

Ecosystem services spatially linked to environmental and socio-economic stakes in the context of offshore wind farm development

Yoann Baulaz, *France Energies Marines*

Maud Mouchet, *Museum National d'Histoire Naturelle, UMR CESCO*



Estimated offshore wind farms' impacts on ecosystem services supply



CONSTRUCTION



- 1. Digging, crushing of the bottom
- 2. Rearrangement of benthos
- 3. Sounds and vibrations



PRODUCTION

- 1. Reef effect
- 2. Reserve effect
- 3. Functional habitat modification
- 4. Barrier effect
- 5. Collision
- 6. Hydrodynamic change
- 7. Lights
- 8. Electromagnetic field
- 9. Metal emissions
- 10. Organic materials enrichment

Experts' estimation:

-  significant impacts
-  non significant impacts

Estimated offshore wind farms' impacts on ecosystem services supply



CONSTRUCTION

- 1. Digging, crushing of the bottom
- 2. Rearrangement of benthos
- 3. Sounds and vibrations



PRODUCTION

- 1. Reef effect
- 2. Reserve effect
- 3. Functional habitat modification
- 4. Barrier effect
- 5. Collision
- 6. Hydrodynamic change
- 7. Lights
- 8. Electromagnetic field
- 9. Metal emissions
- 10. Organic materials enrichment

ECOSYSTEM SERVICES

- 1. Bio-resources ES
- 2. Cultural ES
- 3. Habitat regulation ES
- 4. Environment quality regulation ES
- 5. Abiotic ES
- 6. Regulation of weather and air quality

Experts' estimation:

- significant impacts
- non significant impacts

Baulaz et al. 2023

Estimated offshore wind farms' impacts on ecosystem services demand

Change in ES, leading to a gain or loss of benefits

+

Gain of resources



Co-use



New practices



Gain of socio-cultural value and knowledge



-

Loss of resources

Spatial report

Practice loss/limitation

Loss of socio-cultural value and knowledge

Estimated offshore wind farms' impacts on ecosystem services demand

Change in ES, leading to a gain or loss of benefits



Gain of resources



Co-use



New practices



Gain of socio-cultural value and knowledge



Loss of resources

Spatial report

Practice loss/limitation

Loss of socio-cultural value and knowledge

... for these beneficiaries

Fishing and shellfish professionals

Tourism professionals

Offshore wind energy industry

Other industrial

Commercial navigation professionals

Tourists and residents

Consumers, indirect beneficiaries

Local authorities

Baulaz et al. 2023



All the components of supply, access and demand of ES are affected at various levels.

OWF could be considered as a potential « *regime shift* » for the coastal territories



All the components of supply, access and demand of ES are affected at various levels.

OWF could be considered as a potential « *regime shift* » for the coastal territories

The changes are variables, depending of:

- supports for OWF projects development,
- their integration into local communities
- and governance.

All the components of supply, access and demand of ES are affected at various levels.

OWF could be considered as a potential « *regime shift* » for the coastal territories

The changes are variables, depending of:

- supports for OWF projects development,
- their integration into local communities
- and governance.



Marine Spatial Planning

How to consider all environmental
and socio-economical stakes?



Marine Spatial Planning

How to anticipate
future change?



How to spatialise?



And at what scale?

How to consider all environmental and socio-economical stakes?



Marine Spatial Planning

How to anticipate future change?



How to spatialise?

And at what scale?

Hypothesis: the concept of ecosystem services is an interdisciplinary tool that helps to spatialize the issues at stake in the context of offshore wind energy development.

In what ways could the concept of ecosystem services be useful for marine spatial planning in the context of offshore wind development?

To answer this question, we need to:

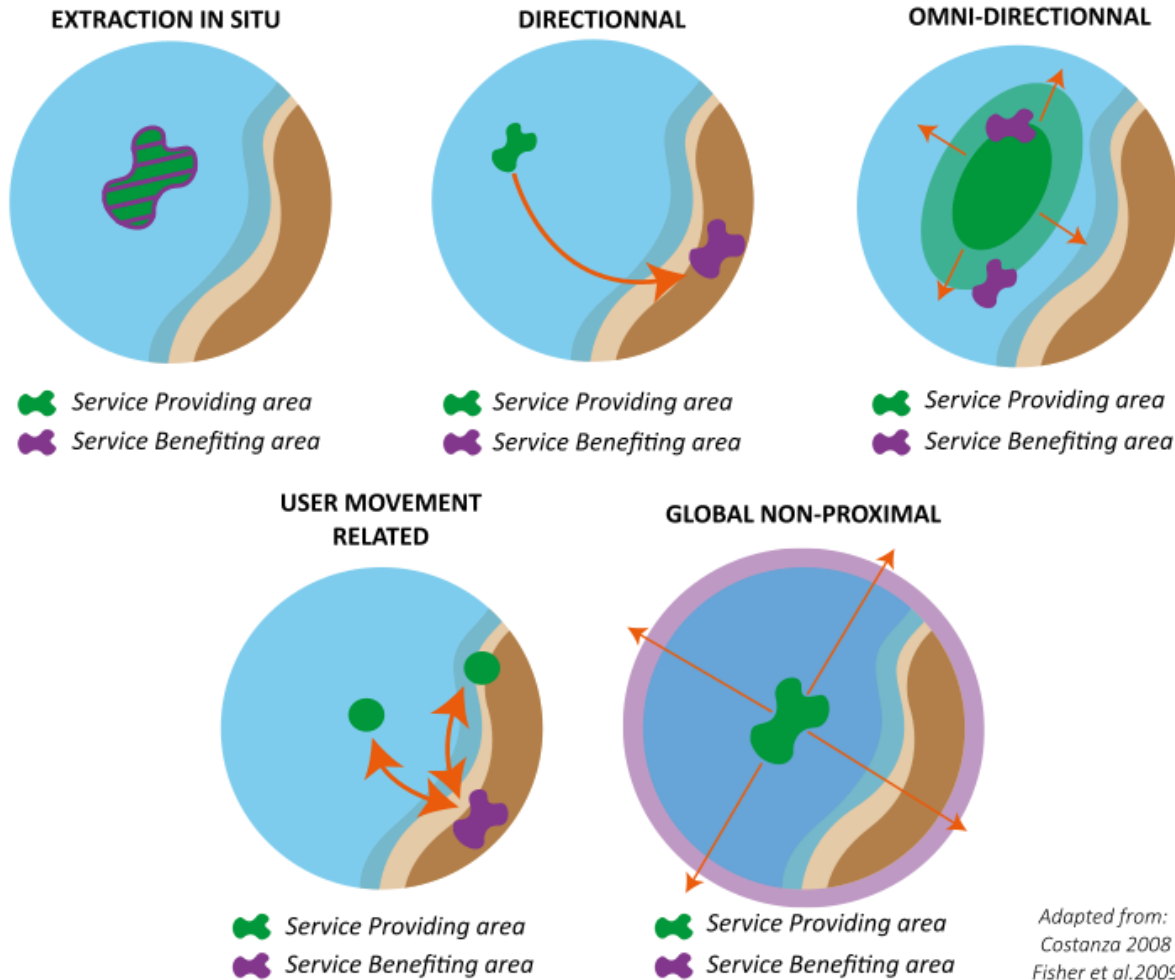
Methodological perspective

1. Identify the spatial patterns of ES
2. Propose indicators to study these ES in the context of offshore wind farm development

Theoretical perspective

3. What is the « influence area » of an offshore wind farm?
4. ES concept is it compatible with the MSP approach?

1. Identify spatial patterns of ES



Service Providing area: spatial unit within which an ecosystem service is provided.

Service Benefiting Area: spatial unit to which an ecosystem service flow is delivered to beneficiaries.

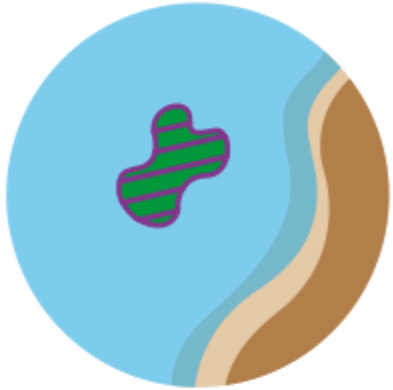
Burkhard et al. 2017



*Adapted from:
Costanza 2008
Fisher et al. 2009*

1. Identify spatial patterns of ES



EXTRACTION IN SITU



-  *Service Providing area*
-  *Service Benefiting area*

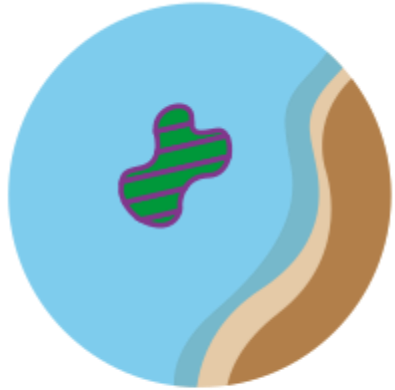
Associated ES



Food provision

1. Identify spatial patterns of ES

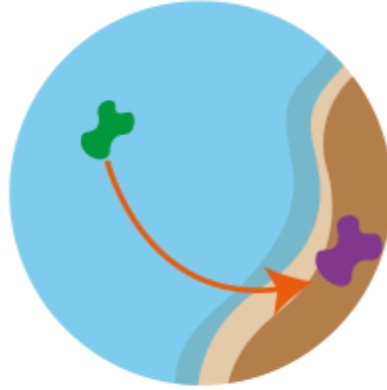




EXTRACTION IN SITU



 Service Providing area
 Service Benefiting area

DIRECTIONNAL



 Service Providing area
 Service Benefiting area

Associated ES

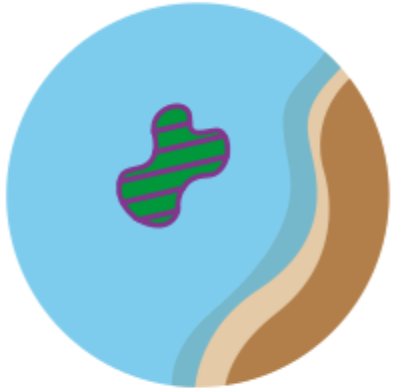
Food provision



Energy production

1. Identify spatial patterns of ES

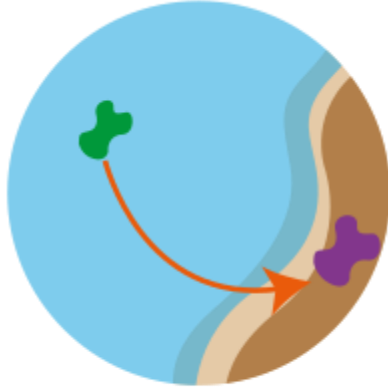




EXTRACTION IN SITU



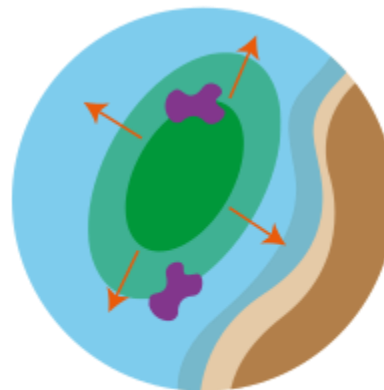
 Service Providing area
 Service Benefiting area



DIRECTIONNAL



 Service Providing area
 Service Benefiting area

OMNI-DIRECTIONNAL



 Service Providing area
 Service Benefiting area

Associated ES

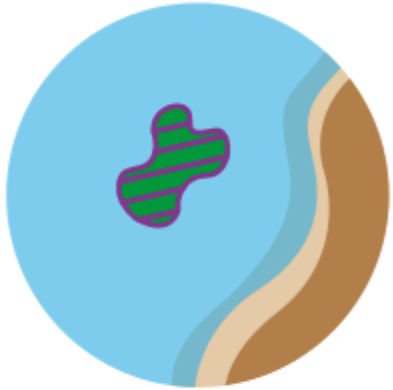
Food provision

Energy production

Habitat maintenance

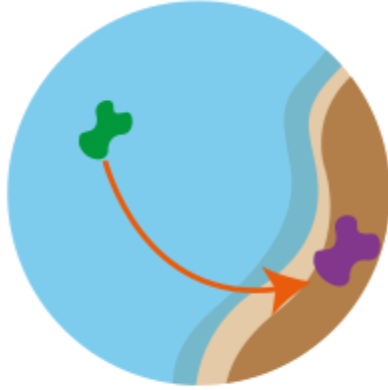
1. Identify spatial patterns of ES

EXTRACTION IN SITU



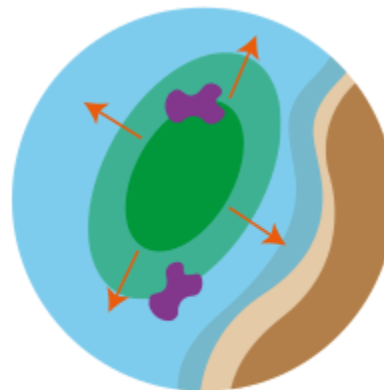
Service Providing area
 Service Benefiting area

DIRECTIONNAL



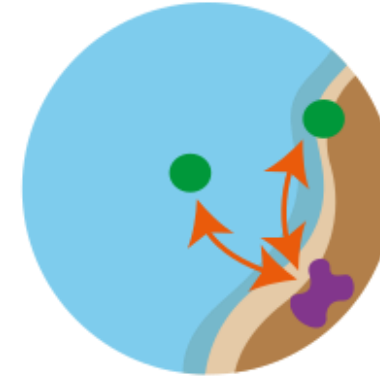
Service Providing area
 Service Benefiting area

OMNI-DIRECTIONNAL



Service Providing area
 Service Benefiting area

USER MOVEMENT
RELATED



Service Providing area
 Service Benefiting area

Associated ES

Food provision

Energy production

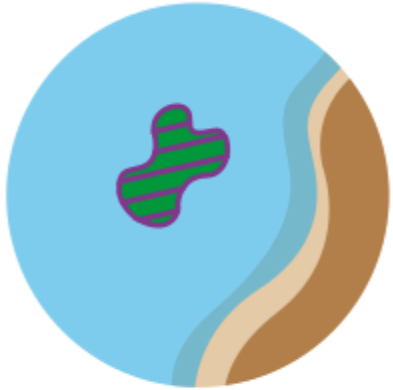
Habitat maintenance

Recreation and tourism

1. Identify spatial patterns of ES

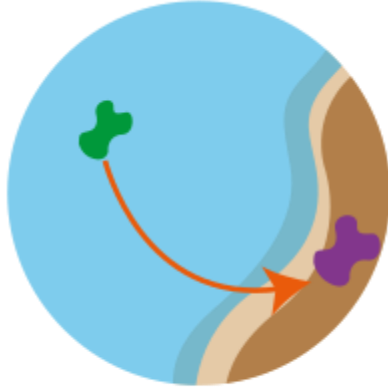


EXTRACTION IN SITU



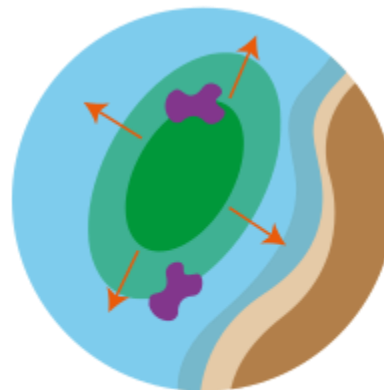
Service Providing area
 Service Benefiting area

DIRECTIONNAL



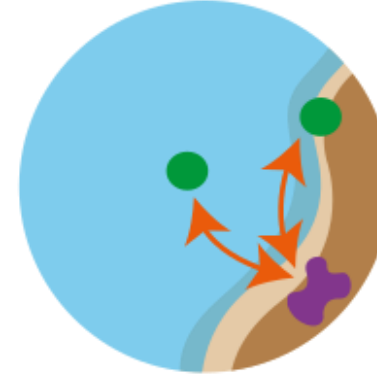
Service Providing area
 Service Benefiting area

OMNI-DIRECTIONNAL



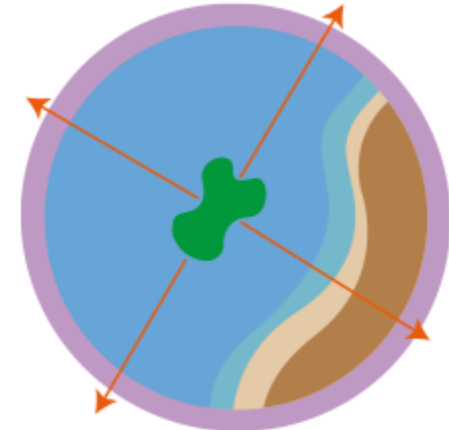
Service Providing area
 Service Benefiting area

USER MOVEMENT
RELATED



Service Providing area
 Service Benefiting area

GLOBAL NON-PROXIMAL



Service Providing area
 Service Benefiting area

Associated ES

Food provision

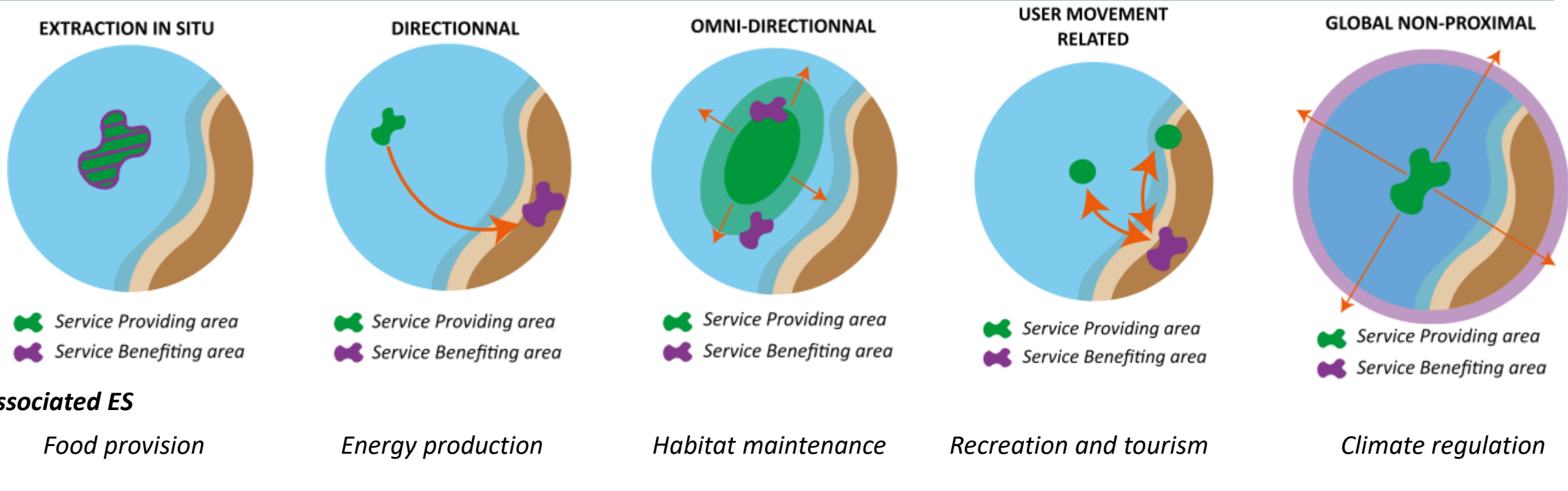
Energy production

Habitat maintenance

Recreation and tourism

Climate regulation

2. indicators to study ES in the context of offshore wind farm



Associated indicators

Based on selected resources (biomass, captures ...)

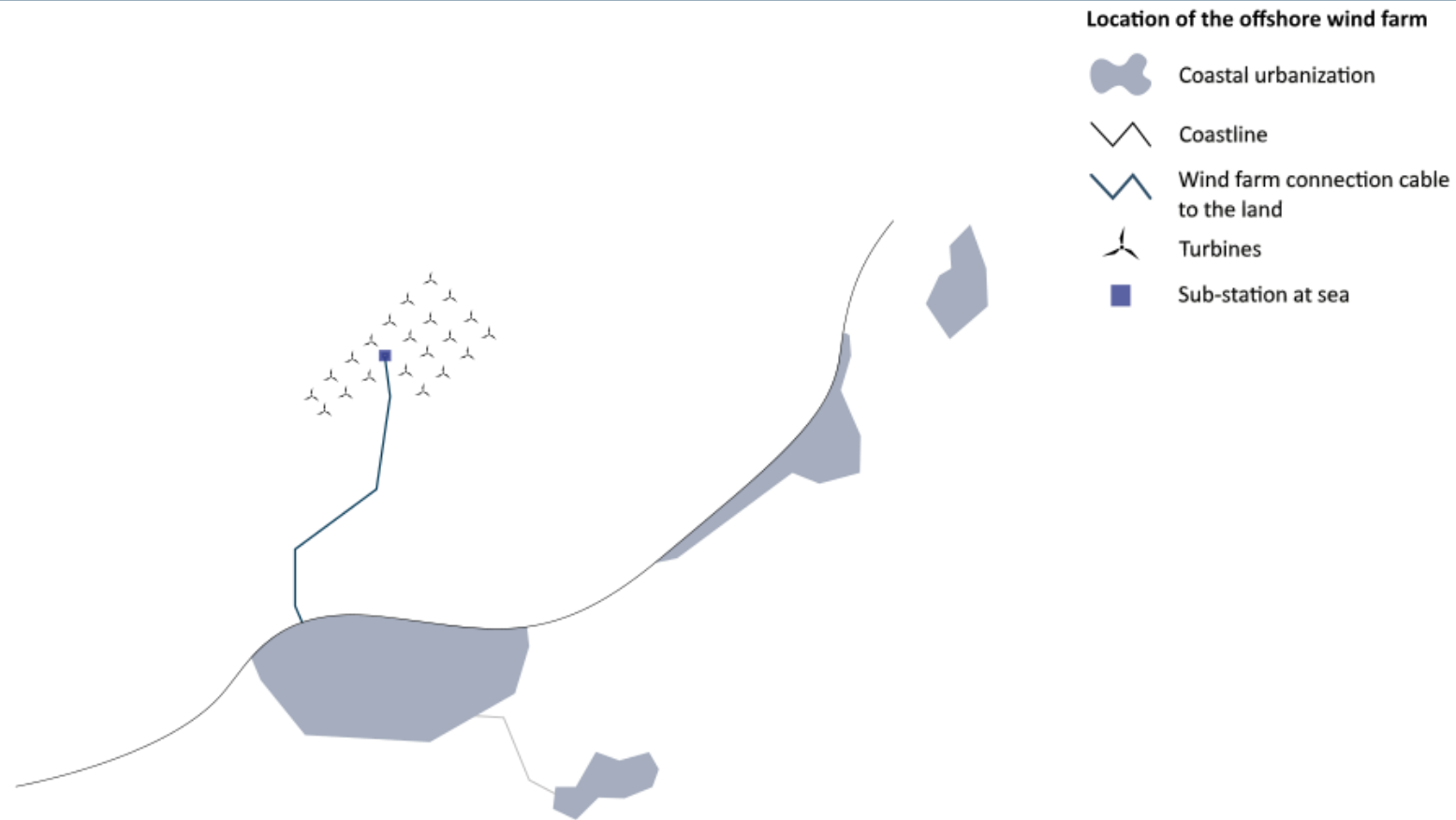
Production and distribution area

Land unit or effect area of the processes (distribution of functional species or habitat)

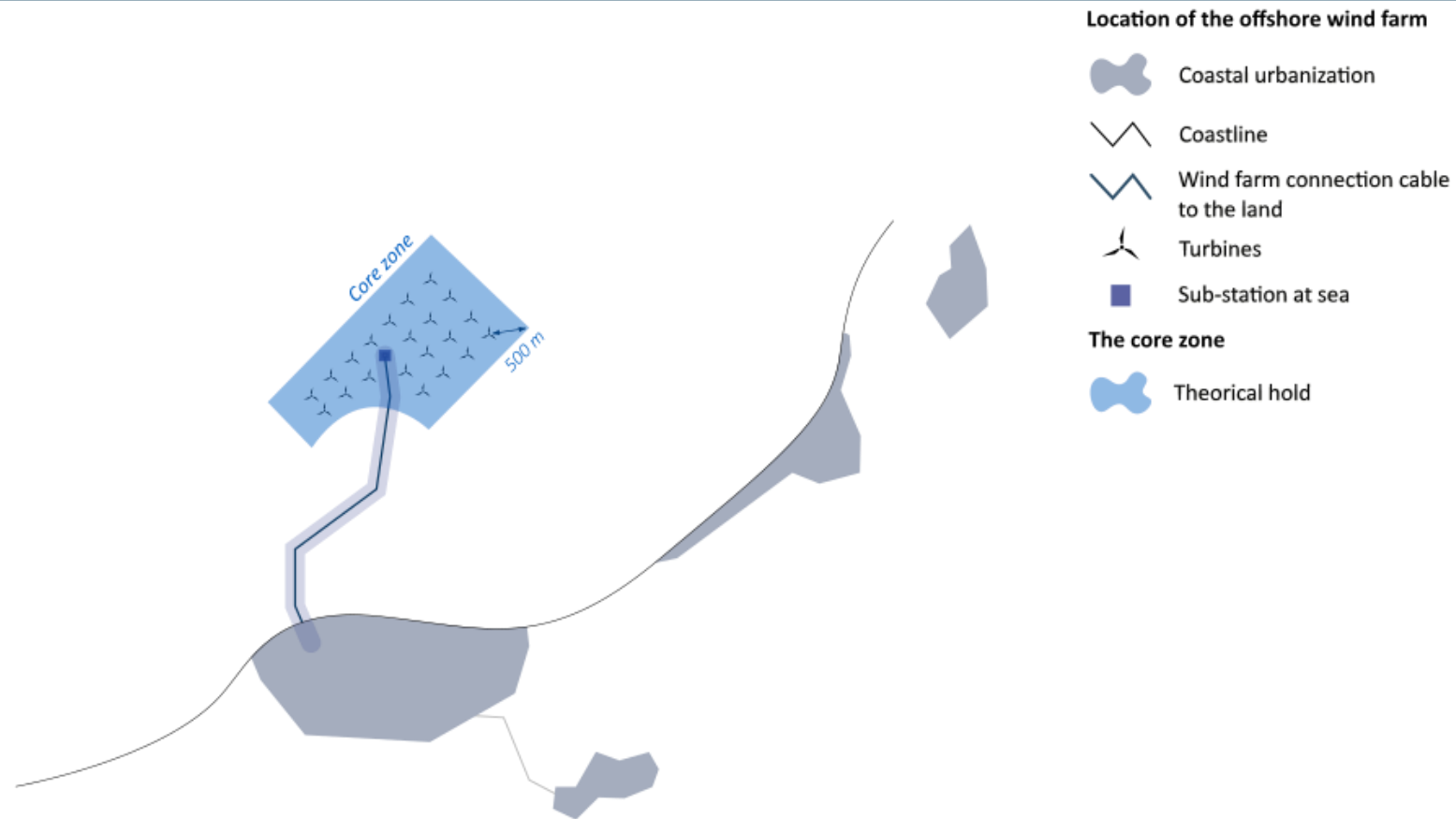
Location of recreation area and extent of visual impacts

Stocks of carbon and nitrogen
Carbon fixed by biomass

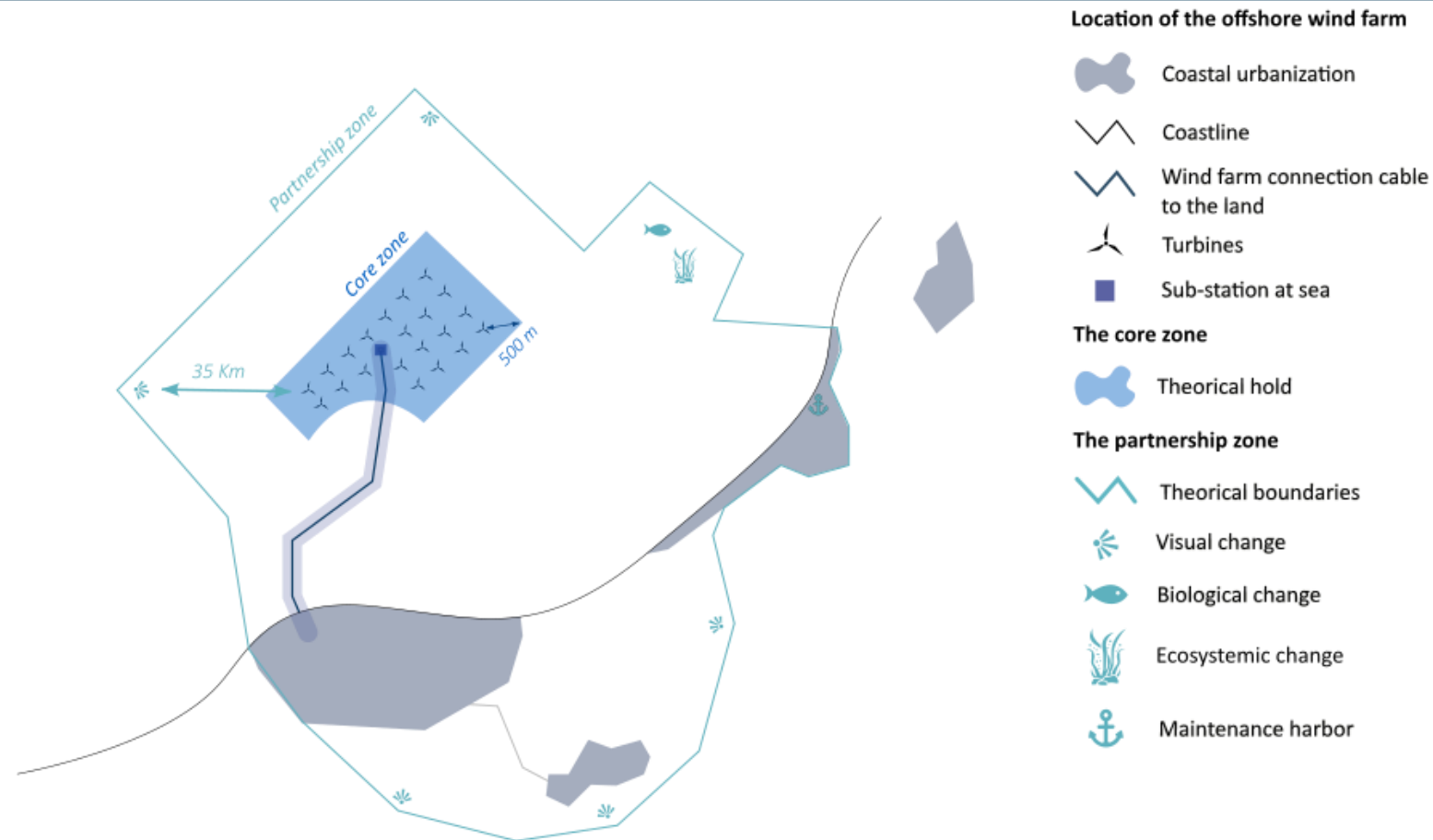
3. What is the « influence area » of an offshore wind farm?



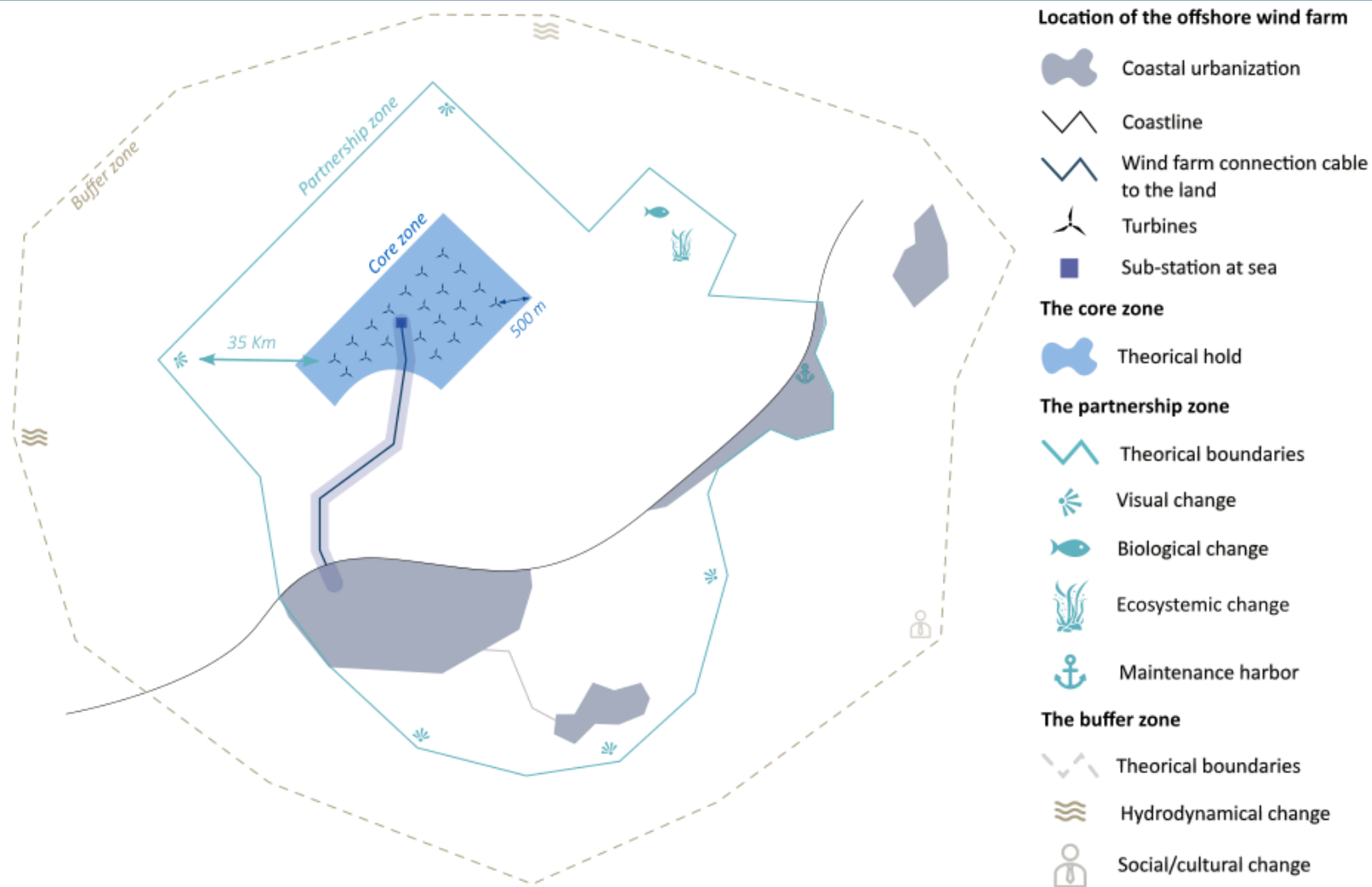
3. What is the « influence area » of an offshore wind farm?



3. What is the « influence area » of an offshore wind farm?



3. What is the « influence area » of an offshore wind farm?



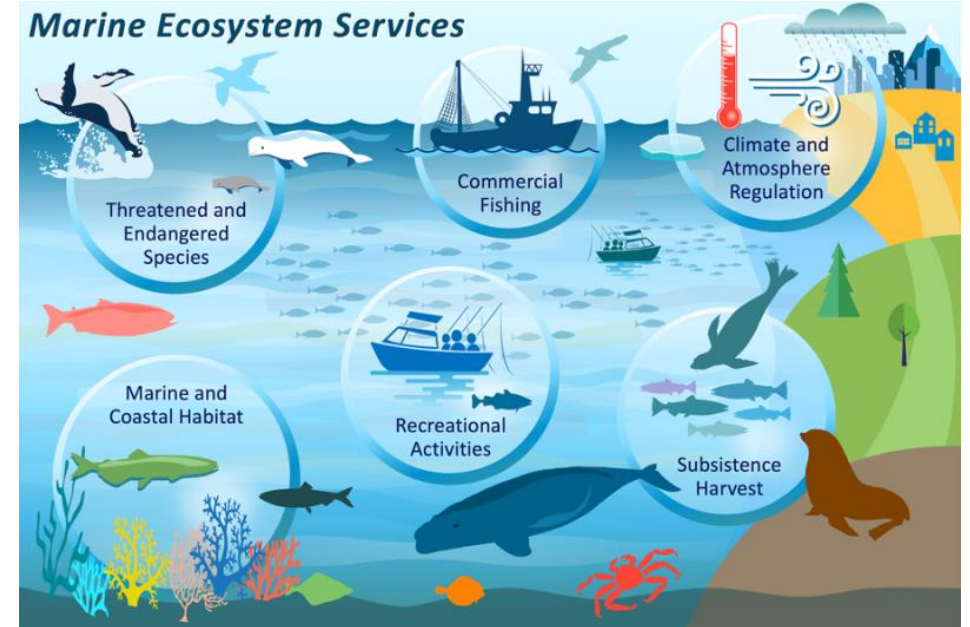
4. Marine spatial planning and ecosystem services: Spot the difference!



wwf.org

Common features

- Systemic approaches*
- Integrated approaches*
- Multidisciplinary approaches*



noaa.gov

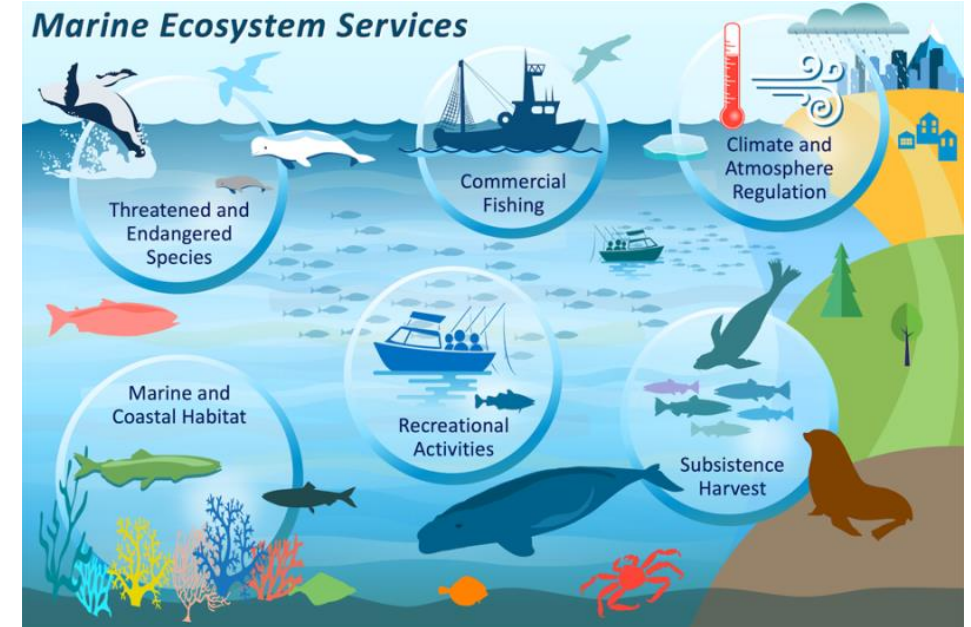
4. Marine spatial planning and ecosystem services: Spot the difference!



wwf.org

Common features

- Systemic approaches*
- Integrated approaches*
- Multidisciplinary approaches*



noaa.gov

In what ways could the concept of ecosystem services be useful for marine spatial planning in the context of offshore wind development?

- To model the current state
- To define scenarios of evolution and to anticipate
- To design support tools for discussion

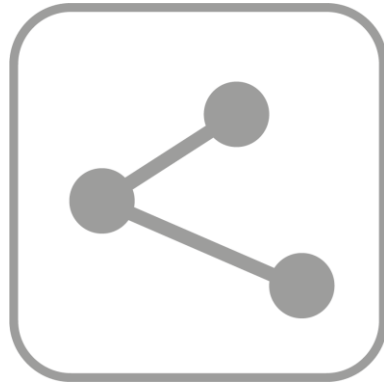
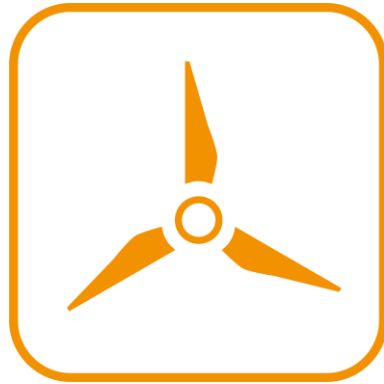
Bottlenecks for integrating ES and MSP

- ES concept criticism (anthropocentric approach, oversimplification, overgeneralization, overcomplicated to apply and validate)
- Not enough integrated approaches
- Complex data needed

Needs and guidelines for future ES mapping approaches

1. Define an indicator system for ES mapping in MSP context
2. Develop more "scenario" approaches to anticipate future changes
3. Engage with local stakeholders
4. Ongoing work to integrate knowledge of ecosystems and SE into management policies and maritime planning
5. Develop methods for assessing the uncertainty and sensitivity of the ES mapping models

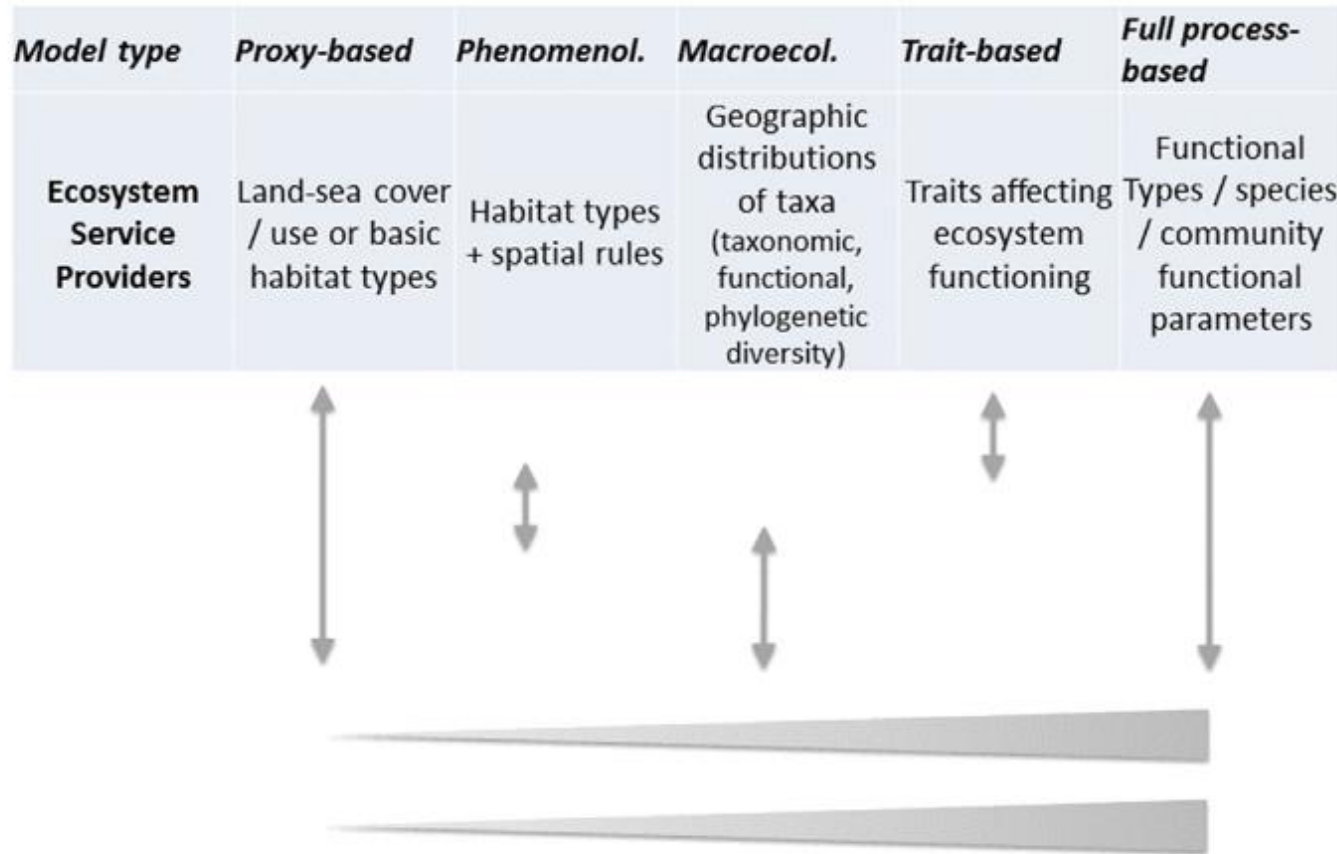
Thanks for your attention!



References

- Baulaz et al. 2023. An integrated conceptual model to characterize the effects of offshore wind farms on ecosystem services.
- Burkhard & Maes 2017. Mapping Ecosystem Services.
- Costanza 2008. Ecosystem services: Multiple classification systems are needed.
- Fisher et al. 2009. Defining and classifying ecosystem services for decision making.

Yoann.baulaz@france-energies-marines.org



SCALES

- Local
- Landscape
- Regional
- Continental
- Global

SKILL NEEDS

DATA NEEDS

Local examples

Proxy-based model :

- Cabral et al. 2015 Marine habitats ecosystem service potential: A vulnerability approach in the Normand-Breton (Saint Malo) Gulf, France
- Pecquet et al. 2022. Combining Ecological Niche Models and ecosystem services indicators to assess impacts of climate change on kelp: application to French coasts.

Phenomenological :

Vanhoutte-brunier et al. 2016 Évaluation des services écosystémiques du champ de laminaires de l'archipel de Molène

Full-process-based

Lavialle G et al. 2023 Mapping marine ecosystem services in a multifunctional seascape: the case of Grande Vasière (Bay of Biscay).

Trait-based

Work in progress related with OWF

- Phenomenological model
- Macroecological model (collision impacts)

Lavorel et al. 2017