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# Biodiversity offset, the challenge of its evaluation and its dimensioning

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# Regional thematic school on the Vulnerability of Reef heritage DIDEM program

## Biodiversity offset, the challenge of its evaluation and its dimensioning

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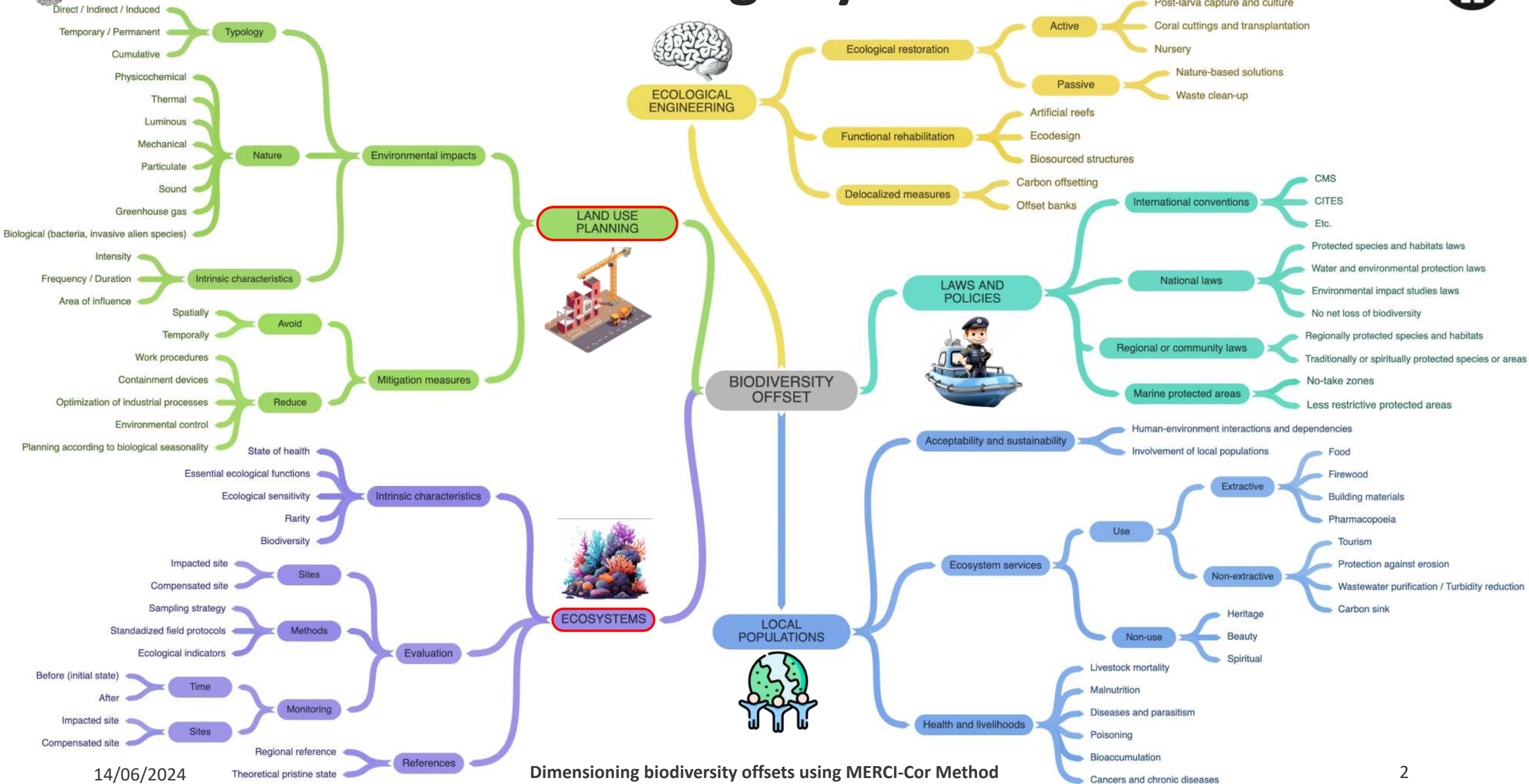
UMR 9220 UR CNRS IRD – ENTROPIE, Saint-Denis, Reunion Island.



June 14, 2024 – Blue Economy Research University of Seychelles

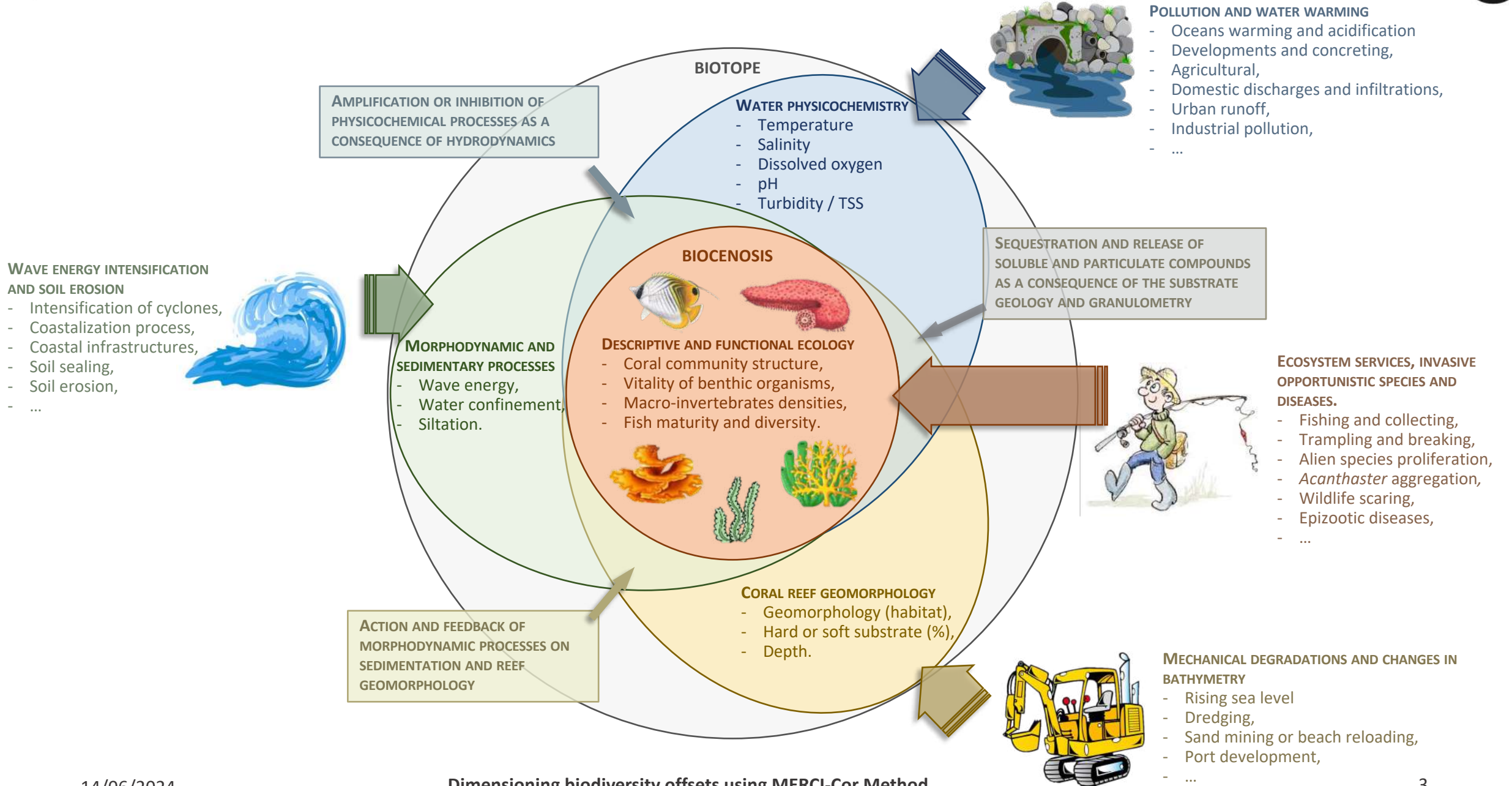


# The offsetting key attributes





# Shared and grouped key attributes

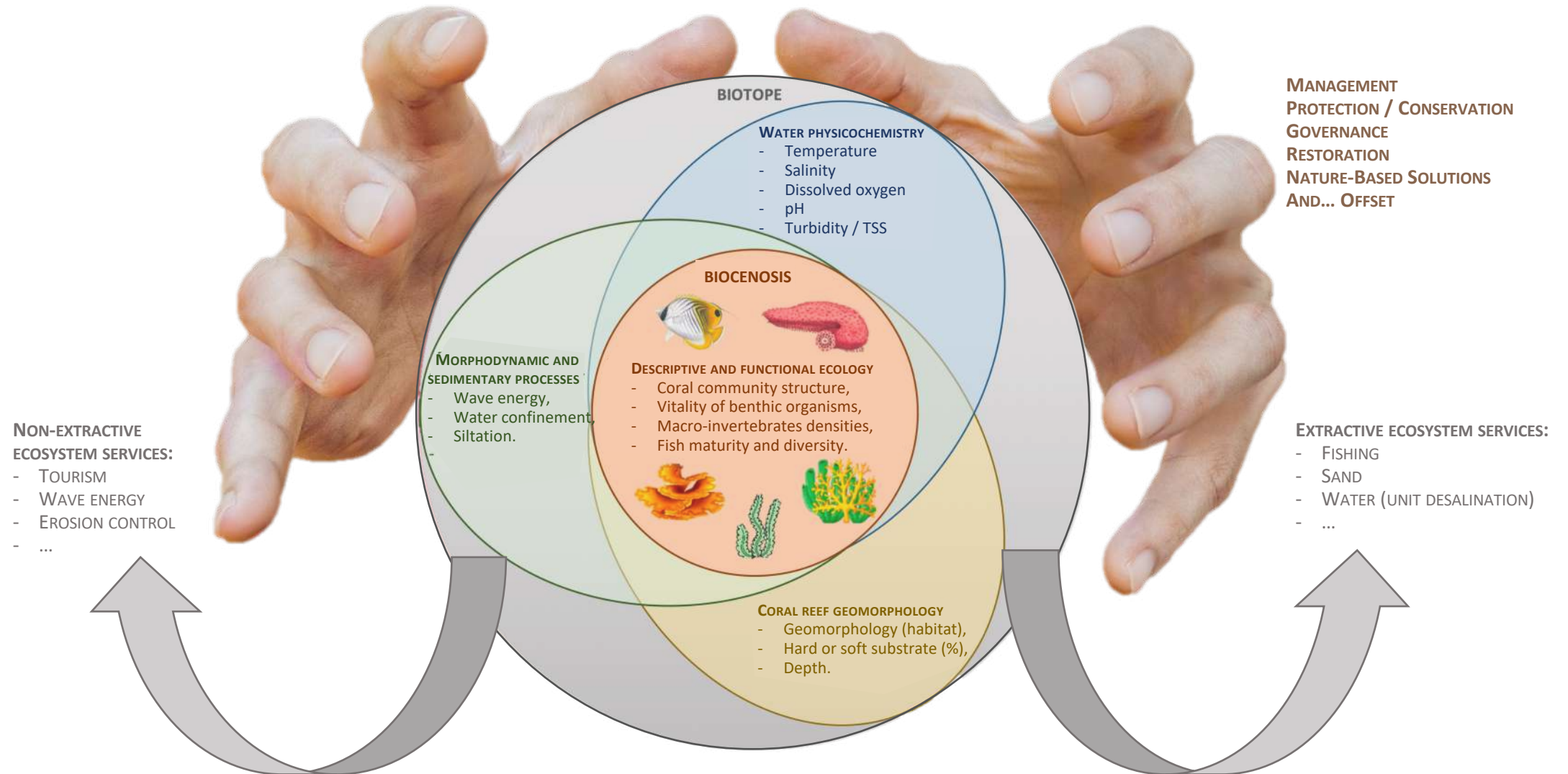




# With a sustainable development objective



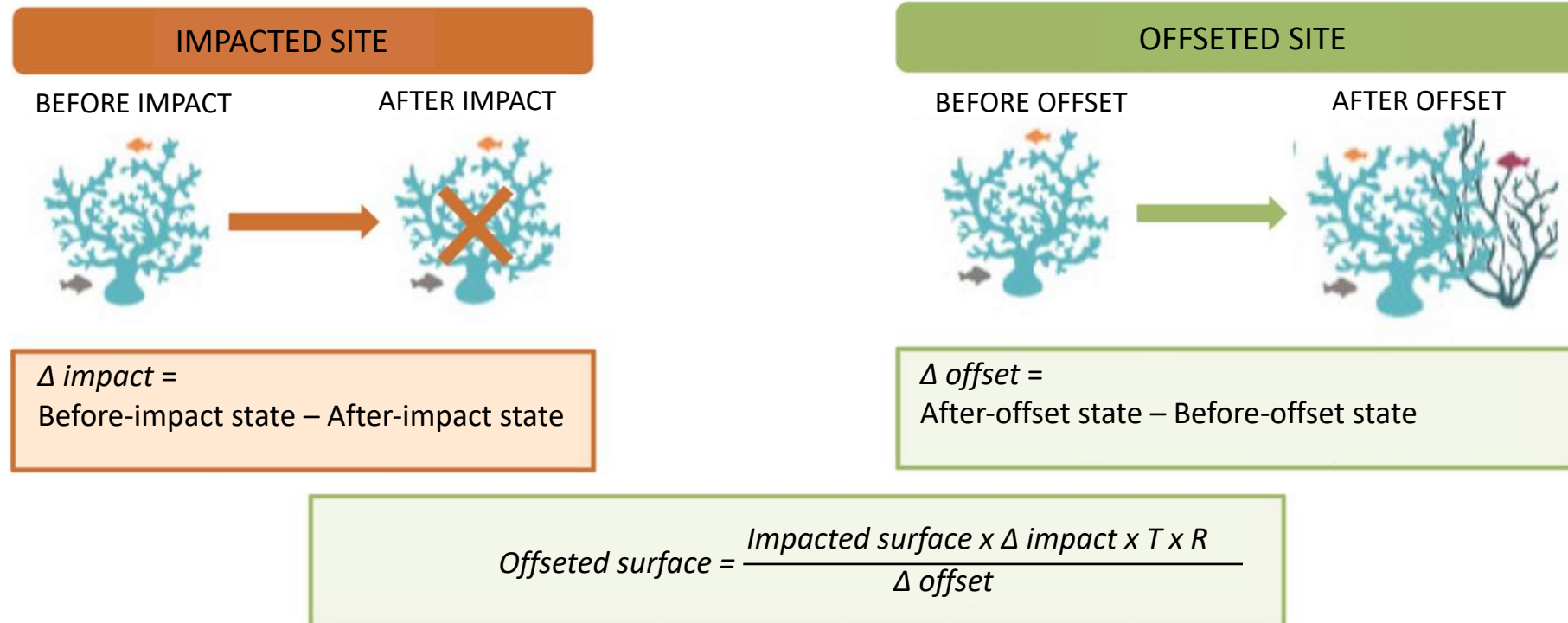
REGULATION, POLICIES AND OFFSETS





# How does the MERCI-Cor method work?

**MERCI-Cor:** Method to avoid, reduce and offset for impacts on the biodiversity of coral reefs and associated ecosystems (i.e. seagrass and mangrove)



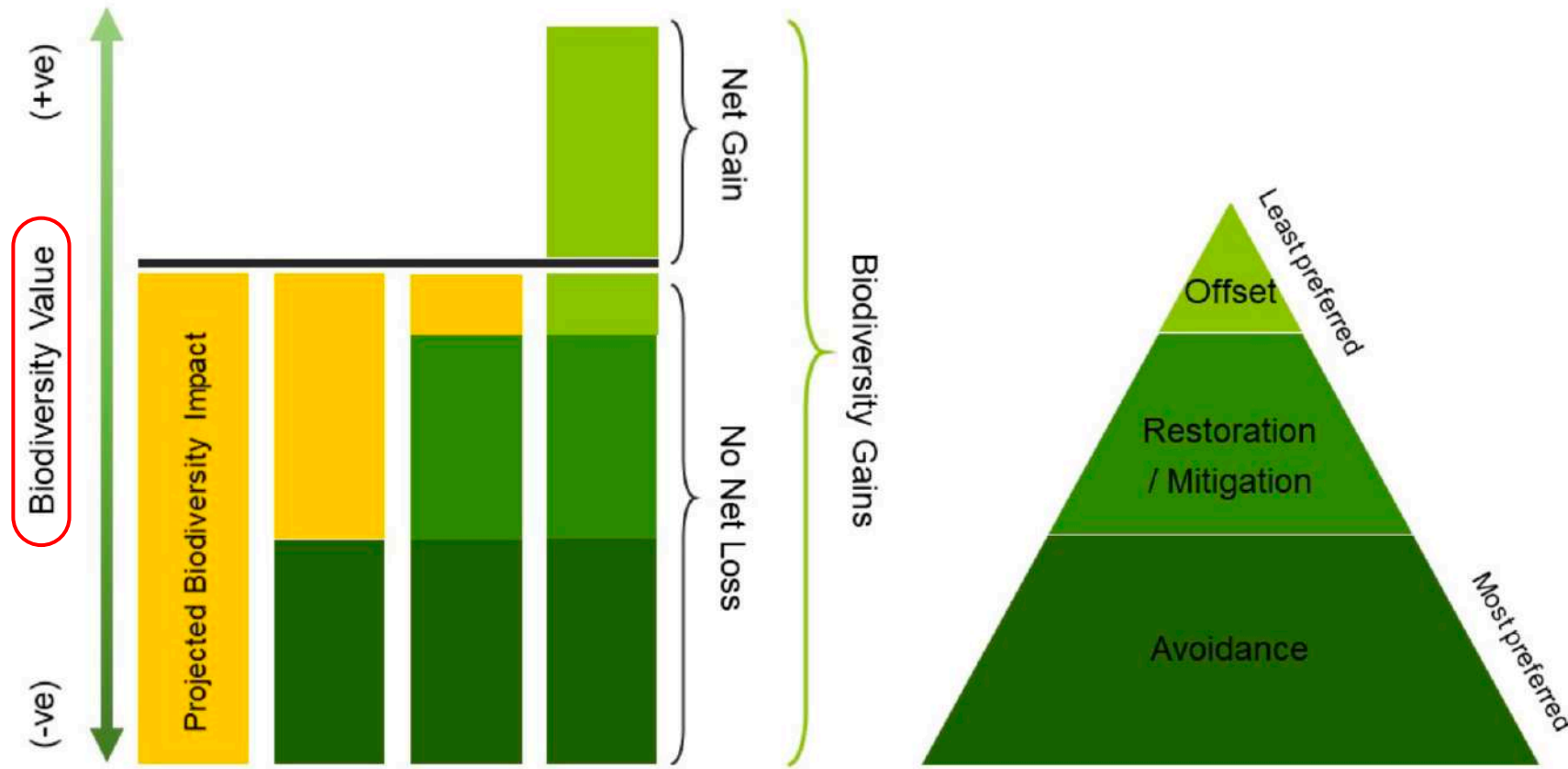
*Adjustment coefficients:*

*T = Time required to achieve the offset measures objectives (1 to 3 score)*

*R = Ecological, socio-political and technical risk of not achieving the objectives set by the offset measures (1 to 3 score)*



# The 'No Net Loss' principle



**Avoid:** Either in space or in time

**Reduce:** Either by industrial processes, or by protective devices, etc.

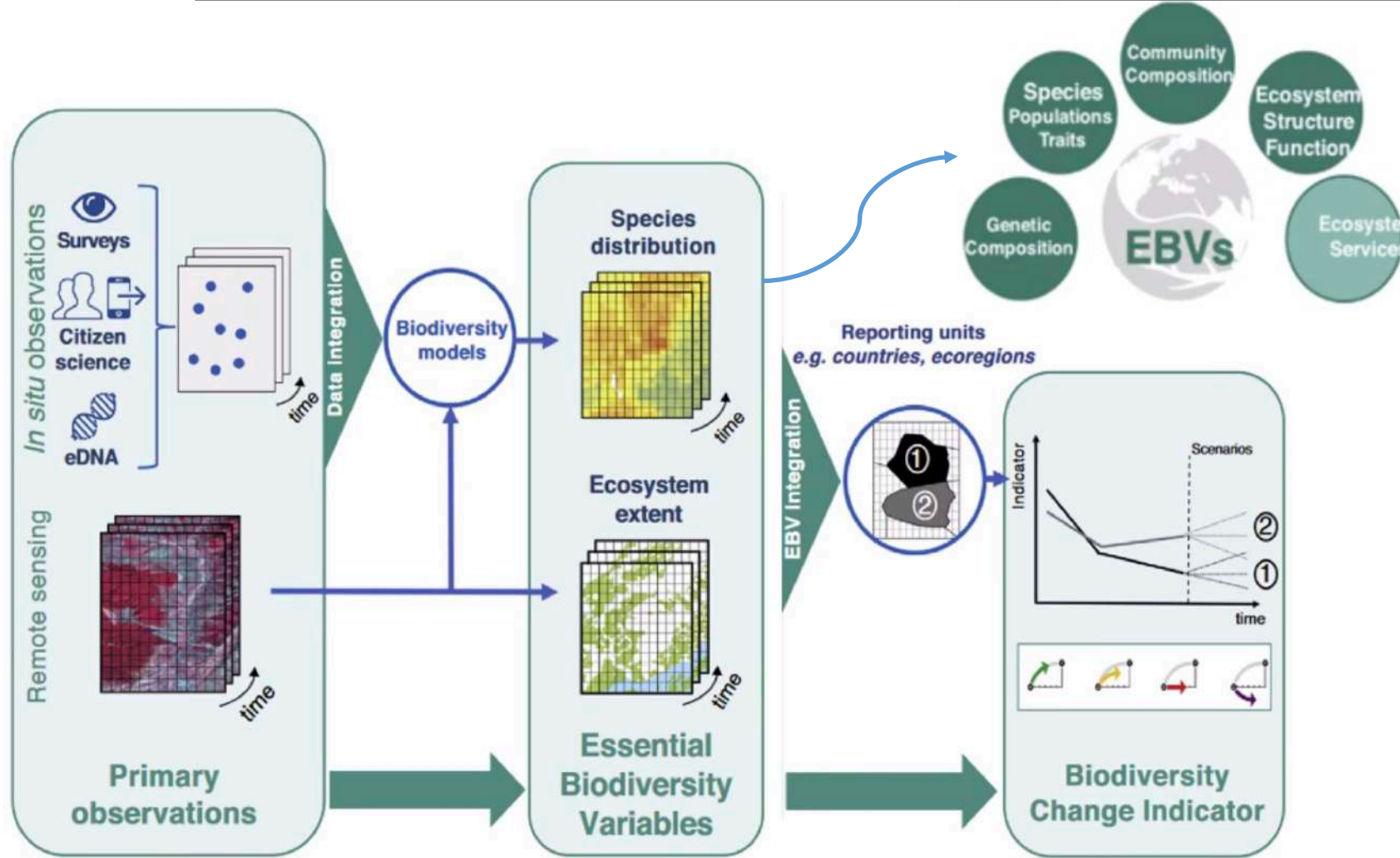
=> **Residual impacts**

**Offset:** Either by nature-based solutions or by manufactured devices such as artificial reefs

Mitigation hierarchy of Biodiversity value (Modified from Energy and Biodiversity Initiative (EBI) - 2005)



# The 'Essential Biodiversity Variables' (EBVs)



How to assess and how to quantify the Biodiversity Value?

How to calculate a Biodiversity Unit, valid for different ecosystems?

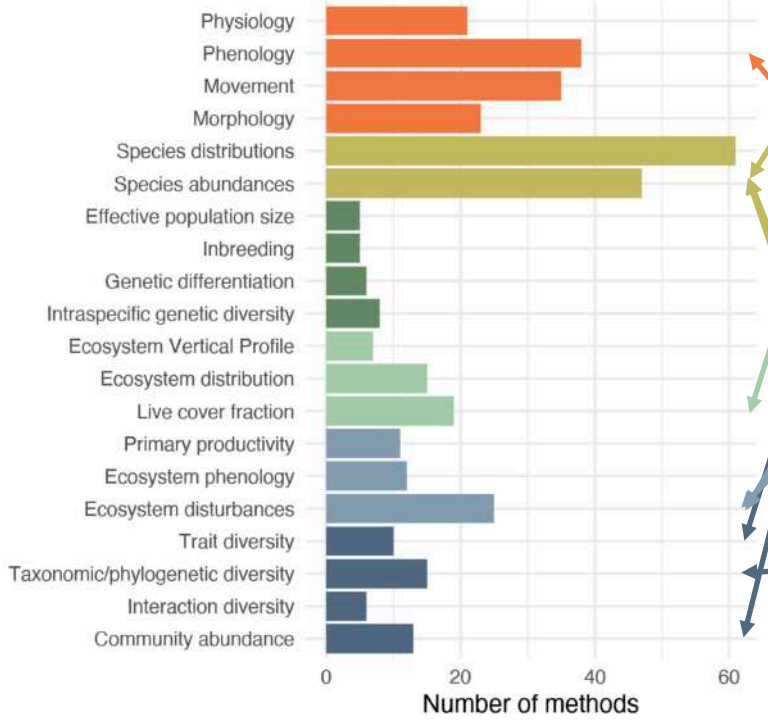
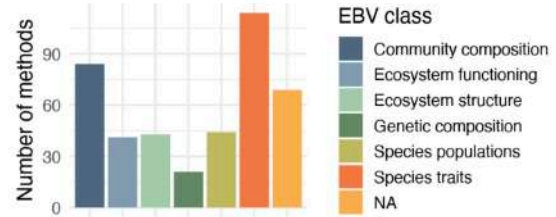
How to compare Biodiversity Value losses due to environmental impacts and gains generated by offset measures?

From observations to the production of EBVs and indicators. In this example, integrated data from different primary sources of observations (e.g. *in situ*, remote sensing) are combined within biodiversity models to produce layers of spatial and temporal variation in ecosystem extent and species distribution EBVs (Navarro et al., 2017)





# Which EBVs should be selected for each ecosystem?



## CORAL REEFS

- Coral cover
- Percentage of *Acropora*
- Coral colonies diameter
- Coral morphotypes diversity

## SEAGRASS

### BENTHIC COMMUNITY STRUCTURE

- Fragmentation
- Seagrass cover
- Seagrass species richness
- Canopy height

### BENTHIC COMMUNITY VITALITY

- Coral state of health (diseases/necrosis)
- Juvenile corals density
- Fleshy algae cover
- Opportunistic sessile fauna cover

- Leaf necrosis
- Epibiota invasion
- Root shedding
- Overgrazing (plowing)

### ASSOCIATED FAUNA

- Fish species richness
- Top-predator size and density
- Parrotfish size and density
- Sea urchin and sea cucumber density

- Fish species richness
- Top-predator size and density
- Parrotfish size and density
- Sea urchin and sea cucumber density

## MANGROVES

- Fragmentation
- Adult mangroves density
- Trunk circumference
- Canopy height
- Mangrove species richness

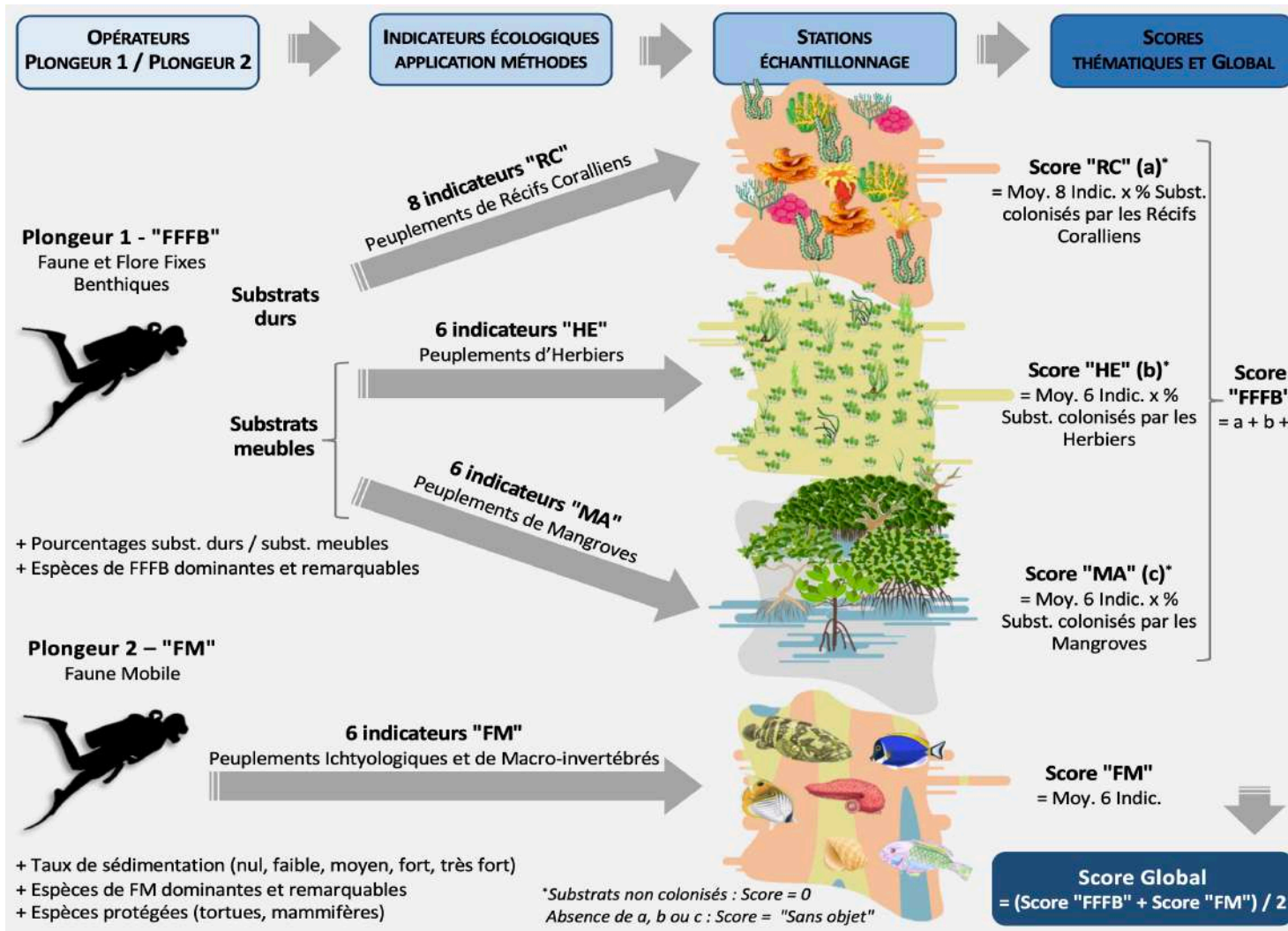
- Leaf necrosis
- Juvenile mangroves density
- Root shedding
- Anthropogenic uses stigmata
- Symbiotic epibiota cover

- Indigenous avifauna
- Crabs bioturbation
- "Keystone" species
- Invasive exotic species
- Fish species richness





# How to measure these EBVs on the field?



## THE STANDARDIZED FIELD PROTOCOLS

- Use Rapid Assessment Methods
- Use standardized measurements
- Use regional references
- Consider the seasonality
- To test and validate hypothesis

## THE RAM METHODS

CORRAM: Coral Reef RAM

SEARAM: Seagrass RAM

MANRAM = Mangrove RAM



# What makes a 'successful' indicator?

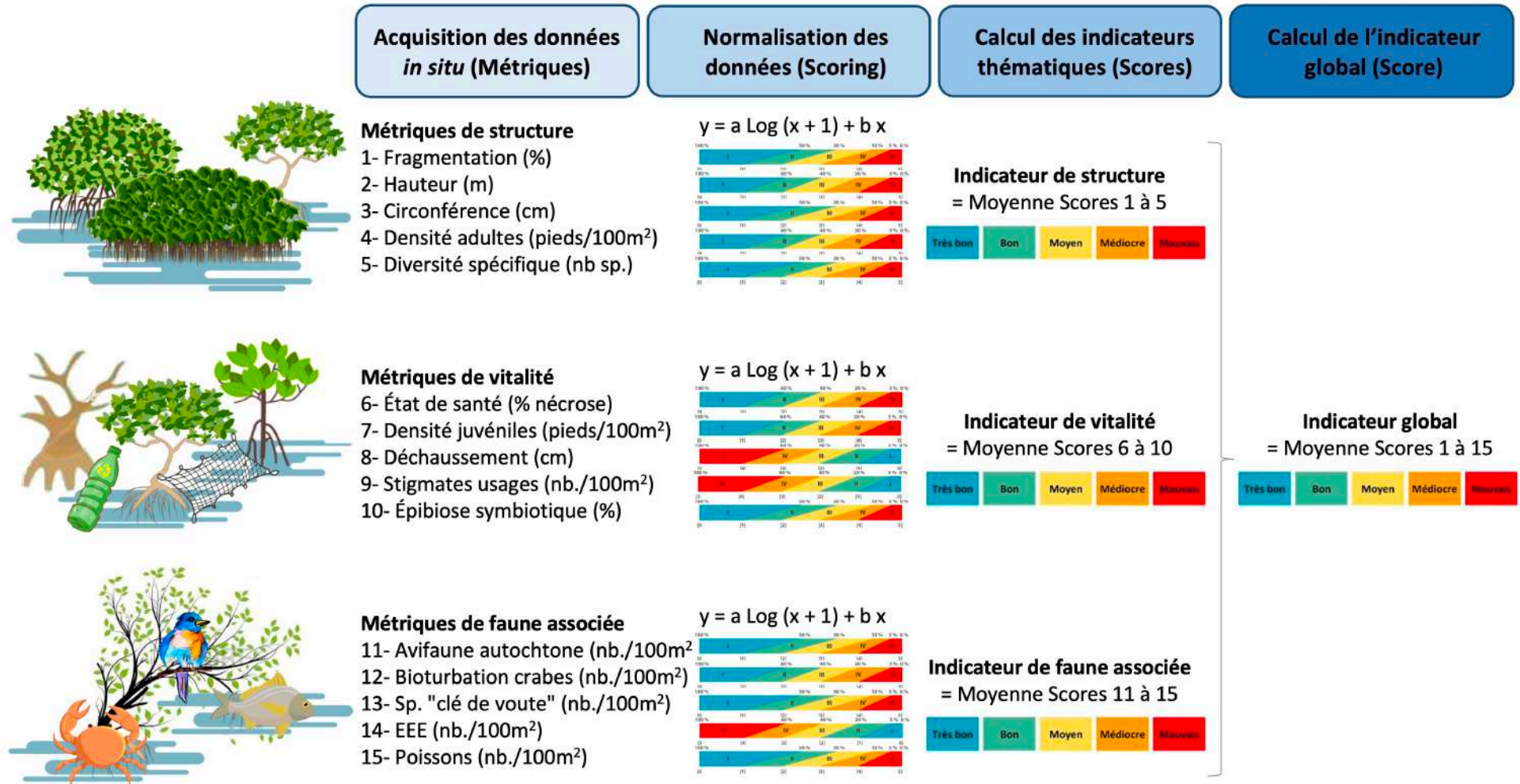
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Experience has shown a number of key factors in determining whether an identified indicator is taken up and produced over time:

- **Scientifically valid** - a) there is an accepted theory of the relationship between the indicator and its purpose, with agreement that change in the indicator does indicate change in the issue of concern; b) the data used is reliable and verifiable.
- **Based on available data** – so that the indicator can be produced regularly over time.
- **Responsive to change** in the issue of interest.
- **Easily understandable** – a) conceptually, how the measure relates to the purpose, b) in its presentation, and c) in the interpretation of the data.
- **Relevant to users' needs**.
- **“Championed” by an institution** responsible for the indicator’s continued production and communication.
- **Used** - for measuring progress, early-warning of problems, understanding an issue, reporting, awareness-raising, etc.

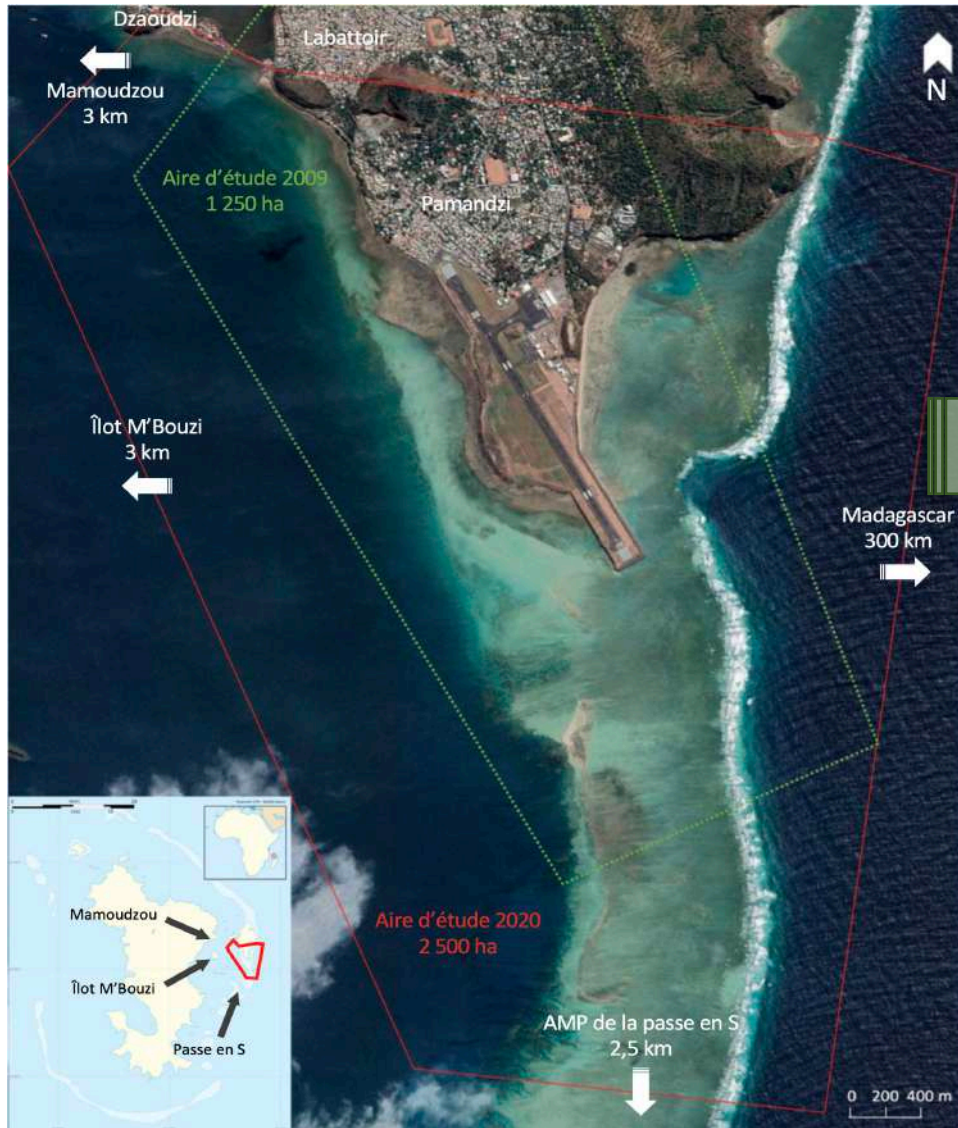


# How to convert EBVs into a single indicator?



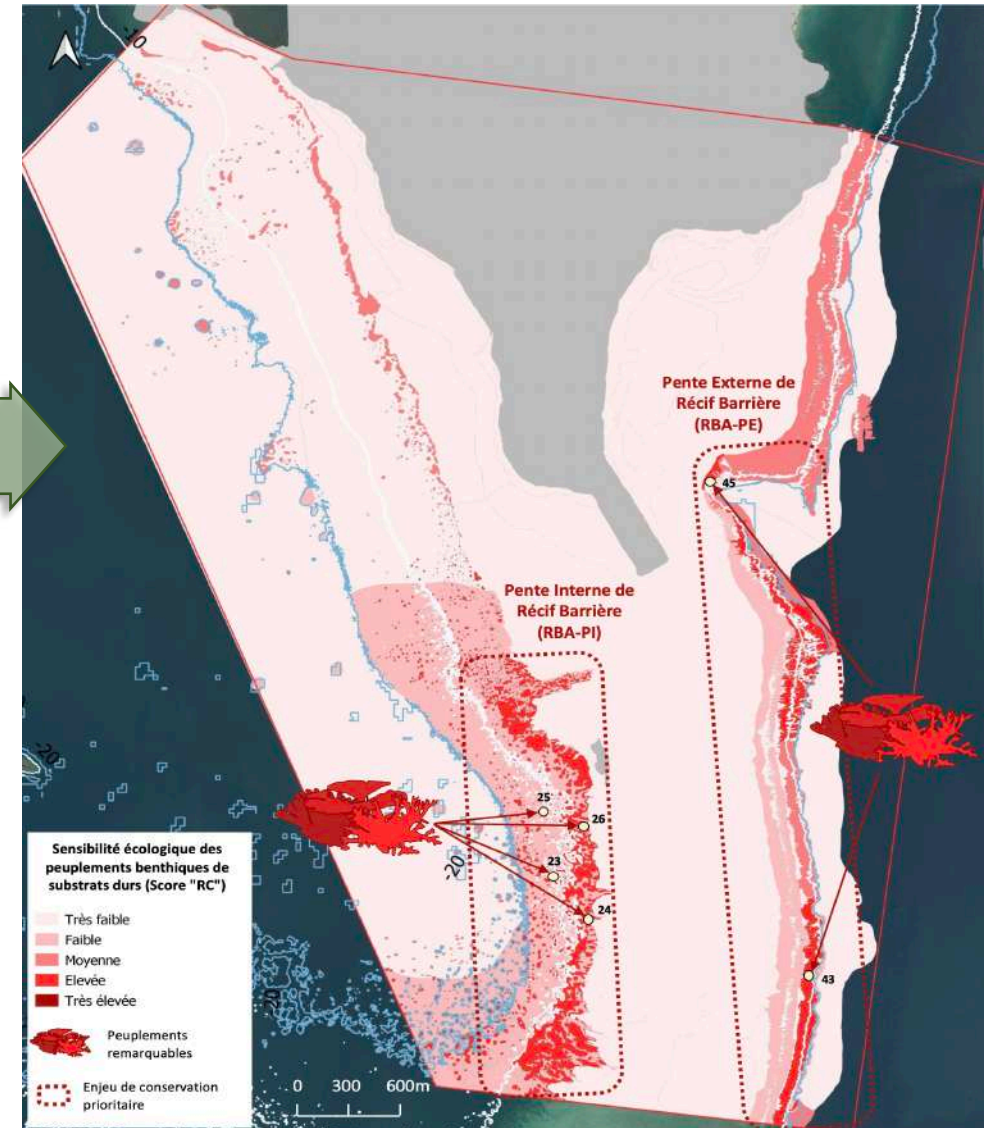


# How to spatialize indicators?



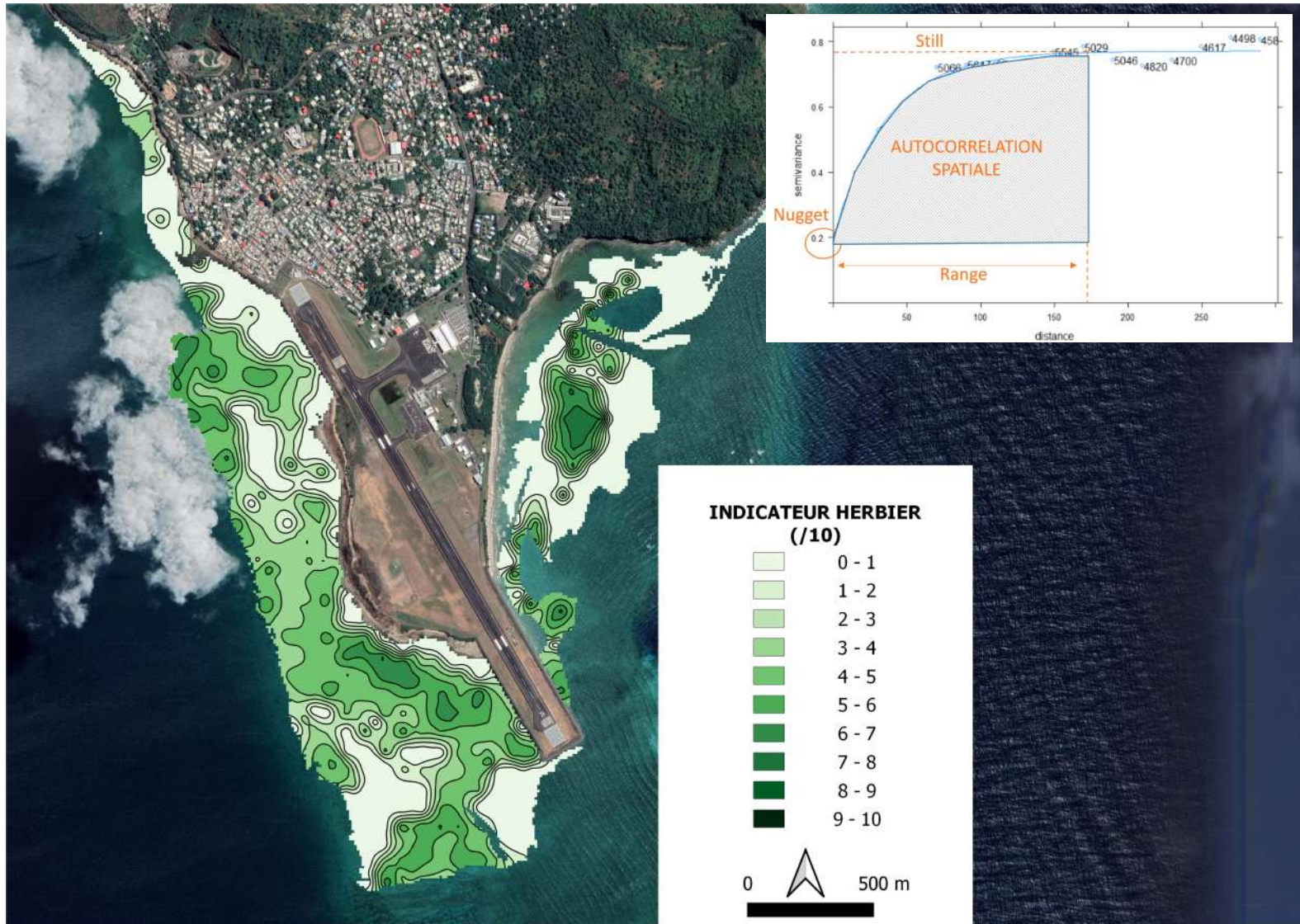
**HABITATS  
MAPPING AND  
SCORING:**

- CORAL REEFS
- SEAGRASS
- MANGROVE
- ASSOCIATED FAUNA





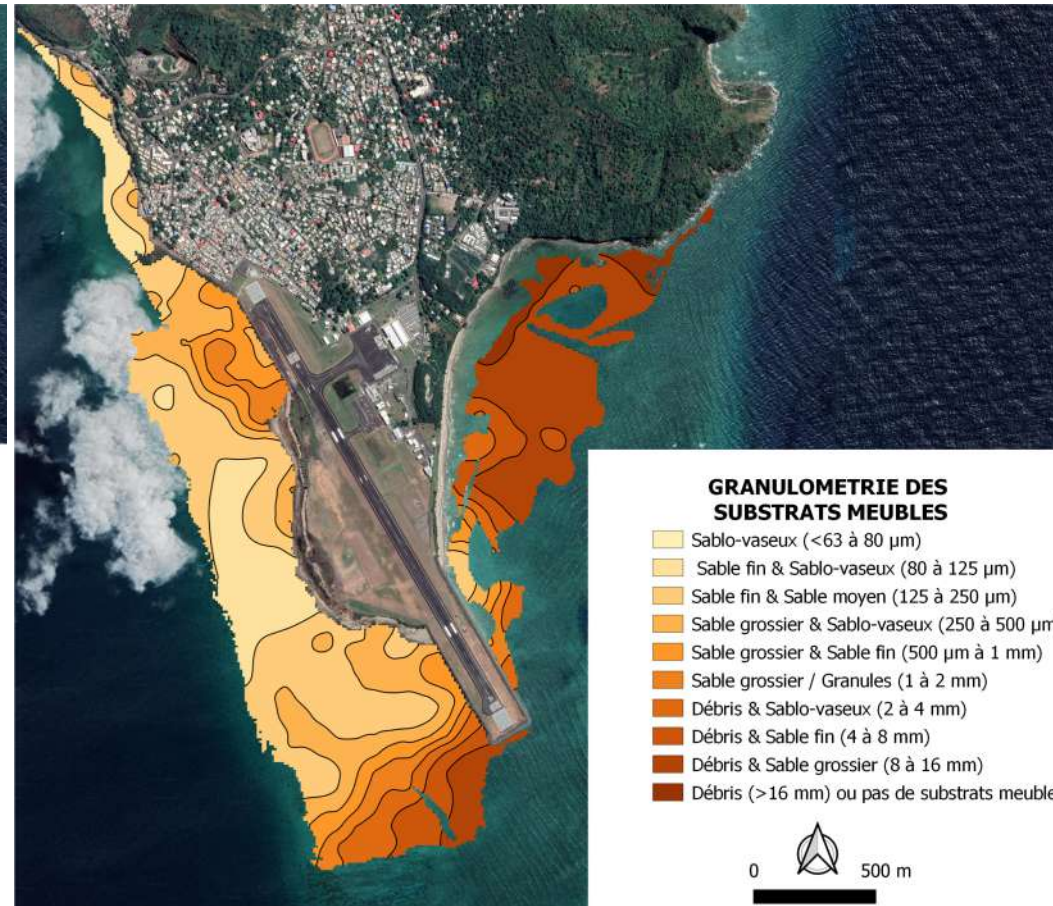
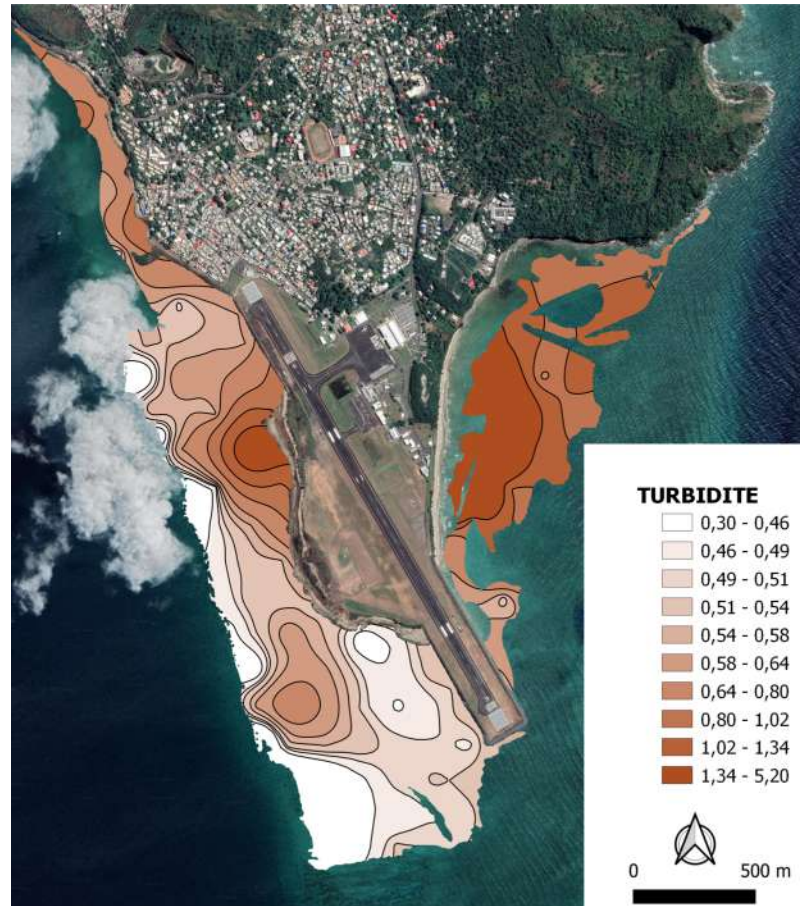
# How to spatialize indicators?



OR BY  
 GEOSTATISTICAL  
 INTERPOLATION  
 (ORDINARY KRIGING)



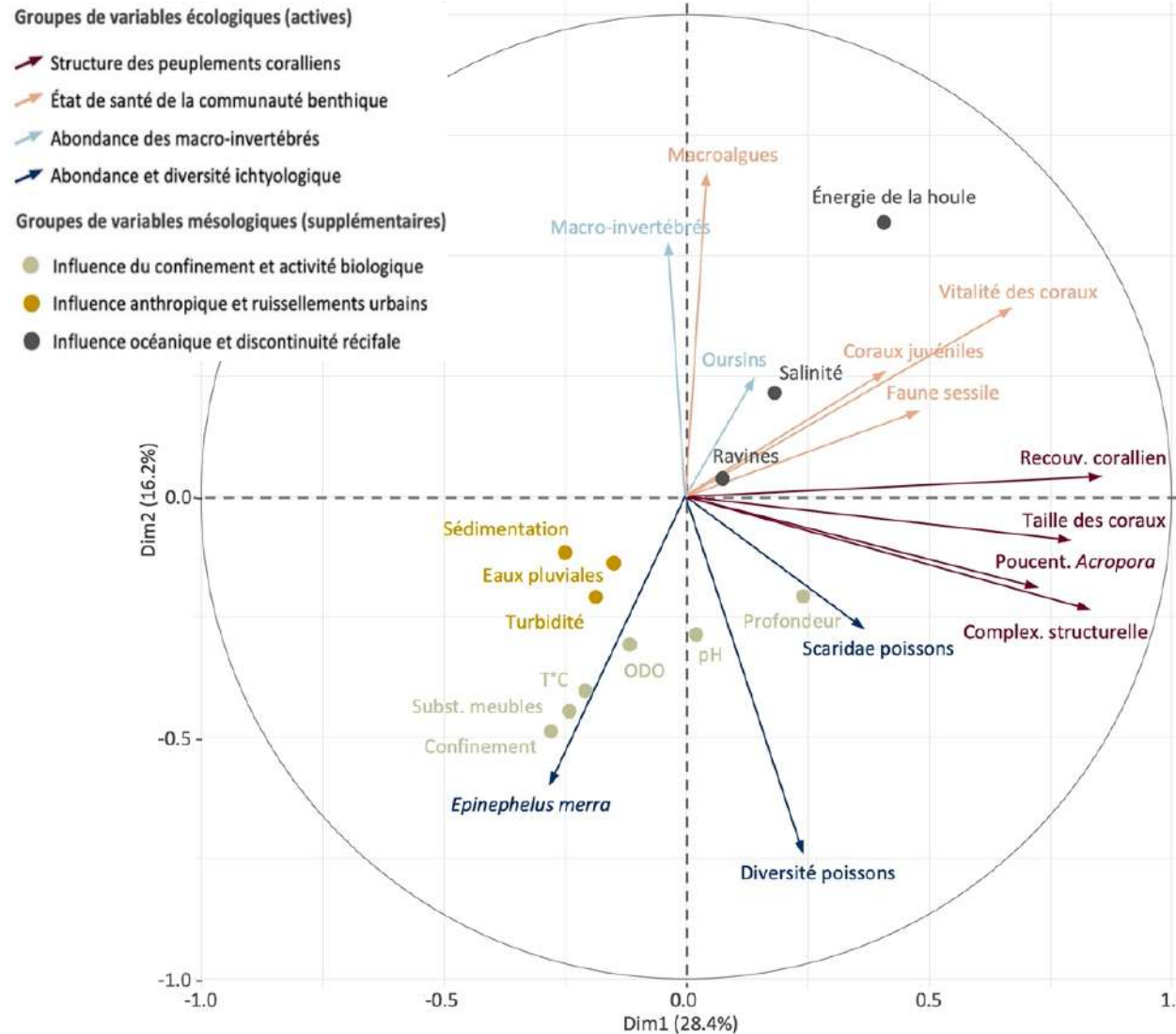
# How to spatialize indicators?



INCLUDING ABIOTIC  
VARIABLES)



# How to spatialize indicators?

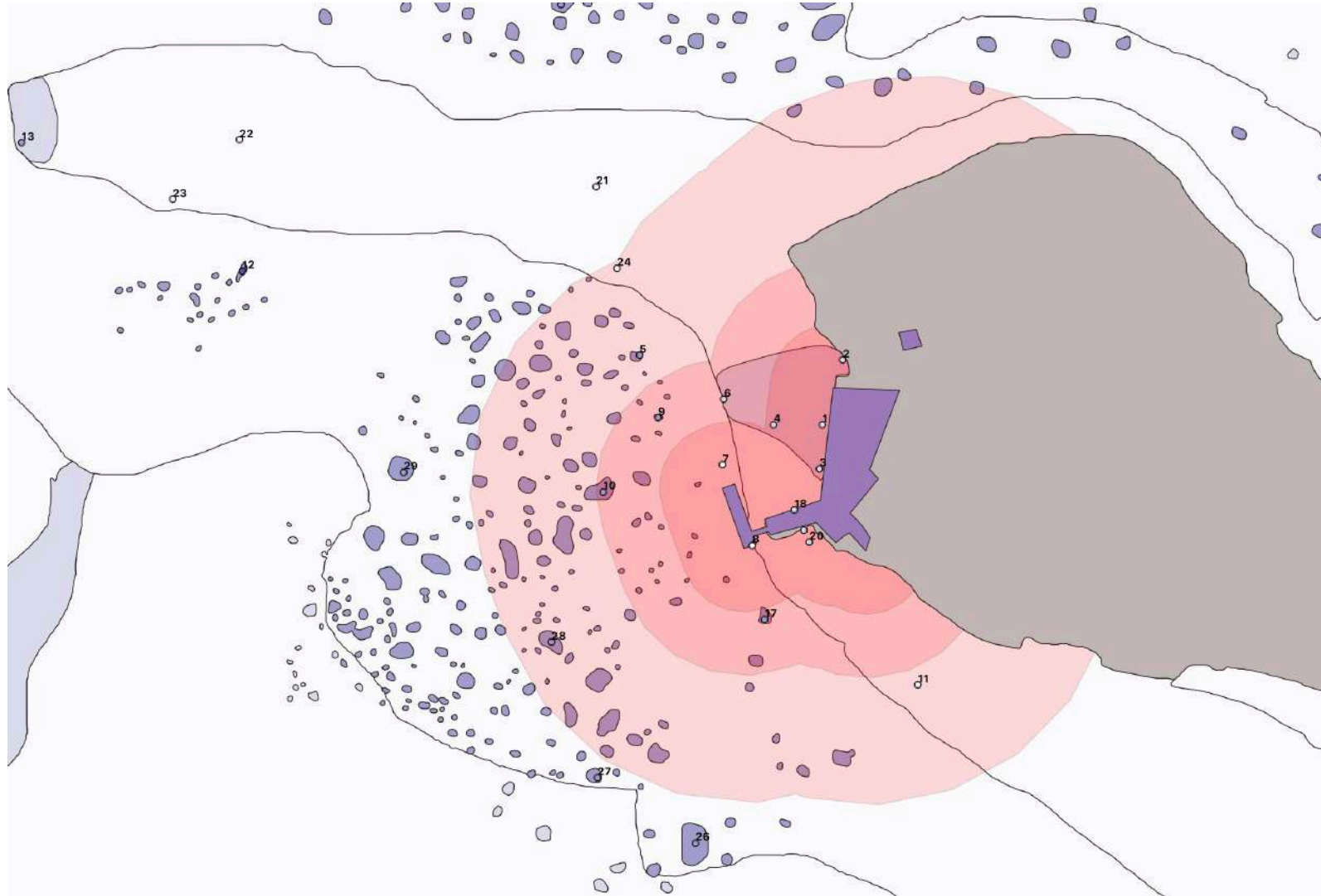


ALLOWING AN  
ANALYSIS OF CAUSAL  
RELATIONSHIPS





# With a view to dimensioning the impacts...





# In order to provide the data necessary for the dimensioning of the offset



**In order to provide the input data necessary for dimensioning of offset according to:**

- The intensity of residual impacts (after avoidance and reduction) on biocenoses (ecological scores), which must be compensated according to a species, functions, habitats approach.
- The surface area of impacted ecosystems.
- The notions of sustainability ( transient, permanent) and additionality (cumulative, synergistic) of the pressures induced by the project.

**The dimensioning of the offset will then be weighted according to the characteristics of the offset-site and ecological engineering techniques, as well as their completion deadlines:**

- Technical risk of not achieving the objectives (divergence from the set ecological trajectory).
- Risk linked to the management of the compensation site (is it protected, according to which protection status?).
- Time between the occurrence of impacts and the initiation of compensation measures.
- Time between the initiation of compensation measures and the achievement of their objectives.
- Sustainability of the measures implemented (self-maintained or requiring regular maintenance).
- Etc..



Thanks for listening  
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