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Opportunities and Challenges for Monitoring Ecosystem Restoration in Protected and Conserved Areas

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Aim: The aim of this technical note is to raise awareness of the challenges and solutions for monitoring ecosystem restoration in and around protected and conserved areas, and to assist restoration practitioners, protected area managers and other decision makers to improve the collection and use of monitoring data as part of adaptive management.

Audience: Ecosystem restoration and protected areas practitioners and policymakers.

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1. Issues and Challenges with Monitoring Ecosystem Restoration

1.1 The importance of monitoring ecosystem restoration

Ecosystem restoration[1] can contribute to improving protected and conserved areas (PCAs) that have become degraded, by reversing the negative trend and placing an ecosystem on the path to recovery (Gann et al., 2019; FAO et al., 2024). Restoration efforts globally have been shown to enhance the conservation value of PCAs, to increase habitat cover and improve connectivity across protected area ecosystems (Janishevski et

[1] The UN Decade on Ecosystem Restoration defines ecosystem restoration as "*the process of halting and reversing degradation, resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice*" (UNEP, 2021).

al., 2015; Possingham et al., 2015). Restoration is also important for delivering Target 2 of the Kunming-Montreal Global Biodiversity Framework aimed at restoring 30% of all degraded ecosystems (CBD, 2025) and, when conducted in PCAs, can also contribute to Target 3 on effectively conserving 30% of land, waters and seas. However, restoration is a long-term and complicated endeavour that takes place in complex social-ecological systems (Bayraktarov et al., 2016; Tedesco et al., 2023). Over the course of a restoration project, many elements of the system may evolve, necessitating adaptive management (Bakker et al., 2018). Therefore, impactful restoration implementation requires not only appropriate planning of biological and socio-economic goals, but also effective monitoring and evaluation. This allows the assessment of progress and informs adjustments to restoration activities and policies as necessary to meet management objectives. Monitoring also provides managers and other decision makers with critical insights into the relationship between interventions and their outcomes, facilitating adaptive management and the learning of lessons for future initiatives (Stephenson, 2019; Stephenson et al., 2022; Mansourian & Vallauri, 2022).

1.2 Issues and challenges to address to facilitate effective restoration monitoring in protected areas

Monitoring the restoration of ecosystems remains challenging (Dudley et al., 2018; Stanturf, 2021; Eger et al., 2022; Mansourian & Stephenson, 2023). Restoration monitoring has often placed too much emphasis on quantitative measures that highlight outputs (e.g., number of seedlings planted; number of people participating in planting), rather than impacts and outcomes (e.g., improvements in habitat quality, ecosystem services and human wellbeing), even though such measures are possible (Mansourian & Stephenson, 2023; Tsafack et al., 2023). Broad top-down objectives and global initiatives (e.g., the Bonn Challenge) have contributed to an emphasis on quantitative rather than qualitative ambitions, such as specifying only the area to be restored rather than the ecological and human benefits (Mansourian et al., 2017). However, effective indicators for restoration outcomes and impacts require a holistic, long-term approach that is frequently absent from donor-funded projects with short lifespans. Whilst numerous metrics for restoration have been proposed, only a small subset are used in practice and focus primarily on environmental indicators, rarely measuring social or socio-economic values (Kenny et al., 2023; Elias et al., 2024). Monitoring guidance for PCAs (e.g., Dalton et al., 2024) often fails to propose relevant and appropriate indicators for specific restoration and conservation goals.

Additionally, monitoring is increasingly focused on the use of complex technological tools, such as bioacoustics or environmental DNA, that are difficult to apply, or impractical in many regions (Djenontin et al., 2018; Stephenson, 2020). Restoration monitoring has also tended to ignore the importance of local capacity, traditional and local knowledge, and community participation (Uprety et al., 2012; Murcia et al., 2016; Reyes-García et al., 2019). Indeed, measures of success extend beyond western scientific methods and can include other traditional or customary mechanisms and observations (Mansourian et al., 2025). These issues are further compounded by restoration projects having budgetary constraints, insufficient monitoring skills or expertise and failing to apply adaptive management principles (Bayraktarov et al., 2016; Höhl et al., 2020).

Restoration monitoring in and around PCAs must overcome these challenges if it is to demonstrate how restoration enhances the value of ecosystem protection. There are several key issues to tackle.

Goals and indicators

- **Lack of clear and common definitions.** There are different definitions and interpretations of restoration. Without clear and consistent terms concerning the objects being measured and the processes involved, it will be difficult to use common indicators, aggregate data from different sources and compare sites, and the measurement of results will be impeded (Mansourian & Stephenson, 2023).
- **Arbitrary approaches for setting objectives.** Good planning is a pre-requisite for good monitoring (Stephenson, 2019) yet there are no common approaches to setting ambitions for restoration. As a result, realistic, effective and measurable objectives are rare (Stanturf, 2015; Mansourian & Stephenson, 2023).
- **Weak indicators disconnected from restoration objectives.** Many indicators focus on activities, such as the area being restored and other quantitative measures (e.g., numbers of trees planted), rather than meaningful outcomes or impacts, and are often disjointed from the intended objectives restoration interventions (Mansourian & Vallauri, 2022). Socio-economic indicators, which demonstrate human benefits, are often neglected in favour of biological indicators. Multidisciplinary monitoring that reflects the multidimensional social and ecological outcomes of restoration is usually lacking.

- **Monitoring frameworks are not harmonised.** High-level global frameworks, such as the Framework for Ecosystem Restoration Monitoring and the Kunming-Montreal Global Biodiversity Framework, do not easily translate into monitoring on the ground. They do not easily align to what is feasible to measure or the specific objectives of ecologically and socially diverse restoration projects (Mansourian & Vallauri, 2022).

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Restoration often involves the propagation and planting of trees and other organisms, but restoration projects need to monitor a broader suite of responses as well as biodiversity states and pressures.

Funding and capacity

- **Inadequate funding.** Monitoring for conservation, including restoration, is often underfunded (Höhl et al., 2020; Stephenson et al., 2022). This results in insufficient capacity, resources, and time dedicated to establishing baselines and measuring outcomes and impacts.
- **Limited capacity.** Long-term, sustainable monitoring requires robust technical and institutional capacity. In practice, projects often fail to consider the extent and limitations of local capacity during the design phase, leading to dissonance between the project ambitions and what can realistically be achieved and measured on the ground (Djenontin et al., 2018).
- **Short-term thinking.** Restoration is a long-term process, with impacts often visible only after extended periods. However, monitoring is frequently carried out in the short term, and constrained by short-term project funding cycles, limiting the ability to assess long-term outcomes and constraining decision-makers' ability to engage with a future-oriented project vision (Abelson et al., 2020).

Monitoring approaches and tools

- **Inadequate monitoring tools available.** While there is a robust and growing portfolio of tools to measure biodiversity, options are often narrower and more expensive for measuring other restoration outcomes, including ecosystem services (Stephenson et al., 2022). Measurement of soil health and susceptibility to erosion, hydrological changes, the impacts of recovering vegetation on flooding, tidal surge etc are often costly, specialist tasks beyond the experience of most protected area managers.
- **Failure to acknowledge Indigenous and local knowledge.** Indigenous and local knowledge may provide locally-relevant and context-specific measures, mechanisms and practices to monitor restoration (Reyes Garcia et al., 2019; Kenny et al., 2023). In spite of this, top-down western scientific approaches often dominate, sidelining and failing to integrate local knowledge into monitoring strategies.
- **Poor engagement of local stakeholders.** Participatory monitoring (Evans et al., 2018), which involves local stakeholders in defining data needs, identifying datasets and collecting data, is vital for building local capacity and ensuring the long-term sustainability of restoration projects. Locally embedded systems that track progress over decades also ensure the necessary long-term timespan for monitoring.

Use of data

- **Lack of baseline data.** Restoration implies recovery, which in many cases means the return of reduced or extirpated species. This can be fast in the case of mobile species like birds and flying insects. However, many restoration projects lack adequate data on key taxa (Key et al., 2022) or social indicators (Mansourian et al., 2025). In some countries, PCA managers are forced to prioritise park security, anti-poaching, and the monitoring of illegal activity over the monitoring of species (Stephenson et al., 2021). Many protected areas will therefore lack robust baseline data on species presence and abundance, and it will be difficult to tell if new species found are recovered or simply discovered.
- **Data not used for adaptive management.** Partly as a result of a lack of suitable indicators or data, many restoration projects fail to apply adaptive management principles (Bayraktarov et al., 2016; Mansourian & Stephenson, 2023).

These global challenges have contributed to widespread inefficiencies and shortcomings in restoration monitoring, leading to poorly designed interventions, misaligned management objectives, and ultimately, the failure to achieve meaningful ecological and socio-economic outcomes.

2. Improving Restoration Monitoring: Potential Solutions and the Way Forward

2.1 Available Approaches and Tools

A wide range of new approaches and tools offer opportunities to improve ecosystem restoration monitoring in and around PCAs. Some monitoring guidance and indicator frameworks are generic and some specific to restoration.

Generic Guidance and Frameworks

The State–Pressure–Response–Benefit (SPRB) indicator framework was adopted by the Convention on Biological Diversity (CBD) to guide indicator development and provides a logical construct for restoration metrics (Mansourian & Stephenson, 2023; Burgess et al., 2024), as well as for PCA monitoring (de Oliveira Roque et al., 2018).

Generic guidance on how to define and choose biodiversity indicators and develop monitoring plans, that could be of use to restoration, includes the Conservation Standards (CMP, 2020) and a suite of monitoring guidelines, frameworks and handbooks (e.g., World Bank, 2004; UNDP, 2009; Brown et al., 2014; Addison et al., 2020; Stephenson, 2021; Stephenson & Carbone, 2021; Burgess et al., 2024; IUCN SSC Species Monitoring Specialist Group, 2025).

Some countries have developed guidelines or plans for monitoring their protected areas, examples including Brazil (de Oliveira Roque et al., 2018), Canada (Parks Canada & the Canadian Parks Council, 2008), Mexico (Figueroa & Sánchez-Cordero, 2008), Nepal (Tucker et al., 2005), the Philippines (Danielsen et al., 2000; NORDECO & DENR, 2001), South Africa (McGeoch et al., 2011) and the USA (Fancy et al., 2009). While these are primarily aimed at conservation, some aspects may be relevant to restoration.

Various global databases provide access to data that may be of use in monitoring conservation in general, and restoration in particular. A comprehensive overview can be found on IUCN SSC Species Monitoring Specialist Group (2023) and in Stephenson and Stengel (2020).

Restoration-specific Guidance and Tools

There is growing interest in satellite and aerial monitoring for restoration (Foo & Asner, 2019; Lee et al., 2023; de Almeida et al., 2025). Unmanned aerial vehicles (UAVs or drones) can facilitate the rapid collection of detailed imagery in the field over large areas. Various sensors can be used, such as visible-light (RGB) cameras, multi- and hyper-spectral cameras (to measure leaf area index, vegetation index), and light detection and ranging (LiDAR) devices to assess ecosystem structure (Mahrad et al., 2020; Lee et al., 2023). While these technologies offer significant advantages, they remain costly and require ground-truthing and contextualisation (Cochard et al., 2023).

Several publications provide ideas and guidance on restoration monitoring and options for forest and ecosystem restoration indicators (e.g., Buckingham et al., 2019; England et al., 2021; Eger et al., 2022; Conservation International, 2023; Mansourian & Stephenson, 2023; Tsafack et al., 2023; FAO & WRI, 2024). A comprehensive monitoring tool to measure progress against the Atlantic Forest Restoration Pact target was developed by Viani et al. (2017) and includes sample indicators such as canopy cover, forest structure, payments for ecosystem services, community participation and qualification of managers. Dudley et al. (2018) include grazing pressure, pollinators, and soil properties; Evans et al. (2018) highlight the importance of selecting indicators with local stakeholders, and de Almeida et al. (2020) emphasise the value of GIS tools for restoration monitoring. Tsafack et al. (2023) proposes an Index of Biotic Integrity for island forest restoration using arthropods as indicators.

A wide range of restoration-specific planning tools, datasets, and frameworks are available to support planning, monitoring, and evaluation of ecosystem restoration efforts. These resources cater to various aspects of restoration, from defining priorities to tracking progress and measuring outcomes.

Planning and monitoring tools and standards

- FAO's Forest and Landscape Restoration Mechanism (FLRM) used the SEPAL (System for Earth Observation Data Access, Processing, and Analysis for Land Monitoring) dataset to develop se.plan to help define restoration priorities and plans.

- UNDP's maps of Essential Life Support Areas (ELSA) seek to identify priority areas that combine protection, management, and restoration of nature to achieve multiple national policy targets (e.g., towards meeting the SDGs or under the multilateral environment agreements such as the CBD; Recondo et al., 2024)
- Some habitat-specific guidance exists, for example for salt marshes and tidal flats (Cutts et al., 2024), coastal wetlands (Cadier et al., 2020), grasslands (Alldredge et al., 2019) and forests (Viani et al., 2017; Conservation International, 2023).
- Monitoring and indicator standards, frameworks and tools (for a comprehensive overview, see WRI's Restoration Monitoring Tools Guide)
- A list of different standards can be found on the IUCN WCPA Restoration Task Force website.
- The Standards for the Practice of Ecological Restoration (SER; Gann et al., 2019). The Recovery Wheel in the Standards (see Fig. 1) measures progress against a number of ecological characteristics. This tool was recently adapted for mangrove restoration by Beeston et al. (2024) who developed a "Progress Wheel" to track ecosystem recovery in restoration projects.

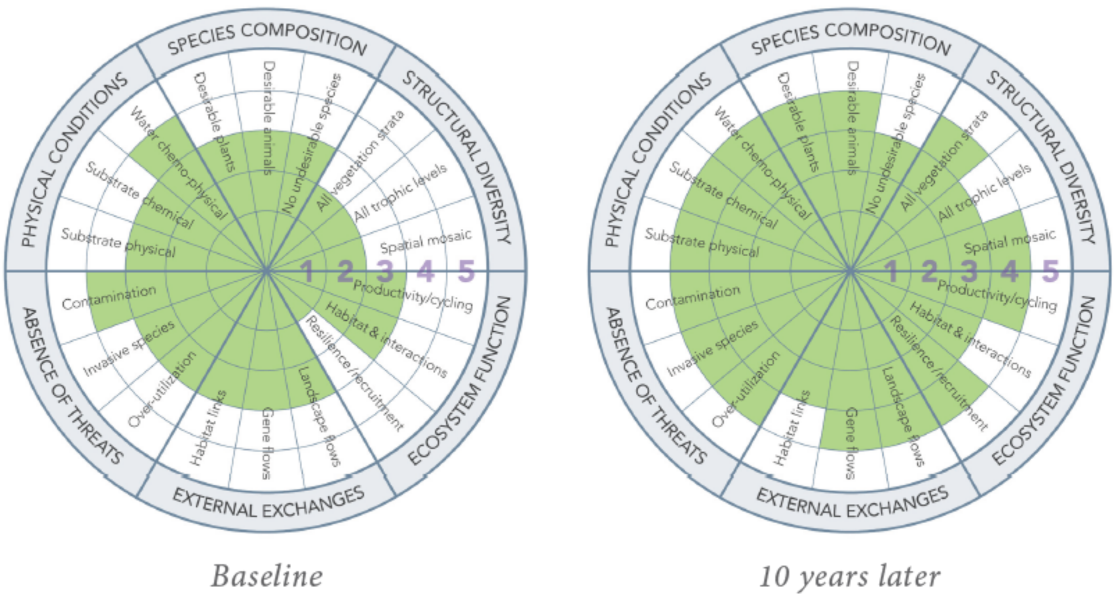

Figure 1: SER's recovery wheel demonstrates metrics proposed for monitoring ecological restoration (Gann et al., 2019).

- The UN Decade on Ecosystem Restoration Standards (Nelson et al., 2024), which were developed to support the UN Decade on Ecosystem Restoration.
- The Global Biodiversity Standard (by BGCI & SER; Bartholomew et al., 2024) includes best practices for restoration implementation and how to develop and enhance monitoring and evaluation activities.
- Assessment, Understanding and Reporting Of Restoration Actions (Aurora; WRI) - a web application to help set up systems to assess and report on restoration.
- The Framework for Ecosystem Restoration Monitoring (FERM) – developed by FAO as a web-based platform to visualise progress towards Target 2 of the Kunming-Montreal Global Biodiversity Framework.
- The IUCN Restoration Barometer was initially developed to measure progress against the Bonn Challenge. It covers four impact and output indicators, on area covered, carbon sequestered, jobs created and area under restoration inside PCAs.

Data on restoration projects

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- Restor (Crowther Lab at ETH Zürich), a data platform on restoration projects.
- The Global Restoration Observatory (GRO), a coalition of restoration actors.
- Global Partnership on Forest Landscape Restoration – case studies on forest restoration.
- WildinSync (https://wildinsync.org), long-term eDNA-based monitoring of biodiversity-positive actions.
- UN Decade on Ecosystem Restoration flagships provides information and some data on certain projects.

Databases and data platforms on habitat cover, land-use change and pressures across biomes

- Examples include Global Forest Watch; Global Pasture Watch; Ocean+ Habitats; Global Mangrove Watch; Coral Reef Watch; Global Coral Reef Monitoring Network; Allen Coral Atlas; Global Seagrass Observing Network; SeagrassSpotter; Global Mangrove Alliance Data Portal)

2.2 Case Studies of Restoration Monitoring in Protected and Conserved Areas

The following case studies provide some varied illustrations from four countries of current practices in restoration monitoring.

Azores, Portugal

In the context of the projects LIFE BEETLES and LIFE SNAILS in the Azores, the monitoring of arthropod communities using SLAM (Sea, Land, Air, Malaise) traps illustrates exemplary practices of biodiversity monitoring in native forest restoration projects (see Tsafack et al., 2023; Borges et al., 2024; Lhoumeau et al., 2024). These projects, led by the Azorean Government and the University of Azores (Azorean Biodiversity Group - CE3C), are restoring the Pristine Hyper Humid Native Forest habitat of endangered endemic beetles and molluscs across the islands of Terceira, Pico, Flores and Santa Maria.

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Monitoring arthropods for native forest restoration projects in the Azores; a SLAM trap is shown on the left.

The application of an arthropod-based Index of Biotic Integrity (IBI) has proven crucial in assessing the ecological condition of native forest sites by acting as a proxy for overall habitat integrity. By incorporating a set of ecological parameters—such as species richness, trophic levels, and the presence of endemic versus introduced species—the IBI provides a detailed measure of habitat quality and restoration success. This approach contributes significantly to conservation efforts by providing insights into the ecological dynamics within these habitats. The IBI method quantifies the impact of restoration actions by providing a nuanced view of ecological health across both endemic and exotic species within these ecosystems, which is essential for maintaining the biodiversity integrity of island ecosystems, facing significant biodiversity and conservation challenges.

Brazil

The Brazilian Biodiversity Monitoring Program (Monitora Program), managed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio), encompasses a set of protocols for monitoring biodiversity in protected areas in Brazil involving different taxa in forest, grassland, savanna, aquatic and marine environments. For grasslands and savannas, the programme is implemented across 20 protected areas to evaluate the effectiveness of ecological restoration work. Herbaceous and woody plants are monitored (sensu Herrick et al., 2005) to establish vegetation cover (using the line-point intercept method) and to measure vascular plant functional biodiversity (using methods that can be applied by non-specialists). This facilitates the assessment of woody plant encroachment in grasslands, the effects of adaptive fire management on vegetation structure, and the effectiveness of ecological restoration actions. Monitoring dry and dead plants and litter helps evaluate fuel load availability and guide fire management. Monitoring bare, unvegetated ground allows for early detection of desertification processes, enabling targeted restoration actions.

Colombia

El Silencio Natural Reserve was established by Fundacion Biodiversa Colombia (FBC) in 2012 in the Middle Magdalena Valley, north-west Colombia (Fundacion Biodiversa Colombia, 2025). FBC implements a science-based conservation strategy to protect and restore the wetlands and Andean moist forests in the and around the reserve that are under severe threat from deforestation and mercury and arsenic pollution.

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Images of vegetation cover inside El Silencio Natural Reserve in 2014 (left) and 2020 (right).

Management actions include restoration of degraded cattle pasture in collaboration with local landowners, community leaders, and environmental authorities with the aim of reestablishing ecological connectivity and habitat quality for critically endangered and endemic species such as the blue-billed curassow, brown spider monkey, and Magdalena River turtle. Restoration combines passive natural regeneration with active interventions including native tree planting, invasive species control, biological corridor establishment, and secondary forest enrichment. Biodiversity recovery is being monitored with a suite of techniques, including camera traps, bioacoustics, and environmental DNA (eDNA) metabarcoding to detect vertebrates from water samples. eDNA data collection is led by trained reserve rangers following the WildinSync protocol using filtration capsules and peristaltic pumps, with laboratory and bioinformatics analysis conducted by ETH Zürich, University of Tolima and FBC. Monitoring data are used to assess success and inform the planning of future actions. The integration of traditional and modern monitoring methods with local capacity building and multi-stakeholder partnerships enhances conservation outcomes and also empowers communities and institutions to co-lead the stewardship of ecosystems under threat.

South Africa

The Cape dwarf-eelgrass (Nanozostera capensis), an endangered seagrass, is being restored in Langebaan Lagoon, South Africa within the West Coast National Park, a marine protected area and a designated Ramsar site (Watson et al., 2023; Bossert et al., in press).

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Seagrass restoration in Langebaan Lagoon, South Africa.

A team of researchers from Stellenbosch University, South African National Park staff and over 40 volunteers, monitored key indicators such as seagrass survival, area cover, leaf length and associated macrofauna. Transplant plots showed successful seagrass establishment and persistence (average area cover expanded by 112%) and were colonised by a variety of macrofauna, including seagrass specialists, such as the critically endangered false-eelgrass limpet (*Siphonaria compressa*). Statistical analyses revealed the influence of factors such as transplant material, planting pattern and site selection on survival rates and area cover, providing valuable insights for future restoration efforts. Beyond informing broader seagrass restoration initiatives across South Africa, the findings highlighted the need to upscale donor material for planting, leading to the establishment of Africa's first seagrass nursery (Bossert et al., in press). Data collected has also been integrated into Langebaan Lagoons 'State of the Bay' reports and shared through scientific publications (Watson et al., 2023; Clark et al., 2024), contributing to both local management and global knowledge on seagrass restoration. This project highlights how science-driven restoration, combined with adaptive management and community engagement, can achieve tangible ecological and conservation outcomes and established a robust model for future projects.

2.3 Implications for Practice in Protected and Conserved Areas

Drawing on existing guidance, and lessons learned from case studies, several key considerations need to be taken into account when monitoring restoration in the context of landscapes, wetlands and seascapes that include PCAs and areas being restored.

Goals and indicators

Set clear, appropriate, feasible and measurable ecological and social objectives. Objectives for restoration initiatives should be aligned with those of the PCAs they are linked to and reflect the conservation values the PCA was established to protect. Where appropriate, objectives also need to be informed by reference ecosystems (Gann et al., 2019) and well aligned with relevant natural resource management plans in the broader landscape, such as for invasive species control or fire management.

Choose appropriate indicators to measure ecological and social outcomes. Indicators should be specific, measurable, achievable, relevant, and time bound. They should also follow the State-Pressure-Response-Benefit framework to measure impacts on biodiversity, ecosystem services and human wellbeing, as well as any reductions in threat and progress with restoration activities and outputs (Mansourian & Stephenson, 2023).

Follow best practices in monitoring design. This should include the use of relevant sampling methods and recognised protocols (e.g., Hill et al., 2005; Sutherland, 2006; Gitzen et al., 2012; Buckland et al., 2015; Henderson & Southwood, 2016) at appropriate temporal and spatial scales. Many restoration projects will have identified reference sites to inform their objectives, and, in some cases, these sites or other control sites can be monitored as counterfactuals to gauge progress against project ambitions. Within a specific PCA, monitoring of restoration activities should also be integrated into broader monitoring plans and practices for the PCA (Parks Canada and the Canadian Parks Council, 2008).

Funding and capacity

Ensure adequate capacity is in place. This will require the capacity of stakeholders for long-term monitoring to be assessed and enhanced as necessary. Relevant partnerships to collect and share data should be developed with local people, academic institutions, NGOs and consultancies. This will be especially important for monitoring impacts beyond PCA boundaries. For example, vegetation restoration in a PCA may influence environmental flows downstream, so water volumes may best be monitored by municipalities or water companies outside the PCA.

Monitoring approaches and tools

Use monitoring methods appropriate for the indicator and the scale of the project. Relevant technological data collection tools, such as satellite-based remote sensing, camera traps, bioacoustics and environmental DNA, can be deployed where they complement human observations and are suitable for the project’s budget and staff capacity. Satellite-based and ground-based remote sensing methods should be integrated with in-situ observations.

Integrate Indigenous and local knowledge. Integrate ILK into restoration monitoring and involve Indigenous Peoples and local communities into both the indicator selection process and data collection and use. In some cases, this may also mean looking at alternative, more locally attuned methods of gathering data, such as where oral rather than written traditions dominate (Mansourian et al., 2025). For example, the Warddeken Indigenous Protected Area combines species-related data collected through camera traps and Indigenous Bininj knowledge to take informed decision regarding reserve management (Karrkad Kanjdji Trust, 2025).

Engage local people and use locally-adapted tools. Simple tools and mechanisms need to be in place that can be used by local stakeholders and can be funded and used in the long term. Some measurements of success are necessarily specialised (e.g., details of changes in soil composition) but other factors, like the return of easily identifiable wildlife species, can be monitored by protected area staff, volunteers or local people. Certain technological methods, like camera traps, also lend themselves to engaging local people in participatory monitoring (Stephenson, 2020) and such citizen science approaches have proven effective in the PCA context (Danielson et al., 2000; Cronemberger et al., 2023).

Embed restoration monitoring in other local processes. The monitoring of environmental and social outputs, outcomes and impacts needs to be integrated into other processes, such as PCA management planning, National Biodiversity Strategies and Action Plans, and the management practices of institutions and communities that rely on ecosystem services from PCAs.

Use of data

Use the data for adaptive management. Monitoring data should be used to inform adaptive management in PCAs (Phillips, 2002) and is especially important for restoration work. This requires that data are not only collected but are analysed in a timely manner and used to adjust activities, to allow the replication of actions and policies that are working well and to change those that are not. Wherever possible data should also be shared openly to promote transparency, collaboration and learning between stakeholders and between PCAs.

Inspire civil society. Results from restoration monitoring can be used in educational displays, infographics and other interpretive materials to demonstrate the potential of nature's recovery to people visiting the PCA.

Share lessons and build knowledge. Restoration is an evolving field so documenting and sharing lessons and experiences – of both successes and challenges – will help accelerate collective progress and improve restoration and restoration monitoring beyond individual sites. Building a results-based management culture and learning from failures as well as successes is vital for adapting and improving (Catalano et al., 2019; Stephenson, 2019) within and beyond PCAs.

Ultimately, if stakeholders follow a simple set of best practices for the participatory monitoring of environmental and social outcomes, taking account of issues highlighted in this guidance, it will lead to more impactful ecosystem restoration in and around PCAs for the benefit of people and nature.

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