformation has a slower pace and cannot be understood in isolation or disregarding geographical and temporal biological variation. The Carajás mosaics of Eastern Brazil have Amazon Forest interspersed with iron-covered cangas and caves enclosed in a reserve with partial exploitation of minerals and conservation of unique ecosystems, the National Forest of Carajás. We describe our Long-Term Monitoring Program (PELD Carajás) including eDNA and standard data for the study of key local systems involving vertebrates, cave invertebrates, vegetation, and other groups. Among the several advantages of eDNA surveying coupled with PELD, we will be able to systematically compare results from different methods to detect diversity using an *in-situ* program that boosts a multi-species collection of biobank reference material. The biological diversity unlocked by using eDNA in different environmental gradients add assessing factors that influence the distribution and organization of biological communities. PELD standardization itself allows independent research groups to use similar sampling protocols and make demographic comparisons of species or assemblages in different vegetation types at local and biome scales. Our expectations include the implementation of this integrative monitoring program, including selected data and methods, long/and or efficient enough to include crucial processes that structure the ecosystems in study. In the long run, we aim to suggest new frameworks for monitoring megadiverse areas in the tropics.

Presentation type

Talk

Affiliation

Instituto Tecnologico Vale

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

2500031 - eDNA metabarcoding of the microbiota as a tool for bathing water quality assessment

Danielly Cristina Marques de Castro[1], Rafaela de Lima Ribeiro[1], Manoel Lopes[1], Alessandro Leite[1], Wilson Nascimento[1], Guilherme Oliveira[1], Alexandre Aleixo[1], Pedro Walfir[1], Leandro Araujo Argolo[1], José Augusto Pires Bitencourt [1]

[1]Instituto Tecnológico Vale

The São Marcos Bay (SMB) is home to a seaport with an intense flow of ships moving industrialized goods and is located near São Luis, a city with precarious basic sanitation system that dumps effluents into the sea. Monitoring water quality is essential to guarantee the ecosystem health, but traditional assessment methods cannot represent the true microbiological diversity. Therefore, eDNA metabarcoding of 16S rDNA amplicon libraries stands out as an efficient way to identify bioindicator microorganisms and to understand the local microbial diversity. Here, we use the Illumina MiSeq platform to analyze samples from six points within the SMB estuarine complex, considering different anthropic interference levels and tides bimonthly. We found a significant difference in richness distribution, highlighting the highest richness on point 4 (port area). Our results indicate that the SMB is mainly composed of aerobic chemoheterotrophic microorganisms, with *Marinobacterium*, *Pseudoalteromonas* and *Vibrio* being the most abundant. *Vibrio* spp. is present in nearly all points throughout the year, for both tides, with the highest relative abundance of ~28% for point 6 (quadrature, July). Other genera of great importance associated with nosocomial origin were detected, such as *Acinetobacter*. We propose *Vibrio* as a putative bioindicator of fecal contamination, as well as *Marinomonas* and *Marinobacterium* as indicators of hydrocarbon contaminants in the SMB. These results allowed us to visualize the current condition of the bathing water quality of the Bay and propose means of mitigating contamination from sanitary waste and industrial contaminants.

Presentation type

Poster

Affiliation

Instituto Tecnológico Vale

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

2500034 - DNA sequencing reveals high arbuscular mycorrhizal fungi diversity in the rhizosphere soil of Prunus africana trees in fragmented Afromontane forests

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Arbuscular mycorrhizal fungi (AMF) play a key role in medicinal plant species, besides their ecological role in shaping plant communities. Knowledge about diversity and structure of AMF communities associated with the endangered *Prunus africana* is valuable in the conservation and domestication of the species for its medicinal products. We investigated the diversity and structure of AMF species communities in the rhizosphere soils of *P. africana* trees occurring in four fragmented Afromontane forests found in Cameroon (Mount Cameroon and Mount Manengouba) and Kenya (Chukaand Malava) using Illumina Miseq sequencing of 18S rRNA gene amplicons. A total of 64 virtual taxa (VT) belonging to eight genera were detected namely *Glomus* (43 VT), *Claroideoglomus* (6 VT), *Paraglomus* (5 VT), *Acaulospora* (4 VT), *Diversispora* (3 VT), *Archaeospora*, *Pacispora*, and *Scutellospora* with 1 VT each. *Scutellospora heterogama* VTX00286 was the most abundant and common species in all four sites (49.62%). Glomeraceae and Gigasporaceae were the most abundantfamilies found across the sites, while Acaulosporaceae, Pacisporaceae, and Archaeosporaceae were rare, represented by <1% of all the detected taxa. Our data show a high diversity of AMF species associated with *P. africana*, and variable community structure partially shaped by local edaphic factors.

Presentation type

Poster

Affiliation

Pan African University, Institute for Basic Science, Technology and Innovation (PAUSTI)

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

2500032 - PIMBA v2.0: advancing biodiversity monitoring with phylogenetic placement

Renato R. M. Oliveira[1], Pierre Barbera[2], Jonathan Ready[3], Hugo de Boer[4], Micah Dunthorn[4], Alexandre Aleixo[1], Santelmo Vasconcelos[1]

[1]Instituto Tecnológico Vale, Brasil, [2]Heidelberg Institute for Theoretical Studies, Heidelberg, Germany, [3]Federal University of Pará, Brasil, [4]Natural History Museum, University of Oslo

Biodiversity monitoring is critical in understanding and conserving our complex ecosystems, helping to detect changes over time to better direct conservation strategies. Recent advances in monitoring approaches using genomics and bioinformatics tools have consistently improved both accuracy and efficiency in biodiversity assessment. PIMBA (PIpeline for MetaBarcoding Analysis) is a tool that aims to simplify and optimize metabarcoding analyses by implementing three primary modules - pimba_prepare, pimba_run, and pimba_plot. First, pimba_prepare allows quality treatment in the raw data, generating high-quality reads. Then, pimba_run performs the clustering and assignment methods, generating the taxon tables and other taxonomy assignment files. Furthermore, pimba_plot allows the generation of basic visualization plots for alpha and beta diversity indexes in the metabarcoding analysis. Here we introduce the latest release, PIMBA v2.0 (https://github.com/ITV-DS/ITV_GEN_PIMBA), which presents a significant enhancement by incorporating the Phylogeny Placement Workbench (https://github.com/pierrebarbera/placement-workbench) into a new module (pimba_plwb), which utilizes the Gappa tool. We applied pimba_plwb to a metabarcoding analysis with soil samples from an ironstone outcrop from the Amazon basin targeting the ITS2 region, comparing its output with two approaches: (i) against a conventional taxonomy-based list of plant species in selected plots; (ii) and against taxonomic assignments generated with a previously constructed DNA barcode reference database with pimba_run. PIMBA v2.0 successfully identified 76% of the genera listed by taxonomists and 94% of the genera identified by pimba_run. These promising results exemplify the potential and flexibility of PIMBA v2.0 as a tool for enhancing our capacity to monitor and understand biodiversity using phylogenetic placement.

Presentation type

Poster

Affiliation

Instituto Tecnológico Vale, Brasil

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250003 - Overcoming challenges for the establishment of eDNA surveys in Colombia

Mailyn Gonzalez[1]

[1]Instituto Alexander von Humboldt

eDNA is increasingly being implemented as a cost-effective tool for monitoring biodiversity and support conservation decisions worldwide. However, in the tropics major challenges remain to integrate eDNA as a cost-effective method for biodiversity assessment. Lack of representation in global genetic databases, access to sequencing technology, adapted protocols, importation cost and time delivery of reagents are some of the challenges preventing eDNA to become a routine approach for biodiversity survey in the tropics. In Colombia, as a result of different alliances with the research community and the private company we have been building capacity to promote the development of eDNA biodiversity surveys in different scenarios. From assessing the soil biodiversity turnover of tropical dry forest in disturbed and undisturbed areas to implementing microorganisms monitoring in environmental assessments and restoration programs in the context of mining industries. Our approach has allowed us to deliver training in eDNA to researchers but also to government agencies, and mining companies. We have incorporated the assessment of bacteria and fungi from soils, water and sediments in context where these biological components were previously disregarded. For eDNA to become a routine biodiversity assessment approach in the tropics, costs of processing samples need to be reduced, genetic databases need to be enriched and further work is needed to understand the turnover of biodiverse communities to established adequate monitoring designs and deliver information that can be integrate by environmental authorities.

Presentation type

Talk

Affiliation

Instituto Alexander von Humboldt, Bogota, Colombia

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250007 - Environmental-DNA (eDNA), a biomonitoring tool to support biodiversity conservation in the Urban Banco National Park (Abidjan, Côte d'Ivoire)

Allassane Ouattara[1], Koffi Nouho Ouattara[1], Karim Ouattara[2]

[1]Université NANGUI ABROGOUA, [2]Université Felix Houphouet Boigny

Environmental DNA (eDNA) approaches applied to biodiversity conservation and biomonitoring is a relatively new biomonitoring tool offering the potential to overcome some of the limitation of the traditional based methods. In the scope of a project funded by CEPF, a monitoring study was performed to identify macroinvertebrates and vertebrates diversity in the Banco River located in the Urban national park (Cote d'Ivoire) in February 2022. Water samples collected in the Banco River were filtered (900-1500 ml) and the filters were sent to the UK (NatureMetrics) for analyses (extraction, amplification, Next generation sequencing and bioinformatics). eDNA Metabarcoding approach identified around 40 taxa and 24 species for vertebrates (Actinopterygii, Aves, Amphibia and Reptilia) for only one sampling campaign at one site in triplicate experiment. These first results highlighted the potential of eDNA metabarcoding approach to support the national park manager for the implementation of conservation strategies. However, four main challenges which can limit the implementation of eDNA approaches were identified: i) the sampling strategies and volume filtered; ii) the analysis process (metabarcoding workflow); iii) the simple bioinformatic tools for analysis and reference database for identification; iv) the cost of equipment's and infrastructure requirement to support the eDNA methods. Nevertheless, three possible solutions can be envisaged, notably the setting up of low cost portable DNA laboratories, the networking for the pooling of equipment and finally the development of collaboration with the private and public funds to support the setting up of portable eDNA laboratories and specific database reference.

Presentation type

Talk

Affiliation

Université NANGUI ABROGOUA

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250004 - Engaging stakeholders to inform conservation decisions in Africa using environmental DNA technology: a showcase in Namibia

Manuel Lopes-Lima[1], Vincent Prie[2], Arnaud Lyet[3], Matthew Walters[4], Lindeque Pauline[4], Shapopi Mutaleni Kamanja[5], Sebastien Brosse[6], Lamech Mwapagha[5], Loic Pellissier[7], Zong Shuo[7], Alice Valentini[2], Filipa MS Martins[1], Pedro Beja[1]

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Sub-Saharan Africa is a hotspot where human population growth, infrastructure development, and the impacts of climate and land-use change are threatening its valuable but still poorly understood biodiversity. eDNA-based surveys and monitoring may help address key biodiversity knowledge gaps that hamper conservation policy and management, but the laboratories, equipment and trained human resources required are still very scarce across the African continent. International partnerships are therefore needed to accelerate the adoption of eDNA technologies through collaborative research and capacity building. Here we illustrate these ideas with a case study on the implementation of eDNA surveys in Namibia, involving joint efforts of international and Namibian stakeholders. Initial work included a pilot survey in major Namibian rivers (Kunene, Okavango, Kwando, Zambezi) and training of a local researcher, showcasing the power of eDNA to assess aquatic and terrestrial biodiversity. This was followed by extensive stakeholder mapping and the organisation of meetings with over 30 local stakeholders from various sectors. The meetings included presentations on the state of the art of eDNA technology and its potential applications in different contexts, using the results of the pilot study as an example. We then discussed each partner's specific portfolio of activities, interests and priorities, leading to the design of new pilot studies to test eDNA methods for different applications in the region (e.g. mining impacts, fisheries management, wildlife monitoring). Future work will include the implementation of five new pilot studies, training of Namibian staff, and ultimately the establishment of an autonomous eDNA laboratory in the country.

Presentation type

Talk

Affiliation

BIOPOLIS Program in Genomics, Biodiversity and Ecosystems, CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Campus de Vairão, Universidade do Porto, 4485-661 Vairão, Portugal

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

2500033 - eDNA metabarcoding support seascapes dynamics in a tropical coastal ecosystem of Brazil

Gabriel Coppo[1], Araiene Pereira[1], Ana Carolina Mazzuco[1], Angelo Bernardino[1]

[1]Universidade Federal do Espírito Santo

Coastal environmental conditions tend to vary over a year, and this dynamic usually influences benthic abundance and diversity, contributing to its variability. Seasonal changes are less pronounced in tropical areas, but most benthic organisms present some seasonality. Here we tested whether phylogenetic diversity, abundance of reads, and benthic sand beach assemblage composition would be associated with the seasonal dynamics of marine seascapes. We identified benthic organisms by eDNA metabarcoding through 18S amplicon sequencing, and characterized the variation in MBON Seascapes Pelagic Habitats Classification, during a 1-year sampling. We observed seasonal differences in seascape coverage with changes in their frequency along the year, overall characterized by high sea surface temperature (>20.9°C), high sea surface salinity (>33.6 PSU), and calm waters (absolute dynamic topography ranging from 0.51 to 0.83m). We detected significantly fewer sequence reads during spring and higher phylogenetic diversity during summer and winter. The higher abundance of sequences and phylogenetic diversity occurred when tropical water masses dominate the seascape, and lower abundance and phylogenetic diversity occurred when subtropical water masses become more frequent. It may be explained by water temperature and organic matter supply. Other studies reported tropical water masses related to benthic recruitment in this region. These findings highlight the association of benthic diversity to environmental conditions such as water temperature and food supply in coastal ecosystems, and support the seascapes dynamics influence on benthic organisms in tropical coastal areas.

Presentation type

Poster

Affiliation

Universidade Federal do Espírito Santo

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250005 - Bacterial composition revealed by eDNA metabarcoding helps uncover environmental impacts in a bay under heavy anthropogenic influence

Luciana Patrícia Silvestre de Souza[1], Danielly Cristina Marques de Castro[1], Rafaela de Lima Ribeiro[1], Manoel Lopes[1], Alessandro Leite[1], Wilson Nascimento[1], Guilherme Oliveira [1], Pedro Walfir[1], Leandro Araujo Argolo[1], José Augusto Pires Bitencourt [1], Alexandre Aleixo[1]

[1]Instituto Tecnológico Vale

Environmental monitoring is an instrument of great importance for the development of mitigation measures of environmental impacts, especially for large projects such as the Terminal Marítimo de Ponta da Madeira (TMPM), which is Brazil's second largest seaport in terms of volume of cargo transport. For this purpose, eDNA metabarcoding arose as an efficient and reliable method for biomonitoring. In this study, we aimed to assess putative anthropogenic impacts in the areas of influence of the TMPM and the city of São Luís-MA. We sequenced 16S rDNA amplicon libraries using an Illumina MiSeq sequencer for Zooplankton and Phytoplankton samples from 5 areas with 3 replicates each, considering dry and rainy seasons as well as quadrature and syzygy tides. While only small differences in bacterial phylum composition between Zoo and Phytoplankton were found, the comparison between rainy and dry seasons was significantly more divergent, with an increased occurrence of phyla such as Firmicutes; Fusobacteria and Epsilonbacteraeota during the dry season. Likewise, at the genus level, nearly all samples from the dry season were composed of taxa with less than 10% of the total abundance, while in the dry season, several genera became more abundant, especially the pathogenic *Vibrio* and *Pseudomonas*, which can represent over 50% of the records. The genus *Fusibacter* was also very abundant, being frequently associated with industrial environments containing oil or kerosene, possibly indicating contamination from the seaport activity. These results point to a severely degraded environment although reversible with the implementation of restoration measures and continued biomonitoring.

Presentation type

Talk

Affiliation

Instituto Tecnológico Vale

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250002 - Challenges and solutions for metabarcoding surveys in highly diverse tropical systems

Jonathan Ready[1], Fabricio Rosa[1], Cintia Carvalho[1], Anna Karolina Queiroz[1], Alan Rodrigues[1], Derlan Silva[1], Marcia Anjos[1], Jessica Dergan[1], Silvana Melo[1], Tiberio Burlamaqui[1], Silvia Barreto[1], João Braullio Sales[1], Jarl Anmarkrud[2], Audun Schroeder-Nielsen[2], Birgitte Thorbek[2], Aisha Amaral[1], Ana Elena Tabosa[1], Karolina Ferreira Rodrigues[1], Luiz Oliveira[1], Naelma Kimura[1], Orlando Reis[1], Yany Pinheiro[1], Bianca Lima Paiva[1], Renato Oliveira[3], Gisele Nunes[3], Santelmo Vasconcelos Jr[3], Valéria Tavares[3], Alexandre Aleixo[3], Guilherme Oliveira[3], Quentin Mauvisseau[2], Hugo de Boer[2]

[1]Universidade Federal do Pará, [2]Universitetet i Oslo - NHM, [3]Instituo Tecnologico Vale - DS

Metabarcoding has emerged as a powerful tool for biodiversity assessment by utilizing DNA extracted from various sample types. It has gained particular relevance in tropical ecosystems due to their high biodiversity and often complex and inaccessible habitats, but there are still many challenges. We present a synthesis of the obstacles to the use of these techniques in lowland Amazonia and some solutions that have helped to promote cost-effective surveying of tropical freshwater fauna with good taxonomic resolution. Varying sample type, sample design and choice of primers and reagents are key to successfully adapting these methods for large scale use, while database curation and logical parameterization in bioinformatic pipelines can help optimize analysis time and provide relevant and informative results for both general conservation as well as management of natural resources.

Presentation type

Talk

Affiliation

Universidade Federal do Pará

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

250006 - The influence of oceanography on marine biodiversity patterns across the Galápagos

Diana A. Pazmiño[1], Alexander Forryan[2], Alberto Naveira-Garabato[2], Marc Rius[3], Luke E. Holman[2, 4]

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Understanding spatial patterns of marine biodiversity is key to advance our understanding of biogeography and to guide conservation efforts. Despite evidence that biodiversity is influenced by processes at different spatial scales, limited work has directly linked oceanography and community data. Furthermore, biodiversity assessments can be difficult in oceanic islands, where access to remote locations may be challenging. Here, we combined environmental DNA (eDNA) metabarcoding data with oceanographic modelling to understand the influence of oceanographic drivers on biodiversity patterns of fish (both elasmobranch and teleost) across the Galápagos Islands. Seawater samples were collected in twenty-three locations across the archipelago. This was followed by the amplification of a subsection of 12S rRNA gene using Illumina MiSeq. We found that fish communities mirrored previously described biogeographic regions almost entirely, except for Roca Redonda, an islet of the Western region whose diversity is closer to samples from the Northern region. However, no significant differences were observed in species richness between bioregions. Geographic distance between sites explained 11,2% of the variation in Beta dissimilarity among sites. Interestingly, oceanographic resistance (a novel metric based on oceanographic current modelling) explained 3,4% of the variation in Beta dissimilarity. These results highlight the influence of local processes such as oceanographic resistance in shaping biodiversity patterns, and underline the importance of using cost-effective methods such as eDNA to understand whole-community patterns across seascapes.

Presentation type

Talk

Affiliation

Galápagos Science Center, Universidad San Francisco de Quito, Isla San Cristóbal, Galápagos 200150, Ecuador

Session

Unlocking eDNA as a Biodiversity Monitoring and Conservation Tool in Tropical Landscapes

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150004 - Integrating ephemeral wetlands in the sustainable management of boreal forests: an innovative biodiversity assessment of unknown vulnerable ecosystems from space to field supported by art for public involvement

Aurélie Davranche[1], Clarisse Blanchet[1], Petri Nummi[2], Jean Secondi[3], Henrik Lindberg[4], Harri Vasander[2], John Loehr[5], Janne Sundell[5], Céline Arzel[6]

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The conservation of biological diversity has become an important goal of managing forests in an ecologically sustainable way. In the European boreal area, the forest industry has focused on spruce forests where the organic soil layer becomes thick and rich in organic material. When it rains, carbon leaches out into the lakes and streams which is a cause of surface water browning. Water browning is expected to hinder key ecosystem processes, particularly through lower primary productivity and loss of biodiversity. Forest practices have resulted in extensive drainage in the boreal area but small water areas can play a role in water browning mitigation. However, there is a global lack of rigor and coherence in the regulatory protection of small aquatic resources. Hence, ephemeral wetlands in boreal forests have been largely overlooked despite the ecosystem services they provide especially in terms of water quality. In this domain, the full benefits are often provided by the cumulative effect of several small wetlands at the catchment scale (network of wetlands). In this project we are investigating modelling of space based data at different resolutions and applying simple fieldwork protocols to monitor the biodiversity and assess ecological functions of unknown ephemeral wetlands in boreal forests. Stakeholders from timber industry to public of different age classes are involved through diverse art activities and communication actions. The objective is to propose a holistic approach to define solutions at watershed scales that integrate networks of ephemeral wetlands in sustainable forest practices.

Presentation type

Talk

Affiliation

Lammi Biological Station, Department of Forest Sciences, University of Helsinki

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150012 - Empowering the Blue Economy in the Global South through transformative eDNA strategies

Isa Elegbede[1, 2]

[1]Geo blue planet, [2]Lagos State University

Environmental DNA (eDNA) has emerged as a powerful tool for monitoring and conserving biodiversity in aquatic ecosystems, with significant implications for advancing the blue economy in the global south. This presentation explores the challenges and transformative strategies associated with unleashing the full potential of eDNA in tropical landscapes. Key challenges encompass limited awareness and understanding, restricted access to advanced eDNA technologies, capacity building gaps, and financial constraints. To address these challenges and foster transformative change, this session proposes a range of strategies. These include targeted educational programs to enhance eDNA literacy, technology transfer initiatives to ensure equitable access to eDNA analysis tools, capacity building efforts to cultivate local expertise, and dedicated funding mechanisms to support research endeavors. Moreover, community engagement and participatory approaches are emphasized as integral components to integrate local knowledge and promote inclusive decision-making processes. The development of comprehensive policy frameworks is also underscored to facilitate responsible eDNA sampling, data sharing, and ethical considerations. By embracing these transformative strategies, the global south can harness the full potential of eDNA as a vital tool for biodiversity monitoring and conservation, unlocking new opportunities for sustainable development within the blue economy in tropical aquatic ecosystems.

Presentation type

Talk

Affiliation

Lagos state university

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150011 - Underwater Hyperspectral Imaging for assessing biodiversity and ecological status of shallow and deep sea coral ecosystems

Touria Bajjouk[1], Maxime Ferrera[2], Tristan Petit[1], Aurélien Arneaubec [2], Jean-Baptiste Féret[3]

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Satellites and hyperspectral imaging data has been successfully used for a wide range of coastal objects around the world. To extend the application of this technology to deeper areas, underwater hyperspectral imaging (UHI) sensor was deployed in shallow and deep sea environments as a part of iAtlantic and Marha European projects. The sensor is a push-broom scanner that records continuously intensities of reflected light for spectral range between 378 and 800 nm.

To integrate the UHI into Ifremer's HROVs and ensure its proper functioning before its deployment, several surveys were firstly carried out in shallow areas. The aimed study sites are shallow coral reefs in La Reunion Island (15 m depth) and deeper area, Lampaul canyon (750 m depth), characterized by the presence of cold water coral (CWC) habitats.

A pre-processing chain has been developed to both improve image geometric quality and perform radiometric calibration. To assess the UHI potential for seafloor substrate and species detection and identification, several machine learning algorithms were applied and compared for deep sea cold water coral (CWC) areas. With an overall accuracy of 0.98, Random Forest has been the algorithm that provides the best results of discriminating seabed types and CWC ecological status, including relevance in their spatial distribution. We also take advantage of UHI high spectral and spatial resolution data to produce diversity index maps derived from Bray-Curtis dissimilarity on shallow coral reef area. Obtained results pave the way towards innovative monitoring of biodiversity in support of ecologists and decision-makers.

Presentation type

Talk

Affiliation

IFREMER, Centre de Bretagne, DYNECO LEBCO, Plouzané, France

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

1500032 - Ditches as critical biodiversity support systems in intensively-managed agro-ecosystems

Natalie Rideout[1], Niloofar Alavi[2, 3], Alex Bush[4], Nellie Gagné[5], Mehrdad Hajibabaei[6], David Lapen[7], Gregory Mitchell[8, 9], Teresita Porter[6], Royce Steeves[5], Donald Baird[1]

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Drainage ditches in agroecosystems are designed for utility, helping farm operators control water levels on their fields, but in increasingly homogenised landscapes they can represent biodiversity refuges, hosting rich communities of plants, macroinvertebrates, fish and associated riparian wildlife. Management of these habitats to support delivery for ecosystem services is becoming increasingly important as agricultural intensification and extensification increases and climate change modifies agroecosystems globally. In the absence of natural open-water habitat in agro-landscapes, drainage ditches can be important sources of ecosystem services in the form of emergent insect secondary production, as they supply the landscape with nutritionally-rich highly unsaturated fatty acids. Avian insectivores—currently experiencing global declines—nest and forage in these drainage ditch networks, relying on emerging aquatic insects, not only as an energy supply, but as a nutritionally-critical component of their diet. We quantify the value of these habitats in terms of aquatic insect production across a drainage ditch network in South Nation river basin, an agriculturally-dominated catchment of the Ottawa River watershed in eastern Canada. This catchment is currently the focus of the Environmental Change Onehealth Observatory (ECO2), a Canadian federal interdepartmental project to study the consequences of erosion of natural capital and associated ecosystem services on: 1. Biodiversity; 2. [Re]emergence of infectious zoonotic diseases of importance to human health; and 3. [Re]emergence of infectious diseases of importance to livestock health, with the aim to find a balance between producing food and other commodities which support the well-being of Canadians with the need to provide increased biosphere stewardship.

Presentation type

Poster

Affiliation

Environment and Climate Change Canada @ Canadian Rivers Institute, Department of Biology, University of New Brunswick, Fredericton, NB, Canada

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150017 - Dynamic Seascapes: quantifying habitat extent and diversity for global ocean Essential Biodiversity Variables

Maria T. Kavanaugh[1], Enrique Montes[2], Daniel Otis[3], Joaquin Trinanes[4], Frank Muller-Karger[3]

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While landscape definitions provide fixed boundaries to identify observational context, including habitat quality, heterogeneity, and extent, pelagic seascape ecology requires a dynamic geographic framework to track changes in ecosystem extent and location; quantify mechanistic relationships between habitat community structure, and ecosystem functioning; and ultimately determine the vulnerability or resilience of pelagic organisms or systems to global change. Dynamic and synoptic seascapes are classified from satellite- and model-based fields that characterize phytoplankton responses to multi-scale physicochemical changes in surface water masses. As part of the US and global efforts to create a Marine Biodiversity Observation Network (MBON), seascapes are validated and extended in time and depth through the integration of in situ bio-optics, repeated observations of primary and secondary producers, long term ecological studies, and marine ecosystem models in subtropical, temperate, subpolar, and polar ecosystems. Seascape maps are produced in near real-time and served to the community via NOAA CoastWATCH, providing: 1) a biogeographical framework for biodiversity assessments, 2) an objective means to conduct ecosystem comparisons, 3) a means to track movement and habitat usages of marine fisheries and migratory species, and 4) a means to quantify interannual variability in the quality and availability of critical habitats. Here we focus on evaluating climate drivers of seascape-based EBVs of Ecosystem Structure, including the variability in surface habitat extent and diversity over time within and across critical regions and ocean basins.

Presentation type

Talk

Affiliation

Oregon State University, Corvallis, OR, USA

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

1500031 - Integrating ephemeral wetlands in the sustainable management of boreal forests: an innovative biodiversity assessment of unknown vulnerable ecosystems from space to field supported by art for public involvement

Aurélie Davranche[1], Clarisse Blanchet[1], Petri Nummi[2], Jean Secondi[3], Henrik Lindberg[4], Harri Vasander[2], John Loehr[5], Janne Sundell[5], Céline Arzel[6]

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The conservation of biological diversity has become an important goal of managing forests in an ecologically sustainable way. In the European boreal area, the forest industry has focused on spruce forests where the organic soil layer becomes thick and rich in organic material. When it rains, carbon leaches out into the lakes and streams which is a cause of surface water browning. Water browning is expected to hinder key ecosystem processes, particularly through lower primary productivity and loss of biodiversity. Forest practices have resulted in extensive drainage in the boreal area but small water areas can play a role in water browning mitigation. However, there is a global lack of rigor and coherence in the regulatory protection of small aquatic resources. Hence, ephemeral wetlands in boreal forests have been largely overlooked despite the ecosystem services they provide especially in terms of water quality. In this domain, the full benefits are often provided by the cumulative effect of several small wetlands at the catchment scale (network of wetlands). In this project we are investigating modelling of space based data at different resolutions and applying simple fieldwork protocols to monitor the biodiversity and assess ecological functions of unknown ephemeral wetlands in boreal forests. Stakeholders from timber industry to public of different age classes are involved through diverse art activities and communication actions. The objective is to propose a holistic approach to define solutions at watershed scales that integrate networks of ephemeral wetlands in sustainable forest practices.

Presentation type

Poster

Affiliation

Lammi Biological Station, Department of Forest Sciences, University of Helsinki

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150001 - Measuring the extent of global inland water protection using novel datasets and methods

Bernhard Lehner[1], Robin Abell[2], Michele Thieme[3], Mira Anand[4], Guenther Grill[4]

[1]McGill University, [2]The Nature Conservancy, [3]World Wildlife Fund, [4]Confluvio Consulting

Inclusion of inland waters in the 30 x 30 target of the Kunming-Montreal Global Biodiversity Framework requires establishing a baseline and measuring progress against it. At the CBD COP15, Protected Planet, including the World Database on Protected Areas (WDPA) and the World Database on OECMs (WD-OECM), was re-adopted as the indicator for tracking coverage of protected and conserved areas through 2030. As a second prerequisite, harmonized global maps that describe the extent of a broad range of freshwater ecosystem types at high spatial resolution are needed to serve as foundation for measuring their current protection status and future trends. Finally, a method is required that looks beyond simply accounting for overlapping areas of inland waters sitting within protected and conserved areas, ideally incorporating measures of effectiveness, fluvial connectivity, representation, and equitable governance. Here, we present new versions of several widely accepted global freshwater ecosystem datasets that take advantage of the latest generation of remote sensing information to define the extent of 30 classes of inland waters, including upcoming new releases of the Global Lakes and Wetlands Database (GLWD) and of the HydroSHEDS global river network. We then outline draft indicators representing a diversity of inland water protection metrics, including the quantification of the spatial extent of protection per freshwater ecosystem type, flow path length of protected and free-flowing rivers, and the integration of upstream protection as a precursor to defining a more comprehensive set of indicators to be developed in the future.

Presentation type

Talk

Affiliation

McGill University

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150007 - Monitoring of wetlands gross primary productivity through Sentine-2 imagery

Anna Spinosa[1], Ghada El Serafy[1], Valeria Mobilia[1], Mario Alberto Fuentes Monjaraz[1]

[1]Deltares

Wetlands are highly valuable ecosystems for biodiversity and human beings. They provide flood alleviation and coastal protection regulating the impact of natural hazards during extreme weather events. Regardless of their importance, the natural wetland extension has drastically declined in the past decades. Conservation practices and monitoring of activities are therefore essential to assess changing patterns in wetlands and ensure their conservation.

The conservation, restoration and sustainable use of the wetlands has also been emphasized by multiple international agreements, such as the Sustainable Development Goals (SDGs) and the Convention on Biological Diversity (CBD). Earth Observations provide data timely and systematically and have the capabilities to enhance our understanding of the ecosystem processes and their drivers of changes thus improving conservation and restoration practices.

This research demonstrates the use of the Sentinel-2 Multi-Spectral Instrument (MSI) to improve gross primary productivity (GPP) estimation accuracy across marshland ecosystems. Multiple remote sensing vegetation indexes (VIs), in-situ and global environmental data are integrated to derive an empirical model formulation for the estimation of the GPP. The model is additionally upscaled across surrounding regions with similar biophysical properties and photosynthesis activity identified via an unsupervised classification algorithm.

The workflow is demonstrated in the study case of Doñana National Park, a UNESCO Biosphere Reserve and a Ramsar site sheltering the largest wetland in Western Europe. Research outcomes support the use of red-edge VIs and precipitation data for primary productivity remote sensing applications in wetlands ecosystems.

Presentation type

Talk

Affiliation

Deltares

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150018 - Satellite Earth observation products to inform ocean Essential Biodiversity Variables in the context of climate change

Victor Martinez-Vicente[1], Shubha Sathyendranath[1], Thomas Jackson[1], Peter I. Miller[1], Stefanie Brosziet[1], Pierre Gernez[2], Laurent Barille[2], Simon Oiry[2], Bede Davies[2], Dimosthenes Traganos[3], Avi Pertiwi[3], Francois Steinmetz[4], Angus Atkinson[1], Josean Fernandes[5], Dionysios Raitsos[6], Sofia Darmaraki[6], Javier Concha[7], Marie-Helene Rio[7], Marc Paganini[7]

[1]Plymouth Marine Laboratory, [2]Nantes University, [3]DLR, [4]Hygeos, [5]AZTI, [6]NKUA, [7]European Space Agency

Increasing pressure on nature due to anthropogenic drivers is leading to a reduction of global biodiversity and its associated benefits at the planetary scale. In coastal and open ocean environments, the most important direct drivers of biodiversity loss (fishing, land and sea use, pollution) combine with climate change. These drivers have accelerated in the last 50 years (IPBES, 2019) and they are predicted to continue (Leclère et al, 2020), despite international efforts in the last decades (Convention on Biological Diversity, CBD, Aichi targets) and renewed efforts (Kunming-Montreal Global Biodiversity Framework). In order to guide further action, it is therefore urgent and important to develop “fit-for-purpose” observation tools from existing remote sensing platforms. These observations should be capable of assessing and monitoring how the community structure and function of coastal ecosystems will respond to the anthropogenic and natural drivers in a changing climate.

We present progress on two projects supported by the European Space Agency (ESA): Biodiversity in the Open Ocean: Mapping, Monitoring and Modelling (BOOMS) and Biodiversity of the Coastal Ocean: Monitoring with Earth Observation (BiCOME). These projects focus on exploring satellite ocean colour and front observations to derive a wide range Essential Biodiversity Variables (EBV) in a intertidal, subtidal and pelagic (coastal and oceanic) ecosystems. The approach is to test conventional and advanced Earth Observation algorithms to assess their ability to retrieve EBV at community and ecosystem level. The results will feed into a roadmap informing ESA about future algorithms and datasets development needs.

Presentation type

Talk

Affiliation

European Space Agency

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150006 - Mapping co-occurrence of terrestrial and lake biodiversity hotspots across Canada: synergies for conservation

Sufyan Mirza[1], Irene Gregory-Eaves[2], Yannick Huot[1]

[1]Sherbrooke University, [2]McGill University

Watersheds represent a fundamental unit in the interconnected aquatic-terrestrial ecosystem, and despite the increase in cross-ecosystem studies, there is still a lack of research investigating the biodiversity of coupled watershed systems where both aquatic and terrestrial species are examined. Here, we bridge this gap by utilizing biodiversity indices to quantify and map whole watershed biodiversity across different Canadian ecozones. Our analysis on the aquatic realm includes phytoplankton and zooplankton taxa collected by the NSERC Canadian Lake Pulse Network, whereas tree species represent the terrestrial dataset obtained from Canada's forest attributes made available by the Government of Canada. We first explored total watershed biodiversity patterns by considering the standardized sum of aquatic and terrestrial datasets and then investigated the relationship between aquatic and terrestrial diversity. Given that land use and other environmental variables are known to affect biodiversity metrics, we also examined how biodiversity varied across key gradients. We found total watershed biodiversity to follow a longitudinal pattern, which was greatest across the eastern ecozones, and followed a positive correlation with the proportion of natural landscapes and average precipitation. We also found biodiversity to be negatively impacted by the presence of agricultural areas and found total watershed biodiversity to be lowest in central-western Canada. Furthermore, moderately positive relationships between aquatic and tree biodiversity were detected and were generally strongest across eastern ecozones. These results provide a first portrait of watershed-scale cross-ecosystem diversity trends in Canada and represent a key resource of large-scale land use planning and climate change mitigation efforts.

Presentation type

Talk

Affiliation

Sherbrooke University

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150015 - The Ocean Tracking Network (OTN) and its role in biodiversity monitoring in aquatic ecosystems

Frederick Whoriskey[1], Sara Iverson[1], Jonathan Pye[1], Evelien VanderKloet[1], Robert Lennox[1]

[1]Ocean Tracking Network, Dalhousie University

The Global Ocean Observing System's (GOOS) Biology and Ecosystems panel has proposed ***Fish Abundance and Distribution*** and ***Marine Turtle, Bird and Mammal Abundance and Distribution*** as Essential Ocean Variables for monitoring changes in aquatic biodiversity, its function and its services to society. Determining distributions of highly mobile aquatic animals that frequently inhabit areas seasonally is challenging. However, this is critical for management and conservation efforts ranging from implementing spatial management for fisheries to defining the boundaries of Marine Protected Areas. The Ocean Tracking Network (OTN) is a global aquatic research, data management, conservation and partnership platform that uses electronic tracking systems in salt and fresh water to provide and share knowledge on the movements, habitats and survival of marine and freshwater species. Since 2008, OTN has built partnerships with regionally based telemetry groups and installed additional research infrastructure to create a global community of researchers using shared compatible equipment, data systems and analytical tools. These monitor and research local-to-global scale movements, distribution, and habitat use of aquatic species and to document how these respond to rapidly changing aquatic environments. Researchers from Academia, Government, Non-governmental organizations, Indigenous groups and citizen science organizations are participating in the network. Current studies include documenting shifting right whale distributions in Canadian waters and determining the overlap of ocean movements of Atlantic salmon with offshore energy projects. OTN is now integrating with new biological, physical and chemical monitoring efforts such as the GOOS pilot Animal Borne Sensors network, and the Canadian Integrated Ocean Observing System.

Presentation type

Talk

Affiliation

Ocean Tracking Network, Dalhousie Univesity

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150003 - Harmonizing freshwater biodiversity monitoring and assessment for healthier livelihoods

John P. Simaika[1], Sandra Poikane[2], Jen Lento[3], Andreas Bruder[4], Kristian Meissner[5], James Stribling[6]

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Nationally and regionally accepted protocols for freshwater biodiversity monitoring and ecological status assessment are globally rare. Indeed, for freshwater biodiversity monitoring there aren't currently any harmonized protocols in existence. Regarding the assessment for ecological status, there are national protocols in place in many countries, with some even harmonized regionally, but restricted to the Global North. Within countries there exists a wide variety of methods and protocols that are in variable degrees of use. The quality of the data collected is also not assured, with essential quality control steps missing from many protocols. The lack of standardized, methods and protocols with minimum performance standards both for biodiversity monitoring and ecological status assessment hinder the reliable assessment of biodiversity and ecological trends at regional, continental, or global scales. This may impact management decisions and actions made to address the freshwater biodiversity crisis.

The IUCN Species Survival Commission Task Force on Global Freshwater Macroinvertebrate Sampling Protocols (GLOSAM) was established in recognition of the need to globally harmonize methods and protocols to help track the biological status and trends of freshwater ecosystems. The GLOSAM aims to: (a) support the application of biodiversity and bioassessment protocols based on benthic freshwater macroinvertebrates, (b) establish globally accepted, harmonized steps for sample collection and data treatment, both for bioassessment and species inventories, which also account for specific biogeographic requirements, (c) ensure the collection of ecologically relevant data of known and acceptable quality and (d) support, promote, and facilitate regionally comparable bioassessment schemes.

Presentation type

Talk

Affiliation

IHE Delft Institute for Water Education, The Netherlands

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150009 - Quantifying changes in the extent of South African estuarine habitats to inform targets of the Global Biodiversity Framework

Heidi van Deventer[1], Philani Apleni[2], Janine B Adams[3], Taryn Riddin[3], Lara van Niekerk[1], Akhona Madasa[1], Anesu Machite[3], Emily Whitfield[3]

[1]Council for Scientific & Industrial Research (CSIR), South Africa, [2]University of Pretoria (UP), South Africa, [3]Nelson Mandela University (NMU), South Africa

Changes in the extent of 324 South African estuaries and outlets were quantified to inform several GBF targets of Goal A: (1) loss in extent; (2) extent required for intervention; (3) protection, and the first two criteria of Red Listing of Ecosystems. Extents were derived to align with four existing National Land Cover (NLC) years: 1990, 2014, 2018 and 2020. Extents were derived in Google Earth Engine (GEE) using Landsat for the first two dates, and Sentinel-1 and -2 with indices for the last two dates. The coastline was divided into two broad classification regions: Region 1: 109 estuaries/inlets without mangroves from the cool temperate biogeographic region bordering Namibia in the west to the warm temperate region; Region 2: 215 estuaries/inlets with mangroves from the temperate to tropical eastern shores on the border with Mozambique. The preliminary results for 2020 for Region 1 showed that Intertidal salt marsh for *Spartina maritima* and Intertidal salt marsh for Succulents achieved a user's accuracy (UA)>73%; threatened seagrass *Zostera capensis* (intertidal and subtidal) had UAs>61%; Macroalgae resulted in a UA=81%. Region 2 results: mangroves were highly separable from forested wetlands and timber plantations with UA=92%; *Zostera capensis* classes were UAs>88% and salt marshes UA=73%. Both regions also had high separability for Sand/mudbanks (UA>71%), though open water were better separable in Region 2 (UA=91%) compared to Region 1 (UA=68%). Final statistics for the GBF targets will be presented at the conference.

Presentation type

Talk

Affiliation

Council for Scientific and Industrial Research (CSIR)

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150010 - The Marine Biodiversity Observation System (MBON): A community of practice to advance the goals of the UN Ocean Decade through co-development of Essential Ocean Variables (EOVs) and Essential Biodiversity Variables (EBVs)

Frank Muller-Karger[1], Joana Soares[2], Isabel Sousa-Pinto[3], Massa Nakaoka[4], Adriano Lima[2], Gabrielle Canonico[5], Ward Appeltans[6], Emmett Duffy[7], Linwood Pendleton[8], Aileen Tan[9], Enrique Montes[10], Abigail Benson[11]

[1]University of South Florida, [2]MBON Secretariat / AIR Centre, [3]CIIMAR/University of Porto, [4]Hokkaido University, [5]U.S. Integrated Ocean Observing System (IOOS), [6]Ocean Biodiversity Information System (OBIS), [7]Smithsonian Environmental Research Center, [8]Ocean Knowledge Action Network (OKAN), [9]Universiti Sains Malaysia (USM), [10]NOAA AOML/CIMAS, [11]USGS/OBIS/GBIF

The status and trends of species population distribution, abundance, and production in coastal and ocean waters are required to inform policy and management in the context of growing human uses of marine resources, coastal development, and climate change. They are fundamental to develop coastal economies, to create and sustain jobs, and to conserve resources.

Over the past decade, two synergistic efforts have identified priority variables to support the developing Blue Economy. The Global Ocean Observing System (GOOS) is implementing Essential Ocean Variables (EOVs). The Group on Earth Observations Biodiversity Observation Network (GEO BON) is implementing the Essential Biodiversity Variables (EBVs). Such efforts emphasize the need for co-development, and collecting data and managing information using best practices and standards. Managing information in an interoperable manner allows comparisons from one place to the other and over time. They are important to guide planning and implementation of the UN Decade of Ocean Science for Sustainable Development (2021-2030). UN Ocean Decade programmes like Marine Life 2030 (https://marinelife2030.org/) bring together partners such as the Marine Biodiversity Observation Network (https://marinebon.org/), GOOS, OBIS, and stakeholders to address such goals. Marine Life 2030 and MBON are open networks that serve as a community of practice to which everyone is invited. Please join by registering in MBON via GEOBON (https://members.geobon.org/pages/index).

Co-design and effective information management and delivery are critical to develop practical and useful regional and global assessments that report to international conventions and treaties (IPBES, GBF/CBD) and requirements at the national level.

Presentation type

Talk

Affiliation

University of South Florida

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150016 - Jellyfish proliferation along Kribi coastal region of Cameroon-Gulf of Guinea: status, challenges and opportunities

Gisele Flodore Youbouni Ghepdeu [1], Durane Tchatchouang Chougong[2], Andre Carrara Morandini[3], Ilka Straehler-Pohl[4], Felix Meutchieye[5], Wilfred Fon Mbacham[6], François Tchoumbougnang[1]

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Jellyfish proliferation is a global issue for the socio-economic, environmental and health impacts of these proliferations. However, information regarding their diversity, ecology, occurrence, and impacts are still lacking in many regions especially the Gulf of Guinea inner section. Preliminary research on jellyfish diversity and ecology reveals the presence of ten species from both Classes Scyphozoa and Cubozoa. Three genera, *Catostylus* (46.31%), *Chimaerus* (25.25%) and *Chrysaora* (19.88%), from three families and three orders were the most abundant. *Catostylus sp3 (34.40%)*, *Chimaerus palmatus (25.25%)*, *Chrysaora sp. (19.88%)* were the most abundant species followed by *Cyanea sp. (8.14%)*, *Catostylus sp2 (7.02%)*, *Catostylus tagi (2.83%)*, *Catostylus sp1 (1.89%)*, *Catostylus sp4 (0.12%)*, *UND Catostylidae (0.06%)*, Hexaradial jellyfish *(0.06%)* and *Anemonia sp. (0.06%)*. Jellyfish size ranges show that identified species could complete all their growth stages in this environment, although few individuals of *Cyanea sp*. were juveniles. Globally, the coastal zone of Kribi enclose a high diversity with about 45.45% of species potentially new to science which taxonomy needs to be confirmed using genomics. Stinging events were recorded with mild and severe cases which required medical treatment. Overlap between high jellyfish occurrence and shrimp and small pelagic fishes of the region were also observed. However, proximate composition of *Catostylus spp*. showed that they can be considered a nutrient source in the region, even though their chemical composition as well as their phylogeny are yet to be discovered.

Presentation type

Talk

Affiliation

ECOP at Specialized Research Station for Marine Ecosystems of IRAD, University of Douala

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150013 - Transformative biodiversity monitoring in Atlantic aquatic ecosystems: sustainable indigenous practices and low-cost technologies

Isa Elegbede[1], Fawas Sanni[1]

[1]Lagos State University

Conventional approaches to biodiversity monitoring in Atlantic aquatic ecosystems encounter challenges rooted in limited resources, inadequate community engagement, and high costs. This study presents transformative solutions through the integration of sustainable indigenous practices and low-cost technologies. By incorporating traditional ecological knowledge and wisdom, context-specific monitoring strategies can be developed, empowering local communities and enhancing the effectiveness of monitoring efforts. Sustainable indigenous practices, rooted in cultural wisdom and understanding, contribute to ecological resilience and foster inclusive decision-making processes. Complementing this, low-cost technologies provide opportunities to democratize biodiversity monitoring. Citizen science initiatives enable broader participation, where individuals contribute to data collection monitoring activities. Mobile applications serve as accessible tools for data gathering, while sensor networks enable real-time monitoring at reduced costs. These technologies enhance data availability and foster a sense of ownership among stakeholders. Moreover, fostering meaningful partnerships with local communities, indigenous groups, and stakeholders is essential for transformative change. Collaboration, trust, and shared ownership create a platform for inclusive decision-making, ensuring diverse perspectives are considered. Capacity building programs, education, and awareness initiatives empower communities to actively participate in monitoring activities. By providing training in data collection methodologies, analytical skills, and the integration of indigenous and scientific knowledge, local communities become active agents of change. Through the integration of sustainable indigenous practices, low-cost technologies, and inclusive partnerships, urgent and transformative change can be realized in Atlantic aquatic ecosystems. This holistic approach promotes resilience, sustainability, and inclusivity, paving way for the preservation and thriving of these invaluable ecosystems for present and future generations.

Presentation type

Talk

Affiliation

Lagos State University

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150005 - Enhancing ocean sustainability through enhanced collaboration between marine biodiversity observation systems

Ana Lara Lopez[1], Karen Evans[2], Gabrielle Canonico[3], Emma Heslop[1], Anya Waite[4], Toste Tanhua[5]

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Recognizing the importance of ocean sustainability, the international community adopted agreements and goals to safeguard marine biodiversity and ecosystems. To track progress against these agreements, coordinated on-going monitoring of marine life is needed. The Global Ocean Observing System (GOOS) provides a framework for the design and implementation of ocean observing systems for marine life via a series of Essential Ocean Variables (EOVs). These EOVs, spanning physical, biogeochemical and marine life observations, provide the foundation for the Essential Biodiversity Variables (EBVs) identified by the Group of Earth Observations Biodiversity Observation Network.

Building on collaborations between the GOOS Expert Panel for Biology and Ecosystems and the Marine Biodiversity Observation Network to coordinate ocean observation networks, we discuss potential areas of cooperation between GOOS and GEO BON. These include:

Enabling synergistic endeavors in identifying and sharing of best practices for the collection and data management of marine biodiversity observations, to ensure interoperability and translate observations into useable information for national reporting requirements under global agreements. This includes addressing challenges in ocean monitoring in areas beyond national jurisdiction.

Collaborate with other UN bodies to identify relationships between EOVs, EBVs and other ocean monitoring indicators to improve interoperability and ensure understanding of changes in marine life and the drivers causing that change.

Linking ocean observation networks, including national and regional, to integrate marine life observations into global networks and national reporting mechanisms.

Through such collaborations, we hope to achieve a global, integrated and comprehensive ocean observing system that provides essential understanding for its sustainable use.

Presentation type

Talk

Affiliation

Department of Oceanography, Dalhousie University

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150008 - Ditches as critical biodiversity support systems in intensively-managed agro-ecosystems

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Drainage ditches in agroecosystems are designed for utility, helping farm operators control water levels on their fields, but in increasingly homogenised landscapes they can represent biodiversity refuges, hosting rich communities of plants, macroinvertebrates, fish and associated riparian wildlife. Management of these habitats to support delivery for ecosystem services is becoming increasingly important as agricultural intensification and extensification increases and climate change modifies agroecosystems globally. In the absence of natural open-water habitat in agro-landscapes, drainage ditches can be important sources of ecosystem services in the form of emergent insect secondary production, as they supply the landscape with nutritionally-rich highly unsaturated fatty acids. Avian insectivores—currently experiencing global declines—nest and forage in these drainage ditch networks, relying on emerging aquatic insects, not only as an energy supply, but as a nutritionally-critical component of their diet. We quantify the value of these habitats in terms of aquatic insect production across a drainage ditch network in South Nation river basin, an agriculturally-dominated catchment of the Ottawa River watershed in eastern Canada. This catchment is currently the focus of the Environmental Change Onehealth Observatory (ECO^2), a Canadian federal interdepartmental project to study the consequences of erosion of natural capital and associated ecosystem services on: 1. Biodiversity; 2. [Re]emergence of infectious zoonotic diseases of importance to human health; and 3. [Re]emergence of infectious diseases of importance to livestock health, with the aim to find a balance between producing food and other commodities which support the well-being of Canadians with the need to provide increased biosphere stewardship.

Presentation type

Talk

Affiliation

Environment and Climate Change Canada @ Canadian Rivers Institute, Department of Biology, University of New Brunswick, Fredericton, NB, Canada

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

150014 - Linking Blue Carbon and marine biodiversity research in Asia: opportunities and challenges of Asia-Pacific Marine Biodiversity Observation Network (AP MBON)

Masahiro Nakaoka[1], Takehisa Yamakita[2], Rempei Suwa[3], Jillian Ooi[4], Amy Then[4], Maria Lourdes Mcglone[5], Severino Salmo[5], Yasmin Primavera Tirol[6], Rohani Ambo Rappe[7], Anchana Prathep[8]

[1]Hokkaido University, [2]Japan Agency for Marine-Earth Science and Technology, [3]Japan International Research Center for Agricultural Sciences, [4]University of Malaya, [5]University of the Philippines Diliman, [6]Aklan State University, [7]Hasanuddin University, [8]Prince of Songkla University

The Asia-Pacific region has the highest marine biodiversity in the world but faces multiple human-induced threats such as pollution, overfishing, coastal development and global climate changes. Marine scientists studying biodiversity in this region established a group called AP MBON (Asia-Pacific Marine Biodiversity Observation Network) in 2019, which is an overlapping subgroup of APBON (Asia-Pacific Biodiversity Observation Network) and MBON (Marine Biodiversity Observation Network). The missions of AP MBON are not confined to scientific research but also include capacity building of next-generation scientists and linking science to society and policy. The initial program has especially focused on seagrass and mangrove ecosystems, which offer ecosystem services such as seafood provisioning, water quality control, disaster reduction and climate change mitigation. Among these services, the sequestration of CO_2 by seagrass and mangrove (Blue Carbon Sink) has been paid increasing attention as a promising measure of greenhouse gas reduction. Precise estimation of their areas as well as their status, including those of biodiversity, is highly required for meeting various social and political needs, such as using Blue Carbon Sink as inventories for carbon neutral policy, setting effective MPAs to meet the goal of “30 by 30” of CBD. In this presentation, we review the current status of blue carbon studies in East and Southeast Asian countries and discuss how these studies can be used for policy-making at various scales (local, national and international governments).

Presentation type

Talk

Affiliation

Hokkaido University

Session

Biodiversity Monitoring in Aquatic Ecosystems to Support a Whole Society Approach to Transformative Change

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000046 - Promoting biodiversity based on the relationship between movement patterns and minimum patch size

Allegra Spensieri[1], Eric Pedersen[1]

[1]Concordia University

Highly fragmented landscapes, such as urban areas, are perceived as having low biodiversity levels. However, when the appropriate conditions are met these areas can support high levels of biodiversity, especially of small organisms such as arthropods. To increase biodiversity levels within cities and other fragmented landscapes, we must understand what these conditions are, including the minimum size of habitable patches and how to promote connectivity between them. To determine how large a patch must be to support a population of a given species, we must first understand how that species moves through its landscape and the biotic factors that it interacts with.

The work presented will be based on small-scale and large-scale movements of the European common blue butterfly (*Polyommatus icarus*) observed in a variety of contexts in Montreal. These observations, and the model built from them, will be used to determine the necessary habitat characteristics of areas populated by this non-native species, including plant presence and patch size. We are not only interested in conveying how *P. icarus* moves through the landscape, but in how this corresponds to the minimum patch size needed to support its populations and how this may influence its range expansion. Findings can be used to better understand how to design landscapes in fragmented areas to promote biodiversity based on minimum patch size and connectivity information, to determine if decreases in biodiversity in a given area are due to new fragmentation events, and to reduce the effects that non-native species may have on native biodiversity.

Presentation type

Poster

Affiliation

Concordia University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90002 - An operational workflow for producing species distribution EBV with annual time-steps

Rob Boyd[1], Tom August[1], Rob Cooke[1], Mark Logie[1], Francesca Mancini[1], Gary Powney[1], David Roy[1], Kath Turvey[1], Nick Isaac[1]

[1]UK Centre for Ecology & Hydrology

We describe a workflow for generating annual estimates of species' occupancy at national scales from raw species occurrence data. We present each step in detail: from data acquisition, data assessment and data manipulation, through modelling, model evaluation, application and dissemination. At each stage, we draw on our experience developing and applying the workflow for almost a decade to outline the challenges that analysts might face. These challenges span many areas of ecology, taxonomy, data science, computing and statistics. In our case, a key output of the workflow is annual estimates of occupancy, with measures of uncertainty, for over 5,000 species in each of several defined "regions" (e.g., countries, protected areas, etc.) of the United Kingdom from 1970-2019. This product corresponds closely to the notion of a species distribution "Essential Biodiversity Variable" (EBV). Throughout, we note where the workflow can be adapted to other situations (e.g., geographic regions or data types). We also highlight areas where the workflow can be improved; in particular, we suggest incorporation of methods to diagnose biases in the species occurrence data, to understand whether and to what extent these bias downstream products, and to mitigate them if needed. Finally, we compare the data products generated using our workflow to the first generation of species distribution EBVs and the "idealized" product as defined by others. Going forward, we hope that this paper can act as a template for research groups around the world seeking to develop similar data products.

Presentation type

Talk

Affiliation

UK Centre for Ecology & Hydrology

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000036 - Optimized sampling of biodiversity: a study of sampling effort

Andrew Gavloski[1]

[1]university of Guelph

Biodiversity loss is a major concern, with agricultural activity, industrial extraction, and infrastructure development being significant contributors. The resulting negative effects on civilization underscore the importance of monitoring the impacts and remediation of environmental degradation. Insect species have been shown to be indicators of ecological health in many environments. However, monitoring methods for insects have varied in their sampling time, which creates difficulty in standardizing the process across different species, seasons, and habitats. Thus, it is important to investigate the sampling effort (SE) required to sample insects from different orders, habitats, and months.

This study aims to answer the question of how seasonality and habitat type affect the SE required to find the species richness of four insect orders: Hymenoptera, Lepidoptera, Ephemeroptera, and Coleoptera and to determine the SE necessary to monitor them. The study will use an arthropod dataset collected from four habitat types in southern Ontario during a five-month period in 2019 and was processed using metabarcoding analysis. Several datasets will be created for each habitat type, month, and order, and analyzed using a modified Monte Carlo bootstrap method to simulate the sampling process. Using the iNEXT package, order richness will be estimated from the collected data and used to determine the SE required to obtain a range of species richness levels.

The findings could make a significant contribution to the field of ecology and conservation by improving the sampling process, saving resources, increasing sampling efficiency, standardizing sampling time, and ultimately enhancing the detection of environmental disturbances.

Presentation type

Poster

Affiliation

University of Guelph

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000045 - Predicting bird extinction risk using threat vulnerability, traits and popularity

Janaina Serrano[1], Laura Pollock[1]

[1]McGill University

The IUCN Red List assesses extinction risk globally, showing higher rates for birds and mammals, and lower rates for amphibians, reptiles, and fish. However, data limitations may contribute to these trends. The conservation status of a species can be influenced by research effort, leading to misclassifications and data deficiencies for listed species. Using species traits to estimate extinction risk is a valuable approach, as traits are more readily available than population dynamics data. However, considering specific threats alongside traits is crucial to avoid misleading conclusions. Vulnerability to certain threats combined with species characteristics determines their extinction risk. We developed a model to explain extinction risk in birds by considering interactions between traits, threats, and popularity. Our findings suggest that larger bird species face threats from hunting and invasive species, while smaller species are more vulnerable to agriculture. Wide habitat breadth protects against resource use threats, and migratory birds are less prone to agricultural threats. Less popular bird species have less accurate extinction risk estimates, highlighting the need for closer examination in assessments. In summary, the IUCN Red List assesses extinction risk globally. The model for birds emphasizes trait-threat-popularity interactions. Understanding these dynamics can improve assessments and ensure accurate estimations of extinction risk.

Presentation type

Poster

Affiliation

McGill University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90003 - Towards the mobilization and integration of historical biodiversity observations

Laetitia Navarro[1], Miguel Clavero[1]

[1]EBD-CSIC

Knowing ecosystem states and biodiversity distribution patterns in past periods is crucial to understand the complex relationships between human societies and environmental change. Having a better knowledge of the past is also key to determine conservation baselines and to guide the management of natural resources. However, the historical information needed to generate this knowledge is scarce and often unavailable to researchers. As a result, most current indicators of environmental change that intend to describe long-term and large-scale processes are based on relatively recent time-series, or space-for-time substitutions. Nonetheless, rich historical information on biodiversity is often contained in a diverse and rich array of historical sources (e.g. geographic dictionaries, paintings, military maps) which are frequently ignored by environmental sciences, and within equally diverse natural archives (e.g. archaeological and palynological records). We will present the outputs of an ongoing collaboration that brings together community ecologists, landscape ecologists, archeologists, palynologists, historians and conservation biologists to discuss the identification, mobilization and integration of ecologically relevant historical information. The spatial, temporal and thematic extent of those historical sources will be discussed, together with the identified pathways to mine, standardize and share this information. We will then address possible approaches for the integration of historical data and its use in biodiversity models. This presentation will hence also lay the basis for and present the objectives of the conference workshop which will extend the initial European scope to the BONs and the biodiversity data products more generally to the EBV classes.

Presentation type

Talk

Affiliation

EBD-CSIC

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000033 - Mapping the invader: early remote sensing of an invasive alien plant using drones and artificial intelligence

Antoine Caron-Guay[1], Etienne Laliberté[1], Mickaël Germain[2]

[1]Université de Montréal (Institut de recherche en biologie végétale), [2]Université de Sherbroooke

Invasive alien plant species (IAPS) have a major negative impact on ecosystems, threatening native biodiversity in particular. This is even more worrying when these IAPS are found in large numbers in a national park, whose main mission is to conserve the territory and its biodiversity in order to ensure its sustainability. This is why, as part of my master's project, I'm interested in the early detection of exotic common reed (Phragmites australis subsp. australis) in the Îles-de-Boucherville national park. To achieve this, I am using new technological approaches such as the use of drones, geographic information software and artificial intelligence (AI). The aim is for the AI model to be able to identify emerging stems of common reed from microdrone photos taken in different environments. This project, if successful, would address the need for biodiversity inventories in the field to detect exotic common reed by combining the use of innovative technological approaches with traditional conservation ecology methods. Ultimately, through better management of this IAPS, this project could be of great benefit to the conservation of native biodiversity in conservation environments.

Presentation type

Poster

Affiliation

Université de Montréal (Institut de recherche en biologie végétale)

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90005 - Harnessing unstructured biodiversity data for change detection and attribution

Simon Ferrier[1], Andrew Hoskins[1], Chris Ware[1], Erin Graham[1], Steve Van Bodegraven[2], Jenet Austin[1]

[1]CSIRO Environment, [2]Microsoft

Big-data initiatives such as the Global Biodiversity Information Facility have revolutionized access to data on known occurrences of species across space and time. Growth in the volume of these data is continuing at a rapid pace, thanks in large part to the advent and popularity of citizen-science apps for recording species observations. However, the highly unstructured nature of many species-occurrence datasets has long presented a major challenge for any attempt to extract useful information on biodiversity change, as records distributed across time have most often been generated not through repeated sampling of the same spatial locations, but rather through largely opportunistic or ad hoc observation. A recent extension of generalised dissimilarity modelling - *obs-pair*GDM - addresses this challenge head-on by allowing spatial and temporal change in the species composition of communities to be detected, and attributed to relevant drivers, through analysis of big unstructured species-occurrence datasets. This analytical capability is now being made available for broader use around the world through the Microsoft Azure cloud-computing service. Essential Biodiversity Variables generated using this capability will, in turn, contribute to the derivation of indicators for reporting progress toward targets and goals under the Convention on Biological Diversity's post-2020 Global Biodiversity Framework.

Presentation type

Talk

Affiliation

CSIRO Environment

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000041 - Assessing the multidimensional complexity of biodiversity using a globally standardized approach

Robert McElderry[1], Camille Fournier de Lauriere[1], Ian Brettell[1], Thomas Elliott[1], Leland Werden[1], Johan van den Hoogen[1], Daniel Maynard[1], Thomas Crowther[1]

[1] Swiss Federal Institute of Technology, Zürich, Switzerland

Assessing the health of ecosystems across the globe is critical for transparent reporting and assessment of biodiversity targets. Understanding the complexity of natural biodiversity requires consideration of the variation of life across species, genetic, and ecosystem levels. Achieving this in a globally standardized way remains a key overarching challenge for international biodiversity efforts.

A common feature of global biodiversity maps is that they estimate something intermediate between the actual and potential state of biodiversity. Interpolating between ground source data that are unevenly distributed around the globe results in maps that reflect environmental patterns more closely than site-level conditions influenced by human activities. Global maps of ecosystem level properties are often acquired through remote sensing and therefore better represent the actual state. However, it would be useful in this case to estimate potential natural states to facilitate impact assessments.

In our SEED biocomplexity assessment framework, we integrate the best available scientific data with satellite imagery to generate maps representing the dimensions of biodiversity across species, genetic, and ecosystem levels. In addition to quantifying the current state of nature within a given area, we also measure intactness via the distance to potential states in each dimension and we combine all dimensions in a single biocomplexity score (0-1). By providing both the current state of biodiversity and the intactness for any location relative to its natural state, this methodology can allow us to assess ecological health in response to both positive and negative human impacts in every region and context across the planet.

Presentation type

Poster

Affiliation

Swiss Federal Institute of Technology, Zürich, Switzerland

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000040 - Detection of taxonomic concept mismatches in biodiversity occurrence data can assist the identification of alien occurrences

Richard Li[1], Yanina Sica[1], Walter Jetz[1]

[1]Yale University

Global databases of species occurrences such as GBIF are an important resource for the early detection as well as continued monitoring of anthropogenic species introductions. Citizen science observations on these platforms offer, for some taxa, unprecedented spatial and temporal observational coverage across thousands of species. However, the heterogeneity of data contained within global databases means that identification of alien occurrences is rarely a straightforward task. Species occurrences under the same scientific name frequently differ from one another in their taxonomic concepts, the result of an ongoing revision process that regularly lumps and splits species. A simple overlay of occurrences over a range map often reveals numerous spurious extralimital occurrences resulting from taxonomic concept mismatch which limit our capacity to identify true introductions.

We share a generalizable method for detecting taxonomic concept mismatches in occurrence databases at the scale of major species groups (tested on the set of all mammal species). We created numerous metrics predictive of mismatch, based on the spatial and metadata properties of species and their occurrences. We then manually verified the mismatch status for occurrences of 200 mammal species, and used these manually classified species to train a logistic regression model predicting taxonomic mismatch status using mismatch metrics, achieving upwards of 73.5% prediction accuracy. We offer some perspective on the key drivers of taxonomic mismatch potential for mammals, and the corresponding global patterns of taxonomic uncertainty. We discuss next steps for integrating mismatch detection into global alien and invasive species informatics workflows.

Presentation type

Poster

Affiliation

Yale University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90009 - Robust models to predict co-occurrence and abundance in a community-based approach

Eric Pedersen[1], Pedro Peres-Neto[1], Alienor Stahl[1]

[1]Concordia University

Accurate estimates of abundance are crucial for successful conservation and management. However, gathering abundance data is costly and resource management often rely on Species Abundance Models (SAMs) to predict abundance. However, either species interactions and/or missing environmental predictors can reduce SAMs predictive performance. Using simulated data, we tested whether it is possible to improve predictions by using easier-to-obtain data on patterns of presences and absences of other species (PA) in the community as a proxy for missing environmental predictors and species interactions. Specifically, we tested the effectiveness of PA-based latent variables as proxies for missing data. We estimated SAMs with PA predictors on a small number of sites and tested how well the models predicted abundance in remaining sites. We split the evaluation of the models into presence-absence and abundance predictions. Our results showed that including PA-based latent predictors improved model performance when compared to models missing abiotic variables. As the abundance of the target species increases, the models tend to have a bigger error rate. The goal of this framework is to offer a new and easier to implement method to accurately predict abundance from both biotic and abiotic information.

Presentation type

Talk

Affiliation

Concordia University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90006 - Combining biodiversity models with monitoring: Producing a ‘satnav’ for nature

Andy Purvis[1]

[1]Natural History Museum & Georgina Mace Centre for the Living Planet

The Kunming-Montreal Global Biodiversity Framework set ambitious outcome goals and action targets for nature and its contributions to people. A new monitoring framework, to be finalised at COP16, is designed to track progress globally and nationally. If we are to reach the outcome goals, we need a ‘satnav’ - a framework that tells us not only where we are but also what the options are for getting us to where we want to be. Most current biodiversity indicators are poorly suited to this challenge because they synthesise observed changes into a trend over the recent past. Navigating to the intended destination requires model-based indicators. However, biodiversity change models face serious obstacles. Unlike climate change - where model projections are already used routinely - biodiversity change is less well mixed (i.e., more spatially heterogeneous) and more multi-dimensional. Additionally, the available historical time series are too scarce and too short for tuning, testing, or validating most biodiversity change models. One way to greatly accelerate model development will be to embed models into the CBD’s new monitoring framework, linking them to streams of relevant new observations from monitoring. New data would rapidly compensate for the lack of historical time series: biodiversity change data from different contexts around the world will contain much more information than would climate change data, precisely because biodiversity change is less well mixed. A Biodiversity Change Model Intercomparison Project would be a second spur to model development: cycles of comparison and review have driven ongoing improvement in global climate change models.

Presentation type

Talk

Affiliation

Natural History Museum & Georgina Mace Centre for the Living Planet

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90001 - The calculation and delivery of Essential Biodiversity Variables for Species Populations

Walter Jetz[1], Melodie McGeoch[2]

[1]Yale University, [2]La Trobe University

Five years since their formalization of Essential Biodiversity Variables for Species Populations (SP_EBVs), significant progress been made around their estimation and delivery. In this presentation we will review examples of this progress and attempt to assess their potential to support indicators of the post-2020 Global Biodiversity Framework.

SP EBVs address probability of species occurrence (distribution) and the predicted counts of individuals (abundance) over contiguous spatial and temporal units for the global extent of species groups. Significant advances from across the biodiversity science community have been made at multiple steps of the SP EBV production pipeline, including data capture and integration, taxonomic harmonization, remote sensing-supported layers, and scaled-up, transparent model production. Models now available for estimating distribution and abundance have developed rapidly and in parallel over the decade.

While envisaged to encompass all taxa at a global scale and over time, progress has inevitably been uneven across taxa and weighted towards species distribution EBVs, although promising examples abundance EBVs are growing in scale and relevance. Efforts have included not only global but also the calculation of national and regional SP_EBVs to support government reporting. Biodiversity targets have driven the translation of EBVs into indicators Species Habitat Index and the distillation of the information from EBV data cubes for tracking change in biological invasions.

The current trajectory of data, models, and engagement suggest that SP EBVs have the potential to benefit a growing set of stakeholders across scales and realms.

Presentation type

Talk

Affiliation

Yale University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90010 - Monitoring rare species: Challenges and opportunities

Varina Crisfield[1], F. Guillaume Blanchet[1], Dominique Gravel[1], Ciara Raudseppe-Hearne[2]

[1]Université de Sherbrooke, [2]Wildlife Conservation Society of Canada

The ongoing biodiversity crisis has spurred increased efforts to monitor trends in biodiversity across spatial scales, and such monitoring has been identified as a critical tool to assess progress towards the goals of the Kunming-Montreal Biodiversity Framework. Rare species, as a group, have been found to be at higher risk of extinction than common species, and as such, monitoring the spatial and temporal trends of rare species may be a priority for biodiversity monitoring programs. However, rare species pose particular monitoring challenges. In our work, we parse rarity into three distinct facets: low local abundance, low regional occupancy, and small range size, and discuss the challenges that each of these rarity dimensions pose to the monitoring of rare species. Species characterised by low local abundance or low regional occupancy may be at risk of under-detection if the intensity of surveys is insufficient at the local or regional scales, respectively. Species characterised by a small geographic range may be overlooked if their range is not included in monitoring efforts. Low regional occupancy and small range sizes are often associated with habitat specialisation, and habitat specialists are at particular risk of being overlooked by monitoring programs unless their habitats are specifically targeted. These challenges should be considered when designing monitoring programs for rare species. Alternatively, methods such as joint species distribution modelling, which can “borrow” information from common species to infer information about rare species, may be useful in cases where targeted searches for rare species are not feasible.

Presentation type

Talk

Affiliation

Université de Sherbrooke

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000037 - Globally standardised biodiversity monitoring with image-recognition of species

Toke T. Høye[1]

[1]Aarhus University

Advances in computer vision and deep learning can improve our understanding of ecological responses to environmental change such as the potentially global insect decline. Cameras can effectively, continuously, and non-invasively observe species throughout diurnal and seasonal cycles. Deep learning models trained on such image data can provide estimates of abundance, biomass, and diversity. Further, deep learning models can quantify variation in phenotypic traits, animal behaviour, and species interactions. Novel camera-enabled monitoring systems hold the potential to generate automated and globally standardised species observations. However, to reach this transformative goal, international collaboration and coordination on a range of outstanding challenges is critical. Such challenges include defining minimal requirements and standards for hardware design, recording software, metadata collection, machine learning models, analyses pipelines, and the integration with existing monitoring programs. I will present current steps towards continental and global collaboration on these challenges and highlight future research avenues to facilitate the transition of these technologies from the current level of demonstration to broad scale application in biodiversity monitoring. I will give examples of applications from mapping of invasive alien plant species along road networks and an emerging global network for monitoring moths using camera traps.

Presentation type

Poster

Affiliation

Aarhus University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000032 - Scaling whale monitoring using artificial intelligence: case study for aerial detection of belugas

Justine Boulent[1], Bertrand Charry[1], Malcolm McHugh Kennedy[1], Emily Tissier[1], Raina Fan[1], Marianne Marcoux[2], Cortney Watt[2], Antoine Gagné-Turcotte[1]

[1]Whale Seeker, [2]Aquatic Research Division, Fisheries and Oceans Canada

Remote sensing is a valuable technique for monitoring cetacean populations over large areas. However, it often generates datasets with thousands of images, which requires significant human effort to analyze. In recent years, automatic solutions based on deep learning have been piloted, but they often have trouble generalizing: how do we ensure that a deep learning model trained on a source dataset is capable of analyzing a target dataset, where certain characteristics such as acquisition conditions, geographic zone, or targeted species may differ? To overcome this challenge, we have developed a "human-in-the-loop" approach to combine the power of deep learning with the expertise of biologists to provide timely, high-quality analysis of new datasets. We tested this approach on 5334 aerial images acquired by Fisheries and Oceans Canada in 2017 for monitoring the beluga population in Cumberland Bay (Clearwater Fjord, Canada). We compared the results obtained with fully manual detections by independent expert annotators. With only 100 manually annotated images, the model achieved between 90% and 91.4% agreement with the experts, surpassing the minimum inter-observer agreement of 88.55% obtained between the experts themselves. This experiment shows that the proposed "human-in-the-loop" method is suitable for counting belugas in new aerial datasets and could be used to improve and extend cetacean monitoring. It also highlights that even expert observers possess various detection biases, inviting a reflection on the standardization of annotation protocols.

Presentation type

Poster

Affiliation

Whale Seeker

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000035 - Quantifying biodiversity maxima along environmental gradients using a novel GAM derivative-based approach

Natalie Dupont[1], Eric Pedersen[1], Ariella Fuzaylov[1]

[1]Concordia University

Determining which environmental conditions lead to the highest biodiversity and identifying high richness habitat patches in space are both important questions in biodiversity monitoring. Properly characterizing peaks in ecological relationships such as these has been a long-standing statistical challenge. Historically, quadratic and higher-order polynomial regressions have been used to test for the presence of a global peak in a relationship. However, this method is now considered a poor indicator of a peak, as a violation of the underlying curve shape assumption can lead to the detection of a peak in datasets where there is no evidence for one. We propose a new method for estimating confidence intervals for locating biodiversity peaks across gradients, using first derivative approximation of Generalized Additive Models (GAM). This method is not only capable of estimating the location of a peak, it is also able to estimate multiple peaks in complex multimodal relationships. Using simulation data with varying curve shapes and residual error levels, we demonstrate that this GAM derivative method performs well, exhibiting both appropriate false positive errors and high statistical power when compared to alternative peak detection approaches. We demonstrate the use of this approach by applying it to quantify peak locations in empirical biodiversity data across environmental disturbance gradients.

Presentation type

Poster

Affiliation

Concordia University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000043 - Monitoring ecological connectivity in national parks with an indicator based on focal species population viability

Simon Paquin[1], Claude Samson[1]

[1]Parks Canada

Maintaining and managing ecological connectivity within and around protected areas is an emerging priority in biodiversity conservation. Connectivity can easily be mapped with recent advances in modelling and remote sensing. Current challenges now revolve around the development of indicators for measuring and monitoring a landscape's level of connectivity. We propose to evaluate the amount of well-connected habitat required to support a viable population of a focal species. We illustrate this approach with a Pine Marten (*Martes americana*) case study in La Mauricie National Park. We used Landsat images to identify suitable habitat patches within the park and 15 km around it. We assumed that martens prefer forested landscapes of ≥500 ha where mature mixed and coniferous stands cover ≥60% of the surface area. Circuit theory and least-cost path models were used to assess the level of connectivity between habitat patches. Results show that between 1984 and 2020 the amount of well-connected habitat declined around the park. Literature reports that a population of ≥ 100 adult martens is required for the species to be sustained over a 30-50-year period. In 1984, the park and its periphery contained enough habitat for >200 adult martens. By 2015, however, most of the suitable habitat had receded from the periphery. In 2020, the remaining habitat patches could no longer sustain >200 adult martens. Our proposed approach provides insightful results with potential to support decision-making processes while keeping in mind the model's many assumptions still requiring onsite validation.

Presentation type

Poster

Affiliation

Parks Canada

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000038 - Machine learning and satellite-based multi-scale segregation of coniferous and deciduous trees: a case study for Montreal city, Canada

Siddhartha Khare[1], Tushar Bharadwaj[1], Sylvia L.R. Wood[2], Elise Filotas[3], Andrew Gonzalez[4]

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Combining machine learning (ML) algorithms with satellite data and ground inventories in urban areas can support city planners in biodiversity monitoring and mainstream the derived knowledge into policy and decision-making. Approaches that remotely map and classify urban trees into broad species groups can be a first step in building a cost-effective urban monitoring system where field surveys are not feasible. To support rapid urban canopy assessments, we (a) applied ML algorithms to detect, map, and classify the urban canopy using multispectral RapidEye and Sentinel-2 remote sensing images, with an airborne LiDAR-derived Canopy Height Model (CHM) and existing inventories of Montreal's urban trees, and (b) developed an application to visualize and compare results from different ML models within the cloud-based geospatial analysis platform Google Earth Engine (GEE). We applied Object-based classification on RapidEye and Sentinel-2 derived spectral indices to categorize the urban canopy into coniferous and deciduous tree species, and trained ML algorithms on a portion of available inventory data. Our results indicate that the Random Forest algorithm performed best compared to the other classifiers, for both RapidEye and Sentinel-2 images, with an overall accuracy of 87% and 83% respectively. The development of this modelling framework in a GEE-environment offers quick analysis, integration, and processing on the cloud platform with a choice of satellite imagery, without data storage limits. This framework offers an easy and transferable approach to characterize the urban canopy using increasingly available remote sensing imagery to generate high-resolution urban forest maps that distinguish coniferous and deciduous trees.

Presentation type

Poster

Affiliation

Indian Institute of Technology Roorkee

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000031 - Managing biodiversity data: why we don't use Darwin Core to store data

Vincent Beauregard[1, 2], Victor Cameron[1, 2], Vincent Bellavance[3], Guillaume Laroque[4, 5], Dominique Gravel[1, 2]

[1]Université de Sherbrooke, [2]Biodiversité Québec, [3]Université Laval, [4]McGill University, [5]Centre de la science de la biodiversité du Québec

Reproducibility in science has been an important driver in adopting standards for sharing data and ultimately participating in global biodiversity knowledge. Many standards, such as Darwin Core, have been proposed to share data among scientists and data beneficiaries, such as governmental agencies and conservation organizations. Organizations with the objective of managing a large amount of data may be tempted to implement complex database systems, such as relational databases, which have been considered best practices to address all data needs. However, recent trends in the software development community have favored decoupled architectures, where each data layer answers a specific need.

As a national biodiversity observation network, we are required to work with varied data structures, such as abundance, time-series, occurrence records, and more. Our data management systems must address the different data needs of our organization, such as data integration, storage, analysis, visualization and revisions. Partners and organisational needs also change over time.

Our initial efforts to accommodate those needs using complex data models such as Darwin Core for data storage required intensive work to develop and were challenging to maintain. A decoupled data layer architecture has proven efficient in designing and maintaining data stores to accommodate our varied data needs, simplify the implementation of new data structures and use cases, and maintain those systems. Each data layer is managed independently to fit specific needs. Specific data layers and interfaces are developed to share and integrate data to and from standard formats for collaboration, such as Darwin Core.

Presentation type

Poster

Affiliation

Université de Sherbrooke - Biodiversité Québec

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90011 - Deep Learning for Species Distribution Modelling

Benjamin Kellenberger[1], Kevin Winner[1], Walter Jetz[1]

[1]Yale University

Species distribution models (SDMs) map species populations in space and uncover their environmental requirements; they are thus fundamental to biodiversity monitoring, habitat protection, and early mitigation of the spread of invasive species. While conceptual advances have improved the prediction quality of SDMs over the past decades, the underlying models themselves have remained relatively unchanged. In parallel, however, the field of machine learning underwent a complete transformation thanks to deep learning (DL) models surpassing any other method in performance and versatility.

To highlight the growing potential for DL to deliver a new generation of SDMs, we perform a formal comparison between multiple DL models with current SDM approaches. To do so, we first revisit multi-layer perceptrons (MLPs), also known as feed-forward neural networks, and equip and train them according to the latest discoveries in the DL community. We also investigate convolutional neural networks (CNNs) that can ingest spatial neighborhoods of each respective location. All models are trained to predict the occurrence likelihood of 352 mammalian species over North America, using 10 bioclimatic rasters at 1km resolution as covariates. While we find MLPs to just about match the performance of baseline models like random forest and maxent, our spatial CNN manages to outperform all by a small margin in area under the receiver operating characteristic curve (0.81 *vs.* 0.77 for the second-best model, maxent). We conclude that DL shows promising results when applied to SDM, but that more research is needed to fully uncover its potential in the long run.

Presentation type

Talk

Affiliation

Yale University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000042 - Why Guyana should be a focus of GEO BON tools and programs

Lesley de Souza[1]

[1]Field Museum of Natural History

In 2022 the South American nation of Guyana approved both an ambitious national development plan and the Kunming-Montreal global biodiversity framework, two documents intended to guide national policy through 2030. We examine how these national and global ambitions intersect, as a case study of a tropical country's strategy to advance biodiversity goals during a transformative economic boom. For each of the 23 Kunming-Montreal targets we ask which indices or monitoring tools appear most practical for tracking progress in Guyana, what sorts of barriers and assets are likely to influence success, and where conflicts between national and global goals may arise. We pay special attention to Kunming-Montreal Target 3 (protected areas coverage), Target 4 (species-level protection), Target 8 (climate change mitigation), Target 14 (integration of biodiversity into government policy), and Target 21 (access to information). Protecting Guyana's biodiversity will require massive new investments in governance, sweeping changes in national land use, large-scale programs of training and capacity-building, a campaign to document and monitor the country's biodiversity and ecosystem services, and strong collaboration between Guyanese and international organizations. As such, Guyana is an ideal candidate for GEOBON tools and programs such as BON in a Box and National BONs.

Presentation type

Poster

Affiliation

Field Museum of Natural History

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000039 - A new insect- and Earth Observation-based biodiversity metric for Africa

Tobias Landmann[1], Faith Ashiono[1], Michael Schmitt[2], Burak Ekim[2], Henri E.Z. Tonnang[1]

[1]International Centre of Insect Physiology and Ecology , [2]Universität der Bundeswehr München

The post-2000 Global Biodiversity Conservation (GBC) Framework of the United Nations requires countries to report on targets that include species or ecosystem-specific biodiversity status information. The GBC and other political frameworks require that localized biodiversity patterns are considered and the establishment of biodiversity status baselines. Here we introduce an easy to implement and spatial explicit biodiversity metric that relies on readily available earth observation (EO) data and insect species data from citizen science platforms. We show how the new metric can be reliably implemented across Africa to estimate overall biodiversity status, given data density and accuracy ramifications.

The first component of the metric is insect-based species richness. This is estimated across various microhabitats in Africa using 20-meter pixel resolution EO variables and butterflies, moths, and rove beetle's species data assemblages (from citizen science). The presence and diversity of these species are known to indicate overall ecosystem integrity and biodiversity. The second spatial component is landscape naturalness which is estimated using data on various human impact factors, at 10-meter pixel resolution. The results showed that the metric is consistent over various agroecological zones in Africa, even when using species richness from different indicator taxa (i.e., stingless bees, butterflies, dragonflies) and independent data for landscape naturalness. Our biodiversity status metric is applicable to data-scarce environments and practical for conservation actions and reporting the status of biodiversity targets on landscape scales. The model we used is well understood and accurate, thus easy to be utilized by policy makers.

Presentation type

Poster

Affiliation

International Centre of Insect Physiology and Ecology (ICIPE)

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90008 - Understanding the limits of biodiversity data

Alice Hughes[1]

[1]APBON/University of Hong Kong

With the launch of the Kunming-Montreal Global Biodiversity Framework (GBF), and associated monitoring framework we are at a crucial time to revisit how we monitor natural systems, and ensure we have the data needed to monitor change. Unlike the Aichi targets which preceded the GBF the need for monitoring and the use of indicators to ensure we are moving in the right direction has been reinforced. However, many of the Headline indicators lack the resolution to track progress at the rate needed, and furthermore whilst ever growing volumes of data exist, these are not always used appropriately or with the sensitivity needed for effective use.

Here I review the recent evolution of increasingly available geospatial data in the context of the GBF, discuss its applications, its limits, and the prevalent gaps of data which is needed for monitoring different elements of the GBF. I also discuss best practice in understanding how we can assess data needs, and the limits of application to ensure it is used effectively, and within it's limits. Finally I discuss strategies to reconcile data gaps to inform better targets and enable better monitoring at all scales.

Presentation type

Talk

Affiliation

APBON/University of Hong Kong

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000044 - Modeling the spatial heterogeneity of dispersal networks for biodiversity analyses and conservation strategies

Paul Savary[1], Jean-Philippe Lessard[1], Pedro Peres-Neto[1]

[1]Department of Biology, Concordia University, Montreal

Determining the relative importance of multiple biodiversity drivers is crucial to translate monitoring efforts into effective and spatially targeted conservation plans. Biodiversity patterns depend on species responses to local environmental conditions, biotic interactions and, importantly, on dispersal processes. Dispersal movements among communities form dispersal networks, which are the spatial backbones of biodiversity dynamics. Because species have varying dispersal capacities and move across landscapes with irregular configurations, dispersal networks are spatially heterogeneous. This heterogeneity is itself a strong moderator of the commonly expected responses of biodiversity patterns to variations in dispersal rates. Consequently, ignoring the spatial heterogeneity of dispersal networks prevents from predicting reliably biodiversity responses to connectivity variations, that are often integral part of conservation strategies. In that context, we propose robust modeling frameworks to alleviate this shortcoming. We will present methods that integrate dispersal network heterogeneity in biodiversity analyses, more than by just including site spatial coordinates in models. Besides, we will propose the “Several Connected vs Several Isolated” empirical test of the influence of dispersal network heterogeneity on species diversity. This test is also designed to indicate whether dispersal is limited or, on the contrary, tends to homogenize communities. Finally, we will illustrate how the architecture of dispersal networks can determine where biodiversity conservation strategies are to be implemented. We believe this will expand the quantitative toolbox available to researchers and conservation practitioners in a scenario where spatial modeling approaches, founded on recent advances in ecological theories, are crucial for successful conservation outcomes.

Presentation type

Poster

Affiliation

Department of Biology, Concordia University, Montreal

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

90004 - Continental-scale multi-taxon distribution EBVs to support biodiversity assessment and monitoring

Kevin Winner[1, 2], Kate Ingenloff[1, 2], Emily Sandall[1, 2], Yanina V. Sica[1, 2], Charles Marsh[1, 2], Jeremy Cohen[1, 2], Ajay Ranipeta[1, 2], Alex Killion[1, 2], Stefan Pinkert[1, 2], Doug Booher[1, 2], Mario Ribeiro de Moura[1, 2], Julia Laterza Barbosa[1, 2], Matthew Kling[1, 2], Anna Schuerkmann[1, 2], John Wilshire[1, 2], Kalkidan Fekadu Chefira[1, 2], David Shen[1, 2], Bort Edwards[1, 2], Matthew Rogan[1, 2], Maisha Lucas[1, 2], Wendy Dorman[1, 2], Shubhi Sharma[1, 2], Tamara Rudic[1, 2], Clara Brandon[1, 2], Lia Vogas Ker Marrara[1, 2], Isa del Toro Mijares[1, 2], Walter Jetz[1, 2]

[1]Department of Ecology and Evolutionary Biology, Yale University, [2]Center for Biodiversity and Global Change, Yale University

Species distribution information that addresses continental or ideally global distributions comprehensively for whole taxa are a key foundation for the Species Distribution EBV. Especially as nations globally agreed to a 30% by 2030 target for area-based conservation which requires reliable, high-resolution, spatially-explicit information to support biodiversity outcomes.

To date, large-scale conservation assessment and planning has largely relied on coarse-grain species distribution data which is limited in its ability to serve as a baseline for monitoring or to inform targeted conservation action.

Higher resolution maps produced by species distribution models (SDMs) are sometimes available for some species or regions, but lack of standardization and missing species usually make aggregate use unreliable. Here we illustrate the approach and outcomes of an effort to produce standardized SDM predictions at high resolution (~1km2) across a broader scope of geographic regions (all of the USA and Canada), comprehensively for a large set of taxa (amphibians, ants, birds, butterflies, mammals, odonates, and reptiles). These predictions represent a baseline EBV to support the assessment of temporal change. Key innovations include the integration of expert information (range maps, ecoregional occurrence) with other data assets and the inclusion of expert feedback for iterative model-improvement. These 1km products represent a new generation of species distribution predictions for GEOBON indicator products such as the Species Habitat and Species Protection Indices developed by Map of Life (MOL). A first view of these predictions, which will be made freely available to support conservation decision-making, research, and education, is accessible through MOL (https://mol.org/).

Presentation type

Talk

Affiliation

Center for Biodiversity and Global Change, Yale University

Session

90007 - Providing the evidence base for reporting on targets for biological invasion

Melodie McGeoch[1, 2]

[1]Securing Antarctica's Environmental Future, [2]La Trobe University

All available evidence shows ongoing introduction, establishment and spread of invasive alien species (IAS) populations worldwide, with growth in ecological and socio-economic impacts. To stimulate action to reduce this problem, Target 6 of the newly adopted Kunming-Montreal Global Biodiversity Framework (GBF) calls, *inter alia*, for a 50% reduction in rates of introduction. But how these rates are to be measured remains unclear. There are widely underappreciated challenges in producing reliable estimates of rates of introduction from available data. If variable survey effort is not carefully accounted for, rates are wrongly estimated. To support progress in this area, we outline and demonstrate the nature of this multifaceted challenge, and provide data and modeling options. The collection of data on survey effort, development of standards for doing so, and refinement of existing modelling approaches for this purpose are instrumental. Improved awareness and investment in developing robust approaches (e.g. collection of survey effort data in surveillance and monitoring protocols) will be needed by Parties for this component of the GBF's mission to be achieved. Meaningful estimates of changes in the introduction rates of IAS are essential to avoid biological invasions from undermining efforts to achieve the mission of the GBF and related policy.

Presentation type

Talk

Affiliation

La Trobe University

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

9000034 - Looking for the ghost species in the global biodiversity hotspots

Roberto Cazzolla Gatti[1]

[1]University of Bologna

One of the most fundamental questions in ecology is how many species inhabit the Earth. However, due to massive logistical and financial challenges and taxonomic difficulties connected to the species concept definition, the global numbers of species, including those of well-studied life forms such as trees and vertebrates still remain largely unknown in many areas of the world. For instance, a recent study, based on global ground-sourced data, estimated that there are likely other 9.000 "ghost tree species" yet to be discovered at the global level. Roughly half of them may be found in tropical South America. Moreover, almost half of all tree species may be rare, with very small populations and limited spatial distribution. These findings highlight the vulnerability of global biodiversity to anthropogenic changes in land use and climate, which disproportionately threaten rare species, and thus ecosystem health. One of the key challenges of humanity in the next decades will be the detailed identification of global biodiversity hotspots taking into account those "ghost species", which are a fundamental insurance factor for ecosystem health but are so elusive and rare and/or live in remote areas of the planet that escape standard monitoring programs. Two main tools to reach this goal are the use of Artificial Intelligence and improved biodiversity estimators (like the recently proposed Absolute and Effective Diversity index, AED). These approaches will increase our knowledge of the ecological and evolutionary mechanisms that take place in biodiversity hotspots and help us to protect them from human alteration of ecosystems.

Presentation type

Poster

Affiliation

Department of Biological, Geological, and Environmental Sciences (BiGeA), University of Bologna, Italy

Session

From Biodiversity Data to Species Population EBVs, Indicators and Decision Support

Biodiversity Change Indicators

70005 - Aerial insights to characterise and develop indicators of coastal active dune condition

Cate Ryan[1], Bradley, S. Case[1], Craig, D. Bishop[1], Hannah, L. Buckley[1]

[1]Auckland University of Technology

Coastal active dune ecosystems (active dunes) occur globally and provide crucial services to people and habitats for biodiversity. Despite their importance, they are amongst the most degraded and neglected ecosystems worldwide. Moreover, there is a relative dearth of information about indicators of active dune condition and related thresholds in the scientific literature, which is needed to inform policy and management to prevent further declines. Remotely sensed imagery can provide synoptic views of these ecosystems, which can be used to assess and monitor several targets of the2022 Kunming-Montreal Global Biodiversity Framework. Using a national scale study from Aotearoa, New Zealand, we developed a method to characterise and develop indicators of active dunes across a gradient of condition. Cover types were identified from classified imagery across a representative sample of active dunes, and characteristic native sand binder plants were identified as key indicators of community composition, where dominant, through clustering and ordination. Spatial pattern analysis of the classified images revealed a gradient of habitat structure whereby the vegetation of active dunes in good condition had relatively greater patch and edge density, and the vegetation of degraded dunes, including dunes with invasive species, was more aggregated. Areal ecosystem extent was also measured to understand temporal change, revealing a 59% reduction in active dunes over a 70-year period. Given the ubiquity of the drivers of active dune ecosystem processes worldwide, we propose that our methods can be generalised to international contexts and can inform aspects of globally relevant ecosystem risk assessments.

Presentation type

Talk

Affiliation

Auckland University of Technology

Session

Biodiversity Change Indicators

7000032 - Ecosystem-based management analysis framework to assess the biodiversity of an ecosystem

Verena Schrameyer[1], Lars Mortensen[2], Jonas B. Mortensen[2]

[1]Department of Marine and Costal Ecology, DHI A/S, [2]Department of Offshore Biodiversity and Ecology, DHI A/S

In recent years, the global focus on biodiversity in marine waters has increased, due to the alarming decline of species. This concern has led to an emphasis on species protection, as seen in initiatives like the European Union's Marine Strategy Framework Directive. This shift has also generated interest from private sector stakeholders aiming to make positive contributions to biodiversity. However, the current understanding of biodiversity in ecosystem-based management lacks precision and often concentrates solely on species richness and distribution. Biodiversity encompasses a wider range of factors, including functional diversity, which directly impacts the provision of crucial ecosystem services. Consequently, there is a need for a comprehensive framework that considers multiple dimensions of biodiversity within an ecosystem context. This study aims to reconcile various biodiversity measures and indicators with ecosystem structure and functioning, enabling marine operators, stakeholders, and managers to assess the broader effects of their biodiversity efforts.

To achieve this, long-term monitoring data from the North Sea seabed were analysed. Standard taxonomic indicators, along with functional indicators, were used along with Ecological Network Analysis. By combining these indices with reference stations, an overall Ecosystem Score was created to reflect the status of Ecosystem Biodiversity. The findings demonstrate the feasibility of using a combination of biodiversity measures to assess ecosystem biodiversity, providing a biodiversity footprint for the chosen site. Furthermore, this approach facilitates predictive modelling of spatio-temporal changes in biodiversity. This method holds great potential as a fundamental tool for marine operators and managers to evaluate the effects of biodiversity actions.

Presentation type

Poster

Affiliation

DHI A/S

Session

Biodiversity Change Indicators

7000031 - Development of biodiversity impact indicators and success measures specific to Quebec for large Quebec institutional investors

Prisca Ayassamy[1]

[1]university of Sherbrooke

In the context of the 15th Conference of the Parties to the Convention on Biological Diversity (COP15), the Caisse de dépôt et placement du Québec (CDPQ), Fondaction, the *Société pour la nature et les parcs* (SNAP Québec), the Center of Quebec Biodiversity Science (CSBQ) and the University of Sherbrooke have launched a joint research project that aims to produce a series of biodiversity indicators for Quebec's institutional investors. These indicators will be used to better measure the impact of investments on biodiversity. Their development will allow, for the first time in Canada, the mobilization of actors from the fields of conservation, biodiversity, research, and finance for the conservation of biodiversity in Quebec. Investors represent an essential lever for the rapid transformation of the economy to reverse the collapse of biodiversity. The indicators that will result from this project will provide a common frame of reference to assess the impacts of investments on local biodiversity and improve decision-making. The results of the project will make it possible to better guide the choices of investors to preserve and protect nature and its essential services to populations.

Presentation type

Poster

Affiliation

University of Sherbrooke

Session

Biodiversity Change Indicators

70006 - The SEED Biocomplexity Index: A holistic and globally-standardised biodiversity metric to support nature-positive policy

Camille Fournier de Laurière[1], Robert McElderry[1], Ian Brettell[1], Thomas Elliott[1], Leland Werden[1], Johan van den Hoogen[1], Daniel Maynard[1], Thomas Crowther[1]

[1]Crowther Lab, ETH Zurich

As we push the biosphere to its breaking point, it has become more urgent than ever to fully internalise nature in our economic system. This requires a global monitoring framework that can measure changes in biodiversity (across genetic, species, and ecosystem levels) over time, and then deliver that information in a form that is comprehensible, actionable, and open.

We present the SEED Biocomplexity Index: a globally-standardised metric for measuring changes in biodiversity over time for every 30x30m terrestrial pixel on the planet. SEED is designed to measure the complexity of the whole system, rather than any one or several components of it, and it will integrate a variety of data sources - including remote sensing, eDNA, and bioacoustics - to continually increase the accuracy and granularity of the model. By hosting SEED on our affiliated Restor platform, we will provide the global community with open access to the world's best biodiversity data in a user-friendly format, and inform land managers about which practices deliver the greatest uplifts in biocomplexity.

We provide case studies for how SEED can be used by governments to track their progress towards their GBF targets; by businesses to understand and mitigate their impacts on nature; and by biodiversity credit systems to confer integrity to their claims. We further discuss the barriers to adopting SEED as a global standard, limitations of the metric and methods for improving it, and the policy mechanisms that can enable the transition to a nature-positive world.

Presentation type

Talk

Affiliation

Crowther Lab, ETH Zurich

Session

Biodiversity Change Indicators

70004 - The Conservation Exchange: Measuring biodiversity benefits of conservation actions in Canada

David Lesbarreres[1], Kristen Lalla[1], Paul Smith[1]

[1]Environment and Climate Change Canada

Addressing biodiversity loss through conservation action involves allocating resources to realize benefits. Since the financial resources available to support conservation are limited, incentives for the private sector are key to ensure that actions are efficient both from a biodiversity and an economic perspective. The Conservation Exchange is an innovative, science-based approach that brings private sector and proven conservation organizations together to enable more conservation projects in Canada. Measuring biodiversity benefits of conservation actions for a national program is a complex undertaking; a biodiversity indicator must be sufficiently nuanced to adequately capture biodiversity benefits, yet be general enough to be applied in a national context. Using an expert elicitation method, biodiversity benefits of conservation actions can be calculated for species-at-risk and broader biodiversity categories. These benefits can be expressed at a local and national level, providing elements of comparison in a growing green economy. Using the restoration of a saltmarsh in Canada, we will present the mechanics of the biodiversity indicator, as well as other potential applications of the Conservation Exchange, an encouraging program to expand conservation capacity, reward active organizations and incentivize new actors in solving the biodiversity crisis.

Presentation type

Talk

Affiliation

Environment and Climate Change Canada

Session

Biodiversity Change Indicators

70003 - Evaluation of the state and trends of habitat change on the Colombian Tropical Dry Forest

Maria Isabel Arce Plata[1], Jaime Burbano Giron[2], Natalia Norden[3], Maria Camila Diaz Corzo[3], Guillaume Larocque[4, 5], Alvaro Javier Vasquez Peinado[6], Timothée Poisot[1, 5]

[1]Université de Montréal, [2]The Nature Conservancy of Colombia, [3]Alexander von Humboldt Biological Resources Research Institute, [4]McGill University, [5]Centre de sciences de la biodiversité du Québec, [6]National University of Colombia

The Tropical Dry forest (TDF) is a highly fragmented biome, with a long history of use for human settlements and agricultural activities. It presents a high beta diversity and a high percentage of its remaining area is located in South America. In Colombia, this biome has been categorized as a critically endangered ecosystem, with just 8% or less of its original distribution remaining. Little is known about the effects of this historical transformation in the ecosystem dynamics and how it has affected the species inhabiting this biome. The Species Habitat Index (SHI), derived from the species population Essential Biodiversity Variable class, measures the change in the quality of species (or a group of species) habitats, considering changes in habitat size and connectivity. This index can be calculated at a global or national level, using global data layers, however here we use official national layers to evaluate changes in the limits of the original distribution of TDF. This information will contribute to the knowledge about the state of this biome and to identify hotspots of change and connectivity loss for native plants, birds, mammals, amphibians and reptile species. Therefore, this study tests how a global indicator endorsed by the CBD for the Kunming-Montreal Global Biodiversity Framework, like the SHI, can be used to evaluate the state of a highly fragmented biome in the country and how it can help to inform decision making and national plans like the national program for the conservation and restoration of the TDF in Colombia.

Presentation type

Talk

Affiliation

Université de Montréal

Session

Biodiversity Change Indicators

70001 - A review of indicators used in global assessments and frameworks

Yanina Sica[1], Renske Gudde[1], Hanno Seebens[1, 2], Aidin Niamir[1]

[1]Senckenberg Biodiversity and Climate Research Institute, [2]Justus Liebig University Giessen

Indicators, standardized tools or measurements used to assess the condition of social and ecological systems, are crucial for monitoring changes, evaluating the effectiveness of measures, and informing researchers and policymakers. However, to our knowledge, there is no comprehensive list of indicators covering the various social and ecological elements that constitute environmental systems. We reviewed the use of indicators in global frameworks and assessments and compiled a dataset of indicators.

We conducted a systematic search of keywords in the assessments of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and extracted indicators from the monitoring frameworks of the Global Biodiversity Framework (GBF) and the Sustainable Development Goals (SDGs).

Over 1000 potential indicators were harmonized and classified according to the specific elements they described. We found that all elements of the socio-ecological system are described by at least one metric. IPBES assessments employ a wide range of indicators, focusing on ecosystem services, biodiversity, and human well-being, and uniquely incorporate indicators on Indigenous and local knowledge. GBF proposes many indicators on ecosystems and governance, while the SDGs focus on human well-being and governance metrics. Indicators of direct drivers of environmental change, scientific knowledge, and anthropogenic assets have less representation.

The resulting dataset is publicly available, providing a valuable resource for scientists, policymakers, and governments to access and search for available indicators. By improving the accessibility and findability of these metrics, we hope to facilitate their utilization in monitoring the targets we set as a society.

Presentation type

Talk

Affiliation

Senckenberg Biodiversity and Climate Research Institute

Session

Biodiversity Change Indicators

70002 - Roles of the Red List of Ecosystems across the Kunming-Montreal Global Biodiversity Framework

Emily Nicholson[1]

[1]University of Melbourne

The Kunming-Montreal Global Biodiversity Framework of the UN Convention on Biological Diversity sets the agenda for global aspirations and action to reverse biodiversity loss. The Framework includes an explicit goal for maintaining and restoring biodiversity, encompassing ecosystems, species, and genetic diversity (Goal A), targets for ecosystem protection and restoration, and headline indicators to track progress and guide action[1]. One of the headline indicators is the Red List of Ecosystems, the global standard for ecosystem risk assessment. The Red List of Ecosystems provides a systematic framework for compiling data on ecosystems including their distribution, integrity and risk of collapse. Here, we examine how it can contribute to implementing the Global Biodiversity Framework. We find that the Red List of Ecosystems provides common theory and practical data that have important roles in 15 of the 23 targets, and is well-placed to aid Parties as they assess, plan and act to achieve the targets and goals, as well as monitor their progress. We outline future work to further strengthen this potential and improve biodiversity outcomes. Fulfilling the promise of the Framework for ecosystems will require collaboration and partnership between a diverse set of practitioners, policy-makers, and scientists.

Presentation type

Talk

Affiliation

University of Melbourne

Session

Biodiversity Change Indicators

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10007 - Remote sensing for estuarine and coastal ecosystem extent mapping in the Greater Cape Floristic Region of South Africa

Anthony Campbell[1, 2], Janine Adams[3, 4], Elhadi Adam[5], Lola Fatoyinbo[1], Daniel Jensen[6], Taryn Riddin [3, 4], Marc Simard[6], Atticus Stovall[1, 7], Lara Van Niekerk[4, 8], Heidi Van Deventer[8, 9]

[1]NASA Goddard Space Flight Center, [2]Goddard Earth Sciences and Technology Research II, University of Maryland, Baltimore County, [3]DSI-NRF Research Chair in Shallow Water Ecosystems, Department of Botany, Nelson Mandela University , [4]Institute for Coastal and Marine Research, Nelson Mandela University, [5]University of the Witwatersrand, Johannesburg, [6]Jet Propulsion Laboratory, California Institute of Technology, [7]University of Maryland, [8]Council for Scientific and Industrial Research, [9]Department of Geography, Geoinformatics and meteorology, University of Pretoria

Estuarine biodiversity is often low due to natural stressors such as inundation and salinity. However, estuaries across South Africa have relatively high plant biodiversity and provide critical ecosystem services. Ecosystem extent mapping in these systems may be limited by spatial, thematic, and temporal resolution resulting in products that exclude meaningful distinctions in habitat across the intertidal zone. We utilize medium to high-resolution (10-30 m) satellite imagery to map ecosystem extent change over the last two decades (2000-2020) to map estuarine ecosystems in the Greater Cape Floristic Region (GCFR) in South Africa. This presentation discusses ecosystem extent relative to water level/inundation, change analysis for two estuaries, Knysna and Langebaan, and the potential of aerial spectroscopy, such as AVIRIS-ng, to further improve ecosystem extent mapping in the GCFR. We compare the suitability of Landsat, Sentinel-2, and AVIRIS-ng for capturing spectral and topographic variability at a salt marsh in California, USA. These maps and analyses provide critical information for planning our planned field data collection as part of the NASA BioSCape biodiversity-focused aerial campaign and future monitoring of blue carbon habitats. During the campaign, we will endeavor to clarify the relationships between biodiversity, topography, and spectra across the estuaries of the GCFR. The BioSCape aerial campaign will provide a snapshot of biodiversity for October-November 2023, and our work will expand on this to understand how the biodiversity of estuaries across the GCFR have changed.

Presentation type

Talk

Affiliation

NASA/UMBC

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10005 - Projecting the 2050 distribution of World Terrestrial Ecosystems (WTEs) to assess potential changes in ecosystem extent and vulnerability

Roger Sayre[1], Terry Sohl[1], Zhuoting Wu[1], Madeline Martin[1], Jill Cress[1], Charlie Frye[2], Deniz Karagulle[2], Kevin Butler[2], Sean Breyer[2], Dawn Wright[2], Clint Brown[2], Regan Smyth[3], Florencia Sangermano[4], Paul Elsen[5], Nick Wolff[6], Patrick Roehrdanz[7]

[1]U.S. Geological Survey, [2]Esri, [3]NatureServe, [4]Clark University, [5]Wildlife Conservation Society, [6]The Nature Conservancy, [7]Conservation International

The 2015 World Terrestrial Ecosystems (WTEs), published in 2020, represent the distribution of European Space Agency 2015 Global Land Cover classes generalized to the biome level (forestlands, grasslands, shrublands, barren lands, croplands, settlements, snow and ice, and water) and subsequently stratified by climate regime and terrain settings. We now report the 2050 projected distributions of these ecosystems using both climate change models and land cover change models. The WTE 2050 ecosystem distributions are derived as a spatial recombination of the three original input layers (climate region, landform, and vegetation/assemblage/land cover type) where the climate regions input and the vegetation/land cover classes input are projected to 2050. As enduring features of the landscape, landforms were not projected to a future distribution. Potential change is observed as changes in the temperature domain, changes in the moisture domain, changes in both temperature and moisture domains, and changes in the vegetation assemblages/land cover classes. Changes in the projected distributions of climate regions as key determinants of ecosystem distributions were globally extensive. Both the climate modeling and the vegetation/land cover modeling use best practice methods and model ensembles from the IPCC community. The modeling of future distributions of ecosystems is important because ecosystems that may experience a strong reduction in distribution over the next ~30 years could be considered as vulnerable, and ecosystems that are both vulnerable to future reduction in distribution and are also currently un- or under-represented in protected areas might merit increased conservation attention.

Presentation type

Talk

Affiliation

U.S. Geological Survey

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10008 - Mapping spatiotemporal dynamics of vegetation and associated drivers for terrestrial protected areas in India using Earth observation time series

Neeti Neeti[1], Somajita Paul[1], Harini Nagendra[1]

[1]Azim Premji University

Protected areas are the foundation of global biodiversity conservation strategies. These areas act as a refuge for biodiversity and provide critical ecosystem services. Protected areas are central to most regional and national level biodiversity conservation strategies. Therefore, it is important to monitor the vegetation status of protected areas, especially in times like these - when climate change poses a major threat to ecosystems and biodiversity. In this study, we investigate the spatiotemporal variation in vegetation characteristics in terrestrial protected areas of India using 22 years of Earth Observation time series datasets (2001-2022). The spatiotemporal variation in vegetation characteristics was analyzed using the annual mean normalized difference vegetation index (NDVI) product MODIS sensors. The long-term variation in total annual precipitation and mean annual temperature from global datasets of Terraclimate were used to determine changes in climatic factors. We performed a trend analysis using the Mann-Kendall test and Theil Sen Slope to investigate long-term changes in vegetation. The influence of climate on vegetation dynamics was assessed through regression while the influence of anthropogenic factors was assessed by investigating trends in residuals of regression. We have found that most protected areas have gone through a major change in vegetation over the years, with more than one-third experiencing a significant decline in vegetation. These protected areas are in the Western Ghats, Himalayan, and Northeast biogeographic zones. Vegetation dynamics are also significantly influenced by climatic factors and anthropogenic activities.

Presentation type

Talk

Affiliation

Azim Premji University

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10002 - Adding value to use of ecosystem extent as an indicator of the state of global forest biodiversity

Simon Ferrier[1], Chris Ware[1], Jenet Austin[1], Hedley Grantham[2], Thomas Harwood[3], James Watson[4]

[1]CSIRO Environment, [2]Wildlife Conservation Society, [3]University of Oxford, [4]University of Queensland

The CBD post-2020 Global Biodiversity Framework lays out an ambitious set of goals and targets aimed at halting and reversing biodiversity loss. The extent of natural ecosystems has been selected as one of a small set of headline indicators against which member countries must now report progress under this framework. We evaluate the effectiveness with which this indicator is expected to capture the overall scope of the ecosystem-focused component of Goal A, and interlinkages with the species-focused component of this same goal, using extensive global data on the integrity, connectivity, and plant-species composition of forests. Results generated for all forest-supporting countries demonstrate that consideration of these additional factors can profoundly alter understanding of the state of forest biodiversity relative to that based on extent alone. Employment of ecosystem extent as a headline indicator must therefore be augmented by appropriate use of component and complementary indicators addressing other key dimensions of ecosystem change.

Presentation type

Talk

Affiliation

CSIRO Environment

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10006 - From genes to earth observation: monitoring marine biodiversity within the OBAMA-NEXT project

Valeria Mobilia[1], Anna Spinosa[1], Ghada El Serafy[1]

[1]Deltares

With biodiversity loss advancing at unprecedent speed in recent years, internationals agreements have been implemented to counteract this decline, such as the European Biodiversity Strategy for 2030. Strong monitoring programs are essential to understand and reverse biodiversity loss, but these are often fragmented and inconsistent across countries. Furthermore, while in situ monitoring techniques are precise, they are resource- and time-consuming, yet they allow limited spatial coverage and temporal resolution.

Here we present OBAMA-NEXT, a four-year EU project that will create a toolbox for generating accurate information on marine biodiversity, by developing algorithms that rely on data from diverse sources. With the collaboration of 22 partners across Europe, OBAMA-NEXT will combine observations from remote sensing platforms with *in situ* biological monitoring to acquire precise marine biodiversity data, thus improving spatial and temporal resolution. This goal will be achieved through the combination of traditional marine monitoring techniques with emerging technologies and tools such as data processing algorithms, artificial intelligence, eDNA. The tool will be evaluated and improved based on 12 Learning Sites spread across the four European regional seas and representing different ecosystems and data sources. The project, together with stakeholders and end-users, will identify data products needed and contribute to meet current policy goals and support the management of marine ecosystems and the services they provide.

Presentation type

Talk

Affiliation

Stitching Deltares

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

1000031 - Assessment of impacts of shoreline change on the nearshore marine environment at Gazi bay, Kenya

Pauline Mwangi[1], James Kairo[2], Joseph Maina[1]

[1]Chuka University, [2]Kenya Marine and Fisheries Research Institute

Coastal shorelines are naturally dynamic systems, influenced by both human and natural processes. Change in shoreline position cause negative impacts within and at the adjacent ecosystems. The study quantified the impacts of shoreline change on the nearshore marine environment at Gazi bay, Kenya; between 1989 and 2020. Using a combination of remotely sensed data and Geographic Information System, shoreline positions were delineated, hotspot areas were identified and possible potential drivers of shoreline change were established. A digital shoreline analysis system (DSAS) computed the rate of shoreline change while a hybrid supervised and unsupervised classification was applied in detecting land use land cover change. It was observed that south western creek of Gazi bay is undergoing shoreline erosion of -1.29 m/y and accretion is mainly experienced at the northern side, while erosion is mainly experienced at the southern side of the bay. About 55% of mangroves were lost between 1989 to 2020 and shoreline prediction indicate that some of the coastal infrastructures will be lost. At Mkurumudzi river mouth there was formation of sandspit, sandbars and estuary degradation. The causative agents of shoreline change include poor land use patterns and climate change. Mangroves are the major source of livelihood and source of income through the sale of carbon credits known as Mikoko Pamoja project in Gazi bay. Nature-based solutions can be employed to ensure sustainable mangrove restoration and shoreline change mitigation. The results of this study provide important data and information for better scenario coastal planning and management.

Presentation type

Poster

Affiliation

Chuka

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10001 - European habitat modelling and mapping

Sander Mucher[1], Stephan Hennekens[1], Sara Si Moussi[2], Bruno Smets[3], Henk Kramer[1], Rob Knapen[1], Wilfried Thuiller[2], Stan Los[1]

[1]Wageningen University and Research, [2]CNRS, [3]VITO

Since Europe's biodiversity continues to decline at an alarming rate, mapping and monitoring the extend of all its habitats is key information for e.g. policy makers and environmental agencies. Machine Learning (ML) and Artificial Intelligence (AI) techniques, such as and Neural Networks or Deep Learning methods could enable an improved monitoring of biodiversity and ecosystems with satellite based high-resolution datasets such as Copernicus High Resolution Vegetation Phenology Product (HR-VPP) to better support European policy making. So understanding where habitats occur across Europe is a crucial element for understanding biodiversity conservation and taking specific actions. Since at the EU level information on habitats is currently limited at the 10km grid level (Annex I), more spatial detailed habitat maps are required using innovative methods such artificial intelligence/machine learning based on high resolution satellite and other ancillary data and integration of in-situ observations as training data from the European Vegetation Archive (EVA). Therefore we have been focusing lately one i) Production of high-resolution habitat suitability maps for Europe at 100 meter resolution for most EUNIS habitat types at level 3, ii) production of very high-resolution habitat suitability maps at 10 meter resolution for e.g. Austria, Portugal and the Netherlands, and iii) explore deep learning techniques for habitat mapping at regional scale. For all used methods the amount of training data from EVA is crucial for the classification / modelling precision, and differs a lot per region. In general much more effort should be made on the collection and the enhancement of the training data.

Presentation type

Talk

Affiliation

Wageningen University and Research

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10010 - Applications of satellite remote sensing in Sub-Saharan Savannas - an ecoregional review

Armando Apan[1], Tek Maraseni[1], Ravinesh Deo[1], Mungandi Nasitwitwi[1, 2]

[1]University of Southern Queensland, Australia, [2]Kwantlen Polytechnic University, Canada

Innovations in satellite remote sensing can improve the observation of highly diverse terrestrial landcover types like the savanna. In Sub-Saharan Africa, the savanna not only consists of three distinct biomes, but it also contains several ecoregions nested within the biomes. Over the years, satellite remote sensing technologies have been largely used to map, monitor or model savanna ecoregions as a collective, with little attention paid to their ecosystem diversity. Such a broad-brush approach may not provide full insight into the drivers of change and ecosystem response of Sub-Saharan savannas under the growing pressures of human induced degradation and climate change.

We systematically reviewed literature to assess the spatial extents and thematic contexts in which satellite remote sensing technologies have been utilized in Sub-Saharan savannas over the period 2000-2020. Our spatially explicit analysis revealed that while the number and diversity of satellite remote sensing publications in Sub-Saharan savannas are increasing, the spatial distribution of regions of interest is uneven. Using intensity maps, we identified potential 'hot spots' and 'cold spots' of satellite remote sensing application. Finally, we explore the challenges and opportunities of implementation of appropriate satellite remote sensing technologies in ecoregions where published literature is low.

Presentation type

Talk

Affiliation

Kwantlen Polytechnic University, Canada & University of Southern Queensland, Australia

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10004 - The future is fusion: bringing to bear new satellites, methods, and stakeholders for mapping ecosystem extent and change

Amy Rosenthal[1], Seamus Lombardo[1]

[1]Planet Labs PBC

As we respond to the urgent challenge of designing a global biodiversity monitoring system, one of our first steps must be the classification and delineation of the Planet's ecosystems, and a plan to track changes in their extent, in line with Goal A of the Kunming-Montreal Global Biodiversity Framework. Earth observation has a crucial role to play in this effort, and there is growing acknowledgement of the potential for public-private partnerships to bring to bear a combination of high spatial, high temporal, and high spectral resolution instruments, alongside fusion data that draw insights from multiple sensors. Planet Labs represents an example of this potential, wherein the public benefit corporation's offerings - including those jointly developed with public, philanthropic, and civil society partners - contribute to global mapping of ecosystem structure, function, and composition. Planet imagery and data have regularly been utilized in the mapping of ecosystem extent for a variety of ecosystems at global, regional, national, and subnational levels, including tropical forests, coral reefs, ponds and lakes, and seagrass meadows. Many studies use Planet's 3m resolution, near-daily imagery to improve geometric accuracy, better delineate ecosystem edges, and precisely track rapid changes in extent, in combination with robust application of publicly available Earth observation data. We suggest that this approach is particularly promising for highly diverse, rapidly changing, and/or spatially constrained ecosystems.

Presentation type

Talk

Affiliation

Planet Labs PBC

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

10003 - Mapping forest cover and change as continuous rather than discrete variables is essential to advance a framework for biodiversity monitoring across products and scales

Victor H Gutierrez Velez[1], Jeronimo Rodriguez[1], Angela Mejia[1], Wilson Lara[2], Mary Blair[3], Maria C Londoño[4]

[1]Temple University, [2]Nibio, [3]American Museum of Natural History, [4]von Humboldt Institute

The consolidation of a global biodiversity monitoring framework requires consistent estimates of ecosystem extent and change across products and scales of analysis to effectively inform conservation action. We argue that achieving this goal requires to advance the mapping of forest cover and change as continuous rather than discrete variables. To support this argument, we harmonized the UMD global forest change product with the national forest surface dataset for Colombia. Then, we compared these maps in terms of accuracy, classification agreement, and estimates of annual forest-area loss. We further analyzed whether areas of map agreement and disagreement have distinct characteristics in terms of canopy height (CH) and above-ground biomass (AGB).

Results show minimal differences in overall accuracy between maps but large differences in omission errors for both forest and non-forest classes. As expected, areas of forest agreement exhibited a tendency towards higher values of CH and AGB, while non-forest classes converged toward lower values. Disagreement occurred in areas with intermediate values of CH and AGB that are significantly distinct from areas of forest and non-forest agreement.

Results suggests that disagreement in forest cover mapping across products and scales can be largely resolved if forest cover and change were represented as continuous rather than categorical variables. Advancing towards this end can facilitate consistency between global and regional forest cover maps, promote accountability in estimates of forest area loss, and facilitate more nuance estimates of carbon and biodiversity loss from forest change. Recent advances in remote sensing are nearing us toward that reality.

Presentation type

Talk

Affiliation

Temple University

Session

Ecosystem Extent Mapping From Satellite Earth Observations: A Framework for Biodiversity Monitoring

Mainstreaming and Communicating Biodiversity Monitoring Across Society

2000032 - Innovation resistance: when benefits might not be enough

Caroline Thivierge[1], Jérôme Dupras[1]

[1]Université du Québec en Outaouais

The advantages of eDNA for monitoring biodiversity are numerous. However, its use could remain limited to scientific circles if we do not pay attention to end users perceptions of it. The acceptance of a new technology is based both on organizational, individual and social determinants, as well as on functional or psychological barriers. Also, the current barriers to the acquisition of biodiversity data can also be a barrier to the adoption of eDNA. This research aims to identify eDNA resistance factors and current institutional barriers to its use and for the acquisition of biodiversity data in general in the province of Quebec.

Presentation type

Poster

Affiliation

Université du Québec en Outaouais

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

200001 - Human histories shape the biodiversity data that decides our future

Melissa Chapman[1], Benjamin Goldstein[1], Christopher Schell[1], Justin Brashares[1], Neil Carter[2], Diego Ellis-Soto[3], Hilary Faxon[4], Jenny Goldstein[5], Joycelyn Longdon[6], Kari Norman[7], Dara O'Rourke[1], Caleb Scoville[8], Lily Xu[9], Carl Boettiger[1]

[1]Department of Environmental Science, Policy, and Management, University of California Berkeley, [2]School for Environment and Sustainability, University of Michigan, [3]Department of Ecology and Evolutionary Biology, Yale University, [4]Department of Society and Conservation, University of Montana, [5]Department of Global Development, Cornell University, [6]Department of Computer Science, University of Cambridge, [7]Département de sciences biologiques, Université de Montréal, [8]Department of Sociology, Tufts University, [9]School of Engineering and Applied Sciences, Harvard University

Monitoring technologies are collecting information about global biodiversity at a rate and resolution that was unfathomable a decade ago. Coupled with advances in computational tools, these billions of species observations are increasingly made available on data-sharing platforms and translated into derivative products, promising to support decisions for a more sustainable future. However, widespread use of biodiversity data often belies the reality that the species these data tell us most about is the one species they never intended to include: humans. We see not only roads, cities, and the rise of surveillance technology reflected in species observations, but shadows of a colonial past, the weekly sway of work schedules in a modern capitalist society, and echoes of our racial and economic disparities. With urgent calls to develop biodiversity indicators that hold countries and companies accountable for their commitments to the Kunming-Montreal global biodiversity framework, 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 explores how uncorrected socio-political disparities in biodiversity data can impact not only our insights about ecosystem processes but also the distributional equity of decisions derived from these data. We show how statistical models can help identify and control for social and political data disparities but only to the extent that we can identify and quantify biases. 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.

Presentation type

Talk

Affiliation

University of California Berkeley

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

200005 - AI for ecosystems: opportunities and challenges for measurement and reporting

Nilufar Sabet-Kassouf[1], Jennifer Garard[1], Sylvia Wood[2], Andrew Gonzalez[3], Andréa Ventimiglia[1], Amy Luers[4]

[1]Future Earth, [2]Habitat, [3]McGill University, [4]Microsoft

The European Union will soon require that nearly 50,000 companies report their impacts on biodiversity and ecosystems through the Corporate Sustainability Reporting Directive (CSRD). Affected companies will report on actual and potential impacts and dependencies on nature across their supply chains, including inter alia biodiversity, ecosystem condition, ecosystem services, and extinction risk.

With little formal guidance to date, ensuring that the vast amounts of ecological data needed to meet CSRD requirements are collected in a scientifically robust way that enables standardized contribution to global efforts presents a major challenge. The use of artificial intelligence (AI) in ecological sciences and remote detection has accelerated exponentially in recent years. There is significant potential for AI to propel biodiversity monitoring in several ways, including advancing rapid data analysis, species identification, habitat mapping, monitoring and surveillance, and modeling. However, applications of AI, strongly rooted in theory in support of global biodiversity monitoring, are not well defined.

Drawing on the results of a survey of expert scientists, we will present an overview of the main opportunities and challenges associated with the use of AI to report on biodiversity and ecosystems, in line with the CSRD regulations and in service of global biodiversity science. We ask experts how AI can best support progress on biodiversity monitoring? At what scales? And what are the barriers to their effective and fair use?

Presentation type

Talk

Affiliation

Future Earth

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

200003 - Monitoring biodiversity on campus: Nature Positive Universities Alliance and the Campus Biodiversity Network

Emily Stott[1], Katherine Collin[2]

[1]University of Oxford, Nature Positive Universities Alliance, [2]Vanier College, Campus Biodiversity Network

Universities and colleges, as research hubs and sites of student engagement, have long beeninstrumental in increasing general understanding of biodiversity and calling for transformativeaction. This panel will discuss two mutually supporting initiatives launched during COP-15 thataim to mainstream biodiversity in post-secondary institutions: the Nature Positive UniversitiesAlliance (NPU) and Campus Biodiversity Network (CBN) project. The Nature Positive Universities Alliance is a worldwide initiative founded by University of Oxford and UN Environment that asks universities to take steps towards restoring species and ecosystems that have been harmed by their impacts and activities, and to enhance their positive impacts on nature. Such impacts are understood to encompass everything a university does, from its teaching and research work to the operations and supply chains that keep it running. Nature Positive Universities commit to establishing a measured biodiversity baseline, timeframe, a target, clear actions, analysis of how actions add up, monitoring and transparent reporting. The Campus Biodiversity Network project, started at Vanier College in Quebec, works in conjunction with NPU to monitor biodiversity directly on post-secondary campuses, enabling institutions to track, compile, and share aggregated biodiversity observations through community-science platforms. While many institutional sites are considered to have low ecological value, often found within highly fragmented and urban areas, the project offers a potential means of tracking the value of small "patches" for biodiversity and of showing the power that institutional sites may have for conservation. Both initiatives align with Targets 12 and 14 of the Kunming-Montreal GBF.

Presentation type

Talk

Affiliation

Vanier College, Campus Biodiversity Network

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

2000033 - Assessing biodiversity using an Ecosystem Integrity-Weighted Carbon Index

Katherine von Stackelberg[1], Lauren Baldarelli[1], Arildo Dias[1], Shaya van Houdt[1], Aap Kaur Suvi[1], Donalda Karnauskaite[1], Kuno Kasak[1], Atilcan Kebabci[1], Igor Milvee[1], Jana Paju-Hamburg[1], Jüri Sildam[1], Dmitri Stepanov[1]

[1]Single.Earth

Developing scalable and practical solutions to assess and monitor biodiversity has become possible with the increasing availability and combination of earth observations, in situ data, and machine-learning. Following COP15, companies are increasingly being called upon to disclose both dependencies and impacts of their economic activities on nature. This has lead to a proliferation of biodiversity footprint reporting tools, many of which rely on simplistic biodiversity metrics, such as mean species abundance. Within the nascent biodiversity credit market, leading proposals call for assessing a “market basket” of biodiversity “goods” with unclear potential for actual impact (e.g., 1% uplift over 1 hectare per credit and similar). Biodiversity also depends on ecosystem characteristics such as habitat connectivity, for instance, which allow species to thrive. Here we present a method to estimate an Ecosystem Integrity Index (EII) based on essential biodiversity variables that address ecosystem structure, function, and composition.The index, which combines Earth observation and machine learning, can be aggregated across multiple scales and allows comparison between local plots and global EII values. Our novel methodology results in an EII-weighted carbon metric to facilitate connection to existing carbon markets. This methodology includes a blockchain-based proxy value called MERIT-token which acts as a bridge between fiat currency and an ecosystem integrity-based natural capital asset. The continuous increase of market focus on carbon emission highlights the value of such an approach, not to mention the urgency of the intervention in human economic activity causing exceedances of planetary boundaries.

Presentation type

Poster

Affiliation

Single.Earth

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

2000031 - Opportunities with eDNA to monitor corporate ecological impact

Karen Dyson[1], Karis Tenneson[1], Andréa Nicolau[1], David Saah[1]

[1]Spatial Informatics Group

Corporations are turning to emerging methods, including eDNA, to monitor the ecological impact of their activities. eDNA has multiple advantages in this space, including flexibility in design, low-cost data collection, scientific robustness, and rapid turnaround of monitoring results. Furthermore, there are many ways in which the data can be analyzed and presented to provide critical insights that inform both internal corporate decision making and risk management and external reporting. Moving beyond traditional indices, we can use multivariate analyses to describe changes in communities of organisms over time, link these changes with environmental gradients, and link biodiversity data to data from other methods like remote sensing to provide a holistic view of corporate biodiversity impact that is also scientifically robust. Here, we will discuss some of the current and future opportunities to use eDNA to monitor the biodiversity impacts of corporate projects, implementation of some of these initiatives in the corporate context, and some of the tradeoffs that occur during implementation to balance corporate requirements with the best available science.

Presentation type

Poster

Affiliation

Spatial Informatics Group

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

200004 - Achieving a real-time online monitoring system for conservation culturomics

Thomas Johnson[1], Joseph Millard[2]

[1]The University of Sheffield, [2]The Natural History Museum (London)

Environmental monitoring is increasingly shifting towards a set of systems that describe changes in real-time. In ecology specifically, a series of challenges have prevented the roll-out of real-time monitoring for features such as biodiversity change or ecosystem service provision. Conservation culturomics, a field concerned with interactions between people and nature, is well-placed to demonstrate how monitoring might move towards a network of real-time platforms, given its existence exclusively in the digital realm. Here we describe a set of considerations associated with the development of real-time monitoring platforms for conservation culturomics. We then introduce a near real-time platform for the Species Awareness Index, a global index of changing biodiversity awareness derived from the rate of change in page views for species on Wikipedia. This platform will update automatically each month, operating in near real-time, with plans to make the underlying data queryable via an API independent of the platform. The real-time Species Awareness Index will represent the first real-time and entirely automated conservation culturomic platform, and one of the first real-time platforms within the discipline of ecology. We conclude by envisioning a future for real-time monitoring, presenting a general framework for real-time monitoring in ecology, and calling for an online real-time observatory that can evolve with the structure of the web.

Presentation type

Talk

Affiliation

The Natural History Museum (London)

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

200006 - Monitoring for 'nature-positive' - meaningful biodiversity indices for business and finance

Brendan Wintle[1], Natasha Cadenhead[2], Rachel Morgain[1]

[1]University of Melbourne, [2]University of Queensland

Robust monitoring and modelling of biodiversity will be essential to ensure that businesses can accurately assess their biodiversity impacts and dependencies and disclose the outcomes of their transformations toward being nature positive. We reviewed existing measures and modelling frameworks being proposed for use by business and finance organisations for the purposes of analysing their nature impacts and risks. We find that several of the proposed measures and approaches are unlikely to serve the purpose of accurately quantifying the impacts of business on biodiversity. Modelled biodiversity indices such as mean species abundance (MSA) and potentially disappeared fraction (PDF) are being proposed as the dependent variable against which a supply chain's impact on biodiversity should be measured. The models (or characterisation functions) being used to assign impacts of resource use are extremely course in spatial scale and resource/commodity classification. Businesses that utilise such approaches to measure and predict the impacts of their activities and benefits of their transformation actions risk exposure to reputation loss and even litigation if their measures and disclosures are shown to be fallacious. There is an urgent need for conservation scientists to help design and translate ecologically realistic measurement and assessment processes that businesses can apply with often limited expertise.

Presentation type

Talk

Affiliation

Melbourne Biodiversity Institute, University of Melbourne

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

200002 - Engaging stakeholders in biodiversity monitoring, from data acquisition to interactive decision making tools

Dominique Gravel[1], Sabrina Courant[2], Anouk Simard[3]

[1]Université de Sherbrooke, [2]Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), [3]Minitères des Forêts, de la Faune et des Parcs, Québec

Communication between scientists, society and decision makers must be rapid and efficient to meet ambitions of the new Global Biodiversity Framework. Biodiversity science however suffers from a severe communication deficit in comparison to other environmental issues. While climate change makes regularly the news and set the public agenda, there is a growing disconnection between biodiversity research and media coverage. Biodiversity is a more complex problem, with multiple dimensions to represent and different meanings from one person to another. Here I will describe how the new scientific partnership Biodiversité Québec attempts at sharing biodiversity information of various forms to support decision making by different actors. Its mission is to collect observation data, to improve the monitoring of biodiversity in Québec and to make syntheses and analyses available to the public. I will briefly overview our approach, from field observations to the representation of Essential Biodiversity Variables and indicators to various stakeholders. The originality of the approach is to engage governments, NGOs, museums, consultants, industries, finance institutions along with researchers in the development of interactive tools to access biodiversity information. In collaboration with specialists from Design Thinking and Business Intelligence, we characterized the needs for information, technological and scientific abilities and user scenarios so that the tools we develop are best adapted to various stakeholders. Biodiversity Québec is also a research infrastructure for collaborative training. Their close contact with partners fosters translation of the most up do date research in biodiversity science and thereby contributes to the reduction of the communication deficit.

Presentation type

Talk

Affiliation

Université de Sherbrooke

Session

Mainstreaming and Communicating Biodiversity Monitoring Across Society

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

140001 - EuropaBON: a journey to accelerate action for biodiversity

Jessica Junker[1], Miguel Fernandez[1], Nestor Fernandez[1], Jose Valdez[1], Henrique Pereira[1]

[1]German Center for integrative Biodiversity Research (iDiv), Leipzig, Germany

Ensuring up-to-date observations on biodiversity change and its response to drivers and management presents a formidable challenge for biodiversity policy. Unfortunately, a coordinated biodiversity monitoring system remains absent across Europe and its Member States. Addressing this critical need, the EuropaBON project leverages the tailored GEO BON recipe to design a Europe-wide Biodiversity Observation Network. The initial phase involved a comprehensive assessment of user and policy needs for biodiversity data monitoring. We identified a list of Essential Biodiversity Variables (EBVs) that should be monitored to effectively address these pressing needs. Building upon this foundation, we conducted an evaluation of existing biodiversity monitoring programs across Europe, analyzing their integration levels and uncovering spatial, temporal, and taxonomic gaps. Additionally, we identified persistent bottlenecks that impede the seamless flow of information from data collectors to data users. Drawing on insights from our assessment, we are actively developing workflows for each EBV. These workflows, underpinned by cutting-edge methodologies, will ensure standardized monitoring practices that enable reliable comparisons across regions and countries. Moreover, we are exploring alternative strategies to establish sampling sites, capitalizing on economies of scale and colocalization. By optimizing resource allocation and coordination, we aim to enhance efficiency, reduce costs, and ultimately strengthen the foundation of our observation network. Finally our case studies underscore the tangible benefits of our approach and demonstrate the potential of the European Biodiversity Observation Network to foster transformative change in biodiversity conservation.

Presentation type

Talk

Affiliation

German Center for integrative Biodiversity Research (iDiv), Leipzig, Germany

Session

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

140002 - Gaps in biodiversity monitoring in Europe: an Essential Biodiversity Variables approach

Joana Santana[1, 2, 3], Miguel Porto[1, 2, 3, 4], Lluís Brotons[5, 6, 7], Jessi Junker[8, 9], W. Daniel Kissling[10], Maria Lumbierres[10], Jannicke Moe[11], Alejandra Morán-Ordóñez[5, 6], Henrique M. Pereira[1, 8, 9], Anne Lyche Solheim[11], Dani Villero[6], Francisco Moreira[1, 2, 3], Pedro Beja[1, 2, 3]

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The EuropaBON project aims to set up a European Biodiversity Observation Network. This requires assessing the current biodiversity monitoring capacity in Europe, in order to identify gaps and priority areas for improvement. Based on the Essential Biodiversity Variables (EBVs) concept developed by the GEOBON network, we evaluated the current in-situ biodiversity monitoring initiatives in Europe in terms of their ability to derive the data required to generate a set of EBVs corresponding to the six generic classes identified by GEOBON (genetic composition, species populations, species traits, community composition, ecosystem function, ecosystem structure), across the freshwater, marine and terrestrial realms. More specifically, we assessed biodiversity monitoring initiatives according to ten criteria: country coverage; taxonomic/ ecosystem coverage; standardized monitoring; time-series data; long-term monitoring; ongoing monitoring; sampling frequency; spatial coverage density; minimum sampling unit; raw data available.

Our study revealed that monitoring across Europe is taxonomically biased; does not cover all regions; sampling density and frequency are usually insufficient for the production of the EBVs at the desired spatial and temporal resolution; there is a lack of long-term time-series data; and raw data needed to produce the EBVs is hardly accessible. Monitoring data is lacking for lichens, fungi, disease vectors, crop pests, zooplankton, freshwater invertebrate species, and marine turtles.

By identifying geographic, taxonomic/ecosystem, temporal and spatial gaps for EBVs generation, this work provides the most comprehensive continental-scale assessment of ongoing monitoring capacities in relation to user and policy needs, with implications for the identification of gaps in biodiversity monitoring in Europe and elsewhere.

Presentation type

Talk

Affiliation

BIOPOLIS-CIBIO/InBIO

Session

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

140006 - Scaling data cubes for Essential Biodiversity Variables

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Scaling data cubes for Essential Biodiversity Variables

Leveraging Big Data in biodiversity science presents an unprecedented opportunity to conduct comprehensive studies across diverse spatial and temporal scales for decision-making and action. Rapid advancements in scientific data management have facilitated the provision of technological solutions to make dataready available to users, circumventing the need for extensive data preprocessing and redundancy. However, keeping up with the latest advancements in efficient data access, loading, and processing, and effectively communicating and integrating new tools and findings for scientific research and decision-making pose significant challenges. During this presentation, we will explore the application of hypercubes (e.g., multidimensional gridded data arrays), for conducting regional and global biodiversity analyses. Specifically, we will examine real-world experiences gained from regional implementations of data cubes within the context of the European B-Cubed project. The B-Cubed project aims to harness the latest advancements in data cubes, enabling global access to biodiversity datasets represented as n-dimensional arrays. By leveraging these data cubes, the B-Cubed project plans to make a significant contribution to the estimation of species level Essential Biodiversity Variables identified by EuropaBON, particularly in alignment with key EU policies such as the habitat directive, Natura 2000 network, and the anticipated Ecosystem Restoration law, demonstrating how through collaborative efforts, we can pave the way for more effective conservation strategies and sustainable environmental management.

Presentation type

Talk

Affiliation

German Centre for Integrative Biodiversity Research (iDiv)

Session

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

140004 - NaturaConnect: designing a coherent Trans-European Nature Network

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The European Union Biodiversity Strategy for 2030 and the Kunming-Montreal biodiversity framework have set ambitious targets to increase the extent, connectivity, and effective management of nature protection areas. Together with key stakeholders, the NaturaConnect project develops knowledge and policy support tools that help bridging the gaps for consistent conservation planning across 27 different countries. The project is sustained on five research Pillars: (1) Multi-sectorial engagement with National and European administrations and other key stakeholders through co-design; (2) Develop scenario narratives and projections based on the Nature Futures Framework; (3) advance predictive models for biodiversity and ecosystem services as a means to fill information gaps and predict responses to land-use and climate change; (4) integrate systematic conservation planning and connectivity analyses for designing a coherent Trans-European Nature Network; and (5) explore enablers and gaps for the Network implementation taking regulatory and financial instruments into account. This addresses two major obstacles identified by the EU Nature Legislation Fitness Check: lack of stakeholder awareness and cooperation, and insufficient knowledge and access to existing funding mechanisms. Equipped with improved data, knowledge, models and spatial planning methods, we aim to support the European Union offering a blue-print for an effective implementation of the Protected Area and Connectivity targets.

Presentation type

Talk

Affiliation

German Center for Integrative Biodiversity Research (iDiv)

Session

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

140003 - Designing Essential Biodiversity Variable workflows: a comprehensive approach to building an European Observation Network

Maria Lumbierres [1], W. Daniel Kissling[1]

[1]Universiteit van Amsterdam

The EuropaBON project aims to co-design a comprehensive European Observation Network that addresses both current and future biodiversity policy demands. The central concept of the project are Essential Biodiversity Variables (EBVs), which form the foundation of our monitoring strategies. The successful production of EBVs relies on the meticulous design of detailed workflows. Workflows are defined as a sequence of tasks needed to process a set of raw data to produce EBVs. We distinguish three primary components: data collection and sampling, data integration and harmonization, and modeling. The nature and structure of these workflows can vary significantly, depending on the EBV class, the taxonomic scope, and the monitoring technique employed to collect the data. We provide a comprehensive review of the workflow components for marine, freshwater, and terrestrial EBVs. This review is intended to support the creation of a large-scale monitoring network, considering the current state of development, emerging tools, and future components that require further development. In our attempt to comprehend and establish these workflows, we have extensively consulted with experts and biodiversity monitoring stakeholders from various domains. This collaborative approach has enabled us to describe the EBV workflow components in detail, considering the unique characteristics of different EBV classes, taxa, and monitoring techniques, including structured in-situ monitoring programs, citizen science observations, satellite and airborne remote sensing, digital sensor, and genetic monitoring.

Presentation type

Talk

Affiliation

Universiteit van Amsterdam

Session

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

140005 - The European Biodiversity Partnership (Biodiversa+) harmonizes transnational biodiversity monitoring schemes across Europe

Petteri Vihervaara[1], Hilde Eggermont[2], Cécile Mandon[3], Claire Blery[3], Magnus Tannerfeldt[4], Rainer Sodtke[5]

[1]Finnish Environment Institute/ Biodiversa+, [2]BelSPO, [3]FRB, [4]FORMAS, [5]DLR

Gathering 80 research programmers and funders and environmental policy actors from 40 European and associated countries, Biodiversa+ (2021-2028) works on five interconnected 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 pre-defined priorities, tightly linked to the research and innovation ecosystem while efficiently informing the policy arena. Building on national/regional monitoring schemes and capacity building for setting up new schemes, this will contribute to improving monitoring of biodiversity and ecosystems across all land and sea habitats in Europe (status and trends). To reach this goal, Biodiversa+ joins forces with EuropaBON, our key collaborator, and other selected key bodies (JRC, EEA, GBIF) in delineating a strategic framework that defines a common vision (end-goal) for biodiversity monitoring across Europe, as well as the major steps, collaborations and governance options to reach it. An overview of the outcomes of Biodiversa+ activities during the first two years will be presented.

Presentation type

Talk

Affiliation

Finnish Environment Institute

Session

From Insight to Action: Mapping Europe's Biodiversity Initiatives and Their Path Towards 2030 Ambitions

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

220005 - Towards a set of Essential Biodiversity Variables for assessing change in mountains globally

James Thornton[1], Dirk Schmeller[2], Roger Sayre[3], Carolina Adler[1]

[1]Mountain Research Initiative & GEO Mountains, [2]Toulouse INP ENSAT, Laboratoire Ecologie Fonctionnel et Environnement, [3]USGS

Mountain systems harbour unique and rich biodiversity and their ecological intactness are imperative for providing key ecosystem services. Ecological intactness of mountain systems is rapidly altered by anthropogenic pressures, while we lack monitoring data on mountain biodiversity. The Essential Biodiversity Variables (EBVs) framework will help to focus efforts related to detecting, investigating, predicting and managing global biodiversity change. We reviewed key biological processes and physical phenomena that strongly influence biodiversity and ecosystems in mountains, and identify seven mountain-relevant EBVs: Species composition, Species abundance, Ecosystem fragmentation, Ecosystem extent, Ecosystem heterogeneity, Species distribution and Ecosystem functional type. Our proposed set of EBVs for mountains will ensure that the most critical drivers and responses of mountain biodiversity change are sufficiently well tracked and understood, enabling effective management and policy interventions. Both are urgently needed to halt further mountain biodiversity loss and to maintain functional mountain ecosystems, part of the global life support system.

Presentation type

Talk

Affiliation

Mountain Research Initiative & GEO Mountains

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

220004 - Multi-temporal habitat maps based on ecological niche models using Google Earth Engine

Elkin A. Noguera-Urbano[1], Gabriel-Alejandro Perilla[1], Cristian A. Cruz-Rodríguez[1], Carlos Jair Muñoz[1], Maria Helena Olaya-Rodríguez[1], Erika Suarez-Valencia[1], Dairo A. Escobar Ardila [1], Gerardo Rodríguez-Tapia[2]

[1]Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, [2]Universidad Nacional Autómoma de México

Ecological niche models result in species distribution maps (SDM), a critical EBV that supports decision-making. Its relevance is pertinent, considering that SDM could be used to evaluate human and climate change impacts on biodiversity. However, the modeling process requires time and is hardware-consuming, or the resulting models represent static habitats and low-resolution maps. Sometimes, they do not reflect the dynamic nature of the species and its environments. Thus, we aimed to implement SDM using remote sensing data (RSD) directly on the GC. Our workflow uses the Google Earth Engine (GEE) capacities integrating species records and RSD to generate SDM. We used 6,136,525 records for 1534 Colombian species of birds and seven covariates, six from MODIS monthly mosaic at 250 m pixel size (Normalized Difference Vegetation Index, Enhanced Vegetation Index, Red surface reflectance, NIR surface reflectance, Blue surface reflectance, MIR surface reflectance) and altitude, via four algorithms (Maxent by Phillips, SVM, Boosted Regression Trees, and Random Forest). The models were projected for 22 years, from 2000 to-2021. The results showed that the performance of the models had high variance, and the ROC and kappa indexes support the RF algorithm with the more realistic habitat maps based on expert consults (845 species; https://biomodelos-iavh.users.earthengine.app/view/biomodelos). The complete set of maps shows how habitat availability has changed over the last two decades and could give a hint toward future habitat-changing trends. This project was granted by The Group on Earth Observations (GEO) and Google Earth Engine (GEE) with technical support from EO Data Science.

Presentation type

Talk

Affiliation

Instituto de Investigación de Recursos Biológicos Alexander von Humboldt

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

220006 - Enhancing collaboration and data accessibility in Earth and environmental sciences: a gateway approach of the FAIR-EASE project

Marie Jossé[1], Yvan Le Bras[2], Jérôme Détoc[3], Erwan Bodéré[3]

[1]CNRS, [2]MNHN, [3]IFREMER

In today's interconnected world, collaborative efforts among scientists across diverse fields are increasingly urgent. The FAIR-EASE project addresses the challenges of data accessibility and fosters integrated uses by opening gateways for earth and environmental sciences.

The project's primary objective is to enable communication, integration, and data processing for multidisciplinary projects across domains. It focuses on different domains of study. These topics provide a comprehensive assessment of the Earth System, including land and soil degradation assessment methodologies and marine omics observations.

FAIR-EASE also emphasizes the definition of products and services for omics-oriented biodiversity observations in the marine environment, contributing to the characterization and monitoring of Earth's biodiversity assets with implications for health and socio-economic interests. The project incorporates, thanks to its partnership with the PNDB (the French Biodiversity data hub e-infrastructure), the French BON EBv operationalization pilot, which leverages the Galaxy-Ecology initiative to develop accessible, reproducible, transparent, generalized, and automatable EBV workflows.

FAIR-EASE collaborates with Galaxy Europe to provide an Earth Analytical Lab, an environment to design workflow, process data and elaborate end-users FAIR products. This platform, accessible through web-based interfaces, integrates Earth System Models and data, offering researchers from various fields interactive tools, on-demand data visualization services, and the capability to analyze and process heterogeneous data. This integration enhances accessibility to Earth System modeling and supports the project's mission of advancing collaboration and data accessibility in earth and environmental sciences.

Presentation type

Talk

Affiliation

MNHN

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

220003 - Calculating occurrence area in a collaborative framework via BON in a Box

Lina Maria Sanchez-Clavijo[1], Maria Camila Diaz[1], Maria Helena Olaya[1], Juan Carlos Rey[1], Victor Rincon[1]

[1]Instituto Humboldt

The most widely used method for estimating Essential Biodiversity Variables (EBV) in the species populations class is using distribution models at national to regional scales. However, occupancy models generate occurrence areas at higher spatial and temporal resolutions that coincide much better with the scales at which biodiversity management takes place. They also allow for the implicit inclusion of covariates that are more closely related to conservation actions. As part of the development of BON in a Box 2.0, we have generated a workflow to calculate an occurrence area EBV, and have implemented two case studies: eBird data for birds and camera trap data for mammals in Colombia. This workflow was designed to be used by people with different levels of expertise and sources of data and it will allow for transparent and replicable implementation. We include modules for the preparation of a detection/non-detection matrix, the preparation and summary of spatial layers into a covariate matrix, and a process to select the most informative models to describe species occupancy. By the end, users will produce maps, graphs and values that will allow them to know how likely it is for focal species or groups to be present in different areas, how this occupancy probability responds to management strategies and spatial variables, how these patterns change over time, and the degree of uncertainty of these measures given available data. This information will in turn, support evidence-based decision making at local and subnational scales.

Presentation type

Talk

Affiliation

Instituto Humboldt

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

220001 - Estimating landscape-level biodiversity metrics across broad spatiotemporal extents via artificial intelligence and citizen science data

Courtney Davis[1], Marc Grimson[2], Álvaro Vega-Hidalgo[1], Shawn Ligocki[1], Guillermo Durán[1], Shufeng Kong[2], Viviana Ruiz-Gutierrez[1], Carla Gomes[2], Daniel Fink[1]

[1]Cornell Lab of Ornithology, Cornell University, [2]Department of Computer Science, Cornell University

Our current ability to monitor and evaluate biodiversity outcomes at local, national, and international scales is limited by available survey data for many taxonomic groups. Data collected via digital citizen science platforms hold immense potential for filling these critical information gaps at large spatial and temporal scales for entire ecological communities when users properly account for factors that influence both the biological (e.g., species interactions) and observational processes (e.g., variation in observer skill and survey effort). Here, we demonstrate the use of a machine learning species distribution modeling framework in combination with data from eBird, the global citizen-science bird monitoring platform, to estimate species and community-level biodiversity metrics at high spatiotemporal resolution, and across national extents. We highlight several case studies of this approach, including an application to estimate occurrence and relative abundance of several avian species in the Andes region of Colombia, and generate predictions of community composition, structure, and diversity throughout the full annual cycle. In doing so, we present a scalable and robust method by which to inform several essential biodiversity variables focused on species populations and community composition for taxonomic groups and regions with sufficient data. While we highlight the utility of our model as applied to eBird checklist data, broad-scale citizen science programs are just one of many growing sources of ecological data streams. AI approaches such as ours can unlock the full potential of many other observational and environmental datasets, thus opening a new and exciting frontier for biodiversity monitoring, evaluation, and conservation.

Presentation type

Talk

Affiliation

Cornell Lab of Ornithology, Cornell University

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

2200031 - Is the essential enough for the unique? Using genetic EBVs to assess the conservation status of unique Eastern Amazonian endemic plants

Bárbara Leal[1], Valeria Tavares[1], Mauricio Watanabe[1], André Cardoso[1], Lourival Tyski[1], Alessandro Alves-Pereira[1], Jeronymo Dalapicolla[2], Guilherme Oliveira[1], Carolina Carvalho[1]

[1]Instituto Tecnológico Vale, [2]Universidade Federal da Paraíba

Genetic data can help evaluating the conservation status of species and enhance the power and effectiveness of monitoring and management strategies, particularly in megadiverse Neotropical areas. The concept of Essential Biodiversity Variables (EBVs) has been recently detailed to explicitly include genetic components. We used genomic data derived from reduced-representation sequencing methods under the genetic EBVs' framework to assess the conservation status of three Eastern Amazon endemic plants: *Carajasia cangae*, *Parapiqueria cavalcantei*, and *Ipomoea cavalcantei*. These species have extremely restricted distributions and are confined to savannah-like iron covered plateaux ("cangas") immerse in a mosaic of conserved and disturbed forest, pastures, and mining. Our data pointed to conservation concerns, due to low effective population sizes, decreased levels of genetic diversity and high inbreeding for *C. cangae* and *P. cavalcantei*. Simulations indicate worse scenarios in a few decades ahead. In turn, the results for *I. cavalcantei* demand maintenance of two genetically distinct populations. Genetic monitoring is crucial for these species' survival according to genetic indicators. Our study also suggests that the vulnerability cannot equally be predicted for co-distributed species, and species-specific estimates to assess extinction risks are mandatory.

Presentation type

Poster

Affiliation

Instituto Tecnologico Vale

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

220002 - Monitoring community composition Essential Biodiversity Variables (EBV) along the Patagonian coastline using Artificial Intelligence: a case study of the Marine Biodiversity Observation Network Pole to Pole of the Americas (MBON Pole to Pole)

Enrique Montes[1], Gregorio Bigatti[2], Gonzalo Bravo[2], Maria G. Palomo[3], Maria Mendez[2], Juan Livore[2], Maria T. Kavanaugh[4], Frank Muller-Karger[5], Christopher Kelble[6]

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Rocky intertidal zones of the Argentinian Patagonia are highly biodiverse habitats. They support assemblages of invertebrates, macro-algae, fishes, and marine mammals that provide nutritional, cultural, economic, and recreational services to local communities. Our understanding of how community composition in such rocky shores responds to episodic stress events, climate change, and pressures due to human activities like harvesting of commercially-important species is limited due to poor observational coverage. This has impaired effective management and conservation of these resources. The Marine Biodiversity Observation Network Pole to Pole of the Americas conducted a workshop in March 27th - 31st, 2023, to train 26 park rangers from nine Marine National Parks in southern Argentina on image-based biodiversity monitoring techniques targeting sessile invertebrates and macro-algal assemblages. The goal was to implement simple yet effective standard methods for estimating percent cover and biodiversity metrics of Community Composition EBVs. Over 4,000 benthic images were collected and analyzed with CoralNet's convolutional deep neural network algorithm to compute percent cover indicators for mollusks, barnacles, macro-algal taxa, bare substrate, and species frequencies across 11 sites spanning latitudes from -49.26 to -42.24 °S. The objectives are to: 1) enable routine and frequent monitoring of key local habitats; 2) define baselines for broad functional groups, species richness, and community composition at each site; 3) characterize oceanographic and atmospheric conditions shaping these assemblages; 4) detect and understand departures of Community Composition EBVs from baseline levels within these National Marine Parks; and 5) inform decision-making of Park authorities and other relevant government agencies in Argentina.

Presentation type

Talk

Affiliation

College of Marine Science, University of South Florida, USA

Session

Ten Years of Essential Biodiversity Variables: How Are We Calculating Them?

Monitoring Soil Biodiversity

2800037 - The Canadian Soil Biodiversity Observatory (CSBO)

Louis-Pierre Comeau[1], Claudia Goyer[1], Wen Chen[1], Marla Schwarzfeld[1], Geng Xiaoyuan[1], Franck Stefani[1]

[1]Agriculture and Agri-Food Canada

Soil biota plays a critical role in providing essential ecosystem goods and services, including climate regulation, food production, freshwater, nutrient cycling, and soil formation. Agricultural expansion and intensification are the largest drivers of global biodiversity loss and soil carbon loss. In Canada, for example, soil carbon content has declined steadily since the beginning of colonization, while in Europe, industrial agriculture has caused significant declines in insect and bird biomass and diversity over the past three decades. However, the effects of land-use change on soil microbial biodiversity and its relationships to soil carbon are not well characterized across biogeographic regions, and baseline data are limited.

The Canadian Soil Biodiversity Observatory (CSBO) aims to establish baseline inventories of Canada's soil biota for representative soil types and ecozones, including habitats within and beyond the agricultural landscape. To this end, 1110 soil samples were collected in six Canadian provinces (Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador) between 2019 and 2023.

The CSBO focuses on six taxonomic groups: archaea, bacteria, fungi, oomycetes, microarthropods and nematodes. Sampling sites were identified using environmental covariates generated at different scales to ensure a cost-effective and statistically representative sampling strategy. The soil biota will be characterized using high throughput sequencing of targeted groups, high throughput culturing and soil fatty acid analysis.

This project is the first step in a long-term effort to document Canadian soil biodiversity and falls within the scope of the International Initiative for the Conservation and Sustainable Use of Soil Biodiversity.

Presentation type

Poster

Affiliation

Agriculture and Agri-Food Canada

Session

Monitoring Soil Biodiversity

2800031 - The journey to farmland soil restoration: understanding and measuring soil biodiversity

Alberto Acedo[1], Rüdiger Ortiz-Álvarez[1], Héctor Ortega-Arranz[1], Vicente J. Ontiveros[2], Miguel de Celis[3], Charles Ravarani[1], Ignacio Belda[1]

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Farms worldwide are making great strides to transform their land management through more sustainable decision-making in the face of climate change. However, every farm and vineyard is on a different path, and it can be difficult for farmers to understand how far along they are on their journey to soil health recovery. A soil microbiome can be an effective tool for assessing and monitoring soil biodiversity. By understanding the biology and ecology of local soil networks, farmers can improve their sustainable farming practices. A new metric, BeCrop Rate, utilizes DNA technologies, artificial intelligence, eco-computing, and environmental data, making it easier to measure changes in the soil and assess the impact of new management techniques. Based on a study of 350 vineyard soils in the United States and Spain, the metric condenses information about soil nutrition, biodiversity, and pathogens into a single 'Rate' that indicates the level of sustainability on a farm and provides a way for farmers to measure soil health and track their progress, as well as a way for consumers to understand the level of sustainability of the food they purchase.

PUBLICATION: *Network Properties of Local Fungal Communities Reveal the Anthropogenic Disturbance Consequences of Farming Practices in Vineyard Soils.* Rüdiger Ortiz-Álvarez, Héctor Ortega-Arranz,Vicente J.Ontiveros, Miguel de Celis, Charles Ravarani, Alberto Acedo, Ignacio Belda. Msystems May 2021, 6(3) e00344-21; DOI: 10.1128/mSystems.00344-21

Presentation type

Poster

Affiliation

Biome Makers

Session

Monitoring Soil Biodiversity

2800034 - Experimental warming effect on soil inhabiting nematode community structure using open top chamber in high altitude areas of Indian Himalayan Region

Priyanka Kashyap[1]

[1]wildlife institute of India

An experimental study using an Open top chamber (OTC) was conducted in the high altitude region of Gangotri Valley in Western Indian Himalaya to understand the effect of altered temperature on the abundance, diversity, and metabolic footprint of soil nematodes. Soil cores were collected from experimental (OTC) and control plots with their replicates. Nematodes were extracted, identified, allotted to trophic groups, and ecological indices were calculated. Data loggers were installed to record air and soil temperature every hour. Soil and air temperature was ~1 °C higher inside OTC compared to the control plot for almost throughout the year except for August- September, and the temperature difference was nearly 1.9 °C higher inside OTC in the second year. Forty-two genera belong to 20 families, and eight orders were recorded for the study region. Nematode community structure analysis showed that bacterial feeder abundance is higher in OTC. Maturity Index (an indicator of disturbance) was lower in OTC and significantly differed. Dissimilarity tests showed that OTC's nematode communities significantly differed from the control plots. The soil moisture was different among the treatment and control plots, suggesting that warming indirectly affects nematode diversity by affecting soil moisture in the treatment plot. As a result, it can be hypothesized that warming-induced soil moisture could be the primary reason for differences in nematode responses between OTC and Control. The experimental baseline information regarding nematode community structure and nematode-specific indices can be used as soil health indicators and long-term climate change impact assessment studies.

Presentation type

Poster

Affiliation

Wildlife Institute of India

Session

Monitoring Soil Biodiversity

2800036 - Effects of a megafire on the arbuscular mycorrhizal fungal community and parameters in the Brazilian Cerrado ecosystem

Jadson Moura[1, 2, 3], Rodrigo Souza[3], Wagner Vieira Júnior[4], Leidiane Lucas[2], Cesar Marin[5]

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To evaluate the effects of a mega-fire on the arbuscular mycorrhizal fungi (AMF) community and parameters in soils under Cerrado vegetation. Study area: Chapada dos Veadeiros National Park, Goiás, Brazil. This site suffered the biggest fire in its history on October 10, 2017, with an affected area of 66,000 ha. We analyzed AMF spore density, roots' mycorrhizal colonization rate, easily extractable glomalin (EEG), as well as the AMF genera present. These parameters were evaluated in burned and unburned areas of five common phytophysiognomies of the region. Fire presence immediately affected the mycorrhizal community parameters in Cerrado soils, which tended to increase afterwards. The presence of AMF genera did not differ between burned and unburned areas, with Acaulospora, Claroideglomus, Diversispora, Glomus, Funneliformis, Sclerocystis, and Gigaspora being present. The recovery of AMF community conditions in the Cerrado after fire events could also be observed in the mycorrhizal parameters evaluated, as the values of spore density, roots' mycorrhizal colonization rate, and EEG were similar in the burned and unburned areas. Research highlights: AMF diversity, and especially their community parameters, show great recovery after fire events, since they are crucial in processes like nutrient cycling and soil aggregation.

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Presentation type

Poster

Affiliation

UniEvangélica - UNB - FACEG

Session

Monitoring Soil Biodiversity

2800035 - Unveiling the hidden world: exploring nematode communities and the impact of agricultural management on soil biodiversity in the Argan biosphere

El Hassan Mayad[1], Amina Braimi[1], Ilyas Filali Alaoui[1], Obidari Tayeb[1], Mohamed Ait Hamza[1], Abdelhamid Elmousadik[1], Fouad Msanda[1]

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Soil biodiversity is crucial for ecosystem services, and understanding its response to agricultural land management practices is vital. This study aims to characterize nematode communities and their response to agricultural land management practices in the Arganeraie biosphere. A total of 96 soil samples were collected from diverse locations, including non-arable soil, organic farms, cereal fields, and conventional systems. Sampling was done at a depth of 0-25cm, and nematodes were extracted using the elutriation method. The results indicated that undisturbed forests had a diverse nematode community, with over 38 genera from 25 families representing all trophic groups. Bacterivores, especially in the Cephalobidae family, were the most abundant, followed by herbivores. Predators, fungivores, and omnivores had intermediate proportions but were less abundant. Arable soil, particularly under continuous monocropping, showed a significant reduction in both taxonomic and functional diversity of nematodes. Conventional systems had low taxonomic and functional biodiversity, but specialized endoparasitic herbivory nematodes were highly abundant. Intensified agricultural practices led to the loss of over 60% of taxonomic biodiversity, with certain trophic groups completely disappearing in most samples. This study provides insights into nematode communities and their response to agricultural land management practices in the Arganeraie biosphere. The findings highlight the negative impacts of intensive agricultural practices on nematode diversity and emphasize the importance of sustainable land management strategies to preserve soil biodiversity. Further research should focus on effective measures to mitigate risks posed by phytoparasitic nematodes in conventionally managed lands and promote the restoration of soil biodiversity in these ecosystems.

Presentation type

Poster

Affiliation

Faculty of Sciences, Agadir, University Ibnou Zohr

Session

Monitoring Soil Biodiversity

2800033 - Measuring the influence of flora to the preservation of biodiversity

Josephine Njala Namyala [1], Joel Kivumbi[1], Lawrence Jacobson Mukuye [1]

[1]Agency for Community Empowerment and Development Support Organization {ACEDSO},Kalisizo ,Uganda

Tree-mediated ecosystem services are recognized as key features of more sustainable agro ecosystems but the strategic management of tree attributes for ecosystem service provision is poorly understood. This study sought to evaluate the influence of tree cover to the conservation of soil biodiversity and ecosystems resources. Agroforestry and tree cover in rural forest zones in Uganda were synthesized. Loss of native earthworm populations resulted in 76% lower soil macroporosity when shade trees were absent in coffee agriculture. Increased tree cover contributed to 53% increase in tea crop yield, maintained 93% of crop pollinators found in the natural forest and, in combination with nearby forest fragments, contributed to as much as 86% lower incidence for coffee berry borer. In certain contexts, shade trees contributed to negative effects resulting from increases in abundance of white stem borer and lace bugs and resulted in 60% reduction of endangered tree species compared to forest. Managing trees for ecosystem services requires understanding which tree species to include and how to manage them for different socio-ecological contexts. This knowledge needs to be shared and translated into viable options with farming communities.

Presentation type

Poster

Affiliation

Agency for Community Empowerment and Development Support Organization (ACEDSO)

Session

Monitoring Soil Biodiversity

2800032 - Understanding the potential risks of Parthenium hysterophorus L on earthworms, soil enzymatic activity: a potential threat to regional soil biodiversity?

Muhammad Nauman Ahmad[1], Afia Zia[1], Yaseen Ahmad[2], Leon Ven Den Berg[3]

[1]The University of Agriculture, Peshawar, Pakistan, [2]University of Gent, Belgium, [3]Unie van Bosgroepen, Ede, Netherlands

This study aimed to assess the impact of Parthenium hysterophorus biomass and biochar on earthworms and soil enzymatic activity. Earthworms play a crucial role as decomposers of organic matter in the soil, promoting plant development and reducing soil bulk density. Parthenium hysterophorus, an invasive weed, has become a major threat to animal and plant biodiversity globally, particularly in Asia. The experiment consisted of various treatments, including different concentrations of wheat straw, Parthenium biomass, and Parthenium biochar added to sterile soil. The cocoon production of earthworms and soil enzymatic activity were measured over several weeks. Results showed that a high concentration of Parthenium had a detrimental effect on earthworm length and weight, with lethal effects observed at the highest concentration. Wheat straw treatments significantly increased earthworm length and cocoon production, while Parthenium biomass treatments decreased these parameters. Biochar treatment also decreased earthworm length and cocoon production but to a lesser extent than Parthenium biomass. The reproductive behavior of earthworms was influenced by the different treatments, with delayed cocoon production in Parthenium biomass-treated soil. Soil enzymatic activity, including dehydrogenase, alkaline phosphatase, and urease, was also affected by Parthenium biomass, with a decline observed in some cases. The study concluded that Parthenium hysterophorus can significantly impact soil biota, which is vital for nutrient availability to plants, posing a serious threat to soil biodiversity and food security worldwide.

Presentation type

Poster

Affiliation

The University of Agriculture, Peshawar, Pakistan

Session

Monitoring Soil Biodiversity

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60001 - Biodiversity Monitoring in Key Biodiversity Areas: Starting a conversation

Chloé Debyser[1], Peter Soroye[1], Ciara Raudsepp-Hearne[1]

[1]Wildlife Conservation Society Canada

Key Biodiversity Areas (KBAs) are sites that contribute significantly to the persistence of biodiversity. KBAs are sites that hold threatened biodiversity, geographically restricted biodiversity, areas of high ecological integrity, important biological processes, and/or that are ecologically irreplaceable (as demonstrated through quantitative analyses). In Canada, the Canadian KBA Coalition seeks to identify most KBAs nation-wide by the end of 2024, resulting in an exceptional opportunity and locus for biodiversity monitoring efforts. First, we describe the biodiversity held within the network of about 1000 KBAs nation-wide. The taxa and ecosystem types that qualify sites as KBAs in Canada represent a diverse and vulnerable set of elements that could contribute answers to the question of “what” to monitor. Second, we explore “where” KBAs could contribute to biodiversity monitoring nationally. We describe the distribution of Canadian KBAs across space, as well as across key landscape characteristics and conservation features, including networks of protected and conserved areas, ecoregions, land cover, and land tenure. Third, we detail the opportunities that KBAs provide for on-the-ground biodiversity monitoring by caretakers, stakeholders, and Indigenous communities. Thus, KBAs can provide a unique model for “how” to conduct biodiversity monitoring in an inclusive way. As the Canadian KBA Coalition begins the work of developing a KBA monitoring framework, we invite all interested parties into the conversation about biodiversity monitoring within the exceptional sites that are Canada’s Key Biodiversity Areas.

Presentation type

Talk

Affiliation

Wildlife Conservation Society Canada

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60003 - The TSX: Estimating long-term trends of Australia's threatened and near-threatened species

Tayla Lawrie[1], Geoff Heard[1], James Watmuff[2]

[1]TERN Australia, University of Queensland, [2]Planticle Pty Ltd

Efforts to reduce species extinctions are advancing globally. The justification, design, and evaluation of targeted conservation actions for any threatened species hinges on up-to-date and robust information on population trends. Yet, until recently, Australia had limited infrastructure for collating the required data and consistently producing and reporting on threatened species trends. The first of its type in the world, the Australian Threatened Species Index (TSX) provides reliable and robust measures of changes in the relative abundance of Australia's threatened and near-threatened species at national, state, and regional levels. In this presentation we will provide introductory information on the methodologies used to generate the index as well as highlight the TSX's online web-application and data visualization tools, which provide a virtual laboratory currently used by government, NGOs, conservation practitioners and researchers across Australia. Looking to the future of the TSX, and its application in conservation decision support, this presentation will also explore the possibility of using advanced statistical approaches to model trends based on species traits and environmental and management covariates, with a view to both infer the drivers of population trends and ultimately predict them into the future under different management and climate scenarios. With continued growth and development, the TSX will strengthen its position as the central repository of threatened species abundance data for Australia, helping support conservation planning for our most imperilled species and bend the curve of species declines.

Presentation type

Talk

Affiliation

TERN Australia, University of Queensland

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60005 - Embedding economic values of ecosystem services in development plans: A case study from Indian Western Himalayan Region

Arghya Chakrabarty[1], Harsh Ganapathi[1], Dayadra Mandal[1], Ritesh Kumar[1], Krishna Giri[2]

[1]Wetlands International South Asia, [2]Indian Council of Forestry Research and Education

High-altitude landscapes provide significant ecosystem services, yet their contributions are seldom recognized and factored in development plans, programmes and investments. The case study from the Chandertal landscape of the Indian Western Himalayan Region demonstrates the interdependencies of development sectors on ecosystem services and ways in which economic values can be recognized and factored into sectoral plans. The landscape social-ecological system characterization rendered five critical ecosystem services: water supply and storage, carbon storage, fodder provision for livestock, flood buffering, and tourism. The ecosystem services supply matrix was established using hydrological models, land use and land cover mapping, field surveys and key-informant interviews. Valuation of these services, using a combination of market and non-market methods, rendered an annual flow ranging from US$ 870.64 million to US$ 895.18 million. Determination of sectoral synergies and trade-offs indicates the need for shifts in institutional decision-making ranging from environmental flow regulation, investment into early warning systems, tourism zonation plans, grazing regulations, regulated infrastructure development and safeguarding carbon stock in the landscape. Integrating these economic values into sectoral development plans will enable effective conservation and management of the landscape to ensure a continued supply of ecosystem services.

Presentation type

Talk

Affiliation

Wetlands International South Asia

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60004 - Structured monitoring is needed to successfully deliver climate and biodiversity goals

Alexandre Changenet[1], Alex Bush[2], Ruben Valbuena[1]

[1]SLU, [2]Lancaster University

Ambitious international policy targets have reinvigorated the global ecosystem restoration agenda, to reduce biodiversity loss and restore ecosystems. Yet, the consistent failure to deliver previous goals should serve as a warning. Targets need to be underpinned by a consistent system for monitoring, reporting and verification (MRV) of restoration gains.

Here, we describe an MRV system to consistently define the biodiversity and ecosystem services (BES) gained within a landscape through restoration actions. This system forms the basis of our outcome-based accountability framework in which high performing restoration projects are financially rewarded for their BES gains, and for the confidence with which gains meet expectations.

The performance of any restoration project would be evaluated by where their BES measurements at any given time lie along restoration benchmark trajectories.

We discuss how the MRV-BES framework could work combining high-throughput taxa identification (automated acoustic recording, eDNA data) with remotely sensed data (airborne LiDAR, multispectral imaging) to link ecological changes to characteristics of forest structure, establishing reference trajectories, and monitoring restoration projects performance.

We show our framework has the potential to incentivise investments in restoration projects using cost-effective monitoring methods. Ultimately, this work can help reverse the loss of biodiversity by informing the decisions of forest managers.

Presentation type

Talk

Affiliation

SLU, Umea

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60006 - Adaptation Monitoring for the multidimensional benefits of forests

Inge Jonckheere[1], Amy Duchelle[1]

[1]FAO of the UN

There is growing recognition on the importance of forests and trees to climate change adaptation and resilience. Climate policies related to adaptation and resilience are proliferating, along with the recognition of the contributions of forests to climate change adaptation and adaptation synergies. This abstract highlights the growing gap in countries' adaptation policy between intent policies and actions by supporting the development of baseline information, methods, tools and guidelines for monitoring the multidimensional benefits of forests. It also responds to the need for more climate adaptation finance. International adaptation finance flows to developing countries are shown to be 5-10 times below estimated needs. Improving monitoring of adaptation can provide needed data and methods for the urgent push to increase climate finance for adaptation, delivering evidence to overcome the gap between intent and action.

While monitoring forest-based adaptation monitoring systems have developed to accurately assess changes in forest carbon stocks and fluxes, monitoring adaptation is complex: it is a moving target that requires a multisectoral perspective. Since the contributions of forests to adaptation are vast and multidimensional, adaptation monitoring calls for the use of a combination of remotely-sensed and field data. Monitoring the adaptation services provided by forests through quantitative and qualitative data is critical. Improved adaptation monitoring can support countries in mobilizing funding for adaptation and disaster risk reduction.

The use of remote sensing to advance the adaptation monitoring is key and should therefore be a main research topic. This talk will indicate gaps, needs and a possible way forward.

Presentation type

Talk

Affiliation

FAO of the UN

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60007 - Map of Life species monitoring and planning interfaces for local to national scales

Tamara Rudic[1], Alexander Killion[1], Walter Jetz[1], John Wilshire[1], Kalkidan Fekadu Chefira[1]

[1]Yale Center for Biodiversity and Global Change

Conservation practitioners and decision-makers can now benefit from species-specific global biodiversity information and tools to analyze, monitor, plan, and report for any area in the world on Map of Life. Our dashboards allow users to access species distributions, occurrences, habitat loss and gain, reserve management, indicator trends, and expected and recorded species lists anywhere, and they provide an accessible interface for users to connect their local data to global biodiversity databases. Bridging this data provides useful information to users with little data access and an opportunity to improve existing estimates to users with high data access. Both benefit from an interface dedicated to understanding how their area of interest contributes to global biodiversity and is changing over time. At Map of Life, we strive to support the mission of GEOBON's Biodiversity Observation Networks (BONs) by developing dedicated interfaces for local- and regional-scale users, including local conservation managers, NGOs, governments, businesses, and other stakeholders.

We will report on our efforts developing these biodiversity interfaces with conservation and government partners in South America, West and Central Africa, and Southeast Asia and describe identified user needs across management scales and technical capacities. Engagement on how these tools and interfaces can best serve BONs in the future are strongly encouraged.

Presentation type

Talk

Affiliation

Yale Center for Biodiversity and Global Change

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

6000031 - 30x30 outcomes for biodiversity depend on national coordination

Isaac Eckert[1], Laura Pollock[1]

[1]McGill University

188 nations have committed to protecting 30% of their land by 2030. For Canada, this means more than doubling the amount of protected land over the next 7 years. But reaching this ambitious target is not enough - we need to be protecting land that captures biodiversity to ensure positive outcomes for nature. We know that both what elements of biodiversity we choose to prioritize and how we coordinate protection across scales can impact our ability to capture biodiversity in protected lands, but it remains unclear which is more important and how these critical decisions will impact 30x30 outcomes. Using models of Canadian plants, vertebrates, and butterflies, we assess; what biodiversity is already protected, what biodiversity can be protected if we reach 30x30, and test how different conservation priorities impact our ability to protect biodiversity through 30x30. We find that existing protected areas only protect 15% of all species, representing only 6% of species at risk and only a single amphibian and reptile. However, large conservation gains are possible and a nationally coordinated approach to reaching 30x30 can protect >65% of all species. How we coordinate protection has the largest impact on biodiversity outcomes, with regional approaches (protecting Provinces & Territories or Ecozones independently) severely limiting biodiversity gains, while prioritizing different elements of biodiversity (specific clades, species-at-risk, or biodiversity facets) only minorly impacts biodiversity gains. Our results highlight the immense potential of 30x30 as well as the critical importance of having a biodiversity-indicator-informed national strategy for expanding protected lands.

Presentation type

Poster

Affiliation

McGill University

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

60002 - Sampling requirements to detect long-term population trends

Easton White[1]

[1]University of New Hampshire

Species monitoring programs are a cornerstone of modern ecological and conservation research. Ideally, these monitoring programs would be designed to ensure they provide sufficient evidence to inform management decisions. However, monitoring programs are often constrained by the available technology, funding cycles, academic calendars, and personnel availability, which can severely limit their effectiveness. Important considerations for monitoring program design include budgetary constraints, site selection, monitoring frequency, and monitoring effort. To address these gaps, we used existing long-term programs and associated datasets to determine the sampling requirements to detect population trends. We found that, on average, 15.9 years were required to detect a change in relative abundance, but this was highly dependent on species life history and the sampling scheme. We also found that species misidentification caused an increase in incorrect trends being ascribed for species. Collectively, our findings will be important for decision-makers and data producers who need to prioritize spending on monitoring as well as make decisions about management actions based on monitoring.

Presentation type

Talk

Affiliation

University of New Hampshire

Session

Mainstreaming Biodiversity Monitoring Into Policy and Practice

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

110004 - Monitoring agricultural land use and farmland biodiversity with Earth observation

Anna Cord[1]

[1]TU Dresden

Agricultural land use is one of the main drivers of biodiversity loss worldwide. Factors that have led to the decline of biodiversity in agricultural landscapes, especially in the last 50 years, are the decreasing quality and quantity of habitats as well as their fragmentation. The causes lie in the widespread use of pesticides, more intensive fertilization due to changes in livestock farming, reduced landscape complexity due to the increase in the size of fields and the loss of connecting landscape elements. In Europe, on the other hand, arable and livestock farming has a long tradition and has produced a rich biodiversity specifically adapted to agricultural landscapes. At the same time, farmland biodiversity is underrepresented in current biodiversity monitoring networks, and monitoring agrobiodiversity faces particular challenges due to the spatial and temporal heterogeneity of these systems. This presentation will summarize examples of how Earth observation and geospatial information can be used to map and monitor agricultural land use (intensity), model future changes in land use, assess the status of farmland biodiversity, and help identify priorities for biodiversity conservation on agricultural land and support their implementation.

Presentation type

Talk

Affiliation

TU Dresden

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

110002 - Earth observation for monitoring and analysis of the drivers of biodiversity changes in terrestrial ecosystems

Roshanak Darvishzadeh[1], Margarita Huesca[1], Andrew Skidmore[1], Elnaz Nienavaz[1], Haidi Abdullah[1], Ruben Van De Kerchove[2], Ben Smith[3], Sander Mucher[4], Susana Baena[5], Wanda De Keersmaecker[2], Mats Lindeskog[3], Sara Si Moussi[6], Stephan Hennekens[4], Wilfried Thuillier[6], Petteri Vihervaara[7], Ida Palmroos[7], Marieke Sassen[4], Claudia Roeoesli[8], Marc Paganini[9]

[1]University of Twente, Faculty ITC, Netherlands , [2]VITO, Belgium, [3]Lund University, Sweden, [4]Wageningen Environmental Research, Netherlands , [5]UNEP-WCMC, United Kingdom, [6]Laboratoire d'Ecologie Alpine, UMR-CNR, France, [7]Biodiversity Centre, Finnish Environment Institute, Finland , [8]University of Zurich, Switzerland, [9]European Space Agency

EO4Diversity-Earth Observation for Biodiversity Modelling project was funded in 2021 as part of the European Commission and European Space Agency joint Flagship Action in Biodiversity and Vulnerable Ecosystems. The project's primary objective is to enhance biodiversity monitoring in terrestrial ecosystems by integrating Earth Observation (EO) data and products into advanced ecological models.

EO4Diversity established a science policy traceability matrix through analysis of major knowledge and policy gaps in biodiversity monitoring of terrestrial ecosystems and demonstrated how the recent EO missions could address these gaps through the execution of three biodiversity pilots. The Biodiversity pilots include (1) Ecosystem productivity and health- in which remotely sensed biophysical variables (e.g., Leaf Area Index) were integrated into LPJ-GUESS ecological model to estimate monthly net and gross primary productivity at two temperate forest sites and then at the European scale; (2) Ecosystem accounting, monitoring and reporting towards policy obligations- in which EUNIS habitats at level 3 at European scale are modelled and mapped by integrating *in-situ* vegetation and EO data into species distribution models using deep learning architectures; and (3) Ecosystem resilience to invasive species- in which the distribution of invasive species are modelled using a set of environmental drivers and EO data and products integrated through species distribution modelling by deep learning techniques. Outputs from these pilots are used in some showcases to demonstrate the scientific utilities of biodiversity pilots and their links to key biodiversity policy priorities and to develop a scientific roadmap for biodiversity monitoring using EO data and products.

Presentation type

Talk

Affiliation

European Space Agency

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

110006 - Predicting species population abundance response to climate, land-use, and future scenarios

Robin Freeman[1]

[1]Institute of Zoology, Zoological Society of London

We present our recent analysis of 1751 population trends of 712 species from the Living Planet Database, focusing on terrestrial and freshwater birds and mammals from 1950-2014. We explore how species abundance trends respond to climate and land-use changes, considering both immediate and time-lagged responses.

Our analysis highlights that recent population trends may be better explained by historical rather than contemporary climate and land-use changes, particularly for larger species; this suggests that some biodiversity responses may be 'locked-in' and efforts to 'bend-the-curve' may be more urgent that previously thought.

Our predictive models also offer interesting opportunities to explore how population abundance may change under different future scenarios. This evidence-based approach, combining historical, contemporary, and future data, can provide a 'leading' indicator of population abundance for decision-making in biodiversity conservation.

We also describe some future directions to better incorporate species/population threats into these models and to further expand the taxonomic, geographical and linguistic coverage of the data that underpins them.

Presentation type

Talk

Affiliation

Institute of Zoology

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

110003 - Effects of land-cover transition dynamics on patterns of forest fragmentation

Maria J. Santos[1], Aman Gupta[1]

[1]University of Zurich

Social-ecological interactions lead to varying patterns of forest fragmentation with strong observed effects on carbon sequestration, species composition and vulnerability of forests to natural disturbances. Yet, the type and spatial distribution of the adjacent landscape may mediate these impacts, with potentially positive consequences for biodiversity and the supply of ecosystem services. To explore this hypothesis, we examined the response of global forest fragmentation patterns to the temporal land-cover dynamics in forest-adjacent landscapes. Our method extracted annual metrics of composition and configuration for dominant forest transitions and approximated these temporal trajectories by fitting sigmoidal and quadratic functions. We apply this method to the Copernicus Climate Change Global Land Cover (C3-GLC) dataset between 1992 and 2020, and find that the majority of forest transitions follow a sigmoidal shape of temporal forest composition change, with <1% of the grids following a quadratic shape of temporal change. We also found that a slower rate of change of the 'transition' land-cover has significant net positive effects on patterns of forest configuration for most land-cover transitions. These effects, however, vary according to the transition land-cover and its amount of compositional change in a landscape. Our preliminary results suggest that the land-cover dynamics of the surrounding landscape may hold important consequences for patterns of forest fragmentation. These co-evolutionary dynamics need to be further explored to understand the potential impact of fragmentation patterns on the functioning of forest ecosystems.

Presentation type

Talk

Affiliation

University of Zurich

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

110005 - Monitoring and assessment of effects by drivers of biodiversity changes in freshwater ecosystems

Petra Philipson[1], Susanne Thulin[1], Niklas Hahn[1], Carsten Brockmann[2], Jorrit Scholze[2], Kerstin Stelzer[2], Alicia Balfanz[2], Miguel Dionisio Pires[3], Tineke Troost[3], Marieke Eleveld[3], Jelle Lever[4], Daniel Odermatt[4], Tamara Keijzer[5], Aafke Schipper[5], Marc Paganini[6]

[1]Brockmann Geomatics Sweden AB, [2]Brockmann Consut GmbH, [3]Deltares, [4]Eawag, Swiss Federal Institute of Aquatic Science and Technology, [5]PBL Netherlands Environmental Assessment Agency, [6]European Space Agency (ESA)

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 global challenges. The Precursor BIOMONDO is 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, drivers of change and requirements related to EBV workflows were compared to possibilities offered by Earth Observation (EO). These findings were the basis for the development of *innovative integrated earth science solutions* that combine EO based products, biodiversity modelling (Delft3D, Heat Tolerance and River Connectivity) and in situ data using advanced data science and information technology. All datasets were compiled in an analysis ready data cube called BIOMONDO Freshwater Laboratory. Machine Learning (ML) techniques were used to analyse time series of data generating Thematic Ecosystem Change Indices (TECI) that show data anomalies, such as change in habitat conditions, water quality and lake water temperature evolution and LCLU in the catchment. The validation of the integrated products are key tasks within BIOMONDO and beyond and interested biodiversity experts have been given access to the novel EO products through the cube, to support the evaluation of impact and benefit of the developments. Results from three Pilots at sites in Europe and Asia focusing on three different topics are presented, eutrophication, heatwaves and connectivity.

Presentation type

Talk

Affiliation

European Space Agency

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

1100031 - Exploring the potential of UAV for plant biodiversity monitoring in farmland

Caterina Barrasso[1, 2], Robert Krüger[3], Lisanne Hölting[1], Anette Eltner[3], Anna Cord[1, 2]

[1]Computational Landscape Ecology, Technische Universität Dresden, [2]Center for Scalable Data Analytics and Artificial Intelligence (ScaDS.AI) Dresden/Leipzig, [3]Geosensor systems, Technische Universität Dresden

Intensification of agriculture with high fertilization rates is causing the decline of wild arable herbs, which in turn has cascading negative ecological impacts. One way to promote the conservation of wild arable herbs can be result-based payment schemes that reward farmers based on observed biodiversity outcomes in their fields. The biggest challenge for these schemes is the cost and time required for biodiversity monitoring. Satellite and UAV remote sensing have already shown promising results for biodiversity monitoring in different ecosystems. In farmland, biodiversity monitoring is particularly challenging due to the small size of the plants and their partly overlapping spectral signatures. However, the combination of multiple UAV sensors started to show opportunities in this research area. Using the latest advances in deep learning, in this study we investigate the potential of UAVs for plant biodiversity monitoring on agricultural land. We focus on a farmland area in the UNESCO biosphere reserve “Upper Lusatian Heath and Pond Landscape” in Saxony, Germany and evaluate the usage of different UAV sensors to disentangle the different plant species. The presentation will focus on opportunities and challenges in monitoring farmland biodiversity with particular emphasis on: i) wild arable herbs for which training data can easily be developed from RGB images, ii) sensor and flight height maximizing the classification accuracy, iii) difficult to map wild arable herbs, and iv) potential for result-based payment schemes for other plant species that were not observed in the study area, but are of interest for the implementation of such schemes.

Presentation type

Poster

Affiliation

Computational Landscape Ecology, Technische Universität Dresden

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

1100033 - GIS evaluation and assessment of habitat degradation on Preuss's red colobus diversity in Cross River National Park, Nigeria

Akinleye Oyegbami[1]

[1]One Health and Development Initiative

Preuss's red colobus species are critically endangered and its population trend keeps decreasing according to the IUCN red list of threatened species. Their natural range is limited to the Cross River National Park Oban Division. Preuss's red colobus spends most of its time in the upper canopy of the rainforest. Habitat degradation is one of the significant threats facing this species. This study assessed habitat degradation in the Oban Division of the Cross River National Park and its impact on Preuss's red colobus diversity. Habitat degradation was examined using the land use land cover change of the study area derived from the Landsat imageries of 2000, 2010, and 2020. The LULC analysis revealed that 2020 had the highest built-up area (165.68 km^2) compared to 2000 when the built-up area was 43.86 km^2. Forest was highly dense in 2000 (3002.90 km^2) compared to 2020 (2598.77 km^2). The study concluded that there is a continuous loss of forest in the study area and this has a negative effect on the diversity of Preuss's red colobus species in the study area. There is, therefore, a need to educate, re-educate, and encourage the governments to provide the locals with a means of livelihood that does not jeopardize the conservation of biodiversity.

Presentation type

Poster

Affiliation

One Health and Development Initiative

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

1100032 - Spatial and temporal (1985-2020) dynamics in papyrus marshes of Lake Tana, Ethiopia

Abrehet Kahsay[1], Biadgilgn Demissie[2], Iris Stiers[2]

[1]Acadamic (Bahir Dar University of Ethiopia), [2]Acadamia

Lake Tana is the largest freshwater lake in Ethiopia and is the source of the Blue Nile. The lake shorelines and those of its tributary river, Gilgel Abay, are characterized by the occurrence of extensive papyrus swamps (*Cyperus papyrus)*. While such papyrus swamps are highly recognized for their outstanding ecological and economical importance, their historical and current spatial distribution and size in the Lake Tana sub-basin have not yet been systematically assessed. The primary goal of this study was to estimate the spatial distribution and temporal dynamics of papyrus swamps in the Lake Tana sub-basin at five-year intervals over a period of 35 years (1985-2020). Our analyses revealed that the total surface area of the papyrus swamps in the study area declined by almost 55% (from 152 km² to 64 km²) during the last 35 years. The small patches of papyrus swamps that existed in the northern and eastern parts of the study area before the 1990s appear to have disappeared in recent years as well. Our data suggests that the strong decline of papyrus swamps mainly resulted from the expansion of crop farming, livestock overgrazing, drainage, and biomass overharvesting, all of which are increasing over time.

Presentation type

Poster

Affiliation

Bahir Dar University and Vrije Universiteit Brussel

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

110001 - Causal inference with Earth Observation data to attribute biodiversity changes

Maria J. Santos[1], Pengjuan Zu[2], Maarten Eppinga[1], Debra Zuppinger-Dingley[1], Anuhbav Gupta[1], Frank Pennekamp[1], Cheng Li[1], Sarah Mayor[1], Camilla Stefanini[1], Yuji Tokumoto[1], Sofia van Moorsel[1], Marylaure Harpe[1], Martin Reader[1], Lidong Mo[2], Veruska Muccione[1], Meredith C. Schuman[1]

[1]University of Zurich, [2]ETH

The feedbacks between biodiversity, ecosystem services and society are sensitive to processes of global change, yet we have poor understanding of the underlying causal links between these domains. To address this shortcoming, we propose a novel framework using causal inference applied to heterogeneous Earth Observation data and modelled outputs to unveil causal links between biodiversity, ecosystem services and socio-economics. We illustrate its application on the biodiverse island of Borneo, for which we inferred causal links among 227 spatially explicit variables in the domains of biodiversity-ecosystem function, ecosystem services, socio-economic landscape and global change. We show generally consistent negative causal links between global change, socio-economic, and biodiversity-ecosystem function domains; while positive causal links emerged between global change and socio-economic domains. We then compared these links with those identified by a review of 7473 studies and showed that while causal inference fails to detect the relationships between socio-economic, global change, and ecosystem service domains, the literature has yet to show the strong relationships between biodiversity-ecosystem function and ecosystem services to global change identified by causal inference. This novel approach makes use of the spatial domain of feedbacks between biodiversity, ecosystem services and society sensitive to processes of global change.

Presentation type

Talk

Affiliation

University of Zurich

Session

Importance of Earth Observation to Monitor and Assess the Drivers of Biodiversity Changes

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100003 - Assessing genetic diversity in the absence of genetic data using indicators: a USA case study

Brenna Forester[1], Chris Funk[2], Linda Laikre[3], Alicia Mastretta-Yanes[4], Jessica da Silva[5], Sean Hoban[6]

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There is a pressing need to assess the genetic diversity status, and loss or maintenance of adaptive capacity, for large numbers of threatened species, ideally using quick and affordable methods. However, DNA based studies of within-species' genetic diversity remain expensive and time consuming, and we lack even basic genetic data for the vast majority of species. I will present one solution to this challenge, using non-genetic data. I will focus on "indicators" for genetic diversity, based on minimum effective population sizes and conserving genetically distinct populations. The indicators, first presented by Hoban, Laikre, and colleagues in 2020, build on core conservation principles that are also used in agriculture, forestry, fisheries, and endangered species legislation. These indicators were recommended by the recent Convention on Biological Diversity (CBD) COP15 agreement. With colleagues, we are testing and improving them in nine countries. We will focus on data collection and calculation of the indicators for more than 150 threatened species in the United States. Initial results suggest that although species have lost only moderate proportion of populations, the majority of extant populations are below the Ne 500 threshold, and many populations are below Ne 50. The results suggest that many populations are already experiencing or are on the precipice of rapid genetic erosion, with consequences for their survival. Although this approach has imperfections, we argue that indicators help identify species experiencing genetic erosion, assist in planning interventions for such species, and make genetic concepts approachable to non-geneticists.

Presentation type

Talk

Affiliation

The Morton Arboretum

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100001 - Estimation and predictive modeling in animal phyla using measures of genetic diversity and differentiation

Anais Aoki[1]

[1]San Diego State University

Conservation management to mitigate extinction of wildlife becomes more crucial than ever as global impacts due to anthropogenic activities and climate change continue to create devastation for species around the globe. Despite ongoing efforts to understand species constantly changing population dynamics due to anthropogenic stressors, there is a strong disconnect between conservation research and conservation policy, what is known as the “Conservation Gap”. Here we conduct a meta-analysis in efforts to “bridge” this conservation gap to elicit broad patterns between species genetics and their conservation status. Using over 500 published articles focused on conservation and population genetics, sampling across a variety of invertebrate and vertebrate taxa, and using IUCN classifications, we aim to address a few important questions: (1) Does observed heterozygosity decrease as species become more endangered?, (2) As species become more endangered, are they also becoming more isolated, therefore more differentiated between populations?, and (3) Are estimates of heterozygosity and differentiation, currently not utilized by the IUCN to rank threatened species, good predictors of endangerment? Our study overwhelmingly shows that heterozygosity, mean number of alleles, and allelic richness, were all significantly lower in species classified as non-threatened to those classified as threatened according to the IUCN. Alternatively, genetic differentiation measured as Fst, was all significantly higher in species classified as threatened, compared to non-threatened species, indicating some degree of substructure among endangered species. These findings indicate that there is a direct relationship between genetic diversity measures and IUCN status, which we explored through predictive modeling.

Presentation type

Talk

Affiliation

San Diego State University

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

10000031 - GEODE: A Genomic Observatories Diversity Explorer

Eric Crandall[1], Rachel Toczydlowski[2], Derek Morr[1], Andrea Pritt[1], Briana Wham[1], Patrick Dudas[1]

[1]Pennsylvania State University, [2]US Forest Service

Genetic variation is the often invisible but foundational layer of global biodiversity, the raw material upon which species' adaptive capacity, and conservation outcomes, depend. The international Convention on Biological Diversity and post-2020 Global Biodiversity Framework confront the global biodiversity crisis by promoting the equitable and sustainable use of biodiversity at genetic, species and ecosystem levels. Yet, while there is a large volume of genomic data that have the potential to provide global genetic biodiversity metrics to governments and NGOs, only 13% of these genomic datasets currently have the necessary temporal and spatial metadata to inform such genetic diversity monitoring efforts. The Genomic Observatories Diversity Explorer (GEODE) will expose the hidden gems of genetic biodiversity to people and their governments. We are doing this by: 1) scaling up a successful crowd-sourced datathon to capture missing spatiotemporal metadata; 2) developing a cloud-based pipeline to discover single nucleotide polymorphisms (i.e. genetic variation) in genomic reads stored on the world's largest open-access genomic database, the Sequence Read Archive; and 3) creating a web-interface, co-designed with stakeholders, to allow users to explore and calculate Essential Biodiversity Variables; which summarize genetic composition in a geographic context. Thus, like a geologist's hammer, GEODE will expose genetic diversity to the world, enabling open access to genetic diversity information for non-geneticists and specialists alike.

Presentation type

Poster

Affiliation

Pennsylvania State University

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

10000033 - Genomic structural variation in ruffed grouse: Bridging the gap from genes to ecology for enhanced biodiversity monitoring

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Genomic structural variations (GSV) play a crucial role in shaping an organism's phenotype and evolutionary trajectory. However, their implications for fitness and conservation are often overlooked. This study examines the genomes of 54 ruffed grouse individuals, a declining game bird species in the eastern USA, to explore the presence of GSV and their potential impact on biodiversity monitoring efforts. Through comprehensive genomic analysis, we found two distinct genomic clusters (genotypes 1 and 2) with no geographic correlation. Comparative analysis revealed significant differentiation on chromosomes 4 and 20 (~14 and 6 Mbp, respectively), indicating structural variations. Notably, genotype 2 individuals exhibited higher diversity on these chromosomes compared to genotype 1 and the whole genome. Within the differentiated regions, several annotated genes related to hormone regulation, cell components, and sperm morphology and motility were identified. These genes offer potential insights into behavioral ecology, fitness-related processes, and adaptive traits. As a declining game bird, understanding the implications of chromosomal inversions is crucial for biodiversity monitoring and management. If inversions in homozygosity have deleterious or detrimental effects, they could significantly impact reproductive success and other ecological aspects. Therefore, population interventions should consider the consequences of moving birds with these inversions. Our findings highlight the importance of GSV in conservation and provide insights into the evolutionary dynamics of ruffed grouse populations.

Presentation type

Poster

Affiliation

Pennsylvania State University, Pennsylvania, USA

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100006 - Using advances in Earth observations to monitor genetic diversity of terrestrial ecosystems and their impact on biodiversity

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A sixth mass extinction is underway. Despite advances in developing essential biodiversity variables (EBVs) for science-based, actionable policies, biodiversity monitoring remains limited by observation methods and sampling logistics. Genetic diversity monitoring, which is important for avoiding species extinctions and designing conservation interventions, is especially limited by the sampling effort required to obtain sufficient genetic sequence information from many individuals. The recent development of EBVs for genetic diversity therefore focuses on the targeted use of genetic sequence data, supported by proxies of sequence diversity which can be more rapidly and frequently obtained, and more directly translated into actionable policies. Earth observations (EOs), especially those from sub-orbital and space-based platforms, can provide repeated and non-invasive, local-to-global observations to complement *in situ* observations. Earth observations thus have the potential to generate proxies for effective genetic diversity monitoring, but this potential is not yet realized. We recently formed a team supported by the International Space Science Institute to develop workflows integrating information derived from EO into genetic EBVs. We will present a preliminary analysis of the expected impact of this integration on genetic diversity monitoring and habitat protection, and initial proposals for integration workflows. We will discuss the inferences the resulting outputs may offer for biodiversity and conservation. Through these efforts, we aim to contribute to a step change in biodiversity monitoring and the development of actionable policies, in response to the Kunming-Montreal Global Biodiversity Framework.

Presentation type

Talk

Affiliation

University of Zurich

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100005 - Global availability of nuclear genetic variation data for area-based conservation, and where do we go from here

Ivan Paz-Vinas[1], Amy Vandergast[2], Chloé Schmidt[3], René Clark[4], Eric Crandall[5], Jeff Falgout[6], Colin Garroway[7], Eleana Karachaliou[7], Francine Kershaw[8], Deborah Leigh[9], David O'Brien[10], Malin Pinsky[4], Gernot Segelbacher[11], Margaret Hunter[12]

[1]Colorado State University, [2]USGS Western Ecological Research Center, [3]German Centre for Integrative Biodiversity Research (iDiv), [4]University of Rutgers, [5]The Pennsylvania State University, [6]USGS Lakewood, [7]University of Manitoba, [8]Natural Resources Defense Council, [9]WSL, [10]Scottish Natural Heritage, [11]University of Freiburg, [12]USGS Wetland and Aquatic Research Center

Protected areas (PAs) are being used to achieve success in global biodiversity protection through area-based conservation efforts. However, intraspecific genetic variation, which is necessary for population health, species persistence, and ecosystem resilience, has rarely been included in PA designs or quality performance assessments. Repurposing existing genetic data could rapidly inform PA design and assess PA effectiveness at preserving genetic diversity at regional to global scales. Yet, the amount of available genetic data within and outside PAs remains unclear. We assessed the extent to which nuclear genetic data are available within PAs, by amassing metadata describing nearly 2 million genotyped individuals, representing 36,363 local populations and 2,809 species from 36 taxonomic groups. Nearly 40% of all genotyped local populations were sampled within PAs, with 47.9% of existing PAs at the global scale having data for at least one local population. Some regions and PAs were particularly data-rich, suggesting that there might be enough genetic data available to include genetic variation in PA design and effectiveness assessments at local to regional scales. However, our assessment revealed significant geographical and taxonomic gaps that may preclude examinations of PAs efficiency at a global scale. Some taxonomic groups were highly data deficient (e.g., arthropods, fungi, mollusca) and spatial gaps were identified in major parts of the World, including biodiversity hotspots. Additional capacity will be needed to reduce taxonomic and spatial data gaps, by collecting new genetic data or by increasing efforts to gather, harmonize and share existing genetic data following FAIR protocols.

Presentation type

Talk

Affiliation

USGS Wetland and Aquatic Research Center

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100007 - From satellites to genes: predicting coral evolution in warming oceans

Oliver Selmoni[1], Phillip Cleves[1], Moisés Expósito-Alonso[1]

[1]Carnegie Institution for Science

Coral reefs are the most biodiverse ecosystem in the oceans, providing shelter to up to one-quarter of all marine species. Over the past decades, anomalous heat waves have caused an unprecedented decline of corals. As heat waves are becoming more frequent and intense, the future of coral reefs is now under threat.

Nevertheless, there are reefs where corals persist despite recurrent exposure to heat stress. In these rare reefs, coral populations show the emergence of genetic traits that are enhancing heat tolerance.

We study how these adaptive genetic traits are spreading across coral populations using a combination of remote sensing and genomic analyses. First, we use satellite imagery to identify reefs that have been exposed to recurrent thermal stress over the past decades. Second, we run genomic analyses to characterize adaptive genetic traits in coral populations that persist under such stressful conditions.

This approach was applied to six coral species living in different regions around the world. Remarkably, we identified adaptive traits that were shared between coral species living thousands of kilometers apart.

The spatial distribution of adaptive genetic traits can be predicted across the reef systems (spanning hundreds of kilometers) occupied by each of the studied populations. These spatial predictions of adaptive vulnerability can inform local conservation strategies. For example, reefs hosting thermally adapted corals could be protected from local stressors through the establishment of new marine reserves. Additionally, these thermally adapted corals could be bred and propagated in underwater nurseries, and then transplanted to restore damaged reefs.

Presentation type

Talk

Affiliation

Carnegie Institution for Science

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100004 - Dynamics of genetic diversity after habitat loss

Jeffrey Spence[1], Kristy Mualim[2, 3], Clemens Weiß[1], Meixi Lin[3], Moisés Expósito-Alonso[2, 3, 4]

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A major goal of conservation is maintaining high levels of genetic diversity across species. Recently, there have been calls to begin monitoring genetic diversity levels across species via large scale genotyping. The hope is that such monitoring will detect when too much of a species' genetic diversity has been lost (e.g., due to habitat loss or climate change) and action can be taken to prevent further loss of genetic diversity. There are several definitions of genetic diversity, but one particularly important measure in terms of various population genetic processes such as adaptation is π, the pairwise heterozygosity. Here we develop mathematical machinery to compute the expected π under complex spatial scenarios. Our modelling, corroborated by realistic simulations and empirical analysis of geospatial genetic data, shows that initially, habitat destruction has almost no impact on π, but in the long term can result in extreme losses in genetic diversity. This result shows that simple monitoring is not enough - genetic diversity will continue to decrease long after habitat destruction ends. Yet, we also show that the time-scale of this genetic diversity loss is quite long - taking a number of generations on the order of the effective population size - giving hope that reversing habitat loss quickly enough can prevent catastrophic consequences.

Presentation type

Talk

Affiliation

Stanford University

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

100002 - Evaluating common conservation tools for genetic diversity

Chloé Schmidt[1], Colin Garroway[2]

[1]German Centre for Integrative Biodiversity Research (iDiv) Leipzig-Halle-Jena, [2]University of Manitoba

Protected areas and the IUCN Red List are widely used conservation tools for protecting and monitoring wildlife in their natural habitats. Protected areas can be designated based on geological, cultural, and ecological significance, and Red List extinction risk is based on abundance and the quality and size of species ranges. Although genetic diversity governs population resilience and ability to persist in changing environments, it is not usually considered in Red List status assessment or protected area decision-making. However, both tools might indirectly be related to genetic diversity. Species with lower extinction risk are predicted to have higher genetic diversity, while low levels of human disturbance and fragmentation in protected areas should also safeguard genetic diversity by supporting large, well-connected wildlife populations. Yet, the effectiveness of these conservation tools for monitoring and maintaining genetic diversity is not well tested. Using publicly available genetic data for hundreds species sampled in >1000 locations, we find that neither Red List status nor protected area status is consistently related to genetic diversity. We discuss the reasons for this lack of effect and implications for global conservation genetics policy.

Presentation type

Talk

Affiliation

University of Manitoba

Session

Global Analyses and Macrogenetic Theories to Quantify and Monitor Genetic Diversity for the Global Biodiversity Framework

Community-Based Monitoring and Traditional Knowledge

270002 - Taking a closer look at urban forest diversity in Montreal using a public and private tree inventory placed along an urbanization gradient

Emma Bacon[1, 2], Marine Fernandez[1], Alain Paquette[1], Carly Ziter[2]

[1]Université du Québec à Montréal, [2]Concordia University

Urban sprawl is a clear threat to biodiversity. With cities growing in number and size, we are faced with the emerging issue of preserving biodiversity in urban environments. In Montréal, a system of 25 urban plots spanning gradients of urban density and socio-economic status were created in 2021 to monitor pollen along an urbanization gradient. Two years since its implementation, numerous projects concerning biodiversity have been added to the research themes of this "Urban Observatory", including the study of urban trees. Within the Urban Observatory, researchers from the Université du Québec à Montréal, the Université du Sherbrooke and Concordia University are studying the effect of urbanization on insects, birds, microorganisms, and humans. To understand these effects, we need to describe the diversity of the urban forest. Historically, public data alone was the basis for calculating urban forest diversity, yet recent studies suggest that this is not fully representative of urban forest composition, structure, and benefits (Hutt-Taylor and Ziter, 2022). Underestimating the composition of the urban forest may hinder our understanding of the role of trees in shaping urban biodiversity. We carried out a comprehensive forest inventory on the Urban Observatory plots, which included both public and private trees. The data collected from this project will allow us to (i) accurately estimate Montréal's urban forest diversity, (ii) study the effect of the urbanization gradient on the composition and structure of the urban forest, and (iii) create a forest diversity database to complement current and future studies involving the Urban Observatory.

Presentation type

Talk

Affiliation

Université de Québec à Montréal, Concordia University

Session

Community-Based Monitoring and Traditional Knowledge

2700031 - Marine plastic pollution: a challenge to marine biodiversity and conservation; case study, Ghana

Paul Adjin-Tettey[1]

[1]Fisheries Commission, Accra-Ghana

Marine plastic pollution is one of the challenges that affect marine biodiversity and conservation. It also affects economies, threatens ecosystems, and poses a potential risk to human health. Research has shown that about 85% of marine plastic pollution originates from land-based sources, because of improper disposal of waste. The uncollected waste that becomes litter then travels through open drainages and watersheds to the oceans. In Ghana, recent statistics indicate that the country generates about 1million tons of plastic waste annually; of this only 2-5% is recycled; the majority of the remaining plastic waste ends up in our oceans, crushing sensitive habitats, such as coral reefs, sea grass and chokes fishing grounds. This project seeks to adopt the bottom-up approach in addressing the issues related to plastic pollution and find a lasting solution to this challenge by building public awareness about marine plastic pollution and collecting comparable data across the coastal regions in the sub-region. The project also seeks to prevent marine litter by demonstrating, educating, and communicating about the flow of plastic pollution from inland fishing communities to the marine environment. Community Communication Centers will be utilized to engage local fishing communities across the region on marine litter reduction. This is necessitated to protect the marine environment, which also serves as a source of employment for the people living in the community.

Presentation type

Poster

Affiliation

Fisheries Commission, Accra, Ghana

Session

Community-Based Monitoring and Traditional Knowledge

2700034 - Community-base monitoring and traditional knowledge

Caroline C Quiah[1]

[1]Center For Youth Initiative and Empowerment

Community-based monitoring (CBM) is a participatory approach that involves the active engagement of local communities in the monitoring and management of their natural resources. It recognizes the invaluable of local communities in conserving and sustainably using their ecosystems, and it leverages their traditional knowledge to inform decision-making processes.

Traditional knowledge refers to the knowledge, practices, and beliefs passed down through generations within a community. It encompasses a deep understanding of local ecosystems, biodiversity, and the interdependencies between human well-being and the environment. Traditional knowledge often includes observations, techniques, and rituals that have proven effective in managing and preserving natural resources over time.

When combined, community-based monitoring and traditional knowledge create a powerful tool for sustainable resource management. By involving local communities in the monitoring process. CBM ensures that their perspectives and insights are enlighten in data collection, analysis, and interpretation, which enhances their ownership and commitment to the management of their resources.

Traditional knowledge complements scientific data and provides additional insights into ecosystem dynamics. It can reveal long-term trends and local indicators of environmental change that may be overlooked by scientific methods alone. Integrating traditional knowledge with scientific data allows for a more comprehensive understanding of ecosystems and their resilience in the developing of effective conservation strategies.

In conclusion, community-based monitoring and traditional knowledge are essential components of sustainable resource management. By engaging local communities and incorporating their traditional knowledge, we can enhance our understanding of ecosystems, promote effective conservation practices and support the empowerment and cultural integrity of communities.

Presentation type

Poster

Affiliation

Center for Youth Initiative and Empowerment

Session

2700036 - Meet the new neighbours: evaluating arthropod diversity in an urban ecological corridor

Nicole Yu[1], Carly Ziter[1]

[1]Concordia University

Green infrastructure are an increasingly popular solution to increase urban biodiversity and provide ecosystem services with various design innovations, where it is important to have continuous monitoring after implementation to evaluate and determine the practicality of such design interventions and management strategies. However, monitoring or maintenance is often lacking after implementation, due to challenges such as to the need for continuous funding, or needing expertise for surveying biodiversity. This research project aims to assess the effectiveness of a recently constructed Sud-Ouest Ecological Corridor (CESO) in promoting urban biodiversity, as well as develop a suitable framework for continuous monitoring. Part of the CESO design includes increasing habitat complexity in existing parks in the borough that were mostly mowed lawns, through differentiated mowing regimes (i.e., infrequent mowing) and planting "biodiversity plots" within each park that differ in size, vegetation, and structure. To assess the outcomes of different design choices and management strategies within the CESO and surrounding area, this project compares arthropod diversity in those areas with a focus on three taxonomic groups: spiders, grasshoppers, and butterflies. These groups were chosen for their potential as ecological indicators, diverse roles in the ecosystem, and ability to persist in urban habitats. Sampling is conducted with pitfall traps and sweep-netting, as well as community science efforts to survey the biodiversity in the area. These methods and results provide insight on whether the design considerations of the CESO were successful in improving arthropod biodiversity, and serve as a baseline for future biodiversity monitoring work.

Presentation type

Poster

Affiliation

Concordia University

Session

Community-Based Monitoring and Traditional Knowledge

270004 - Using community science to advance conservation in the Technoparc Wetlands and Adjacent Federal Lands of Montreal

Katherine Collin[1]

[1]Technoparc Oiseaux

The 215 hectares of woods, marshes, and *friches* north of the Pierre-Elliott-Trudeau airport in Montreal known as the Technoparc wetlands have been visited by community scientists since the 1970s. Still mostly unprotected, the site is subject to ongoing pressures of fragmentation and development, but also intense interest, particularly for Quebec's birding community, with 220 avifauna species observed on site. Community monitoring has enriched the site's biodiversity profile and led to limited, but promising, gains for conservation.

In 2021-2022, when 20 hectares of the site came under threat of immediate development, community-science documentation of *Asclepias syriaca* and *Danaus plexippus*, as well as avifauna, was enlisted to show the site's value; development plans were subsequently withdrawn. Conservation efforts have since been bolstered by the City of Montreal formally rezoning 16 ha of the broader site for conservation in January 2022 and by 25 municipalities within the Montreal Metropolitan Community (CMM) unanimously passing resolutions calling for the site's protection.

Biodiversity data for the site is regularly compiled on platforms such as eBird and iNaturalist, generated in the context of bird walks, frog counts, fish surveys, marsh monitoring, nest watches, and monarch tagging. Collaborations with Environment Canada, Concordia University and local colleges confirm the site's role as a living laboratory. Annual bioblitzes, hosted by Technoparc Oiseaux and the Campus Biodiversity Network, and supported by the CMM and municipal partners, are helping to increase awareness of the site's conservation needs and engaging more people each year in biodiversity monitoring in Montreal.

Presentation type

Talk

Affiliation

Technoparc Oiseaux

Session

Community-Based Monitoring and Traditional Knowledge

2700032 - Monitoring biodiversity for action in West Africa, with focus on Liberia

Kelvin Moses Gyekye[1]

[1]ZORZOR DISTRICT WOMEN CARE INC

This abstract highlights the importance of monitoring biodiversity in West Africa, particularly in Liberia, to inform effective conservation efforts and promote sustainable development in the region.

Liberia stands out as a country with rich biodiversity, including unique ecosystems such as tropical rainforests, mangroves, and coastal areas. However, this biodiversity faces numerous challenges, including habitat loss, deforestation, climate change, illegal wildlife trade, and unsustainable land-use practices.

Engaging local communities, indigenous groups, and stakeholders in biodiversity monitoring is crucial for promoting sustainable practices and ensuring the long-term conservation of natural resources. Community-based monitoring programs empower local residents to actively participate in data collection, reporting wildlife sightings, and identifying potential threats to their surroundings.

Monitoring biodiversity in West Africa, with a specific focus on Liberia, is essential for understanding the state of natural resources, identifying threats, and taking effective conservation actions and interdisciplinary approaches, such as;

Citizen Science: Engaging local communities, volunteers, and citizen scientists to participate in data collection, including wildlife observations, species identifications, and ecological monitoring.

Collaborative Partnerships: Promoting collaborations between research institutions, government agencies, NGOs, and local stakeholders to pool resources, expertise, and knowledge. Collaborative partnerships foster information sharing, capacity building, and coordinated conservation efforts.

Environmental Education and Awareness: Promoting environmental education programs and awareness campaigns to foster a deeper understanding of biodiversity conservation among local communities, policymakers, and the general public. Education and awareness initiatives help in building a conservation-oriented mindset and encouraging sustainable practices.

Presentation type

Poster

Affiliation

Zorzor District Women Care Inc

Session

Community-Based Monitoring and Traditional Knowledge

270001 - Local and traditional knowledge restoration techniques of savannah landscapes for climate change adaptation, Burkina Faso

Nouhou Zoungrana[1]

[1]Université Félix Houphouet Boigny

Land degradation is occurring in almost all terrestrial biomes and agro-ecologies, in both low- and high-income countries. Thus, the populations have developed traditional techniques (Zaî system, stone cordons, half-moons, etc.) to better manage water for agriculture in the face of its degraded lands. We refer to the literature review on local techniques and traditional methods of water and soil conservation, using cultural mapping which integrate Geographic Information Systems and social data. This article aims to map its different techniques, assess the impacts, the involvement of gender with social aspects and policies. The studies were carried out at the beginning of the rainy season in Zitenga. We therefore retain local and traditional water and soil conservation techniques that contribute to local and national economies, sequester significant amounts of carbon, strengthen food and clean water supplies and safeguard biodiversity. Local and traditional water and soil conservation techniques is strongly connected to sustainable development and contributes directly to UN Sustainable Development Goals 1, 2, 6, 13, 14 and 15, through: creating jobs and sustainable value chains; enhancing food security and dietary diversity; increasing water availability; supplying wood energy for cooking; mitigating the effects of climate change and enhancing the resilience of ecological and social systems. It can also contribute to Goal 16 by increasing the availability of natural resources. A policy brief is in perspective for taking into account indigenous and local knowledge in water and soil conservation policies.

Presentation type

Talk

Affiliation

Université Félix Houphouet Boigny

Session

Community-Based Monitoring and Traditional Knowledge

2700033 - Monitoring carbon stocks in the reforested areas of the Tierras colectivas del Alto Bayano

Maximiliane Jousse[1], Catherine Potvin[1]

[1]McGill University

Monitoring essential ecosystem service variables (EESVs) is essential to quantify the value of an ecosystem and to motivate conservation policies. Carbon stocking is one such example of an EESV, and tropical forests are one of the world's biggest sinks, storing about one quarter of all terrestrial carbon. Despite increasing rates of deforestation, the tropics have great potential for re-creating sinks through reforestation. In this project, we develop a culturally appropriate protocol for carbon monitoring in the reforested areas of Bayano, Panama, with the local indigenous peoples using LiDAR, hand measurements, and carbon calculators. This reforestation project is led by McGill Office of Sustainability and aims to offset a part of the university's carbon footprint. LiDAR has long been used for monitoring carbon stocks; however, it is expensive, bulky, and requires expert knowledge. An app has been developed to make the use of LiDAR more accessible. With this app, we can bring LiDAR to remote areas such as Bayano. The protocol will be elaborated, tested, and applied, with a team of locals to ensure the continued monitoring of carbon stocks in the reforested area. The aims of the project are twofold: to evaluate the reforestation efforts through carbon stock monitoring, and to bridge the technological divide. We hope that working with the local indigenous peoples will empower them to become autonomous in their own desire to reforest, as well as allow for indigenous science in the form of continued monitoring of carbon stocks in the reforested areas of Bayano.

Presentation type

Poster

Affiliation

McGill University

Session

Community-Based Monitoring and Traditional Knowledge

270003 - What does vegetation-climate mismatch mean to the understory? Using iNaturalist to explore trends in species composition in low-elevation conifer forests in California's Sierra Nevada

Christopher Field[1], Avery Hill[2], Connor Nolan[1]

[1]Stanford University, [2]California Academy of Sciences

Due to the rate of recent climate change, large tracts of forests are stranded in climate conditions to which they are not best adapted. Comparisons between historical climatic niches and modern distributions of conifer trees in California's Sierra Nevada mountains have shown that a significant amount of Vegetation-Climate Mismatch (VCM) is present at the lower elevation, warmer edges of conifer distributions. This VCM portends ecological transitions in these regions, but the rate and structure of these transitions is difficult to determine from climate and dominant vegetation data alone. We leverage the immense sample size and taxonomic breadth of iNaturalist records across the Sierra Nevada to identify trends in species composition between VCM conifer forests and surrounding vegetation. Many understory plants, insects, and other taxa observed by iNaturalist users are motile or have shorter generation times than conifer trees. These characteristics may make them more geographically responsive to recent climate shifts, and useful for building a more complete picture of the relationship between VCM and shifts in species composition. We've identified more than a dozen species across diverse taxonomic groups that are entirely absent from non-VCM conifer forests but frequently observed in VCM conifer forests and the broadleaf vegetation further downslope. We plan to extend our analysis to identify patterns in species co-occurrence in these regions as well. VCM will increase in scope and severity as climate change continues, and this work contributes to a more complete understanding of the impacts it will have on the ecology of the Sierra Nevada.

Presentation type

Talk

Affiliation

California Academy of Sciences

Session

Community-Based Monitoring and Traditional Knowledge

270006 - Public monitoring network as a tool to monitor ecosystem and biodiversity in highly challenging areas: lesson learned from Reef Check Indonesia Network in Indonesia

Derta Purwita[1], Naneng Setiasih[1], Habibi Abdullah[2]

[1]Reef Check Indonesia Foundation, [2]Reef Check Indonesia Network

Monitoring is crucial to understanding how ecosystems and biodiversity change over time. Yet, it is problematic for coral reefs in Indonesia. Its reef, which contains the highest coral biodiversity in the world, is scattered over thousands of islands. Public reef monitoring (PRM) is one of the solutions.

Reef Check (RC) is an international standardized PRM. In Indonesia, it was started as a one-area project in 1997. In 2003 a Reef Check Indonesia Network (RCNI) was established. Local stakeholders work alongside scientists and professionals to monitor reefs. In 2023, various organizations and individuals implemented RC in almost all provinces with coral reefs in Indonesia. During mass bleaching events, RCNI became a base for bleaching network development, reporting Indonesia's most widespread bleaching data.

Our experience provides three important lessons: 1) High-quality information is crucial, as many doubts the ability of non-scientist to gather data and build analysis. RC requires all the monitors to undergo rigorous yet simple certification, supported by an automated data analysis system and a network of scientists; 2) Continuous resources are key. Besides the conventional project-based approach, RC is integrated into the government system, university curriculum, diving business, and a cross-subsidy mechanism was developed; 3) Maintaining a network is about maintaining human relationships. The common interest has to be embedded in a "friendship and fun" manner. Nowadays, social media can provide many tools.

There are still many gaps that we have to overcome to strengthen the network. However, we believe the same concepts can be replicated in other ecosystems.

Presentation type

Talk

Affiliation

Reef Check Foundation Indonesisa

Session

Community-Based Monitoring and Traditional Knowledge

2700035 - Local and traditional knowledge restoration techniques of savannah landscapes for climate change adaptation, Burkina Faso

Nouhou Zoungrana[1]

[1]Université Félix Houphouet Boigny

Land degradation is occurring in almost all terrestrial biomes and agro-ecologies, in both low- and high-income countries. Thus, the populations have developed traditional techniques (Zaî system, stone cordons, half-moons, etc.) to better manage water for agriculture in the face of its degraded lands. We refer to the literature review on local techniques and traditional methods of water and soil conservation, using cultural mapping which integrate Geographic Information Systems and social data. This article aims to map its different techniques, assess the impacts, the involvement of gender with social aspects and policies. The studies were carried out at the beginning of the rainy season in Zitenga. We therefore retain local and traditional water and soil conservation techniques that contribute to local and national economies, sequester significant amounts of carbon, strengthen food and clean water supplies and safeguard biodiversity. Local and traditional water and soil conservation techniques is strongly connected to sustainable development and contributes directly to UN Sustainable Development Goals 1, 2, 6, 13, 14 and 15, through: creating jobs and sustainable value chains; enhancing food security and dietary diversity; increasing water availability; supplying wood energy for cooking; mitigating the effects of climate change and enhancing the resilience of ecological and social systems. It can also contribute to Goal 16 by increasing the availability of natural resources. A policy brief is in perspective for taking into account indigenous and local knowledge in water and soil conservation policies.

Presentation type

Poster

Affiliation

Université Félix Houphouet Boigny

Session

Community-Based Monitoring and Traditional Knowledge

270005 - Understanding climate change in the Hindukush Range: perceptions and adaptation strategies of local communities in Pakistan

Uzma Saeed[1], Muhammad Ali Nawaz[2]

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The communities in Chitral Valley, Pakistan, heavily rely on natural resources, which are adversely affected by human activities and climate change. This study used various research methods to examine the communities' perceptions of climate change and their adaptation strategies. The results indicated that the communities identified significant changes in weather and climate, including changes in temperature, rainfall, the onset of seasons, snow cover, glacier melt, flooding and drought events, including pest attacks.

These findings align with the meteorological records of Chitral Valley, which show an average temperature increase of 0.32°C per decade between 1973 and 2022 and a gradual decrease in precipitation. In addition, maximum temperatures have been rising, while minimum temperatures have been decreasing, indicating a trend of increasing daytime temperatures, and decreasing night-time temperatures. These climatic changes have had profound effects on the livelihoods of mountain communities, leading to reduced crop yields, livestock-rearing challenges, water scarcity, decreased pastureland productivity, increased health expenses, diminished business opportunities, and heightened disease risks for both humans and livestock.

The communities have implemented various strategies to adapt, such as water management, changing crops, infrastructure development, institutional support, migration, livelihood diversification, and transitioning to clean energy sources. They have also emphasised the negative impact of human-wildlife conflict on biodiversity loss. The study recommends that the government support the communities by providing accessible livelihood opportunities, improving market access, and sharing knowledge and information about climate change.

Presentation type

Talk

Affiliation

Quaid I Azam University, Islamabad

Session

Community-Based Monitoring and Traditional Knowledge

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200038 - Safeguarding biodiversity through Biobank: challenges and opportunities from African perspective

Lucky Nesengani[1], Sinebongo Mdyogolo[1], Ntanganedzeni Mapholi[1]

[1]University of South Africa

Biobanking provides an exciting opportunity for biodiversity research to be conducted on stored biospecimens that drives the economy, development, and for conservation purposes. The above is true in the developed countries; however, this is still a dream to be realised in many developing countries especially in the African continent due to inadequate and lack of infrastructure and capacity. Some of the challenges include permits, cultural believes and Nagoya consideration. As a result, there are few biobanks established in Africa with majority in Southern Africa focusing on human biospecimens. However, the concern has always been on the understanding of ethico-legal consideration for compliance and regulation of biobanking. In South Africa and some other African countries, biobanking relies on small to medium, rarely structured, and in an isolated manner. As a result, there is a lack of communication between systems, leading to inefficiency of the existing systems. African continent has extraordinary biodiverse with a need to establish a well-coordinated and functioning biobank to safeguard biodiversity. Our article outlines the procedure and principles for biobanking to serve as a guideline document that will drive the initiative and establish conversations around establishing biobanks that may be centralised and serve larger communities. This will also bring the sense of urgency to develop strategies that will be supported by the important parties as it is a priority to preserve the unique genetic diversity of the continents' natural resources while also exploiting them for food security and accelerated capacity development, and economic growth.

Presentation type

Poster

Affiliation

University of South Africa

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200031 - Soundscape monitoring in protected areas: technical challenges, lessons learned and future perspectives

Dárlison Andrade[1], Ivan Campos[2]

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The *Monitora* is one of the largest biodiversity monitoring programs in the world. It has the main goals of assessing the effectiveness of the Brazilian Federal Protected Areas, contributing to the evaluation of species' conservation status, providing data on invasive species, and detecting biodiversity variations due to climate change. However, generating comparable data on different ecosystems is a technical challenge. Traditionally, each ecosystem type (forest, grassland, desert etc) has its own sampling methods. There is a need for standardized *in situ* sampling protocols capable of providing information on biodiversity states and trends in different biomes.

To address this challenge, since 2021 the ICMBio runs an acoustic monitoring project at the *Serra do Cipó* National Park, a core area of the *Espinhaço* Biosphere Reserve. The protocol was designed to be modular, to cover different ecosystem structures and to provide data for soundscape studies. The data is used to detect the main soundscape differences between sites and in a single location across time. Acoustic indices are used within the acoustic regions approach to generate seasonal signatures of the daily acoustic dynamic. Activity of birds, anurans, insects and mammals will be measured. Automated detection of species of interest will also contribute to the monitoring of taxa focus of conservation actions.

Within the next three years, it is expected to implement this acoustic monitoring project in protected areas in four different Brazilian biomes (Amazon, Atlantic Forest, *Cerrado* and *Caatinga*). The proposed protocol has a great potential to soundscape monitoring of protected areas worldwide.

Presentation type

Poster

Affiliation

National Center for Wild Bird Conservation and Research (CEMAVE), Chico Mendes Institute for Biodiversity Conservation (ICMBio), Brazil / Biological Sciences Institute (ICB), Federal University of Minas Gerais (UFMG), Brazil

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20002 - Regional cooperation for biodiversity observation and capacity development: Asia-Pacific Biodiversity Observation Network

Hiroyuki Muraoka[1]

[1]Gifu University / National Institute for Environmental Studies

Asia-Oceania region is characterized by many biodiversity hotspots, complex geographical characteristics and climatic zones, diverse cultures based on diversity in nature, increasing impacts of climate change, rapid changes in usage of land, coasts and ocean, APBON will further convene the existing biodiversity data and knowledge in the region.

APBON (est. 2009) is a network for observations and assessment of biodiversity, and a platform for science-policy engagement to contribute to effective biodiversity conservation and sustainable use of biodiversity at the national, regional and global scales. APBON has developed networks, facilitated communication for sharing knowledge, and built the capacity of researchers and stakeholders through workshops/webinars/publications. Key findings by APBON include descriptions of species new to science, mapping tropical forest cover change, evaluating impacts of hydropower dams and climate change on fish species diversity in the Mekong, and mapping “Ecologically and Biologically Significant Areas” in the oceans.

APBON will further develop the network for addressing local, national and regional biodiversity issues with particular attention to the impacts of changes in climate and society. The planned activities include, launching ‘master sites’ for long-term and multiple monitoring; promoting interdisciplinary research and problem-solving approaches with filling observational and knowledge gaps by integrating technologies and platforms; promoting data sharing and data accessibility by networking the observation networks and collaboration with partner organizations; delivering information and knowledge through stakeholder engagement at local, national, and regional scales.

Presentation type

Talk

Affiliation

Gifu University / National Institute for Environmental Studies

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20001 - Lessons learned from a transnational network of European national and sub-national monitoring schemes - governance issues and solutions

Petteri Vihervaara[1], Aino Lipsanen[1], Cécile Mandon[2], Hilde Eggermont[3], Guillaume Body[4], Mathieu Basille[4], Mona Naeslund[5], Michelle Silva del Pozo[4], Alberto Basset[6], Senem Onen Tarantini[6], Lars Dienesen[7], Toke Hoye[8], Rob Hendriks[9], Anna Heck[10], David Eichenberg[11]

[1]Finnish Environment Institute, [2]FRB/Biodiversa+, [3]BelSPO/Biodiversa+, [4]OFB, [5]SEPA, [6]MUR, [7]IFB, [8]MoE-DK, [9]LNV, [10]VL O, [11]BMU

European Biodiversity Partnership (Biodiversa+) (2021-2028) has biodiversity monitoring as one of it's key working areas with the ultimate aim to establish a transnational network of European national and sub-national monitoring schemes. The outcomes of the first two years of activities were synthesized in a Biodiversa+ strategic biodiversity monitoring governance document (Phase 1) which describes a way forward to integrate "the national and sub-national biodiversity monitoring coordination centres/hubs" with a European biodiversity monitoring coordination centre (BMCC) designed by the EuropaBON project. Biodiversa+ partners from over 23 countries have participated in this work via active contributions to surveys, country-by-country interviews, and workshops. As an outcome of this, a conceptual model of "national hubs" - as a (sub-)national counterpart to the European scale or international biodiversity monitoring networks - was designed. The key functions of the national coordination centers could include, for instance, coordination and implementation of biodiversity monitoring, improving and supporting data management and interoperability, steering and co-funding of activities, enabling societal interactions, networking and capacity building. The possibilities to find synergies with the national hubs and the other key initiatives such as European Environment Agency's Eionet expert network and Copernicus services, or Global Biodiversity Information Facility's national and European nodes were investigated too. A list of key recommendations towards a transnational network of European national and sub-national hubs, and an overview of the next steps in the future will be described.

Presentation type

Talk

Affiliation

Finnish Environment Institute

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20006 - Finnish Ecosystem Observatory as a national cooperation model bridging biodiversity data providers and users

Petteri Vihervaara[1], Peter Kullberg[1], Saku Anttila[1], Martin Forsius[1], Ida Palmroos[1], Riikka Paloniemi[1], Heidi Lehtiniemi[1], Pekka Vanhala[1], Päivi Sirkiä[1], Pekka Hurskainen[1], Tuija Mattsson[1], Kirsi Valanne[1], Aapo Ahola[1], Aapo Kahilainen[1], Veera Norros[1], Tiina Laamanen[1], et al.[1]

[1]Finnish Environment Institute

Integration of in-situ data, remote sensing and models is often suggested as an ideal new form to provide comprehensive overview of biodiversity across various scales of biodiversity observation networks (BONs). In a real world such an operational biodiversity synthesis hub can be build up in many ways, but so far there are only a few operational national BONs up and running; one of them has been recently build up in Finland. Finnish Ecosystem Observatory (FEO) has been constructed during a four-year project (2020-2024) which has included continuous discussions with data providers, key data users, as well as technical experts of biodiversity monitoring schemes and remote sensing, modelers, and data scientists. The key outcomes include, for instance, a revision of the status of over 70 national species monitoring schemes, a roadmap of eDNA and other molecular biological methods to support monitoring schemes, and remote sensing workflows for operational data products to support monitoring of habitats. Use of biodiversity data in the society has been demonstrated via five case studies, such as, development of automated national biodiversity indicators, Red List of Ecosystems and Birds and habitats directive reporting, carbon-neutral land-use planning, biodiversity data products for municipalities, and ecosystem accounting. Findability of biodiversity and ecosystem (meta-) data has been in the core of development of a national data portal at the first stage. In the future, FEO in collaboration with FinBIF will provide core services for national biodiversity coordination, and develop data infrastructures towards true accessibility and interoperability.

Presentation type

Talk

Affiliation

Finnish Environment Institute

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20013 - Arctic BON: update from the Circumpolar Biodiversity Monitoring Program (CBMP)

Tom Barry[1], Courtney Price[2], Tom Christensen[3], Kári Fannar Lárusson[2], Catherine Coon[4], Jennifer Lento[5], Joseph Culp[6], Willem Goedkoop[7], Steinunn Hilma Ólafsdóttir[8], Øystein Leiknes[9], Douglas MacNearney[10], Erica Oberndorfer[11], Jim Lawler[12], Tahzay Jones[12], Donald McLennan[13]

[1]University of Akureyri, [2]Conservation of Arctic Flora and Fauna, [3]Aarhus University, [4]Bureau of Ocean Energy Management, [5]University of New Brunswick, [6]Wilfred Laurier University, [7]Swedish University of Agricultural Sciences, [8]Marine and Freshwater Research Institute, Iceland, [9]Norwegian Environment Agency, [10]Environment and Climate Change Canada, [11]Agriculture and Agri-Food Canada, [12]US National Parks Service, [13]Independent

The Circumpolar Biodiversity Monitoring Programme (CBMP) is an international network of scientists, governments, Indigenous organizations, and conservation groups working to harmonize and integrate efforts to extend and develop common approaches to monitoring Arctic biodiversity. The CBMP is the monitoring programme of the Conservation of Arctic Flora and Fauna (CAFF)— the biodiversity working group of the Arctic Council—and serves as the Arctic BON of GEOBON.

This presentation will provide an overview of the CBMP's international efforts to monitor and report on the status and trends of the Arctic's unique biodiversity. It will share insights from recent State of the Arctic Biodiversity Reports including an overview of biodiversity monitoring efforts and results across Arctic coasts, lands, lakes, rivers, and seas. The presentation will also showcase development of an Arctic Biodiversity Monitoring Toolkit to help implement recommendations and advice arising from the CBMP and share results from the Arctic Biodiversity Dashboard, a reporting tool to visualize and display results. The presentation will trace the process and approach taken in the last two decades to develop and implement the CBMP, including challenges encountered and lessons learned and also summarize the CBMP's impact on Arctic biodiversity monitoring, science, and policy. The presentation will conclude with observations on key issues and next steps.

(*Note the listed authors are co-chairs and co-leads of the CBMP and its ecosystem groups. It is not possible to include the hundreds of colleagues involved in CBMP implementation efforts*)

Presentation type

Talk

Affiliation

Conservation of Arctic Flora and Fauna (CAFF)

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

2000336 - Updating historical data to assess insect decline in Canadian boreal forest

Christian Hébert[1]

[1]Natural Resources Canada-Canadian Forest Service

Biodiversity underpins human activities by providing most ecosystem services that make human life possible on Earth. Insects account for about half of known species on Earth and they have multiple ecological roles that provide the biological basis for maintaining ecological processes in ecosystems. Through pollination, pest control and nutrient cycling (decomposition), insects influence forest productivity. They also provide food and nutrients to higher trophic levels, over 50% of bird food requirements being fulfilled by insects. In 2008, a decline of aerial insectivorous birds has been reported in Canada by McCraken and he suggested that insect populations could have dropped. However, he also noticed that "*No large-scale programs are in place to monitor population levels of aerial insects*".

In 2017, a paper reported a 76% drop in insect biomass in protected areas of Germany. It was followed by other papers also highlighting insect declines around the World, but a close examination of data showed that Canada had been overlooked. Also, most data showing insect decline came from open habitats, which led to the conclusion that insect declines were mainly linked to urbanization and agricultural intensification. There is an urgent need to address the biodiversity decline issue in Canada, particularly in the boreal forest where these disturbances are not as important than in deciduous and mixed forests, which are located in the south. By updating historic data-driven studies, we could determine if global changes are involved in biodiversity decline.

Presentation type

Poster

Affiliation

NRCan - Canadian Forest Service - Laurentian Forestry Centre

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200037 - Biodiversity monitoring in agro-zootechnical activities, agroforestry and livelihoods in Karamoja sub-region region in Uganda

Peace Anne Kobusingye[1], Fredrick Lwasampijja[1], Fortunate Ayebare[2], Namugabi Mary[3]

[1]Appropriate Community Development Agriculture Initiatives (ACDAI), Masaka, Uganda, [2]Alliance on Agriculture and Pollution Organization (AAPO), Masindi, Uganda, [3]Makerere University, Kampala, Uganda

Agroforestazione is a combination of sustainable agriculture, farming methods and zootechnics with a particular eye to environmental protection in Karamoja sub-region region. This paper sought to monitor biodiversity dynamics of agro-zootechnical activities, agroforestry and livelihoods in Karamoja sub-region region in Uganda. The study focused on agroforestry (tree species like; hedge, Acacia Senegal, Key apple), agriculture and animal husbandry.

The study was conducted in among smallholder farmers, where 300smallholder farmers were interviewed using structured questionnaires. Expert meetings, key informant interviews, and selected focus group discussions were used as sources of qualitative data. Results showed strong evidence of the benefits that agro-forestry tree species provided to communities in Karamoja. Benefits from agro-zootechnical activities and agroforestry to livelihood development in communities included; fuelwood, conservation, shade, fencing, construction, farm tools, fodder, fruit, medicine, use of trees for flash flood control, erosion control and waterway fixation, resilient crop production, resilient livestock production and efficient utilization of green water. Communities commonly planted three agro-forestry tree species including; hedge, Acacia Senegal and Key apple in their home gardens, croplands and grazing lands.

The growing population in Karamoja rendered pastoralism a viable way of life and consequently livelihoods in Karamoja began to change, gradually moving away from primarily relying on pastoralism to more diversified livelihoods like crop production and agro-forestry.

Presentation type

Poster

Affiliation

Appropriate Community Development Agriculture Initiatives (ACDAI)

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20004 - Biotablero: An application of workflows to calculate biodiversity indicators in Colombia

Maria Camila Diaz Corzo[1], Victor Rincón[1], Maria Alejandra Molina[1], Maria Helena Olaya[1], Luis Fernando Urbina[1]

[1]Humboldt Institute

BioTablero, a website that allows the spatial visualization of biodiversity indicators at the national level in Colombia, was launched in May 2022. In one of its modules, users can make geographic queries of indicators related to ecosystems, landscapes and species; and for each indicator, the system produces complementary maps and graphs to show spatial and temporal aspects of the generated information. As part of Bon in a Box 2.0, we developed workflows to automate the calculation of these indicators. We will present three of the main indicators calculated in BioTablero: 1) Connectivity of protected areas - percentage of connected area, where protected areas are considered as connected when they are 10km or less apart; 2) Forest loss and persistence - calculated from multitemporal analyses of forested area in the country from 2000 to 2021; and 3) Persistence of Human Footprint - based on the Human Footprint Index, and how it has changed from 1970 to 2018. By making these workflows available for the GEOBON community, we hope that users can calculate these indicators at different scales and countries, favoring their constant replicability and updating.

Presentation type

Talk

Affiliation

Humboldt Institute

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200040 - Scalability of soil health assessment based on empirical and functional interrelationships

Saurav Das[1], Dinesh Panday[2], Bharat Sharma Acharya[2], Bijesh Maharjan[1]

[1]University of Nebraska-Lincoln, [2]Rodale Institute

Soil health, fundamental to sustainable agriculture, encompasses a variety of physical, chemical, and biological indicators, such as soil organic matter, soil organic carbon, pH, nutrient levels, aggregate stability, microbial activity, and community structure. However, holistic assessment of these indicators presents substantial spatiotemporal, financial, and technical hurdles, consequently limiting soil health research scalability and inhibiting the broad implementation of sustainable soil health management strategies. This study advocates for a minimum, yet robust set of soil health indicators that are cost-effective and readily interpretable using a meta-analysis approach. This minimum indicator set aims to decrease the expense and complexity of soil health assessments, thereby enhancing accessibility and spatiotemporal monitoring for stakeholders, specifically land managers, and producers. Employing cutting-edge statistical and machine learning methodologies such as Principal Component Analysis (PCA), Hierarchical Clustering, Random Forest, Support Vector Machine (SVM), and Mixed Model Regression, the study identifies indicators that are responsive to management practices and interprets the nutrient and ecological capacity of the soil. The study also leverages the vast dataset to formulate a crop-response curve for selected soil health indicators enabling prioritization of management strategies that amplify these indicators, assisting producers in attaining higher yield and investment return. This study will be instrumental in improving the scalability of soil health assessments, adoption of sustainable soil management practices, and augmenting the productivity and resilience of agricultural systems.

Presentation type

Poster

Affiliation

Rodale Institute

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20008 - Status of marine biodiversity monitoring in nearshore areas of East and Southeast Asia

Masahiro Nakaoka[1], Takehisa Yamakita[2], Rempei Suwa[3], Jillian Ooi[4], Amy Then[4], Maria Lourdes Mcglone[5], Severino Salmo[5], Yasmin Primavera Tirol[6], Rohani Ambo Rappe[7], Anchana Prathep[8]

[1]Hokkaido University, [2]Japan Agency for Marine-Earth Science and Technology, [3]Japan International Research Center for Agricultural Sciences, [4]University of Malaya, [5]University of the Philippines Diliman, [6]Aklan State University, [7]Hasanuddin University, [8]Prince of Songkla University

Coastal ecosystems in East and Southeast Asia are the hotspots of marine biodiversity in the world, but they are threatened by various types of human-induced threats. Establishing sustainable programs of marine biodiversity monitoring and sharing the obtained data through networks of scientists and stakeholders are required towards biodiversity conservation and sustainable use of the sea. Nevertheless, the current efforts are still limited due to this region's resource and capacity deficiency. One of the missions of AP MBON (Asia-Pacific Marine Biodiversity Observation Network) is to help marine scientists of the region to establish the networks of biodiversity monitoring programs, including integration of observed EOVs and EBVs to global databases, and linking scientists and stakeholders for better utilization of marine biodiversity data. To achieve these goals, we conducted a preliminary survey on the status of marine biodiversity monitoring in each country. With the list of ongoing marine biodiversity monitoring programs, we will report variations in the types of organizations in charge (e.g., national governments, local governments, academia, NGOs, private sectors, etc.), monitored EOVs/EBVs, spatial and temporal scales of monitoring (e.g., how many sites, how long, how often), management status of monitoring data, the links to existing global biodiversity databases, and how the data have been utilized for the decision-making. Based on the report, we will discuss opportunities and challenges for establishing sustainable biodiversity monitoring programs in Asia-Pacific regions.

Presentation type

Talk

Affiliation

Hokkaido University

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20011 - Monitoring biodiversity at the subnational level: example of the province of Québec

Sabrina Courant[1], Anouk Simard[1], Chantale Langevin[1], Caroline Dubé[1], Lyne Pelletier[1], Guillaume Sena[1]

[1]Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs

Climate change is disrupting ecosystems to an unprecedented degree. Some species or communities will react more quickly than others. Since 2016, in order to increase our ability to anticipate and react to these changes, the government of Québec has implemented a biodiversity monitoring network to monitor fauna and flora communities in several ecosystems on Québec's territory. The objective is to measure common biodiversity, to observe the actual and upcoming changes in these ecosystems and to promote information sharing with stakeholders working in ecosystem management and conservation. The presentation will provide an initial assessment of this innovative approach.

Presentation type

Talk

Affiliation

Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200033 - Advancing biodiversity conservation and restoration: the role of the ELIXIR Biodiversity Community

Physilia Chua[1], Katharina F Heil[1], Peter Maccallum[1], Josephine Burgin[2], Robert M Waterhouse[3, 4], Toni Gabaldón[5, 6]

[1]ELIXIR, [2]EMBL-EBI, [3]University of Lausanne, [4]Swiss Institute of Bioinformatics, [5]Barcelona Supercomputing Centre, [6]Institute for Research in Biomedicine

Biodiversity loss is a key societal challenge that humanity must address. Unless concrete actions are taken to stem this decline, this will lead to catastrophic effects on the Earth's biosphere, and negatively impact human health and well-being. ELIXIR aims to address the technical challenges of biodiversity science by leveraging its suites of services and expertise to enable FAIR data analyses and management. This will enhance our understanding of life on our planet and facilitate biodiversity conservation and restoration. The newly formed ELIXIR Biodiversity Community is developing technical and community-oriented plans, including an Implementation Study to enhance ELIXIR Services application and build connections across Research Infrastructures in biodiversity. The ELIXIR Biodiversity Community will collaborate with other existing ELIXIR Communities and international consortia to develop appropriate action plans to combat biodiversity loss.

Members of the ELIXIR Biodiversity Community are also involved in externally funded projects. These include Biodiversity Genomics Europe (BGE), Biodiversity Community Integrated Knowledge Library (BiCIKL), and AgroServ (Integrated SERvices supporting a sustainable AGROecological transition). BGE is a pan-European consortium scaling up biodiversity genomics to meet the needs of tackling the biodiversity crisis. BiCIKL connects infrastructures and enables researchers to access services across the lifecycle of biodiversity data. AgroServ provides customised services and facilities for interdisciplinary research on agroecosystems to promote sustainable agriculture and biodiversity preservation. The ELIXIR Biodiversity Community will develop and strengthen these connections across the many infrastructures and services, which will be key to overcoming the complex technical challenges posed by the current heterogeneity of biodiversity data.

Presentation type

Poster

Affiliation

ELIXIR

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20017 - Marine Biodiversity Observation Network (MBON): Coordinating marine life observations to support conservation, restoration, and equitable development

Joana Soares[1], Adriano Lima[1], Masahiro Nakaoka[2], Isabel Sousa Pinto[3], Gabrielle Canonico[4], Enrique Montes[5], J. Emmett Duffy[6], Maria Teresa Kavanaugh[7], Daniel Otis[8], Digna Rueda Roa[8], Sebastian Digeronimo[8], Frank Muller-Karger[8]

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Good marine life science and data are needed to make every decision involving the ocean. Historically, decisions about ocean uses have been based on physical and chemical data. Emerging technologies now allow the incorporation of biology and ecosystem Essential Ocean Variables observations and Biodiversity Essential Variables into surveys and monitoring programs at local and regional scales. Best practices allow for this information to be interoperable, scalable, usable, and implementable by local groups and nations, and across ocean basins.

An increase in coordination, capacity development and implementation is required to ensure the long-term availability of marine biodiversity and ecosystem information. The Marine Biodiversity Observation Network (MBON) provides a platform for such a community of practice, fostering the integration of biological and ecological observations into coastal and ocean observing systems and monitoring programs. This includes integrating new methods and advanced technologies to evaluate marine biodiversity and collaborating to integrate best practices in data management, including data formatting standards for biological data using DarwinCore schema. This allows partners to quickly integrate biological and other data into national databases and publish to international open data repositories. Such integration allows the application and re-use of data to develop indicators and support decision-making about marine ecosystem services and nature-based solutions for climate change mitigation. The goal is to manage ocean use better and satisfy national and international reporting frameworks. This is an opportunity to expand marine life understanding, and to jointly contribute to the MBON and the Marine Life 2030 programme of the UN Ocean Decade.

Presentation type

Talk

Affiliation

College of Marine Science, University of South Florida, Florida, USA

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200032 - An example of cross-taxon approach for biodiversity monitoring in Basilicata: linking biodiversity indicators to habitat structure and functions

Emanuela Carli[1], Francesca Pretto[1], Giuseppe Miraglia[2], Giovanna Potenza [2], Irene Prisco[1], Rossana Cifarelli[2], Gaetano Caricato [2], Achille Palma[2], Matilde Martini[3], Francesco Santi[3], Jacopo Iaria[3], Francesca Maura Cassola[3], Roberto Cazzolla Gatti[3], Laura Casella[1], Pierangela Angelini[1]

[1]Italian Institute for Environmental Protection and Research, Rome, Italy, [2]Regional Agency for the Protection of the Environment of Basilicata via della Fisica 18 C/D, 85100 Potenza, [3]ALMA MATER STUDIORUM - UNIVERSITY OF BOLOGNA, Department of Biological, Geological,and Environmental Sciences (BiGeA), BIOME - Biodiversity and Macroecology Lab, Bologna, Italy

Biodiversity monitoring represents the first step for alerting us to the shifting dynamics of ecosystems in response to environmental changes. From habitat loss to invasive species, monitoring allows to detect and understand the drivers of changes. By collecting and analysing data on species distribution, abundance, and genetic diversity, scientists gain insights into the health of ecosystems and the impacts of human activities. Habitat monitoring may include different indicators, such as the historical ones (canopy cover, species composition), or other more innovative, using also eDNA. Multi-taxonomical data are invaluable for making informed conservation decisions, developing effective management strategies, and mitigating the negative impacts.

Here we propose a test in Southern Italy, an area that includes the upper and middle valley of the Agri river, one of the main valleys of the Basilicata Region, located along the main axis of the Southern Apennines. The investigated area, spreading for 260 km2, includes mountains, hills, an artificial reservoir (Pertusillo Lake), and one of the main Centers of Oil exploitation in Italy. Here, we collected data in 105 vegetation plots, and we located 25 nested plots for lichens; 20 nested plots for animals (carabids, birds, micromammals), in which we survey occurrence and abundance of every species, according to their phenology, and following the National standards.

With a multi-taxonomical approach, we aimed at reaching more comprehensive insight on ecosystems conservation status and management practices impacts, ensuring more sustainable use of the resources.

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Presentation type

Poster

Affiliation

ARPA Basilicata

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200039 - Qu'est-ce qui est à la base de la pollution marine

Glody Ngalina Fulu[1]

[1]Association des humanistes pour l'encadrement des filles mères et des personnes des œuvres.

La pollution de la ressource en eau est l'une des principales causes de pollution environnementale avec les pollutions de l'air. La qualité et la disponibilité de la ressource en eau sont sans conteste l'un des plus grands enjeux de notre siècle. Sa préservation passe par une meilleure gestion des polluants, essentiellement issue des activités humaines. Voyons d'où vient la pollution de la ressource en eau et quelles mesures existent pour la contrôler et réduire la menace qu'elle fait peser sur notre environnement.

Pour lutter contre la pollution de l'eau, nous devons préserver les océans. Pour cela, chacun de nous peut agir au quotidien. Par exemple, nous pouvons acheter des produits ménagers respectueux de l'environnement afin d'éviter de déverser des produits. En tant que jeunes, nous pensons qu'un moyen crucial pour parvenir à un changement transformateur est d'intégrer l'éducation transformatrice sur la biodiversité et le changement climatique.

Presentation type

Poster

Affiliation

Association des humanistes pour l'encadrement des filles mères et des personnes des œuvres

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20012 - Anywhere is reliant on everywhere - is there a case for an Oceania biodiversity observing network?

Mark Grant[1], Beryl Morris[1], Jane Lattimore[2], Ben Macdonald[3], Siosiua Halavatau[4], Graciela Metternicht[5], Richard Lucas[6]

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Ecological teleconnections are driven by climate in one area affecting local ecological processes, that in turn affect ecological processes over long, cross-continental distances. Thus, systematically collected regional environmental data, including from the underrepresented Pacific Island countries and Territories, are necessary to achieve broader global ecological understanding.

Outstanding biodiversity monitoring efforts exist across Oceania, such as from International Long Term Ecological Research (ILTER) affiliates, TERN Australia, New Zealand's Manaaki Whenua, Papua New Guinea's National Forest Inventory, and projects by the Secretariat of the Pacific Regional Environment Programme (SPREP), the Pacific Community (SPC) and French Territories via various agencies.

However, such separate efforts cover a myriad of variables, and the multi-jurisdictional data use different monitoring and data exchange standards. Thus, inclusion of such data in macrosystem ecological studies and modelling is complex.

Using a Science of Team Science (SciTS) approach, some key groups in the Pacific region are gathering support for others to join them in scoping the feasibility of recognising and uniting a range of existing country-level monitoring projects in the region as the basis of an integrated Oceania biodiversity observation network.

The envisaged network would build on existing efforts to form a network of individuals and organisations conducting biodiversity monitoring in the South Pacific region. A regional network would allow for cooperation on standards for monitoring, methods and data management, and facilitate collaborative research. It would also provide a mechanism for managers and decision-makers to develop common responses on issues of importance for ecosystems in the Oceania region.

Presentation type

Talk

Affiliation

Terrestrial Ecosystem Research Network (TERN), Australia

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20016 - EBVs facilitate international cooperation & harmonization

Michelle Silva del Pozo[1], Guillaume Body[1]

[1]French Agency of Biodiversity

What protocol should we use to monitor biodiversity across scales? We would all like to have an easy and concrete answer to this impossible question. But the reality is that we are facing very diverse landscapes in terms of geography, ecology, sociology, monitoring history and funding resources; designing a unique protocol would be arduous work. On top of that, there are already many well-established monitoring programs regionally and/or globally, each with their own protocols. A better question to ask would then be: how to harmonize these biodiversity monitoring programs?

Biodiversa+, the European biodiversity partnership, aims to answer this question at the European scale, which remains very challenging due to biological, historical, cultural and technical reasons. We analyzed how biodiversity monitoring programs running at the European level dealt with this issue, and we identified the different strategies that have been adopted, their rationale, their benefits and drawbacks. Applying the Essential biodiversity variable (EBV) framework allows to preserve existing and locally-adapted protocols and programs, while providing comparable outputs at larger scales. High scientific quality can be ensured, together with acceptable governance principles, regardless of the working scale. We present this tactic as one of the possible solutions to move towards harmonized, and not necessarily unique protocols. Further work remains to be done among the different biodiversity monitoring communities setting common minimum requirements to improve the programs' characteristics and ensure their cross-scale integration

Presentation type

Talk

Affiliation

French Agency of Biodiversity

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20014 - The EBV grammar allows application to real-world monitoring programs

Mathieu Basille[1], Guillaume Body[1]

[1]French Agency of Biodiversity

Biodiversity monitoring in Europe benefits from a large diversity of programs, which however often rely on disparate protocols, and produce outputs in a variety of formats. Biodiversa+, the European biodiversity partnership, adopted the Essential biodiversity variable (EBV) framework to account for this diversity while preserving existing programs (i.e. no modification of protocols already in place) and enforcing a necessary level of comparability of programs outputs at higher scales (e.g. European or global). Essential biodiversity variables provide basic information of status and trends of biodiversity, at the species or ecosystem level, as necessary bricks for evaluation, communication and management. We designed a comprehensive EBV grammar using existing reference systems, that allows an operational approach from the ground up to link science outputs and policy requests. Starting with the biological item under focus (which species or ecosystem), the grammar describes the "where" (geographic scale, extent and coverage), the "when" (temporal resolution and extent), and the "what" (the actual variable that is measured) to fully and unambiguously define the EBV. Following a flexible hierarchical approach complementary to the 21 EBV classes previously defined, the design of the EBV grammar enables comparability of the outputs of biodiversity monitoring programs using a common language, that can be further summarized at different geographic, temporal, and thematic levels.

Presentation type

Talk

Affiliation

French Agency of Biodiversity

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200035 - The Neotropical Biodiversity Monitoring Networks: a database of initiatives

Cecilia Cronemberger[1], Gabrielle Rangel[2], Clarissa Rosa[3], Juliana Hipólito[4], Marcos Figueiredo[5], Elisa Abad[6], Laura Figueireido[7], Agnis Souza[8], Fabio Roque[7], Helena Bergallo[2], William Magnusson[3], Ivan Campos[9]

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Essential Biodiversity Variables (EBVs) are an important tool to assess progress towards international conservation goals. The first challenge in operationalizing EBVs is assessing biodiversity data sources. Efforts to map and classify existing data sources are being undertaken worldwide, and have found that the distribution of in-situ biodiversity monitoring schemes is biased towards temperate developed countries, with fewer initiatives in the tropical megadiverse countries. However, numerous technicians and researchers collect biodiversity data in local or regional initiatives in the neotropical region. If organized, such data could be aggregated and used in EBVs. The Neotropical Biodiversity Monitoring Networks Initiative is a database of metadata, such as site locations, monitored taxa and variables, of initiatives where biodiversity variables are measured in situ, over time, in multiple sites, following standardized protocols, in any ecosystem in the neotropics. This information will be published as layers in a web map and a data paper in a peer-reviewed journal. So far, we have received information about 60 networks, most of national and subnational extent, which monitor 3365 sites in 22 countries, including terrestrial, continental waters and marine environments. These networks collect biodiversity data which may contribute to all six EBV classes, but mainly to the 'species distribution' EBV. This initiative is intended to provide a catalog of monitoring data sources in the neotropical region, and thus stimulate new uses of these collections of data, such as informing EBVs, increase collaboration between institutions and networks and integration between data sources.

Presentation type

Poster

Affiliation

National Center for Wild Bird Conservation and Research (CEMAVE), Chico Mendes Institute for Biodiversity Conservation (ICMBio), Brazil / Biological Sciences Institute (ICB), Federal University of Minas Gerais (UFMG), Brazil

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20015 - Influence of the EBV framework on biodiversity monitoring systems and services

Guillaume Body[1], Mathieu Basille[1]

[1]French Agency of Biodiversity

Do you really know… what is the biodiversity being monitored on your territory? Who is involved in monitoring programs, and how much they cost? Where are monitoring data and monitoring outputs stored? And if you have this information, how do you share it? Those questions are of global concern, but regional, national, sub-national, and local actors are as much, if not even more, concerned. Those questions also apply equally in marine, terrestrial and freshwater environments.

The Essential biodiversity variable (EBV) framework provides a solution to tackle those questions. In France, accordingly, we are developing new tools, such as an EBV based monitoring programs dashboard, new processes, such as storing EBV data outputs, and new services, such as an EBV viewer, to improve our monitoring processes. Those new data management tools based on the EBV grammar and framework will smooth the connections among communities working with biodiversity monitoring : strategic governing bodies, evaluation teams of the status of biodiversity, communication teams, researchers, and, most importantly, scientific operators of biodiversity monitoring programs. This new organization has also the power to better highlight people and organizations in charge of biodiversity monitoring across scales. We present this work-in-progress, empowered by Biodiversa+, the European biodiversity partnership, as a concrete use of EBVs in a national environmental protection agency, the French biodiversity agency (OFB).

Presentation type

Talk

Affiliation

French Agency of Biodiversity

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

200034 - Potential contribution of Brazilian governmental biodiversity monitoring networks to Essential Biodiversity Variables

Cecilia Cronemberger[1, 2], Helena Bergallo[2], Leonardo Oliveira[2], Ivan Campos[3]

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As the most biodiverse and one of the most unequal countries in the world, Brazil faces a huge challenge in balancing biodiversity conservation, economic growth and socioenvironmental justice. Biodiversity monitoring can be an important tool in this context. Although remote monitoring metrics, such as deforestation indexes, are well stablished, *in situ* biodiversity monitoring initiatives are relatively recent and isolated. This work aimed to identify and describe *in situ* biodiversity monitoring initiatives managed by the environmental federal government agencies IBAMA and ICMBio, to understand the interactions among networks and the potential of the data they collect to be used as conservation tools. Six monitoring networks were evaluated, which monitor terrestrial, freshwater and marine ecosystems in three of six Brazilian terrestrial biomes: Amazon, Atlantic Forest and Cerrado, as well as different marine habitats along the coastline. These networks monitor 87 variables, 64 of which are state variables and relate to seven Essential Biodiversity Variables (EBVs): species distributions, species abundances, morphology, reproduction, movement, taxonomic/phylogenetic diversity, and live cover fraction. Species distributions and abundances are the EBVs with the most potential contribution from the evaluated networks. There are overlaps and interactions among networks, with similar data collected by more than one group. However, these networks are not interconnected, as each one houses data in a separate database, which makes their application limited and not user-friendly. Promoting integration and interoperability between networks is a fundamental step to allow their use as data sources for national statistics and reports, as well as to EBVs.

Presentation type

Poster

Affiliation

National Center for Wild Bird Conservation and Research (CEMAVE), Chico Mendes Institute for Biodiversity Conservation (ICMBio), Brazil / Biological Sciences Institute (ICB), Federal University of Minas Gerais (UFMG), Brazil

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

20018 - From EBV operationalization pilot to GBiOS: a French BON point of view

Coline Royaux[1, 2], Olivier Norvez[2, 3], Marie Jossé Jossé[4], Pauline Seguineau[2], Tanguy Genthon[2], Julien Sananikone [2], Octave Cheminée[2], Romain Julliard [2], Aurélie Delavaud[3], Marc Eleaume[2], Sandrine Pavoine [2], Dominique Pelletier[5], Jean-Baptiste Mihoub[1], Yvan Le Bras[2]

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The community studying biodiversity needs to build a framework to get 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 approaches to reach that aim is the concept of Essential Biodiversity Variables (EBV). As we can potentially extract a lot of information from raw datasets sampled at different ecological scales, the EBV concept represents a useful basis for identifying appropriate data to be collated as well as associated analytical workflows for processing these data.

Thanks to FAIR (Findable, Accessible, Interoperability, Reusable) data and source code implementation, it is possible to make a transparent assessment by generating operational biodiversity indicators through the EBV framework, and help designing biodiversity monitoring.

Through the BiodiFAIRse network, we established how ecological sciences can benefit from existing open standards, tools and platforms used by many infrastructures, particularly regarding the Galaxy platform for code sources accessibility and both GBIF and DataOne network for data sharing using the Ecological Metadata Language standard. We propose that these implementation choices can help fight the biodiversity crisis by supporting the important mission of GEO BON Network: “Improve the acquisition, coordination and delivery of biodiversity observations and related services to users including decision makers and the scientific community” and can play a crucial role in the setup of the Global Biodiversity Observation System (GBiOS) to help reach the needs of the Global Biodiversity Framework.

Presentation type

Talk

Affiliation

Sorbonne University

Session

Linking Biodiversity Monitoring Networks to Assess Biodiversity Change Across Scales

Biomolecular Approaches for Global Biodiversity Observation

240003 - Biodiversity Genomics Europe: Building reference genomes and reference DNA barcodes to underpin global biodiversity observation

Pedro Beja[1], Claudio Ciofi[2], Peter Hollingsworth[3], Dimitris Koureas [4], Mara Lawniczak[5], Camila Mazzoni[6], Robert Waterhouse[7], Biodiversity Genomics Europe Consortium[8]

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High-quality reference libraries are of critical importance for providing biological context to DNA-based biomonitoring surveys. The decreasing costs and increasing throughput of DNA sequencing platforms are transforming understanding of biodiversity dynamics at the species and genetic levels. High throughput DNA barcoding of individual specimens provides a rapid identification tool, and metabarcoding of bulk-samples and/or eDNA substrates enables structured comparisons of species diversity across space and time. Likewise, targeted population-level resequencing projects provide genome-wide insights into patterns of intra-specific genetic diversity, and meta-genomic surveys illuminate the community diversity of genes associated with different places and environments. However, a general rate-limiting factor is the limited coverage of reference libraries against which biodiversity genomic data can be compared and contextualized. In this presentation, we will summarize the progress and ambition of the Biodiversity Genomics Europe Consortium whose aim is to massively accelerate the production of reference barcodes and reference genomes for European biodiversity. The initiative brings together 33 institutions from 20 countries and involves the establishment of European hubs for the International Barcode of Life and the Earth Biogenome Project. The work program involves building pipelines, infra-structure and sample flows for DNA barcoding and reference genome sequencing, and has an initial focus on establishing reference resources for pollinators, endangered species, ecological keystone species, economically important species, and species in biodiversity hotspots. Ultimately the long-term goal of the Biodiversity Genomics Europe consortium is to provide and deploy reference resources to enhance understanding of European biodiversity, and improve the efficacy of DNA-based biomonitoring programmes.

Presentation type

Talk

Affiliation

Royal Botanic Garden Edinburgh

Session

Biomolecular Approaches for Global Biodiversity Observation

240006 - Mapping the forest microbiome with eDNA and remote sensing

Andrew K. Skidmore[1], Haidi Abdullah[1], Andjiin Siegenthaler[1], Devara P. Adinigrat[1], Yiwei Duan[1], Mélody S. D. Rousseau[1], Alejandra Torres Roriguez[1], Roshanak Darvish[1], Tiejun Wang[1], Gerard Arjen de Groot[2]

[1]Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, The Netherlands, [2]Wageningen Environmental Research, Wageningen UR, The Netherlands

Environmental DNA (eDNA) is transforming how ecological community composition, especially microbial communities, are being used for biodiversity monitoring, by allowing thousands of taxonomic units to be identified *in situ* from a sample of only a few grams of soil, water, or plant material. Despite this paradigm shift, the spatial distribution of microbiological biodiversity, and its critical role in ecosystem functioning, remains largely unknown due to sparse *in situ* observations. Here, we describe a fundamentally different approach to biodiversity monitoring by coupling eDNA community composition from *in situ* plots with imaging spectroscopy to upscale the relative abundance of microbiological taxa based on the remote sensing across landscapes. We examined whether the diversity of microorganisms in soil could be estimated by alpha diversity derived from image spectroscopy remote sensing imagery. We show that alpha diversity of the microbiome can be mapped in central and northern European temperate forests using image spectroscopy reflectance when combined with eDNA. The resulting patterns of the soil microbiome and ecosystem function across these European forests indicate provide plausible and new insights into biologically relevant patterns and ecosystem function.

Presentation type

Talk

Affiliation

Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, The Netherlands

Session

Biomolecular Approaches for Global Biodiversity Observation

240004 - Tracking species ranges at biogeographical scales with standardized eDNA metabarcoding across a network

Jennifer Sunday[1], Kate Sheridan[1], Margot Hessing-Lewis[2], Emmet Duffy[3], Matthew Lemay[2]

[1]McGill University, [2]Hakai Institute, [3]Smithsonian Institute

Monitoring biodiversity change at large spatial scales is necessary to detect, attribute, and respond to biodiversity's responses to climate change and conservation interventions. While environmental DNA (eDNA) metabarcoding holds promise to rapidly survey occurrences of marine species across biogeographic scales, all datasets aren't generated equally, and variations in sampling effort - including spatial and temporal replication - can cloud inference when data are combined. Here we apply data-driven estimates of how biodiversity coverage increases as a function of spatial replication in nearshore habitats of the NE Pacific Ocean, and use results to design, implement, and evaluate a broad, networked, annual biogeographic survey of marine biodiversity spanning two nations from Alaska to Southern California. From the first two years of implementation, we evaluate resultant biodiversity coverage and functional bias in species detected as a function of sampling effort, and suggest a minimum effort required for such samples to be interoperable. We also evaluate biogeographic patterns detected, including species' ranges and community turnover against expectations and other assessments. We find that monitoring biodiversity at large spatial scales is achievable with high capacity sharing in a newly formed network.

Presentation type

Talk

Affiliation

McGill University

Session

Biomolecular Approaches for Global Biodiversity Observation

2400032 - Using surface environmental DNA to monitor arthropod biodiversity within a forested ecosystem

Michael C. Allen[1], Julie L. Lockwood[1], Robert Kwait[1], Anthony R. Vastano[1], Donnie L. Peterson[1, 2], Leon A. Tkacenko[1], Alex Kisurin[1, 3], Oliver Stringham[4], Jordan Angle[5], Benjamin Jaffe[6]

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Terrestrial arthropods are abundant and diverse with outsized ecological and economic importance. Our ability to monitor this diversity is hampered by the variety of sampling techniques and taxonomic expertise required to catalog the species in an area. DNA metabarcoding approaches are a major advance but have mainly been limited to trapping studies where DNA is extracted from captured individuals. Here we illustrate the promise of terrestrial plant surfaces as reservoirs of environmental DNA (eDNA) that is rich in arthropod biodiversity information. We posit that collection of surface eDNA could enable easier and more rapid arthropod inventories. We collected 40 paired samples using two novel terrestrial surface eDNA sampling techniques in a New Jersey, USA forest. Metabarcoding of the samples revealed 645 and 1025 operational taxonomic units (analogous to species) using primer sets from the COI and 16S regions, respectively. Accumulation curves suggest that our sampling captured about half of the diversity available to detect using our methods. Matching to reference databases revealed 28 arthropod orders, 179 families, 354 genera, and 286 species. Foliage samples revealed more species than tree bark. The two primer sets and the two sampling substrates revealed distinct taxonomic assemblages. Our study highlights the promise of exploiting eDNA left on plant surfaces for contributing to rapid, cost-effective arthropod inventories, and thus realizing a range of ecological research and monitoring goals.

Presentation type

Poster

Affiliation

Department of Ecology, Evolution, and Natural Resource Management, Rutgers University, New Brunswick, New Jersey, USA

Session

Biomolecular Approaches for Global Biodiversity Observation

240005 - The logistics of mainstream environmental DNA analysis

Joseph Craine[1]

[1]Jonah Ventures

Taking aquatic eDNA metabarcoding science from boutique research of hundreds of samples to a mainstream tool for hundreds of thousands of samples requires a focus on end-to-end logistics. The logistical challenges of this scaling requires operational development while optimizing cost-benefit tradeoffs among time, cost, and quality of data in three main areas. First, eDNA samples must be acquired rapidly and cleanly under a variety of conditions in a manner that maximizes the amount of target DNA in an eventual PCR. Another challenge here is shifting the focus from individual samples that maximize the amount of water filtered to an array of field and lab replication for generating effort-response curves for asymptotic diversity. Together, this changes the landscape of best options for water sampling. Second, as eDNA science scales, lab processing must be scalable, reliable, inexpensive, and effective with low-template samples. Here, I'll focus on the role of lab automation and its impact on the economics and speed of lab processing as well as the detection and correction of inevitable contamination. Lastly, scaling eDNA science requires scaling bioinformatic processing of data. This entails a shift to cloud-based storage, processing, and serving of data, which presents new challenges, but also new opportunities. Cloud-based computing is more complex than PC data processing, but massive parallelization speeds processing. There are challenges to cloud-based databasing, but this infrastructure allows for such things as dynamic data processing to take advantage of updated reference libraries and growing sample databases.

Presentation type

Talk

Affiliation

Jonah Ventures

Session

Biomolecular Approaches for Global Biodiversity Observation

2400036 - Combining remote sensing and eDNA metabarcoding for mapping biodiversity in large rivers globally

Shuo Zong[1, 2], Alice Valentini [3], Tony Dejean [3], Vincent Prie [3], J Decotte[3], Rafik Neme [4], Gabriel Michelin [5], E Bairrao-Ruivo[5], Mailyn Gonzalez [6], Jorge Moreno [4], Arnaud Lyet [7], Kathy Hughes [7], Manuel Lopes-Lima[8], Sebastien Brosse [9], Camille Albouy [1, 2], Loic Pellissier [1, 2]

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Biodiversity is declining rapidly in rivers globally, and efficient biodiversity monitoring methods are urgently required to guide ecological conservation and policy decisions. However, for many large rivers along which anthropogenic pressure increases, there is currently no biodiversity data that can inform planning. Environmental DNA (eDNA) metabarcoding from river water samples combined with remote sensing and machine learning from rivers shows promise to become a fast and efficient biodiversity observatory and decision making tool. Here, we combined eDNA metabarcoding targeting fishes and remote sensing describing the environment in and around river for several rivers across four continents (Africa: Casamance, Okavango , Kunene; Asia: Mekong, Kinabatangan; Europe: Danube, Rhone, Americas: Maroni, Magdalena, Oyapock). We related species diversity from eDNA metabarcoding to environmental variables reflecting natural environmental conditions and anthropogenic disturbances. We found major differences in species diversity between the rivers investigated, but also within rivers. The species richness patterns predictable by machine learning using remote sensing predictors showed the importance of both water quality and the surrounding riparian habitat. Our goal is to develop a routine monitoring system that can serve stakeholders by combining technologies to better manage freshwater habitats and conserve aquatic biodiversity. Through these ongoing investigations, we aim to enhance our capacity to monitor biodiversity on a large scale in river systems, providing policy-makers and stakeholders with invaluable insights for making informed ecological management decisions.

Presentation type

Poster

Affiliation

ETH Zurich

Session

Biomolecular Approaches for Global Biodiversity Observation

240008 - The biodiversity and characterization of Scleractinian coral microbiomes across global scales

Colin Howe[1], Joseph F. Pollock[2], Sofia Roitman[3], Jesse R Zaneveld[4], Rebecca Vega Thurber[5], Monica Medina[1]

[1]Penn State University, [2]The Nature Conservancy, Coral Reef Resilience, [3]New England Biolabs, [4]University of Washington, [5]Oregon State University

Corals host an incredibly diverse, complex and dynamic community of microorganisms. These microbial communities play an important role in the overall development, physiology, and health of the collective coral holobiont. The biodiversity of microbial life found within coral holobionts is under threat as sea temperatures continue to rise because of climate change. Moreover, identifying consistent and long-term associations within coral holobionts remains difficult, due to the ecological response of host and environmental factors that shape microbial community composition. Thus, it is imperative to characterize the vast diversity of coral holobiont communities and identify the eco-evolutionary dynamics that shape them. To this end, the Global Coral Microbiome Project (GCMP) has collected, sequenced and analyzed a dataset of 1400 coral species from over 30 scleractinian families, several outgroups and eDNA. Each coral colony was sampled across anatomical mucus, tissue and skeleton compartments. We targeted bacteria and archaea using paired-end 16s rRNA amplicon sequences to survey the biodiversity of the coral holobiont at high taxonomic resolution. We applied an evolutionary framework to identify a phylosymbiotic association of host and microbe across divergent and globally successful scleractinian families. Preliminary results comparing Caribbean corals between complex and robust clades revealed coral species with a more recent common ancestor shared a similar microbiome in contrast to corals who are more distantly related. Overall, we present our characterization of the biodiversity of coral holobionts found across global scales and discuss our approach to identifying which microbes show long-term and consistent associations with ecologically successful scleractinian families.

Presentation type

Talk

Affiliation

Penn State University

Session

Biomolecular Approaches for Global Biodiversity Observation

240007 - Highly resolved temporal sampling showcases the potential of environmental DNA metabarcoding for holistic biodiversity monitoring of seasonal dynamics

Till-Hendrik Macher[1], Robin Schuetz[1], Arne Beermann[1], Florian Leese[1]

[1]University of Duisburg-Essen

Freshwater biodiversity is declining at an alarming rate and increasing numbers of invasive species are spreading. While traditional biodiversity assessments of freshwater ecosystems offer comprehensive insights into the ecosystem health, they remain cost- and time-consuming and are often limited in spatial-temporal resolution, struggling to efficiently depict ecosystem changes. Furthermore, assessing multiple taxonomic groups can render traditional biomonitoring even more cost- and time consuming. Environmental DNA (eDNA) metabarcoding, as a new complementary tool for biomonitoring, might help closing this gap, as it can efficiently explore patterns of multi-trophic species occurrences whilst retaining high resolution at comparably low efforts and costs.

To evaluate the efficacy of eDNA metabarcoding in a regulatory context, the GeDNA project was initiated with funding from the German Environment Agency (UBA). As part of this project, we conducted a study at the river Lippe estuary to demonstrate the potential of eDNA metabarcoding. Over the course of one year, we collected 2 liters of water every two weeks, from which we extracted and amplified the eDNA of vertebrates, invertebrates, fungi, and diatoms.

Our study found compliant species occurrence patterns over the course of the year for all four taxonomic groups. For example, we observed various invasive species, migratory activity, and indications of spawning events. Moreover, our data allowed us to investigate changes in alpha diversity resulting from a significant flooding event and the subsequent recovery. In conclusion, our results demonstrate the potential of eDNA metabarcoding as holistic biodiversity monitoring method, without extensive sampling efforts or costs.

Presentation type

Talk

Affiliation

University of Duisburg-Essen

Session

Biomolecular Approaches for Global Biodiversity Observation

2400034 - Affordable short-read genome assembly allows diverse downstream genetic analyses on non-model fishes

Eric Garcia[1], Roy L. Roberts[2], Brendan N. Reid[3], Rene C. Clark[3], Jem G. Baldisimo [1], John C. Whalen[1], Abner A. Bucol[4], Ivan R. Lopez[1], Malin L. Pinsky[3], Kent E. Carpenter[1], Chris E. Bird[2]

[1]Old Dominion University, Virginia, USA, [2]Texas A&M University-Corpus Christi, Texas, USA, [3]Rutgers University, New Brunswick, NJ, USA, [4]Silliman University, Dumaguete, Philippines

Many population genetic analyses require or are improved by the presence of a reference genome for the focal organism. However, given that producing the long-read data that is traditionally used by assembling software remains expensive, we still lack genomic information for the great majority of non-model species. Here, we test the performance of four commonly used tools (ABySS, HipMer, SOAPdenovo, and SPAdes) in generating short-read de novo assemblies from six marine fish species with contemporary and historical samples (collected over 100 ya) available. We demonstrate that assemblies with high values for N50 and BUSCO Complete and Single Copy are possible using only short-read data, and highlight a case study where this type of assemblies can later be used in combination with capture and lcWGS to investigate the loss of genetic diversity in marine fish populations from the Philippines as a result of anthropogenic impacts (overfishing and habitat degradation). Overall, successful genome assembly from short reads allows for a large suite of downstream genetic analyses from contemporary or museum specimens, and represents a new paradigm for studying non-model organisms, especially for large-scale projects, programs monitoring genetic diversity, or studies with limiting resources.

Presentation type

Poster

Affiliation

Old Dominion University, Virginia, USA

Session

Biomolecular Approaches for Global Biodiversity Observation

240002 - Implementing long-term genomic observation in the marine environment: the European Marine Omics Biodiversity Observation Network (EMO BON)

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There are many individual biological observation stations in Europe, however there are few and inconsistent links among them. The European Marine Omics Biodiversity Observation Network (EMO BON) is an initiative from the ESFRI (European Strategy Forum on Research Infrastructures) research infrastructure European Marine Biological Resource Centre-European Research Infrastructure Consortium (EMBRC-ERIC) to unite marine stations under one centrally organised observation network that uses shared protocols, international standards and agreed policies. EMO BON aims to establish a coordinated, long-term, marine biodiversity observation network. Currently, EMO BON includes 17 marine stations, located from the Arctic to the Red Sea, which regularly sample for genomic marine biodiversity at different marine habitats (the water column, the soft substrates, and the hard substrates). EMO BON generates high-quality genomic biodiversity data that will be made openly accessible and thereby support constructive dialogue towards a holistic understanding of our ocean. By using omics techniques, in this case metagenomics and metabarcoding, EMO BON captures the most representative amount of biodiversity data, produces maximal information on community biodiversity, and provides the means to access the pool of genes present in an ecosystem. The genomic data can reveal the biodiversity of different communities from microorganisms to Metazoa, their temporal trends and shifts, the ecological relationships among species, and their responses to environmental changes. EMO BON thus becomes the European contribution to the global marine biodiversity observation efforts and plans to collaborate and integrate further with other global entities.

Presentation type

Talk

Affiliation

Flanders Marine Institute (VLIZ)

Session

Biomolecular Approaches for Global Biodiversity Observation

2400031 - Using eDNA testing to monitor metropolitan marine pollution effects in the Pacific Northwest

Neha Acharya-Patel[1], Karen Cram[2], Lauren C Bergman[1], Shirley Lyons[3], Rene Warren[4], Lauren Coombe[4], Christopher J. Lowe[3], Farida Bishay[5], Inanc Birol[4], Tara Maconald[2], Caren C. Helbing[1], Emma Groenwold[1]

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Globally, coastal waters experience degradation from pollution associated with multiple discharges including storm water, industrial and agricultural runoff, and nutrient enrichment from municipal wastewater. The responses of benthic communities to nutrient enrichment and often associated low-oxygen conditions has some striking parallels worldwide. For example, certain indicator taxa are well-known to proliferate in response to high nutrient input and corresponding anoxic conditions while others are sensitive to these conditions. Traditional assessment of macroinfaunal benthos involves the detailed analysis of each individual specimen within a sample by taxonomic experts. Damage to some organisms incurred during sampling at substantial depths often makes taxonomic identification very difficult or impossible. Our research aims to validate environmental DNA (eDNA) methodologies that are conducive to standardization and widescale adoption for pollution impact monitoring in these susceptible urban environments. With the Helbing Lab's well validated pipeline we have developed sensitive qPCR assays from the mitogenome sequences for multiple benthic indicator species routinely used for monitoring programs in Pacific Northwest marine environments. These qPCR assays reliably detect the presence and relative abundance of these indicator species in their predicted ecological distribution with respect to their tolerance to pollution. Our results are highly comparable to conventional methods and demonstrate yet another way eDNA can be used to assess the health of our Oceans

Presentation type

Poster

Affiliation

University of Victoria

Session

Biomolecular Approaches for Global Biodiversity Observation

240001 - ARMS-MBON: long-term genetic monitoring of marine hard-bottom communities

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To understand global shifting trends in marine biodiversity it is essential to apply cost-efficient biomonitoring approaches in a coordinated and standardized manner, to generate comparable data across geographical regions and countries. In this context, DNA metabarcoding is particularly useful to document biodiversity over larger spatiotemporal scales and in habitats with limited access, such as marine hard substrata which are difficult to sample for quantitative ecological studies; for this reason, we have established the Autonomous Reef Monitoring Structures Marine Biodiversity Observation Network (ARMS-MBON). ARMS-MBON deploys ARMS in ports, marinas, and nature reserves along the European coastline, including polar regions and the Red Sea. The network maintains 25 observatory sites deploying ARMS on a regular basis. Using metabarcoding data and associated (meta)data (e.g., pictures, voucher specimens), the community composition is analyzed through a dedicated workflow hosted at the Tesseract Virtual Research Environment and built under the Internal Joint and Collaborative Initiative of LifeWatch ERIC. ARMS MBON has now become part of the European Marine Omics Biodiversity Observation Network (EMO BON), a larger European initiative for the observation of genomic biodiversity. The first sampling campaigns (2018 and 2019 deployments) produced 567

physical samples from 56 ARMS across 15 observatories. Preliminary results show the robustness and sensitivity of ARMS in detecting rare, alien, and key species. They also document a significantly increased species richness in marine protected areas, as compared to the other study sites. We suggest that the ARMS-MBON data and protocols should be used in biological monitoring programs and long-term ecological research.

Presentation type

Talk

Affiliation

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Session

Biomolecular Approaches for Global Biodiversity Observation

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180012 - Canadian outputs related to eDNA methods standardization to accelerate implementation for decision support

Cathryn Abbott[1]

[1]Fisheries and Oceans Canada

Standards development and their precise implementation will be essential for the successful translation of eDNA science into decision support across a wide range of environmental settings and jurisdictions. Aquatic ecosystems in Canada are massive in spatial scale, thus enabling the use of eDNA data for management decision-making is a high priority for Fisheries and Oceans Canada. This talk will introduce three recent science outputs related to standardization and quality control for both targeted and taxonomically broad eDNA methods. First, a National Science Advisory Process generated formal guidance and a reporting template for targeted eDNA analysis of aquatic invasive species and species at risk to encourage consistent reporting and interpretation of results. Second, a Novel Applied eDNA Metabarcoding Reference Sequences online portal ('NAMERS') with quality-controlled whole mitogenomes and nuclear ribosomal DNA cistrons from all freshwater fish in British Columbia was created to provide complete and easily accessible reference data for defensible survey design and data analysis. Third, engagement with the Canadian Standards Association led to two national eDNA standards: one on reporting requirements and terminology and a second on performance criteria for targeted qPCR. These outputs will be presented within the context of key needs and challenges to remain cognizant of to ensure eDNA standards are fit-for-purpose and transferable among various end-users. Many lessons can be learned from diagnostic fields of study.

Presentation type

Talk

Affiliation

Fisheries and Oceans Canada

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180011 - eDNA-based biodiversity monitoring: running projects and future directions in Japan

Hitoshi Araki[1]

[1]Hokkaido University, The eDNA Society

The eDNA Society was founded in 2018 in Japan. The society aims at fostering and developing eDNA science as a discipline that contributes to human well-being, such as sustainable use of ecosystems and environmental conservation. In this presentation, I will introduce our activities for biodiversity monitoring as well as educational/promotional activities in the last six years, which shed light on the strong demands for standardization for protocols of eDNA sampling, filtering, preservation, and following analyses. I also suggest the potential of the eDNA applications for 1) monitoring species diversities at the local, nationwide, and global scales, 2) biodiversity monitoring by collaborations among citizens, corporations, scientists, and governments, 3) multi-trophic level, ecosystem-wide monitoring, and 4) monitoring intra-genetic variations for conservation purposes.

Presentation type

Talk

Affiliation

Hokkaido University, The eDNA Society

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

1800032 - Autonomous samplers and eDNA metabarcoding: sampling day and primer choice have greatest impact on fish detection probabilities.

Devin N. Jones[1], Patrick Hutchins[1], Rodney Richardson[2], Regina Trott[2], James M. Birch[3], Kevan Yamahara[3], Elliott Barnhart[4], Adam J. Sepulveda[1]

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Biomonitoring is crucial for the management of native and invasive species. The use of environmental (e)DNA samples offers a rapid, accurate, non-invasive, and cost-effective tool for biomonitoring. We leveraged the use of autonomous robotic samplers to collect, filter, and store aquatic eDNA samples at two sites in the Upper Snake River (Wyoming & Montana, USA). We collected eDNA samples daily or sub-daily from July-September in 2021 and 2022 and used a metabarcoding approach to assess differences in fish community composition at both large (i.e., seasonal) and small (i.e., sub-daily) time scales. We also assessed differences in fish community composition between sites and among different DNA filter pore sizes. We found that there was no difference in fish species detections among three different filter pore sizes, between sites, or between seasons. However, at a fine temporal scale, we found substantial variation in the number of detections throughout a single day. Our results indicate that fine temporal-scale sampling should be considered when using eDNA samples for biodiversity monitoring, if neglected then inferences may result in type II error (false-negatives) and inefficient allocation of limited resources to achieve conservation outcomes.

Presentation type

Poster

Affiliation

U.S. Geological Survey, Northern Rocky Mountain Science Center

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

1800035 - Temporal dynamic of marine fish biodiversity measured with environmental DNA (eDNA)

Loïc Pellissier[1], Romane Rozanski[1], Camille Albouy[1], David Mouillot[2], Stéphanie Manel[2], Laure Velez[2], Régis Hocdé[2]

[1]ETH Zürich - Ecosystems and Landscape Evolution (ELE) , [2] MARBEC, University of Montpellier, CNRS, Ifremer, IRD, Montpellier, France

Marine fish communities suffer from anthropic pressures and climate change that influence their spatio-temporal dynamic. To preserve these ecosystems, Marine Protected Areas (MPAs) dedicated to support the recovery of organism populations and preservation of their habitats have been implemented worldwide. However, assessing MPA effectiveness requires regular monitoring, that might be prevented due to the time and costs involved. Environmental DNA (eDNA) metabarcoding represents a promising method for regular biomonitoring thanks to its advantages compared to traditional methods such as a larger spatio-temporal coverage, a higher detection of rare species or its time and cost-effectiveness. We used an eDNA metabarcoding time series to assess the temporal dynamic of fish communities in the Calanques National Park (France), an MPA from the north-western Mediterranean Sea. From June 2021 to January 2023, we seasonally sampled two stations, respectively considered as no-take area and regulated area, at depths varying between 20 and 80 m. For the 112 taxa detected, we observed a seasonal signal with significant lower detections in Winter potentially due to migratory behaviors or changes in the metabolism of some species. We also highlighted a depth gradient with significant dissimilarities between fish communities detected at 20 m and 80 m. Although more taxa were detected in the no-take area, it did not represent a significant compositional difference when compared to the regulated area. This study represents one aspect of a project aiming at assessing the potential of eDNA as a conservation tool that would serve stakeholders for MPAs management and improvement over time.

Presentation type

Poster

Affiliation

ETH Zürich - Ecosystems and Landscape Evolution (ELE)

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180010 - Up-scaling of insect biodiversity monitoring using DNA metabarcoding: lessons from the LTER Germany network

Dominik Buchner[1], Peter Haase[2], Florian Leese[1]

[1]University of Duisburg-Essen, Essen, Germany, [2]Senckenberg Gesellschaft für Naturforschung

DNA-based methods are increasingly used to upscale and improve biodiversity monitoring world-wide. Especially DNA and environmental DNA metabarcoding have reached a technology readiness level that allows their routine application in principle. However, many steps in the metabarcoding analysis still require manual handling, which slows down the process, increases costs and limits data comparability because of many different ways of treating samples exist. Thus, standardisation and automation of laboratory workflows are key requirements for maximum benefit. We here show a laboratory workflow that automates most steps of DNA metabarcoding and includes important parameters for quality assurance and quality control. Using data from the LTER German Malaise trap program we analysed 1,815 samples with each up to several ten thousand specimens obtained from 2019 and 2020 through 75 traps. We uncovered 33,299 plausible insect species. This number is almost as high as the total number of insect species known for Germany (~35,500). As Malaise traps capture only a certain fraction of insect species, we argue that many species recorded here are unknown from Germany or new to science in general. Our approach uses robotics and replicated analysis with on average 1.4 million sequence reads and costs per sample less than 50 USD including supply, labor (Germany) and maintenance. We discuss how this workflow can be upscaled to continental biodiversity monitoring and show international standardisation could improve data quality further for sound environmental decision making.

Presentation type

Talk

Affiliation

University of Duisburg-Essen

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180001 - Connecting biodiversity to biomonitoring: applying environmental DNA metabarcoding in large-scale bioassessment programs

Donald Baird[1, 2], Alex Bush[3], Erik Emilson[4], Nellie Gagné[5], Mehrdad Hajibabaei[6], Brianna Levenstein[1], Wendy Monk[1, 2], Teresita Porter[6], Royce Steeves[5]

[1]Environment & Climate Change Canada, [2]University of New Brunswick, [3]University of Lancaster, UK, [4]Natural Resources Canada, [5]Department of Fisheries and Oceans, [6]University of Guelph

Unlike most field research, biomonitoring programs generally operate at large scale (regional to national), and obtain data using standardised methods which are quality assured. This has the benefit of generating consistently-observed datasets of ecological communities often containing thousands of observations across space and time. Such programs would seem to be ideally suited for large scale biodiversity status and trends analysis, yet it remains true that for practical reasons such programs tend to focus on a reduced set of target organisms to assess the health of natural ecosystems under anthropogenic threat. Moreover, the current state of taxonomic identification limits consistent observations to relatively coarse taxonomic levels. It has been much debated whether making additional efforts to obtain genus/species level data could improve current bioassessment approaches, but this remains unresolved. However, the advent of cheap, repeatable and accurate identification of biomonitoring samples through DNA metabarcoding has offered a unique opportunity to explore this question in more detail. We report on a large-scale regional study on over 400 river macroinvertebrate biomonitoring sites in the Canadian Maritimes, where we make a direct comparison of compositional data obtained by traditional identification methods and from a multi-marker DNA metabarcoding pipeline. From this comparison, we highlight not only the ability of DNA metabarcoding to generate consistently observed biodiversity information at large scale, but also reveal some major shortcomings in current biomonitoring practice which relate to the inevitable shortcuts required to support low-cost sample processing using traditional methods.

Presentation type

Talk

Affiliation

Environment & Climate Change Canada / University of New Brunswick

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

1800033 - iTrackDNA: standardizing targeted environmental DNA resources for adoption in environmental surveys and decision-making

Mark Louie Lopez[1], Louis Bernatchez[2], Jérôme Dupras[3], Valerie Langlois[4], Caren Helbing[1]

[1]University of Victoria, [2]Université Laval, [3]Université du Québec en Outaouais, [4]Institut national de la recherche scientifique (INRS)

Environmental DNA (eDNA), or genetic material that organisms release into the environment, can provide rapid, non-destructive, accurate, and cost-effective biodiversity information. However, inconsistent methods and subpar eDNA detection tools present a threat to end-user (regulators, industry, Indigenous Peoples, NGOs) uptake due to unacceptable high false negatives and false positives that can impair efficient management decision-making. Here, we provide the latest updates on the iTrackDNA project, a multi-year, large-scale applied research initiative supported by Genome Canada, Genome British Columbia, and Genome Québec that aims to standardize eDNA technology based on targeted quantitative PCR (qPCR) to address issues with researchers and end-users across Canada and industries. This presentation will outline recent efforts designed to increase end-user capacity using cutting-edge, easily accessible, and ethically sound analytical genomics-based targeted eDNA tools for effective decision-making by: 1) supporting the creation of a second national eDNA standard on targeted qPCR-based assay performance criteria; 2) providing annotated mitochondrial genomic resources and new bioinformatic pipelines ('*unikseq*') to advance tool development; 3) developing validated eDNA and eRNA kits to monitor conservation priority species within Canadian coastal and inland ecosystems; 4) generating decision support software (iTrackDNA mobile app) for regional biodiversity data collection; and 5) constructing eDNA training and inter-lab validation frameworks for consultants, researchers, regulators, and managers. By establishing national eDNA standards and decentralizing specific eDNA resources, iTrackDNA aims to increase the eDNA community of practice and confidently enable eDNA applications in inland and coastal ecological surveys as well as biosurveillance for mining, forestry, energy, and infrastructure projects.

Presentation type

Poster

Affiliation

University of Victoria

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180005 - Challenges and opportunities of standardised biodiversity eDNA surveys in remote African rivers: the case of Corubal River, West Africa

Manuel Lopes-Lima[1], Vincent Prié[2], Mutaro Camará[3], Luis Ceriaco[1], Vasco Fernandes[1], Sonia Ferreira[1], Duarte Goncalves[1], Miguel Lecoq[4], Filipa Martins[1], Diogo Parrinha[1], Aissa Regalla de Barros[5], Alice Valentini[1], Luis Palma[1], Pedro Beja[1]

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Biodiversity information to set conservation strategies is increasingly needed even in remote regions, which are under growing pressure from climate change and multiple anthropogenic drivers. Here we illustrate the power of standardised eDNA surveys to characterise biological communities in an overlooked biodiversity hotspot in West Africa (Corubal River). The survey (February 2022) was carried out in articulation with local stakeholders, and it involved sampling at 11 aquatic transects, covering the the main river and associated streams and wetlands. At each site, about 60L of water were filtered using a peristaltic pump and a capsule filter, and each filter was preserved in a buffer. DNA extraction, amplification, purification, sequencing and bioinformatic processing followed standardised procedures, to ensure reproducibility, avoid contamination, maximising detectability and reducing false positives. Amplification involved primers targeted at vertebrates (V05), fish (teleo), freshwater bivalves (Unionida and Venerida) and all Eukaryotes (EUKA02). We detected at least 65 mammal, bird, amphibian and reptile species inhabiting both the river (e.g., Hippopotamus, African Clawless Otter, Senegal Flapshell Turtle) and the surrounding forests (e.g., Chimpanzee, Red and Pied Colobus, Giant Forest Hog). However, we missed abundant reptiles such as crocodiles. We also detected almost a thousand fish haplotypes, albeit with low taxonomic resolution due to incomplete barcode libraries, and a critically endangered freshwater mussel. The study supported the value of eDNA surveys, highlighting the need to filter large volumes, covering habitat diversity at reach and landscape levels, adjusting primers to target species, enhancing genomic resources, and using standardised procedures throughout the workflow.

Presentation type

Talk

Affiliation

BIOPOLIS-CIBIO, Campus de Vairão, Universidade do Porto, 4485-661 Vairão, Portugal

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180013 - Leveraging specialized environmental genomics facilities to implement standardized DNA-based biomonitoring programs

Beverly McClenaghan[1], Nicole Fahner[1], Avery McCarthy[1], Greg Singer[1], Mehrdad Hajibabaei[1]

[1]eDNAtec

Environmental genomics offers unparalleled levels of detail about biodiversity and an affordable solution to large-scale biodiversity monitoring. As these eDNA-based approaches shift from primarily academic applications into regulatory frameworks and the end-users of eDNA data continue to expand, there is also an increasing demand for optimized methods to meet the range of users' biodiversity monitoring goals and standardized workflows to support long-term, large-scale programs. Centralized, high-capacity facilities specialized in environmental genomics can lead the way in developing the necessary tools and implementing standardized eDNA-based biodiversity monitoring programs by providing the infrastructure and depth of knowledge required to design and support such large-scale, long-term programs. Here, we present three case studies demonstrating how the Centre for Environmental Genomics Applications (CEGA), an ISO certified facility dedicated to the application of genomics for environmental characterization, is working with collaborators across sectors to advance environmental DNA methodologies and create robust workflows to support monitoring programs. First, we present optimized field and lab methods that CEGA developed to generate whole-ecosystem biodiversity data to support commercial fisheries management. Second, we demonstrate a repeatable workflow for benthic marine impact monitoring customized from sampling design through to data interpretation to integrate with an ongoing monitoring program. Third, we show how CEGA is pioneering new workflows to support the emerging assessment needs for nature-based solutions.

Presentation type

Talk

Affiliation

eDNAtec

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180004 - A model toolkit for standardized biomonitoring in freshwater STREAMs: training, community-based monitoring, DNA metabarcoding, bioinformatics

Teresita Porter[1], Michael Wright[1], Reagan Mallinson[2], Donald Baird[3], Mehrdad Hajibabaei[1]

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STREAM (Sequencing the Rivers for Environmental Assessment and Monitoring) is a Canada-wide community-based freshwater biomonitoring program. A standardized training and kick-net sampling approach is combined with the 'Biomonitoring 2.0' method of eDNA metabarcoding of freshwater stream-bottom macroinvertebrates. Large-scale, rapid identification of macroinvertebrates for routine environmental assessment helps overcome the scientific data bottleneck for identifying freshwater stream-bottom macroinvertebrates, allowing for rapid dissemination of watershed biodiversity reports with a target turnaround time of two months. Since the establishment of STREAM in 2019, over 300 community participants have been trained and over 1500 samples have been collected across Canada. STREAM participants include non-governmental organizations, local watershed groups, and Indigenous communities. Community groups can use STREAM reports to generate the critical mass of data needed to address information gaps in their communities and elevate their collective work in aquatic ecosystem management, conservation, and restoration. The STREAM project synthesizes these data to help build a clear picture of watershed health in Canada. We will summarize STREAM's methodologies and showcase the power of community-based monitoring in case studies that highlight some of the outcomes and successes from watershed groups, NGOs, and Indigenous communities across Canada.

Presentation type

Talk

Affiliation

Centre for Biodiversity Genomics @ Biodiversity Institute of Ontario & Department of Integrative Biology, University of Guelph

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

1800031 - Application of eDNA methods to determine distribution and estimate biomass of oolichan on the Pacific Coast of North America

Michael J Allison[1], Meredith Pochardt[2], Morgan Hocking[3], Mary Lesperance[4], Francis Juanes[2], Caren C Helbing[1]

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Protection of aquatic species relies on timely, reliable, and detailed monitoring data, which can be challenging for species whose life histories and distributions are not well described. Oolichan (*Thaleichthys pacificus*), a culturally and ecologically important anadromous smelt, develop in the ocean and return to freshwater along the Pacific Coast of North America as adults to spawn in the region, but not necessarily the specific river, in which they hatched. Their populations have steeply declined since the 1990s, and supporting their recovery relies on accurate knowledge of spawning locations and abundance. Here we assess spawning oolichan populations in Haisla First Nations territory near Kitimat, British Columbia, a region with significant recent development including a liquefied natural gas processing plant and increased marine traffic. We developed a highly specific and sensitive oolichan eDNA assay with a limit of detection of 0.6 copies/sample, limit of quantitation of 2.2 copies/sample, and efficiency of 90%. Using eDNA we have detected oolichan in over ten streams in the study region, corroborating Haisla traditional knowledge and demonstrating greater sensitivity than paired conventional monitoring methods. Daily variation in the eDNA signal during Oolichan spawning is correlated to egg drift and can be used to estimate stock strength and spawn timing. Additional analyses are planned to integrate water quality and flow as well as monitoring eDNA signals during the larval outmigration period to support estimation of oolichan stock biomass using eDNA. This project presents a unique opportunity to protect a vital endangered species while advancing eDNA method capabilities.

Presentation type

Poster

Affiliation

University of Victoria

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180017 - Fostering coordination and incentives: empowering global biodiversity monitoring through eDNA and blockchain

Kristy Deiner[1], Miguel Fernandez[1], Jonathan Ledgard[1], Elvira Mächler[1], Alex von Minckwitz[1], Tom Walker[1], Luis Wyss[1]

[1]SimplexDNA

Monitoring biodiversity at a global scale is imperative for understanding the impact of our regenerative future of life on Earth. In this decade of restoration and immense actions to restore and rejuvenate Earth's ecosystems, eDNA emerges as a clear method that will be used to inform successes. However, eDNA technologies still face challenges in terms of accessibility and cost, particularly in the most biodiverse places of the world. While there is interest in using the technology and sampling can be done by almost anyone anywhere, there remain several barriers to implementation. These barriers can be viewed as a coordination problem more than anything else. Investment flows into restoration and conservation projects need verification of impact and local regenerators need markets to compensate them for their work to preserve and manage biodiversity. We present a novel solution that explores the utility of blockchain and tokenization to enable a distributed and participatory network of samplers across society, labs and investors. The goal is to build an open-access world biodiversity monitoring database using environmental DNA, while at the same time connecting the data demand market (estimated at 25 B USD a year) with those who create the data using blockchain enabled coordination tool called the Proof of Life Protocol.

Presentation type

Talk

Affiliation

ETH Zurich/SimplexDNA

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180016 - The Norwegian Insect Monitoring Program: lessons in metabarcoding-based biomonitoring

Marie Davey[1], Tone Birkemoe[2], Hege Brandsegg[1], Sondre Dahle[1], Tobjørn Ekrem[3], Frode Fossøy[1], Oddvar Hanssen[1], Arne Laugsand[1], Markus Majaneva[1], Arnstein Staverløkk[1], Anne Sverdrup-Thygeson[2], Frode Ødegaard[3], Jens Åström[1]

[1]Norwegian Institute of Nature Research, [2]Norwegian University of Life Sciences, [3]Norwegian University of Science and Technology

In 2020, the Norwegian Environmental Agency initiated the first phases of a nation-wide insect monitoring program that relies on passive insect sampling with malaise and window traps at two week intervals from April to October, focusing on semi-natural grasslands and forest ecosystems. Species identification is conducted using a non-destructive lysis-based DNA isolation method followed by metabarcoding of the COI region, which allows preservation of the insect material for additional analyses, including morphological identifications. To date we estimate more than 20 000 species have been detected, including a variety of red listed and alien species, and we are already able to track seasonal shifts in community composition as well as between-locality variation in biomass. Method development in the program has highlighted the need for standardization at all stages, from field equipment to laboratory and bioinformatics protocols. In order to optimize and standardize our monitoring program, we have examined the effects of trapping effort per locality, trap manufacturer and trap design on the biodiversity we recover. In the lab we have optimized DNA isolation, PCR cycling, and sequencing conditions to ensure repeatable results and maximize species recovery. The bioinformatics workflow currently implemented in the program highlights the importance of high quality, complete reference databases, and uses a variety of internal checks to quantify uncertainty in taxonomic assignments. Finally the program participates in a larger Scandinavian network that aims to share and harmonize methods in terrestrial DNA-based insect monitoring.

Presentation type

Talk

Affiliation

Norwegian Institute for Nature Research

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

1800034 - There's always a better way: the application of eDNA to effectively assess biodiversity

Prabir Roy[1]

[1]Parks Canada

Conservation studies typically use the organism as the basic unit of assessment, however relying on direct observation increases the response time to detect real change. Environmental DNA (eDNA) is the genetic material that is continuously shed from all organisms via physiological (e.g., cells shed via gut mechanics) and ecological processes (e.g., spawning-release of gametes). Despite the increasing use of eDNA in conservation practice, the tool requires further methodological improvement and standardization, based on comparative studies with traditional methods to gain universal acceptance as an assessment tool. Georgian Bay Islands National Park has delivered a project with the objectives to build capacity and develop primers for Species at Risk monitoring in Ontario. The project was delivered in collaboration the University of Victoria, McMaster University, University of Guelph, and Royal Ontario Museum. We developed eDNA primers for Eastern Fox Snake; Spotted turtles and Northern Map Turtle. The project successfully surveyed Blanding turtle eDNA by combining traditional biomonitoring knowledge at Rouge National Urban Park and Henvey Inlet First Nation where GPS tracking tags had identified their presence during hibernation. Sampling occurred under the ice, and outside of typical timing windows. Many challenges were addressed related to combining traditional biomonitoring with eDNA laboratory support and field implementations, which will be discussed further through project outcomes.

Presentation type

Poster

Affiliation

Parks Canada

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180008 - Developing lab standard procedures and guidelines to improve uptake of eDNA methods by resource managers: an overview of two national-scale programs (READI-Net and iTRACK)

Katy Klymus[1], Margaret Hunter[1], Caren Helbing[2], Valerie Langlois[3], Jacob Imbery[2], Julie Couillard[3], Adam Sepulveda[1]

[1]U.S. Geological Survey, [2]University of Victoria, [3]Institut National de la Recherche Scientifique

The utility of eDNA as an ecological monitoring tool has been rapidly adopted globally by eDNA practitioners. Nationwide and even continent wide (e.g. DNAquanet) initiatives are driving further research, tool development, and improvement in application. However, there is still resistance among other stake holders and policymakers in eDNA implementation as a monitoring tool. Part of this resistance lies in the concern over lack of standardization in eDNA methods. Here I discuss the process of laboratory procedure standardization and guideline development that is taking place in two national-scale initiatives, the READI-Net (Rapid eDNA Assessment and Deployment Initiative & Network) program in the United States and the iTRACKDNA (Non-Destructive Precision Genomics for Environmental Impact Tracking in a Global Climate Change Era) program in Canada. Through these efforts we aim to increase decision maker confidence in use of eDNA data for natural resource management.

Presentation type

Talk

Affiliation

U.S. Geological Survey

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180015 - International eDNA Standardization Task Force (iESTF)

Mehrdad Hajibabaei[1], John Darling[2], Kristian Meissner [3], Florian Leese[4], Kelly Goodwin[5], Toshifumi Minamoto[6]

[1]University of Guelph, [2]U.S. Environmental Protection Agency, [3]Finnish Environment Institute, [4]Uni. Duisburg-Essen, [5]NOAA, [6]Kobe University

Environmental DNA (eDNA) approaches are providing access to biodiversity data essential for addressing various research questions from detecting invasive species to ecological surveys and trophic interactions. However, eDNA can also address the need for biodiversity information in environmental assessment and biomonitoring programs especially in the face of current biodiversity decline because of climate change and anthropogenic activities. This requires a shift from artisanal to industrial scale application of eDNA approaches. Rather than locking in on one of many disparate approaches, now is an opportune moment for the eDNA methods' community to seek international standards. Organizations such as ISO (International Organization for Standardization) can provide an internationally recognized framework for the standardization of eDNA laboratories and specific procedures and tools. To effectively coordinate international eDNA standardization efforts and interface with relevant organizations we have formed the International eDNA Standardization Task Force (iESTF). iESTF leverages resources and knowledge from members of the eDNA community for coordinated and timely adoption of international eDNA standards. iESTF will engage with the eDNA research community to help set minimum quality requirements for standardized procedures while allowing room for growth and optimization in this rapidly advancing field. The task force will also engage with stakeholders including policy makers, managers, and various industry user groups, providing a point of contact for information, resources, and educational material. Finally, iESTF will work closely with various ISO working groups for effective development of standards for a variety of applications. In this presentation we introduce iESTF, its role and future plans.

Presentation type

Talk

Affiliation

University of Guelph

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

1800036 - Better Biomolecular Ocean Practices (BeBOP)

Kathleen Pitz[1], Anaïs Lacoursière[2], Nicholas Jeffery[2], Raissa Meyer[3], Neil Davies[4], Christina Pavloudi [5], Jodie van de Kamp[6], Raïssa Meyer[7], Alison Watts[8], Susanna Theroux[9]

[1]Monterey Bay Aquarium Research Institute, [2]Government of Canada, Department of Fisheries and Oceans, [3]Alfred Wegener Institute Helmholtz, [4]Gump South Pacific Research Station, [5]Centre de Recherche Insulaire et Observatoire de l'Environnement , [6]Commonwealth Scientific and Industrial Research Organisation, [7]Alfred Wegener Institute for Polar and Marine Research, [8]University of New Hampshire, [9]Southern California Coastal Water Research Project

Methodological information is essential to understanding the biomolecular data it generates (its limitations, strengths, and the ability to integrate and compare it with other datasets). However, in the biomolecular community, this information is often buried in publications that lack sufficient detail and are neither machine-readable nor actionable. This is an issue across environments. Within the marine environment, the Better Biomolecular Ocean Practices (BeBOP), an endorsed UN Ocean Decade Project and part of the IOC-UNESCO Ocean Best Practices System (OBPS), has started an effort to exhume and empower these critical information artifacts. Within BeBOP, we are developing machine-readable templates and new metadata specifications that are designed to work together to enable open-access sharing of protocol information. This new standard, called Minimum Information about an Omics Protocol or MIOP, records the relevant scientific metadata but also metadata pertaining to ethical, legal, and social issues that are as vital for the interpretation and (re)use of omic data and the biosamples from which they are derived. This work is done in alignment with strategic Ocean Biomolecular Observing Network (OBON) partners in ocean observing and contributing to OBON's aims for capacity sharing and inter-programme coordination (OBON - OceanPractices; both UN Ocean Decade programmes).

Presentation type

Poster

Affiliation

University of New Hampshire

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180007 - Building a standardized eDNA assessment and monitoring program in estuarine systems

Alison Watts[1], Fouad El Baidouri[1], Jeffrey Miller[1], Edward Buskey[2], Nikki Dix[3], Matthew Ferner[4], Jason Garwood[5], Jason Goldstein[6], Thomas Grothues[7], Christopher Peter[8], Yoshimi Rii[9], Schooler Shon[10], Sylvia Yang[11]

[1]University of New Hampshire, [2]Mission-Aransas NERR, [3]Guana Tolomato Matanzas NERR, [4]San Francisco NERR, [5]Apalachicola NERR, [6]Wells NERR, [7]Jacques Cousteau NERR, [8]Great Bay NERR, [9]He'eia NERR, [10]South Slough NERR, [11]Padilla Bay NERR

eDNA monitoring is becoming more common in estuarine assessment, and has great potential for standardized biological monitoring across sites and regions. At the same time, application and interpretation of eDNA results can be challenging, and resource managers must have a clear understanding of both the strengths and limitations when evaluating eDNA-based monitoring data. To assess the usefulness of a standardized eDNA monitoring approach we are collecting water samples in coordination with existing long term water quality and fish monitoring programs in 10 estuaries in the United States. These sites represent very different conditions (e.g., latitude, geomorphology, temperature, salinity, etc.) and fish communities. By applying the same sampling and analysis method at each location we are able to compare the results from a standardized method to better understand the practical use of eDNA monitoring in estuarine systems. We seek to answer three questions posed by managers in stewardship programs: *How many species are detected by eDNA sampling in a given estuary? How does eDNA-based monitoring compare to traditional fish surveys?* And *what is the relative cost of these methods?* Our initial findings indicate that it is relatively straightforward to add eDNA sample collection to an existing water quality program, but site conditions impact the quality of the results. Highly turbid and productive systems may require additional cleanup or specialized primers to optimize available information in a way that is useful for resource managers.

Presentation type

Talk

Affiliation

University of New Hampshire

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180014 - Marine biodiversity monitoring on the US West Coast: harmonizing survey methods and synthesizing data for eDNA-based ecosystem assessments

Nastassia Patin[1], Susanna Theroux[2]

[1]Scripps Institution of Oceanography, [2]SCCWRP

The West Coast Ocean Biodiversity Observation Network (WC-OBON) is a UN Decade of Ocean Science program that brings together marine monitoring programs to advance environmental DNA (eDNA) method development and harmonization. Its members include the California Cooperative Oceanic Fisheries Investigations (CalCOFI), the Southern California Coastal Water Research Program (SCCWRP) Bight Regional Monitoring Program, the California Current Ecosystem Long-Term Ecological Research program (CCE-LTER), and the Southern California Coastal Ocean Observing System (SCCOOS), among others. The goals of the WC-OBON are centered on a) aligning eDNA methods to improve data comparability, b) generating regional DNA reference libraries, and c) developing bioinformatic frameworks to integrate DNA and environmental datasets. The specific objectives to achieve these goals include harmonizing sampling and processing protocols, setting guidelines for reporting data and metadata, improving sequence reference databases for regional marine taxa, and improving bioinformatic workflows for processing metabarcoding data. We will present the results of an eDNA sampling intercalibration study wherein 4 marine eDNA water filtration protocols were compared. We will further discuss a multi-institution collaboration to improve marker gene sequence reference libraries for California Current zooplankton and macroinvertebrate taxa, as well as the development of a Data Management Guide for eDNA sampling and the adoption of this guide by multiple programs. Finally, we will introduce a new approach to processing metabarcoding data based on the outcomes of a NOAA/NCAR sponsored hackathon. Together, these efforts will provide an unprecedented resolution of key ecological indicators across space, time, and trophic levels to improve marine ecosystem assessment and management.

Presentation type

Talk

Affiliation

SIO / NOAA / SCCWRP

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180003 - Roadmap for implementing environmental DNA (eDNA) and other molecular monitoring methods in Finland

Tiina Laamanen[1], Veera Norros[1], Kristian Meissner[1], Petteri Vihervaara[1]

[1]Finnish Environment Institute (SYKE)

Roadmap for implementing environmental DNA (eDNA) and other molecular monitoring methods in Finland asses the state-of-the-art in molecular monitoring methods in Finland within the international context, identify challenges and development areas and propose an action plan for promoting the implementation of molecular methods in national monitoring programs. In Finland, molecular monitoring methods have been tested by all major institutions responsible for environmental monitoring. Methods are applied routinely in the monitoring of individual game species such as the wolf, and European & Canadian beaver. However, other areas such as the monitoring of biodiversity remain less developed, and national efforts and expertise are scattered across different organizations.

We did a literature review where we ranked research papers from the last 5 years on the Technology Readiness Level scale. At most of the papers TRL was 5 or higher: basic technology is developed and demonstrated in the field, but only a few cases are in routine implementation. We did also conducted an international webropol survey and received 171 responses. Based on the survey, we see that currently the key limiting factors are funding, expertise, lack of method standards and reference libraries.

We envision that by 2030, reliable, internationally standardized molecular methods are routinely used in national biological monitoring. To reach that goal, we propose concrete actions: 1) a cross-governmental funding instrument, 2) a permanent working group, 3) a national network, 4) an online platform for knowledge transfer, and 5) a national data management system with collectively agreed metadata formats and standards.

Presentation type

Talk

Affiliation

Finnish Environment Institute (SYKE)

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180006 - GOTeDNA: the centralized interactive guidance on optimal timing for eDNA

Anaïs Lacoursière-Roussel[1], Melissa Morrison[1], Kimberly Howland[1], Francis Leblanc[1], Nellie Gagné[1], Geneviève Parent[1], Renée Bernier[1], Claudio DiBacco[1], Marion Chevrinais[1], Marc Trudel[1], Catalina Gomez[1], Nathalie Simard[1], Nick Jeffery[1], Michael Kinnison[2], Erin Grey[2]

[1]Government of Canada, Department of Fisheries and Oceans, [2]University of Maine

With its power to increase coastal survey coverage, environmental DNA (eDNA) is increasingly employed to monitor ecosystems and support decision-making. Currently, there is no guidance on optimal timing for eDNA studies and monitoring programs for most species. Consequently, projects may fail to detect species of interest or spend more time and resources than needed. Knowledge of optimal detection windows, regional variation, and factors to consider in sampling plans is required to facilitate consistent, transparent communication between eDNA end-users, science and service providers and to avoid confusion regarding appropriate management responses. This project aims to provide guidance on optimal eDNA sampling periods and standardized sampling procedures for assessing and monitoring coastal species using eDNA. First, we will present GOTeDNA, the centralized interactive online tool currently in development to report, visualize and predict trends in spatio-temporal eDNA distributions. By updating the tool as data are accrued, the degree of confidence in predicted optimal eDNA sampling periods will increase and be spatially-refined. Second, we will show our approaches for streamlining processes to gather, compile, organize, and continually update eDNA data to guide decisions on appropriate monitoring periods and interpretation of time-series for specific taxa and regions. Third, we will briefly explain how we plan to define inter-regional differences in eDNA persistence for co-occurring species observed in Maritimes, Arctic and Maine based on biological/physical factors affecting eDNA. This comprehensive approach will improve confidence by streamlining operational requests, addressing inconsistencies in reporting among eDNA studies, and facilitating integration of results in management decisions.

Presentation type

Talk

Affiliation

Government of Canada, Department of Fisheries and Oceans

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

180002 - ANEMONE: Japan's inclusive network for eDNA-based biodiversity monitoring

Michio Kondoh[1], Tanaka Kenta[2], Hisashi Yamakawa[3], Masakazu Hori[4], Reiji Masuda[5], Satoshi Nagai[4], Akifumi Tanabe[1], Masa-aki Yoshida[6]

[1]Tohoku University, [2]University of Tsukuba, [3]Kazusa DNA Research Institute, [4]Japan Fisheries Research and Education Agency, [5]Kyoto University, [6]Shimane University

The All Nippon eDNA Monitoring Network (ANEMONE) is a comprehensive nationwide biodiversity monitoring network in Japan that employs eDNA metabarcoding. Its establishment can be traced back to 2015 when academic scientists initiated the first eDNA monitoring endeavor in Maizuru Bay, Kyoto. Since its inception, ANEMONE has diligently conducted over 5,000 surveys at more than 1,000 sites, resulting in the successful identification and categorization of over 900 distinct fish taxonomical groups. The primary objective of ANEMONE is to monitor fish biodiversity in various aquatic ecosystems, encompassing coastal and pelagic oceans, rivers, and lakes. Currently, ANEMONE operates 77 fixed monitoring stations, each with varying survey frequencies, receiving support from universities, research institutes, and local governments. Since 2020, local citizens have actively participated in eDNA-based surveys, and their involvement continues to grow annually. The eDNA metabarcoding procedure adheres to a standardized protocol provided by The eDNA Society, involving processes such as water collection, filtration, DNA extraction, and molecular analysis utilizing MiFish primers and sequencing. Subsequently, Claident, a high-throughput analysis pipeline, translates the obtained sequence data into taxonomic occurrences. These valuable data are made accessible to the public through ANEMONE DB, a dedicated database maintained at Tohoku University. In recognition of the vast potential of eDNA monitoring data in addressing a broad spectrum of nature-related social issues, a consortium was established on June 1, 2022, encompassing academia, government bodies, and private sectors. This collaborative effort aims to explore and harness the transformative power of eDNA monitoring data for innovative solutions in diverse fields.

Presentation type

Talk

Affiliation

Tohoku University

Session

Standardized eDNA-Based Biodiversity Monitoring to Inform Environmental Stewardship Programs

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30006 - GEO BON Working Group on Ecosystem Services: 2023-2026 Strategy Plan

Ana Sofia Vaz[1], Nuria Piston[2], Flavio Affinito[3], Agnes Vari[3]

[1]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Campus de Vairão, Universidade do Porto, [2]University of Granada, Ecology Department, Granada, Spain, [3]McGill University

Work on ecosystem services has focused strongly on describing different types of services from nature, quantifying their temporal and spatial variation, and recognizing the numerous trade-offs that emerge when considering multiple services. Although ecosystem service indicators do exist, there are large informational, conceptual, and methodological biases that need to be addressed before we can make reliable estimates of where and how ecosystem services are changing. This talk will present the new implementation plan of the GEO BON Working Group on Ecosystem Services (ESWG) for 2023-2026. The plan sets the objectives, milestones and activities of the ESWG to expand, integrate, standardize, and harmonize the ways we understand, measure, and predict ecosystem services change. This is aligned with the GEO BON's vision for a global observation network that contributes to effective management policies for the world's biodiversity and ecosystem services.

Presentation type

Talk

Affiliation

CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Campus de Vairão, Universidade do Porto

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30005 - Monitoring ecosystem services with Essential Ecosystem Service Variables

Amanda Schwanted[1], Carina Firkowski[1], Flavio Affinito[2, 3], Peter Rodriguez[1], Marie-Josée Fortin[1], Andrew Gonzalez[2, 3]

[1]University of Toronto, [2]McGill University, [3]Québec Centre for Biodiversity Science

Ecosystems worldwide are changing due to anthropogenic pressure. As ecosystem structure and function change, so does their capacity to support human wellbeing. Understanding how this change affects ecosystem services requires monitoring the state of human-nature interactions. However, an agreed-upon methodology to monitor ecosystem services is not yet available. To support ecosystem services monitoring, GEO BON recently proposed the use of Essential Ecosystem Service Variables (EESVs). These variables capture the multiple facets of an ecosystem service and are organised into six classes: *ecological supply*, *use*, *demand*, *anthropogenic contribution*, *instrumental value* and *relational value*. Yet, EESVs have only been proposed as a conceptual framework and lack use cases. We analysed EESVs for three interlinked ecosystem services in British Columbia: water quality regulation (regulating), wild Chinook commercial fisheries (provisioning) and orca whale-watching (cultural). We focused on EESV classes with available data from public and private sources. Using trend and intervention analysis, we show how EESVs are changing and affected by policy. Furthermore, we discuss key challenges and solutions, while providing guidance on using EESVs to monitor ecosystem service change and to provide decision support. We found that the EESV framework can (1) account for multiple dimensions of ecosystem services, (2) provide a valuable pathway for linking data to monitoring and decision support, and (3) encourage comparisons and interconnections among ecosystem service indicators adopted by the monitoring frameworks of different policy agendas and conventions. We highlight key challenges in the operationalisation of EESVs and suggest improvements for the framework to effectively support policy.

Presentation type

Talk

Affiliation

McGill University

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000040 - Ecosystem services valuation and payment for livelihood sustainability in the Indian Central Himalayan Region

Vishwambhar Prasad Sati[1]

[1]Mizoram University

This article examines the valuation and payment of ecosystem services for livelihood sustainability in the Indian Central Himalayan Region. Data were gathered from both primary and secondary sources on biodiversity resources - tangible (goods) and intangible (services) as the Himalaya is a repository of these resources, also called ecosystem services. The ecosystem services are interlinked with the highlands (providers) and the lowlands (beneficiaries) and provide livelihoods to large populations. Forests cover about 63% of the total geographical area with rich biodiversity. Water resources are abundant as about 42% of the national water need is met by the Ganga River and its tributaries that originate and flow through the region. The hydroelectricity generating capacity is about 30000 MW. The environmental sustainability index is high due to the clean and pollution-free environment. Agro-biodiversity is substantially high and therefore, several crop races/cultivars grow here, although, arable land is only 18%. However, the people of the highlands are unable to use these biodiversity resources optimally because of the rugged terrain, remoteness, and adverse situation. As a result, the people of the highlands are poor, facing acute malnutrition and food scarcity problems. Valuation of both tangible and intangible ecosystem services can be done and payment can be made. Taxes can be levied on the intangible resources mainly used by the downstream people and green bonuses can be paid to the upstream people.

Presentation type

Poster

Affiliation

Mizoram University

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000041 - Monitoring of eco-system services of urban areas of the Southern Aravalli Range under changing land use pattern

Pragya Singh Solanki[1], Laxmi Kant Sharma[1]

[1]Department of Environmental Science, Environmental remote sensing lab, Central University of Rajasthan, Bandarsindri-305817, [India]

Nature in urban areas provides important opportunities for recreation, along with social, psychological, and physical health benefits. The Urban Heat Island effect, or the difference in temperatures between rural and urban areas, is a result of two main urban characteristics: the thermal properties of building materials which store more heat, and the reduction of the cooling effect of vegetation. Therefore, natural infrastructure contributes to a reduction in urban heat islands.

The Aravalli Range is believed to be the oldest range of Fold Mountains in India that runs in a south-west direction covering four states in the country. The southern region of the range has significant urban areas that have undergone major transformation in the past two decades.

In this paper we used a spatially explicit integrated modelling tool (InVEST) to quantify these changes in two ecosystem services, i.e. urban cooling and urban nature access 2000 to 2022. The InVEST urban cooling model calculates the cooling effect of vegetation based on climate data and land use/land cover. The model also calculates urban nature access based on the location and amount of urban nature, the location and number of people, and the per-capita need or demand for urban nature. The outcome estimates a temperature reduction by vegetation and quantifies the extent to which supply meets demand, at the individual, administrative and city level.

Our findings highlight the significance of considering ecosystem services when making decisions about land use and management and connecting those decisions with incentives that appropriately reflect societal benefits.

Presentation type

Poster

Affiliation

Central University of Rajasthan

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000031 - Spatial analogy between biodiversity and ecosystem services in Uganda

Filbert Amanya[1], Tonny Kiggundu[1], Rose Nalubega[2]

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Ecosystems services sustain humans all over the world. The unsustainable use of ecosystem services around the world has led to widespread degradation which now threatens human health and livelihoods. Although the maintenance of ecosystem services is often used to justify biodiversity conservation actions, it is still unclear how ecosystem services relate to different aspects of biodiversity and to what extent the conservation of biodiversity will ensure the provision of services. The aim of this study was to find out whether biodiversity priorities, biomes, species richness and vegetation diversity hotspots co-occur in space with ecosystem services. The distribution of the ranges and hotspots of five ecosystem services (surface water supply, water flow regulation, carbon storage, soil accumulation, and soil retention) was assessed in Uganda's biomes. Coincidence, overlap, and correlation analyses were used to assess spatial analogy between ecosystem services and species richness (plants and animals) and vegetation diversity hotspots. The grassland and savanna biomes contained significant amounts of all five ecosystem services. There was moderate overlap and a generally positive but low correlation between ecosystem services hotspots and species richness and vegetation diversity hotspots. Species richness was mostly higher in the hotspots of water flow regulation and soil accumulation than would be expected by chance. The water services showed varying levels of analogy with species richness hotspots and vegetation diversity hotspot. These results indicate that actions taken to conserve biodiversity in Uganda will also protect certain ecosystem services and ecosystem services can be used to strengthen biodiversity conservation in some instances.

Presentation type

Poster

Affiliation

Rural - Urban Environment Agency (RUEA)

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30004 - Developing a Thematic Center on Biodiversity, Ecosystem Services, Global Change and Sustainable Development: a case study in Sierra Nevada (Spain)

Nuria Pistón[1, 2], Javier Martínez-López[1, 2], Ricardo Moreno[2], Andrea Ros-Candeira[2], Carlos Navarro[1, 2], Beatriz P. Cazorla[1, 2], Javier Herrero[3], Ana del Águila[1, 4], Thedmer Postma[1, 2], Irati Pacho[2], José C. Pérez-Girón[1, 2], Ana Sofia Cardoso[5], Pedro Magaña[2], Carson Silveira[1, 2], Juan M. López Torralbo[1, 2], Manuel Merino-Ceballos[2], Manuel Pacheco-Romero[6, 7], Ana Mellado[1, 4], Ana Sofia Vaz[5], Domingo Alcaraz-Segura[1], Regino Zamora[1]

[1]University of Granada, [2]Interuniversity Institute for Earth System Research in Andalusia, [3]TRAGSATEC, [4]LifeWatch-ERIC ICT Core Seville, [5]University of Porto, [6]University of Lüneburg, [7]University of Almería

Nature's contributions to people (NCP) frame the variety of interactions between peoples and nature; embracing the concept of ecosystem services (ES), such people-nature interactions fall into material (food provision), regulating (air quality amenity) and non-material contributions (physical and psychological experiences). NCPs and ESs are essential for human subsistence and quality of life, yet deciding about the most appropriate tools and data to use to support scientifically-based decision-making remains a challenge. The Smart EcoMountains project aims to help dealing with this challenge in Sierra Nevada (Spain), by delivering robust datasets and tools to comprehend biodiversity, NCPs and global change information. Using a combination of methodological tools, such as remote sensing, social surveys and artificial intelligence, the project focused on modelling multiple ecosystem functions underlying NCPs and ESs, including flood and erosion control, surface water supply and runoff, aquifer recharge, evapotranspiration, grazing, aboveground carbon storage, heat mitigation and seed dispersal, as well as cultural aspects of nature and land use/land cover change at distinct spatial and temporal scales. The main output of the project, within the European Research Infrastructure LifeWatch-ERIC, is to develop "Virtual Research Environments" with accessible educational contents and management tools, expected to aid managers, policy makers, and citizens dealing with important global change issues that affect biodiversity and NCPs in mountain systems and its surroundings.

Presentation type

Talk

Affiliation

University of Porto

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000037 - Integration of ecosystem services into environmental zoning of watersheds as input for territorial planning

Cesar Rojas[1], Magnolia Longo[2]

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[2]Grupo de investigación Limnología, Universidad Jorge Tadeo Lozano, Bogotá, Colombia

The ecosystem services (ES) valuation is a milestone in biodiversity conservation, allowing theconvergence of interests between science and decision-making regarding its strategic public value.However, the ES concept used in environmental management instruments for watersheds remains in ecosystem management. Watersheds are socio-ecosystems in the supply and demand of ecosystem services, supporting biodiversity conservation. Therefore, recognizing the importance of ES provided by watersheds can support biodiversity conservation.

This analysis integrates information on the supply and demand of ES and species distribution models in the Coello River basin, Tolima, Colombia. The aim was to identify biodiversity areas and their ES, contributing to the construction of spatial indicators that support the planning of watersheds. To this end, first, the supply of water-related ES was characterized at the basin scale using Invest models of water yield, sediment retention, and carbon storage. Second, the ES demand was mapped from land and water use through spatial analysis. Third, the distribution of species in the basin employed Maxent models. Finally, the information was integrated through a habitat suitability model. Relevant zones were identified for ES supply according to the current planning instrument in the study area. This evaluation confirms that the balance between ES supply and demand can support territorial planning at the basin scale. The balance of ES can be related to the species distribution results. ES accounting provides an opportunity for a better understanding of territorial elements for the conservation and use of biodiversity, facilitating the construction of knowledge for planning land use.

Presentation type

Poster

Affiliation

Faculty of Engineering, Francisco Jose de Caldas, Distrital University of Bogota, Colombia

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30007 - Advancing Essential Ecosystem Service Variables (EESV)

Agnes Vari[1], Nuria Piston[2], Sofia Vaz[3], Flavio Affinito[1]

[1]McGill University, [2]University of Granada, Ecology Department, Granada, Spain, [3]3CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado, Campus de Vairão, Universidade do Porto

A firm conceptual background as well as an operational set of indicators is needed for both monitoring biodiversity and monitoring ecosystem services (ES). ES monitoring, and specifically EESVs need to be clear on targeted ES and their different aspects/classes. The ES working group of GEOBON is setting out to clarify the conceptual background, review existing variables and indicators for EESVs and identify new EESV as the first steps of its program. The ES working group will explore these questions along existing frameworks, integrating ecological and social components, that can be used to inform and measure EESVs and identify priority gaps that need to be filled for successful monitoring of ES.

Presentation type

Talk

Affiliation

McGill University

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000034 - Mapping changing ecological networks and ecosystem services with data fusion and machine learning

Evan Fricke[1]

[1]Massachusetts Institute of Technology

Changes to animal biodiversity often impact ecosystem functioning and ecosystem services through alteration of networks of ecological interactions among species. Yet empirical data on species interactions and their links to ecosystem functioning are relatively limited. This hampers the ability to quantify how animal biodiversity changes affect ecological networks and ecosystem functioning at large spatiotemporal scales. I will share how we have used data synthesis and machine learning to predict species interactions and their links to ecosystem function globally by leveraging data from scientific literature and species trait data. I will discuss how such models can be used for analyses of changing ecological networks and animal functional roles over space and time, and how they may be used to monitor change in ecosystem services. I will focus on our application of this approach in the context of seed dispersal by animals. I will discuss projects addressing how animal biodiversity changes have affected 1) plants' ability to track climate change globally and 2) tropical forest regrowth as a natural climate solution.

Presentation type

Poster

Affiliation

Massachusetts Institute of Technology

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30002 - Aligning conservation goals, net-zero emission targets, and cultural values: the Indigenous Guardians Program in Canada

Camilo Alejo[1], Maria Isabel Arce Plata[2], Andréa Vertimiglia[1]

[1]Future Earth Canada Hub - Concordia University, [2]Universite De Montréal

The latest Conferences of the Parties have emphasized the need to simultaneously tackle the intertwined climate and biodiversity crises while integrating Indigenous Peoples and Local communities in monitoring actions and environmental targets. The recent Indigenous Guardians program funded by the federal government in Canada may represent a policy opportunity to advance environmental targets and facilitate reconciliation processes. Previous studies have explored the scope and opportunities of Indigenous Guardians programs, however; little is known about their specific contributions to climate change mitigation and biodiversity conservation. To address this lacuna, we estimate the contribution of Canada's Indigenous Guardians program in conserving carbon stocks and biodiversity across terrestrial Canadian ecosystems. To perform these estimates, we rely on land use and land cover change dynamics, biomass, and soil carbon maps, and a Biodiversity Habitat Index. Relative to other land tenure regimes, and even after controlling for confounders using quasi-experimental methods, our results suggest that the Indigenous Guardians program has a pivotal influence in conserving irrecoverable carbon stocks and biodiversity in strategic ecosystems such as peatlands and boreal forests. The results highlight the importance of essential biodiversity variables to evaluate environmental policies at the local and regional scales. Furthermore, we demonstrate that Indigenous-led monitoring actions align social well-being and cultural values with the 30X30 conservation goals and net-zero emission targets.

Presentation type

Talk

Affiliation

Future Earth Canada Hub - Concordia University

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000035 - The influence of institutional arrangements on biodiversity and ecosystem services

Evelyne Ivy Kabasuga[1], Emily Kakokooko[2], Jacobson Koowai [2]

[1]Strategic Partners in Research and Development Organization (SPRDO),Uganda, [2]Century Environmental Development Agency (CEDA),Uganda

The value of ecosystem services increasingly being recognized. Conservation biologists have suggested that ecosystem service based arguments may be potentially useful in developing support for the preservation of species and diverse ecosystems, but their knowledge of the institutional context for the management of such ecosystems is limited. There is increasing interest in how market-based instruments can be used to take care of these values. Thus, within conservation, direct payments approaches have attracted considerable interest, reflecting the economic approach to ecosystem services within this policy sector. But the market is one among many institutions — there is in fact a range of institutional arrangements to realize the value of ecosystem services. Research on the commons that deals with institutional issues that emerge when resources become valuable has much to contribute to understanding of the institutions relevant to the management of ecosystem services. A number of the institutional challenges that emerge with the management of common pool resources (e.g. non timber forest products, water, grazing) are relevant to the new resources created by the establishment of markets for ecosystem services (e.g. water supply, carbon sequestration or pollination). This paper analyses the relevance of knowledge about institutions for commons management to the understanding of ecosystem service based approaches to biodiversity conservation.

Presentation type

Poster

Affiliation

Strategic Partners in Research and Development Organization (SPRDO)

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30003 - Environmental change, biodiversity and emerging diseases in Canada: the rationale for the Environmental Change & One Health Observatory ECO2

Nick H. Ogden[1], David LApen[2], Oliver Lung[3], Antoinette Ludwig[1], Philippe Berthiaume[1], Donald J. Baird[4]

[1]Public Health Agency of Canada, [2]Agriculture and Agrifood CAnada, [3]Canadian Food Inspection Agency, [4]Environment and Climate Change Canada

Environmental changes directly impact the health of humans, fauna, flora and the environment in general. The health of these endpoints is accepted under the banner of 'one health'.

Here we describe how a 'one health' approach can help develop disease prevention and mitigation strategies in a sustainable context. As a central example, we will use the case of an environmental observatory located in eastern Ontario, Canada. This observatory is the center of a large network of observation systems, allowing researchers to answer several vital questions for decision-makers: how infectious disease and other risk is evolving in time and space, and how it can be monitored effectively, and finally, how to generate novel approaches for the development and testing of effective intervention and control strategies in context of the degree and nature of natural capital in agro-ecosystems. We will present results from these long-term studies to illustrate the advantages of this approach, particularly concerning the complex interactions of ecosystem elements supporting zoonotic disease suppression. We illustrate how the use of this combined One Health Observatory approach has improved the knowledge of the risk associated with antimicrobial resistance, and mosquito-borne diseases, and importantly, how natural capital and weather/climate regulate vector borne diseases. This approach has also made it possible to highlight the contribution of earth observation/remote sensing , and metagenomic/metabarcoding for the monitoring and prediction of changes in risk on the territory.

Presentation type

Talk

Affiliation

Public Health Agency of Canada

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

30001 - Earth observation of ecosystem properties in ecosystem service models: a systematic review

David Ferguson[1], Elena Bennett[1], Klara Winkler[1]

[1]McGill University

Ecosystem services (ES) are one way to quantify, analyze, and manage the benefits that flow from ecosystems to humans. Yet the capability to assess these services accurately across large spatial extents remains limited. Many current ES models are based on categorical typologies of land-use and land-cover (LULC), with the assumption that all ecosystem properties within a LULC type are identical. To represent ecosystem heterogeneity more precisely, there have been calls within the ES community to explore modelling approaches that incorporate earth observation (EO) data that capture additional ecosystem properties, at finer spatial and temporal resolutions. I have reviewed the use of EO data in ES models over the past ten years, highlighting which EO data, at which geographical extent and spatial/temporal resolutions, have been used in ES models. This review of 41 papers, spans all categories of ES models and shows the direct linkages between individual EO datasets and ES models (i.e., MODIS Normalized Difference Vegetation Index was the most used EO data input in models reviewed, used as a proxy for live vegetation cover in 58% of the total ES models, and 83% of regulating service models). One promise of using EO for ES assessments was to allow the community to increase the spatial extent of work while maintaining fine temporal and spatial resolutions (and maintaining information resolution about ecosystems by avoiding loss through classifying to LULC); this study shows that, while the promise has been partially realized for some ES, there are more opportunities still in the field.

Presentation type

Talk

Affiliation

Department of Natural Resource Sciences, McGill University

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000039 - Monitoring trend breakpoints in vegetation indices to inform the status of forest carbon services

Peter Rodriguez[1], Andrew Gonzalez[2], Marie-Josée Fortin[1]

[1]University of Toronto, [2]McGill University

Canada's vast forests have become in recent decades net carbon sources due to the impact of disturbances such as wildfires, harvesting, and pest outbreaks. To improve the monitoring of forest carbon services, we use time series of vegetation indices (MODIS' NDVI & EVI at 250m) and a trend breakpoint detection algorithm (BFAST). Trend breakpoints reveal abrupt changes in trends that can be associated with forest stand replacing disturbance events (e.g., fire, harvest) or non-stand replacing disturbance events (e.g., drought, pest outbreaks). We illustrate the potential of this approach by analyzing forested areas within and around Algonquin Provincial Park (Ontario) for a 20-year period (2003-2022). We found different percentages of breakpoints according to vegetation indices: 5.3% NDVI (i.e., less robust forest vegetation greenness index) and 4.6% with EVI (i.e., more robust forest vegetation greenness index). Most of these breaks were negative (78.1% for NDVI and 78.7% for EVI). Relatively few negative breaks overlapped with remote sensing-derived forest stand replacing disturbances (forest fires: 1%; harvests: 12%) implying that most identified negative breaks may be related to forest non-stand replacing disturbances. Further, about 5.6% of the forested areas experienced negative trends (browning), while 21.9% experienced positive trends (greening). The identified areas of change (i.e., areas that showed trend breakpoints and/or trends) can help improve the parametrization of forest carbon models and determine the drivers of these changes. Monitoring forest greenness indices at different spatial-temporal scales will advance our understanding of forest carbon services dynamics in a changing world.

Presentation type

Poster

Affiliation

University of Toronto

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000038 - An integrative assessment of non-material nature's contribution to people in Mountain National Parks

Nuria Pistón[1, 2], Ana Sofia Vaz[3], Javier Martínez-López[1, 2], Ana del Águila[1, 4], Daniel Molina [1], Ana Sofia Cardoso[3], Pedro Magaña[2], Fernando Luque de la Torre[1], Andrés Herrera Espino[1], Siham Tabik[1], Eugenio Martínez-Cámara[5], Francisco J. Rodríguez-Díaz[1], Thedmer Postma[1, 2], Rohaifa Khaldi[1, 4], Ricardo Moreno[1, 2], Andrea Ros-Candeira[1, 2], Irati Pacho[2], Carlos Navarro[1, 2], Manuel Merino-Ceballos[2], Regino Zamora[1], Domingo Alcaraz-Segura[1]

[1]University of Granada, [2]Interuniversity Institute for Earth System Research in Andalusia, [3]University of Porto, [4]LifeWatch-ERIC ICT Core Seville, [5]University of Jaen

The non-material contributions that nature provides to people (NCP) are frequently highly valued and demanded by society as they are the basis for important aspects of human well-being reflecting psychological, philosophical, social, and spiritual principles. Although data from social media has become popular to quantify and map non-material NCP, different methods for automating the analysis are still being explored. It is still a challenge to sort the important information from the irrelevant data among the millions of images and comments shared on social media (such as Twitter and Flickr) and convert them into typologies of supply and demand of NCP. In this study, we present a methodological integration of deep learning models, dictionaries of keywords and social surveys for the classification and validation of human-nature interactions and aspects of non-material NCP using social media data from mountain national parks in Spain and Portugal (Europe). For that, we have identified up to five pre-trained models that are relevant for non-material NCP estimation. Our investigation helps researchers and other interested parties to decode the non-material NCP distributions and benefits. Our methods and results will be accessible within a LifeWatch-ERIC "Virtual Research Environment".

Presentation type

Poster

Affiliation

University of Porto

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000036 - Trade - offs of ecosystem services to hydrological watershed land management

William Kayemba[1], Betty Nabatanzi[1], Joseph Kabogoza[2]

[1]Global Initiative Uganda (GIU),Masaka,Uganda, [2]Millennium Development Consult (MDC),Jinja, Uganda

Communities value ecosystem services for their survival. These values can help inform the management of ecosystems such as watershed lands. However, the trade-offs in ecosystem goods and services associated with different social and management conditions are poorly understood. As a result, we explore values attached to the goods and services of different watersheds. We compared the ecosystem goods and services and the broader total economic value to establish the experience of different watersheds, their social conditions, and different management choices associated with these values. The highest total economic values were associated with government management watershed land and were probably due to the government's priority to be involved in the high-value tourism destinations. This is, however, associated with losses in a range of local community-level values and the social capital of the resource-user community. For example, resource users near the government protected watersheds had the lowest value for measures of hydrological knowledge. Watershed land sites displaying greater community-level values were characterized by high social capital, and users had the most confidence in their ability to manage the resource. This research recommends that trade-offs occur in values associated with the interests and responsibilities of the management. The ability to cope with disturbance and change will depend on these values and responsibilities, and local communities are less likely to respond when government management and interests are strong.

Presentation type

Poster

Affiliation

Global Initiative Uganda (GIU)

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

3000033 - Using old fields for new purposes: modelling the impact of field restoration in the Montérégie

Catherine Destrempes[1], Elena Bennett[1], Jesse Rieb[1]

[1]McGill University

Efforts to ensure the supply of certain ecosystem services (ES), such as food, have led to expansion and industrialization of landscapes, often at the expense of other ES. Such agricultural expansion and landscape intensification has reduced landscape diversity and increased vulnerability to shocks like pest and climate events. Recently, COP15 goals have emphasized the need to restore and protect natural space worldwide. Nature-based solutions (NBS), have been proposed as one method to protect natural spaces while providing multiple benefits such as carbon sequestration and recreation. However, the degree to which multiple benefits could be provided by NBS remains unclear and questions persist regarding the role of spatial configuration in NBS and its impact on the mix of services that can be provided. Using the Montérégie, an agricultural region southeast of Montreal, Quebec, Canada, as a study landscape, I investigated the impact of one NBS, restoration, on the provision of six ES (crop production, maple syrup production, deer hunting, water quality regulation, above-ground carbon storage, and outdoor recreation). I created nine scenarios to assess the effects of different restoration amounts (0%, 15%, and 30% of the landscape) and different spatial configurations of that restoration (random, or focused on abandoned fields, or on degraded fields). In each scenario, I modeled the provision of all six ES. I expect to find that increasing the area restored played a key role in increasing service provision, and the location of the restoration played an important but secondary role in determining delivery for some services.

Presentation type

Poster

Affiliation

McGill University

Session

Monitoring Ecosystem Services: Where Do We Stand and How Do We Move Forward?

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

1200034 - Artificial Intelligence for monitoring climate change impacts on neotropical amphibians in a large-scale passive acoustic monitoring program

Juan Sebastián Cañas [1], Maria Paula Toro-Gómez[1], Diego Llusia[2], Larissa Sugai[3], Juan Sebastián Ulloa[1]

[1]Instituto Humboldt, [2]Universidad Autonoma de Madrid, [3]K. Lisa Yang Center for Conservation Bioacoustics Cornell Lab of Ornithology

As global climate change accelerates, the need to develop standardized biodiversity monitoring programs becomes increasingly urgent. An essential aspect of this effort is understanding the effects of climate change on anuran amphibians' reproductive behavior, specifically their calling activity and breeding phenology, which are influenced by climatic conditions. Passive acoustic monitoring (PAM) offers a promising approach to track these species traits. Since 2019, our collaborative, country-wide acoustic monitoring program in Brazil has been assessing the impact of climate change on neotropical amphibians. With the involvement of over 40 researchers, we have established an acoustic anuran observatory and leveraged artificial intelligence tools to enhance the program's efficiency and ecological insights. In particular, we show how the project is developing: (1) a high-quality dataset with the patterns of acoustic activity of neotropical amphibians; (2) a machine learning workflow to train, tune and deploy models capable of detecting species activity; (3) EBV-ready datasets (phenology, physiology, acoustic traits) for the class species traits; (4) predictions of changes in species behavior, distribution, and persistence based on a novel tool: acoustic species distribution models. By fostering collaboration between machine learning researchers and ecologists in biodiversity monitoring networks, this project aims to inform effective policies for climate change mitigation and biodiversity conservation.

Presentation type

Poster

Affiliation

Instituto Humboldt

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

1200032 - Assessment of long-term biodiversity changes of fish populations in boreal hydroelectric reservoirs

Camille Lévesque[1], Dominique Gravel[1], Katrine Turgeon[2]

[1]Université de Sherbrooke, [2]Université du Québec en Outaouais

Hydroelectric dams are man-made constructions giving us the power to generate renewable energy, using the potential energy from reservoirs. Although hydroelectricity is one of the greenest energies in use today, it has its share of consequences on the surrounding environment of the dams. Altered hydrological regime, changed water and soil biochemistry and habitat structure are all variables affected by a river impoundment. These perturbations of the environment can impact greatly the biotic component of the ecosystem, first disrupting the primary production and, by domino effect, affecting all trophic levels. Previous studies have outlined a few common repercussions when it comes to fish populations, most notably the loss of native species in favor of invasive ones, a restructuration of the fish assemblage structure and possibly a 'boom' in productivity in the first few years following impoundment, because of a nutrient input. However, most studies to this day have focused on tropical and temperate reservoirs and few have outlined the long-term impacts on boreal reservoirs. The purpose of the present study is to fill the void of knowledge surrounding impoundments in boreal reservoir and get a better understanding of the effects of such a massive disruption of the environment on the reservoirs' biodiversity. To achieve this goal, essential biodiversity variables (EBVs) will be applied to a set of time series on fish populations in hydroelectric reservoirs in the *Nord-du-Québec* and *Côte-Nord* regions of Quebec.

Presentation type

Poster

Affiliation

Université de Sherbrooke

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120013 - Vulnerability of downstream ecosystems: evaluating environmental flows in the Indus River Basin

Kashif Mehmood[1], Bernhard Tischbein[1], Martina Flörke[2], Rashid Mahmood[3]

[1]University of Bonn-Germany, [2]University of Bochum, Germany, [3]Chinese Academy of Sciences

Environmental flows (EFs) are crucial for maintaining the ecological integrity of rivers and aquatic habitats, which are critical for supporting biodiversity. This study was conducted in the Indus River basin (IRB), which has heavily been modified because of human activities to estimate and monitor the situation of EFs in the region. EFs were calculated using the flow duration curve shifting method, flow duration curve analysis, low flow indices, the Tennant method, the Smakhtin approach, Tessman method, and Pastor method. The estimated EFs were compared with the downstream flows to highlight the time (years, months, and seasons) when the environmental flows were unmet. EFs of 880 m^3/s (38% of the MAF), 412 m^3/s (48% of the MAF), 425 m^3/s (44% of the MAF), 389 m^3/s (56% of MAF), 184 m^3/s (50% of MAF) and 231m^3/s (38% of MAF) were estimated for the Indus River at Tarbela dam, the Jhelum at Mangla dam, the Chenab at Marala headworks, the Ravi at Balloki headworks, Sutlej at Sulemanki headworks, and below Kotri barrage respectively, to conserve the downstream ecosystems. The study found that EFs were violated between 41-54% of the time during the study period, particularly for the Chenab, Ravi, and Sutlej rivers. The results of the study highlighted that the Chenab, Ravi, and Sutlej Rivers are particularly vulnerable to ecosystem and biodiversity as the estimated EFs were not met most of the time. These findings underscore the urgent need to take appropriate measures to ensure EFs for the conservation of the downstream ecosystems.

Presentation type

Talk

Affiliation

University of Bonn-Germany

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120016 - Using a camera system to monitor small riverine organisms

Frederic de Schaetzen[1], Luiz G.M. Silva[1], Roman Stocker[1]

[1]ETH Zurich

In recent decades, freshwater invertebrate and fish populations have declined drastically under the impact of human activity and climate change, leading to a loss in diversity. To improve freshwater biodiversity management, it is vital to enhance our capacity to monitor aquatic biota, particularly through non-invasive, broadly deployable methods that generate long-term (months to years) and continuous (hourly to daily) data with the appropriate taxonomic resolution. This requires the development and application of innovative sampling approaches that can generate standardizable metrics. To that end, we present the Riverine Organism Drift Imager (RODI), an underwater camera system developed to automate the sampling of drifting aquatic organisms. RODI leverages recent developments in imaging and machine learning technologies and has successfully passed the proof of concept stage with several prototype deployments in a Swiss alpine river. The results showed that a convolutional neural network could successfully classify an annotated image dataset with eight classes of organisms (macroinvertebrates and fish) to the family level (F1-score = 0.94). Current developments aim to improve deployment times from a few hours to weeks. Ultimately, we envision RODI to sample organism drift near-continuously in a non-invasive manner, generating real-time data on drifting organisms with unparalleled temporal resolution, providing a tool for monitoring freshwater quality and biodiversity on a global scale.

Presentation type

Talk, Poster

Affiliation

ETH Zürich

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120002 - Linking structural and functional diversity measures to better understand drivers of change in Arctic freshwaters

Jennifer Lento[1], Daniel Bogan[2], Fernando Chaguaceda[3], Joseph Culp[4], Erin Larson[2], Danny Lau[3], Brianna Levenstein[1], Jordan Musetta-Lambert[5], Rebecca Shaftel[2], Willem Goedkoop[3]

[1]Canadian Rivers Institute and University of New Brunswick, [2]Alaska Centre for Conservation Science, University of Alaska Anchorage, [3]Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, [4]Cold Regions Research Centre, Wilfrid Laurier University, [5]Environment and Climate Change Canada

The ongoing effects of climate change on the Arctic are evidenced by changes to freshwater habitats and ecological processes that have dramatic impacts on the Arctic's freshwater biodiversity. Predicting future changes to biotic communities and identifying key areas for ongoing monitoring requires a better understanding of the taxonomic structure of these communities and its relationship to functional diversity and redundancy. This presentation will highlight recent findings about the state of benthic macroinvertebrate community structure in Arctic lakes and rivers and the underlying environmental drivers linked to climate change. Through the application of harmonized trait databases to circumpolar observation data, we will explore the ecological mechanisms that explain the observed patterns in taxonomic structure and the subsequent functional responses. We will use these linkages to identify potential changes to structural and functional diversity that might be expected under future climate change scenarios.

Presentation type

Talk

Affiliation

Canadian Rivers Institute and University of New Brunswick

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120005 - REFRESH: Renewing data and filling knowledge gaps for freshwater species of South Africa to inform species and ecosystem conservation

Albert Chakona[1], Nico Smit[2], Savel Daniels[3], Wynand Malherbe[2], Pedro Braganca[1], Lizaan de Necker[1], Marliese Truter[1], Musa Mulambo[4], Betsie Milne[5], Nicolas Telford[6], Nelson Miranda[3], Dewidine van der Colff[6]

[1]NRF-South African Institute for Aquatic Biodiversity (NRF-SAIAB), [2]North Wester University (NWU), South Africa, [3]University of Stellenbosch, South Africa, [4]Albany Museum, South Africa, [5]Sol Plaatjies University, South Africa, [6]South African National Biodiversity Institute (SANBI)

South Africa's 2018 National Biodiversity Assessment (NBA) showed that freshwater taxa, specifically freshwater fishes, are far more imperiled than their terrestrial counterparts. Because distributional information for these taxa remain incomplete and, in many instances, are outdated and are taxonomically and geographically biased, it is likely that the extent of the threat is even greater. For many freshwater groups, particularly invertebrates, information on their diversity, distribution and conservation status is limited or completely lacking, with the exception of Odonata. The REFRESH Project was initiated to address gaps for seven groups of freshwater taxa (freshwater fish, freshwater fish parasites, Potamonautes, Mollusca, large branchiopods, Odonata, amphibians) by; (i) mobilising and updating information from various sources, (ii) using species distribution data to identify regions that remain poorly explored and prioritise these for sampling, and (iii) identifying long-term monitoring sites to generate data on trends and status of the country's freshwater biodiversity. This information will contribute towards the fulfilment of national policy on biodiversity conservation enshrined in the National Environmental Management: Biodiversity Act (NEMBA) and the Water Act, as it will feed into various evidence-based decision-making tools that are currently impeded by limited availability of freshwater data. These tools include the South African national and global IUCN Red List, the Environmental Impact Assessment screening tool of the Department of Forestry, Fisheries and Environment (DFFE), and the update of the National Freshwater Ecosystem Priority Areas (NFEPAs). Project data will also stimulate renewed interest in revisionary taxonomy to address the taxonomic impediment.

Presentation type

Talk

Affiliation

NRF-South African Institute for Aquatic Biodiversity (NRF-SAIAB)

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120011 - A monitoring framework for reporting the extent of wetland restoration interventions relative to pressures and impacts for target 2 of the GBF

Heidi van Deventer[1], Philani Apleni[2], Esmeralda Ramburran[3], Andrew Wannenburg[3], Laven Naidoo[4], Philemon Tsele[2]

[1]Council for Scientific & Industrial Research (CSIR), South AFrica, [2]University of Pretoria (UP), South Africa, [3]Department of Forestry, Fisheries & the Environment (DFFE), South Africa, [4]GCRO, South Africa

Target 2 of the Global Biodiversity Framework (GBF) requires that membership countries should have at least 30% of the extent of ecosystems under restoration by 2030. The South African Department of Forestry, Fisheries and the Environment (DFFE) had invested in five types of intervention programmes over more than a decade, including those related to the coast, ecosystems, fire, invasive species removal, and wetlands. Two of these programmes focused on inland water restoration: The Working for Water programme prioritised the removal of alien invasive tree species to improve infiltration and run-off in South Africa, that is geographically predominantly an arid to semi-arid country. The Working for Wetlands programme focused on erosion control and flow management of wetlands. The minimum extent of historic interventions relative to the extent of degraded inland (freshwater) wetland types, modelled at a national scale, is assessed for an aquifer-dependent and groundwater Strategic Water Resource Area for reporting to Target 2. In addition, we compare the locality and extent of these interventions relative to finer-scale hotspot areas where degraded peatlands and transformed forested wetlands were quantified for this warm temperate to subtropical Maputaland Coastal Plain, totalling approximately 8 000 km². An innovative framework for the monitoring and reporting of interventions in this landscape is presented to address gaps, maximise opportunities and improve reporting of intervention actions towards target 2 of the GBF.

Presentation type

Talk

Affiliation

Council for Scientific & Industrial Research (CSIR), South Africa

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120009 - Monitoring and indicator framework for continental waters in Mexico

Melanie Kolb[1]

[1]Institute of Geography, UNAM, Mexico

Updated information on continental waters is key to affront the water crisis and to enable the science-policy bridge but remains scarce for most countries. This proposal aims to provide a framework for monitoring indicators related to hydrological ecosystem services (HES), as well as relevant information for several components of the socio-ecological system under scrutiny. Using hydrological ecosystem services allows to connect the supply of the ecosystems directly to water use and extraction, accounting for trade-offs among users and other services, as well as fostering stakeholder involvement. To generate knowledge as a basis for informed decision making in the 21st century, a hierarchical indicator framework is proposed, that in a second step can be populated with data generated by different sampling techniques. The use of this indicator framework provides guidance towards the efficient generation of data, information and knowledge for managing HES by 1) centering the first level of variables on water quality and quantity and biodiversity, 2) focusing on complementing monitoring techniques, including low and high tech options, and citizen science, that need to be implemented in a transdisciplinary and interinstitutional set up in the second level and 3) considering the local context and stakeholders, monitoring sites and frequency could be established. The concrete development of underlying conceptual frameworks (complex systems theory expressed in ecosystem integrity and ecosystem criticality, earth system dynamics), multiple sampling techniques and transdisciplinary science for governance are presented.

Presentation type

Talk

Affiliation

Institute of Geography, UNAM, Mexico

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

1200031 - Urban wetlands: biodiversity reservoirs or ecological traps?

Thamarasi Aththanayaka[1], Brian Hayden[1], Gregory Mitchell[2], Donald Baird[3]

[1]Department of Biology, University of New Brunswick, [2]Wildlife Research Division, Environment & Climate Change Canada, [3]Water Science & Technology Directorate, Environment & Climate Change Canada

Urban wetlands are increasingly important as habitats for riparian aerial insectivorous birds and bats due to the reduction of natural space in urban environments. Recent research has indicated that both of these animal groups are in major decline in Canada, and globally. Aerial insectivores depend on a critical habitat provisioning service - emerging benthic insect biomass from wetlands - which supplies essential fatty acids not available from terrestrial prey. Yet urban wetlands remain under constant anthropogenic pressure, notably in terms of chemical contamination.

We are studying a set of seven discrete urban floodplain wetlands within the City of Fredericton, in New Brunswick, which includes at least one site which is significantly contaminated with heavy metals. Our study examines biodiversity-ecosystem function relationships within the wetland benthic community, how this is influencing habitat provisioning for aerial insectivores in terms of food quantity (emergent biomass) and quality (fatty acid content), and how these factors are reflected in the composition and abundance of bird and bat assemblages over the bird breeding season (May - July). The aim of our study is to assess the relative costs and benefits of 'urban living' across an established contamination gradient, and to assess the role of urban wetlands as ecological traps.

Presentation type

Poster

Affiliation

Department of Biology, University of New Brunswick

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120010 - Correcting biases in remotely-sensed surface water to map global dynamics in wetland ecosystem extents over three decades

Ruben Remelgado[1], Carsten Meyer[2]

[1]TU Dresden, Germany, [2]German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig

Non-marine aquatic ecosystems are central to biodiversity protection, water provision, flood regulation, and climate-change mitigation. Diverse science and policy applications related to aquatic ecosystems, not least of all ecosystem monitoring, depend on reliable time-series data on different ecosystems' areal extents. Here, satellite remote sensing of permanent and seasonal surface water provides crucial inputs. Yet, spatially uneven and gradually improving data coverage in historical satellite archives translate into inconsistencies in existing surface-water time-series, leading to biased perceptions of globally increasing surface-water extents. In this talk, I will present a global time-series product that consistently captures the annual dynamics (since 1992) in areal extents of different aquatic ecosystems, as distinguished in the RAMSAR wetland typology. As a key input for our ecosystem mapping, we modeled bias-corrected annual surface-water extents (including that underneath vegetation or in deep gorges that are invisible to remote sensing) based on quality-filtered, remotely sensed reference data of permanent/seasonal water occurrences and relevant hydrological covariates (e.g., precipitation regimes, stream topography, basin-wide land cover). We assessed the quality of the bias-corrected surface-water product via cross-validation of surface-water predictions and comparisons of long-term changes against those observed locally by gauge stations. To showcase the potential of the presented data, I will provide an overview of global and regional long-term directional changes as well as inter-annual fluctuations in areas of different aquatic ecosystem types.

Presentation type

Talk

Affiliation

TU Dresden

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120018 - Artificial Intelligence for monitoring climate change impacts on neotropical amphibians in a large-scale passive acoustic monitoring program

Juan Sebastián Cañas[1], Maria Paula Toro-Gómez[1], Diego Llusia[2], Larissa Sugai[3], Juan Sebastián Ulloa[1]

[1]Instituto Humboldt, [2]Universidad Autónoma de Madrid, [3]K. Lisa Yang Center for Conservation Bioacoustics Cornell Lab of Ornithology

As global climate change accelerates, the need to develop standardized biodiversity monitoring programs becomes increasingly urgent. An essential aspect of this effort is understanding the effects of climate change on anuran amphibians' reproductive behavior, specifically their calling activity and breeding phenology, which are influenced by climatic conditions. Passive acoustic monitoring (PAM) offers a promising approach to track these species traits. Since 2019, our collaborative, country-wide acoustic monitoring program in Brazil has been assessing the impact of climate change on neotropical amphibians. With the involvement of over 40 researchers, we have established an acoustic anuran observatory and leveraged artificial intelligence tools to enhance the program's efficiency and ecological insights. In particular, we show how the project is developing: (1) a high-quality dataset with the patterns of acoustic activity of neotropical amphibians; (2) a machine learning workflow to train, tune and deploy models capable of detecting species activity; (3) EBV-ready datasets (phenology, physiology, acoustic traits) for the class species traits; (4) predictions of changes in species behavior, distribution, and persistence based on a novel tool: acoustic species distribution models. By fostering collaboration between machine learning researchers and ecologists in biodiversity monitoring networks, this project aims to inform effective policies for climate change mitigation and biodiversity conservation.

Presentation type

Talk

Affiliation

Instituto Humboldt

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120003 - The South African Biodiversity Data Pipeline for Wetlands and Waterbirds (BIRDIE)

Francisco Cervantes (SANBI)[1], Nancy Job[1]

[1]South African National Biodiversity Institute

In the face of a crisis in biodiversity and ever-increasing pressure on our wetland ecosystems, waterbirds can serve as flagship monitoring indicators. Through cross-disciplinary collaboration, increased computer power, and the application of statistical ecology, this project hopes to achieve previously inaccessible insights and that the raw data might not reveal, about the distribution and population dynamics of waterbird species and their association with the wetlands that support them. The South African Biodiversity Data Pipeline for Wetlands and Waterbirds, affectionately named BIRDIE, is a multi-institutional collaboration. It aims to link nation-wide, citizen science-driven, waterbird data to conservation managers, researchers and other stakeholders and, through a constructed data pipeline, to support site management and decision making. At a national level, the outputs from BIRDIE will contribute to Red-Listing assessments and the National Biodiversity Assessment, and reporting on international commitments, such as the RAMSAR Convention on Wetlands of International Importance, the Agreement on the Conservation of African-Eurasian Migratory Waterbirds, and the Convention on Biological Diversity.

Presentation type

Talk

Affiliation

South African National Biodiversity Institute

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120001 - Optimising the use and impact of data from freshwater biodiversity surveys and monitoring programs for measuring progress towards the 2030 action targets

Eren Turak[1], Marc Pienaar[2], Thilina Surasinghe[3], Heidi van Deventer[4], Michele Walters[5]

[1]Freshwater BON (FWBON), [2]South African Observation Environmental Network (SAEON), [3]Department of Biological Sciences, Bridgewater State University, [4]Council for Scientific and Industrial Research (CSIR), [5]Department of Nature Conservation Tshwane University of Technology

Global measurement of freshwater biodiversity change is an ambitious task. Its success depends on optimising the use of resources and opportunities available for monitoring. We surveyed 125 researchers and practitioners involved in generating 189 data sets containing taxa occurrence records. The contributors to the survey included residents of 51 countries. We first evaluated the contribution of these datasets to nominated Kunming-Montreal Global Biodiversity Framework indicators, under the assumption that the data would only be used to measure the biodiversity variables that the data creators originally intended. Then, we explored how these datasets, including by-catch, might be used beyond the intended purpose, including to measure variables and indicators at the gene- and ecosystem-level. 42% of datasets was suitable for gene-level analyses, either because the sampling methods included molecular techniques that produced genetic information or because the specimens, besides being accessible, had been appropriately stored to ensure the integrity of the DNA is preserved. Furthermore, these datasets can contribute to track possible change in extent or integrity at the ecosystem-level. For example, 71 % and 12 % of the datasets had the potential to contribute to estimating changes in ecosystem integrity and ecosystem extent respectively. The incorporation of bycatch analysis, genetic information, and ecosystem-level data will enhance the contributions made by researchers and practitioners who record species occurrences. This is particularly valuable when these data creators possess a comprehensive understanding of how their data can generate additional information, beyond their initial expectations.

Presentation type

Talk

Affiliation

Freshwater Biodiversity Observation Network (FWBON)

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120012 - Challenges in assessing change and protection levels in river and wetland ecosystem types of Africa for reporting to target 1 and 3 of the GBF

Heidi van Deventer[1], Lukho Goso[2], Mpho Sadiki[2], Christel Hansen[2], Lindie Smith-Adao[1]

[1]Council for Scientific & Industrial Research (CSIR), South Africa, [2]University of Pretoria (UP), South Africa

The extent of river and inland wetland ecosystem types at a continental scale such as Africa, provides a critical overview of potential range-restricted extents and rate of decline for the headline indicator of monitoring - the red listing of ecosystems (RLE). Using the global ecosystem types of the International Union for Conservation of Nature (IUCN), we combine the Freshwater Ecoregions of the World with other global and continental datasets to determine the ability of mapping the extent of freshwater ecosystem types for Africa to the ecosystem functional group level. The extent of these types is then measured against the thresholds used for identifying range-restricted ecosystems at a continental scale. Subsequently, the integrity of these ecosystems will be determined. Owing to the lack of instream flow and water quality across the continent, available land cover datasets were used to assess the capability of quantifying changes for loss in the extent or integrity of these systems. The feasibility of using connectivity indices will be evaluated for reporting at a catchment scale. These results will be combined for reporting both to target 1 of the Global Biodiversity Framework (GBF) as well as determine rates of changes for RLE. In addition, we assess which of the river and wetland ecosystem types meet the 30% protection level of Target 3 of the GBF. The location of ecosystems with severe shortfalls are identified where interventions would be required by 2030. Recommendations to improved reporting and monitoring will be tabled.

Presentation type

Talk

Affiliation

Council for Scientific & Industrial Research (CSIR), South Africa

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120017 - Unlocking the potential of landscape images for freshwater biodiversity monitoring

Lars Iversen[1], Mette Bendixen[2]

[1]Department of Biology, McGill University, Montreal, Quebec, Canada., [2]Department of Geography, McGill University, Montreal, Quebec, Canada.

To track freshwater systems response to Global Change we need high resolution data across large extents to improve measures of land use change, track biotic changes and better understand the effects of conservation management. Remote sensing data is quickly improving and providing some of these needed data products. However, the orthogonal nature of much remote sensing data and the ground proofed information needed when appending biological information to such data introduce limitations. Further, they are still very limited in terms of identifying small freshwater species and the complexity of habitat types. Landscape images provide promising complements to airborne remote sensing for mapping habitat characteristics and biodiversity at the biologically relevant scales needed. Here we explore how capturing a landscape scene in a photo with a spatial and temporal reference, can provide a stepping-stone between large-scale remote sensing data and individual freshwater organisms. We show that opportunistic and unstandardized images of pond habitats combined with deep learning algorithms can be used to map the distribution of two protected amphibian species. We also find that detection probability depends on species life history strategies and the seasonal timing of the image acquisition. These results highlight the potential use of landscape and habitat images in species detection. Combined with citizen science approaches to data collection and deep learning algorithms for automating data extraction and synthesis, these datasets open the gates for achieving unprecedented new coverage of freshwater biodiversity.

Presentation type

Talk

Affiliation

McGill University

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120007 - The Vigilife programme - Sentinel Rivers

Vincent Prié[1, 2, 3], Manuel Lopes-Lima[2, 3], Loïc Pellissier[4, 5], Sébastien Brosse[6], Franck Pressiat[7], Baptist Mulot[8], Arnaud Collin[9], Tangi Corveler[9], Benjamin Allegrini[1], Tony Dejean[1, 9]

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The Global Life Observatory - Vigilife - is organised as an international alliance of public and private partners united by a mission, common goals and operating procedures. The Sentinel Rivers programme is part of Vigilife and aims to monitor the world's most important rivers with environmental DNA. The monitoring follows standardised protocols that are easy to replicate in time and space. These protocols are optimised from sampling to laboratory work. Sampling consists of bank to bank transects, pumping 60 litres of water per site. We run 12 PCR replicates and use high sequencing depth. Primers used are prokaryots and eukaryots to cover all life, mussels and fish as bioindicators of aquatic ecosystem quality, and vertebrates for charismatic species. The sampling plan is based on remote sensing, human footprints and changes in the hydrology of the river and its main tributaries.

The Maroni River, between French Guiana and Suriname, is the first Vigilife river. From the estuary to the headwaters, we sampled 600 km of river at 57 sites. We detected all bivalve species and 80% of the fish species known from the entire basin. We detected 63% of all known mammal species, including bats, and 86 bird species. This pilot project shows that, by using optimised protocols, it is possible to carry out efficient biodiversity surveys that can be replicated for long-term monitoring. The Vigilife Sentinel Rivers protocol is currently being replicated in South America, Europe, South East Asia and Africa.

Presentation type

Talk

Affiliation

CIBO, Biopolis

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120004 - The future of global river health monitoring

Lauren M. Kuehne[1], Chris W. S. Dickens[2], David Tickner[3], Mathis L. Messager[4, 5], Julian D. Olden[6], Gordon C. O'Brien[7], Bernhard Lehner[4], Nishadi Eriyagama[8]

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Rivers are the arteries of human civilisation and culture, providing essential goods and services that underpin water and food security, socio-economic development and climate resilience. They also support an extraordinary diversity of biological life. Human appropriation of land and water together with changes in climate have jointly driven rapid declines in river health and biodiversity worldwide, stimulating calls for an Emergency Recovery Plan for freshwater ecosystems. Yet freshwater ecosystems like rivers have been consistently under-represented within global agreements such as the UN Sustainable Development Goals and the UN Convention on Biological Diversity. Even where such agreements acknowledge that river health is important, implementation is hampered by inadequate global-scale indicators and a lack of coherent monitoring efforts. Consequently, there is no reliable basis for tracking global trends in river health, assessing the impacts of international agreements on river ecosystems, and guiding global investments in river management to priority issues or regions.

To address this gap, we present a comprehensive set of scalable indicators that can support “top-down” global surveillance of river health while also facilitating standardised “bottom-up” local monitoring efforts. We evaluate readiness of these indicators for implementation at a global scale and chart a road map for an adequate monitoring framework to be in place and implemented by 2030, with the potential for substantial enhancement by 2050. Lastly, we present recommendations for coordinated action and investment by policy makers, research funders and scientists to develop and implement the framework to support conservation and restoration of river health globally.

Presentation type

Talk

Affiliation

Department of Geography, McGill University, Montreal, QC, CANADA; RiverLY research unit, National Research Institute for Agriculture, Food and Environment (INRAE), Lyon, FRANCE

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120006 - Establishing eDNA freshwater biomonitoring in Hong Kong

Mathew Seymour[1]

[1]The University of Hong Kong

Rivers are among the most threatened ecosystems, yet they provide immense value in the ecosystem services they provide. While taxonomy and biological quality elements (BQEs) are established to provide riverine ecological assessment, they are limited by the morphotaxonomic methods presently employed. Advancements in high throughput sequencing now enable high-resolution ecological assessment using Environmental DNA (eDNA). Establishing whether eDNA is suitable for environmental assessment is has rapidly drawn increase interested but has yet to be incorporated in many areas including Hong Kong. Here we present the current efforts to establish eDNA freshwater biomonitoring efforts in Hong Kong including two multi-year studies on 1) freshwater macroinvertebrates and 2) Hong Kong wide Chironomidae assessment at the eDNA and eEcology lab (seymourlab.net).

Presentation type

Talk

Affiliation

The University of Hong Kong

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120015 - Community-science data as a yardstick of effectiveness in wetland restoration: eBird data as a proxy of avifaunal community structure in restored wetlands

Christine Santos[1], Thilina Surasinghe[1]

[1]Bridgewater State University

Restoration lays the foundation to transition impaired wetlands into ecologically functional, self-sustaining ecosystems. While the practice of wetland restoration is gaining popularity among environmental stewards, how wetland restoration help recuperate eroded biodiversity remains understudied. The timescale of ecological processes underlying restoration, the novelty of restoration practice, ill-defined restoration targets, inadequate systematic monitoring, and lack of mandates and funding for monitoring inhibit empirical assessments of restoration success. Scientifically rigorous assessments on restoration effectiveness are critical to advance both the theory and practice of wetlands restoration and to incorporate restoration into wetland-oriented policies. In this study, using eBird community-science data, we explored how avifaunal communities vary across wetlands in various restoration states (impaired, passively naturalized, and fully restored). We collected bird occupancy data from three counties in southeastern Massachusetts from 2015-2022 from eBird and pipelined the bird occupancy data for 16 sites, filtered observations <5 hours which included <10 observers with transects lengths <5km, and converted the presence-only data into presence-absence matrix. The Generalized mixed-effects models we ran identified restoration status as a significant predictor of both bird species richness and abundance where fully restored wetlands had the greatest species richness and abundance. Both metrics showed improvements as time passes since restoration. This information can be helpful for future policies and management actions related to wetland restoration and conservation in Massachusetts. Our study showed how citizen science data can be effectively tooled as a yardstick of restoration success.

Presentation type

Talk

Affiliation

Department of Biological Sciences, Bridgewater State University, MA, USA

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

1200033 - Role of citizen science and traditional knowledge in biodiversity monitoring

Pradeep Mehta[1, 2, 3, 4]

[1]Member of FWBON, [2]Regional Representative WCPA, [3]Member of IUCN CEM, [4]Member of IUCN CEC

Citizen science and indigenous knowledge are of utmost importance when it comes to biodiversity monitoring. Science requires long-term monitoring, which is impossible with a handful of scientists with limited resources. Citizen science bridges this gap by involving the local communities in long-term monitoring. Citizens can be trained and engaged in biodiversity monitoring which could be used for long-term planning, actions, and policies.

Traditional knowledge, especially indigenous knowledge systems also plays a very important role in biodiversity monitoring as they have been sustainably using local species for ages and have immense knowledge of local biodiversity. Indigenous communities around the globe have immense knowledge of the local biodiversity and its uses. This knowledge could be utilized not only to monitor but also to monitor the impact of climate change and sustainable utilization of bio-resources. They have been the custodians of biodiversity but have been devoid of the actual benefits as per Nagoya Protocol. By involving them, they could be benefitted from ABS (Access and Benefit Sharing).

Presentation type

Poster

Affiliation

CHINAR

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

120008 - DNA barcode a tool for genetic identity and phylogeography study: Case study of Barilinae fish Opsarius bendelisis (Hamilton, 1807) from South Asia

Pranab Gogoi[1], Kavita Kumari[1], Archana Sinha[1], Suresh V.R.[1], Simanku Borah[1]

[1]ICAR-CIFRI

The present study investigated the genetic identity and phylogeography of *Opsarius bendelisis* reported from South Asia *i. e*. India, Nepal, and Bangladesh. Bayesian phylogenetic approach, species delimitation, and genetic divergence estimate based on cytochrome oxidase subunit (COI) sequence along with morphometric and meristic data established the identity of *O. bendelisis* from widespread geographical location. For 160 COI sequences, reported from North-Eastern India, Eastern India, Northern India, Central-Western India, Southern India, Bangladesh, and Nepal, 28 haplotypes were identified by Dna SP v6. h3 and h14 were the most frequent haplotypes and were shared by individuals from North-East India, Eastern India, and Bangladesh. Analysis of molecular variance (AMOVA) showed significant differences among and within the population. Most of the populations of *O. bendelisis* showed less gene flow and high differentiation. Neutrality tests showed no significant demographic expansion, except for Central-Western India. A median-joining network analysis and Maximum Likelihood (ML) phylogeny of haplotypes displayed an apparent geographical pattern suggesting a significant phylogeographic structure in the population. The findings provide valuable information for accurate estimation of diversity, conservation, and management of *O. bendelisis*.

Presentation type

Talk

Affiliation

ICAR-CIFRI

Session

Innovative Approaches to Monitoring, Documenting, and Communicating Change in Freshwater Biodiversity

Remote Sensing for Biodiversity Monitoring

160006 - Ecosystem Explorers: a novel method combining remote sensing and citizen science for priority habitat mapping and biodiversity monitoring

Samantha Suter[1], Natalie Welden[1], Brian Barret[1]

[1]University of Glasgow

As we globally tackle the ecological crisis, continuous calls are made for an integrative approach to biodiversity monitoring. Two of the largest applications in environmental monitoring include remote sensing and citizen science that can improve spatial and temporal reach, address financial constraints, and heighten research impact and knowledge exchange. Uniting the public with researchers to utilise improvements in remote sensing for earth observation has great potential that is currently not being achieved. We aimed to address this gap and maximise the benefits both remote sensing and citizen science tools can bring by creating a new biodiversity monitoring approach. Here, we describe our research involving the establishment of a novel citizen science survey that uses earth observation (Sentinel-2 satellite imagery for habitat classification mapping) to help locate a priority habitat - species-rich grasslands, across Scotland. The methodology outlines an approach to further enhance global habitat and vulnerable species monitoring as a new biodiversity observing system, demonstrating the potential of combining citizen science and remote sensing. We highlight how utilising open-source technologies and participatory research has wide-scale applicability across lower income nations to democratise science for local community empowerment and improve biodiversity literacy and conservation agency. The results support the involvement of stakeholder and community engagement to enable scientific communication and how collaboration has the potential to inform local to global policy. This research outlines an innovative tool for global biodiversity monitoring across habitats and species to be used by stakeholders, NGOs, and governments.

Presentation type

Talk

Affiliation

University of Glasgow

Session

Remote Sensing for Biodiversity Monitoring

160004 - Satellite imagery, remote sensing and GIS use in estimating biomass of aquatic vegetation

Arrey Blanden Arrah[1], Nchayi Darille Ndah[2]

[1]Green Lead Avocacy for Research and Development, [2]Banyang-Mbo Wildlife Sanctuary, National Forest Reserve Cameroon

The research project exploited the possibilities to estimate the biomass of aquatic vegetation in a shallow lake using satellite image. An image, with one infrared and three visible bands, was exploited in this research project. The project was carried out in the Municipal lake of the city of Yaounde-Cameroon. The ArcMap and ERDAS IMAGINE software packages were used for image processing and spatial analysis. Biomass estimation or prediction from the image was carried out using six combinations of multispectral band ratios and NDVI. The spectral indices were extracted and predictive equations for biomass generated using simple linear and quadratic regression models. This research project gave the following results; (i) biomass map and biomass estimated from satellite image (ii) relationship between measured biomass and remote sensing estimated biomass in the study area. There was significant positive correlation (r=0.62, p=0.001) between measured biomass and remote sensing estimated biomass found in sandy and clayey soils. The ratio of band 1/band 3 gave the strongest relationship (r=0.62, p=0.001). Testing the simple linear (r2=0.41, p=0.001) and quadratic models (r2=0.52, p=0.001) this band ratio also gave the best fit and it was used for biomass prediction. The quadratic model predicted more biomass and yielded slightly higher prediction error (RMSE=2.28) than the linear model (RMSE=2.21). About 90% of the predicted biomass of both models gave approximately 10% higher biomass as compared to the measured biomass.

Presentation type

Talk

Affiliation

Ministry of Scientific Research and Innovation/National Institute of Cartography, Cameroon.

Session

Remote Sensing for Biodiversity Monitoring

1600034 - Integrated monitoring strategies for biodiversity conservation - a case study from India

S.K. Sharma[1]

[1]Doon Valley International School, Dehradun, India

India, because of its unique biogeographic location, is ranked tenth in its species-richness and endemism amongst the biodiversity-rich countries but due to anthropogenic activities coupled with the increasing human population have led to a grim biodiversity scenario. Numerous important plant and animal species that facilitate ecosystem functions are on the verge of extinction, while others are threatened or vulnerable. Himalayan forests in the State of Uttarakhand in India meet the major part of the energy needs causing massive deforestation, and adversely affecting the ecosystem functioning of the region. In a bid to assess the threats to different species as a result of ongoing landscape changes, the State is now using state-of-the-art space-based satellite technology. Utilization of spatial and temporal analysis tools of the GIS and RS are helping to determine the rates, causes, and scale of biodiversity loss. Monitoring and assessing the damage of the Himalayan region through satellite imagery is more relevant than physical land verification because most of the areas are inaccessible due to poor communication. Satellite imagery of the present land cover has helped in dividing the region into three micro zonations. Thus, the recently acquired satellite images on a 1: 50,000 scale have been used to prepare thematic maps depicting land use, in otherwise, difficult and unapproachable terrain. Remote sensing has provided the most efficient tool available for determining landscape-scale elements of biodiversity, such as the relative proportion of matrices and patches and their physical arrangement.

Presentation type

Poster

Affiliation

Doon Valley International School, Dehradun, India

Session

Remote Sensing for Biodiversity Monitoring

1600032 - AI-generated data augmentation for automated muskox detection and counting

Simon Durand[1, 2], Jérôme Théau[1, 2], Samuel Foucher[1]

[1]Université de Sherbrooke, [2]Quebec Centre for Biodiversity Science

The muskox (*Ovibos moschatus*) holds a significant role in the Arctic, encompassing sociocultural, economic, and ecological aspects. However, effectively monitoring muskox populations is a difficult task due to various challenges associated with data acquisition. Consequently, important demographic parameters are often lacking or imprecise. Encouraging advancements in animal detection present considerable potential for enhancing the accuracy and efficiency of detection and counting methods. This study aims to assess the effectiveness of an object detection model in automating the detection and counting of muskox populations using nadir aerial imagery and ultimately, to extend this approach to satellite imagery.

An object detection model was initially developed to detect muskoxen in nadir aerial imagery, which shares a similar configuration to satellite imagery. Approximately 90 nadir-like aerial images were obtained from various locations, with a majority originating from the province of Quebec. However, the limited availability of samples for model training raises the potential risk of overfitting. To address this risk, Few-Shot Learning strategies were implemented. Strategies used include classical data augmentation, which involves basic augmentation operations (e.g., translation, scaling, cropping, rotation), and advanced operations, which involve generating artificial images. Two convolutional neural networks, namely Faster R-CNN and HerdNet, were trained and compared. Preliminary findings indicate that HerdNet (f1-score: 92.6 %) outperformed Faster R-CNN (f1-score: 78.9 %) in muskoxen detection. This presentation will delve into the details of these performance differences based on augmentation operations and explore the potential for generalization to satellite imagery.

Presentation type

Poster

Affiliation

Université de Sherbrooke

Session

Remote Sensing for Biodiversity Monitoring

160005 - Mapping foliar functional traits at the Station de biologie des Laurentides with imaging spectroscopy

Alice Gravel[1], Etienne Laliberté[1]

[1]Université de Montréal

New approaches for monitoring the changing biodiversity of forest ecosystems are increasingly needed to study its ecological impacts. In recent years, ecologists have relied on the use of remote sensing to study vegetation at larger scales. Imaging spectroscopy enables the measurement of reflected light in hundreds of narrow bands to obtain a complete reflectance spectrum of each pixel of an image. Linking foliar traits to these remote sensing signatures allows ecologists to map vegetation canopy chemistry, providing valuable insights into the biochemical processes in forests. However, to our knowledge, methods to map foliar traits in forests of Quebec, Canada, have not been developed yet. This research project focuses on mapping leaf functional traits at the Station de Biologie des Laurentides using airborne imaging spectroscopy. Foliar samples from tree crowns were collected using a drone platform to gather leaf trait data. We used partial least squares regression (PLSR) models to predict leaf traits from reflectance spectra at the canopy-level. These PLSR models were then applied to each pixel of the hyperspectral imagery to produce high-resolution foliar trait maps for the entire 16-km^2 study area. Our results show that imaging spectroscopy combined with predictive models offer a promising tool for characterizing functional biodiversity and monitoring forest ecosystems in Quebec. This project contributes to the extensive research aiming to use remote sensing to assess and monitor forest biodiversity at larger scales.

Presentation type

Talk

Affiliation

Laboratoire d'écologie fonctionnelle végétale (LEFO)

Session

Remote Sensing for Biodiversity Monitoring

160001 - Project AMAZECO: Covering the Amazon with an Ecosystem Structure Essential Biodiversity Variable (EBV) product combining satellite and airborne LIDAR

Ruben Valbuena[1], Danilo R. A. Almeida[2], Mauro Assis[3], Eric B. Gorgens[4], Carlos A. Silva[5], Jean Ometto[6], Michael Keller[7]

[1]Swedish University of Agricultural Sciences (SLU), Sweden; Bangor University, UK, [2]Bangor University, UK; Luiz de Queiroz College of Agriculture, University of São Paulo (USP/ESALQ), Piracicaba, SP, Brazil, [3]Earth Observation and Geoinformatics Division, National Institute for Space Research (INPE), São José dos Campos, Brazil; Departament of Forest Engineering, Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM), Brazil, [4]Departament of Forest Engineering, Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM), Brazil, [5]University of Florida, USA, [6]Earth Observation and Geoinformatics Division, National Institute for Space Research (INPE), São José dos Campos, Brazil, [7]International Institute of Tropical Forestry (US Forest Service), USA; Jet Propulsion Laboratory (NASA), USA

The AMAZECO project helps governments use LIDAR data for their conservation and sustainable development purposes, in a globally harmonized manner, to ensure all information can be used for monitoring UN 2030 Global Sustainable Goals. We aim to transform the sheer amount of data available through LIDAR surveys into simple information describing ecosystems that can be meaningful and easy to conceptualize by decision- and policy-makers. Our vision is a crowdsourced global product fed from local efforts, by creating tools to facilitate local stakeholders to use these data for their conservation and sustainable development purposes, empowering local action while enabling a globally-harmonized product. We concentrate on ecosystem vertical profiles (EVPs), which characterize the vertical distribution of sessile biological entities in an ecosystem. We can deliver platform-independent EVP traits from both satellite and airborne LIDAR sensors and provide the means for a global ecosystem structure LIDAR product that can be crowdsourced through Biodiversity Observation Networks (BONs). This was enabled by high performance computing (HPC) workflows for common satellite and airborne LIDAR derivation of ecosystem traits, producing and implementing a first prototype product covering the whole of the Amazon region with traits produced from combined satellite and airborne LIDAR. The product consists of multilayered raster data products with LIDAR measures of EVP traits, estimations of their uncertainties and a demonstration of how airborne LIDAR can be used to improve those over a satellite product. The code developed has procedures incorporated in the rGEDI package and HPC pipelines to enable replication in national BONs.

Presentation type

Talk

Affiliation

Swedish University of Agricultural Sciences (SLU), Sweden; Bangor University, UK

Session

1600033 - Detecting changes: using drones and artificial intelligence to identify biodiversity in Quebec's peatlands

Charles Picard-Krashevski[1], Etienne Laliberté[1], Mickaël Germain[2]

[1]Université de Montréal, [2]Université de Sherbrooke

Today, more than ever, the environmental situation is at a critical level. Science clearly shows that it's time to act to counter global warming, but an obvious problem holding back research is the lack of environmental data on a planetary scale. In order to get data of this magnitude, the only possible methods are satellite imagery or even aircraft flight. However, these methods offer very low spatial resolution, and identifying plant species from these data is virtually impossible. On the other hand, a botanist taking data in the field may have excellent spatial resolution but can only cover a very small area. The aim of this project is to see how the use of drones and the training of convolutional neural network models could help in data acquisition for plant biodiversity monitoring in peatlands. To achieve this, the project will be divided into two parts: the identification of shrub species and the identification of arboreal species. Since shrub species are smaller in size, they will be detected using multi-label classification while the arboreal species will be detected using object detection. In order to obtain a more generalized model, images were taken in different peatlands in 13 administrative regions of Quebec. These images are then annotated, and a model is trained to recognize these species. If successful, this project will make it possible to identify the vegetation of much larger territories much faster, without depending as much on the availability of expert botanists for data acquisition.

Presentation type

Poster

Affiliation

Université de Montréal

Session

Remote Sensing for Biodiversity Monitoring

160007 - The Global Biodiversity Standard: opportunities and challenges of remote sensing to assess restoration sites for impacts on biodiversity conservation and restoration

David Bartholomew[1], Kiran Baldwin[2], Luiz Henrique Rondina Baqueiro[3], George Gann[4], Jose Manuel Mamani[5], Amarizni Mosyaftiani[4], Narindra Ramahefamanan[6], Paul Smith[1]

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Ensuring degraded ecosystems are under effective restoration is a key target under the Global Biodiversity Framework. The Global Biodiversity Standard (GBS; https://www.biodiversitystandard.org/) is a new, site-based methodology designed to assess and certify the impacts of restoration projects on biodiversity, and to mentor practitioners to achieve better biodiversity outcomes. The methodology for assessing and certifying projects combines remote-sensing and ground surveys for biodiversity change. Whilst ground surveys provide an accurate assessment of current conditions, remote sensing provides a critical tool for assessing historical changes in biodiversity.

Projects applying for certification under the GBS are assessed under the 21 sub-attributes of the six key ecosystem attributes of the ecological recovery wheel from the SER Standard. This wheel outlines the essential characteristics of an ecosystem that must be restored. Advances in remote sensing provide opportunities to understand historical trends in many of these sub-attributes or can identify proxy sites to measure them. Whilst some sub-attributes are easily assessed, many remain difficult to assess using remote sensing, highlighting key areas where future remote sensing advances should focus.

The GBS methodology is being tested by 'GBS hubs' in Brazil, India, Kenya, Madagascar, Peru, and Uganda. Testing has spanned a wide range of landscape interventions, including plantations, agroforestry, natural regeneration, and the ecological restoration of native ecosystems and a wide range of ecosystems, including forests, savannas and wetlands. Here, we present findings from the testing phase, including the opportunities and challenges of using remote sensing for monitoring biodiversity change.

Presentation type

Talk

Affiliation

Botanic Gardens Conservation International

Session

Remote Sensing for Biodiversity Monitoring

1600031 - Integration of drone remote sensing and deep learning image processing for heronries census in Quebec

Camille Dionne-Pierre[1, 2], Jérôme Théau[1, 2], Samuel Foucher[1], Jérôme Lemaître[3], Mathieu Varin[4], Maxime Brousseau[4]

[1]Université de Sherbrooke, [2]Centre de la science de la biodiversité du Québec, [3]Ministère de l'Environnement, de la Lutte contre les changements climatiques, [4]Centre d'enseignement et de recherche en foresterie de Sainte-Foy

The great blue heron (*Ardea herodias*) is considered as an indicator of the quality of wetlands and aquatic environments. Its monitoring allows assessing the impacts of anthropogenic pressures on these precious ecosystems. Monitoring of colonial waterbirds populations can be complex, considering their sensitivity to disturbances, the difficult access to their habitat, and the complexity of their environment. Currently, the great blue heron is monitored by helicopter in Quebec, requiring significant costs. Several studies on wildlife detection have shown the potential of imagery acquired by drone for wildlife monitoring. Furthermore, object detection methods based on convolutional neural networks (deep learning) have also shown promising results to improve detection of animals using different types of imagery and accelerate data manipulation.

The objective of this project is to use the full potential of imagery, remote sensing and deep learning to optimize the current census methods of heronries in Quebec. Visible and thermal imagery of heronries were acquired by drone during summer of 2023. This presentation will describe the processing pipeline as well as preliminary results of nest and heron detections. We predict that the convolutional neuronal networks based models will accurately detect the herons and their nests on drone acquired imagery. Based on the results of this project, recommendations will allow the optimisation of the procedures concerning the heronries census in Quebec.

Presentation type

Poster

Affiliation

Université de Sherbrooke

Session

Remote Sensing for Biodiversity Monitoring

160003 - Influence of temperate forest autumn phenology on segmentation of tree species from UAV imagery using Deep Learning

Myriam Cloutier[1, 2], Etienne Laliberté[1, 2], Mickaël Germain[3]

[1]Université de Montréal, [2]Institut de recherche en biologie végétale, [3]Université de Sherbrooke

Remote sensing of forests has become increasingly accessible with the use of unoccupied aerial vehicles (UAV), allowing for repeated high-resolution imagery. When used with deep learning, forest monitoring can be done at larger spatial and temporal scales and capture phenological changes. In temperate forests during autumn, leaf senescence happens when leaves change colour and drop. The timing of senescence varies according to species, age group and environmental conditions. However, the influence of leaf senescence in temperate forests on tree species segmentation using a Convolutional Neural Network (CNN) has not yet been evaluated. We acquired high-resolution UAV imagery over a temperate forest in Quebec, Canada on seven occasions between May and October 2021. We segmented and labeled 22 000 tree crowns from 14 different classes to train and validate a CNN for each imagery acquisition. The CNN-based segmentation showed the highest F1-score at the start of leaf colouring and the lowest F1-score at peak fall colouring. The timing of the different events occurring during senescence, such as leaf colouring and leaf fall, varied substantially between species and within species, leading to higher variability in the remotely-sensed signal. On the contrary, both deciduous and evergreen tree species that presented distinctive and constant traits between individuals were better classified. While UAV imagery and deep learning can provide accurate tree species predictions, tree segmentation in a heterogenous forest with variable conditions remains challenging. The consideration of these factors can lead to optimized UAV data acquisition for tree segmentation in temperate forests, especially during senescence.

Presentation type

Talk

Affiliation

Université de Montréal, Institut de recherche en biologie végétale

Session

Remote Sensing for Biodiversity Monitoring

160002 - Forest functional diversity-productivity relationships revealed by RS-EBVs

Zhaoju Zheng[1], Yuan Zeng[1], Bernhard Schmid[2], Dan Zhao[1], Meredith Schuman[2], Felix Morsdorf[2]

[1]State Key Laboratory of Remote Sensing Science, Aerospace Information Research Institute, Chinese Academy of Sciences, [2]Remote Sensing Laboratories, Department of Geography, University of Zurich

Spatially explicit data of plant functional traits and diversity are essential for understanding biodiversity effects on ecosystem functioning. Combining airborne LiDAR and imaging spectroscopy allows mapping of individual-level trait variation, showing great potential for developing species traits EBVs, but is usually constrained to local or regional scales. To scale-up functional diversity assessments, we derived per-pixel community-level functional traits (community-weighted means, CWMs) by combining Sentinel-2 satellite 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 by moving window approach. Finally, we investigated the influence of single-trait CWMs, multi-trait FD indices and environmental variables on remotely-derived aboveground ecosystem carbon stocks (aboveground biomass, AGB) and primary productivity (kernel normalized difference vegetation index, 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 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 the relationship between trait diversity and ecosystem functioning across large, contiguous areas.

Presentation type

Talk

Affiliation

State Key Laboratory of Remote Sensing Science, Aerospace Information Research Institute, Chinese Academy of Sciences

Session

Remote Sensing for Biodiversity Monitoring

AI for Insect Monitoring

190001 - A machine learning pipeline for automated insect monitoring

David Rolnick[1]

[1]McGill University

As insect populations crash, hard data on insect abundance and biodiversity remains woefully inadequate. Camera traps, conventionally used for monitoring terrestrial vertebrates, are now being modified for insects, especially moths. We describe a complete machine learning-based software pipeline for automated monitoring of moths via camera traps, including object detection, moth/non-moth classification, fine-grained identification of moth species, and tracking individuals. We believe that our tools, which are already in use across three continents, represent the future of massively scalable data collection in entomology.

Presentation type

Talk

Affiliation

McGill University

Session

AI for Insect Monitoring

190002 - Lesson learned from implementing a network of automated insect-monitoring systems in north-eastern North America

Maxim Larrivée[1]

[1]Montreal Insectarium

Insect biodiversity has declined globally in recent decades and there is mounting evidence that this decline is accelerating. A large-scale collapse of insect biodiversity would have important consequences on many ecosystem services we rely on. To date, insect monitoring has been hampered by the large number of individuals, high diversity in samples and a lack of trained experts along with many technical challenges to ensure consistent and standardized insect monitoring. Recent major advances in automated sensors, deep learning and computer vision offer the best practical and cost-effective solution for more standardized monitoring of insects across the globe. Here I present the lessons learned, challenges and the unique opportunities from an insect biodiversity monitoring stand point that have arisen from the implementation of automated monitoring of insects systems in north-eastern North-America.

Presentation type

Talk

Affiliation

Montreal Insectarium

Session

AI for Insect Monitoring

190003 - The AMI-trap: an AI-assisted scalable system for long-term, autonomous monitoring of moths

Grace Skinner[1], Tom August[1], Alba Gomez Segura[1], Simon Teagle[1], Dylan Carbone[1], Jenna Lawson[1], David Roy[1]

[1]UK Centre for Ecology & Hydrology

Rapid changes in insect populations around the world have sparked growing concern given the implications on global ecosystem health and food security. To date insects have been underrepresented in biodiversity studies compared to vertebrates due, in part, to difficulty in identifying individuals to species level. The resulting knowledge gaps (both geographic and taxonomic) highlight the need for a practical and cost-effective system for monitoring insects at scale.

The AMI-Trap (Autonomous Monitoring of Insects) has been developed to address this need. Building upon the original design by Aarhus University, UKCEH and partners have engineered a resilient, reliable, and scalable system which uses UV lighting and a high-resolution camera to attract and photograph moths. The images are inputted into a machine learning pipeline to detect, track, and classify individuals, informing on species presence, relative abundance, and trends over time.

The AMI-trap offers a non-lethal, time-efficient, and more standardised alternative to manual collection, sorting, and classification of insects by experts. Its autonomous operation allows for monitoring in hard-to-reach places, facilitating a more complete understanding of insect biodiversity. This knowledge is needed to identify drivers and interventions to curtail further loss.

We will present results that contrast AMI-trap results with those collected via traditional monitoring methods to highlight the opportunities and challenges that this technology presents. With AMI-trap deployments being rolled out globally in the near-future, we will explore the ecological questions that this new tool allows us to answer, such as how UK land composition and farm management practices affect moth biodiversity.

Presentation type

Talk

Affiliation

UK Centre for Ecology & Hydrology

Session

AI for Insect Monitoring

190004 - Globally standardised biodiversity monitoring with image-recognition of species

Toke Thomas Høye[1]

[1]Aarhus University

Advances in computer vision and deep learning can improve our understanding of ecological responses to environmental change such as the potentially global insect decline. Cameras can effectively, continuously, and non-invasively observe species throughout diurnal and seasonal cycles. Deep learning models trained on such image data can provide estimates of abundance, biomass, and diversity. Further, deep learning models can quantify variation in phenotypic traits, animal behaviour, and species interactions. Novel camera-enabled monitoring systems hold the potential to generate automated and globally standardised species observations. However, to reach this transformative goal, international collaboration and coordination on a range of outstanding challenges is critical. Such challenges include defining minimal requirements and standards for hardware design, recording software, metadata collection, machine learning models, analyses pipelines, and the integration with existing monitoring programs. I will present current steps towards continental and global collaboration on these challenges and highlight future research avenues to facilitate the transition of these technologies from the current level of demonstration to broad scale application in biodiversity monitoring. I will give examples of applications from mapping of invasive alien plant species along road networks and an emerging global network for monitoring moths using camera traps.

Presentation type

Talk

Affiliation

Aarhus University

Session

AI for Insect Monitoring

190005 - DIOPSIS: Digital Identification of Photographically Sampled Insect Species

Chantal Huybers[1]

[1]Naturalis

Insects represent the largest percentage of all organisms in the world, but their populations are in rapid decline. To improve our understanding of trends in insect species occurrence and abundance, automated monitoring systems can provide a non-invasive, cost-effective, and standardised method. Here we present the DIOPSIS v2 system, a fully autonomous camera system designed for monitoring flying insects both during day and nighttime. The camera takes photos of insects attracted to a yellow screen, which can be oriented horizontally or vertically. Built in LED lights attract insects, especially and enable nighttime detections. A 4G connection and solar panels make these cameras work completely autonomously in field locations. Specialised deep learning software is developed to analyse the images for insect detection, classification and biomass estimates. DIOPSIS cameras have been used in the Netherlands since 2019, with over 150 cameras deployed across various locations nationwide. Here we present an overview of the system and its implementation for analysing insect trends in various landscapes.

Presentation type

Talk

Affiliation

Naturalis

Session

AI for Insect Monitoring

190006 - A step towards worldwide biodiversity assessment: The BIOSCAN-1M Insect Dataset

Zahra Gharaee[1]

[1]University of Waterloo

In an effort to catalog insect biodiversity, we propose a new large dataset of hand-labelled insect images, the BIOSCAN-1M Insect Dataset. Each record is taxonomically classified by an expert, and also has associated genetic information including raw nucleotide barcode sequences and assigned barcode index numbers, which are genetically-based proxies for species classification. This dataset presents a curated million-image dataset, primarily to train computer-vision models capable of providing image-based taxonomic assessment, however, the dataset also presents compelling characteristics, the study of which would be of interest to the broader machine learning community. Driven by the biological nature inherent to the dataset, a characteristic long-tailed class-imbalance distribution is exhibited. Furthermore, taxonomic labelling is a hierarchical classification scheme, presenting a highly fine-grained classification problem at lower levels. Beyond spurring interest in biodiversity research within the machine learning community, progress on creating an image-based taxonomic classifier will also further the ultimate goal of all BIOSCAN research: to lay the foundation for a comprehensive survey of global biodiversity. Our paper introduces the dataset and explores the classification task through the implementation and analysis of a baseline classifier.

Presentation type

Talk

Affiliation

University of Waterloo

Session

AI for Insect Monitoring

190007 - Automatic classification of pollinator insects using deep learning

Swapna Purandare[1]

[1]Indraprastha Institute of Information Technology

Pollinator insects play a key role in the sustainability of ecosystems by pollinating and regenerating flowering plants. However, pollinator insects are declining all over the world due to anthropogenic factors such as the use of pesticides, habitat loss, and changes in land use. A further decline in pollinator insects has been predicted in the wake of climate change. It is important to conserve insect pollinators to sustain the stability of ecosystems. The first step in the process of insect pollinator conservation is to survey their diversity and abundance at various spatial and temporal scales. The current insect collection methods are invasive as they require insects to be killed and preserved for documentation purposes. An alternate non-invasive method is to collect images of insects and use the images for documentation and diversity assessment. However, insect classification and identification are labor-intensive tasks requiring a high level of expertise in taxonomy. To address this challenge, we developed an automated system to classify insect pollinators by using deep learning techniques. We chose the transfer learning approach that uses Convolutional Neural Networks (CNN) to classify the field-taken images of flower visiting insects. We expect this automated classification system to help improve the efficiency of the insect monitoring process and aid in their conservation.

Affiliation

Indraprastha Institute of Information Technology

Presentation type

Talk

Session

AI for Insect Monitoring

190008 - Statistical solutions for dealing with the imperfect detection ability of automated insect monitoring systems: some examples applied to moth traps

Marc Bélisle[1]

[1]Université de Sherbrooke

Recent advances in automated detection and recognition of insects offer unprecedented monitoring possibilities but these are not without challenges in terms of data analysis. Despite efforts to standardize protocols, the ability to detect individuals or species will remain dependent on many variables including weather, time of day, habitat, species, and technology used (e.g., trap dimensions and placement, light source). Such variations in detection probability induce bias in typical estimators used to analyze insect data like generalized linear (mixed) models. For instance, the non-detection of individuals leads to variations in the proportionality between counts of individuals and actual abundance, which in turn bias estimates of population trends or comparisons between sites or habitats. To overcome these issues, we advocate the simultaneous estimation of both ecological (state or vital rate) and observation processes with hierarchical models inspired from capture-mark-recapture theory. Using data collected from automated moth traps, we illustrate how such analyses can be used to estimate quantities such as unbiased site occupancy through time as well as species-specific species detectability. We also discuss how these models can be implemented as well as some of their crucial assumptions along with how they can also be used to address misidentifications.

Presentation type

Talk

Affiliation

Université de Sherbrooke

Session

AI for Insect Monitoring

190009 - Automated distance estimation for large-scale population density modeling

Timm Haucke[1]

[1]Massachusetts Institute of Technology

Frameworks such as the Random Encounter Model or Camera Trap Distance Sampling enable accurate animal population density modeling using camera traps. However, these frameworks usually require estimating parameters, such as the average movement speed of the animal or the effective detection distance of the camera, from the captured images. Both parameters can be inferred by first estimating the distances between the camera and captured animals. This has traditionally been done manually, which makes the application of these frameworks to large datasets prohibitively costly. To address this, we propose a computer vision workflow to compute camera-animal distances automatically using monocular depth estimation. To obtain good distance estimations, we introduce a robust scene calibration procedure which uses objects at known distances. We find that the parameters obtained by our method result in population density estimates that are highly similar to what is obtained using the manual approach. Finally, we make our distance estimation method accessible to practitioners by providing open-source command-line and graphical user interface implementations.

Presentation type

Talk

Affiliation

Massachusetts Institute of Technology

Session

AI for Insect Monitoring

190010 - Embracing behavioral variability for data-driven classification of firefly flash patterns

Owen Martin[1], Chantal Nguyen[1], Raphael Sarfati[1], Dieu My Nguyen[1], Michael Iuzzolino[1], Murad Chowdhury[1], Ryan Lauer[1], Orit Peleg[1, 2]

[1]University of Colorado Boulder, [2]Santa Fe Institute

Many nocturnally active fireflies use precisely timed bioluminescent patterns to identify mates, making them especially vulnerable to light pollution. As urbanization continues to brighten the night sky, firefly populations are under constant stress, and close to half of the species are now threatened. Ensuring the survival of firefly biodiversity depends on a large-scale conservation effort to monitor and protect thousands of populations. While firefly species can be identified by their flash patterns, current methods require expert measurement and manual classification and are infeasible given the number and geographic distribution of fireflies. Here we present the application of recurrent neural networks (RNNs) for accurate automated firefly flash pattern classification. Using recordings from commodity cameras, we can extract flash trajectories of individuals within a swarm and classify their species with a precision and recall of approximately seventy percent. In addition to scaling population monitoring, automated classification provides the means to study firefly behavior at the population level. We employ the classifier to measure and characterize the variability within and between swarms, unlocking a new dimension of their behavior. Our method is open source, and deployment in community science applications could revolutionize our ability to monitor and understand firefly populations.

Presentation type

Talk

Affiliation

University of Colorado Boulder

Session

AI for Insect Monitoring

Advances in Biodiversity Modeling from Monitoring to Mitigation

40007 - Understanding the macro-ecological patterns of genetic diversity, a perspective from mutations-area relationship

Meixi Lin[1], Oliver Selmoni[1], Kristy Mualim[1], Moises Exposito-Alonso[1]

[1]Carnegie Institution for Science

Anthropogenic climate change and land use alterations have already driven several thousand species to extinction. A silent yet potentially more dangerous impact of human activities is the significant loss of intra-species genetic diversity before extinction is imminent. However, we still lack information on the global distribution of genetic diversity as synthesizing genetic information across species and space boundaries has only become possible in recent years.

Here, we present an ongoing effort to characterize genetic diversity and predict its loss at a macro-ecological scale. We compiled an expanding geo-referenced genomic dataset, that currently consists of 10,095 individuals from twenty species, spanning a geographic area from 0.03 million to 115 million km^2 globally. Analogous to the species-area relationship, we found that genetic diversity (M, measured as the number of polymorphic sites) increases with the area surveyed (A) following a power-law function: $M = cA^z$. Using global land cover transformation data, we estimated that more than 10% of global genetic diversity may have already been lost. We are developing the MAR shiny web application to aid more researchers to calculate and visualize the MAR for their species of interest through an interactive platform. To understand how genetic diversity loss caused by range reduction could induce loss in adaptability, we are building the feedback model for genetic diversity loss by iteratively simulating the effects of range and adaptability loss.

Overall, we hope to provide an interesting case study that demonstrates the importance of biodiversity modeling to translate genetic data into conservation actions.

Presentation type

Talk

Affiliation

Carnegie Institution for Science

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000031 - The effect of prospective ecosystem services models on arable farming in the central region of Uganda

Fortunate Ayebare[1], Paul Biriiso [1], Edward Kawuma[2], Nandawula Josephine[2]

[1]Global Alliance on Agriculture and Pollution Agency (GAHPA), [2]Research International Consult Uganda (RICU)

Uganda is one of the most vibrant and developing countries in Sub-Saharan region, being a relatively young democracy with hefty disparities in wealth and land ownership, besides being heavily impacted by HIV/AIDS. The shores of Lake Victoria in the Central of Uganda are an agricultural enclave, consisting of small-scale and large-scale farming communities, forests cover, protected areas and urban settlements. We employed a scenario planning approach to this region to investigate how land use, land cover, and ecosystem services could change in the future. Semi-structured interviews were used to examine the influencers of alterations among local resource users in the shores of Lake Victoria in the Central of Uganda. These influencers were discussed with a wider group of stakeholders during a scenario construction practicum. The models were further edited and later tested for consistency and plausibility by stakeholders. Syntheses of land use and ecosystem services in the different scenarios are currently under construction. Growth, investments, and law enforcement were acknowledged as major influencers of future land use change in the Lake shore areas. Other scenarios captured three different combinations of these major influencers and a discussion of the implications of other factors such as agricultural practices, infrastructure, tourism, population dynamics, equality, health and livelihoods. Current analyses point toward changes in land use across all three scenarios but with different ecosystem services being the most important. Explored scenarios can be used to create more vibrant policies for future management of agriculture and other ecosystems in the Lake shore areas.

Presentation type

Poster

Affiliation

Global Alliance on Agriculture and Pollution Agency (GAAPA)

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000039 - Rapid evaluation of connectivity indicators to safeguard multispecies persistence in human-transformed landscapes

Jacqueline Oehri[1], Sylvia L.R. Wood[2], Eluna Touratier[1], Brian Leung[1], Andrew Gonzalez[1]

[1]McGill University, [2]Habitat

Safeguarding ecological connectivity is central to the goals and targets of the Kunming-Montreal Global Biodiversity Framework (KM-GBF) of the Convention on Biological Diversity. Therefore, computationally efficient methods for the assessment and evaluation of ecological connectivity for multiple species are required. We developed the “Rapid Evaluation of Multispecies Connectivity” (REMC) framework, a scalable method to generate ensemble connectivity maps for multiple species with different habitat needs across any region of interest. Through a literature review, we identified a key-set of ten multispecies connectivity indicators that align with the criteria for Essential Biodiversity Variables as well as area-based and species persistence conservation targets.

Using our REMC-framework, we assessed the current status (2021) and recent change (2011-2021) of these connectivity indicators for seven species representative of forest habitat use across the St-Lawrence Lowlands in Quebec, a priority conservation area in Canada. For the majority of investigated species, the current amount of effectively connected habitat is below a 30%-threshold of the total area (cf. Target 3 in the KM-GBF). Most of the assessed connectivity indicators, including metapopulation persistence, have declined in the last decade, mainly via a division of contiguous habitat into smaller fragments, whereas total habitat area has largely remained unchanged. These results indicate that continued habitat fragmentation is a key threat to local and regional biodiversity in the St-Lawrence Lowlands.

Tools like the REMC-framework that can rapidly and efficiently assess change in connectivity for multiple species, scales and indicators will be valuable for guiding action to reach commitments to the KM-GBF.

Presentation type

Poster

Affiliation

McGill University

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000041 - Mapping more of biodiversity - modeling advances to improve data-deficient species distribution estimates

Shubhi Sharma[1], Kevin Winner[1], Jussi Mäkinen[1], Walter Jetz[1]

[1]Yale University

In recent decades, ecology has seen unprecedented growth in the amount and variety of biodiversity data collected. Species distribution models (SDMs) are a popular tool used to relate occurrence data with environmental variables to characterize a species distribution. Conservation planning fundamentally depends on maps of species' current and future habitat suitability. However, the accuracy with which SDMs are able to model species' distributions is limited by the amount of data available- as much as 30% of known species continue to lack sufficient data to allow for appropriate characterization of their geographic distributions. While SDMs have become increasingly sophisticated, they are unusable for data-deficient species.

Here we present a novel modeling framework that extends SDMs to allow data-deficient species to borrow predictive strength from data-rich species. Specifically, we demonstrate how shared evolutionary history among species can inform the likelihood of shared environmental distributions and be used to estimate the spatial distributions of data-deficient species. We explore how this model can improve species richness maps of South American hummingbirds by improving individual data-deficient species estimates. This work represents a concrete way forward for SDMs to allow the integration of ancillary information and has wide applicability in helping us estimate how our biodiversity is likely to be distributed across geographic space. By better understanding how species are distributed in geographic space, we can develop more effective conservation strategies.

Presentation type

Poster

Affiliation

Yale University

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40008 - RangeShifter and MerMADE: Process-based models for forecasting and scenario-focused modelling of terrestrial and marine species.

Rebekka Allgayer[1], Justin Travis[1], Greta Bocedi[1], Damaris Zurrel[2], Tamsin Woodman[1], Cristina Rueda Uribe[1]

[1]University of Aberdeen, [2]University of Potsdam

The development and application of process-based models provides new opportunities for forecasting how species will respond to environmental changes, for contributing to development of future scenarios and for informing management actions. Furthermore, these models have the potential to be used to assess the efficacy of alternative biodiversity monitoring. Here, we will describe two modelling platforms, RangeShifter and MerMADE that have been developed to facilitate process-based modelling for terrestrial and aquatic/marine species, respectively. We will illustrate their use with case studies for orangutan and sand eels and highlight opportunities for scaling their use up to large numbers of species. One major challenge that continues to limit the uptake of process-based biodiversity models is how hungry they are in terms of data required for parameterisation. We will discuss how modelling and monitoring can be more effectively integrated to improve both and to thus improve the future of monitoring, management and mitigation

Presentation type

Talk

Affiliation

University of Aberdeen

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000036 - A model-based global indicator of the capacity of terrestrial ecosystems to retain biological diversity under climate change: the Bioclimatic Ecosystem Resilience Index

Simon Ferrier[1], Thomas Harwood[2], Chris Ware[1], Andrew Hoskins[1]

[1]CSIRO Environment, [2]University of Oxford

The Bioclimatic Ecosystem Resilience Index (BERI) combines advances in macroecological modelling, biodiversity informatics, remote sensing and high-performance computing to estimate the capacity of landscapes to retain species diversity in the face of climate change, as a function of the area, integrity, and connectivity of natural ecosystems. The indicator assesses the extent to which any given spatial configuration of natural habitat will promote or hinder climate-induced shifts in biological distributions. It does this by analyzing the functional connectivity of each grid-cell of natural habitat to areas of habitat in the surrounding landscape which are projected to support a similar assemblage of species under climate change to that currently associated with the cell of interest. Results for the BERI are generated at 30-arcsecond grid resolution across the entire terrestrial surface of the planet, with potential to be applied nationally and sub-nationally at finer spatial resolutions as required. It is now recognized as a component indicator for monitoring and reporting progress in minimizing impacts of climate change on biodiversity under Target 8 of the CBD's post-2020 Global Biodiversity Framework.

Presentation type

Poster

Affiliation

CSIRO Environment

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000032 - Correcting for sampling bias when modelling citizen science data

Guillaume Blanchet[1], François Rousseu[1]

[1]Université de Sherbrooke

Citizen science data are an amazing resource because they harness the effort of a huge number of citizens interested in biodiversity. However, what citizen science data have in quantity they often lack in informativeness because citizen science data only inform us on where and when an individual of a species was found. These data are known as presence-only data. Citizen science data are also highly abundant where people live and travel with almost no record anywhere else. As such, little to no information is available in remote areas such as the northern regions of Canada. In this work, we propose to adapt the log-Gaussian Cox Process, a modelling framework designed for presence-only data, for it to explicitly account for sampling effort. Also, since citizen science data present many more records for charismatic species, we propose a novel technique that combines convex polygons and cumulative density curves to assess whether there is enough data for a species to be modelled. To illustrate how our new approach performs, we relied on the research grade iNaturalist bird data and compare the modelled obtained with the ones from eBird for over 600 bird species. The models from eBird use much richer data but are ensemble models, which have limited interpretability. With our approach, we are able to reproduce the prediction of eBird using iNaturalist data with the additional advantage that our approach is much more interpretable allowing conservation decisions to be made in a more straightforward way.

Presentation type

Poster

Affiliation

Université de Sherbrooke

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40011 - Automated detection of high-conservation-value forests with remote sensing and AI

Tobias Andermann[1]

[1]Uppsala University

Convolutional Neural Networks (CNNs) allow the seamless integration of multiple complex and heterogenous data types, making them very suitable tools for modeling biodiversity. Here we apply such CNN models to learn the complex correlations between biodiversity and the multidimensional biotic and abiotic matrix that the species community interacts with and exists within. The proof-of-concept model is trained on polygons with high and low biodiversity values distributed across Sweden. The model learns how to correlate biodiversity value with the multitude of spatial predictors used in the model, including data products from remote sensing techniques. This allows us to produce continuous heat-maps (rasters) of biodiversity value across the entire country of Sweden at a 10x10m spatial resolution, providing estimates at a spatial scale that is useful for conservation planning, biodiversity offset evaluation, and simulation-based (in silico) impact assessments of infrastructure projects and other anthropogenic landscape modifications. In our ongoing work we are combining this model architecture with high-resolution biodiversity data generated with environmental DNA, improving the predictive power and taxonomic resolution of these models. With increasing biodiversity data becoming available across the world, these models can eventually be applied on a global scale, constituting computational tools for standardized and automated high-resolution biodiversity predictions and impact assessments.

Presentation type

Talk

Affiliation

Uppsala University

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40001 - GEO BON Eco-code: modeling the monitoring to mitigation pathway

Mark Urban[1], Damaris Zurell[2], Santiago José Elías Velazco[3], Greta Bocedi[4]

[1]University of Connecticut, [2]University of Potsdam, [3]National Scientific and Technical Research Council (CONICET), [4]University of Aberdeen

Time is running out to limit further devastating losses of biodiversity. Despite ongoing progress in building international monitoring and biodiversity frameworks, the models supporting these frameworks remain underdeveloped. Models that clarify assumptions and quantify predictions are required to inform all aspects of biodiversity conservation, including planning and implementing monitoring networks, detecting and attributing biodiversity patterns, projecting future changes, and designing conservation strategies to mitigate these changes. International assessments of biodiversity loss have thus far relied on generic models and uncertain data to synthesize the growing biodiversity crisis and to inform policymaking. These assessments tend to derive biodiversity indices from broader, global-scaled analyses while neglecting biological mechanisms, the dynamics of individual species, and critical ecological feedbacks. Here, we highlight the current gaps, outline a new GEO BON working group and K2A action hub, and suggest an internationally collaborative way to fill gaps. We need to make rapid progress in developing biodiversity models because, ultimately, these models are the unsung heroes that will determine the success or failure of biodiversity conservation.

Presentation type

Talk

Affiliation

University of Connecticut

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000038 - Species distribution modelling in biodiversity monitoring and impact assessment: case studies and plans for a national model service in Finland

Veera Norros[1], Ida Palmroos[1], Riikka Puntila-Dodd[1], Harri Kuosa[1], Heikki Peltonen[1]

[1]Finnish Environment Institute

While the in situ and remote biodiversity observation networks are becoming denser, modelling is needed to identify the drivers of biodiversity patterns, to interpolate across data gaps and to extrapolate to unobserved situations such as contrasting future scenarios. Species distribution models that explain and predict species' occurrence or abundance patterns based on environmental factors provide a flexible set of tools that allow the examination of a variety of policy relevant biodiversity issues - ideally in an objective, transparent and repeatable manner. We present two case studies that apply joint species distribution modelling to 1) assess the power of remote sensing variables to identify forest areas with high biodiversity potential, 2) predict the medium- and long-term consequences of different climate change and land use scenarios on a coastal ecosystem under heavy human influence. In the future, species distribution models that are automatically updated as data accumulates can provide the society with an up-to-date estimate of the state, drivers and trends of biodiversity. At the same time, particular care must be taken to describe and communicate the uncertainties related to the modelling and the caveats in the interpretation of the results. To promote international discussion on the best practices for such model services, we present a work-in-progress, the Finnish scheme for a national species distribution modelling service linked to the Finnish Biodiversity Information Facility.

Presentation type

Poster

Affiliation

Finnish Environment Institute

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40002 - Biodiversity change across space, time, and the tree of life

Thomas Frederick Johnson[1]

[1]University of Sheffield

Biodiversity and ecosystem function face unprecedented threats from climate change and the 6th Mass Extinction may be underway. Some of the most important signals of this collapse come from time series that document declining biodiversity. Time series describing abundances for suites of species over large geographic and temporal scales are typically used to evidence this decline in biodiversity. Here we show that the precision of these estimates is undermined by widespread failure to accommodate phylogenetic, spatial, and temporal structure in such data. We remedy this with a novel statistical framework, applied to 10 high-profile datasets containing thousands of species, that simultaneously accounts for all three of these features of data. We demonstrate that the simplicity of existing methodologies hides the correct trend: our analysis leads to a reversal of conclusions about declines (or increases) in 7/10 datasets. We also show that existing methods massively underestimate the uncertainty in trends for each subset of biodiversity represented in these datasets. Finally, despite this re-estimation of high uncertainty, our method provides a way to acquire more robust estimates of future biodiversity trends which is critical for developing policy to protect our biosphere.

Presentation type

Talk

Affiliation

University of Sheffield

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000033 - Biodiversity models to solve land-use conflicts in periglacial environments

Luca Bütikofer[1]

[1]University of Lausanne

As a consequence of global warming, glaciers around the world are melting at an increasing pace, exposing pristine terrain to new colonization. These recently deglaciated environments are characterised by extremely variable micro-climates and rapid succession dynamics, typically resulting in highly diverse species communities. In the Alps, periglacial environments are likely to become objects of land-use conflicts among water management, hydroelectric power, tourism, and conservation. However, data for these remote and novel environments are sparse, causing land managers to rely on anecdotal and subjective evidence when handling such conflicts. Synthesising and generalising available data is therefore key in shifting decision-making towards more reliable and objective grounds.

We integrated multiple data sources ranging from field surveys to remote sensing products (i.e. Landsat, MODIS and Sentinel), to rank the periglacial systems of the Swiss Alps in terms of biodiversity and conservation value. We started by collating several sources of current and historical glacier extents to derive time-series of glacial evolution for each periglacial system. Then, we modelled each system's biodiversity in two ways. (1) In a lower-resolution, macro-ecological analysis we explained plant species richness as a function of time since deglaciation, while accounting for other environmental factors. (2) In a higher-resolution analysis, we modelled species distributions and counted the number of overlapping species for each 25x25 m^2 of periglacial land. Finally, we combined the two biodiversity estimates in a single score and weighted it against the suitability for other land-uses, thereby generating a much needed decision-support tool for the local land-managers.

Presentation type

Poster

Affiliation

University of Lausanne

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000042 - Plant diversity estimation of typical forest and grassland in China by remote sensing

Yuan Zeng[1]

[1]Aerospace Information Research Institute, Chinese Academy of Sciences

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 crown-by-crown variations in biochemical and structural properties, using airborne imaging spectroscopy and LiDAR data. We also estimated forest functional diversity from tree neighborhoods to whole forests based on multi-dimensional traits, which provided the capacity to conduct individual level trait-based ecology with wall-to-wall data. We further scaled up the functional diversity monitoring to the regional scale after clarifying the effect of scale on functional diversity monitoring from individual trees to communities. For grassland diversity estimation, we eliminated the soil effects on spectral diversity indices based on the inverted linear spectral unmixing model, which improved 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, which improved the accuracy of UAV LiDAR-based grassland height estimation. Based on the variations in biochemical and structural traits, we also explored the applicability of clustering algorithms in grassland species diversity estimation and found it performed better than using spectral diversity indices for grassland types with complex structures.

Presentation type

Poster

Affiliation

Aerospace Information Research Institute, Chinese Academy of Sciences

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40012 - RL and conservation: Will algorithms save the planet and will we regret it when they do?

Carl Boettiger[1]

[1]UC Berkeley

This talk will have two parts. First, I will introduce our work on an deep reinforcement learning (RL), with emphasis on the search for robust decision strategies in the face of imperfect measurements and highly uncertain dynamics which characterize the global biodiversity crisis. I will highlight some of the possibilities this opens up, as well as the many ways in which it can go wrong.

In the second part, I will zoom out to survey how these RL approaches are already being applied from start-ups to mega-corporations. I will argue that the main contribution of these approach is not the computational power of the artificial intelligence, but the ability to factor the problem into component bits. This has substantial implications for how we build models for biodiversity, as well as the kind of social infrastructures: governance, markets, software, etc, required to translate models into solutions.

Presentation type

Talk

Affiliation

UC Berkeley

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000040 - Greater Himalayan climate emergency - is conservation working for snow leopards?

Uzma Saeed[1], Uzma Ashraf[2]

[1]Quaid I Azam University, Islamabad, Pakistan, [2]Environment & Energy and Efficiency Institute, University of California, Davis, USA

The accelerated pace of warming in the greater Himalayan region is putting its ecosystems and native species, particularly the endangered snow leopard, at risk. Evaluating the susceptibility of species to climate change is crucial for developing effective strategies to mitigate its impacts. In this study, researchers investigated the potential effects of climate change on snow leopards using simulation scenarios. Two regions, one including China (along with Pakistan, India and Nepal) and the other excluding it, were analyzed to understand dispersal differences and model outcomes. The study aimed to comprehend species distribution in response to climate change scenarios and predict future habitats to aid conservation efforts.

Based on the data collected, the results indicated that approximately 16.9% and 23% of snow leopard habitats may disappear by 2070 in the region (Pakistan, India and Nepal) under 4.5 & 8.5 GHGs emission scenarios. In the region including China (along with Pakistan, India and Nepal), a 10%-13% reduction in habitats was anticipated by 2070. The findings provide important insights for developing conservation plans to address the challenges posed by climate change. Conservation initiatives in the greater Himalayan area are recommended to focus on preserving climate refuge areas and establishing migration routes to manage species in the future.

Presentation type

Poster

Affiliation

Quaid I Azam University, Islamabad

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000034 - A person-centred view of biodiversity: understanding and improving access to benefits from nature

Adriana De Palma[1]

[1]Natural History Museum, London

Global biodiversity indicators often underestimate the extent to which biodiversity has disappeared from people's day-to-day lives. They are therefore often poorly suited to understanding how many of nature's benefits can be accessed by the people who need them most. For example, green space is important for people's physical and mental health. I use a person-centred view of the Biodiversity Intactness Index (BII) to show the scale of ecosystem degradation that most people experience where they live: most of us live in neighbourhoods whose biodiversity is more comparable to that in intensive agriculture than that of a natural ecosystem. Taking the UK as a case study, I use high-resolution predictions of the health of nature (BII) to highlight socioeconomic biases in access to nature. I also show how small-scale interventions such as urban parks and biodiversity-enhanced school estates have high leverage in reducing such inequality and in improving nature's ability to contribute to most people.

Presentation type

Poster

Affiliation

Natural History Museum, London

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000037 - Beta-diversity of amphibians and reptiles in Ontario

Katherine Ziebarth[1], Marie-Josee Fortin[1], Njal Rollinson[1]

[1]University of Toronto

Reptiles and amphibians are experiencing a global decline. Anthropogenic factors (habitat loss and climate change) are among the many forces causing such decline. At a regional scale, understanding the drivers of amphibian and reptile diversity may be important in the establishment of protected areas. This study leveraged data from the Ontario Reptile and Amphibian Atlas, a citizen science initiative of amphibian and reptile presence data, to uncover the regional-scale drivers of the beta diversity of amphibians and reptiles in Ontario. Using univariate and multivariate regression trees, we found that temperature, agriculture, and road density were most strongly associated with the beta-diversity values. Our findings emphasize that amphibian and reptile diversity is greatest in southern and central Ontario, where human density is also highest. Future research should examine temporal changes in diversity while accounting for variation in sampling intensity, to recommend conservation areas for wildlife corridors.

Presentation type

Poster

Affiliation

University of Toronto

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40004 - The Ecosystem Integrity Index: a novel measure of terrestrial ecosystem integrity with global coverage

Samantha Hill[1], Michelle Harrison[1], Calum Maney[1], Neil Burgess[1]

[1]UNEP-WCMC

While the important of ecosystem integrity has long been recognised, conservation science tends to focus on the monitoring of species or habitats to avoid the complexities of working at the ecosystem level. We present a novel index that represents the integrity of terrestrial ecosystems globally at 1km^2 resolution: the Ecosystem Integrity Index (EII). The index provides a simple, yet scientifically robust, way of measuring, monitoring and reporting on ecosystem integrity. It is formed of three components; structural, compositional and functional integrity, and measured against a natural (current potential) baseline on a scale of 0 to 1. We present findings that ecosystem integrity is severely impacted in terrestrial areas across the globe, with countries, on average, having lost around one third of their ecosystem integrity. Natural areas are severely reduced in extent with approximately one half of all countries estimated to have retained less than 10% of high integrity, natural ecosystems. The EII has been developed to help national governments measure and report on Goal A of the CBD's Global biodiversity framework, for which it has been listed as a Component Indicator, and for non-state actor contributions to also be recognized, for instance it is listed as an indicator by both the Taskforce for Nature-Related Financial Disclosures (TFND) and the Science Based Targets Network (SBTN). The EII aims to enable these actors to make informed decisions on the conservation, restoration and sustainable use of ecosystems for which they are wholly or partly responsible.

Presentation type

Talk

Affiliation

UNEP-WCMC

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40003 - Exploring the mysteries of biodiversity change: Bayesian quantification of species extinction and colonization by incorporating sampling effort

Clara Casabona Amat[1], Dominique Gravel[1]

[1]Université de Sherbrooke

Accurately quantifying species extinction and colonization through time is essential for understanding biodiversity change. However, directly observing and confirming these events poses significant challenges. Existing methods for inferring extinction often rely on proxy information, such as recorded species sightings, but they frequently overlook crucial factors like sampling effort and colonization dynamics at a local scale. To effectively detect local extinctions and colonization differentiate them from the absence of sampling, it is imperative to incorporate sampling effort into the modelling process.

In this study, we propose a Bayesian methodology that integrates information on species sightings with sampling effort data to estimate the probabilities of local extinction and colonization and infer the posterior distribution of the extant probability of the species in a region. Furthermore, considering sampling effort allows us to differentiate true colonization events from cases where species remain unsampled due to lack of survey efforts.

To validate the performance of our model, we evaluate its effectiveness using simulated data. Additionally, we demonstrate its application using real observations from eBird, highlighting its potential usefulness across a wide range of vertebrate species. Our approach provides a comprehensive framework for understanding the dynamics of species loss and colonization, thereby contributing to a better monitoring of long-term biodiversity changes.

Presentation type

Talk

Affiliation

Université de Sherbrooke

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40009 - Unveiling climate-biodiversity interactions: linking Earth system and biodiversity modeling

Dirk Nikolaus Karger[1], Petra Sieber[2], Johanna T. Malle[1], Victor Boussage[1], Gabriele Midolo[3, 4], Niklaus E. Zimmermann[1], Irena Axmanová[4], Milan Chytrý[4], Stephan Kambach[5], Helge Bruelheide[5], Wilfried Thuiller[6], Maya Gueguen[6], Sara Si-Moussi[6]

[1]Swiss Federal Research Institute WSL, [2]ETH Zurich, [3]Research Institute on Terrestrial Ecosystems (IRET), [4]Masaryk University, [5]Martin Luther University, [6]Laboratoire d'Ecologie Alpine (LECA)

Terrestrial ecosystems play a central role in shaping the Earth's climate and act as vital regulators of energy, water, chemical elements and trace gases. In climate change research, understanding the complex relationship between biodiversity and climate remains a central concern. Although we have made considerable progress in predicting the responses of biodiversity to a changing climate, the impact of such changes on the climate system remains uncertain. To effectively address the challenges of global climate change and biodiversity, it is essential to develop a comprehensive understanding of the links between species and climate. A major obstacle lies in the representation of biodiversity in climate models, which requires bridging the gap between two different disciplines - biodiversity modelling and climate modelling - each characterized by unique paradigms and approaches. Here, we provide a first overview of the challenges and opportunities of integrating biodiversity into the coupled biosphere-atmosphere regional climate model COSMO-CLM^2, and explain how vegetation surveys and habitat classification systems can serve as invaluable tools for establishing links between biodiversity and regional climate models. In addition, we reveal the profound influence of changes in land surface structure on climate and biodiversity by showing the complex relationship between habitat composition and climate-related feedback parameters. By providing a comprehensive overview of the challenges and opportunities related to biodiversity feedback to the climate system, we pave the way for future collaboration between Earth system modelling and biodiversity modelling, and an effective attribution and detection of biodiversity change.

Presentation type

Talk

Affiliation

Swiss Federal Research Institute WSL

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

4000035 - Changes in habitat availability of terrestrial vertebrates due to deforestation and climate change in Colombia as a tool for prioritizing conservation areas

Maria Camila Diaz Corzo[1], Maria Isabel Arce Plata[2], Jaime Burbano Girón[3], J. Nicolás Urbina-Cardona[4]

[1]Humboldt Institute, [2]Montreal University, [3]The Nature Conservancy, [4]Javeriana University

Biodiversity loss occurs in different ways, among which species extinction plays a significant role. They are influenced by habitat loss and climate change processes, which are recognized as two primary drivers of global biodiversity decline. The impacts of these drivers, whether acting independently or in combination, exhibit diverse responses based on taxonomic and geographic conditions. Consequently, habitat availability experiences both positive and negative effects. It is crucial to consider future climate change and deforestation scenarios to anticipate potential changes in habitat availability. These scenarios allow the identification of priority conservation areas and provide early warnings of species extinction risks within these areas. The present research seeks to address habitat availability changes in Colombian regions, using the Species Habitat Index (SHI) as a proxy. We evaluated its dimensions, on native vertebrate species of birds, amphibians, reptiles, and mammals, in climate change and deforestation scenarios to identify priority areas for conservation.

Presentation type

Poster

Affiliation

Humboldt Institude

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40006 - Connecting the dots: using agent-based models to link habitats and biodiversity

Lars Mortensen[1], Verena Schrameyer[2], Jonas Brandi Mortensen[1]

[1]Department of Offshore Biodiversity and Ecology, DHI A/S, [2]Department of Marine and Coastal Solutions, DHI A/S

Connectivity between habitats plays a crucial role in preserving the health of marine ecosystems by facilitating species dispersal and recruitment. Moreover, the level of biodiversity within an ecosystem has frequently been associated with the extent of its connections to the broader regional area. However, ongoing extensive development in the world's oceans poses an increased risk of disrupting habitat connectivity, which can lead to cascading effects of biodiversity degradation in disrupted and connected ecosystems alike.

To support decision-makers and managers in effectively managing their biodiversity footprint, we have developed an integrated approach that combines agent-based modeling and ecological modeling with local and regional hydrodynamic models. This approach enables the assessment of connectivity within both local and regional areas. By modeling hydrodynamic interactions, we can understand how entities (e.g., species), proxies (e.g., functional traits), or concepts (e.g., biodiversity) within a local area are linked to other areas at both local and regional scales. Furthermore, by incorporating observational data on biodiversity, hydrodynamic information, and static data using general additive models and machine learning algorithms, we can map the spatial distribution of biodiversity. The integration of these two modeling approaches allows for predicting the spatio-temporal distribution of biodiversity and enables quantitative assessments of how biodiversity will change over time and space as a result of anthropogenic disturbances.

This approach empowers stakeholders, developers, and managers to transition from qualitative to quantitative assessments of biodiversity footprints. By quantifying the impacts of anthropogenic disturbances, decision-makers can make more informed choices regarding marine ecosystem management and conservation strategies.

Presentation type

Talk

Affiliation

DHI A/S

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40005 - Towards continuous monitoring of biodiversity exposure to climate change risk

Josep M Serra-Diaz[1], Cory Merow[1], Mark C. Urban[2]

[1]Department of Ecology and Evolution & Eversource Center. University of Connecticut. CT, USA., [2]Department of Ecology and Evolution. University of Connecticut, CT, USA.

The past two decades have seen the rise of biodiversity data mobilization. This includes an extraordinary variety of data types ranging from museum specimen records to citizen science data acquired from mobile applications. Currently, multiple types of biodiversity data infrastructure store vast quantities of data but how these data can be put to use to monitor biodiversity change is still unknown. We propose a new approach to species distribution modeling (SDM) called 'Species Exposure Modeling' (SEM) that focuses on estimating the timing of potential biological risks to global change.

SEM is designed to (1) address concerns about the misuse of SDMs for forecasting applications, (2) focus on the role of extreme weather, (3) improve the temporal precision of forecasts and (4) advance new statistics to understand changes over species ranges. SEM correlates species presence data with environmental variables and is targeted toward identifying species niche boundaries — instead of delineating species distributions. We present a workflow example for plant species that combines in-depth data quality assessment together with high temporal resolution weather data to identify future species exposure to climate change. Exposure provides a useful metric to focus targeted monitoring or detect trends in species experiencing novel conditions. Exposure forecasts can be synthesized across species ranges or among co-occurring species to create 'exposure horizon profiles' to estimate the magnitude, timing, abruptness and stability of exposure. We argue that, while incomplete, these exposure forecasts will serve global ecological monitoring and forecasting to identify high risk taxa, regions, or communities.

Presentation type

Talk

Affiliation

University of Connecticut

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

40010 - Mapping plant biodiversity from the skies using open science, remote sensing, and deep learning

Lauren Gillespie[1, 2], Megan Ruffley[1], Moisés Expósito-Alonso[1, 2, 3]

[1]Carnegie Institution for Science, [2]Stanford University, [3]Howard Hughes Medical Institute

Anthropogenic habitat destruction and climate change are altering the geographic distributions of plant communities worldwide. However, traditional biodiversity modeling approaches are typically built for one species or ecosystem at a time, are of coarse spatial resolution, and are not designed to capture rapid temporal change. To address these gaps, we generated an open-source biodiversity dataset of over 650,000 citizen science observations paired with high-resolution remote sensing images in California. Using this dataset, we train a deep convolutional neural network-*deepbiosphere*-to predict the presence of 2,221 plant species simultaneously, outperforming both traditional bioclimatic species distribution models and previous deep learning approaches. We showcase that *deepbiosphere* is able to capture individual species distributions of keystone species such as coastal redwoods (Sequoia sempervirens) and known community assemblages of associated understory herbaceous plants. *Deepbiosphere* can also detect macroecological trends in biodiversity, successfully capturing both spatial community turnover dynamics across diverse habitats in Northern California and temporal changes in plant community composition from severe wildfire in the Sierras. Finally, *deepbiosphere* can be used as an efficient feature extractor for several downstream spatial mapping tasks such as cropland mapping and vegetation classification, outperforming both state-of-the-art deep learning approaches for crop type mapping and algorithms used by the National Park Service for official fine scale vegetation maps of Redwood National and State Parks. Following this approach, deep neural networks continuously trained on public remote sensing imagery and citizen science observations could enable inexpensive, automatic, and scalable monitoring of biodiversity and detect rapid anthropogenic impacts on global ecosystems.

Presentation type

Talk

Affiliation

Stanford University

Session

Advances in Biodiversity Modeling from Monitoring to Mitigation

Innovative use of Earth Observation Products in Support of Nature Finance Challenges

230005 - Seven challenges for integrating Earth observation in monitoring biodiversity and water impacts of corporate operations and financial decisions: aligning perspectives through systems thinking

Leon T. Hauser[1], Alexander Damm[1], Maria J. Santos[1]

[1]Department of Geography, University of Zurich, Switzerland

Human alterations to natural systems have caused unprecedented biodiversity declines and water insecurity, prompting the need for a transformative change of our consumption and production systems. Corporate and financial institutions are central to this transformation and need to screen and reshape their operations and portfolios for long-term biosphere resilience. Yet, available independent data as well as the integration of untapped data streams are needed to narrow down loopholes that could allow greenwashing. In particular, a more extensive integration of satellite earth observation may contribute to address current data gaps to improve independent, spatially and temporally dense monitoring efforts of a comprehensive set of core metrics on biodiversity and water impacts in alignment with policy, market needs and scientific and environmental integrity.

Here, we review seven challenges conceptually-based on systems thinking, i.e. generally defining (i) system boundaries, (ii) system components and interactions, and (iii) perturbation outcomes, which we propose are important leverages for the implementation of earth observation-based reporting on responsible consumption and production systems. Such systems thinking approach navigates the complexity and multi-dimensionality of biodiversity and water risks, and reconciles conflicting perspectives when modeling impacts on biodiversity loss and water insecurity of company and financial activities. We discuss future directions to enable a better integration of satellite remote sensing in the transition from aggregated self-disclosed company impacts to independent spatially-resolved risk factors. This will require an extended uptake of state-of-the-art methods and analysis-ready products, awareness of biases and limitations, and a broader understanding of biodiversity and water processes at risk.

Presentation type

Talk

Affiliation

Department of Geography, University of Zurich, Switzerland

Session

230002 - Geolocated asset data: the fundamental building block for geospatial nature risk analysis by financial institutions

Christophe Christiaen[1]

[1]Oxford Sustainable Finance Group, University of Oxford; UK Centre for Greening Finance and Investment

Financial institutions are becoming increasingly aware of the value of nature to our global economy. Hence biodiversity decline and nature degradation is causing significant financial risks across many companies and sectors in our economy. Initiatives such as TNFD are providing frameworks for measuring, managing and reporting these risks, but at the end of the day they all rely on robust data, most of which will have to come from external sources to the reporting entity. Earth observation data provides information about the state of our planet at a global scale and how it is changing in near real time. As such it could be an invaluable source of information for financial institutions, but uptake to date has been very limited. A key problem is attributing what can be observed or modelled using satellite and geospatial datasets, to individual entities and economic actors. Therefore geolocated asset data tied to ownership information, is a fundamental building block to make geospatial datasets relevant, usable and actionable for the finance sector. In this presentation we will highlight innovative asset mapping techniques as well as geospatial analysis methods for attributing nature-related financial risks to counterparties.

Presentation type

Talk

Affiliation

Oxford Sustainable Finance Group, University of Oxford; UK Centre for Greening Finance and Investment

Session

Innovative use of Earth Observation Products in Support of Nature Finance Challenges

230003 - Leveraging the Biodiversity Intactness Index (BII) within the TNFD Framework: a pathway to sustainable corporate stewardship

Gareth Thomas[1]

[1]Natural History Museum

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. The integration of Earth observation data, including satellite imagery for land-use classification, forms a pivotal component of the index. By incorporating these data sources into the PREDICTS database of primary biodiversity data from peer-reviewed studies from 48,000 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: identifying priority locations; evaluating nature impacts across locations; assessing the benefits of mitigation and management opportunities; and setting, tracking, and reviewing progress towards a nature-positive target.

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.

Presentation type

Talk

Affiliation

Natural History Museum Innovation Unit

Session

Innovative use of Earth Observation Products in Support of Nature Finance Challenges

230001 - In absence of silver bullets, can EO data be the keystone block enabling broadscale and meaningful financial market engagement with nature?

James D'Ath[1]

[1]Taskforce on Nature-related Financial Disclosures (TNFD), London, UK

Society, business and finance depend on nature's assets and the services they provide. The acceleration of nature loss globally is eroding the ability of nature to provide these vital services. Taking action to conserve and restore nature is now a critical global priority and doing so will reduce risks to business and finance. So mobilising business innovation and private finance to halt and reverse nature loss and contribute to nature-positive outcomes will be a major source of new commercial opportunity and competitive advantage. But at the heart of this sits robust and effective data collection, monitoring, and verification of physical assets. What is the role earth observation data can play in this mobilisation to enable the financial sector to engage more readily and at scale?

Presentation type

Talk

Affiliation

Taskforce on Nature-related Financial Disclosures (TNFD), London, UK

Session

Innovative use of Earth Observation Products in Support of Nature Finance Challenges

230004 - Catalyzing nature-positive land-use and conservation through market-led, globally applicable natural capital accounts

Benjamin Leutner[1], Michael Obersteiner[2], Sonja Stuchtey[1], Robert McElderry[3], Tom Crowther[3], Martin Stuchtey[1]

[1]The Landbanking Group, [2]Environmental Change Institute, University of Oxford, Oxford, UK, [3]Crowther Lab, ETH Zürich, CH

Delivering on the objectives of the GBF, i.e. halting and reversing the global loss of biodiversity and ecosystem functioning, is crucial for the vitality of our economy and the future of our civilization. Going forward, every land-use decision taken must adhere to a nature-positive paradigm. Indeed, there is building pressure from ground-up and top-down for economic actors to commit to nature-positive agendas.

Today, land-stewards, both institutional and private, struggle to afford long-term investments into maintaining and growing their natural capital, e.g. healthy soils, because markets incentivize extraction over conservation and restoration. Direct market actors and capital investors, on the other hand, are desperate to become nature-positive, but miss standardized, verifiable, and investable pathways for doing so.

To bridge this gap, we are developing a solution that connects private markets with land-stewards enabling each to assess, monitor, track and market conservation and restoration outcomes via standardized natural capital accounts of individual parcels of land. At the heart of our platform lays a transparent, earth observation-driven monitoring system (MRV) for biophysical appraisal of natural capital and ecological integrity along the dimensions of biodiversity, carbon, soils and water.

Going beyond MRV, we are building bridges into markets, by creating investment pathways for insetting, philanthropic and compliance markets. This empowers land-stewards and investors to drive land restoration and nature protection with real financial backing and long-term outlooks, while simultaneously helping guide investment portfolios and companies towards nature-positive outcomes.

Here, we demonstrate our end-to-end product focusing on monitoring and outcome-based financing for nature-positive agriculture.

Presentation type

Talk

Affiliation

The Landbanking Group

Session

Innovative use of Earth Observation Products in Support of Nature Finance Challenges

GEO BON Global Conference

MONITORING BIODIVERSITY FOR ACTION

A whole of society approach for urgent and transformative change

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www.geobon.org/conf2023/schedule