The monitoring global guideline framework for biodiversity monitoring

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Key Concepts of Today's Talk

Overview of the UNESCO Chair BioMONITec Project

WP3: Monitoring Global Guideline

UNESCO Chair on Sustainable Management of Conservation Areas, CUAS – 2020-2024

Mission

"Empower and enable personalities, institutions and societies to face present and future challenges in the management of conservation areas"

More than 900 Chairs and UniTwin partners

- Contribute to the agenda of mankind
- Thinktanks and bridgebuilders between academia, civil society, local communities, research and policy-making

Test sites

- 738 UNESCO Biosphere Reserves
- 1,155 UNESCO World Heritage sites
- 177 UNESCO Global Geoparks
- 271,000 Protected Areas worldwide

UNESCO Chair
BioMONITec Project – 2021-2024

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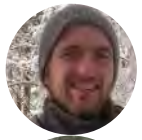

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Project Goals

- Comparison of traditional and modern / new biodiversity monitoring techniques
- Implementation of workflows in nature conservation
- Standardisation of monitoring methods

Key Work Packages

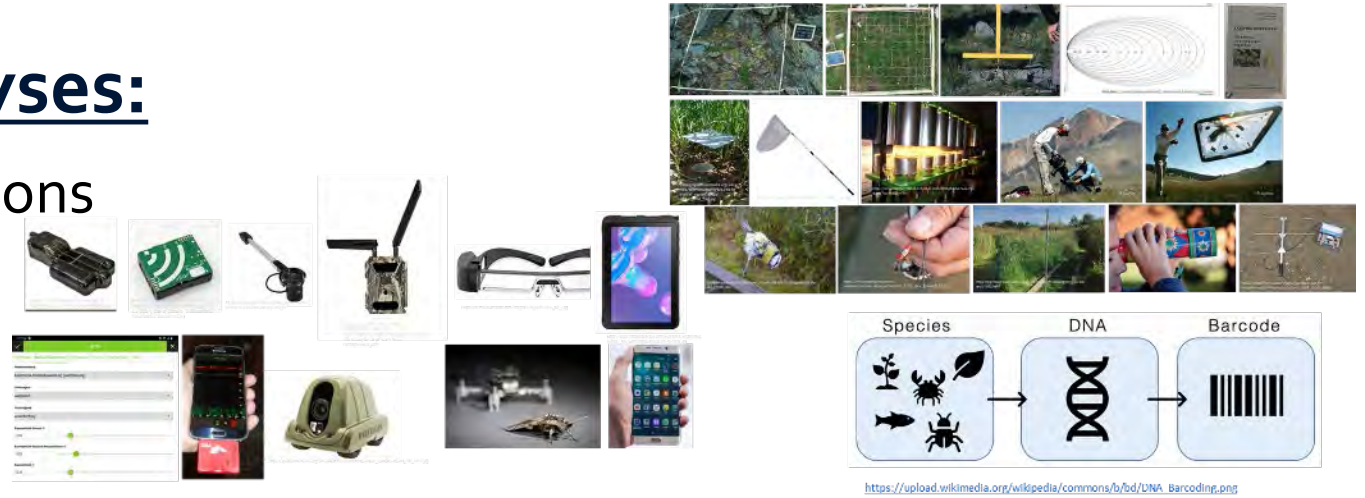
- Ecofaunistic / ecofloristic analyses
- MoniConfig – online monitoring configurator
- MoniGloG – Monitoring Global Guideline

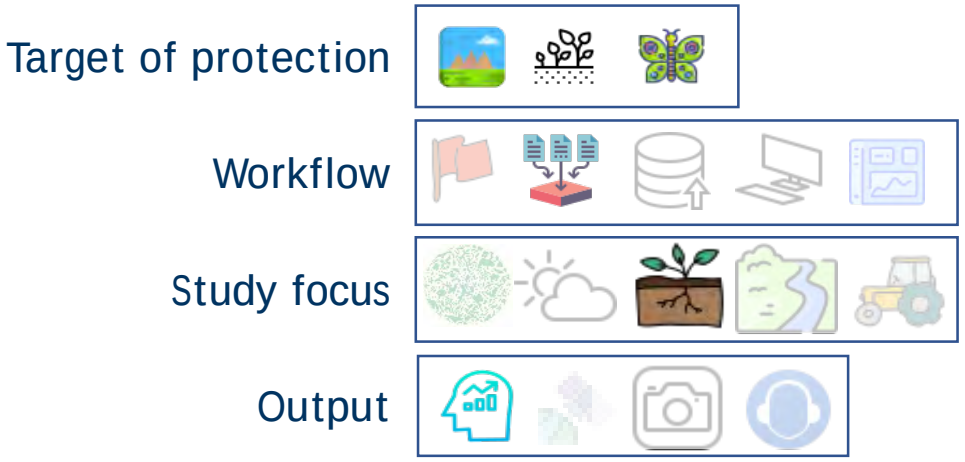
BioMONITec Work Flows and MoniConfig

Ecofaunistic / Ecofloristic Analyses:

Use of complementary tools in Pilot Actions

- Sensors and devices
- Traditional methodologies
- Genetic techniques





MoniConfig:

- Collection of traditional and new methods and tools for biodiversity monitoring
- Online catalogue of tools
- Decision support for quality planning of the biodiversity monitoring system (BMSys)

Monitoring Global Guideline

To be published in:
IUCN WCPA Technical Series

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International standards and recommendations for monitoring
Provide uniform framework for decision-making and a common understanding and terminology (terrestrial and freshwater habitats)

Justification for Guideline

1. A biodiversity monitoring system (BMSys) must be:
   - reliable, reproducible, and standardised;
   - reflect the current state;
   - comparable (harmonised data sets);
   - applicable to different problems;
   - usable in different geographical regions and on different spatial scales
   - applicable to different groups of living organisms
2. We observe a deficit in:
   - conception and methodologies used in BMSys;
   - selection of objects to be monitored – some indicators have low informative value
3. MoniGloG aims to fulfil requirements while correcting the deficits

Considering:

- indicators

- collaboration

- data generation

- communication

- terrestrial habitats

Considerations for Monitoring

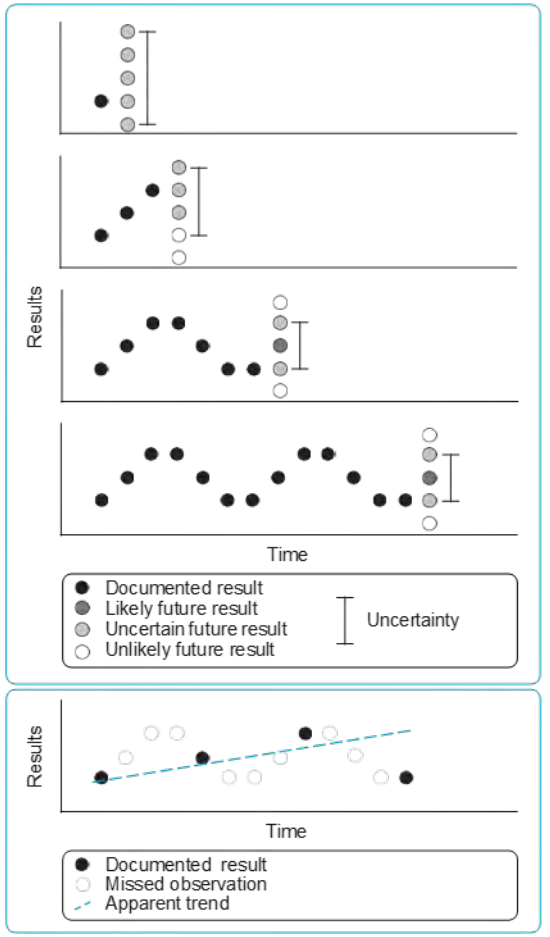
1. Integration with local communities
2. Detecting trends and correlations: the value of time series
3. Continuity risks: avoiding disruptions and gaps in data
4. Setting up monitoring systems: costs and outcomes
5. Art of omission: daring to simplify
6. Obligations: international conventions and policies
7. Dashboard controls: site-level monitoring for management purposes
8. Protected Area management effectiveness evaluation tools
9. Typologies of monitoring: not all monitoring is the same
10. BMSys: designing modular, multi-scale, and multi-purpose monitoring systems

Considerations for Monitoring

Value of Time Series to detect trends and Avoiding Gaps in Data

Trends become clear only after many data points have been acquired.

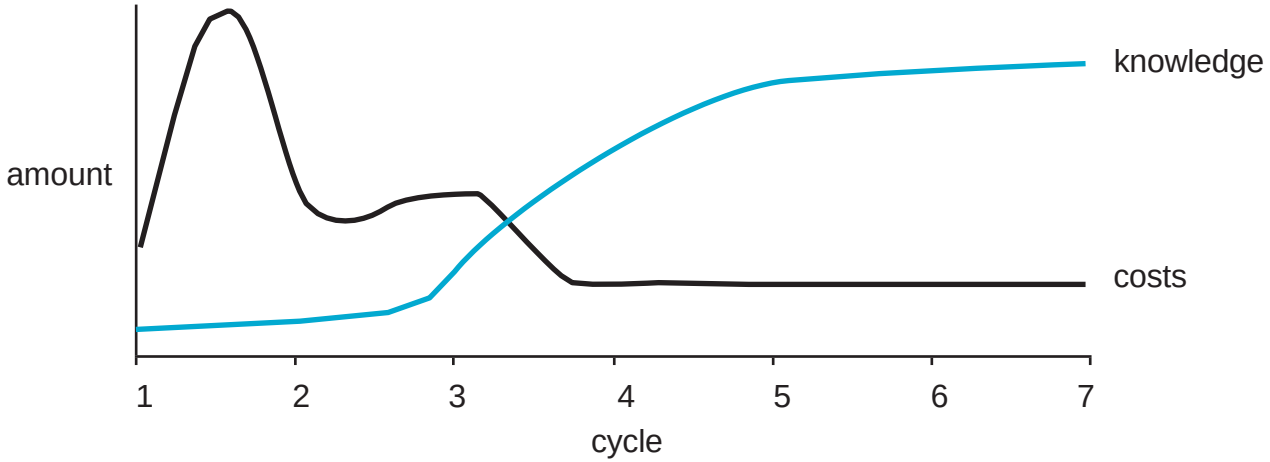
Sampling at the wrong frequency leads to faulty conclusions.



Costs vs. knowledge gain

High up-front costs; high late-stage knowledge

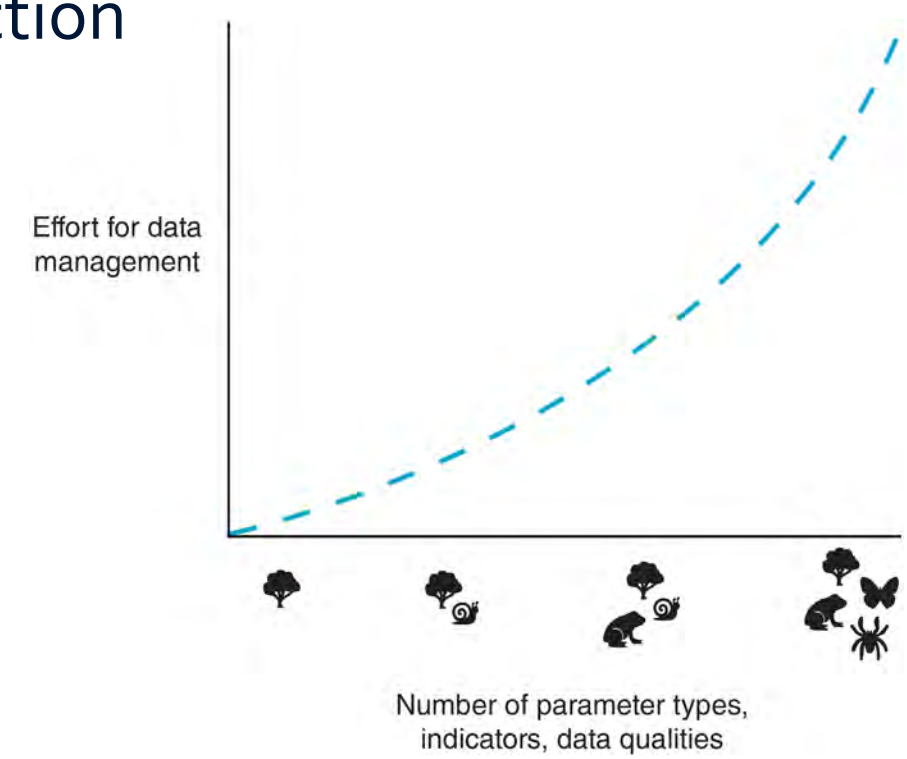
Long-term commitment is necessary for monitoring to pay off.



Considerations for Monitoring

Art of Omission: simplifying indicator selection

Greater numbers of indicators and methods make data management exponentially more challenging.

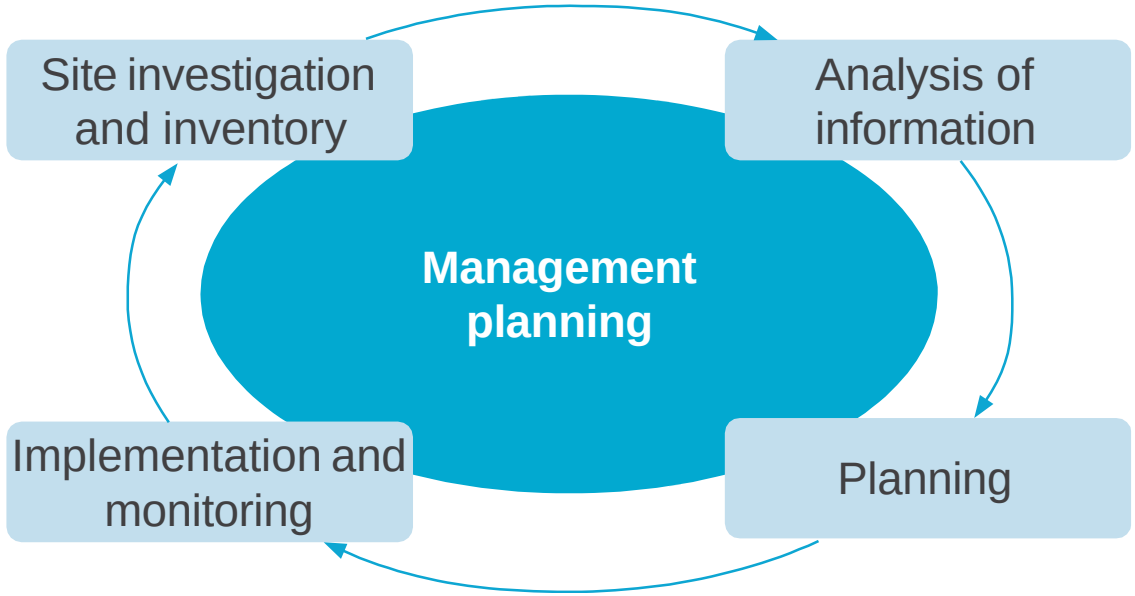


Biodiversity monitoring obligations

International and regional legal obligations, site-specific goals.

Effective Date	Name of Convention / Protocol / Programme	Interval and Type of Reporting
1975	Ramsar Convention on Wetlands	Every 3 years: National reports to Conference of the Parties
1975	World Heritage Convention	Every 6 years: Report on site integrity to World Heritage Centre
1979	EU Birds Directive	Every 6 years: Report on population size and trends of bird species
1983	Convention on Conservation of Migratory Species	Every 3 years: National progress reports on implementation
1992	EU Habitats Directive	Every 6 years: Conservation status and trends of species and habitats
1993	Convention on Biological Diversity	Every 4 years: National reports to CBD
1995	Man and the Biosphere Programme	Every 10 years (5-year interim reports): Site- specific evaluation report to MaB Programme
2016	UNESCO Global Geoparks	Every 4 years: Site-specific revalidation report to UNESCO Global Geoparks

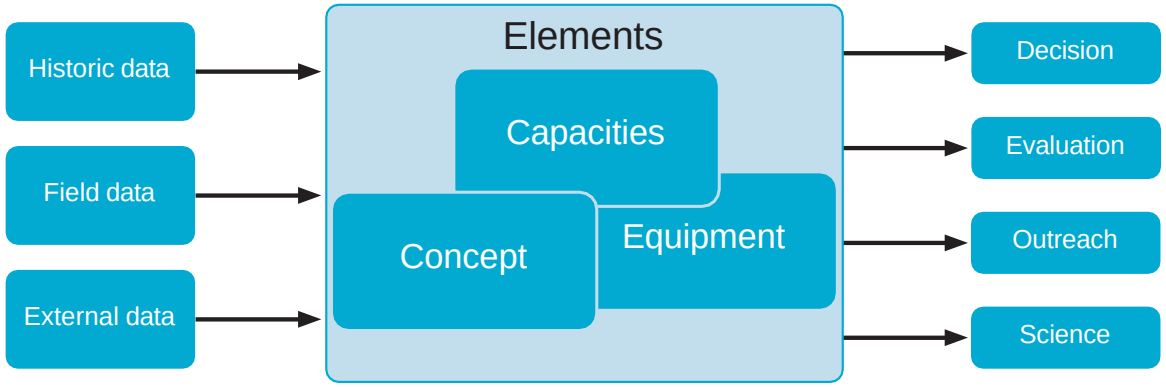
Considerations for Monitoring



Outcome-based management

PA Management Effectiveness through tools such as METT, IMET, RAPPAM.

Monitoring provides information to determine management effectiveness



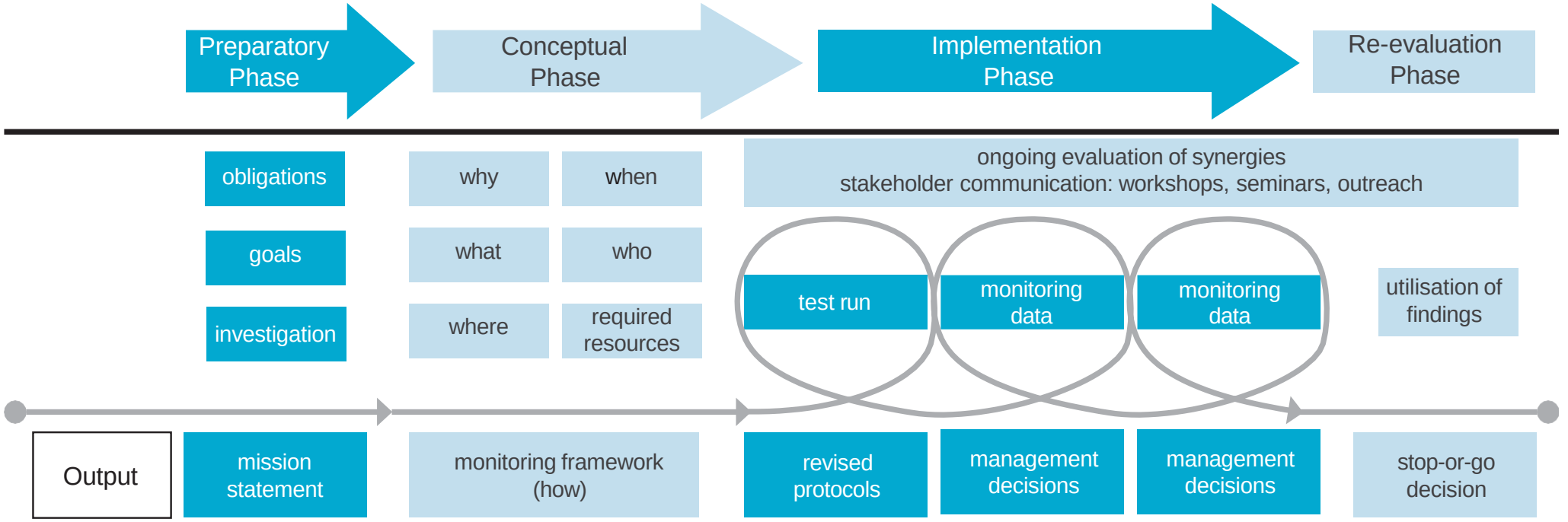
Designing modular and multi-scale BMSys

Utilising pre-existing networks, data, and methodologies will help establish new BMSys.

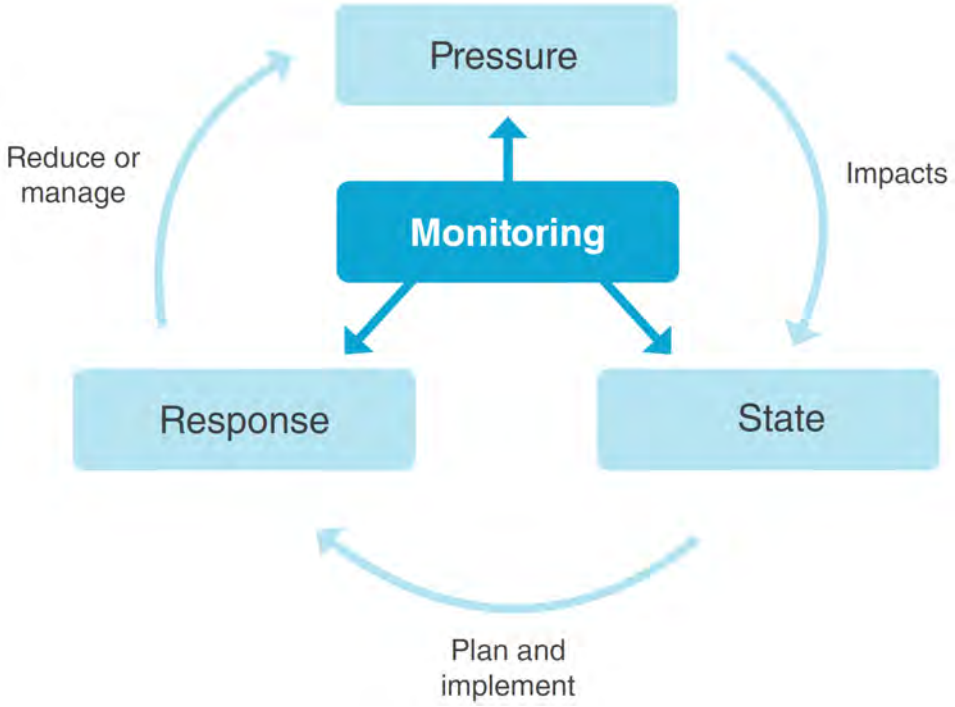
MoniGloG: Four Phases of BMSys Design

Framework divided into four phases:

1. Preparatory Phase
2. Conceptual Phase
3. Implementation Phase
4. Re-evaluation Phase

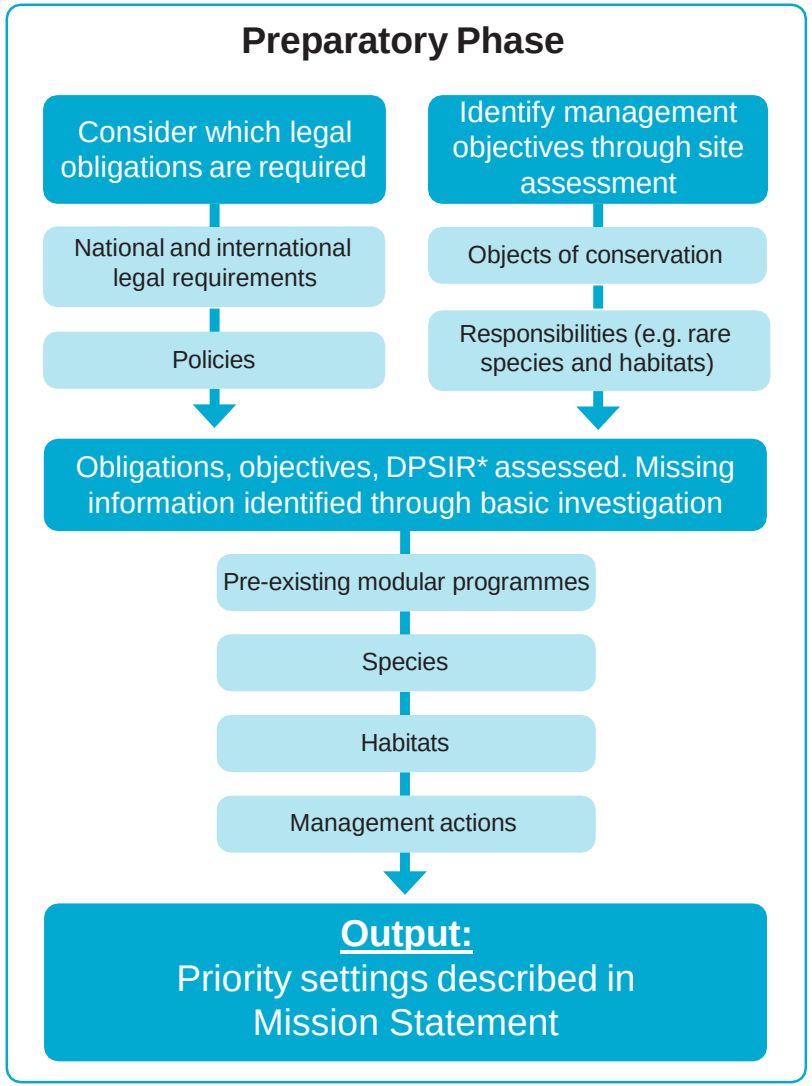


Phase 1: Preparatory Phase



Monitoring is involved in many parts of a management programme.

Having a clear picture of the main pressures, impacts, and interactions on site-level biodiversity will guide management activities to meet specific goals.



Phase 2: Conceptual Phase

Conceptual Phase

Output from Preparatory Phase:
Priority settings described in Mission Statement

Why
- Study focus
- Expected outcome
- Visitor, scientific, cultural value

What
- Indicator or proxy
- Level of accuracy
- Population or habitat size and status

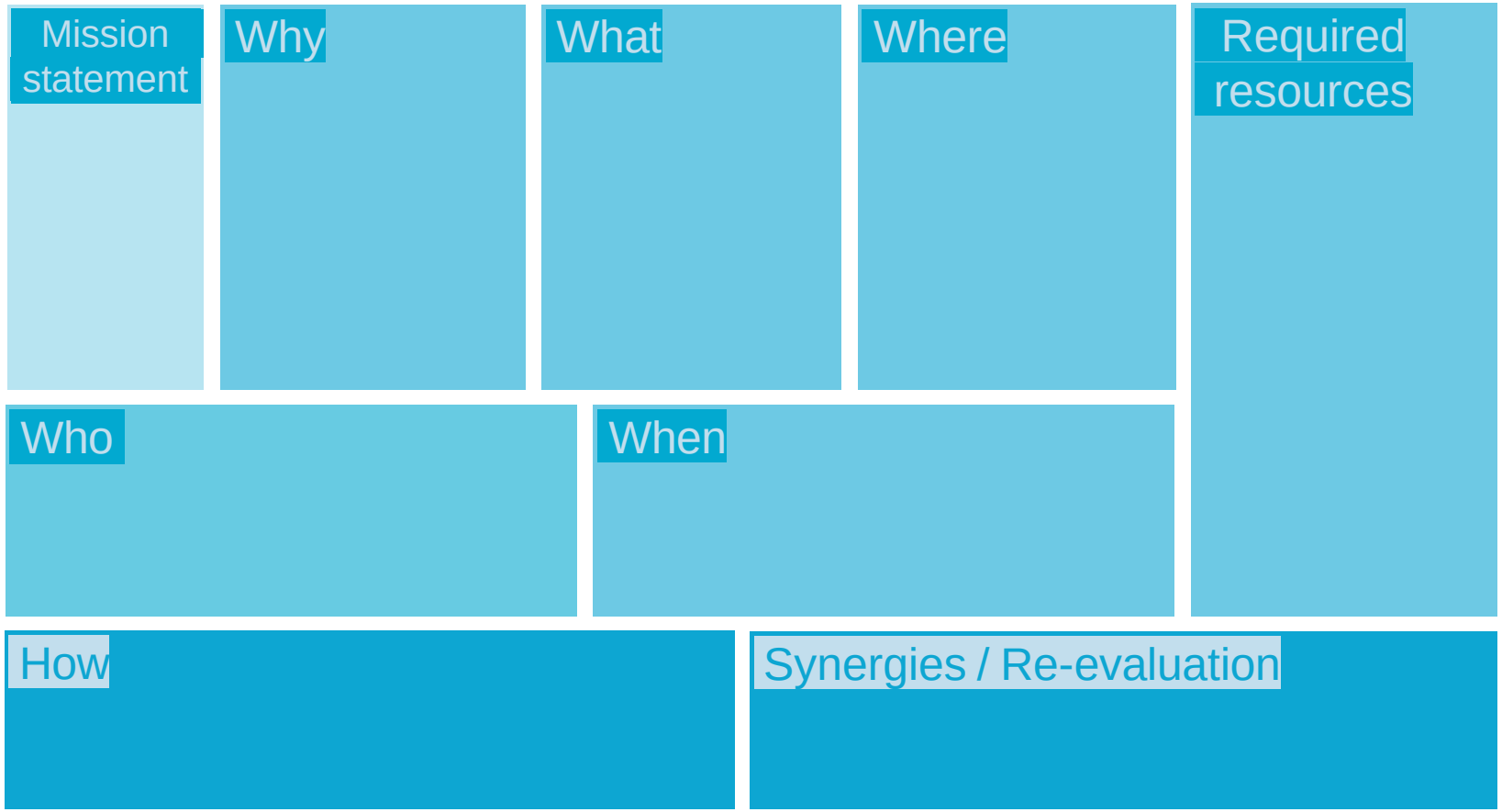
Where
- Area of interest
- Area- or plot-based
- Plot distribution
- Minimum spatial resolution

When
- Initiation timing
- Repeat interval
- Duration
- Special circumstances

Who
- Partners and stakeholders
- Size of team
- Staff expertise
- External help

Required resources
- Estimated budget
- Infrastructure
- Human resources on hand
- Human resources required
- Future involvement
- Supplemental resources available

Output:
Optimal scope of the monitoring programme determined based on available resources and site factors



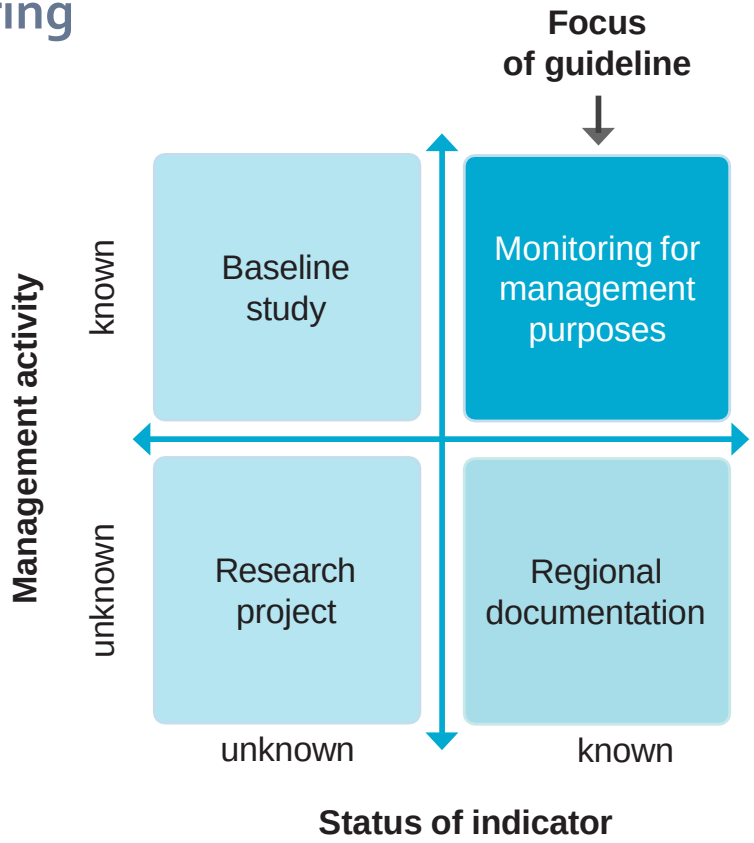
The Monitoring Concept Worksheet provides a starting point for discussion amongst the stakeholders and PA staff. It is provided in a digital annex that can be printed out poster size.

Phase 2: Conceptual Phase

Why: the purpose of monitoring

Category	Use of results	Local	Regional	National	International	Total
Purpose of BMSys	Planning (management)	0-5	0-5	0-5	0-5	
	Evaluation (management)	0-5	0-5	0-5	0-5	
	Governance (reporting)	0-5	0-5	0-5	0-5	
Knowledge transfer	Activation (stakeholder contribution)	0-5	0-5	0-5	0-5	
	Public relations (stakeholder outreach of information)	0-5	0-5	0-5	0-5	
	Science (research)	0-5	0-5	0-5	0-5	
	Education (awareness)	0-5	0-5	0-5	0-5	
	Total					

A point system will help focus the programme.

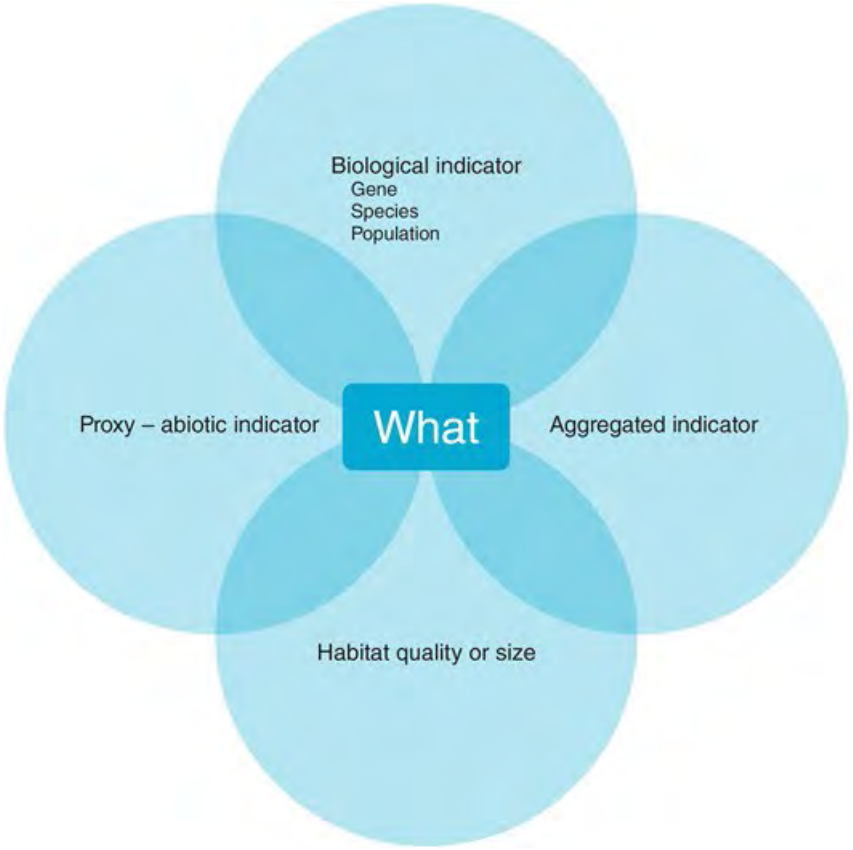


The purpose of the BMSys is guided by the starting point of the management programme.

An unknown starting point is usually made clear with pilot actions or academic research.

Phase 2: Conceptual Phase

What: selecting indicators



Some biotic indicators are difficult to monitor.

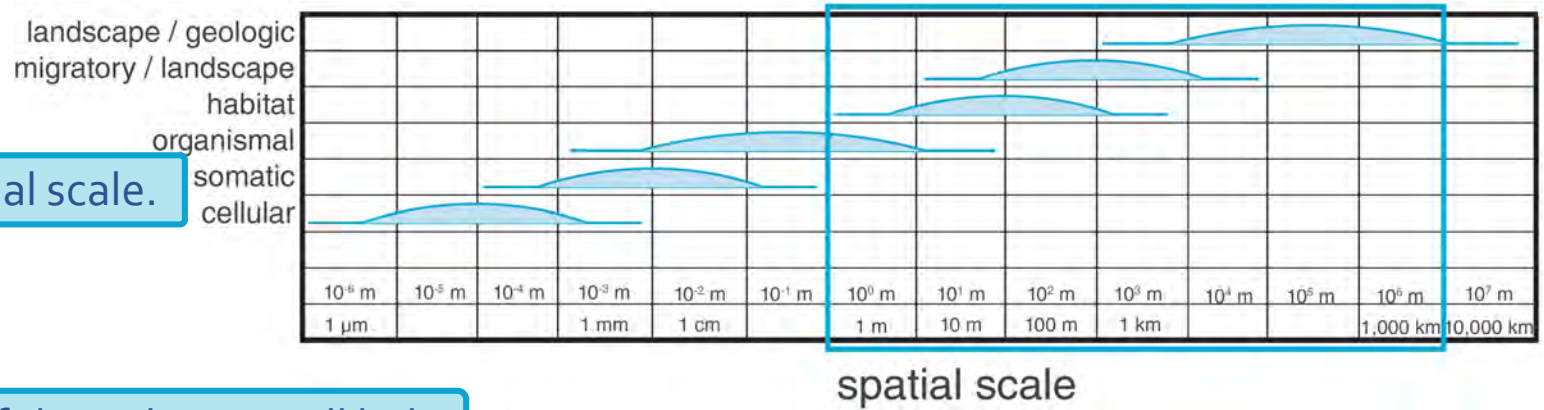
Proxy indicators provide a convenient alternative.

Conservation target	Challenge of monitoring	Proxy indicator
Rosalina alpina, Alpine longhorn beetle: endangered species	Larvae live in old partially dead *Fagus sylvatica* (beech trees), the limiting ecosystem factor.	Dead or dying beech wood in large-scale surveys to deduce beetle conservation status
Calcareous fen containing *Cladium mariscus*, swamp sawgrass: priority habitat	The favourable conservation status of the habitat depends on the range of fluctuation of the water level.	Fluctuations of the water level can be measured with a data logger
Habitat that is difficult to access or reach	Survey of habitat is laborious or hazardous.	Remote sensing data for habitat-based metrics

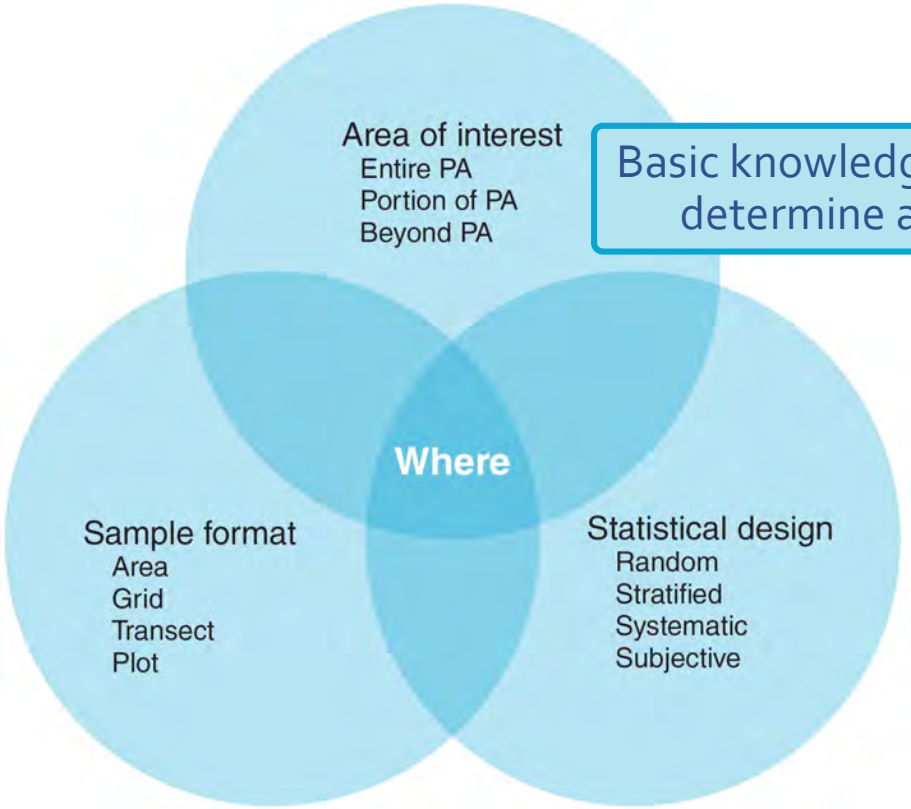
A good indicator is sensitive to change, characteristic for the site, and easy to sample or determine.

Phase 2: Conceptual Phase

Where: scale of spatial features



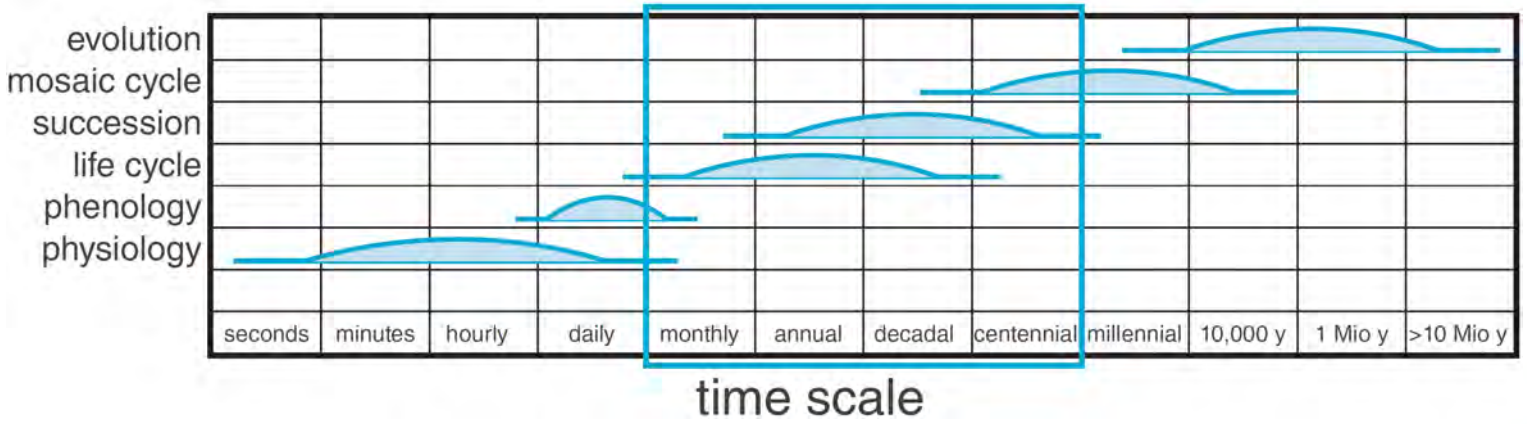
Different species occupy niches of different spatial scale.



Basic knowledge of the indicator will help determine an effective plot design.

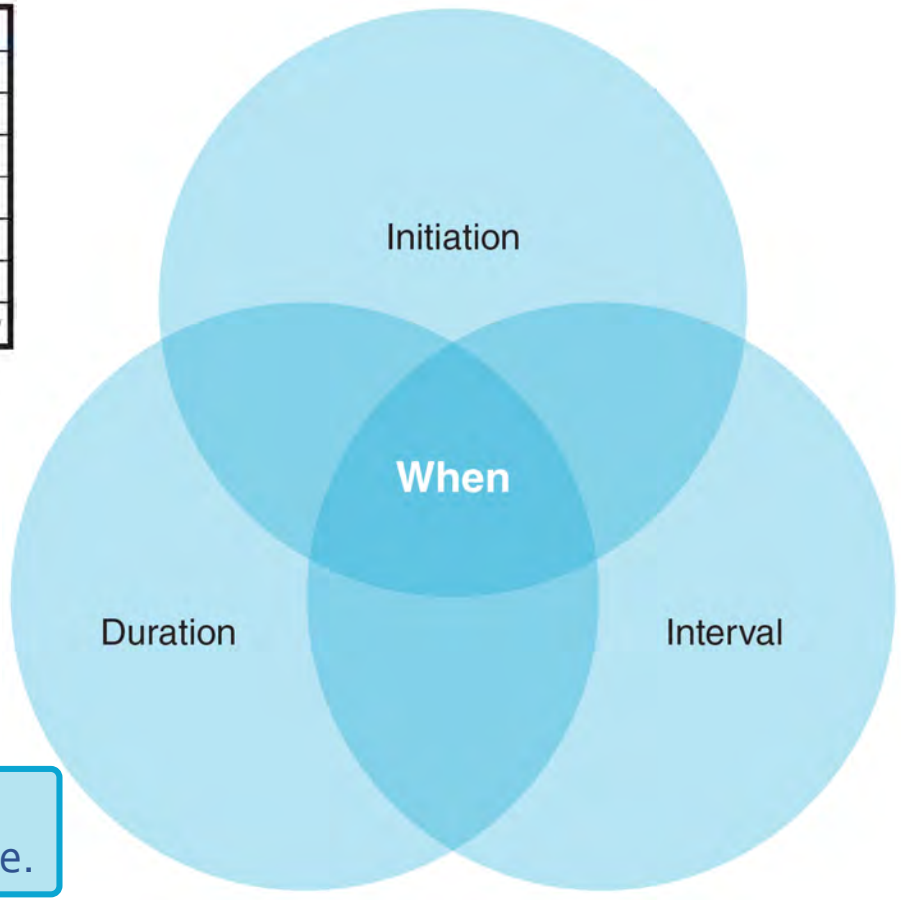
Phase 2: Conceptual Phase

When: scale of temporal features



Life cycles of species vary widely.

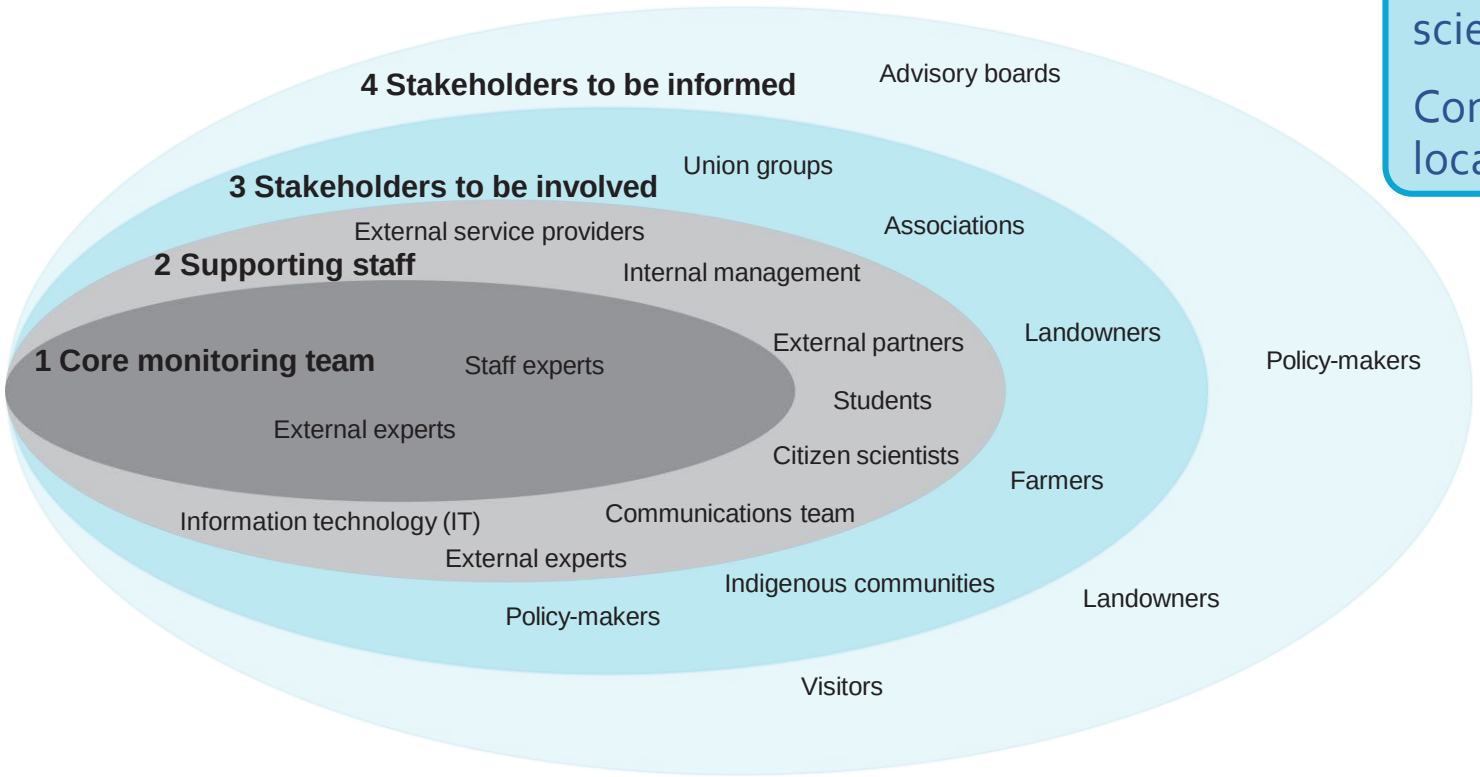
This affects the selection of monitoring techniques.



Temporal dynamics affect when monitoring should start, how often monitoring should occur, and how long the programme should continue.

Phase 2: Conceptual Phase

Who: identifying stakeholders



The actors involved in the monitoring activity will affect the scope and quality of data collection.

Park rangers, professional staff, hired experts, and scientists have specialised knowledge.

Community-based participants may help generate local acceptance of the PA management programme.

Four levels of participation are indicated here:

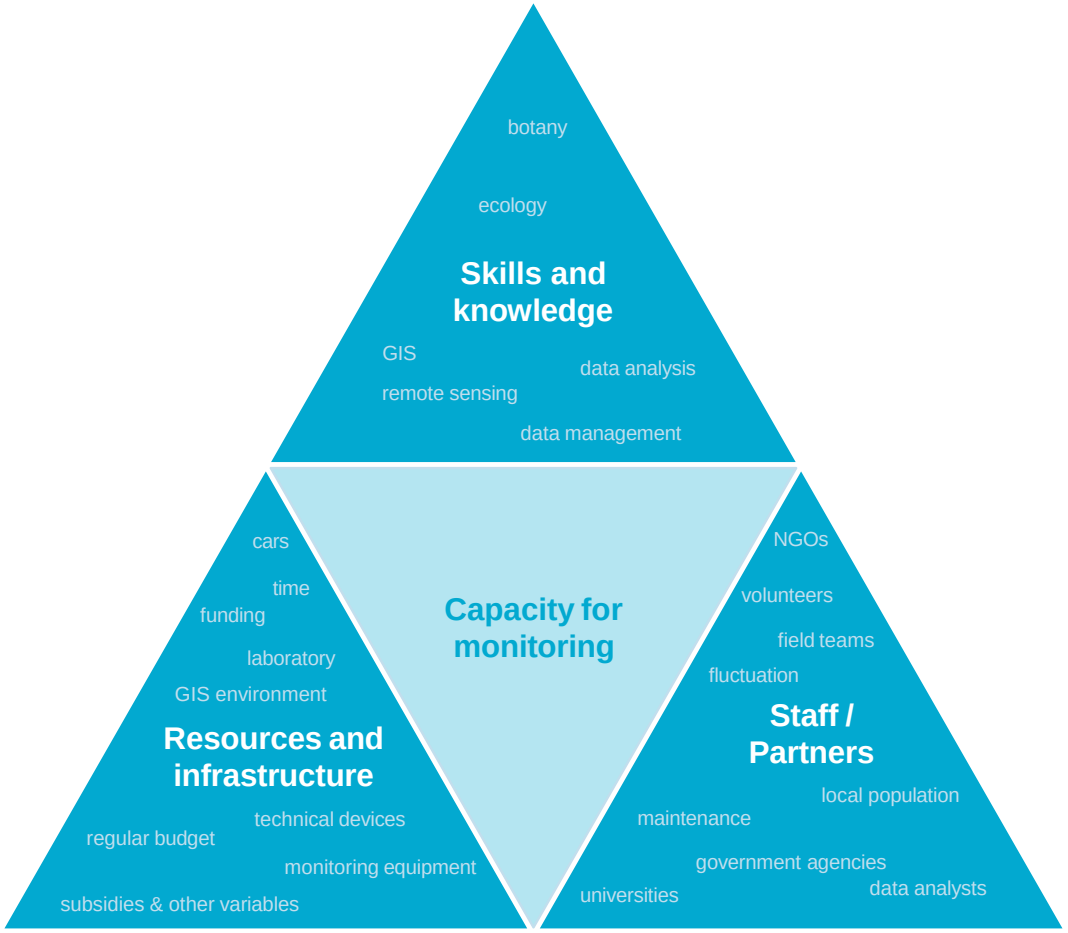
1. Core monitoring team;
2. Supporting PA staff;
3. Involved stakeholders;
4. Informed stakeholders.

Phase 2: Conceptual Phase

How much: identifying the resource frame

Two primary factors

1. Financial resources
   - Establishment vs. ongoing cycles
   - Material resources
2. Human resources
   - Administrative staff
   - Permanent staff
   - Seasonal technicians
   - Skilled technicians



Phase 2: Conceptual Phase

Output: Scope of BMSys is defined

Mission statement

A monitoring programme is developed to fulfil stakeholder requirements through examination of the state of key populations or habitats. Effective biodiversiy monitoring will be accomplished only through sound systems knowledge, adequate and systematic planning of resources, and clear conservation goals.

Why establish a monitoring programme?

A likely answer will be to comply with national or international conventions such as meeting biodiversity targets. Monitoring can identify achievements or successes in species recovery. On the other hand, it can show where conservation efforts are lagging, thereby directing future management plans. In these ways, monitoring can support developed frameworks and allow transferability of succesful elements to similar sites.

- What is the study focus (e.g. population size, biodiversity assessment, species distribution)?
- What should be the outcome of monitoring (e.g. effieciency reviews of measures)?
- What will the results be used for (e.g. documentation of species, educational puposes, scientific communication)?

What will be monitored?

A wide variety of indicators may be the focus of a monitoring programme. The state of targeted habitats or ecosystems can be monitored. Species biodiversity or species abundance can also be monitored. Depending on the goals of the programme, species genetic diversity can be estimated using appropriate tools. Protected area obligations may mandate surveying a high number of indicator species or habitats, which may be unrealistic based on the allocated budget. In this case, a manager may be able to select suitable proxies representing a group of species or ecological interactions. Finally, nature-based solutions or ecosystem services may be monitored as a measure of ecosystem health.

- What is the study object (e.g. habitat type, species, biodiversity, ecosystem service)?
- Is it possible to monitor species or is it better to assess the habitat suitablilty?
- Are there any other proxies that could be monitored instead?

Where will monitoring take place?

This question can be answered through detailed assesment of the site. Monitoring of entire habitats will require a different approach than monitoring of single species. Highly mobile species will require a different approach than sedentary species. Through identification of the spatial resolution of the target of observation, a catalogue of suitable options will become apparent.

- What is the spatial scale of the monitoring technique?
- How is the area of interest defined (e.g. habitat type, location)?
- Does the BMSys involve an area- or plot based design?
- How are the plots distributed, e.g. transect line, randomly, grid, stratified sample?
- What is the minimum mapping unit or the resolution of the spatial data?

How many resources are available for the monitoring programme?

There are two primary elements to answer the question. A realistic estimate of financial costs should be made, considering the difference of costs between the establishment phase of the programme and continuation in subsequent monitoring cycles. Generally, the establishment phase will demand the greatest financial resources. The second component is the demand for human resources.

- What is the estimated budget to set up a monitoring programme (plot establishment, monitoring devices, IT infrastructure)?
- How many teams and human resources are needed?
- Does the PA have administrative staff, permanent field workers, or seasonal technicians available for the programme?
- Will the available funding and human resources be sufficient to effectively complete the monitoring process, and will availability in subsequent monitoring cycles be guaranteed?
- Are there human resources for analysis and reporting of long-term monitoring results or must this be outsourced?
- Can supplemental resources be mobilised if needed?

Who is involved in the monitoring programme?

Monitoring can be accomplished by a variety of stakeholders, ranging from highly trained specialists to untrained nature enthusiasts. To meet official obligations that are determined by conventions, professional staff or scientists will usually be the most suitable contributors to the monitoring programme. For continuity and training purposes, it is generally recommended to use staff that will be available for more than one monitoring cycle.

- Which stakeholder(s) have the rights to use the findings?
- Which partners and stakeholders are involved, and what are their expected contributions?
- How many teams or people are needed?
- What level of expertise is needed from the staff (e.g. intern, ranger, field staff, junior / senior expert)?
- Should monitoring be carried out by external partners?

When will monitoring take place?

The temporal resolution of a monitoring scheme will depend on the phenological activity of the target species or habitat to best observe the selected indicators. Design in time should be determined by the available methodology and will be guided by expert consultation.

- What is the best time of year to carry out the monitoring?
- At what intervals should the process be repeated: weekly, montly, annually, every five years?
- What is the temporal scale of the monitoring technique?
- Do the intervals of monitoring change as the programme moves on?
- Are there external circumstances that may justify additional monitoring efforts (e.g. fire or flooding)?

How will the monitoring programme be implemented?

- Are there social, cultural or ethical concerns about the BMSys?
- Are legal constraints expected?
- Who will design the technical framework?
- When should the preliminary manual be ready?
- What are the spatial dimensions and time frame of the test runs?
- Who can implement the test runs?
- At what point should the manual be finalised?

Which synergies can be used?

- Are existing baseline datasets available?
- In which situations should the monitoring programme be terminated or re-evaluated?

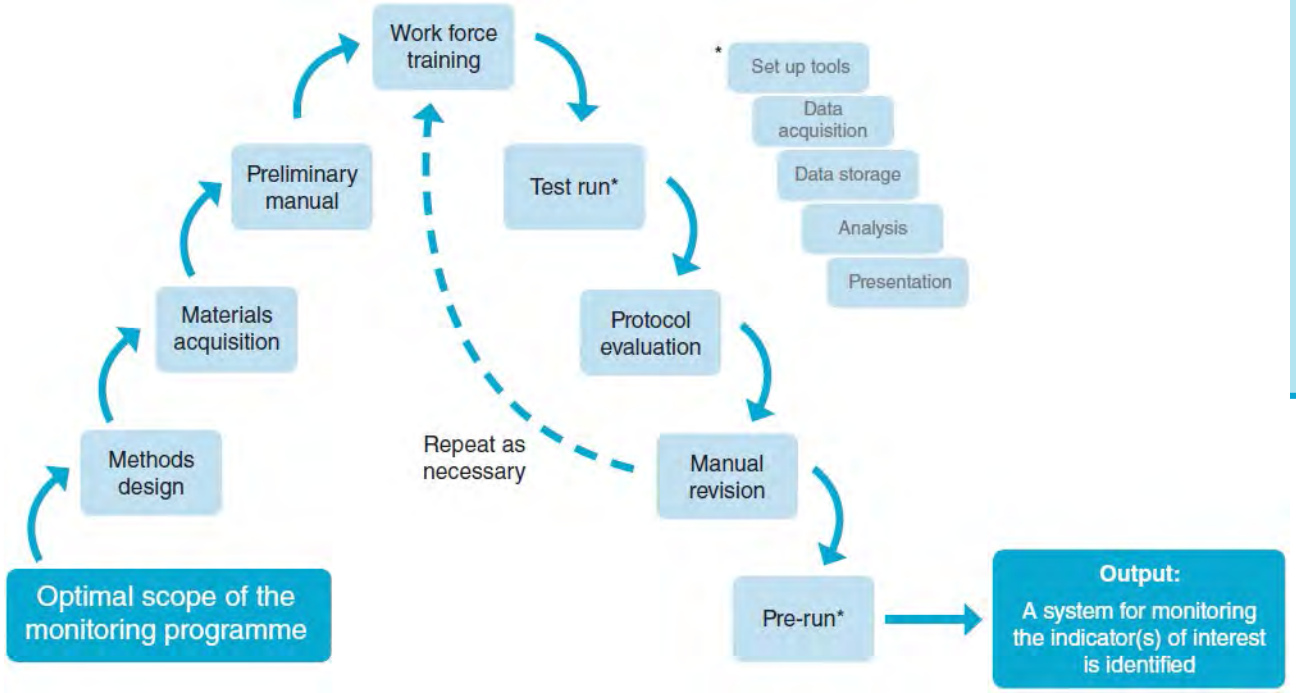
Upon completion of the conceptual phase, the necessary resources and research questions for establishment of the BMSys will be identified, but they will not be worked out in detail.

Phase 3: Implementation Phase

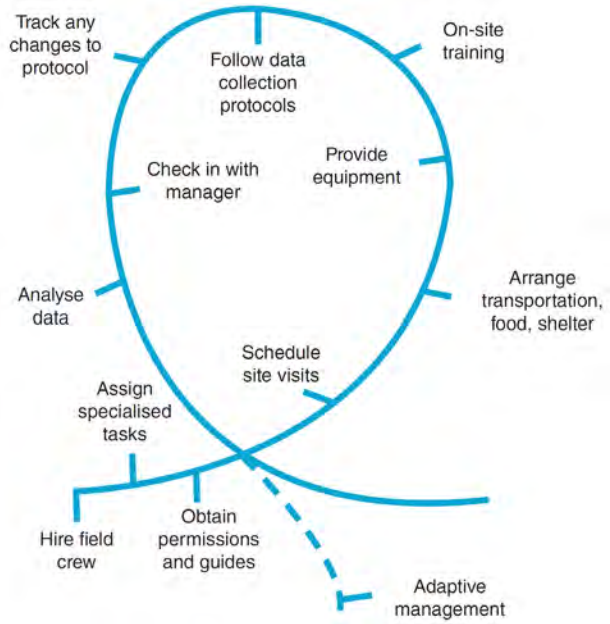
Implementation takes the framework from the Conceptual Phase and puts it into action.

Key preparatory steps include:

- Selection of tools and methods;
- Hiring the work force;
- Conducting test runs;
- Developing a field manual.



Monitoring cycles should follow a consistent work flow, as outlined to the right.



Phase 3: Implementation Phase

Biodiversity monitoring test sites

Test sites allow verification that tools and methodologies are suitable.

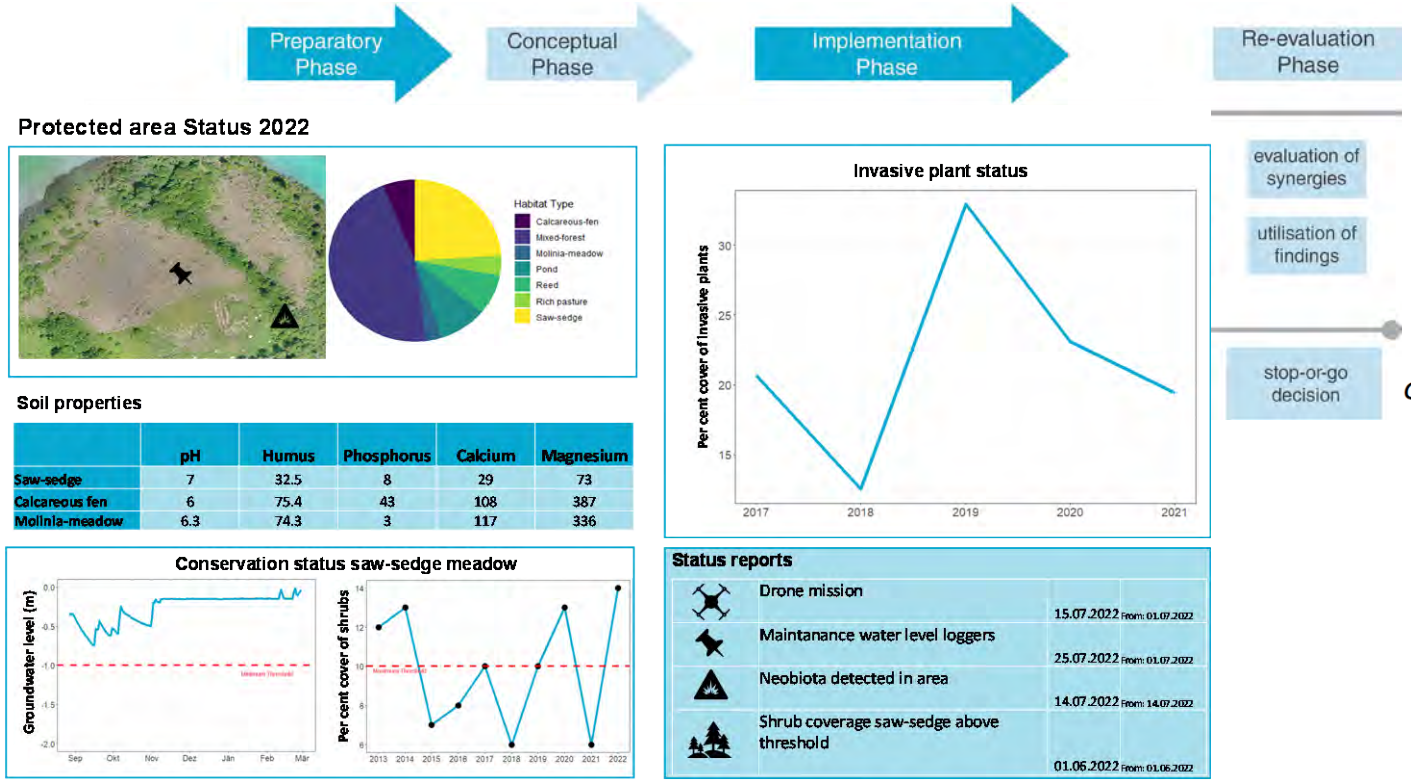
Left:
Lendspitz-Maiernigg Natura 2000 Area is located near a technology park and a university in Klagenfurt, Austria.

Photo © Lakeside Science & Technology Park

Phase 4: Re-evaluation Phase

Re-evaluation should be based on the results of management actions following a pre-set number of monitoring cycles.

Data provided in the form of a dashboard can help decision-makers determine future monitoring actions.



Checklists are provided to ensure that stakeholders receive the key information.

Checklist 6 Communication.

- ✓ Reporting to decision-makers
  - ❑ Stakeholder reporting
  - ❑ Scientific output
  - ❑ Public outreach
- ✓ Transparency
  - ❑ Open data access
  - ❑ Dashboard
  - ❑ Report findings regardless of the monitoring outcome
  - ❑ Share the results with all parties

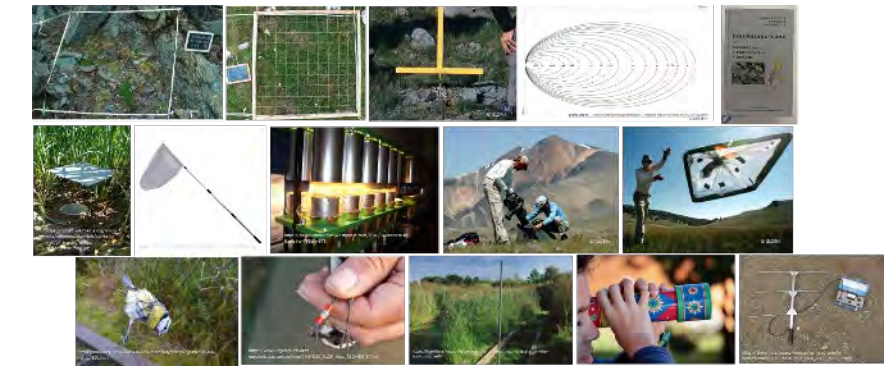
Discussion on Tools and Methods

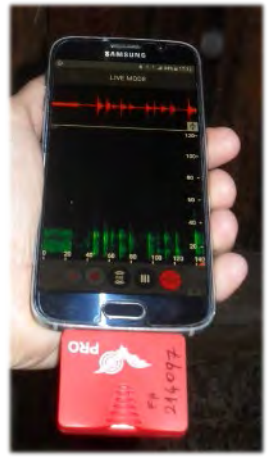
Suitability for PA management	
Very well suited	1
Well suited	2
Less suitable	3
Unsuitable	4
Not relevant	-

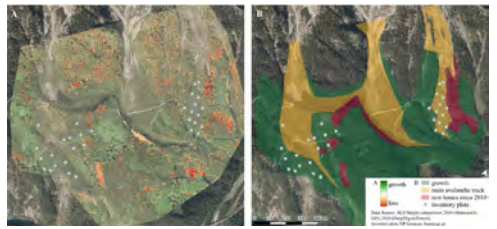
	Objects of observation	Acoustic devices and sensors	Optical devices	Satellite remote sensing	Close range remote sensing	Telemetry and tracking tools	Olfactory devices	AI, apps, and platforms	Genetic methods	Mapping (area-based, polygons)	Mapping (grid-based)	Mapping (transects, plots, points)	Trapping (nets, enclosures, etc.)	Direct observation (counts, measurements, etc.)	Indirect observation (tracks, nests, etc.)	Acoustic detection	Attractants (pheromones, light, colour, etc.)	Substrate collection (soil, water, etc.)	Laboratory (microscopy, culturing, etc.)
Landscapes, land cover, vegetation	Forests and shrublands	4	4	2	1	4	4	1	4	1	3	3	-	1	-	-	-	-	-
	Glaciers, mountains, rocky habitats	4	3	1	1	4	4	1	4	1	3	3	-	1	-	-	-	-	-
	Wetlands, rivers, water bodies	4	4	1	1	4	4	1	3	1	3	3	-	1	-	-	-	-	-
	Grasslands, savannas, deserts	4	4	2	1	4	4	1	4	1	3	3	-	1	-	-	-	-	-
	Urban areas, artificial habitats	4	4	2	1	4	4	1	4	1	3	3	-	1	-	-	-	-	-
Species and populations	Fungi and lichen	4	4	4	4	4	4	3	1	4	1	1	-	4	-	-	-	1	2
	Microbes	4	4	4	4	4	4	4	1	4	1	1	-	4	-	-	-	1	1
	Plants	4	4	4	2	1	4	1	1	4	1	1	-	4	-	-	-	2	-
	Mammals	2	2	4	2	1	3	2	1	4	1	4	3	2	1	3	2	4	4
	Bats	1	3	4	4	2	4	3	1	4	1	3	3	3	2	4	3	4	4
	Birds	1	2	4	3	2	4	1	1	4	1	4	3	3	2	1	3	3	4
	Fish	4	2	4	3	3	4	3	1	4	1	3	3	3	4	4	3	3	4
	Reptiles	4	2	4	4	3	4	2	1	4	1	3	2	3	4	4	3	3	4
	Amphibians	2	2	4	4	3	4	1	1	4	1	3	2	3	4	3	3	3	4
	Insects	2	3	4	4	4	2	3	1	4	1	1	2	4	3	2	1	2	3
	Other invertebrates	3	3	4	4	4	3	3	1	4	1	1	2	4	4	4	1	1	3

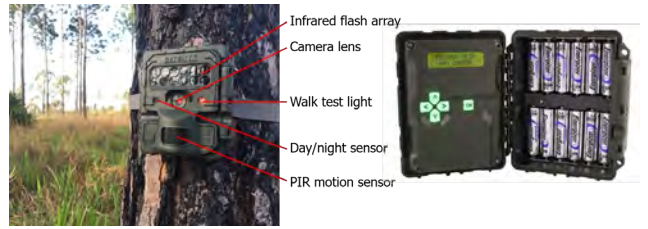
We provide a review of common traditional approaches to monitoring in comparison to today's state-of-the-art technologies.

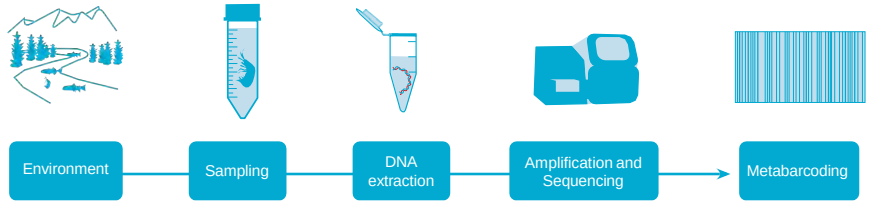
Traditional Tools











State-of-the-Art Tools

KÄRNTEN
UNESCO Chair on Sustainable Management of Conservation Areas

What are we missing? What do we need?

Conservation standards

Examples of good mission statements

Real World Examples

Integration with local communities

Ongoing Cycles

Real-world field implementation

Capacity-building

How to develop the skills needed to perform the work

Data interpretation

How to analyse / act upon the data

Long-term programmes

Real-world example of the value of time series

unesco Chair

Important questions for you

Your thoughts on MoniGloG?

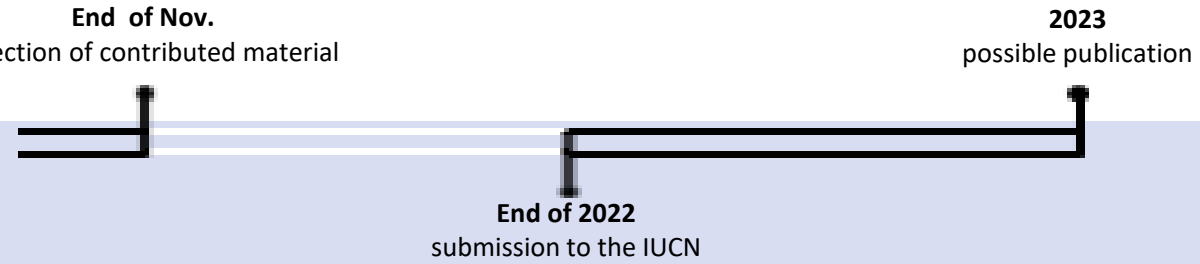
What use do you see in a monitoring guideline? Do you have any experience with guidelines regarding bio-monitoring?

What could you add?

Could you contribute to some of the missing topics or add material on your own experiences/ real-world examples

How do we continue/ remain?

Would you like to contribute? Would you want to be involved in a local discussion or a workshop? Would you like to involve a colleague or provide possible contributors?



Thank your for your interest and contribution!

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