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Biodiversity offset, the challenge of its evaluation and its dimensioning

Mathieu Pinault

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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

PINAULT Mathieu, PhD

MAREX Ltd- Marine Expertise Company. Saint Leu, Reunion Island.

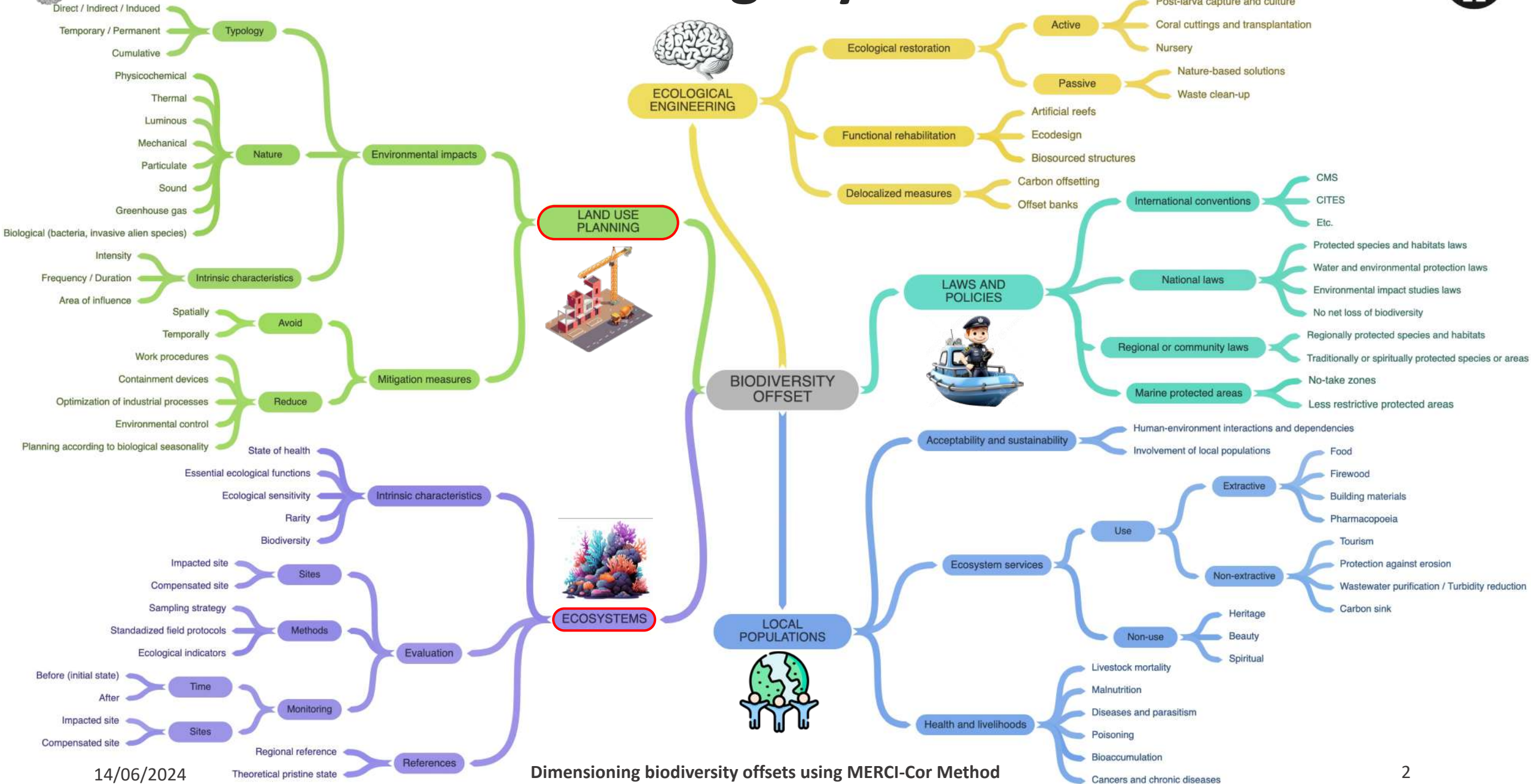
UMR 9220 UR CNRS IRD – ENTROPIE, Saint-Denis, Reunion Island.



June 14, 2024 – Blue Economy Research University of Seychelles



The offsetting key attributes





Shared and grouped key attributes

WAVE ENERGY INTENSIFICATION AND SOIL EROSION

- Intensification of cyclones,
- Coastalization process,
- Coastal infrastructures,
- Soil sealing,
- Soil erosion,
- ...



AMPLIFICATION OR INHIBITION OF PHYSICO-CHEMICAL PROCESSES AS A CONSEQUENCE OF HYDRODYNAMICS

MORPHODYNAMIC AND SEDIMENTARY PROCESSES

- Wave energy,
- Water confinement,
- Siltation.

ACTION AND FEEDBACK OF MORPHODYNAMIC PROCESSES ON SEDIMENTATION AND REEF GEOMORPHOLOGY

BIOTOPE

WATER PHYSICO-CHEMISTRY

- Temperature
- Salinity
- Dissolved oxygen
- pH
- Turbidity / TSS



POLLUTION AND WATER WARMING

- Oceans warming and acidification
- Developments and concreting,
- Agricultural,
- Domestic discharges and infiltrations,
- Urban runoff,
- Industrial pollution,
- ...

SEQUESTRATION AND RELEASE OF SOLUBLE AND PARTICULATE COMPOUNDS AS A CONSEQUENCE OF THE SUBSTRATE GEOLOGY AND GRANULOMETRY

BIOCENOSIS

DESCRIPTIVE AND FUNCTIONAL ECOLOGY

- Coral community structure,
- Vitality of benthic organisms,
- Macro-invertebrates densities,
- Fish maturity and diversity.



ECOSYSTEM SERVICES, INVASIVE OPPORTUNISTIC SPECIES AND DISEASES.

- Fishing and collecting,
- Trampling and breaking,
- Alien species proliferation,
- *Acanthaster* aggregation,
- Wildlife scaring,
- Epizootic diseases,
- ...



CORAL REEF GEOMORPHOLOGY

- Geomorphology (habitat),
- Hard or soft substrate (%),
- Depth.



MECHANICAL DEGRADATIONS AND CHANGES IN BATHYMETRY

- Rising sea level
- Dredging,
- Sand mining or beach reloading,
- Port development,
- ...



With a sustainable development objective

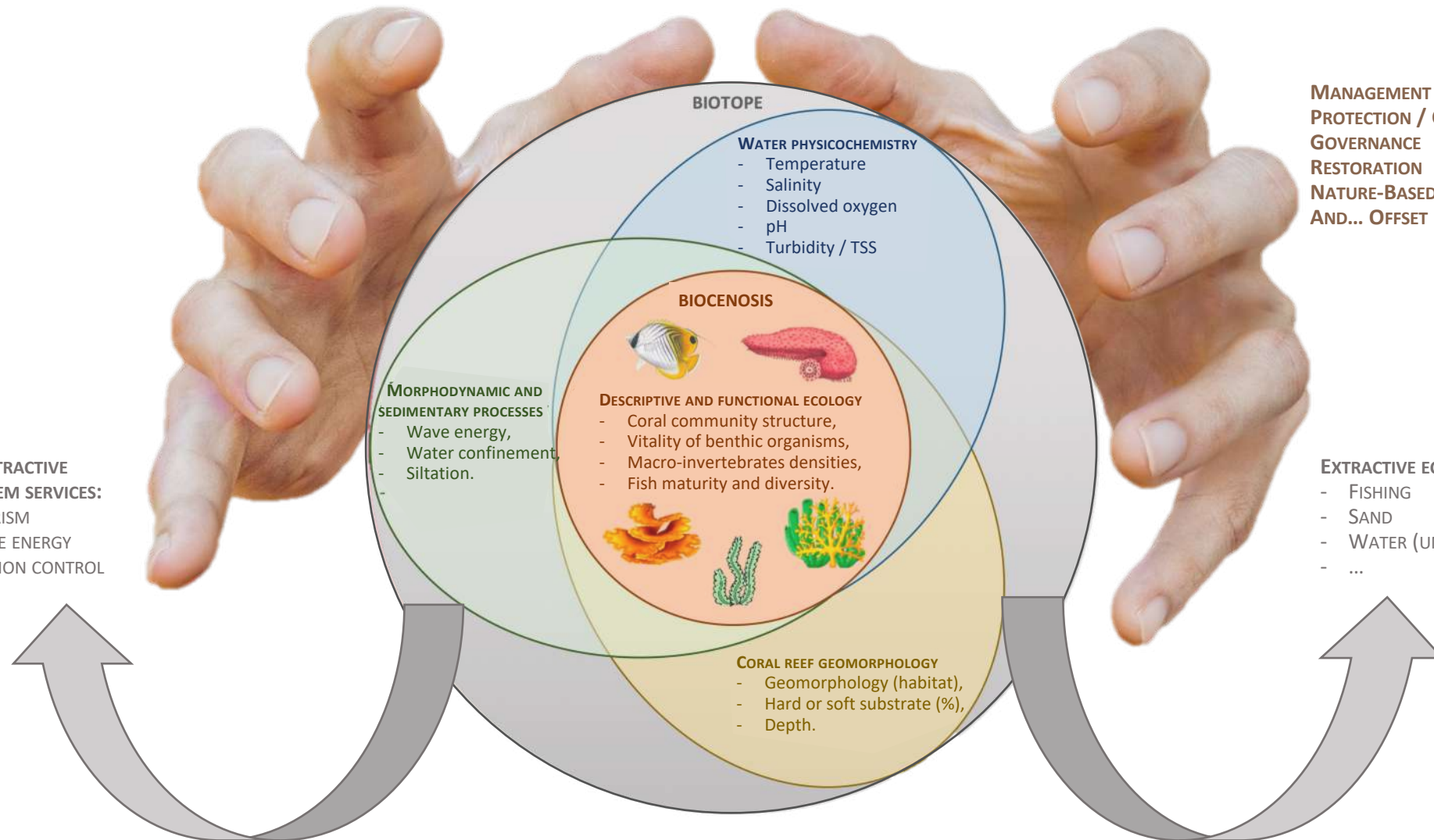


REGULATION, POLICIES AND OFFSETS

MANAGEMENT
 PROTECTION / CONSERVATION
 GOVERNANCE
 RESTORATION
 NATURE-BASED SOLUTIONS
 AND... OFFSET

NON-EXTRACTIVE
 ECOSYSTEM SERVICES:
 - TOURISM
 - WAVE ENERGY
 - EROSION CONTROL
 - ...

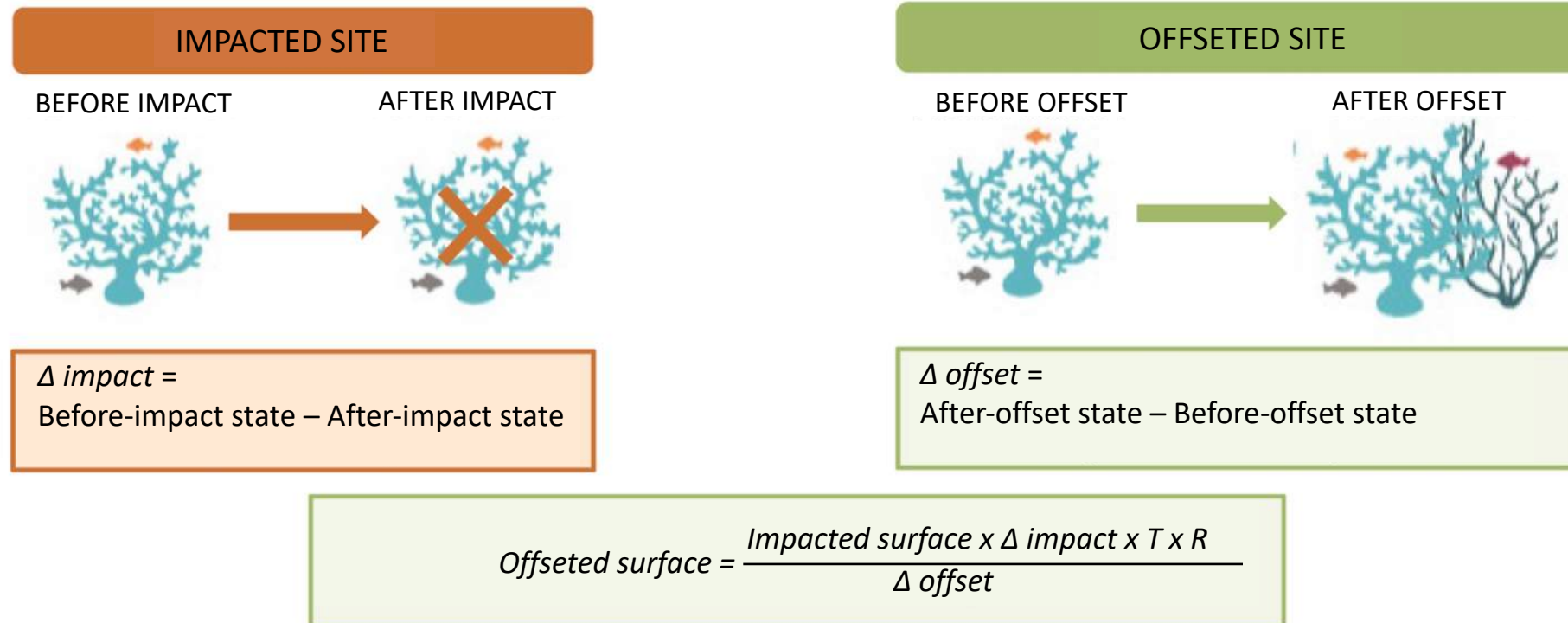
EXTRACTIVE ECOSYSTEM SERVICES:
 - FISHING
 - SAND
 - WATER (UNIT DESALINATION)
 - ...





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)



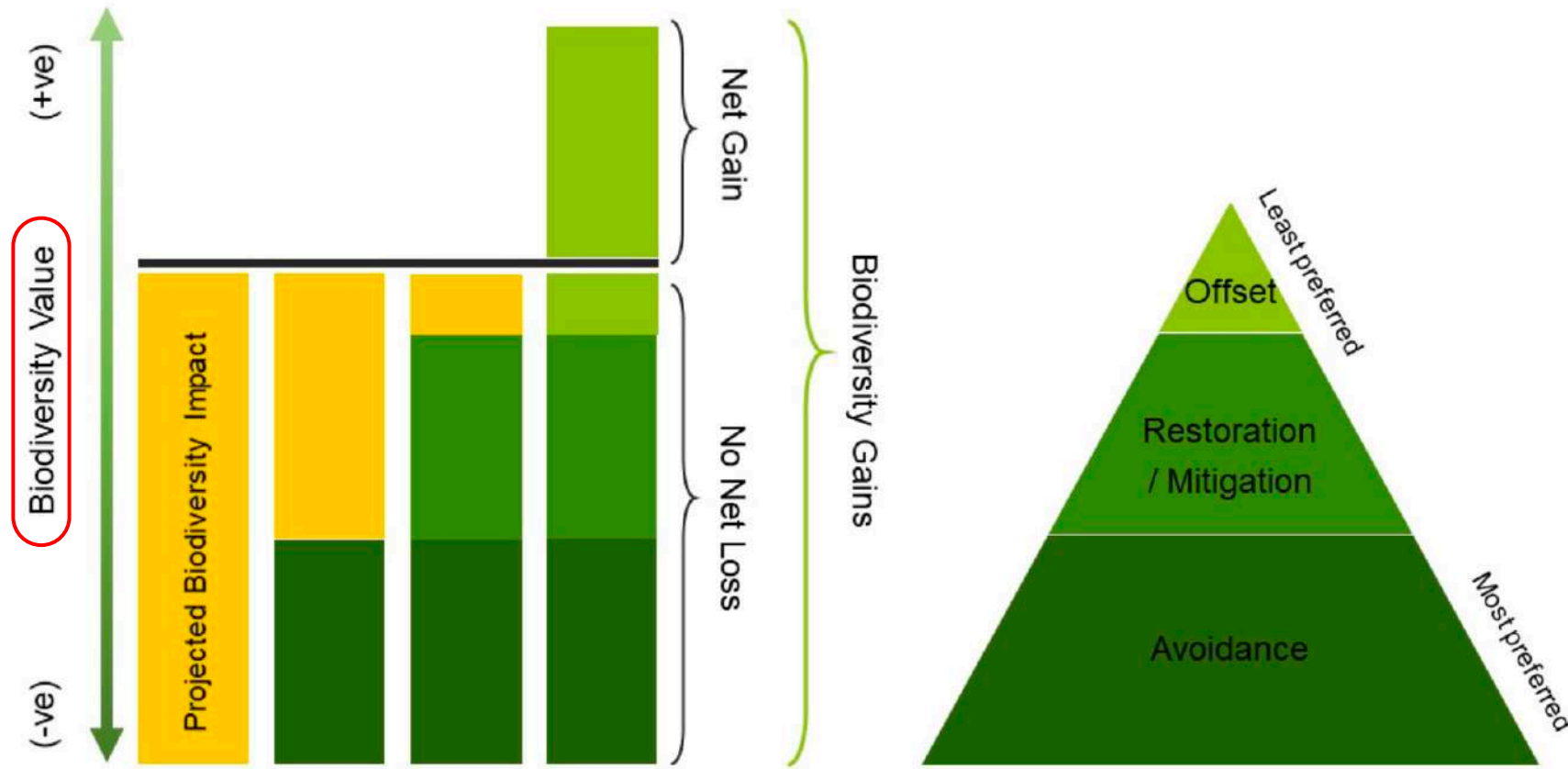
Adjustment coefficients:

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.

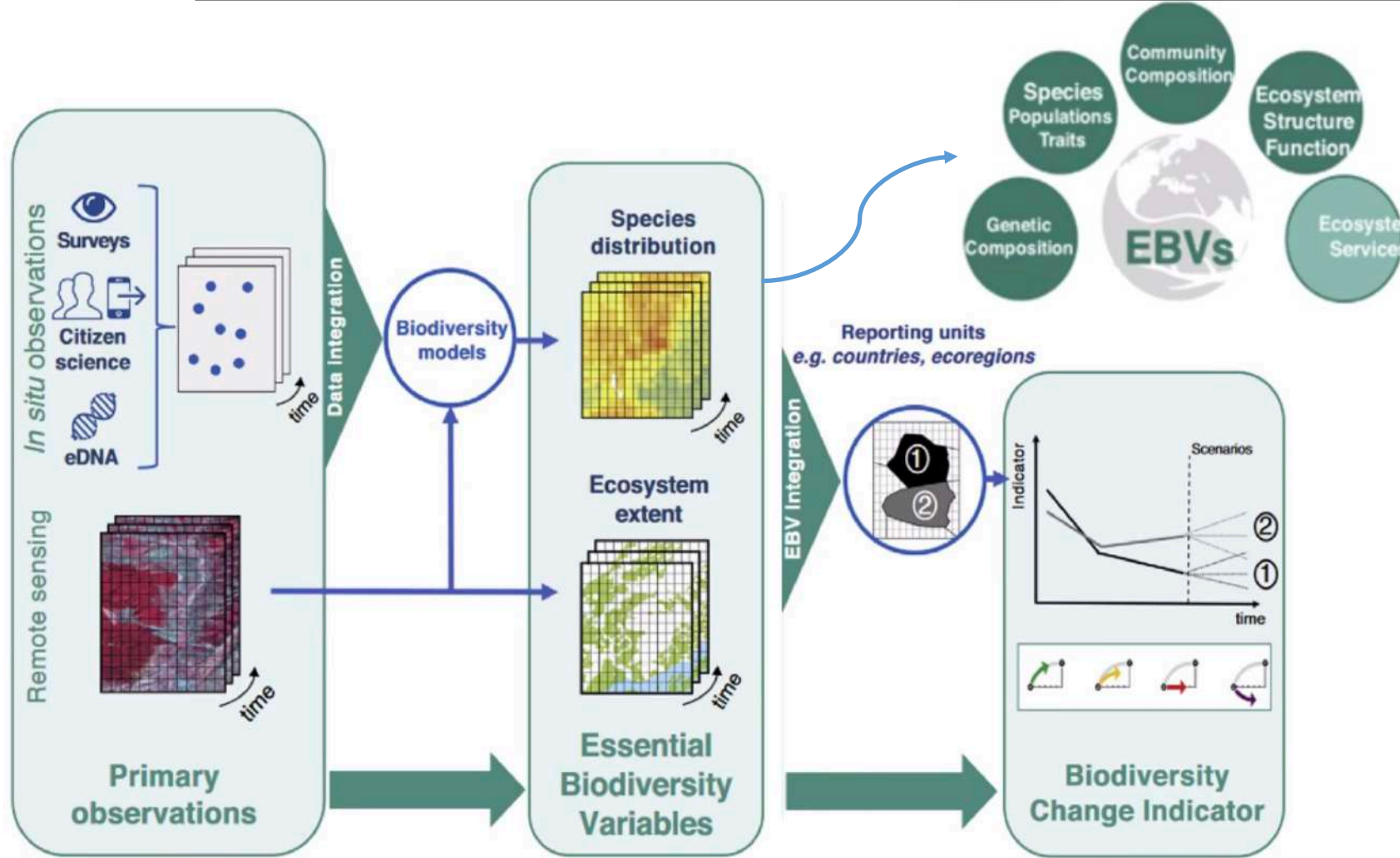
=> **Residual impacts**

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?

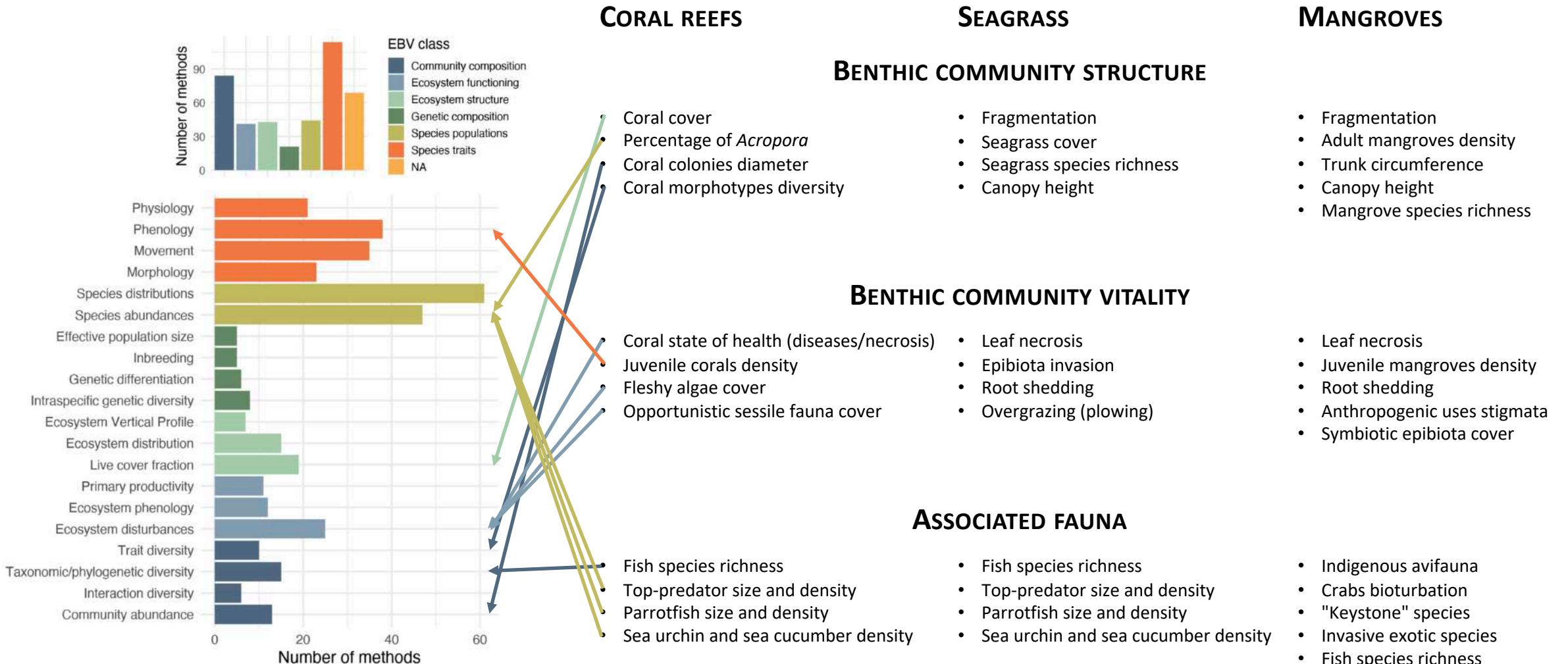
How to calculate a Biodiversity Unit, valid for different ecosystems?

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)

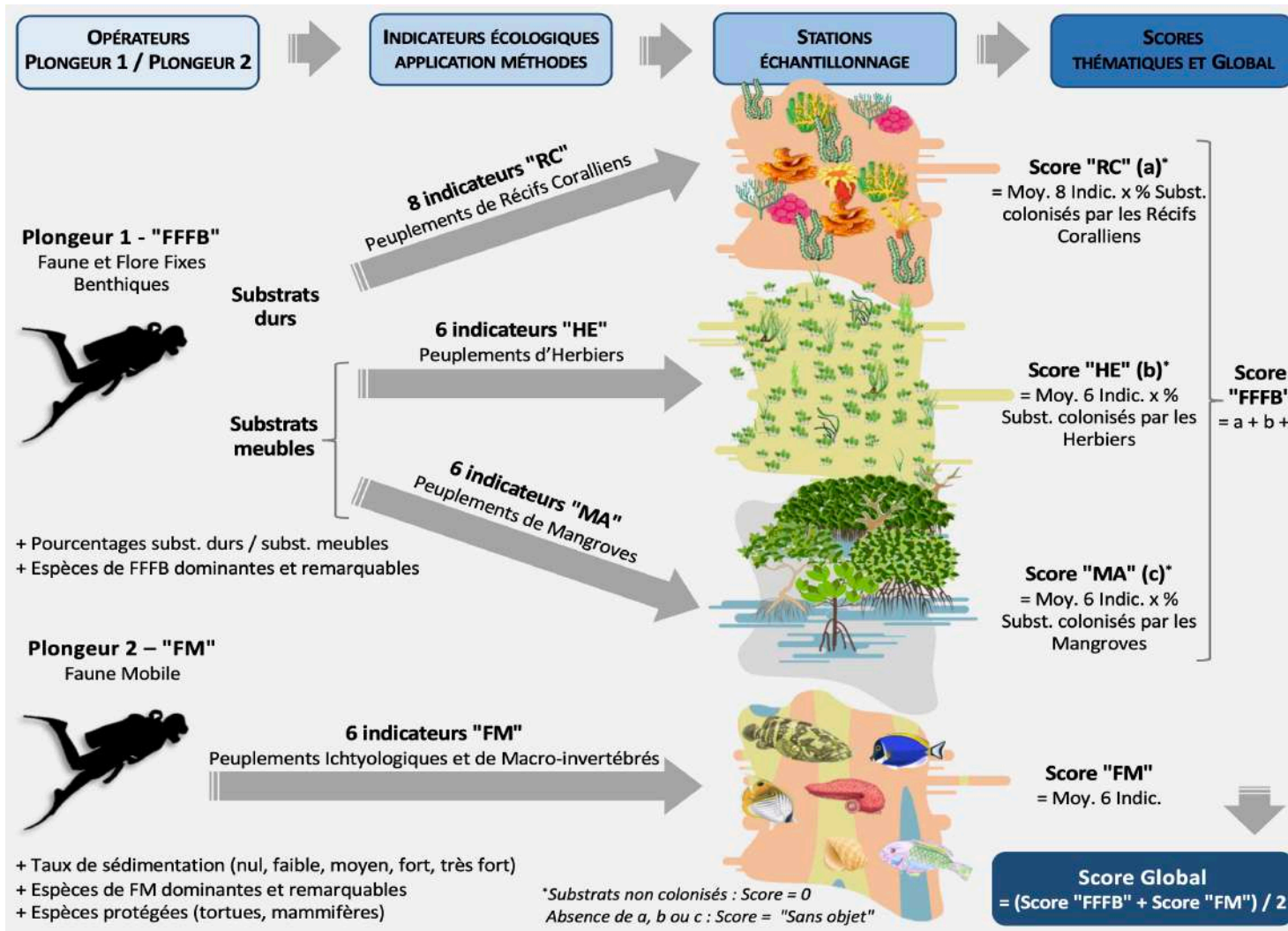


Which EBVs should be selected for each ecosystem?





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



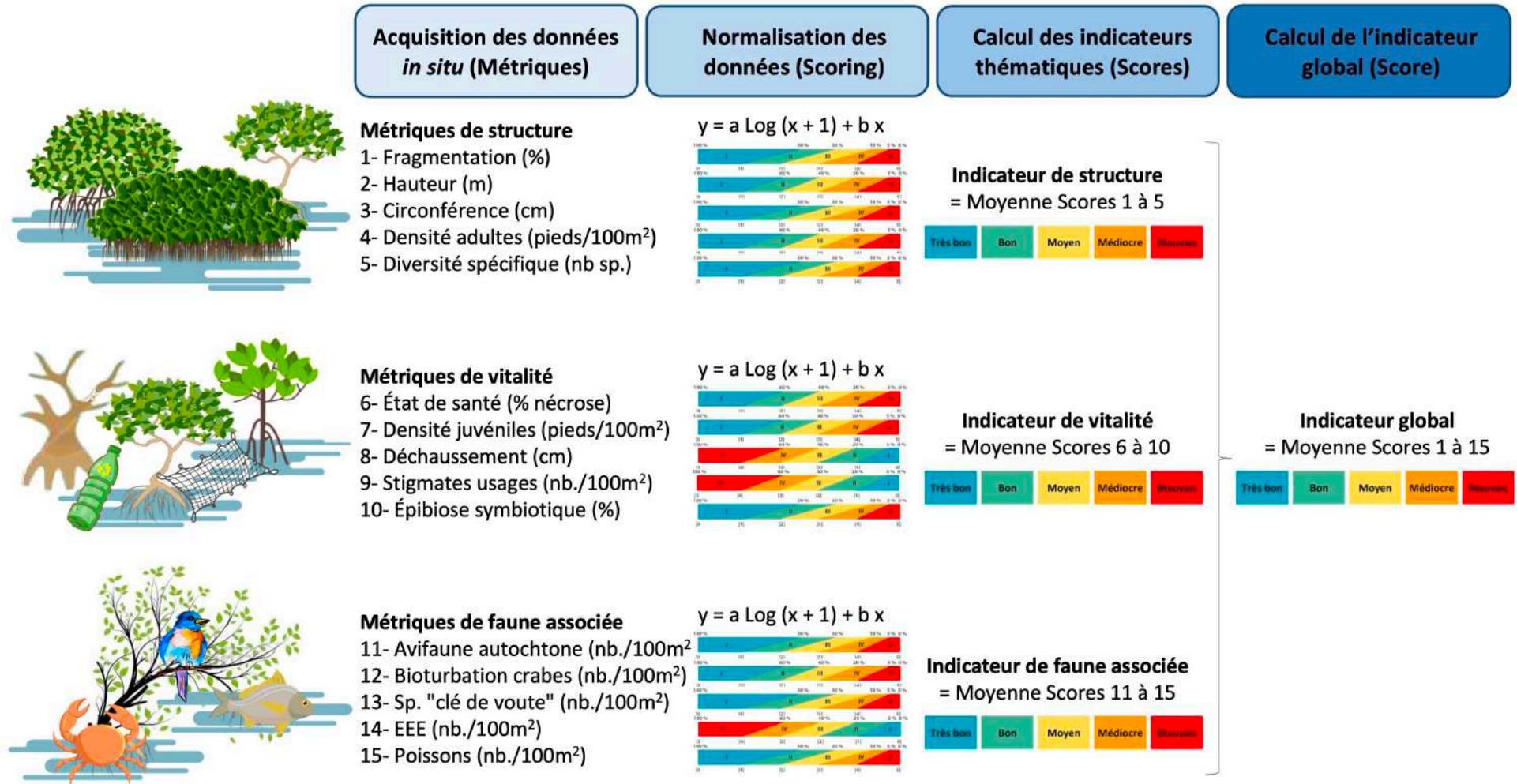
What makes a 'successful' indicator?

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.

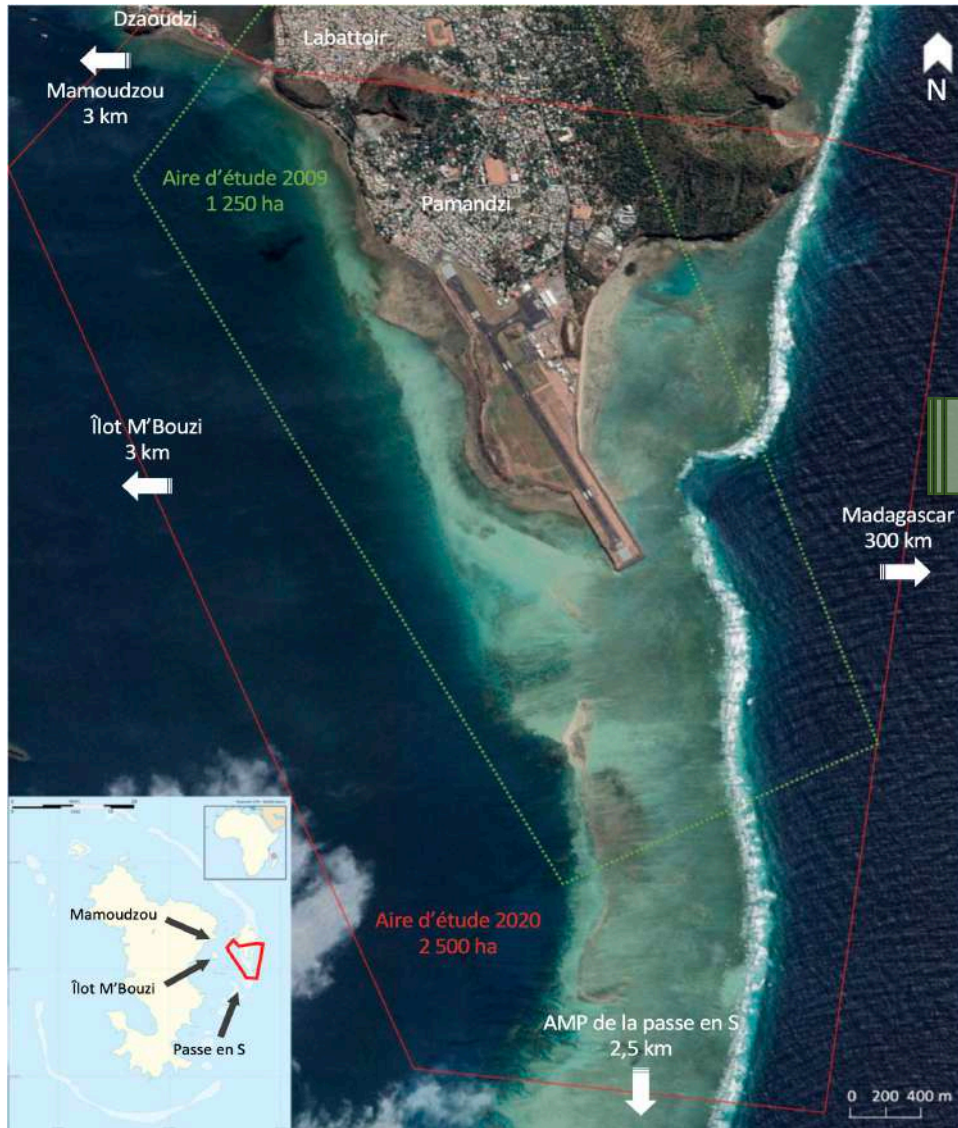


How to convert EBVs into a single indicator?



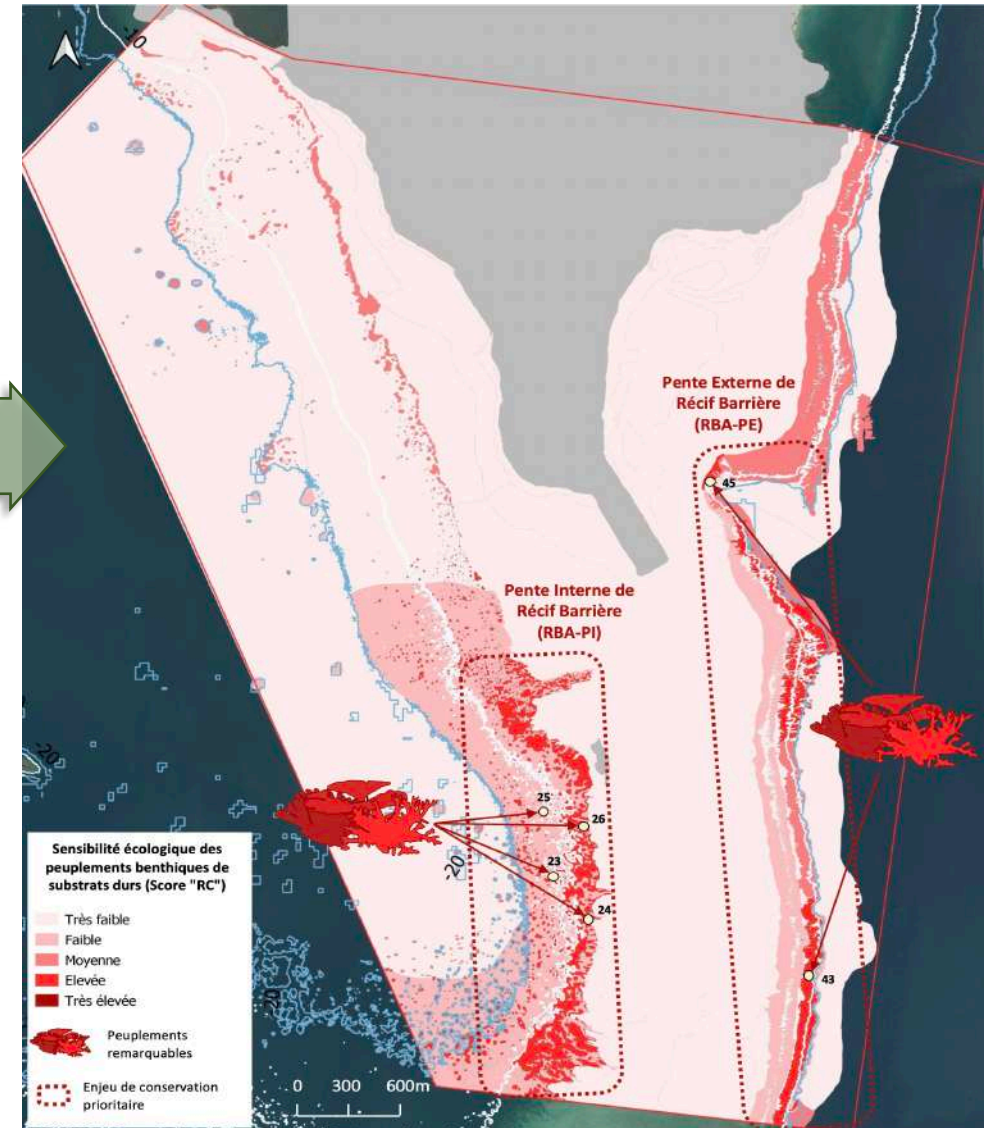


How to spatialize indicators?



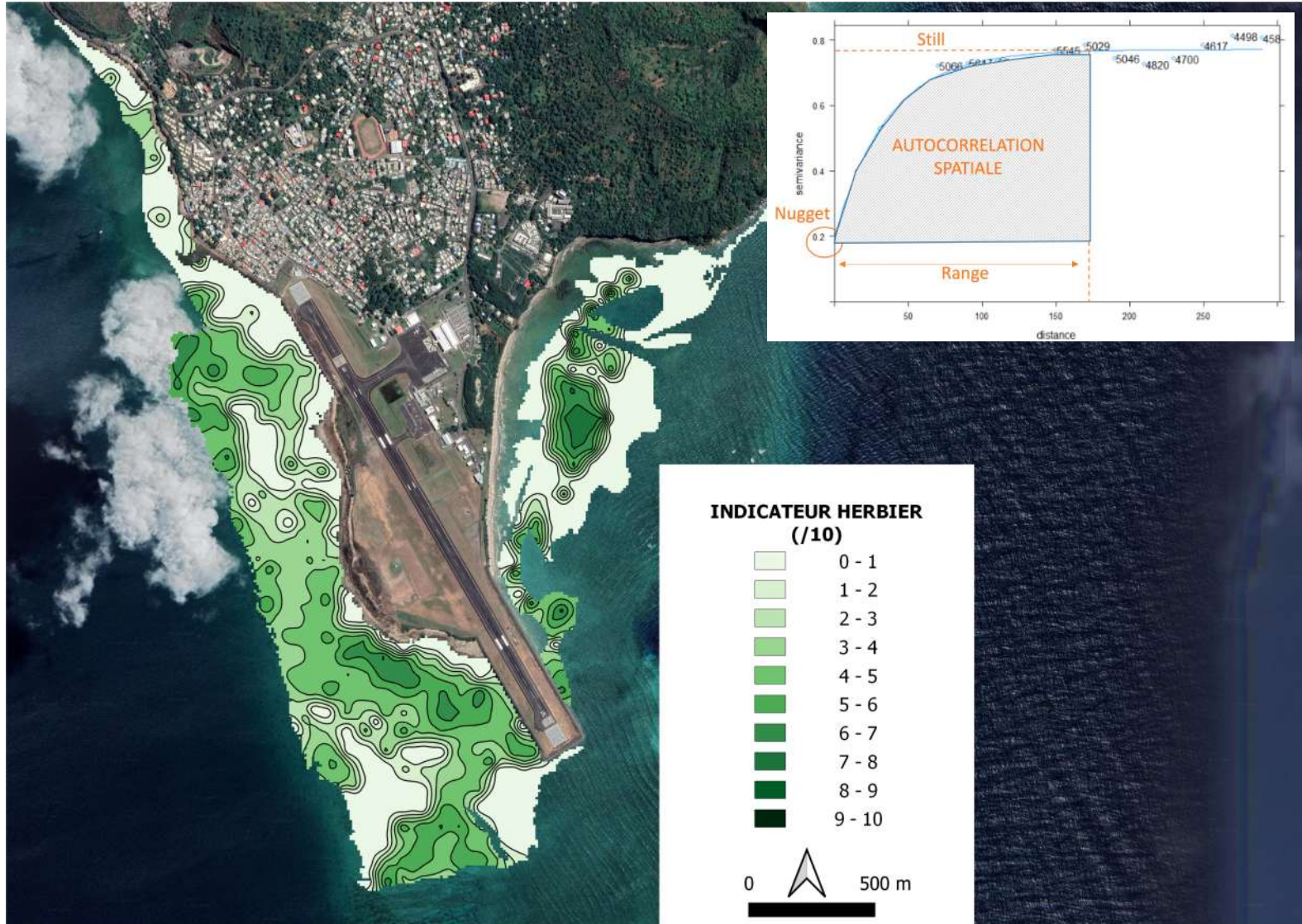
**HABITATS
MAPPING AND
SCORING:**

- CORAL REEFS
- SEAGRASS
- MANGROVE
- ASSOCIATED FAUNA





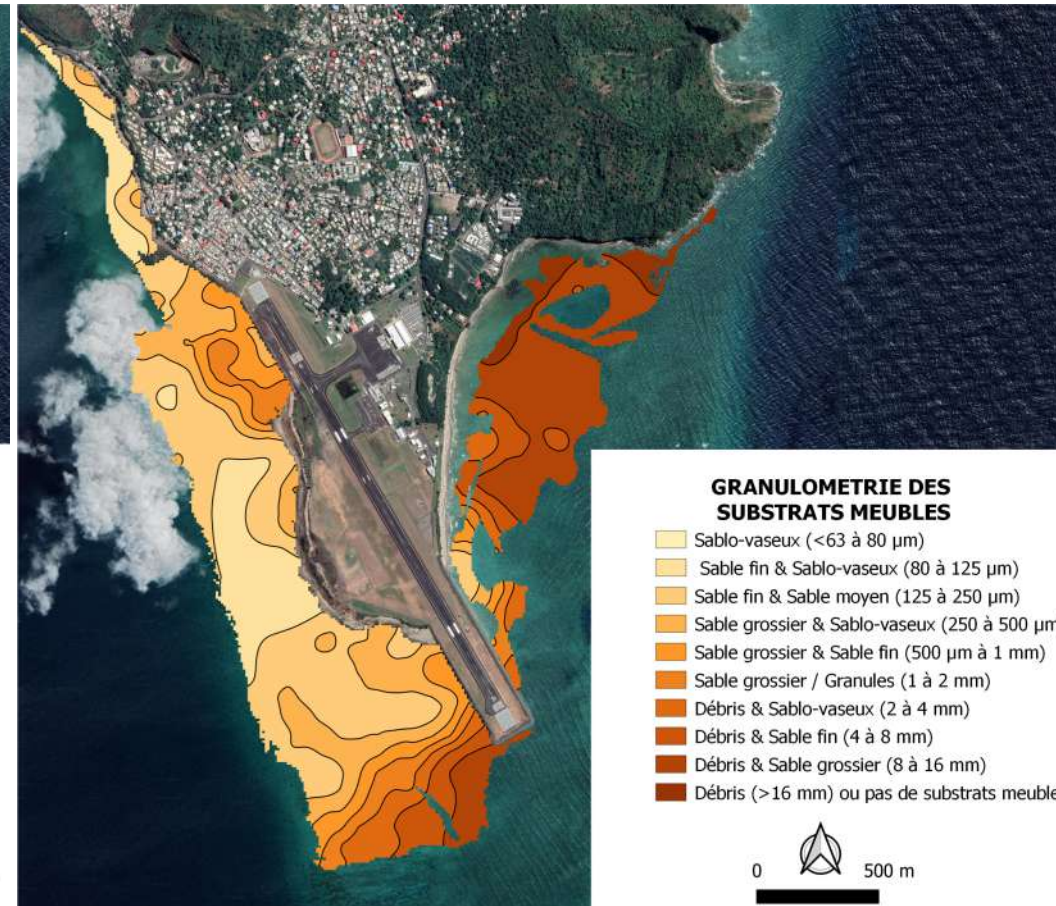
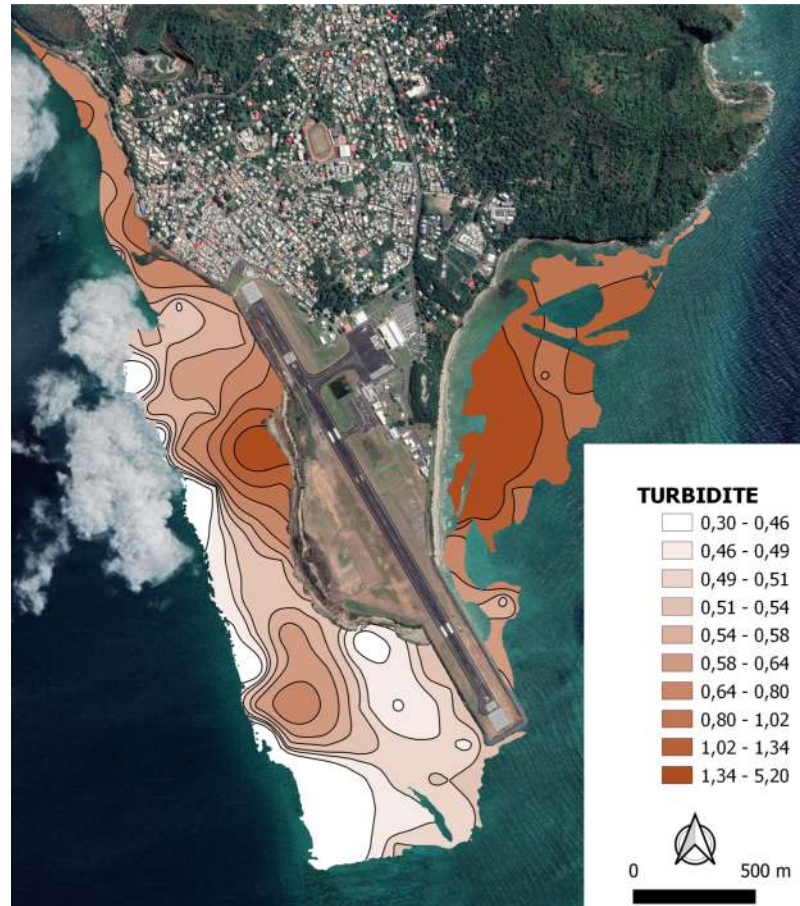
How to spatialize indicators?



OR BY
 GEOSTATISTICAL
 INTERPOLATION
 (ORDINARY KRIGING)



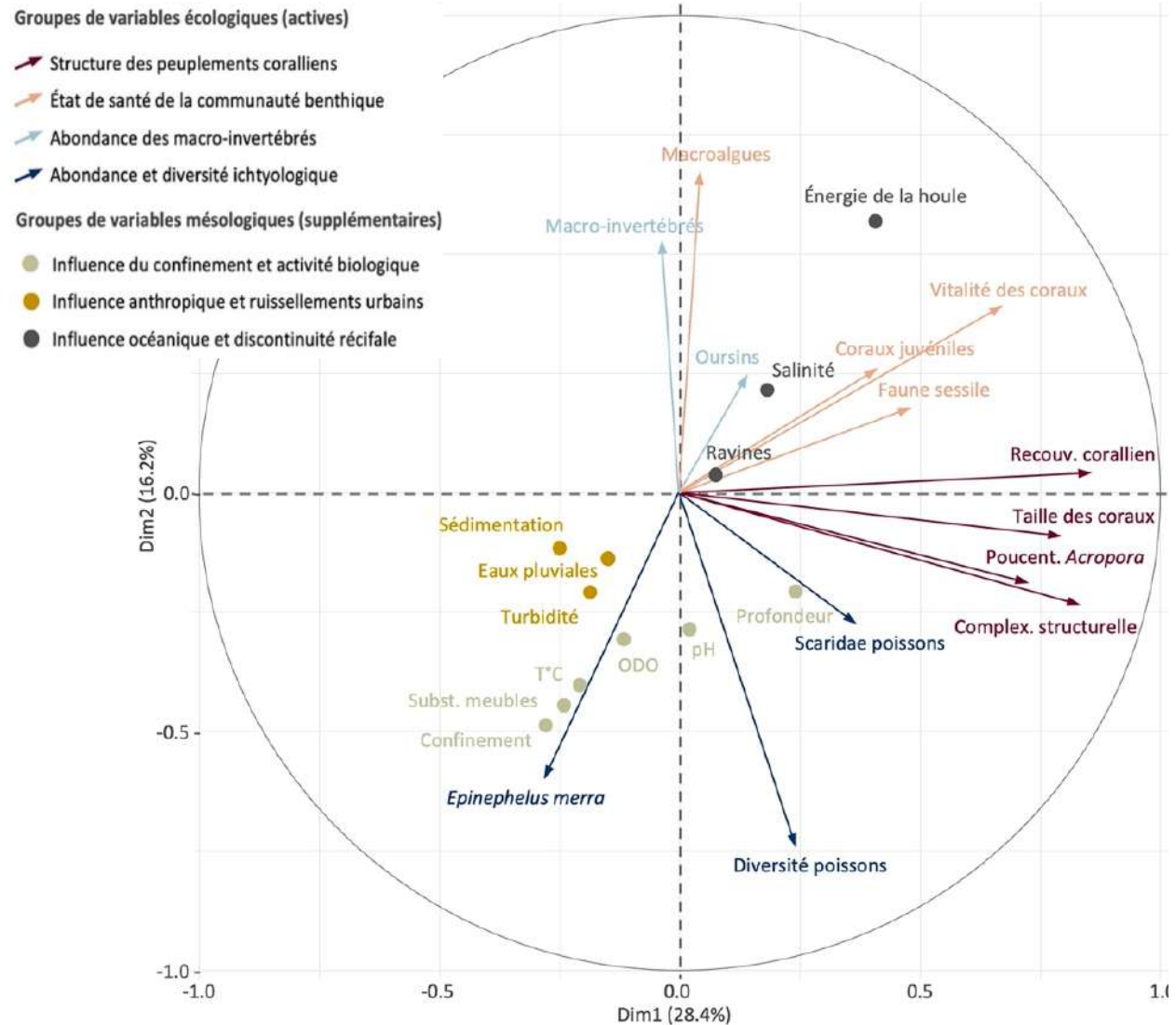
How to spatialize indicators?



INCLUDING ABIOTIC
VARIABLES)



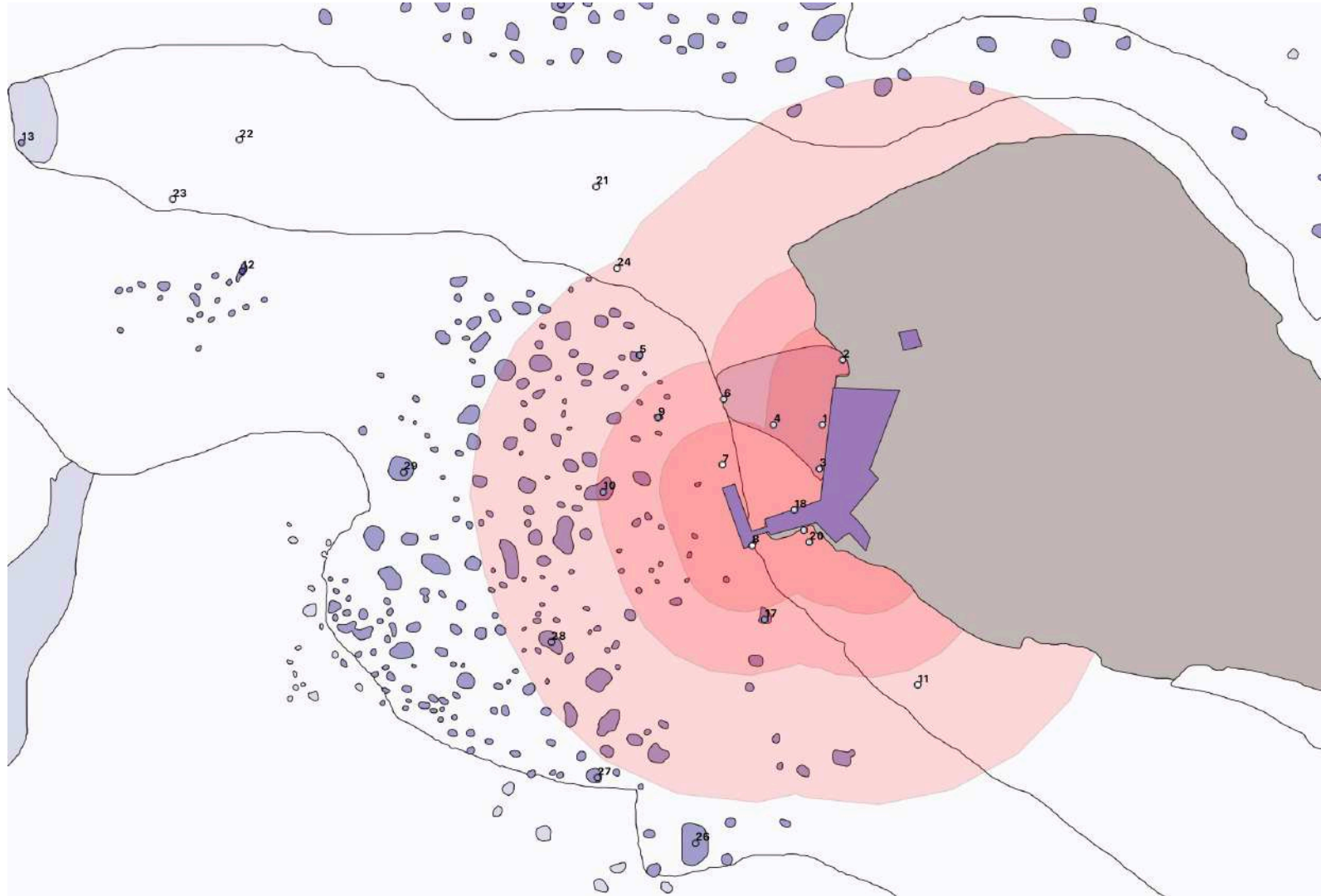
How to spatialize indicators?



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
math.pinault@gmail.com

