



# MARINE SABRES

*Aiming to reverse biodiversity decline by strengthening the conservation of coastal and marine areas, balancing human and ecosystem needs, and upscaling ecosystem-based management*

## A Simple Social-Ecological Systems analysis framework for marine biodiversity resilience and ecosystem sustainability

Kyriazi, Z., Verling, E., Smith G., Gregory, A., Atkins, J., Elliot, M. Hummel, H., Meirelles de Oliveira, B., Borja, A.

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# Systems Approaches for Biodiversity Resilience and Ecosystem Sustainability



## Overarching Aim:

To conserve and protect biodiversity by integrating Sustainable Ecosystems and a Resilient Blue Economy.

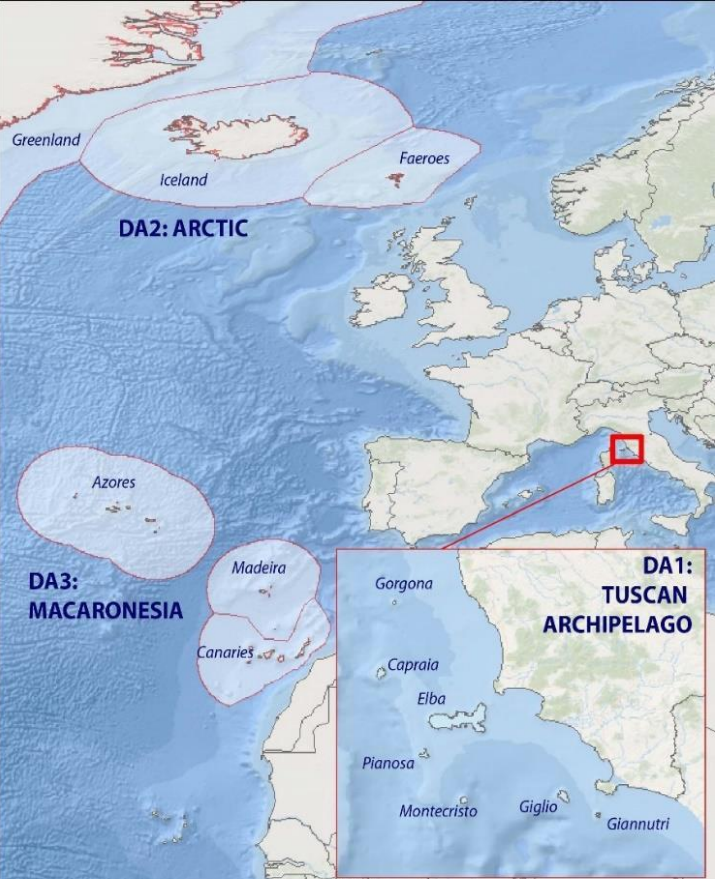
This will be done by bringing [stakeholders together](#) from government, policy, business and coastal and marine management, with scientists to co-design a [Simple Social-Ecological System \(SES\) analysis framework \(the Simple SES\)](#).

Which will be used to [improve the uptake of Ecosystem-Based Management \(EBM\)](#) and [strengthen interventions and measures](#) for the protection and conservation of coastal and marine areas, their biodiversity and [Ecosystem Services \(ES\)](#).....”



# 22 Partners

# Horizon Europe Project



**3 Demonstration Areas (DAs):**

Tuscan Archipelago

Arctic North

East Atlantic



# 11 Countries

**Started in 2022 and will last for 4 years Funding: €9.8m**

# Demonstration areas: Where and what?



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**DA 1: Tuscan Archipelago Territories: Italy (IT)** focusing on the maintenance and restoration of natural carbon sinks.

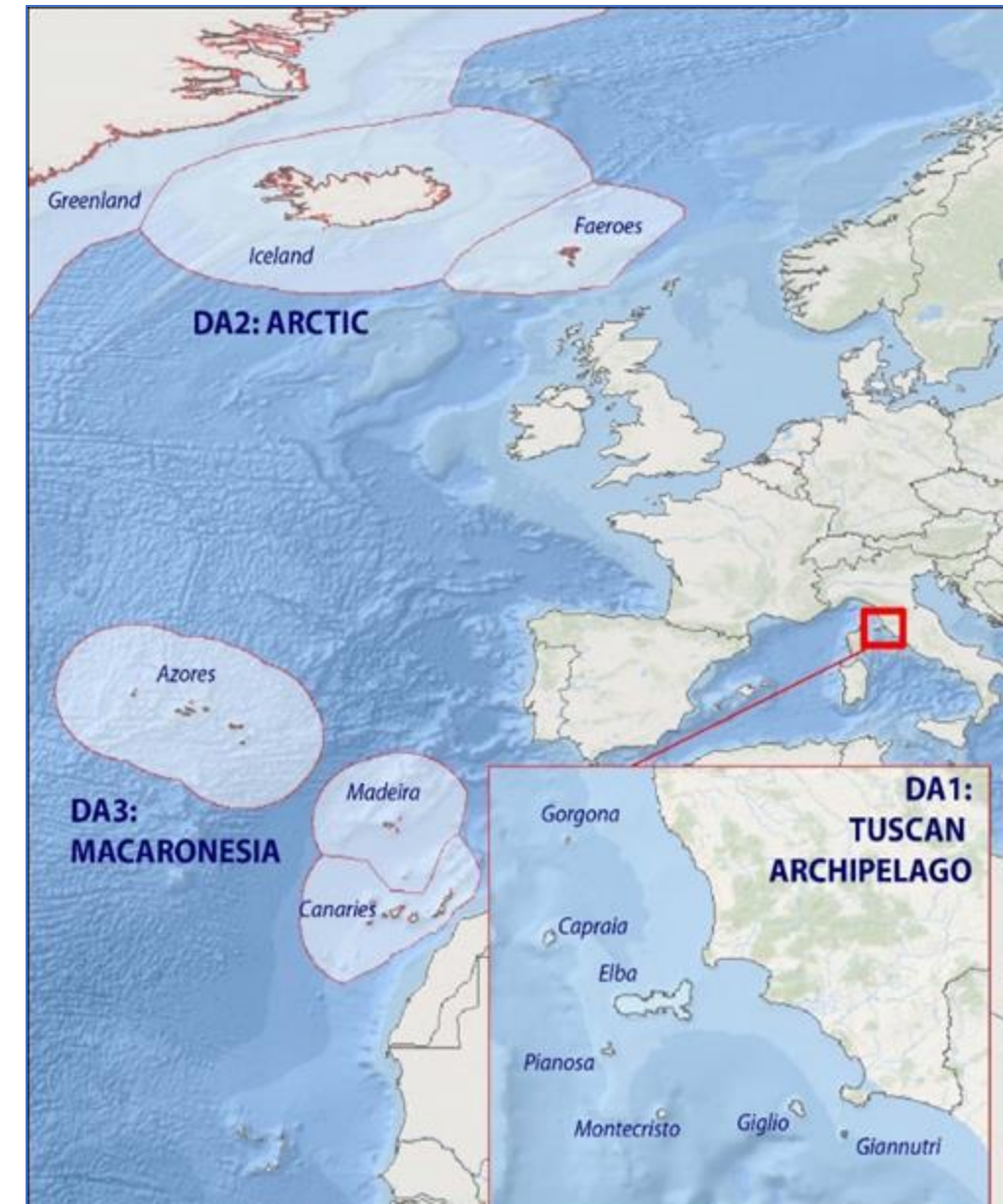
**Aim:** increasing the regulatory ES, by enhancing the carbon sequestration ability of seagrass habitats.

**DA 2: The Arctic North-East Atlantic Territories: Iceland (IS), Greenland (DK), Faroes (DK)** focusing on the effects of climate change and changing oceanographic conditions on fisheries.

**Aim:** increasing food provisioning ES, by sustainably caught fisheries and the sustainable development of aquaculture.

**DA 3: Macaronesia Territories: Azores (PT), Madeira (PT), Canaries (ES)** focusing on balancing biodiversity conservation and responsible use of the region nature-based tourism and nautical recreation.

**Aim:** increasing the benefits from conservation and restoration from increased cultural ES (tourism).

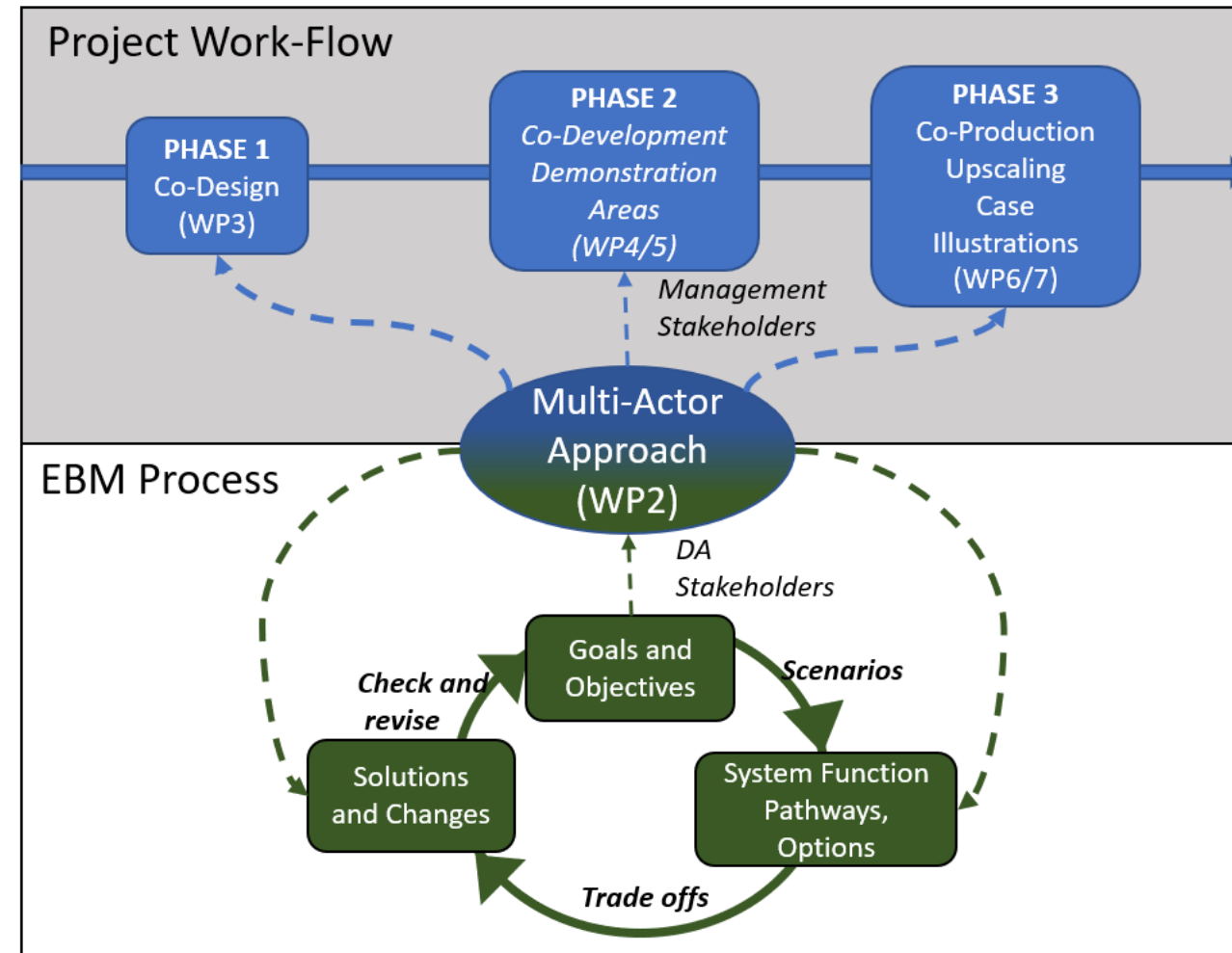


# Workflow: a multi-actor approach towards Ecosystem Based Management (EBM)

**PHASE 1: Specification and development of the SES analysis framework (the Simple SES)** by project experts and identification of priority components to be included in the analysis by stakeholders from the three Demonstration Areas (DAs).

**PHASE 2: Application and testing of the Simple SES** to check its functionality, attempt a baseline assessment of each DA system and parallel Identification of desired scenarios and costing of pathways towards transformation

**PHASE 3: Refinement of the Simple SES and** packaging of all tools and guidance used to suggest a Decision Support System (DSS) Upscaling of the Simple SES will be tested it in more complex systems.

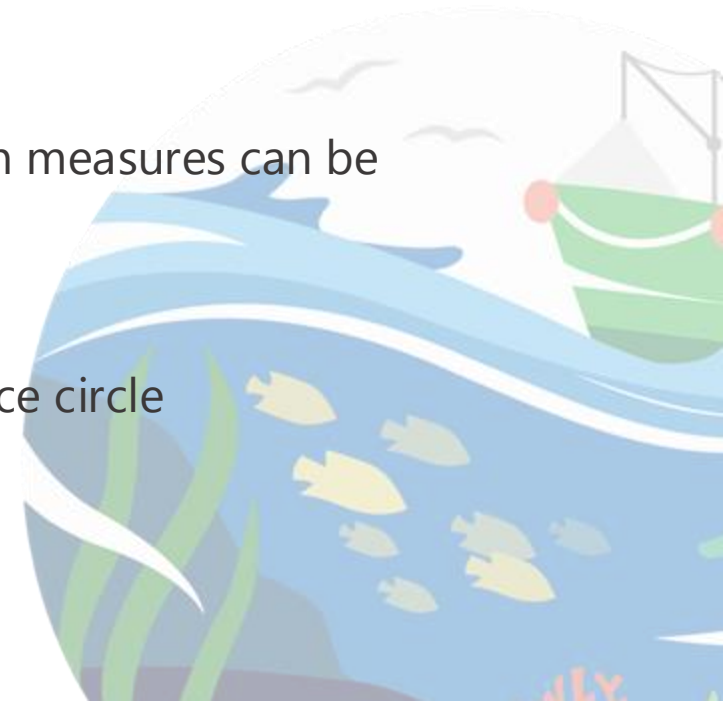


# What are Social Ecological Systems (SES) analysis frameworks

- SES frameworks are models composed of subsystems, which aim to describe the components and interactions between human systems and ecological systems.
- They are used by managers and decision makers to support EBM, balancing human well-being and economic activity, with environmental protection and conservation.
- By considering the system as a whole, targeted conservation and protection measures can be directed at any element of the SES.
- The challenge is to position correctly each element in the cause consequence circle



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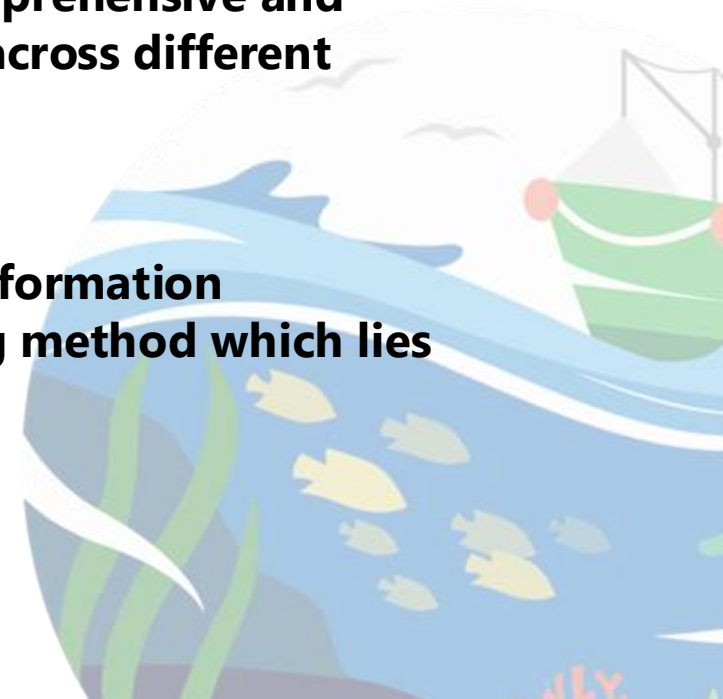


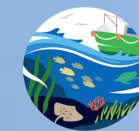
# Specification and development of the Simple SES by project experts

- **SWOT analysis to compare nine SES frameworks** (Ecocycle Framework, Ecosystem Services Framework, Integrated Ecosystem Assessment, Integrated Systems Analysis, Social-Ecological System Framework, Social-Ecological Action-Situation Framework, Sustainable Livelihoods Approach, Systems Analysis Framework, and Turner Vulnerability Framework).
- The **Integrated Systems Analysis (ISA)** is the most suitable, due to its **comprehensive and inclusive approach, stakeholder integration, and communication utility across different operations levels.**
- An adapted ISA framework was proposed that incorporates a **Process and Information Management System (PIMS)** and the **DAPSI(W)R(M) problem structuring method** which lies at the heart of the ISA framework.

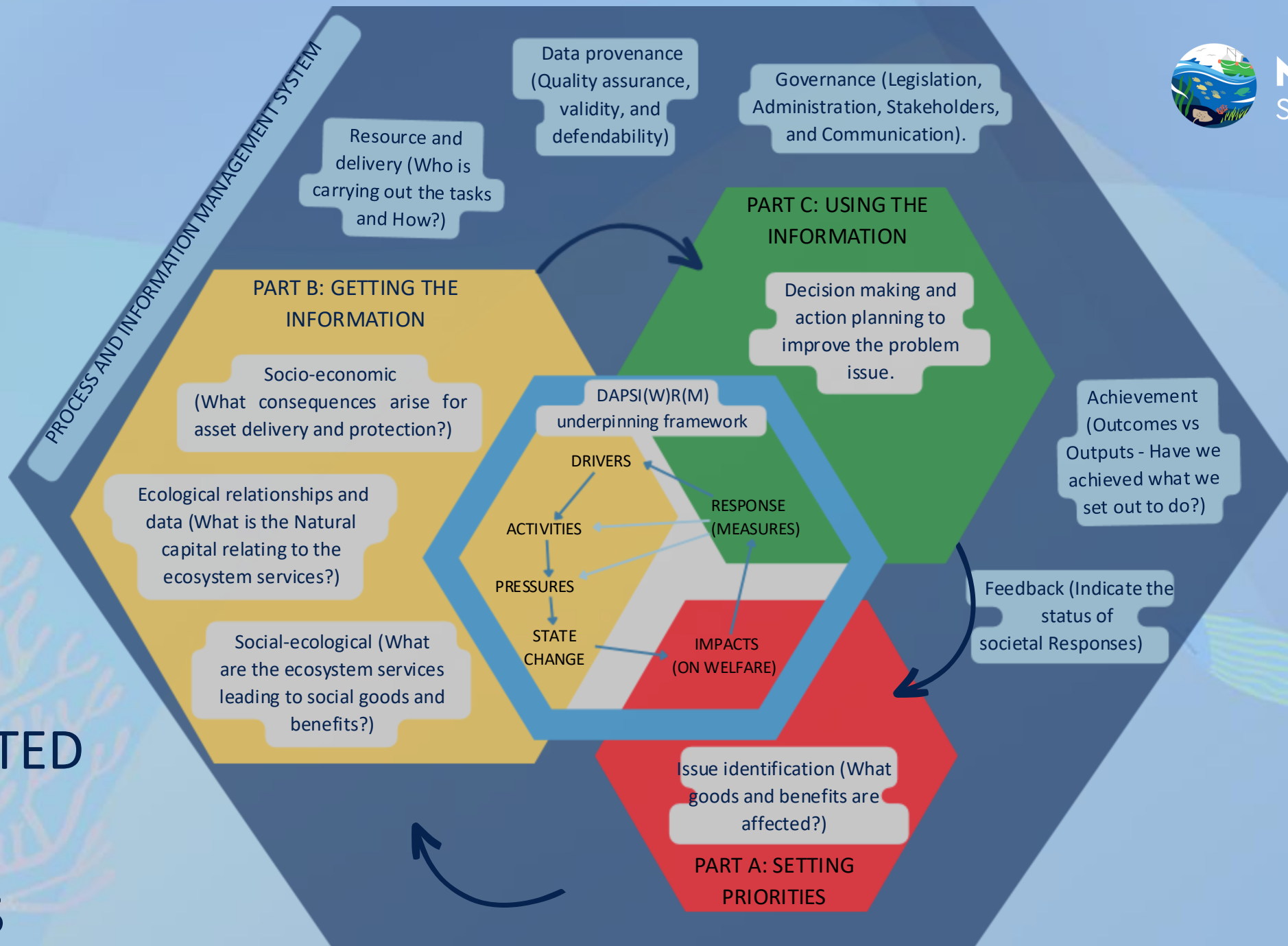


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# THE INTEGRATED SYSTEMS ANALYSIS



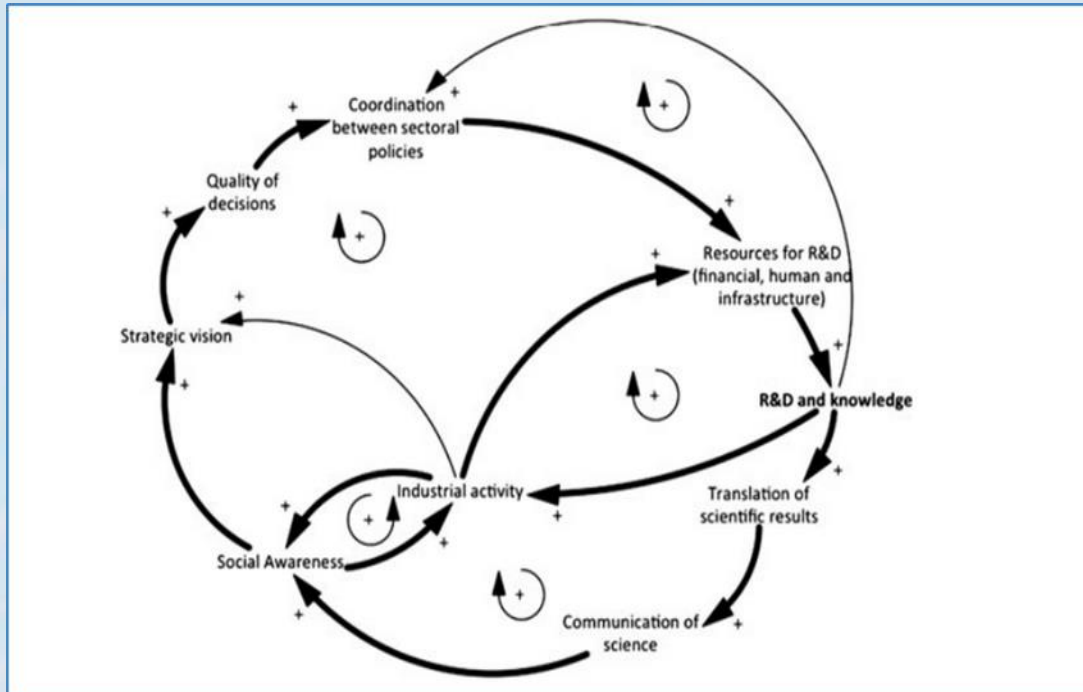
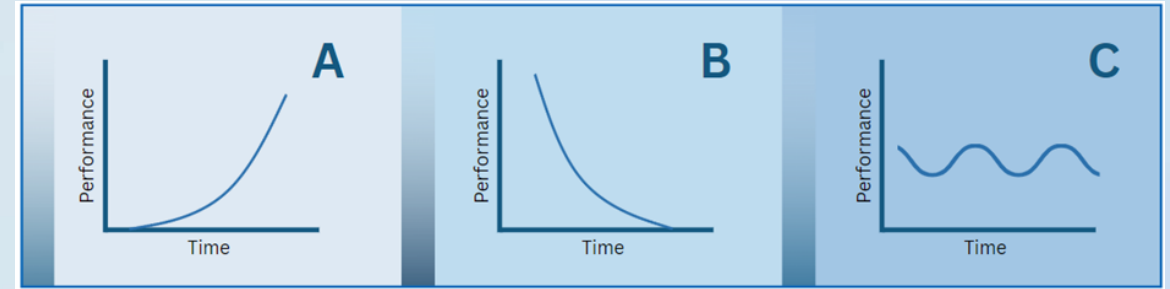




# Integration of systems thinking tools in the Simple SES

## Behaviour Over Time Graphs

The BOTs can be used to connect past observed behaviour with future behaviour in a way that offers insight into **underlying causal structures**.



## Causal Loop Diagrams

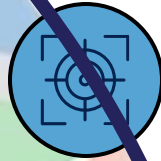
A qualitative systems-based tool that **shows the relationships between a set of elements** that are variables (factors liable to change, e.g. indicators) operating in a system.

## Indicators

variables which provide information on complex phenomena, and if selected appropriately, these indicators **can show changes in the outcomes of the complex system**



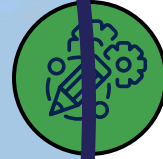
# DAPSI(W)R(M) and modelling process



Establish the focal issue and identify the number of impacts on human wellbeing associated.



Break down the different elements that create the causal chain related to the DAPSI(W)R(M) Framework.



Taking each element, in turn, to identify the relevant time horizon over which the effects take place.



Assessing the relationship between elements of the system to create data sheets to create a casual loop diagrams (CLD).



Causal loop analysis, identify key leverage points, and explore the system's behavior by tracing out the loops and storytelling to inform stakeholders and management responses.

# What does the Simple SES include?



A written guidance document

A Data Analysis Excel

A copy and paste KUMU Code

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Marine SABRES Deliverable 3.1  
**Simple Social-Ecological Systems Guidance**

UCC, MaREI, LifeWatch, ordini, MARE, DTU, sjokovinn, eco logic, RIFS, INFANNOUNATSPINN, A Z Ti, HufoS, UNIVERSITÀ DI PISA, University of Algarve, WAGENINGEN, AALSBORG UNIVERSITY, Umeå University, Royal Netherlands Institute for Sea Research, WWF, Cefas, UNIVERSITÄT DUISBURG ESSEN

### The Integrated Systems Analysis

This workbook includes all relevant and referenced tables relating to the Integrated Systems Analysis (Part 3) of the Simple SES guidance.

Tasks	Link to tables						Progress	
Exercises	E1 Goods and Benefits	E2(a) Ecosystem Services	E2(b) Marine Processes and Functioning	E3 Pressures	E4 Activities	E5 Drivers	E6 Closing the Loop	
Behaviour Over Time Graphs	Goods and Benefits	Ecosystem Services	Marine Processes and functioning		Pressures	Activities	Drivers	
Adjacency and Sensitivity matrices	Goods & Benefits and Ecosystem Services	Ecosystem Services and Marine Process and Functioning	Marine Process and Functioning and Pressures		Pressures and Activities	Activities and Drivers	Drivers and Goods & Benefits	
Kumu Export Sheets	Labels and Types	KUMU Goods and Benefits & Ecosystem Services	KUMU Ecosystem Services and Marine Processes and Functioning	KUMU Marine Processes and Functioning and Pressures	KUMU Pressures and Activities	KUMU Activities and Drivers	KUMU Drivers and Goods and Benefits	

Once you have completed the sheet/task, check the box to indicate your progress.

### THE PROCESS AND INFORMATION MANAGEMENT SYSTEM (PIMS)

This workbook includes all relevant and referenced tables relating to the Process and Information Management System (PIMS) in Part 1 of the Simple SES guidance.

Link to tables	Tasks				Progress	
Resource Management	People/Skills	Financial Resources	Other Resources (e.g., IT, natural resources)	Communication & Monitoring	Reallocation & Adjustment Mitigation notes	
Risk Management	Risk Description	Impact description	Impact, Probability and Priority Level			
Stakeholder Engagement, Communication and Management	Stakeholder typology	Stakeholder Communication Plan	Stakeholder Power Grid			
Data Management	File Types & Formats	Documentation	Storage, Security & IP	Data Sharing	Preservation	
Outcome Evaluation	Scope of the goal	Objectives	Indicator/Target			
Process Evaluation						

Once you have completed the sheet/task, check the box to indicate your progress.

```

Kumu_Code_Style
Edit View

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controls {
  bottom {
    filter {
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      by: "element type";
      as: buttons;
      multiple: true;
      default: show-all;
    }
  }
}

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    density, average-degree;
  }
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}

Ecosystem Service */
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Marine Processes and Functioning */
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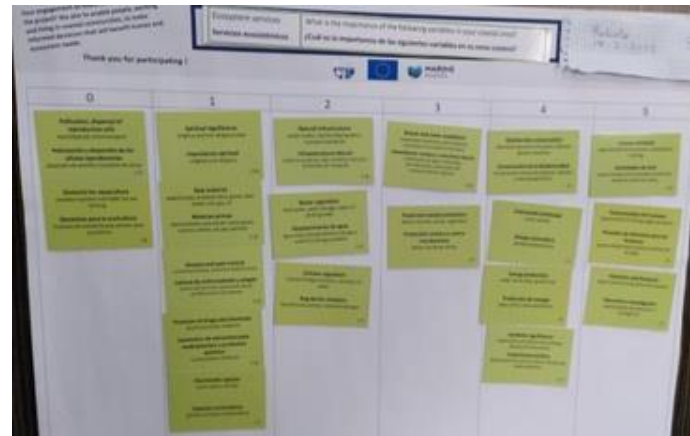
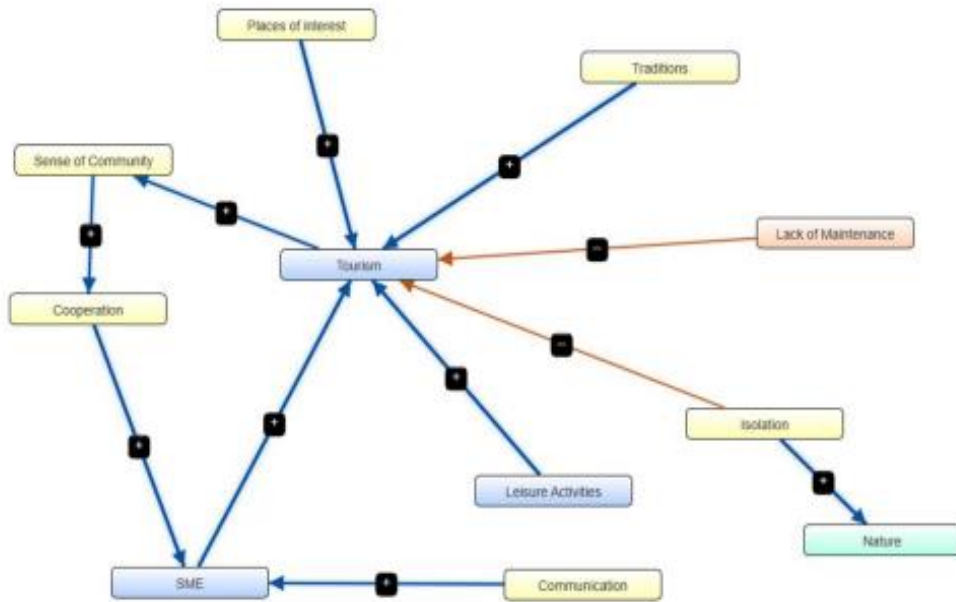
Pressures */
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}
    
```

A Process Management Excel

# Stakeholder engagement

## Creation of stakeholder groups in each DA and:

- Collection of their views on their environment (ecological (incl pressures), economic, societal components in their DA) via workshops and interviews
- Provision of their appraisal and feedback on the results, tools, and outputs of the project to ensure they are usable and useful via dedicated annual workshops of key SH, to



# Identification of priority components by stakeholders

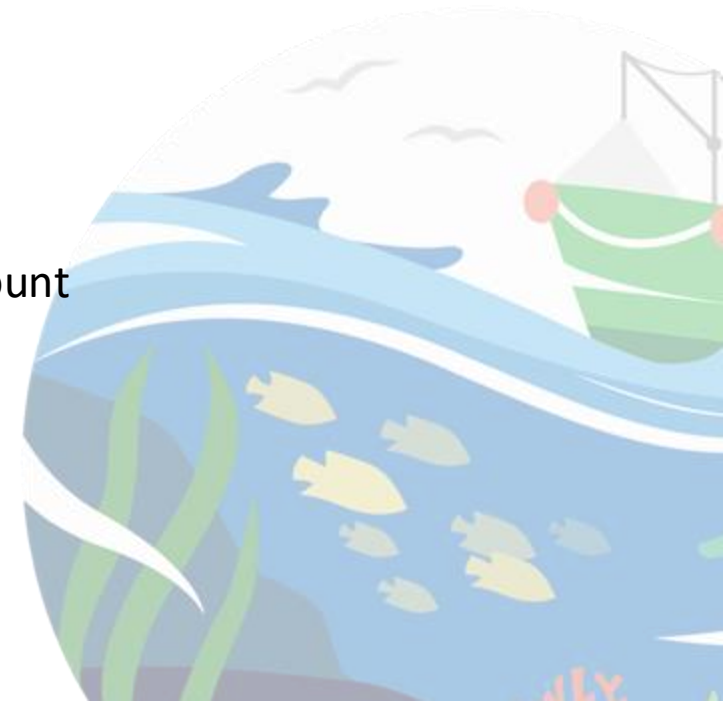
**Priority components in common:** Biodiversity, Nature, Large-scale Tourism, Economy, Pollution

**Priority components in each geographic area:**

- ❖ Arctic: climate change, exotic spp, PAs, indigenous society, seasonality
- ❖ Mediterranean: communication, PAs, (seagrass) habitats, harbour
- ❖ Macaronesia: conservation, control of rules & regulations, local fisheries

**Knowledge on existing guidelines & tools:**

- in general, SH are aware of European rules and guidelines
- yet, are hardly aware of, or do not use, specific tools (as ES concept, EBM, DSS)
- for policy and management actions the regional differences must be taken account
- they are not used to using the concepts mentioned in the project

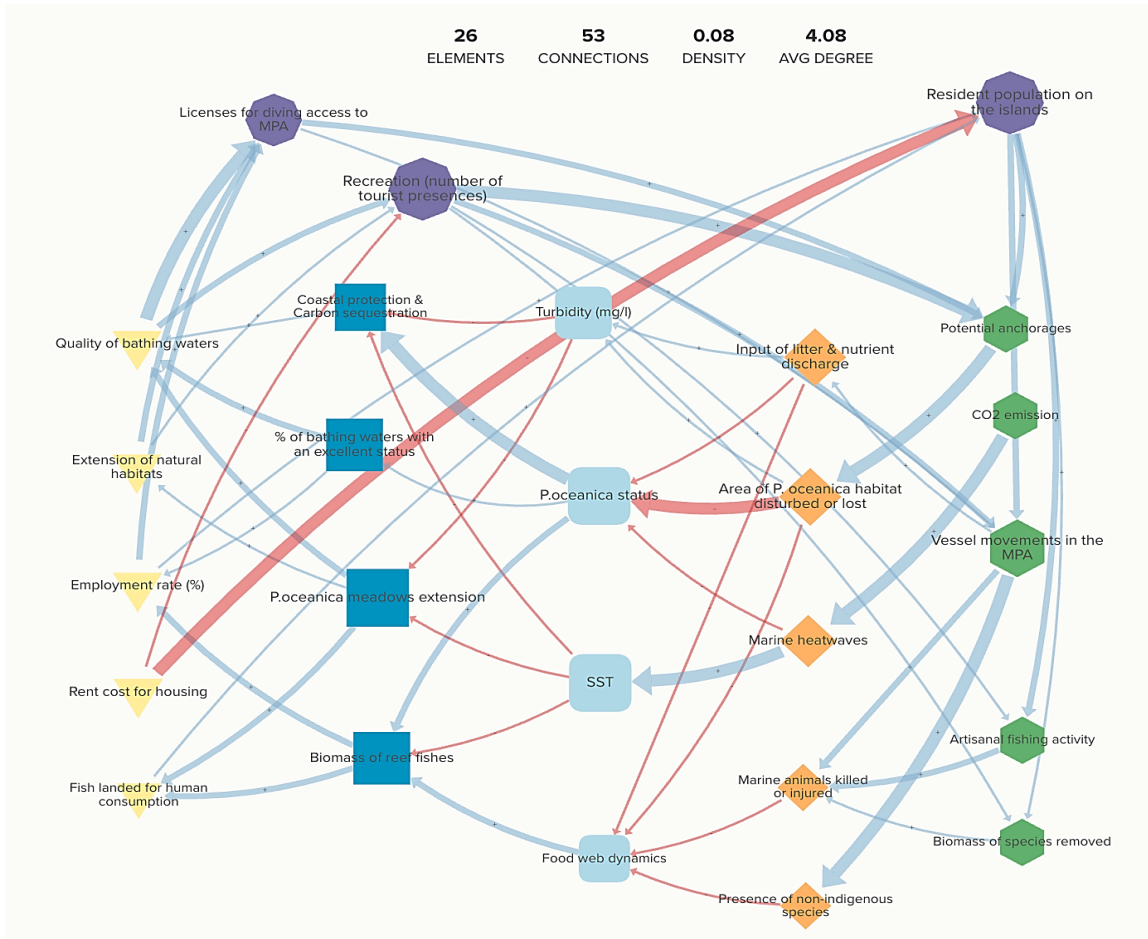


# Testing and evaluating the simple SES

The DA experts/partners were guided via several workshops on how to apply the Simple SES in their DA using their own expert judgement, literature and SH input from the previous step

However, the results of the application of the simple SES framework were considered not robust enough to support the development of the rest of the project.

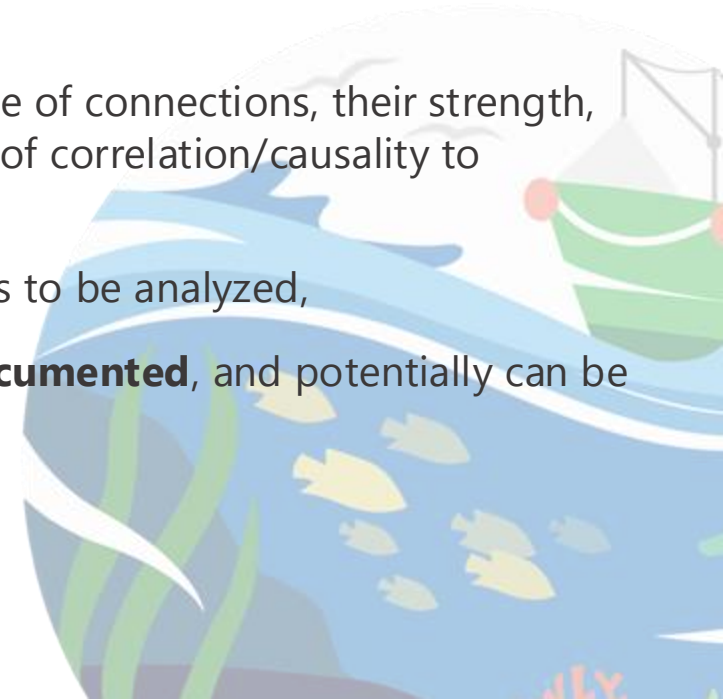
To proceed with the rest of the work that relies on the CLDs (scenarios, pathways, impact assessment, governance and the final dss) and help refine the simple SES, a different method for producing CLDs was developed and applied in the DAs



An example of a Causal Loop Diagram produced by the Simple SES application for the Tuscany Archipelago

# Concerns and recommendations for the refinement of the simple SES

- ❖ The necessity of **in-depth knowledge about systems science**, at the first stages of the modeling process
- ❖ **Data scarcity** or quality of data should be considered
- ❖ **updating the CLD analysis slows down the process**
- ❖ Feedback from the DA applications found **barriers** with the process **related to communicability and replicability**
- ❖ Opportunities to **improve the transferability to managers and end users** of the approach were presented within this initial application of the simple SES
- ❖ The structure of the **resulting model showed limitations** as the presence/absence of connections, their strength, presence/absence of indicators, exclusion/inclusion criteria for indicators, and use of correlation/causality to establish the connections that summed up to a limited trust in the results.
- ❖ **The loop-analysis and selection was very time-consuming**, with excessive loops to be analyzed,
- ❖ But, when considering the replicability of the **process**, users considered it **well documented**, and potentially can be applied in other sites, with considerable efforts.





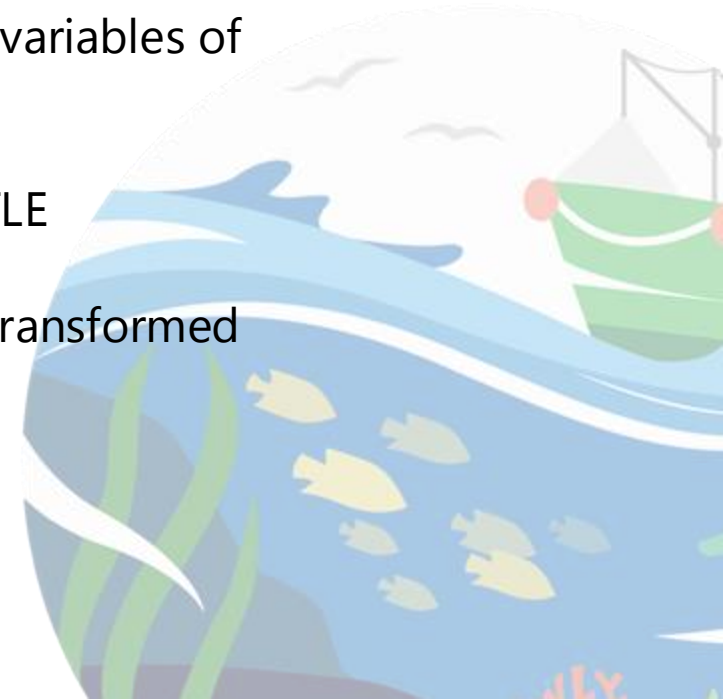


# From CLDs to transformation pathways

In a different exercise (not presented here) the regionalised SSP1 and SSP2 were identified as more relevant to be used as the desired futures for each DA

To understand the pathway for the required transformation, we will:

- Identify trade-offs, enablers and barriers, challenges and opportunities for SSP1 and SSP2 based on the mapped system, DA expertise and stakeholder's input
- navigate the new CLDs to explore the systemic properties that lead to the variables of interest (mapped with PESTLE).
- Map these loops and other systemic properties that lead to variables PESTLE
- Propose (to be discussed with stakeholders) ways that the system can be transformed towards desired scenarios



# Upcoming work: Development and application of social-economic scenarios

- ❖ Stakeholder-driven scenarios of pathways for transformation have been co-developed
- ❖ The scenarios will be used to generate costed potential options for development and “futures” aligned with major policy objectives for sustainability, resilience, biodiversity, and Ecosystem Services
- ❖ For each of the three DAs, the trade-offs between different social, ecological, and economic aspects will be characterized
- ❖ Stakeholder appraisal of outcomes (the CLDs, the scenarios, the measures)
- ❖ Refinement of the sSES based on new iterations while considering feedback from DA experts and stakeholders
- ❖ Development of a DSS that addresses all the above





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# Thank you!

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