



# Introduction to community-based environmental monitoring:

practical guidance for monitoring of natural resources  
by Indigenous Peoples and local communities.



Transformative  
Pathways



Forest  
Peoples  
Programme

# Acknowledgements

This practical guide has been written by researchers, practitioners and indigenous leaders as part of the project “Indigenous peoples and local communities leading and scaling up conservation and sustainable use of biodiversity”, known in short as the Transformative Pathways Project. Funding for the Transformative Pathways project is provided by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) through the International Climate Initiative (IKI). The project team would like to thank the Forest Peoples Programme for editing the guidance and Andrew Brown at Raygun Design for their support with the design.

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**Project website:** [transformativepathways.net](http://transformativepathways.net)

**Cover photo:** Samburu Indigenous Peoples doing Community Resource Mapping at Kiltamany.

**Credit:** Indigenous Information Network (IIN)

This report has been produced with funding support from the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV). The views expressed in this publication remain the sole responsibility of Forest Peoples Programme and do not necessarily represent those of the donor organisation that supported this work.

Supported by:



based on a decision of the German Bundestag





Woman and her daughter prepare bush mangoes they collected from the forest. **Credit:** Stephanie Brittain, Interdisciplinary Centre for Conservation Science (ICCS).

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# Glossary

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**Abundance** - The representation of a species in a particular ecosystem. It is usually measured as the number of individuals found per sample.

**Camera trap surveys** - a method of monitoring that uses small cameras usually attached to trees, which are triggered by movement to photograph the animals (usually medium to large-bodied) that pass in front of them.

**Degree of fragmentation** - The degree of forest fragmentation of large contiguous forest areas into smaller patches of forest.

**Density** - The number of individuals of a given species occurring at a defined location.

**Diversity** - The number of species in a community and a measure of the abundance of each species.

**Environmental DNA** - or eDNA is DNA that is collected from a variety of environmental samples such as soil or water, rather than directly sampled from an individual organism.

**Forest cover** - The amount of forest covering a given area of land.

**GIS** - A geographic information system (GIS) consists of integrated computer hardware and software that store, manage, analyse, edit, output, and visualize geographic data.

**IPs & LCs** - Indigenous peoples and local communities.

**Land use change** - The conversion of human use of an area of land from one state to another.

**Line transects surveys** - A path along which one counts and records occurrences of the objects of study (e.g. plants). Lines are commonly walked, but can also be cycled or driven.

**Non-timber forest products (NTFPs)** - foods, substances, materials and/or commodities obtained from forests other than timber.

**Occupancy** - The proportion of places occupied by a species or natural resources in a given location.

**Open searches** - consist of the monitor walking, or standing at a central point for a pre-defined period of time (e.g. 20 minutes) and recording everything seen or heard.

**Participatory mapping** - a process that seeks to visually show the association between land and communities.

**Point Surveys** - commonly used monitoring approach for bird monitoring and consist of staying at a predefined point for a certain time and documenting all birds seen or heard.

**Quadrant survey** - counting and recording individuals of different species (usually floristic species within a pre-defined grid).

**Relative abundance** - A measure of the frequency or rarity of a species relative to other species at a given location.

**Remote sensing** - The acquisition of information about an object or phenomenon without making physical contact with the object, in contrast to in situ or on-site observation.

**Species wealth** - Number of species at a given location.

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Hills in Philippines. Credit: PIKP

## Introduction and background

**This guide is for the local organisations working with communities (e.g. community-based organisations and local non-governmental organisations), which are facilitating Indigenous Peoples and Local Communities (IPs and LCs) to design and implement environmental and biodiversity monitoring activities on their lands. The guide includes approaches and considerations for all aspects of environmental monitoring, but with a particular focus on biodiversity monitoring in response to the needs and priorities set by partners of the Transformative Pathways Project.**

Generally speaking, biodiversity monitoring is often motivated by a concern to ensure its long-term persistence, either because we value it for its own sake or to ensure the sustainable use of biodiversity as a resource. It may also be motivated by a desire to understand the positive and negative impacts of human activities on biodiversity, to develop more sustainable practices, or to provide evidence that existing practices of IPs and LCs are supporting biodiversity, for people or organisations outside communities.

Despite the growing emphasis within conservation policy and practice on enabling IPs & LCs to participate in conservation and sustainable use programmes, and despite awareness of the need to find deeper common ground between often seemingly divergent Western and indigenous values and priorities and focus on upholding people's rights, the reality on the ground often does not reflect these aspirations. To address this gap, IPs & LCs may wish to monitor their biodiversity and seek technical support to do so, as well as to report on it in a way that is useful to them and that is also in line with external conservation approaches. Without external support, it may be difficult for some to enter locally-gathered monitoring data into national and international indicators of the state of biodiversity, either because the pathways to do this are unclear, the data collected are not considered robust or because they do not fit with the priorities or methods of external conservation actors.

We have developed this guidance to help local organisations working with IPs and LCs to develop community-based monitoring programmes in forests. These programmes often bridge the gap between indigenous peoples' and local communities' biodiversity management and external policies and practices. Our guide takes you through the key stages of designing and implementing a biodiversity monitoring strategy, including practical tips and signposting to other resources, so that you can build an understanding of the variety of approaches that can be used for biodiversity monitoring. Although the stages are set out sequentially, you will need to move backwards and forwards as the community refines its plan to achieve its monitoring objectives, depending on the resources available. By producing this guidance, we hope to help combine the best of western and traditional knowledges and values, which are equally valid, and are rooted in varying degrees and forms in the ancestral practices of indigenous peoples' communities.



This guide is intended for use when a community has expressed a desire to monitor biodiversity, but wants additional support or facilitation to do so. This guide aims to help communities monitor both biodiversity of local importance for socio-cultural and economic purposes, and biodiversity of external conservation concern, such as species protected by national and international regulations and agreements. By monitoring biodiversity of importance both to local communities and to a wider conservation audience, IPs and LCs can more clearly demonstrate their role as environmental stewards, including to support their land claims, inter alia by demonstrating that they are the best guardians of their ancestral lands.

Enabling local organisations to better facilitate and support IPs and LCs will promote more robust community-based monitoring efforts. In turn, communities will be better equipped to independently develop and manage community monitoring programmes and community land-use plans. They will also be able to contribute sound evidence on the state of biodiversity on their lands to help shape local, national and international conservation policy, as well as contribute practically to biodiversity conservation and the sustainable use of natural resources.

We have developed this practical step-by-step guide for use in community projects within the Transformative Pathways project and globally. This guide is part of a series being developed as part of the Transformative Pathways project, and will be accompanied by additional training materials and resources that local communities and organisations can draw on to meet their needs: [transformativepathways.net](https://transformativepathways.net)

## What is biodiversity monitoring?

**Biodiversity is the diversity of life on Earth. Technical definitions define it at three levels: the variety of different types (species) of plants, fungi, microorganisms and animals, the genetic variation within species, and the variety of ecological communities.**



*The nelicourvi weaver, *Ploceus nelicourvi*, endemic to Madagascar. Photographed around Ranomafana National Park. Credit: Ricardo Rocha.*

Biodiversity monitoring allows people to identify changes in the condition of biodiversity over time and space, assess the status of biodiversity (e.g. whether a species or habitat is threatened or not), identify the source of threats and study their impact, or measure the success of management activities to support particular components of biodiversity. It can also be used to predict changes in biodiversity in response to environmental changes.



Monitoring can also demonstrate the effects of land use changes on biodiversity. This may include infrastructure development, construction and the conversion of natural areas to agricultural land, which play an important role in habitat destruction, degradation and fragmentation. Land use change can also include the restoration of natural areas, either passively, by allowing nature to recolonise, or actively, for example by planting trees.

Monitoring biodiversity and the effects (positive or negative) of various human actions on it allows us to understand why changes in habitats and species populations occur and what approaches work best to halt declines and restore species and habitats in different circumstances.

## What is Community Monitoring of biodiversity and why is it important?

In community-based biodiversity monitoring, both monitoring and decisions on how to act on monitoring results are initiated by the community for its own purposes, rather than for the purposes of those outside the community. The extent to which external support and assistance is required or desired may depend on local capacities, the stage of the monitoring process, and the type of monitoring being undertaken. If IPs and LCs wish to carry out monitoring or data analysis that requires scientific skills and knowledge that they do not possess, they may need to invest in training community members or use external expertise. Other types of monitoring may be carried out from start to finish by the community without scientific expertise, perhaps with some initial support from a local organisation. The community may wish to store and manage monitoring data itself, or outsource data storage. But in either case, the community decides how this information is managed, shared and used. Community monitoring is part of a broader set of strategies and actions to improve the sustainability of indigenous and community-based natural resource management, including biodiversity management, at the local level (Box 1).

Community biodiversity monitoring can enable better informed internal decision-making on biodiversity and natural resources compared to external efforts (although there are some limits to what it can do, which will be discussed). In some circumstances, deciding the goals and objectives of monitoring may also be a legal right. For example, the right to participate in resource management and conservation, and the right to participate in decision-making where human rights may be affected, are enshrined in international policy that protects the collective rights of indigenous peoples, including the UN Declaration on the Rights of Indigenous Peoples (UNDRIP)<sup>1</sup>, and the International Labour Organisation Convention 169 on the Rights of Indigenous and Tribal Peoples<sup>2</sup>.

### BOX 1: What is community-based biodiversity management?

Community-based biodiversity management is an approach that promotes the conservation and sustainable use of biodiversity at the local level, and focuses on increasing the decision-making power of local communities and organisations to secure access to and control over their natural resources.

For example, The Ogiek of Mount Elgon, Kenya play an active role in the management of their natural resources. Community monitoring is a vital tool in their environmental governance system because it increases the transparency of local management of natural resources, including biodiversity, and allows them to demonstrate their management to the outside world. It can also provide additional information for decision-making.

<sup>1</sup> UN Declaration on the Rights of Indigenous Peoples (UNDRIP) [https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP\\_E\\_web.pdf](https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf)

<sup>2</sup> International Labour Organisation Convention 169 on the Rights of Indigenous and Tribal Peoples [https://www.un.org/en/genocideprevention/documents/atrocities-crimes/Doc.16\\_Indigenous%20and%20Tribal%20Peoples%20Convention.pdf](https://www.un.org/en/genocideprevention/documents/atrocities-crimes/Doc.16_Indigenous%20and%20Tribal%20Peoples%20Convention.pdf)



CASE STUDY

# Wapichan Monitoring Programme in Guyana

The South Rupununi District Council (SRDC), the institution representing the majority of Guyana’s indigenous Wapichan people, established a monitoring programme in 2013 that focuses in part on mining activities. SRDC monitors using handheld GPS, smartphones and drones to collect data and report to village councils and the SRDC.

One focus of the monitoring programme has been illegal mining in Marudi Mountain, sacred to the Wapichan and also an important watershed. Many streams are polluted, directly affecting fragile ecosystems and local communities. For example, sampling by the Wapichan, with the support of WWF, has revealed that local women in one village have mercury contamination levels above WHO recommended safe limits.

Reports produced by SRDC’s monitoring programme and advocacy efforts have led the Guyanese government to strengthen the enforcement of mining regulations in Marudi so that illegal mining in the area is reduced. The efforts of the SRDC and its monitoring programme have led to the establishment of a government working group that works with the SRDC to collectively address issues affecting the Wapichan territory. The model is being replicated in other regions with environmental problems.



Marudi Mine, South Rupununi, Guyana. Sluicer pumping untreated water into an abandoned mine pit.

Credit: Vicki Brown/FPP

3 Forest Peoples Programme, International Indigenous Forum on Biodiversity, Indigenous Women’s Biodiversity Network, Centres of Distinction on Indigenous and Local Knowledge and Secretariat of the Convention on Biological Diversity (2020) Local Biodiversity Outlooks 2: The contributions of indigenous peoples and local communities to the implementation of the Strategic Plan for Biodiversity 2011-2020 and to renewing nature and cultures. A complement to the fifth edition of Global Biodiversity Outlook. Moreton-in-Marsh, England: Forest Peoples Programme. Available at: [www.localbiodiversityoutlooks.net](http://www.localbiodiversityoutlooks.net)

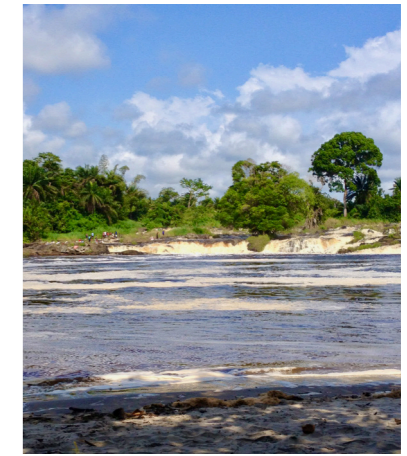
# Overview



**Stage 1:**  
Getting prepared



**Stage 2:**  
Determine monitoring needs & objectives



**Stage 3:**  
Develop a participatory monitoring plan



**Stage 4:**  
Prepare the monitoring team



**Stage 5:**  
Collection & analysis of data



**Stage 6:**  
Community reporting & validation

Figure 1: Overview of guidance





Workshop discussion on species sightings in a community forest, East Cameroon.

**Credit:** Paul Barnes, Interdisciplinary Centre for Conservation Science (ICCS).

## Stage 1: Preparation

**To be successful, a monitoring programme must be realistic. Monitoring requires long-term commitment and adequate financial and technical resources. However, insufficient thought is often given to whether these conditions are in place before embarking on a monitoring programme.**

Answering the four questions in STAGE 1 will help you determine whether you are ready to start planning and supporting community monitoring activities or whether you need to do some preparatory work and fundraising first. Below, we explain why each of these considerations is important and offer some practical steps and resources to help you think through them.

It is likely that the community will initially approach you (the local organisation), perhaps because they have identified problems that they would like to address through monitoring, but feel that they need external support in the first instance to do so. Once the community has contacted you, you should ask yourself the following two initial questions:

### **Q1. Could you access adequate funding to support the community in its activities?**

Funding is often necessary to support monitoring activities over time, even if communities do all the work themselves using low-tech approaches. For example, funding may be needed to cover the costs of materials, inter-community dialogues or workshops, feedback or data management. However, the short-term nature of many of the available grants challenges the often long-term needs of communities for ongoing biodiversity monitoring. Additionally, while some funders are funding local organizations and communities directly, the funding structures are often still top-down and bureaucratic. In addition, funders' priorities may not coincide with the community's monitoring priorities, meaning that they either do not receive the funding or must change their priorities to align with those of the funder. Combined, these barriers can undermine the longevity and purpose of community monitoring efforts.

Before committing to support biodiversity monitoring, discuss at the outset what financial resources are currently available, what additional resources could be raised and the resources needed for this fundraising. Also consider the minimum financial resources needed to collect the data to achieve the monitoring objectives within the required timeframe. This should include the costs of monitoring teams, training and meetings that are likely to occur, as well as the costs of establishing or maintaining a community-owned and managed data management system. Think about both up-front and long-term ongoing costs; the one-off costs are likely to be a lot easier to fundraise for than ongoing costs.



**Q2. Do you have the capacity and skills to provide practical support for as long as the community needs it?**

Practical support may be necessary for the community to achieve its own monitoring objectives. This technical and logistical support may be necessary for several years before reaching the stage of running a fully autonomous monitoring programme. Good practice standards exist to facilitate community monitoring programmes over the medium to long term. This may include ecological monitoring expertise, community facilitation skills, training support so that community members no longer have to rely on external experts, and support for liaison with external data users such as governments and international organisations. Needs will vary widely, including depending on what communities want to monitor and why.

Community mobilisation, capacity, skills and self-reliance in monitoring can evolve in parallel with their monitoring objectives. You can support and invite communities to take increasing ownership of their existing datasets, biodiversity management methods and projects, which can be progressively handed over, and provide training on how to start a monitoring programme from scratch. While true ownership can only be taken, not given, you can proactively help by offering project planning and problem solving, as well as training in any external data collection and analysis techniques, so that communities can become increasingly self-sufficient. This will allow the support organisation to return to more distant and strategic support, bearing in mind that turning back too soon may also leave communities unable to continue.

Given the above, a key question is: Can you, as an organisation, take on a new partnership with the community, and can you provide monitoring and training support, at the level the community wants, for as long as necessary? If not, is it possible to establish relationships with other partners (e.g. a local university) who can provide the necessary support for this work? Ensuring that adequate support is available to the community for as long as it is needed is key to building community trust and enabling ownership of long-term follow-up activities. As providing practical support sometimes requires a lot of time and resources, make sure that you do not over-commit yourself. If working with several communities, it is best to start with a small number of communities and monitoring programmes that are not too complex or ambitious, and expand later.

- If the answer to the above two questions is NO, you need to consider whether you are in a position to help the community achieve its objectives. If NO, you will need to determine whether you are able to seek additional funding or partnerships that will enable you to provide this support within the required timeframe.
- If the answer is YES and you wish to proceed in partnership with the community and vice versa, the next step is to engage in an exploratory dialogue with the community to answer the following two questions:

**Q3. Have you determined whether and why the community is committed to participate in monitoring activities?**

It is useful to discuss the community's motivations for monitoring at the outset, to determine why community monitoring is desired and what community members hope to gain from it. The details of what is to be monitored and why do not need to be fleshed out at this stage (they will be covered in STAGE 2); instead, the aim here is to clarify what the community wants to get out of monitoring, overall.

Community members will have different reasons for wanting to participate in a community monitoring programme, some may not be as interested as others, and some may not even want the programme. Monitoring involves costs for community members, such as time spent in community meetings and training, and time spent collecting data, which are often unevenly distributed across the community. If the incentives for monitoring come from an external actor, or if communities do not aim to achieve a locally relevant and widely shared goal, community monitoring is unlikely to be sustainable on its own in the long term.

**Q4. Have you discussed the risks with the community?**

Risks may also be incurred by the community, so it's important to assess the risks of monitoring activities in a context of increasing threats to indigenous territories. For example, community A approaches asks for help with monitoring in a conflict zone. Where are the threats? Is there a possibility of harassment of community members who will be monitoring there? Could conflict occur if some members of the community choose not to take part in monitoring? What approach do you take to support the community in such situations?

Even if community members have contacted you for monitoring support, their motivations, the potential costs and risks and desired benefits of participating in a monitoring programme should be discussed openly, especially if there is varying interest within the community. One way to have this discussion would be in an exploratory dialogue between the organisation and the community, following a process of free, prior and informed consent (Box 2). Whatever form the discussion takes, it should be completed before any follow-up activities are undertaken.

Initial discussions could also introduce the basic concepts of biodiversity monitoring, provide an overview of some of the approaches and technologies that may or may not be employed, and explore both the importance and potential of community-based monitoring and the potential costs involved. Community motivations to carry out monitoring, the costs (e.g. time, money and resources), and risks (e.g. from heightened conflicts, physical threat) both in the short and long term should be openly and thoroughly discussed. This discussion will help to clarify the community drivers to monitor, ensure that they are committed and have considered the possible risks to participating. It will also help to identify and address at the outset any doubts or possible barriers to participation. This discussion is likely to need revisiting as the monitoring plans develop; open communication and alignment of expectations at all stages is key to success.



## BOX 2: Free, prior and informed consent (FPIC)

FPIC is the process whereby the participant(s) and the community grant permission prior to the commencement of activities, without coercion and with full knowledge of the nature and potential consequences of the planned activities. In the case of community-based monitoring, the initiative for monitoring comes from the community itself or its leaders. However, the whole community should have a say in deciding whether monitoring should go ahead, in light of the relationship that develops with you, and discussions about how monitoring can be carried out and who will use the data.

To obtain FPIC for your monitoring role, you must provide the community with all the information necessary for them to make an informed decision about whether they can go ahead, including the potential benefits and, more importantly, the potential negative consequences of their involvement. FPIC is not a one-off process. It begins before activities start and should be requested on an ongoing basis, particularly if new activities, objectives or partners are introduced that may affect an individual's or community's perception of risk of involvement.

For more information on how to obtain consent, visit the Forest Peoples Programme website:

[https://www.forestpeoples.org/en/lands-forests-territories-law-policy-global-finance-trade/training-tool/2017/resources-free-prior#:~:text=Free%2C%20Prior%20and%20Informed%20Consent%20\(FPIC\)%20is%20an%20international,their%20land%2C%20territories%20and%20resources.](https://www.forestpeoples.org/en/lands-forests-territories-law-policy-global-finance-trade/training-tool/2017/resources-free-prior#:~:text=Free%2C%20Prior%20and%20Informed%20Consent%20(FPIC)%20is%20an%20international,their%20land%2C%20territories%20and%20resources.)

Or the Cultural Survival website:

[https://www.culturalsurvival.org/sites/default/files/guidetofreepriorinformedconsent\\_0.pdf](https://www.culturalsurvival.org/sites/default/files/guidetofreepriorinformedconsent_0.pdf)

## Q5. Are the necessary community structures in place to lead community monitoring activities, and do you have clear plans to guide interactions and communication between the community and potential partners?

After initial discussions, the next step is to determine what community structures already exist that can facilitate community monitoring, and to support the community in defining a monitoring team. In this step, the following should be clarified:

1. **The teams needed to carry out community monitoring:** This would probably include a group of people to oversee the monitoring activity, the people who will actually carry out the monitoring, and someone who will manage the data they collect. The community should also choose someone who will be responsible for coordinating the whole process and who will be supported by you in doing so.
2. **Determine how each team is organised, including the roles that different team members will have:** Social inclusion should be taken into account when forming teams (e.g. taking gender and age equality into account) so that the most marginalised people can participate in the process. Apart from the ethical benefits of inclusion, a diversity of voices brings different perspectives and priorities to monitoring that might otherwise have been overlooked.
3. **Identify potential collaborators:** You should discuss with the community what other potential collaborators should be involved, such as other NGOs, local government agencies, academia or even individuals (see Box 3 on stakeholder analysis for guidance on how to identify potential collaborators).
4. **Determine communication:** Once the community has defined the monitoring teams, it should be discussed and agreed how and how often the teams will interact and communicate with each other and with identified collaborators.

### Vignette:

*The Alat community has decided that they need to monitor the biodiversity of their land, because they want to demonstrate their environmental management to national and international decision-makers who doubt their ability to protect the biodiversity of their land. They also want to report on local management of biodiversity and monitor illegal use by outsiders. They have contacted a local organisation with which they have strong links and have worked together to identify other collaborators. As a community, they have identified those who are interested in participating in monitoring, including elders, youth, men and women. The community has decided to appoint a representative to act as a key contact between the local organisation, the community and potential collaborators. They have also decided that holding monthly meetings between the monitoring teams, the whole community and their partner organisation is a good way of ensuring that everyone is informed of progress, and sharing their knowledge or concerns throughout the process.*



### BOX 3: Stakeholder analysis.

A stakeholder analysis is a useful tool for identifying individuals or groups with an interest or influence on a particular issue. Conducting a stakeholder analysis is a useful step in understanding which key actors and stakeholder groups the community could contact during the design, implementation and feedback phases of monitoring. These may be potential partners, participants or important people with whom to share information.

When conducting a stakeholder analysis, facilitate community input and ask the following questions:

- 1. Who are the stakeholders?** List all the actors who may be defined as stakeholders. Stakeholders may be those directly involved in the community-based monitoring, or those directly or indirectly affected by it, or by its results. Stakeholders can be individuals, formal entities, recognised groups or groups of similarly affected individuals.
- 2. What are their interests in community-based monitoring?** Determine the level of interest each actor identified has in community-based monitoring. Interest can be judged as high, medium, low or zero. If the community determines that the interest is zero for a particular actor, then that actor is not a stakeholder and can be removed from the list.
- 3. What is their power in decision-making processes?** Discuss and agree on the level of power of each actor or group of actors to influence decision-making. Again, influence can be judged as high, medium, low or none. Consider whether there are unequal power relations between women and men, different indigenous or non-indigenous groups, or between community and state actors, which may mean that some groups have less voice than others.



### Stage 1 Checklist

- Do the **funding, skills and technical resources available** match the ambition of the monitoring programme, over a long enough time for the programme to become self-sustaining if it needs to?
- Have you had initial discussions with the community to **explore their aspirations for biodiversity monitoring** and how you might support them?
- What are the **risks** that the community may encounter as a result of either monitoring, or being unable to participate in monitoring?
- **Has the community considered possible collaborators outside the community?**
- **Has the community agreed on means of communication between you, the community and potential collaborators?** Are there structures in place so that the team is well organised, interacts well with each other, with your organisation and with other potential collaborators?

If yes, proceed to the next step. If no, consider what needs to be done before moving on to the next step.





Foresters carefully mark the trees for easier monitoring during a training on resource inventory mapping held in Nueva Viscaya, Philippines. **Credit:** Ella Carino, PIKP.

## Stage 2: Identify monitoring priorities

In STAGE 1, you prepared for monitoring by taking into account the financial and human resources available to you and the community for monitoring, helped communities reflect on the different stakeholders in monitoring and the overall intention and motivation for biodiversity monitoring, ensuring that community members agreed on what they wanted, with an FPIC process related to your involvement. It also helped the community to reflect on existing structures and to define the necessary teams to lead and coordinate the monitoring work, taking into account social inclusion and possible barriers to participation for some community members.

In STAGE 2, you will work with the community to determine who will use the data and how it will be used, and to determine which biodiversity features they want to monitor, the changes in those features they want to monitor, and the timeframe and scale needed to do so. At this stage, the community should ask themselves the following four questions:

### Q1. Who will use the data, why and how?

Determining who can use the data, why they are the intended users and how they would be used is important for several reasons.

First, the features of biodiversity, the changes in those features that the community wishes to monitor, and the indicators selected to monitor those changes (see Q2 to Q4 below) must be understandable and appropriate to the needs of those interpreting and using the data. For example, if the community wishes to report on community use of its biodiversity, then it may decide to monitor biodiversity of local socio-cultural or economic importance, and may choose local indicators that can be clearly and easily interpreted by the whole community. However, if the objective of monitoring is to demonstrate their environmental management to national and international decision-makers, they may choose to also monitor biodiversity that is of national or international importance, due to its threatened status, for example. In this example, they may choose indicators that are more widely used in conservation.

Secondly, if knowledge-sharing between the community and other actors is likely, clear processes are needed to ensure that the community retains control over the data, where desired. Relatedly, if the community wishes to take full ownership of long-term monitoring, this may influence the monitoring methods used and how data are stored (see Box 4). Finally, end-user needs may also affect how results are presented. For example, maps created for use by local or national administrations may need to follow a certain format in order to be more widely used. In contrast, maps intended for communities may contain different information, such as local names of rivers, areas or resources.



If the intended user of the data is unclear from the initial motivation for monitoring (see STAGE 1 Q3), spend some time now with the community considering which groups of people will use the final results, and which may require access to the data itself, following FPIC principles. This can be reviewed if necessary as monitoring plans are developed.

#### **BOX 4: Storage of community-owned data**

Ideally, the community should identify a centralised location within the community to store data, but this will not be appropriate or possible in all cases. Ensuring that data remains in the community and is managed by the community helps to increase local control and increases the sustainability of the monitoring programme beyond the reach of any external support. However, it is not always realistic for communities to manage and interpret data on their own, so some level of external support is likely to be required, combined with community capacity building in the short to medium term.

#### **Q2. What aspects of biodiversity does the community want to monitor?**

Once it has been determined why the community wants to monitor and who will use the results and access the data, the community can determine which biodiversity features they want to monitor. For example, do they want to monitor animals, forest quality or water quality? Why do they want to monitor these features?

Consider which biodiversity features to monitor and why, and how monitoring should be conducted, as early as possible in the process. Failure to reach agreement on these issues may result in poorly structured monitoring activities that do not provide sound information, information that is unrelated to the questions the community wants answered, or activities that require too much effort, money or other resources, making the programme unsustainable.

#### **Q3. What kinds of changes in these characteristics does the community want to monitor?**

Having determined why the community wishes to monitor and which biodiversity feature or features it wishes to monitor to achieve its objectives, the community should decide what changes in those features it wishes to monitor over time. For example, does the community want to learn about changes in the abundance, density or occupancy of a particular species? If they want to monitor changes in forest quality, do they want to monitor changes in species richness or diversity? Or, if the community is more concerned about water quality, do they want to collect data on pollution, sedimentation or water flow?

It is a good idea for the community to bring the above three questions together and agree on one or more precise and achievable monitoring objective(s) to help focus the planning process. This objective may be quite limited at first, and may become more ambitious over time as the monitoring programme becomes more established. For example, the community might start by wanting to map the distribution of a few species that are relatively easy to monitor and of high interest and importance to community members, and later add more sophisticated methods and more biodiversity features.

Facilitating community dialogue and using participatory approaches such as problem trees, the Life Plan or situation analysis (Box 5) can help the community identify the key biodiversity features they want to monitor, as well as the key issues and threats affecting biodiversity in their territory.

This is also a useful process for determining whether community monitoring will be able to provide the data they need to meet their monitoring objectives. For example, monitoring the types and quantity of non-timber forest (NTFPs) products used by local communities will underestimate the total use being extracted from the forest if people from outside are also entering the community's land to collect NTFPs. This may mean that communities think that the rate of use is more sustainable than it really is.

It should be borne in mind that different social groups, such as men and women or the elderly and the young, often have different priorities for follow-up, as well as different capacities to express them in public. Therefore, separate discussions with different social groups may result in a more comprehensive understanding of the diversity of priorities and needs than can be achieved from one integrated meeting.

#### **Vignette:**

***The Alat community has decided that they want to monitor biodiversity for three different reasons. Firstly, they want to document their environmental stewardship to national and international decision-makers. To do this, they have decided to monitor the distribution of elephants on their land and, if possible, will try to document the relative abundance of elephants throughout the year. They also want to document the presence of their totem species, many of which have not been seen for several years but are of strong local, and at times international importance for conservation. Secondly, they want to monitor the health of the biodiversity that is important to their livelihoods. They are especially interested in documenting the health of the bamboo forest, the distribution and diversity of flowers and herbs used for medicine and honey production, and the impact that livestock grazing has on floristic diversity compared to areas that are not grazed. Finally, they want to map and document cases of illegal use of biodiversity by outsiders, in particular illegal charcoal burning, logging, hunting and agricultural encroachment.***



## BOX 5: Approaches for determining local priorities

### 1. Life Plan

A Plan de Vida is a Costa Rican idea meaning Soul Purpose, or 'life plan'. It is a tool for community empowerment and self-determination, developed by indigenous peoples in Colombia and throughout Latin America.

Official development plans may differ from local priorities in terms of the time frame in which change is expected to occur and in terms of the type of priorities identified (for example, official development may prioritise economic development and be planned from offices far from the community). But for indigenous communities, priorities may be more focused on their territory, languages and oral traditions.

A Plan de Vida allows communities to plan and assess priorities on their own terms, based on their own priorities and cultural values, without external intervention. See here how the Misak indigenous people of Colombia are implementing their Plan de Vida, a community-driven long-term plan for the self-determined development of their territory: [https://vimeo.com/145578206?embedded=true&source=vimeo\\_logo&owner=2291319](https://vimeo.com/145578206?embedded=true&source=vimeo_logo&owner=2291319)

### 2. Situation analysis

An alternative approach that could be adopted is situation analysis, which explores the drivers of change affecting biodiversity in a landscape. During such an analysis, the local organisation should help the community to consider the relevant environmental, social, economic, political and institutional systems that affect biodiversity, how they have changed over time and how they expect them to change in the near future. A better understanding of this context will enable better development of focused and achievable monitoring objectives.

For more information on how to conduct a situation analysis, see:

International Union for Conservation of Nature (IUCN) (2018) 'Situation analysis - An approach and method for analysing the context of projects and programme. Global M&E Initiative.' <https://library.alnap.org/help-library/situation-%20analysis-an-approach-and-method-for-analysing-the-context-of-projects-andx>

World Wide Fund for Nature (WWF) (2006) 'Basic Guidance for Step 1.4 - Situational Analysis. Resources for Implementing the WWF Standards'. [https://awsassets.panda.org/downloads/1.4\\_situation\\_analysis\\_2007\\_02\\_19.pdf](https://awsassets.panda.org/downloads/1.4_situation_analysis_2007_02_19.pdf)

## Q4. What is the suitable timeframe and scale of monitoring for the community's needs?

The area to be monitored, the time frame required for monitoring, and the frequency of monitoring activities will influence the approaches that can be used and the resources required to carry out monitoring effectively. For example, short-term monitoring may be required over a defined area of land to monitor the effects of a specific incursion, while monitoring may be required over a wider area for a short period of time to build an evidence base for a specific time-limited purpose, such as a court hearing or lobbying on a proposed new law. It is important to consider the area of land where monitoring is required: is it needed in a particular area or across the whole territory? How often are monitoring activities needed and over what period of time? Once these questions have been raised, the community can move on to consider what methods might work best and where they should be employed in the landscape.

Participatory mapping (Box 6) is a useful method for defining the spatial scope of monitoring, including documenting indigenous peoples' and local communities' lands and territories and mapping points of cultural significance, as well as areas believed to harbour biodiversity of local and international importance. The results can be used as a basis for identifying priority areas for further monitoring.

### BOX 6: Participatory mapping

Participatory mapping is a group exercise in which local people map the land they use or own. Participatory mapping uses a range of tools and techniques from drawing a freehand map, to plotting features on a scaled base map, to producing a digitised and geo-referenced map using handheld GPS technology and appropriate mapping software.

The following is an overview of the participatory mapping process:

**Ensure agreement:** The participatory mapping process should be explained in initial meetings with each community, when FPIC is requested to carry out the assessment (see Box 3).

**Preparation of a base map:** Prior to any mapping workshop, a simple, clear and easy-to-interpret base map covering the entire geographical area in question is prepared. This can be a topographic map or an aerial or satellite image showing basic geographic features, or compiled from multiple existing sources such as published maps, land title documents, aerial photographs and open access internet-based sources.

**Initial mapping workshop:** With the community or their representatives, identify and map prominent features, trails and areas of natural resource importance onto the base map, before discussing who has authority over land areas and potential conflicts.

**Digitisation of the results:** The data may now be copied into a GIS project, using reference points and the base map coordinate reference system. The styles of the data (colours, icons, fills, etc.) are based as far as possible on the style of the maps produced during the workshops, and consider the needs of the end user.

**Consultation and validation:** The organisation can review the digitised maps with each community, work with the community to obtain ground truthing of the map with GPS data, agree on necessary modifications, and finally report back to the community. Participatory mapping works best as a series of learning cycles in which the understanding of natural resources, customary systems and the geographic information gathering techniques to describe them can be constantly improved throughout the process or project.

### Stage 2 Checklist

- **Has the community defined the end-users of monitoring data?** If those using the data are actors outside the community, does the community have a clear policy or approach to knowledge sharing that ensures they do not lose their rights to the data?
- **Does the community know what they want to monitor and why?** What characteristics of biodiversity do they want to monitor? Does the monitoring of these characteristics make sense to the end users of the results?
- **What kinds of changes in these characteristics does the community want to monitor?** Do they want to monitor changes in diversity, distribution or contamination of water or soil, for example? How does monitoring these changes help to achieve the “why” of monitoring and make the changes they want to monitor appropriate for the end user?
- **Has a timetable and scale of monitoring been decided that is appropriate to the needs of the community?** Has the community determined the area it wishes to include in its biodiversity monitoring, how long does it need to monitor for in general?



### Useful links:

*Participatory mapping: guidelines for communities and organisations:*

<https://www.forestpeoples.org/sites/default/files/documents/Guidelines%20for%20mapping.pdf>

*Guidance on the implementation of the social requirements of the carbon stock approach:*

<https://highcarbonstock.org/wp-content/uploads/2022/09/HCSA-Implementation-Guide-Appendix-3-Apr-2020.pdf>





The Chutes de la lobé are a site of strong symbolic belief for the Batanga, Maabi and Pygmeé peoples that live locally. Cameroon. **Credit:** Stephanie Brittain, Interdisciplinary Centre for Conservation Science

## Stage 3: Development of a participatory monitoring plan

By now, the community has a clear idea of the support and resources available for monitoring (STAGE 1), as well as the biodiversity characteristics they want to monitor and why, the changes they want to track over time, and the area and timeframe likely to be needed to achieve their objectives (STAGE 2).

At this stage, the community can select the most appropriate and feasible methods for monitoring (STAGE 3A), before selecting the most appropriate survey design that also takes into account bias where possible, and indicators that will help them know if change is occurring (STAGE 3B). At both stages, decisions will depend on both the objectives of the monitoring and the financial and human resources available.

### STAGE 3A: Selection of methods

Monitoring methods are the approaches and tools used to collect data. At this stage, the following two issues need to be discussed with the monitoring teams:

#### Q1: What methods are available to the community and what can they tell you?

The most appropriate methods depend on the monitoring objectives and the financial and human resources available. Social monitoring methods are methods that help to document people's traditional knowledge or experiences of biodiversity.

For example, participatory mapping is a mapping process that seeks to visually show the association between land and communities. Mapping can be used to map biodiversity and its threats, culturally important sites, track land use changes and delineate territories.

Seasonal calendars and community timelines are two other visual tools that can be used to get a picture of major livelihood activities and changes in biodiversity throughout the year, as well as key events that are important in a community's history, as a complement to other monitoring methods.

Narrative diaries and field diaries have been used to record community voices but in written form, often over longer periods of time. Icon-based diaries have also been used to self-report on activities such as hunting, to document the presence of biodiversity or threats to biodiversity observed during their daily lives. Icon-based diaries also overcome challenges with low literacy rates in some places, resulting in more inclusive data collection.



The use of participatory photography and video can facilitate understanding of local people's values, worldviews and perceptions, particularly about biodiversity and its threats, about sites of cultural significance or about ongoing conflicts. Similarly, statements, stories and narratives are effective tools for understanding and documenting cultural knowledge alongside documentation of biodiversity and can be used as a tool to facilitate dialogue between local communities and other actors, such as local authorities, for example.

Ecological monitoring methods are methods that allow biodiversity to be documented directly through observation. For example, quadrat surveys involve counting and recording individuals of different species (usually floristic species) within a quadrat placed or marked out on the ground to count and document the species and diversity of species within that quadrat. By placing several quadrats in the landscape, the community can get an idea of the variation in floristic diversity at different locations.

Line transects are lines of a predefined length running through a habitat, or part of a habitat. The number of species (usually plants, trees or mammals) along the transect can be observed and recorded at regular intervals. They are particularly useful when the community wishes to illustrate a particular gradient along which plant or animal communities change.

Point censuses are commonly used for bird monitoring and consist of staying at a predefined point for a certain time and documenting all birds seen or heard. Counts are usually carried out in the morning, usually during the breeding season, when birds are more noisy and territorial. Counts should also be conducted in suitable weather conditions, which usually means little wind and no rain.

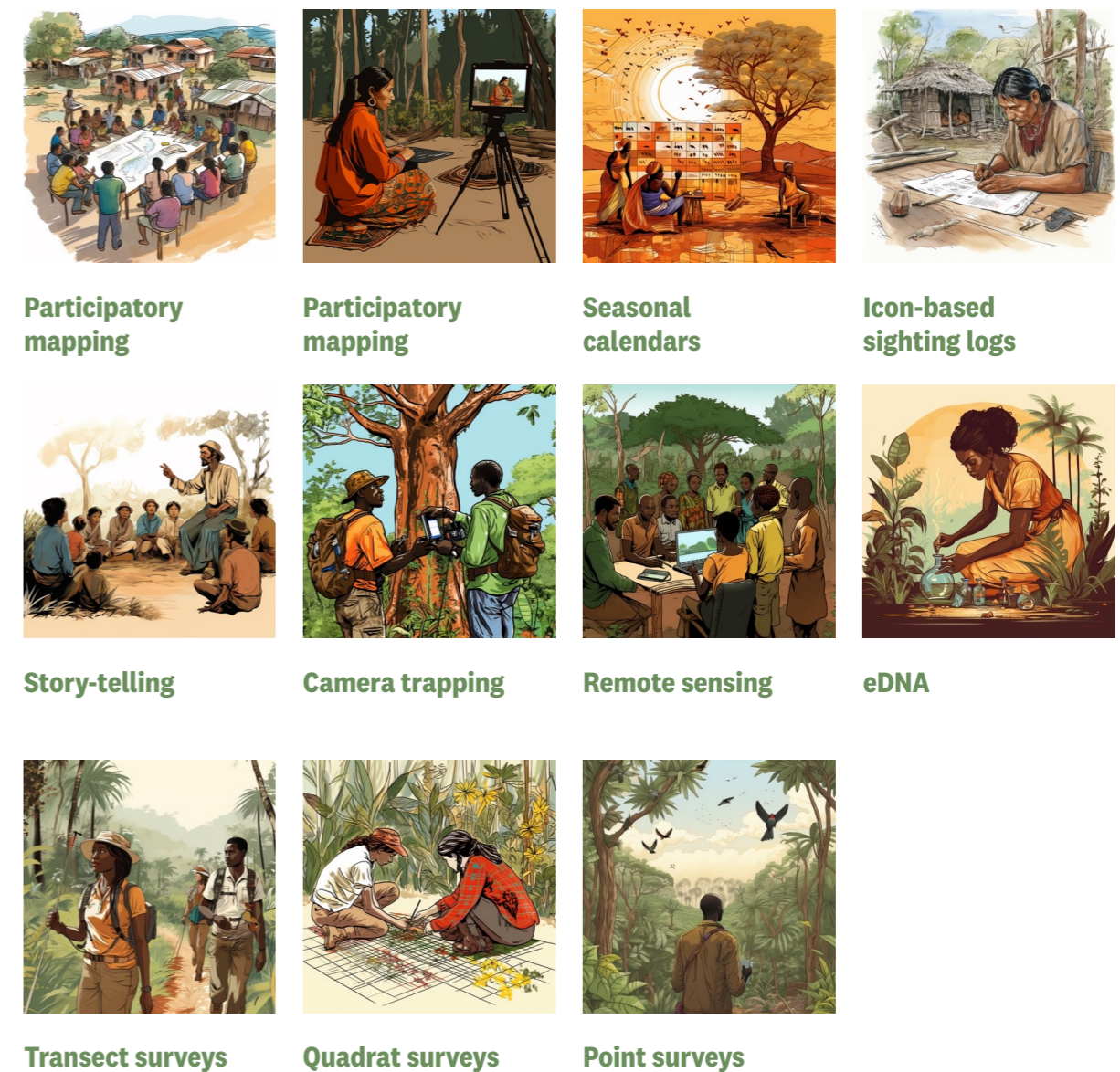
Camera traps are small cameras that are usually attached to a tree and are triggered by movement, photographing animals (usually medium to large-bodied) that pass in front of them. They are very useful for monitoring areas that people do not usually go to or find difficult to reach, and can be particularly useful for obtaining images of animals that tend to avoid people. Cameras can be placed in one or several grids at least 1-2 km apart, covering a gradient (e.g. from near to far from a village or protected area, or from high to low altitudes). Cameras can also be placed at strategic points where species are believed to reside, simply to gather evidence of their presence.

Unlike the previous methods, which lend themselves more to selective monitoring, the open search method is more applicable when conducting surveillance monitoring (see Box 9). Open searches consist of the monitor walking, or standing, at a central point for a pre-defined period of time (e.g. 20 minutes) and recording everything they see and hear. The monitor could also record the first 20 species observed in one column, and then start the list again in another column and record the next 20 species observed, continuing to create new lists until the 20 minutes are reached. This approach will give a pseudo-measure of abundance; common species will be in most lists, while rare species will be in one.

Finally, there are also a number of emerging methods that allow information about the environment to be extracted without physical contact from a great distance (known as remote sensing). These methods lend themselves to providing information on forest connectivity or forest cover, e.g. through GIS. Another promising method is the use of environmental DNA (or eDNA) to monitor population and biodiversity health. Environmental samples, such as water, sediment or air, are collected and the genetic remnants that organisms have shed into their environment are studied to obtain information on the presence of species.

See Tables 1a and 1b for summaries of some social and ecological monitoring approaches, including their financial and technical considerations. When choosing monitoring methods, bear in mind that different approaches can complement each other. For example, participatory mapping or icon based diaries can give an idea of what biodiversity is present and where, while camera traps can be used to estimate presence and relative abundance in more detail. That said, monitoring plans should be as simple as possible; start small and expand the scope of monitoring, if desired, over time as community monitoring activities are consolidated.

**Figure 2:** Illustrations of different participatory and ecological monitoring methods





## Q2. What indicators will the community use to measure changes in the features of biodiversity over time?

Once the community has determined the objective and suitable methods for monitoring, it can develop a set of indicators (Box 7). In simple terms, indicators tell you whether changes in the biodiversity features being monitored are occurring. For example, some indicators might be changes in the number of sightings of a species or local resource; changes in the perceived harvest volume of a resource over a given period; or changes in land use over a given period of time, such as agricultural encroachment over a year. See the appendix for a list of ecological indicators most commonly used in biodiversity monitoring. Note that this is a list of ecological indicators, so it does not include social and biocultural indicators, which a community may also want to take into account (see case studies 2 and 3 for some additional considerations).

### BOX 7: Use of indicators for biodiversity monitoring

For indicators to be useful, the number of indicators should be limited and well related to the monitoring objectives. They should be understandable and appropriate to the needs of those interpreting and using the data. They can be quantitative (e.g. changes in the availability of a non-timber forest product over time or in water quality), or they can be qualitative (e.g. perceived changes in the way people relate to particular biodiversity or places over time). A key consideration in finalising indicators is whether they are feasible given the financial and logistical resources available to the community and partner organisation.

## CASE STUDY 2:

# Moving from reactive planning to proactive development to conserve indigenous community values and biodiversity<sup>4</sup>

There is growing awareness of the need to balance multiple social values in land use and development planning. In northern Australia, indigenous people hold title to 60% of the land area and cultural values are closely linked to natural values. The researchers present a novel framework for integrating biodiversity and cultural values to facilitate their use in environmental impact assessment processes in the Nyikina Mangala native title determination area in the Kimberley, Western Australia.

The authors demonstrate 1) how social and cultural values can be spatially organised and analysed to support mitigation planning, 2) how social, cultural and biodiversity values can reinforce each other for better conservation outcomes and minimise conflict, and 3) how this information, in the hands of indigenous communities, provides capacity to proactively assess development proposals and negotiate mitigation measures to conserve social, cultural and biodiversity values following the mitigation hierarchy.

From the values defined through a Healthy Country Planning<sup>5</sup> process, communities and researchers developed spatial datasets to represent cultural/heritage sites, freshwater features, common native animals and plants represented by biophysical habitat types, and legally protected threatened and migratory species represented by potential habitat models.



Renita Bid (front) with younger generations of Ngarinyin people Janaya Nulgit and Kimberley Nulgit harvesting sap.

**Credit:** Annette Ruzicka

<sup>4</sup> Heiner, M et al. (2019) Moving from reactive to proactive development planning to conserve Indigenous community and biodiversity values. *Environmental Impact Assessment Review*. 74 pp 1-13. <https://doi.org/10.1016/j.eiar.2018.09.002>

<sup>5</sup> Healthy Country Planning (HCP) is an adaptation of the *Conservation Standards*, developed for use with Indigenous communities. <https://conservationstandards.org/library-item/healthy-country-planning/>



## CASE STUDY 3:

## An invader in our waters: actions of the Guna People (Panama) in relation to the Lionfish

The lionfish is a priority invasive alien species that was first recorded on the east coast of the United States in 1992, but has since spread up the coast to Mesoamerica. Although the lionfish was first recorded in the Guna yala region of Panama in 2009, it was not until early 2010 that communities became aware of the danger posed by the species. That year, several local fishermen and divers and three young children were stung by the fish and had to be transported from Gunayala to Panama City, due to a lack of local medication and knowledge of how to mitigate pain and injury.

To address the lack of information, the Guna initiated a project to investigate the potential impacts of lionfish on the natural dynamics of the communities and their culture. It is important for the Guna Yala indigenous communities to look for viable ways to manage lionfish that do not undermine their cultural, environmental and food systems, given their dependence on the sea and coral reef systems<sup>6</sup>.

One of the first objectives was to develop a participatory map of where the fish had been sighted. In addition, interviews were conducted with community members, lobstermen and fishermen, and a literature review was conducted to gather knowledge and information on lionfish.



Lion Fish. **Credit:** Adobe Stock - Tan Kian Khoon

<sup>6</sup> Forest Peoples Programme, *International Indigenous Forum on Biodiversity, Indigenous Women's Biodiversity Network, Centres of Distinction on Indigenous and Local Knowledge and Secretariat of the Convention on Biological Diversity (2020) Local Biodiversity Outlooks 2: The contributions of indigenous peoples and local communities to the implementation of the Strategic Plan for Biodiversity 2011-2020 and to renewing nature and cultures. A complement to the fifth edition of Global Biodiversity Outlook. Moreton-in-Marsh, England: Forest Peoples Programme. Available at: [www.localbiodiversityoutlooks.net](http://www.localbiodiversityoutlooks.net)*



An invader in our waters: actions of Guna People, Guna Yala village, Panama. **Credit:** Caroline de Jong, Forest Peoples Programme



**Table 1a:** Summary table of available participatory methods for monitoring biodiversity and threats, and possible trade-offs between accuracy, cost, time and expertise required. For all methods, cost and time depend on the intensity and duration of monitoring activities. The accuracy of the method depends on the ability of monitors to design and follow a robust monitoring protocol and correctly identify detected species.

| Method                              | Potential accuracy  | Cost   |  | Time required to collect data using these methods   | Technical and analytical skills  |
|-------------------------------------|---|--|--|---|--|
|                                     | <p><b>Medium:</b> The method may produce accurate data, but with a higher probability of misidentification of species, or with a lower level of detail than methods offering high accuracy.</p> <p><b>High:</b> If properly implemented, the method can produce detailed and reliable species population data that can be used to inform decision-making and feed into national reporting. Less chance of species misidentification or poor recall based on direct and present sightings.</p> | <p><b>\$</b> equipment and data analysis costs.</p> <p><b>\$\$</b> Some higher equipment or analysis costs, and/or longer data collection periods.</p> <p><b>\$\$\$</b> Monitoring and/or analysis costs and long data collection periods.</p> |  | <p><b>Low:</b> The time needed to carry out monitoring and the physical requirements are comparatively low.</p> <p><b>Medium:</b> Longer periods of time may be needed to carry out monitoring or more effort may be required for data collection.</p> <p><b>High:</b> Data collection is time-consuming and often takes place in physically difficult circumstances.</p> | <p><b>Low:</b> The method can be applied by people with little or no previous experience and with some direct guidance. Little experience in data analysis is required.</p> <p><b>Medium:</b> Some practical training is needed on how to use the equipment or how to manage or analyse the data, as well as knowledge of species identification.</p> <p><b>High:</b> More intensive training is needed for more complex equipment, survey design considerations and/or data collection/analysis approaches, as well as species identification skills.</p> |
| Participatory mapping               | <b>High</b>   | <b>\$\$</b>  |  | <b>Low</b>  | <b>Low</b>   |
| Participatory photography and video | <b>High</b>   | <b>\$</b>  |  | <b>Low</b>  | <b>Low</b>   |
| Diaries                             | <b>Medium-High</b>  | <b>\$</b>  |  | <b>Medium</b>   | <b>Medium</b>  |
| Community calendar                  | <b>Medium-High</b>  | <b>\$</b>  |  | <b>Low</b>  | <b>Low</b>   |
| Seasonal calendars                  | <b>High</b>   | <b>\$</b>  |  | <b>Low</b>  | <b>Low</b>   |
| Statements, stories and accounts    | <b>Medium-High</b>  | <b>\$</b>  |  | <b>Low</b>  | <b>Low</b>   |

**Table 1b:** Summary table of common monitoring methods available for monitoring biodiversity and threats, and possible trade-offs, ranging roughly from low to high technology. See Box 8 for definitions of technical terms related to monitoring (e.g. precision, accuracy and power to detect change).

| Method                      | Potential accuracy | Cost   | Time required to collect data using these methods | Technical and analytical skills |
|-----------------------------|--------------------|--------|---|---------------------------------|
| Quadrat Surveys             | High               | \$     | Medium  | Medium - High                   |
| Line transects              | High               | \$\$\$ | High  | High                            |
| Open search method          | Medium             | \$     | Medium  | Medium - High                   |
| One-off surveys             | Medium             | \$\$   | Medium  | Medium - High                   |
| Camera trap                 | High               | \$\$\$ | Medium-High                                       | Medium - High                   |
| Remote surveillance methods | High               | \$\$\$ | Under   | High                            |
| eDNA                        | High               | \$\$\$ | High  | High                            |

### STAGE 3B: Define the survey design and account for biases

By now, the community should know what biodiversity to monitor, why, at what scale and over what timeframe (STAGE 2), and have identified the most appropriate method(s) for data collection to achieve its monitoring objectives (STAGE 3A), while taking into account the financial and human resources available (STAGE 1).

In STAGE 3B, it is time to determine how to design the monitoring across the landscape and reflect again on the proposed design in light of the previous stages to ensure that the community can collect informative data within the constraints of their budget. Below are six key questions you can ask the community monitoring team to help the community develop their monitoring plan.

#### Q1. How much and how often is monitoring necessary to obtain robust data?

The effort that the community puts into monitoring activities (e.g. how many people monitor, in what area and how often) will influence the precision and accuracy of the monitoring data obtained and the ability (e.g., power) of those data to detect changes that the community wishes to monitor, such as changes in species richness or occupancy (see Box 8). Obtaining data that show a change in populations over time will require a long-term effort, even if not much time is needed for each monitoring activity each time the community carries it out.

If the community needs to undertake specific biodiversity monitoring, the likely rate of change in biodiversity or threats to biodiversity and the speed with which you want to detect these changes are key considerations in deciding the frequency and duration of monitoring activities. At this stage, work with the community to determine a sustainable level of effort that communities are willing and able to devote to monitoring, and discuss the implications this may have for their desired objectives. A basic principle of survey design is to conduct surveys as infrequently as possible and as often as necessary to obtain the data required to meet monitoring objectives.

Another consideration is that it may not always be necessary to carry out targeted monitoring of specific biodiversity features, particularly if time and community resources are scarce, or if the objective of monitoring is simply to demonstrate what biodiversity is present on community lands in general. In such cases, surveillance monitoring may be an appropriate and sensible option (see Box 9).



### BOX 8: Precision, accuracy and power

For monitoring to be useful, the data it produces must be accurate and precise:

- Precision refers to the consistency of the measurements; in other words, if you make the measurement several times, do you get the same result?
- Accuracy refers to how close the result is to the truth.

Another aspect to consider is the *ability* of the monitoring data to detect changes over time. For example, is the dataset powerful enough to show whether a duiker population is increasing or decreasing? This depends on the amount of data collected, as well as its precision and accuracy. In cases where it is unlikely to be powerful enough to detect changes over time, it may be better to focus on surveillance monitoring, which simply reports on the biodiversity occupying the territory at the time (Box 9).

Another consideration is that it may not always be necessary to carry out targeted monitoring of specific biodiversity features, particularly if time and community resources are scarce, or if the objective of monitoring is simply to demonstrate what biodiversity is present on community lands in general. In such cases, surveillance monitoring may be an appropriate and sensible option (see Box 9).

### BOX 9: Targeted and surveillance monitoring

Conservationists often use targeted monitoring, i.e. monitoring biodiversity to answer a specific question. However, surveillance monitoring differs from targeted monitoring in that it is not linked to a specific question, but serves to check the status of biodiversity in a given territory and to alert to changes, so that you are aware of problems that may arise that you have not taken into account beforehand. Having key monitors in the community who regularly carry out surveillance monitoring can serve as a good basis for targeted monitoring for particular purposes at a later stage.

#### Vignette:

***The Alat community wanted to monitor the total number of elephants on their land throughout the year, and for this they decided to use a combination of camera traps and line transects. However, when they started collecting data for this, they realised that for the data to be sufficient for the kind of results they wanted, they would have to do a lot of monitoring throughout the year and across the landscape, for which the community had neither the time nor the resources. They therefore decided to supplement their camera traps with repeated open searches throughout the year, and limited themselves to recording the presence or absence of elephants on each walk. Focusing on surveillance monitoring and using simpler analytics initially allowed them to build their team and partnerships, and to do something more ambitious later on.***

#### Q2. In which seasons do you have to monitor?

Habitats may change throughout the seasons, making it easier or more difficult to locate the species that the community wishes to monitor. In addition, the presence or distribution of species may change from season to season. So should monitoring be carried out during the same season each year, or should it be carried out in two different seasons each year to study the differences between the data from one season and another?

The answer to this question depends on the approach and objectives of the monitoring; it is possible that external agents enter the area and hunt or fell trees at certain times of the year, which may require monitoring only during part of the year, whereas exploring how encroachment, logging or external hunting changes seasonally would require monitoring efforts at various times throughout the year.

#### Q3. Where do you need to monitor?

Monitoring may not be necessary throughout the whole territory. For example, to demonstrate that a species is present, or to record agricultural encroachment, monitoring may only be necessary at waterholes, or at the boundaries of the territory. In contrast, comparing species diversity between the community's territory and an adjacent national park, for example, may require more extensive monitoring to ensure that different habitats are represented in such an effort.

#### Q4. Is there room for flexibility?

Unforeseen ecological events (e.g. droughts or fires) or changes in social pressures (e.g. conflicts or changes in neighbouring or local land uses) can affect the biodiversity that communities are monitoring. Ideally, monitoring programmes should be flexible enough to cope with these unforeseen events, record them and, if necessary, increase the frequency of monitoring. Surveillance monitoring that is not tied to a specific target is particularly useful in providing such flexibility in the face of unforeseen events. Follow-up monitoring in conjunction with monitoring of specific targets is often a good way forward.

#### Q5. Have you considered potential sources of bias in the survey design?

Biased monitoring data are not only inaccurate, but are systematically skewed in a certain direction. For example, they may be systematically too high or too low. Biased monitoring data can result in inaccurate estimates that do not reflect reality. All monitoring methods are subject to biases, which typically include observer bias (e.g. factors affecting a person's ability to accurately detect and record biodiversity, such as their level of experience), biophysical bias (e.g. seasonality and variation in biodiversity), and biophysical bias (e.g. seasonality and variation in biodiversity), seasonality and variation in the abundance or distribution of biodiversity) and bias induced by survey design (e.g. double counting of detections, or assigning more monitors to a particular area, resulting in more sightings from that area compared to others).

For biodiversity monitoring results to be meaningful, monitoring teams must try to reduce these sources of bias through good survey design. Failure to do so can lead to two main problems: 1) thinking that animals are declining, when they are not, or 2) believing that the population is stable, when in fact it is declining.

To account for bias, differences in the ability of individuals to detect biodiversity or the ease of detecting biodiversity in different habitats in the landscape (e.g. it is easier to detect animals in plains than in dense forests), or between different seasons, times of day or weather conditions can be considered.

#### Q6. Has the community planned the analysis?

Having determined the methods, indicators and survey design, and considered how to take into account potential biases that may affect the quality of the data, it is important for the community to reflect on what the data will look like once collected, and whether the type of data and the format in which it will be collected will allow them, or their partners if they wish, to carry out the analysis.

If neither the community nor its partners are able to analyse the data in a way that meets their monitoring objectives, it is time to review the monitoring plan. For example, is it too difficult to collect data on the biodiversity feature being monitored or the change the community wishes to monitor, or is the interpretation of the type of data produced beyond the expertise of the community or your organisation? If the latter, consider what additional partners may be needed to assist with this analysis, and ensure that consent is obtained from the whole community before bringing them in to assist at this stage. Alternatively, consider whether changing the biodiversity feature, the type of change to be monitored or the indicator will result in data that can be more easily analysed, while still achieving the monitoring objectives.

#### Vignette:

*Having conducted forest walks and simple analyses, the Alat community is ready for more comprehensive monitoring, and now they want to add monitoring of the duiker population in their forest. They walk through the forest in groups and count the number of animals they see. However, as they only go on a few walks a year and use their usual forest trails, they very rarely see a duiker. In addition, one of the groups has more experienced monitors and usually sees more duikers than the other groups. The monitoring teams review their data and monitoring plan, and suspect that observer bias (e.g. one team has more experienced monitors than the others) and study design bias (e.g. they are only studying well-used forest trails close to home) may be affecting the data. Thus, the monitoring teams distribute the more experienced monitors among the teams, so that each team has someone with more experience. They also plot a series of transects covering a gradient starting 1 km from the village and moving towards less used areas of the forest, and increase the number of trails throughout the year.*



#### Stage 3 Checklist

1. **Has the community determined which method(s) are most appropriate for its monitoring objectives?** Has the community reflected on the best methods in light of the community's monitoring needs and financial/human resource constraints?
2. **Has the community decided which indicators they will use to monitor changes in biodiversity over time?** Are the indicators clearly linked to the biodiversity feature and the changes they wish to track over time? Will the selected indicators provide relevant and useful information for data users? Are the selected indicators feasible given the financial and logistical resources available to the community and partner organisation?
3. **Have the monitoring teams agreed on the survey design and monitoring strategy?** Where, by whom, how often and when?
4. **Has the community considered potential monitoring biases,** has it refined its strategy as far as possible to limit these biases, and has it considered whether it will have the capacity to detect changes in biodiversity?
5. **Does the proposed monitoring plan allow for flexibility in case of unforeseen events?** A good way to achieve this is to combine surveillance monitoring with specific monitoring of priority biodiversity.
6. **Has the community planned for analysis?** The community needs to design to analyse: make sure that the data will be analysable to produce robust answers to the questions they want to address, and that your organisation's staff or partners have the skills to support the community in analysing that data, if needed.

If yes, proceed to the next step. If no, complete these steps or, if necessary, go back to the previous steps to reflect more deeply on your budget and human resources, on the purpose of monitoring, and on how the information collected can be used more usefully to achieve the community's objectives.





The Akha leaders from Ban Mae Chan Tai are exploring biodiversity in the community forest. (Mae Chai Tai is Akha community in Chiang Rai province.) **Credit:** IMPECT, Thailand

## Stage 4: Preparing the monitoring team - training and capacity building

In the previous stages, the community considered what biodiversity it wanted to monitor and why (STAGE 2), and selected appropriate methods, indicators and survey designs to collect the data needed to meet its monitoring objectives (STAGE 3).

In STAGE 4, you may need to provide training and capacity building focused on how to carry out the desired monitoring. Capacity building for community monitoring can really motivate community members and broaden their support. It is essential that capacity building, where necessary, is a central element of the planning, development and implementation of the monitoring programme.

**Q1. Have you delivered or arranged for theoretical and practical training in data monitoring and management, where needed?**

Training can be divided into theoretical and practical sessions, which may include individual training on the use of the tools, so that monitoring teams can practice using the equipment, if appropriate. The duration of training will depend on the needs of the community and the individual teams, but should cover the following:

### Relevant for the whole community and monitoring teams:

- **Recap of the objectives of biodiversity monitoring:** What is monitored and why?
- **Monitoring methods:** An overview for the community and those monitoring the process; how to use and deploy the equipment for those who will actually do the monitoring?

### Relevant for monitoring teams in particular:

- **A recap on survey design:** What areas are surveyed, how, when and how often, and by whom?
- **How to complete data entry:** From standardised data collection forms filled in with paper and pen to GPS data via online platforms such as Mapeo or Sapelli, to participatory approaches such as mapping and storytelling.
- **How the data will be managed:** Where and how the data will be stored, including backups, and who will have access. The community person(s) designated to oversee data collection (STAGE 1) will oversee the secure storage and entry of community data, and may require additional training in data management and analysis methods.



- **A wrap-up on analysis:** the approaches that can be used, the types of results that can be obtained, and who will be responsible for analysis in the short, medium and long term. For example, you might plan to support the community to undertake more data analysis over the course of the project, and identify key people to work with in the early stages of the project. For more information on analysis, see STAGE 5.
- **Establish a schedule of regular meetings between you and the community:** Review the initial communication processes developed in STAGE 1 and finalise the plan for regular meetings and data sharing over the next few months to ensure that any problems are identified and addressed quickly.



Here, the latex is being collected from the tree bark of the Indian rubber tree (*Ficus elastica*) in a private rubber plantation in the heart of the Western Ghat forests. This process of collecting latex is called rubber tapping. Photo taken in the Uttara Kannada district of Karnataka. **Credit:** Apoorva Kulkarni, Interdisciplinary Centre for Conservation Science/ICCS

### Stage 4 checklist

1. **Is the community well aware of the monitoring methods available to them?**  
Do community monitoring teams have good knowledge and practical skills in the monitoring methods they will use?
2. **Are the design and focus of the survey clear to the community, and** do they agree on who will do the monitoring, when, where, how often and with what methods?
3. **Does the community have the necessary skills for data collection?** Has the community monitoring team demonstrated that it knows how to enter, store or catalogue data?
4. **Has the community determined how the data will be managed,** in what format the data will be entered and stored, and by whom?
5. **Does the community have the necessary skills for data analysis?** Is the data to be collected straightforward and clearly linked to the monitoring objectives set? Can you or your partners support data analysis in the short term and build community capacity over time, when needed?
6. **Are learning and adaptation opportunities scheduled with the community?** Are there clear lines of contact with the community in case of problems between meetings?







Women carrying out a bean counting exercise to quantify their attitudes toward different wildlife species that they interact with. Photo taken close to Kasungu National Park, Malawi. **Credit:** Lessah Mandoloma, Interdisciplinary Centre for Conservation Science/ICCS.

## Stage 5: Data collection and analysis

At this stage, the community monitoring teams are already trained and prepared for monitoring (STAGE 4). It is now time to start collecting data. During this process, you should continue to support community leaders and be available to provide additional training to build capacity, especially in the first few months of monitoring when the processes and equipment used are fairly new.

The need for further assistance can be identified through the data checking process, an important step before proceeding to data analysis and the production of results.

### Q1. Data checking

Monitoring teams should work together to double-check the data collected as soon as possible after data collection, when observations are still fresh. It is also useful to keep a record of any events that occurred during data collection, any problems that may have affected the results or the quality of the data, and any decisions made during data cleaning, such as removing duplicates, for example.

#### **Vignette:**

*The Alat community has carried out its first round of camera traps, forest walks and forest transects. They have met to reflect on the monitoring process so far and to check the data. Data from the camera traps have been downloaded and saved on memory cards ready for analysis. The teams conducting the forest walks and line transects now meet to review the data sheets and check whether all the required information has been completed (e.g. the person collecting the data, the data, the area in which it was collected and the species detected). The teams then discuss whether any of the data collected seems out of place. Are there species documented that are not known to be resident in the area? Is there any possibility that double counting of species has occurred and, if so, which entry should be deleted?*

*This process is useful for the community to take a closer look at the data and identify any problems that need to be addressed before monitoring continues. For example, certain data collectors may need more training support as they have more errors or uncertainty about the monitoring and data entry process than others. Individuals should have a long-term monitoring structure in place to identify any need for ongoing support and to maintain motivation, although the latter is less of an issue for community monitoring than for external monitoring initiatives.*



At this stage, the person or group of people managing the data could coordinate the sharing of results within the community, and with any external actors, as identified in STAGE 2. There should be consistent communication between monitoring to keep track of monitoring activities on the ground and quickly identify data failures or repetitions.

## Q2. Data analysis

Data analysis is a process of inspecting, cleaning, transforming and modelling data with the aim of uncovering useful information and informing conclusions. In biodiversity monitoring, data analysis helps to obtain information on the changes in biodiversity that the community intended to monitor. It can lead to maps showing the distribution of biodiversity in the landscape or changes in land cover. It can provide information on the preference of species for certain habitats or areas over others, and allow, for example, the overlaying of different land management plans with species monitoring data. It is important that the data are provided in a format that allows monitoring teams and/or their partners to carry out analyses. Analysis of the data provides the information necessary for the community to help plan and manage the biodiversity of their land.

### Vignette:

*Once the data has been checked for duplicates and possible errors, and additional training has been provided to the monitoring team in the early stages of data collection, the Alat community has now collected its first round of data and is ready for analysis. Some questions that the community may ask itself when analysing the data include the following:*

*Which species were photographed by camera traps the most and least frequently? Which species were captured by many cameras and which by few? Are there species that are only photographed in forests or clearings? If camera traps are set several times a year, how do the answers to the above questions change over time?*

*The community may also ask questions of the field diary data, such as whether there have been any changes in the habitat quality or land use, and whether there are any apparent changes in the distribution or frequency of detection of species or their threats.*

*Finally, has the transects or forest walk data indicated any changes in the encounter rates of species, their distribution or changes in resource use or other possible threats?*

In the short term, the monitoring methods selected by communities are likely to influence the degree to which communities can lead the analysis and creation of results. If ownership of the process of data analysis and interpretation of results is really important in the short term, this should influence the monitoring approach (e.g. targeted or surveillance) and methods (e.g. high-tech or low-tech) that are selected in STAGE 3.

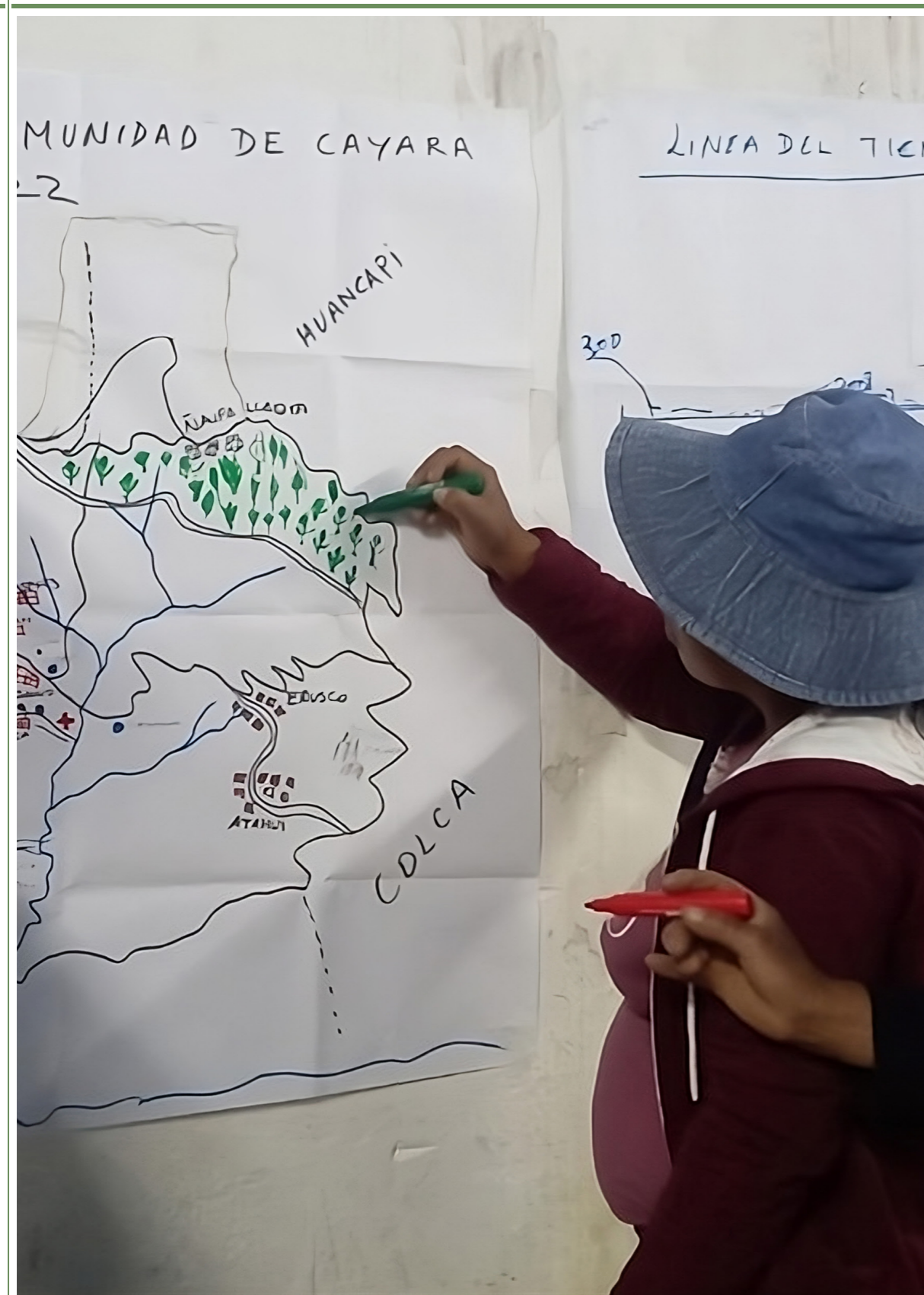


## Stage 5 Checklist

Have you held a debriefing meeting with the monitoring teams in the initial data collection period to check the following?

1. **Discuss and resolve any initial problems with data collection and data entry:** Are data being collected and collated as planned? Are those responsible for collecting and collating data clear about their roles and responsibilities? Is additional help needed?
2. **Create and review some preliminary results: Is the process of creating results from the data as smooth as it could be?** What changes to the data format might make it easier to create results in the future? Do the results created help to meet monitoring objectives and make sense to monitoring teams?





CHIRAPAQ mapping Cayara, Peru. Credit: CHIRAPAQ

## Stage 6: Community information and sharing of results

**Congratulations on reaching the final stage of this guide! The community will have started the monitoring process and will have checked and analysed the data at least up to the preliminary results stage (STAGE 5). Now is the time to communicate these results to the whole community and to think about how to achieve the greatest possible impact as monitoring progresses, if appropriate. This is also the stage where the community can begin to discuss the implications of the results for ongoing natural resource management.**

Remember that there are a wide range of reasons for monitoring, some of which will be internally focused to help communities manage their own resources for their own purposes, and some more externally focused to enable communities to demonstrate biodiversity trends in their areas to government, for example. How the reports are produced will depend on the community's reasons for monitoring.

### Q1. Community reporting

At this stage, you could offer to work with the community and organise a meeting with the monitoring teams and the whole community to discuss the following:

- **How the monitoring has gone or is going:** Review the initial objectives of the monitoring. What were the intended objectives of the monitoring? Are the data collected contributing to the achievement of these objectives? If not, what changes should be made to the monitoring programme?
- **What do the results say about the state of biodiversity and the environment in general?** Are there any results that stand out as particularly surprising, or some that are meaningless and need more data to fully understand the situation?
- **Reflect and review:** In the light of the results, what, if anything, should be done differently to better achieve the monitoring objectives? Does any other member of the community now wish to participate?
- **Review stakeholder involvement:** Having seen the results, are there other stakeholders that the community would like to engage now, or inform of the preliminary results at this stage, and if so, how best to present these results to them? (See sharing results below).
- **Adaptive management for sustainable use:** What measures, if any, are needed to ensure that the use of natural resources and the environment is sustainable in the long term?

See our separate guidance document on customary sustainable use and adaptive management by communities for more detailed guidance:

<https://transformativepathways.net/news/>

## Q2. Sharing results

Another key issue to discuss with the monitoring teams and the wider community is how the results should be used and shared, and how to have a wider impact. This links to STAGE 1, where communities considered what they want from their monitoring, and to STAGE 2, where they considered who will be the end user of the results.

In some cases, the results may be intended for use at the community level. Sharing results within and between indigenous and local communities may involve less formal, and more playful approaches, including

- **Storytelling and oral tradition:** Elders and community members pass down traditional knowledge, ecological practices, and cultural values through spoken narratives, songs, and chants.
- **Community meetings and gatherings:** Gatherings where knowledge and expertise are shared openly among community members. These gatherings provide a platform for discussion and exchange of ideas.
- **Reviewing of participatory mapping:** This helps to embed understanding, conserve biodiversity and protecting their cultural heritage.
- **Community-based education:** Indigenous communities have community-based education systems where traditional knowledge and skills are taught to the younger generation. Elders and community members serve as teachers and mentors.
- **Cultural festivals and events:** provide opportunities for indigenous communities to communicate their work within and between their communities, and showcase their knowledge to the wider public if desired.
- **Craftmanship and arts:** Embedding their work on community-based monitoring into their traditional crafts, such as pottery, weaving, and carving, which reflect their cultural identity and connection to nature.
- **Community learning exchanges:** whereby indigenous communities participate in knowledge exchange programmes with neighbouring communities or external partners to foster cross-cultural learning and sharing of best practices.
- **Visual technologies:** whereby indigenous communities share knowledge and experiences through participatory photography or video.

However, in other cases, the results are intended to have a wider impact and influence decision-makers at local, national or international level. There are many different ways in which the results of community biodiversity monitoring can be used to achieve this wider impact, so it is important that the results are presented in the right way for different audiences.

1. **Peer-reviewed scientific articles:** The community may be interested in sharing results with an international scientific audience. Co-authoring articles with collaborators can be time-consuming, but going through the peer-review process can add seriousness to the results. Conversely, journals are increasingly seeking to highlight the experiences of indigenous peoples in recognition of the crucial role they play in conservation and the need for rights-based approaches to conservation, such as a recently published and open access special issue on conservation and human rights co-authored by indigenous peoples<sup>7</sup>.
2. **Feeding into national and global monitoring frameworks:** Local monitoring data is relevant and should be taken into account in national and international reporting, in National Biodiversity Strategy Action Plans (NBSAPs) and through independent and complementary processes such as Local Biodiversity Outlooks<sup>8</sup> and the Indigenous Navigator<sup>9</sup>. One practical step could be to contact the national government focal points for the Convention on Biological Diversity to find out about your country's National Biodiversity Strategy and Action Plan (NBSAP) and to participate in the NBSAP process. Alternatively, visit the website of the International Indigenous Forum on Biodiversity<sup>10</sup> and the Indigenous Navigator to learn about indigenous peoples' processes and initiatives on community-based monitoring and information systems.
3. **Presentations at conferences, meetings and dialogues:** You can help organise communities to present their most important results to decision-makers. The way in which the community shows the results is very important. In this case, it is best to use graphs and figures to show the results, accompanied by a clear explanation of what the figures say and the implications of these results.
4. **Online platforms and media:** Some indigenous communities use digital platforms, websites, social media, and radio programmes to share their knowledge and advocate for their rights.

<sup>7</sup> Special issue on Human Rights & Conservation (2023). *Oryx*, 57:3, pp288-378. <https://www.cambridge.org/core/journals/oryx/issue/2C7954E5544A36301B4E0FABF9721361>

<sup>8</sup> Local Biodiversity Outlooks: <https://localbiodiversityoutlooks.net>

<sup>9</sup> Indigenous Navigator: <https://indigenousnavigator.org>

<sup>10</sup> International Indigenous Forum on Biodiversity: <https://iifb-indigenous.org>



## CASE STUDY 4:

## Examples of community-led and community-supported data analysis at Mount Elgon, Kenya.

Ongoing collaboration between the Forest Peoples Programme (FPP) and the Ogiek indigenous peoples of Mount Elgon has resulted in examples of both autonomous and externally supported data analysis and output creation. For example, the Ogiek have autonomously collected and tagged community mapping data, and designed GPS points on a base map to create thematic layouts of historical sites, forest encroachment and culturally significant places for use in legal and advocacy work. Meanwhile, FPP has also worked together with the Ogiek to develop maps to visualise community priorities, such as land-use zoning, the status of school funding within and adjacent to Ogiek territory, and hearings on historical injustices<sup>11</sup>.



Mount Elgon, Kenya. **Credit:** Stephanie Brittain, Interdisciplinary Centre for Conservation Science.

### Stage 6 Checklist

- **Discuss progress:** Have you met with the monitoring team and the wider community to review the original monitoring objectives and discuss progress?
- **Examine and discuss the results:** Has the whole community had the opportunity to see and discuss the results?
- **Integrate feedback:** Have you made space for the views of the monitoring team and the community, and have you established a way to integrate them into the monitoring plan?
- **Adaptive management for sustainable use:** If relevant, have you consulted our separate guidance on customary sustainable use and adaptive management, and begun to discuss what actions may be needed to ensure more sustainable use of biodiversity, or next steps for monitoring priority biodiversity?
- **Sharing the results:** Have you reflected on what the intended purpose of the monitoring is (STAGE 1), who are the intended end-users of the results (STAGE 2) and decided how best to use and share the results to achieve this?



<sup>11</sup> Kenrick, J., Rowley, T., & Kitelo, P. (2023). "We are our land"—Ogiek of Mount Elgon, Kenya: Securing community tenure as the key enabling condition for sustaining community lands. *Oryx*, 57(3), 298-312. doi:10.1017/S003060532300008X

# Appendix

## Appendix 1: Examples of ecological metrics commonly used to monitor biodiversity and its threats.

| Indicator   | Definition   |
|---|--|
| <b>Occupancy</b>  | The proportion of places occupied by a species or natural resources in a given location.   |
| <b>Density</b>  | The number of individuals of a given species occurring at a defined location.  |
| <b>Wealth</b>   | Number of species at a given location  |
| <b>Diversity</b>  | The number of species in a community and a measure of the abundance of each species.   |
| <b>Relative abundance</b>   | A measure of the frequency or rarity of a species relative to other species at a given location.   |
| <b>Total (absolute) abundance</b>   | Total number of individuals per species at a given location.   |
| <b>Forest cover/connectivity</b>  | The amount of forest covering a given area of land.  |
| <b>Degree of fragmentation</b>  | The degree of forest fragmentation of large contiguous forest areas into smaller patches of forest.  |
| <b>Land use change</b>  | The conversion of human use of an area of land from one state to another.  |
| <b>Changes in environmentally damaging activities</b>   | A change in the pace of activities that lead to losses in biodiversity, both within and outside the community. This may be logging, hunting or resource gathering. |
| <b>Perceived changes in the distribution or observability of natural resources</b>  | A change in the perceived abundance and ease of finding natural resources may be an indicator of resource decline.   |
| <p>The broader bounties of nature should be identified by the community, but may include High Conservation Values around community needs (e.g. sites or resources important for local livelihoods, health, nutrition, water) or cultural values (e.g. for cultural, religious, traditional or historical purposes).</p> |  |





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