MPA Short Course

6. Introduction to the Principles of MPA Monitoring

UK International Development
Partnership | Progress | Prosperity

Developed by the Ocean Country Partnership Program for the University of Cape Coast

MPA Course Overview

1. ~~Introduction to MPAs~~ ✓
2. ~~MPAs around the world~~ ✓
3. ~~MPAs in Ghana~~ ✓
4. ~~MPA identification and regulation~~ ✓
5. ~~MPA management planning & management~~ ✓
6. **MPA monitoring** — You are here!
7. MPAs & Marine Spatial Planning
8. Your Voice

Learning Objectives

- Introduce MPA Monitoring and why it’s important
- Present the concept of MPA Research and Monitoring Plans (RMPs)
- Describe the main elements of MPA monitoring design
- Explain the importance of MPA monitoring data and research in MPA assessments
- Data management principles and practice

https://www.academia.edu/36398968/MPA_monitoring_Auto_Micro_UAS

What is monitoring?

*'… to observe and check the progress or quality of something **over a period of time**; keep under **systematic review**.'* (Oxford English Dictionary)

..and why do we need to do it?

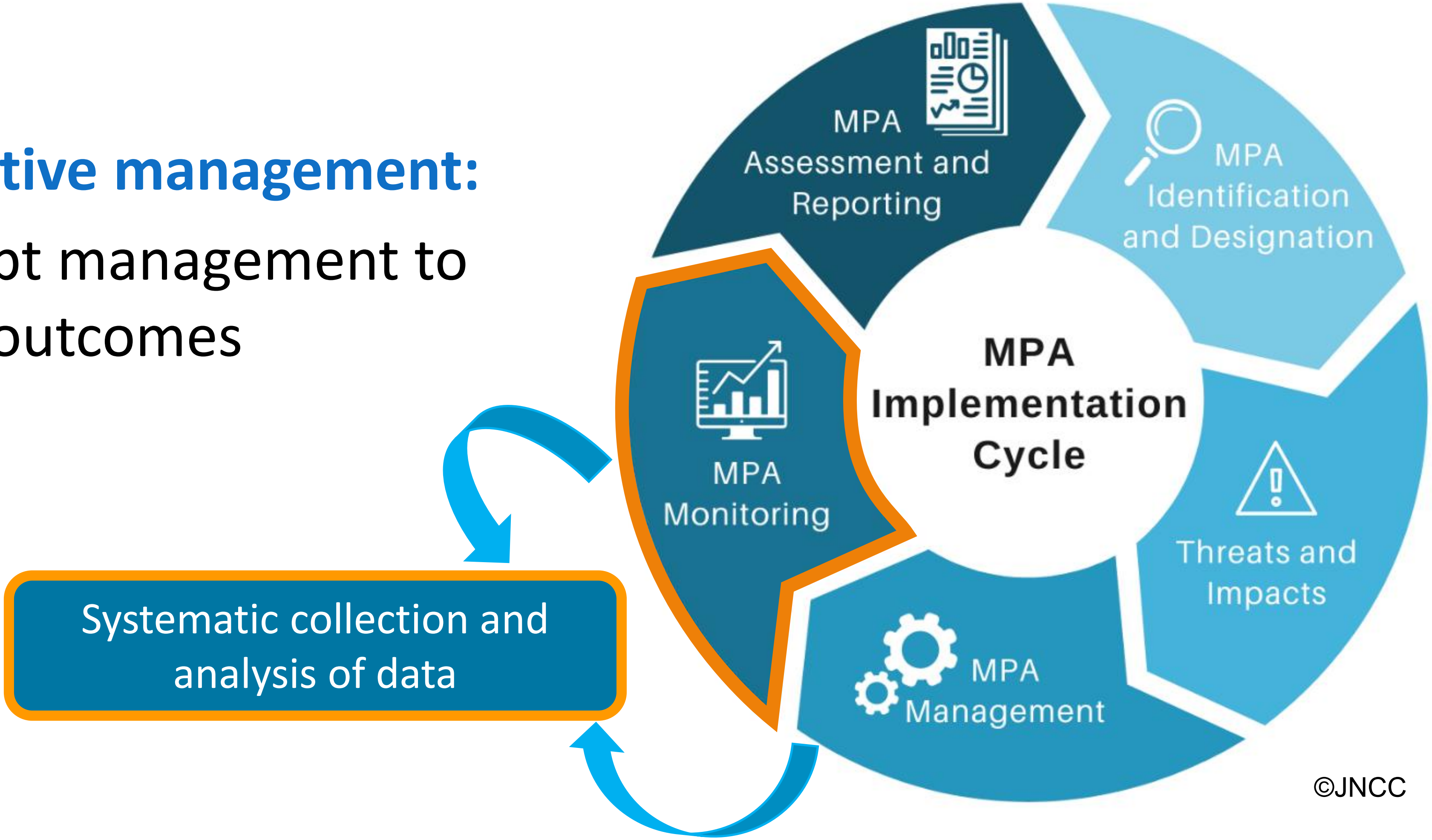
- SMART management objectives: effectiveness is **Measurable**
- Two main functions:
  1. Is the MPA achieving what it set out to?
  2. If not, does management need to change?

https://foresightsurveyors.com/

Monitoring & the MPA Cycle

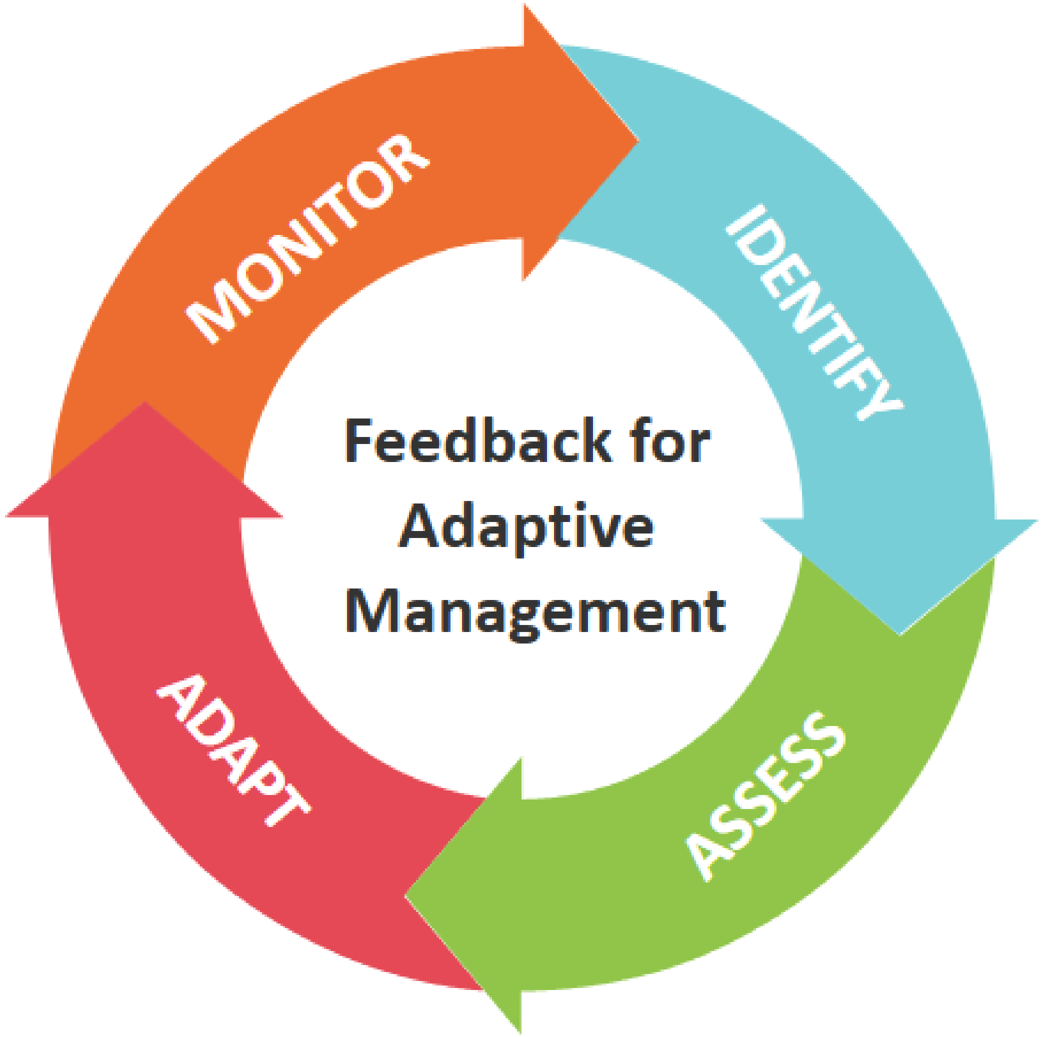
Crucial part of adaptive management:

- Review and adapt management to enable positive outcomes

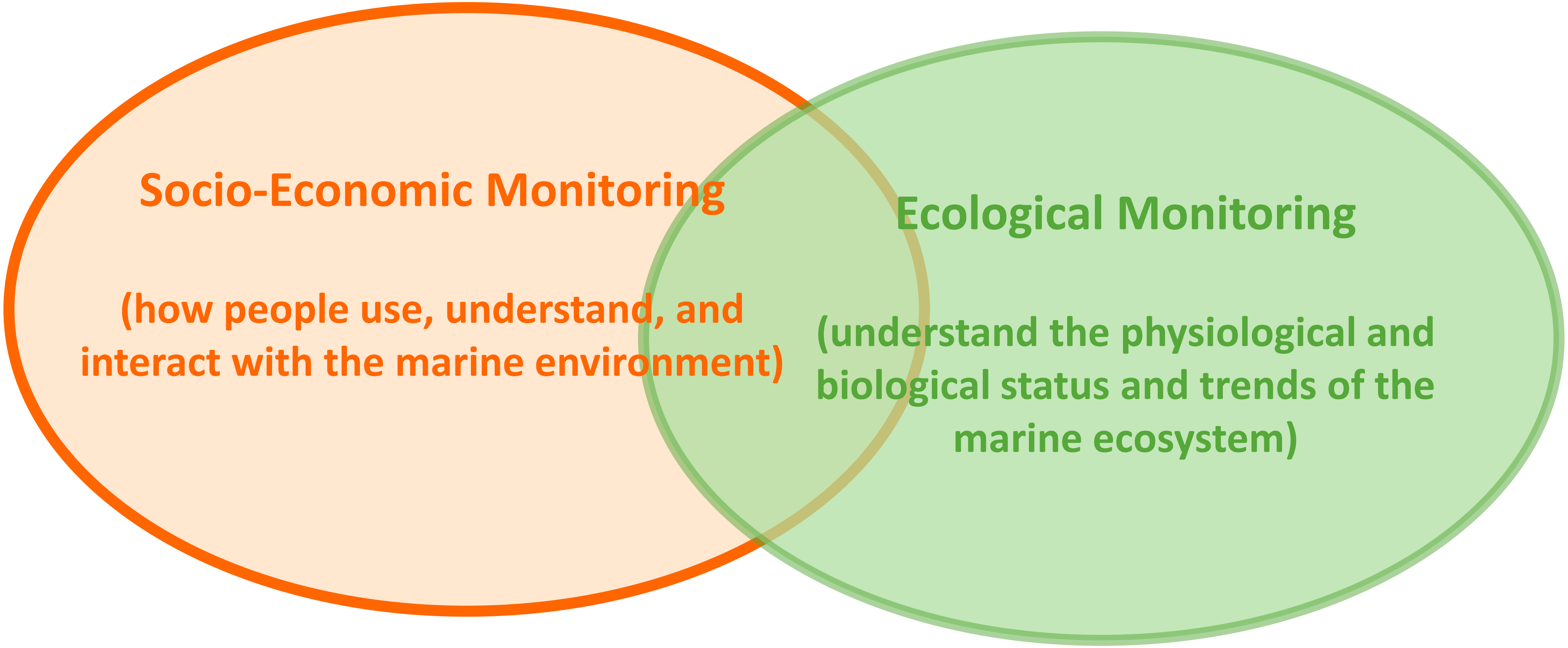


Why do we monitor?

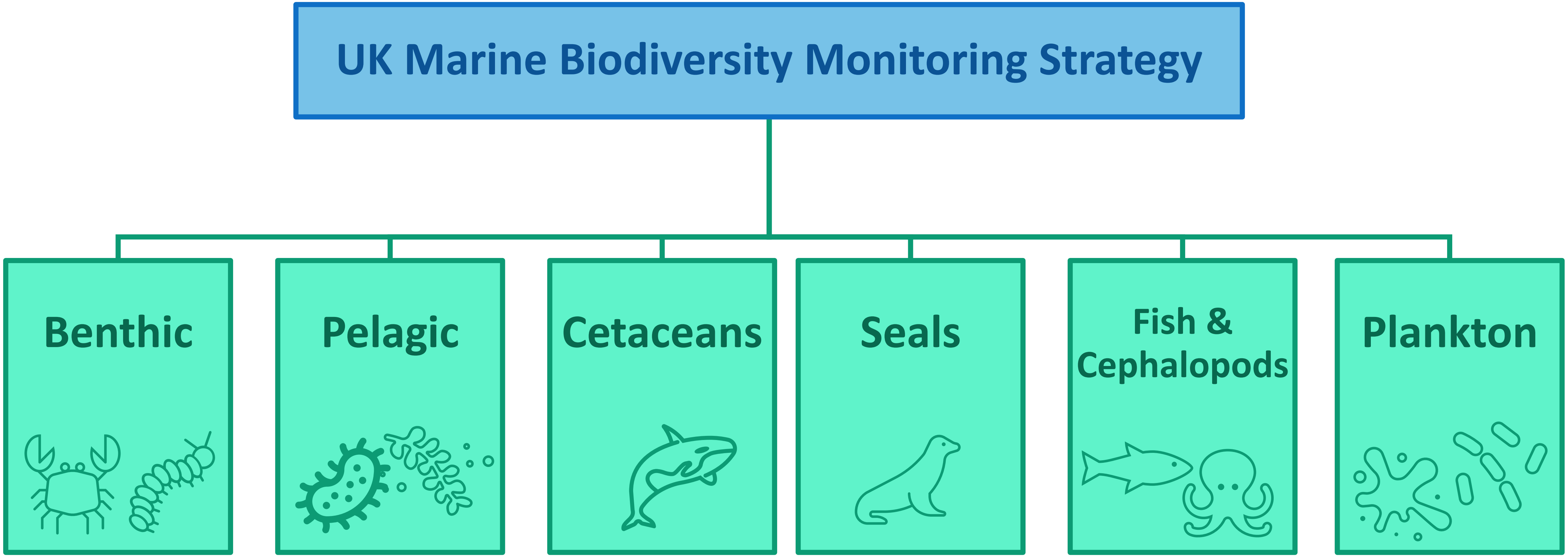
1. Assessing conservation aims
2. Evaluate ecological health and resilience
3. Measure socio-economic benefits and costs
4. Enhancing management and policy decisions



What to monitor?



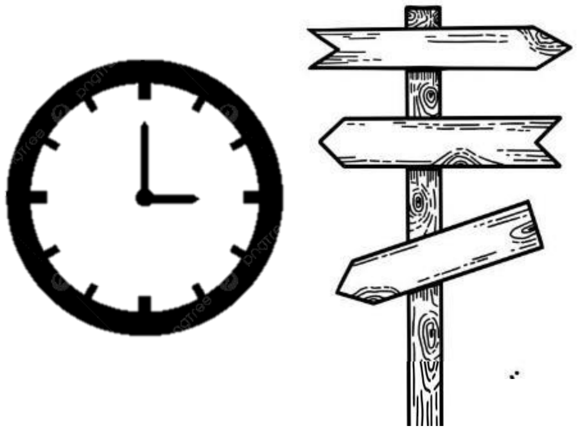
What to monitor?

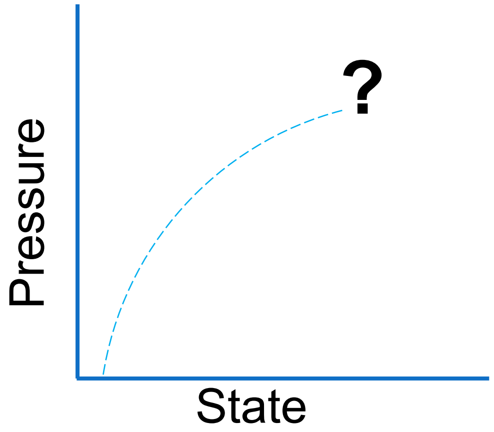


What monitoring is needed?

1. Define monitoring objectives & parameters to be used
2. Define statistical power & significance levels
3. Review existing monitoring (if any) of parameters
4. Determine gap between existing monitoring & required monitoring
5. Identify activities required to fill the gap, if any

Types of Monitoring





1. Sentinel monitoring
to measure rate and direction of long-term change

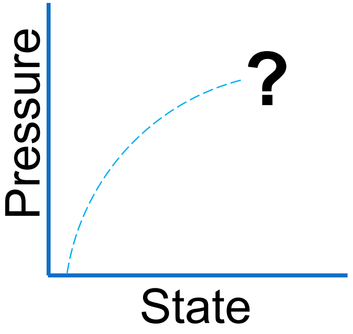
2. Operational monitoring
to investigate pressure-state relationships

3. Investigative monitoring
to determine management needs and effectiveness

Which monitoring type is *relevant*?

Considerations:

1. Management Objectives
2. Resource Availability
3. Timeframe
4. Ecological Complexity



Which monitoring type is *feasible*?

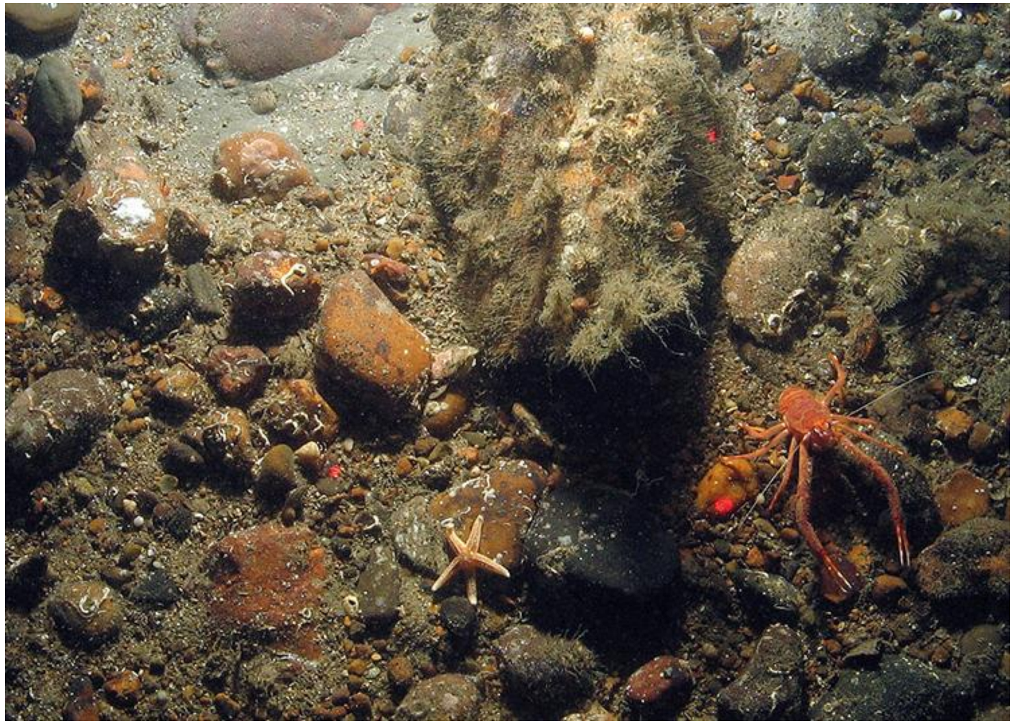
For operational and investigative monitoring consider:

- Mobile and ephemeral (short-lived) habitats
- Confidence in habitat data
- Confidence in pressure data
- Is the pressure-state gradient is well understood?
- Are there suitable control sites?

Please refer to handout for feasibility flow diagram

Important factors to consider

1. Existing data
2. Indicators
3. Frequency
4. Power



What Are Indicators?

Biodiversity Indicators	Species richness, diversity indices, population abundance
	Presence and health of keystone species
	Changes in composition of ecological communities
Habitat Indicators	Cover, extent or health of a habitat-forming species (coral cover, seagrass extent, health of mangroves)
	Physical characteristics (substrate complexity, …)
	Sedimentation rates and water clarity
Human Activities and Pressure	Fishing effort, catch composition
	Pollution levels (e.g. nutrient runoffs, oil spills,…)
	Tourism, recreational activities

Example: Conservation objective: Maintain an area of seagrass in favourable condition

Indicator: Extent of the seagrass beds

No decrease in extent from an established baseline, subject to natural change.

Extent/ha of seagrass measured during peak growth period twice during reporting cycle.

Map the extent of the seagrass bed using aerial photographs

Indicator: Density of characterising species *Zostera marina*

Average shoot density should not deviate significantly from an established baseline, subject to natural change.

The number of shoots per m^2, measured x2 in summer during reporting cycle

Measure the average shoot density of *Zostera marina* in the field

Frequency of monitoring?

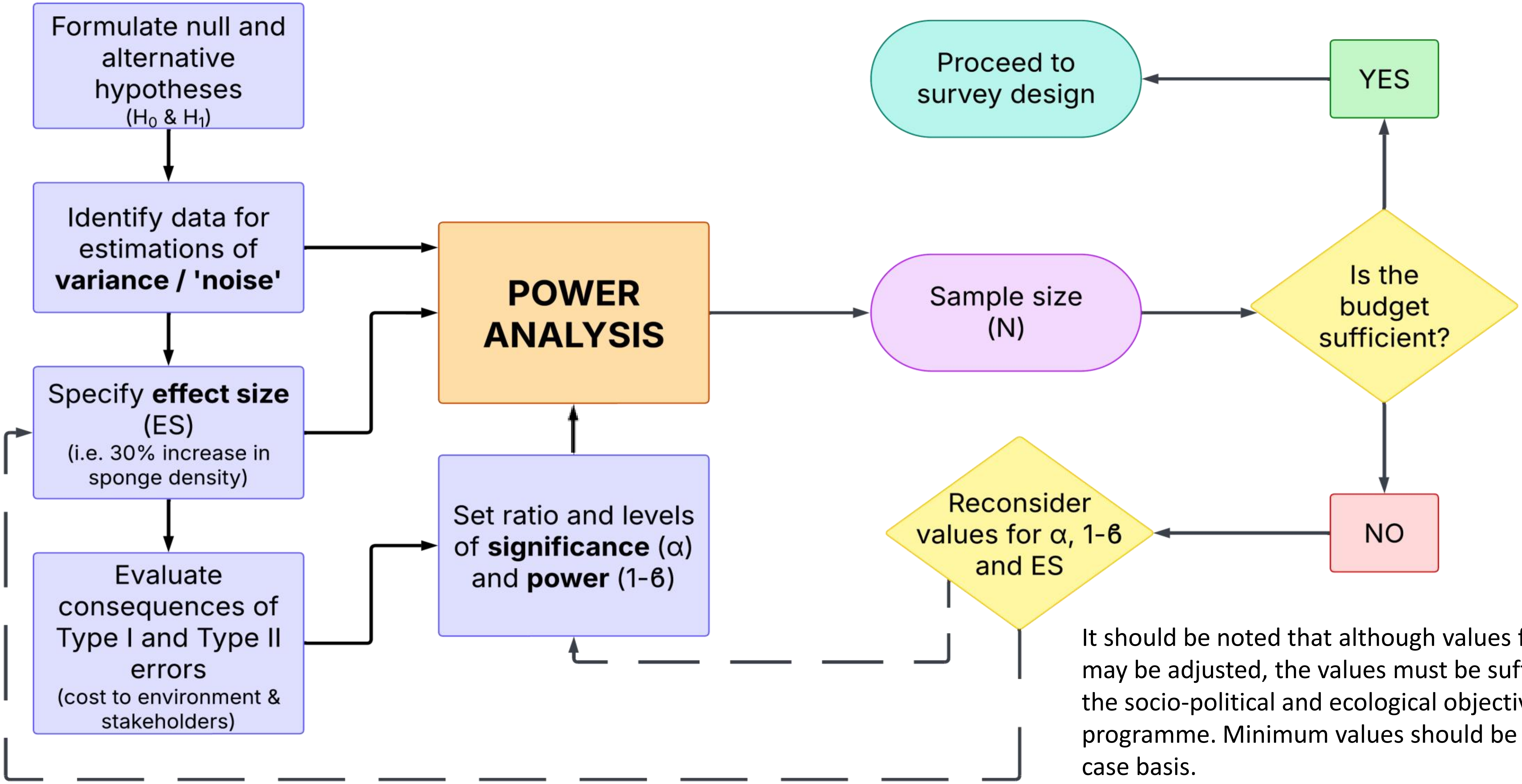
SEASONALITY

RECOVERY RATES

ACTIVITY AND PRESSURES

AVAILABLE RESOURCES

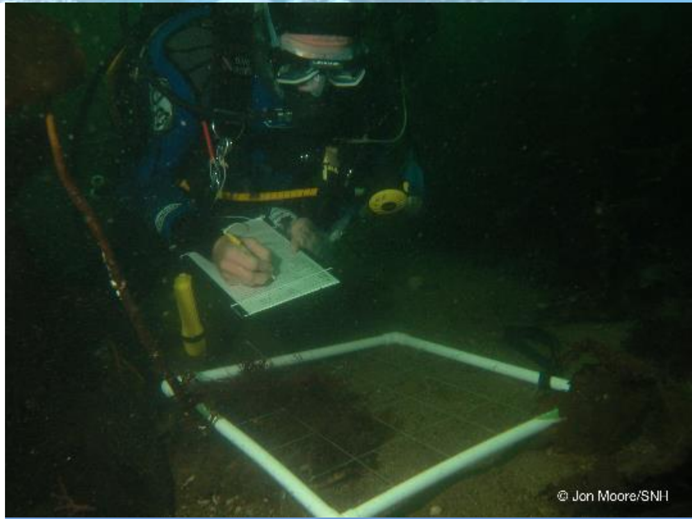
Power Analysis



It should be noted that although values for α, 1-β and ES may be adjusted, the values must be sufficient to achieve the socio-political and ecological objectives of the programme. Minimum values should be set on a case-by-case basis.

Monitoring approaches:

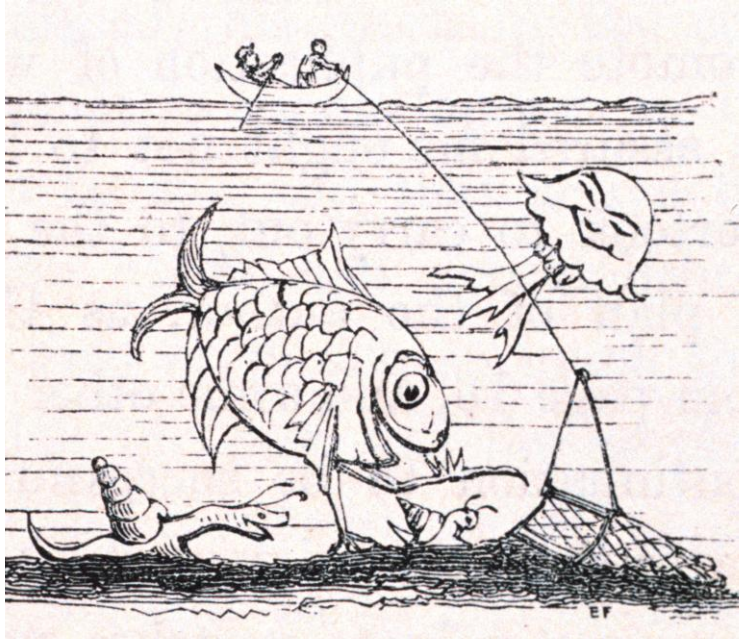
1. **Field Surveys and Sampling:**
   Direct observations, underwater surveys, and biodiversity assessments.
2. **Remote Sensing Technologies**:
   Satellite imagery and other remote sensing tools to gather data on the physical and biological characteristics.
3. **Citizen Science and Stakeholder Engagement:**
   Engaging local communities, fishermen, industry and other stakeholders in data collection and monitoring activities.
4. **Genetic and Molecular Techniques:**
   Molecular tools, such as DNA analysis and genetic markers to study population genetics, connectivity and biodiversity.



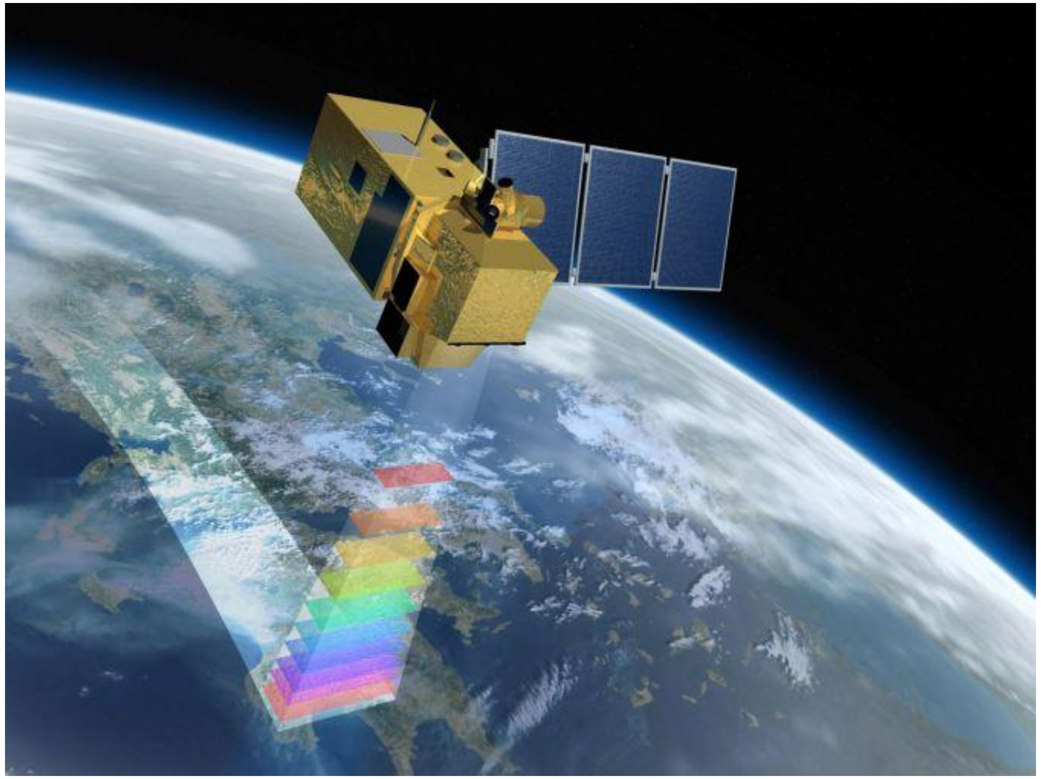
Earth Observation

Earth Observation means gathering information about the Earth's physical, chemical and biological systems…

via **remote sensing** technologies - without making physical contact.



Source: Forbes & Godwin-Austen, 1859



Source: ESA

Example: Marine data for maritime safety University of Ghana

Five operational services are provided which make use of EO tools:

- Potential fishing zone charts overlaid with vessel traffic;
- Monitoring and forecasting oceanographic variables;
- Coastal vulnerability indices;
- Mapping of coastal ecosystems and habitats; and
- Ocean condition forecasts disseminated as SMS alerts.

https://marine.copernicus.eu/news/copernicus-data-supports-ecosystem-monitoring-and-maritime-safety-africa

Example: Oil Spills

Copernicus Marine global ocean products were used to track Wakashio oil spill trajectories in the Indian Ocean (July 2020).

https://marine.copernicus.eu/news/copernicus-data-supports-ecosystem-monitoring-and-maritime-safety-africa

Which monitoring approaches should you choose?

ECOLOGICAL CONSIDERATIONS

What are you trying to monitor?

What are the threats / pressures?

Are there multiple pressures / threats?

Do you have a reference site?

Does it have variable distribution? Is it static/mobile?

What evidence/ data do you already have?

Is management already in place?

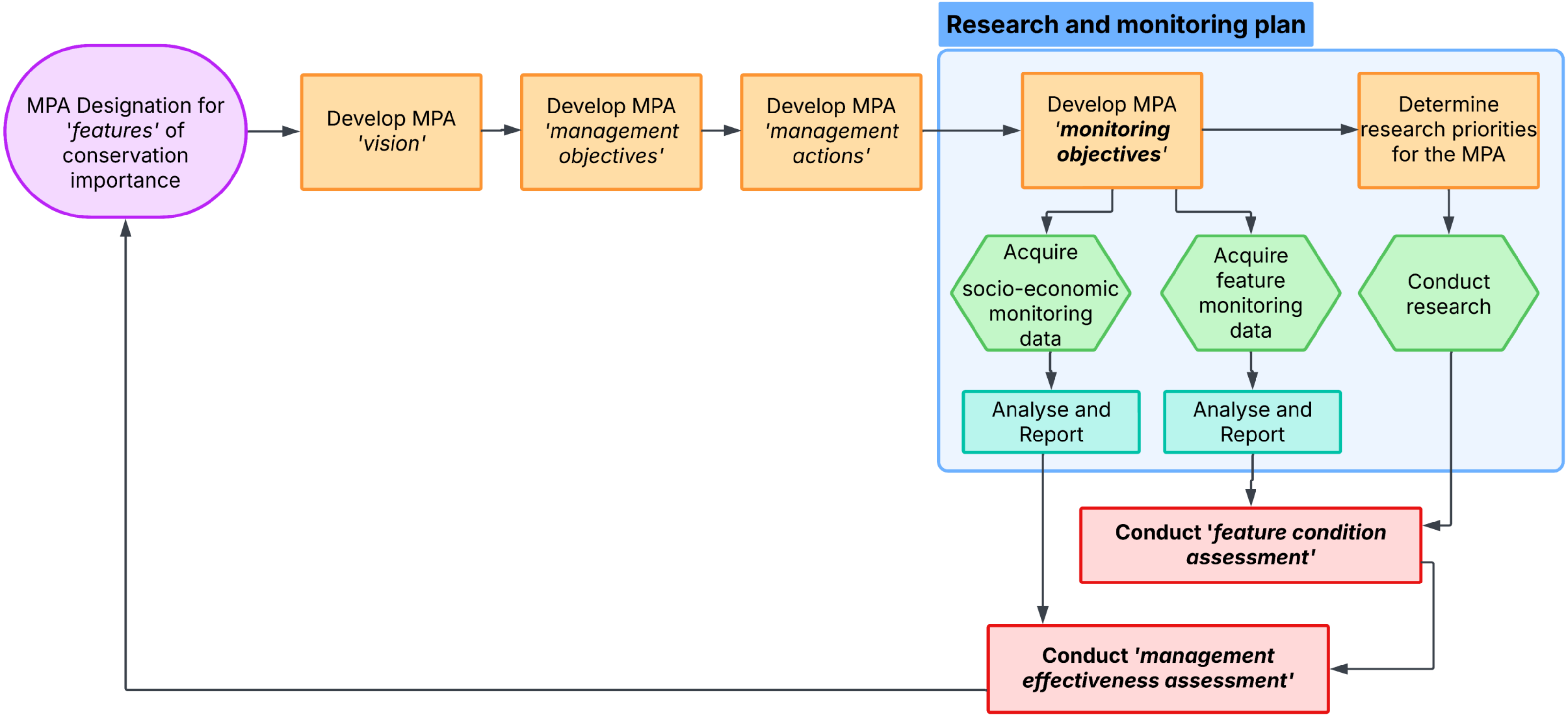
OTHER CONSIDERATIONS

Time?

Resource constraints?

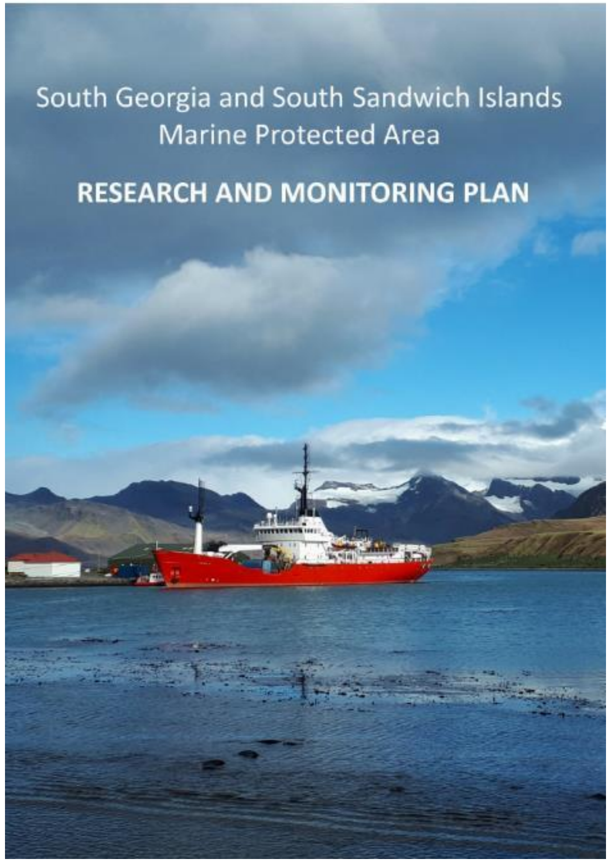
Data quality and standardisation?

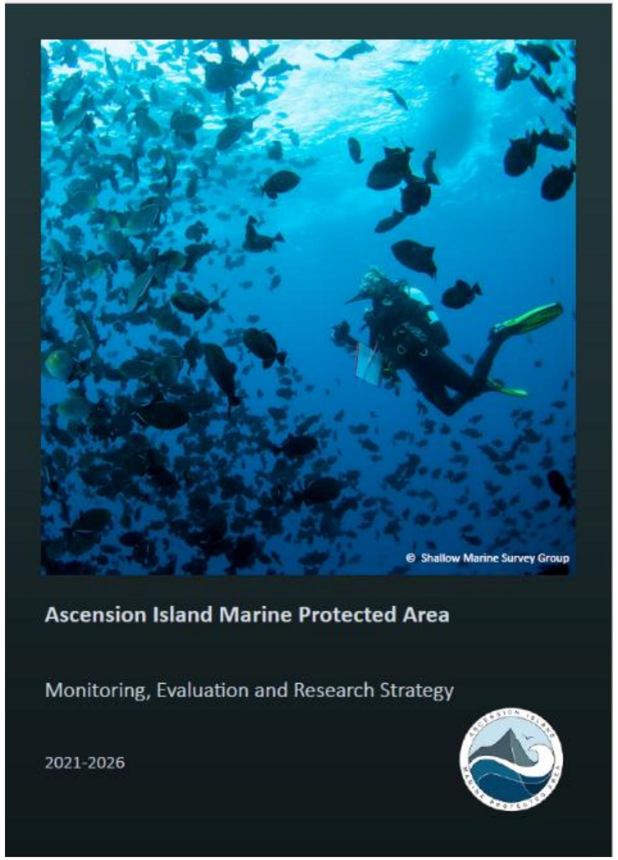
A hierarchy of objectives



Research and Monitoring Plans (RMPs)

- Strategy document to structure and plan monitoring
- Linked to MPA management plan
- What? How? Where? Who? When?
- Co-ordinate & maximise resources





Challenges of monitoring

Baseline data

May not be available

Approximations?

Longer to identify a trend

Inaccessibility and harsh environmental conditions:

Time and safety constraints

Cost and Resources:

Research vessels, equipment maintenance, personnel, and data analysis.

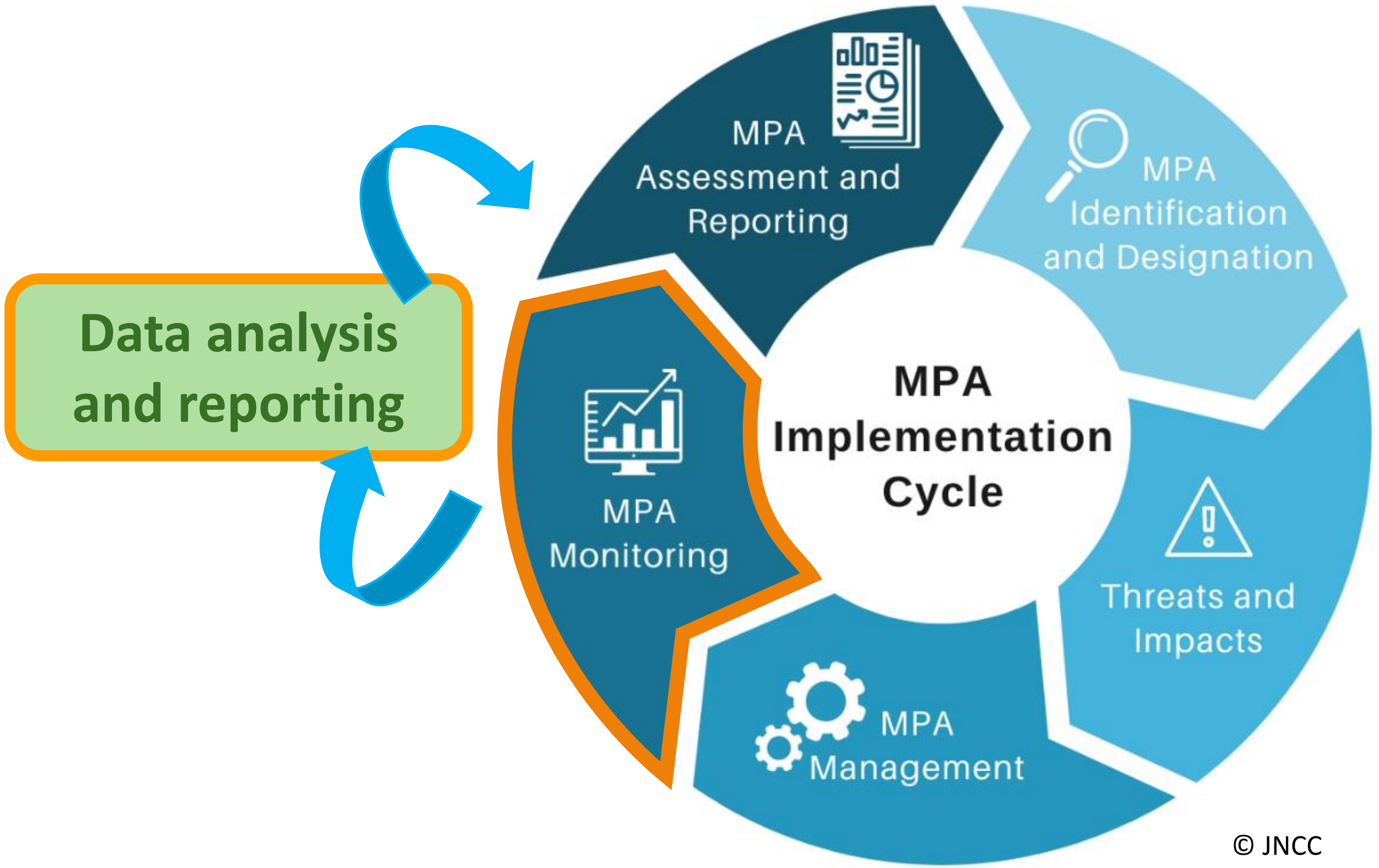
Frequency of monitoring efforts.

Technical Expertise:

Often requires specialized technical expertise in deep-sea research, e.g. operation of remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), submersibles.

Data Analysis and Reporting

The analysis and reporting phase involves processing and interpreting monitoring data and communicating the results to relevant stakeholders.



Benefits of Good Data Management

- Help organisations to optimize the use of data within the policy in place
- Increased confidence and trust datasets
- Value for money collect once, use many times
- Better quality and consistency of data
- Help effective decision making and protection of the environment
- Effective care of data and control over data access
- Avoid duplication
- Improved knowledge

Simplifying dataflows: collection to storage

- Develop proformas for both survey and analyses for easy transformation
- Fixed fields
- Standardised vocabulary
- Simplified and streamlined data entry – no repetition of effort

Survey Metadata

Station Metadata

Sample Metadata

Analysis Metadata

Metadata Example

Data

Metadata

Date: 21-23 of May 2013

Site : South of Isle of Scilly

GPS Longitude : -6.2122

GPS Latitude : 49.6902

Features*:* Subtidal coarse mixed habitat and *Atrina fragilis*

Description**:** Spatial extent of the Subtidal coarse/mixed sediments' is **81.39 km2.** Two records of the Fan Mussel were found.

Method: Acoustic data, grab and camera sampling

Licence*:* open/OGL

Attribution and copyright*:* JNCC & Cefas

This data revealed **features of conservation importance** - In 2019 the site was **designated as Marine Conservation Zone (MCZ)**

Data Storage

- Cost of collection **vs** cost of storage
- Survey logs
- Multiple locations
- Multiple copies
- Fireproof storage

Data Storage

Computers

Hard drives

Paper

Size

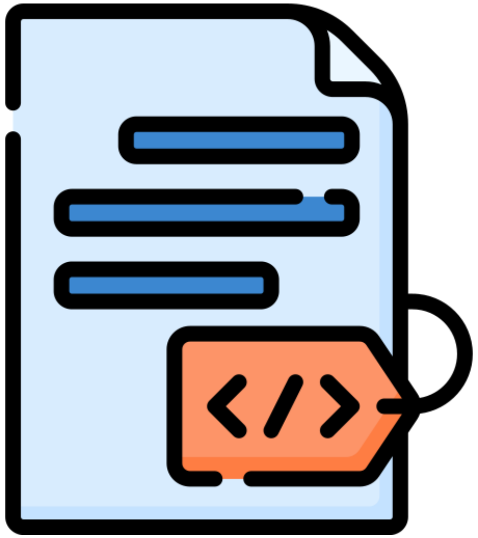
Cost

Backups

Cloud Storage

Data Standards & Protocols

- Metadata standards
- Need to know how data was
  - Collected
  - Processed
  - Analysed
  - Stored
- Methods need to be **repeatable**



The FAIR principles of Data

F

FINDABLE

- Unique identifier
- Rich metadata
- Keywords enabled

A

ACCESSIBLE

- Retrieved via open & authorized tool
- Metadata always accessible
- Accessible/readable format
- All in one place

I

INTEROPERABLE

- Common language
- Common vocabulary
- Linked to other relevant data products

R

REUSEABLE

- Richly described
- Clearly stated licence
- Clear data origin

Data quality: Key Features

Accuracy
Correctness of the data

Consistency
Standardising data entry

Completeness
Missing values can lead to misleading analysis

Uniqueness
Data are unique if appear only once

Timeliness
Data are available when expected and needed

Validity
Data matches the required format for use

@Data quality dimensions

Summary

You should now:

- Understand MPA monitoring and why it’s important
- Recognise the utility of MPA Research and Monitoring Plans (RMP)
- Have an overview of the main elements of MPA monitoring design
- Understand the importance of MPA monitoring data and research in MPA assessments