

# NESTORE - Newsletter

2  
years

Project duration: 36 months (2022- 2025) | Total budget: €3,344K

**NESTORE**, is a :

- 🔗 **Multi-model approach**, using innovative tools from the ecosystem perspective;
- 🔗 **Integrative approach**, of the cumulative impacts of offshore wind farms at several spatial and temporal scales;
- 🔗 **Interdisciplinary approach**, including governance issues.



Assessing the cumulative impact of OREs in environmental impact studies has become mandatory for wind farm developers. In this context, NESTORE aims to develop and test operational tools to meet this legal obligation. These tools are based on multi-scale modelling of offshore wind farms interacting with the marine environment, the living organisms and other human activities.



**Nathalie Niquil**  
Project's scientific manager



## OBJECTIVE

To develop appropriate tools to study the potential cumulative impact of offshore wind farms and other human activities on the functioning of marine ecosystems.



This project receives French State funding managed by the French National Research Agency under the France 2030 investment plan. It is also supported by the SUD Provence-Alpes-Côte d'Azur, Bretagne and Occitanie regions.

## Modelling and governance

One of NESTORE's task is linking environmental (MSFD) and socio-economic stakes (MSP) of marine governance with the ecosystem approach tools. The aim is to propose scenarios that can provide answers and trends to inform decision-making and to define long-term objectives. The exploratory work has made it possible to identify the most operational elements from the various legislative texts framing environmental objectives: generally speaking, the tools of the ecosystem approach are moderately well suited for the regulatory framework. However, depending on the environmental objectives, the current tools

of the ecosystem approach can provide trends without requiring major adaptations of the models. Consideration has also been given to how models can better take into account the effects of offshore wind farms and the cumulative effects of other human activities. In addition, an approach based on 'ecosystem services' has been tested to establish the link between the MSFD and the MSP. This approach produced a synthesised view of the environmental and socio-economic issues associated with each ecosystem service, making it possible to identify any gaps.

## Studying cumulative impacts of offshore wind farms

As part of a thesis due to finish at the end of 2025, Yansong Huang examined the potential cumulative impacts of offshore wind farms in the Eastern English Channel during the construction and exploitation phases using a spatialised trophic model (OSMOSE). Different scenarios were simulated to assess the response of fish and cephalopods to the following cumulative impacts: fishing access restrictions, underwater noise and sediment resuspension. The first results showed a slight drop in biomass and catches on a local scale. These effects differ from one wind farm to another due to the complexity of trophic interactions and the spatial variability of environmental conditions.

### • M...

#### MSFD

Marine Strategy Framework Directive

#### MSP

Marine Strategy Planning

#### Modelling

Simplified representation of a real system or process in order to better understand, analyse and predict its functioning

### • S...

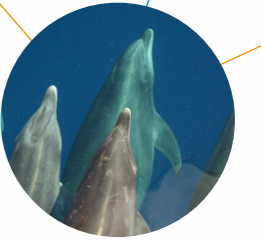
#### Scenario

In modelling, a scenario is the simulation of a hypothetical or future situation to explore the possible consequences of different actions or events

## Marine megafauna: a major challenge in the Gulf of Lion

In the Gulf of Lion, where several floating wind farms will soon be installed, the conservation of marine megafauna is considered a major issue. As such, it must be taken into account when assessing the cumulative impact of offshore wind farms. This work was initiated as part of a Master's internship by Alizée Fraysinet. It has helped to improve the integration of the bird and marine mammal compartments in the spatialised trophic model developed by Seyer et al. (2023). Based on this model, the potential effects of offshore

wind farms on the ecosystem of the Gulf of Lion (reef, reserve and attraction) have been studied in relation to the scenarios of SER-France Renouvelables (2023) in which the number of wind farms, their surface area and distance from the coast vary. The increase in the presence of prey inside the farms seems to attract predatory species such as bottlenose dolphins and mackerel. On the contrary, piscivorous birds avoiding the park areas would head for the coast.



Bird's attraction/avoidance to farms

Biofouling

Complete closure of fishing activities in farms

Diagram showing the scenarios simulated in the Gulf of Lion model. Three pressures (in blue) induced by floating wind farms in the Gulf were considered: biofouling, farm closures, attractions/avoidance, for the four scenarios proposed by the Syndicat des Energies Renouvelables (in green): 'out of restricted area', 'far from the coast', 'balance', 'cost reduction'.



## INTERVIEW

### 3 questions to Théo Grente

*Research engineer at Université de Caen-Normandie, Théo is involved in the algorithmic optimisation development of the LIM-MCMC model, frequently used in marine ecosystem modelling.*

#### What is the LIM?

LIM or Linear Inverse Modeling is a mathematical tool. Coupled with the calculations of the Monte Carlo Markov Chain (LIM-MCMC), it makes it possible to consider all possible representations of the marine ecosystem while respecting all the constraints governing its functioning.

#### What is it used for?

The LIM-MCMC's interest lies in exploring all possible representations and selecting a representative sample of around a hundred thousands to obtain an overall view. This is interesting as it provides a distribution of values for multiple indicators of ecosystem structure and functioning, rather than a single value.

#### What have you been working on, in the NESTORE project?

I've optimised this model. Having a sample with thousands of scenarios is interesting but requires fairly long calculation times. Here, I've managed to reduce the calculation time by a factor of 40! For example, in the article by Quentin Nogues et al. (2021) on the cumulative effects of a wind farm and climate change on ecosystem properties, obtaining the scenarios took 120 hours. After optimising the LIM-MCMC model, the same calculations took only 3 hours. The more complicated the model, the greater time saving.

This optimisation opens up new prospects, in particular the possibility of working on more complex models that better represent the ecosystem, by increasing the number of compartments or by integrating additional physico-chemical constraints.

## NESTORE continues in 2025

### Around the LIM

The collaboration with the Royal Belgium Institute of Natural Sciences continues around the LIM to model food webs inside and outside the wind farm. Their method for reconstructing diet is currently being compared with another promising method (MixSIAR), evaluating their effects on different indices of the structure and functioning of food webs.

### Towards new collaborations

Work is underway to spatialise ecosystem services to integrate the impact of offshore wind farms on human activities. The approach combines mapping areas of 'service provision' via trophic indicators and changes in 'access to services' with a

Bayesian spatial model. This method adapts a model developed by the AZTI institute (Research Centre on Marine and Food - Spain), with whom exchanges have been initiated to share experiences and consider future collaborations.



**NESTORE will be concluded with a public report of recommendations summarising the project's results.**