Case study of The Region of Galicia

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Regions to boost National Maritime Spatial Planning
REGINA-MSP
Co-funded by the European Union

The case study area of the Region of Galicia is in the N-W of Spain. It is bordered by Portugal to the south, the Atlantic Ocean to the west, and the Cantabrian Sea to the north. Galicia is the region of Spain with the most length of coastline (around 1,660 km), characterized by a narrow continental shelf an the presence of Rías, that are high productivity ecosystems.

All its waters belong to the **North-Atlantic demarcation** (**DM-NOR**), one of the five marine demarcations in which the Spanish marine waters are divided according to the Law 41/2010 on the protection of the sea.

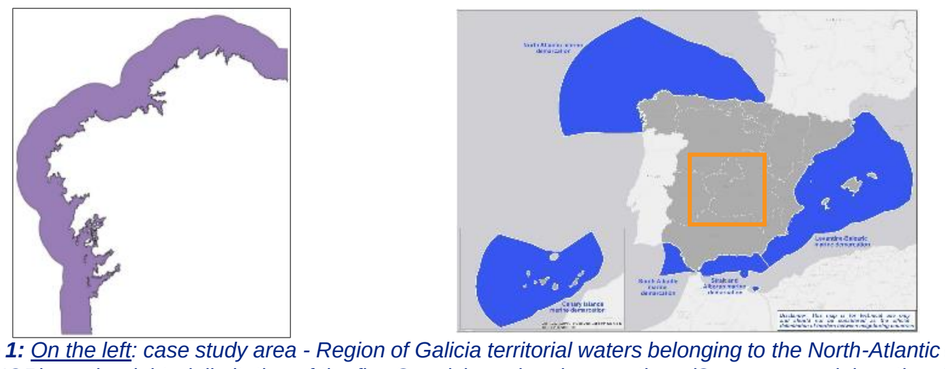

Figure 1: *On the left: case study area - Region of Galicia territorial waters belonging to the North-Atlantic demarcation (DM-NOR); on the right: delimitation of the five Spanish marine demarcations (Source: own elaboration; IEO, CSIC).*

The Case Study

Galicia holds a strong legacy of maritime activity. It is characterized by a high aquaculture and fishery production, the increase in sectors such as tourism and maritime recreational activities and the identification of High Potential Areas (ZAP) for the installation of offshore wind farms.

Coastal areas, mainly inside the rias, concentrate many uses, which can overlap and that should be properly managed to avoid conflicts and promote synergies.

Case study focuses in 3 topics:

- Advance in the development of knowledge and information to facilitate the planning of **offshore aquaculture** in the coastal waters, outside the rias
- Assessment of **underwater noise** due to vessel traffic at local level to deliver guidance to its integration in the maritime planning process.
- Identification of the areas where **blue tourism** activities are carried out in marine environments, along with their quantification in socioeconomic terms.

Underwater Noise

Underwater noise (UWN) analysis: Deployment of a Passive acoustic monitoring (PAM) device in the vicinity of the island of Sálvora (Ría de Arousa). 50 meters depth.
Period: From October 6, 2023 to January 9, 2024.
25,232 5-minute wav files (recorded at a sampling rate of 128 kHz)= 1.77 TBytes of information.

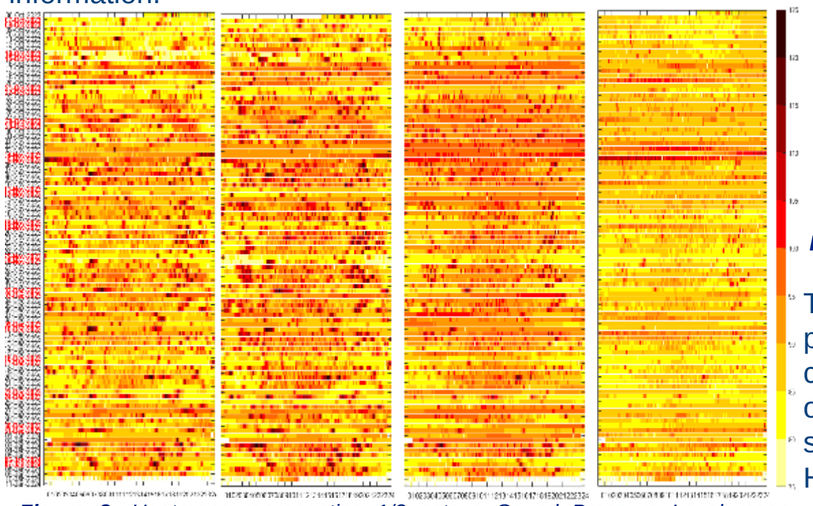

Figure 3: *Heatmaps representing 1/3 octave Sound Pressure Level mean values each 5 minutes in different bands: 63 Hz; 125 Hz; 2kHz; and 10kHz.*

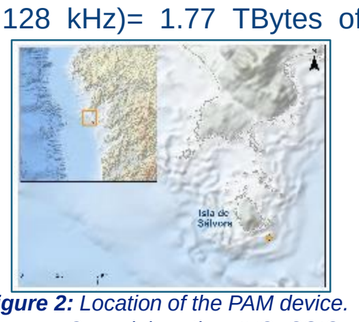

Figure 2: *Location of the PAM device. Source: Own elaboration. IEO, CSIC.*

The average sound pressure level has been calculated at different 1/3 octave frequency bands, specifically at 63 Hz, 125 Hz, 2 kHz and 10 kHz.

Whistle detection algorithm based has been applied.

Main results

- Increase in vocalization between 9:00 a.m. and 10:00 a.m.
- Between October 2 - November 3, the number of whistles detected were lower, probably due to a higher ambient noise, probably from vessels.

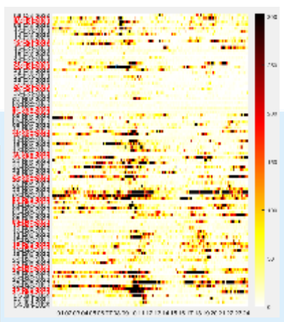

Figure 4*. Heatmap with the number of candidate whistles per wav file.*

Inclusion of UWN into MSP:
- *Identification of sensitive areas and species*
- *Georeferenced activity-specific radiated noise studies*
- *Identification of expected potential adverse impacts*
- *Set targets and mechanisms for underwater noise reduction*

Detailed Planning for Off-shore Aquaculture

The entire Galician territorial sea has been identified as a high-potential area for aquaculture in the Spanish Maritime Spatial Plans (POEM). Decision making on the location of marine cultures requires an in-depth knowledge of parameters that are critical for the development of the target species and for the sustainability of the aquaculture establishments.

Local climatic conditions, mainly *significant wave height*, were considered: Aquaculture areas were established at a **bathymetry between 20 and 150 m**.

Support of experts in aquaculture ➔ **8 species (4 fish, 3 bivalve and 1 crustacean)** were considered.

Optimal development thresholds ⟺ Environmental parameters

Historical data sets of Temperature, salinity, NO3, O2, pH and chlorophyll collected, evaluated and weighted to identify the most suitable offshore areas for the establishment of aquaculture systems for the selected species.

Figure 5: *In violet marine areas with significant wave heights of less than 15 meters.*

- Analysis of thermohaline and biogeochemical variables

"*The percentage of time in which the different target species are in comfort conditions has been analysed*".

Annual and Seasonal averages

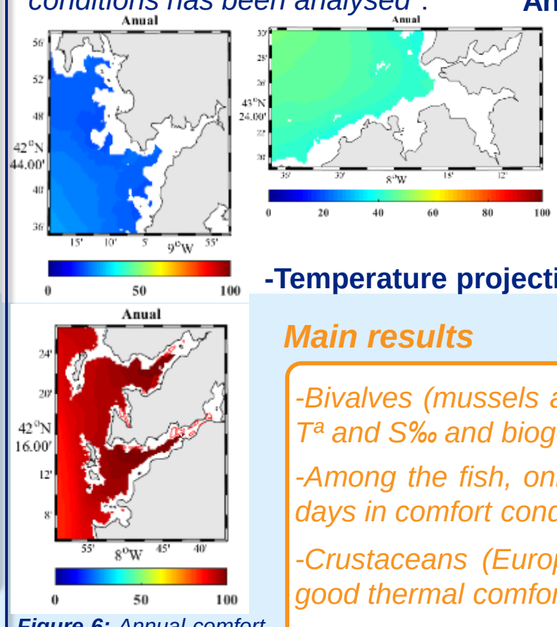

Figure 6: *Annual comfort percentage (temperature and salinity) for different species in Galician coasts.*

SOURCES
- Tª and S‰: METEOGALICIA. MOHID model. Period 2014-2023.
- Biogeochemical variables and chlorophyll: COPERNICUS program. Period 2011-2020
- Future temperature projections RCP8.5 scenario (IPCC, 2014). DELFT3D model.

-Temperature projections for next decades ➔ Influence in aquaculture.

Main results

-Bivalves (mussels and scallops) show favourable conditions regarding to Tª and S‰ and biogeochemical parameters for growth in the study area.

-Among the fish, only Bluefin tuna show values of more than 50% of the days in comfort conditions with respect to temperature.

-Crustaceans (European lobster) shows a low percentage of days with good thermal comfort, that potentially difficult its culture.

-Future temperature rise would benefit the culture of sea bream, sea bass and lobster, while negatively affecting salmon and scallops.

"There is a lack of precise local information on species optimal growth values for some of parameters considered"

Two Stakeholders' workshops

Figure 7: *Participatory workshops organised in the framework of the Galician Case Study.*

Offshore marine aquaculture in Galicia

Integration of Underwater Noise in MSP

Tourism

Tourism is a fundamental activity in the region, with marine-related activities being one of the most significant attractions in Galicia.

A total of 45 companies were identified that offer tourism services exclusively developed at sea, primarily focused on maritime transport and leisure activities. Their direct impact on the regional economy amounts to €17.6 million, involving nearly 300 workers.

When analysing the overall impact on the Galician economy, these activities effectively double their contribution, reaching €32 million and nearly 600 workers in the coastal area studied, representing 0.05% of Galicia's total GDP.

Key message

Marine tourism has a significant impact on the Galician economy, effectively doubling its contribution in terms of both value added and job creation. Despite the limitations and special permits required for certain recreational activities, no major challenges were identified in the development of marine tourism initiatives.

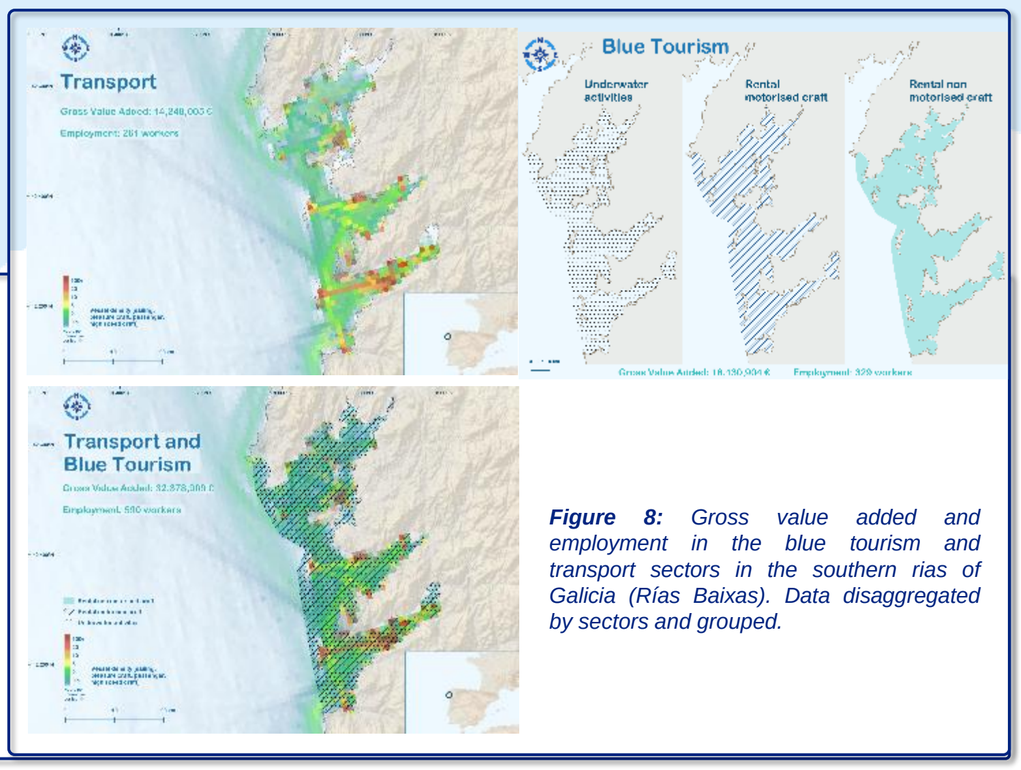

Figure 8: *Gross value added and employment in the blue tourism and transport sectors in the southern rias of Galicia (Rías Baixas). Data disaggregated by sectors and grouped.*

ACKNOWLEDGEMENT
This poster was produced for the REGINA-MSP project, which has received funding from the European Maritime and Fisheries and Aquaculture Fund of the European Union under the Grant Agreement number: 101081219.