Requirement Baseline

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PEOPLE-ECCO: Enhancing Ecosystems Conservation through Earth Observation Solutions, Capacity Development and Co-design

Requirement Baseline

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Abbreviations and acronyms

Acronym	Definition
AI	Artificial Intelligence
API	Application Programming Interface
ARPA	Amazon Region Protected Areas
AWS	Amazon Web Services
ArcPy	ArcGIS Python
BACI	Before-After-Control Impact
BBEMA	Bedeque Bay Environmental Management Association
BON	Biodiversity Observation Network
BSPB	Bulgarian Society for the Protection of Birds
CBD	Convention on Biological Diversity
CCDC	Continuous Change Detection and Classification
CCI	Climate Change Initiative
CEDA	Centre for Environmental Data Analysis
CEPF	Critical Ecosystem Partnership Fund
CI	Conservation International
COP	Conference Of the Parties
COP4N2K	COPernicus For Natura 2000
CORINE	Coordination of Information on the Environment
CSO	Civil Society Organization
DFO	Fisheries and Oceans Canada
DHI	Dansk Hydraulisk Institut
DRC	Democratic Republic of the Congo
EA	Early Adopter
EC	Ecosystem Conservation
EO	Earth Observation
ESA	European Space Agency
ESRI	Environmental Systems Research Institute
ESRIN	European Space Research Institute
ETH	Federal Institute of Technology (Zurich)
EU	European Union
EUGD	European Union's Green Deal
GBIF	Global Biodiversity Information Facility
GCF	Global Conservation Fund
GEE	Google Earth Engine
GES	Good Environment Status
GFC	Global Forest Cover
GFW	Global Forest Watch
GHS	Global Human Settlement
GIS	Geographic Information Systems
GMW	Global Mangrove Watch
GPS	Global Positioning System
GUI	Graphical User Interface
GZE	Greater Zakouma Ecosystem

HI	Habitat Intactness
IBA	Important Bird and Biodiversity Area
IMET	Integrated Management Effectiveness Tool
IP	International Programs
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
ITC	Faculty of Geo-Information Science and Earth Observation of the University of Twente
IUCN	International Union for Conservation of Nature
JRC	Joint Research Committee
KBA	Key Biodiversity Area
KPI	Key Performance Indicator
LIFE	L'Instrument Financier pour l'Environment
LRI	Lebanon Reforestation Initiative
LT	LandTrendr
LULUCF	Land Use, Land Use Change, and Forestry
MCSAV	Mangroves, Corals, and Submerged Aquatic Vegetation
MEFDD	Ministry of Forest Economy and Sustainable Development
MONRE	Ministry of Natural Resources and Environment
MOU	Memorandum Of Understanding
MPA	Marine Protected Area
NASA	National Aeronautics and Space Administration
NGO	Non-Governmental Organization
OBIS	Ocean Biodiversity Information System
PAME	Protected Area Management Effectiveness
PDR	People's Democratic Republic
PEI	Prince Edward Island
PEIWA	Prince Edward Island Watershed Alliance
PEOPLE	Pioneer Earth Observation apPLications for the Environment
PEOPLE-ECCO	Enhancing Ecosystems Conservation through Earth Observation Solutions, Capacity Development and Co-design
PPP	Public Private Partnership
QGIS	Quantum Geographic Information Systems
RB	Requirement Baseline
RCM	Reef Check Malaysia
RS	Remote Sensing
SDG	Sustainable Development Goal
SFM	Sustainable Forest Management
SGP	Small Grants Programme
SNV	SNV Netherlands Development Organization
SPA	Special Protection Area
SPOT	Satellite Pour l'Observation de la Terre
SST	Sea Surface Temperature
STI	Space Technology Institute
SYKE	Finnish Environment Institute

TNC	The Nature Conservancy
TRIDOM	Tri-National Dja-Odzala- Minkébé
TSCM	Technical and Scientific Cooperation Mechanism
UN	United Nations
USAID	United States Agency for International Development
USFS	United States Forest Service
WCMC	World Conservation Monitoring Centre
WCPA	World Commission on Protected Areas
WCS	Wildlife Conservation Society
WRI	World Resources Institute
WWF	World Wide Fund for Nature

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1 Introduction

Ecosystem Conservation (EC) is critical to halt global biodiversity loss, mitigate the effects of climate change, and maintain the overall health and sustainability of our planet. Furthermore, ecosystems provide essential services such as clean air and water and climate regulation which are fundamental to human well-being and survival. The 2019 Assessment Report of Biodiversity and Ecosystem Services (IPBES, 2019) by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) warns that, due to human impact on the environment, up to one million plant and animal species are threatened with extinction. The report highlights the need for transformative changes across economic, social, political, and technological factors in order for nature to be conserved, restored and used sustainably while simultaneously meeting other global societal goals. Similarly, the Sixth IPCC Assessment Report (Calvin et al., 2023) highlights that effective ecosystem conservation and restoration are necessary to help protect biodiversity, build ecosystem resilience and ensure essential ecosystem services in the face of a changing climate.

Effective planning, monitoring, and assessment of conservation efforts is required to evaluate ecosystem functions and to determine whether conservation interventions have the desired impact. Evaluating the effectiveness of conservation efforts often requires historical information on an ecosystem, and diverse ecosystem metrics upon which to evaluate the overall change in a landscape. There is a huge opportunity for satellite Earth Observation (EO) applications for within the field of ecosystem conservation, to meet the needs for regular, repeat evaluations of conservation practices over long time periods covering large, often remote, areas.

Civil Society Organizations (CSOs) and Non-Governmental Organizations (NGOs) are key actors in achieving an effective conservation and restoration of ecosystems, as these multifaceted organizations work on the interface of project implementation, education, public policy advocacy, and research. In an open information and consultation process for NGOs/CSOs organized by the European Space Agency (ESA), CSOs and NGOs highlighted the importance of (i) developing tools to monitor ecosystems under conservation and restoration; and (ii) developing clear processes for the detection of critical ecosystems and identifying high-priority sites for conservation/restoration.

The Enhancing Ecosystems Conservation through Earth Observation Solutions, Capacity Development and Co-design (PEOPLE-ECCO) project is financed by ESA and has the ambitious goal of developing innovative high-quality EO-based application products, targeting the evaluation and planning of conservation initiatives in collaboration with NGOs/CSOs active in the field.

Working towards these overarching goals the project aims to build on EO initiatives and projects, and bring in elements of novelty in order to address two parallel conservation objectives:

> **Objective A:** Monitor conditions and management effectiveness of existing protected areas; and
> **Objective B:** Site suitability identification of high-priority areas to be protected.

The PEOPLE-ECCO consortium includes:

- University of Twente's Faculty of Geo-Information Science and Earth Observation (ITC) – a leading institute for education, scientific research and technology development in EO and geoinformation science. ITC has a long history of education, training and institutional strengthening, especially for biodiversity and natural resource management in the Global South. ITC leads the PEOPLE-ECCO project
- Hatfield – a science-driven and service-oriented company that builds solutions to complex environmental challenges, with a depth of experience in conservation projects in Canada and around the world. Hatfield is a trusted partner for the development of cutting-edge and practical EO technologies.
- DHI – a profit-for-purpose research and consultancy organization based in Denmark, with a global presence and over 50 years of experience. Specializing in water, environment, and health, DHI offer advisory services, software development, and tailored Decision Support Systems using Earth Observation, AI, machine learning, and geospatial analysis.
- 52North – a German software company specializing in geospatial technologies. Its mission is to develop open-source software solutions for the geospatial domain, particularly in areas such as environmental monitoring, disaster management, and research data infrastructures. 52North aims to foster collaboration and innovation with the geospatial community by providing software and expertise that enable the sharing and analysis of geospatial data.

The PEOPLE-ECCO project is implemented in close collaboration with six Early Adopters. This collaboration will take the form of co-design with the goal of producing open-source tools that are useful, accessible, and broadly applicable to a variety of ecosystems and use cases.

The Early Adopters are:

- **African Parks** – a leading non-profit conservation organisation that takes on the complete responsibility for the long-term management of protected areas across Africa in partnership with host governments and local communities.
- **International Union for Conservation of Nature (IUCN)** Vietnam – present in Vietnam since 1993, IUCN operates under a Memorandum of Understanding (MOU) with the Ministry of Foreign Affairs.
- **Bulgarian Society for the Protection of Birds (BSPB)** – the oldest and largest member-based CSO dedicated to biodiversity conservation in Bulgaria, founded in 1988, with work areas including ecosystem and species protection, protected area management, conservation education and sustainable agriculture.
- **Lebanon Reforestation Initiative (LRI)** – started in 2010 as a USAID-funded project, since 2014 LRI is a not-for-profit NGO registered at the Lebanese Ministry of the Interior. LRI aims to expand, manage and protect Lebanon's forests and landscapes through a community-based approach.
- **Prince Edward Island Watershed Alliance (PEIWA)** – a non-profit cooperative association of watershed management groups on Prince Edward Island (PEI), Canada. Its mandate is to improve and enhance the environmental quality of PEI watersheds for the benefit of all residents.
- **Reef Check Malaysia (RCM)** – non-profit organization leading citizen scientists to promote stewardship of sustainable reef communities worldwide.

Additionally, ESA and ITC have established a Project Advisory Board to provide recommendations, feedback, and potential connections for further engagement with other key NGOs/CSOs. The Advisory Board members are:

- Amanda Fronzi, World Wide Fund for Nature (WWF) Italy
- Randall Jiménez, IUCN
- Grace Nangendo, Wildlife Conservation Society (WCS) Uganda
- Petteri Vihervaara, Finnish Environment Institute (SYKE)

1.1 Scope of the Requirement Baseline

The Requirement Baseline is Deliverable 1.2 (D1.2) of the PEOPLE-ECCO project. This aims to analyse and consolidate user requirements related to the project by engaging the Early Adopters, the Advisory Board, and the wider community of CSO/NGOs active in ecosystems conservation. This Requirement Baseline is a living document that is progressively revised with the Early Adopters along the agile development process of the PEOPLE-ECCO project following a user co-design scheme.

1.2 Approach for requirements consolidation

To consolidate the user requirements, the PEOPLE-ECCO consortium completed the following:

- Desktop research of conventions, agreements, laws and regulations, strategies, and policies, initiatives, datasets, and tools that are address the ecosystem conservation objectives relevant to the PEOPLE-ECCO project.
- Iterative interviews with Early Adopters and affiliated organizations to explore mandates, capacity, and requirements relevant to the PEOPLE-ECCO project.
- Consultation and review with members of the Advisory Board.
- Technical scoping of existing tools and available platforms for the development of PEOPLE-ECCO tools.
- Surveying the wider community of NGOs and CSOs to obtain their feedback on the planned PEOPLE-ECCO solutions and demonstrations.
- Presentation of PEOPLE-ECCO requirements, gaps in information and tools, and proposed solutions to address them in a workshop open to all participants of the BIOSPACE25 conference[1], hosted in Frascati by ESA in February 2025.
- Final consolidation of requirements, considering Early Adopter requirements, demonstrations, and feasibility of solutions in the context of technologies and resources available for the PEOPLE-ECCO project.

Section 2 summarizes the important policies, laws and regulations, and international initiatives and agreements that are relevant to the PEOPLE-ECCO project.

Section 3 summarizes the profiles and requirements of the Early Adopters detailing the key characteristics, their current technical capacity, and their requirements as user stories.

[1] https://biospace25.esa.int/

Section 4 summarizes the outcomes of the iterative requirement consolidation process. This is based on the Early Adopter inputs and the results of the survey of other NGOs/CSOs. The PEOPLE-ECCO solutions are presented and defined within the context of Early Adopter workflows related to PEOPLE-ECCO objective A and B.

Section 5 summarizes the demonstration areas selected in collaboration with the Early Adopters. It presents the characteristics, conservation challenges, and opportunities presented by the site in relation to the PEOPLE-ECCO objectives. The risks for each demonstration are identified and a list of mitigations are presented.

2 Policy and Initiatives review

There are many conventions, agreements, laws and regulations, strategies, and policies at global, regional, and national levels that address the sphere of ecosystem conservation. This section aims to summarize the most relevant of these for the PEOPLE-ECCO project based on our professional judgement, and to synthesize the key drivers for the products developed. When using the term "*policy*" we refer to the suite of conventions, agreements, laws and regulations, strategies and policies.

The review subsequently addresses notable initiatives, datasets, and existing tools that are important for protected area effectiveness monitoring and suitability identification, especially those used by NGOs/CSOs.

By reviewing the key policies, initiatives, and pre-existing tools the PEOPLE-ECCO project will be able to refine the innovative EO-based applications and products that meet the needs and requirements of Early Adopters, address requirements laid out by key policies and initiatives and build upon pre-existing tools. This aims to ensure the project maximizes the impact of the EO-integrated solutions and products that will be developed and helps avoid a duplication of efforts.

2.1 Review of Policies

Key policies relevant to protected area management and planning and the PEOPLE-ECCO project are outlined in Table 1.

Within Europe, the EU Biodiversity Strategy for 2030 (European Commission. Directorate General for Environment., 2021) and the EU Forest Strategy (European Commission, 2021) emphasize the importance of adaptive forest restoration and ecosystem-based management, which are essential for maintaining biodiversity and mitigating climate change. The EU Carbon Removal Certification and the revisions to the LULUCF (land use, land use change, and forestry) regulation further support these efforts by setting targets for carbon sequestration through land-based measures. The Katowice Forest Declaration and the EU's Green Deal further underscore the need for sustainable forest management and a transition to a circular economy

At a global scale, the UN New York Declaration on Forests, the Convention on Biological Diversity (CBD) COP-15 Target 2, and the Ramsar Convention's Strategic Plan for Wetlands, highlight the importance of protecting critical habitats, and restoring degraded ecosystems. The Global Forest Goals and the UN Decade on Ecosystem Restoration aim to increase forested areas, improve livelihoods, and stop ecosystem degradation.

Collectively, these policies provide the context and drivers for the development and implementation of EO-based tools by the PEOPLE-ECCO project. These tools will prove to be valuable with regard to the monitoring of environmental changes, assessing the effectiveness of conservation efforts, and planning future actions regarding protected areas.

Table 1 Key Policies Relevant to Ecosystem Conservation

Policy	Relevant Indicators	Relevance to PEOPLE-ECCO
European Commission	▪ EU Biodiversity Strategy for 2030 where 30% of the budget dedicated to climate action is planned for investment in biodiversity and nature-based solutions. ▪ EU Forest Strategy that calls for adaptive forest restoration and ecosystem-based management to achieve EU policy targets. ▪ EU Carbon Removal Certification where the legal target as defined by the European Climate Law is to remove about 225 Mt CO2e. The revisions to the LULUCF regulation (amendment 2023/839) even have set a target for land-based removals of 310 Mt CO2e per year by 2030. ▪ Katowice Forest Declaration which enforces the role of forests in climate mitigation and adaptation, biodiversity conservation, and de-urbanization initiatives. ▪ European Union's Green Deal (EUGD) which lays out policies around three key objectives: climate neutrality by 2050; development of a circular economy, and ensuring a just transition for all. ▪ Marine Strategy Framework Directive is a key piece of EU legislation aimed at protecting the marine environment. It focuses on achieving Good Environment Status (GES) of the EU's marine waters by 2020 and maintaining it thereafter. ▪ Habitats Directive promotes the maintenance of biodiversity by requiring Member States to take measure to maintain or restore natural habitats and wild species at a favourable conservation status. This directive has led to the creation of Natura 2000 sites. ▪ Birds Directive protects all wild bird species naturally occurring in the E.U. It provides a framework for the conservation of birds and their habitats, including the designation of Special Protection Areas (SPAs). ▪ The Nature Restoration Regulation is a key element of the EU Biodiversity Strategy, which sets binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters.	▪ PEOPLE-ECCO tools could support the evaluation of diverse nature-based solutions such as forest-restoration, ecosystem-based management, and the creation of protected areas, thus helping ensure EU policy targets are met.

	▪ SDG 13 Take urgent action to combat climate change and its impacts. ▪ SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. ▪ SDG 15 Progress towards sustainable forest management.	▪ PEOPLE-ECCO's tools could help monitor the effectiveness of protected areas in the pursuit of combatting climate change and the sustainability of forest management practices already in place.
Forest Declaration Assessment	▪ UN New York Declaration on Forests for halving the loss of natural forests by 2020 and striving to end it by 2030 and eliminating deforestation from the production of agricultural commodities.	▪ PEOPLE-ECCO's EO-based tools could help in tasks related to the tracking of deforestation and forest degradation, thus supporting the declaration's goals.
Convention on Biological Diversity	▪ COP 15 Target 2: 30 percent of areas of degraded terrestrial, inland water, and coastal marine ecosystems, under effective restoration. ▪ The Technical and Scientific Cooperation Mechanism (TSCM) – aims to promote and facilitate technical and scientific cooperation among Parties. Specifically aiming to: a) support regional and subregional support networks; b) enable technology assessment and monitoring of appropriate technologies; c) promote and facilitate the development, transfer, and use of appropriate technologies; d) promote and encourage joint research, cooperation, and collaboration in the use of scientific advances; e) promote the development, implementation, and scaling-up of innovative solutions; and f) to facilitate access to and exchange of relevant technical and scientific data, information, and knowledge.	▪ PEOPLE-ECCO tools could help monitor the effects of the 30 by 30 policy both in terrestrial and marine ecosystems. ▪ The PEOPLE-ECCO tools could support the TSCM by creating open-source, easily reproducible workflows that support the sharing of scientific knowledge as well as provides relevant knowledge transfers associated with the aforementioned pipelines.
Convention on Wetlands Convention sur les zones humides Convención sobre los Humedales Ramsar	▪ Strategic Plan for 2016 – 2024 Goal 3. Wisely Using All Wetlands – restoration is in progress in degraded wetlands, with priority to wetlands that are relevant for biodiversity conservation, disaster risk reduction, livelihoods and/or climate change mitigation and adaptation.	▪ PEOPLE-ECCO tools could help monitor efforts in wetland ecosystems.
United Nations Convention to Combat Desertification	▪ Achieve Land Degradation Neutrality by 2030.	▪ PEOPLE-ECCO tools could help monitor conservation and restoration efforts, helping evaluate progress towards the goal of Land Degradation Neutrality.

	▪ Increase forest area worldwide by 3% by 2030. ▪ Improve livelihoods of forest dependent people. ▪ Increase area designated as protected and manage them effectively. ▪ Mobilize Resources for Sustainable Forest Management (SFM). ▪ Enhance Coordination, Cooperation, Coherence, and Synergies. ▪ Promote governance frameworks to support the implementation of SFM.	▪ PEOPLE-ECCO tools could help monitor the expansion or reduction of select ecosystems and ensure the sustainability of forest management practices.
	▪ UN Decade on Ecosystem Restoration aims to halt the degradation of ecosystems and restore them to achieve global goals.	▪ PEOPLE-ECCO tools could further strengthen the monitoring of restoration efforts, helping ensure the goals of the UN Decade on Ecosystem Restoration are met.

2.2 Major initiatives and datasets

Numerous international and national initiatives are important for ecosystem conservation and planning efforts (Table 2). The PEOPLE-ECCO project aims to build upon these pre-existing efforts to prioritize and maximize its efforts to produce impactful tools for conservation monitoring and planning.

Organizations like World Wide Fund for Nature (WWF), Conservation International (CI), and The Nature Conservancy (TNC) lead efforts such as the Living Planet Campaign, Global Conservation Fund, and Lands and Waters Initiative, respectively, focusing on protecting critical habitats and establishing protected areas. BirdLife International's Important Bird and Biodiversity Areas (IBA), the Key Biodiversity Areas (KBAs), and the Wildlife Conservation Society's Global Conservation Program also contribute significantly by identifying and conserving vital bird species, habitats, and biodiversity-rich regions. IUCN publishes the Red List of Species and Ecosystems.

Additionally, many datasets have been published that are highly relevant to conservation and planning efforts (Table 3). Some of these datasets include the Global Canopy Height dataset for 2020 developed by researchers at ETH Zürich, as well as Planet's commercially available suite of "planetary variables" which include soil water content and forest carbon. Furthermore, the World Resources Institute's (WRI) Tropical Tree Cover dataset maps tree cover across the tropics, and the Allen Coral Atlas and Coral Reef Watch provide crucial data on coral ecosystems. Finally, large technology companies such as Meta have started collaborating with organizations such as the WRI to develop Very-High resolution global canopy height layers (1m resolution). Global Mangrove Watch and Global Forest Watch make datasets available and also offer tools for the monitoring of mangroves and terrestrial forests respectively via their portals. The EU Grassland Watch provides grassland information in 3689 Natura 2000 sites in 27 EU Member States.

Finally, global networks such as GEO BON and GBIF provide data infrastructures for biodiversity information, such as BON in a Box which consolidates diverse biodiversity-related tools and resources in order to improve data analysis and collaboration.

Table 2 Major initiatives relevant to the PEOPLE-ECCO project.

Organization	Initiative Description
WWF	▪ Living Planet Campaign: Focuses on protecting critical habitats and species, including the establishment and management of protected areas. ▪ Amazon Region Protected Areas (ARPA): Aims to protect 150 million acres of the Amazon rainforest through the creation and management of protected areas,
Conservation International	▪ Global Conservation Fund (GCF): Provides funding to create and expand protected areas, focusing on biodiversity hotspots and high-biodiversity wilderness areas. ▪ Seascapes Program: Works to establish marine protected areas (MPAS) to conserve marine biodiversity and promote sustainable fisheries.
The Nature Conservancy	▪ Lands and Waters Initiative: Focuses on conserving critical lands and waters through land acquisition, easements, and the establishment of protected areas. ▪ Coral Triangle Initiative: Aims to protect marine biodiversity in the Coral Triangle region through the creation of MPAs and sustainable fisheries management. ▪ Mapping Ocean Wealth: Focuses on quantifying and visualizing the benefits that marine ecosystems provide to people.
BirdLife International	▪ Important Bird and Biodiversity Areas (IBA) Program: Identifies and conserves critical habitats for bird species, often leading to the establishment of protected areas. ▪ Preventing Extinctions Programme: Focuses on protecting critically endangered bird species and their habitats, often through the creation of protected areas.
WCS	▪ Global Conservation Program: Works to establish and manage protected areas in key biodiversity regions worldwide. ▪ Wildlife Action Plans: Develop and implement action plans for the conservation of specific species and their habitats, often involving the creation of protected areas.
IUCN	▪ World Commission on Protected Areas (WCPA): Provides guidance and support for the establishment and management of protected areas globally. ▪ Red List of Ecosystems: Identifies ecosystems at risk and promotes their conservation, often through the establishment of protected areas. ▪ Key Biodiversity Areas (KBAs): support the identification, mapping, monitoring, and conservation of key areas for biodiversity globally with the goal of safeguarding the most critical sites for nature on Earth.
gef	▪ Biodiversity Focal Area: Funds projects that establish and manage protected areas to conserve biodiversity globally. ▪ Small Grants Programme (SGP): Supports community-based projects that contribute to biodiversity conservation including the creation of protected areas.
planet.	▪ Planetary Variables: Drawing on their constellation of satellites, Planet's Planetary Variables Initiative aims to deliver 'Planetary Variables' to help track some key characteristics that define ecosystem health.

	▪ Land & Carbon Lab: aims to provide the world's most comprehensive, timely, and accessible data on land use, land cover, and carbon emissions by leveraging geospatial data and AI. ▪ Ocean Watch: an open data platform aimed at delivering science to policy makers working on the sustainable management of the marine environment. ▪ Resource Watch: an open data platform aiming to provide trusted and timely data for sustainable management of forests, water, climate, and other key resources. ▪ Global Restoration Initiative: focuses on restoring degraded landscapes to improve ecosystem health and the well-being of humans who depend on each landscape. ▪ Global Forest Watch: open data platform that aims to offer free, real-time data, technology, and tools to monitor the world's forests.
	▪ The Allen Coral Atlas: the initiative maps the world's coral reefs and monitors their threats to provide actionable data and a shared understanding of coral ecosystems.
	▪ Coral Reef Watch: is a free online platform that provides global analysis of sea surface temperature (SST) and aims to identify coral reefs at risk of bleaching.
	▪ Global Mangrove Watch: is an online remote sensing (RS) data and monitoring platform that provides necessary data and tools to monitor mangroves at a global scale. It aims to be the most complete and up-to-date source of information on mangroves worldwide.
	▪ GeoBon: Global network of researchers dedicated to improving the ability to acquire, coordinate, and deliver biodiversity information at the regional, national, and global scales.
	▪ Global Biodiversity Information Facility: International network and data infrastructure funded by international governments to provide everyone with open access to data about life on Earth.
	▪ Ocean Biodiversity Information System: It has the ultimate mission of building and maintaining a global alliance that collaborates with scientific communities to facilitate the free and open access to, and application of, biodiversity and biogeographic data, as well as information on marine life.
	▪ EU Grassland Watch: Aims to provide information on the grasslands in 3,689 Natura 2000 sites across 27 EU Member States. ▪ Forest Information System for Europe: Aims to plant 3 billion trees by 2030. Additionally, aims to bring together data, information, and knowledge gathered through forest-related policy drivers in Europe. ▪ Knowledge Centre for Biodiversity: EU Commission initiative on better knowledge management for policy-making on biodiversity. It aims to track and assess progress by the EU and its partners, foster cooperation and partnership, and underpin policy development. ▪ EU Biodiversity Strategy Dashboard: shows the progress of the EU and its member states towards the targets set for 2030 under the EU Biodiversity Strategy. The

	dashboard allows users to visualize progress towards each individual indicator defined by the EU Biodiversity Strategy.
Land Monitoring Service	▪ Copernicus Land Monitoring Service: Provides geographical information on land cover and its changes, land use, ground motion, vegetation state, water cycle, and earth surface energy variables.
Copernicus Marine Service	▪ Copernicus Marine Service: Provides free and open marine data such as ocean biochemistry, surface ocean carbon, waves analysis, physics analysis, and more.
NATURE POSITIVE INITIATIVE	▪ Nature Positive Initiative: Promotes the integrity and implementation of 'Nature Positive' by 2030. It's core work includes preserving the integrity of 'Nature Positive' as a measurable 2030 global goal, as well as advocating for the full implementation of the Kunming-Montreal Global Biodiversity Framework by governments and other stakeholders.
ipbes	▪ Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES): Independent intergovernmental body established by States to strengthen the science-policy interface for biodiversity and ecosystem services. ▪ IPBES rolling work programme up to 2030: Initially focuses on three topics; a) understanding the importance of biodiversity in achieving the 2030 Agenda for Sustainable Development; b) understanding the underlying causes of biodiversity loss and determinants of transformative change and options for achieving the 2050 'Vision for Biodiversity'; and c) measuring business impact and dependence on biodiversity and nature's contributions to people. The work programme also has 6 objectives within these topic; i) assessing knowledge, ii) building capacity, iii) strengthening the knowledge foundations, iv) supporting policy, v) communicating and engaging, and vi) improving the effectiveness of IPBES.
UN WCMC environment programme	▪ UN Environment Programme World Conservation Monitoring Centre (UNEP – WCMC): Works at the interface of science, policy, and practice to tackle the global crisis on nature, aiming to advance the transition towards a sustainable future. ▪ Protected Planet: A global platform for knowledge and data on the trends and status of protected and conserved areas with the goal of providing policymakers with the best possible information on these areas. ▪ Connectivity Conservation: UNEP-WCMC promotes connectivity conservation and the conservation of migratory species across diverse biomes. In so doing they support the implementation of the Convention on Migratory Species (CMS), the Convention on Biological Diversity (CBD), and biodiversity policy relating to areas beyond national jurisdiction in the ocean. ▪ Global Wildlife Trade: Provide dedicated scientific, policy, and knowledge management support to efforts implementing the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As part of this work relevant species-focused assessments and trade data analyses are supplied to national and regional authorities working towards more sustainable international trade.

Table 3 Major datasets relevant to the PEOPLE-ECCO project.

Parameter / theme	Dataset	Coverage	Time period	Source	Availability
Biomass	ESA CCI (Climate Change Initiative) Global Forest Above Ground Biomass	Global	2010, 2015, 2016 - 2021	ESA	Dataset: ▪ CEDA Archive ▪ Google Earth Engine (limited temporal coverage) ▪ CCI Open Data Portal Code: ▪ Unavailable in an open repository
Biomass	Aboveground Biomass Carbon Density	Global	2010	NASA	Dataset: ▪ NASA EarthDATA Code: ▪ Unavailable in an open repository
Biodiversity	Biodiversity Intactness Index	Global	2000 – 2015	UNEP-WCMC	Dataset: ▪ Natural History Museum Data Portal (UK) ▪ Resource Watch Code: ▪ Unavailable in an open repository
Built-up Area	GHS Built-up Surface	Global	1975 – 2030	JRC	Dataset: ▪ Copernicus Emergency Management Service ▪ Google Earth Engine Code: ▪ Unavailable in an open repository
Land Cover	World Cover	Global	2020 – 2021	ESA	Dataset: ▪ ESA WorldCover Viewer ▪ AWS Registry of Open Data ▪ Google Earth Engine ▪ Terrascope ▪ Zenodo ▪ ESA download Code: ▪ Unavailable in an open repository
Land Cover	Dynamic World	Global	2015 – 2025	WRI / Google	Dataset: ▪ Google Earth Engine Code: ▪ https://github.com/google/dynamicworld

LandCover/LandUse Breakpoints	Google Global Landsat-based CCDC Segments	Global	1999 – 2019	Google	Dataset: ▪ Google Earth Engine Code: ▪ Unavailable in an open repository
LandCover/LandUse Change	Global 2000-2020 Land Cover and Land Use Change	Global	2000 – 2020	Potapov et al., 2020	Dataset: ▪ Google Earth Engine ▪ GLAD Code: ▪ Unavailable in an open repository
Canopy Height	Global Canopy Height	Global	2020	ETH Zurich	Dataset: ▪ Google Earth Engine ▪ ArcGIS Hub Code/Interactive Demo: ▪ https://github.com/langnico/global-canopy-height-model
Canopy Height	High Resolution 1m Global Canopy Height	Global	2009 – 2020 (Mostly 2018 – 2020)	WRI / Meta	Dataset: ▪ Google Earth Engine ▪ AWS S3 Bucket Code: ▪ Unavailable in an open repository
Agriculture	World Cereal	Global	2021	ESA / World Cereal Consortium	Dataset: ▪ openEO ▪ Google Earth Engine ▪ Terrascope ▪ World Cereal Zenodo repository Code: ▪ Unavailable in an open repository
Grassland	EU Grassland Watch	EU	1994 – 2025	European Commission / COP4N2K	Dataset: ▪ COP4N2K API Code: ▪ Unavailable in an open repository
Elevation	NASADEM	Global	2000	NASA JPL	Dataset: ▪ OpenTopography API ▪ Microsoft Planetary Computer Code: ▪ Unavailable in an open repository

Tree cover	Tropical Tree Cover	Tropics	2020	GFW / WRI	Dataset: ▪ Global Forest Watch (GFW) ▪ Google Earth Engine Code: ▪ https://github.com/wri/sentinel-tree-cover
Tree Cover	EC JRC Global Map of Forest Cover	Global	2020	JRC	Dataset: ▪ Google Earth Engine ▪ https://forobs.jrc.ec.europa.eu/GFC ▪ Global Forest Watch Code: ▪ Unavailable in an open repository
Tree Cover Loss	Global Forest Change	Global	2000 – 2023	GLAD lab / Google / USGS / NASA	Dataset: ▪ Global Forest Watch ▪ Google Earth Engine ▪ NASA EarthDATA
Mangrove Extent	High-Resolution Mangrove Extent (10m)	Global	2020	GMW	Dataset: ▪ Global Mangrove Watch (GMW) Web Portal Code: ▪ https://github.com/globalmangrovewatch
Water Content	Planet Soil Water Content	Global	2002 – 2024 (at 1000m 2017 – 2024 (at 100m)	Planet	Dataset: ▪ Sentinel-Hub (with a Planet account or a Sentinel Hub account with a paid or trial subscription) ▪ Planet Subscriptions API Code: ▪ Unavailable in an open repository
Surface Water Mapping	Global Surface Water	Global	1984 – 2021	JRC	Dataset: ▪ Google Earth Engine ▪ Global Surface Water Explorer ▪ Planetary Computer ▪ Sentinel-Hub Code: ▪ Unavailable in an open repository
Surface Temperature	Planet Land Surface Temperature	Global	2002 – 2024 (at 1000m 2017 – 2024 (at 100m)	Planet	Dataset: ▪ Sentinel-Hub (with a Planet account or a Sentinel Hub account with a paid or trial subscription) ▪ Planet Subscriptions API Code: ▪ Unavailable in an open repository

Biomass	Planet Crop Biomass	Global (limited since 2019)		Planet	Dataset: ▪ Sentinel-Hub (with a Planet account or a Sentinel Hub account with a paid or trial subscription) ▪ Planet Subscriptions API Code: ▪ Unavailable in an open repository
Forest Carbon	Planet Forest Carbon	Global	2013 – 2024	Planet	Dataset: ▪ Sentinel-Hub (with a Planet account or a Sentinel Hub account with a paid or trial subscription) ▪ Planet Subscriptions API Code: ▪ Unavailable in an open repository
Protected Areas	World Database on Protected Areas	Global	Updated Annually	UNEP-WCMC / IUCN	Dataset: ▪ Protected Planet Code: ▪ Not applicable
Protected Area Management Effectiveness (PAME)	Global Database on Protected area Management Effectiveness	Global	1996 – Onwards		Dataset: ▪ Protected Planet Code: ▪ Not applicable

2.3 Existing Tools

Prior to the PEOPLE-ECCO project, many tools have been developed to support protected area management effectiveness (PAME) analyses, before-after control-impact (BACI) analyses, and conservation prioritization and suitability mapping efforts. Geographic Information Systems (GIS) technology is a crucial tool in the field of conservation. Using GIS, conservation practitioners visualize, analyse, and interpret geospatial data to understand relationships, patterns, and trends throughout a landscape. The most widely used GIS software are QGIS (free and open-source) and ArcGIS (ESRI commercial software). Both are commonly used due to their low barriers to entry and accessible user interfaces.

Specialized applications and tools are also available for ecosystem characterisation, PAME and impact assessment, and conservation planning, which are summarized in Table 4, Table 5, and Table 6.

Table 4 Available Ecosystem Characterization tools.

Tool	Description	Access Type	Gaps & Limitations
Spectral Recovery	A Python package developed to address the needs of forest landscape restoration and wetland restoration practitioners. It leverages EO time-series and spectral indexes to monitor changes to diverse ecosystems.	Free to use / Open-Source	▪ Programming Required
LandTrendr (Landsat-based Detection of Trends in Disturbance and Recovery)	An algorithm that leverages timeseries analysis of Landsat data to detect changes in land cover and land use, focusing on disturbance and recovery patterns in ecosystems.	Requires a GEE account.	▪ Programming required ▪ Not open source
Coastal Mapper	A web-based interactive tool designed to perform coastal zone mapping using EO data combined with advanced deep learning methods in a user-friendly way.	DHI proprietary software	▪ Not open source ▪ Tailored with local VHR imagery
EU Grassland Watch	An initiative focused on the monitoring and characterization of grassland ecosystems across Europe. It leverages EO data, field surveys, and advance data analytics, to assess the health, biodiversity, and extent of Natura 2000 Grassland habitats.	Free to use / Open-Source / Still under development	▪ Ease of data access – not currently accessible by API

Table 5 Available Protected Area Management Effectiveness and Conservation Action Effectiveness Assessment tools.

Tool	Description	Access Type	Gaps & Limitations
EnvImpactEval	An R package that offers a user-friendly and statistically sound approach for assessing and conducting BACI designs using EO data.	Free to use / Open-Source	▪ Programming required ▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers ▪ Still under development
Epower	An R package that offers a user-friendly robust approach for assessing the statistical power of BACI designs.	Free to use / Open-Source	▪ Programming required ▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers
IMET	A software tool that enables an in-depth Protected Area Management Effectiveness (PAME) assessment of marine and terrestrial protected areas, regardless of their management categories and governance types.	Free to use	▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers
TerrSet	An integrated geospatial software system for monitoring and modeling landscapes for sustainable development and conservation.	Free to use / Open-Source	▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers

Table 6 Available Conservation Planning and Suitability Assessment tools.

Tool	Description	Access Type	Gaps & Limitations
Marxan	A widely used decision support tool for creating reserve networks that meet specified conservation goals. It uses algorithms to identify the most cost-effective areas for protection.	Free to use	▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers
Zonation 5	A spatial prioritization software that is commonly used for conservation planning. It ranks areas based on their conservation value, considering factors like species richness, habitat quality, ecosystem services, and threat levels.	Free to use	▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers
InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs)	A tool to map and value ecosystem services that can be used to identify areas that provide significant ecosystem services and should be prioritized for protection.	Free to use / Open-Source	▪ Limited computational scalability ▪ Requires integration of diverse ecosystem characterization layers
Prioritzr	An R package that provides a flexible interface to solve systematic conservation planning problems.	Free to use / Open-Source	▪ Programming required ▪ Requires integration of diverse ecosystem characterization layers ▪ Limited computational scaling
MaxEnt / MaxNet	A stand-alone Java/R application for modelling species geographic distributions.	Free to use / Open-Source	▪ Requires integration of diverse ecosystem characterization layers ▪ Limited computational scaling
TerrSet	An integrated geospatial software system for monitoring and modeling landscapes for sustainable development and conservation.	Free to use / Open-Source	▪ Requires integration of diverse ecosystem characterization layers ▪ Limited computational scaling
INCA tool	QGIS plugin aimed at supporting the calculation of various ecosystem services accounts.	Free to use	▪ Requires integration of diverse ecosystem characterization layers ▪ Limited computational scaling
ARIES	A tool leveraging a cloud-based and AI technologies on human-nature interdependence to address complex sustainability problem.	Free to use / Open-Source	▪ Requires integration of diverse ecosystem characterization layers

3 Early Adopter Profiles and Requirements

In this section we identify the profile, mandate, and technical capacities of each Early Adopter in relation to the PEOPLE-ECCO project. We conducted multiple interviews with key staff and documented working practices, technical capacity, and capacity development requirements. We described their needs for tools and products that could be developed during the PEOPLE-ECCO project as user stories.

User stories are simple, concise descriptions of a feature or functionality from the perspective of the end user. The purpose of user stories is to capture the requirements and expectations of users in a way that is easy to understand and prioritize. The key elements of a user story include:

- Role: Who is the user or persona that will benefit from the feature?
- Goal: What does the user want to achieve or do?
- Benefit: Why does the user want to achieve this goal? What is the value or benefit?

We documented all the relevant requirements, even if some requirements are technically challenging with current remote sensing technologies and may not be addressed by the PEOPLE-ECCO solutions.

3.1 African Parks

African Parks is a non-profit conservation organization that takes on total responsibility for the rehabilitation and long-term management of protected areas in partnership with African Governments and local communities. African Parks' approach combines world class conservation practice with business expertise. African Parks operate globally with entities across Africa, with a head office in South Africa and satellite funding offices in the Netherlands, Switzerland, United States, Germany, United Kingdom, and Hong Kong.

African Parks currently manages 23 national parks and protected areas in 13 countries covering 20 million hectares. African Parks is rapidly growing, ambitiously aiming to directly manage 30 protected areas by 2030, across 25 recognised ecosystems[2], totalling at least 30 million hectares and thus contributing to the global target of protecting 30% of the Earth to keep the planet flourishing.

Working Practices

African Parks pioneered the "Public Private Partnership" (PPP) model for protected area management. Under this model African Parks is fully responsible for all park management functions and are 100% accountable to the Government who remains the owner and determines policy for the landscape.

This is achieved through long-term agreements that are on average 20-years (mandates), putting in place funding solutions (money), establishing sound management, and clear governance by

[2] As per the OneEarth 2023 / Dinerstein *et al.* 2017.

creating separate legal entities per park or country, each with their own Board representing key stakeholders (management).

To achieve its goals, African Parks engages local communities, and law enforcement, to help enact and maintain its diverse management plans across parks they manage. These management activities include but are not limited to rewilding, re-introduction of species, and the creation of ecodevelopment zones for the sustainable use of natural resources. Furthermore. African Parks often collaborates with different entities in the creation of diverse EO-based outputs through different individual projects. However, this involvement generally is related to the sharing of data and knowledge and being able to benefit from the final outputs which feed into management decisions.

To monitor the effectiveness and impact of their management activities, African Parks has a highly detailed key performance indicator (KPI) framework. These KPIs include but are not limited to species distributions, abundance, and area protected. African Parks continually revises and adds to its KPI framework and has currently been looking to add a landscape connectivity metric, as well as a habitat intactness metric. Both these metrics can help evaluate protected area effectiveness and determine potential site suitability for conservation.

Most of the site suitability identification work carried out by African Parks takes place within areas that are already protected, and generally large restoration or conservation work. Their prioritization workflows mostly follow their own internal process. The organization follows a structured hierarchy for future interventions and sites based on area, need, ease of work with governance, ecosystem targeting, and other important considerations.

Technical Capacity

With the expansion of parks managed by the organization, African Parks is implementing an expansion of capacity in information technology and geospatial technologies. African Parks' Head Office in Johannesburg, South Africa, provides technical support to the African Parks management teams at the park level. This includes business intelligence support (data science) and dedicated geospatial support.

As a result, African Parks have improved capacity to utilize the methods and tools to be developed in the PEOPLE-ECCO project. African Parks' current technical capacity includes the capacity to use ArcGIS (Pro and Online) at different levels throughout the organisation which allows them to conduct complex GIS-based prioritization analyses for large landscapes, and the ability to work with various remote sensing (RS) datasets. In the head office they have one person dedicated to remote sensing, with a few other staff that are competent in Google Earth Engine (GEE), SentinelHub, and Copernicus EO Browser. The organisation has a few staff with Python programming capacity as well as some staff comfortable programming in R. Despite only two parks having a staff member with a dedicated remote sensing and GIS role, most of the parks' research teams comprise individuals who dedicate some of their time to GIS application. There is also one dedicated regional geospatial/GIS analyst. The aim is to increase geospatial capacity across the organization over the next few years.

Capacity Development Requirements

African Parks' capacity development requirements centre around programming, scripting, and sharing remote sensing knowledge. African Parks is additionally interested in the ability to streamline remote sensing workflows so that people who don't regularly use RS/GIS tools, might be able to use the tools developed, and those who are regular remote sensing and GIS tool users can apply analyses with greater efficiency.

African Parks User Stories related to the PEOPLE-ECCO Project

As the head of the Geospatial Unit of African Parks, I want:

- A tool/process to generate consistent ecosystem characterisation layers across a range of ecozones derived from EO data that will enable us to assess core metrics for ecosystem condition. The ecosystem characterisation layers include:
    - Woody plant cover density in forests, shrublands, and dense savannas (annual with multi-year change);
    - Grassland and open savanna extent and condition (annual with multi-year trends);
    - Fire extent footprints (ideally polygons/areas, not only points), frequency (e.g. monthly or quarterly), intensity and ignition source (to determine causes and legality of fires); and
    - Anthropogenic land use, including density and type (e.g., residential, commercial, mining, croplands, linear infrastructure, etc.).
- Based on the above characterisation layers, a tool/process to generate an indicator of habitat intactness (HI). The HI should specifically focus on anthropogenic impacts on ecosystems/land cover or lack thereof. Habitat Intactness may be indicated by:
    - Built-up area and imperviousness/pressure/intensity (or conversely the ability to be rehabilitated or restored) thereof;
    - Linear man-made infrastructure;
    - Mining and quarrying areas;
    - Cropland and pastureland, including small-scale and/or subsistence crops, especially in natural vegetation mosaics;
    - Deforested and degraded areas;
    - Areas impacted by inappropriate fire regimes;
    - Overgrazed areas; and
    - Degradation and transformation of natural habitats through non-human actors such as elephants, and invasive species, both of which are challenging to accurately detect.
- A tool/process to generate an indicator of actual structural landscape connectivity based on ecosystem characterization layers. Connectivity can be measured by:
    - Applying the above HI indicator to a wider area in order to determine the extent of land above a certain intactness level between core protected areas and other viable conservation areas, as well as in the landscape/s as a whole.

As the Nature-based Solutions project manager of African Parks, I want:

- A tool/process to support the quantitative monitoring and assessment of conservation management impact, using a counter-factual or BACI framework. This would include for a selected indicator (e.g. intactness):
    - Sampling intervention areas and reference areas;
    - Statistical analysis appropriate to the datasets;
    - Visualization of results in appropriate charts and graphics;
- A tool/process that can assist in better understanding and quantifying of ecosystem services beyond carbon stock (e.g. net carbon flux, water provision, soil retention, and biodiversity metrics).

3.2 IUCN Vietnam

Headquartered in Switzerland, IUCN was established in 1948. It is an international authority working on a wide range of themes related to nature conservation, forests, ecosystem management, protected areas, global policy and governance and rights. IUCN is the world's largest and most diverse environmental network, harnessing the knowledge, resources and reach of our more than 1,400 Member organizations and 15,000 experts. Vietnam became an IUCN State member in 1993. IUCN Viet Nam has 11 members including one State member – Ministry of Natural Resources and Environment (MONRE) – and 10 NGO members. In 2015, the IUCN National Committee was established to strengthen the voice of members in IUCN's work.

IUCN started working in Vietnam in 1993 where it began collaboration with government agencies, research institutions, the private sector, and international organizations. Some of its flagship projects include the Critical Ecosystem Partnership Fund (CEPF), which supports civil society participation in the conservation of Viet Nam's highly threatened wildlife.

A strength of IUCN is its ability to facilitate alliances and build networks among stakeholders. Its close relationship with the Vietnamese government helps IUCN communicate with and secure support for measures such as the shift to less intensive but higher value farming systems in Vietnam or the creation of necessary protected areas in key biodiversity hotspots.

Technical Capacity

IUCN Vietnam has strong internal ArcGIS Pro and QGIS capacity, which interacting with remote sensing related data. IUCN typically relies on global datasets freely available from third parties, combined with local data to generate metrics and assess key indicators. When more expertise is required, IUCN Vietnam collaborates with government agencies and external partners and consultants. The key organizations are:

- SNV (Netherlands Development Organisation with a history of working in Vietnam);
- Southern Institute of Ecology, Vietnam Academy of Science and Technology;
- Vietnam Space Technology Institute (STI), belonging to the Vietnam Academy of Science and Technology (VSAT);
- Vietnam National Remote Sensing Department (NRSD).

In the past, IUCN has collaborated with NASA (National Aeronautics and Space Administration) and ESA (recently through Hatfield). IUCN as an Early Adopter would seek to stimulate the use of

products and tools developed under PEOPLE-ECCO by their collaborative partners in Vietnam and beyond.

Capacity Development Requirements

IUCN Vietnam's capacity development requirements are centred around the stakeholders the organization believes would benefit most from the work PEOPLE-ECCO will be proposing. Content introducing remote sensing concepts and how to obtain/integrate diverse EO-based datasets into their work would most likely be of interest to different groups. Furthermore, improved coding skills (JavaScript, Python, and R) required for customizing the tools developed by PEOPLE-ECCO to suit user-specific requirements.

IUCN Vietnam User Stories

As the Programme Coordinator for IUCN Vietnam, I want:

- A tool/process that produces ecosystem characterization layers that enable me to map in the Northwest region of Vietnam (Son La), Northwest Central of Vietnam (Thanh Hoa, Nghe An provinces), and Lao PDR (Houaphan and Xien Khouang provinces):
    - Tree canopy cover (annually);
    - Natural forest cover loss and maintenance of remnants of natural forest (annually);
    - Extent and expansion of annual crops (e.g. cassava and corn) over the past five years (with the possibility to update the analysis annually); and
    - Extent and expansion of agroforestry systems (e.g. shade grown coffee, longan, etc.) over the past five years (with the possibility to update the analysis annually).
- A tool/process that leverages the ecosystem characterization layers mentioned above and third-party datasets to identify priority areas for conservation to improve *landscape integrity*, e.g. Decree ND156/2028/NĐ-CP which specifies land use and land cover requirements for areas with steep slopes, high and seasonally concentrated rainfall, and certain soil types.
- A tool/process that enables a transboundary analysis of Vietnam and Lao PDR, specifically targeted at evaluating changes in the trends of the ecosystem characterization layers mentioned above. This could include an assessment of conservation management impact at the district, commune, province or catchment level, using a counter-factual or BACI framework. This would include for a selected indicator (e.g. landscape integrity):
    - Sampling intervention areas and reference areas;
    - Statistical analysis appropriate to the datasets;
    - Visualization of results in appropriate charts and graphics.

3.3 Bulgarian Society for the Protection of Birds

The BSPB is one of the largest environmental CSOs in Bulgaria. Founded in 1988, it has been working for 35 years to preserve wild birds and their habitats for the benefit of nature and people. It is the national partner of BirdLife International. BSPB is a citizens' society organization with a real membership and structures across Bulgaria. Its work focuses on implementing the concept of the Important Bird Areas and establishing a functionally connected network of Special Protection Areas (SPAs) as a cornerstone of the Natura 2000 network. A central component of

BSPB's work is dedicated to conserving globally threatened species, among which many raptors. BSPB does this by applying a diverse range of conservation measures to mitigate threats that may face them at a national and international level along the flyway. BSPB has a team of about 35 people and operates at the national level with 6 regional offices. BSPB has successfully implemented over 15 LIFE projects and has received the prestigious "Best of the Best LIFE Nature projects" Award of the EU for an imperial Eagle conservation project. BSPB's experts have been recognized at an international level and three of them received the prestigious Whitley Award for their conservation work in Bulgaria.

Technical Capacity

BSPB have a part-time GIS specialist who is most comfortable working in GUI-based software environments like QGIS or ArcGIS. Within that framework their GIS specialist occasionally uses Python (ArcPy), most often to access data from Rest APIs or for database related work. Additionally, BSPB has developed a mobile data collection app in collaboration with a third party. However, the organization has limited remote sensing experience.

Capacity Development Requirements

BSPB capacity development requirements are centred around their lack of in-house remote sensing expertise. Content introducing remote sensing concepts and how to obtain/integrate diverse EO-based datasets into their work would most likely be of interest to them. Further content would then build from there if adequate.

BSPB User Stories

As a Conservation Officer for BSPB, I want

- A tool/process that will generate consistent ecosystem characterization layers from EO data that will enable us to assess core metrics to assess the conditions of grasslands and other important ecosystems for local and migratory bird species. These ecosystem characterization layers could include:
    - Grassland extent and condition (annual with multi-year trends);
    - Woody plant cover density in and around grassland ecosystems (annual); and
    - Grassland management regime (grazing intensity, cutting, land conversion to arable land, vegetation overgrowth, etc.).
- A tool/process that will support grassland condition assessment, through tracking trends in the above-mentioned characterisation layers. This tool may support the assessment of grassland condition by producing:
    - Trends quantifying grassland encroachment, degradation, conversion, and grazing intensity (e.g., trend of spectral indexes accounting for seasonality).
- A tool/process that will support the monitoring of inland waterbodies/wetlands and allows us to identify areas the dry up annually as well as variability over the past 5 or more years.

As a Conservation Manager for BSPB, I want:

- A tool/process that will support the evaluation of grassland condition within a land parcel as an input to my decision-making process for land purchase for conservation prioritization.

- A tool/process that will support evaluation of grassland habitat connectivity as an input for conservation site suitability and prioritization assessment. Grassland habitat connectivity can be measured in this scenario by applying the above-mentioned grassland condition tool/process to parcels between areas that are currently under management by BSPB or are a Natura2000 site. The condition of the plots between these managed parcels can be given a score based on their current condition thus allowing us to determine whether pre-existing managed conservation plots are adequately connected or not.

3.4 Lebanon Reforestation Initiative

The LRI is a Lebanese NGO registered at the Ministry of the Interior and Municipalities under no.1186 on June 18th, 2014. LRI started as a project launched in 2010 by the United States Forest Service (USFS) Office of International Programs (IP) through the support and funding of the United States Agency for International Development (USAID). LRI aims to expand, manage, and protect Lebanon's forests and landscapes through a community-based approach. LRI works on building resilient communities to environmental threats, increasing environmental awareness and education, advocating for forest conservation, and advancing research in the forestry field. LRI's objectives include:

1. support for municipalities and local community members to develop and implement forest management plans in their village;
2. bring diverse communities together and support them to advocate for improved forest management policies;
3. identify and develop research gaps throughout the different fields of ecological restoration and wildlife conservation and hinder the sustainability of landscape management; and
4. provide technical assistance to relevant local stakeholders.

Technical Capacity

LRI has staff that are familiar with basic Python and R programming. Additionally, LRI has a mapping team composed of three individuals who have basic knowledge of remote sensing principles and GIS systems. The organization has experience working with Sentinel-2 and SPOT data, as well as Landsat, which they traditionally access through Google Earth Engine.

Capacity Development Requirements

LRI aims to enhance its understanding and learn about the implementation of remote sensing monitoring tools to better advocate for biodiversity characterization exercises of existing or newly recommended sites for protection. Additionally, LRI seeks to promote relevant measure to the Ministry and other concerned authorities. To achieve this, LRI is working towards unifying and standardizing the approach it uses to manage protected areas in Lebanon, aligning it with regional and international standards.

LRI User Stories

As a Program Manager for the LRI, I want:

- A tool/process that helps me produce ecosystem characterization layers related to tree cover, grasslands, and shrublands:
    - Shrub and tree cover density (annual, with multi-year change);
    - Tree cover height (annually);
    - Grassland extent (annual with multi-year change); and
    - Fire extent (spatial not only points) and frequency (e.g. monthly or quarterly);
    - Changes in grassland, forest, or shrubland condition (as determined by changes in a spectral index while accounting for seasonality).
- A tool/process to support the quantitative monitoring and assessment of conservation management impact, using a counter-factual or BACI framework. This could include a trend in a spectral index accounting for seasonality. This could in turn allow me to assess current interventions and plan for future interventions.

3.5 Prince Edward Island Watershed Alliance

Prince Edward Island Watershed Alliance (PEIWA) is non-profit cooperative association of watershed management groups on Prince Edward Island (PEI), Canada. Its mandate is to improve and enhance the environmental quality of PEI watersheds for the benefit of all residents. PEIWA is an umbrella organization that provides support for 25 island watershed groups-covering 95% of PEI. The Alliance empowers Island watershed groups to achieve their goals by promoting cooperation, by serving their needs and by providing a strong, united voice in addressing Island-wide watershed issues. PEI contains one Marine Protected Area (MPA), Basin Head designated in October of 2005. The MPA is under the official management of Fisheries and Oceans Canada (DFO) however the Souris and Area Branch watershed group contributes with knowledge and experience relating to the ecology, management, conservation and use of the area.

Working Practices

As an umbrella organisation of PEI's 25 watershed groups, PEIWA aims to help them achieve their goals by promoting cooperation, serving their needs and providing a strong, united voice in addressing Island-wide watershed issues. The PEI watershed groups operate with a community-driven ethos, emphasizing inclusivity and collaboration. Successful watershed management is built upon extensive community input and engagement, making it a transparent process that encourages participation from all stakeholders. This ensures that the management plans reflect the community's shared vision and goals for the watershed, fostering widespread buy-in and support. Each group designs its own visions and guiding principles, addressing key issues to create tailored management and conservation plans for its specific watershed priorities. Once plans are finalized, groups implement recommendations while maintaining regular monitoring, reporting, and updates to adapt to evolving conditions. Collaboration is central to their success, and as central coordinator, PEIWA fosters cooperation among groups, allowing them to share resources and expertise while advocating for their collective interests at a provincial level. This approach ensures sustainable and inclusive management of PEI's watersheds.

To achieve their goals PEIWA and its associated watershed groups are dedicated to conserving and restoring the ecological health of Prince Edward Island through a combination of local knowledge, data collection and collaborative efforts. Their work focuses on addressing critical environmental challenges, including agricultural runoff, coastal erosion, water quality issues and the restoration of vital habitats, like eelgrass beds and riparian zones.

Technical Capacity

The 25 watershed groups under the PEIWA have fragmented and varied capacities of using geospatial technologies and to some extent remote sensing, yet they share a foundational

reliance on data, maps, and spatial analysis. While most use GIS for geospatial data analysis and management in their activities, mostly ArcGIS as the primary platform, others incorporate tools like QGIS and R, reflecting diverse technical practices. Many rely on satellite basemaps, drones, and global positioning systems (GPS) for field surveys, alongside region-specific datasets like river temperatures, coastal morphology, and marine habitat surveys.

Individual groups illustrate unique strengths. For example, the *Souris and Area Branch of the PEI Wildlife Federation* integrates satellite and drone data with coastal and saltmarsh surveys, focusing on restoration outcomes and big connectivity analyses for Atlantic salmon habitats in collaboration with organizations like the Canadian Wildlife Federation. They leverage local knowledge and geospatial tools to assess ecosystem dynamics under climate change, prioritizing high-value areas for conservation through ongoing projects extending to 2033.

Similarly, *Bedeque Bay Environmental Management Association (BBEMA)* employs sonar, drones, and historical water quality databases dating back to 2005, which are uploaded to centralized platforms like DataStream (datastream.org) . Their focus on eelgrass habitat involves detailed GPS and drone surveys, enabling the selection of priority conservation sites through seven years of accumulated data. Yet, challenges persist in differentiating eelgrass from visually similar species like sea lettuce, prompting calls for refined classification techniques.

However, data integration remains a challenge and efforts to consolidate and harmonize datasets remain ongoing, with preliminary initiatives like shared portals and collaborative mapping workshops starting to address these gaps. However, challenges persist, including inconsistent data integration, a lack of standardized methods, and difficulty in addressing ecosystems holistically beyond watershed boundaries. Despite these hurdles, some groups excel in niche areas like salmon habitat monitoring, which benefits from better funding and consistent practices.

Capacity Development Requirements

The diversity in technical capacities across the 25 watershed groups highlight a need for capacity-building initiatives that combine centralized support with localized development. A central repository of technical expertise within PEIWA could provide consistent guidance, standardized tools, and training programs on key topics such as geospatial analysis, drone operations, and ecosystem monitoring. Simultaneously, it is essential to empower individual groups by building their technical competencies through tailored support that addresses their unique challenges and priorities. This dual approach—centralized training complemented by localized capacity

development—will enable the watershed groups to enhance their effectiveness, foster collaboration, and bridge existing gaps in technical and geospatial capabilities.

Capacity development and streamlined use of spatial data are also recognized as key priorities to enhance collaboration and improve geospatial practices across the organizations.

PEIWA User Stories

As Conservation Planner in a watershed organisation under PEIWA I want:

- A tool/process that will support ecosystem characterization such as:
  - Submerged aquatic vegetation extent (seasonal with multi-year change);
  - Coastal ecosystem types (annual with multi-year trends), including coastal wetlands, salt marshes and dunes;
  - Coastline extent and dynamics (Seasonal with multi-year change);
  - Coastal and riparian zone runoff zones (Seasonal with multi-year change); and
  - Water quality (particularly focussing on red water mapping caused by sediment runoff as well as macronutrients (e.g. chl.A)) (Near real time).
- A tool/process to generate an indicator of habitat intactness based on the ecosystem characterization layers and third-party data. Intactness may be indicated by:
  - Thresholds and Warning Triggers (e.g. aquatic vegetation density thresholds per km^2, percentage change of a particular ecosystem type, annual erosion patterns exceeding a certain m level or water quality levels exceeding a certain level).
- A tool/process to generate an indicator of landscape connectivity based on ecosystem characterization layers. Connectivity can be measured by:
  - Distance between eelgrass (or other aquatic vegetation types) beds;
  - Size of individual eelgrass (or other aquatic vegetation types) beds (in m^2);
  - Size of coastal ecosystem types and distance between similar ecosystem types; and
  - Types of land cover between similar ecosystem types (e.g. developed or natural).

As a Project Manager at PEIWA, I want:

- A tool to induce cooperation and collaboration between watershed groups as well as NGOs/CSOs working on conservation management on PEI, so that we can share data and insights to enhance our conservation initiatives. Tools could include:
  - A central platform to facilitate the sharing of geospatial data and insights between watershed groups and collaborating NGOs/CSOs;
  - Metrics and indicators that can be used to measure the effectiveness of joint conservation initiatives; and/or
  - Development of common data standards and metadata.
- A tool to easily access, visualise and export satellite data assets for PEI, such as:
  - A platform to retrieve and access Sentinel 2 and Landsat data for PEI and individual watersheds (both multitemporal cloud free composites and individual dates);
  - Compare two or more images with overlay or side by side functionality; and
  - Export data as GeoTIFF or jpg files.

3.6 Reef Check Malaysia

Reef Check Malaysia (RCM) is part of the world-wide Reef Check network. Since it was registered in 2007, Reef Check Malaysia has become established as a leader in coral reef conservation in Malaysia. RCM's main sites of operation include Tioman island, Mantanani island and the Mersing Group of islands. Reef Check Malaysia's activities are organized around four core programs: 1) EcoAction: training survey divers and conducting coral reef surveys at over 200 locations around Malaysia to monitor coral reef health; 2) Management: working with stakeholders to improve the management of coral reefs in Malaysia to secure long term conservation goals; 3) Science: conducting studies on reef resilience and rehabilitation to better understand coral reefs and impacts; and 4) Advocacy: raising awareness of the importance of coral reefs and the valuable ecosystem services they provide.

Only an estimated 1.4% of Malaysia's total marine area (511,000 km^2) is currently under protection. RCM is able to support PEOPLE-ECCO by providing monitoring data from 300 coral reef sites around Malaysia. As the coordinator of the annual International Coastal Clean-up in Malaysia, RCM also has access to data on marine debris from numerous sites around Malaysia. RCM also has data on water quality and seagrass health but on a more limited geographic coverage. A critical component of managing marine ecosystems at a local level is data on ecosystem health. RCM's 17-year data set for coral reef health provides part of the solution but field data collection is expensive and time consuming. The PEOPLE-ECCO project's large-scale demonstrations would provide RCM a complementary and cost-effective way to ensure that existing protected areas are effectively and equitably managed, and that ecologically representative and well-connected systems of Pas and other effected area-based conservation measures can be implemented.

Technical Capacity

RCM focuses on high-quality field surveying and has limited EO and GIS technical capacity. RCM is using basic GIS for reporting to create maps of surveyed areas. Furthermore, DHI in collaboration with RCM developed MCSAV[3] (an interactive tool to map coastal ecosystems - Mangroves, Corals and Submerged Aquatic Vegetation - using EO data) by providing training data and testing the tool, hence RCM is overall familiar with EO workflows from the user-side.

Capacity Development Requirements

RCM's capacity development requirements are mainly centred around the use of basic GIS and EO tools with focus on the user-perspective rather than in depth data analysis. This includes introducing EO concepts on a broader level and how to use EO data and GIS tools with user-interfaces for non-data science experts to efficiently obtain information for reporting, data validation (comparing survey data with EO data), planning, and communication.

[3] https://mcsav-malaysia.dhigroup.com/ (accessed January 2025)

RCM User Stories

As a Programme Manager at RCM, I want:

- A tool/process that can be used for internal and external work purposes.
    - For internal work, I want a tool that supports me in assessing the health of coral reefs around Malaysia and complements our field survey data about the following ecosystem characterization layers:
        - Coral extent (annually);
        - Marine vegetation extent (annually);
        - Sand extent (annually);
        - Rock extent (annually); and
        - Mangrove extent (annually).
    - For external work I want a tool that can be used for communication to support our awareness programs for local communities and governmental organizations. This should include intuitive data presentation with maps and graphs that help visualized the marine environmental status (both in the aquatic and intertidal zones) at specific locations as well as at a regional scale. This tool should be intuitive to use for non-data experts to maximize our outreach.

As the Chief executive officer of RCM, I want:

- A tool/process that points out areas that undergo change thus helping us prioritize our monitoring and survey efforts.

3.7 Survey of Wider Conservation Community

In addition to capturing to diverse requirements of the project's Early Adopters, a survey was developed to capture the EO-related needs and requirements of conservation focussed CSOs and NGOs.

This was done in two ways:

- The distribution of a Microsoft Forms survey; and
- The facilitation of a workshop at the BioSpace25 conference hosted by ESA at ESRIN, Frascati, Italy from 10-14 February 2025.

3.7.1 Summary of online survey

Characterization of participating NGOs/CSOs

A total of 35 NGO/CSO participants completed the online survey "Earth Observation solutions for CSOs/NGOs active in Ecosystems Conservation" between 20 January and 14 February 2025 (see annex 1). Participating NGOs indicated to predominantly work at the global (11 answers) or the national scale (14 answers), with a single organization covering the continental level (1 answer), several working within countries (3 answers), or at the sub-national level (6 answers).

While the survey has a geographic bias focusing on participants from Europe, (South-East) Asia and Africa, these participants' fields of work covered a wide range of terrestrial and aquatic ecosystems. The main activities of the participating organizations related to ecosystem conservation fall under the categories of community engagement (31 answers), management of (protected) areas (27 answers), research (24 answers), and policy and advocacy (23 answers). When asked about the most relevant international policy frameworks and initiatives that drive

their activities, fifteen participants mentioned the CBD-GBF, while seven mentioned the United Nations SDGs. Other highlighted policy frameworks include the Paris Agreement, Ramsar Convention, and various European frameworks, policies, and regulations. Within the relevant national policy frameworks, National Biodiversity Strategies and Action Plans that fall under the CBD-GBF, and national/local implementations of EU policies were often mentioned.

Existing practices

Survey participants indicated that their organizations currently monitor the effectiveness of their conservation actions within protected areas (28) and work to identify high-priority areas to be protected (30 votes), aligning to two parallel conservation objectives addressed in the PEOPLE-ECCO project. While field surveys were mentioned as the most frequent data source supporting these initiatives, many organizations already include satellite remote sensing data and, to lesser extents, UAV and airborne data in their workflows. Derived high-level geospatial layers, e.g., land cover maps or ecosystem-specific layers, are currently the most used data source after field surveys.

Requirements for methods/tools to be developed

The open questions of the online survey on participants' priorities towards the development of tools for the two parallel conservation objectives of the project provided a wide range of requirements from the wider user community. Recurring requirements included open solutions that process free and/or large volumes of EO data, integrate various sources of EO data with in-situ data and/or sensor networks, and are easy to use for stakeholders with limited technical capacity. Emphasis was repeatedly placed on systematic and standardised data processing and analysis.

Several participants highlighted the need for derived data products that evaluate ecosystem status/condition/health, intactness/integrity, connectivity/fragmentation, or threats. The temporal aspect and opportunities of EO data was highlighted by several participants indicating the need for near-real-time monitoring, land use change detection, and detection of deforestation and degradation. Additionally, there was high demand for the accurate mapping of land use or of specific ecosystems of interest.

Technical capacity and gaps

While more than two thirds of the respondents indicated that EO data is used often or very often in their organisation, almost all of them indicate that EO capacity within their organization needs to be strengthened. Desktop GIS and image processing software such as QGIS, ArcGIS and Google Earth (Pro) are frequently used within the CSOs/NGOs. Conversely, the use of EO cloud processing solutions and interfaces is much less established among the participating organizations. Only Google Earth Engine is used (rarely, often, or very often) by more than half of the respondents. The OpenEO API or OpenEO Platform were reported to be used by only 21% of the respondents, and of those most indicated these were used rarely. The most frequently used programming languages by the participating organizations were R and Python.

When asked in an open question for specific EO capacity development needs that the PEOPLE-ECCO project should focus on, the differences in capacity among CSOs/NGOs became apparent, with some organizations requiring training on EO basics and others requiring specific training on processing of large data volumes or advanced classification models.

3.7.2 Workshop at Biospace25

Characterization of workshop participants

35 participants took part in the workshop organized for Biospace25. Of them, 54% identified their work as being Academic/Research oriented, 23% identified as working for a CSO/NGO, and another 23% were split between government positions, the private sector, and space agencies.

While the workshop did have a bias around professionals in Academia/Research, this provided a useful opportunity to canvass the opinions of EO-experts regarding their priority requirements for conservation-focussed tools to be developed, as well as the gather best practices for successful co-design and capacity development activities. Additionally, the workshop provided an opportunity to gather people from diverse backgrounds to discuss EO-related conservation needs for diverse ecosystem types.

The gathering of this information was done in two ways:

1. The use of interactive 'WooClap' questions for participants to share their opinions on technical requirements for solutions to be developed, the types of capacity development that must be engaged in, and their best practices for co-designing EO-tools.

2. The use of breakout groups to discuss current EO-based conservation requirements by ecosystem type/function.

Co-design Best Practices

Through the information gathering process, workshop participants indicated that the majority of them (63%) had not participated in a co-design process. Among those that had, half of them (50%) had provided 'EO-expertise' throughout the process, while the remainder were split among 'ecosystem expertise' and 'capacity development roles'. Only 11% of those who had previously participated in a co-design process previously had participated as 'conservation practitioners'.

When participants were asked what the best practices in co-design were, the most 'up-voted' answers included:

- Setting clear boundaries and expectations;
- Being open to criticism;
- Going over multiple iterations throughout the co-design process;
- Listening and reflecting; and
- Setting a common dictionary to agree on concepts and definitions at the start of the process.

Conversely when asked what pitfalls to avoid during a co-design process, the most common responses included:

- The assumption that Scientists know it all;
- Arrogance on all sides;
- Lack of stakeholder engagement; and
- Preconceived concepts or ideas.

Finally, when asked what ensures/enables success, workshop participants answered:

- Proper time management;

- Following a stepwise approach;
- Having well-defined limitations; and
- Proper facilitation of co-design activities.

Requirements for methods/tools to be developed

When identifying requirements for methods/tools to be developed by the PEOPLE-ECCO project, workshop participants highlighted that one of the main inhibitors of EO uptake within this field is a lack of (access-to) user-friendly platforms to process/inspect data. In addition, sometimes the fine scale of ecosystem patterns and processes may require higher resolution EO data that is only available commercially.

Furthermore, the breakout group discussions highlighted the need for:

- Tools able to produce high-quality, repeatable, and scalable ecosystem characterization layers;
- Tools enabling conservation practitioners to conduct statistically robust impact assessments of conservation actions; and
- Reproducible workflows that enable the assessment and prioritisation of sites for conservation, based on land cover condition and other relevant datasets.

Capacity Development Requirements

The Biospace25 workshop also provided the opportunity for participants to share their views regarding what capacity development efforts are required to increase the use of EO-data within conservation workflows.

When participants were asked what EO experts needed to learn regarding conservation work, responses included:

- That conservation work not only focusses on ecosystems, but people as well;
- How complicated conservation related work can be;
- The level of detail required to be effective within the field; and
- The ethical implications of model bias.

When workshop participants were asked what conservation specialists needed to learn about EO, responses included:

- The limitation of existing products and challenges;
- What EO technologies cannot do; and
- What information or tools are already available.

Finally, when participants were asked what the most important training needs were for conservation NGOs/CSOs, responses included:

- Integration of field data and EO data;
- Open-source coding;
- EO processing platforms;
- Sources of EO data; and
- Basic EO principles.

4 PEOPLE-ECCO Requirement Baseline

This consolidated requirement baseline incorporates results from the Early Adopter consultations, Online Survey, Open Workshop, and Early Adopter Co-design Living Lab, facilitated during the Biospace25 conference (see Early Adopter Profiles and Requirements above). The requirement baseline describes the common gaps and limitations, capacity development requirements, and technical requirements for the PEOPLE-ECCO project. Within the technical requirements section, the requirements for the PEOPLE-ECCO system are briefly outlined, the workflow requirements co-developed with each Early Adopter are provided, and finally the datasets and tools to be developed are described. The development of the tools is subject to testing in WP3 (Algorithm Trade-off and Proof of Concept), and changes may be made in the agile development process with the Early Adopters.

4.1 Gaps and Limitations

Early Adopters and wider conservation community highlighted several broadly consistent gaps and limitations considering the integration of EO into their conservation monitoring and planning efforts. These gaps and limitations can be considered opportunities and requirements for the PEOPLE-ECCO project. The key gaps and limitations are:

- **Programming knowledge**: proficiency in programming is required to access and use many available EO-derived datasets for conservation action effectiveness monitoring or conservation planning. CSO/NGO programming capacity is extremely variable and often low.
- **Global vs local ecosystem characterization datasets:** it is challenging to find existing datasets covering CSO/NGO areas of interest that meet information content requirements or have sufficient accuracy to serve as inputs for conservation action effectiveness monitoring or conservation suitability exercises. Many available global or regional datasets are not suitable for local management applications.
- **Dataset integration:** integration of EO-based data often requires addressing different spatial resolutions, time periods, coordinate reference systems, and data types.
- **Computation scaling limitations:** existing tools and methods often have computation scaling limitations for large areas, given that many are not available for use in a cloud computing environment.
- **Reproducibility:** conservation monitoring necessarily requires reproducible workflows encompassing data gathering, processing, and evaluation of key metrics.

4.2 Capacity Development Requirements

Throughout the requirement gathering process participants were questioned about their priorities regarding capacity development materials, and the need for them. This was done during iterative meetings with PEOPLE-ECCO Early Adopters, the online survey that was distributed amongst the wider conservation community, the open workshop hosted at Biospace25, and the Early Adopter Co-design Living Lab. Many of these capacity development requirements were largely consistent throughout the requirement gathering process and are summarized below:

- **Integration of field and EO data:** conservation CSOs/NGOs highlighted the need for training materials on how best to integrate field and EO data in a methodologically robust manner.
- **Open-source coding:** CSOs/NGOs highlighted a desire to have materials readily available for them to learn how to program and use certain EO workflows.
- **EO processing platforms:** CSOs/NGOs highlighted the need to have materials readily available for them to learn how to access and leverage the different EO processing platforms that are currently available to them.
- **Sources of EO data:** CSOs/NGOs highlighted the need and desire to learn about the different sources of EO data and its acquisition.
- **Basic EO principles:** CSOs/NGOs highlighted the requirement to have materials focused on the knowledge of basic EO principles to better understand how to leverage the information EO data contains.
- **Example applications:** CSOs/NGOs indicated that they would appreciate examples of what can be done with EO in their field, to communicate to colleagues and superiors.

4.3 Technical Requirements

The consolidation of requirements confirms a general framework to address PEOPLE-ECCO **Objective A** (Monitor conditions and management effectiveness of existing protected areas) and **Objective B** (Site suitability identification of high-priority areas to be protected). However, Early Adopters and the broader community indicated that Objective A should more broadly address **monitoring and assessment of conservation actions**, which offers the ability to address areas outside existing protected areas. Many conservation organizations do not have a mandate to manage protected areas, hence the preference for a broader scope for Objective A. Similarly, Objective B can be interpreted as data and methods to support **prioritization of conservation actions**, not limited to the identification of potential protected areas.

PEOPLE-ECCO addresses CSO/NGO requirements that vary considerably, given the huge variety of target ecosystems, conservation actions, and management goals. However, as illustrated in Figure 1, the requirements for analysis related to Objective A or B are consistent with regards to 1) the integration of datasets for ecosystem characterization; 2) the derivation of landscape level or ecosystem condition trajectory data; and inputs of user provided data for analysis related to Objective A or B. In some cases, ecosystem characterization can be effectively completed using existing freely available regional or global-scale EO-derived data layers. CSOs/NGOs will prioritize using existing available datasets if suitable. However, in many cases global or regionally available products alone are insufficient to adequately characterize the landscapes of interest – customized ecosystem characterization data or landscape or ecosystem condition trend data must be generated to supplement or replace existing datasets.

It is important to recognize that the objectives of PEOPLE-ECCO are not to focus on needs for ecosystem characterization data. Fundamentally, PEOPLE-ECCO responds to the need for **modular EO-supported workflows** that are flexible enough to combine existing ecosystem characterization datasets with new datasets and analysis, which can be used by multiple PEOPLE-ECCO Early Adopters and a wider community of CSOs/NGOs. The following section describes the technical requirements of the PEOPLE-ECCO platform to support address this requirement.

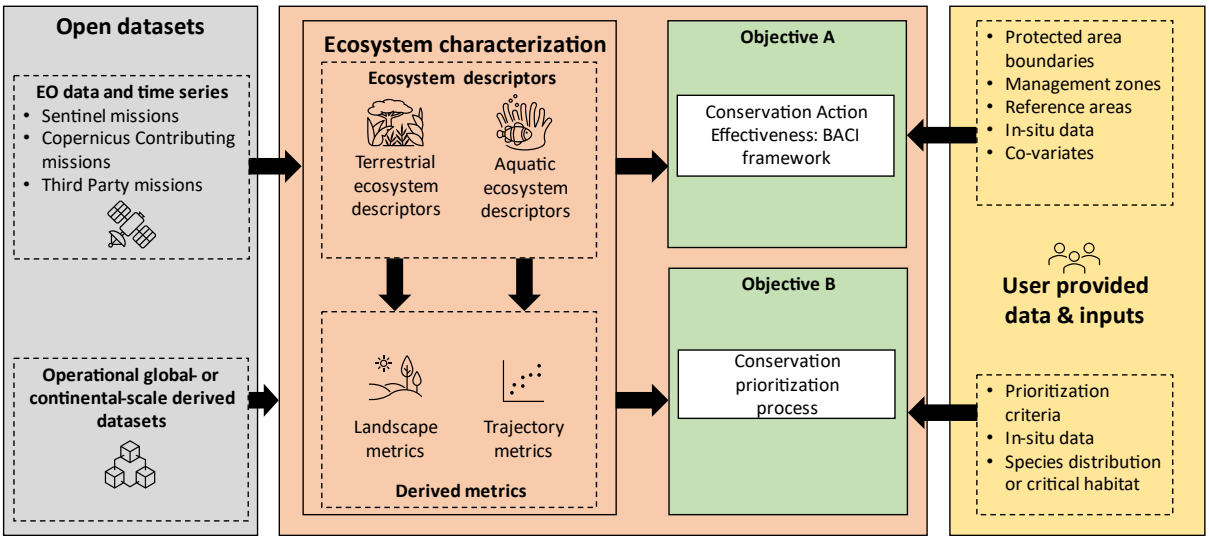

Figure 1 Framework for development of algorithms for PEOPLE-ECCO Objective A and Objective B.

4.3.1 User Environment / Platform

The user environment must standardize and simplify the access and processing of EO data. It must allow CSO/NGO users to collaborate and use EO data for a variety of applications linked to Objectives A and B.

All user requirements share a common typical set of required steps: data loading, pre-processing, data storage, analysis, and publication. Many standard pre-defined processes are required. However, the unique requirements of the Early Adopters means that workflows must be implemented as modular user-defined processes. The **openEO Platform**[4] (proposed by ESA and adopted by our consortium) meets the technical requirements and provides processing and analytics functionality in a cloud environment. To support Early Adopters with a variety of EO programming capabilities, our PEOLE-ECCO system will include a lightweight design approach that consists of a simple wrapper layer around openEO platform, allowing for a simplified abstraction of the platform for Early Adopters. An authorization/authentication layer manages the access to the PEOPLE-ECCO system.

The PEOPLE-ECCO system will be fully documented in **D4.1: Technical Specifications.**

4.3.2 PEOPLE-ECCO Workflow Requirements

The following sections describe the PEOPLE-ECCO baseline workflow requirements that are the target for implementation in the project, with full implementation subject to testing in WP3: Algorithm Trade-off and Proof of Concept.

African Parks

African Parks' workflow (Figure 2) aims to leverage existing open datasets in conjunction with their own data and flexible parameterisation. The ecosystem characterization layers required are largely available and layers of interest can be used for BACI analysis for conservation action

[4] https://openeo.cloud/

effectiveness assessment, while a habitat intactness index can support conservation planning activities within a specific landscape.

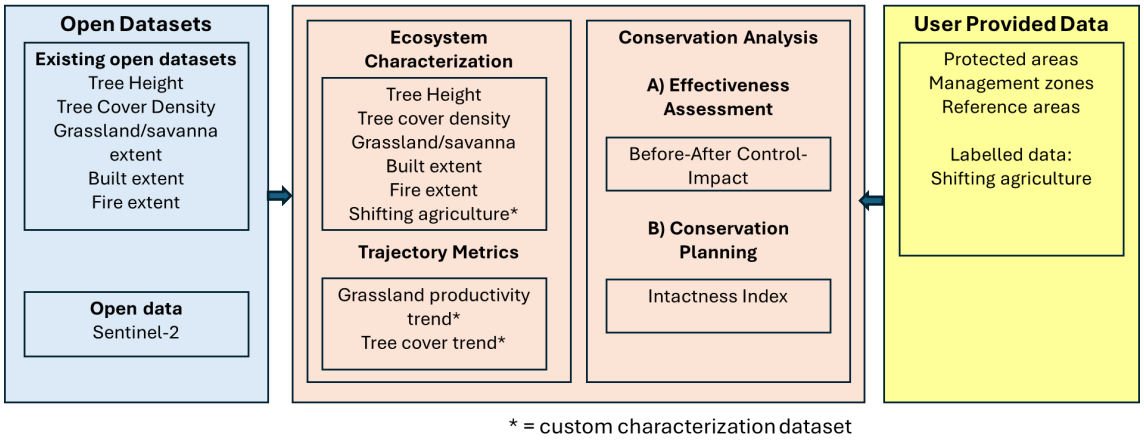

Figure 2 Proposed PEOPLE ECCO workflow for African Parks.

Potential open-data sources that could be used for their workflow include (see Table 3 above for more information):

- Tree Height – Global Canopy Height (Lang, 2022), High Resolution Global Canopy Height (Tolan et al., 2024), Global Forest Canopy Height (Potapov et al., 2021);
- Tree Cover Density – Tropical tree cover (Brandt et al., 2023), Global 2000-2020 LULC Change (Potapov et al., 2022);
- Grassland / savanna extent – Dynamic World (Brown et al., 2022)
- Built Extent – GHS Built-up Surface (Pesaresi, 2023)
- Fire Extent – Global wildfire perimeters (Artés et al., 2019)
- Cropland – World Cereal (Van Tricht et al., 2023)

IUCN Vietnam

IUCN Vietnam's workflow (Figure 3) aims to leverage existing open datasets in conjunction with their own data to produce ecosystem characterization and trajectory metrics, with the goal of allowing them to conduct assessment of a transition of land use using a BACI framework and perform conservation planning based on watershed analysis.

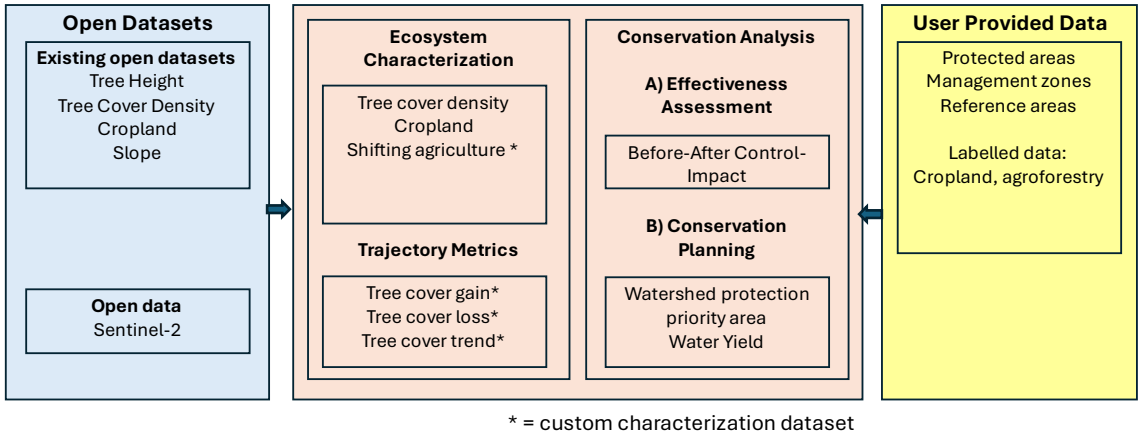

Figure 3 Proposed PEOPLE ECCO workflow for IUCN Vietnam.

Potential open-data sources that could be used for their workflow include (see Table 3 above for more information):

- Tree Height – Global Canopy Height (Lang, 2022), High Resolution Global Canopy Height (Tolan et al., 2024), Global Forest Canopy Height (Potapov et al., 2021);
- Tree Cover Density – Tropical tree cover (Brandt et al., 2023), Global 2000-2020 LULC Change (Potapov et al., 2022);
- Cropland – World Cereal (Van Tricht et al., 2023)
- Slope – NASADEM (NASA JPL, 2021), Copernicus DEM GLO-30 & GLO-90
- For water yield assessment/ modeling, soil, evapotranspiration, and precipitation data would be required.

BSPB

BSPB's workflow (Figure 4) aims to leverage existing open datasets in conjunction with their own socio-economic and parcel data to produce ecosystem characterization and trajectory metrics, with the goal of allowing them to assess the effectiveness of their conservation actions pertaining to land they have purchased using a BACI framework, as well as perform conservation planning exercises based on a variety of ecosystem characterization layers such as a grassland productivity trend.

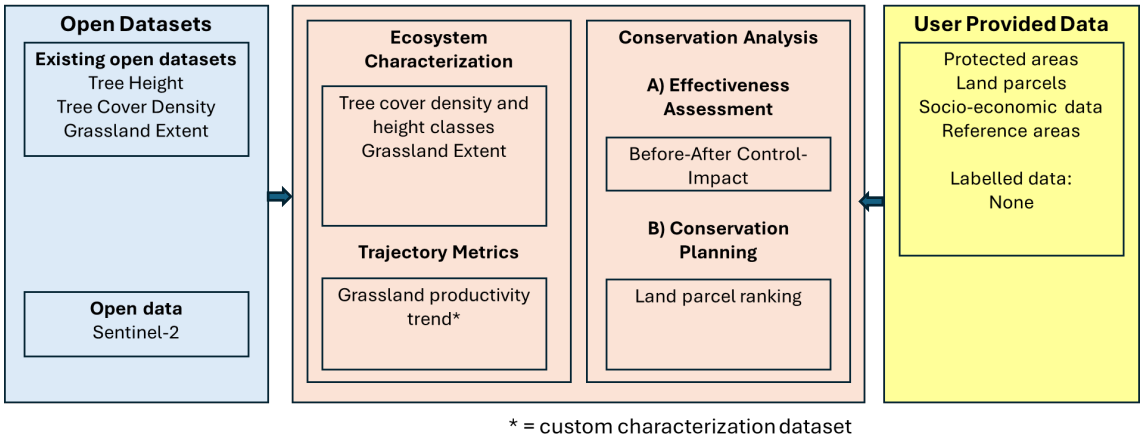

Figure 4 Proposed PEOPLE ECCO workflow for BSPB.

Potential open-data sources that could be used for their workflow include (see Table 3 above for more information):

- Tree Height – Global Canopy Height (Lang, 2022), High Resolution Global Canopy Height (Tolan et al., 2024);
- Cropland – World Cereal (Van Tricht et al., 2023); and
- Grassland – EU Grassland Watch.

LRI

LRI's workflow (Figure 5) aims to leverage existing open datasets in conjunction with their own data to produce ecosystem characterization and trajectory metrics, with the goal of allowing them to assess the effectiveness of their conservation actions throughout the country of Lebanon using a BACI framework, as well as perform conservation planning exercises helping the organisation towards their goal of creating a forested corridor throughout the country.

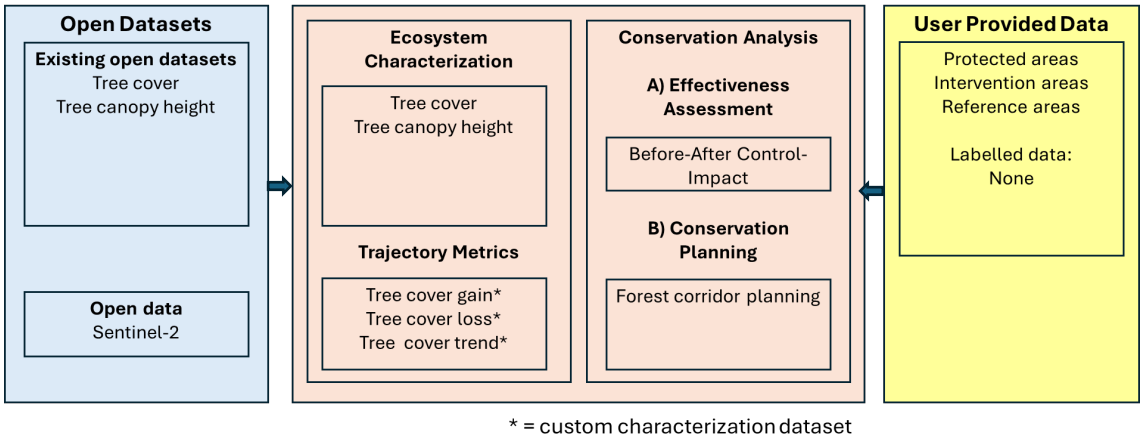

Figure 5 Proposed PEOPLE ECCO workflow for LRI.

Potential open-data sources that could be used for their workflow include (see Table 3 above for more information):

- Tree Height – Global Canopy Height (Lang, 2022), High Resolution Global Canopy Height (Tolan et al., 2024);
- Tree Cover – Global 2000-2020 LULC Change (Potapov et al., 2022);

Reef Check Malaysia

Reef Check Malaysia's workflow (Figure 6) aims to leverage existing open datasets in conjunction with their own local knowledge to produce ecosystem characterization and trajectory metrics, with the goal of allowing them to prioritize their field monitoring efforts.

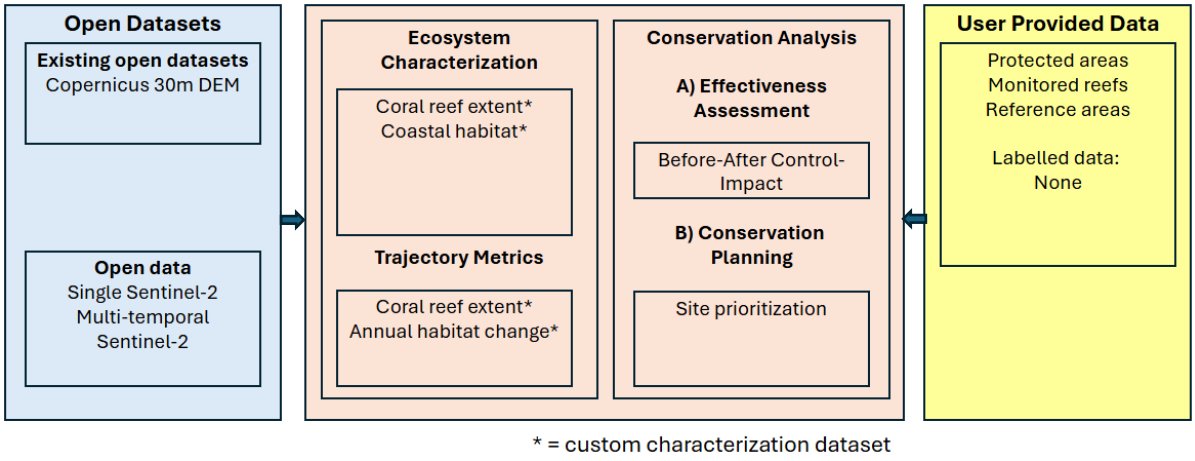

Figure 6 Proposed PEOPLE ECCO workflow for Reef Check Malaysia.

Few open-date source dataset are relevant in coastal and marine habitats. Their workflow will mainly rely on the Sentinel-2 data archive.

PEIWA

Prince Edward 's workflow (Figure 7) aims to leverage existing open datasets in conjunction with their own data to produce ecosystem characterization and trajectory metrics, with the goal of allowing them to assess the effectiveness of their conservation actions throughout the island's watershed management units, as well as perform conservation planning exercises helping the organisation towards better response to ecosystem change and prioritize conservation efforts.

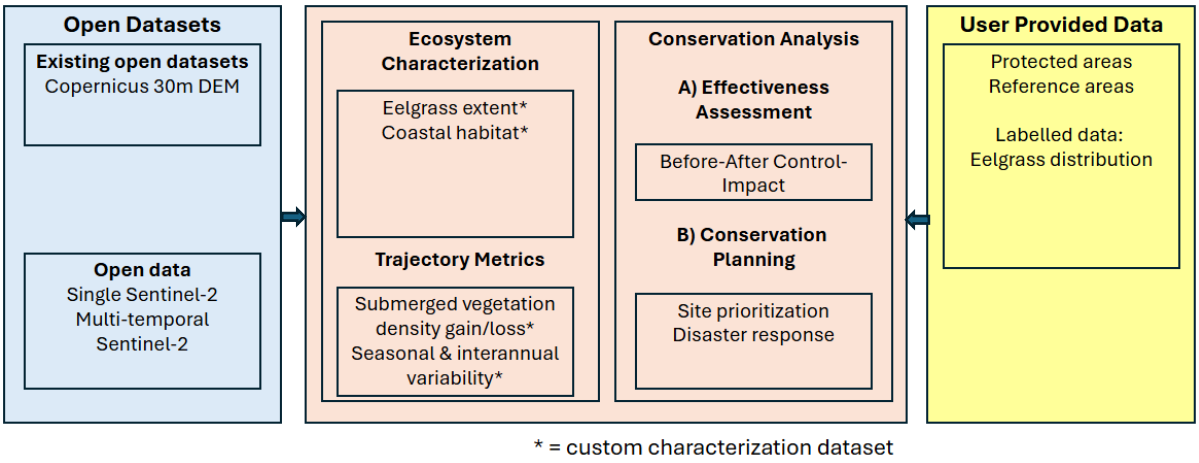

Figure 7 Proposed PEOPLE ECCO workflow for PEIWA

Few open-date source dataset are relevant in coastal and marine habitats. Their workflow will mainly rely on the Sentinel-2 data archive.

4.3.3 Ecosystem Characterization Dataset requirements

The following sections define the baseline requirements for ecosystem characterisation datasets to support the PEOPLE ECCO workflows. These dataset requirements may be adjusted during the agile development process of the project.

Shifting agriculture extent

The shifting agriculture extent product is a binary product that classifies pixels that have undergone shifting cultivation in the previous user-defined period **(years)**. This product is expected to be derived from Sentinel-2 timeseries using locally calibrated models. The shifting agriculture extent product can be used standalone or integrated with other readily available datasets to produce a habitat intactness index. It can be used in efforts to assess conservation action effectiveness, as well as conservation action prioritization. A version of this product is expected to support demonstrations with African Parks (woodland savanna ecosystem) and IUCN Vietnam (humid forest ecosystem).			
Coverage		Defined by the User (wall-to-wall, sub-national)	
Mapping Classes and Definitions	**Other**	0, a pixel that has not displayed shifting cultivation characteristics over the selected period.	
	Shifting Agriculture	1, a pixel that has displayed shifting cultivation characteristics over the selected period.	
Time Period		User defined, e.g. 5 years	
Update Frequency		Can be updated annually to capture new shifting agriculture areas	
Geographic Reference System		WGS84/UTM in respective zone or local preference	
Spatial Representation		Pixel Level 100 m^2 to 1ha	
		High Resolution	High to Medium Resolution
Minimum Mapping Unit (MMU)		100 m^2	1000 m^2
Spatial Resolution		10 m	20-100 m
Measurement Accuracy		Accuracy > 80%	Accuracy > 80%
Positional Accuracy		~10 m (CE90)	~15 m (CE90)
Format		Raster data (8bit GeoTIFF)	
Quality Assurance		The QA involves multiple quality checks (QC) carried out at different stages of the workflow flow both for input data, intermediate and final products.	

Submerged aquatic vegetation and coral reef habitat types

The submerged aquatic vegetation and coral reef habitat is habitat classifier that handles pre-processing of pixels values from coastal aquatic environment. This product is expected to be derived from Sentinel-2 timeseries using locally calibrated models. The number and type of classes can be adjusted to fit local conditions. It can be produced as a once-off or calculated at seasonal or annual basis. A version of this products is expected to support the use cases for RCM and PEIWA conservation efforts.			
Coverage		Defined by the User (sub-national, regional)	
Mapping Classes and Definitions	**Single Date**	User- or pre-defined number of aquatic habitat classes	
	Change Product*	Pixel-based change over the selected period	
Time Period		User defined, e.g. 5 years	
Update Frequency		Can be updated annually or seasonally	
Geographic Reference System		WGS84/UTM in respective zone or local preference	
Spatial Representation		Pixel Level	
		High Resolution (Sentinel-2)	High to Medium Resolution (Landsat)
Minimum Mapping Unit (MMU)		100 m^2	900 m^2
Spatial Resolution		10 m	30 m
Measurement Accuracy		N/A	N/A
Positional Accuracy		~10 m (CE90)	~15 m (CE90)
Format		Raster data (8bit GeoTIFF or similar)	
Quality Assurance		The QA involves multiple quality checks (QC) carried out at different stages of the workflow flow both for input data, intermediate and final products. Preferably with human-in-the-loop local fine-tuning with increased training samples generated by local experts.	
*** Change Products require at least two individual processed data sets.**			

4.3.4 Landscape & Trajectory Metrics

The following section defines the baseline requirements for an ecosystem condition trajectory analysis workflow that can support the PEOPLE ECCO conservation effectiveness analysis or prioritization analysis, depending on the Early Adopter and context. This workflow requirement may be adjusted during the WP3: Algorithm Trade-off and Proof of Concept.

Vegetation Condition Trend

Multi-year trajectories of spectral indices can provide an indicator of the trend of vegetation conditions over time due to vegetation recovery or degradation related to conservation actions. Seasonal Sen's Slope **(**Hipel & McLeod, 1994) can be used to quantify the trend of a spectral index while accounting for seasonality of vegetation phenology. Addressing seasonality makes it particularly useful for analyzing environmental data that exhibit regular seasonal patterns, driven by temperature, precipitation, or vegetation phenology. Using field information on actual recovery across a wide range of conditions, a relate the Seasonal Sen's Slope metrics to field metrics of recovery. The vegetation condition trend metrics complement other ecosystem characterization data as an input to conservation effectiveness assessment or prioritization. The method is expected to support demonstrations with African Parks, IUCN Vietnam, BSPB and LRI.	
Coverage	Defined by the User (wall-to-wall, sub-national)
Mapping Classes and Definitions	African Parks: Savanna grassland productivity using SAVI IUCN VN: Forest cover and density using NBR BSPB: Grassland productivity using SAVI LRI: Forest cover and density using NBR
Time Period	Minimum 5 years. From 2016 onwards if based on Sentinel-2
Update Frequency	Retrospective analysis depending on the period of conservation action
Geographic Reference System	WGS84/UTM in respective zone or local preference

Spatial Representation	Pixel Level 10 to 30m	
	High Resolution (Sentinel-2)	High to Medium Resolution (Landsat)
Minimum Mapping Unit (MMU)	100 m^2	900 m^2
Spatial Resolution	10 m	30 m
Thematic Accuracy	N/A	N/A
Positional Accuracy	~10 m (CE90)	~15 m (CE90)
Quality Assurance	The QA involves multiple quality checks (QC) carried out at different stages of the workflow both for input data, intermediate and final products.	

4.3.5 Conservation Action Effectiveness Assessment

Most Early Adopters and many conservation organizations expressed the requirement for a standardized method for Before-After Control-Impact (BACI) analysis.

PEOPLE-ECCO will build upon the concept of the EnvImpactEval tool developed by ITC to enable users to conduct statistically robust BACI analysis of conservation actions in a reproducible and computationally scalable way, using an openEO process graph. This workflow requirement may be adjusted during the WP3: Algorithm Trade-off and Proof of Concept.

PEOPLE-ECCO BACI tool

The PEOPLE-ECCO BACI tool will support users to complete BACI analysis. Functionality will include
• Identify intervention sites for analysis
• Find statistically appropriate reference sites for a BACI analysis or be able to take sites identified using expert knowledge as input, alternatively.
• Identify input EO-derived ecosystem characterization data either:
  ○ two time-steps (before-after) for both reference and impact sites, or
  ○ an ecosystem characterization trend dataset (e.g. vegetation condition trend) covering a relevant period of time defined by the conservation action to be evaluated.	

Inputs	▪ **Ecosystem characterization and trajectory layers** (two time-steps or a single dataset covering a relevant period of time) – Geotiff ▪ **Ancillary data layers** enabling matching of intervention and reference sites – Geotiff, Geojson or Shapefile ▪ **Reference sites** defined using functions provided by the tool or selected by the user – Geojson or Shapefile ▪ **Intervention sites or areas** – Geojson or Shapefile
Outputs	▪ **BACI Results Data Table** showing the BACI contrast, and p-values for each impact unit – CSV ▪ **BACI Results Raster** showing the pixel-based results for the intervention sites; can be aggregated to different spatial levels – Geotiff
Features	▪ **User Friendly** (will be integrated into the PEOPLE-ECCO system which will abstract complicated programming away from users). ▪ **Flexible** (can use ecosystem characterization layers of interest to each user and can be customized to use reference sites provided by the user or create its own statistically robust reference sites). ▪ **Reproducible** (the tool provides an easy to reproduce methodology for conducting robust BACI assessments)

4.3.6 Conservation Action Prioritization

For all Early adopters and many conservation organizations, prioritization is highly dependent on local circumstances, ecosystems, and conservation goals. The requirements for conservation prioritization include 1) ability to create user defined workflows within the PEOPLE-ECCO platform to address specific use case needs 2) export datasets created using PEOPLE-ECCO workflows for analysis within desktop GIS software such as QGIS or Esri ArcGIS. For example,

IUCN is interested to prioritize conservation actions based on evaluation of water yield ecosystem services benefits. The ecosystem services analysis would be completed using established tools, such as the InVEST toolbox (see section 2.3 above). The African Parks conservation prioritization actions could be informed by an intactness index dataset, which is defined below.

Habitat Intactness

Habitat Intactness is a complex landscape metric that we defined as the degree to which an area does not display degradation signs related to human pressures. The workflow will provide a scalable, reproducible, and accessible method to calculate an intactness index. User flexibility includes weight of individual datasets, datasets to be included in the analysis, and output resolution.		
Coverage	Defined by the User (wall-to-wall, regional, national, sub-national)	
Mapping Classes and Definitions	African Parks, combines: ▪ Built-up Area ▪ Cropland ▪ Tree Cover, Tree Height ▪ Burnt area (recent and historical)	
Time Period	2016 onwards, if based on Sentinel-2	
Update Frequency	Annual, retrospective analysis depending on the period of conservation actions and availability of input datasets	
Geographic Reference System	WGS84/UTM in respective zone or local preference	
Spatial Representation	Pixel Level 10 to 30m	
	High Resolution (Sentinel-2)	High to Medium Resolution (Landsat)
Minimum Mapping Unit (MMU)	100 m^2	900 m^2
Spatial Resolution	10 m	30 m
Thematic Accuracy	>85%	>85%
Positional Accuracy	~10 m (CE90)	~15 m (CE90)
Quality Assurance	The QA involves multiple quality checks (QC) carried out at different stages of the workflow both for input data, intermediate and final products.	

5 PEOPLE-ECCO Large-scale demonstrations

The demonstration and test areas for the PEOPLE-ECCO project are identified in the following sections. Subsequently the risks and mitigation measures for each demonstration are summarized in Table 8. The test sites and demonstration areas may be subject to refinement during the agile development cycles of the project. Figure 8 and Table 7 summarize the demonstration and test sites.

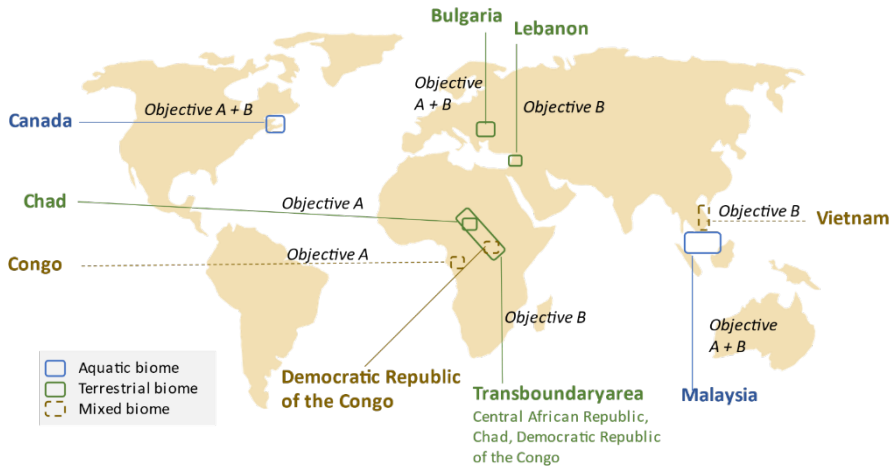

Figure 8 Overview of the distribution of demonstration sites for the PEOPLE-ECCO project.

Table 7 Summary of PEOPLE-ECCO demonstration and test sites, the objective they address, their Early Adopter, their size, and country or region of they are in.

Demonstration Site	Test Site	Objective	Early Adopter	Size	Country/Region
Prince Edward Island & Nova Scotia		**A & B**	**PEIWA**	**~95,000 km²**	**Canada / Prince Edward Island**
	Bedeque Bay Watershed	A	PEIWA	387 km²	PEI
	Basin Head Marine Protected Area	A	PEIWA	9 km²	PEI
	Entire Prince Edward Island	A + B	PEIWA	~16,000 km²	PEI
	Nova Scotia Peninsula	B	PEIWA	~75,000 km²	PEI
Eastern Coastline of Peninsular Malaysia	-	**A + B**	**RCM**	**~90,000 km²**	**Malaysia**
	Tioman Island	A + B	RCM	0.3 km²	Malaysia
	Mantanani Islands	A + B	RCM	1.95 km²	Malaysia
	The Mersing Group of Islands	A + B	RCM	1.14 km²	Malaysia
	Entire East Coast of Peninsular Malaysia	B	RCM	~90,000 km²	Malaysia
Greater Transboundary Ecosystem	-	**A + B**	**African Parks**	**~80,000 km²**	**Chad, DRC, Congo**
	Greater Zakouma Ecosystem	A + B	African Parks	47,000 km²	Chad
	Odzala-Kokoua National Park	A + B	African Parks	13,755 km²	Congo
	Greater Garamba Ecosystem	A + B	African Parks	14,800 km²	DRC
Conkouati-Douli National Park (Marine Component)		**B**	**African Parks**	**5,135 km²**	**DRC**
	Selected sites	**B**	African Parks		DRC
Son La, Houaphanh, Xien Khouang		**A + B**	IUCN Vietnam	**46,490 km²**	**Vietnam, Laos PDR**
	Selected sites / watersheds	A + B	IUCN Vietnam		Vietnam, Laos PDR
Bulgaria (Natura2000 sites)		**A + B**	**BSPB**	**110,994 km²**	**Bulgaria**
	Bulgarian Green Belt (Natura2000 sites)	A + B	BSPB	9,210 km²	Bulgaria
Akkar, North, & Mont Lebanon Governorates		**A + B**	**LRI**	**2,926 km²**	**Lebanon**
	Selected sites	A + B	LRI		Lebanon

5.1 Marine demonstrations

5.1.1 Prince Edward Island Watershed Alliance

PEIWA has identified the following demonstration areas and test sites:

Bedeque Bay Watershed (387 km^2) – The marine areas, coastal zones and relevant inland areas of the Bedeque Bay watershed, located on the south shore of central Prince Edward Island along the Northumberland Strait, serves as a dynamic and representative test site for the project. Bedeque Bay is among the most intensively developed watersheds on the island, with agriculture as its dominant industry. Approximately 75% of the watershed is cleared for agricultural use, with 61% under a three-year intensive crop rotation, primarily for potato cultivation. Alongside agriculture, the area supports a thriving aquaculture industry, with the Dunk and Wilmot estuaries producing over 65% of Prince Edward Island's oysters, making it the island's largest oyster-producing region.

Basin Head Marine Protected Area (9 km^2) – The Basin Head Marine Protected Area (MPA), located on the Gulf of St. Lawrence in the Eastern part of PEI, is one of only two MPAs in Canada accessible by land and the only one in this region. The MPA encompasses three management zones. Zone 1 (Inner Channel), extending 3 km eastward, is the most protected area as it provides the critical habitat for Irish moss. Zone 2 (Lagoon) serves as a buffer zone and features a 5 km lagoon, including a 3 km shallow channel fringed with eelgrass and a central sandy substrate. Zone 3 (Outer Coast) extends 1 nautical mile offshore and 3 nautical miles along the coast, preserving the integrity of the surrounding dune structures. This carefully managed ecosystem not only supports the conservation of its unique marine life but also provides opportunities for research, education, and community engagement.

Prince Edward Island (~16,000 km^2): Prince Edward Island (PEI) is renowned for its diverse and dynamic coastal areas, shaped by natural forces like wind, tides, waves, and rainfall. Spanning 3,000 kilometers, the island's coastline features a mix of beaches, sand dunes, cliffs, marshes, bays, estuaries, and inlets. These ecosystems are constantly evolving, with erosion and flooding being common natural processes. However, as climate change intensifies, these forces are expected to cause more dramatic changes, especially in areas where human development intersects with the coast. The island's coastal regions present both challenges and opportunities. With rising sea levels and more intense storms, flooding and shoreline erosion pose significant risks, particularly to properties near the shore. The demonstration in PEI provides significant value due to its comprehensive representation of a range of coastal and marine dynamics. As an island with diverse ecosystems —ranging from beaches and dunes to marshes, estuaries, and marine protected areas— PEI serves as a microcosm of larger, global coastal and marine environments. Its varied geography and complex interactions between land, sea, and climate

make it an ideal setting for testing adaptive strategies to climate change, erosion, flooding, and habitat restoration. The island's relatively small size allows for a large-scale, integrated approach to management, where lessons learned can be scaled up or adapted for other regions facing similar marine and coastal challenges.

Prince Edward Island and Nova Scotia (~80,000 km^2): PEI and Nova Scotia collectively encompass over 10.000 km of coastline, offering a broader, more diverse marine environment to devel op and demonstrate tools for screening marine areas for protected areas suitability. This site encompasses a wide range of coastal and marine ecosystems across both provinces,

offering a unique opportunity to examine different biophysical, ecological, and human-use factors that influence the potential for establishing protected areas. PEI and Nova Scotia, with their interconnected marine environments along the Gulf of St. Lawrence and Atlantic Ocean, provide a dynamic setting for evaluating the effectiveness of tools designed to assess and identify high-priority marine areas for conservation. The rich biodiversity in these waters, coupled with key industries such as fishing, aquaculture, and tourism, highlights the need for balancing environmental protection with sustainable economic activities. These provinces' coastal regions include estuaries, marine wetlands, deepwater habitats, and important migratory pathways, all of which are critical for various species, including those with commercial, cultural, and ecological significance. This demonstration site not only reflects the regional variation in ecological characteristics but also emphasizes the need for decision-support tools that can integrate multiple layers of data—such as habitat quality, biodiversity hotspots, human impacts, and socio-economic factors—into a cohesive approach to marine conservation.

5.1.2 Reef Check Malaysia

Three test sites differing in geographical characteristics and facing different ecosystem challenges were identified. In all cases, RCM is able to support PEOPLE-ECCO by providing historical monitoring data, that are key in the development of large-scale ecosystem characterization tools. Complementing RCM's existing coral reef health surveys with large-scale EO derived data will help establish more representative and consistent measure for area-based conservation efforts, as well as identify focus areas for conservation and protection plans.

Tioman Island, Malaysia (0.3 km^2): Situated off the East Coast of Peninsular Malaysia, Tioman Island is a well-known tourist destination and has some of the best reefs in the country. However, unsustainable tourism practices have led to deterioration of reefs. RCM has been working to protect coral reefs around the island since 2014 by promoting sustainable tourism, school programs on marine conservation, and coral reef rehabilitation.

Mantanani Islands (1.95 km^2): Situated in the South China Sea, off the West Coast of Sabah, Borneo, the area used to be a hotspot for fish bombing. RCM has been working at this site since 2012 with reef rehabilitation and waste management. They focus on supporting the local communities by establishing a community managed protected area.

The Mersing Group of Islands (1.14 km^2): Situated on the East Coast of Peninsular Malaysia, the Mersing Group consist of five clusters of islands. The local communities still practice artisanal fishing practices and marine resources are the main source of livelihood. The Mersing islands are not as developed in terms of tourism as of yet. RCM has been working here since 2020 with a focus on increasing local stakeholders' interest in conservation, promoting sustainable tourism, management of coral reefs, and the management of plastic waste.

Eastern Coastline of Peninsular Malaysia (~90,000 km^2): Large sections of the East Coast of Peninsular Malaysia need better maps of coral reef presence. The whole coastline is a priority to get more targeted field campaign to assess the individual reefs condition and rotate field efforts more systematically. Especially the southern half from Kuatan down to Singapore. Secondary priority is the entire Malaysian coastline north of Kuatan.

5.2 Terrestrial demonstrations

5.2.1 African Parks

African Parks' management plans provide the basis for vegetation condition trend analyses aiming to assess conservation action effectiveness, pertaining to grassland and forested ecosystems. The diverse landscapes, land-uses and threats across the parks and within the greater transboundary ecosystem of Southern Chad, Eastern Central African Republic, and Northern DRC provide the opportunity to test and develop a habitat intactness index to support conservation prioritization efforts by African Parks.

Greater Zakouma Ecosystem (Chad) (47,000 km²): Zakouma National Park (3,053 km²) in Chad will be used as a test site for the project. It, as well as the surrounding broader Greater Zakouma Ecosystem (GZE) landscape, spans the Sahelian Acacia and East Sudanian Savanna ecoregions and are characterized by extensive floodplains in the wet season. Once a home for elephants, ivory poaching has decimated this landscape. The park plays a strategic role as the GZE's north-eastern anchor of a 245,000 km² conservation area, spanning across central Africa. The effects of pastoralism, both transhumance and sedentary, on large-scale habitat degradation is not yet fully understood. However, encroaching cropland in the southwest of the landscape and general overgrazing are a concern.

Odzala-Kokoua National Park (13,755 km²): This park in Congo falls within the Northwestern Congolian lowland forest ecoregion. For decades the park's biodiversity suffered whilst occupied by rebel groups and armed poachers, leaving devastation in their wake. In 2016, African Parks overhauled law enforcement efforts and today, the park is a region of stability for wildlife and communities. However, the woody savannah area is transitioning to woodland due to this megaherbivore decline.

Greater Garamba Ecosystem (14,800 km²): Garamba National Park (5,112 km² as a test site) and adjacent protected areas form a key biodiversity hotspot and one of the largest intact primary forests situated in the Congo Basin, the largest carbon sink and the second-largest tropical rainforest in the world. Unfortunately, poaching of key species such as forest elephants remains a significant threat. Combined with the effects of climate change savanna patches within the tropical forest are gradually transitioning to forest-like habitats.

Conkouati-Douli National Park (5,135 km²): The park is managed by the Ministry of Forest Economy and Sustainable Development (MEFDD), in partnership with the NGO Noé, an NGO part of African Parks' Incubator Programme. Despite not being directly managed by African Parks, the Early Adopter has a close relationship with the management group of the park and provides mentoring and technical support through the Incubator Programme.

5.2.2 IUCN Vietnam

Northwestern Vietnam (Son La Province) and Lao PDR (Houaphanh and Xieng Khouang Provinces) (46,490 km²): The Son La province in Northwestern Vietnam, and the Houaphan and Xien Kouang provinces in Lao PDR have seen a great amount of deforestation taking place mostly driven by cassava and corn agriculture to meet demand from the instant noodle and animal feed markets. This has led to deforestation on steep slopes which in turn destabilizes the soil and can lead to a variety of environmental issues as well as increase the risk of natural disasters such as large soil displacements and flooding.

Faced with these challenges provincial governments, such as that of Son La in Vietnam, have put in place agroforestry strategies aiming to incentivize a move away from cassava and corn cultivation and towards more sustainable agroforestry systems. Through this policy the provincial government of Son La aims to help protect and increase biodiversity, increase slope stability and in so doing improve climate resilience and in the region. However, the same cannot be said for the Provinces of Houaphan and Xieng Khouang, who have not adopted similar policies.

These landscapes provide the opportunity for a BACI study focusing on the vegetation condition trend and shifting agriculture layers, wherein the impact of Son La's provincial policies can be evaluated, thus meeting IUCN Vietnam's identified need to monitor the effectiveness of government policies in reversing and halting the deforestation of important forests for monocrop plantations. Understanding the uptake and progress of such policies on the landscape will help IUCN Vietnam prioritize areas of the landscape for protection.

5.2.3 Bulgarian Society for the Protection of Birds

Bulgaria (110,994 km^2): Of the area of Bulgaria, 41% is Protected Areas, which hold various types of land uses, including forestry, arable land, pastureland, settlements and other urbanized land plots, as well as strictly protected areas. Habitat loss of grasslands has been severe over the last 15 years due to overgrowth with bushes and trees, but mostly due to conversion to arable land aided by agricultural subsidies. Methods for identifying sites that should be protected, need special management, or have been recently damaged but could be restored, is crucial to achieving conservation goals and their proper management and monitoring in the future.

The Green Belt (9,210 km^2) consists of a series of protected sites (Eastern Rhodopes, Sakar, Derventski Heights, Western Strandzha, Strandzha) designated for the protection of landscapes, rock formations, and rare plants. A small part of the territory is under strict legal protection according to the Bulgarian Protected Areas Act. In 1988 part of the area was declared as a CORINE Site because of its European value for habitats, rare and threatened plants, and animal species, including birds. In 1997 the whole territory was designated as an Important Bird Area by BirdLife International. Strandzha was protected as a Nature Park in 2007.

Grasslands are among the habitats that have been heavily affected by agriculture and the construction of photovoltaic installations. These threats could be mitigated by proper management plans and the effective monitoring of cumulative effects of land use practices at a landscape level by BSPB. The management plans are expected to be developed in the near future, however a lack of standardized, accurate and regular monitoring allowing comparability is a serious challenge for the preparation of management measures, their proper implementation, and evaluation of their effectiveness.

Within the Green Belt, the demonstration will focus on Natura2000 sites where EU Grassland Watch has confirmed the production using an openEO compatible system of required ecosystem characterization data. Once the demonstration in the Green Belt has been successfully completed the approach will be tested on Natura2000 sites across Bulgaria, provided data from EU Grassland Watch is available.

5.2.4 Lebanon Reforestation Initiative

Lebanon (Akkar Governorate, North Governorate, and Mont Lebanon Governorate) (2,926 km^2): Lebanon has a high diversity of ecosystems due to its varied topography. Lebanon's fauna and flora suffered a heavy toll from the Lebanese civil war. In addition, shepherds have always

been an essential part of Lebanon's culture, history, heritage, and sustainable local food production. Due to the dispersed landscapes, urbanization, and land use changes, they are continuously on the move, struggling to find a reliable permanent pasture with suitable carrying capacity for their small ruminants. LRI aims to support local communities and other stakeholders with sustainable and climate-adapted management plans for conservation, restoration, and pastoral use.

The demonstration within the three governorates will provide the opportunity to evaluate the conservation action effectiveness of reforestation activities LRI has carried out, as well as assist LRI in their identification of areas to be protected, improved, or restored with the goal of increasing connectivity and providing wildlife corridors. Carrying out the demonstration at a governorate scale will demonstrate the replicability of the products developed, thus allowing them to be used on other regions of the country. It is important to note that this is an additional demonstration site, with the size constrained due to accessibility and security considerations.

5.3 Demonstrations Risk Analysis

The variety in ecosystem types, locations, sizes, and thematic topics among the multiple PEOPLE-ECCO demonstration sites, inherently comes with a variety of risks that can be shared or demonstration specific. The project has identified key risks to the proposed demonstrations. Key risks include:

- Cloud Cover;
- Topography;
- Ecosystem Complexity;
- Data Availability; and
- Demonstration Size.

In addition to these demonstration area related risks, the development of tools and workflows upon the openEO API provides an additional risk. The openEO API and openEO Platform are still under development and it is to be expected that certain features may not be fully operational or simply not be available to developers. This in turn increases the possibility that any give task may require a greater amount of effort than is currently anticipated. This uncertainty will be mitigated by the continuous assessment of project scope and development feasibility, throughout the testing and development process. Any change in the project's ability to deliver the tools and workflows listed above shall be properly communicated to Early Adopters to foster open communication, ensuring the outputs of the project are of value to PEOPLE-ECCO stakeholders.

Finally, there is a risk associated to the safety and accessibility of working certain areas, particularly when field work might be involved in validation or data gathering efforts. This is particularly relevant in Lebanon, due to the recent conflict that has taken place, and the general instability in the region. These security and accessibility risks will be mitigated by maintaining clear and regular communication with Early Adopters to stay informed about security concerns in areas where the project aims to work. If risks are high, discussions will be carried out to find alternative solutions for validation or data collection efforts.

Table 8 summarizes the risks associated with each demonstration site. The mitigating actions the project will employ are discussed below.

Table 8 Risks and mitigations associated with demonstration sites.

	Cloud Cover		Topography		Ecosystem Complexity		Data Availability		Demonstration Size	
	P	C	P	C	P	C	P	C	P	C
Prince Edward Island and Nova Scotia	H	L	L	L	M	M	L	L	M	M
Southeast Malaysia Coastline	H	L	L	L	M	M	L	L	M	M
Greater Transboundary Ecosystem of Southern Chad, Eastern Central African Republic, and Northern DRC	H	L	M	L	M	M	L	L	H	H
Conkouati-Douli National Park	H	H	L	L	M	M	L	L	M	M
Son La (Vietnam), Houaphanh (Lao PDR), and Xien Khouang (Lao PDR) Provinces	H	L	H	H	H	M	M	M	M	M
Bulgaria	L	L	M	L	L	L	L	L	M	M
Akkar, Northern, and Mont Lebanon Governorates (Lebanon)	L	L	M	M	M	M	L	L	L	L

Key:

P = Probability: H=High; M=Medium; L=Low

C = Consequence: H=High; M=Medium; L=Low

5.4 Risk Mitigation

To address the risks associated with the PEOPLE-ECCO demonstrations, the following mitigation strategies have been identified:

- **Cloud cover** is a risk that is likely to occur in most demonstrations, but with a low consequence if mitigation measures are followed. This typically requires exploiting the full time series of Sentinel-2 data to composite cloud free data into monthly or seasonal composites or metrics.
- **Topography** can create shadows which skew the spectral values of affected features in optical imagery and significantly impact the signal-to-noise ratio of satellite-based radar imagery. In order to mitigate this risk, the project will evaluate the quality of products in relation to slope gradient in an effort to inform the Early Adopters of impacted demonstrations, of product uncertainty.
- **Ecosystem Complexity** is a risk that can vary wildly demonstration to demonstration, impacting the effectiveness of EO-based tools aiming to characterize a landscape or assess the effectiveness of conservation actions. To mitigate this risk the PEOPLE-ECCO project will test solutions at a small scale and scale up slowly to the full demonstration sites.
- **Data Availability** can pose a risk when aiming to develop tools for areas where the availability of data is limited and its acquisition is not possible. To mitigate this risk the PEOPLE-ECCO project has discussed with Early Adopters regarding the availability of local data and knowledge. This information will be incorporated in a robust validation methodology to communicate uncertainty with Early Adopters. Several demonstrations rely on external datasets as part of the workflows. The project has confirmed the availability of the necessary data to carry out the necessary demonstrations (i.e. Discussions with EU Grassland Watch confirming the availability and pertinence of their data for the Bulgarian Use Case).
- **Demonstration Size** can pose a large risk to a variety of demonstration sites due to the computational requirements involved in computing high-quality EO-based layers over a large area. The PEOPLE-ECCO project will mitigate this risk by using the openEO API, which abstracts the handling of computational scalability from the user. In addition to this, very large-scale demonstrations may require chunking to be completed. The GZE demonstration with African Parks will only be attempted once the demonstrations in other sites have successfully been completed due to the exceptionally large size of this demonstration.

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7 Annexes

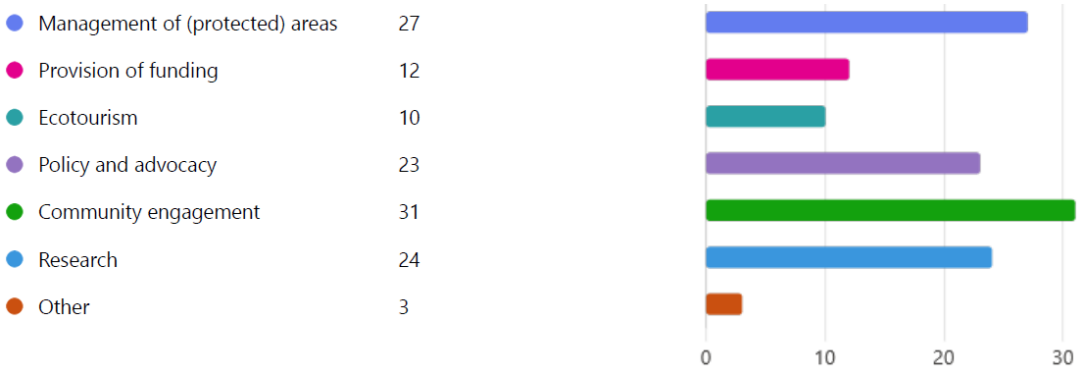
Annex 1: Anonymized summary of answers to the online survey “Earth Observation solutions for CSOs/NGOs active in Ecosystems Conservation”

Annex 1: Anonymized summary of answers to the online survey "Earth Observation solutions for CSOs/NGOs active in Ecosystems Conservation"

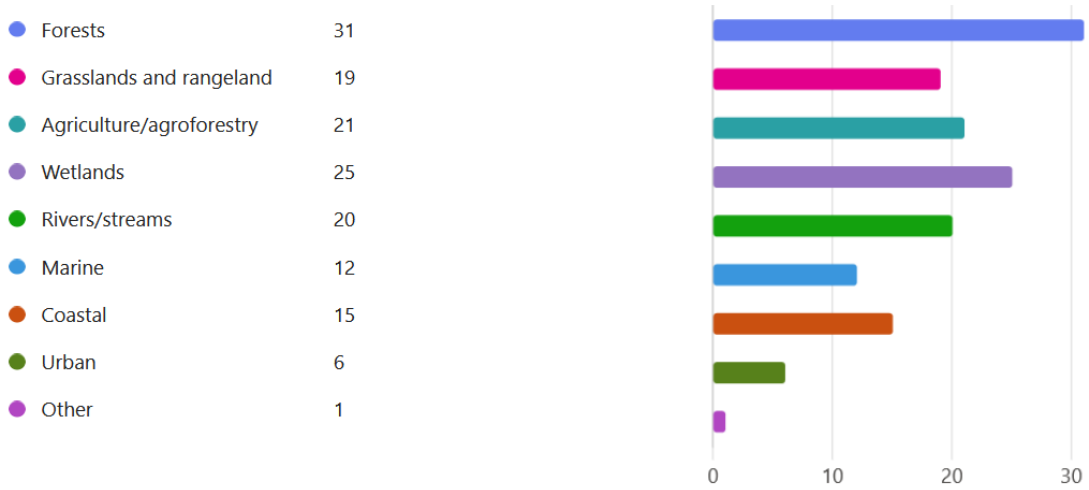
Question 3. Could you briefly (in 1 or 2 sentences) describe the scope of your organization?

***** national partner with focus on birds conservation.
regional organization with aim to protect natural processes, typical natural and cultural landscapes,
We work at the interface between science, policy, and communities to provide a common understanding of the status of Pacific salmon, steelhead, and their habitats in *****
Freshwater: we work to protect water recharge areas, this includes: forest fires control, management and prevention, soil conservation, and water balance
***** is focused on halting the loss of the country's extraordinary biodiversity and ensuring that human use of the country's natural resources is sustainable and equitable. ***** has been working to address the loss of wildlife, shrinking forests, endangered rivers, and global pollution.
***** is a trusted independent conservation organization founded on an understanding of the complex relationship between human activities and nature, with a focus on finding workable solutions and mobilizing action from stakeholders and supporter s.
national non-government organisation working on to sustain natural world for the benefit of people and wildlife by focus on six major themes: forests, oceans, wildlife, food, climate and energy, as well as freshwater
***** is a leading conservation organization dedicated to safeguarding *****'s rich biodiversity and promoting sustainable development. Through collaboration with local communities, government agencies, and other stakeholders, we implement initiatives that protect wildlife habitats, address climate change, and build a resilient fu ture for both people and nature.
Global not-for-profit organisation dedicated to the conservation and restoration of wetlands
***** NGO working for the protection of bees and pollinators from environmental threats.
One of the world's leading conservation organisations dedicated to protecting the environment and addressing the most pressing threats to nature and biodiversity.
International organization with focus on nature protection and growth the human well being
Nature conservation on site and landscape level
NGO, our aim is to harmonize the coexistence of human and natural environment . We focus on various issues within topics of forests, freshwater and large carnivores.
***** working on conservation practices like Wildlife, forest, food, climate change etc.
***** Is the Non-Government Organizations that into conserving of natural resources ranging from forestry, wildlife and Freshwater.
I worked for ***** more than 7 years and now I worked for ***** nearly 2 years and I am law enforcement and technology is very important for my team.
national organization for nature protection, which is a part of an international organization
Conservation of nature, biodiversity, ecosystems and environmental systems (water, soil, marine) that contain natural assets
***** is activly working on Freshwater, Forest, Biodiversity, Ocean, Climate & Energy, Food and market to conserve the nature in Pakistan for future generations
International NGO directly acting on ecosystem conservation
OUR organization is an international non-governmental organization that works in the field of wildlife conservation and endangered species and the reduction of human impact on the environment.
Conserving nature, focusing on large, intact landscapes and ecosystems.
***** aims to expand, manage, and protect ***** forests and landscapes through a community-based approach. ***** works on building resilient communities to environmental threats, increasing environmental awareness and education, advocating for forest conservation, and advancing research in the forestry field.
National organisation in ***** focusing on coral reef conservation. We conduct an annual programme of coral reef surveys covering 300 sites and use the data to improve management and awareness.
National NGO dedicated to protecting ***** forests and ecosystems through extensive tree planting initiatives and public awareness campaigns
We are conservation organizations based in *****. We promote home based conservation. We also promoted community base adaptation
Wildlife Conservation
Wetland habitat management for waterbirds, landowner conservation stewardship
We are local NGO workin on Forestry and agriculture conservation with focus on conservation, livelihoods and protecting lnadscapes
Protecting wildlife and wild-lands through field conservation
Environmental conservation and animal protection
We are an international nonprofit organization dedicated to promoting environmental conservation and empowering communities to create a positive impact on our planet.
Global organisation to advance wildlife research, conservation and education with a focus on community-led conservation in Africa and youth action across the globe.

Question 4. What categories best describe the activities related to ecosystems conservation that your organization undertakes?



Question 5. Which ecosystem(s) does your organization focus on?



Question 6. At which geographic level does your organization work?

Question 7. Please name the continent, country/countries or areas your organization is working in.

Europe - the Balkans; Asian part of Turkie; North East Afrika	Italy	Papua New Guinea
Asia, Lebanon and KSA	Kenya	Slovakia
Asia, Pakistan	LAC countries	Slovakia with cooperation on European level predominantly central and eastern Europe region
Asia-Pacific, Cambodia	Lebanon	South Africa
EU countries	Malaysia	Tanzania, Uganda, DRC, Congo, USA
Europe, Bulgaria	Malaysia	Madagascar
Europe, Bulgaria	Myanmar	Uganda
Indonesia	North America, Canada	Western Central and Northern Eastern Uganda

Question 8. Are there international policy frameworks and initiatives that drive your activities, or that your activities aim to support? Which are the most relevant ones?

Answer	#	Answer	#
Convention for Biological Diversity (CBD) Global Biodiversity Framework (GBF)	15	Biodiversity hotspots	1
United Nations Sustainable Development Goals (SDGs)	7	IPBES	1
Paris Agreement	4	EU Deforestation Regulation	1
European Green Deal, European Biodiversity Strategy, EU Restoration Law	4	Natura 2000	1
Ramsar Convention	3	REDD+	1
Convention on International Trade in Endangered Species (CITES)	2	Rewilding Europe	1
African-Eurasian Migratory Waterbird Agreement (AEWA)	2	The Pacific Salmon Treaty	1
Bonn convention (Convention on the Conservation of Migratory Species of Wild Animals)	2	Water for everyone	1
UN Decade on Ecosystem Restoration	2	EU Water Framework Directive	1
Bern convention (Convention on the Conservation of European Wildlife and Natural Habitats)	1	European Sustainability Reporting Standards (ESRS)	1
Biodiversity Red Lists	1	EU Corporate Sustainability Reporting Directive (CSRD)	1
Carpathian Convention on Biodiversity	1	Taskforce on Nature-related Financial Disclosures (TNFD)	1
CBD Strategy and Action Plant 2019-2024	1	EU's common agricultural policy (CAP), pesticide and GMO regulations	1
UNESCO Conservation Standards	1	IUCN Species Survival Commission (SSC) standards	1
Global Forest Goals	1	UN Great Apes Survival Partnership (GRASP) standards	1

Question 9. Are there national policy frameworks and initiatives that drive your activities, or that your activities aim to support? Which are the most relevant ones?

Bougainville Food Security policy 2022-2032
Conservation Action Plans, Village Land Use Plans, District Land Use Plans, Protected Area Management Plans.
Generally, the national policy frameworks we work on are the implementation of EU regulations or policies.
Kenya Vision 2030, the Wildlife Conservation and Management Act, the Environmental Management and Coordination Act (EMCA), and the National Climate Change Action Plan
Malaysia's Shared Prosperity Vision 2030, and National Policy on Biological Diversity
National and regional impact and enforcement of EU policies
National Biodiversity Conservation Strategy, National Strategy for Regional and Territorial Development
National Biodiversity Strategies and Action Plans
National Biodiversity Strategies and Action Plans
National Biodiversity Strategies and Action Plans, National Climate Action Plans, Protected Area Legislation and Policies, E cosystem Restoration Policies, National Invasive Species Strategies
National country laws on wildlife and environment
National Development Strategy, National polices on Environment, Biodiversity and Climate Change
National Environment Act 2019, National Forestry Policy 2001, Uganda Wildlife Policy 2014, National Climate Change Policy 2015, National Wetlands Policy 1995 (Revised 2021)
National forestry program, National implementation of mentioned international policy frameworks
National Policy on Biological Diversity
Various, in the countries where we are active
Wild Salmon Policy
Wildlife Act, Environment Act

Question 10. In a few keywords or 1 to 2 sentences, could you describe the core actions related to ecosystem conservation of your organization?

1. Integrated spatial planning to identify forest areas for legal protection, and to ensure forest blocks are contiguous and connected, and representative forest types are conserved. 2. Effective regulation and enforcement to minimise further loss of natu ral forest cover. 3. Advocate for policies and incentives from the Federal Government to reduce drivers of deforestation, and keep fore sts standing to safeguard ecosystem services. 4. Advocacy for new Protected Areas to achieve 20% target. 5. Establishmen t of community conserved areas or "Other Effective Area-based Conservation Measures" (OECM) to allow different actors to maintain forest habitats with legal protection.

1. Supporting the Bonn Challenge and AFR100 to restore 100 million hectares of degraded African land . 2. Strengthening wildl ife corridors and reducing habitat fragmentation.

Activities related to ecosystem restoration and wildlife habitat protection. In addition, we work to support indigenous communities in forest areas.

Advocacy, capacity building, technical assistance

biomonitoring, policy advocacy and regulatory follow up and interaction, pollinator-related data gathering.

Coral reef surveys. Coral reef rehabilitation. Conservation activities such as ghost net removal, coral predator management, mooring buoy management. Education and awareness for schools

Developing management plans, advising on restoration, awareness

ensuring local communities own and drive decisions on their lands, village land use planning, conservation action planning at site, reginal and national levels, educaiton materials, decision support systems and dashaboards, tree planting, forest restoratio n and protection, community forest monitoring,

Forest, Marine, Human

Habitat restoration, freshwater practice, community engagement, etc

Human wildlife conflict management and biodiversity conservation in and outside protected areas

Identification of places of high conservational value; support of piloting measures to better the state of these areas; ammen ding relevant policies on national and regional level, f.e. management plans of conservation areas; dam removal, habitat restorati on,

*****'s core actions in ecosystem conservation include: developing global standards (e.g., Red Lists, Green List), restoring degraded ecosystems (e.g., Bonn Challenge), promoting nature-based solutions, and supporting sustainable resource use and biodivers ity-friendly policies at all levels.

***** focuses on community-led forest restoration, biodiversity monitoring using geospatial technology, chimpanzee habitat conservation, early warning systems, and sustainable livelihoods for forest-adjacent communities. These activities integrate Collaborative Forest Management (CFM), reforestation, and climate resilience strategies to enhance ecosystem conservation.

Landcover and/ use mapping, measuring habitat condition, fire mapping, NDVI

management measures, proposal of mitigation measures, field monitoring

mangrove and forest restoration, creating environmental teaching material for school children

Natural process restoration

Planting forest trees, Fencing, Environmental Awareness, Agroforestry

planting trees, Conserving ecosystem, managing, and community engagements for awareness

Planting trees, mangroves, teaching children on forestry and protected area

Purchasing land, management oper areas

purchasing land, powerlines retrofitting, creating teaching material for schools, species action plans development and implementation

Supporting local authorities and communities in managing their forestry resources and enhancing landscape resilience.

Supporting national agencies to manage protected areas.

We prioritize areas of intervention and focal species, raise funds, and work on the ground with communities and in the field to help these ecosystems thrive

We work with partners to support the development of strategic plans for community-led salmon monitoring and stewardship, and to democratize salmon population and habitat data through development of open-access, online data tools.

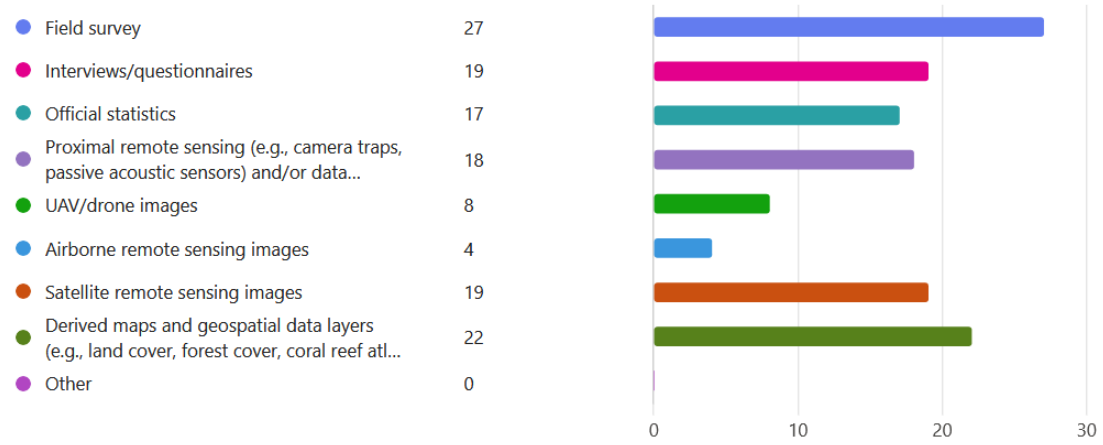
Wetland Restoration and River Management (Freshwater), Reforestration (forests) Wildlife Tracking and h abitat protection

***** focuses on protecting and restoring critical habitats, promoting sustainable resource management, engaging local communities in conservation efforts, and monitoring biodiversity to ensure the resilience and health of *****'s ecosystems.

Question 11. Does your organization monitor conditions and/or management effectiveness of existing protected areas?

Yes: 28
No: 7

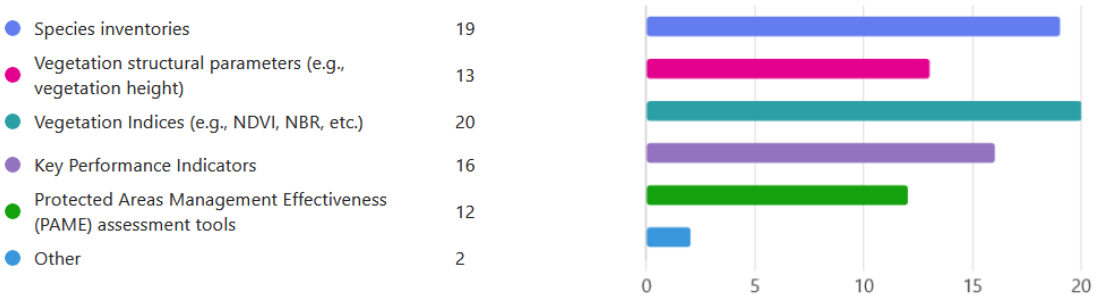
Question 12. Which of the following data sources does your organization use to monitor conditions and/or management effectiveness of protected areas?



Question 13. (Optional) Specify selected data sources.

Earthdata, Global forest watch, FAO , Global Mangrove Watch, Copernicus, Sepal; Global Forest Change; Copernicus, USGS, local drone data; Own coral reef survey programme; GLAD/UMD; NASA; GFW; Maxar, Planet, Esri

Question 14. Which of the following methodologies and/or tools does your organization use to monitor conditions and/or management effectiveness of protected areas?



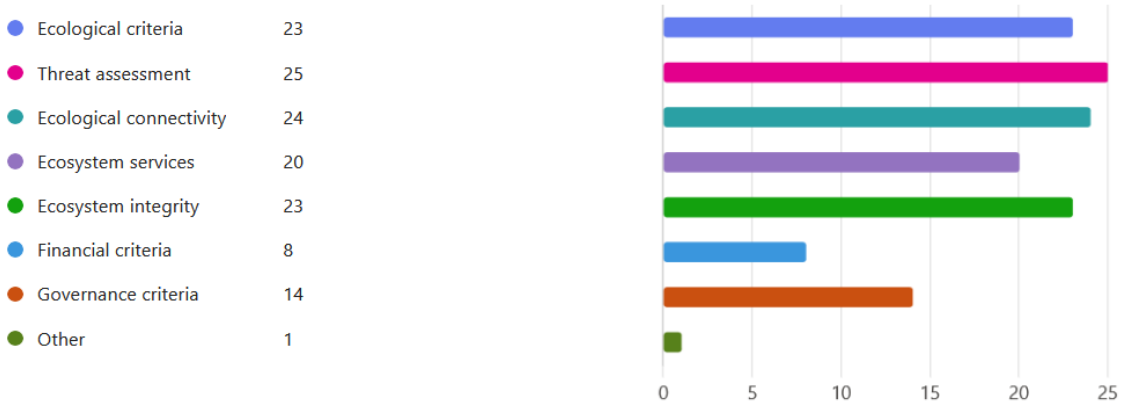
Question 15. (Optional) Specify selected methodologies and/or tools.

Red List of Ecosystem; water system related assessment tools; DISTANCE surveys, vegetation plots,

Question 16. Does your organization perform identification of high-priority areas to be protected?

Yes: 30
No: 4

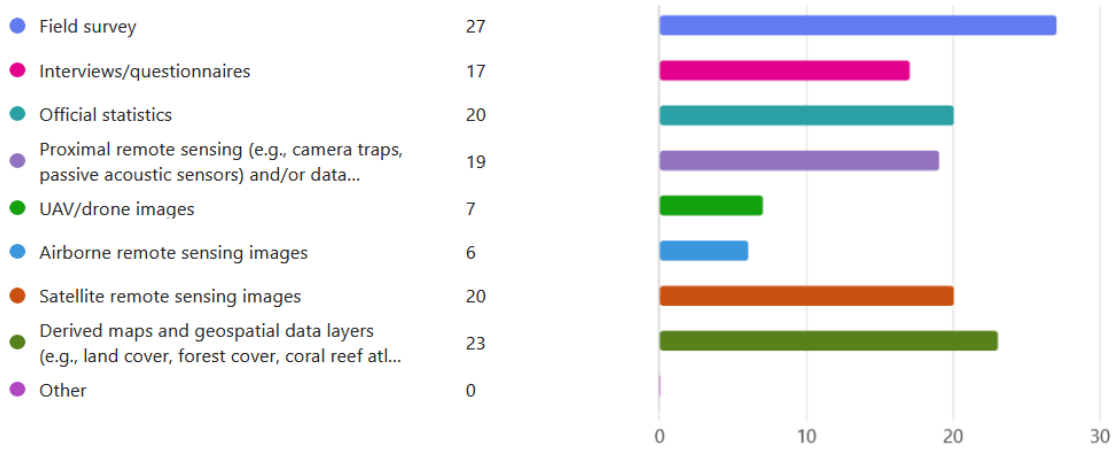
Question 17. Which of the following criteria does your organization use to identify high-priority areas to be protected?



Question 18. (Optional) Specify selected criteria.

Ecological connectivity and Ecosystem services; biodiversity

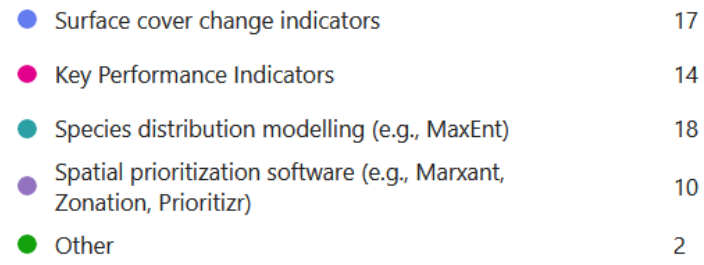
Question 19. Which of the following data sources does your organization use to identify high-priority areas to be protected?



Question 20. (Optional) Specify selected data sources.

Earthdata, Global forest watch, FAO , Global Mangrove Watch, Copernicus, Sepal

Question 21. Which of the following methodologies and/or tools does your organization use to identify high-priority areas to be protected?



Question 22. (Optional) Specify selected methodologies and/or tools.

Suitability modelling in ArcGIS pro

Question 23. What are your organization's priorities towards development tools for monitoring of conditions and/or management effectiveness of protected areas?

Monitoring of conditions of the protected areas is very important because of the changes in the climate and ever increasing anthropogenic pressure on the ecosystems.
Based on open source data (affordable and easily repeatable)
An stablished methodology is needed to standardise the monitoring actions
Integration of Remote Sensing Data: Leveraging advanced remote sensing technologies (satellite, drone, and airborne remote sensing) to enhance the accuracy and scale of data collection, particularly for monitoring large and remote protected areas, also to detect and monitor various threats (deforestation, land use change, habitat fragmentation). Use of Geospatial Data Layers: Developing geospatial data products, such as land cover, and ecosystem condition maps, to supp ort spatial prioritization and management effectiveness assessments that later can be link to biodiversity metrics such as STAR metric. Surface Cover and Change Detection: Improving surface cover change indicators to detect alterations in land use, forest degra dation, and ecosystem shifts within protected areas over time. Key Performance Indicators (KPIs): Creating standardized Key Performance Indicators (KPIs) that integrate ecological and thre at data, with socio-economic and governance information providing a clear understanding of the intensity and impact of threats on ecosystems.
Currently, we do not have priority on development tools. However, we focus on improving the methodologies we are currently applying to annual forest cover and land cover monitoring. The definition and term of forest conditions are always a challeng e when we use them to advocate with government agencies, e.g. the authority classified grasslands as secondary forest.

***** prioritizes developing advanced monitoring tools such as remote sensing technologies, GIS mapping systems, and real-time data collection platforms to assess the conditions and management effectiveness of protected areas. We focus on creating robust data products like key biodiversity indicators and ecosystem health metrics, and employ methodologies including participatory monitoring and adaptive management practices to overcome barriers related to data accessibility, technical capacity, and stakeholder engagement.
Build accessible tools for stakeholders at the local level to enable them in developing locally relevant and actionable products/maps from EO data
It would be amazing to have access to the Land Parcel Information Systems or some indication of coverage regarding crop type or land use in the landscape.
My organisation priorities include enhancing data collection and analysis systems to assess biodiversity, habitat health and human-wildlife interactions effectively. More so its priorities include promoting the integration of geospatial technologies and remote sensing for real time tracking of environmental changes and threats like deforastation and poaching. To lift barriers, spatial data tools (use of high resolution satelite imagery), interoperable data platforms, citizen science will be very key.
Our current barrier is about the remote sensing method to assess deforestation in dry forest.
It would be nice to have accessible satellite based products that could be used to verify the conditions and management effectiveness of f.e. forestry activities, forest structure, bark beetle infestations. Smimilarly it would be nice to have a small scale UAV based solution.
Land cover/land use, suitable wildlife habitat
Geospatial tools
METT and COPS will be implemented for protected areas and smart tool for field monitoring ranger effort, threats and biodiversity movement
e.g. Expanding the use of satellite imagery, monitoring through mobile apps, automatic evaluation of images from phototraps
Tools and data that are free of cost and easy to use for poorly trained government staff
Availability of high resolution data with global coverage
Measuring intactness/integrity of landscapes comparable across ecosystems is a key priority, but current methods are too technically complex or resource intensive to be scalable. One-off donations of equipment or support are insufficient for monitoring conditions over spatial and temporal scales. In addition to natural vs non-natural, more detailed information on land use and land cover is needed, distinguishing vegetation types from each other with high accuracy for the purpose of mapping understanding threats to particular habitats.
We conduct point surveys of coral reefs. We would like to have better mapping of coral reefs so we can better manage coral reef areas.
Integrated monitoring system (GIS, remote sensing, field surveys, community based reporting), Real-time data collection (sensors, field data collection)
Information about current condition, presence of ecosystem types, key impacts
we need to gain skills on GIS/maping and doing field surveys and field mapping and species identification for protected area to conserve and understanding conservation
Access to high resolution imagery
Stress indicators would be suitable both for monitoring conditions and management effectiveness: - changes in vegetation structure or health due to climate change - increased distribution of invasive species - illegal activities tracking such as hunting or fishing - tourism stress - presence of pests - species monitoring (birds or big mammals migrating) As for methodologies, something that allows for increased coverage, faster information retrieval and mostly open source
***** seeks advanced Earth Observation tools to enhance real-time monitoring and decision-making in our program areas, including: Fire Risk Monitoring & Early Warning Systems • Thermal anomaly detection using VIIRS/MODIS to track wildfire threats. • Automated alerts and predictive modeling for fire-prone areas. Deforestation & Habitat Degradation Tracking • High-resolution forest cover change detection (e.g., Sentinel-2, PlanetScope). • Near real-time illegal activity alerts for forest degradation. Chimpanzee Habitat Connectivity & Land Use Change Monitoring • Fragmentation analysis to assess habitat loss and corridor viability. • AI-driven land use classification to inform conservation planning. Community-Based Reporting Integration • Mobile GIS tools (Survey123, KoboToolbox) for local monitors to ground-truth satellite data. • Crowdsourced data validation for increased accuracy. Key Data Products & Methodologies Needed Forest Health Indicators – NDVI, canopy loss, biomass estimation. Fire Risk & Burn Severity Mapping – Thermal anomaly trends, hotspot analysis. Habitat Connectivity Models – Least-cost path analysis for chimpanzee corridors.

Automated AI/ML-based Change Detection – Cloud-based alerts for rapid response. Integration of EO Data with Community Reports – Linking remote sensing insights with on-the-ground observations.
Data standards; Standard indixes and protocols; Multiple sources of data, need APIs to connect to our internal systems (we us e Esri ArcGIS Online platform and apps)

Question 24. What are your organization's priorities towards development of tools for site suitability identification of high-priority areas to be protected? What type of data products (e.g., indicators) or me...

***** prioritizes the development of advanced spatial analysis and predictive modeling tools to accurately identify high -priority conservation areas. We focus on assessing biodiversity significance, ecological connectivity, and threat levels by utilizing data products such as species distribution maps, habitat quality indicators, and comprehensive land -use data. Additionally, we employ methodologies like GIS-based suitability analysis, multi-criteria decision-making frameworks, and machine learning algorithms. These tools and approaches help us overcome challenges related to data gaps, enhance the precision of site selection, and ens ure the effective protection of critical ecosystems.
1. GIS-based modeling, remote sensing
As mentioned above, we are focused on improving the methodologies.
Automated fire mapping across years
Availability and accessibility of biodiversity data
Based on open source data (affordable and easily repeatable); satellite-based imagery allowing us to evaluate habitat status (based on key landscape condition/disturbance indicators) at regional and provincial scales consistently; able to capture disturban ces within privately owned lands where govt. data on disturbances are not well represented or inaccurate
Data standards; Standard indixes and protocols; Multiple sources of data, need APIs to connect to our internal systems (we us e Esri ArcGIS Online platform and apps)
Ecosystem intactness and connectivity (as above). As well as biodiversity.
Field data and remote sensing data
GIS datasets
***** prioritizes advanced geospatial tools and data-driven methodologies to improve the identification of high -priority areas for conservation, restoration, and protection. These tools should enhance precision, efficiency, and community participation in decision-making. Key Priorities Chimpanzee Habitat & Corridor Suitability Analysis • Identifying key forest fragments and wildlife corridors to maintain chimpanzee population connectivity. • Using least-cost path modeling and habitat suitability indices. Deforestation & Land Degradation Risk Assessment • Detecting forest loss, encroachment, and illegal activities using machine learning change detection (e.g., Sentinel -2, PlanetScope). • Mapping degraded areas suitable for restoration based on vegetation indices. Climate Resilience & Fire Risk Mapping • Assessing fire-prone areas using historical burn scars and thermal anomaly trends (e.g., VIIRS/MODIS). • Integrating climate projections to prioritize areas needing urgent intervention. Community-Led Site Identification & Validation • Integrating community-based mapping tools (Survey123, KoboToolbox) for participatory conservation planning. • Crowdsourcing habitat degradation reports to refine remote sensing outputs. Key Data Products & Methodologies Needed Habitat Suitability Indices – AI/ML-based models combining vegetation cover, proximity to threats, and species occurrence data. Land Degradation & Restoration Potential Maps – NDVI, soil moisture, and land use change trends. Fire Risk & Climate Vulnerability Models – Predictive analytics using historical fire data and climate projections. Automated Change Detection Alerts – Cloud-based monitoring systems for rapid response and decision -making. Integrated GIS & Community Data Platform – Merging Earth Observation insights with local knowledge to enhance accuracy.
Mapping of coral reefs to determine reef extent/area in order to plan protected areas.
Maxent
Relevant indicators would be: - ecological integrity - relevance in terms of connectivity - value in terms of ecosystem services (such as areas with springs or with high carbon content) - presence of rare species - habitat historical coverage Having indices capable of attributing a value to all of these aspects and locating areas of interest w ould be helpful
Remote identification of areas to be investigated on field for suitability for protection.
Satellite data, Softwares and capacity building trainings
Spatial Prioritization Tools: Enhancing the use of spatial prioritization software (e.g., Zonation) to systematically identif y areas with the highest ecological and conservation value.

Geospatial and Derived Data Products: Utilizing geospatial data layers, such as land cover, and ecosystem condition maps to assess ecological integrity and ecosystem services. Surface Cover Change Detection: Incorporating surface cover change indicators to identify areas experiencing rapid land use change or degradation, which could be prioritized for protection. Key Performance Indicators (KPIs): Creating standardized Key Performance Indicators (KPIs) that integrate ecological and thre at data, with socio-economic and governance information, allowing for a comprehensive evaluation of suitability and conservation impact.
We would need training in WebGIS or PostGIS, as well as dealing with large datasets and interconnecting and analysing large datasets.
We would require support and training

Question 25. How would you describe your organization's overall need for Earth Observation (EO) capacity development?

- 1 (2,9%) No need - we do not want to use EO data or tools
- 0 (0%) No need - we have sufficient internal EO capacity
- 17 (50%) Some need -we have some EO capacity that needs to be strengthened
- 16 (47%) High need - we have limited or no EO capacity that needs to be strengthened
- 0 (0%) I don't know

Question 26. How often are Earth Observation data used in your organization?

- 1 (2,9%) Never used
- 9 (26,5%) Rarely used
- 9 (26,5%) Often used
- 14 (41,2%) Very often used
- 1 (2,9%) I don't know

Question 27. How often are the following GIS and image processing software used in your organization

	Never used	Rarely used	Often used	Very often used	I don't know
QGIS	8.8%	11.8%	41.2%	35.3%	2.9%
ArcGIS pro / ArcMap	9.1%	15.2%	9.1%	66.7%	
Google Earth / Google Earth Pro	2.9%	14.7%	26.5%	50%	5.9%

Question 28. (Optional) Add other GIS and image processing software frequently used within your organization

ArcGis; ArcGIS pro; Google Earth Engine; R; R programming spatial packages

Question 29. How often are the following cloud processing solutions and interfaces used in your organization?

	Never used	Rarely used	Often used	Very often used	I don't know
Google Earth Engine	17.6%	35.3%	29.4%	5.9%	11.8%
Planetary Computer	50%	20.6%		5.9%	23.5%
Sepal	55.9%	14.7%	2.9%		26.5%
OpenEO API/Platform	57.6%	15.2%		6.1%	21.2%
Thematic Exploitation Platforms	54.5%	12.1%	6.1%		27.3%

Question 30. (Optional) Add other cloud processing solutions and interfaces frequently used within your organization.

Coiled.io; Maxar Pro, Planet Explorer

Question 31. How would you rate your organization's use of the following programming languages

	Never used	Rarely used	Often used	Very often used	I don't know
Python	25%%	43.8%	12.5%	18.8%	

R	19.6%	35.3%	26.5%	14.7%	5.9%
JavaScript	35.3%	29.4%	17.6%	2.9%	14.7%
Julia	51.5%	15.2%			33.3%

Question 33. Do you have any specific knowledge gaps related to Earth Observation data and analysis that PEOPLE-ECCO's capacity development activities could focus on?

Advanced EO Data Processing & Machine Learning Knowledge Gap: Limited expertise in AI/ML-based change detection for deforestation, land degradation, and fire monitoring. Capacity Need: Training on automated classification models using Google Earth Engine (GEE), Python, or TensorFlow. Fire Risk Prediction & Early Warning Systems Knowledge Gap: Limited predictive modeling for wildfires and real-time risk assessment using EO data. Capacity Need: Training on fire behavior modeling using climate and thermal datasets (VIIRS/MODIS, Sentinel-3). Monitoring & Evaluating Conservation Impact with EO Knowledge Gap: Need for better methods to quantify and report conservation effectiveness using EO data. Capacity Need: Training on impact assessment methodologies, including remote sensing-based restoration monitoring. Potential Support from PEOPLE-ECCO Workshops & Training Modules – Hands-on training in GEE, QGIS, Python, and AI-driven EO analytics. Technical Support & Data Access – Facilitating high-resolution imagery access and computational tools. Knowledge Exchange – Peer learning with EO experts and conservation practitioners.
Basicaly all remote sensing activities are underdevelopped within our national branch, compared to international.
Data manipulation and analysis
How to get started!
I think cloud processing solution and interface. This tools will be useful provided with good quality satellite imagery. it w ould help to reduce the cost invest in physical hardware and software
In the team we would mainly need to learn how (1) to make possible to see all available datasets with a single click on a web map, (2) give some insights on the share of landuse / agricultural lands within a circle around a point, i.e., make a geospatial qu ery on dataset., (3) integrate Earth Observation data into the EU Polllinator Hub (https://pollinatorhub.eu)
It's a gaps on Google Earth Engine use to detect deforestation in dry forest and also coding with python for QGIS or an other GIS softwer
Monitoring landcover change, and forestfires scars
Satellite image processing, ArgGIS/QGIS advanced uses
there are many but there is a need to engage in specific local decision making processes and listen what are the needs and pr iorities and than connect that to EO data and tools.
We don't ned to become EO data and analysis experts, we need relatively simple to use tools and methods that make use of thes e technologies
We have no knowledge of earth observation data
We need training of GIS and Mapping and other programs
Yes, I have several knowledge gaps related to Earth Observation (EO) data and analysis that PEOPLE-ECCO's capacity development activities could help address. Specifically, I would benefit from training in advanced EO data processing and interpretation, integrating EO datasets with local environmental information, and applying machine learning techniques for conservation modeling. Additionally, gaining expertise in specialized EO tools and platforms, as well as managing and analyzing large-scale spatial data, would significantly enhance my ability to contribute effectively to our conservation projects.

Question 35. If you have additional comments on the needs of your organization that could be addressed by the PEOPLE-ECCO project (www.people-ecco.eu), you can use this field.

***** sees a potential for collaboration with the PEOPLE-ECCO project in enhancing its geospatial capabilities for conservation and climate resilience. In addition to the priorities outlined, we identify the following key needs: Near Real-Time Monitoring for Conservation Decision-Making • Support in developing an automated alert system for deforestation, wildfires, and land encroachment. • Assistance in setting up a cloud-based EO platform to facilitate real-time decision-making. Capacity Development for Local Conservation Teams • Hands-on training for field teams and local conservation practitioners in Earth Observation tools and analysis. • Developing a training manual or toolkit tailored to local conservation needs. Integrating Socioeconomic & Ecological Data for Conservation Planning • Support in linking EO data with social and economic datasets to enhance conservation planning. • Training in multidimensional modeling to assess human-wildlife conflict zones and conservation impact. Improving Access to High-Resolution & Cloud-Free Data • Support in cloud-masking techniques for clearer satellite observations in heavily vegetated areas. Long-Term Collaboration on EO-Based Conservation Innovations • Exploring joint projects or pilot studies to test and refine EO solutions. • Knowledge exchange opportunities with other conservation organizations using EO for biodiversity protection.
We are interested in mapping chimpanzee habitat suitability, habitat quality, connectivity, and major threat drivers e.g. vil lage-level land use/land cover change, mining, charcoal production, fire, iand llegal small scale logging, illegal bushmeat trade.