AZTI

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

www.azti.es

Revista de
Investigación Marina
[31.1]

ISOBAY 2026

The 19th International Symposium on Oceanography of the Bay of Biscay

Kursaal, Donostia-San Sebastián
June 16-18

Bay of Biscay

ISOBAY 2026. The 19th International Symposium on Oceanography of the Bay of Biscay. Revista de Investigación Marina, AZTI, 31(1): 01-215.

La serie *'Revista de Investigación Marina'*, editada por la Unidad de Investigación Marina de AZTI, cuenta con el siguiente Comité Editorial:

Editor: Javier Franco

Adjuntos al Editor: Edorta Aranguena e Irantzu Zubiaur

Comité Editorial: Haritz Arrizabalaga
Oihane C. Basurko
Ángel Borja
Guillem Chust
Almudena Fontán
Ibon Galparsoro
Arantza Murillas

La '*Revista de Investigación Marina'* de AZTI edita y publica investigaciones y datos originales resultado de la Unidad de Investigación Marina de AZTI. Las propuestas de publicación deben ser enviadas al siguiente correo electrónico jafranco@azti.es. Un comité de selección revisará las propuestas y sugerirá los cambios pertinentes antes de su aceptación definitiva.

Edición: 1.ª Junio 2026
© AZTI
ISSN: 1988-818X
Unidad de Investigación Marina
Internet: www.azti.es
Edita: Unidad de Investigación Marina de AZTI
Herrera Kaia, Portualdea z/g
20110 Pasaia
Foto portada: AZTI.

© AZTI 2026. **Distribución gratuita en formato PDF a través de la web: www.azti.es/RIM**

ISOBAY 19

The 19th International Symposium on Oceanography of the Bay of Biscay

16–18 June 2026
Kursaal, Donostia-San Sebastián

Introduction

The International Symposium on the Oceanography of the Bay of Biscay, ISOBAY, was first held in Oviedo in 1988. Over the past nearly 40 years, held every two or three years and alternating venues between France and Spain, ISOBAY has become a well-established forum where marine researchers from the Bay of Biscay region share new approaches, discoveries, and findings with fellow scientists, contributions that help us understand how this marine environment functions and propose management measures in the context of global change.

This year, 2026, ISOBAY celebrates its 19th edition, and it does so, for the fourth time, in Donostia, which previously hosted the conference in 1990, 2000 and 2008. The event, organized by AZTI, will take place at the Kursaal Conference Center, right in the heart of the city and just a few dozen meters from the coast.

Over the years, ISOBAY has maintained the broad themes or core areas of marine science, such as physical oceanography, marine geology, biogeochemistry, marine biology, and fisheries. It has also incorporated new research areas that have emerged in response to the major challenges associated with better managing human activities in marine environments. Thus, this edition includes sessions dedicated to the blue economy, pollution, new technologies, anthropogenic impacts on the marine environment, marine environmental quality assessment, and marine ecosystem management.

ISOBAY has been from the beginning a forum to bring together early career and senior researchers, allowing master and PhD students to discuss, in a relaxed environment, their initial research findings. This spirit has been maintained over time and across several generations of marine researchers.

Once again, we have received many submissions (a total of 166), which reflect, on the one hand, the interest that ISOBAY generates within the local scientific community and, on the other, the significant global research capacity of the various institutions contributing to knowledge about the Bay of Biscay. Approximately one-third of these will be presented orally, and the rest as posters, and we want to acknowledge the Scientific Committee for their support in selecting the oral contributions. In addition, we will feature two invited keynote presentations that are sure to be inspiring.

This document contains the abstracts of all the papers received. Furthermore, an agreement has been reached with the journal "Continental Shelf Research," edited by Elsevier, for the publication of a special issue dedicated to the Bay of Biscay. Further details regarding this will be provided during the Symposium.

We hope you find ISOBAY of interest and that you enjoy your stay in Donostia.

Dr. Ángel Borja, AZTI

Chair of the Organizing Committee

SCIENTIFIC COMMITTEE

David Amouroux. University of Pau (France)
Pierre Anschutz. EPOC – Université de Bordeaux (France)
Magalie Baudrimont. EPOC – Université de Bordeaux (France)
Celia Besteiro. Universidad de Santiago de Compostela (Spain)
Paco Bustamante. LIENSs – La Rochelle Université (France)
Nathalie Caill-Milly. IFREMER (France)
Javier Cristobo. Instituto Español Oceanografía (Spain)
Marie-Noëlle De Casamajor. IFREMER (France)
Robert Duran. University of Pau (France)
Almudena Fontán. AZTI (Spain)
Arantza Iriarte. EHU (Spain)
François Le Loch. IRD (France)
Ionan Marigomez. EHU (Spain)
Maria Grazia Pennino. Instituto Español Oceanografía (Spain)
Araceli Puente. Universidad de Cantabria (Spain)
Pilar Rios. Instituto Español Oceanografía (Spain)
Andrés Rodríguez Arias. Universidad de Oviedo (Spain)
Alberto Serrano. Instituto Español Oceanografía (Spain)

ORGANIZING COMMITTEE

Angel Borja. AZTI
Javier Franco. AZTI
Meritxel González Intxausti. AZTI
Marina Santurtún. AZTI
Anna Rubio. AZTI

COLLABORATORS

REDEIA
POA (Pasaia Ocean Autonomy)
MARINNONET Project

KEYNOTE SPEAKERS

Raquel Somavilla, Senior Scientist, Spanish Institute of Oceanography (IEO)
Abigail McQuatters-Gollop, Professor of Marine Conservation, University of Plymouth

Index

SESSION 1: GEOLOGY, EROSION, TRANSPORT AND SEDIMENTATION

SESSION 2: PHYSICAL OCEANOGRAPHY, CLIMATE-OCEAN RELATIONS

SESSION 3: BIOGEOCHEMICAL CYCLES

SESSION 4: BLUE TECHNOLOGIES

SESSION 5: ANTHROPOGENIC EFFECTS, QUALITY ASSESSMENT AND ECOSYSTEM MANAGEMENT

SESSION 6: FISHERIES AND AQUACULTURE

SESSION 7: BIODIVERSITY, STRUCTURE AND FUNCTIONING OF ECOSYSTEMS

SESSION 1:
GEOLOGY, EROSION, TRANSPORT AND SEDIMENTATION

Onshore-offshore continuity of geological structures along the Basque coast: a key to understanding the evolution of the North Pyrenean frontal zone

Diego SABAROTS-URQUIA (1), Philippe RAZIN (2), Thibault CAVAILHES (1), Sébastien ZARAGOSI (1), Carine GRELAUD (3), Hervé GILLET (1), Thierry MULDER (1), Adrien EUDE (1), Laurent LONDEIX (1), Benoit GOUILLEUX (1), Tristan LE MORVAN (1), Arnaud CLAVIER (4)

(1) EPOC Laboratory, University of Bordeaux, (2) EPOC Laboratory - ENSEGID Bordeaux INP, (3) EPOC Laboratory, ENSEGID Bordeaux INP, (4) Port de St Jean de Luz, Navire Itsas Belara

Oral

Tectonics, sedimentation, foreland basin, Basque Pyrenees, morpho-bathymetry, seismic data.

New morpho-bathymetric data offshore the Basque coast allow the extension of geological structures identified onshore and improve understanding of the tectonic and sedimentary evolution of the frontal Basque Pyrenees, where outcrop data remain limited.

Our approach combines the analysis of surface data both onshore (existing studies, photogrammetric models of cliffs, etc.) and offshore (morpho-bathymetric maps, continental shelf sampling), together with subsurface data (boreholes and seismic profiles).

The syn- to post-tectonic Tertiary series of Biarritz (upper Lutetian to Oligocene) were deposited in a relatively deep flexural basin, located on both the allochthonous Basque flysch units (Albian to Cuisian), forming the active southern margin, and the flexured South Aquitaine autochthonous domain to the north.

At this stage, key questions are:

(1) the tectonic or stratigraphic (erosional) nature of the contact between the Biarritz Tertiary series and the Basque flysch, especially the eastward disappearance of the thick Jaizkibel turbiditic series (Ypresian);

(2) the origin of diverse synsedimentary deformations affecting the Tertiary series (normal faults, various types of folds, thrusts, detachments, diapiric structures). Their synchronism suggests a gravitational component, possibly linked to the persistence of a deep basin during orogeny in the western North Pyrenean domain;

(3) the emplacement of clay-evaporitic Triassic units, commonly associated with the Tertiary series. These ductile levels acted as décollement horizons at the base of thrust units and may crop out offshore at thrust fronts or within diapirs. Some material may have been resedimented (MTCs) or flowed into the basin to form stratiform units (Bas-adour, Bidart, maybe intersected by Bayonne offshore borehole), which can also act as detachment levels within the Tertiary sequence.

These preliminary results highlight the value of an integrated onshore-offshore approach to better constrain tectono-sedimentary relationships and the transition between the Pyrenean chain and the South Aquitaine Basin.

Investigating the hydroclimatic variability of the southwestern Bay of Biscay over the last centuries: new insights from the infra-decadal study of a marine sedimentary core of the Capbreton canyon.

Eva Bénard (1), Frédérique Eynaud (2), Julie Bignon (2), Isabelle Billy (2), Olivier Ther (2), Thierry Sauzeau (3)

(1) EPOC - CNRS, (2) EPOC - Université de Bordeaux, (3) Criham - Université de Poitiers

Oral

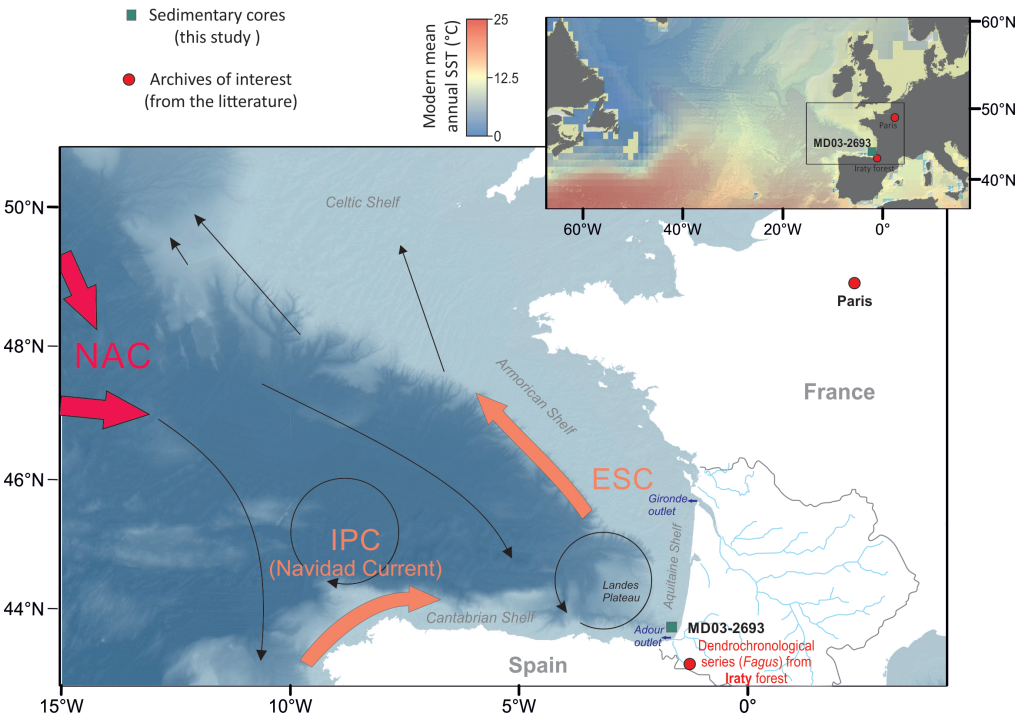
Paleohydrology, Paleoclimatology, Historical trends, Last Millenia, Neritic margins, Shore landscapes

Introduction

This work presents the high resolution study of the first meters of the sedimentary core MD03-2693, collected in 2003 (SEDICAR 4 cruise, Bourillet, 2004) at a depth of 431 meters from the terrace of an abandoned meander of the Capbreton Canyon. The coring site records exceptionally high sedimentation rates, mixing pelagic deposits interbedded within a matrice of fine terrigenous particles mainly sourced by the nepheloid decantation processes. As the site is located away from the active thalweg axis and is protected from erosive turbidite events, a continuous sedimentation, of approximately 1.2 cm per year, has built an over-dilated Holocene sequence (e.g., Gaudin et al., 2006 ; Mary et al., 2015, 2017), and, thus enables paleoenvironmental reconstruction at an unprecedentedly high temporal resolution. Previous studies conducted on the MD03-2693 core at decadal to centennial scales have demonstrated a strong connection between the trapped sedimentary signals and the hydroclimatic variations marking the Bay of Biscay area and the North Atlantic (Mary et al., 2017 ; Eynaud et al., 2025). These highlights underscore the potential for further investigations of this rare archive at infra-decadal resolution, something we have undertaken on a quasi-annual timescale over the past few centuries.

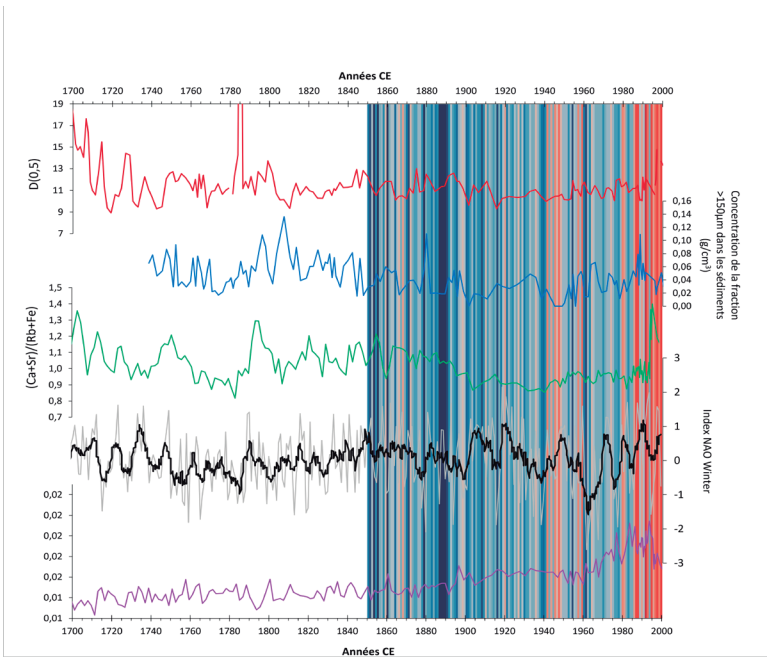
Methods

In order to reconstruct paleoceanographic conditions in relation to hydroclimatic contexts of the Bay of Biscay and of its proximal French Atlantic margin. A multiproxy combining sedimentological and paleoecological analyses have been conducted. A X-ray fluorescence logging of the core was employed to characterize variations in the elemental composition of the sedimentary inputs. Grain-size analyses were done to document changes in the hydrodynamic conditions and in the sediment transport processes. Finally, a palynological analysis focused on dinoflagellate cyst assemblages was initiated to provide indicators of sea-surface environmental variations. The achieved data are then compared with meteorological and historical chronicles to relate the identified signals within the sedimentary record to well-known meteo-marine and climatic events.



Results and Discussion

The first results show us very high resolution data that allow us to understand the impact of marine-weather phenomena that remain to be better defined through signals. However, our data allow to approach the different dynamics and punctual or permanent processes of the Bay of Biscay, and to establish the causes and consequences. Combining these data sets will help us to build robust hydroclimatic chronologies for the Bay of Biscay. These records will then be compared with other regional information to provide a reference framework for the North Atlantic Ocean and Western Europe.



[1] Bourillet J.-F., 2004. PROGRAMME SEDICAR 4 cruise, RV Marion Dufresne.
[2] Gaudin et al. 2006. Processus et enregistrements sédimentaires dans les canyons sous-marins Bourcart et de Capbreton durant le dernier cycle climatique, thèse de doctorat, Université de Bordeaux.
[3] Eynaud et al., 2025. History of the sedimentary regimes of the Aquitaine margin (May of Biscay, France) at the outlet of its main tributaries during the last millenium : a mirror of the North Atlantic and European climate, Global and Planetry Change.
[4] Mary et al. 2015. High frequency environmental changes and deposition processes in a 2kyr-long sedimentological record from the Capbreton canyon (Bay of Biscay), The Holocene, 25(2), 348-365.
[5] Mary et al. 2017. Changes in Holocene meridional circulation and poleward Atlantic flow : the Bay of Biscay as a nodal point, Climate of the Past, 13, 201-216.

Changes in Sediment Accumulation associated with a seagrass declines in a temperate tidal lagoon

Sabine SCHMIDT (1)

(1) CNRS EPOC

Poster

In the context of global change, coastal environments are often presented as blue carbon sinks. However, the capacity of these systems to store carbon is largely dependent on the production of biomass and sedimentation processes. It is therefore essential to investigate sedimentation rates over the last few decades in order to estimate carbon burial more accurately. Sedimentation intensity is determined by sediment input and hydrodynamics, as well as natural (storm) or anthropogenic (dredging) disturbances. Coastal ecosystems, including saltmarshes, mangroves and seagrass beds are renowned for their high productivity. However, these ecosystems are also subject to increasing pressures. For instance, seagrasses have experienced a significant drastic worldwide decline, which could alter their storage capacity.

The Arcachon Bay is a unique and ecologically important meso-tidal lagoon located on the Atlantic coast of southwestern France. The Arcachon Bay is home to seagrass meadows composed of two types of Zostera: Zostera noltei and Zostera marina. The Arcachon Bay is the largest area of dwarfgrass (Z. noltei) in Europe. This species has shown remarkable stability in its distribution between the 1950s and 1990s. However, analysis of satellite and aerial data indicates a decline in seagrass was observed in mid-2000, with a loss of approximately 33% recorded between 1989 and 2007. A number of hypotheses have been formulated in an attempt to identify the factors responsible for this drastic regression. These include pollution from runoff in agricultural areas, which introduces excess nutrients or heavy metals, changes in hydrodynamics and sedimentation patterns, climate change and particularly two severe heatwaves in 2003 and 2006. A key concern is the impact of these changes on sedimentation. It is therefore important to ascertain whether this regression has an impact on sedimentation.

In September 2022, interface cores were collected in order to determine sediment and mass accumulation rates (SAR, MAR) in Arcachon Bay. A total of nine sites were sampled, with two cores taken from each site were sampled in two contrasting locations: one where Zostera is present (Healthy) and one where sediment is bare (Bare), but where seagrass was present before 2005. The 18 cores were sampled at 1 cm intervals. Each sediment sample was weighed wet and after oven dried at 62°C to determine the dry bulk density, assuming a sediment density of 2.65 g cm-3. The estimate of sedimentation intensity was achieved through the use of a combination of radionuclides (210Pb, 226Ra, 137Cs, 232Th). Sedimentation and mass accumulation rates (SAR in cm yr-1; MAR in g cm-2 yr-1) were determined using 210Pb, whose 22.3 year half-life is well suited to studying sediment deposition on timescales of several decades. The long-lived radionuclide, 232Th (T1/2 = 1.4 10^10 years), is a tracer of the detrital fraction. It was used to normalise 210Pbxs in order to correct for potential changes in activity associated with changes in sediment rather than time. The radionuclides of interest were measured using a low background Broad Energy gamma detector equipped with a CryocyleTM II (Mirion). The sediment and mass accumulation rates (SAR, MAR) were calculated using the constant initial concentration (CIC) model applied to 210Pbxs.distribution in sediment.

SAR and MAR accumulation rates ranged from 0.06 to 0.41 cm/year and 60 to 440 mg/cm2/an, respectively. Sedimentation rates tend to be higher in covered sediments. However, a noticeable rupture in accumulation intensity was observed around 2005, which corresponds to a period of decline in seagrasses in the Arcachon Bay. The underlying mechanism is that the absence of Zostera promotes sediment resuspension during tidal cycles, which is corroborated by higher concentrations of suspended particles. An intra-site comparison of the surface 210Pbxs activities, normalised by 232Th to correct for sand dilution, revealed that the Bare sites and some Healthy sites were eroding. The comparison of the normalized surface 210Pbxs activities among sites suggest that there has been a loss of sediment ranging in thickness from 0 to 14 cm. These results underscore the fact that sedimentation intensity can vary significantly over multi-year to decadal timescales. In the event of erosion, caution should be exercised with regard to sediment and carbon balances.

SESSION 2:
PHYSICAL OCEANOGRAPHY, CLIMATE-OCEAN RELATIONS

30 years of physical connectivity patterns in the Bay of Biscay from a Lagrangian perspective

Nadine Steiger (1), Ivan Manso-Narvarte (1), Ainhoa Caballero (1), Anna Rubio (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA),

Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral
Connectivity, Lagrangian transport, dispersal, Bay of Biscay

Understanding ocean physical connectivity is essential for characterizing and predicting transport patterns, which in turn play a fundamental role in different marine processes. Here, we present a 30-year atlas of surface water connectivity for the Bay of Biscay (BoB), derived from Lagrangian particle simulations driven by daily high-resolution surface velocity reanalysis fields. Lagrangian simulations are used to characterize transport pathways within and between key subregions across integration times of 7, 30, and 90 days, thereby capturing connectivity from weekly to seasonal scales.

Results show that the obtained seasonal cycle of connectivity reflects the seasonal variability of regional ocean circulation: i) the along-slope transport by the Iberian–Poleward Current (IPC), ii) the presence of transport barriers along the continental slope, and iii) the enhanced cross-shelf transport from the Spanish shelf during spring and from the French shelf during summer. Regional maps of particle origins and transit times reveal areas of strong isolation along the French coast and zones of intensive mixing at the French-Spanish border. While interannual variability is evident, the simulations also indicate a slight but significant long-term decrease in transport from the Spanish to the French shelf, associated with a reduced intensity of the IPC.

Overall, these results highlight how physical circulation governs pathways of transport and retention within the BoB, offering insights into its potential role in different key ocean processes such as marine litter or plankton dispersal, genetic exchange, and ecosystem functioning.

Forty years (1986–2025) of physical processes controlling nutrient fluxes and primary production in the southeastern Bay of Biscay

Marina Chifflet (1), Almudena Fontán (1), Guillem Chust (1), Angel Borja (1), J. Germán Rodriguez (1), Joana Larreta (1), Luis Ferrer (1), Ivan Manso-Narvarte (1), Guillermo Boyra (1), María Santos-Mocoroa (1), Marta Revilla (1), Javier Franco (1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

Winter mixing, Eastern North Atlantic Central Water (ENACW), river runoff, coastal upwelling, nutrient enrichment, chlorophyll-a, Bay of Biscay

Continental shelves, despite occupying a relatively small area of the global ocean, exhibit productivity levels that far exceed those of the open ocean. This study focuses on the continental shelf of the southeastern (SE) Bay of Biscay. In this region, nutrient availability, which regulates chlorophyll-a and primary production, is primarily driven by exchanges with the deep ocean and inputs from land. We hypothesize that nutrient enrichment is mainly driven by winter mixing, riverine inputs, the advection of nutrient-rich subpolar Eastern North Atlantic Central Water (ENACW) and coastal upwelling. The objective of this study is to quantify the variability and relative importance of these processes in regulating nutrient supply and primary production on the SE Bay of Biscay continental shelf over the past 40 years.

To address this hypothesis, we use data from the long-term hydrographic monitoring program VARIACIONES, established in 1986, which provides a 40-years record (1986–2025) of hydrographic and biogeochemical observations. These data are complemented by surface nutrient measurements collected since 1995, through the Basque monitoring network for ecological status assessment (Basque Water Agency -URA-) as well as hydrographic observations obtained since 2007 from the Donostia offshore buoy (Basque Meteorological Agency) and opportunistic research surveys. Additional sources of information (reanalyses, remote sensing, rive-gauge records, meteorological stations) are also incorporated. This study forms part of the Marine and Coastal Climate Change Observatory.

The analysis reveals marked variability in the physical drivers regulating nutrient supply. Extreme winter mixing events occurred since 2005, leading to deeper winter mixed layers and potentially enhanced nutrient availability. Increased precipitation and river discharge since 2013 may have strengthened continental nutrient inputs. A freshening that began in 2014 has persisted to the present, leading to the predominance of nutrient-rich subpolar ENACW advected into the region and likely contributing to enhanced nutrient availability and increased chlorophyll-a concentrations on the shelf.

Multiplatform observations to characterize high resolution near-coastal dynamics in the Southeastern Bay of Biscay

Ainhoa Caballero (1), Ivan Manso-Narvarte (1), Simón Ruiz (2), Luis Ferrer (1), Asier Nieto (1), Anna Rubio (1

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia,

(2) IMEDEA (CSIC-UIB)

Oral

SWOT, Sentinel, Bay of Biscay, mesoscale, submesoscale dynamics

Introduction

The southeastern Bay of Biscay (SE-BoB) is a highly dynamic coastal region where mesoscale and submesoscale processes control hydrographic structure, cross-shelf exchanges and biological productivity [1]. High-resolution data from in situ platforms, together with satellite capabilities, are therefore essential to resolve fine-scale dynamics [2]. Within the PIXEL project, a coordinated observing system was implemented in spring 2025 to enhance the monitoring capacity in the SE-BoB through the integration of gliders and satellite products. This work presents a multiplatform analysis of near-coastal dynamics, characterizing the main mesoscale and submesoscale structures sampled.

Methods

The PIXEL glider survey was conducted in the SE-BoB between 31 March and 13 April 2025. It followed butterfly shaped transects spanning the shelf and upper slope and sampled hydrographic profiles (temperature, salinity) and acoustic backscatter between the surface and 250 m depth.

With regard to satellite data, two altimetry data sources were considered: (i) Daily L4 gridded altimetry data provides region-wide interpolated fields, but with limited resolution and accuracy near the coast; and (ii) the SWOT L3 maps offer ~2 km resolution and reduced noise within 10 km of the coastline, representing a major improvement for coastal applications [3]. Absolute geostrophic velocities were computed by combining sea surface height (SSH) anomaly from altimeters with a Mean Dynamic Topography. In addition, attention was paid to the SWOT overpass on 9 April 2025, which occurred during the central part of the glider mission. Sentinel-3 OLCI chlorophyll-a (chl-a) products were also used to investigate physical–biogeochemical coupling.

In this study, the temporal evolution of temperature and salinity along the glider path; the mesoscale and submesoscale structures encountered; and the consistency between glider, SWOT geostrophic currents and chl-a distributions are examined. This allowed to interpret in 3D (i.e. water column from the glider and surface from satellite fine scale altimetry and ocean colour maps), the attribution of observed hydrographic transitions to specific dynamical features.

Results and Discussion

Results

Temperatures during the mission ranged from ~12 to 14.5 °C, with a gradual warming consistent with early spring conditions (Figure 1). A thermocline developed near 20 m, and a subsurface temperature maximum around 50 m was evident until 10 April. Salinity showed higher variability at the beginning of the period, with surface values of 33–33.5 psu indicating coastal and riverine influence (not shown).

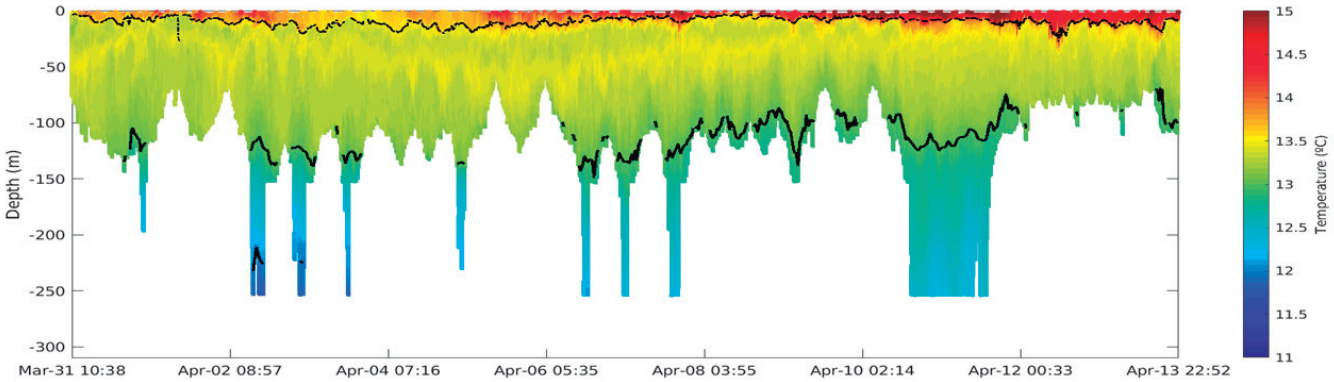


Figure 1. Temperature profiles during the mission. Black lines indicate the 12ºC and 13ºC isotherms.

L4 gridded altimetry represented the broad-scale circulation but failed to resolve important mesoscale structures evident in SWOT fields (Figure 2a). L4 currents appeared weaker and smoother, especially near the slope. By contrast, SWOT revealed sharper SSH gradients and more realistic current magnitudes, providing fine-scale detail in regions where conventional nadir altimetry is usually degraded.

The 9 and 10 April altimetry and chl-a maps revealed a cyclonic circulation feature northwest of the area indicated in Figure 2b, with geostrophic velocities up to ~10 cm s^{-1}. During this interval, glider derived drift vectors (not shown) indicated predominantly south-eastward motion.

The combined glider–SWOT–chl-a analysis highlighted (i) frontal zones and confluence regions collocated with strong temperature and salinity gradients; (ii) cyclonic and anticyclonic vortices modulating shelf–slope exchanges; and (iii) narrow surface filaments likely associated with submesoscale processes, potentially driven by frontal instabilities and bathymetric effects (Figure 2b).

In the eastern butterfly, glider-inferred eastward currents coincided with a chl-a filament, suggesting frontal uplift or along-front transport. Dynamic height and temperature maps pointed to cooler, higher-SSH waters in the northwestern sector and warmer, lower-SSH waters in the southwestern, consistent with a complex submesoscale pattern.

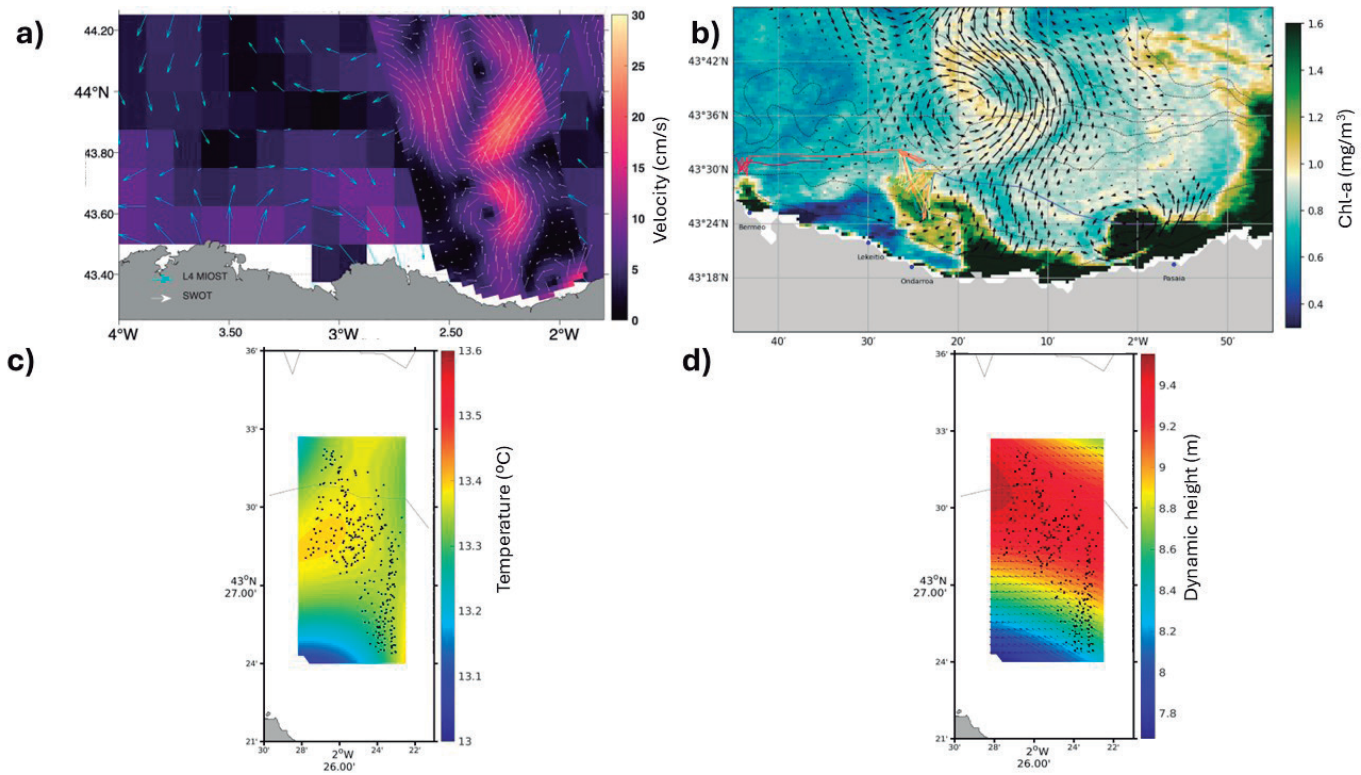


Figure 2. a) Combined L3v3.0 SWOT and L4 altimetry data (9 April 2025) for the area and period of study. b) Chl-a (10 April 2025) and L3v3.0 SWOT-derived currents, together with the glider path. The red square indicates the eastern butterfly area. c) Glider-derived temperature and d) dynamic height field and currents at 50 m depth. Black dots in figures c and d indicate glider observations.

Discussion and conclusions

The PIXEL survey demonstrates the strong 3D complementarity between gliders and satellite data for high-resolution coastal oceanography in the SE-BoB. The glider provided detailed vertical structure and along-track hydrography, capturing a rapid transition from fresher nearshore to more saline offshore conditions, together with thermocline intensification and fine-scale variability. Satellite data added the necessary two-dimensional context, revealing mesoscale cells, fronts and filaments that interacted with the glider trajectory.

The better agreement of SWOT geostrophic velocities with glider and chl-a data confirms the higher potential of SWOT to resolve mesoscale and submesoscale dynamics in steep slope coastal regions where traditional altimetry performs poorly. This has direct relevance for fisheries surveys and ecosystem studies in the SE-BoB, where understanding physical drivers at submesoscale is critical.

Overall, the experiment highlights the value of integrated multiplatform observing strategies combining autonomous platforms and high-resolution satellite products, which could also be combined in the following steps with hydrodynamic modelling and 48-hours low-pass filtered HF radar current fields. Such approaches substantially improve our ability to characterize fine-scale dynamics over the SE-BoB shelf and slope and provide a robust framework for interpreting physical controls on biological and acoustic variability.

Acknowledgements: We acknowledge the Basque Government for providing AIS data, and the Spanish General Secretariat for Fisheries (SGP) for sharing logbook data within PIXEL project. This work is funded by Eusko Jaurlaritza – Basque Government through the European Maritime, Fisheries and Aquaculture Fund and by #ebegi project funded by the Directorate of Agriculture, Fisheries, and Food Policy of the Department of Economic Development, Sustainability, and Environment. This study has been conducted using EU Copernicus Marine Service (https://marine.copernicus.eu/) and AVISO/DUACS, 2024. SWOT Level-3 KaRin Low Rate SSH Expert (v3.0) [Data set] https://doi.org/10.24400/527896/A01-2023.018.

[1] Caballero, A., Rubio, A., Ruiz, S., Le Cann, B., Testor, P., Mader, J., & Hernandez, C. (2016). South-Eastern Bay of Biscay eddy-induced anomalies and their effect on chlorophyll distribution. Journal of Marine Systems, 162, 57-72.

[2] Rubio, A., Caballero, A., Orfila, A., Hernández-Carrasco, I., Ferrer, L., González, M., ... & Mader, J. (2018). Eddy-induced cross-shelf export of high Chl-a coastal waters in the SE Bay of Biscay. Remote Sensing of Environment, 205, 290-304.

[3] Verger-Miralles, E., Mourre, B., Gómez-Navarro, L., Barceló-Llull, B., Casas, B., Cutolo, E., et al. (2025). SWOT enhances small-scale eddy detection in the Mediterranean Sea. Geophysical Research Letters, 52, e2025GL116480. https://doi.org/10.1029/2025GL116480.

The Pasaia Ocean Autonomy (POA): Strengthening operational, multidisciplinary monitoring in the SE Bay of Biscay with autonomous platforms

Anna Rubio (1), Ivan Manso-Narvarte (1), Asier Nieto (1), Nadine Steiger (1), Ainhoa Caballero (1), Jaime Valls (1), Marina Chifflet (1), Guillermo Boyra (1), Bea Sobradillo (1), Udane Martinez (1), Julien Mader (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

The Pasaia Ocean Autonomy (POA) hub is expanding the EuskOOS-RI observing system by integrating ocean gliders and other marine autonomous systems into its operational infrastructure in the SE Bay of Biscay. POA's main added value is to improve how we monitor oceanic and coastal processes: enabling rapid, adaptive sampling and sustained, multiplatform observations that can be aligned with evolving scientific and societal needs. POA is also building a service framework to provide external access to platforms and operational support, strengthening collaboration within the wider European research community.

POA is designed to support a multidisciplinary approach to key scientific questions, including the coupling between physical dynamics (fronts, stratification, mixing, circulation and mesoscale features) and biogeochemical cycles that sustain ecosystem functioning. By combining physical and biogeochemical sensors with complementary coastal observing assets (e.g., HF radar and satellite products), we will showcase how gliders help connect coastal-to-offshore gradients and link high-frequency variability to larger-scale drivers. In addition, we have already demonstrated the potential of active acoustics onboard gliders in several campaigns, showing how we can complement more traditional measurements and open new avenues for cross-disciplinary analyses.

These multidisciplinary observations enable more complete descriptions of water-column dynamics and support climate-change-related questions, such as shifts in stratification and mixing, marine heatwaves, and ecosystem responses. POA is also aimed to make these observations available in near real time and fully operational, contributing to the completion and long-term evolution of EuskOOS-RI as an integrated, end-to-end observing and information system for the SE Bay of Biscay.

Bay of Biscay numerical simulations dedicated to river plumes during the 21st century - the RiOMar project

Guillaume Charria (1), Maud Martinez-Almoyna (2), Marc Sourisseau (3), Anne Gaymard (4), Xavier Couvelard (5), Martin Plus (3), Sébastien Theetten (2), Jean-François Le Roux (2), Ivane Pairaud (2)

(1) Ifremer / LOPS, (2) Ifremer, Laboratory for Ocean Physics and Satellite remote sensing (LOPS), (3) Ifremer, DYNECO Pelagos, (4) Univ. Brest, Laboratory for Ocean Physics and Satellite remote sensing (LOPS), (5) Service Hydrographique et Océanographique de la Marine (SHOM)

Oral

river plume dynamics, numerical modelling, coastal ocean dynamics, marine heatwaves

The RiOMar project aims to define and develop an original, integrated approach with environmental managers that combines augmented observatories, innovative digital tools, and model simulations. This approach will be used to anticipate the future of coastal water quality (e.g. primary production, oxygenation, acidification, eutrophication, contamination, and toxic algae) and the functioning of marine ecosystems in the French metropolitan coastal area under the influence of rivers in the 21st century. Numerical simulations integrating climatic and anthropogenic stressors will focus on three periods: the recent past (2000–2020) and the present (2022–2025) to understand the effects of environmental measures already implemented, the period around 2050 when climate impacts emerge (2030–2050), and the end of the 21st century when climate impacts are stronger (2080–2100).

An overview of the high-resolution simulations performed using CROCO model in the Bay of Biscay and the English Channel will be presented. A few illustrations will be used to describe model validation and the main simulation features. Preliminary results dedicated to major river plume dynamics and to marine heatwaves will be presented.

Reconstructing mesoscale surface circulation in the Bay of Biscay using an advection-based neural network

Juan Manuel López Contreras (1), Ganix Esnaola (2), Aida Alvera-Azcárate (1), Alexander Barth (1)

(1) University of Liège, (2) University of the Basque Country

Oral

Ocean mesoscale dynamics play a major role in phytoplankton productivity and other physically driven ecological processes in the Bay of Biscay, a region characterized by complex bathymetry and a large-scale poleward current that promotes the formation of slope water oceanic eddies (SWODDIES). These features strongly influence the horizontal transport and distribution of tracers, contributing to a highly variable environment with impacts in physical phenomena and biological variability. However, the role of submesoscale to mesoscale circulation in shaping chlorophyll distribution remains difficult to quantify, partly due to the limited characterization of surface currents at these spatial scales.

High-resolution ocean color and sea surface temperature datasets capture fine-scale tracer variability and provide an opportunity to infer surface circulation through an inverse approach. In this study, we explore the capability of a neural network to reconstruct ocean surface currents and mesoscale features in the Bay of Biscay based on the advection visible in tracer fields, complemented by auxiliary variables such as next-generation altimetry products, including SWOT.

We implemented a convolutional encoder–decoder architecture (U-Net type) trained with an advection-based cost function that minimizes the difference between advected tracer fields and their observed distributions, while incorporating constraints on physical boundaries and flow properties such as divergence. The method is evaluated using daily fields from the Irish–Iberian Biscay (IBI-MFC) reanalysis and a non-assimilative biogeochemical hindcast for the period 1993–2019.

The network is then used to reconstruct velocity fields for the year 2020, showing consistent spatial patterns along selected transects, with an RMSE of 0.039 m/s compared to a mean velocity of 0.059 m/s, and recreating persistent mesoscale features previously described for the area. This approach highlights the potential of tracer observations to improve our understanding of mesoscale surface circulation and transport processes in the Bay of Biscay.

Seasonal stratification, warming, and bottom-water deoxygenation in the West Gironde Mud Patch (Bay of Biscay): local signature or regional drivers?

Maria Eduarda Mezzari Csunderlick (1), Bruno Deflandre (2), Louis Marié (3), Bastien Lamarque (2), Martin Danilo (4), Robert Schlegel (5), Guillaume Charria (3), Sabine Schmidt (4)

(1) Univ. Bordeaux, EPOC, (2) Univ. Bordeaux, CNRS, EPOC, (3) Ifremer, LOPS - Brest, (4) CNRS, EPOC, (5) Univ. Sorbonne, LOV, Villefranche-sur-mer

Oral

Seasonal stratification, Bottom-water deoxygenation, Warming, Marine Heat Waves, Marine Cold Spells, Sea Surface Temperature (SST)

Introduction

Coastal deoxygenation has been increasingly reported over the last few decades, particularly in river-dominated margins (RiOMar). This phenomenon has also been recently observed in the bottom waters overlying the West Gironde Mud Patch (WGMP), located around 40 km from the Gironde estuary on the continental shelf of the Bay of Biscay. Several hypotheses have been proposed to explain this seasonal deoxygenation, including the duration of stratification, the intensity of primary production, the sediment oxygen consumption, and the possible advection of oxygen-depleted waters from the northern Bay of Biscay. However, these initial results still require to be consolidated, particularly regarding the spatiotemporal dynamics of the phenomenon and the identification of the dominant controlling mechanisms. For this reason, observations have been intensified since 2023 within the framework of the RiOMar project (PPR « Un océan de solution »).

Methods

This work aims to analyse the structure and dynamics of the water column at different spatial and temporal scales. The objectives are (1) to document the variability of water column stratification and dissolved oxygen (DO) levels, (2) to evaluate potential advective processes, and (3) to assess the risk of increasing deoxygenation in the context of climate change. Two main sources of data were used: satellite data and in situ measurements. Sea surface temperature (SST) data from 1982 to 2025 (L4 Copernicus Marine Service) were analysed to characterise long-term trends and to investigate the frequency, intensity, temporal dynamics of extreme events and their potential impact on water column structure and bottom-water oxygen levels. In situ data were collected during the springs 2023, 2024 and 2025, and the autumns 2024 and 2025 using a ScanFish system, to measure temperature, salinity, DO, turbidity and chlorophyll-a. The transects covered both the longitudinal axis of the WGMP, from 38 to 82 m depth, as well as cross-sections at 40 and 55 m depth, extending beyond the boundaries of the WGMP.

Results and Discussion

An important seasonal variability in SST, ranging from < 11 to > 19 °C, was evidenced by both in situ and satellite measurements. An STL (seasonal-trend decomposition using Loess) analysis of the 1982-2025 SST records revealed a long-term warming trend of +0.027°C per year. This trend is paired with an increase in the frequency and duration of marine heatwaves (MHW) over time, with the most significant MHWs recorded in 2006, 2011, 2023, 2024 and 2025. Conversely, marine cold spells (MCS) have become progressively less frequent and intense over the last decade. The most significant MCSs were recorded in 1984 and 1993, while the most recent one, in 2022, was considerably less intense than historical episodes. Overall, these results clearly show that autumn and winter periods have warmed steadily, with no equivalent compensatory cooling observed. This warning is likely to enhance the water column stratification, thereby limiting vertical mixing and bottom oxygenation.

ScanFish transects revealed pronounced thermal stratifications in May 2023, June 2024 and May 2025, with a well-defined thermocline at approximately of 20 m depth. Conversely, transects conducted in October 2024 and 2025 showed a deeper and weaker stratification (around 40 m depth), resulting from surface cooling and wind-driven mixing. In October 2024, destratification was initiated in the proximal area, likely driven by seasonal weather changes and increased river discharge (up to 1124 m^3 s-1). By comparison, the water column during October 2025 remained stratified even in the proximal area, consistent with a much lower river discharge (around 250 m^3 s-1). Lower DO levels were observed in the bottom waters during both years, oxygen saturation decreasing for instance from 70% in June to 52% in October 2024.

Transects conducted in October 2025 both inside and outside the WGMP revealed a similar structure of the water column. The mixed layer extended to comparable depths, and below this layer, oxygen saturation averaged around 68% between 40 m and the seafloor. These results provide no clear evidence for the advection of deoxygenated waters from the northern Bay of Biscay. In addition, they suggest that bottom water deoxygenation is not a phenomenon specific to the WGMP.

The observed warming of the surface waters, combined with pronounced seasonal variability and continental inputs, enhances the water column stratification. Stronger and more persistent stratification reduces vertical mixing and limits oxygen exchanges between surface and bottom layers, thus exacerbating the bottom water deoxygenation. As temperature continues to rise, this process is likely to intensify, potentially leading to more frequent and severe deoxygenation events in the area. To better understand how the structure of the WGMP water column evolves and its response to ongoing global change, long-term observations are required, integrating the interactions between hydrodynamics, continental inputs, and hydrological and biogeochemical processes, as well as key climate indicators (e.g. NAO, ONI, AMOC).

Study of the effect of metocean transport of harmful algae Ostreopsis at different spatiotemporal scales for bloom management in the SE Bay of Biscay

Ivan Manso-Narvarte (1), Amandine Declerck (2), Nadine Steiger (1), Agnès Petrau (2), Sarah Itoiz (2), Sergio Seoane (3), Anna Rubio (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) Rivages Pro Tech SUEZ, (3) UPV/EHU

Oral

Ostreopsis, Lagrangian simulations, Connectivities, Harmful algal blooms, Coastal management

Introduction

Understanding the physical drivers shaping the occurrence, dispersion, and coastal impacts of Ostreopsis blooms is essential for managing risks of harmful algal blooms in the southeastern Bay of Biscay (SE-BoB) (Drouet et al., 2021). Within the OSTREOBILA project, we investigate the role of ocean transport across three complementary spatial scales (regional, inter-municipality, and beach scale) to quantify retention, connectivity, and transport patterns by means of Lagrangian simulations.

Methods

At the regional scale, we forced the OpenDrift Lagrangian model with CMEMS IBI model surface velocity fields (https://doi.org/10.48670/moi-00029) to simulate backward trajectories of Lagrangian particles. Particles were seeded on a regular 0.08º x 0.08º grid within three Basque regions: i) French Basque shelf (43.379N to 43.6N), ii) Gipuzkoa shelf (1.788W to 2.41W) and iii) Bizkaia shelf (2.41W to 3.15W). In each monthly simulation between 1994 and 2024, particles are seeded every five days and run for 30 days backward in time.

At the inter-municipality scale, the MOHID Lagrangian model was forced with (i) surface velocity fields derived from the high-frequency (HF) radar system (https://info.euskoos.eus/) refined to 500 m via a reduced optimal interpolation (ROOI; Jordà et al., 2016) method on French Basque coast and (ii) CMEMS IBI model surface currents on Gipuzkoa coast. A five-year (2021–2025) statistical analysis of observed waves and wind conditions over the littoral area was conducted to identify representative meteo-ocean scenarios. Based on this analysis, four typical periods were defined, characterized by contrasting conditions: along-shore versus across-shore winds and currents, moderate to high wave energy, and different tidal phases.

At the beach scale, analyses are ongoing. The approach consists of forcing the MOHID Lagrangian model with surface velocity and wave fields derived from a very high-resolution coastal model developed at Rivages Pro Tech, applied to two sites: Erromardie Beach and Ondarreta Beach. As for the inter-municipality scale, the analysis will focus on identifying transport pathways, but at a finer spatial and temporal resolution. In particular, it will aim to characterize transport patterns and quantify retention times under different metocean conditions.

Results and Discussion

At the regional scale, we preliminarily explored how the Spanish and French Basque coasts are physically connected. The simulations show consistently high connectivity among French coastal areas, while Gipuzkoa–France exchanges remain moderate, and Bizkaia–France connectivity is comparatively low. Connectivity within the Basque coast shows a medium-to-low linkage between Gipuzkoa and Bizkaia, reflecting the influence of regional circulation. Seasonal variability is

prominent: autumn, winter, and spring exhibit the strongest cross-regional connections, driven by the slope current, whereas summer conditions favour increased retention. Overall, the French Basque coast consistently emerges as a retention hotspot, accumulating a larger proportion of particles regardless of season, highlighting its vulnerability at a regional scale to incoming Ostreopsis transport from coastal sources. Next steps include using HF radar–derived surface currents, refined to 500 m via the ROOI method, for finer connectivity analysis.

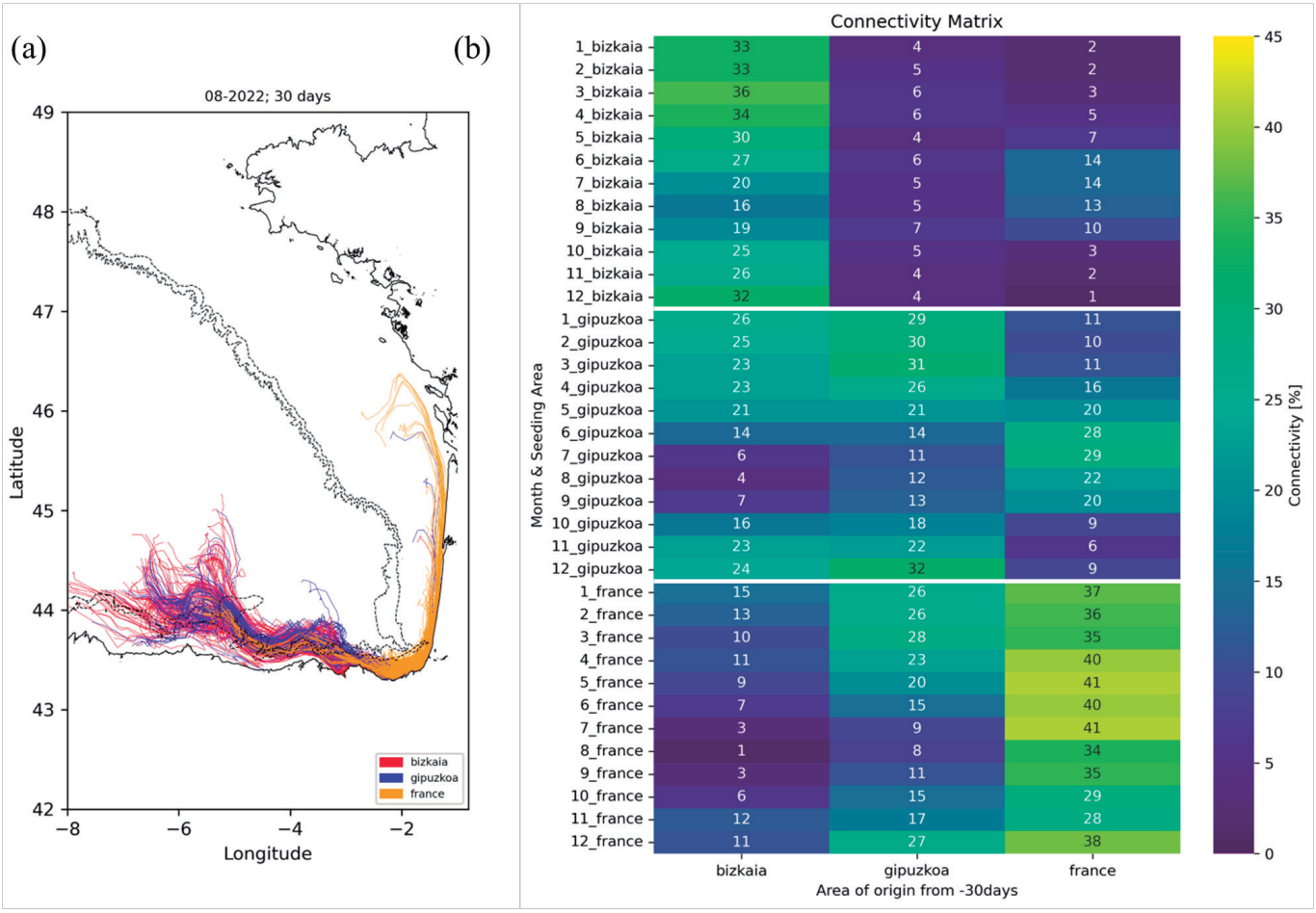


Figure 1. (a) Example of August 2022 of the results of 30 days of backward simulation with particles seeded on the French Basque shelf (yellow) and in the Spanish Basque shelf in front of Gipuzkoa (blue) and Bizkaia (red). (b) The connectivity matrix between the French and Spanish Basque coastal waters (Gipuzkoa and Bizkaia) as monthly means over the 1994-2024 period.

At the inter-municipality scale, the results show that connectivity patterns exhibit high variability depending on meteo-ocean conditions. In particular, tidal influence is clearly demonstrated, with marked differences between high and low tide conditions (Figure 2a,b). When the tide is high, particles are transported over a wider area, reaching a greater number of municipalities.

Similarly, surface transport is more extensive under energetic conditions: more municipalities are reached when wave heights are larger and when winds blow in an across-shore direction, compared to along-shore winds (Figure 2c,d).

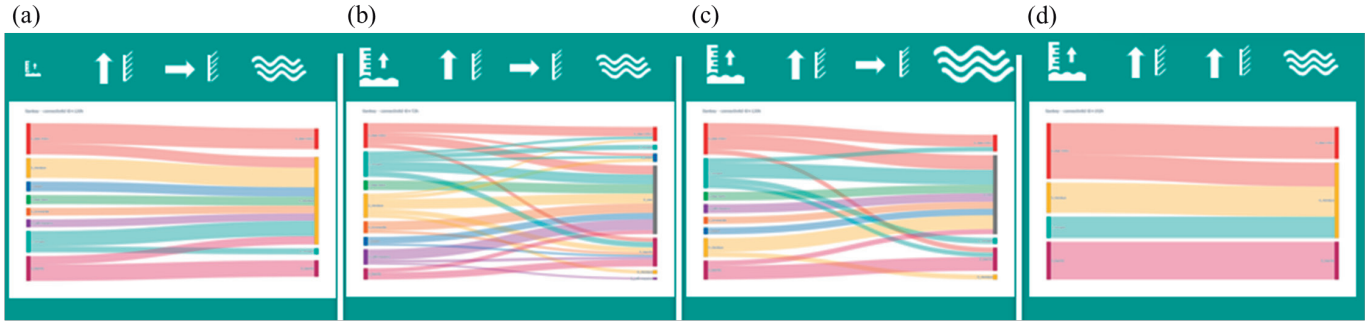


Figure 2. Connectivities between different municipalities on the French Basque Shelf under different metocean conditions: (a) low tide, along-shore currents, across-shore winds, medium waves; (b) high tide, along-shore currents, across-shore winds, medium waves; (c) high tide, along-shore currents, across-shore winds, big waves; and (d) high tide, along-shore currents, along-shore winds, medium waves.

At the beach scale, preliminary investigations assess whether the variability observed at larger scales is also relevant at finer spatial scales, with a particular focus on transport pathways and retention processes under contrasting meteo-ocean conditions. When available, model results will be compared with drifting buoy observations to evaluate the consistency of simulated transport patterns.

Together, these multiscale analyses demonstrate that physical transport is a key driver of Ostreopsis distribution, explaining both the spatial heterogeneity of bloom impacts and the cross-border connectivity observed in the region. The results support the development of operational early warning indicators and future modelling tools for coastal management.

[1] Drouet, K., Jauzein, C., Herviot-Heath, D., Hariri, S., Laza-Martinez, A., Lecadet, C., ... & Siano, R. (2021). Current distribution and potential expansion of the harmful benthic dinoflagellate Ostreopsis cf. siamensis towards the warming waters of the Bay of Biscay, North-East Atlantic. Environmental Microbiology, 23(9), 4956-4979.
[2] Jordà, G., Sanchez-Roman, A., & Gomis, D. (2017). Reconstruction of transports through the Strait of Gibraltar from limited observations. Climate Dynamics, 48(3), 851-865.

From ocean predictions to actionable solutions: the science-based evolution of IBI-MFC for user-driven coastal services

Stefania Ciliberti (1), Roland Aznar (1), Lluis Castrillo (1), Bruno Levier (2), Elodie Gutknecht (2), Romain Escudier (2), Guillaume Reffray (2), Breogan Gomez (1), Arnau Buñuel (1), Axel Alonso (1), Álvaro Pascual (1), Ivano Barletta (1), Alice Dalphinet (3), Wagner Langer Costa (3), Jose María García-Valdecasas (1), Selma Cabo (1), Cristina Ramos (1), Óscar Ballesteros (1), Luis Ferrer (4), Manuel García (1), Lotfi Aouf (3), Marcos Sotillo (1), Sylvain Cailleau (2)

(1) NOW Systems, (2) Mercator Ocean International, (3) Météo-France, (4) AZTI

Oral

operational oceanography, data assimilation, coastal modelling, validation, ocean products, downstream services

Accurate predictions of the ocean are crucial for supporting applications ranging from marine protection to climate research and coastal management. Within the framework of the Copernicus Marine Service, the Iberia-Biscay-Ireland Monitoring and Forecasting Centre (IBI-MFC) provides regular and systematic operational ocean model-based products for physics, waves and biogeochemical components in the European North-East Atlantic façade and adjacent shelf seas. Operational systems operate through a robust and mature integrated service that combines efficient operational production with continuous advances in ocean science, numerical modelling and data assimilation capabilities, enabling the use of new accurate Earth Observations.

The IBI-MFC service is a joint initiative involving Mercator Ocean International (MOi, France, leader), NOW Systems (Spain, co-leading), Météo-France (France), and Centro de Supercomputación de Galicia (CESGA, Spain).

IBI-MFC is based on state-of-the-art numerical models at a horizontal resolution of 1/36º: its product catalogue includes historical reconstructions of the ocean state through multi-year (MY) reanalysis products starting from 1993 (1980 for the wave component), as well as near-real-time (NRT) analyses and forecasts with a lead time of up to 10 days.

The scientific assessment of the IBI-MFC products is performed by implementing a multi-observations/multi-models validation framework, aimed at supporting both the qualification of pre-operational developments and the continuous operational product quality monitoring. This framework relies on a wide range of satellite and in-situ observations as well as intercomparisons with other model systems.

Among the most recent advances, the IBI-MFC service now delivers MY products with the same resolution and analogous configurations as the NRT systems. To enhance the use of MY products for climate assessment, the IBI-MFC is also providing new Interim products, which ensure more frequent updates of the reanalysis and bring it closer to real time (currently reaching up to month M-4).

The forecasting and reanalysis products generated by the IBI-MFC provide essential information for a wide range of coastal applications in the Gulf of Biscay, engaging coastal communities and stakeholders, supporting user-driven innovative services, and facilitating dialogue between data providers and end-users. To further support downstream use of regional Copernicus Marine core products, IBI-MFC continues to refine and expand its product portfolio. The upcoming operational IBI-MFC release will include a new wave spectra dataset, delivered operationally to users, enabling improved nesting of coastal wave models within the IBI regional wave solution.

Another example of successful downstream application is represented by the EUSCOMvu project (fostered by the Copernicus Marine User Engagement Program), that implements a multi-parameter operational assessment service, developed by NOW Systems, using the EUSkadi coastal operational system developed by AZTI for the Gulf of Biscay. This project has contributed to enhance reliability of coastal operational forecasting service in support to search and rescue operations, marine

environment management and protection and coastal planning. It also has demonstrated the added value of the coastal downscaling with respect to the Copernicus Marine IBI parent solution, particularly regarding the use of coastal freshwater inputs from rivers. Assessment of the performances of coastal high-resolution salinity provided by the EUSkadi highlighted gaps in the regional IBI-MFC solution that will be addressed in the next operational release through improved representation of the river freshwater inputs using the Copernicus EFAS product.

This contribution illustrates how regional services such as IBI-MFC act as a backbone for downstream coastal services. By connecting large-scale ocean predictions with high-resolution coastal models and stakeholder-tailored information, IBI-MFC helps turn ocean data into actionable information that supports coastal resilience, environmental protection, and sustainable blue-economy activities.

Characterization of meteorological sea level residuals for coastal early warning in the Basque Country

Santiago Gaztelumendi (1), Joseba Egaña (1), Manuel Gonzalez (2), Andrea del Campo (2)

(1) Basque Meteorology Agency (Euskalmet), (2) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Introduction

Sea level variability in coastal environments results from the interaction between astronomical tides, atmospheric forcing, and oceanographic processes, posing a major challenge for accurate coastal hazard prediction. Along the Basque coast, total sea level, combined with wave conditions, is a key driver of coastal impacts and forms the basis of operational early warning systems jointly developed by Basque Meteorology Agency (Euskalmet) and AZTI. However, the reliable estimation of the non-tidal component of sea level, i.e., the meteorological residual or storm surge, remains a critical limitation.

This study presents a systematic characterization of meteorological sea level residuals along the Basque coast, based on long-term tide gauge observations complemented with atmospheric data. The astronomical tide is removed using harmonic analysis, allowing the extraction of consistent residual time series representative of the meteorological contribution to sea level variability.

The resulting dataset is analysed in terms of statistical distribution, temporal variability, and extreme values, as well as its relationship with key atmospheric drivers such as wind and atmospheric pressure. Particular attention is given to the characterization of high-impact events and their contribution to total sea level extremes. Results show that meteorological residuals play a significant role in extreme sea level conditions, especially during severe weather events. The characterization of these residuals provides essential information to improve the estimation of total water levels in operational contexts, reducing uncertainties in coastal early warning systems.

Beyond its operational application, this work contributes to a better understanding of atmosphere–ocean interactions at coastal scales and provides a basis for future developments in climate variability analysis, extreme event assessment, and impact-based forecasting tools for coastal risk management.

Exploring Mean Sea Level Variability for Coastal Flood Risk Assessment along the Basque Coast

Manuel Gonzalez (1), Andrea del Campo (1), Joseba Egaña (2), Santiago Gaztelumendi (2)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) Basque Meteorology Agency (Euskalmet)

Poster

Introduction

In the context of climate change, coastal flood risk assessment increasingly requires a more comprehensive representation of the processes contributing to total water levels. Along the Basque coast, extreme water levels are typically evaluated as the combination of astronomical tides, meteorological residuals, and wave effects. However, additional contributions related to mean sea level variability may also play a relevant role and are not yet systematically considered in operational frameworks.

In particular, two components are of growing interest: the long-term increase in mean sea level associated with climate change, and shorter-term anomalies linked to oceanographic conditions such as marine heatwaves. Recent events, including the anomalously warm conditions observed in 2023 and 2024, suggest that these processes may lead to elevated baseline sea levels at monthly to seasonal scales, potentially amplifying the impact of high tides and storm events.

This study explores the contribution of low-frequency mean sea level variability to coastal flood risk. An approach based on digital filtering and time series reconstruction is applied to tide gauge records to isolate the slowly varying component of sea level, separating it from higher-frequency processes such as tides and storm surges. The analysis focuses on selected case studies of high-impact events, with the objective of assessing whether periods of elevated mean sea level coincide with extreme total water levels. Special attention is given to evaluating the potential role of marine heatwaves as a driver of positive sea level anomalies through thermal expansion and related processes.

The aim is to determine whether these additional components systematically modulate extreme water levels and whether their inclusion could improve the interpretation of past events and the characterization of coastal flood risk. Although the work is exploratory, it is specifically oriented towards assessing the relevance of incorporating mean sea level variability into the operational coastal forecasting and early warning systems operated by Basque Meteorology Agency (Euskalmet). The results will help evaluate the potential added value, limitations, and practical feasibility of integrating these processes into existing risk assessment tools.

Extreme Tide Event Simulation in the Basque Coast Using SCHISM

Santiago Gaztelumendi (1), Antonio Castaño (1), Jose Daniel Gomez de Segura (1), Ivan R. Gelpi (1)

(1) Basque Meteorology Agency (Euskalmet)

Poster

Introduction

The Basque Meteorological Agency (Euskalmet) is currently integrating SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) into its coastal modelling framework to improve predictive and analytical capabilities in highly dynamic coastal environments of the Basque Country. SCHISM's flexible unstructured mesh architecture and semi-implicit numerical schemes enable an efficient representation of regions characterized by strong spatial gradients, complex geometries, and multiscale hydrodynamic interactions.

Several model configurations have been developed for the Basque coastal domain, based on different grid setups. In this study, we focus on a high-resolution configuration for the eastern sector of the Basque coast, including the Txingudi estuarine system, implemented in the context of Euskalmet's activities within the Region4Climate (R4C) project. Although the model is capable of representing detailed fluvial–marine interactions, this work specifically addresses the simulation of extreme tidal conditions, typically associated with spring tides and specific meteorological forcing, which can significantly enhance water-level variability and modify local circulation patterns.

Model simulations were forced using a combination of regional ocean boundary conditions, atmospheric fields, and local hydrological inputs. A set of hindcast experiments covering selected high-tide episodes was produced to assess the ability of SCHISM to reproduce peak water levels, tidal phase and amplitude, and current intensification in confined areas.

Validation was carried out using tide-gauge observations, radar-derived current measurements, and in situ hydrographic data. Results show good agreement in the representation of water-level extremes, including both the timing and magnitude of tidal signals during energetic events.

These results highlight the potential of SCHISM within the Euskalmet coastal modelling framework, particularly for the analysis of extreme tidal conditions. This work provides a solid basis for further developments toward both research and operational applications, including early warning systems and improved coastal risk assessment under high-impact scenarios.

The Portuguese man-of-war in the blue summer of the Bay of Biscay

Ferrer Luis (1), Franco Javier (1), Beldarrain Beatriz (1), Castro Raúl (1), Santos María (1), Borja Ángel (1), Claver Cristina (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster
Portuguese man-of-war, Swarm, SOFT, Wind

Introduction

The Portuguese man-of-war (*Physalia physalis*) is a wind-propelled colony of specialized polyps. Although it lives mainly in warm tropical and subtropical waters (Wilson, 1947; Totton and Mackie, 1960), its presence in the temperate waters of Europe has increased in recent summers. We have been studying the presence of this colonial organism on the northern coast of Spain since 2012 (e.g. Ferrer et al., 2015, 2024). During the summer of 2023, the presence of numerous specimens along the coast from Galicia to the Basque Country (hereafter referred to as the 2023 PMW swarm) forced local authorities to close several beaches. The aim of this research was to estimate the possible trajectories and region of origin of the 2023 PMW swarm.

This research was partially supported by two projects funded by the European Union's Horizon Europe research programme: GES4SEAS (Achieving Good Environmental Status for maintaining ecosystem SErvices, by ASsessing integrated impacts of cumulative pressures, grant agreement no. 101059877, www.ges4seas.eu) and OBAMA–NEXT (OBserving And MApping marine ecosystems – NEXT generation tools, grant agreement no. 101081642, www.obama-next.eu).

Methods

We conducted two field experiments to obtain information on the drift of small low-density objects. In the first experiment, we designed and made the two forms of the Portuguese man-of-war (i.e. right- and left-handed prototypes). In the second experiment, we used small satellite-tracked surface drifting buoys called marmokas (see Figure 1). A detailed description of these field experiments can be found in Ferrer et al. (2024). To estimate the possible trajectories and region of origin of the 2023 PMW swarm, we used the Sediment, Oil spill and Fish Tracking model (SOFT). This model is an easy-to-use and computationally efficient Lagrangian particle tracking tool. Following the methodology used in previous work (e.g. Ferrer and Pastor, 2017; Ferrer and González, 2021), we ran SOFT backwards in time from 31 August 2023 to 30 June 2022. In the numerical simulations, we used hourly wind fields from the ERA5 global reanalysis with different parameterizations (i.e. wind drag coefficients and drift angles).

Results and Discussion

In the first experiment, we released the designed PMW prototypes in coastal waters. The observations confirm the need to consider the main characteristics of an organism when predicting its drift. In the second experiment, we released 27 surface drifting buoys in the open waters of the Bay of Biscay between May 2015 and June 2022. The maximum and mean speeds of the buoys were 136 cm/s and 35 cm/s, respectively. On average, the drift of the buoys was from west-northwest to east-southeast. The trajectories of these buoys show the complexity of the drift of a small low-density object at the air−water interface of the sea.

The simulations carried out with SOFT show that the region of origin of the 2023 PMW swarm was located in the open North Atlantic Ocean for young and adult specimens. Many juvenile specimens were found along the Basque coast during the summer of 2023. This suggests that reproduction took place in the Bay of Biscay in late spring and throughout the summer. The trajectories obtained with SOFT using different drift angles become longer and more complex as the value of the wind drag coefficient increases. Therefore, the selection of an appropriate wind drag coefficient is crucial for a successful estimation of the region of origin. Figure 1 shows an example of simulated trajectories.

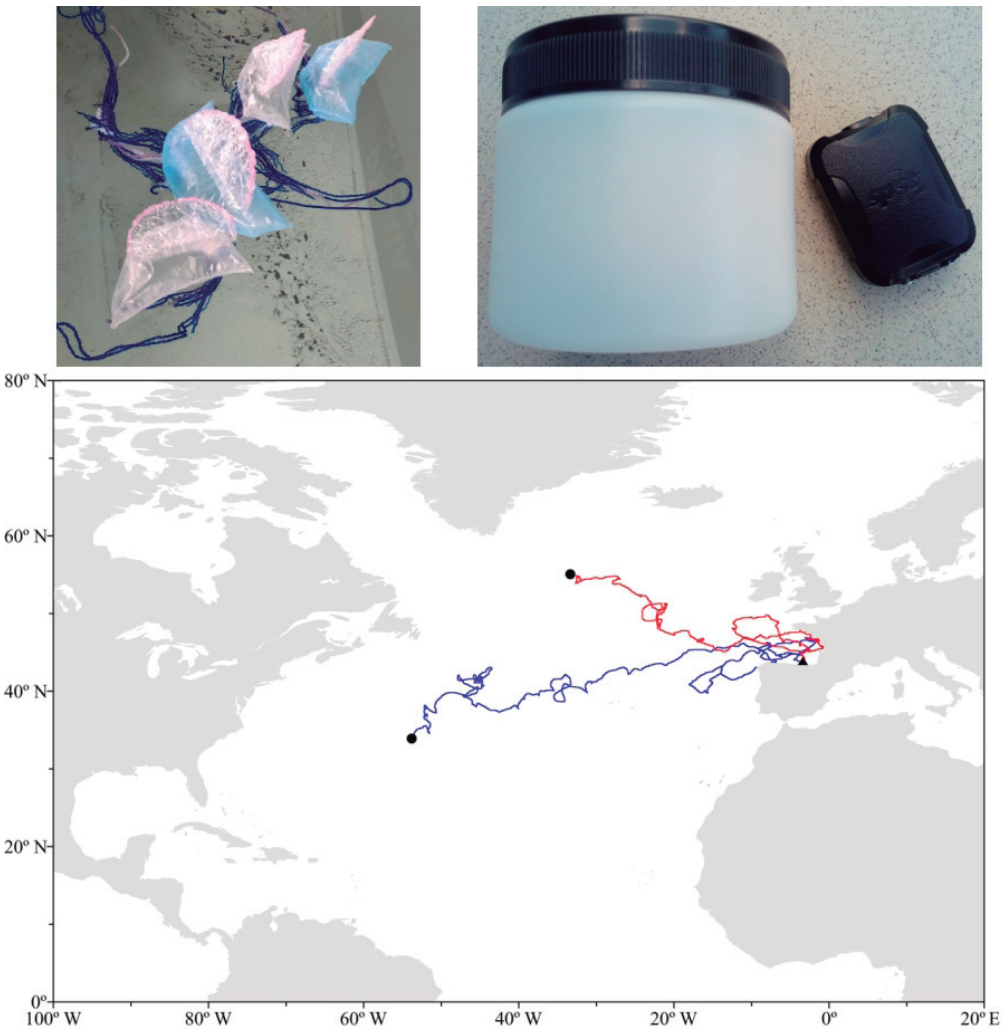


Figure 1. Top: Low-density prototypes of right- and left-handed *P. physalis*, and components of the satellite-tracked surface drifting buoys used in this study. Bottom: Simulated trajectories of a Portuguese man-of-war from 28 July 2023 (initial date) to 28 July 2022 (final date) obtained with SOFT, using a wind drag coefficient of 0.08 and drift angles of –22.5° and +22.5° (red and blue lines, respectively). The black triangle and circles indicate the initial and final locations of the Portuguese man-of-war in the SOFT simulations, respectively.

References

[1] Ferrer, L., González, M., 2021. Relationship between dimorphism and drift in the Portuguese man-of-war. Cont. Shelf Res. 212, 104269. https://doi.org/10.1016/j.csr.2020.104269.
[2] Ferrer, L., Pastor, A., 2017. The Portuguese man-of-war: gone with the wind. Reg. Stud. Mar. Sci. 14, 53–62. https://doi.org/10.1016/j.rsma.2017.05.004.
[3] Ferrer, L., Sagarminaga, Y., Borja, A., Nogues, M., Alegre, M.J., Santos, M., Boyra, G., Álvarez, P., Beldarrain, B., Castro, R., Bidegain, G., González, M., Revilla, M., Zorita, I., Solaun, O., Fontán, A., Rodríguez, J.G., 2024. The Portuguese man-of-war: adrift in the North Atlantic Ocean. Estuar. Coast. Shelf Sci. 301, 108732. https://doi.org/10.1016/j.ecss.2024.108732.
[4] Ferrer, L., Zaldua-Mendizabal, N., Del Campo, A., Franco, J., Mader, J., Cotano, U., Fraile, I., Rubio, A., Uriarte, Ad., Caballero, A., 2015. Operational protocol for the sighting and tracking of Portuguese man-of-war in the southeastern Bay of Biscay: observations and modeling. Cont. Shelf Res. 95, 39–53. https://doi.org/10.1016/j.csr.2014.12.011.
[5] Totton, A.K., Mackie, G.O., 1960. Studies on Physalia physalis (L.). Part 1. Natural History and Morphology. Part 2. Behaviour and Histology. Discovery Reports 30, 301–408.
[6] Wilson, D.P., 1947. The Portuguese man-of-war, Physalia physalis L., in British and adjacent seas. J. Mar. Biol. Assoc. U.K. 27, 139–172. https://doi.org/10.1017/S0025315400014156.

Are TRANSPOrT processes regulaTING the recruitment and size of European anchovy in the Bay of Biscay?

Beñat Iglesias (1), Aitor Albaina (2), Beatriz Beldarrain (1), Guillermo Boyra (1), Ainhoa Caballero (1), Beñat Campo (1), Unai Cotano (1), Iván Manso-Narvarte (1), María Santos-Mocoroa (1), Naroa Aldanondo (1)

(1) AZTI, (2) EHU

Poster

Introduction

The European anchovy (Engraulis encrasicolus) is a key ecological and socio-economic resource in the Bay of Biscay (BoB), and the dynamics of its population depend critically on the survival of early life stages (ELS). Despite extensive research, major uncertainties persist regarding the mechanisms driving recruitment variability and the recent decline in individual body size. TRANSPOTTING is a multidisciplinary project aimed at understanding how physical transport processes and trophic interactions shape the survival, recruitment, and population characteristics of the anchovy in the BoB. The project is based on the hypothesis that off-shelf transport of anchovy ELS reduces predator–prey encounters, thereby increasing the recruitment strength and enhancing the survival of slow-growing individuals. This process may ultimately contribute to the observed decrease in mean anchovy size. To test this hypothesis, TRANSPOTTING integrates Lagrangian transport modelling, autonomous acoustic platforms, genetic approaches (qPCR and metabarcoding), and otolith microstructure analyses, combining historical datasets with an expanded sampling strategy. Beyond the BIOMAN (May) and JUVENA (September) surveys, the project will conduct four new multidisciplinary oceanographic surveys in July–August 2026 and 2027 to monitor transport conditions, ELS distributions, predator communities, and hydrography during the key summer development period. The specific objectives include: (1) characterising transport processes affecting the distribution of anchovy ELS; (2) estimating their historical transport; (3) comparing predation pressure on the anchovy ELS in coastal vs. oceanic areas; (4) evaluating the advantage-disadvantage of offshore transport in relation to predation-induced mortality; (5) understanding how retention-dispersal processes affect recruitment and juveniles size; and (6) evaluating the potential of semi-autonomous tools for future operational monitoring. By integrating physical, ecological, and trophic information, TRANSPOTTING will provide a novel framework to understand how early-life transport processes regulate recruitment strength and individual size. The project aims to support improvements in stock assessment, survey strategies, and strengthen adaptive management of a key ecological and economic resource in the BoB.

SESSION 3:
BIOGEOCHEMICAL CYCLES

Identifying the origin of methylated mercury compounds in coastal and marginal waters of the Bay of Biscay (Adour Estuary, Cap-Breton Canyon): Implications for Hg bioaccumulation in the marine food chain

David Amouroux (1), Alina Kleindienst (1), Emmanuel Tessier (1), Rosanna Margalef-Marti (1), Natalia Torres-Rodriguez (2), Oceane Asensio (1), Claire Gassie (1), Deny Malengros (2), Aubin Thibault de Chanvalon (1), Lars-Eric Heimburger-Boavida (2), Remy Guyoneaud (1)

(1) Université de Pau et des Pays de l'Adour, E2S-UPPA, CNRS, IPREM, Institut des Sciences Analytiques et de Physico-chimie pour l'Environnement et les Matériaux, (2) Aix Marseille Université, CNRS, IRD, Univ. Toulon, Mediterranean Institute of Oceanography (MIO)

Oral

methylmercury, coastal and marginal waters, biogeochemistry, methylation, demethylation, bioavailablity

Coastal environments are highly dynamic zones, and potential hotspots for methylated mercury (MeHg) bioaccumulation and major potential source of Hg exposure to humans since coastal fisheries surpass open ocean catch. The main sources of MeHg to the marine and coastal fish food chain can originate from direct fluvial and estuarine inputs, coastal and deeper sediments effluxes or potential water column Hg methylation (1, 2). The objective of this work was to investigate if MeHg compounds are produced or degraded within the water column of such coastal and marginal waters. The ambient Hg species distribution and reactivity along a river-estuarine-coastal ocean continuum in the Adour estuary and adjacent coastal zone, including the Cap-Breton Canyon (SE Bay of Biscay), were conducted with seasonal sampling at coastal sites (2020-22) and vertical profiles investigation during spring time (May 2022). MeHg reactivity measurements were achieved by incubation experiments employing Hg stable isotopic tracers at selected depths, combined with 16S rDNA diversity analysis of the microbial community (3). Hg compounds distribution exhibits the highest THg (mean = 6.6 pM) and MeHg concentrations (mean = 0.2 pM) in riverine and estuarine samples, whereas THg (mean = 1.08 pM) and MeHg concentrations in coastal to offshore waters were relatively low (mean = 0.05 pM). The particle bound fraction of Hg compounds was also more important at lower salinity. Light-induced demethylation in surface waters was relatively uniform over seasons and always hampered by particles in waters with a major freshwaters influence. We also found important dark demethylation in surface and deep waters, potentially biotically mediated. Highest MeHg in deep waters at the canyon station (up to 0.19 pM) was entirely present in the form of dimethyl Hg (DMHg). We also detected biotically mediated methylation, exclusively in deep waters, coinciding with highest abundance of phyla having methylation potential (16S rDNA analysis). Our results confirm that MeHg transformations are seasonally driven in coastal and estuarine influenced (Adour River) surface waters, along with abiotic and biotic demethylation pathways. We also present here first evidences that DMHg can be produced in the Cap-Breton Canyon deep waters and represents an important MeHg species (3). These outcomes suggest that MeHg compounds formation and/or accumulation in deeper marginal waters might have been overlooked and provide a significant source of bioavailable MeHg to the pelagic food chain in the Bay of Biscay.

[1] A. Sharif, M. Monperrus, E. Tessier, S. Bouchet, H. Pinaly, P. Rodriguez-Gonzalez, P. Marron, D. Amouroux; Fate of mercury species in the coastal plume of the Adour River estuary (Bay of Biscay, SW France). Science of the Total Environment (2014), 496, 701-713.

[2] T. Stoichev, A. Thibaut de Chanvalon, S. Veloso, J. Deborde, E. Tessier, L. Lanceleur, D. Amouroux; Assessing and predicting the changes for inorganic mercury and methylmercury concentrations in surface waters of a tidal estuary (Adour estuary, SW France). Marine Pollution Bulletin (2023), 186, 114400.

[3] A. Kleindienst, E. Tessier, J. Bieser, N. Torres-Rodríguez, O. Asensio, A. Dufour, C. Gassie, L.E. Heimbürger-Boavida, R. Guyoneaud, D. Amouroux ; Incubation experiments, observations and modeling highlight the key role of dimethylmercury on seawater methylmercury distributions. Environmental Science and Technology (2025), 59, 19283–19294.

Mesozooplankton contributions to pelagic food-webs and vertical carbon flux at a deep-ocean site in the Bay of Biscay

Bellineth Valencia (1), Alejandro Isla (1), Andrés Gutiérrez-Rodríguez (1), Mikel Latasa (1), María Teresa Granell (1), Antonio Bode (2), Iñaki Huskin (1), Ángel López-Urrutia (1), Raquel Somavilla (3)

(1) Centro Oceanográfico de Gijón - Instituto Español de Oceanografía, (2) Centro Oceanográfico de A Coruña - Instituto Español de Oceanografía, (3) Centro Oceanográfico de Santander - Instituto Español de Oceanografía

Oral

Mesozooplankton, grazing, carbon flux, diel vertical migration, Bay of Biscay

Mesozooplankton (200-2000 µm) play a critical role in pelagic food webs and the biological carbon pump due to the production of fast sinking fecal pellets, consumption of sinking particles, and release of metabolic byproducts at mesopelagic depths. Despite their importance, it is still uncertain how environmental variability affects the structure and trophic interactions of mesozooplankton, as well as their contribution to the vertical carbon flux in the deep ocean. We explored daily changes in mesozooplankton biomass, grazing impact, trophic position, and contribution to vertical carbon flux over five days at an oceanic site in the Bay of Biscay (RADCAN time-series station G4, 4700 m) during September 2024, a period characterized by oligotrophic conditions with low surface chlorophyll concentrations (0.16 ± 0.012 mg Chla m^{-3}). Nighttime biomass (1512 mg DW m^{-2}) was within the range measured over a 10-year period at station G4 during September (2013-2023: 231 – 9255 mg DW m^{-2}). Mesozooplankton grazing estimated by gut fluorescence represented a low impact on the phytoplankton community (1-3%). Consistent with this result, mesozooplankton trophic position estimated by compound specific isotope analysis of amino acids (CSIA-AA) varied from 2.5 to 4.2, suggesting that most of its diet was obtained by consuming other zooplankton. The distribution of mesozooplankton biomass among size classes (0.2-0.5 mm, 0.5-1.0 mm, 1.0-2.0 mm, > 2.0 mm) showed a higher contribution of organisms > 2.0 mm both day and night. However, there was a considerable increase in the contribution of larger organisms at nighttime (93%) compared to daytime tows (37%), reflecting diel vertical migration by mesozooplankton with an increase in epipelagic biomass of 41% at night. Due to their respiration at mesopelagic depths (calculated by empirical equations), migrant mesozooplankton contributed to the active export of carbon, representing a major flux of carbon to the deep-ocean in addition to sinking particles.

Ostreopsis blooms promote production of volatile organic sulfur compounds: environmental and health implications.

Sarah Sadorge (1), Marie Morere (1), Mathilde Monperrus (1)

(1) IPREM UMR CNRS UPPA

Oral

Harmful algal bloom, Dinoflagellate, Intoxication, Sulfur cycle, Dimethyl sulfide, Dimethyl disulfide

Blooms of the benthic dinoflagellate Ostreopsis have been associated with occasional episodes of acute respiratory symptoms, skin irritations, and general discomfort in people exposed on adjacent beaches. This microalgae, well known for producing potent toxins, has been implicated in health issues during bloom events; however, the presence of these toxins in marine aerosols does not fully explain the variety and intensity of symptoms reported, suggesting that other factors, such as the emission of volatile compounds, may also play a role. This study aims to identify the volatile organic compounds (VOCs) present in both water and air during an Ostreopsis bloom, to characterize the VOCs produced by monoclonal Ostreopsis strains in culture, and to assess their potential risks to the environment and human health. Air and water samples collected during blooms revealed the presence of dimethyl sulfide, methanethiol, dimethyl disulfide and dimethyl trisulfide, with concentrations significantly exceeding established toxicity and ecotoxicity thresholds (e.g., MeSH up to 4.7 µmol.L−1, exceeding the PNEC of 0.0021 µmol.L−1 by ~2000-fold; DMS up to 44 µmol.L−1, exceeding PNEC of 0.0047 µmol.L−1 by ~9000-fold). In contrast, only dimethyl sulfide was detected in monoclonal cultures of Ostreopsis strains. These results indicate a possible contribution of microorganisms associated with Ostreopsis blooms in sulfur VOCs production.

[1] https://doi.org/10.1016/j.envpol.2026.127853

Vertical chlorophyll-a structure under varying physical conditions: Insights from three glider missions in the southeastern Bay of Biscay

Marina Chifflet (1), Ivan Manso-Narvarte (1), Nadine Steiger (1), Asier Nieto (1), Almudena Fontán (1), Joana Larreta (1), Ainhoa Caballero (1), Anna Rubio (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

marine biogeochemical observations, glider, mesoscale, fronts, clorophyll-a, vertical, Bay of Biscay

The marine biogeochemical (BGC) cycle supports the base of the trophic chain, impacting the whole ocean ecosystem. The monitoring of BGC variables and the understanding of how physical (sub)mesoscale processes affect the BGC cycle, are crucial for the proper management of marine areas. However, there are still knowledge and observational gaps about these interactions in the southeastern Bay of Biscay. To address these gaps, gliders emerge as suitable autonomous underwater vehicles for monitoring these processes, providing continuous along-track observations of BGC variables at high spatio-temporal resolution.

In this study, we present the results of the analysis of the chlorophyll-a (Chl-a) biomass and hydrographic conditions from three BGC glider missions conducted in late autumn 2023, early autumn 2024, and summer 2025. The three missions reveal marked differences in vertical Chl-a patterns, from strong summer stratification to autumn mixing, reflected in the depth of the subsurface phytoplankton maximum (SPD) and the contribution of different layers to the total vertically integrated Chl-a. In November 2023, the presence of the Adour plume dominated the first days of the mission and leaded to a high surface Chl-a contribution (30–70%) to the 0–100 m integrated Chl-a, followed by progressive water-column homogenization. In September–October 2024, at the beginning of the mission Chl-a concentration peaked at 20–30 m and then shifted to the surface by the end of the mission when waters had stronger coastal influence. In contrast, August 2025 showed a persistent deep Chl-a maximum at 50–60 m under strong summer stratification. However, mean integrated Chl-a displayed limited variability between missions. These results are put into perspective with the evolution of the mixed layer and pycnocline depths, the variability of Adour runoff, and comparisons with fixed-stations observations. Finally, we explore the relative role of photo-acclimation and biomass for the depth of the Chl-a maximum.

These high-resolution subsurface glider observations provide new insights into the seasonal physical-biogeochemical coupling in the Bay of Biscay, enabling the understanding of small-scale processes and dynamics beyond the reach of pointwise measurements or satellite remote sensing.

Early diagenetic processes on a multi-century timescale in the West Gironde Mud Patch (Bay of Biscay, NE Atlantic)

Nicolas Dubosq (1), Bruno Deflandre (1), Sylvain Rigaud (2), Frédérique Eynaud (1), Aurélia Mouret (3), Martin Danilo (4), Nathalie Labourdette (1), Antoine Gremare (1), Sabine Schmidt (4)

(1) Univ. Bordeaux, CNRS, Bordeaux INP, EPOC, UMR 5805, F-33600 Pessac, (2) Univ Nîmes, EA 7352 CHROME, F-30021 Nîmes, (3) Univ. Angers, Nantes Université, Le Mans Univ, CNRS, UMR 6112, LPG, F-49000 Angers,, (4) CNRS, Univ. Bordeaux, Bordeaux INP, EPOC, UMR 5805, F-33600 Pessac

Poster

Bay of Biscay; RiOMar; early diagenesis; organic carbon; authigenic minerals; multi-century timescale

Introduction

River-dominated ocean margins (RiOMars) play a key role in global biogeochemical cycles, yet their functioning in temperate regions remains poorly constrained over long timescales. We investigated early diagenetic processes in the West Gironde Mud Patch (WGMP), a temperate RiOMar located in the Bay of Biscay off the Gironde estuary, using short interface and long gravity sediment cores.

Methods

Sediment cores were dated using ^{14}C and ^{210}Pb, and analyzed for porosity, specific surface area (SSA), grain size, and both particulate (organic carbon, pigments, Mn and Fe oxyhydroxides, sulfides) and dissolved (NO_3^-, NH_4^+, SO_4^{2-}, Mn_d, Fe_d, Si_d) compounds.

Results and Discussion

The sediment consists of muddy sediments that have accumulated rather continuously over the last 400 years. Results indicate that the depth distributions of redox species follow the classical diagenetic sequence of electron acceptors involved in the microbially mediated degradation of organic matter. However, sulfate reduction appears to be limited in depth, likely due to the decreasing reactivity of organic matter and its mineral-associated protection, leading to reduced availability. We suggest that this may enhance the WGMP's capacity to store organic matter, as reflected by relatively high organic carbon contents normalized to SSA (0.40-0.59 mg m^{-2}). The constancy of these values with depth further indicates that burial efficiency is strongly controlled by particle size and associated mineral surface area.

Depth profiles of dissolved and particulate species, together with porewater saturation indices, indicate that the WGMP acts as a sink for major elements through adsorption on sediment particles (Corg, Fe, Mn) and precipitation of authigenic mineral such as apatite (P), pyrite (Fe, S) and clays (Si). The organic matter remineralization coupled with sulfate reduction over most of the sediment column leads to the conversion of 20-30% of Fe oxyhydroxides into pyrite, which is significantly higher than the <10% typically reported in comparable environments. The increase in median grain size from 10 to 20 µm, which is estimated to have occurred during the first half of the 20th century, appears to have reduced the WGMP's capability to store organic carbon, Fe, Mn and P. The current and projected decrease in the discharge of Gironde estuary, which is the main source of sediments for the WGMP, is expected to further reinforce this trend in the coming decades. This highlights the need to study the evolution of the biogeochemical functioning of RiOMars, as well as their capacity to store organic carbon and associated elements in response to global change.

Analysis of biogenic compounds in sediment interstitial water: how to measure NO_3, NO_2, NH_4, PO_4, Si, Fe, Mn, SO_4, H_2S, DIC, DOC, alkalinity, and salinity in 6 mL of water.

Pierre ANSCHUTZ (1), Céline CHARBONNIER (1), Dominique POIRIER (1), Martin DANILO (2), Paul KANFER (3)

(1) Univ. Bordeaux, EPOC, (2) Univ. Bordeaux, CNRS, EPOC, (3) univ. Bordeaux, EPOC

Poster

analytical methods; early diagenesis; blue carbon; intertidal zone; FairCarboN

The exchange of dissolved compounds at the water-sediment interface is crucial for the functioning of aquatic ecosystems. This is particularly true in environments where the water column is shallow, such as ponds, shallow lakes, coastal marshes and intertidal zones. Fluxes at the water-sediment interface can be measured directly using in situ or ex situ incubation methods. In order to understand the processes responsible for these fluxes, it is necessary to measure the gradients of dissolved compounds beneath the interface and correlate them with the concentrations of reactive species in the sediment's solid phase. Certain dissolved compounds, such as oxygen or sulphides, can be measured using microprobes that provide vertical profiles with high spatial resolution. However, when studying the behaviour of major biogenic compounds, such as carbon, nitrogen, phosphorus and silica, and the elements that influence their chemistry, such as iron, manganese and sulphur, it is necessary to use ex situ analytical methods, which require the extraction of interstitial water. In order to obtain vertical profiles whose gradient shapes can be interpreted in terms of fluxes and reactions, interstitial water must be extracted with high vertical resolution. Interstitial water is generally extracted from sediment cores. This is done with a vertical resolution of 5 mm to 1 cm over a thickness of a few decimetres. This can be achieved by cutting the cores into horizontal slices and collecting the water by centrifugation or a press system, or by inserting porous rhizons into the sediment through holes drilled at regular intervals in the core tube to extract the interstitial water. For core tubes typically measuring 10 cm in diameter, the volume of water recovered is limited to a few millilitres. The goal is to analyse as many parameters as possible from this small sample.

Throughout our various research projects on benthic biogeochemical processes in the Bay of Biscay and its associated coastal environments and watersheds, we have gradually optimised our methods to enable the analysis of as many biogeochemical compounds as possible using the smallest possible sample size. We have also minimised costs and analysis time, enabling the analysis of large sample series, as in past and recent research projects focusing on environments associated with the French coastline. Measurements are based on published methods that have been optimised for small volumes. NO_3, NO_2, PO_4, Si, Fe, Mn, SO_4 and H_2S analyses are performed using spectrophotometry. NH_4 and DIC analyses are performed using a continuous-flow method. These analyses are performed manually, enabling us to work quickly while maintaining the best possible control over each step. DOC and alkalinity are analysed using standard equipment for this type of measurement (a combustion TOC analyser with an infrared cell, and a titrator). Tests have shown that diluting the samples with H_2O does not affect the results, so these two parameters are analysed using 1.5 ml of sample.

To prepare and store interstitial water samples, you will need 2 ml of the frozen sample, 1.5 ml of the sample acidified with HCl, 0.5 ml of the sample fixed with zinc acetate and 1 ml of the refrigerated sample. Filter waters through a cellulose acetate syringe filter. 1 mL of water is filtered through a GF/F syringe filter and stored in a pre-combusted glass vial. This gives a total volume of 6 mL for analysing all the listed parameters. All these analytical methods for small volumes of water can also be applied to samples taken from the supernatant water of incubation cores, since collecting a minimal amount of water at each time point during incubation helps to maintain a relatively constant water level above the water-sediment interface.

This presentation serves as an introduction to a paper that will be submitted to the special issue of the ISOBAY conference, in which all protocols will be detailed and made available to the community of aquatic biogeochemistry specialists. Some examples of benthic profiles of biogeochemical compounds in sediments collected in the Arcachon Bay or in coastal zones of Brittany will be shown. One of the result that will be described is that the study of benthic alkalinity fluxes, vertical profiles of interstitial water, and the solid fraction of intertidal sediments in blue carbon zones along the French coastline shows that denitrification plays a role in the alkalinity balance in eutrophic areas. The reduction of Fe and Mn oxides plays a minor role because the storage of dissolved Fe(II) and Mn(II) represents a low mass balance. Sulfate reduction is the primary source of alkalinity, with the majority of reduced sulfate being stored in the sediment as particulate sulfide. In the salt marsh sediments we studied, the production of alkalinity increases the estimate of CO_2 sequestered by these environments by up to 50%.

Silica: the overlooked nutrient in saltmarsh biogeochemistry

Pierre Anschutz (1), Paul KANFER (1), Céline Charbonnier (2), Bruno Deflandre (1), Dominique Poirier (1), Martin Danilo (1)

(1) University of Bordeaux, (2) University of bordeaux

Poster
Dissolved silica, nutrient, saltmarsh, tidal pumping, benthic fluxes, coastal biogeochemistry, early diagenesis

Introduction

Dissolved silica (DSi) is a key nutrient that controls diatom productivity, shapes coastal food webs and influences the biological carbon pump. However, its biogeochemical role in coastal ecosystems, including saltmarshes, which are hotspots of ecosystem functions, remains poorly quantified. Nitrogen and phosphorus cycles are quite well studied but DSi dynamics in these systems are largely unconstrained. However, DSi has a strong potential to regulate overall nutrient stoichiometry, enhance organic carbon preservation, and act as sensitive indicator of environmental change in coastal ecosystems. Addressing this gap is critical to understand saltmarsh functioning and contribution to coastal biogeochemical budgets. This study investigates the role of DSi in a temperate saltmarsh of the Arcachon Bay by integrating three complementary approaches: (1) high-resolution tidal pumping to quantify DSi lateral fluxes, (2) sediment incubations to determine DSi benthic fluxes, and (3) sediment core analyses to reconstruct diagenetic processes. Our results show that DSi is not a passive component but an active biogeochemical species. Tidal pumping reveals a consistent DSi export during ebb tides, identifying the saltmarsh as a significant source of Si to adjacent coastal waters, with possible implications for phytoplankton community. Incubations show that DSi vertical fluxes are significative and strongly participate to Si budgets. Core analyses further indicate that dissolution is strongly enhanced by microbial activity and root-mediated processes, pointing to a direct coupling between Si and carbon cycling. These demonstrate how important silica is to saltmarsh and coastal biogeochemistry. Accurately evaluating coastal ecosystems contributions to global element cycles, particularly under ongoing climatic and anthropogenic pressures, requires incorporating intertidal zones Si budgets.

Metabolic cooperation between Ostreopsis and associated microorganisms: implications for the sulfur cycle.

Sarah Sadorge (1), Marie Morere (1), Claire Gassie (1), Marisol Goni (1), Mathilde Monperrus (1)

(1) IPREM UMR CNRS UPPA

Poster

Harmful algal bloom, Dinoflagellate, Microorganisms, Co-metabolisms, Sulfur Volatile Organic Compounds

Introduction

Blooms of the benthic dinoflagellate *Ostreopsis* have been associated with occasional episodes of acute respiratory symptoms, skin irritation, and general discomfort in people exposed on adjacent beaches of the Basque coast. Recently, the presence of volatile organic sulfur compounds (VOSCs) produced during these blooms has been detected. However, the presence of *Ostreopsis* alone does not fully explain the production of these sulfur VOCs, suggesting a possible contribution from microorganisms associated with *Ostreopsis* blooms. This study aims to identify microorganisms present during *Ostreopsis* blooms and to better understand the cooperation between *Ostreopsis* and other microorganisms in sulfur cycle, leading to the production of VOSCs. An experimental incubation of mucus sample collected during *Ostreopsis* blooms at Erromardie in 2025 was carried out under oxic and anoxic conditions following a nychthemeral cycle. Samples were taken at sunset and at dawn to evaluate the influence of light and oxygen on VOSCs production and bacterial activity. As expected, during the day, the balance between heterotrophic bacterial activity and microalgal photosynthetic activity led to an oxygen saturation. Whereas, during the night, heterotrophic bacterial activity decreased oxygen levels. Bacterial activity was evaluated through transcriptomic approaches targeting 16S rRNA genes. Dimethyl sulfide (DMS), methanethiol (MeSH), dimethyl disulfide (DMDS), and dimethyl trisulfide (DMTS) were detected under both conditions : with and without oxygen, but at different concentrations. Moreover, variations in these concentrations were also observed between day and night. These results suggest a significant contribution of associated microorganisms to the production of sulfur VOCs during *Ostreopsis* blooms.

Nutrient exchanges across sediment -water interface, the role of resuspension events

Aubin Thibault de • hanvalon (1), Andrieux Francoise (2), Mouret Aurélia (3), Parodi Quentin (3), METZGER Edouard (3)

(1) IPREM, CNRS, Université de Pau et des Pays de l'Adour, Pau, France, (2) IFREMER, DYNECO, F-29280 Plouzané, France, (3) Univ Angers, Nantes Université, Le Mans Université, CNRS, LPG, F-49000 Angers, France

Poster
phosphate, resuspension exchanges, desorption

Introduction

Prediction of bloom occurrence in coastal ocean is an interdisciplinary challenge. The biogeochemical approach relies on nutrient availability. In coastal ocean, main sources are fluvial input, oceanic input mainly from upwelling current and benthic-pelagic exchanges. The contributions of sediment are generally described as diffusive or advective flux. However, in the case of phosphate, exchanges from particles desorption are particularly important after resuspension events.

To estimate the contribution of sediment for the phosphate pool available in the surrounding of the Loire estuary, monitoring was established off the coast of Le Croisic, in an area of the continental shelf directly influenced by the Loire and Vilaine rivers. First sediment cores were collected in November 2023 and January 2024. Total fluxes measured from sediment incubations lie between 4 and 7 ± 2 mmol.m-2.d-1 while diffusive flux was below 1 mmol.m-2.d-1. Exchanges induced by resuspension were also quantified thanks to desorption experiments. Sediment concentrations ranging from 100 to 10 g.L-1 were resuspended in 2.5 mmol.L-1 $NaHCO_3$ solutions during 30 hours and described with Langmuir isotherms. It reveals that resuspension is the main contributor of the phosphate pool, 2 order of magnitude higher than the advective efflux and one order higher than the fluviatile input.

This research contributes to understand how chemical forcing of bloom development can rely on extreme events, such as resuspension and require a close coupling of hydrodynamic, biogeochemical and microbiological approaches.

Spatiotemporal variability of nutrient pollution in a mesotidal river–estuary system: the Adour River–Estuary Continuum (Bay of Biscay)

Bahar Rezaei (1), Mathieu Sebilo (2), monperrus mathilde (3), lanceleur laurent (3), sous damien (3)

(1) Universite de Pau et des Pays de l'Adour, UPPA,IPREM, UMR, 5254, Anglet, France, (2) Sorbonne Université, (3) Universite de Pau et des Pays de l'Adour

Poster

Adour estuary; nutrient dynamics; nitrate; spatial heterogeneity; temporal trends; tributary confluence; water quality

Introduction

Abstract

The Adour river–estuary continuum in southwestern France provides a relevant framework for assessing how tributary inputs, longitudinal transport, and estuarine transition interact to structure nutrient and physicochemical conditions. Here, we integrate multi-parameters monitoring data from the fluvial Adour downstream of Dax, the major tributaries (Gave de Pau, Gave d'Oloron, Gaves Réunis, Bidouze), and the downstream transition from Urt to the estuarine sectors of Lahonce and Bayonne.

The analysis combines cross-station comparison, smoothing-based visualization (LOWESS), non-parametric trend detection (Mann–Kendall andTheil–Sen), and bivariate relationships across key parameters including nitrate, nitrite, ammonium, orthophosphate, organic carbon, conductivity, dissolved oxygen, pH, suspended solids, and temperature. Across the network, spatial differentiation is stronger than recent monotonic temporal change.

A clear hydrochemical contrast opposes a dilute Gave-type sector, particularly the Gave d'Oloron, to a persistently enriched lower-Adour continuum (Dax to Bayonne). Intermediate conditions characterize the Gaves Réunis and Gave de Pau, while the Bidouze exhibits high variability. Nitrate emerges as the strongest spatial discriminator, with elevated concentrations in the lower Adour and Bidouze contratsing with lower levels in the Gave d'Oloron which are associatedwith cooler and well-oxygenated waters. In contrast, ammonium and orthophosphate show weaker spatial structuring and more episodic dynamics.

LOWESS vizualization highlights strong internal variability, whereas Mann–Kendall and Theil–Sen analyses indicate limited monotonic change. Overall, the system is primarily governed by persistent spatial organization, tributary confluences, and river–estuary transition, suggesting that nutrient inputs to the estuary are mainly controlled by stable upstream sources and tributary contributions rather than by recent temporal changes. Variability is instead driven by episodic inputs, likely associated with hydrological events, localized sources and internal processes. This study underscores the need to distinguish apparent variability from statistically robust trends and identifies nitrate as the dominant structuring factor of the Adour continuum

Methods

The monitoring network was assembled to characterize nutrient and physicochemical conditions across the main hydrographic compartments of the lower Adour system, including the fluvial main stem, major tributaries, confluence sectors, transitional reaches, and directly estuarine stations (Figure 1). Monitoring data for the selected stations were retrieved from the Adour-Garonne basin database through Eaufrance and, where relevant, complemented by hydrometric and pluviometric records from Hydroportail.

The analysis focused on the 2020–2025 interval, corresponding to the common time window represented in the time-trend figures across stations. The broader archive length of the underlying records differed among stations, with some series extending back to the early 1970s and others beginning only in 2020. The present study therefore interprets recent cross-station behavior primarily within the harmonized 2020–2025 analytical window rather than by combining the full historical record across an uneven station network.

The variables considered in this study included nitrate, nitrite, ammonium, orthophosphate, organic carbon, conductivity, dissolved oxygen, pH, suspended particulate matter, and water temperature. Suspended particulate matter was included because of its relevance to riverine and estuarine biogeochemical functioning, particulate transport, and potential coupling with nutrient dynamics.

The analytical strategy combined four complementary components. First, concentration behavior was compared across stations to distinguish persistent baseline differences from episodic departures and to identify groups of stations sharing similar hydrochemical behavior. Second, temporal structure was examined using LOWESS-smoothed (Cleveland, 1979; Heiler, 2000) visualization, allowing detection of non-linear variability, multi-year curvature, and short-term deviations from baseline. Third, monotonic trend assessment was performed using the Mann–Kendall test (Forthofer & Lehnen, 1981; Mann, 1945) together with Theil–Sen slope estimation (Sen, 1968; Theil, 1992). This non-parametric framework was used to determine whether observed temporal variation could be interpreted as statistically supported directional change rather than fluctuation around a stable or non-monotonic trajectory (Helsel et al., 2020). Fourth, bivariate relationships among nutrients and physicochemical variables were examined to identify recurring associations, station-discriminating variables, and contrasts between baseline hydrochemical organization and event-driven responses.

Interpretation was based on a strict distinction between smoothed temporal structure and monotonic trend evidence. LOWESS smoothing was used descriptively to summarize internal variability and to reveal possible inflections or late-period shifts, but such structure was not interpreted as a temporal trend unless it was also supported by Mann–Kendall and Theil–Sen results. This distinction was essential because many station-by-variable series showed visible internal structure without statistically strong monotonic change.

Results and Discussion

LOWESS vizualization highlights strong internal variability, whereas Mann–Kendall and Theil–Sen analyses indicate limited monotonic change. Overall, the system is primarily governed by persistent spatial organization, tributary confluences, and river–estuary transition, suggesting that nutrient inputs to the estuary are mainly controlled by stable upstream sources and tributary contributions rather than by recent temporal changes. Variability is instead driven by episodic inputs, likely associated with hydrological events, localized sources and internal processes. This study underscores the need to distinguish apparent variability from statistically robust trends and identifies nitrate as the dominant structuring factor of the Adour continuum

SESSION 4:
BLUE TECHNOLOGIES

MARINNONNET: Fishing in the Atlantic Marine Bioresources Innovation Ecosystem

Ibon Cancio (1), Juan Luis Gomez-Pinchetti (2), Tiago H. Silva (3), Elisabete Costa (4), María Garcí-Portela (5), Yannis Kablan (6), Priscillia Gourvil (7), Olivier P. Thomas (8), Eve Savage (9), Carlota Freiría (10), Jose Luis Soengas (10)

(1) Plentzia Marine Station (PiE-EHU), University of the Basque Country, (2) Spanish Bank of Alage (BEA), University of Las Pasmas de Gran Canaria, (3) I3BS, University of Minho, (4) BLUEBIO ALLIANCE, (5) IEO/CSIC Vigo, (6) Pole Mer Bretagne Atlantique, (7) Station-Biologique de Roscoff-CNRS, University of Sorrbone, (8) University of Galway, (9) University of Munster, (10) CIM, University of Vigo

Oral

Blue Bioeconomy, Marine Biotechnology, Atlantic Area, Marine Bioresources, Aquaculture, Marine bioproducts, biodiversity observation

Introduction

Europe’s link to the Atlantic Ocean is undeniable. Sectors such as maritime transport and tourism are motors in European economy, however the use of marine biological resources has still to unleash its enormous potential. Key areas such as fisheries and aquaculture are regarded as traditional activities and are declining or face implementation problems while the full potential of **Marine Biotechnology** faces bottlenecks to be brought from the ocean to the lab bench and from there to the market. Research and knowledge on **ocean bioresources** is growing exponentially, reinforcing the idea that Marine Biotech can change society. Diverse sustainable value-chains can be developed through exploring marine organisms as source of valuable products, from materials and chemical compounds for industry to cosmetics and pharmaceuticals, within a **Circular Blue Bioeconomy** context. How to boost and catalyse developments in the sector in the Biscay Bay?

MARINNONET is a joint initiative (Interreg Atlantic Area) between key players of the Marine Biotech in Brittany, Canary Islands, Galicia, Basque Country, North Portugal and N & W Ireland. It aims to leverage the combined complementary capabilities of its members for the benefit of the regional blue innovation ecosystems it represents, ensuring the competitiveness of a sustainable Blue Bioeconomy in the Atlantic Area.

Methods

MARINNONET's approach is based on the premise that each region of the Atlantic Area possesses unique R&D&I capabilities to boost the competitiveness of in the Blue Bioeconomy companies, providing technical assistance to innovators. Regional discussion forums joining researchers, government agencies, businesses, and society at large were implemented along with two workshops connecting academia and innovators to enable the structural changes necessary to guarantee the transregional competitiveness of the Blue Biotech sector. On this basis, the project has developed joint and coordinated R&D&I activities focused on common elements for the six participating regions. MARINNONET has funded 16 market-driven pilot projects in three thematic areas (a-Sustainable aquaculture, b-Omics and marine biodiversity observation, c-Marine-derived products for industry) to showcase the diverse pathways that such a network could support connecting innovators and innovation facilitators. All 1 year pilots are conducted in two of the MARINNONET scientific partners collaborating transregionally plus a local innovator. They include a wide scope of interests and goals along TRLs 4 to 6.

Results and Discussion

Total list of 16 pilots (9 finished and 7 running and funded with up to 30K € each) is as follows.

.-**FUNCTIONALGAE**. Innovative use of *C. crispus*-derived ingredients to enhance sustainability and functionality in aquaculture feeds (Partners: UVigo & EHU, Innovator: CEAMSA)

.-**ULVACEL** Innovative approaches for the cultivation of the green seaweed *Ulva* in two contrasting locations in open waters and its valorisation to cellulose for materials (P: ULPGC & UVigo, I: MACROCARBON)

.-**Kelp-Secure**. Improving kelp biobanking and seed production for improved yield and tolerance to climate change (P: SBR & UG, I: ALGOLESKO)

.-**COLORHYNCHUS**. Validating real-time welfare indicators in rainbow trout aquaculture: melanin-based skin spots, mucus quality, and behavioral synchronization as early-warning tools for commercial farm implementation (P: UVigo & EHU, I: BioOneHealth).

.-**LEPISOSSEL**. *Lepidodinium* impact on mussel physiology & flavor (P: IEO/CSIC & EHU, I: Jealsa Foods S.A.U).

.-**COAST**. Converting oysters & shells to treasures (P: UG & EHU, I: Teahan Shellfish Ltd).

.-**ToMostFish**. Towards molecular observation of female reproduction capacity in in tuna fisheries: ribo-tools (P: UVigo & EHU, I: AZTI).

.-**AI_BIOdiv**. Automated Imaging for marine biodiversity (P: SBR & UG, I: FairScope).

.-**KelPet**. Alternative seaweeds for pet food (P: UG & UMinho. I: BLUEPET).

.-**MITOXIN**. Marine microalgae biotoxins for industrial application (P: IEO/CSIC & UG, I: Cifga).

.-**ALGACAP**. Algae genetic advancement for carbon capture (P: UVigo & EHU, I: ALGAverso).

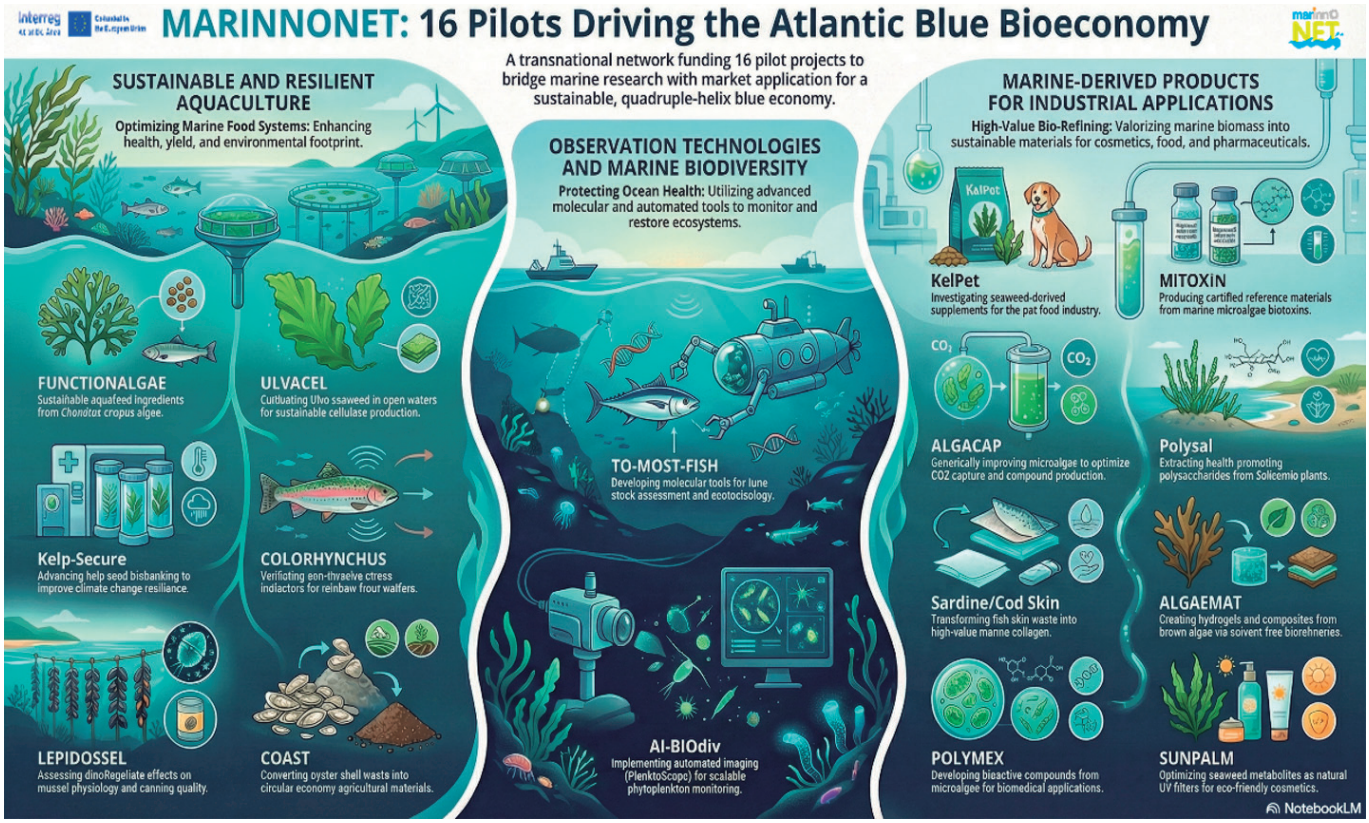
.-**POLYSAL**. Unlocking the potential of polysaccharides from *Salicornia* sp.: Extraction, characterization and biological activity (P: UMinho & UG, I: HORTA dos Peixinhos).

.-**Sardine/CodSkin**. Transforming marine biomass from sardine & codfish skins to marine collagen: a biorefinery approach to sustainable biotechnological innovation (P: UMinho & UVigo, I: COMUR).

.-**ALGAEMAT**. Integrated valorization of brown algae for advanced functional materials (P: UMinho & UVigo, I: PORTO-MUIÑOS, S.L).

.-**POLYMEX**. Characterization of microalgae exopolysaccharides for biomedical and new materials applications: improved extraction procedures, biochemical characterization and bioactivity (P: ULPGC & UMinho, I: Canarias Tech. Insi POLYMEX).

.-**SUNPALM**. Sustainable UV-filters from *Palmaria* (P: UG & EHU, I: Sea Believe SUNPALM).



This approach has shown that **transregional bridges** can be stablished across Atlantic Area countries and innovation ecosystem, connecting researchers and innovators to provide solutions and marketable products through marine biotechnology. Products for the Food, Feed and Cosmetics industries, materials for construction and biomedical industry have been provided and solutions proposed for industrial carbon capture and marine biodiversity observation. In recognition of its impact, the European Commission honored the MARINNONET initiative with a **2025 Atlantic Award** for its innovative contributions to the sustainable maritime bioeconomy.

Acknowledgements: European Union, INTERREG Atlantic Area 2021-2027, Ref. MARINNONET-EAPA_0017/2022.

Molecular tools based on ribosomal markers to aid histology in the quantitative analysis of tuna reproductive maturity and in stock assessment

Joyanta Bir (1), Oihane Diaz de Cerio (2), Maren Ortiz-Zarragoitia (2), Patricia Lastra Luque (3), Deniz Kukul (3), Iker Zudaire (3), Ibon Cancio (1)

(1) CBET+ Research Group, Dept. Zoology & Animal Cell Biology; Faculty of Science & Technology and Research Centre for Experimental Marine Biology & Biotechnology (PiE-UPV/EHU), University of the Basque Country, E-48620 Plentzia., (2) CBET+ Research Group, Dept. Zoology & Animal Cell Biology; Faculty of Science & Technology and Research Centre for Experimental Marine Biology & Biotechnology (PiE-UPV/EHU), University of the Basque Country, E-48620 Plentzia, (3) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia.

Oral

Marine biotechnology and molecular tools have a lot to contribute to the scientific evaluation of commercial fish stocks. Fecundity assessment in fisheries is an important part of stock management in the Biscay Bay, gonad histology constituting the gold-standard approach in assessments. In tuna as batch-spawners with asynchronous ovary organization, it is difficult to define gonad maturation stage necessary to calculate spawning stock biomass and an unbiased numerical index would be of much use. Oogenesis in teleosts begins with massive accumulation of 5S rRNAs and tRNAs in oocytes, both transcribed by RNA polymerase III (RNAP-III). We have developed easily applicable molecular indices based on differential accumulation of RNA transcripts along oogenesis. This study measures the differential transcriptional regulation of tRNAs and ribosomal RNAs in frozen Skipjack, Yellowfin (YFT), Bigeye and Bluefin tuna along oogenesis. Ovarian total-RNA (>50 ovaries per species) was analysed through capillary electrophoresis in an Agilent 2100-Bioanalyzer. Resulting electropherograms allowed quantifying concentrations of tRNAs, 5S, 5.8S and 18S rRNA (last two transcribed by RNAP-I) and calculating tRNA/5.8S and 5S/18S rRNA indices. Indexes numerically ranked ovaries from earliest (high values) to latest (low) maturation stage, in accordance with the histological staging into previtellogenic, cortical alveoli, early and advanced vitellogenic. Instead of four discrete groups, indexing places each individual across the developmental continuum. The approach was validated benchmarking YFT data using other two capillary electrophoresis equipments (Agilent Fragment-Analyzer) and Revvit (LabChip). Strong correlation was observed: Bioanalyzer vs LabChip (r=0.96) and Bioanalyzer vs Fragment-Analyzer (r=0.95), this making our indexing approach universal for application in many different laboratories. Thus, the molecular tools validated allows accurate and unbiased identification and ranking of oogenic stages in tuna species with applications in the assessment of the reproductive potential of stocks in tuna fisheries.

Acknowledgements: Basque Government (IT1743-22), Spanish MICIU & EU-FEDER/ERDF PID2023-146085NB-I00), EU-INTERREG-Atlantic-Area 2021-2027 (MARINNONET-EAPA_0017/2022 project).

From wild populations to elite strains: selective breeding, cryopreservation, and scale-up of Saccharina latissima seedstock production in the SeaMark and Kelp-Secure projects

Zofia Nehr (1), Cock J. Mark (2), Le Madec Francis (2), Grego Michele (3), Reddy Maghesnee (4), Le Moine Mathilde (5), Bak Urd G. (6), Potin Dan (2), Préchoux Aurélie (7), Thomas Olivier P. (4), Probert Ian (8), Potin Philippe (2)

(1) Station Biologique De Roscoff Sorbonne Université / CNRS, (2) Sorbonne Université, CNRS, Integrative Biology of Marine Models Laboratory, Station Biologique de Roscoff, France, (3) Sorbonne Université, CNRS, FR2424, Roscoff Culture Collection, Station Biologique de Roscoff, France., (4) School of Biological and Chemical Sciences, Ryan Institute, University of Galway, Ireland, (5) Algolesko, Terre plein du Port, 29750 Loctudy, France, (6) Ocean Rainforest, 20 Mjólkargøta, FO-180 Kaldbak, Faroe Islands, (7) Algaia Research and Development Center, 91 rue Edouard Branly, 50000 St Lô, France, (8) Sorbonne Université, CNRS, FR2424, Roscoff Culture Collection, Station Biologique de Roscoff, France

Oral
Selective breeding, sugar kelp, mariculture

Introduction

The sugar kelp *Saccharina latissima* is a commercially valuable species with broad applications in food, feed, nutraceuticals, and biomaterials, and its cultivation is expanding rapidly across Northern Europe. Yet kelp domestication in Europe remains in its infancy. Unlike in Asia, where the closely related *Saccharina japonica* has benefited from decades of selective breeding (1) , European cultivation still relies on wild specimens, with little to no control over desirable traits such as yield, morphology, or biomolecule content (3). Establishing a robust selective breeding pipeline for *S. latissima* is therefore a critical step towards a more competitive and sustainable European kelp aquaculture sector.

Methods

Fertile blades of *Saccharina latissima* were collected from populations surrounding partner farms and spores were released in the laboratory. Gametophytes were grown, isolated, and sexed using PCR markers (2), yielding a collection of 241 clonal gametophytes. Controlled crosses were performed by pairing randomly chosen male and female gametophytes under winter condition (10°C, white light, 8h:16h day:nigth photoperiod). F1 sporophyte growth was monitored through photographs taken weekly throughout the full cultivation cycle (from few centimetres to 1 metre blades) and finally in a two-month common garden experiment Both intraregional and interregional crosses were conducted. At the end of the experiment, blades were harvested, dried and milled for analysis of monosaccharide and uronic acid by HPAEC-PAD. Intrarregional Breton crosses were subjected to untargeted metabolomic profiling by UPLC-MS/MS with annotation using the MarinLit database and GNPS2.

Gametophyte culture conditions were optimised through a full factorial experiment testing light intensity, nitrogen concentration, iron depletion, and temperature. After three months, cultures were scored visually under a binocular micrscope and with the naked eye on a scale from 0 to 4.

For cryopreservation, gametophyte strains were incubated in a cryoprotectant solution (10% DMSO, 9% D-sorbitol) and cooled to -40°C at -1°C/min using a controlled-rate freezer. They were then plunged into to liquid nitrogen and stored at -150°C. After four days, three samples were thawed, place in fresh half-strength Provasoli Enriched Seawater medium (4) under progressively increasing light conditions (48h of darkness then 24h of semi darkness). Recovery was assessed under a epifluorescence microscope after two months and fertility were assessed by crossing after six months.

Results and Discussion

Building the foundations of kelp breeding

The SeaMark project (Horizon Europe, grant agreement No. 101060379) aimed to initiate selective breeding by the establishment of a clonal gametophyte collection, the production and phenotyping of F1 hybrid sporophytes, and the identification of elite parental strains. Sampling was restricted to natural populations surrounding partner farms, in order to work with locally-sourced genetic resources and avoid introduction of non-native genotypes.

This yielded a collection of 241 clonal gametophytes, from which 135 controlled crosses were performed using randomly selected parental pairs. To evaluate whether relying solely on local material could limit genetic diversity and improvement potential, both intraregional and interregional crosses were included.

F1 sporophyte growth was monitored throughout the full cultivation cycle; from juveniles of a few centimetres to individuals reaching one metre; and in a two-month common garden experiment designed to minimise environmental variation. This phenotyping revealed no significant difference in growth performance between intraregional and interregional crosses (Fig.1), providing strong evidence that locally-sourced genetic resources are sufficient to underpin effective breeding schemes. The best-performing crosses were identified, and the corresponding parental gametophyte strains were transferred to partner farms for replication of the crosses at sea.

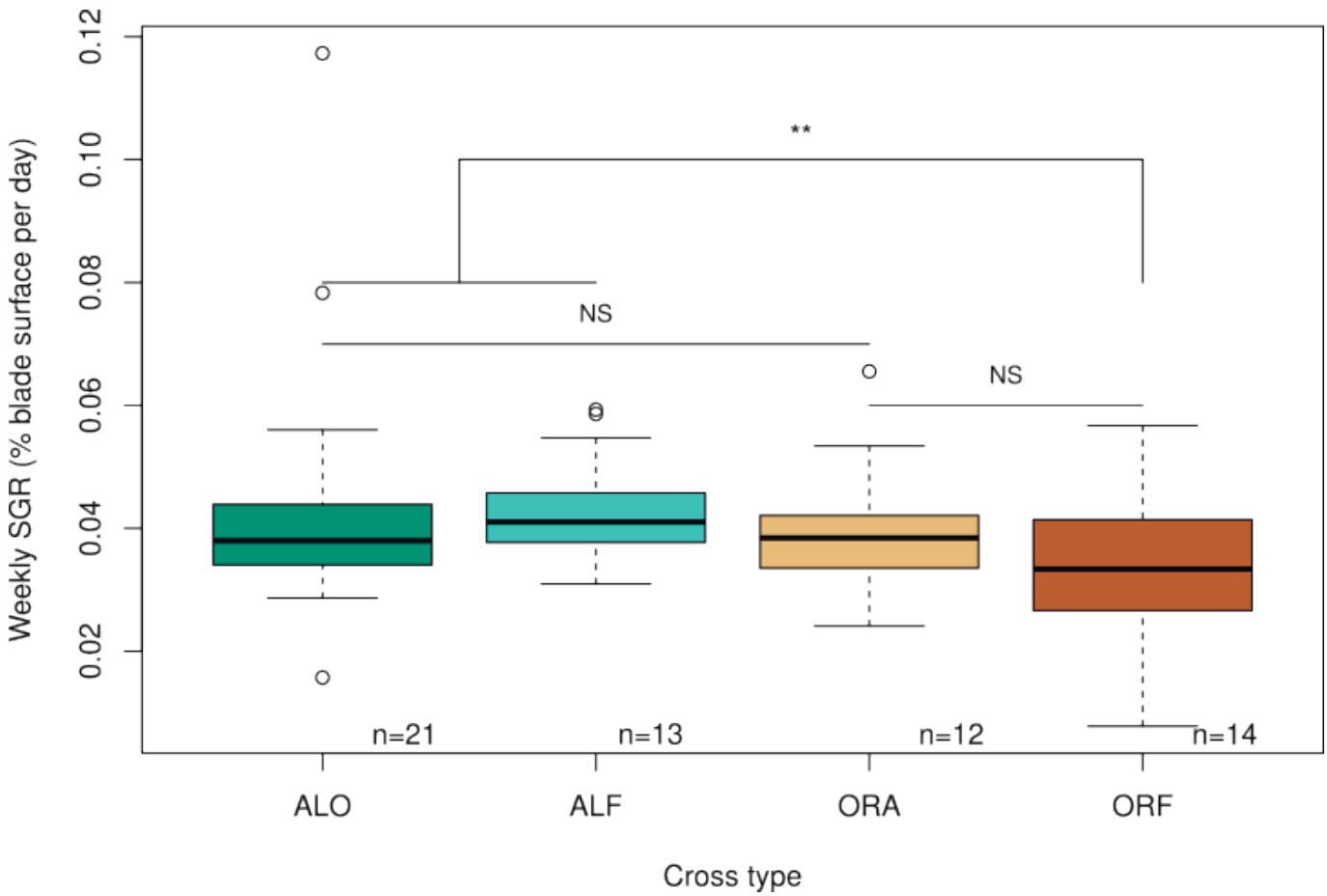


Figure 1. Weekly SGRs in 300 L and 4000 L tank systems. Comparison of weekly SGRs for the four classes of cross. n, number of crosses; NS, no significant difference; **, p-value < 0.005; ALO, Brittany x Brittany cross; ORF, Faroe Islands x Faroe Islands cross; ALF, Brittany x Faroe Islands cross; ORA, Faroe Islands x Brittany cross.

This work also exposed bottlenecks inherent to the kelp breeding pipeline. First, gametophytes grow very slowly under standard culture conditions, making large-scale biomass production for seeding purposes both time-consuming and logistically challenging, with a significant risk of strain loss. Second, although gametophytes represent ideal candidates for early-stage selection, being small, easily cultured in the laboratory, and functionally equivalent to seedstock, the link between parental gametophyte traits and sporophyte progeny performance remains poorly characterised, severely limiting the ability to apply selection at this stage.

Overcoming the bottlenecks

The pilot project Kelp-Secure (Interreg MarInnoNet, grant agreement No. EAPA_0017/2022) was specifically designed to address each of these bottlenecks through four activities: optimisation of gametophyte culture conditions, scale-up using photobioreactors, biomolecular phenotyping, and development of cryopreservation methods.

Culture optimisation and scale-up

To identify optimal growth conditions for gametophytes, we conducted a full factorial experiment investigating the independent and combined effects of light intensity, nitrogen concentration, iron depletion (a known inhibitor of sexual development), and temperature. Cultures were assessed after three months, both visually under a binocular microscope and with the naked eye. The results revealed that gametophytes have a narrow window of optimal conditions: mortality was consistently higher at high light intensities and elevated temperatures, while best performance was observed under oligotrophic conditions with low nitrogen concentrations. (Fig.2) These findings provide a base for the optimisation of gametophyte production systems, including photobioreactor-based scale-up, which was subsequently tested within the project.

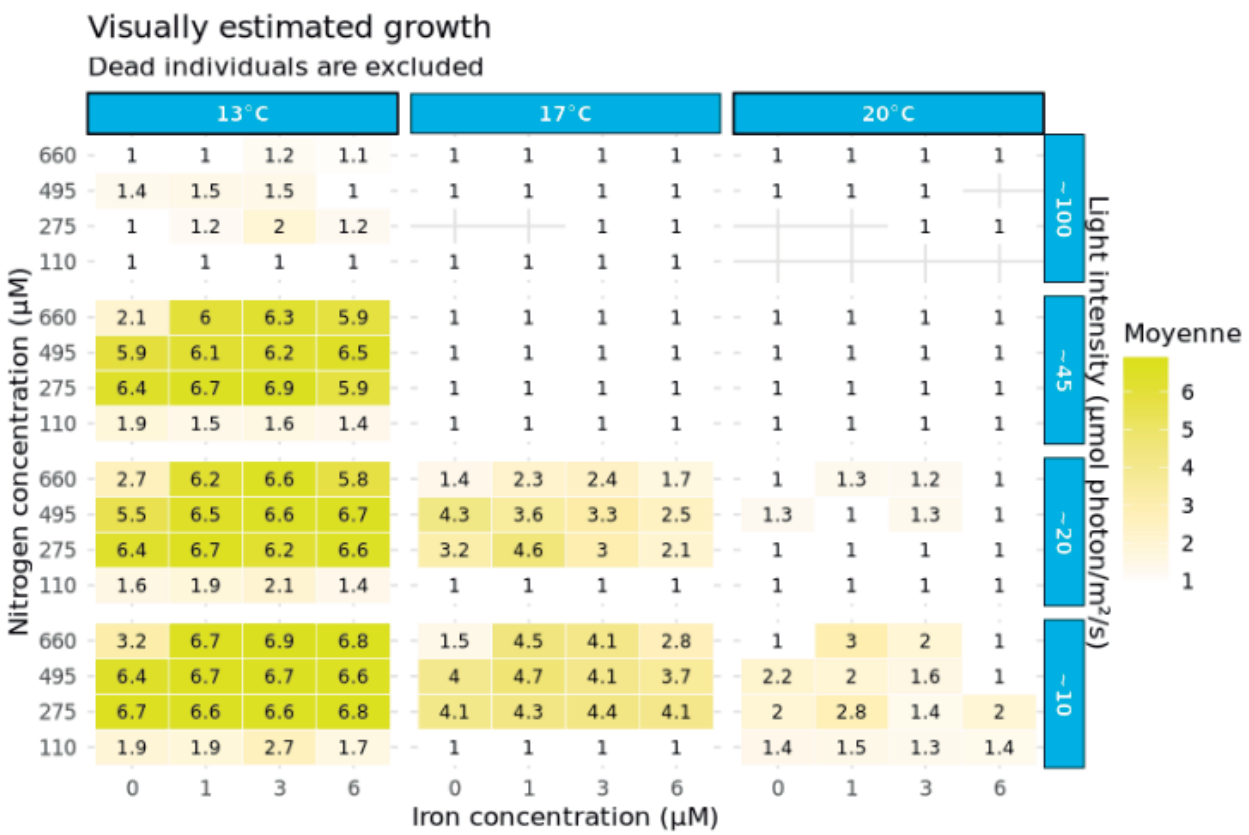


Figure 2: Visually estimated growth of gametophyte across 192 different culture conditions. Growth was assessed under a binocular microscope and with the naked eye, and scored on a scale from 0 (no fragment visible) to 4 (fragment visible and pigmented). The two scores were summed to produce a composite growth index.

Cryopreservation

To ensure the reliable long-term conservation of elite genetic resources, we developed and validated a cryopreservation protocol applicable to all strains in the collection. Following cryopreservation and thawing, all strains successfully recovered and regained fertility, confirming the robustness of the approach as a tool for safeguarding genetic material. However, post-thaw recovery remains a technically demanding step: gametophytes require a long adaptation period before resuming normal growth, and further optimisation of post-thaw culture conditions will be necessary before the protocol can be implemented routinely at scale.

Biomolecular profiling

Regarding biomolecule composition, we investigated saccharide content, with a particular focus on alginate content and quality, as well as the broader biomolecular profile of Breton crosses. Alginate content and quality varied among crosses, but these differences were not associated with intra- or interregional origin; rather, they appeared to be determined by the specific parental combination. Untargeted biomolecular profiling further identified two crosses producing a high-value compound not previously described in S. latissima, opening promising future developments.

Conclusion

Taken together, the results from SeaMark and Kelp-Secure provide the foundational tools necessary for a selective breeding pipeline for S. latissima in Europe. The establishment of a well-characterised clonal gametophyte collection, optimised culture protocols, a validated cryopreservation method, and initial biomolecular phenotyping data represent an important first step towards kelp domestication. It should be noted that only a single generation of crosses has been completed to date, and that meaningful improvement in yield and other quantitative traits will inevitably require multiple, successive rounds of selection. The infrastructure and protocols now in place nonetheless provide a solid and replicable basis upon which future, longer-term breeding programmes can be built, with realistic prospects for the gradual development of elite, well-characterised seedstock for the European kelp aquaculture sector.

Sedimentological and geophysical characterization of offshore wind farm sites: from data acquisition to exploitation.

CLEMENT Elyna (1), LAURENT Marie (1), IGNACIO Agathe (1), MERINDOL Méril (1), LABARTHE Carla (1), FAVE Nona (1), MARCHES Elodie (1), LUSVEN André (1)

(1) SHOM (Service National d'hydrographie et d'océanographie)

Poster

Wind-farm sites, Acquisition, Sedimentolgy, Geophysic, Geomorphology, Hydrodynamic

Introduction

The development of offshore wind energy requires in-depth knowledge of the morphology of the seabed, the nature and dynamics of sediments, and the oceanographic conditions in potential installation areas. In this context, Shom (National Hydrographic and Oceanographic Service) has been commissioned by the French government to carry out sedimentological and geophysical studies of sites identified for future offshore wind farms.

This work is divided into three main stages. The first consists of a detailed summary of existing knowledge to inform the public debate phases. It is based on the compilation of bathymetric and sedimentary data, supplemented by information on waves, currents, tides, and the presence of man-made objects. In a second stage, these data are enriched by dedicated oceanographic campaigns, using multibeam echo sounders, side-scan sonars, sub-bottom profilers, and sediment sampling tools (Van-Veen and Shipeck grabs). Hydrodynamic conditions are documented using measurement networks, in particular in situ measurement buoys.

In a final step, all of these data are processed to produce digital terrain models, acoustic imagery mosaics, sediment type and thickness maps, grain size analysis results, morpho-sedimentary structure maps, and inventories of anthropogenic objects. Combining current and historical geomorphological, sedimentological, and hydrodynamic data also provides a better understanding of the temporal evolution of the seabed and the dynamics associated with sea conditions.

Sedimentological and geophysical characterization of offshore wind farm sites in the Bay of Biscay.

LAURENT Marie (1), CLEMENT Elyna (1), IGNACIO Agathe (1), MERINDOL Méril (1), LABARTHE Carla (1), FAVE Nona (1), MARCHES Elodie (1), LUSVEN André (1)

(1) SHOM (Service National d'hydrographie et d'océanographie)

Poster

Offshore wind farms, Sedimentology, Geophysic, Geomorphology, Sediment hydrodynamic

Introduction

To support the development of offshore wind energy in France, Shom (National Hydrographic and Oceanographic Service) has been commissioned by the French government to study sites that could host future offshore wind farms. In this context, hydrographic surveys were carried out between 2021 and 2025 on the continental shelf of the Bay of Biscay. The data acquired has enabled sedimentological and geophysical studies to be carried out off the coast of three areas: offshore Morbihan, Vendée and Ile d'Oléron.

Methods

These studies aim to provide high-resolution seabed and subsoil data to assess the feasibility and implementation strategy for offshore wind farms. Deliverables include digital terrain models (DTMs), acoustic imagery, seabed sediment maps, loose sediment thickness maps, geological and sedimentary structure maps, and an inventory of anthropogenic objects.

Results and Discussion

These products enabled the identification of sedimentary structures such as banks, sandy patches, sorted bed forms, and dunes off the Charente and Vendée coasts. Outcropping rocks were also observed particularly off Ile d'Oléron and the Morbihan coast. Faults, rock alignments, and atypical circular structures, potentially interpreted as biocarbonate constructions, were identified and require consideration for risk mitigation.

Sediment samples were used to produce detailed maps of the sedimentary nature of the seabed. The results reveal a high content of fine fractions in the three study areas, consistent with the "Grande Vasière" in the Bay of Biscay. Finer fractions are also observed near the coast, particulary in sheltered environments such as the Bay of Marennes-Oléron.

Combined sedimentological data with oceanographic data (currents, swells, and tides), were used to analyses sediment dynamics. At depths around 110 m near the Plateau de Rochebonne, statistical analyses (1980–2024) indicate very limited sediment transport, mainly due to the attenuation of hydrodynamic energy at depth.

These datasets support risks assessment for the development of offshore wind farms on the continental shelf of the Bay of Biscay, and improve regional knowledge of sedimentology and geophysics. They provide a high-resolution reference dataset for use by offshore wind development stakeholders to guide and compare project-specific reconnaissance campaigns and support the definition of offshore infrastructure design and construction strategies. This data may also be considered for any future oceanographic studies in the Bay of Biscay.

Tracking Endangered Marine Megafauna Across Years: Spatial Ecology Insights for Adaptive Marine Planning

Ana Cazali (1), Maite Louzao (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Biologging, spatial ecology, marine megafauna, non-breeding habitat, marine protected areas, conservation planning.

Introduction

Understanding the spatial ecology of endangered marine megafauna is fundamental for evaluating the effectiveness of existing conservation and management measures. Using a multi-year biologging (light level geolocators, GLS) dataset spanning more than a decade, we analysed non-breeding movements of a critically endangered seabird, the Balearic shearwater (Puffinus mauretanicus), across the NE Atlantic Ocean, to identify persistent high-use areas and evaluate temporal shifts in habitat utilisation. GLS tracks were processed to derive Kernel Utilization Distributions, allowing us to quantify core activity zones and assess site fidelity across years. We then compared these ecologically important areas with the current network of Marine Protected Areas (MPAs) to evaluate the adequacy of conservation coverage and to reveal spatial gaps where key habitats remain outside formal protection. This work provides a robust, evidence-based framework for assessing spatial conflicts and informing adaptive marine spatial planning. Our results highlight the critical role of long-term tracking in capturing dynamic habitat use and supporting the design, refinement, and evaluation of MPAs for endangered megafauna. Beyond its scientific contribution, this approach offers practical value for practitioners engaged in marine conservation, spatial modelling, and biodiversity policy.

Methods

Multi-year biologging (light level geolocators, GLS) dataset spanning more than a decade

Seasonal variation in nutritional composition and metal content of four macroalgae species from the Bay of Biscay as a food source

Marina Salido (1)

(1) University of the Basque Country

Poster

Introduction

Macroalgae are a key component of coastal ecosystems and are widely considered a valuable marine resource within the blue economy framework, due to their nutritional properties and low environmental impact. However, consuming them may pose risks associated with metal accumulation. In this context, the present study evaluates the nutritional composition, iodine and metal content of four local species from the Bay of Biscay: Ulva rigida, Bifurcaria bifurcata, Halopteris scoparia and Halopithys incurva, aiming to assess their potential as a food source. Seasonal variability was also assessed. Significant differences were observed in the nutritional composition of the species. H. incurva showed the highest protein content (14.0 ± 3.3 g/100 g DW), and B. bifurcata showed the highest carbohydrate content (28.7 ± 7.1 g/100 g DW). All species had a high dietary fibre content (averaging 34.8 % DW), supporting their role in digestive health. Sodium levels approached the recommended intake limit (EFSA 2024), suggesting that consumption should be moderated. Meanwhile, iodine and Cd concentrations remained below the established safety limit (ANSES 2016, European-Union 2023). No safety limit has been established for Hg, Pb and As in algal food products. Seasonal variation influenced most nutritional parameters, though no consistent trends were identified across species, suggesting species-specific responses to environmental drivers such as seasonal changes in temperature, nutrient availability, and coastal inputs. Overall, these macroalgae show considerable potential as a nutritious and sustainable food source, since their sodium and iodine content does not pose a risk, though attention should be paid to their metal content. Further research is needed to clarify seasonal dynamics and metal regulation in order to improve risk assessment and dietary recommendations.

[1] ANSES. (2016). Opinion of the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) on the updating of the French Population Reference Intakes (PRIs) for vitamins and minerals. https://www.anses.fr/en/system/files/NUT2017SA0086EN.pdf

[2] EFSA. (2024). Dietary Reference Values for the EU. https://multimedia.efsa.europa.eu/drvs/index.htm

[3] ANSES. (2016). Opinion of the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) on the updating of the French Population Reference Intakes (PRIs) for vitamins and minerals. https://www.anses.fr/en/system/files/NUT2017SA0086EN.pdf EFSA. (2024). Dietary Reference Values for the EU. https://multimedia.efsa.europa.eu/drvs/index.htm European-Union. (2023). Commission Regulation (EU) 2023/915 of 25 April 2023 on maximum levels for certain contaminants in foodstuffs and repealing Regulation (EC) No 1881/2006. Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:32023R0915

Enhancing Carbon Fixation in Tetraselmis chuii through UV-Induced Mutagenesis for CO_2 Capture Applications

Nekane Salvador-Picado (1), Paula Santiago-Díaz (2), Antera Martel (2), Juan Luis Pinchetti (2), Esther Blanco Rayón (1)

(1) University of the Basque Country, (2) University of Las Palmas de G.C

Poster

Introduction

Climate change is a major global challenge, with increasingly frequent extreme weather events. Microalgae have emerged as a promising solution due to their rapid growth and high photosynthetic efficiency, enabling effective CO_2 capture. However, wild-type strains have limited carbon fixation capacity, restricting large-scale applications.

This study aimed to enhance decarbonization efficiency in Tetraselmis chuii (BEA 1291B) through strain improvement. Random mutagenesis using UV radiation was applied to generate genetic variability, and four strains with the highest photosynthetic rates were selected for further analysis alongside the original strain.

The original strain and selected mutants were cultivated in F/2 medium supplemented with bicarbonate to simulate industrial conditions. Cultures were maintained at 20 °C under 100 µmol photons m^{-2} s^{-1} and a 16:8 h light:dark cycle for 7 days in a controlled chamber equipped with SIA technology (patent WO2023275423A1). Microalgal growth was monitored daily. At the end of the experiment, photosynthetic rate, carbonic anhydrase and Rubisco activities, and protein and lipid content were measured.

Mutant strains showed improved photosynthetic performance, reaching 109%, 160%, 180%, and 194.8% relative to the original strain (100%). However, the original strain exhibited the highest final cell concentration and lipid content.

These results demonstrate the potential of mutagenesis-based strategies to enhance carbon fixation in microalgae, while highlighting trade-offs between photosynthetic efficiency, growth, and biochemical composition. Further research is needed to develop strains that combine high photosynthetic performance with increased production of valuable compounds, enabling cost-effective industrial applications.

Acknowledgements: This work was funded by the MARINNONET Interreg Atlantic Area Project (EAPA_0017/2022) through the pilot action ALGACAP.

Isolation, characterization, identification and screening of interesting biotechnological activities of marine fungi in different systems of the Bay of Biscay

Amaia Zarrabeitia-Elorriaga (1), Amaia Hernandez (2), Ainhoa Montero (2), Zuriñe Baña (2), Iñigo Azua (2)

(1) Euskal Herrriko Unibertsitatea, (2) Euskal Herriko Unibertsitatea

Poster

Marine-derived fungi, bioprospecting.

Introduction

The aquatic ecosystems of the Bay of Biscay host a highly diverse microbial community, with marine bacteria being among the most extensively studied group. In contrast, marine-derived fungi, despite their essential roles in aquatic biogeochemical cycles, remain largely unexplored, and knowledge of their diversity, ecological functions, and biotechnological potential is particularly limited in this region. Given the marine ecosystem conditions, including high salinity, low temperatures, and periods of oligotrophy, a high degree of taxonomic and phenotypic fungal diversity is expected, since only a few studies have addressed this microbial group.

Methods

To help fill this gap, different marine derived fungi have been isolated from different systems within the Bay of Biscay, specifically from seawater samples, plastisphere and sediments. Each fungi, was characterized macroscopically on Sabouraud agar, documenting colony color, shape, texture, size and growth patterns. Microscopic characterization of fungi was based on the fruiting bodies in microcultures, followed by lactophenol blue staining and light microscopy examination. Finally, the taxonomic identification of fungi was performed through amplification and sequencing of ITS regions using standard molecular protocols. Moreover, biotechnologically interesting enzymatic activities have been detected by using differential media; caseinases, ligninolytic enzymes, laccases, amylases, lipases and polyesterases.

Results and Discussion

Most isolates obtained in this study were filamentous fungi, partly reflecting the selection strategy based on colony morphology, which favored filamentous growth forms. Biotechnologically interesting activities are widely spread across marine-derived fungi from the Bay of Biscay. Nonetheless, these findings reveal a previously underreported diversity of fungi in the Bay of Biscay and underscore the potential of aquatic ecosystems as valuable reservoirs for fungal bioprospecting. The taxonomic richness detected suggests that marine-derived fungi from this region may hold significant ecological relevance and biotechnological potential, highlighting the need for further research into their functional roles and possible applications.

SESSION 5:
ANTHROPOGENIC EFFECTS, QUALITY ASSESSMENT AND ECOSYSTEM MANAGEMENT

HEAVY METAL ACCUMULATION IN ELASMOBRANCHS FROM THE BAY OF BISCAY AND ITS ECOLOGICAL AND HEALTH IMPLICATIONS

Noelia Beatriz Suárez Sánchez (1), Mario Menéndez Miranda (2), Álvaro Baragaña Roces (1), Illán Fernández Pérez (1), Ángel Muñoz (3), Ayoze Castro Alonso (4), María José Caballero Cansino (5), Laura Miralles López (1), Yaisel Juan Borrell Pichs (1), María Trinidad Pérez Méndez (1)

(1) Universidad de Oviedo, (2) SERIDA, (3) Rula de Avilés, (4) Universidad de las Palmas de Gran Canaria, (5) Universidad de Las Palmas de Gran Canaria

Oral
elasmobranchs, heavy metals, chemical speciation

The ocean is essential due to its socio-economic relevance and the ecological functions it performs. However, it is increasingly threatened by anthropogenic activities. Among emerging pollutants, heavy metals stand out because of their persistence and toxicity. In this context, elasmobranchs are particularly vulnerable owing to their high trophic positions and their life-history traits such as longevity, slow growth and late sexual maturity, which improve bioaccumulation and biomagnification. These processes have negative physiological, ecological, economic and health effects considering the connection between human, animal and environmental health ("One Health"). This study evaluates interspecific patterns of heavy metal accumulation in elasmobranchs from the Cantabrian Sea. Concentrations of arsenic (As), cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb) and zinc (Zn) were quantified by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) in 47 muscle samples from three shark species, Galeorhinus galeus, Prionace glauca and Scyliorhinus stellaris and, one ray species, Raja undulata, obtained from the Avilés fish market. Chemical speciation analyses were performed for arsenic and mercury to determine inorganic arsenic (iAs) and methylmercury (MeHg), the most toxic forms for human consumption. Analyses revealed significant interspecific differences in metal concentrations, indicating different contamination profiles potentially associated with habitat, diet or ecological patterns. Arsenic was the most abundant element overall, whereas cadmium consistently showed the lowest levels. Mercury concentrations increased with body size in some species, supporting biomagnification processes. Nearly 40% of the samples exceeded European regulatory thresholds for commercialization (iAs, Cd, Hg y Pb), particularly for iAs and total Hg. When estimated weekly intake (EWI) was considered, MeHg concentrations surpassed the provisional tolerable weekly intake (PTWI) under current Spanish fish consumption rates for all the samples. These results suggest sustained environmental exposure to heavy metals in the Cantabrian Sea and raise concerns regarding both biodiversity conservation and seafood safety.

Harnessing passive sampling to meet the challenges of increasingly stringent European water legislation

Maria Jesús Belzunce Segarra (1), Natalia Montero Ruíz (1), Javier Franco San Sebastian (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia

Portualdea z/g, 20110 Pasaia

Oral

passive sampling, chemcatchers, organotin compounds, emergent compunds, estuarine waters

As European water quality standards continue to evolve, the gap between regulatory requirements and current analytical capabilities is widening. The recently proposed Directive (COM(2022) 540 final) reflects an increasingly stringent regulatory landscape, requiring the monitoring of priority substances at ultra-trace levels that are often beyond the reach of traditional approaches based on the analysis of grab water samples. This study explores the potential of Chemcatcher passive samplers as a robust solution for monitoring analytically challenging contaminants, including organotin compounds (TBT and DBT), antibiotics and estrogenic hormones.

Unlike discrete water sampling, which only provides a snapshot of contaminant concentrations at the exact sampling time, Chemcatchers integrate the fluctuation of contaminants, providing time-weighted average (TWA) concentrations that are representative of the entire exposure period. This approach is particularly valuable for detecting substances present at concentrations below the limits of quantification (LOQ) of standard methods used in routine water quality monitoring laboratories. To illustrate this potential, two sampling campaigns were conducted in two estuaries of the Basque Country during both, rainy and dry seasons, enabling the assessment of environmental variability and the identification of potential point and diffuse sources of contamination. As an example of obtained results, estrogenic hormones were measured in waters by Chemcatchers in the range of 0,03 to 0,54 $ng \cdot L^{-1}$ against concentrations below the quantification limit measured by traditional approaches.

Rather than focusing solely on specific numerical results, this research emphasizes the broader potential of passive sampling. By providing a more representative picture of pollutant concentrations in dynamic systems such as estuaries, Chemcatchers are a reliable resource for complementing traditional monitoring networks, supporting compliance with future, stricter environmental quality standards. The findings underscore that as legislation moves toward parts-per-trillion (ppt; ng·L-1) or lower thresholds, the high-resolution data provided by passive samplers are consolidating their role as an essential tool for environmental analysis and regulatory enforcement in complex aquatic systems.

Production-time dependent ecotoxicity of oil Low Energy Water Accommodated Fractions (oil-LEWAFs): microalgae and copepod toxicity assays

Wiame El Ouahabi (1), Tamer Hafez (1), Ionan Marigómez (1), Robert Duran (2), Esther Blanco Rayón (1)

(1) University of the Basque Country, (2) Universite de Pau et des Pays de l'Adour

Oral

Oil spills release complex mixtures of chemicals into seawater, making the aqueous fraction to be bioavailable to marine organisms. Assessing the toxicity of these aqueous mixtures is challenging due to variability in their preparation methods and the limited standardization of ecologically relevant testing approaches. Microalgae, Isochrysis galbana, and copepods, Acartia tonsa, are widely used in marine ecotoxicology due to their relevance as ecosystem components and sensitivity to contaminants. This study aimed at determining how the oil-LEWAF toxicity changes for these test organisms depending on the oil-LEWAF production-time and the type of oil.

Oil-LEWAFs were prepared for light naphthenic crude oil (LO-LEWAF) and heavy #6 fuel (HO-LEWAF) at a 1:40 oil-to-water loading ratio under controlled low-energy mixing in darkness at 20°C. Oil-LEWAFs produced at 24, 40, 70, and 96 h were tested. I. galbana and A. tonsa were exposed separately to eight test concentrations (0-55%) of either LO-LEWAF or LH-LEWAF for 72 h. Growth inhibition was measured in I. galbana, and mortality in A. tonsa.

Oil-LEWAF toxicity changed depending on the oil-LEWAF production time and the type of oil. LO-LEWAF was more toxic that HO-LEWAF for both test organisms. After exposure to LO-LEWAF, maximum growth inhibition in I. galbana occurred at 24–40 h, while peak mortality in A. tonsa occurred at 70 h. Based on toxicity criteria rather than on chemical criteria, our results support that, depending on the test organism and the tested oil types, different LEWAF production-times should be used to test the ecotoxicity of aqueous mixtures released after oil spill. Thus, the risk assessment would account for worst-case scenarios and maximum toxic power of the oil aqueous mixtures.

Acknowledgements: This work was supported by the AMMONTOX project (Ministry of Science and Innovation of Spain, REF: PID2021-123945OB-I00) and the Basque Government CRG CBET+ (IT-1743-22).

Cyanobacterial Bioassays to Evaluate Estuarine Health under Treated Sewage Influence in the Bay of Biscay

Evgeni Bunin (1), Robert Duran (2), Cristiana Cravo-Laureau (2), Maren Ortiz-Zarragoitia (3)

(1) University of Pau and Adour Region UPPA, (2) University of Pau and Adour Region, UPPA, CNRS, IPREM, (3) Plentzia Marine Station; University of the Basque Country (EHU)

Oral

Bioassays, Anabaena cyanobacteria, flow cytometry, treated sewage, environmental monitoring

Sewage treatment plants (STPs) are essential for reducing anthropogenic pressures on aquatic ecosystems, yet treated effluents can still modify biotic communities and contribute to the accumulation of contaminants in estuarine sediments. Estuaries, characterised by dynamic physicochemical conditions, remain challenging environments for predicting ecological risk. Evaluating the influence of an individual STP on sediment quality therefore requires integrated, multi-organism bioassays. Although filamentous cyanobacteria have been proposed as emerging ecotoxicological models, their suitability for complex sediment-derived mixtures remains insufficiently explored [1]. This study assessed the responses of *Anabaena cylindrica* (SAG 1403-02) under nutrient-limited conditions, evaluating growth inhibition, cell viability, and pigment fluorescence following exposure to estuarine sediment extracts with varying contamination levels. The objective was to determine the relevance of cyanobacteria-based endpoints for detecting STP impacts, in comparison with established ecotoxicological models.

Surface sediments (0–10 cm) were collected from three estuaries receiving treated effluents (Bayonne, Bilbao-Galindo, and Guriezo), including upstream, discharge, and downstream sites, during two seasonal sampling campaigns. A four sampling place in the estuary of Plentzia was included as reference site. Freshwater elutriates were prepared following ASTM E1391–03 [2], diluted in modified BG-11 medium (50% nutrients), and inoculated with exponentially growing *A. cylindrica*. Growth was monitored over 72 h in microplate format using (allo-)phycocyanin (APC) fluorescence, while cytometric analyses (Calcein-AM and DAPI staining) were performed on selected dilutions to assess cell viability and membrane integrity within APC-positive populations. Method validation under standard BG-11 conditions was consistent with OECD Guideline 201 (2011) [3], yielding reproducible growth rates and a linear APC–cell concentration relationship without fluorescence saturation. Exposure to reference toxicants confirmed the sensitivity of cytometric endpoints: trimethoprim induced concentration-dependent reductions in growth, filament size, metabolic activity, and membrane integrity, with comparable trends observed for potassium bichromate.

Growth inhibition (specific growth rate, SGR) reflected both nutrient stress and contaminant toxicity. SGR profiles showed two pronounced peaks under contaminated elutriates, consistent with responses observed in other bioassays. Strong concordance was found at all sites in the highly contaminated Bayonne estuary across seasons, and at discharge/downstream sites in Guriezo during summer. Conversely, upstream sites in Guriezo and the pristine Plentzia reference site displayed uniform SGR patterns across dilutions. Cytometry confirmed that APC fluorescence reliably discriminated cyanobacterial cells from pigment-bearing particulate matter, unlike chlorophyll or phycoerythrin. Decreased mean Calcein fluorescence in contaminated Bayonne sites suggested reduced metabolic activity, while DAPI-positive proportions increased with dilution, mirroring SGR trends. The coefficient of variation of DAPI fluorescence emerged as a sensitive indicator of general toxicity, particularly at Bayonne and downstream of Galindo.

In conclusion, *A. cylindrica* demonstrated strong potential as a bioindicator for assessing STP-derived impacts on estuarine sediments. Cyanobacteria-based growth and cytometric endpoints effectively captured toxicity patterns consistent with established models. While responses clearly detected treated sewage impacts in moderately contaminated systems, some endpoints were less discriminating under highly polluted conditions, underscoring both the applicability and current limitations of cyanobacterial bioassays for complex sediment matrices.

[1] Poniedziałek, B., Falfushynska, H. I., & Rzymski, P. (2017). Flow Cytometry as a Valuable Tool to Study Cyanobacteria: A Mini-Review. Limnological Review 2017, Vol. 17, Pages 89-95, 17(2), 89–95. https://doi.org/10.1515/LIMRE-2017-0009

[2] ASTM. (2014). E1391-03 Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing and for Selection of Samplers Used to Collect Benthic Invertebrates. ASTM.

[3] OECD. (2011). Freshwater Alga and Cyanobacteria, Growth Inhibition Test. OECD Guidelines for the Testing of Chemicals, OECD Guidelines for the Testing of Chemicals, Section 2: Effects on Biotic Systems, 2.

Seasonal dynamics and species shift of Ostreopsis on the French Basque coast (2020–2025)

Elvire Antajan (1), Florian Ganthy (1), Sarah Itoiz (2), Agnès Pétrau (2), Myriam Perrière-Rumèbe (1), Claire Méteigner (1), Marie-Noëlle de Casamajor (1), Florence Sanchez (3), Muriel Lissardy (4), Aurélie Bocquet-Escourrou (5)

(1) IFREMER, (2) Rivages Pro Tech SUEZ, (3) Ifremer, (4) IFEMER, (5) GIS Littoral Basque / CAPB

Oral
Harmful algal bloom, Ostreopsis, Quantitative PCR,

During summer blooms of unidentified *Ostreopsis* species on the French Basque coast (Atlantic) in 2020 and 2021, numerous people experienced irritation and respiratory disorders, with the number of analysed cases reaching 674 in 2021. Investigations conducted at that time revealed the presence of both *Ostreopsis* sp. 9 (≡ *O.* cf. *siamensis*) and *O.* cf. *ovata*, for which the French Basque coast represents a new northern distribution limit. Furthermore, the detection of ovatoxins, characteristic of *O.* cf. *ovata*, in both environmental samples and cultured strains confirmed the toxic nature of these blooms. Following these events, a monitoring program was implemented along the French Basque coast in 2022 to investigate the seasonal dynamics of *Ostreopsis* in relation to environmental conditions, and to develop and test a molecular tool based on qPCR for tracking the relative abundance of the two species. This presentation will highlight the results of four years of monitoring (2022–2025), including recent findings that indicate a shift in species composition, with *O.* cf. *ovata* becoming dominant during the most recent summer. These results provide a critical basis for the development of decision-support tools aimed at anticipating *Ostreopsis* blooms and mitigating their impacts on coastal biodiversity and public health. They also contribute to the proposal of a standardized monitoring protocol for managers responsible for bathing water quality.

Rapid advancement of biofouling introduction likelihood in ports under current global change: a case study from the Bay of Biscay

Deva Menéndez-Teleña (1), Veronica Soto-López (1), Eva García-Vazquez (1), Marlene Bartolomé (1)

(1) University of Oviedo

Oral

Ports, biofouling, invasive alien species, maritime traffic, decision support.

Maritime transport is a major global pathway for the unintentional spread of invasive alien species (IAS), with hull biofouling representing one of the most relevant vectors for port environments. Under current global change, increasing maritime traffic and connectivity are expected to accelerate the introduction of IAS through ports.

This study presents an operational screening framework to characterize biofouling introduction likelihood at the port level using routinely collected maritime traffic data. The approach integrates vessel size, duration of port stay, and geographic origin to derive a relative indicator of biofouling introduction likelihood, designed to support prioritization rather than high-resolution prediction.

The framework is applied to an 18-year dataset (2004–2021) from the Port of Gijón (Bay of Biscay), allowing the identification of high-likelihood terminals, vessel types, and source regions. Results indicate that a single bulk-cargo terminal concentrates approximately 70% of the cumulative introduction likelihood, largely associated with large vessels and prolonged port residence times. A limited number of source countries account for the majority of the estimated likelihood, highlighting specific pathways for targeted management attention.

To contextualize potential biological implications, standardized invasive species databases were used to identify species potentially associated with high-likelihood source regions. Twenty-three non-indigenous species were identified, of which 30.5% have already been reported in the port or adjacent areas, providing retrospective consistency with observed patterns.

By relying exclusively on data routinely collected by port authorities, the proposed framework offers a pragmatic and transferable decision-support tool to support early screening and prioritization under scenarios of increasing introduction pressure, contributing to pathway-focused prevention of biofouling-mediated IAS introductions in port systems.

Predicting culturable Escherichia coli and enterococci concentrations from reverse transcription quantitative PCR and hydro-meteorological data for bathing water management

Maialen Sagarduy (1)

(1) SUEZ - Rivages Pro Tech

Oral

Bathing water management; Fecal indicator bacteria; Reverse transcription quantitative PCR; Viable but non- culturable cells; Water quality modelling

Rapid decision-making for bathing-water management requires analytical methods faster than conventional culture-based assays, which typically require 18–72 h to deliver results. Reverse transcription quantitative PCR (RT-qPCR) provides same-day detection of Escherichia coli and Enterococcus spp., but it quantifies both culturable and viable but non-culturable (VBNC) cells, making its outputs not directly comparable to regulatory thresholds based on culture methods. To reconcile molecular and culture-based assessments, this study evaluates whether integrating RT-qPCR data with hydro-meteorological predictors and machine-learning models can yield culture-equivalent estimates suitable for operational use.

Between 2015 and 2024, monitoring data collected at 50 sites along the South-West Atlantic coast of France combined culture-based counts, RT-qPCR cycle threshold (Ct) values, and environmental variables including turbidity, salinity, solar irradiance, rainfall, wind, and wave conditions. Several tree-based ensemble regression algorithms were compared using five-fold cross-validation, and XGBoost regression consistently achieved the best performance across all modelling configurations. On independent test datasets, predictive accuracy was high, with unbounded RMSE values ranging from 0.34 to 0.41 $\log_{10}$ units. When focusing on concentration ranges relevant for bathing-water management, RMSE decreased to 0.25 $\log_{10}$ units for E. coli and 0.19 $\log_{10}$ units for Enterococcus spp. in seawater.

Model-based predictions substantially improved agreement with culture-based regulatory classifications compared to raw RT-qPCR outputs, particularly by reducing false-positive classifications at low concentrations. Feature importance analysis using SHAP showed that Ct values were the dominant predictors, while environmental variables such as solar irradiance, turbidity, salinity, and rainfall modulated bacterial capturability in biologically consistent ways.

The modelling framework was independently replicated on a second coastal study site in the South-East of France using locally trained models and the same methodology, yielding comparable predictive behavior despite reduced data availability. Overall, coupling RT-qPCR measurements with interpretable machine-learning models provides a robust and transferable approach for translating molecular signals into culture-equivalent concentrations, enabling faster and more reliable bathing-water quality assessments to support timely public health decision-making.

Long-term (2008-2022) variability in growth, condition, bioaccumulation and health status in mussels from the Basque Coast

Miren Carnicero (1), Jon Saenz (1), Nestor Etxebarria (1), Jose Antonio Carrero (2), Belen Gonzalez (1), Javier Aguirre-Rubi (1), Ander Urrutia (1), Ionan Marigomez (1)

(1) Research Centre for Experimental Marine Biology and Biotechnology "Plentziako itsas Estazioa", University of the Basque Country (PiE-EHU), Plentzia, Basque Country, Spain, (2) IBEA Research Group, Department of Analytical Chemistry, Faculty of Science and Technology, University of the Basque Country (EHU), Leioa, Basque Country, Spain

Oral

Mussel Watch biomonitoring was carried out for over two decades (2008–2022) along the Basque Coast. *Mytilus galloprovincialis* collected across diverse locations (Arrigunaga, Arriluze, Plentzia, Mundaka, Hondarribia and Pasaia) were analyzed to assess long-term variability in growth, condition, bioaccumulation, and health status. Growth and condition, tissue concentrations of legacy contaminants, and general histopathology (parasites, inflammation...) were recorded and examined in parallel with meteorological data to explore potential environmental drivers. Preliminary results reveal spatial and temporal variability across all parameters. Growth and condition indices show consistent patterns that are distinct for locations influenced by ports (Arriluze, Pasaia) compared to less impacted locations. Metal bioaccumulation follows coherent long-term trends across locations for some metals (e.g., Cu, Ag, Hg), whereas for others (e.g., Cr) it shows sporadic peaks at specific sites, suggesting localized inputs. Bioaccumulation and histopathology are aligned with growth and condition, with more relevant inflammatory responses and higher contaminant tissue burdens observed in ports than in other locations. Plentzia displays elevated parasite prevalence, possibly linked to local seasonal changes in anthropogenic pressure. Overall, the integration of biological and chemical indicators highlights the influence of both long-term and site-specific stressors on mussel populations. Long-term, multi-parameter monitoring programmes are essential for identifying drivers influencing ecosystem health and for supporting coastal management strategies.

Acknowledgements: Co-funded by BLUEADAPT (HORIZON-HLTH-2021-ENVHLTH-02 and UKRI/HM Gov), HOBE project (TED2021-132109B-C21, MCIN/AEI/10.13039 /501100011033 and EU NextGeneration EU/PRTR), and B4 (COLAB22/08 U Basque Country) research projects and Basque Gov Consolidated Research Group CBET+OH (IT-1743-22). We are indebted to Irune Valenciano, Xabier Lekube and PiE-EHU students for their support in sample processing.

Mapping Pressures on Coastal Fish Nurseries in the Bay of Biscay

Lamé Alicia (1), Fabri-Ruiz Salomé (1), Delaunay Damien (1), Mauffret Aourell (2), Brun Mélanie (3), Régimbart Amélie (1), Brind'Amour Anik (1)

(1) DECOD (Ecosystem dynamics and sustainability: from source to sea), L'Institut Agro, Ifremer, Inrae, Nantes, France, (2) Ifremer, Chemical Contamination of Marine Ecosystems Unit (CCME) unit, Nantes, France, (3) Ifremer, Service Valorisation de l'Information pour la Gestion Intégrée et la Surveillance (VIGIES), Nantes, France

Oral

Cumulative anthropogenic pressures, nurseries, fishing activity and contamination

Estuarine and coastal ecosystems provide essential ecological functions, notably serving as nursery habitats for the early life stages of many marine species. However, these environments face multiple anthropogenic pressures whose impacts on marine communities require identification, quantification, and spatial characterization.

This study examines pressure sources likely to affect juvenile fish in coastal and estuarine nurseries of the Bay of Biscay. Selected pressures include seabed disturbance (fishing, dredging, disposal, and marine aggregate extraction), non-indigenous species, and chemical contamination. Data were categorized by pressure type and analysed both individually and cumulatively within a common spatial framework.

Specific spatial treatments were applied to integrate the different data sources. Fishing activity was derived from logbook and Vessel Monitoring System (VMS) data, aggregated temporally at the monthly scale and spatially across various resolutions (25–2000 km²). Effort indicators were calculated separately for passive gears (number of trips) and active gears (fishing hours), then aggregated by major nursery sectors along the French coastline. Contamination pressure index were spatialized using two complementary approaches: buffer-based methods to represent activity footprints, and kernel density estimation combined with generalized additive models (GAMs) to generate continuous pressure gradients accounting for spatial heterogeneity.

Following spatial standardization, pressures index were weighted using an activity–pressure matrix reflecting the relative contribution of each human activity. The resulting cumulative pressure indicator was generated for the main coastal and estuarine nursery areas along the French coastline. This indicator supports assessment of biodiversity metrics related to the environmental status of coastal fish communities, facilitating implementation of the Marine Strategy Framework Directive (MSFD) in coherence with the Water Framework Directive (WFD), and promoting a land–sea continuum in ecological status interpretation. Ultimately, the indicator is designed to identify highly impacted areas and inform coastal spatial planning.

Assessing the ecological footprint of bottom-trawling on benthic habitats of the Basque continental shelf

Natalia Montero (1), Joxe Mikel Garmendia (1), Udane Martínez (1), Sarai Pouso (1), María Mateo (1), Germán Rodríguez (1), Iñigo Muxika (1), Ibon Galparsoro (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

Sedimentary habitats, seabed impact, infauna, epifauna, management strategies

Benthic habitats are fundamental to marine ecosystem productivity, providing Essential Fish Habitats (EFH) for spawning, nursery and foraging. However, the integrity of these ecosystems is increasingly threatened by bottom-contact fishing, which degrades biogenic and geological structures, disrupting ecological processes and the associated ecosystem services. The severity of this impact is determined by multiple factors, including gear type, seabed characteristics, the sensitivity of the species present and the frequency and intensity of fishing activity.

This study evaluates the impact of trawling on the Basque continental shelf, drawing on data from seven sampling campaigns conducted between 2022 and 2025. Using an integrative approach, 75 beam trawls and 69 sediment grab samples were analysed to characterize megabenthic epifauna and macrobenthic infauna across varying depths, sediment types and fishing intensities (derived from Vessel Monitoring System (VMS) and logbook data1). Statistical analyses, including taxonomic similarity (Γ+) and specialised indices such as the Benthos Sensitivity Index to Trawling Operations (BESITO)2 and the Sentinels of Seabed (SoS)3 indicator, revealed distinct ecological responses. While macrobenthic infauna composition is primarily governed by environmental variables (depth and sediment granulometry), megabenthic communities exhibit a clear shift in structure along the fishing-pressure gradient. Areas subjected to high trawling intensity showed a marked decline in sensitive, long-lived, and large taxa, which were replaced by opportunistic and tolerant species. These findings demonstrate that while environmental factors dictate the baseline community, fishing pressure is the primary driver of structural degradation in sensitive epifauna. This research provides a robust empirical framework for monitoring seafloor integrity and developing management strategies to safeguard vulnerable marine ecosystems in the Bay of Biscay.

[1] General Secretariat for Fisheries. SGP-AZTI database. [Data set]
[2] González-Irusta et al., 2018. https://doi.org/10.1093/icesjms/fsy030.
[3] Serrano et al., 2022. https://doi.org/10.1016/j.ecolind.2022.108979.

Ecosystem-Based Maritime Spatial Planning in the Bay of Biscay: What Spain and France Got Right and What's Missing

Ibon Galparsoro (1), Natalia Montero (1), Gotzon Mandiola (1), Iratxe Menchaca (1), Olivier Laroussinie (2), Neil Alloncle (2)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) CEREMA

Oral

Marine Spatial Planning, Ecosystem-based Approach, Management, Human Activities, Conservation

Maritime Spatial Planning (MSP) Directive (Directive 2014/89/EU) establishes a framework for MSP across EU Member States with marine waters, aiming to promote the sustainable growth of maritime economies, the development of marine areas, and the sustainable use of marine resources. Despite the Directive´s explicit requirement that the plans apply an ecosystem-based approach, the practical guidance necessary to translate this obligation into coherent planning processes and operational measures remains insufficient, resulting in persistent gaps between legal intent and implementation practice.

France adopted the maritime spatial plans in April/May 2022, while Spain adopted its plan in February 2023. Both countries are now in the plans´ evaluation phase, and thus it becomes essential to assess the extent to which ecosystem-based approach principles were incorporated into the plans. To this end, we applied the assessment framework developed by Galparsoro *et al*. (2025), publicly available as a web app tool (https://aztidata.es/EB-MSP/), to systematically evaluate the entire planning process. The assessment framework is composed by 130 actions or task that should be addressed during the planning process. The assessment was performed using a semi-quantitative scoring system that considers the implementation degree, relevance, respondent confidence and the underlying knowledge base, which provided a transparent benchmark for the standardised evaluation of both plans.

Our findings indicate that although both countries have developed robust legal and governance frameworks, substantial shortcomings persist in the integration of climate change considerations, ecosystem functioning, and cumulative human pressures. The assessment further reveals a limited incorporation of socio-economic objectives and insufficient cross-border stakeholder engagement. By highlighting these priority gaps, the study provides clear entry points for MSP practitioners to move beyond formal compliance towards maritime spatial plans that are both ecologically robust and socially equitable.

[1] Galparsoro, I., N. Montero, G. Mandiola, I. Menchaca, Á. Borja, W. Flannery, S. Katsanevakis, S. Fraschetti, E. Fabbrizzi, M. Elliott, M. Bas, S. Barnard, G. Piet, S. Giakoumi, M. Kruse, B. McAteer, R. M. Runya, O. Lukyanova, T. Morato, A. Van Gerven, S. Degraer, S. Neuenfeldt, V. Stelzenmüller, 2025. Assessment tool addresses implementation challenges of ecosystem-based management principles in marine spatial planning processes. Communications Earth & Environment, 6: 55 https://doi.org/10.1038/s43247-024-01975-7

A toolbox to assess the cumulative pressures and environmental status of the seas

Angel Borja (1), Iratxe Menchaca (1), Sarai Pouso (1), María C. Uyarra (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

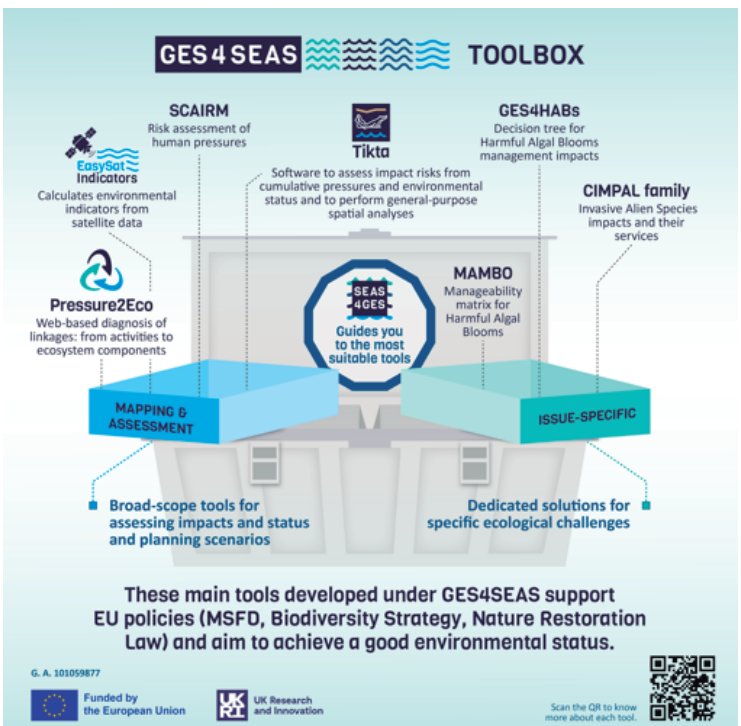
Tikta, SCAIRM, SEAS4GES, Pressure2Eco, EasySat Indicators, GES4HABs, MAMBO, CIMPAL

Introduction

In the European project GES4SEAS, some tools were developed, allowing policy implementing authorities to assess and predict impacts of multiple human pressures at sea. In total, eight tools are grouped into a toolbox (Figure 1) (https://www.ges4seas.eu/toolbox/). It provides practical, science-based instruments for assessing cumulative impacts, monitoring ecological components, and exploring management scenarios. Its goal is to help practitioners and decision-makers identify the most suitable approaches for their specific context, whether they are conducting Marine Strategy Framework Directive (MSFD) assessments, designing Marine Spatial Planning (MSP) measures, etc. By bringing these tools together, GES4SEAS ensures that managers, scientists, and policymakers can select methods that best match their data availability, policy needs, and ecosystem context.

Methods

The GES4SEAS toolbox includes (Figure 1): (i) Decision-support systems for Ecosystem-Based Management (EBM), such as SEAS4GES; (ii) Tools for understanding linkage frameworks between activities-pressures-ecosystem components-ecosystem services, like SCAIRM, Pressure2Eco (iii) For holistic assessment, like Tikta, that includes three different modules for cumulative effects, environmental status and ecosystem services assessments; and (iv) Tools for specific ecological challenges, such as harmful algal blooms (HABs) (GES4HABs, MAMBO), invasive alien species (IAS) (CIMPAL family tools) or EasySat Indicators. Each tool is designed to be policy-relevant, with clear links to the needs for implementing different directives or policies, such as the MSFD, EU Biodiversity Strategy 2030, and the Nature Restoration Regulation.



Results and Discussion

Here, we include a description of the tools.

SEAS4GES (Selection of Ecosystem-based Approaches for Good Environmental Status) (https://zenodo.org/records/14765920) is a decision-support system helping users identify the most appropriate EBM approach for their specific needs, skills and data context. It builds on a structured library of 35 EBM tools. After responding to a series of 14 interactive and structured questions, it provides a ranked list of EBM tools matched to the user's requirements and resources. Outputs include a detailed suitability matrix and an ordered list, showing which tools are most appropriate given the user's goals, data availability, and expertise. Its fundamentals can be consulted in Franco et al. (2025), Papadopoulou et al. (2025) and Barnard et al. (2026).

Pressure2Eco is a pathway explorer, a web-based application that explores linkages between human activities, pressures, and ecosystem components. It provides visual diagnostics (chord diagrams, Sankey plots, hierarchical tables), spatial maps, and gap analyses, highlighting where key linkages or data are missing, through clear metrics of coverage and uncertainty. It generates recommendations based on data gaps, offering practical guidance for preparing spatial and temporal datasets. It can be applied with no scientific expertise and serves marine spatial planners, environmental managers, and researchers conducting Cumulative Effects Assessments (CEAs), Environmental Status Assessments, Environmental Impact Assessments, or MSP. It supports MSFD implementation (Article 8 linkages) and complements frameworks such as HELCOM, ODEMM, and SCAIRM for EBM, by harmonising vocabulary and aligning key concepts.

SCAIRM (Spatial Cumulative Assessment of Impact Risk for Management) is a risk-based framework for evaluating the cumulative impacts of human activities on marine ecosystems and ecosystem services. It integrates both qualitative and quantitative data. It identifies the main anthropogenic threats, evaluates alternative planning scenarios, and evaluates ecosystem-based assessment management plans. It can be used by scientists, with outputs useful for decision-makers and planners engaged in MSP, Strategic Environmental Assessment, and EBM. Its outputs directly support the MSFD, the MSP Directive, and the Nature Restoration Regulation. The fundamentals can be consulted in Piet et al. (2023, 2024).

Tikta is a software to assess impact risks from cumulative pressures onto ecosystem components, environmental status, ecosystem services and custom spatial and non-spatial analyses. It includes data/metadata management, a spatial analysis framework and visualization of results (maps and tables), all within a selected environment. The software already includes implementations of these assessment methods: (1) CEA; (2) NEAT: Nested Environmental status Assessment Tool, and (3) NEAT-ES: NEAT for Ecosystem Services. The fundamentals are described in Berg et al. (2025).

GES4HABs (Harmful Algal Blooms Decision Tree) is a decision-support tool designed to guide policy makers and managers in addressing HABs within MSFD assessments. It builds on existing monitoring data and HABs' event records in Marine Reporting Units. It generates a decision tree that identifies management pathways based on the state and causes of HABs, helping to prioritise resource allocation and mitigation strategies. The primary users are scientists and technicians, and the outputs can be useful for policy makers, environmental managers, and MSFD stakeholders. It supports the inclusion of HABs in GES assessments, helping to meet EU obligations for descriptor-based reporting and management. The fundamentals can be consulted in Sagarmínaga et al. (2023).

MAMBO (Environmental Matrix for the Management of Blooms) proposes to address the "manageability" of HABs and their interaction with human and environmental pressures through a two-axis framework: trophic status of waters and anthropogenic influence. It classifies HAB events into categories that determine whether they are likely manageable through intervention or primarily driven by natural conditions. It provides guidance on whether to apply Article 8 assessments, consider Article 14 exceptions, or carry out further monitoring. The fundamentals can be consulted in Sagarmínaga et al. (2023).

CIMPAL (Cumulative Impacts of Invasive Alien Species) is a family of tools that quantifies the cumulative impacts of IAS, jellyfish blooms, and HABs on marine habitats and ecosystem services. Tools in this family include CIMPAL (negative IAS impacts), CIMPAL+ (positive impacts of IAS), CIMPAL-JH (including of IAS, jellyfish and HABs), and CIMPAL-ES+ (positive IAS impacts on ecosystem services). It generates high-resolution maps of cumulative impact scores, rankings of species by their ecological or ecosystem service impacts, and recommendations for priority sites and species requiring management. CIMPAL is designed to be used by scientists and technicians, and the results useful for policy makers, competent authorities, and the RSCs. It supports MSFD Descriptor 2 on IAS, the EU Biodiversity Strategy 2030, and reporting under the Kunming–Montreal GBF Target 6. The fundamentals can be consulted in Chiappi et al. (2025).

EasySat Indicators (https://aztigps.shinyapps.io/easysatindicators/) is a tool that helps non-expert users to work with satellite data stored in NetCDF format, following the CF standard. It simplifies the process of calculating marine environmental indicators and exporting results in user-friendly formats. It offers two types of calculations: (i) pixel-based statistics to generate marine indicator maps; and (ii) location-based statistics (e.g., marine monitoring stations, or areas). The available statistic metrics include mean, standard deviation, minima, maxima, count, median, 90th percentile and the Mann-Kendall trend's tau value. Results can be downloaded as GeoTIFF and CSV files for further analysis in Excel, or GIS. The outputs can be utilised directly or as inputs in other tools (i.e. Tikta), for the assessment of the status of marine waters, e.g. within the European WFD or the MSFD. The fundamentals can be consulted in Sagarminaga and Borja (2025).

As conclusion, this set of tools allows environmental managers and scientists, to (i) choose tools according to their needs and capacities, (ii) perform integrated and holistic assessments required by different policy frameworks (e.g., MSFD) in a harmonized manner, aligning terminology, processes, and outputs, (iii) address key ocean challenges, such as HAB, (iv) visualizing outputs through maps, and (v) identify data gaps for better interpretation of results. Outputs obtain will enable policy- and decision- makers to take inform-decisions and define effective measures for the sustainable management of human activities and marine ecosystems.

[1] Barnard, S., A. Franco, E. Amorim, N. Papadopoulou, C. J. Smith, M. Elliott, A. Borja. 2026. The Practical Application of Ecosystem-Based Management Tools to Marine Ecological Assessment: Optimizing Tool Selection for Specific Applications – The SEAS4GES Decision Support Tool. Pages 1-18 in B. D. Fath, editor. Encyclopedia of Ecology. Elsevier. DOI 10.1016/B978-0-443-21964-1.00049-5

[2] Berg, T., Andersen, J.H., Murray, C., Carstensen, J., Stock, A., 2025. GES4SEAS Deliverable 4.2. Framework and toolbox for assessment and analyses of CIA/CEA, GES status, Ecosystem Services, and uncertainty. 81 pp.

[3] Chiappi, M., Y. Stranga, C. Kalloniati, K. Tsirintanis, G. Tsirtsis, E. Azzurro, S. Katsanevakis, 2025. CIMPAL expanded: unraveling the cumulative impacts of invasive alien species, jellyfish blooms, and harmful algal blooms. Frontiers in Marine Science, 12: 10.3389/fmars.2025.1631423.

[4] Franco, A., M. Elliott, E. Amorim, S. Barnard, C. J. Smith, Á. Borja, R. Cormier, N. Papadopoulou, 2025. Assessment tools are needed to support marine ecosystem-based management, but how to get them used practically? Frontiers in Marine Science, Volume 12 - 2025: 10.3389/fmars.2025.1643943

[5] Papadopoulou, N., C. J. Smith, A. Franco, M. Elliott, A. Borja, J. H. Andersen, E. Amorim, J. P. Atkins, S. Barnard, T. Berg, S. N. R. Birchenough, D. Burdon, J. Claudet, R. Cormier, I. Galparsoro, A. Judd, S. Katsanevakis, S. Korpinen, L. Lazar, C. Loiseau, C. Lynam, I. Menchaca, C. O'Toole, D. Pedreschi, G. Piet, D. Reid, I. A. Salinas-Akhmadeeva, V. Stelzenmüller, J. E. Tamis, L. Uusitalo, M. C. Uyarra, 2025. 'Horses for courses' – an interrogation of tools for marine ecosystem-based management. Frontiers in Marine Science, 12: 10.3389/fmars.2025.1426971.

[6] Piet, G., A. Grundlehner, R. Jongbloed, J. Tamis, P. de Vries, 2023. SCAIRM: A spatial cumulative assessment of impact risk for management. Ecological Indicators, 157: 111157. DOI: https://doi.org/10.1016/j.ecolind.2023.111157

[7] Piet, G., Bentley, J., Jongbloed, R., Grundlehner A., Tamis, J., de Vries, P (2024): A cumulative impact assessment on the marine capacity to supply ecosystem services. Science of the Total Environment, 948: 1–15.

[8] Sagarminaga, Y., E. Garcés, J. Francé, R. Stern, M. Revilla, E. Magaletti, E. Bresnan, G. Tsirtsis, H. H. Jakobsen, N. Sampedro, A. Reñé, J. Camp, Á. Borja, J. G. Rodríguez, E. Spada, K. Pagou, R. De Angelis, A. Lanzén, L. Ferrer, P. Borrello, L. Boicenco, J. Kobos, A. Mazaris, S. Katsanevakis, 2023. New tools and recommendations for a better management of harmful algal blooms under the European Marine Strategy Framework Directive. Frontiers in Ocean Sustainability, 1: 10.3389/focsu.2023.1298800.

[9] Sagarminaga, Y., Borja, A., 2025. EasySat Indicators: empowering environmental managers to calculate indicators from satellite data stored in netcdf files. (1.0.0). Zenodo. https://doi.org/10.5281/zenodo.17472746

Mapping Cumulative Impact Risk and Testing Management Scenarios in the Bay of Biscay

Olga Lukyanova (1), Sarai Pouso (1), Gotzon Mandiola (1), Angel Borja (1), Ibon Galparsoro (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

marine spatial planning, ecosystem-based management, anthropogenic pressures, ecosystem sensitivity, scenario analysis

Marine ecosystems are increasingly exposed to multiple anthropogenic pressures, necessitating the assessment of their cumulative effects on biodiversity to inform management decisions on how and where human activities can be carried out. We developed a spatially explicit probabilistic model by integrating the linkage-based framework of cumulative effects assessments (tracing linkage chains between human activities, generated pressures, and ecosystem components' sensitivities) into a Bayesian Belief Network (BBN). BBN enabled combining quantitative data (e.g., activity intensity, species abundance, habitat presence) with qualitative information (e.g., expert-elicited assessment of the magnitude of pressure generation by a given activity, ecosystem components' sensitivities, interactions of pressures). We applied the model to estimate cumulative impact risk in the Bay of Biscay, a transboundary region shared by Spain and France, explicitly assessing the impact risk on both benthic and pelagic components of this ecologically complex area.

The assessment included a broad range of conservation-relevant ecosystem elements (species, habitats, and processes) and four dominant human activities in the region: fisheries, maritime transport, development of the offshore renewable energy, and conservation. We evaluated multiple future scenarios, including changes in fishing effort, expansion of offshore wind farms, and implementation of management measures such as no-take areas or gear restrictions within marine protected areas (MPAs). Potential fishing effort displacement was explicitly accounted for.

The analysis identified spatial patterns of low, moderate, and high impact risk, while quantifying associated uncertainty. Several high-risk areas overlapped with existing MPAs, highlighting the need for effective management implementation. Scenario analyses further demonstrated how management measures (including their unintended effects, such as fishing displacement) can influence ecological outcomes and sectoral trade-offs, providing decision support for ongoing spatial planning efforts in both Spain and France.

Lessons learnt about intertidal seagrass (Nanozostera noltei) restoration along the Basque coast (SE Bay of Biscay)

Joxe Mikel Garmendia (1), Ángel Borja (1), Guillem Chust (2), Javier Franco (1), Gotzon Mandiola (3), Natalia Montero (3), Mireia Valle (2)

(1) AZTI, Marine and Coastal Environmental Management, Pasaia, (2) AZTI, Global Change in Marine Ecosystems, Sukarrieta, (3) AZTI, Gestión Ambiental Marina y Costera, Pasaia

Oral

Restoration, Intertidal, Estuaries, Seagrasses, Nanozostera noltei

Seagrass meadows provide key ecosystem services, including carbon sequestration and biodiversity support. Consequently, interest in their conservation and restoration has increased. In the Basque Country, they occur naturally in only three of 12 potential estuaries and consist of a single species, Nanozostera noltei, which grows almost entirely in intertidal transitional waters and is listed as Endangered in the Basque Catalogue of Threatened Marine Fauna and Flora.

Since 2008, different conservation and restoration approaches have been explored, supported by reduced anthropogenic pressures and improved habitat quality. Initial restoration actions involved transplants in the Butroe and Urola estuaries. While Urola failed, the Butroe transplant has shown remarkable long-term success: the 4.8 m² transplanted between 2009 and 2012 expanded to 3035 m² in 2025, an increase of more than 630-fold. New patches also appeared 1000 m both upstream and downstream of the original transplant area, evidencing natural colonisation.

From 2012 onwards, seed sowing was tested in the Oria, Bidasoa and Urumea estuaries. Oria was the only successful case, where 125–175 seeds sown in 2015–2016 produced a 53.4 m² patch by 2020. However, this patch disappeared in 2023 due to competition with invasive Spartina spp. Nonetheless, new patches emerged 1000 m downstream in 2021 and expanded to 123.2 m² in 2025. Furthermore, additional plantations were carried out in Oria using naturally detached shoots deposited on the Cantabrian shoreline in 2025.

Our results demonstrate that, although post-restoration dynamics are strongly influenced by environmental conditions, hydrodynamics and biological interactions, the restoration of intertidal N. noltei through transplantation and seeding is feasible when baseline conditions are favourable. Seed-based restoration is more cost-effective and environmentally gentle than sod transplantation, while still enabling natural colonisation. Active restoration thus appears necessary in estuaries where the species was lost, and long-term monitoring remains essential to evaluate success, identify constraints and guide future actions.

Benefits and values from marine cultural ecosystem services: the contribution of recreational activities to mental health in the Basque coast

Sarai Pouso (1), Maite Erauskin-Extramiana (1), Claudia Escudero (2), Natalia Montero (1), Isaias Cruz Irujo (3), Angel Borja (1), María C. Uyarra (1), Aitziber Olano-Arbulu (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) University of Navarra, (3) Mako Pako - Basque Shark Diving

Oral

marine recreational activities, human well-being, cultural ecosystem services, therapeutic values

Marine and coastal ecosystems provide diverse opportunities for outdoor sports and recreation, which are increasingly recognized as contributors to human well-being, through their positive effects on physical and mental health.

The relationship between contact with nature on human health and well-being has been widely studied mainly from two research domains. Environmental psychology has produced robust evidence of the positive health effects of exposure to nature; yet, these studies emphasize health outcomes, while paying little attention to the role of environmental characteristics (e.g. environment types, conditions, and ecological status). In contrast, studies within environmental sciences field, particularly those adopting the ecosystem services framework, investigate how natural capital contributes to human well-being through active and passive human–nature interactions (i.e. cultural ecosystem services).

Such studies primarily investigate how environmental characteristics, functions and processes provide different types of ecosystem services and human benefits, mainly focusing on the benefits from an economic perspective. Far fewer examples address the non-monetary benefits, and even fewer explore the therapeutic values of nature exposure. Furthermore, research in both fields has predominantly focused on terrestrial “green” spaces, with considerably less attention given to marine and coastal “blue” environments.

The objectives of this study are (i) to explore how different marine recreational activities (MRAs) contribute to mental health, and (ii) to assess whether the type of MRA influences the type and magnitude of these health outcomes. The study was conducted along the Basque coast (southeastern Bay of Biscay), an area characterized by diverse coastal ecosystems and recreational opportunities that attract both residents and tourists.

A survey was designed to collect information on the types and spatial distribution of MRAs, participant characteristics, the feelings and emotions associated with the MRA practice, and perceived psychological restoration. Two psychometric scales were adapted: the Positive and Negative Affect Schedule (PANAS) scale and the Restoration Outcome Scale (ROS). The survey was completed in by more than 500 individuals who regularly engage in MRAs (summer 2023), or who participated in marine wildlife observation activities, including cetacean-watching tours (summer 2024) and shark-diving tours (summer 2025).

More than 30 distinct MRAs are practiced along the Basque coast, each associated with specific environmental, oceanographic and meteorological conditions. Some activities are practiced from the shore (e.g., seaside walking, shore-based fishing), others depend on waves (e.g., surfing, bodyboarding), or wind (e.g., windsurfing), while some require sheltered waters (e.g., bathing, rowing). Additional activities rely on the presence of marine wildlife (e.g., cetacean watching, shark diving) or visually appealing seascapes (e.g., SCUBA diving, sailing). All MRAs were associated with increases in positive affect, whereas negative emotional responses were infrequent. ROS results indicated that MRAs positively contribute to increasing relaxation and calmness, attention restoration and facilitate mental clarity. The magnitude and nature of these effects varied depending on the specific activity and the user’s profile.

This study suggests that the ocean, through MRAs, can support different aspects of human well-being. It also highlights the need to consider individual MRAs when assessing health benefits and underscores the relevance of generating activity-specific evidence to inform the effective management of coastal areas that sustain these activities.

Microbiological monitoring of bivalve mollusc harvesting areasin the Oka estuary (Northern Spain) following wastewater system improvements

J.German Rodriguez (1), Joana Larreta (1), Oihana Solaun (1), Izaskun Zorita (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Introduction

The Oka estuary (Bay of Biscay, Northern Spain) has undergone a long-term wastewater sanitation program aimed at improving the water quality, including the reduction of microbial contamination in its transitional waters. The sanitation of the Oka estuary advanced significantly after the 2004 approval of the Urdaibai General Sanitation Plan, which addressed the outdated condition of the Gernika treatment plant and initiated a comprehensive wastewater collection and treatment strategy. Between 2007 and 2014, major works were carried out to build the main collector and connect scattered rural households and both river margins to the system. A new high-capacity wastewater treatment plant in Lamiaran (Bermeo) began operating in 2015, progressively incorporating discharges from Bermeo, Mundaka, Sukarrieta, and Busturia, and by 2021 almost the entire watershed was connected to the treatment network. Further progress continued in 2023 with the construction of an additional collector in Ajangiz to intercept remaining untreated discharges. This study evaluates whether these interventions led to measurable improvements in shellfish microbiological quality by analysing Escherichia coli levels in Magallana gigas oysters collected before and after the sanitation upgrades using ISO-compliant methods. Results show a clear decline in E. coli concentrations in oysters, closely paralleling reductions observed in estuarine waters, confirming the effectiveness of targeted wastewater infrastructure improvements in enhancing shellfish safety and overall estuarine health.

Assessing the Influence of Global Change Drivers on the Degradation Behavior of Common Plastics in Coastal and Marine Environments

Esteban Pascual-Parra (1), Ainhoa Hernández-García (2), Javier Pérez-Barberia (3), Andrés Arias (2), José M. Rico (4)

(1) Oceanographic Centre of Gijon, Spanish Institute of Oceanography, Gijon, Asturias, Spain / Department of Organisms and Systems Biology, University of Oviedo, Oviedo, Asturias, Spain, (2) Department of Organisms and Systems Biology, University of Oviedo, Oviedo, Asturias, Spain, (3) Mixed Institute for Research in Biodiversity (CSIC, University of Oviedo, Principality of Asturias), Mieres, Asturias, Spain., (4) Department of Organisms and Systems Biology, University of Oviedo, Oviedo, Asturias, Spain / Institute of Natural Resources and Territorial Planning (INDUROT), Mieres, Spain / Head of the Climate Change Chair, University of Oviedo, Asturias, Spain

Poster

Plastic degradation; marine pollution; microplastics formation; UV weathering; intertidal exposure

Plastic debris entering marine environments undergoes progressive weathering that promotes fragmentation into microplastics, yet the relative influence of polymer type and environmental exposure pathways on degradation dynamics remains insufficiently quantified. This study experimentally evaluated the degradation of six common consumer plastics − Polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), polypropylene (PP), and polystyrene (PS) −, under three environmentally relevant scenarios: controlled UV-A irradiation in seawater, buoyant exposure simulating floating ocean debris, and intertidal coastal deployment subject to tidal cycles. Over periods of three to six months, physical and optical deterioration was assessed using a standardized six-criterion index encompassing discoloration, gloss loss, surface erosion, microcracking, particle detachment, and porosity, supported by colorimetry, image analysis, and scanning electron microscopy. Multivariate Bayesian ordinal regression was applied to jointly model degradation responses across treatments.

Results reveal marked polymer-specific and environment-dependent degradation patterns, with intertidal conditions producing the most severe surface damage due to combined photochemical, mechanical, and biological stressors. Extensive microcracking, porosity development, and particle release indicate active fragmentation pathways likely to generate secondary microplastics. Floating conditions produced moderate degradation, while laboratory UV exposure alone induced measurable but comparatively limited deterioration. These findings highlight that real-world coastal processes substantially accelerate plastic breakdown beyond photodegradation alone, underscoring the importance of multi-stress environmental simulations when predicting microplastic generation in marine systems.

Microplastics in Porifera: A Systematic Review

Javier Costas-Pérez (1), Javier Cristobo (2), Pilar Ríos (2), Esteban Pascual-Parra (3)

(1) Centro de Investigación Mariña (CIM–UVigo), Universidade de Vigo, Facultade de Ciencias do Mar, Campus Lagoas-Marcosende, 36310 Vigo, Spain / Ecoafrik Platform, Rúa das Pontes 9, Nigrán (Pontevedra), Spain / Oceanographic Centre of Gijon, Spanish Institute of Oceanography, Gijon, Asturias, Spain, (2) Oceanographic Centre of Gijon, Spanish Institute of Oceanography, Gijon, Asturias, Spain, (3) Oceanographic Centre of Gijon, Spanish Institute of Oceanography, Gijon, Asturias, Spain / Department of Organisms and Systems Biology, University of Oviedo, Oviedo, Asturias, Spain

Poster

Bibliographic research, Biomonitorization, MPs, Pollution, Sea sponges

Introduction

This systematic review provides a comprehensive revise of almost all published works addressing the occurrence and effects of microplastics in species of the phylum Porifera. To this end, all articles, datasets, theses, and conference proceedings available in Scopus, Google Scholar, and Bielefeld Academic Search Engine (BASE) up to end of December 2025 were considered. Only those studies that were not available for consultation were excluded. Due to the low volume of published works, data extraction and synthesis were conducted manually. A total of 35 works was considered, 29 of which were peer-reviewed articles. The selected works were analysed with regard to experimental approaches, microplastic occurrence and characteristics in sponges, associated physiological and biological effects, and the proposed use of sponges for microplastic monitoring. Despite the ecosystemic relevance of the group, the number of published works is very low, highlighting the need to establish a larger bibliographic base in order to clarify the physiological effect of MPs and their presence in sponges. Overall, the available evidence reveals substantial methodological heterogeneity across studies, highlighting the urgent need for harmonised and validated protocols to ensure comparability and reproducibility, improve assessments of sponge health under microplastic exposure, and robustly evaluate their suitability as bioindicators of microplastic pollution in aquatic environments.

Linking Marine Ecosystems to Human Well-being: Cetacean Watching in the Basque coast

Aitziber Olano Arbulu (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

wildlife watching, CICES cascade, cultural ecosystem service, sociocultural value, mental restoration

Marine ecosystem services provide diverse social and economic benefits; however, their sustained supply is increasingly threatened by anthropogenic pressures. To determine environmental integrity and promote human well-being, it is necessary to investigate the functioning of marine ecosystem services. Marine cultural ecosystem benefits, such as wildlife tourism, are increasingly valued for their contributions to human well-being and local economies. This study applies the Common International Classification of Ecosystem Services (CICES) cascade framework to assess the "presence of cetaceans" cultural ecosystem service along the Basque coast (Bay of Biscay). The links in the cascade between the different steps were analysed focusing on Delphinus delphis, the most common cetacean species in the area, and cetacean populations in general. Indicators for each step of the cascade were chosen to link the environmental and socio-economic systems. Sociocultural valuation using validated psychometric scales, the Positive and Negative Affection Scale (PANAS) and Restoration Outcome Scale, showed that cetacean sightings enhanced participants' emotional well-being and restorative experiences, especially among women and those with strong nature connectedness. The study shows that meteorological and oceanographic variables (wind speed and wave height) strongly limit the recreational activity and consequently, the human benefits derived from it. These findings demonstrate the utility of the CICES cascade in capturing the complex flow from ecological conditions (biophysical factors, function and services supply) to human benefits and values. This approach highlights the importance of combining sociocultural valuations with more traditional ecological and economic valuations, to fully understand nature's contributions to people.

Environmental health monitoring (2011–2023) in the Nerbioi estuary (SE Bay of Biscay): Evidence from contaminants and biological effects in Sole

Izaskun Zorita (1), Tifanie Briaudeau (2), Gisele Mejuto (2), Maren Ortiz-Zarragoitia (2), Urtzi Izagirre (2), Maria Jesus Belzunce Segarra (3), Joana Larreta (4), Iratxe Menchaca (4), Marta Revilla (3), José Germán Rodríguez (3), Ainhize Uriarte (4)

(1) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia, Portualdea z/g, Pasaia 20110, Spain., (2) CBET Research Group, Dept. Zoology and Animal Cell Biology, Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PiE-EHU, University of the Basque Country EHU, Basque Country, Spain, (3) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia, Portualdea z/g, Pasaia 20110, Spain, (4) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Txatxarramendi irla z/g, Sukarrieta 48395, Spain

Poster

Flatfish, Biomarker, Sediment, Pollution, Estuary

The Nerbioi estuary (SE Bay of Biscay) is a recovering ecosystem whose sediments remain contaminated and may still pose risks to the biota. This study assessed long-term trends in the environmental health of the Nerbioi estuary based on sediment chemistry and contaminant-related biological effects in sole (*Solea* spp.). Monitoring campaigns were conducted every autumn from 2011 to 2023. Contaminant concentrations were analysed in sediments, while liver and gonads of fish were examined for histopathology. Blood samples were used to determine micronuclei frequency as a biomarker of genotoxicity, and plasma was analysed for vitellogenin and steroid hormones (estradiol and 11-ketotestosterone) as indicative of endocrine disruption. Sole abundance was also evaluated to detect potential population-level effects.

Overall, sediment contaminant levels fluctuated throughout the study period without a clear trend. Biological effects showed no consistent temporal patterns, although genotoxicity decreased in recent years. Histopathological alterations varied over time, likely influenced by a mix of factors such as sediment resuspension caused by periodic dredgings, chronic exposure to emerging contaminants still present in domestic and industrial effluents, and diffuse discharges. Most histopathological findings indicated mild severity, although one case of a liver nodule (2016) and one intersex male (2023) were detected, accompanied by signs of a slight vitellogenin induction. However, these effects were not reflected at the population level, as sole abundance showed no temporal trend, suggesting an undisturbed health status.

This long-term dataset enabled the assessment of the environmental health of the Nerbioi estuary over 13 years, confirming the ongoing ecosystem recovery. Although not alarming at low prevalence, the detection of recent occasional carcinogenic and endocrine-related alterations highlights the importance of sustained monitoring programmes to continue surveying the estuary’s environmental health. This work was funded by Agencia Vasca del Agua (URA) and Consorcio de Aguas Bilbao Bizkaia (CABB).

Analyzing pH trends across the Basque coast using high frequency Submersible Autonomous Moored Instrument and long-term observations

Ernesto Villarino (1), Dorcas Akua-Essel (2), Leire Citores (1), Joana Larreta (1), Ander Lopez (3), Angel Borja (1), Susana Flecha (4), Manuel Gonzalez (1), Luis Cuesta (1), Uxue Urkia (1), Xabier Esteban (5), Dorleta Orue-Echevarria (5), Guillem Chust (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) University of Cape Coast, (3) Tecnalia, (4) CSIC, (5) NATURKLIMA

Poster

ocean acidification, pH, Basque coast, SAMI, ocean observation, monitoring

Increased CO2 concentrations in the atmosphere have triggered ocean acidification over the past decades in the global ocean. However, regional efforts of pH monitoring across the southern Bay of Biscay's Basque coast remain elusive, with only a few short-term studies limited to the ocean's surface. Within the Marine Observatory of Climate Change in the Basque Country, we examined long-term pH trends across depth and found significant pH decreases over time in all depth layers at rates of 0.022–0.041 units decade-1, presumably driven by the global increase of atmospheric CO2. In turn, the observed pH seasonality and vertical patterns appeared to be tied to the combined effects of environmental factors alongside the development of the thermocline, as well as to differences in the biological activity across the water column. These findings will be complemented by a recently deployed high-frequency SAMI-pH autonomous sensor, operating since 2021 in a fixed station and collecting hourly pH data, which will help to characterize seasonal and diel pH patterns. In addition, we will contextualize the high-frequency pH observations with other ocean variables regularly sampled within the marine observatory, including temperature, oxygen, salinity and chlorophyll-a. Taken together, these findings highlight the importance of investing efforts in ocean observation and pH monitoring in coastal areas and warn on the effect of ocean acidification on marine ecosystems and the services they provide to society.

Paradigmatic environmental responses to the Tributyltin (TBT) ban in the Bidasoa Estuary

Oihana Solaun (1), Joana Larreta (1), José Germán Rodríguez (1), Izaskun Zorita (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Introduction

Despite the global ban on tributyltin (TBT), residual contamination persists in many estuaries and ports. This study presents the results of the 2025 monitoring programme conducted in the Bidasoa estuary (Bay of Biscay), integrating chemical, sedimentological, and biological indicators to assess the current chemical status and identify potential legacy sources.

All TBT measurements in surface waters were below the analytical quantification limit (0.0002 µg L^{-1}), confirming the good chemical status of the water body according to the criteria established in Royal Decree 817/2015 and indicating a clear recovery after the isolated exceedances observed in early 2024.

Sediment analyses in two small harbours (a marina and a fishing harbour) revealed TBT concentrations lower than those measured in 2021, consistent with a long-term decreasing trend since 2007. However, once normalised to 5% total organic carbon, values substantially exceeded OSPAR sediment quality standards, underscoring the role of port basins as historical contaminant reservoirs.

In biological indicators, organotin concentrations in gastropods (*Tritia nitida*) remained below accredited quantification limits (10 µg kg^{-1}, ww). Nonetheless, no affected females were observed in the marina (OSPAR Class A/B), whereas 60% of females from the fishing harbour displayed imposex (OSPAR Class C), showing values consistent with those reported in 2021. This pattern mirrors sediment contamination and highlights the ecological relevance of what is deposited in them, despite the overall decline in exposure.

The 2025 dataset provides strong evidence of environmental recovery in the Bidasoa estuary, particularly in the water column, while emphasising the persistent influence of contaminated harbour sediments and the need for sustained biomonitoring. These findings provide a valuable case study for understanding long-term contaminant dynamics in estuarine systems under post-ban conditions.

We would like to thank the Basque Water Agency (URA) for funding these studies.

Environmental Status of Organotin Compounds in Coastal and Port Areas of the Basque Country in 2025

Joana Larreta (1), José Germán Rodríguez (1), Oihana Solaun (1), Izaskun Zorita (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Tributyltin compounds, ports, water, sediments, biomonitoring, IMPOSEX, Basque coast

Introduction

Despite the total ban on tributyltin (TBT) in antifouling paints applied to vessel hulls since 2008, its persistence in coastal environments remains a challenge for environmental management. This study presents an integrated assessment of the presence, distribution, and biological effects of organotin compounds—including TBT, dibutyltin (DBT), and monobutyltin (MBT)—in water, sediments, and biomonitor organisms across various estuaries and port areas of the Basque Country during 2025. High-sensitivity chemical analytical techniques were combined with biological indicators to robustly characterize residual contamination levels and associated impacts.

TBT concentrations in surface waters were predominantly below the quantification limit, although isolated exceedances were detected in estuaries with port activity, reflecting the influence of persistent local sources. Comparison of measured concentrations with regulatory criteria suggests an overall favourable chemical status, albeit constrained by the narrow margin between regulated values and current analytical detection capabilities.

In contrast, port sediments showed markedly higher and spatially heterogeneous concentrations, underscoring their role as historical reservoirs of the contaminant. Locations such as Pasaia exhibited TBT levels far exceeding international guideline values, whereas other sites, such as Plentzia, recorded concentrations below detection limits. Degradation indices (Butyltin Degradation Index, %Butyltin degradation) indicate progressive transformation of TBT into less toxic congeners and reveal a clear downward trend compared with previous years.

Biological analyses revealed strong gradients of imposex in gastropods, ranging from complete absence in areas with low anthropogenic pressure to severe levels in specific port zones. These findings align with the spatial distribution of the contaminant in sediments. The use of oysters as biomonitors provided additional insight, showing exceedances of guideline values only at stations close to direct sources.

Overall, this study confirms a strong sustained environmental recovery in the region, although critical hotspots associated with contaminated sediments remain, highlighting the need for continued monitoring and the implementation of targeted management strategies in port environments.

We would like to thank the Basque Water Agency (URA) for funding these studies.

Assessment of open science practices in marine sciences: results of the ANR SODIO project

Elh Boube Abdoulkadri Zara (1), Schmidt Sabine (1), Schmitt Francois (2), Sudre Joël (3), Schmechtig Catherine (4)

(1) EPOC - Université de Bordeaux, (2) Laboratoire d'Océanologie et Géosciences, (3) UAR2013 Data Terra, (4) OSU Ecce Terra

Poster
open science, data management

Introduction

Assessing the impacts of human activities and climate change on biogeochemical cycles and marine ecosystems, as well as ensuring sustainable management of coastal and ocean water quality, constitute major challenges for scientists and policymakers. However, identifying these impacts is challenging due to the high variability of environmental conditions and limited data availability. To address this issue, French research funding agencies have been promoting open science, the unhindered dissemination of research outputs, methods and data, for several years. This initiative is based on the development of a national research infrastructure dedicated to Earth data, Data Terra, with ODATIS forming the pole dedicated to French coastal and marine data. This infrastructure is designed to assist the research community in complying with the EU INSPIRE Directive. However, open science practices within the French marine community, particularly with regard to data sharing and management, remain inconsistent and are not yet fully systematic.

The ANR RESO SODIO project aims to enhance awareness of the current state of open science practices within the French marine research community. Specifically, it targets scientific projects funded by the INSU LEFE CYBER call, which supports multidisciplinary research projects at deepening our understanding of biogeochemical cycles and how marine ecosystems function, in order to improve our assessment of their past and future changes. Some of these projects focused on the Bay of Biscay, such as VOG, which was dedicated to studying the biological and geochemical processes of the western Gironde salt marsh, or DYCIDEMAIN, which investigated carbon dynamics at the exchange interfaces of temperate tidal marshes in the Île de Ré area. The primary objectives of SODIO are threefold: firstly, to understand the data sharing practices in place for these projects; secondly, to identify any barriers to open data sharing; and thirdly, to propose tools to help the community. Since 2014, LEFE CYBER has supported over 130 projects led by 96 principal investigators (PIs).

Methods

A survey was conducted among project leaders (PIs) to assess their data storage and sharing practices, as well as their needs. The first requests to complete the questionnaire were sent out in June 2025. It took up to four reminders to obtain a significant number of responses by February 2026. PIs were also asked to provide any additional information or feedback they thought would be helpful, if necessary. Twenty-nine PIs agreed to be interviewed. This was carried out between September 2025 and March 2026.

Results and Discussion

The results, based on a good response rate (75%), reveal that fewer than half of the respondents actively encourage their partners to archive their data, and some believe it is not their responsibility. The most commonly cited benefits of data archiving include data reuse, transparency and reproducibility, scientific valorisation, institutional mandates, data producer protection and journal editorial requirements.

The most frequently reported obstacles include a lack of knowledge about data repositories and the need for technical support to prepare data, including metadata, documentation and format selection for handling diverse data types. There is also limited awareness of existing platforms, particularly for certain data types such as codes and model outputs, and for large datasets, such as images. The PIs also highlight challenges related to the interoperability of multi-source data and the absence (or knowledge) of a common nomenclature, particularly for biological data. The heterogeneity and diversity of national, European and international platforms also makes selecting the most suitable solution difficult.

Furthermore, feedback suggests that colleagues may not be fully engaged, particularly in collaborative projects, or that they may not fully apprehend the importance of data archiving in comparison to only publication in journals. Furthermore, some researchers have emphasised that the two-year archiving period after the project ends is insufficient for preserving the scientific value of the data. Many continue to store their data locally (on personal computers or external hard drives), which increases the risk of data loss due to hardware failure or staff turnover.

In light of these outcomes, the ANR RESO SODIO project, along with the help of the projet SO'ODATIS, will now develop a series of tutorials and practical guides to encourage good practices in data management within the French marine research community. The purpose of this presentation is to share these findings with a broader audience and encourage discussion on data opening and management practices.

From Compliance to Recovery: How Management Actions Restore Estuarine Fish Communities

Ainhize Uriarte (1), Joxe Mikel Garmendia (1), Marta Isabel Revilla (1), Izaskun Zorita (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Long-term monitoring, fish assemblages, ecological guilds, trophic guilds, estuarine recovery

Introduction

Since 1983, an ecohydrological monitoring programme is being conducted in the Nervion estuary (Basque coast, southeastern Bay of Biscay), by the Bilbao Bizkaia Water Consortium (CABB), the entity in charge of sanitation and wastewater treatment for the population residing in the surrounding area. The programme generates physico-chemical and biological time series and applies standardised methodologies for the assessment of ecological status. Over the years, this long-standing and methodologically standardised monitoring programme has become a reference for long-term estuarine monitoring in Spain.

Within this framework, fish fauna has been monitored based and the application of the AFI (AZTI Fish Index) used to characterise the functional and taxonomic structure of fish communities throughout the Nervion estuary, where they act as indicators of the ecological status of the system. The AFI applies a comprehensive multimetric framework that captures key structural and functional attributes of fish communities, enabling the detection of spatial and temporal gradients associated with pressures arising from urban discharges and providing a robust assessment of their response to anthropogenic disturbances in the estuary.

Analysis of the ecological and trophic structure of the fish communities shows a sustained increase in resident, marine and juvenile marine species, consistent with a gradual recovery of estuarine functionality and the growing use of the system as a breeding ground. At the same time, the increase in piscivorous and benthivorous species suggests the reactivation of higher trophic, whilst the persistently low representation of diadromous species indicates limitations in longitudinal connectivity that still restrict the complete recolonisation of the system. Taken together, these trends reflect an estuary in transition towards greater ecological complexity, with a trophic structure and functionality closer to those of a recovered coastal-estuarine ecosystem. This work was funded by Bilbao Bizkaia Water Consortium (CABB).

Towards a multi-source satellite operational detection of vessels for activities and pressures identification and mapping

Asier Anabitarte (1), Igor Granado (1), Jose A. Fernandes-Salvador (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

ship detection, remote sensing, AIS, human activity, human pressures, machine learning, computer vision

Biodiversity is crucial for maintaining a healthy planet, economic prosperity and human well-being. However, 18 sectors have been identified in the Atlantic Ocean that impact marine ecosystems and biodiversity. Two of the most prevalent are shipping and fishing (e.g. emissions, noise, strikes, habitat disturbance, and bycatch). Therefore, monitoring these activities is an important task to support data-driven ecosystem management. Satellite remote sensing has been proposed as a complementary monitoring approach to enhance in situ observations for biodiversity assessment and human activities identification. There are three sources that can be used to detect human activities: synthetic aperture radar (SAR), optical imagery (e.g. from Sentinel-2) and automatic identification system (AIS) data. Despite their own limitations, this work shows how these data sources can be integrated for operational detection and mapping of vessel activities, supporting both pressures assessments in biodiversity studies and enforcement by authorities when anomalies in the behaviour of fishing vessels are detected. In this study, deep-learning algorithms are used for vessel detection and identification. Specifically, AIS data is used to identify fishing activity, detect gears and/or map their activities, most of which are inferred through kinematic analysis based on vessel speed and heading. For SAR and optical imagery, computer vision models are applied to detect vessels and identify potential activity not captured through AIS analysis, including cases where AIS signals are absent, irregular, or intentionally disabled. Moreover, this work identifies the needed changes on ships registration in Europe for an effective real-world implementation of a system. Furthermore, the developed framework could be adapted for detecting other human activities (e.g. aquaculture or windfarms) and its mapping useful for spatial planning and biodiversity research.

Toward a population-based assessment of ecological status: methodological considerations based on the ELFI-C multi-metric index

Lespagnol Pierre (1), Lamé Alicia (1), Fabri-Ruiz Salomé (1), Delaunay Damien (1), Régimbart Amélie (1), Brind'Amour Anik (1)

(1) DECOD (Ecosystem dynamics and sustainability: from source to sea), L'Institut Agro, Ifremer, Inrae, Nantes, France

Poster

nurseries, coastal communities, multi-metric index, methodological approaches

Introduction

Coastal and estuarine ecosystems play a crucial role, serving as nurseries for numerous fish and invertebrate species, allowing them to develop through larval and juvenile stages. Yet these habitats are increasingly exposed to multiple anthropogenic pressures threatening their ecological integrity. Their contribution to ecosystem functioning and fisheries productivity makes their protection both ecologically essential and a regulatory priority. In this context, the Marine Strategy Framework Directive (MSFD) requires member states to assess the environmental status of coastal fish communities as part of their Good Environmental Status (GES) objectives. While community-level indicators such as the ELFI-C — adapted from the Water Framework Directive's ELFI index — provide a useful starting point, MSFD assessment require evaluation at the population level, highlighting the need for more refine species-specific methodologies.

We propose four methodological approaches of increasing complexity to assess the ecological status of coastal communities and their constituent species. Starting from a community-level baseline, the framework progressively refines assessment to the species level, deconstructs degraded metrics through tolerance-based attribution, and culminates in an advanced integrated metrics-pressures approach. The final step uses ecological network analyses to explore and quantify the relationships between anthropogenic pressures, ecological metrics, and species, offering a mechanistic understanding of ecosystem functioning that goes beyond conventional indices.

Cross-approach comparisons and sensitivity analyses will ultimately guide the selection of a preferred methodology for robust, MSFD-compliant population-level ecological assessments.

Long-term (2014-2022) trends in polar contaminants of emerging concern (CECs) bioaccumulated in mussels, Mytilus galloprovincialis, from the Basque Coast

Miren Carnicero (1), Belen Gonzalez (1), Ander Urrutia (1), Ionan Marigomez (1)

(1) Research Centre for Experimental Marine Biology and Biotechnology "Plentziako itsas Estazioa", University of the Basque Country (PiE-EHU), Plentzia, Basque Country, Spain

Poster

Introduction

Mussels (*Mytilus galloprovincialis*) archived in the Biscay Bay Environmental Biospecimen Bank (BBEBB) were used to investigate the occurrence and temporal variability of polar contaminants of emerging concern (CECs) in six localities of the Basque Coast (Arrigunaga, Arriluze, Plentzia, Mundaka, Hondarribia and Pasaia) over a nine-year period (2014–2022). Polar CECs constitute a diverse group of compounds increasingly being released to our coastal environments with recognised potential to provoke deleterious biological effects. Frozen mussels (soft tissues) were pooled, freeze-dried and homogenised to analyse more than 300 polar CECs including pharmaceuticals, personal care products, pesticides and industrial chemicals. Target analytes were determined using high resolution mass spectrometry (UPLC–HRMS q Orbitrap).

Preliminary results indicate the presence of multiple polar CECs across all study sites, with detection patterns varying among compound groups, locations and years, and ranging between 300 and 2000 ng/g of additive concentration. Some compounds appear to show relatively consistent occurrence (e.g., mexacarbate, caprolactam, cotinine) suggesting continuous inputs. Other chemicals display a higher temporal variability or site-specific patterns (e.g., bentazone, sertraline), potentially linked to local sources, changing environmental conditions, or the physicochemical properties of the chemicals. Overall, the bioaccumulation of polar CECs in mussels from the Basque Coast reveals their widespread occurrence. Thus, this study contributes to a better understanding of the spatio-temporal dynamics of polar CECs in coastal ecosystems.

Acknowledgements: Co-funded by BLUEADAPT (HORIZON-HLTH-2021-ENVHLTH-02 and UKRI/HM Gov), HOBE project (TED2021-132109B-C21, MCIN/AEI/10.13039 /501100011033 and EU NextGeneration EU/PRTR), and B4 (COLAB22/08 U Basque Country)) research projects and Basque Gov Consolidated Research Group CBET+OH (IT-1743-22). We are indebted to Irune Valenciano and Xabier Lekube for their support to access BBEBB archives.

Physalias in the classroom: science communication and risk perception of Physalia physalis in educational settings

Deva Menéndez-Teleña (1), Susana Acle (2), Itziar Álvarez-Trasobares (3), Leocadio Blanco Bercial (4), Jorge Cabrera Gámez (5), Mario Cabrera Lavara (6), Gemma Capeans García (6), Antonio Carlos Domínguez Brito (5), Pili Fernández Martín (7), May Gómez Cabrera (8), Fernando González Taboada (7), Carlos Guardado Fernández (6), Juan Höfer (9), Alicia Herrera (8), Iñaki Huskin (7), Mario Iglesias (10), Alejandro Isla (7), Yago Iván Baragaño (6), Melanie Juza (11), Ángel López-Urrutia (7), Diego Macias Moy (12), Ico Martínez Sánchez (8), Itziar Munuera Fernández (13), Laura Prieto (14), José Manuel Rico Ordás (6), Ramón Rubio García (15), Javier Ruiz (16), Verónica Soto López (17), Nicolás Felipe Weidberg López (6), José Luis Acuña Fernández (6)

(1) University of Oviedo, (2) Bioparc Acuario de Gijón, (3) Instituto de Ciencias Marinas de Andalucía (ICMAN-CSIC), (4) Bermuda Institute of Ocean Sciences - Arizona State University, (5) Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería (IUSIANI), ULPGC, (6) Observatorio Marino de Asturias, Departamento de biología de Organismos y Sistemas, Universidad de Oviedo, (7) Centro Oceanográfico de Gijón (IEO-CSIC), (8) Universidad de Las Palmas de Gran Canaria (ULPGC), (9) Pontificia Universidad Católica de Valparaíso (PUCV), (10) Catedra MediaLab, Universidad de Oviedo, (11) SOCIB – Sistema de Observación y Predicción Costero de las Illes Balears, (12) Joint Research Centre (JRC), Comisión Europea – Ispra, (13) Centro Oceanográfico de Gijón (IEO-CSIC, (14) Grupo Oceanografía de Ecosistemas, Instituto de Ciencias Marinas de Andalucía (ICMAN-CSIC), (15) Cátedra MediaLab, Universidad de Oviedo, (16) Consejo Superior de Investigaciones Científicas (CSIC), (17) Departamento de Ciencia y Tecnología Náutica Universidad de Oviedo

Poster

Science communication, Risk perception, Ocean literacy, Marine biosafety, Environmental awareness

Science communication in the marine field plays a key role in promoting ocean literacy and fostering scientific vocations. In this context, the Portuguese man o' war (Physalia physalis) has gained increasing ecological and social relevance due to the rise in its occurrences along coastlines, generating public concern.

Within the framework of the PHYSALIA project, the educational initiative "Physalias in the classroom" was developed to bring marine research closer to students through interactive sessions combining scientific content and participatory methodologies. The activity was implemented in more than six educational centers across Spain, including primary schools, secondary schools, and vocational training institutions, reaching over 200 students.

The sessions addressed the biology and ecology of P. physalis, research methodologies, and broader topics such as marine biosafety, environmental change, and conservation. As an innovative component, 3D-printed replicas equipped with tracking systems were incorporated, allowing students to visualize trajectories in real time through digital tools.

To assess the impact, pre- and post-session questionnaires were administered. Results show that more than 90% of students positively evaluated the activity, and over 95% reported an improvement in their perception and preparedness regarding potential encounters with the species.

These findings highlight the potential of evaluated science communication actions to enhance knowledge, risk perception, and the connection between science and society, contributing to environmental awareness from early educational stages.

Cumulative Effects Assessment in the Bay of Biscay: Integrating EMODnet Data within the Tikta Software

Oihana Solaun (1), Iratxe Mentxaka (1), María C. Uyarra (1), Sarai Pouso (1), Ángel Borja (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Understanding the cumulative impacts of human activities on marine ecosystems is essential for advancing ecosystem-based management and achieving Good Environmental Status (GES). This contribution presents an integrated assessment approach that uses publicly available information from the European Marine Observation and Data Network (EMODnet) on human activities occurring in the Bay of Biscay, together with data on ecosystem components. By combining these datasets, we aim to produce a spatial assessment of cumulative pressures in the study area.

The assessment will be carried out using the Cumulative Effects Assessment (CEA) module of Tikta, a tool developed within the GES4SEAS project. Tikta enables the integration of spatial datasets on pressures and ecosystem components through standardized sensitivity matrices. Its modular structure supports transparent workflows and reproducible analyses, making it suitable for regional-scale evaluations.

In this study, EMODnet's harmonized datasets—covering human activities including fisheries, maritime transport, energy infrastructure, and coastal uses—were combined with EMODnet Seabed Habitats and species-level information to produce a comprehensive representation of the socio-ecological system. Then, the Tikta software was applied to compute cumulative impact scores, identify hotspots of pressure, and explore the relative contribution of different activities to overall impact patterns.

The integration of Tikta and EMODnet data provides a robust foundation for Marine Spatial Planning in the Bay of Biscay by mapping pressures, ecosystem sensitivities, and cumulative effects. This approach helps identify ecological and spatial conflicts, supports the sustainable development of new uses, and ensures consistency with Good Environmental Status objectives. It also enables decision-makers to prioritize management actions and better understand the balance between human activities and ecosystem conservation. Moreover, the work also highlights the value of open-access platforms like EMODnet and the potential of tools such as Tikta to improve integrated marine assessments across European waters.

Toluidine-eosin staining proposal for tissue biomarkers in oysters (Magallana gigas)

Ane Rementeria (1), Iratxe Aldama (1), Emilia Martin (1), Urtzi Izagirre (1), Beñat Zaldibar (1), Jörg Schäfer (2), Esther Blanco Rayón (1)

(1) University of the Basque Country, (2) University of Bordeaux

Poster

Introduction

Marine pollution is considered a major environmental issue. Indeed, the United Nations' 2030 Agenda includes in its 14th Developmental Goal: "to conserve and sustainably manage oceans, seas and marine resources". Among the threats that pose a risk to marine environments, heavy metals, including copper (Cu) and silver (Ag), are of very relevant.

Environmental health status programmes have used bivalves, particularly mussels and oysters, as reliable sentinel organisms measuring different biomarkers ranging from biochemical to tissue level. However, unlike mussels, some tissue level biomarkers such as the density of basophilic cells (VvBAS) have not been measurable in oysters because, among other reasons, no suitable staining method existed to properly differentiate these cells. Nevertheless, the toluidine-eosin (T&E) staining technique has allowed a clear visualisation of basophilic cells in bivalves, including oysters. This study proposes T&E staining as a method for measuring VvBAS in oysters. For this purpose, histological samples of oysters exposed through diet to Cu and Ag stable isotopes during 21 days were selected. Conventional haematoxylin-eosin (H&E) staining was already employed to measure some cell and tissue-level biomarkers, including the atrophy of the digestive gland and the integrity of the digestive tissue (CTD ratio).

The T&E staining method enabled a clear differentiation of the basophilic cells in the digestive gland, allowing to measure the VvBAS parameter in oysters, alongside the previously mentioned tissue-level biomarkers.

The obtained results revealed that exposure to Cu and Ag affected the density of basophilic cells. Moreover, atrophy and digestive tissue integrity biomarkers exhibited similar trends using both staining techniques, therefore indicating the usefulness of T&E staining. Finally, this study highlights the importance of further investigation in this field in order to develop new biomarkers and standardised procedures. Funded by Basque Government (grant to CRGs (IT1743-22).

Reversal of severe feminization due to exposure to xenoestrogens in Chelon labrosus from the Urdaibai estuary one year after the closing of the wastewater treatment plant of Gernika

Joyanta Bir (1), Natalia Naharro (1), Xabier Lekube (1), Urtzi Izagirre (1), Ainara Valencia (1), Iratxe Rojo-Bartolomé (1), Maren Ortiz-Zarragoitia (1), Oihane Diaz de Cerio (1), Nestor Etxeberria (2), Ailette Prieto (3), Ibon Cancio (4)

(1) CBET+ Research Group, Dept. Zoology & Animal Cell Biology; Faculty of Science & Technology and Research Centre for Experimental Marine Biology & Biotechnology (PiE-UPV/EHU), University of the Basque Country, E-48620 Plentzia, (2) IBEA Research Group, Dept. Analystical Chemistry, PiE-UPV/EHU, (3) ailette.prieto@ehu.eus, (4) Plentzia Marine Station (PiE-EHU), University of the Basque Country

Poster

Chelon labrosus, intersex, Urdaibai, xenoestrogenicity, WWTP, biomonitoring, recovery

UNESCO established the Urdaibai Biosphere Reserve, around the Oka River estuary crossing Gernika and draining into the Biscay Bay, in 1984. Male *Chelon labrosus* mullets with oocytes in testis (intersex) were identified downstream the Gernika Waste Water Treatment Plant in 2007. Following different project-associated samplings, the 'Biscay Bay Environmental Biospecimen Bank' (BBEBB) launched a monitoring program to sample mullets every summer in the outlet of the Gernika WWTP showing poor chemical treatment efficiency. Until 2018 high intersex prevalences and overexpression of xenoestrogenicity/feminisation marker-genes was identified and up to 50% of males showed intersex-testis with presence of xenoestrogens (mainly alkylphenols) in their bile and in the WWTP effluent. 2021 represents an inflexion point with the closure of the WWTP and deviation of all treatment activities to a new, more coastal, facility. Here we present a historic revision of xenoestrogenicity in Gernika from 2007 to 2024, analysing the unexplored 2018 to 2024 BBEBB samples. Intersex-condition was identified every year until 2021, when 53% of males showed oocytes in testis (30% in 2019, 33% 2020). The intersex-severity-index (ISI) began to increase in 2014 and 40% of 2021 intersex-males displayed ISI values above 3. Situation reversed with the WWTP closure, no intersex-males appearing after 2021. Recovery was corroborated through molecular 5S/18S-rRNA, 5S/5.8S-rRNA and tRNA/5.8S-rRNA indexing with high values in ovaries and intersex-testes and low in all testes 2022 to 2024. Similarly, estrogenicity (*cyp19a1a*) and oocyte (*gtf3ab*, *42sp43*) marker-genes displayed significantly higher transcription levels in ovaries and 2021 intersex-testes than in testes after 2022. Testis specific *amh* showed the inverse profile. Hepatic levels of alkylphenols (HPLC-MS/MS) also decreased significantly from 2021 onwards. Recovery was total reflecting that intersex condition is not imprinted into adults due to early life stage exposure. Sometimes good things happen to good fish!

Funded: Basque-Government (IT1743-22), Spanish MCIU&EU-FEDER/ERDF (PID2023-146085NB-I00).

Mechanisms of organic contaminants degradation in porewater via aphotic Fenton reaction

Simon Negre (1), MOUSQUES-SOULAS Lucas (1), Thibault de Chanvalon Aubin (1), MONPERRUS Mathilde (1)

(1) IPREM UMR 5254 CNRS UPPA

Poster
Contaminants, estuary, porewater, degradation

Understanding the fate of emerging contaminants is a central goal to manage their impact. After being emitted by human activities, most of them deposits with solid particles and some can accumulate in estuarine sediments where they can be degraded. One of the degradation processes is induced by aphotic Fenton reaction. Oxidation of Fe(II) by O_2 generates a chain of reactions which produces $O_2^{\cdot-}$, H_2O_2 and HO·, so-called reactive oxygen species (ROS). This reaction is favored by regular oxidation events, such as tide, which bring oxygen in Fe(II)-rich waters. Highly reactive, especially hydroxyl radical HO·, ROS are known to be an efficient generalist oxidant of organic pollutants.

The aim of our study is to evaluate the capacity of the ROS produced in the porewater by aphotic Fenton reaction in the resilience of aquatic ecosystems. To address this question, we studied nine contaminants, chosen for their various properties; structure, usage, recalcitrance in the environment, known reactivity with ROS. The study focused on reproducing the reaction in a synthetic media to overview the conditions of the reaction; various quantities of iron, contaminants and matrix components such as ions or organic matter was studied. To reproduce the reaction, a spike of Fe(II) was added to the reaction media to induce the reaction and an important production of ROS. We conducted a degradation experiment with porewater sampled in Adour estuarine, under regular tides, to compare with controlled conditions in synthetic media. A significant degradation is observed in water with the addition of Fe(II) for most of contaminants with different degradation potentials depending on the contaminants. The other experiments conducted demonstrated the central role of hydroxyl radical HO· in the reaction of degradation and low influence of natural matrix components as ions, pH or organic matter. The comparison with degradation observed in porewater from Adour estuary confirms that this reaction can effectively degrade contaminants in natural matrices highlighting a potential role in natural resilience.

Role of aphotic Fenton reaction in natural degradation of organic contaminants in porewaters

Simon Negre (1), MONPERRUS Mathilde (1), Thibault de Chanvalon Aubin (1), MOUSQUES-SOULAS Lucas (1)

(1) IPREM UMR 5254 CNRS UPPA

Poster
Contaminants, estuary, porewater, degradation

Introduction

Aquatic ecosystems and their sediments represent a main receptacle for contaminants accumulation via deposition with suspended solid particles. Understanding their degradation in porewater of these sediments is then essential to understand their general fate in the environment. Each specific ecosystem can exhibit various resilience mechanism. As a result, study of many different ecosystems is important to obtain an overview of a natural resilience capacity at a larger scale. Estuaries, in particular, are an interface between continental and oceanic water, with periodic variations and for which the large watershed represents a large source of potential contamination.

The aphotic Fenton reaction is one of the degradation processes, happening in darkness and abiotically. In porewater, when Fe(II) is oxidized by O_2, the reaction generates reactive oxygen species (ROS); $O_2^{\cdot-}$, H_2O_2 and $HO^{\cdot}$. These highly reactive species, especially hydroxyl radical, are known to be able to degrade organic contaminants. We aim to have an overview on the potentiality of Fenton reaction to degrade contaminants in porewater from various ecosystems. We here studied how typical conditions in three porewaters modulates Fenton induced degradation. Two porewater where extracted from the Loire and the Adour estuary, and the last one was extracted from a freshwater river tributary upstream Adour river. We characterized the porewater in terms of salinity, organic matter composition, initial contaminations, sulfide content, pH, then add organic contaminants and simulated redox oscillations by adding successive spikes of Fe(II) to start the Fenton reaction. In all waters studied, we observe a degradation of studied contaminants with the addition of Fe(II) and the production of ROS. However, the composition of the matrix influenced degradation, with varying pH, salinity, and organic matter concentrations affecting the degradation potential. In addition, not all contaminants respond in the same way to the matrix composition influence of Fenton reaction. If some pharmaceuticals compounds degraded more in Loire estuary than in synthetic media, pesticides degradation dropped in porewaters.

Marine plastics as hotspots for antibiotic-resistant bacteria in coastal and estuarine systems of the Bay of Biscay

Amaia Hernandez Fernandez de Retana (1), Iñigo Azua (1), Amaia Zarrabeitia (1), Ainhoa Montero (1), Zuriñe Baña (1)

(1) Euskal Herriko Unibertsitatea

Poster

Antibiotic resistance, Antibiotic-resistant bacteria, plastisphere

Introduction

Antibiotic resistance represents a major global concern for human and environmental health, as aquatic ecosystems increasingly accumulate antibiotic residues capable of selecting resistant bacteria. Recent studies have reported the presence of a wide range of antibiotics along the Basque coast, raising the likelihood that antibiotic-resistant bacteria (ARB) proliferate under this sustained selective pressure. On the other hand, plastic pollution has also emerged as a critical environmental pollutant from anthropogenic sources. Due to their hydrophobic properties, plastics in marine systems adsorb antibiotics and other contaminants, potentially transforming the plastisphere into a reservoir for ARB and a hotspot for the transfer of antibiotic resistance genes (ARGs).

Methods

To investigate this issue, samples were collected from several marine and estuarine systems across the Bay of Biscay, including the Plentzia bay and estuary, the port of Getxo, and the beach and port of Donibane Lohizune/Saint-Jean-de-Luz. Marine bacteria were cultured in ZoBell Marine agar in order to quantify total culturable bacteria, as well as in Marine agar supplemented with selected antibiotics (azithromycin, erythromycin, ciprofloxacin and sulfamethoxazole-trimethoprim). Antibiotic selection was based on environmental detectability, clinical relevance, and spectrum of activity. After incubation (24-72 h), representative ARB colonies were isolated and taxonomically identified through amplification and sequencing 16S rDNA.

Results and Discussion

Our results confirm the presence of environmental ARB in seawater samples and plastics. Notably, plastics harboured a higher abundance of culturable ARB, supporting the idea that the plastisphere may operate as a reservoir and potential amplification zone for antibiotic resistance, with implications for horizontal gene transfer of ARGs.

Future analyses will aim to understand the mechanisms of resistance by detection of ARGs, and to assess whether these ARGs are coded on bacterial chromosomes or in mobile genetic elements like conjugative plasmids. This work sets the foundation for understanding how anthropogenic pollutants shape microbial resistance dynamics in coastal ecosystems.

Thrown but not gone: status of beach litter in the Basque coast.

Oihane C. Basurko (1), Joana Larreta (1), Marivi Lucero (1), Goretti Garcia (1), Inma Martin (1), Arantza Maceira (1), Eli Bilbao (1), Sarai Pouso (1), Iratxe Menchaca (1), Iñaki Rico (1), Maria C. Uyarra (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Management, Marine litter, Marine Strategy Framework Directive, Monitoring

Marine litter is only one of the many pressures affecting the marine environment. Yet, it represents a growing concern, as every year millions of tons of marine debris end up in the ocean, causing serious environmental, economic, aesthetic, and health impacts. In Europe, the challenge of marine litter is being addressed through a combination of policy, monitoring, and mitigation efforts driven primarily by the Marine Strategy Framework Directive (MSFD), which requires Member States to achieve Good Environmental Status and specifically, mandates action under Descriptor 10 on marine litter. To this end, over the course of one year, we monitored nine beaches across Bizkaia (five beaches) and Gipuzkoa (four beaches), following the guidelines produced by the European Technical Subgroup on Marine Litter. In the context of ULYSSES Data for Science project, we conducted quarterly surveys that captured seasonal variability in the accumulation and composition of marine litter. None of the monitored beaches achieve the good environmental status for the Marine Litter descriptor, as they overpassed the European established at 20 items per 100m. The Ereaga beach, located at the mouth of the estuary river of Nerbioi, was the beach with the highest number of items per 100m. When calculating this indicator by area (rather than by 100 m, as indicated in the guidelines), the ranking of beaches, according to marine litter concentration, largely change. As expected, it was observed variability along the year, being the winter the season where the highest quantity and weight of marine litter was quantified. Furthermore, large differences between beaches were observed regarding the typology of the marine litter found. While in some beaches large amount of litter originated at sea was quantified (e.g., La Arena) other beaches presented more litter originated in land (e.g., Ereaga). As already reported, plastic litter represented the highest proportion of all the quantified litter. Single-use plastics accounted for 30%, while fishing-related items represented only 4%. The top 10 items included pieces of hard plastic items, cigarette butts, pieces of foam, candy wrappers, fishing gear, ear swabs, fragments of paper and cardboard (including tissues and napkins), foil, and construction materials.This study has allowed us to i) assess one criteria of the Marine Litter Descriptor 10 and conclude its bad status, ii) identify potential measures that could help improving the current situation, and iii) suggest a potential methodology to better assess the status of Marine Litter in European seas.

Microplastic abundance and characterization in different environmental compartments of the Urdaibai Biosphere Reserve

Nagore Blasco (1), Thomas Maupas (2), Uxue Uribe-Martinez (2), Juan Francisco Ayala-Cabrera (2), Nikole Arrieta (3), Denis Benito (1), Tifanie Briaudeau (1), Jose Antonio Carrero (3), Alberto de Diego (2), Luis Angel Fernandez (3), Nerea Garcia-Velasco (1), Ainara Gredilla (3), Jennifer Huidobro (3), Leire Kortazar (3), Xabier Lekube (1), Maria Angeles Olazabal (3), Markel Sanz (4), Erik Urionabarrenetxea (1), Irune Valenciano (4), Beñat Zaldibar (1), Urtzi Izagirre (1), Manu Soto (1)

(1) Cell Biology in Environmental Toxicology + One Health (CBET+) Research Group, Dept. Zoology and Animal Cell Biology; Research Centre for Experimental Marine Biology and Biotechnology (PiE-UPV/EHU), University of the Basque Country EHU, (2) IBeA Research Group, Dept. Analytical Chemistry; Research Centre for Experimental Marine Biology and Biotechnology (PiE-UPV/EHU), University of the Basque Country EHU, (3) IBeA Research Group, Dept. Analytical Chemistry, University of the Basque Country EHU, (4) Research Centre for Experimental Marine Biology and Biotechnology (PiE-UPV/EHU), University of the Basque Country EHU

Poster

Microplastic, estuary, Urdaibai, sediment, biota

Introduction

Microplastics (MPs) are contaminants of high concern as they have been detected on a global scale in all environmental compartments. Monitoring of MPs in estuaries is crucial since these areas act as high-accumulation and transit zones where land-derived plastic waste meets the ocean. The aim of the study was to determine MP abundances and characterization in different environmental compartments (sediment and estuarine biota) of the Urdaibai Biosphere Reserve to infer their impact on estuarine ecological status. The presence of MPs was determined aided by a one-year monitoring program (2022-2023) with 6 sampling points in which sediment and invertebrates (mussels, shrimps and polychaetes) were collected. The isolation of MPs from sediments was performed by density separation before H2O2 oxidation of the co-extracted organic matter. Concerning biota, alkaline digestion for 48 h at 40 ◦C and filtering were conducted. MPs concentration and their characterization (polymer, shape, colour, size) were determined by analyzing filters using both optical microscopy and micro-Raman spectroscopy. In sediments, PET fibers were the main MPs (34.6 %) followed by PE and PP fragments. Arteaga point in July 2022 appeared to be the main MPs hotspot (165 particles/kg), although MPs contamination found in Urdaibai sediments is comparable to other European rivers. In biota, >70 % of the analyzed items were cotton fibers, whereas only 8.68 % were confirmed as plastic. The majority of MPs detected in the three spp. were colourless PET fibers (<1600 µm). Mussels from the two outermost points (Txatxarramendi, Tejera) presented a mean of 0.33 MP/individual. Mussels and shrimps showed higher MP ingestion frequency in comparison to polychaetes. This work enables the determination of MP baselines in a protected area, providing essential data for ecosystems health assessment and an improved plastic waste management and regulations. Funded: Basque Government (IT1743-22, IT- 1446-22) and MICINN (PID2020-118685RB-I00).

Spatial Risk Assessment and Conservation Strategies for Benthic Habitats along the Spanish North Coast

Corinna Lange (1)

(1) Instituto Español de Oceanografía (IEO-CSIC), Santander

Poster

spatial risk assessment; benthic habitats; Dendrophyllia cornigera; maërl beds; kelp forests; anthropogenic pressures; fishing pressure; conservation planning; marine spatial planning

Introduction

Benthic habitats along the Spanish North Atlantic coast support high biodiversity and play a key role in ecosystem functioning yet are increasingly exposed to multiple anthropogenic pressures (Galparsoro et al., 2014; Halpern et al., 2008). Addressing these pressures, as required by European policy frameworks (e.g. MSFD, NRR), requires spatially explicit approaches that integrate habitat distribution and human activities to support ecosystem-based marine spatial planning. This study, conducted within the EU-funded BIODIV project, assesses habitat–pressure interactions for three benthic habitats of conservation concern in the Spanish North Atlantic marine demarcation (NOR): (i) coral gardens formed by *Dendrophyllia cornigera*, a habitat-forming cold-water scleractinian typical of circalittoral rocky substrates; (ii) maërl beds composed of free-living coralline red algae; and (iii) kelp forests dominated by *Laminaria hyperborea*, *Saccharina latissima*, *Laminaria ochroleuca*, and *Saccorhiza polyschides*.

Methods

The study combines spatial habitat information with pressure data to identify areas of potential conflict and support the development of conservation measures. While the overall analytical framework is consistent across habitats, workflows differ depending on data availability and habitat characteristics. The most detailed quantitative analysis focuses on *D. cornigera*, a habitat-forming cold-water coral strongly associated with hard substrates and highly sensitive to physical disturbance (Abad-Uribarren et al., 2022; Roberts et al., 2009). Habitat suitability for *D. cornigera* was derived from species distribution models, generating spatial layers of predicted presence and model uncertainty (Elith & Leathwick, 2009). These were combined with fishing-pressure data for bottom trawling (BT), gillnets (GN), and longlines (LL) derived from regional Vessel Monitoring Systems and logbook datasets (Fernandez-Arcaya et al., 2024), with fishing effort represented separately by gear type (BT as Swept Area Ratio and static gears as fishing time per unit area). Effort categorisation was applied in a gear-specific manner, reflecting the documented interaction of each gear with the seabed. In the absence of ecological thresholds for static gears, but informed by their documented interaction with the seabed, effort classes for GN and LL were defined using threshold values from Punzón et al. (2026), and habitat–pressure overlap was translated into gear-specific risk classes by combining fishing effort, habitat suitability, and model uncertainty, explicitly retaining uncertainty and differentiating between lower- and higher-confidence risk areas.

Results and Discussion

The resulting maps reveal clear differences among fishing gears. BT pressure is spatially extensive across the continental shelf and upper slope, but overlap with predicted *D. cornigera* habitat is limited to a narrow, discontinuous fringe, likely overestimating actual interactions due to the species' strong association with hard substrates (Abad-Uribarren et al., 2022). In contrast, GN and LL effort overlaps more directly with the predicted habitat distribution. For GN (Figure 1), most overlapping areas are classified as low or medium risk, with high-risk cells occurring as small but recurrent patches, while LL overlap shows a similarly fragmented pattern dominated by low-risk areas, with only isolated cells reaching medium risk levels. For maërl beds and kelp forests, the analysis follows a more descriptive and integrative approach due to differences

levels. For maërl beds and kelp forests, the analysis follows a more descriptive and integrative approach due to differences in data availability, with analyses centred on Galician waters, reflecting decadal variations in the distribution of maërl beds, and the recent regional contraction of kelp forests. Habitat information is combined with spatial and literature-based evidence on key pressures, including fishing, aquaculture, sedimentation, eutrophication, coastal development, and climate-driven stressors, to identify dominant pressure pathways and highlight habitat-specific vulnerabilities. Across all habitats, the study moves beyond pressure mapping towards management-relevant outputs, proposing spatially differentiated conservation measures that account for habitat characteristics, pressure types, and model uncertainty. For *D. cornigera*, this includes precautionary consideration of gear-specific restrictions in areas of recurring overlap between suitable habitat and bottom-contact fisheries, while for maërl beds and kelp forests, proposed measures focus on regulating local pressures, prioritising restoration, improving monitoring, and establishing protected areas. By integrating habitat distribution, uncertainty, and pressure overlap, this work provides a practical framework to support targeted conservation and ecosystem-based marine spatial planning in the Spanish North Atlantic.

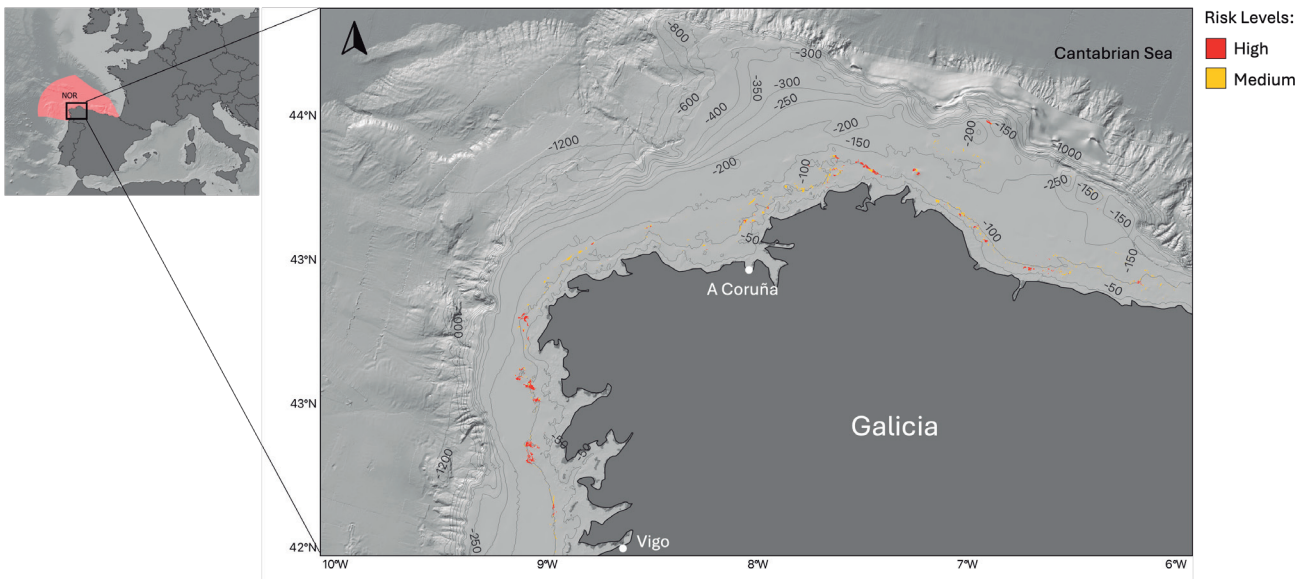


Figure 1. Spatial overlap between the predicted distribution of the coral species *Dendrophyllia cornigera* and gillnet fisheries in the North Atlantic marine demarcation (NOR). The map shows gear-specific risk classes derived from gillnet fishing effort, habitat suitability, and model uncertainty, highlighting the narrow and fragmented spatial distribution of potential conflict zones along the predicted habitat belt.

[1] Abad-Uribarren, A., Prado, E., Sierra, S., Cobo, A., Rodríguez-Basalo, A., Gómez-Ballesteros, M., & Sánchez, F. (2022). Deep learning-assisted high resolution mapping of vulnerable habitats within the Capbreton Canyon System, Bay of Biscay. Estuarine, Coastal and Shelf Science, 275. https://doi.org/10.1016/j.ecss.2022.107957
[2] Elith, J., & Leathwick, J. R. (2009). Species distribution models: Ecological explanation and prediction across space and time. Annual Review of Ecology, Evolution, and Systematics, 40, 677–697. https://doi.org/10.1146/annurev.ecolsys.110308.120159
[3] Fernandez-Arcaya, U., Rodríguez-Basalo, A., Verísimo, P., Rodriguez, J., Ceballos, E., Gonzalez-Irusta, J. M., García-Alegre, A., Plaza-Morlote, M., Serrano, A., & Punzón, A. (2024). Bottom fishing beyond trawling. Spatio-temporal trends of mobile and static bottom fisheries on benthic habitats. Marine Policy, 159. https://doi.org/10.1016/j.marpol.2023.105805
[4] Galparsoro, I., Borja, A., & Uyarra, M. C. (2014). Mapping ecosystem services provided by benthic habitats in the European North Atlantic Ocean. Frontiers in Marine Science, 1(JUL). https://doi.org/10.3389/fmars.2014.00023
[5] Halpern, B. S., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., d'Agrosa, C., ... & Watson, R. (2008). A global map of human impact on marine ecosystems. science, 319(5865), 948-952.
[6] Punzón, A., Fernández-Arcaya, U., De la Torriente, A., Rodríguez-Basalo, A., Ceballos, E., Ruíz-Sobrón, M., Sánchez, F., Serrano, A., & González-Irusta, J. M. (2026). Effects of the static fishing gears, gillnets and longlines, on benthic habitats. ICES Journal of Marine Science, 83(3). https://doi.org/10.1093/icesjms/fsag023
[7] Roberts, J., Wheeler, A., Freiwald, A., & Cairns, S. (2009). Cold-water corals: the biology and geology of deep-sea coral habitats. Cambridge University Press.

THE BESITO TRAIT LIST. AN UPDATED LIST OF BIOLOGICAL TRAITS FOR SPANISH BENTHIC FAUNA

Ana Antolínez (1), Ana De la Torriente (2), Marian Blanco (1), Ana García-Alegre (1), Alberto Serrano (1), José Manuel González-Irusta (1)

(1) Centro Oceanográfico de Santander (IEO-CSIC), (2) Centro Oceanográfico de Santander (IEO) & Fundación Charles Darwin

Poster

Traits, BESITO, SoS, Trawling impacts, Functionallity, Benthic habitats

Introduction

Taxonomy-based approaches have historically been the main framework for assessing benthic habitats despite they provide limited information on ecosystem functioning and do not fully capture the functional responses of benthic habitats to anthropogenic disturbances (Serrano et al., 2022; van Denderen et al., 2024). In response to these limitations, trait-based approaches have emerged as a complementary alternative. The development of these functional indicators has been strongly driven by the implementation of management frameworks, particularly the Marine Strategy Framework Directive (MSFD) and the Habitats Directive (HD). Within this context, the BESITO index (González-Irusta et al., 2018) and the SoS indicator (Serrano et al., 2022) represented key milestones in the development of trait-based tools for benthic habitat assessment. These tools constituted the starting point for the creation of the dataset presented here.

In this work we present an updated and harmonized dataset comprising more than 800 benthic species with assigned biological traits and sensitivity scores. Although originally developed to support the assessment of trawling impacts though the use of the BESITO index and the SoS indicator, the dataset may be adapted for its application in a wider range of functional ecological approaches, including the assessment of other pressures (e.g. De la Torriente Diez et al., 2022). The dataset covers multiple Spanish marine regions, providing an unprecedented spatial coverage for benthic functional assessments. This collaborative effort consisted of: (i) the definition of relevant biological traits, scoring criteria, and sensitivity classes; (ii) the assignment of trait scores for each species based on an extensive bibliographic review; and (iii) a periodic interregional expert review process, including the comparison of trait assignments across regions to reach expert consensus. The resulting dataset provides a standardized and robust framework for the functional assessment of benthic habitats and supports the implementation of ecosystem-based marine management and environmental policies.

[1] De la Torriente Diez, A., González-Irusta, J. M., Serrano, A., Aguilar, R., Sánchez, F., Blanco, M., & Punzón, A. (2022). Spatial assessment of benthic habitats vulnerability to bottom fishing in a Mediterranean seamount. Marine Policy, 135(June 2021). https://doi.org/10.1016/j.marpol.2021.104850

[2] González-Irusta, J. M., De la Torriente, A., Punzón, A., Blanco, M., & Serrano, A. (2018). Determining and mapping species sensitivity to trawling impacts: the BEnthos Sensitivity Index to Trawling Operations (BESITO). ICES Journal of Marine Science, 75(5), 1710–1721. https://doi.org/10.1093/icesjms/fsy030

[3] Serrano, A., de la Torriente, A., Punzón, A., Blanco, M., Bellas, J., Durán-Muñoz, P., Murillo, F. J., Sacau, M., García-Alegre, A., Antolínez, A., Elliott, S., Guerin, L., Vina-Herbón, C., Marra, S., & González-Irusta, J. M. (2022). Sentinels of Seabed (SoS) indicator: Assessing benthic habitats condition using typical and sensitive species. Ecological Indicators, 140, 108979. https://doi.org/10.1016/j.ecolind.2022.108979

[4] van Denderen, P. D., Plaza-Morlote, M., Vaz, S., Wijnhoven, S., Borja, A., Fernandez-Arcaya, U., González-Irusta, J. M., Hansen, J. L. S., Katsiaras, N., Pierucci, A., Serrano, A., Reizopoulou, S., Papadopoulou, N., Sköld, M., Smith, C. J., Nygård, H., Van Hoey, G., Dinesen, G. E., Virtanen, E. A., … Valanko, S. (2024). Complementarity and sensitivity of benthic state indicators to bottom-trawl fishing disturbance. Ecological Applications. https://doi.org/10.1002/eap.3050

Inclusive citizen science as a tool for monitoring anthropogenic impacts on coastal ecosystems: insights from plastic pollution across the Basque coast

Zuriñe Baña (1), Olatz Ortega-Vidales (1), Oihane Diaz de Cerio (1), Eider Bilbao (1), Pamela Ruiz (1), Belen Gonzalez-Gaya (1), Mireia Irazola (1), Ainara Achurra (2), Harkaitz Eguiraun (1), Aitor Laza (1), Miren Bego Urrutia (1)

(1) Research Centre for Experimental Marine Biology and Biotechnology, UPV/EHU (PiE-EHU), (2) Department of Didactics of Mathematics, Experimental Sciences, and Social Sciences

Poster

Introduction

Plastic pollution constitutes one of the most pervasive threats to ecosystem health and biodiversity in the Bay of Biscay. Coastal monitoring programs are essential for understanding the distribution and abundance of plastic debris, but systematic long-term data collection requires significant effort and resources. In this context, citizen science has emerged as a valuable tool that enhances monitoring capacity while promoting environmental awareness.

Methods

The inclusive citizen-science project “¡Atención! ¡No me aplastes! - Kontuz! Ez nazazu zapaldu!”, was created to help people learn more about the coast and to encourage environmental care among diverse social groups. The project combines educational and scientific objectives with a strong social inclusion component, as it actively involves communities frequently underrepresented in scientific initiatives. To date, more than 4,500 participants have contributed to the monitoring of microscopic biodiversity and microplastics on Basque beaches since 2023.

Citizen scientists collect samples following standardized protocols by using 50×50 cm quadrats at the swash line, sieve sand (> 1 mm) to collect larger microplastics, and classify particles based on size, shape, and colour supported by the digital application AplastApp, which enables semiautomated measurements from uploaded images. Moreover, surface sediment from 15x15 cm quadrats, is gathered in wet and dry sand to assess the smaller microplastics presence through densimetric separation and filtration (> 20 um). Visual control of the filters is then performed using stereomicroscopes.

Results and Discussion

Results revealed the widespread presence and diversity of microplastics across monitored beaches. Beyond scientific outputs, participants demonstrated an increased interest in science and reported higher environmental awareness and engagement. Overall, this project demonstrates how inclusive citizen science can strengthen monitoring of anthropogenic impacts and support ecosystem management.

Benefits and values from marine cultural ecosystem services: the contribution of recreational activities to mental health in the Basque coast

Sarai Pouso (1), Maite Erauskin-Extramiana (1), Claudia Escudero (2), Natalia Montero (1), Isaias Cruz Irujo (3), Angel Borja (1), María C. Uyarra (1), Aitziber Olano-Arbulu (1)

(1) AZTI, (2) University of Navarra, (3) Mako Pako - Basque Shark Diving

Poster

marine recreational activities, human well-being, cultural ecosystem services, therapeutic values

Marine and coastal ecosystems provide diverse opportunities for outdoor sports and recreation, which are increasingly recognized as contributors to human well-being, through their positive effects on physical and mental health.

The relationship between contact with nature on human health and well-being has been widely studied mainly from two research domains. Environmental psychology has produced robust evidence of the positive health effects of exposure to nature; yet, these studies emphasize health outcomes, while paying little attention to the role of environmental characteristics (e.g. environment types, conditions, and ecological status). In contrast, studies within environmental sciences field, particularly those adopting the ecosystem services framework, investigate how natural capital contributes to human well-being through active and passive human–nature interactions (i.e. cultural ecosystem services).

Such studies primarily investigate how environmental characteristics, functions and processes provide different types of ecosystem services and human benefits, mainly focusing on the benefits from an economic perspective. Far fewer examples address the non-monetary benefits, and even fewer explore the therapeutic values of nature exposure. Furthermore, research in both fields has predominantly focused on terrestrial “green” spaces, with considerably less attention given to marine and coastal “blue” environments.

The objectives of this study are (i) to explore how different marine recreational activities (MRAs) contribute to mental health, and (ii) to assess whether the type of MRA influences the type and magnitude of these health outcomes. The study was conducted along the Basque coast (southeastern Bay of Biscay), an area characterized by diverse coastal ecosystems and recreational opportunities that attract both residents and tourists.

A survey was designed to collect information on the types and spatial distribution of MRAs, participant characteristics, the feelings and emotions associated with the MRA practice, and perceived psychological restoration. Two psychometric scales were adapted: the Positive and Negative Affect Schedule (PANAS) scale and the Restoration Outcome Scale (ROS). The survey was completed in by more than 500 individuals who regularly engage in MRAs (summer 2023), or who participated in marine wildlife observation activities, including cetacean-watching tours (summer 2024) and shark-diving tours (summer 2025).

More than 30 distinct MRAs are practiced along the Basque coast, each associated with specific environmental, oceanographic and meteorological conditions. Some activities are practiced from the shore (e.g., seaside walking, shore-based fishing), others depend on waves (e.g., surfing, bodyboarding), or wind (e.g., windsurfing), while some require sheltered waters (e.g., bathing, rowing). Additional activities rely on the presence of marine wildlife (e.g., cetacean watching, shark diving) or visually appealing seascapes (e.g., SCUBA diving, sailing). All MRAs were associated with increases in positive affect, whereas negative emotional responses were infrequent. ROS results indicated that MRAs positively contribute to increasing relaxation and calmness, attention restoration and facilitate mental clarity. The magnitude and nature of these effects varied depending on the specific activity and the user’s profile.

This study suggests that the ocean, through MRAs, can support different aspects of human well-being. It also highlights the need to consider individual MRAs when assessing health benefits and underscores the relevance of generating activity-specific evidence to inform the effective management of coastal areas that sustain these activities.

Ecosystem-Based Maritime Spatial Planning in the Bay of Biscay: What Spain and France Got Right and What's Missing

Ibon Galparsoro (1), Natalia Montero (1), Gotzon Mandiola (1), Iratxe Menchaca (1), Olivier Laroussinie (2), Neil Alloncle (2)

(1) AZTI, (2) CEREMA

Poster

Marine Spatial Planning, Ecosystem-based Approach, Management, Human Activities, Conservation

Maritime Spatial Planning (MSP) Directive (Directive 2014/89/EU) establishes a framework for MSP across EU Member States with marine waters, aiming to promote the sustainable growth of maritime economies, the development of marine areas, and the sustainable use of marine resources. Despite the Directive´s explicit requirement that the plans apply an ecosystem-based approach, the practical guidance necessary to translate this obligation into coherent planning processes and operational measures remains insufficient, resulting in persistent gaps between legal intent and implementation practice.

France adopted the maritime spatial plans in April/May 2022, while Spain adopted its plan in February 2023. Both countries are now in the plans´ evaluation phase, and thus it becomes essential to assess the extent to which ecosystem-based approach principles were incorporated into the plans. To this end, we applied the assessment framework developed by Galparsoro *et al*. (2025), publicly available as a web app tool (https://aztidata.es/EB-MSP/), to systematically evaluate the entire planning process. The assessment framework is composed by 130 actions or task that should be addressed during the planning process. The assessment was performed using a semi-quantitative scoring system that considers the implementation degree, relevance, respondent confidence and the underlying knowledge base, which provided a transparent benchmark for the standardised evaluation of both plans.

Our findings indicate that although both countries have developed robust legal and governance frameworks, substantial shortcomings persist in the integration of climate change considerations, ecosystem functioning, and cumulative human pressures. The assessment further reveals a limited incorporation of socio-economic objectives and insufficient cross-border stakeholder engagement. By highlighting these priority gaps, the study provides clear entry points for MSP practitioners to move beyond formal compliance towards maritime spatial plans that are both ecologically robust and socially equitable.

Referencias

[1] Galparsoro, I., N. Montero, G. Mandiola, I. Menchaca, Á. Borja, W. Flannery, S. Katsanevakis, S. Fraschetti, E. Fabbrizzi, M. Elliott, M. Bas, S. Barnard, G. Piet, S. Giakoumi, M. Kruse, B. McAteer, R. M. Runya, O. Lukyanova, T. Morato, A. Van Gerven, S. Degraer, S. Neuenfeldt, V. Stelzenmüller, 2025. Assessment tool addresses implementation challenges of ecosystem-based management principles in marine spatial planning processes. Communications Earth & Environment, 6: 55 https://doi.org/10.1038/s43247-024-01975-7

SESSION 6:
FISHERIES AND AQUACULTURE

Multifrequency Acoustic Characterization of a Surface Scattering Layer and its influence on the vertical distribution of Anchovy in the Bay of Biscay

Beatriz Sobradillo Benguria (1), Guillermo Boyra (1), Maria Santos (1), Elorri Arévalo (1), Almudena Fontán (1), Enrique Nogueira (1), Guillem Chust (1), Paula Alvarez (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

Surface scattering layer, Engraulis encrasicolus, multifrequency acoustics, Bay oy Biscay

Understanding how environmental and ecological drivers shape the spatial behaviour of pelagic fish is essential for fisheries assessment, ecosystem-based management, and anticipating climate-driven changes. In the Bay of Biscay, European anchovy (Engraulis encrasicolus) is a key species for Spanish and French purse-seine fleets. However, fishers have recently reported increasing difficulties in catching anchovy, often attributing this to unusually deep schools and to dense accumulations of gelatinous organisms that clog fishing nets. Scientific acoustic surveys have consistently detected a near-surface scattering layer locally known as zikiña (meaning trash or debris in Basque), whose biological identity remains unresolved due to unsuccessful net sampling. However, the persistence of this acoustic signature suggested that it may structure the habitat and influence anchovy behavior, detectability and catchability. The potential association of warmer water conditions with deeper school locations was also examined, exploring the vertical distribution of anchovy optimal spawning temperature (14ºC isotherm).

This study used high-resolution multifrequency echosounder data (18–200 kHz) from the autumn JUVENA 2021 survey to explore the acoustic characteristics of the zikiña layer, with the aim of developing its acoustic signature. This signature was then applied to BIOMAN spring survey datasets (2013–2025) to examine whether the spatial patterns previously observed in juvenile anchovy in relation to zikiña might also influence adult vertical distribution, or whether spring zikiña could potentially shape adult behaviour.

Preliminary inspection of acoustic records across datasets suggests that adult anchovies may occupy deeper strata when dense surface layers are present. Although the 14ºC isotherm has not consistently deepened, increasing marine heatwaves are altering surface habitats, potentially favouring gelatinuous proliferations. This study aims to provide the first robust multifrequency characterization of zikiña and to evaluate its ecological significance, highlighting the possibility that dynamic surface scattering layers may need to be considered in future stock assessment approaches.

Long-Term Trends in Biological Metrics of Horse Mackerel Population: A 20-Year Analysis.

Paula Alvarez (1), Maria Korta (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

Trachurus trachurus, Length frequency distribution, Length–weight relationship, Total weight–Gonad weight relationship Condition factor, Von Bertalanffy grouth parameter

In order to assess changes in key biological parameters for the western stock of horse mackerel (Trachurus trachurus, L.), an analysis was conducted over a 20-year period, drawing upon various data sources. Specifically, fisheries information, including the length of landed specimens, and biological metrics such as length, weight, gonad weight, and age, were obtained from samples collected at the AZTI's laboratory from catches landed in Basque Country ports. Furthermore, we incorporated scientific data acquired from MEGS surveys conducted between 2007 and 2025.

An analysis of fish length revealed that, on average, fish size increased by 34% from 2002 to 2022. Following the application of potential and logarithmic equations to establish relationships between variables including length, total weight, gonad weight and total weight, as well as length and age over time, it was observed that fish of the same age tended to be longer and heavier. However, the gonad weight for fish of similar total weights decreased, as did the growth parameters (K) of the VB growth models. The results suggest that the population directs its efforts towards increasing height and weight, potentially at the expense of reproduction. This change in population ‘s strategy would be reflected in the continuous recruitment failures observed in the population and in the increase in average sizes due to the lack of incorporation of young individuals into the stock.

Navigating Future Waters: The Resilience of the Atlantic Bluefin Tuna under Climate Change

Maite Erauskin-Extramiana (1), Mireia Valle (1), Leonardo Cruz (2), Barbara Muhling (3), Josean Fernandes-Salvador (1), Mercedes Pozo (3), Guillermo Ortuño-Crespo (4), Stephanie Brodie (5), Elliot Hazen (3), Steven Bograd (3), Haritz Arrizabalaga (1), Gorka Merino (1), Nerea Lezama-Ochoa (3)

(1) AZTI BRTA, (2) Department of Ecology, Federal University of Rio Grande do Norte, (3) Institute of Marine Sciences, University of California Santa Cruz, (4) IUCN WCPA High Seas Specialist Group, (5) Commonwealth Scientific and Industrial Research Organization (CSIRO)

Oral

Introduction

Atlantic bluefin tuna (ABFT) is an ecologically and economically valuable species. As global warming drives marine species toward cooler or deeper waters, ABFT distributions are expected to shift, potentially disrupting predator-prey dynamics and fisheries interactions. This study models future habitat suitability for ABFT, its primary prey (as a proxy for food availability), and the drifting longline fishery that targets adult ABFT under three climate scenarios (SSP1-2.6, SSP3-7.0, SSP5-8.5). Results indicate a poleward shift in ABFT distribution, with habitat losses in tropical regions and gains in boreal zones. Prey species show similar trends, increasing spatial overlap with ABFT in higher latitudes while decreasing in tropical areas. These boreal regions may act as climate refugia or 'bright spots,' with a projected 15% increase in prey overlap by century's end. However, ABFT key spawning grounds—the Mediterranean Sea and Gulf of Mexico—are projected to become significantly less suitable for adults, with habitat suitability declining by up to 27% and 73%, respectively, threatening reproductive success. Meanwhile, overlap with the drifting longline fishery may decline by 4%, unless fishing efforts also shift poleward. Regions such as Greenland and northern Europe may become increasingly important for ABFT persistence and expansion. These distributional changes could challenge current international agreements and quota systems, underscoring the need for adaptive, climate-resilient management strategies.

Towards trustworthy Artificial Intelligence for Marine Research, Fisheries and Environmental Management

Jose A. Fernandes-Salvador (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

Artificial Intelligence, ethics, conservation, marine science, fisheries, biodiversity, marine policy, marine economics, international law, European Artificial Intelligence Act, best practices, trustworthy artificial intelligence

Artificial Intelligence (AI) is advancing at an unprecedented pace, offering transformative opportunities for marine research, fisheries management, environmental governance, and policy development. Particularly in the context of the interconnected data needs of ecosystem management and biodiversity conservation. These technologies can enhance data acquisition, processing, and decision support, enabling more integrated approaches to ecosystem management and biodiversity conservation. Yet their adoption in these domains remains limited by the absence of coherent frameworks that ensure transparency, validation, and ethical alignment with ecological and socio-economic sustainability goals. This work proposes a comprehensive framework built on three critical pillars for trustworthy AI: socio-economic and legal viability, data governance, and technical and scientific robustness. On the one hand it aims to be a guideline for developer teams. On the other hand, it aims to be a guideline for final users (e.g. industry and managers) for designing the requirements and evaluating such systems. The first pillar underscores the need for AI systems that are cost-effective, scalable, environmentally sustainable, and legally supported, balancing short-term costs with long-term social and ecological benefits. The second stresses adherence to fair, reliable, and ethical access to digital resources, recognising that without strong governance, data and algorithms risk becoming fragmented or misused. The third pillar addresses the necessity of rigorous validation across entire AI pipelines, including preprocessing, model evaluation, and benchmarking against alternative ground truths, to ensure reliability in real-world applications. Together, these pillars provide a blueprint for developing ethical, reliable, and policy-relevant AI systems that can strengthen trust, improve sustainability, and guide decision-making across marine science, fisheries, environmental management and European legislation.

Uncovering Changes in Fishing Activities in the South Bay of Biscay Fleet Using Statistical and Machine Learning Approaches

Claire Kermorvant (1), Fourez Carla (2), Bru Noelle (1), Janc Anaïs (3), Weigel Benjamin (3), Cabral Henrique (3), Lissardy Muriel (2), Susperregui Nicolas (4), Henneveux Aurélien (5), Caill-Milly Nathalie (2)

(1) Université de Pau et des Pays de l'Adour, Laboratoire de Mathématiques et de leurs Applications de PAU - UMR 5142 CNRS, F-64600, Anglet, France, (2) Ifremer, COAST, 1 Allée du Parc Montaury, F-64600, Anglet, France, (3) INRAE, EABX, 33612, Cestas, France, (4) Comité Interdépartemental des Pêches Maritimes et des Elevages Marins des Pyrénées Atlantiques et des Landes (CIDPMEM 64-40), 12 quai Pascal Elissalt, 64500 Ciboure, (5) Organisation de Producteurs Pêcheurs d'Aquitaine, 12 quai Pascal Elissalt, 64500 Ciboure

Oral

Machine learning ; Fleet typology ; Spatial descriptors ; Fishing fleet dynamics ; Multivariate analysis

Recent studies show that fishing fleets may exhibit different responses to political, social, economic and environmental pressures and changes. These responses may include spatial or temporal shifts in fishing activity and changes in target species. This study aims to determine whether changes have occurred in the fishing practices of vessels of the Bayonne maritime district. A close collaboration between fishers and scientific institutions enabled the collection, cleaning and analysis of fisheries data since 2005. The approach was applied to twelve species selected for their local importance.

Using several statistical and machine-learning methods, the process for detecting changes in fishing activity was as follows: 1) Define length threshold of vessels based on activity using decision tree to construct fleets; 2) For each fleet and targeted species, investigate temporal and spatial changes in fishing patterns using statistical spatial descriptors (barycenter, ellipses...); 3) Identify similar spatial patterns according the spatial descriptors using a hierarchical clustering performed on the results of a Hill–Smith analysis. This process allows to create a typology of fleet–species-time groups having similar spatial footprint.

Shifts in the spatio-temporal distribution of fishing activity were effectively observed. Hierarchical clustering revealed three main clusters: one includes most large longliners targeting hake in north-west of Ireland, the second contains other large vessels targeting hake and anglerfishes throughout the area, and the third cluster includes small vessels targeting other species in the Bay of Biscay. Within this latter cluster, some species (e.g. sole with small gillnetters) are now predominantly fished further north, while others (e.g. bogue with purse seiners) tend to be targeted more to the south. Most of the patterns revealed in this study differ markedly among the fleets studied, highlighting the importance of working at the fleet-segment level rather than at the scale of the entire fleet.

Socio-economic assessments of Marine Recreational Fisheries in the Spanish Basque Country

Hélène Gomes (1), Bachiller Eneko (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral
Marine Recreational Fisheries, Socio-economics, Ecosystem services

Marine recreational fisheries (MRF) are increasingly recognised for their ecological, social and economic relevance, yet their socio-economic dimension remains poorly studied. Addressing this gap, this study provides the first assessment of the socio-economic impacts of two major recreational fishing modalities –shore fishing and spearfishing– in the Basque Country (eastern Cantabrian Sea), through two complementary analytical approaches. The first considers MRF as economic activities and applies an input–output methodology to estimate their direct and indirect contributions to the regional economy. The second focuses on shore fishing as an ecosystem service, using an individual travel-cost method to assess its non-market (i.e., cultural) value and the social benefits for fishers. Although preliminary due to current data limitations, the results already reveal the considerable cultural and socio-economic importances of these activities within the region and highlight their relevance beyond purely ecological considerations. This way, it is estimated that both shore fishing and spearfishing generate more than €850,000 of economic production, €450,000 of gross value added, and 11 full-time jobs per year in the regional economy while the consumer surplus associated with shore fishing as ecosystem service reaches €1,053,199 per year. This work responds directly to the recognized need for more systematic and robust economic information within European data-collection frameworks and will support more informed comparisons between MRF and other marine-related sectors. Thus, it will provide valuable insights for future regional and European initiatives aimed at integrating the socio-economic dimension of MRF into marine environment management.

[1] HYDER, K., RADFORD, Z., PRELLEZO, R., WELTERSBACH, M. S., LEWIN, W. C., ZARAUZ, L., FERTER, K., RUIZ, J., TOWNHILL, B., MUGERZA, E. & STREHLOW, H. V. Y. 2017a. Research for PECH Committee - Marine recreational and semi-subsistence fishing - its value and its impact on fish stocks Place Published: Brussels Publisher: European Parliament, Policy Department for Structural and Cohesion Policies. Brussels.
[2] LEONTIEF, W. W. 1936. Quantitative input and output relations in the economic systems of the United States. The review of economic statistics, 105-125.
[3] AYDıN, M., TUNCA, S., KARADURMUŞ, U. & DURGUN, D. 2013. Valuation of recreational fishing benefits: A snapshot from Ordu, Turkey. Ege Journal of Fisheries and Aquatic Sciences, 30, 147-154.
[4] KOWALEWSKI, J. 2009. Methodology of the input-output analysis. HWWI Research Paper.

Role of selenium in mercury detoxification in rainbow trout fed marine sustainable aquafeeds: insights into nanoparticle formation

Marianna Alves Cancian (1), Claudia Marchán-Moreno (1), Silvia Queipo-Abad (1), Tamara Fernández-Bautista (1), Maïté Bueno (1), Emmanuel Tessier (1), David Amouroux (1), Stéphanie Fontagné-Dicharry (2), Zoyne Pedrero Zayas (1)

(1) Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, IPREM, Institut des Sciences Analytiques et de Physico-chimie pour l'Environnement et les Matériaux, (2) INRAE, Université de Pau et des Pays de l'Adour, E2S UPPA, NUMEA

Oral

Mercury–selenium interactions; Methylmercury detoxification; Sustainable aquafeeds

Aquaculture has rapidly expanded as a major alternative to wild fisheries, intensifying the demand for sustainable aquafeeds. In this context, plant-based ingredients and fish byproducts, such as tuna processing waste, have emerged as cost-effective and environmentally friendly substitutes for traditional fishmeal provided by marine fisheries. However, these alternatives introduce a complex toxicological scenario: tuna byproducts are enriched in methylmercury (MeHg), a highly toxic compound prone to bioaccumulation and biomagnification, but also in selenium (Se), an essential element known to mitigate mercury (Hg) toxicity. This duality highlights the need to better understand Hg–Se interactions in aquaculture species.

Therefore, this study aims to investigate Hg–Se interactions in tissues to better understand their role in Hg detoxification. Rainbow trout (Oncorhynchus mykiss), a model fish species in aquaculture, were fed twelve experimental diets (plant- vs. tuna-based) containing different forms of Se and MeHg for six months. Key tissues, including liver, brain, kidney, blood, and muscle, were analyzed through total element quantification, Hg speciation, and Hg isotopes.

In general, the tuna byproduct-based diet resulted in lower Hg levels than the plant-based diets, with muscle Hg concentrations remaining below the European Commission's safety threshold. In addition, the distribution of Hg species in the brain differed markedly depending on the supplemented diet, with inorganic Hg (iHg) predominating in fish fed tuna byproduct-based diets. This pattern suggests MeHg demethylation and may be related to the natural presence of selenoneine in the marine-based diet. The potential influence of the diets on the formation of Hg and Se nanoparticles, considered the end products of Hg detoxification, will also be presented.

Integrated digital services and biophysical IBMs for fisheries and aquaculture in the Bay of Biscay

Manuel Ruiz Villarreal (1), Gonzalo Gonzalez-Nuevo (1), Sofía González Pérez (1), Adrian Sanjurjo (1), Daniel Rodríguez Abal (1), Luz María García García (1), Paz Sampedro (1)

(1) IEO-CSIC

Oral

Individual-Based Models (IBM), FAIR data, Fisheries management, Early life stages, Ecosystem-based management

Integrating long-term ocean observing systems with advanced data infrastructures is essential for the sustainable management of fisheries and aquaculture in the Bay of Biscay and the Iberian Atlantic. Since the 1980s, the Spanish Institute of Oceanography (IEO-CSIC) has characterized key oceanographic processes—such as upwelling and river plumes—that drive ecosystem productivity. Recently, these efforts have shifted toward ensuring that datasets are FAIR (Findable, Accessible, Interoperable, and Reusable) through open-source tools and OGC-compliant services. This digital transformation enables the development of high-level products designed to support decision-making in the marine sector by bridging the gap between raw environmental data and applied biological knowledge.

This contribution demonstrates how standardized data workflows facilitate two critical applications for the regional blue economy. In the field of aquaculture, the integration of in situ monitoring, satellite data, and particle-tracking models provides operational forecasts for the transport of Harmful Algal Blooms (HABs) and gelatinous zooplankton, offering vital early-warning services for shellfish farmers and coastal managers. Simultaneously, for fisheries management, the synergy between PELACUS spring surveys and biophysical Individual-Based Models (IBMs) allows for a mechanistic understanding of the early life stages of small pelagic fish, such as sardine and anchovy, by simulating growth and survival conditioned by prey density, temperature, and advection.

We will also illustrate how, despite their potential, the integration of biophysical models into formal stock assessments remains scarce. Additionally, we will highlight biophysical IBMs as robust tools for testing critical ecological hypotheses that traditional assessments cannot address, particularly within a changing oceanic environment. While these models are not suited to predict absolute recruitment values, they are key for validating connectivity hypotheses and simulating "what-if" management scenarios under diverse climate projections. Finally, we conclude that addressing operational stock assessment needs through sustained multidisciplinary collaboration and interoperable data services provides the necessary foundation for a truly ecosystem-based management of fisheries and aquaculture in the North-Atlantic region.

Tracking Time-Varying Productivity in Bay of Biscay and Celtic Sea Fish Stocks using Peterman’s Productivity Method

ADRIAN MENCIA (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

productivity, non-stationary, Peterman's Productivity Method, stock-recruitment, recruitment, state-space,

Current scientific advice on fishing opportunities commonly relies on stationary stock-recruitment relationships. However, recent global evidence indicates that many marine fish species exhibit non-stationary productivity, often characterised by temporal fluctuations in the maximum reproductive rate. The shift away from stationary assumptions of traditional methods is supported not only by inherent biological dynamic changes, but also by increasing scientific evidence of climate driven regime shifts. Peterman’s Productivity Method (PPM), offers a state-space modelling framework that employs the Kalman filter to estimate and track time-varying stock-recruitment productivity parameters. In this work we have implemented univariate and multivariate PPM to ICES category 1 stocks in the Bay of Biscay and Celtic Sea. We have characterized changes in productivity over the last decades by comparing Akaike Information Criterion (AIC) values across Ricker models with various time-variable configurations. Investigated process covariance structures include time-covarying productivity, which allows for detection of simultaneous patterns among stocks. Alongside this, we explore a potential approach for integrating assessment uncertainty into the PPM framework and also investigate the inclusion of Dynamic Factor Analysis (DFA) loadings to better capture shared trends. Understanding changes in productivity at individual and community level will allow us to advance in ecosystem-based fisheries management by adjusting exploitation level to actual productivity and defining strategies that account for the synchrony or asynchrony among stocks.

BYGUARD: a multi-taxa spatiotemporal tool to support bycatch reduction in the Bay of Biscay

Isabel García-Barón (1), Amaia Astarloa (1), Mikel Basterretxea (2), Leire Citores (1), Arnaitz Mugerza (2), Josu Paradinas (2), Elsa Cuende (2)

(1) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Pasaia, Spain, (2) AZTI,Marine Research, Basque Research and Technology Alliance (BRTA), Txatxarramendi ugartea z/g, 48395 Sukarrieta, Spain

Poster

Decision Support System (DSS), fisheries, risk assessment, spatiotemporal modelling, sensitive species

Introduction

Bycatch of sensitive species remains one of the main ecological challenges for global fisheries. Elasmobranchs, cetaceans, and seabirds are particularly vulnerable to demersal trawling, demanding practical, accessible, and data-driven tools to support sustainable fishing. In this context, we present BYGUARD, a user-oriented catch-size prediction platform developed by AZTI and currently being updated to provide bycatch-related risk information. Designed as an interactive Shiny application, BYGUARD provides fishers with operational, spatially explicit bycatch risk maps to inform voluntary avoidance strategies. The tool integrates observer data, historical records, and semi-quantitative bycatch risk assessments to generate monthly and seasonal probability maps. A key innovation is the inclusion of multiple sensitive taxa within a single predictive framework, offering a holistic view of interaction hotspots. Deployable on local servers, the platform is accessible via standard devices aboard vessels. BYGUARD demonstrates how integrative modelling and accessible design can reduce unwanted interactions, helping fisheries align with EU conservation objectives and fostering more responsible fishing practices across diverse management contexts.

Fine-Scale Mapping of Mackerel Catches in the SE Bay of Biscay using AIS data

Nerea Goikoetxea Bilbao (1), Ainhoa Caballero (2), María Mateo (1), Leire Ibaibarriaga (1), Iñaki Quincoces (1)

(1) AZTI,Marine Research, Basque Research and Technology Alliance (BRTA), Txatxarramendi ugartea z/g, 48395 Sukarrieta, Spain

(2) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Pasaia, Spain

Poster

mackerel, automatic identification system (AIS), landing distribution, fishing effort, Bay of Biscay.

Introduction

Handliners (LHM) and purse-seiners (PS) are two important fleets targeting Atlantic mackerel in the southeastern Bay of Biscay (SE-BoB). In recent years both fleets have experienced a marked decline in catches. The situation has been particularly difficult for the LHM fleet that was not able to fully utilise its fishing quota. This has raised concerns about changes in the species' spatial distribution and availability. Understanding the spatiotemporal patterns of mackerel catches is therefore essential for interpreting the dynamics of this fishery and supporting its sustainable management.

Logbooks and Vessel Monitoring System (VMS) data have been widely used to study fishing activity, but these sources present limitations such as low positional accuracy, repeated or inconsistent entries, and low-frequency location updates. The increasing availability of AIS data, with higher temporal resolution and improved positional quality, offers a promising alternative. Within this context, the objective of this study is to use AIS data to better characterize mackerel fishing operations of Basque LHM and PS fleets in the SE-BoB.

Methods

First, AIS data from both LHM and PS Basque fleet targeting mackerel in the SE-BoB were collated for the February-May fishing seasons of the 2017-2024 period. AIS data were then processed to remove duplicates, exclude land and port positions, and filter anomalous values in speed (>20 kn) and ping rate (>60 min), following the methodology proposed by Mendo et al. (2024)[i]. Second, AIS trajectories from vessels operating during the mackerel season were grouped according to vessel type, fishing gear, and activity period. Third, speed-over-ground (SOG) metrics were used to distinguish fishing behaviour from transit. Specifically, fishing events were identified by analysing the distribution of speed profiles: for each gear type a bimodal distribution was fitted using the EM (Expectation-Maximization) algorithm (Benaglia et al., 2009[ii]) allowing to separate the SOG corresponding to fishing and to routing. To identify the SOGs corresponding to fishing as a fishing event, vessels were required to maintain fishing speed ranges for a minimum duration (30 min for PS and 15 min for LHM) according to expert knowledge. The first position meeting both speed and duration criteria was assigned as the location of the fishing haul (Figure 1). These AIS-detected fishing events data were cross-referenced with logbook data to validate the temporal alignment between inferred fishing activity and reported catches. Finally, logbook trip catches were proportionally allocated to the previously identified fishing hauls according to fishing effort (hours).

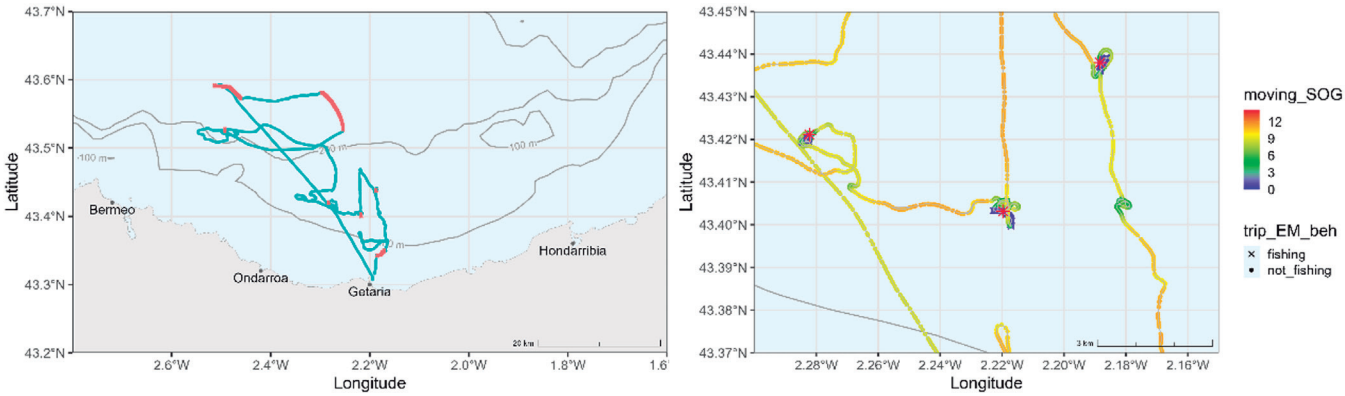


Figure 1. Example of a PS vessel trajectory derived from AIS data (left), including a zoomed view highlighting SOG patterns during the operation (right). The red asterisks in the zoomed view represents the inferred fishing hauls.

Results and Discussion

The method successfully allocated 73 % of PS and 37% of LHM mackerel catches to AIS-detected fishing hauls. The different performance between fleets is due to the differences in the number of trips between logbook data and AIS records. For LHM, 10,442 fishing trips were initially identified in the logbooks compared with only 4,372 LHM trips detected in the AIS data. A total of 3,694 overlapping trips were identified across both datasets, and the methodology successfully allocated LHM logbook catches to AIS-detected fishing hauls for 3,043 of these trips (82% trips). Conversely, PS logbook and AIS datasets shared 1,770 trips (out of the initial 2,092 AIS trips and 2,456 logbook trips). For 1,596 of these shared trips (90%), catches recorded in the logbooks were successfully allocated to AIS-detected LHM fishing hauls. In most cases, LHM conducts between 1 and 5 sets per trip, whereas PS typically performs between 1 and 3 sets. However, occasional trips may comprise more than 10 sets. Regarding haul duration, LHM operations are generally shorter and more consistent, with a mean duration of 42 minutes. In contrast, PS activity shows greater variability and a higher mean haul duration of 105 minutes, indicating more heterogeneous hauling behaviour.

The interannual variability analysis confirmed the declining trend in catches that the LHM fleet has been experiencing in recent years (not shown). In general terms, for LHM fisheries the mackerel catches are distributed along the coast between 2º45'W and 2º25'W (Figure 2d); while, the main fishing grounds of the PS fleet are concentrated between 2º12'W and 2º10'W (Figure 2b), although catches also occur within the area where the LHM fleet operates.

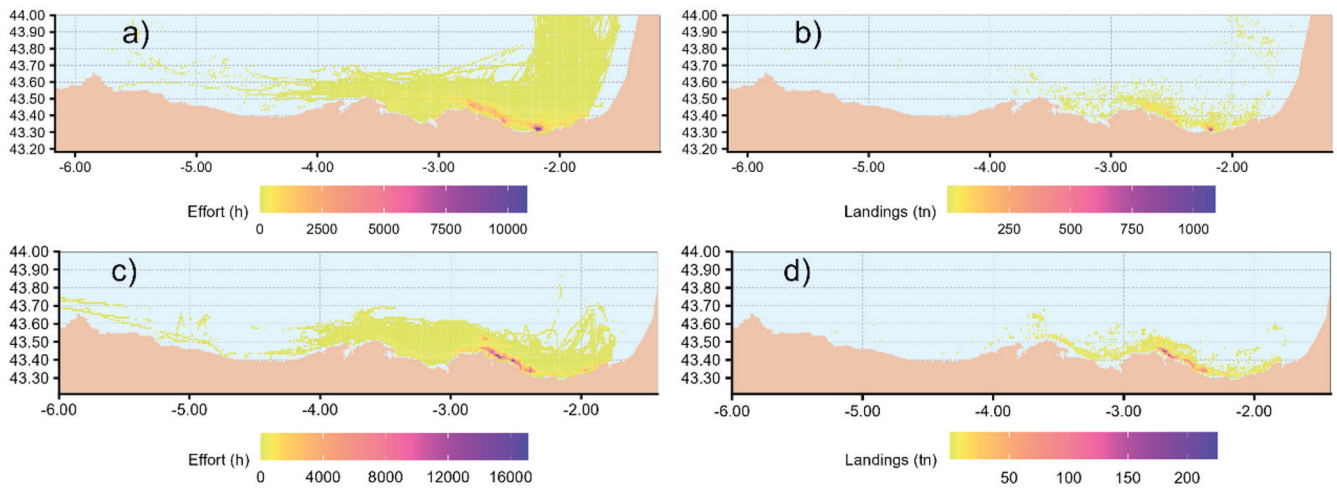


Figure 2. Spatial distribution of PS fleet effort (h) (a) and mackerel landings (tons) (b) and of LHM effort (c) and landings (d) in the SE-BoB, using February-May AIS and logbook data from 2017-2024.

Although results for LHM could be improved with additional AIS data, the findings demonstrate the potential of AIS to enhance the reconstruction of fine-scale mackerel fishing activity for PS and LHM fleets. This data source enables the identification of fishing events more effectively than previous attempts based on other data sources such as VMS, which provides position reports at a lower temporal resolution. This can be particularly relevant for short-duration fishing manoeuvres in fleets such as PS and LHM. Despite the identification algorithm was only based on SOG, other input variables, such as course changes over time could also be valuable for refining the fishing activity (e.g. to infer the circle formed by the PS net). In future work, AIS-detected fishing haul positions could be validated by information provided by onboard observers or GPS devices installed on vessels (Sala-Coromina et al., 2026[i]). The obtained fishing locations can form the basis of future analyses of spatiotemporal patterns in the fishery.

Acknowledgements: We acknowledge the Basque Government for providing AIS data, and the Spanish General Secretariat for Fisheries (SGP) for sharing logbook data within PIXEL project. This work is funded by Eusko Jaurlaritza – Basque Government through the European Maritime, Fisheries and Aquaculture Fund.

highly resolved vessel tracking data. ICES Journal of Marine Science, 81 (2): 390-401. doi.org/10.1093/icesjms/fsad209

[2] Benaglia, T., Chauveau, D., Hunter, D.R., Young, D., 2009. mixtools: An R Package for Analyzing Finite Mixture Models. Journal of Statistical Software, 32(6): 1–29. doi.org/10.18637/jss.v032.i06

[3] Sala-Coromina, J., Silvestre, M., Coutinho, F.H., Carreton, M., Blanco, M., Ribera-Altimir, J., Recasens, L., Company, J.B., 2026. Identifying purse seine vessel operations through machine learning models for better spatial fishing effort estimates. Fish and Fisheries, 1-14. doi.org/10.1111/faf.70078

Analysis of the temporal variability of maturity ogives for the Southern component of the Northeast Atlantic Mackerel (Scomber scombrus).

Gersom Costas (1), Carmen Hernández (2), Dolores Garabana (3), M.Rosario Navarro (2), Paula Sancho-Martínez (2) and Clara Dueñas-Liaño (2),

(1) Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Vigo. 36390 Vigo, Spain
(2) Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Santander. 39004 Santander, Spain
(3) Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de A Coruña. 15001 A Coruña, Spain

Poster

Scomber scombrus, ogive, maturity, Bay of Biscay, Northeast Atlantic.

Introduction

Atlantic mackerel (Scomber scombrus) is a temperate pelagic species that is predominantly located on both sides of the North Atlantic, with two distinct stocks: the western stock in the Northwest Atlantic (NWA) and the eastern stock in the Northeast Atlantic (NEA). In the Northeast Atlantic, mackerel has been considered as a single stock, which is traditionally divided into three spawning areas/components: The North Sea, the Western and the Southern components. Recently ICES has reported that the population has declined to historic lows, leading it to recommend a reduction in catches to allow for recovery. Therefore, the study of its life history parameters, such as maturity ogives, that determine the dynamics of this population are crucial for assessing population changes, and thus provide essential information for its management.

Methods

The objective of the present study is to assess the temporal variability of maturity at age and at size ogives for the period 2000-2025 integrating data from the Southern component: Galician waters and the southern Bay of Biscay (ICES Subdivision 9aN and Division 8c). To accomplish this objective, we analyse a total of 53,702 individuals during the spawning season (February – June) from commercial catches and acoustic surveys. The annual variability of length-at-maturity (L50) and age-at-maturity (A50) values for sex combined, were performed using a logistic model. We investigated the interannual variability of maturity ogives to identify long-term trends.

Results and Discussion

Understanding changes in the L50 is essential for assessing the reproductive potential of the stock and predicting future population dynamics, thereby ensuring the sustainable management of the NEA mackerel fishery.

Health status assessment of long-line cultured mussels on the Basque coast

Markel Montaño Lekue (1), Denis Benito (1), Tifanie Briaudeau (1), Urtzi Izagirre (1), Izaskun Zorita (2)

(1) EHU, (2) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Poster

Introduction

Over the last decade, initiatives have been undertaken to promote the aquaculture sector along the Basque coast, especially in mollusc production. As a result, an offshore mussel farm was launched in 2019, in Mendexa (Biscay, Spain). Mytilus galloprovincialis were seeded on a long-line system until reaching commercial size (50-90 mm). In 2021, biometric parameters (total weight, meat weight, and shell length, height, and width) were recorded monthly to monitor growth of the bivalves and to survey the population's condition index. Health status was assessed monthly through histopathological analyses (atrophy of the digestive gland, adipogranular (ADG) cell index, connective tissue index and gill structure index). Parasitological studies were also conducted. Sex and gamete developmental stages were determined to characterize the reproductive cycle. Condition index values remained low, which may be suboptimal for mussel commercial production. Tissue biomarkers indicated concerning relative signs of stress, however a low parasite load was observed, which could be beneficial for the crop. These results constitute key factors that must be taken into account to optimize mussel production and marketability. Overall, the results underscore current challenges for aquaculture in this region, particularly given the presence of toxic algal species and the marked decline in natural mussel populations along the Basque coastline.

Work funded by the Basque Government (Grant to Consolidated Research Group, CBET+, IT1743-22) and by the European Maritime and Fisheries Funds "00001-INA2020-33-AVACON".

Assessing the vulnerability of common dolphin population to bycatch

Amaia Astarloa (1), Beñat Iglesias (1), Estanis Mugerza (1), Mikel Basterretxea (1), Arnaitz Mugerza (1), Lluis Horrach (1), Cristina Claver (1), Arkaitz Pedrajas (1), Isabel García Barón (1), Maite Louzao (1)

(1) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA)

Poster

Fisheries interactions, biological sampling, population demographics, sex ratio

Introduction

Fisheries bycatch remains a significant global challenge, requiring extensive knowledge of species-fishery interactions and comprehensive data collection for effective assessment. This study analyzed biological data from bycaught individuals to better understand the demographic impacts on affected populations. By taking advantage of regulation APA/1200/2020—which mandates that cetaceans dying during fishing operations must be stored on board and brought to port for scientific analysis—biological sampling and examinations were conducted on individuals caught in the fleets monitored by AZTI in the Bay of Biscay. Throughout the 2022–2026 period, the common dolphin (Delphinus delphis) was the most frequently recorded species, with 60 entries detailing sex, morphological measurements, spatial location, date, and gear type. Bycatch events primarily occurred during winter months on the French shelf of the Bay of Biscay, involving bottom trawlers. Biological data revealed significant ($p<0.05$) differences in sex ratios, with 80% of individuals being males. Based on established length-at-age correlations, findings also indicated that 55% of the analyzed males were immature, compared to 38% of females. These results align with previous studies in the Northeast Atlantic, suggesting that vulnerability to capture varies by sex and age, likely driven by behavioral differences or group segregation.

Analysis of the temporal variability of maturity ogives for the Southern component of the Northeast Atlantic Mackerel (Scomber scombrus).

Gersom Costas (1), Carmen Hernández (1), Dolores Garabana (1), M.Rosario Navarro (1), Paula Sancho-Martínez (1), Clara Dueñas-Liaño (1)

(1) Spanish Institute of Oceanography

Poster

Scomber scombrus, ogive, maturity, Bay of Biscay, Northeast Atlantic.

Introduction

Atlantic mackerel (Scomber scombrus) is a temperate pelagic species that is predominantly located on both sides of the North Atlantic, with two distinct stocks: the western stock in the Northwest Atlantic (NWA) and the eastern stock in the Northeast Atlantic (NEA). In the Northeast Atlantic, mackerel has been considered as a single stock, which is traditionally divided into three spawning areas/components: The North Sea, the Western and the Southern components. Recently ICES has reported that the population has declined to historic lows, leading it to recommend a reduction in catches to allow for recovery. Therefore, the study of its life history parameters, such as maturity ogives, that determine the dynamics of this population are crucial for assessing population changes, and thus provide essential information for its management.

Methods

The objective of the present study is to assess the temporal variability of maturity at age and at size ogives for the period 2000-2025 integrating data from the Southern component: Galician waters and the southern Bay of Biscay (ICES Subdivision 9aN and Division 8c). To accomplish this objective, we analyse a total of 53,702 individuals during the spawning season (February – June) from commercial catches and acoustic surveys. The annual variability of length-at-maturity (L50) and age-at-maturity (A50) values for sex combined, were performed using a logistic model. We investigated the interannual variability of maturity ogives to identify long-term trends.

Results and Discussion

Understanding changes in the L50 is essential for assessing the reproductive potential of the stock and predicting future population dynamics, thereby ensuring the sustainable management of the NEA mackerel fishery.

Size-structured spatio-temporal dynamics of the Bay of Biscay anchovy fishery

iosu paradinas (1), leire ibaibarriaga (1), Naroa Aldanondo (1), marga Andres (1), maria Mateo (1), joaquin martinez-minaya (2)

(1) AZTI, (2) UPV

Poster

Engraulis encrasicolus,compositional data, spatio-temporal modelling, species distribution models, small pelagic fisheries.

Small pelagic fisheries are increasingly challenged by strong spatio-temporal variability in stock distribution, declining body size, and rising operating costs. In the Bay of Biscay European anchovy fishery ({\it Engraulis encrasicolus}), first-sale prices are tightly linked to fish size, making the ability to anticipate when and where valuable size categories occur critical for economic sustainability. Here, we develop a spatio-temporal model to characterise the distribution of European anchovy during its primary fishing season.

Using fisheries-dependent data (2013–2024), we decompose commercial catches into total biomass and compositional structure by size category, modelled within a Bayesian hierarchical framework. Size composition was analysed using additive log-ratio transformations, allowing the identification of spatial, seasonal and interannual patterns. We demonstrate a strong positive linkage between juvenile size observed in autumn surveys and the dominance of larger commercial size categories in the subsequent fishery, providing empirical evidence that early life-history conditions propagate into economic outcomes. Spatially, large anchovy were concentrated in central sectors of the Cantabrian Sea, while smaller individuals predominated toward the eastern Bay of Biscay, with recurrent seasonal shifts in size composition. In contrast, catch volume exhibited a comparatively weak spatial structure, with limited predictive gains over null models.

By integrating biological variability, size-dependent market value and spatial accessibility, the proposed framework offers a transferable decision-support tool to organise fishing calendars in space and time, enabling fleets to improve economic performance without increasing fishing pressure.

The Quota Paradox: Larger TAC Shares Do Not Guarantee More Sustainable EU Fleets in the Bay of Biscay

Mary Grace Catapang (1), Arantza Murillas-Maza (2), Eneko Bachiller (2)

(1) University of the Basque Country, AZTI, (2) AZTI

Poster

Introduction

This study raises a fundamental question of whether the current quota allocation system ensures equitable access to fishing opportunities among fleets in the European Union (EU). The Common Fisheries Policy (CFP) requires Member States to apply transparent and objective environmental, social, and economic criteria in allocating fishing opportunities—incentivising those fleets using more sustainable practices (CFP Reg. 1380/2013, Article 17). However, national quota distribution remains heavily based on historical track records, while the application of sustainability criteria is inconsistent among Member States, limited to select measures with low levels of transparency.

Accordingly, this study examines whether fleets receiving larger quota shares also make stronger contributions to the sustainable blue economy. It assesses the sustainability of EU fleet clusters, operating in the Bay of Biscay (BoB), in relation to their quota allocation for a set of stocks using a Blue Fishing Index (BFI). BFI measures multidimensional sustainability using environmental, social, and economic indicators (e.g., stocks at risk, CO2 emissions, working conditions). The index was applied to fleet clusters from EU member states operating within the same supra-region (NAO), using a common vessel-length class and predominant fishing gear, and targeting the same species. The analysis was conducted separately for clusters targeting the selected species including Atlantic mackerel (*Scomber scombrus*) and European hake (*Merluccius merluccius*) with stocks subject to Total Allowable Catches (TACs) and, exploited by heterogenous fleets spanning both small-scale and large-scale fisheries. Data sources include official data from STECF AER 2025 and ICES assessments. Results suggest that certain fleet clusters obtain unbalanced fishing opportunities when considering their sustainability scores. These findings provide an empirical basis for more transparent and sustainability-oriented quota allocation, with relevance for CFP implementation in the BoB and beyond. But also, to improve fleet management towards a sustainable blue growth, which will finally promote equitable access to common resources and environmental sustainability.

Use of Semi-Pelagic Trawl Doors in the Bay of Biscay: Impacts on Catches, Fuel Consumption and Seabed Contact

Elsa Cuende de Francisco (1)

(1) AZTI

Poster

Semi-pelagic trawl doors Bottom trawling Seabed impact Fuel consumption Catch composition Bay of Biscay Trawl fisheries Environmental impact

Reducing the environmental impact of bottom trawling in the Bay of Biscay is a key challenge for sustainable fisheries management, particularly in relation to seabed disturbance and fuel consumption. An experimental fishing campaign was carried out aboard the research vessel Emma Bardán in ICES Division 8b to assess the impacts of semi-pelagic trawl doors, compared with conventional bottom doors, on fuel consumption, seabed contact and catch composition under bottom trawl operating conditions. Thirty-six valid hauls were analysed using acoustic sensors to monitor door behaviour and continuous measurements of engine fuel consumption. Semi-pelagic doors remained off the seabed for most of the towing time, with contact estimated at less than 1% of total trawling duration, and reduced mean instantaneous fuel consumption by 3.55% compared to bottom doors ($p < 0.05$). Differences in catch composition were observed between door types, while no significant differences in size distributions were detected. These results indicate that semi-pelagic trawl doors can substantially reduce seabed impact and fuel consumption without altering catch size structure.

Interdisciplinary workshop on Fisheries Data Visualization and Adaptation Strategies under global changes: students' point of view

Nathalie Caill-Milly (1), Fourez Carla (2), Carter Caitriona (3), Bru Noëlle (4)

(1) Ifremer LERAR, (2) Futurs-ACT, (3) INRAe, (4) UPPA

Poster

Biodiversity, student engagement, multidisciplinary approach, visualization tool

Introduction

In January 2026, a workshop held in Anglet (France), was organized as part of the AVIZONS research project. The event brought together students and their supervisors (biologists, computer scientists, political scientists, future fishers, future chefs, students in design fiction) and stakeholders (representatives of professionals, researchers, funders) to collaboratively improve a useful fisheries data visualization tool for decision making and to imagine possible scenarios of the evolution of fishing in a changing climatic and regulatory context.

The workshop focused on integrating diverse datasets, including fisheries' landings (tonnage, price) from vessels from the Bayonne maritime district, scientific surveys (abundance, size structure), environmental variables, and regulatory frameworks. This data supports multivariate spatio-temporal analyses of marine resources and their exploitation and aims to assess biodiversity dynamics and anticipate environmental and socio-economic change.

Students took part in interdisciplinary roundtables to test and enhance the web-based visualization application. Four interdisciplinary groups explored adaptation scenarios: (1) spatial/temporal shifts in resource distribution, (2) changes in target species, and (3–4) alternative socio-economic and regulatory strategies.

Key outcomes highlighted the need for improved integration of regulatory data, enhanced visualization of fleet characteristics, real-time economic indicators, and inclusion of environmental drivers (e.g., river flow, plankton). Student participants emphasized the importance of user-oriented design, transparency, and decision-support tools for both professionals and other users.

The workshop also underscored broader challenges, including climate-driven species redistribution, market instability, regulatory complexity, and the need for adaptive governance. Proposed solutions included strengthened data sharing, early quota implementation for emerging species, and improved communication across stakeholders.

This interdisciplinary approach demonstrates the value of collaborative frameworks in developing innovative tools to support sustainable fisheries management under changing environmental and regulatory conditions.

Decoding the Biological and Environmental Drivers of European Sardine Spawning: A 26-Year Perspective from the Southern Bay of Biscay

Patricia Cortegoso-Xavier (1), Carmen Hernández Hernández (1), Antonio Bode (1), Pedro Fonseca (2), Susana Garrido (2), Isabel Riveiro (1)

(1) Spanish Institute of Oceanography, (2) Portuguese Institute of the Sea and the Atmosphere

Poster

Sardina pilchardus, European sardine, reproductive dynamics, environmental drivers, Bay of Biscay.

Introduction

The European sardine (Sardina pilchardus) is a small pelagic fish of high ecological and economic importance. In the Northeast Atlantic, the Iberian sardine is considered a single stock extending from the Strait of Gibraltar to the southern Bay of Biscay.

This species plays a key role in marine food webs, acting as an essential intermediate link between plankton and higher trophic levels. Due to the fluctuations observed in their populations in recent decades, it is essential to improve our understanding of the key drivers of sardine recruitment. In multiple spawning species such as sardine, spawning duration is shaped by the interaction between intrinsic factors (e.g., age and body condition) and extrinsic factors (e.g., food availability and environmental conditions).

Methods

The aim of this study is to quantify the influence of these intrinsic and environmental factors on the proportion of spawning sardines during the reproductive season in the southern Bay of Biscay. To address this, we analysed a 26-year time series (1998–2024) combining commercial catch data with spring acoustic surveys (PELACUS) conducted in March and April. We assessed the effects of age, body condition, trophic position, temperature, chlorophyll concentration and zooplankton biomass on spawning activity using generalized additive models (GAMs).

Results and Discussion

Our results provide new insights into the reproductive dynamics of this species and highlight the relevance of integrating physiological and trophic indicators into stock assessment. This approach can contribute to improving fisheries management and preparing for potential shifts associated with climate variability.

Management Strategy Evaluation of Bay of Biscay anchovy incorporating size trends and recruitment uncertainty

Leire Citores (1), Leire Ibaibarriaga (1)

(1) AZTI

Poster

Management Strategy Evaluation, Bay of Biscay, fishery, anchovy, changing productivity

The management of European anchovy (Engraulis encrasicolus) in the Bay of Biscay exemplifies a continuous effort on scientific monitoring systems for adults and recruits, ensuring that the most recent survey information is efficiently incorporated into the management advice process. Since the reopening of the fishery more than a decade ago, the stock has been managed under an agreed management plan. The 2024 benchmark, in which the previous two-stage biomass model was replaced by a statistical catch-at-age model, created the need to re-evaluate the management plan within this updated framework. This new stock assessment also raised concerns about current and future productivity and the resilience of the stock under changing ecological conditions. In the recent period, anchovy body size from the scientific monitoring programs have shown a progressive decline, while recruitments have been the largest of the time series.

In this context, we developed a full-feedback Management Strategy Evaluation (MSE), using FLBEIA tool, conditioned on the most recent stock assessment model. Given the observed patterns in body size and recruitment, we evaluated how alternative assumptions regarding future size trajectories and stock recruitment relationships propagate through the assessment and advice process, and how they may affect the robustness of management strategies. Performance of the current management plan and alternative strategies, such as the ICES escapement approach applied to short-lived species, was evaluated using commonly applied indicators such as, biological risk, expected catches and catch variability.

The results provide valuable insights into the robustness and performance of the current management plan under the updated benchmark framework and in the context of changing ecological conditions. More broadly, this work highlights the value of integrating MSE as a final step in benchmark processes to ensure resilient and adaptive management strategies.

Could collaboration between scientists and fisheries managers improve traceability and reduce mislabelling in the skate and ray trade of the Bay of Biscay? Evidence suggests it can.

Clara Piedrafita Zubillaga (1), Daniel A. Gómez-Lobo (1), Isabel Gómez Álvarez (1), Johanne Wauters (1), Pablo de la Calva Castiñeira (1), Trinidad Pérez (1), Laura Miralles (1), Yaisel Borrell (1)

(1) University of Oviedo

Poster

Accurate identification of skates and rays in commercial fisheries is often challenging due to high morphological similarity between species and phenotypic plasticity within taxa. In already heavily exploited elasmobranchs, this difficulty can lead to frequent misidentification along the supply chain, contributing to commercial mislabelling that obscures catch statistics, facilitates Illegal, Unreported and Unregulated (IUU) fishing, and undermines conservation efforts. Here, we use DNA barcoding to assess species mislabelling in skates and rays (Rajidae) commercialized in primary fish markets of the Cantabrian Sea (southern Bay of Biscay) and evaluate whether collaborative actions between scientists and fisheries managers can improve labelling accuracy. Between November 2024 and March 2025, 416 individuals were genetically identified, representing eight species and revealing an overall mislabelling rate of 23.1%. The most frequently mislabelled species were Raja montagui and Raja brachyura, while Raja clavata was commonly used as a substitute label. During sampling, high phenotypic plasticity was also observed within R. clavata, with eleven distinct dorsal morphotypes documented, further complicating morphological identification at auction. Mislabelling also concealed the commercialization of protected or regulated species, including the sandy skate (Leucoraja circularis) and the undulate skate (Raja undulata). Midway through sampling (February 2025), a collaborative intervention between researchers and fish market managers was implemented. Identification guides were distributed, informal training was provided to fishermen and market staff, and auction labelling categories were partially updated. Following this intervention, mislabelling decreased from 26.6% to 20.6%, demonstrating measurable improvement, particularly for species with newly introduced commercial labels. This case study shows that coordinated actions between scientists and fisheries managers can improve traceability in skate and ray fisheries. Strengthening labelling accuracy, species-specific monitoring and personnel training, together with integrating molecular tools into routine fisheries controls, represents a practical pathway to enhance traceability and support the sustainable conservation of Rajidae populations in the Cantabrian Sea.

Systematic Assessment of PET Bycatch in a Highly Selective Artisanal Tuna Fishery of the Northeast Atlantic

Louzao Maite (1), Oyarzabal Iñaki (1), Onandia Iñigo (1), Ruiz Jon (1), Astarloa Amaia (1), García-Barón Isabel (1), Cotano Unai (1), Uriarte Andres (1)

(1) AZTI

Poster

fisheries bycatch, artisanal tuna fishery, protected species, fishing selectivity, migratory seabirds, Northeast Atlantic.

Fisheries bycatch is a major driver of marine megafauna decline, and international management bodies increasingly require member states to monitor and mitigate impacts on non-target species. Within the Atlantic, ICCAT mandates systematic reporting of bycatch of Protected, Endangered and Threatened species (PETs), yet significant data gaps remain in artisanal fisheries. To help fill this gap, the Spanish artisanal tuna fleet—composed of trolling and pole-and-line métiers—implemented an onboard observer programme in from 2016 to 2019 across the Northeast Atlantic, an important migratory and overwintering corridor for many marine megafauna. We examined catch composition, PET bycatch, and fate of captured individuals. The fishery showed extremely high selectivity, with more than 99% of catches corresponding to target tuna species and negligible discards. PET bycatch events were infrequent, though occasionally involved multiple individuals. Observers documented the presence of 18 PET species in the surrounding area three marine mammals and 15 seabirds). However, only three megafauna (seabird) species actually interacted with the fishery and were bycaught: great shearwater Ardenna gravis (39 individuals), northern gannet Morus bassanus (nine), and northern fulmar Fulmarus glacialis (one). Great shearwater accounted for two-thirds of captures, with more than 90% released alive. Spatial patterns were consistent with species' habitat preferences, with shearwaters primarily captured in oceanic waters and gannets near shelf-slope areas. This study provides the first systematic assessment of PET bycatch for this fleet and fills a key knowledge gap for ICCAT, offering actionable insights for targeted bycatch mitigation and regional conservation planning in the Northeast Atlantic.

Uncovering Changes in Fishing Activities in the South Bay of Biscay Fleet Using Statistical and Machine Learning Approaches

Claire Kermorvant (1), Fourez Carla (2), Bru Noelle (1), Janc Anaïs (3), Weigel Benjamin (3), Cabral Henrique (3), Lissardy Muriel (2), Susperregui Nicolas (4), Henneveux Aurélien (5), Caill-Milly Nathalie (2)

(1) Université de Pau et des Pays de l'Adour, Laboratoire de Mathématiques et de leurs Applications de PAU - UMR 5142 CNRS, F-64600, Anglet, France, (2) Ifremer, COAST, 1 Allée du Parc Montaury, F-64600, Anglet, France, (3) INRAE, EABX, 33612, Cestas, France, (4) Comité Interdépartemental des Pêches Maritimes et des Elevages Marins des Pyrénées Atlantiques et des Landes (CIDPMEM 64-40), 12 quai Pascal Elissalt, 64500 Ciboure, (5) Organisation de Producteurs Pêcheurs d'Aquitaine, 12 quai Pascal Elissalt, 64500 Ciboure

Poster

Machine learning ; Fleet typology ; Spatial descriptors ; Fishing fleet dynamics ; Multivariate analysis

Recent studies show that fishing fleets may exhibit different responses to political, social, economic and environmental pressures and changes. These responses may include spatial or temporal shifts in fishing activity and changes in target species. This study aims to determine whether changes have occurred in the fishing practices of vessels of the Bayonne maritime district. A close collaboration between fishers and scientific institutions enabled the collection, cleaning and analysis of fisheries data since 2005. The approach was applied to twelve species selected for their local importance.

Using several statistical and machine-learning methods, the process for detecting changes in fishing activity was as follows: 1) Define length threshold of vessels based on activity using decision tree to construct fleets; 2) For each fleet and targeted species, investigate temporal and spatial changes in fishing patterns using statistical spatial descriptors (barycenter, ellipses...); 3) Identify similar spatial patterns according the spatial descriptors using a hierarchical clustering performed on the results of a Hill–Smith analysis. This process allows to create a typology of fleet–species-time groups having similar spatial footprint.

Shifts in the spatio-temporal distribution of fishing activity were effectively observed. Hierarchical clustering revealed three main clusters: one includes most large longliners targeting hake in north-west of Ireland, the second contains other large vessels targeting hake and anglerfishes throughout the area, and the third cluster includes small vessels targeting other species in the Bay of Biscay. Within this latter cluster, some species (e.g. sole with small gillnetters) are now predominantly fished further north, while others (e.g. bogue with purse seiners) tend to be targeted more to the south. Most of the patterns revealed in this study differ markedly among the fleets studied, highlighting the importance of working at the fleet-segment level rather than at the scale of the entire fleet.

Evaluating the effects of octopus trap fisheries on benthic habitats and vulnerable species in the Cantabrian Sea

Marina Prieto Amador (1), Augusto Rodríguez-Basalo (1), Marta Ruiz (1), Eva M. Velasco (1), Sebastián Jiménez (1), Berta Ramiro-Sánchez (2), Ana Antolínez (2)

(1) Spanish Institute of Oceanography (IEO), (2) Spanish Institute of Oceanography

Poster

octopus trap fisheries, ROV surveys, benthic habitats

Octopus traps fisheries are a traditional activity along the Cantabrian coast, yet their potential effects on benthic habitats and sensitive species remain poorly understood. Within the BIODIV project, the IMNASHA scientific survey conducted an experimental assessment of the interaction between octopus traps and the seafloor using a Before-After Control-Impact (BACI) design. The study combined ROV surveys, real-time monitoring of the gear, and onboard observation during commercial fishing operations to characterize habitat condition and document sensitive species.

The study took place at three stations in the Sonabia–Castro Verde–Cabo de Ajo (SoCaVA) area, characterized by rocky seabeds and differing levels of fishing pressure. At each station, ROV LIROPUS dives were conducted before, during, and after fishing simulations to record the state of benthic habitats, the presence of sensitive species, and associated marine litter. Twelve fishing operations were performed using lines of octopus traps deployed from a commercial vessel. Acoustic beacons and ROV inspections were used to track gear position and its interaction with the seabed.

Data collection is now complete, and the analysis of habitat impacts, interactions with sensitive species, by-catch, and gear displacement is ongoing. This study will provide the first controlled assessment of the ecological footprint of octopus traps fisheries in rocky habitats of the Cantabrian Sea and inform mitigation strategies to ensure compatibility between small-scale fishing and the conservation of ecologically valuable benthic communities.

Towards trustworthy Artificial Intelligence for Marine Research, Fisheries and Environmental Management

Jose A. Fernandes-Salvador (1)

(1) AZTI

Poster

Artificial Intelligence, ethics, conservation, marine science, fisheries, biodiversity, marine policy, marine economics, international law, European Artificial Intelligence Act, best practices, trustworthy artificial intelligence

Artificial Intelligence (AI) is advancing at an unprecedented pace, offering transformative opportunities for marine research, fisheries management, environmental governance, and policy development. Particularly in the context of the interconnected data needs of ecosystem management and biodiversity conservation. These technologies can enhance data acquisition, processing, and decision support, enabling more integrated approaches to ecosystem management and biodiversity conservation. Yet their adoption in these domains remains limited by the absence of coherent frameworks that ensure transparency, validation, and ethical alignment with ecological and socio-economic sustainability goals. This work proposes a comprehensive framework built on three critical pillars for trustworthy AI: socio-economic and legal viability, data governance, and technical and scientific robustness. On the one hand it aims to be a guideline for developer teams. On the other hand, it aims to be a guideline for final users (e.g. industry and managers) for designing the requirements and evaluating such systems. The first pillar underscores the need for AI systems that are cost-effective, scalable, environmentally sustainable, and legally supported, balancing short-term costs with long-term social and ecological benefits. The second stresses adherence to fair, reliable, and ethical access to digital resources, recognising that without strong governance, data and algorithms risk becoming fragmented or misused. The third pillar addresses the necessity of rigorous validation across entire AI pipelines, including preprocessing, model evaluation, and benchmarking against alternative ground truths, to ensure reliability in real-world applications. Together, these pillars provide a blueprint for developing ethical, reliable, and policy-relevant AI systems that can strengthen trust, improve sustainability, and guide decision-making across marine science, fisheries, environmental management and European legislation.

Long-Term Changes in Life-History Traits of Atlantic Horse Mackerel (Trachurus trachurus) in the Southern Bay of Biscay (2007–2025)

Hernández Carmen (1), Dueñas-Liaño Clara (2), Navarro María Rosario (2), Costas Gersom (3)

(1) Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Santander, Calle Severiano Ballesteros, 16, 39004, Santander, Spain, (2) Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Santander, Calle Severiano Ballesteros, 16, 39004, Santander, Spain., (3) Instituto Español de Oceanografía (IEO-CSIC), Centro Oceanográfico de Vigo. Subida a Radio Faro, 50-52, 36390 Vigo, Spain.

Poster

Atlantic horse mackerel (Trachurus trachurus), life-history traits, growth, temporal trends, Bay of Biscay

Introduction

The Atlantic horse mackerel (Trachurus trachurus) is a medium-sized pelagic species widely distributed in the Eastern Atlantic and Mediterranean, structured into several stocks. This study focuses on the western stock in the Eastern Atlantic, specifically on its southern distribution limit in the Cantabrian Sea and the southern Bay of Biscay (ICES Division 8c), an area that represents a transition zone with the southern stock. In recent years, ICES stock assessments have highlighted a marked decline in spawning stock biomass (SSB), reaching historical minima, which led to the implementation of a fishing moratorium in 2023 and 2024. These changes point to potential shifts in population status and underline the need to better understand temporal variability in life-history traits.

The aim of this study is to analyse interannual fluctuations in key biological parameters, including length frequency distribution, length–weight relationships, mean length, growth, and condition factor, using a 19-year time series (2007–2025) derived from the Spanish Institute of Oceanography (IEO-CSIC) sampling programme. Growth patterns were assessed using the von Bertalanffy Growth model, as well as potential and logistic models. Results reveal notable temporal changes in mean length and growth dynamics, together with shifts in condition, suggesting variability in population structure and individual performance over time. Importantly, a degree of parallelism is observed between the trends in several biological parameters and the decline in SSB estimated for the stock.

These findings contribute to a more comprehensive understanding of the biological dynamics of horse mackerel at the southern limit of its distribution and provide relevant context for interpreting the current stock status, with implications for its management and sustainable exploitation.

SESSION 7:
BIODIVERSITY, STRUCTURE AND FUNCTIONING OF ECOSYSTEMS

Decadal Shifts in Phytoplankton Size Structure Across French Coastal Ecosystems

Adrien Voisin (1), Noailly Agathe (2), Jude-Lemeilleur Florence (1), Gailhard-Rocher Isabelle (3), Lheureux Arnaud (1), Lemoine Maud (4), Claquin Pascal (5), Savoye Nicolas (1), Lefebvre Alain (4), Sautour Benoit (1), Del Amo Yolanda (1)

(1) UMR CNRS 5805 EPOC, (2) UMR CNRS 5805 EPOC & EPHE - PSL, (3) OFB, (4) IFREMER, (5) MERSEA, Caen University

Oral

Phytoplankton diversity, Size structure, Coastal ecosystems, Climate change, Ecological trajectories

According to literature estimates, 60–80% of the planet's biodiversity are harbored by marine ecosystems, within which coastal ecosystems represent key biodiversity hotspots. These diverse and dynamic regions are increasingly threatened by climate change, which drives ocean warming, alters nutrient regimes, and amplifies anthropogenic pressures. Due to its short life cycle, and high metabolic plasticity, phytoplankton responds rapidly to environmental variations, making it particularly relevant for detecting and understanding ongoing ecosystem changes. Using a decade (2012-2022) of long-term monitoring data from SOMLIT and PHYTOBS-networks (Research Infrastructure ILICO) across seven contrasted French coastal sites localized in the English Channel/North Sea, the Atlantic (Celtic sea and Bay of Biscay) and the Mediterranean façades, this study investigates spatial and temporal variations in phytoplankton community composition. Particular attention was given to phytoplankton size structure (pico-, nano-, microphytoplankton), an essential ecological trait that remains relatively underexplored under the full spectrum of size classes integrative view. To address this question, we analyzed a decadal time-series data of phytoplankton size-class dynamics to detect temporal trends and identify the environmental drivers influencing their variability. Spatio-temporal variability across sites is also investigated using a multivariate approach coupling phytoplankton community composition with environmental variables. Over the 2012-2022 period, ecological trajectories exhibited a widespread increase of picophytoplankton abundances at all stations, primarily linked to local (+0.44 to +1.81°C) and global warming (NHT index) during this period, and was systematically associated to the picoeucaryote group increase. In warmer and oligotrophic Mediterranean sites where cyanobacteria are distinctly prevalent, the picophytoplankton increase is also due to the rise of the cyanobacteria community itself. In all other facades, characterized by more eutrophic conditions, lower temperatures and a relatively even distribution of other phytoplankton groups (large diatoms and pico- and nano-eukaryotes), a significant rise of cryptophytes was also observed. These overall observed shifts towards smaller phytoplankton communities are liable to profoundly affect trophic dynamics, ecosystem resilience and the associated ecosystem services.

Phytoplankton production, trophic cycling and vertical carbon export in oceanic waters of the Gulf of Biscay during summer oligotrophic conditions

Andrés Gutiérrez Rodríguez (1), Mikel Latasa (1), Bellineth Valencia (1), Alejandro Isla (1), Viena Puigcorbé (2), Paula Sabaté-Fábregas (2), Bernardo Pérez (3), Enol Navarro-Murillo (1), Felipe González (1), Teresa Granell (1), Pilar Fernández (1), Xosé Anxelu Gutiérrez Morán Gutiérrez Morán (1), Raquel Somavilla (3), Renate Scharek (1)

(1) Centro Oceanográfico de Gijón (IEO-CSIC), (2) Institut Ciències del Mar (ICM-CSIC), (3) Centro Oceanográfico de Santander (IEO-CSIC)

Oral

Primary production, phytoplankton, microzooplankton grazing, microbial foodwebs, carbon cycling, vertical export

The biological carbon pump comprises a suite of biological processes that transport photosynthetically fixed organic carbon from the upper ocean to deeper layers. This key mechanism regulates atmospheric CO2 by storing organic matter and remineralized CO2 in the ocean interior. Despite its importance for marine ecosystem functioning and Earth's climate, our quantitative understanding of the BCP remains limited, partly due to the strong temporal and spatial variability of its driving biological and physical processes, as well as the scarcity of export measurements. Here, we present depth-resolved measurements of phytoplankton biomass and production, zooplankton grazing and vertical carbon export rates obtained during the first cruise of the BIOTROPHEX project (RV Ángeles Alvariño, 2-13 September 2024), which aims to characterize plankton-mediated biogeochemical and trophic fluxes in oceanic waters of the Gulf of Biscay (RADCAN time-series station G4, 4700 m). These measurements were conducted using a quasi-Lagrangian sampling strategy, tracking the same water parcel for 5-7 days (hereafter “cycle”) with two drifting arrays. One array was equipped with an in situ incubation system for daily 14C-primary productivity and dilution grazing experiments across the euphotic zone, while the second carried VERTEX-type sediment traps deployed at 125, 200, and 500 m depth to quantify particle carbon export via gravitational sinking over a ‘cycle’. In addition, daily samples were collected for dissolved inorganic nutrients, particulate organic carbon, total and size-fractionated and chlorophyll a and mesozooplankton gut fluorescence. Surface chlorophyll a concentrations (0.16 ± 0.012 mg Chla m-3) and depth-integrated primary productivity (311 ± 35 mg C m-3 d-1) were low, consistent with strong stratification and oligotrophic conditions. Microzooplankton grazing was tightly coupled to phytoplankton growth, consuming up to ~90% of daily primary production, whereas mesozooplankton herbivory consumed only a minor fraction of this production (1-3%). Accordingly, carbon export via gravitational sinking was low, with ~5% of primary production being exported down to 100 m. However, a substantial fraction of the exported carbon reached 200 and 500 m, indicating a low attenuation through the upper mesopelagic zone. Overall, these results depict a low-production, low-export regime during the summer oligotrophic conditions, where phytoplankton production is largely balanced by losses, primarily through microzooplankton grazing, which channels most of this carbon towards the microbial food web and limits both direct mesozooplankton consumption and vertical carbon export.

Twenty-Six-Year Copepod Dynamics in the Lower Zone of Two Estuaries in the SE Bay of Biscay (1998–2023)

Iratxe Rubio (1), Ibon Uriarte (1), Fernando Villate (1), Arantza Iriarte (1)

(1) Euskal Herriko Unibertsitatea

Oral

Estuaries under anthropogenic pressure may exhibit long-term changes in zooplankton density, but also alterations in zooplankton phenology, seasonality, and extreme-event frequency. To test whether zooplankton time series differ in trajectory and stability between estuaries with contrasting anthropogenic pressure, we analysed log-transformed densities of 12 copepod taxa (1998–2023) from the neritic waters of two estuaries of the Basque coast (southeast Bay of Biscay): an anthropogenically impacted system (Bilbao) and a protected one (in the Urdaibai Biosphere Reserve). To disentangle seasonality, interannual trends, and autocorrelation, we fitted generalized additive mixed models (GAMMs) with an AR(1) structure in residuals for each estuary. We compared candidate models combining: (1) a common versus estuary-specific temporal trend and (2) a common versus estuary-specific seasonal pattern. Model selection was based on AIC (fits under ML) and the best-supported model for each taxon was refitted using REML for inference and diagnostics. Estuary-specific seasonality explained most taxa variations (7/12), pointing to a predominantly phenological signal. Evidence for divergent long-term trajectories between estuaries was limited (3/12 taxa). The remaining two taxa were adequately described by a shared seasonal pattern and a common inter-annual trend across estuaries. In addition, effect magnitudes (log-units·year^{-1}) were higher in the anthropogenically impacted estuary for the taxa exhibiting estuary-specific trajectories. Extreme-event frequency and persistence were also assessed and found to be taxon-dependent. Overall, these findings suggest that differences between the analysed estuaries are expressed more strongly in variability and phenology than in long-term mean trends, with potential consequences for trophic coupling, intermittent food availability for consumers, and the predictability of estuarine functioning.

PHYSALIA: a project to understand the biology and ecology of the Man’o’War

José Luis Acuña-Fernández (1), Susana Acle (2), Itziar Álvarez-Trasobares (3), Leocadio Blanco-Bercial (4), Jorge Cabrera-Gámez (5), Mario Cabrera-Lavara (6), Gemma Capeans (6), Antonio Domínguez-Brito (7), Pili Fernández-Martín (8), May Gómez-Cabrera (9), Fernando González-Taboada (8), Carlos Guardado-Fernández (6), Alicia Herrera (9), Juan Höfer (10), Iñaki Huskin (8), Mario Iglesias (11), Alejandro Isla (8), Yago Iván-Baragaño (6), Melanie Juza (12), Angel López-Urrutia (8), Diego Macías-Moy (13), Ico Martínez-Sánchez (14), Deva Menéndez-Teleña (15), Itziar Munuera-Fernández (8), Laura Prieto (16), José Manuel Rico Ordás (6), Ramón Rubio-García (11), Javier Ruiz-Segura (17), Verónica Soto-López (18), Nicolás Weidberg-López (6)

(1) University of Oviedo, (2) Bioparc Acuario de Gijón, Playa de Poniente s/n · 33212 Gijón · España, (3) Grupo Oceanografía de Ecosistemas, Instituto de Ciencias Marinas de Andalucía (ICMAN-CSIC), Avda. República Saharaui s/n · 11510 Puerto Real · Cádiz · España, (4) Bermuda Institute of Ocean Sciences - Arizona State University, St George's Bermuda, (5) Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería (IUSIANI), ULPGC, C/Pract. Ignacio Rodríguez s/n · 35017 Las Palmas, (6) Observatorio Marino de Asturias, Departamento de biología de Organismos y Sistemas, Universidad de Oviedo, C/ Catedrático Rodrigo Uría, SN · 33006 Oviedo · Asturias · España, (7) Instituto Universitario de Sistemas Inteligentes y Aplicaciones Numéricas en Ingeniería (IUSIANI), ULPGC, C/Pract. Ignacio Rodríguez s/n · 35017 Las Palmas · España, (8) Centro Oceanográfico de Gijón (IEO-CSIC), Avda. Príncipe de Asturias, 70 bis · 33212 Gijón · España, (9) Marine Ecophysiology Group (EOMAR). IU-ECOAQUA, University Las Palmas de Gran Canaria, Departamento de Biología, Edificio de Ciencias Básicas, Campus Universitario de Tafira, Universidad de Las Palmas de Gran Canaria 35017 Las Palmas de Gran Canaria · España, (10) Pontificia Universidad Católica de Valparaíso (PUCV), Av. Brasil, 2950 · Valparaíso · Chile, (11) Cátedra MediaLab, Universidad de Oviedo, Campus de Gijón, Edificio Polivalente, C. de Luís Ortiz Berrocal, s/n, Planta 3, 33203 Gijón, Asturias, Spain, (12) SOCIB – Sistema de Observación y Predicción Costero de las Illes Balears, Parc Bit · Edificio Naorte · 07121 Palma · Illes Balears · España, (13) Joint Research Centre (JRC), Comisión Europea – Ispra, Via Enrico Fermi, 2749 · 21027 Ispra (VA) · Italia, (14) Martínez Sánchez, Ico email: ico.martinez@ulpgc.es name: Ico surname: Martínez Sánchez work center: Universidad de Las Palmas de Gran Canaria (ULPGC), C/ Juan de Quesada, 30 · 35001 Las Palmas de Gran Canaria · España position: Technician, (15) Menéndez Teleña, Deva email: menendezdeva@uniovi.es name: Deva surname: Menéndez Teleña work center: Departamento de Ciencia y Tecnología Náutica Universidad de Oviedo, C/ Blasco Garay s/n · 33394 Gijón · Asturias · España position: Assistant Professor, (16) Grupo Oceanografía de Ecosistemas, Instituto de Ciencias Marinas de Andalucía (ICMAN-CSIC), Avda. República Saharaui s/n · 11510 Puerto Real · Cádiz · España, (17) Consejo Superior de Investigaciones Científicas (CSIC), C/ Serrano, 117 · 28006 Madrid · España, (18) Departamento de Ciencia y Tecnología Náutica Universidad de Oviedo, C/ Blasco Garay s/n · 33394 Gijón · Asturias · España

Oral

Sailing, Physalia physalis, beaching, Cantabrian Sea, navigation model, observation

Venomous, stinging Man’o’War *Physalia physalis* represent a growing concern in the coasts of the Bay of Biscay, where their presence and abundance has increased markedly in recent years. Modelling the arrival of those animals to our beaches has been a main focus of research, although physical models of navigation of these natural sailors still rely on a handful of old *in situ* observations. Project PHYSALIA brings together a team with diverse scientific and technological backgrounds to understand and model the biology and ecology of *P. physalis* using state of the art methods, with a particular emphasis on their navigation patterns at a range of scales from local to global. So far, PHYSALIA has conducted field observations of sailing animals using drones in combination with wind and current measurements. These observations reveal a unique behavior which is at odds with the common perception of these animals as passive drifters, which will require refinement of current navigation models. Moreover, the PHYSALIA consortium has maintained P. physalis colonies in captivity during long, unprecedented periods, collecting precious biological information. In a second phase of the project, material and virtual replicates of *P. physalis* will be deployed at sea and in silico to verify hypotheses about their navigation and population biology.

Environmental and geographic drivers of Physalia physalis strandings in Asturian coast

Gemma Capeáns-García (1), Yago Iván-Baragaño (1), Carlos Guardado (1), Leticia Viesca (1), Iñaki Huskin (2), Anna Cunill (3), Ángel López-Urrutia (2), Itziar Munuera (2), Pili Fernández (2), José Alejandro Isla (2), Susana Acle (4), Ana Marrero (5), José Luis Acuña (1), Fernando González-Taboada (2)

(1) Universidad de Oviedo, (2) Centro Oceanográfico de Gijón (IEO-CSIC), (3) Universidad de Las Palmas de Gran Canaria, (4) BIOPARC Acuario de Gijón, (5) Protección Civil 112 Asturias

Oral

Physalia physalis, monitoring, morphology, stranding

The presence of the colonial siphonophore *Physalia physalis* has increased in recent years in the southern Bay of Biscay. The arrival of vagrant colonies to the shore poses a public health risk that triggers beach closures, causing social alarm and harming local economies. On the other hand, the inability to detect and characterize the strandings hinders further understanding and poses a challenge for scientists and coastal managers. Here, we present results from a field monitoring network deployed along the Asturian coast during the summer of 2025, with the aim of mapping the incidence and identifying the environmental drivers leading to *Physalia physalis* stranding in the southern Bay of Biscay. By coordinating reports from emergency services and citizen science platforms, we recorded the date, location, and abundance of 2,000 stranding events, and characterized the morphology of more than 1,000 colonies. Strandings showed a highly aggregated distribution, with synchronous events lasting a few days and simultaneously affecting tens of kilometers of coastline that lead to 47 beach closures. Daily abundance averaged 40 colonies but reached peaks over 300 colonies during midsummer. Pneumatophore length increased progressively through summer from a few mm to up to 30 cm. The arrival of the two chiral morphs alternated depending on prevailing wind conditions, but the right-handed chiral morph predominated over the season (90%). We further analyzed the association between strandings and meteorological conditions, in relation to coastal orientation and exposure, to identify the environmental drivers and to map coastal hotspots of stranding risk. Our results provide a high-resolution observational baseline for the development of predictive models and early warning systems of *Physalia physalis* strandings in the Bay of Biscay, toward an anticipative, proactive coastal management in a changing ocean.

Surface scattering layers (SSL ‘zikiña’): microbubbles trapped by jelly

Enrique Nogueira (1), Beatriz Sobradillo (2), Isabel Maneiro (1), María Santos (2), Esther Velasco Senovilla (1), Udane Martínez (2), Guillermo Boyra (2)

(1) Centro Oceanográfico de Vigo (IEO-CSIC), (2) AZTI Basque Research & Technology Alliance

Oral

Sound Scattering Layers (SL), 'Zikiña', Gelatinous zooplankton, Glycosaminoglycans (GAGs), Bay of Biscay

Introduction

Scattering layers (SL) are recurrent acoustic signatures in the ocean1. In JUVENA cruises, conducted every September since 2003, surface scattering layers (SSL) are usually encountered in the epipelagic (20-40 m depth), extending from the outer shelf to oceanic domains in some areas of the Cantabrian Sea, the typical habitat of juvenile anchovies. Basque purse-seine fishermen refer to these SSL as ‘zikiña’ (meaning ‘trash’ or ‘debris’ in Basque) due to their appearance on ecograms. They also report that this SSL often interfere with the distribution of anchovies.

Methods

During JUVENA 2021 cruise, we characterised the acoustic properties of the SSL-zikiña and collected plankton samples within this layer for ground-truthing of the observed echo traces. To do this, we used a Bongo net (40 cm mouth diameter, 335 µm mesh-size) equipped with flowmeters to estimate the filtered volume and a transponder that enabled real-time monitoring of the trawl trajectory through the SSL-zikiña via the vessel’s HiPAP (high precision acoustic positioning). After each haul, the nets were not rinsed to avoid damaging the delicate gelatinous organisms and minimise sample handling prior to imaging. Fresh zooplankton samples were analysed onboard immediately after retrieval using an in-flow imaging device (FlowCam Macro).

Results and Discussion

A total of 15 zooplankton hauls were carried out at locations where an SSL-zikiña was observed in the echograms. Zooplankton abundance in this layer ranged from low to moderate (7-617 ind·m-3), with an overall mean of 154 ind·m-3. Non-gelatinous zooplankton accounted for an average 80.4 % (range: 58.5 to 97.8 %), whereas gelatinous organisms represented the remaining 19.6 % (range: 2.2 to 41.5 %). When expressed as biovolume, however, the relative contribution of gelatinous organisms surpasses that of non-gelatinous.

The non-gelatinous assemblage was dominated by small radiolarians (class Acantharia; average abundance 41.5 %; ca. 74-200 µm ESD central capsule) and medium-sized calanoid copepods, mainly from the genera Temora, Acartia, Centropages and Paracalanus (average abundance 16.7 %; 1-2 mm body length). The gelatinous component comprised blastozooids and oozoids of salps from the genera Thalia and Salpa (average 5.5 %; 1-8 mm body length), siphonophores of the suborders Physonectae and Calycophorae (average 3.7 and 1.2 % respectively), colonial Radiozoa (suborder Collodaria; average 4.5 %), Appendicularia (order Copelata; average 1.2 %) and doliolids (average 0.3 %). These organisms are highly watery and contain / secrete sticky organic polymers, known as glycosaminoglycans (GAGs). Acoustically, all these gelatinous organisms are classified as ‘fluid-like’ scatterers, with the exception of the ‘gas-bearing’ Physonectae siphonophores whose colonies contain a small pneumatophore (of ca. 0.8 mm average length).

At first glance, it may seem counterintuitive to link the acoustic characteristics of the SSL-zikiña -a fairly strong signal detectable at all frequencies, peaking at 38 and 70 kHz- to the zooplankton abundance and composition within this layer, given their low to moderate concentration and the presumed 'fluid-like' nature of most of the organisms. However, the acquired images of gelatinous zooplankton revealed the presence of microbubbles adhered to the surface of the bodies of salps oozoids and blastozooids, to specialised zooids of the colony of siphonophores (e.g. nectophores), or to the matrix embedding the colonial radiolarians.

The plausible adhesion of air microbubbles to the GAGs-rich surfaces of gelatinous organisms is a well-documented physio-chemical process. In several onboard experiments, in which samples collected from the SSL-zikiña plankton tows were immersed in air oversaturated seawater, we confirmed that the number of microbubbles attached to the surface of gelatinous organisms increased significantly after immersion. An acoustic backscattering model2 confirmed that the size of the attached microbubbles, which ranged between 50 and 200 µm diameter, was consistent with the acoustic characteristics of the SSL-zikiña. Additionally, it is important to note that the estimated concentration of gelatinous organisms in the samples likely underrepresents their true abundance in the SSL-zikiña because nets were not rinsed, and, despite careful sample handling and processing, these extremely fragile organisms inevitably deteriorate or fragment before imaging.

In summary, we infer that the SSL-zikiña originates from the presence of substantial amounts of gelatinous organisms capable of retaining air microbubbles due to their GAG-rich compounds that constitute their tissues. Acoustically, this ability effectively confers 'gas-bearing' properties to organisms that would otherwise be 'fluid-like' scatterers. The adhered microbubbles likely originate from atmospheric entrainment associated with breaking waves3 and from phytoplankton production within the subsurface chlorophyll maximum layer (SCML) at the pycnocline, a characteristic late-summer feature in the Bay of Biscay that promotes oxygen oversaturation4 and the formation of microbubbles, which subsequently rise toward the surface layer through buoyancy (bubble detrainment), and can be eventually trapped by gelatinous organisms and their jelly remains (e.g. larvacean houses).

[1] 1 Proud R. et al. 2018. Fine-scale deth structure of pelagic communities throughout the global ocean based on acosutic sound scattering layers. Marine Ecology Progress Series 598: 35-48. Doi: 10.3354/meps12612.
[2] 2 Shima A. 1970. The natural frequency of a bubble oscillating in a viscous compressible liquid. Journal of Fluids Engineering, Transactions of the ASME, 92: 555–561. Doi: 10.1115/1.3425065.
[3] 3 Deane G.B. et al. 2013. The suspension of large bubbles near the sea surface by turbulence and their role in absorbing forward-scattered sound. IEEE Journal of Oceanic Engineering 38 (4): 632-641. Doi: 10.1109/JOE.2013.2257573.
[4] 4 Serret P. et al. 1999. Seasonal compensation of microbial production and respiration in a temperate sea. Marine Ecology Progress Series 187: 43-57. Doi: 10.3354/MEPS187043.

Role of macrozooplankton predatory species in shaping the mortality of European anchovy early life stages in the Bay of Biscay

Beñat Campo Mendizabal (1), Naroa Aldanondo (1), Guillermo Boyra (1), María Santos-Mocoroa (1), Unai Cotano (1), Aitor Albaina (2)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) University of the Basque Country (EHU), Department of Zoology and Animal Cell Biology

Oral

Bay of Biscay, DNA, egg and larval mortality, European anchovy, hatch-date distribution, macrozooplankton, otolith, predation, qPCR, recruitment

Recruitment success in small pelagic fish populations, such as the European anchovy, is mainly determined by the degree of survival in their early life stages (ELSs), particularly eggs and larvae. It is commonly assumed that predation is a major source of mortality during ELSs and can also influence the size structure of survivors through growth-selective processes. While the mortality exerted by planktivorous fish is well known, that exerted by other potential predators, such as various macrozooplankton species, remains largely unstudied. The present study has aimed to assess the mortality on anchovy ELSs by macrozooplankton species in the Bay of Biscay. A total of 12 macrozooplankton samples were collected during May -the anchovy peak spawning period- in 2024, covering most of the spawning area from inshore to offshore waters. The composition of the macrozooplankton community revealed a distinct cross-shelf pattern. Quantitative PCR assays were conducted with an anchovy-specific probe in order to detect anchovy DNA traces within the guts of 612 individual macrozooplankton specimens and, in consequence, to detect anchovy ELS predation events. qPCR assays confirmed predation on anchovy ELSs by 27 taxa out of the 53 tested. Mysids showed the highest prevalence of positive results for anchovy remains; their abundance being positively associated with a shallower depth, this could suggest a high predatory pressure on the anchovy ELSs in the inner-shelf area. The estimated mortality was contrasted with the hatch-date distribution of the juveniles collected in September, which found no recruits originated from this period. Although the mortality exerted by planktivorous fish must have had a similar or even greater impact, our results suggest that predation by macrozooplankton could be significantly contributing to the lack of recruits found during the anchovy spawning peak in 2024 in the Bay of Biscay.

Northeast Atlantic neuston dynamics reveal rapid tropicalisation in the Bay of Biscay (2014-2025)

Yago Iván-Baragaño (1), Gemma Capeans-García (1), Nicolás Weidberg (1), Ángel López-Urrutia (2), Fernando Taboada (2), José Luis Acuña (1)

(1) Departamento de Biología de Organismos y Sistemas, Universidad de Oviedo, (2) Centro Oceanográfico de Gijón, Instituto Español de Oceanografía - CSIC

Oral

Neuston, Tropicalisation, Bay of Biscay, Global change, Citizen science

Tropicalisation is the increasing occurrence of subtropical marine species in temperate regions, which often reflects regional shifts in atmospheric and oceanic dynamics driven by global climate change. These shifts primarily affect the ocean surface, the habitat of neustonic organisms. In the Bay of Biscay, tropicalisation is well documented in benthic and pelagic marine species, but its effect on neuston remains unclear. In recent years, emblematic neuston species like *Physalia physalis* and *Velella velella* have been repeatedly reported in the region. However, it remains unresolved whether these reports represent vagrant colonies or a broader environmental response consistent with tropicalisation.

To address this knowledge gap, we used citizen-science records to characterise the stranding patterns of nine neustonic species across the Northeast Atlantic, differentiating them by their surface navigation strategies and typical ranges. Data were standardised and filtered to minimise taxonomic, spatial and sampling-effort biases. Seasonal and long-term dynamics were assessed using Quantile Generalised Additive Models (QGAMs), while regional trends were evaluated via Generalised Linear Models, post-hoc comparisons, and correlations with key environmental drivers.

Our results reveal a persistent seasonal signal across species, alongside a significant increase in the relative occurrence of *P. physalis* in the Bay of Biscay compared to other Northeast Atlantic areas. Records in this basin surged from being rarely observed prior to 2019 to comprising more than 9% of regional coastal reports in 2025. These patterns align with a recent intensification of North Atlantic westerlies redirected toward the Bay during spring, which persist over summer inside the basin weakening the classical northeast wind regime. Overall, our findings strongly suggest the expansion of tropical neuston species to temperate regions, mirroring tropicalisation trends reported for other marine taxa in a changing climate.

Experimental assessment of Predation behavior and feeding preferences of introduced flatworm Postenterogonia orbicularis on wild and cultivated bivalve species in Arcachon Bay

Guillaume Bernard (1), Nowaczyk Antoine (2), Villetorte Quentin (1), Vieira Johan (3), Massé Cécile (4)

(1) Ifremer ODE/COAST/LERAR, (2) University of Bordeaux, (3) CAPENA, (4) Patrinat

Oral

A new polyclad flatworm has been observed within oyster farms in Arcachon Bay in 2020. The discovery of this non-indigenous species, now identified as Postenterogonia orbicularis, coincided with a high oyster and mussel mortality that raised the question of its potential impact on bivalve farming activities. It was however unclear if flatworms preferentially feed on living bivalve trough active predation or behave as necrophagous/scavenger feeding on dead organisms.

Given the fact that the exact diet of P. orbicularis is largely unknown, addressing the feeding preferences as well as the kinetics and rates associated with P. orbicularis nutrition appeared of particular importance. The present study aimed to assess the feeding preference of P. orbicularis among six types of preys belonging to five species of native and exotic bivalves present in Arcachon Bay. The kinetics associated with predation and feeding of single P. orbicularis individuals have then been obtained based on the analyses of video footages obtained during experiments carried out in controlled conditions under IR light, either involving a single type of prey or the six types together. The effect of the vitality of the bivalve preys (dead or alive) on feeding behavior of P. orbicularis has also been tested based on a similar experimental set-up.

Among the six types of tested prey, mytilids and especially the NIS Asian date mussel Arcuatula senhousia, were significantly the most predated by P. orbicularis individuals, whereas flat oyster Ostrea edulis was not predated in our experiment involving a single flatworm. This preference was also confirmed by (1) a shorter lag-time for flatworm to initiate a predation event on mytilids than on oyster Magallana gigas, and (2) the systematic choice of A. senhousia or Mytilus spp. as the first prey when choice was given to flatworm in plurispecific experiments. Regarding the vitality of the prey, results indicated that freshly dead mussels were also preferentially targeted by P. orbicularis individuals compared to living bivalves. In exploring these feeding preferences, our results would then contribute to better understand and unravel the potential impact of the arrival of P. orbicularis in European waters for bivalve populations.

From estuary to open coast: Spatiotemporal dynamics of soft-bottom marine benthic alien species over 31 years in the Basque coast (SE Bay of Biscay)

Iñigo Muxika (1), Izaskun Zorita (1), Azeez Baki (2), Ángel Borja (1)

(1) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia, Portualdea z/g, Pasaia20110, Spain,
(2) Thomas More University of Applied Sciences, Mechelen Campus Botanique, Lange Ridderstraat 44, 2800, Belgium

Oral

Exotic species, Macroinvertebrates, Introduction, Trends, Basque coast

Marine biological invasions are accelerating under the combined pressures of global trade and climate change, posing one of the most significant threats to marine biodiversity. In this study, we assessed the temporal and spatial patterns of soft-bottom marine benthic alien species along the Basque coast (SE Bay of Biscay) using annual data collected from 51 estuarine and coastal stations between 1995 and 2025. Species records were compared against a compiled list of 373 marine macroinvertebrates considered exotic, cryptogenic, or invasive in the Bay of Biscay based on recent literature. A total of 30434 records corresponding to 1,549 species were examined, of which 61 were classified as non-indigenous species (NIS) (4.1%). The percentage of NIS increased significantly over time, with annual introductions ranging from 0 to 6 newly detected species. The highest NIS number percentages (>12%) were recorded at several stations across the Urola, Bidasoa, Nerbioi, Deba, and Oiartzun estuaries, all of which correspond to highly urbanized systems with industrial activities, port operations, or intense maritime/river transport, and a long history of anthropogenic pressure. In contrast, the lowest NIS values occurred at the most coastal, open-water stations, which experience lower anthropogenic influence and reduced propagule retention. These findings underscore the importance of targeted monitoring and adaptive management strategies to mitigate the spread of NIS in the region’s estuarine and coastal ecosystems. Work funded by the Agencia Vasca del Agua (URA).

Updated Distribution of the Invasive Species Postenterogonia orbicularis, with a New Record for Europe and Particular Emphasis on Marine Traffic as its Way of Dispersal

Emma Shorter Rodríguez (1), Ricardo López Alonso (1), Verónica Soto López (2), Deva Menéndez Teleña (2), Esteban Pascual Parra (1), María Diez Muños (4), Pelayo Rico Fernández (1), Ana del Cerro (3) y José M. Rico (1)

(1) University of Oviedo, Department of Organisms and Systems Biology

(2) University of Oviedo, Department of Nautical Science and Technology

(3) Regional Agrifood Research and Development Servicie (SERIDA, Gijón) Department of Animal Health

(4) IEOceanographic Centre of Santander

Oral
Biological Invasions, Polyclad flatworms, Aquaculture, Mussel and Oyster Farming, Pest

The invasive flatworm Postenterogonia orbicularis, native to New Zealand and Australia, was first recorded in Europe in 2023 along the Bay of Biscay (northern Spain). This polyclad species is carnivorous, preying on economically important bivalves, such as mussels and oysters. In its native range, it is considered a pest for aquaculture facilities specialising in mussel culture, suggesting a potential threat to Spanish bivalve farms. Its introduction is most likely linked to maritime traffic or aquaculture activities, consistent with global patterns of human-mediated dispersal. This study presents a comprehensive inventory of all known records of the species, documents its first occurrence in the Mediterranean and updates its distribution across Spanish waters. A total of 2,071 specimens of P. orbicularis were recorded across multiple locations along the Spanish coast, including locations in the Bay of Biscay, Sada (Coruña) and, for the first time, the Mediterranean Sea (Valencia). Morphological and molecular techniques (COI) were used to identify the specimens. The phylogenetic analysis indicates slight differentiation between Atlantic and Mediterranean samples, as well as affinity between some Asturian and Japanese specimens, suggesting different introduction events. Maritime connectivity analyses indicate that all sampled sites are linked via shipping routes to potential source regions (New Zealand, Japan) and secondary hubs (France), supporting ship-mediated dispersal as one of the most plausible pathways of introduction. Studying an invasive species such as P. orbicularis is essential for determining how to manage the invasion better and alert potentially endangered sectors such as aquaculture.

Lesion recovery in Eunicella verrucosa: regeneration patterns observed in aquaria

Álvaro Romo (1)

(1) Aquarium de San Sebastián

Oral

Basque coast, Ecosystem engineering, Octocorallia, Tissue regeneration, Coral aquaculture

Anthropogenic activities and climate change impacts are responsible of tissue damage in benthic coral forests. In octocorals, these lesions lead to tissue loss, exposing the skeletal axis and removing the main layer of defense against pathogens, diseases, and epibionts. While tissue regeneration is a widely known process, it is essential to understand the regenerative capacities of corals to manage and develop more actively and effectively, methods for its maintenance and recovery. Therefore, the objective of this study is to assess the regenerative capacity of *Eunicella verrucosa*, a temperate cold-water octocoral of great ecological importance, after inducing a mechanical lesion leaving the axial skeleton bare. The lesion recovery, at macroscopic and microscopic level and its daily regeneration rate along time, was assessed according to three factors: nubbin size, lesion size and sex. The results showed that, under present experimental conditions, *Eunicella verrucosa* nubbins are able to recover from lesions of different sizes (2.5 - 11.6 mm^2) in less than a month. It can be concluded that the recovery process is similar to the one described for tropical corals, and is dependent on the sex of the coral, and lesion and fragment sizes. This study provides new information on tissue regeneration in octocorals, which can be used to improve and ease their maintenance and management both in aquaria and in the field.

Using biophysical modelling to improve eDNA survey design and timely detections

Ane Pastor-Rollan (1), Craig Sherman (2), Morgan Ellis (2), Kate Tuohey (2), Ross Vennell (3), Cian Foster-Thorpe (4), Eric Treml (5)

(1) Technical University of Denmark (DTU Aqua), (2) Deakin University, (3) Cawthron Institute, (4) Australian Government Department of Agriculture, Water and the Environment, (5) Australian Institute of Marine Science

Oral

Environmental DNA; biophysical modeling; particle tracking; invasive species; sampling design

Environmental DNA (eDNA) has become an increasingly important tool for detecting rare or cryptic marine species, including marine pests. However, in dynamic marine environments, the detection of species through eDNA remains incredibly challenging. This is largely due to complex interactions among biological processes, such as shedding and decay processes (Andruszkiewicz et al., 2021), physical transport, and water sampling designs. These factors can strongly influence detection probability, inflate false negatives, and limit the effectiveness of eDNA-based monitoring and management (Ellis et al., 2022).

This presentation synthesizes recent advances in the biophysical modeling of eDNA dynamics, building on a modeling framework that integrates eDNA transport, decay, and detection within realistic hydrodynamic settings (Pastor Rollan et al., 2024). This research is structured into four interconnected themes: (1) eDNA concentration dynamics, including shedding and decay processes; (2) transport driven by advection, diffusion, and mixing; (3) sampling design across spatial and temporal scales; and (4) biophysical modeling of eDNA detectability.

Using modeling case studies, we illustrate how coupled hydrodynamic–particle tracking approaches can be applied to quantify spatiotemporal variability in eDNA distributions, inform sampling design, and identify potential source regions contributing to detections at monitoring sites. These developments demonstrate how model-informed eDNA approaches can enhance early detection, support biosecurity surveillance, and contribute to more effective marine management.

[1] Andruszkiewicz Allan, E., Zhang, W. G., C. Lavery, A., & F. Govindarajan, A. (2021). Environmental DNA shedding and decay rates from diverse animal forms and thermal regimes. Environmental DNA, 3(2), 492–514. https://doi.org/10.1002/edn3.141

[2] Ellis, M. R., Clark, Z. S. R. R., Treml, E. A., Brown, M. S., Matthews, T. G., Pocklington, J. B., Stafford-bell, R. E., Bott, N. J., Nai, Y. H., Miller, A. D., Sherman, C. D. H. H., Heng, Y., Miller, A. D., & Sherman, C. D. H. H. (2022). Detecting marine pests using environmental DNA and biophysical models. Science of the Total Environment, 816, 151666. https://doi.org/10.1016/j.scitotenv.2021.151666

[3] Pastor Rollan, A., Sherman, C. D., Ellis, M. R., Tuohey, K., Vennell, R., Foster-Thorpe, C., & Treml, E. A. (2024). Current Trends in Biophysical Modeling of eDNA Dynamics for the Detection of Marine Species. Environmental DNA, 1–13. https://doi.org/10.1002/edn3.70021

Spatial and temporal dynamics of opportunistic green algae on intertidal rocky shores: links to environmental drivers along the Basque Coast

Océane Lauga (1), Lalanne Yann (1), Lissardy Muriel (2), De Casamajor Marie-Noelle (2), Sanchez Florence (2), Monperrus Mathilde (3), Pigot Thierry (3)

(1) UNIV PAU & PAYS ADOUR/E2S UPPA, Collège STEE, 1 allée du Parc Montaury, 64600 Anglet, France, (2) IFREMER, Departement Océanographie et Dynamiques de Ecosystèmes ODE/COAST/LERAR, 1 allée du Parc Montaury, 64600 Anglet, France, (3) Universite de Pau et des Pays de l'Adour, UPPA, CNRS, IPREM, UMR, 5254, Anglet, France

Oral

Opportunistic green macroalgae; Midlittoral; Coverage; Biomass; Rocky substrate; Basque coast; environmental drivers

Over the past few decades, coastal eutrophication has intensified worldwide, promoting the mass development of opportunistic macroalgae and leading to harmful macroalgal blooms, including green tides.

Along the French Basque coast, designated as a Marine Protected Area (MPA), opportunistic green algae do not form floating or stranded mats but instead colonize rocky substrates directly or develop as epiphytes. Their early seasonal development and prolonged persistence in the midlittoral zone have recently raised important ecological and socio-economic concerns in an area of high conservation value. In this context, the CARTAV program aims, for the first time, to characterize the spatio-temporal variability of this colonization along this coastline.

From February to October 2025, monthly monitoring was conducted at four representative sites using a stratified and spatially balanced random sampling design covering the midlittoral zone. Algal cover, biomass, and morphotypes were quantified using quadrat sampling. In addition, genetic analyses (DNA barcoding) were performed to refine taxonomic identification. Environmental drivers, including temperature, light, swell, and nutrient concentrations, were also examined.

Results indicate the main structuring factor was the vertical position on the rocky shore. morphologies dominate the upper zone, whereas only epiphytic laminar forms prevail in the lower zone. Seasonal dynamics were characterized by growth beginning in late winter, with a major peak in spring, followed by a summer decline and an autumn resurgence. However, significant differences were observed among sites. A high abundance of limpets was associated with low algal cover in the upper zone, suggesting strong top-down control, whereas the rarity of grazers at other sites could limit this natural regulation.

Overall, this study explores the mechanisms controlling the proliferation of opportunistes green macroalgae on rocky intertidal shores and provides new insights to support improved monitoring and management of this area.

Integrated Assessment of Blue Carbon Ecosystems in Basque estuaries

Mireia Valle (1), Ainhize Butrón (2), Malake Muñoz (2), Joxe Mikel Garmendia (1), Javier Franco (1), Roland Garnier (1), Raquel Liebana (1), Laura Alonso (1), Emmanuella Orero (3), Iris E. Hendriks (3), Guillem Chust (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA) (2) Ihobe, (3) IMEDEA, CSIC-UIB

Oral

Seagrass, saltmarshes, climate change mitigation, ecosystem services

Blue carbon ecosystems (BCEs) such as saltmarshes and seagrass meadows contribute to global climate regulation through their ability to capture and store carbon. They also support key ecosystem services such as habitat provision, flood and shoreline protection, enhancement of water quality and a variety of cultural services. These multiple co-benefits highlight the importance of integrating BCE management into climate change mitigation and adaptation strategies. In this study, we present recent advances towards a comprehensive assessment of the climate-mitigation potential of BCEs through an integrated analysis of carbon stocks, measurements of greenhouse gas (GHG) fluxes, microbiome composition, and spatial-temporal habitat dynamics. Blue carbon stocks were quantified in sediment cores and above- and below-ground biomass samples from *Nanozostera noltei* seagrass meadows and three saltmarsh habitat types: high-saltmarsh (dominated by *Juncus maritimus*), mid-saltmarsh (dominated by *Halimione portulacoides*), and low-saltmarsh (dominated by *Spartina* spp.). Sampling was conducted in the estuaries of Oka, Lea and Bidasoa, where natural *N. noltei* meadows are present. To estimate total blue carbon stock, we compiled existing BCEs cartography and performed a spatial-temporal analysis of *N. noltei* extent using high-resolution habitat maps. The sediment microbiomes were characterized across all sampled BCE types, providing the first baseline of vertically structured microbial communities that mediate key carbon transformation pathways in these ecosystems. In situ rates of CO_2 fluxes (ppm s^{-1}) and CH_4 fluxes (ppb s^{-1}) were measured to quantify net GHG exchanges for each BCE type. The generated data will provide new insights to support more effective conservation and management strategies that jointly address climate-change mitigation, adaptation, and biodiversity preservation in BCEs.

Spatiotemporal Dynamics of the Mussel Symbiome in the Basque Coast

Ander Urrutia (1&2), Miren Carnicero (1&2), Jon Saenz (2&3) Isabelle Arzul (4), Germaine Chevignos (4) and Ionana Marigomez (1&2)

(1) Research Centre for Experimental Marine Biology and Biotechnology "Plentziako itsas Estazioa"(PiE-EHU)

(2) CBET+ OH Research Group, Department of Zoology and Animal Cell Biology

(3) Eolo Research Group, Department of Applied Physics II Faculty of Science and Technology, University of the Basque Country (EHU), Leioa

(4) Ifremer, ASIM Adaptation et Santé des Invertébrés Marins, La Tremblade F-17390, France

Oral

Mytilus galloprovincialis, Symbiome, Parasites, Infection dynamics, Basque coast,

Mussels are key components of coastal ecosystems and are widely used as sentinels of ecosystem health. Recently, their populations have declined sharply along the Basque Coast and across the Bay of Biscay. Although mussel responses to environmental and anthropogenic pressures have been extensively investigated using biochemical, molecular, and histological approaches, the role of their associated symbionts in their fitness remains insufficiently explored. Here, we compare the microbial eukaryote communities associated with *Mytilus galloprovincialis* collected in spring between 2014 and 2022 across six locations along the Basque Coast (Arriluze, Arrigunaga, Plentzia, Mundaka, Pasaia, and Hondarribia). The mussel symbiome was analysed using 18S metabarcoding of lyophilized pooled samples from each location and year (n = 1628). In parallel, a general screening was conducted by light microscopy on individual mussels (n = 460). Metabarcoding revealed that ciliates, diatoms, and dinoflagellates were among the most diverse microeukaryotic clades of symbionts in mussels. The spatiotemporal variability of these groups contributed to explaining a marked shift observed from 2017 onwards, during which the relative abundance of dominant protist groups declined, resulting in a sustained increase in overall diversity. The relative abundance of major protist groups was lower in harbour sites (Arriluze) than in less anthropized locations (Plentzia), which were particularly rich in diatoms and ciliates. In contrast, metazoan parasites, including copepods and trematodes, were more prevalent in industrial ports. Histological screening indicated that infections were caused by some of these endosymbionts as well as by metazoan parasites. The cumulative prevalence of parasite infections also peaked in 2017, coinciding with increased microeukaryotic diversity. Overall, this study highlights the association between the mussel symbiome, anthropogenic pressures, and environmental conditions, and underscores the importance of considering parasitic groups separately when evaluating parasite burden for host and ecosystem health.

Acknowledgements: This study was co-funded by the BLUEADAPT project (HORIZON-HLTH-2021-ENVHLTH-02 European Union's Horizon Europe research and innovation programme and UKRI/HM Goverment) the HOBE project (TED2021-132109B-C21 funded by MCIN/AEI /10.13039/ 501100011033 and by the EU NextGenerationEU/ PRTR) and the Basque Government Consolidated Research Group CBET+OH (IT-1743-22).

Tropicalization signals of the marine biodiversity in the Bay of Biscay

Guillem Chust (1), Elorri Arevalo (1), Almudena Fontán (1), Marina Chifflet (1), Paula Alvarez (1), María Santos (1), Leire Ibaibarriaga (1), Naroa Aldanondo (1), Ernesto Villarino (1), Joana Larreta (1), Manuel González (1), Eneko Bachiller (1), María Korta (1), Angel Borja (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA)

Oral

Bioversity, climate change, tropicalization, Bay of Biscay, fish, benthic

Global ocean warming, extreme events, and accelerating sea-level rise are challenges that coastal communities and fishing sector must address to reduce damages in coming decades. The aim of this research is to present the trends and knowledge gaps of the marine observatory of climate change of the Bay of Biscay. We selected marine climate change indicators (ocean state, biogeochemistry, biodiversity, and commercial species) and used Mixed Generalized Additive Models and Community Temperature Index to detect trends of historic data. Results of long-term time series of the last four decades indicate ecosystem shifts associated with a gradual warming of sea surface over the bay and down to 100 m depth starting in the 1980s, together with a deepening of 14 ºC isotherm (a proxy of the thermocline depth in this region). In particular, we found evidence mainly of a process of tropicalization (i.e. favouring warm-affinity species) in fish assemblages and benthic invertebrates, with a lesser impact on deborealization (i.e., decreasing abundance of cold-affinity species). Analysis of bottom trawl data (> 200 fish species) revealed abundance changes according to their life-history and ecological traits, promoting small, fast-growing and warm-affinity species that feed at a slightly low trophic level. In certain small pelagic fishes, we found signals of earlier phenology in spring spawning or migration, and body size shrinkage. Other potential impacts to coastal ecosystems are related to the observed increase of marine heat waves, sea level rise, wave extreme increase, and a continuous pH decline on the shelf during the last two decades, with unexplored consequences to shell-forming marine organisms in the area. Accurately estimating rates of sea warming, ocean acidification, and biodiversity turnover is key to assessing how close the Bay of Biscay ecosystem may be to a tipping point, and for defining the best adaptation measures to minimize local impacts.

SOCAVA, STUDYING THE NATURAL VALUS OF THE EASTERN CANTABRIA COAST IN THE FRAME OF THE BIODIV PROJECT

José Manuel González-Irusta (1), Berta Ramiro-Sánchez (2), Ana Aja (2), Ana Antolinez (2), Ignacio Bolado (2), Enma Catalán (2), Ana De la Torriente (2), María Huerta (2), Sara García-Sala (2), Ana Navarro (2), Marina Prieto (2), María Ruiz (2), Enrique Talledo (3), Eva Velasco (2)

(1) IEO-CSIC, (2) Centro Oceanográfico de Santander (IEO-CSIC), (3) Secretos del Oceano

Oral

Red Natura 2000, Benthic habitats, Predictive Distribution Models, Outreach

The eastern coast of Cantabria is an area of great geomorphological complexity, characterized by the presence of large limestone massifs, steep cliffs, and the narrowest section of the continental shelf in northern Spain, located off Cape Ajo. Enhance by this complexity, this area of the Cantabria coast hosts a great diversity of habitats and species, which have been studied under the SOCAVA (SOnabia, CAstro Verde, and Ajo) action of the BIODIV project. During this research action the main communities present in this part of the Cantabria coast, both in the infralittoral zone (through scuba diving), and in the circalittoral and bathyal grounds, using the ROV LIROPUS 2000 have been studied. Samples obtained during various research surveys were used to characterize the primary benthic habitats present in the study area using network biogeographical clustering. Once the main biological assemblages were defined, they were mapped using prediction distribution models, following the methodology applied by the research team in previous works used in other areas of the Natura 2000 Spanish network. Furthermore, the sensitivity of different habitats to the main human activities in the area, mainly artisanal fisheries, was evaluated through a risk analysis. Carried out over the last three years, the project also included a significant outreach component, creating abundant audiovisual content published on the project's social media channels, as well as the documentary 'SOCAVA vida sumergida,' which was awarded as the Best Cantabrian Sea Documentary at the 49th edition of the Donostia-San Sebastian International Underwater Film Festival CIMASUB.

Regional variability in the trophic ecology of Illex coindetii: A multi-tissue isotopic approach across Iberian waters

Lola Jean (1), Lucia Lopez Lopez (2), Juanjo Ortiz (2), Lucia Merino (2), Maria Diez (2)

(1) IEO Santander, IMBRSea, (2) IEO Santander

Oral

Illex coindetii, Trophic ecology, Ontogenic shifts, Stable isotopes analysis, Eye lens analysis.

As mesopredators, squids have a pivotal position in the marine food web, influencing both top-down and bottom-up processes. Their rapid growth, high reproductive rate, and short lifespan allow them to adapt rapidly to their environment, yet complicate their inclusion in management strategies, traditionally developed for longer-lived species. As their importance in fisheries grows, with landings rising over recent decades, scientists are urged to understand their ecology better. In Iberian waters, *Illex coindetii* is a key species for fisheries, yet most of our knowledge of its trophic ecology comes from stomach content analysis, which only reveals its general diet. Consequently, limited information exists about its long-term feeding habits and ontogenic shifts. To address these gaps, we integrated stable isotope analysis of $\delta^{15}N$ and $\delta^{13}C$ of muscle and eye lenses. First, we analysed muscle tissue from 77 individuals collected in 2024 across three regions: the Gulf of Cadiz, the Spanish Mediterranean, and the Southern Bay of Biscay. We tested size-related trophic changes and regional variability. As expected, our results showed a general increase in isotopic signature with size, but distinct patterns among regions: $\delta^{15}N$ increased with size in the Gulf of Cadiz and the Mediterranean, but not in the Bay of Biscay, while size influenced $\delta^{13}C$ only in the latter. These results suggest that *Illex coindetii* adapts its feeding strategy to local conditions, with feeding habitat shifts during the species' growth. Ongoing eye lens analyses will help us explore these feeding strategies in more detail, confirm whether the regional patterns observed in muscle and eye lenses are consistent from juveniles to adults, and describe the trophic changes along the species ontogeny. Our analyses highlight regional differences in the life cycle of *Illex coindetii* with potential implications for stock management.

Isotopic evidence of seasonal dietary shifts in common dolphins in the Bay of Biscay

Beñat Iglesias (1), Tiphaine Chouvelon (2), Paula Mendez-Fernandez (3), Maite Louzao (1), Isabel García-Barón (1), Luis Horrach (1), Estanis Mugerza (1), Arnaitz Mugerza (1), Arkaitz Pedrajas (1), Jérôme Spitz (3), Amaia Astarloa (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), (2) Ifremer, (3) Pelagis

Oral

Understanding the seasonal trophic ecology of common dolphins (Delphinus delphis) in the Bay of Biscay (BoB) is essential for interpreting their interactions with components of this dynamic marine ecosystem, including fisheries. We analysed $\delta^{13}C$ and $\delta^{15}N$ values measured in muscle samples from 179 individuals stranded or bycaught between 2015 and 2025 along the French and Basque coasts. All samples were corrected for lipids and for the Suess effect. Bayesian mixing models (MixSIAR) were run separately for each season using prey grouped by taxonomy and horizontal and vertical habitats, to quantify the seasonal proportional contributions of the different prey groups to dolphin diet composition. Across the year, dolphins consistently relied on neritic fish, particularly low-trophic-level epipelagic and demersal species (e.g., anchovy Engraulis encrasicolus or blue withing Micromesistius poutassou), which constituted the bulk of the diet in all seasons. Winter had the highest contribution of these two groups (70%), while spring showed a more diversified diet pattern, with a notable increase in the contribution of oceanic–mesopelagic fish (e.g., Notoscopelus kroyeri) and mid-trophic-level neritic species (e.g., Atlantic mackerel Scomber scombrus). Summer and fall diets resembled winter patterns, with the exception that fall showed a relatively high proportion of oceanic–mesopelagic fish. Although credible intervals varied among prey categories, the overarching pattern was robust: common dolphins in the BoB primarily feed on neritic fish year-round, complemented seasonally by mesopelagic species and, to a lesser extent, cephalopods. The dominance of neritic prey, particularly in winter, is consistent with known patterns of dolphin distribution and seasonal fisheries activity in the region. This study provides a comprehensive assessment of seasonal dietary patterns through the use of isotopic ratios, offering valuable insight into the ecological processes shaping dolphin–fishery interactions in the BoB.

Understanding the drivers behind trophic rewiring in marine predators

Lucía López-López (1), Óscar García-Aguilar (1), Manuel Hidalgo (2), Nina Larissa Arroyo (3), María Diez (1), Olaya Fernádez-Zapico (1), Miguel García-Rebollo (4), Daniel Iglesias (1), Lucía Merino (1), Isabel Muñoz (4), Juan José Ortiz (1), Irene Rabanal (1), Susana Ruiz-Pico (1), Eva Velasco (1), Izaskun Preciado (1)

(1) Centro Oceanográfico de Santander (COST-IEO, CSIC), (2) Centro Oceanográfico de Baleares (COB-IEO, CSIC), (3) Centro Oceanográfico de Canarias (COC-IEO, CSIC), (4) Centro Oceanográfico de Cádiz (COCAD-IEO, CSIC)

Oral

feeding interaction, trophic network, metaweb, trophic rewiring, body size, abundance, demersal community

Understanding how biodiversity is assembled within ecological networks across local to regional scales remains a central challenge in community and ecosystem ecology. This requires identifying which potential trophic interactions are actually realized. Here, we use an extensive dataset of feeding interactions, based on standardized groundfish surveys spanning more than 20 years in the Southern Bay of Biscay. We focused on for four demersal predators (Lophius boudegassa, Lophius piscatorius, Zeus faber and Merluccius merluccius), to investigate the drivers determining which potential trophic interactions become realised. To this end, for each sampling point and year, we listed all potential feeding interactions based on predator-prey co-occurrences, and identified the realised interactions through stomach content analyses. We explored the resulting patterns using statistical models supported by a wide set of explanatory variables, including the consumer-resource body size ratio, the consumer and resource abundances, and the abundance, diversity and mean size of alternative prey. Our results indicate that less than 20% of the potential interactions became realised. The model explained nearly 40% of the variance in the probability of consumption, with all variables contributing significantly. Our results highlight that prey abundance is the primary factor driving realized feeding interactions. Prey size was also an important driver dependent of the predator species, however, our analyses did not identify an allometric window for optimal consumption in most predators. These insights can guide the development of more realistic models of marine food webs and avoid unrealistic assumptions that may impact network analyses.

Mapping the Chase: Spatial Dynamics of Megafauna and Small Pelagic Fishes in the Bay of Biscay

Aitor Lekanda (1), Maite Louzao (1), Amaia Astarloa (1), Guillermo Boyra (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia

Oral

Predator–prey dynamics, spatial ecology, marine megafauna, small pelagic fish, Bay of Biscay.

Predators play a pivotal role in structuring pelagic ecosystems, yet their distribution does not always mirror patterns of prey biomass. Predator–prey interactions are shaped by environmental conditions, behavioural strategies, and the spatial configuration of prey, all of which influence encounter rates across multiple scales. Using a decade of multidisciplinary survey data (2013–2023) from the Bay of Biscay, we quantified the spatial distribution of marine megafauna and small pelagic fish to examine how prey availability shape predator occurrence. Our analyses revealed consistent spatial associations between key predators—common dolphins and northern gannets—and their principal prey, juvenile and adult anchovies and sardines. While predator densities were positively correlated with prey presence, the highest predator abundances did not necessarily coincide with areas of maximum prey biomass. Juvenile anchovies formed large, interconnected aggregations detectable even in low-biomass regions, supporting persistent predator use. In contrast, predator density associated with adult anchovies and sardines increased with prey biomass, highlighting the importance of prey energy content. These findings align with previous evidence emphasizing vertical accessibility for seabirds and predator preference for adult small pelagic species. By integrating decadal spatial patterns, this study identifies regions of recurrent predator–prey co-occurrence that are ecologically significant and relevant for conservation. Our results underscore the need to consider spatial heterogeneity when assessing predator–prey dynamics and designing ecosystem-based management strategies. Incorporating these insights into fisheries management can reduce megafauna bycatch, enhance fishing efficiency, and support long-term conservation objectives in the Bay of Biscay.

Untangling the food web of the North East Atlantic: Structure, Connectivity, and Resilience.

María Díez-Muñoz (1), Manuel Hidalgo (2), Lucía López-López (1)

(1) Centro Oceanográfico de Santander (COST), Instituto Español de Oceanografía (IEO) - CSIC, (2) Centro Oceanográfico de Baleares (COB), Instituto Español de Oceanografía (IEO) - CSIC

Oral

Trophic Webs, Networks, Resilience, North Atlantic, Connectivity.

Resilience, in ecology, can be defined as the capacity of a system to resist or absorb disturbances and reorganize, recover, or adapt to them, maintaining its health, structure, functionality, and identity. The increase of strength and diversity of disturbances due to global change makes ecosystem resilience crucial for protecting biodiversity and ecosystem services. A key element for ecosystem resilience is how its components connect and organize themselves spatially and temporally, thereby maintaining the critical ecological processes that influence the system's dynamics. Consequently, understanding ecosystem connectivity is key to strengthening its capacity to adapt to climate change. In this context, food webs provide a powerful tool for studying ecosystem structure and function by investigating knowledge about trophic organization, interactions and connectivity.

This study investigates the structure and connectivity of North Atlantic marine ecosystems (ICES subdivisions VIIIc and IXa) by constructing taxonomically-resolved ecological networks and analysing their structural patterns. This approach will allow to understand the interaction patterns of species and their implications for the stability and functioning of ecosystems. To this end, a metaweb was developed through an exhaustive review of the literature on marine trophic interactions present in the continental shelves of the Cantabrian Sea and other Iberian ecosystem, including more than 400 species and over 5000 interactions. Based on species presence/absence data for the study area, a representative subset was obtained to perform a topological network analysis using graph theory. These results enable a comprehensive assessment of ecosystem structure, complexity and connectivity through diverse ecological network indicators such as a mean trophic level, connectance or modularity. These insights are fundamental for assessing regional resilience and the temporal dynamics of the food web to inform operational conservation strategies.

Understanding the winter ecology of auks (family Alcidae, class Aves) in the Southeastern Bay of Biscay

Javier Franco (1), Paula Setién (1), Ane M. Arraibi (2), Manena Fayos (3), Goretti García (1), Isabel García-Barón (1), Beñat Iglesias (1), Aitor Lekuona (4), Maite Louzao (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualdea z/g, 20110 Pasaia, (2) CRFS Bizkaia, (3) CRFS Cantabria, (4) Diputación Foral de Gipuzkoa

Oral

Winter, auks (Alcidae), ecology, mortality, cachexia, Bay of Biscay

The wintering season constitutes a critical period in the annual cycle of seabirds, especially of pelagic species, during which individuals are highly vulnerable due to harsh environmental conditions and limited energy reserves. The Southeastern Bay of Biscay (SBoB) is an important wintering area for several species of the Alcidae family. However, many aspects of their wintering ecology in this area remain poorly understood. We investigated the wintering ecology of three alcid species, the common guillemot (*Uria aalge*), the razorbill (*Alca torda*) and the Atlantic puffin (*Fratercula arctica*), by means of three approaches: a) analysing the primary causes of admission to wildlife recovery centers in the SBoB in the period 2010-2021; b) assessing the overall condition of stranded individuals to gain insights into their health status; c) determining the geographic origin of the birds wintering in the SBoB using recoveries of banded individuals and stable isotope analysis of feathers to infer migratory patterns. Cachexia emerged as the leading cause of admission for the three species in the 2010-2021 winter months, reflecting the impact of prolonged adverse weather and limited foraging opportunities. Necropsy data of individuals recovered between 2016 and 2025 revealed consistently low energy reserves, suggesting high vulnerability to starvation. Ring recoveries and feather stable isotope analyses confirmed that most individuals originated from colonies in the British Isles, although puffins showed more diverse and northerly origins. This study demonstrates how integrating different but complementary approaches provides a more comprehensive understanding of the wintering ecology and drivers of mortality in marine species. Such multidisciplinary frameworks are essential for identifying conservation priorities, assessing population-level risks and informing management actions in a rapidly changing marine environment.

A biologging-informed assessment of seabird bycatch risk in small-scale fisheries

Isabel García-Barón (1), Arkaitz Pedrajas (2), Javier Franco (1), Amaia Astarloa (1), Beñat Iglesias (1), Maria Mateo(2), Maite Louzao (1)

(1) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Pasaia, Spain, (2) AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Txatxarramendi ugartea z/g,48395 Sukarrieta, Spain

Oral

Automatic Identification System (AIS), conservation, Ecosystem-Based Fisheries Management, seabird

Seabird bycatch in artisanal fisheries remains a critical issue in marine conservation, particularly in coastal regions where small-scale fleets operate in areas that overlap with key seabird foraging habitats. The European shag (Gulosus aristotelis), a pursuit-diving species currently listed as Vulnerable in Spain, is especially susceptible to incidental capture due to its benthic feeding behaviour and strong reliance on nearshore environments heavily used by artisanal fisheries. In this study, we assess the exposure of European shags to artisanal fishing activities in the southern Bay of Biscay through the integration of high-resolution seabird tracking data and fisheries monitoring information. Between 2022 and 2025, several individuals were equipped with GPS and time-depth recorders, yielding 20 complete, high-quality datasets. This biologging data allowed us to describe foraging areas, incorporating not only the spatial distribution of dives but also dive behaviour and effort. We produced both unweighted and time-weighted maps of foraging intensity that better represent habitat use and potential encounter probability with fishing gear. To quantify spatial and temporal exposure, we integrated these biologically informed foraging layers with contemporaneous Automatic Identification System (AIS) data from artisanal longliners and netters operating in the region. This combined approach reveals the extent to which foraging grounds overlap with the distribution, timing, and activity patterns of different métiers. Core foraging areas were concentrated in the inner Bay of Biscay and along the Cantabrian and northern French coasts, with notable interindividual and interannual variability. Exposure levels differed between fishing gears, shaped by the degree of spatial overlap as well as gear-specific characteristics such as deployment depth and operational schedules, and how these align with the diving behaviour and ecological traits of the species. Overall, this interdisciplinary framework, integrating biologging, AIS-based fleet monitoring, and métier-specific gear attributes, provides a robust basis for identifying where and when potential interactions are most likely to occur. Studies like ours provide essential evidence for developing targeted mitigation strategies and supporting sustainable management of artisanal fisheries, thereby contributing to the advancement of ecosystem-based fisheries management approaches.

Understanding cetacean stranding dynamics along the Basque Coast (southeast Bay of Biscay): insights from more than thirty years of data (1993-2024)

Andrea Estarrona (1), Denis Benito (2), Irune Valenciano (2), Xabier Lekube (3), Urtzi Izagirre (4), Jon Sáenz (5), Manu Soto (1)

(1) Research Centre for Experimental Marine Biology and Biotechnology (PiE-EHU/UPV), University of the Basque Country (EHU/UPV), Plentzia, Basque Country, Spain, (2) Research Centre for Experimental Marine Biology and Biotechnology (PiE-EHU/UPV), University of the Basque Country (EHU/UPV), (3) University of the Basque Country (EHU/UPV), Leioa, Basque Country, Spain ///// Research Centre for Experimental Marine Biology and Biotechnology (PiE-EHU/UPV), University of the Basque Country (EHU/UPV), Plentzia, Basque Country, Spain, (4) University of the Basque Country (EHU/UPV), Leioa, Basque Country, Spain /// Research Centre for Experimental Marine Biology and Biotechnology (PiE-EHU/UPV), University of the Basque Country (EHU/UPV), Plentzia, Basque Country, Spain, (5) University of the Basque Country (EHU/UPV), Leioa, Basque Country, Spain

Oral

Stranding, management, conservation, small delphinid

For some cetacean species, strandings are the most important source of information and constitute a passive and non-invasive method for the study of their biology, physiology, diet and causes of death. However, the recovery of carcasses is limited by ecological and physical drivers beyond simple coastline availability. Therefore, the main objective of the present work was to examine the spatiotemporal distribution of stranding events along the Basque Coast to improve future response strategies, strengthen coordination within the Basque Stranding Network (SAREUS), and develop approaches better suited to the conditions of the Bay of Biscay. For this, the complete stranding record data from 1993 to 2024 was used for an initial descriptive review, and different geographical zones of the coast were defined to understand the characteristics of each region. A total of 636 strandings were reported in the period analyzed. The results revealed strong evidence that the stranding distribution follows spatial patterns determined by complex processes, which require further analysis. Small delphinids showed seasonal trends in strandings peaking at the end of winter/start of spring, possibly due to migration, bycatch and/or environmental conditions. Donostia-San Sebastian was identified as the main hotspot accounting for 83 strandings. This study also reports a potential positive consequence regarding the conservation of the bottlenose dolphin, following French restrictions on fishing activity in North Atlantic waters that aimed to reduce incidental catches. Overall, information provided herein is essential for a better understanding of cetacean stranding dynamics on the Basque Coast and provides a basis for more effective monitoring, response and conservation measures. Thanks to Fundación Biodiversidad (MITECO, PRTR, NextGenerationEU), Basque Government for funding the SAREUS project, and to AMBAR Foundation for data collection from 1993 to June 2022. This work was supported by the CBET+ (IT1743-22) Consolidated Research Group (Basque Government).

HARMFUL PHYTOPLANKTON IN THE PORT OF BILBAO (2024-2025)

Laia Moreno Martínez (1)

(1) University of the Basque Country, UPV/EHU

Poster

Introduction

Port ecosystems are highly dynamic environments where anthropogenic pressures can alter environmental conditions. These changes can significantly influence the structure and composition of phytoplankton communities (Shaik et al., 2021), in some cases favoring the proliferation of harmful species (Harmful Algal Blooms, HABs). Whether due to their toxicity or their capacity for massive blooms, these species pose a risk to both biodiversity and human health (Hallegraeff, 1998), making early detection essential. In this context, combining optical microscopy with molecular techniques such as DNA metabarcoding improves the detection of harmful taxa, including those that are morphologically difficult to identify or present in low abundances.

The present study was conducted during 2024 and 2025 with 8 and 12 sampling campaigns respectively, covering all seasons of the year. Three stations (BIL-1, BIL-2, and BIL-3) were defined along the longitudinal axis of the estuary mouth. Samples were collected at a depth of 1 m, approximately 3 hours after high tide. The analysis included taxonomic identification via DNA metabarcoding and cell counts using optical microscopy.

The phytoplankton community was dominated by dinoflagellates and diatoms, with other groups such as haptophytes, dictyocophyceae, chlorophytes, raphidophyceae, and pelagophyceae observed to a lesser extent. More than 60 harmful phytoplankton taxa belonging to approximately 35 genera were identified, with no significant differences in presence across the three sampling stations. Recurrent genera included Pseudo-nitzschia, Dinophysis, and Alexandrium, among others.

The high number of harmful taxa and the recurrent detection of key genera across all three stations highlight the need for continuous monitoring in this port system, using complementary techniques to provide a more accurate representation of the phytoplankton community.

[1] Hallegraeff, G. M. (1998). Transport of toxic dinoflagellates via ships' ballast water: bioeconomic risk assessment and efficacy of possible ballast water management strategies. Marine Ecology Progress Series, 168, 297-309.
[2] Shaikh, S. M. S., Tagde, J. P., Singh, P. R., Dutta, S., Sangolkar, L. N., & Kumar, M. S. (2021). Impact of Port and harbour activities on plankton distribution and dynamics: A multivariate approach. Marine pollution bulletin, 165, 112105.

First record of mortality derived from plastic ingestion in a juvenile Kogia breviceps in the Bay of Biscay

Denis Benito (1), Andrea Estarrona (1), Maider Iturrondobeitia (2), Julen Ibarretxe (2), Nahiara Muguerza (3), Irune Valenciano (1), Xabier Lekube (1), Urtzi Izagirre (1), Manu Soto (1)

(1) PiE-EHU, (2) Faculty of Engineering in Bilbao, PiE-EHU, (3) Fac. Science and Technology, PiE-EHU

Poster
Stranding, Kogia, Conservation, Plastic, Pathology

The stranding network of the Basque Country (SAREUS) attended the stranding event of a juvenile female *Kogia breviceps* specimen on Zarautz beach (Gipuzkoa, Spain) the 2nd of October 2025. The carcass was transported to the Plentzia Marine Station (PiE-EHU), where it was stored at 4 °C for four days prior to necropsy. The examination was conducted by a TRAGSATEC veterinarian following the standardized protocol of the Spanish Ministry for the Ecological Transition and the Demographic Challenge. Necropsy revealed severe and consistent pathological findings: 1) massive presence of plastic and vegetal debris occupying the majority of the volume of the main stomach, 2) generalized pulmonary congestion together with bloody froth in respiratory airways and presence of sand in the oesophagus, and 3) haemorrhagic liver and meninges together with serosanguineous liquid in the pericardium. The conclusion, based on an integrative interpretation of the macroscopic observations, is that the individual stranded the shore alive and drowned as a consequence of a debilitated physiological condition most likely caused by the plastic ingestion. To further understand the events that happened on the last days of the animal, and to try to identify aberrant behaviours that could lead to plastic ingestion, the stomach content was thoroughly analysed, which included the chemical characterization of the plastic debris through ATR-FTIR analysis and the taxonomic identification, when possible, of vegetal and animal remains. As far as the authors are aware, the event described herein is the first report of *Kogia breviceps* mortality derived from plastic ingestion, making the investigation of this case of great importance, potentially leading to critical novel information regarding relatively unknown species such as the pigmy sperm whale.

Thanks to Fundación Biodiversidad (MITECO, PRTR, NextGenerationEU), Basque Government for funding the SAREUS. This work was supported by the CBET+ (IT1743-22) Consolidated Research Group (Basque Government).

The macroalgal community composition at Ondarreta beach (San Sebastian) influences the abundances of Ostreopsis spp.

Yago Laurenns-Balparda (1), Alan Fernández-Valero (2), Sergio Seoane (2)

(1) University of the Basque Country, (2) University of the Basque Country (UPV/EHU)

Poster

Ostreopsis cf. ovata; Ostreopsis sp. 9; Benthic harmful algal blooms; Substrate; South-East Bay of Biscay;

Introduction

The dinoflagellate *Ostreopsis* has become a prevalent and abundant genus during the warmer months in the Bay of Biscay (Drouet et al., 2021; Laurenns-Balparda & Seoane, 2024; Seoane & Siano, 2018). In fact, the co-occurrence of both *Ostreopsis* cf. *siamensis*, recently referred to as *Ostreopsis* sp. 9, and *Ostreopsis* cf. *ovata* has been confirmed in the south-east Bay of Biscay (Chomérat et al., 2022; Laurenns-Balparda & Seoane, 2025), with the latter linked to multiple health issues reported since 2020 in the area (Paradis et al., 2024). It is hypothesised that not all macroalgal species possess equivalent capacities to harbour *Ostreopsis*, and factors such as roughness or morphology appear to influence the presence of these microalgae (Monserrat et al. 2022; Totti et al., 2010). This background along with the characteristics of Ondarreta beach (San Sebastian) led us to implement a comparative study of the abundances of *Ostreopsis* in different macroalgal species throughout the summer of 2025 at this touristic site.

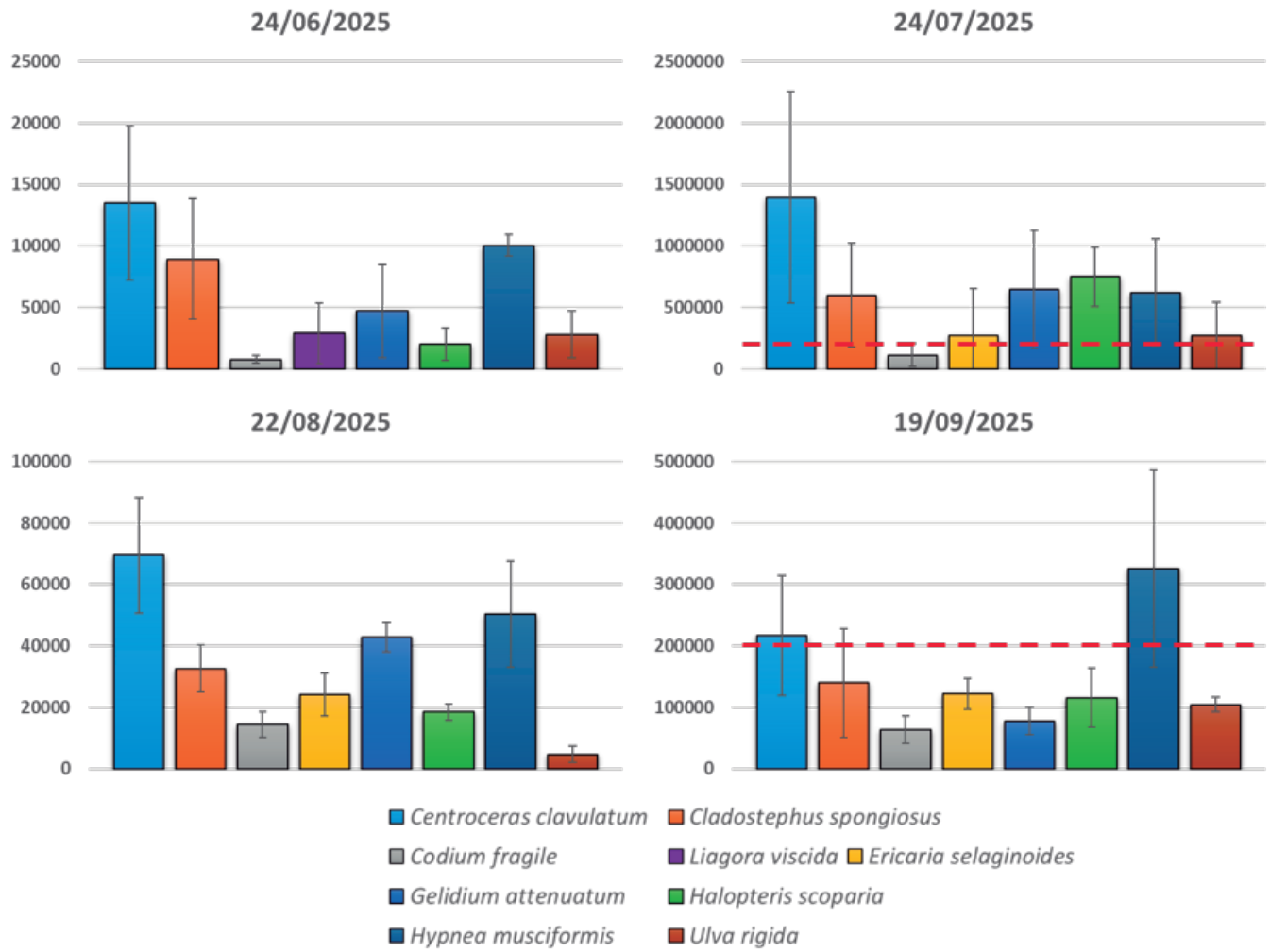
Methods

Samplings were conducted on a monthly basis from June to September 2025 at Ondarreta beach. Samples of the eight most abundant species of macroalgae, as well as water column samples, were collected for subsequent microscopic analysis, and physicochemical parameters were measured. Seven species of macroalgae were consistently found throughout the four months: *Centroceras clavulatum, Cladostephus spongiosus, Codium fragile, Gelidium attenuatum, Halopteris scoparia, Hypnea musciformis* and *Ulva rigida*.

Results and Discussion

The observed environmental data were consistent with the coastal region under study, with water temperatures ranging between 21.4 and 22.9 °C, stable salinity (35–37) and pH (7.8–8.1), and oxygen saturation ranging between 79.5 and 90.3

%. The planktonic abundances of *Ostreopsis* spp. did not exceed 1.4 × 10^4 cells/L throughout the study period, and were thus low compared to the recorded values at Ondarreta beach in previous summer periods (Laurenns-Balparda & Seoane, 2025). The epiphytic abundances of *Ostreopsis* spp. exhibited significant temporal differences. In June, values did not surpass 1.5 × 10^4 cells/g. In July, a significant increase in the epiphytic abundances of *Ostreopsis* spp. was observed in every macroalgal species, which exceeded the 2 × 10^5 cells/g threshold established by Berdalet et al. (2022), except for *C. fragile;* and with *C. clavulatum* recording the maximum of the study with 1.4 × 10^6 cells/g. In August, a significant decrease in the epiphytic abundances of *Ostreopsis* spp. was observed in every macroalgal species, with all values falling below 7 × 10^4 cells/g, especially in *C. fragile* and *U. rigida*. Finally, in September, an upturn was observed and most macroalgal species recorded abundances over 10 ^{4} cells/g, with the exception of *C. fragile* and *G. attenuatum*. In both *C. clavulatum* and *H. musciformis* the established limit value (Berdalet et al., 2022) was surpassed. These results suggest that the *Ostreopsis* blooms at Ondarreta beach are both rapid and intense, with significant growth peaks, but also substantial decreases in their abundance (Chomérat et al., 2022). Regarding the interspecific differences among macroalgae, the epiphytic abundances of *Ostreopsis* spp. were found to be significantly higher in *C. clavulatum* than in *U. rigida* and *C. fragile*. Moreover, the abundances in *H. musciformis* were significantly higher than in *C. fragile*. Both *C. clavulatum* and *H. musciformis* are characterised by a three-dimensional and flexible morphology, with multiple ramifications that could facilitate the adhesion and proliferation of *Ostreopsis* spp. cells (Aligizaki & Nikolaidis, 2006; Monserrat et al., 2022). In contrast, *C. fragile* is characterised by a laminar thallus devoid of ramifications. While *C. fragile* exhibits a three-dimensional morphology, it lacks the flexibility and ramification observed in the other studied species. Thus, the morphology of *C. fragile* and *U. rigida* appears to hinder the adhesion and subsequent proliferation of *Ostreopsis* cells (Totti et al., 2010).



The results of the present study suggest that *Ostreopsis* spp. blooms at Ondarreta beach are fast and intense, but highly variable within the summer period, which underscores the importance of a high-frequency sampling to obtain representative data of the real dynamics of this genus. Furthermore, *Ostreopsis* spp. seem to prefer three-dimensional, flexible and ramified species of macroalgae, such as *C. clavulatum* and *H. musciformis*, which could provide greater shelter and support for these dinoflagellates to bloom when the conditions are optimal.

[1]Aligizaki, K., & Nikolaidis, G. (2006). The presence of the potentially toxic genera Ostreopsis and Coolia (Dinophyceae) in the North Aegean Sea, Greece. Harmful Algae, 5(6), 717–730. https://doi.org/10.1016/j.hal.2006.02.005
[2] Berdalet, E., et al. (2022). Environmental, human health and socioeconomic impacts of Ostreopsis spp. blooms in the NW Mediterranean. Harmful Algae, 119, 102320. https://doi.org/10.1016/j.hal.2022.102320
[3] Chomérat, N., et al. (2022). First characterization of Ostreopsis cf. ovata (Dinophyceae) and detection of ovatoxins during a multispecific and toxic Ostreopsis bloom on French Atlantic coast. Marine Drugs, 20(7), 461. https://doi.org/10.3390/md20070461
[4] Drouet, K., et al. (2021). Current distribution and potential expansion of the harmful benthic dinoflagellate Ostreopsis cf. siamensis towards the warming waters of the Bay of Biscay, North-East Atlantic. Environmental Microbiology, 23(9), 4956–4979. https://doi.org/10.1111/1462-2920.15406
[5] Laurenns-Balparda, Y., & Seoane, S. (2024). First report of Ostreopsis cf. siamensis exceeding alert thresholds in Bay of Plentzia (South-East Bay of Biscay). UNESCO Harmful Algae News, (77), 16–17. https://doi.org/10.5281/ZENODO.14364118
[6] Laurenns-Balparda, Y., & Seoane, S. (2025). Summer Ostreopsis blooms in San Sebastian (South-East Bay of Biscay): The importance of substrate features. Marine Pollution Bulletin, 211, 117484. https://doi.org/10.1016/j.marpolbul.2024.117484
[7] Monserrat, M., et al. (2022). The role of habitat in the facilitation of Ostreopsis spp. blooms. Harmful Algae, 113, 102199. https://doi.org/10.1016/j.hal.2022.102199
[8] Paradis, C., et al. (2024). Impacts on human health potentially caused by exposure to an unprecedented Ostreopsis spp. bloom in the Bay of Biscay, French Basque coast. Wilderness & Environmental Medicine, 35(1), 13–21. https://doi.org/10.1177/10806032231220405
[9] Seoane, S., & Siano, R. (2018). New limits of Ostreopsis distribution in the Bay of Biscay: A first report of Ostreopsis in Santander Bay, Cantabria (northern Spain). UNESCO Harmful Algae News, (60), 10. https://doi.org/10.5281/ZENODO.5109875
[10] Totti, C., et al. (2010). Ostreopsis ovata bloom along the Conero Riviera (northern Adriatic Sea): Relationships with environmental conditions and substrata. Harmful Algae, 9(2), 233–239. https://doi.org/10.1016/j.hal.2009.10.006

Assessing Spatial Variability of Algal Turfs Across Multiple Scales

Julia Muñoz-Acero (1), Vega Martín-Broncano (1), Anton Vázquez-Arias (1), Pilar Díaz-Tapia (1)

(1) Universidade de Santiago de Compostela

Poster
algal turf, turf-forming seaweed, spatial variability, Galicia

Introduction

The ecological roles of algal turfs are highly variable, influenced by their physical structure and interactions with other organismal groups. Despite being composed of a diverse community of small macroalgal species, turfs are often treated as a homogeneous functional group in ecological studies. Identification of taxa at lower taxonomic ranks is particularly challenging for non-expert taxonomists, as many species are less than 5 cm in height. As a result, fine-scale variability in species composition is frequently overlooked, even though it may substantially affect the ecological function and interactions with other species. Notably, algal turfs can hinder the recovery of kelp forests in ecosystems that have experienced a disruption of balance, potentially through allelopathic mechanisms, thereby reinforcing altered ecosystem states.

Understanding the biodiversity and ecology of algal turfs is crucial and represents a fundamental step toward elucidating their ability to maintain space occupancy. This study aims to evaluate biodiversity in turf-forming seaweed across multiple spatial scales in the northwest of Spain. Spatial variability was analyzed across intertidal and subtidal habitats using a hierarchical nested sampling design, in which sub-transects were randomly selected within progressively smaller spatial units, ranging from 1 km down to 10 cm. Field sampling was conducted along the coast of the municipality of Vigo and on the Cíes Islands, part of the Maritime–Terrestrial National Park of the Atlantic Islands of Galicia. For each sample, species of macroalgae were identified and their total cover was quantified. These data were statistically analyzed to reveal multiscale spatial patterns in algal turf assemblages.

[1] Syafruddin, G., Pratama, A. M., Yasir, I., Ferse, S. C., & Ambo-Rappe, R. (2025). Sediment, substrate, and structure: Factors shaping algal turf dynamics in urban Indonesian reefs. Regional Studies in Marine Science, 86, 104172.
[2] Altman-Kurosaki, N. T., Pratte, Z. A., Stewart, F. J., & Hay, M. E. (2025). Coral–algal competition: allelopathy, temporal variance, and effects on coral microbiomes. Coral Reefs, 44(1), 49-62.
[3] Villaespesa, E. R., Urra, J., Salas, C., & Gofas, S. (2023). Faunal turnover between meso-and infralittoral algal turf assemblages: A case study in a highly biodiverse Marine Protected Area of the northern Alboran Sea (W Mediterranean). Regional Studies in Marine Science, 60, 102842.
[4] Harvey, B. P., Allen, R., Agostini, S., Hoffmann, L. J., Kon, K., Summerfield, T. C., ... & Hall-Spencer, J. M. (2021). Feedback mechanisms stabilise degraded turf algal systems at a CO2 seep site. Communications biology, 4(1), 219.
[5] Connell, S. D., Foster, M. S., & Airoldi, L. (2014). What are algal turfs? Towards a better description of turfs. Marine Ecology Progress Series, 495, 299-307.
[6] Filbee-Dexter, K., & Wernberg, T. (2018). Rise of turfs: a new battlefront for globally declining kelp forests. Bioscience, 68(2), 64-76.
[7] Gorman, D., & Connell, S. D. (2009). Recovering subtidal forests in human-dominated landscapes. Journal of Applied Ecology, 46(6), 1258-1265.

Microbial drivers of carbon storage and greenhouse gas fluxes in Blue Carbon Ecosystems

Raquel Liébana (1), Emmanuella Orero (2), Iris E. Hendriks (2), Mireia Valle (1), Guillem Chust (1), Laura Alonso-Sáez (1)

(1) AZTI, Marine Research, Basque Research and Technology Alliance (BRTA), Txatxarramendi ugartea z/g, 48395 Sukarrieta, Spain, (2) Global Change Research Group. Mediterranean Institute for Advanced Studies (IMEDEA), Spanish National Research Council-University of the Balearic Islands (CSIC-UIB), Esporles, Spain

Poster

Blue Carbon Ecosystems, Sediment microbial communities, Methane cycling, Carbon sequestration, Greenhouse gas emissions

Introduction

Blue Carbon Ecosystems (BCEs), such as saltmarshes and seagrass meadows, play a major role in coastal carbon budgets due to their long-term carbon sequestration capacity. These ecosystems host complex, vertically stratified sediment microbial communities that transform, stabilize, and store carbon. Along sediment depth gradients, microorganisms mediate diverse oxidative and reductive metabolic pathways, including organic matter remineralization, sulfate reduction, fermentation, methanogenesis, and methane oxidation, which collectively regulate ecosystem-level greenhouse gas (GHG) dynamics.

Two key microbially driven processes determine whether coastal ecosystems function as net carbon sinks or sources: (i) the oxidation of organic matter through sequential redox reactions that release CO_2, and (ii) methanogenesis, restricted to deeper anoxic layers where specialized archaea convert fermentation products into CH_4. BCEs accumulate substantial stocks of organic material which may enhance heterotrophic respiration and methanogenesis, potentially intensifying CO_2 and CH_4 emissions. In addition, dynamic hydrology and shallow redox transitions characteristic of estuarine systems can reduce microbial methane oxidation efficiency, increasing the likelihood of CH_4 transfer to the water column.

In this study, we investigated sediment microbiomes from representative BCEs along the Basque coast. Sampling covered intertidal seagrass beds of *Nanozostera noltei* and saltmarsh habitats distributed along an altitudinal gradient: high marsh (*Juncus maritimus*), mid marsh (*Halimione portulacoides*), and low marsh (*Spartina* spp.). Sediment cores were collected from vegetated and unvegetated areas, spanning full vertical profiles to capture depth-related microbial transitions. In parallel, *in situ* CO_2 and CH_4 fluxes were measured to quantify net GHG exchange. By integrating microbiome characterization with GHG flux data, this study aims to identify microbial groups involved in organic matter oxidation and methane cycling, which shape carbon sequestration and GHG dynamics in BCEs. Ultimately, the results will contribute to identifying key microbial indicators for ecosystem management, conservation, and climate-mitigation strategies.

John Dory: environmental and fishing drivers along 4 decades in the northern Spanish shelf

Marian Blanco (1), Antonio Punzon (1), Jose Manuel Gonzalez-Irusta (1), Alberto Serrano (2), Francisco Velasco (1)

(1) COST IEO-CSIC, (2) COS IEO-CSIC

Poster

demersal; John Dory; environmental effects, trawling impacts, bottom trawl surveys

Introduction

Spatial distribution patterns of John Dory (Zeus faber, L.) were examined in relation to depth, substrate type, near-bottom temperature and salinity and geographical location as environmental variables, and fishing effort as anthropogenic variables. Data were collected during more than 40-year period (1983-2025) of autumn sampling using IBTS demersal trawl surveys in the northern Spanish shelf. No clear patterns have been observed along the time series. Key determinants of John Dory spatial distribution were the water depth and the sea bottom temperature and the latitude. These results are consistent with previous studies (Vrgoc et al, 2006; Maravelias et al, 2007). Zeus faber showed a spatial agregattion in hotspots of abundance. This distribution is discussed in relation to the trophic ecology of the species (Velasco & Olaso, 1998). Relationships between distribution and trawl fishing activities are evaluated together with the possible effects of climate change in increasing its frequency of occurrence (Dunn, 2001).

Methods

Data come from IBTS bottom trawl survey carried out by the IEO (Instituto Español de Oceanografía) every autumn since 1983. A baca 44/60 bottom otter trawl with a mesh size of 10 mm in the cod end was used. Horizontal opening was of 18.9 m and vertical opening of 2.5 m. The sampling unit was made up of 30-min hauls during daytime at a speed of 3 knots. Bottom trawl gear was monitored using a Scanmar net control system.A stratified sampling scheme was used with 5 geographical sectors and 3 depth strata (70-120 m, 121-200 m and 201-500 m).

From each haul, number of specimens and total biomass were collected. Length structure was also recorded.

The evolution of biomass and frequency of occurrence along the historical series was analysed. We also looked at changes in depth along the historical series. A GAM distribution model was aplied to see the combined effect of the variables on the distribution.

Results and Discussion

No clear patterns have been observed along the time series. Key determinants of John Dory spatial distribution were the water depth and the sea bottom temperature and the latitude. These results are consistent with previous studies (Vrgoc et al, 2006; Maravelias et al, 2007). Zeus faber showed a spatial agregattion in hotspots of abundance. This distribution is discussed in relation to the trophic ecology of the species (Velasco & Olaso, 1998). Relationships between distribution and trawl fishing activities are evaluated together with the possible effects of climate change in increasing its frequency of occurrence (Dunn, 2001).

[1] Dunn, M.R., 2001. The biology and exploitation of John dory, Zeus faber (Linnaeus, 1758) in the waters of England and Wales. ICES J. Mar. Sci., 58, 1, 96--105, doi = 10.1006/jmsc.2000.0993

[2] Maravelias, C.D. and E.V.Tsitsika and C. Papaconstantinou, 2007. Seasonal dynamics, environmental preferences and habitat selection of John Dory (Zeus faber). Estuarine, Coastal and Shelf Science, 72, 4, 703-710, doi = 10.1016/j.ecss.2006.12.002

[3] Velasco, F. and Olaso, I., 1998. John Dory Zeus faber (Linnaeus, 1758) feeding off Galicia and in the Cantabrian Sea: Dietary shifts with size. Bol. Inst. Esp. Ocean., 14, 1/2, 69-79}

[4] Vrgo□c, N., Krstulovic Sifner, S., Dadic, V., Jukic-Peladic, S., 2006. Demographic structure and distribution of John Dory, Zeus faber L. 1758, in the Adriatic Sea. Journal of Applied Ichthyology 22, 205e208

An updated assessment of Porifera diversity in Spanish waters: the Bay of Biscay as a key region

Pilar Rios (1), Laura García-Guillén (2), Pelayo Baragaño (2), Javier Cristobo (2)

(1) Instituto Español de Oceanografia (IEO-CSIC). Centro Oceanográfico de Gijón, (2) Instituto Español de Oceanografía (IEO-CSIC). Centro Oceanográfico de Gijón

Poster

Marine biodiversity; Species checklist; Biogeography; Demospongiae; Oceanographic surveys

Introduction

A checklist of marine Porifera recorded in Spanish jurisdictional waters was compiled within the framework of scientific support for updating the official lists of marine species for the Ministry for the Ecological Transition and the Demographic Challenge (MITECO). This checklist integrates data from oceanographic surveys conducted by the Spanish Institute of Oceanography (IEO-CSIC) and an extensive review of scientific literature published between 1912 and 2025.

The dataset is organized according to the five demarcations established under the Marine Strategy Framework Directive: North Atlantic (NOR), South Atlantic (SUD), Strait of Gibraltar and Alboran Sea (ESAL), Levantine–Balearic (LEBA), and the Canary Islands (CAN). All species records were taxonomically validated and critically cross-checked to reduce inaccuracies and ensure completeness.

A total of 583 sponge species have been recorded in Spanish marine waters, representing 100 families, 27 orders, and 4 classes. Demospongiae is the most diverse class, comprising 523 species, followed by Calcarea (39 spp.), Hexactinellida (13 spp.), and Homoscleromorpha (8 spp.).

Biogeographically, the LEBA demarcation shows the highest species richness (305 spp.), followed by NOR (282 spp.), ESAL (258 spp.), CAN (197 spp.), and SUD (154 spp.). Only 41 species are shared across all five demarcations, most belonging to Demospongiae. Notably, only two Calcarea species occur in all demarcations: Clathrina clathrus (Schmidt, 1864) and Clathrina coriacea (Montagu, 1814).

Regarding demarcation-restricted diversity, NOR and LEBA present the highest numbers of exclusive species, with 79 and 77 species, respectively. Among these, 14 species in NOR and 16 in LEBA have their type locality within these regions.

In the Spanish sector of the Bay of Biscay, sponge biodiversity studies are primarily based on the work of Ferrer Hernández and Lombas. Most analyzed specimens derive from oceanographic campaigns conducted in key areas such as the Avilés Canyon System, the El Cachucho Marine Protected Area, and the Capbreton Canyon System.

This updated checklist provides a robust baseline for future biodiversity assessments, biogeographical analyses, and conservation strategies, highlighting the importance of continued taxonomic and deep-sea research in Spanish marine ecosystems.

Benthic Biodiversity of El Cachucho: Insights from the First Marine Protected Area in the Southern Bay of Biscay

Pilar Rios (1), Elena Prado (2), Alberto Abad-Uribarren (3), Pelayo Baragaño (4), Cristina Boza (4), Elvira Ceballos (2), Javier Costas (4), Inés Fernández (5), García-Guillén Laura (4), Florencio González (4), Esteban Pascual (4), Bernardo Pérez (2), Juan Manuel Rodríguez (3), Augusto Rodriguez-Basalo (2), Cristina Rodríguez-Cabello (2), Javier Cristobo (4)

(1) Instituto Español de Oceanografia (IEO-CSIC). Centro Oceanográfico de Gijón, (2) Centro Oceanográfico de Santander, Instituto Español de Oceanografía (IEO-CSIC), Spain, (3) Centro Oceanográfico de Santander, Español de Oceanografía (IEO-CSIC), Spain, (4) Centro Oceanográfico de Gijón, Instituto Español de Oceanografía (IEO-CSIC), Spain, (5) Centro Oceanográfico de Gijón, Español de Oceanografía (IEO-CSIC), Spain

Poster

Benthic biodiversity; El Cachucho MPA; Bay of Biscay; Deep-sea ecosystems; Vulnerable marine ecosystems; Habitat 1170 reefs

Introduction

Benthic fauna in the El Cachucho Marine Protected Area (southern Bay of Biscay, Cantabrian Sea) has been investigated since 2003 through a series of multidisciplinary surveys conducted by the Spanish Institute of Oceanography. The most recent campaign, carried out in 2024 aboard the Ángeles Alvariño, focused on assessing the conservation status of vulnerable habitats and mapping the extent of Habitat 1170 (reefs) within the MPA/SAC El Cachucho and its surrounding areas.

This contribution analyses the biodiversity of benthic macrofauna and megafauna within this Marine Protected Area, drawing on data obtained from several research projects (ECOMARG, INDEMARES, SponGES, INTEMARES, BIODIV) conducted by IEO-CSIC.

In addition, this study updates existing knowledge of the area by integrating previous project reports, scientific publications, and datasets compiled in the framework of research on marine invertebrate and fish diversity. Samples were collected using a wide range of sampling gear, including rock dredge, beam trawl, otter trawl (GOC-73), suprabenthic sledge, box corer, and remotely operated vehicles (ROVs). Furthermore, a ROTV (Politolana) system was used to acquire underwater imagery along transects, enabling detailed documentation of benthic communities.

To date, a total of 688 species belonging to nine zoological phyla have been identified within the El Cachucho MPA: 41 Porifera, 83 Cnidaria, 8 Brachiopoda, 1 Bryozoa, 72 Mollusca, 19 Annelida, 291 Arthropoda, 74 Echinodermata, and 99 Chordata. This work also includes new species records for the study area.

Finally, the study expands the known bathymetric ranges of numerous species and provides relevant information on key habitats, including sponge grounds, cold-water coral reefs, gorgonian forests, and pennatulacean aggregations. These habitats are considered vulnerable, highly sensitive to anthropogenic impacts, and of significant ecological value.

El Cachucho reveals a complex and fragile world, where biodiversity and vulnerability coexist, demanding both scientific attention and lasting protection. Safeguarding this MPA is not only a regional priority, but a crucial step toward preserving the integrity of deep-sea ecosystems in the North Atlantic.

Benthic habitat mapping and sensitivity assessment in a candidate marine protected area on the Cantabrian shelf, southern Bay of Biscay

Berta Ramiro-Sánchez (1), Sara García (2), Ana Antolínez (3), Marina Prieto (1), Marta Ruiz (1), Eva Velasco (1), Ana Navarro (1), José Manuel González-Irusta (1)

(1) CSIC-Spanish Institute of Oceanography, (2) Universidad Politécnica de Valencia, (3) CSIC-Spanish Insitute Oceanography

Poster

habitat-forming species, community modelling, network-based clustering, benthic diversity, Cantabrian Sea

Introduction

Spain's marine Natura 2000 network currently covers around 21% of its exclusive economic zone, with the goal of reaching the 30% target committed to internationally by 2030. Along the northern coast, several sites protect a wide range of offshore benthic habitats and ecosystems, including the Marine Protected Area of El Cachucho (García-Alegre et al., 2014) and the Sites of Community Importance (SCI) of the Avilés Canyon System (Sánchez et al., 2014) off the Asturian coast, and the Jaizkibel-Capbretón Marine Site to the east, near the French border. However, a significant spatial gap exists between these western and eastern sites, leaving the central and eastern Cantabrian shelf largely unprotected. In this context, the eastern coast of Cantabria offers a great opportunity to bridge this gap. While the area already hosts two small coastal protected areas—the Punta Ballena fishing reserve and the Santoña artificial reefs—both are insufficiently sized to adequately fulfil their protective function and are limited to very nearshore waters. A future SCI extending from the coast to the outer shelf and upper slope would not only connect these local areas but also contribute to filling the broader gap in the regional network. Moreover, Cabo de Ajo marks the narrowest point of the Iberian continental shelf, characterised by steep environmental gradients and high geomorphological complexity, making it an ideal setting for studying how environmental drivers shape benthic biodiversity.

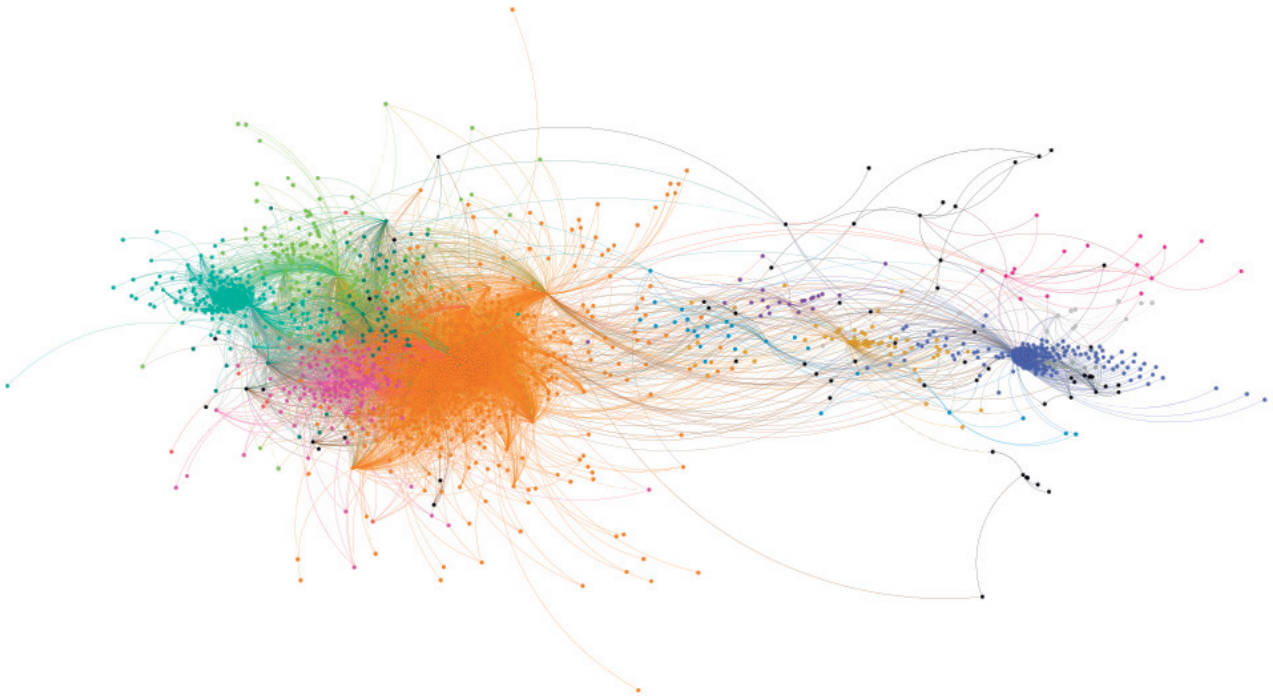
Methods

To evaluate the conservation potential of the circalittoral and bathyal bottoms of this area for strengthening regional network connectivity, we conducted an ROV-based oceanographic survey on the Cantabrian coast between Cabo de Ajo and Punta Ballena, covering water depths from 30 to 500 m, with a focus on hard-substrate environments. Video footage was analysed to annotate habitat-forming species. Network biogeographical clustering (Vilhena and Antonelli, 2015) was then applied to species density data to identify distinct biological assemblages. The identified assemblages were modelled using species distribution models (GAMs), producing continuous habitat maps following an "assemble first, predict later" approach (Ferrier and Guisan, 2006; Serrano et al., 2017; De la Torriente et al., 2019). The sensitivity of predicted assemblages to fishing pressure was evaluated using indicators of the structural and functional attributes of each assemblage. We also examined how associated biodiversity varied taxonomically and functionally among the different habitat types.

Results and Discussion

The biogeographical network analysis allowed the identification of a mosaic of 13 distinct assemblages, reflecting hard and soft substrates and the influence of steep environmental gradients at circalittoral and bathyal depths. Sensitivity to fishing pressure varied considerably among assemblages, with fishing footprints observable on the bathyal slopes. Taxonomic and functional diversity also varied with depth, with shallower assemblages supporting richer and more functionally diverse associated fauna compared to deeper habitats.

The diversity of assemblages across a relatively compact area underscores the high natural value of the region and its importance for conservation. The spatial predictions and sensitivity assessments provide a scientifically grounded framework to support the designation and management of the future SCI, contributing to the long-term protection and connectivity of marine habitats in the southern Bay of Biscay.



[1] De la Torriente, A., González-Irusta, J. M., Aguilar, R., Fernández-Salas, L. M., Punzón, A., & Serrano, A. (2019). Benthic habitat modelling and mapping as a conservation tool for marine protected areas: A seamount in the western Mediterranean. Aquatic Conservation: Marine and Freshwater Ecosystems, 29(5), 732-750.
[2] Ferrier, S., & Guisan, A. (2006). Spatial modelling of biodiversity at the community level. Journal of applied ecology, 43(3), 393-404.
[3] García-Alegre, A., Sanchez, F., Gomez-Ballesteros, M., Hinz, H., Serrano, A., & Parra, S. (2014). Modelling and mapping the local distribution of representative species on the Le Danois bank, El Cachucho marine protected area (Cantabrian sea). Deep Sea Research Part II: Topical Studies in Oceanography, 106, 151-164.
[4] Sánchez, F., González-Pola, C., Druet, M., García-Alegre, A., Acosta, J., Cristobo, J., ... & del Río, G. D. (2014). Habitat characterization of deep-water coral reefs in La Gaviera canyon (Avilés Canyon System, Cantabrian Sea). Deep Sea Research Part II: Topical Studies in Oceanography, 106, 118-140.
[5] Serrano, A., González-Irusta, J. M., Punzón, A., García-Alegre, A., Lourido, A., Ríos, P., ... & Cartes, J. E. (2017). Deep-sea benthic habitats modeling and mapping in a NE Atlantic seamount (Galicia Bank). Deep Sea Research Part I: Oceanographic Research Papers, 126, 115-127.
[6] Vilhena, D. A., & Antonelli, A. (2015). A network approach for identifying and delimiting biogeographical regions. Nature communications, 6(1), 6848.

New insights into the diversity and bathymetric distribution of Scaphopoda in the Central Cantabrian Sea and the Avilés Canyons System

Omar Sánchez (1), Javier Martinez-Pérez (2), Andrés Arias (1)

(1) Department of Organisms and Systems Biology (Zoology), University of Oviedo, Asturias, Spain, (2) Biodiversity and Conservation Group (BIOCON), ECOAQUA, University of Las Palmas de Gran Canaria, Canary Islands, Spain

Poster

deep-sea; tusk shells; Bay of Biscay; malacology; oceanographic campaigns

Introduction

Scaphopods (Mollusca: Scaphopoda), commonly known as tusk shells or tooth shells, constitute an important, yet still insufficiently known, component of benthic marine assemblages, particularly in deep-sea environments where patterns of diversity, distribution, and bathymetric range remain poorly documented. In this study, the taxonomic composition, abundance, and depth distribution of Scaphopoda were examined from material collected during the BIOCANT I-III and COCACE oceanographic campaigns, covering habitats from the continental shelf to the abyssal plain over a depth range of 50–4.700 m. A total of 15 taxa belonging to 3 families were recognised, with Gadiliidae and Dentaliidae accounting for most of the observed diversity. Among live-collected specimens, *Antalis agilis* was the most abundant species (56 specimens), followed by *Entalina tetragona* and *Fissidentalium capillosum*. Bathymetric data revealed a broad depth distribution, from the shallow occurrence of *Dischides politus* (50–144 m) to abyssal records of *Gadila* spp. showing the widest bathymetric range (1.189–4.700 m). Remarkably, at least four taxa assigned to the genus *Gadila* and *Cadulus*, may represent new undescribed species, highlighting the still largely unexplored diversity of this group. Altogether, these results underscore the exceptional scientific value of these campaigns and reveal how fragmentary our current knowledge of scaphopod diversity and distribution still is, especially in deep-sea environments.

Exotic Gastropods of the Northern Iberian Peninsula: A Comprehensive Review

Omar Sánchez (1), Javier Martínez-Pérez (2), Andrés Arias (3)

(1) Universidad de Oviedo, (2) Biodiversity and Conservation Group (BIOCON), ECOAQUA, University of Las Palmas de Gran Canaria, Canary Islands, Spain, (3) Department of Organisms and Systems Biology (Zoology), University of Oviedo, Asturias, Spain

Poster

marine invasions; Bay of Biscay; tropicalization; malacology; meridionalization

Introduction

Marine biological invasions are among the main drivers of ecological change in coastal ecosystems, altering native communities, species distributions, and biogeographic patterns. Along European Atlantic shores, the recognition of exotic molluscs is further complicated by the coexistence of recent introductions, historical records, and poorly resolved distribution limits. This study reviews the exotic gastropods reported from the northern coast of the Iberian Peninsula. The revised dataset comprises 31 species belonging to 15 families. Nassariidae and Muricidae are the most diverse families, with six exotic species each, followed by Trochidae with five species. Overall, 14 species are considered established, whereas 17 are regarded as casual records. Pontevedra stands out as the most affected province, probably owing to its long fishing tradition and shellfish farming history, particularly oyster cultivation, which likely constitute the main introduction pathway for many of the exotic mollusc species recorded to date in our region. In addition to the taxa reviewed here, several other species have been reported from the study area and show a clear Mediterranean affinity. However, due to the Portuguese marine fauna remains insufficiently known, it is still uncertain whether these northward occurrences reflect ongoing processes of meridionalization or tropicalization, or whether they simply correspond to the natural northern distribution limit of some species. The review also highlights significant uncertainties in the regional literature. Several species recorded nearly a century ago, or even only a few decades ago, may actually represent misidentifications that have subsequently been repeated in the literature and should therefore be reassessed. Likewise, some shell-based records may not reflect true introductions, as ornamental shells may reach the coast through accidental loss or breakage. Overall, the exotic gastropod fauna reported from the northern Iberian Peninsula is still far from being fully resolved, as established species coexist with casual occurrences, long-standing doubtful records, and taxa whose biogeographic status remains uncertain.

Characterization of recurrent blooms of the dinoflagellate Adenoides sinensis at a beach in the Basque coast

Garazi Barrenetxea (1), Ibon Uriarte (1), Aitor Laza-Martínez (1)

(1) University of the Basque Country (UPV/EHU)

Poster

Adenoides sinensis, intertidal zone, meiofauna, microphytobenthos, sand-dwelling dinoflagellates, vertical migrations

Introduction

Recurrent winter blooms of a sand-dwelling dinoflagellate (initially identified as *Adenoides*-like) were investigated in an intertidal sandy beach in Sopela (Basque coast) to identify the environmental drivers underlying this atypical seasonal pattern. While phytoplankton blooms in temperate regions typically peak in spring, with a secondary increase in autumn, this population reaches maximum abundance in winter, suggesting distinct controlling mechanisms. LSU rDNA (D1–D2 region) sequencing confirmed the species as *Adenoides sinensis* H. Gu, X. Li & Z. Luo, a species described in China in 2018, and revealed identical sequences to two strains from China and New Zealand. This represents the second report of the species since its description and its first observation outside the Pacific Ocean. A monthly sampling program (September 2024–August 2025) was conducted to assess abiotic (irradiance, temperature, salinity, and nutrients) and biotic factors (microalgae as potential competitors and meiofauna as potential consumers). The bloom initiated in late autumn, peaked in winter (up to 5,600 cells cm^{-2}), and declined towards spring. Biotic interactions appeared to play a key role in the population dynamics. Peak abundances of *A. sinensis* coincided with minimal densities of both competing microalgae (diatoms) and potential grazers, especially harpacticoid copepods. Multivariate analyses indicated negative relationships between *A. sinensis* and both competitors and consumers. Abiotic variables did not show clear limiting effect: salinity remained relatively stable and nutrient concentrations were consistently high in interstitial water. Despite lower winter temperature and irradiance, light availability appeared sufficient to sustain growth. Vertical migration within the sediment—although not directly assessed—likely enhances light utilization by allowing cells to reach the surface during low tide, thereby supporting bloom development under otherwise potentially light-limiting winter conditions.

Temperature sensitivity and environmental regulation of key extracellular enzymatic activities in Bay of Biscay: implications for biogeochemical stoichiometry under climate change

Zuriñe Baña (1), Amaia Zarrabeitia-Elorriaga (2), Amaia Hernandez-Fernandez de Retana (2), Iñigo Azua (2)

(1) University of Basque Country - Plentzia Marine Station (UPV/EHU-PiE), (2) University of Basque Country (UPV-EHU)

Poster

Extracellular Enzymatic Activities, Temperature Sensitivity, Environmental Regulation, Biogeochemical Stoichiometry, Climate Change

Introduction

Extracellular enzymatic activities (EEAs) produced by marine microorganisms are fundamental drivers of the degradation and recycling of high-molecular-weight dissolved organic matter (DOM) in the ocean, directly shaping carbon, nitrogen, and phosphorus cycling. Among these enzymes, leucine aminopeptidase (LAP), alkaline phosphatase (AP), and the α- and β-glucosidases (α-GLU, β-GLU) are considered major agents that initiate the breakdown of polymeric substrates enriched in nitrogen, phosphorus, and carbon, respectively. Understanding the regulation, kinetics, and temperature sensitivity of these activities is crucial to anticipate how climate-driven environmental changes may alter coastal biogeochemical functioning.

Methods

This study examines the kinetic behavior and environmental controls of LAP, AP, α-GLU, and β-GLU in surface waters of the port of Getxo (Biscay, southeastern Bay of Biscay) over a three-year period (2022–2025). The results provide new insights into the functioning of microbial enzymatic systems in dynamic coastal environments subjected to both natural variability and anthropogenic influence.

Results and Discussion

Across the full study period, all four measured enzymatic activities exhibited biphasic Michaelis–Menten kinetics, indicating the presence of at least two distinct enzymatic systems or substrate-use strategies within the microbial community. The first kinetic component consisted of high-affinity, low-activity enzymes that operate efficiently at low substrate concentrations and are typically associated with natural, oligotrophic conditions. The second component was formed by low-affinity and high-activity enzymes that act in the presence of abundant substrates, often linked to coastal productivity, episodic nutrient inputs, or pulses of fresh organic matter.

Temperature was found to be a key regulator of the Vmax of high-affinity enzymatic fractions. Activation energies (Ea) derived from Arrhenius relationships revealed clear differences in thermal sensitivity among enzymes. LAP exhibited the highest activation energy (Ea = 1.46 eV), indicating that nitrogen-degrading high-affinity processes are particularly responsive to temperature changes. β-GLU followed with a moderate thermal sensitivity (Ea = 0.87 eV), while AP presented a lower sensitivity (Ea = 0.66 eV). These results imply that warming conditions may disproportionately accelerate nitrogen-related enzymatic degradation relative to carbon- and phosphorus-related processes, potentially altering microbial nutrient acquisition strategies. Furthermore, the marked temperature dependence of LAP suggests that protein-rich DOM degradation could intensify more rapidly than other pathways in a warming ocean.

In contrast, low-affinity enzymatic fractions were not primarily controlled by temperature. Instead, they responded strongly to biological and ecological factors, particularly chlorophyll-a concentration (a proxy for primary production) and bacterial abundance. These relationships indicate that these enzymes are dynamically regulated by microbial community interactions and productivity pulses rather than by direct thermal forcing. Such behavior is consistent with the understanding that low-affinity enzymes are often inducible and activated in response to fresh organic matter inputs, phytoplankton exudation, dissolved organic matter composition or particle association lifestyle.

Interestingly, α-GLU did not show significant regulation by any of the measured environmental variables, suggesting that this particular glucosidase may be governed by factors not included in the present dataset or that its expression is more constitutive and less responsive to short-term environmental variability.

In the context of climate change, the differential regulation of high-affinity (temperature-controlled) versus low-affinity (biologically controlled) enzymes may have profound consequences for coastal carbon, nitrogen, and phosphorus cycling. As seawater temperatures rise, the enhanced sensitivity of LAP and, to a lesser extent, β-GLU and AP suggests that the relative rates of nitrogen, carbon, and phosphorus remineralization may decouple, leading to disproportionate nitrogen release from organic matter. Simultaneously, changes in phytoplankton dynamics and bacterial abundance—both expected to be affected by warming, stratification, and altered nutrient inputs—will modify the activity of low-affinity enzymes that respond to productivity and community structure. Such combined shifts could distort the canonical Redfield stoichiometry (C:N:P = 106:16:1) that underpins marine biogeochemical models. Increased LAP activity may accelerate N release relative to C and P, potentially creating relative carbon limitation for heterotrophic bacteria or altering the balance between autotrophic and heterotrophic processes. Enhanced β-GLU or AP activity under future environmental regimes could further reshape C:N:P transformations, depending on the relative strength of temperature versus ecological forcing. In a warming scenario, temperature-driven acceleration of high-affinity enzymes may shift the baseline rates of nutrient regeneration, while ecologically driven changes in low-affinity enzymes may alter the system’s response to episodic productivity events. Such combined modifications may amplify mismatches between C, N, and P cycling, potentially impacting microbial loop efficiency, nutrient availability for phytoplankton, and broader ecosystem functioning.

Taken together, these results underscore the importance of extracellular enzyme dynamics as sensitive indicators of environmental change in coastal waters. The coexistence of dual kinetic components allows microbial communities to maintain functional resilience, although their differing regulatory drivers can leave the system exposed to rapid environmental changes. Therefore, understanding the kinetics and regulation of EEAs is crucial not only for predicting microbial responses but also for anticipating changes in coastal biogeochemical stoichiometry and the ecological consequences in a future ocean increasingly shaped by climate change.

Range expansion and shifting aggregation dynamics of tub gurnard Trigla lyra (Scorpaenoidei: Triglidae) in the Cantabrian Sea (1993–2025)

Juan Carlos Arronte (1), Jose Manuel González-Irusta (1), Francisco Velasco (1), Alberto Serrano (1)

(1) Instituto Español de Oceanografía (IEO-CSIC). C.O. de Santander

Poster

Trigla lyra SDM Delta GAM

Introduction

Tub gurnard (*Trigla lyra*) is a demersal species of commercial interest in the Cantabrian Sea, although its long-term distributional dynamics remain poorly understood. We analysed its spatio-temporal distribution over a 33-year period (1993–2025) using data from the DEMERSALES bottom trawl survey series.

Species distribution was modelled using a delta GAM framework, including bathymetry, seabed slope, sediment composition (organic matter, mud, fine and coarse sand), bottom temperature, and salinity as environmental predictors. Temporal changes in spatial structure were assessed using geostatistical aggregation curves, occupied area, centre of gravity, and an Index of Persistence.

Geostatistical aggregation curves showed that both occupied area and maximum local density increased with population abundance. From the mid-2000s onward, a progressive decline in the Space Selectivity Index indicates a sustained expansion of the species' distribution range, consistent with the marked increase in abundance observed since 2015. Analyses of occupied area and centre of gravity further supported this pattern, revealing a westward shift of the distributional centroid and a substantial increase in occupied area over the study period. The Index of Persistence identified several stable aggregation cores along the shelf break, mainly between 100 and 300 m depth on soft-sediment habitats.

This expansion is consistent with the meridionalization process described for Lusitanian demersal species in the southern Bay of Biscay and was likely driven primarily by reduced fishing pressure, while the potential contribution of intermediate-water warming, although plausible, remains to be confirmed.

Untangling the Aphanopus Species Complex: Implications for Fisheries Management

Javier Martínez Pérez (1), Álvaro Fueyo Rodríguez (2), Omar Sánchez Fernández (2), JOANA PATRICIA Reis Vasconcelos (1)

(1) Universidad de Las Palmas de Gran Canaria, (2) universidad de Oviedo

Poster

Introduction

Accurate species identification is essential for fisheries management, particularly when cryptic species overlap in distribution and show high morphological similarity. Misidentification can bias catch-based estimates of exploitation rates and increase the risk of overexploiting sympatric populations. This challenge is illustrated by two commercially important deep-water scabbardfish species, the black scabbardfish (Aphanopus carbo) and the intermediate scabbardfish (A. intermedius), which occur sympatrically across the Atlantic Ocean. These species are extremely difficult to distinguish morphologically. External differences are virtually imperceptible to the naked eye and reliable identification typically requires detailed examination of characters such as vertebrae counts or dorsal-fin spine morphology. Although recent studies have shown that wavelet-based analyses can improve discrimination between species, the otolith regions responsible for this separation remain limited. Genetic analyses supported the close resemblance between both species. Haplotype analysis of mitochondrial cytochrome oxidase I (COI) sequences revealed separation between the two species across samples from Madeira, the Canary Islands, mainland Portugal, Scotland and Bay of Biscay, despite the detection of only a single A. intermedius specimen. This pattern was consistent with analyses including NCBI sequences, which clustered into two clearly differentiated groups. However, the low number of mutations underlying this separation resulted in an average genetic distance of only ~1% between species. These findings suggest that A. carbo and A. intermedius may represent lineages undergoing an early stage of diversification. However, a more comprehensive assessment integrating additional evidence, including nuclear markers, genomic approaches, and broader geographic sampling, is required to clarify the extent and dynamics of this process. Such information is essential to define appropriate biological units for management, reduce species misidentification in fisheries statistics, and avoid the implementation of management measures that could inadvertently increase fishing pressure and compromise the sustainability of these valuable resources.

New insights into the diversity of mesopelagic fishes in the Central Cantabrian Sea and the Avilés Canyon System

Javier Martínez Pérez (1), Omar Sánchez Fernández (2), Airam N. Sarmiento Lezcano (3), Andres Arias (2)

(1) Universidad de Las Palmas de Gran Canaria, (2) Universidad de Oviedo, (3) IEO A Coruña

Poster

Introduction

Mesopelagic fishes are the most abundant teleosts in the open ocean, with high species richness and a key role in active carbon flux. However, their taxonomic composition and distribution patterns remain poorly documented in many regions. This study aims to characterize the taxonomic composition and diversity of mesopelagic fishes in the central Cantabrian Sea, providing a baseline for understanding the structure and ecological dynamics of these communities. Taxonomic composition and diversity of deep-pelagic fishes were examined using material collected during the BIOCANT I-III oceanographic expedition, covering habitats from the continental shelf to the abyssal plain, at depths ranging from 25 to 4,700 m. A total of 16 taxa were identified, representing 9 families and 7 orders, with Myctophiformes and Stomiiformes emerging as the most diverse and abundant groups. Spatial differences were detected among stations, with marked variation in species richness, abundance, and diversity, and with some stations showing more even communities whereas others were characterized by stronger dominance patterns. The mesopelagic fish assemblage was largely dominated by myctophids, particularly Benthosema glaciale, while similarity analyses revealed a core group of stations with relatively comparable species composition and others with more singular or weakly represented assemblages. These results provide new insights into the composition and diversity of mesopelagic fish communities in the central Cantabrian Sea.

From juveniles to adults: wavelet analysis reveals regional otolith contour patterns in Trachurus trachurus

Javier Martínez Pérez (1), Marina Shui Fernández (1), Alberto Rodríguez Díaz (1), Fabiana Rosano (2), Ana Rita Vieira (3), Alba Jurado-Ruzafa (4), Gioele Capillo (5), Joana Vasconcelos (1)

(1) Universidad de Las Palmas de Gran Canaria, (2) University of Milano - Bicocca, Italy, (3) Faculdade de Ciências, Universidade de Lisboa, (4) IEO Tenerife, (5) University of Messina

Poster

Trachurus trachurus, otolith contour shape, population structure, Northeast Atlantic, western Mediterranean

Introduction

Otolith contour analysis provides a sensitive tool for detecting phenotypic structuring in widely distributed pelagic fishes. We investigated morphotypic differentiation in otolith contour shape of Trachurus trachurus from 232 juveniles and 534 adults collected across the Northeast Atlantic and western Mediterranean, including Deba North (Basque Country), Tapia Norte (Asturias–Galicia border), Cape Corrubedo (Galicia) and Cape Ortegal (A Coruña), Lisbon, Gulf of Cádiz, Mauritania, the Alboran Sea and the Tyrrhenian Sea, using wavelet functions. Our results revealed clear regional variation, with high local classification accuracy in both adults and juveniles, generally above 95%. Adults from Galicia showed the deepest notch and the most pronounced antirostrum, with Mauritania showing similar but less marked features. Otoliths from the Gulf of Cadiz and the Alboran Sea showed similar outline trends, namely a less profound notch and, consequently, a less pronounced rostrum. In juveniles, the deepest notch was observed in the Gulf of Cadiz, whereas the remaining localities showed a shallower indentation. The antirostral region was especially marked in Gulf of Cadiz and Mauritania. These results support the presence of regional otolith signatures across life stages and suggest that fine-scale spatial heterogeneity may already be detectable early in life. The observed differences among Atlantic, Mediterranean and Northwest African localities indicate spatially structured phenotypic variability within T. trachurus. Expanding sampling in underrepresented areas will help clarify whether these patterns reflect local environmental conditions, connectivity, or adaptive divergence.

Modelling ecosystem components from zooplankton to fish and climate hazards in the Bay of Biscay: insights from the NECCTON project

Sarah Albernhe (1), Ciavatta Stefano (1), Fauny Olivia (1), Kay Susan (2), Travers Morgane (3), Merillet Laurène (4), Titaud Olivier (4), Millington Rebecca (5), Powley Helen (5), de Mora Lee (5), Misi Quentin (1), Lehodey Patrick (1)

(1) Mercator Ocean international, (2) Met Office, (3) Ifremer, (4) CLS (Collecte Localisation Satellites), (5) PML (Plymouth Marine Laboratory)

Poster

Ecosystem modelling, Population dynamics, Trophic chain, European project, Operational products, Climate change impacts

Introduction

Home to rich and complex ecosystems, the Bay of Biscay is of critical ecological and socioeconomic importance. Understanding the functioning of this ecosystem, and particularly the population dynamics of the diverse species that constitute its richness, is essential for its sustainable management. Here, we present a suite of marine ecosystem modelling products developed for this region within the framework of the NECCTON project, a four-year Horizon Europe initiative coordinated by Mercator Ocean International and involving 23 European partners. NECCTON aims to advance operational marine ecosystem modelling in support of biodiversity conservation and fisheries management, by developing an innovative fully integrated modelling system that more accurately represents the functioning of the marine ecosystem.

The modelling products developed by European partner institutions span the full trophic chain of the Bay of Biscay, from biogeochemical processes to upper trophic levels. Using diverse numerical models (ERSEM, SEAPODYM, OSMOSE, MIZER), these products encompass: particulate organic carbon and carbon fluxes, mesozooplankton, micronekton functional groups resolved by diel vertical migration behaviour, small pelagics (European anchovy, sardine, and mackerel), pelagic fish, and benthic macrofauna communities.

Beyond trophic components, NECCTON also delivers a set of climate hazard indicators (heat waves, acidification, hypoxia, etc.) applied to key species (Atlantic herring, seabass, seabream, mussel, seaweeds, and cold-water corals), providing critical insights into the cumulative pressures faced in the Bay of Biscay under ongoing climate change.

Together, these products constitute an integrated and operational modelling framework for the Bay of Biscay, offering unprecedented coverage across biological compartments and stressor dimensions. All datasets are open-access and can be explored, manipulated, and downloaded through a dedicated interactive viewer, enabling broad accessibility for both the scientific community and operational users.

A recent new discovery, from two vintage expeditions, in the deepest Bay of Biscay

Inma FRUTOS (1), Graham BIRD (2)

(1) University of Lodz, (2) independent researcher

Poster

Introduction

The beginning of deep-sea oceanography studies in the mid-19th century pointed out the Bay of Biscay as a place attracting the curiosity of researchers. Such interest promoted historical expeditions to explore its deep realm and, indeed, starting the inventorying of its deep-sea benthic fauna. Despite these earliest studies and the subsequent sampling effort accomplished with the deep-sea expeditions of the 20th and 21st centuries, the biodiversity within the deep-sea fauna in the Bay of Biscay is far from being completely known.

During the 1980s, study of tanaidacean crustaceans from French surveys of the Biscay Abyssal Plain, seven individuals were ascribed to the genus *Armatognathia* that did not match the description of any of its then-known species. After nearly 40 years, these specimens have now been relocated and re-examined. *Armatognathia*, established by Kudinova-Pasternak in 1987 from the Madagascar Basin, has been recently classified within the new family Paranarthrurellidae and currently holds four species: *A. birsteini*, *A. milonga*, *A. shiinoi*, and *A. swing*. Within a family strictly confined to the deep-sea, *Armatognathia* species are dwellers in the abyss of the Indian, Atlantic and Pacific oceans.

The new *Armatognathia* sp.1 was collected during both the French NORATLANTE (October 1969) and INCAL (August 1976) expeditions at one and three stations, respectively, all located on the Biscay Abyssal Plain at depths of 4540–4798 m.

Armatognathia sp.1, the northernmost Atlantic record, shares its occurrence in the North Atlantic abyss with *A. swing* (from the Gay Head–Bermuda transect), and both are separated from *A. milonga* inhabiting the Argentine Basin abyssal province.

Chelator insignis (Crustacea: Isopoda) as deep-sea host for Trophomera (Nematoda: Benthimermithidae) in the Bay of Biscay

Inma FRUTOS (1), Alexei V. TCHESUNOV (2)

(1) University of Lodz, (2) M. V. Lomonosov Moscow State University, Department of Invertebrate Zoology

Poster

Introduction

Benthimermithids are the most common marine nematode parasitoid taxa mainly dwelling in the deep sea. They have a larval stage parasitizing the body cavity or internal organs of deep-sea invertebrates (e.g., polychaetes, priapulids, molluscs and crustaceans), that at juvenile stage, they molt and quit the exhausted host for free-living into the sediment where they do not feed but reproduce.

Within the framework of ECOMARG project, the Le Danois Bank was sampled in 2003 and 2004 at nine stations by means of a sledge in order to characterize the deep-sea suprabenthic communities, and a total of 7223 isopods belonging to 52 species were identified. One of the most abundant isopod, the desmosomatid *Chelator insignis* (Hansen, 1916), reported 4 specimens fully infested by the benthimermithid nematode *Trophomera* sp.

Recorded between 619 and 1062 m depth in the intraslope basin on muddy sediments with high organic content, *Chelator insignis* abundance ranged between 0.2 and 4.8 ind./100 m2 showing the highest density between 1049 and 1062 m depth. After its diet characterization, this isopod is a carnivore species mainly feeding on polychaetes and crustaceans. Although accidentally swallowed detritus with eggs of *Trophomera* could be the way to penetrate into *Chelator insignis*, previously infested preys could also provide the vector of infestation in this isopod.

Herein, it is the first find of genus *Trophomera* in still living deep-sea asellote isopods placing *Chelator insignis* as host for its late larval developing stage in the Bay of Biscay.

Updating diversity and ecology of Eusirus species (Crustacea: Amphipoda) in the Bay of Biscay

Inma FRUTOS (1), Jean Claude SORBE (2)

(1) University of Lodz, Department of Invertebrate Zoology & Hydrobiology, (2) Muséum national d'Histoire Naturelle, ISYEB-UMR 7205, Paris, France

Poster

Within the amphipod family Eusiridae, the genus *Eusirus* holds 32 species reported from the Atlantic (11 species), Southern Ocean (9 species), Pacific (6 species), Indian (4 species) and Arctic (2 species) oceans. This cosmopolitan genus lives from the shelf to the hadal depths.

In the Bay of Biscay, four species has been reported from circalittoral to bathyal depths so far: *Eusirus biscayensis*, *E. bonnieri*, *E. leptocarpus* and *E. longipes*. During a multidisciplinary study of the benthic and demersal ecosystem at the Le Danois Bank (southern Bay of Biscay), 18 individuals ascribed to the genus *Eusirus* that did not match the description of any of its known species, were recorded.

In 2003 and 2004, within ECOMARG project framework, the suprabenthic fauna was quantitatively sampled at nine stations between 486 and 1062 m depth by means of a suprabenthic sledge. In the total of suprabenthic fauna collected – 38210 individuals belonging to 305 species –, 37.9% were amphipods belonging to 121 species. The Eusiridae family occurred at all stations and *Eusirus* contributed with four species: *E. biscayensis*, *E. leptocarpus*, *E. longipes*, and the new *Eusirus* sp.A. This bathyal new species inhabit at the top of the Le Danois Bank and its intraslope basin between 498 and 829 m depth, and it is better represented in the deeper stations whereas its three congeneric dominate at the top of the bank.

With this new discovery – the third species of *Eusirus* to be described in the bay – the abundance and distribution of the well-established populations of *Eusirus* are analyzed along the southern margin of the Bay of Biscay after more than 20 years of sampling effort to characterize the suprabenthic communities on the slope, seamount and canyons.

CARTOGOUF: A Multi-Source Approach to Benthic Habitat Mapping in the Capbreton Canyon

Léa Marmion (1), Adrien Goujard (2), Hélène Marsac (3), Jean-François Brisard (3), Laure Marini (3), Jean-Damien Bergeron (1)

(1) ABYSSA, (2) ARGYRO MARINE, (3) Créocéan

Poster

Capbreton canyon, high-resolution map, deep-water habitats, multi-tool methodology

Introduction

In the Bay of Biscay, the Capbreton Canyon, which extends over 300 km in length and more than 2,000 m in depth, is one of the most remarkable submarine canyons on the Atlantic margin. Its complex geomorphology and specific hydrodynamic conditions have prompted numerous scientific campaigns over the past few decades. These have highlighted its geological characteristics (notably the presence of autogenous carbonates), as well as the sedimentological and biological features.

Despite this wealth of information, the data remain fragmented. To adopt a comprehensive ecosystem-based approach, the CARTOGOUF project aims to map the benthic habitats of the Capbreton Canyon.

To this end, a multi-tool methodology has been defined.

Using multiple data sources, a high-resolution map of the canyon and the adjacent continental shelf has been produced.

Particular attention will be paid to the Serpentin area. Optical observations conducted using underwater drone surveys (ROVs and AUVs) will be integrated with existing geological and environmental data. The transects will cover around twenty kilometres, from the axial trough to the continental shelf, at depths ranging from -100 to -800 m. This approach will enable the identification and characterisation of deep-water habitats, following the European EUNIS typology, including Vulnerable Marine Ecosystems (VMEs), such as Cold-Water Coral (CWC) communities or biogenic habitats of the mudflats (EUNIS A5.3) and reefs (EUNIS A4.2).

Finally, CARTOGOUF will contribute to showcasing the richness of the Capbreton Canyon through the production of a dynamic online mapping tool and the creation of a 3D print of the canyon, supporting both scientific understanding and public awareness.

CARTAV: Characterisation of green algae in intertidal habitats along the Basque coast

Muriel Lissardy (1), Marie-Noëlle de Casamajor (1), Florence Sanchez (1), Claire Meteigner (2), Coralie Connes (2), Loïc Rigouin (2), Océane Lauga (3), Ronan Sulpice (4), Serena Rosignoli (4), Masami Inaba (4), Yann Lalanne (3)

(1) Ifremer - Département Océanographie et Dynamiques des Écosystèmes ODE/COAST/LERAR - 64600 Anglet - France, (2) Ifremer - Département Océanographie et Dynamiques des Écosystèmes ODE/COAST/LERAR - 33120 Arcachon - France, (3) UNIV PAU & PAYS ADOUR/E2S UPPA, Collège STEE, 1 allée du Parc Montaury, 64600 Anglet, France, (4) School of Biological and Chemical Sciences, University of Galway, Ireland

Poster

Introduction

Over the past several years, rocky shores along the Basque coast have experienced a resurgence of green algae blooms, suggesting environmental disturbances that may lead to ecological imbalance in rocky intertidal habitats. These blooms have been reported across the Basque Country Marine Protected Area. To investigate this phenomenon, four representative sites distributed along this coastline were selected for monitoring. These sites were chosen primarily because historical observation data are available, allowing comparisons with previous ecological conditions.

The originality of the CARTAV project lies in its multidisciplinary approach to assessing this issue. One of its main innovations is the use of drone-based imagery to characterize green algae blooms on intertidal rocky habitats. This technology provides high-resolution spatial data and enables precise mapping of areas affected by algal proliferation. In addition, field surveys are conducted using the quadrat method to estimate the coverage and biomass of opportunistic green algae. Genetic analyses of algal samples from targeted habitats were performed to identify the species responsible for the colonization.

To better understand the drivers of algal proliferation, several environmental parameters are monitored, including temperature, light availability, and nutrient concentrations. Hydrodynamic data are also examined in order to integrate the influence of physical processes on the distribution and development of green algae. These complementary datasets provide essential information for understanding the origin, temporal evolution and spatial dynamics of the phenomenon.

By combining drone imagery, field measurements, genetic identification and environmental monitoring, this approach enables accurate and dynamic mapping of areas affected by green algae blooms. The results will contribute to improved management of Natura 2000 sites along the coastline and to a broader understanding of this phenomenon at the regional scale. The project also supports habitat management objectives linked to the Water Framework Directive and the Marine Strategy Framework Directive.

CIRCACAV - Biodiversity and functioning of remarkable habitats « underwater caves » and « gorgonian reefs » Marine Protected Area FR7200813 “ Rocky Basque coast and offshore extension”

de CASAMAJOR Marie-Noëlle (1), SARTORETTO Stéphane (2), GOUILLIEUX Benoît (3), CHENESSEAU Sandrine (4), BIANCHIMANI Olivier (5), BUJAN Stéphane (3), RAVEL Christophe (2), LAUDET Antoine (6)

(1) Ifremer LERAR, (2) Ifremer LERPAC, (3) Université de Bordeaux-CNRS, (4) Institut méditerranéen de biodiversité et d'écologie marine et continentale, (5) Septentrion Environnement, (6) Ifremer LERAR/LERPAC

Poster

Marine cave, gorgonain reef, EBQI, hydrozoa, conservation, Marine Protected Area

Introduction

The CIRCACAV project aim to acquire knowledge about little-known habitats in the Bay of Biscay, particularly circalittoral habitats. They are of major functional interest in terms of the biodiversity they harbour.

Biological and ecological data on ten « underwater caves » and one « gorgonian reefs » are collected during sampling campaign. Alls data collected on biodiversity in caves aim to assess to the ecological status using an Ecosystem Based Quality Index (EBQI) initially developed in the Mediterranean sea. At the same time, in order to characterise the geomorphological structure of the caves, a 3D reconstruction is being carried out on three caves using photogrammetry. Moreover, this 3D reconstruction also serves as a tool to raise public awareness about the preservation of this habitat.

Animal forests, such as gorgonian gardens are biodiversity hotspots, so, the aim is to focuses on the biological monitoring of two major species for the gorgonian reef habitat over an annual cycle. These are the engineer species *Paramuricea grayi* in northern limit of its range in the southern Bay of Biscay and the hydroid Amphisbetia operculata and its associated fauna.

In order to understand the biological parameters studied, environmental factors are also considered to assess fluctuations throughout the year in the two habitats studied. Two environmental parameters in particular are studied because they constitute the predominant environmental forces in the southern Bay of Biscay: swell and temperature.

From an expertise perspective, this project provides marine protected area managers with scientific data that will help them to select high-level protection zones within protected areas. In addition, this project also includes a participatory science component with various activities: involvement in environmental data collection, creation of habitat information sheets for users, and raising awareness among divers...

Layers of Resilience: Using eye lens isotopic archives to reconstruct predator life-histories in the Bay of Biscay.

María Díez-Muñoz (1), Manuel Hidalgo (2), Juan José Ortiz (1), Izaskun Preciado (1), Anna M. Sturrock (3), Lucía López-López (1)

(1) Santander Oceanographic Center (COST), Spanish Institute of Oceanography (IEO, CSIC), Severiano Ballesteros 16, Santander 39004, Spain, (2) Balearic Oceanographic Center (COB), Spanish Institute of Oceanography (IEO, CSIC), Moll de Ponent s/n, Palma 07015, Spain, (3) School of Life Sciences, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, United Kingdom

Poster

Stable isotope analysis, archival tissues, Bay of Biscay, ontogeny.

Introduction

Marine predators play a pivotal role in ecosystems stability by transferring energy across habitat boundaries. While traditional tracking methods often face logistical constraints, stable isotope analysis (SIA) has emerged as a powerful tool for mapping these dynamics. These chemical markers reveal essential data on movement patterns, foraging niches and trophic levels, providing a comprehensive view on their ecological role. As archival tissues, the proteinaceous eye lenses of fish and cephalopods provide a chronological record of an organism's life history. These structures are characterized by concentric lamellar growth, where each successive layer retains its original isotopic signature as the tissue becomes metabolically inert after deposition. However, the novelty of this technique leaves critical uncertainties regarding the periodicity of layer deposition, fine-scale variability of isotopic incorporation and potential sex-specific differences in lens development.

To address current methodological gaps, this study investigates sex-differentiated eye lenses from three ecologically distinct species in the Cantabrian Sea (Bay of Biscay): the short-finned squid (*Illex coindetii*), the European hake (*Merluccius merluccius*) and the thornback ray (*Raja clavata*). These species were selected to represent contrasting life-cycle strategies and mobility patterns within the study area. Lenses were delaminated at the highest possible precision for posterior δ13C and δ15N isotopic analysis. Expected outcomes of this approach aim to capture fine-scale ontogenetic isotopic shifts, establishing a baseline for back-calculated time series. By reconstructing life-cycle movements and trophic positions, this study seeks to identify critical refuge areas and explore how trophic flexibility and predator-driven connectivity enhance the resilience of marine communities in the Bay of Biscay.

Too Soon to Save: The Hidden Cost of Acting Without Knowledge of Species Interdependence

Muhammad Umer Gurchani (1)

(1) École normale supérieure

Poster

Predator–prey interactions, Marine food webs, Structural uncertainty, Phylogenetic and functional diversity, Adaptive conservation timing

Introduction

Conservation is commonly justified through the precautionary principle: when biodiversity loss may be irreversible, decision-makers are urged to act despite incomplete scientific certainty. In practice, this promotes early, front-loaded commitments—rapid designation of protected areas and immediate allocation of limited budgets. The underlying intuition is clear: delay risks extinction.

Yet ecosystems are not collections of independent units; they are structured networks of dependence. Species are linked through predator–prey, mutualistic, and competitive interactions. When this interdependence is poorly understood, early irreversible commitments can lock in protection strategies based on a mis-specified ecological structure, foreclosing alternatives that modest learning would have revealed. The risk, therefore, is not only biological loss but epistemic error embedded in permanent decisions.

This tension echoes decision-theoretic results on quasi-option value: when actions are irreversible and information improves over time, waiting can be rational because it preserves flexibility. The key issue is thus not whether to act under uncertainty—often unavoidable—but how the timing of irreversible conservation relative to the evolution of ecological knowledge affects long-run biodiversity outcomes.

Existing conservation planning tools typically optimize under fixed representations of ecological structure. Even uncertainty-aware approaches focus on noisy states or parameter values while underemphasizing structural ignorance about interaction networks—the form of uncertainty most directly tied to cascading effects and resilience. What remains largely unexamined is whether acting early under structural ignorance can perform worse than delayed, knowledge-informed strategies under identical resource constraints.

We address this question by quantifying the cost of acting with limited knowledge of ecological interdependence. We model conservation as a sequential decision problem under partial observability and introduce a hindsight-based learning framework that transforms conservation from a static optimization problem into a learning problem: determining when to commit and when to wait.

Empirically, we apply this framework to North Atlantic and Bay of Biscay using predator–prey data from the ICES stomach-content database, which integrates regional contributions, including datasets from AZTI. This grounds the analysis in observed interaction records from the marine system under study and allows us to evaluate how timing and learning shape biodiversity outcomes in a real ecological network.

Methods

We model conservation as a partially observable Markov decision process (POMDP) in which (i) ecological states are observed noisily and incompletely, and (ii) interaction strengths governing dynamics are initially uncertain and learned over time. Policies map beliefs—not true states—into actions, capturing the exploration–exploitation trade-off between protection and learning.

We implement two complementary ecosystem settings:

Empirical predator–prey system (marine food web).

We reconstruct a trophic network using predator–prey records from the ICES stomach-content database, which provides species-resolved prey counts from North Atlantic sampling. We infer a predator–prey interaction matrix and estimate interaction strengths through a Bayesian model. Posterior diagnostics (Gelman–Rubin near 1 and high effective sample sizes) support stable inference of interaction parameters. This posterior interaction matrix is treated as the best available full-knowledge proxy for defining a "teacher" model used for counterfactual evaluation.

Synthetic ecosystem with known ground truth.

We generate a phylogeny under a Yule process, evolve functional traits along the tree under an Ornstein–Uhlenbeck process, convert trait distances into interaction strengths in a generalized Lotka–Volterra system, and embed the community in a spatial grid with heterogeneous carrying capacities. We compute biodiversity using phylogenetic diversity (PD) (Faith's metric) and functional diversity (FD) (Rao's quadratic entropy). This controlled environment allows direct measurement of timing effects because the true interaction structure is known.

Hindsight counterfactual training and epistemic regret

A key contribution is a hindsight-based supervision signal for learning under structural uncertainty. As time progresses, the agent's ecological model improves via updated beliefs over interaction structure. At each step, we compute counterfactual "hindsight-optimal" actions: what should have been protected earlier if the agent had known then what it knows now. The gap between realized actions and these hindsight-optimal choices defines an epistemic regret signal—the biodiversity loss attributable purely to acting before learning key dependencies.

We then train a student policy using inverse reinforcement learning (IRL) on these hindsight-optimal annotations. The student does not observe the true interaction structure and must infer latent reward weights (e.g., emphasis on PD, FD, uncertainty reduction) that best replicate the teacher's counterfactual decisions.

Results and Discussion

Results (summary)

Across simulated ecosystems, we find that biodiversity outcomes depend less on "how much" is protected than when protection is committed relative to knowledge. In the synthetic system (2000–2010), using 2010 knowledge to re-evaluate earlier choices shows that earlier protection can outperform a 2010-optimized baseline only when ecosystem knowledge is sufficiently accurate; otherwise, early action can lock in mistakes that reduce 2010 biodiversity.

Training the student via IRL on hindsight annotations yields a consistent learning signature: the mismatch-based reward improves and stabilizes, indicating convergence toward the hindsight-optimal policy under partial observability. The learned weights are interpretable: the uncertainty-related feature receives the largest magnitude weight, implying that reducing epistemic uncertainty is the dominant driver of the teacher's counterfactual strategy, with PD and FD contributing meaningfully but secondarily. Biodiversity gains exhibit a trade-off rather than uniform increases: the learned policy tends to move along a PD–FD frontier under a fixed budget, reflecting structural tension between sites that secure evolutionarily distinct lineages and those that maximize functional differentiation.

Implications

These results challenge the blanket logic of precaution in interdependent ecosystems: acting early can be worse than acting later when the interaction structure is poorly known and decisions are costly to reverse. Conservation performance is therefore fundamentally shaped by the option value of learning and by policies that explicitly manage when to commit. Methodologically, the framework links POMDP-based adaptive management with hindsight counterfactuals and reward learning, providing a practical way to quantify the hidden cost of ignorance and to train agents that learn when waiting is welfare-improving under deep ecological uncertainty.

Referencias

[1] Arrow, Kenneth J., and Anthony C. Fisher. 1974. “Environmental Preservation, Uncertainty, and Irreversibility.” The Quarterly Journal of Economics 88 (2): 312–319. https://doi.org/10.2307/1883074

[2] Chadès, Iadine, Daniel Spring, Frank Adriaensen, et al. 2021. “A Primer on Partially Observable Markov Decision Processes (POMDPs) for Ecologists.” Methods in Ecology and Evolution 12 (2): 267–284. https://doi.org/10.1111/2041-210X.13537.

[3] Faith, Daniel P. 1992. “Conservation Evaluation and Phylogenetic Diversity.” Biological Conservation 61 (1): 1–10. https://doi.org/10.1016/0006-3207(92)91201-3.

[4] Iacona, Gwenllian D., Hugh P. Possingham, and Michael Bode. 2017. “Waiting Can Be an Optimal Conservation Strategy, Even in a Crisis Discipline.” Proceedings of the National Academy of Sciences of the United States of America 114 (39): 10497–10502. https://doi.org/10.1073/pnas.1702111114.

[5] Montoya, José M., Stuart L. Pimm, and Ricard V. Solé. 2006. “Ecological Networks and Their Fragility.” Nature 442 (7100): 259–264. https://doi.org/10.1038/nature04927.

[6] Pinnegar, John K., Nicolas Goni, Verena M. Trenkel, Haritz Arrizabalaga, Webjørn Melle, James Keating, and Guðmundur Óskarsson. 2015. “A New Compilation of Stomach Content Data for Commercially Important Pelagic Fish Species in the Northeast Atlantic.” Earth System Science Data 7 (1): 19–28. https://doi.org/10.5194/essd-7-19-2015.

Is DNA metabarcoding an option for formaldehyde-preserved zooplankton time series?

Aitor Albaina (1), Anders Lanzén (2), Irati Miguel (3), Fernando Rendo (4), María Santos (2)

(1) University of the Basque Country (UPV/EHU), (2) AZTI, (3) 3Genetics, Sequencing and Genotyping Unit, Advanced Research Facilities (SGIker), University of the Basque Country (UPV/EHU), (4) 3Genetics, Sequencing and Genotyping Unit, Advanced Research Facilities (SGIker), University of the Basque Country (UPV/EHU),

Poster

Zooplankton, time series, archived plankton samples, formaldehyde, DNA extraction, metabarcoding

The recovery of amplifiable DNA from formaldehyde-fixed (FF) zooplankton samples has long been considered unfeasible, but advances in degraded-DNA retrieval have renewed interest in FF samples. To access the information stored in long-term zooplankton time series, we evaluated methods for extracting amplifiable DNA from community samples preserved for up to 28 years in formaldehyde at room temperature. A method previously reported as successful in FF zooplankton stored at 4 °C proved ineffective here, likely due to the differing storage conditions. In contrast, by adapting two protocols developed for FF museum specimens—a harsher (HHA) and a softer (HPC) extraction approach—we were able to amplify and sequence a subset of samples. As expected, DNA integrity and sample pH decreased with preservation time, and only short DNA fragments were recoverable, ruling out standard ≥300 bp metabarcoding markers. While DNA integrity appeared to be a better predictor than DNA yield for amplification success, the presence of a gel band of the expected size did not always guarantee congruence with microscopy assessments. Although amplifiable DNA was recovered from most samples, including some of the oldest, community compositions concordant with microscopy were consistently recovered only from samples preserved for up to two years. Beyond this point, the HHA and HPC methods produced divergent results, reflecting a trade-off between removing formaldehyde-induced cross-linkages and avoiding additional DNA damage. Among the three small universal markers tested (~120–170 bp), only the 18S rRNA V9 region consistently amplified. We conclude by providing recommendations aimed at improving the methods assessed here.

How citizen science contributes to knowledge about biodiversity Northward expansion of species of nudibranchia order (mollusks) in the southern part of the Bay of Biscay (Basque coast)

de CASAMAJOR Marie-Noëlle (1), GOUILLIEUX Benoît (2), SARTORETTO Stéphane (1), VANHAELEN Alex (3), LAPLACE Myriam (4), MEYNIER Romain (4), SUSPERREGUI Nicolas (5), BIDOU Nicolas (6), LISSARDY Muriel (1)

(1) Ifremer, (2) Université de Bordeaux-CNRS, UMR 5805 EPOC, Station Marine d'Arcachon, (3) Institut royal des Sciences naturelles de Belgique, (4) Urpean, (5) CIDPM6440, (6) Cap Gouf Exploration

Poster

Citizen science, nudibranchs, biodiversity, Bay of Biscay

Introduction

The order of Nudibranchia is represented on the French basque coast by less than hundred species previously described in the litterature. Nevertheless, this group was poorly studied in this area. Even today no dedicated project aims to study them. Thus, the available data is quite old. This work presents the result of opportunistic observations made during research programs, but also the observation of citizens, divers, and fishermen. In this context, two species were identified in situ and/or in laboratory when sampling was possible. They were observed in the Natura 2000 area "Basque rocky coast and offshore extension" as well as in adjacent areas. The presence of Tethys fimbria Linnaeus, 1767 was reported by a professional fisherman in 2025, while Marionia gemmii Almón, Pérez & Caballer, 2018 were observed during scientific campaigns aimed to characterize the biodiversity of the circalittoral rocky habitat. Observations by recreational divers allowed to identify their presence at the scale of the area but also the frequencies of observation. These results extend the northern range of these two species including them in the French coast of the Bay of Biscay. These observations are important for describing current changes within benthic communities in the context of global change, but also in providing knowledge especially in the context of defining certain areas for strong protection within this marine protected area.

Rapid homogenization of subtidal rocky macroalgal assemblages following the invasion of Rugulopteryx okamurae in a port environment

Nahiara Muguerza Latorre (1), Olatz Arriaga (2), María Bustamante (1), Iñaki Saiz-Salinas (1), Alberto Santolaria (1), Javier Tajadura (1), Iñigo Uriarte (1), Endika Quintano (2)

(1) University of the Basque Country, (2) University of the Basque Country (EHU)

Poster

Introduction

The invasive brown alga *Rugulopteryx okamurae*, native to the northwestern Pacific, has rapidly expanded along the European Atlantic coast, reaching the Basque Coast in 2023 (and likely present since 2022). Based on a long-term annual monitoring dataset (2010–2025), we evaluated the spatio-temporal variability of subtidal rocky macroalgal assemblages at two sites within a port environment on the western Basque Coast following the establishment of *R. okamurae*. After its arrival a marked shift in community composition and structure was detected. From 2022 onwards, macroalgal taxa richness, density, evenness and diversity declined sharply, while assemblages from both sites became increasingly similar, revealing strong biotic homogenization. Multivariate analyses indicated a fast reorganization of the macroalgal community coinciding with the expansion of the invasive species. Prior to the invasion, assemblages were characterized by diverse native macroalgae, including structurally complex and calcareous forms. These were progressively replaced by a persistent canopy dominated by *R. okamurae*, accompanied by the collapse of basal and crustose layers. Results revealed a substantial reduction in morphological and structural complexity, reflecting an invasion-driven transition towards simplified assemblages. Our outcomes show that *R. okamurae* acts as a powerful habitat-modifying species in port environments, rapidly restructuring subtidal rocky phytobenthic communities. These findings highlight the importance of long-term monitoring programs for detecting abrupt ecological shifts and informing management strategies in newly invaded regions.

Colour polymorphism in the sea anemone Anemonia viridis in the intertidal zone of Asturias (Spain): a new colour morph

Silvia de la Uz (1), Jacobo López (1), María Alejandra Rodríguez (2)

(1) TRAGSA. Centro de Experimentación Pesquera. Asturias., (2) Centro de Experimentación Pesquera. Asturias.

Poster

Anemonia viridis, sea anemone, morphotype, colour, pigment

Introduction

The snakelocks *Anemonia viridis* (Forsskäl, 1775) is a marine anemone inhabiting intertidal and shallow sublittoral zones in both the Mediterranean Sea and the northeastern Atlantic Ocean. This species lives in symbiosis with photosyntetic dinoflagellates, known as zooxanthellae, located in the endoderm. These symbionts play a key trophic role and may influence morphotype expression. In addition to the chlorophyll pigments of zooxanthellae, the coloration of sea anemones is determined by various ectodermal pigments.

Anemonia viridis exhibits five colour morphs, characterized by the expression pattern of genes encoding fluorescent and non-fluorescent proteins (Wiedenmann et al. 1999; Wiedenmann et al. 2000). The morphotypes var. *rustica* and *vulgaris* show no detectable fluorescence, whereas var. smaradigna, viridis and rufescens contain high concentrations of green fluorescent proteins in their tentacles. Additionally, var. *rufescens* exhibits an orange-red fluorescent pigment.

The distinct bathymetric distribution of *A. viridis* morphotypes, along with differences in size and reproductive strategies (ecotypes), has led some authors to propose species-level differentiation. Although these hypotheses have been rejected, the functional significance of the different morphs remains unclear (Porro et al. 2019). The present study provides preliminary data on the distribution and biometric characteristics of morphotypes in intertidal areas of Asturias, contributing to a better understanding of this species.

Methods

The study was conducted at two intertidal sites on the western coast of Asturias (Bay of Biscay, Spain): Santa Gadea and Campiecho. Ten individuals of *A. viridis* were collected monthly at each site from April 2025 to March 2026. Specimens were gently detached from the substrate and immediately transported to the laboratory. To minimize the likelihood of sampling clonemates, individuals were collected at least 2 m apart unless they displayed different colour morphs.

Sea anemones were anesthetized using a MgCl2 solution to prevent muscle contraction during measurement. For each specimen, morphotype was determined based on coloration patterns and, when necessary, confirmed using ultraviolet light. As pedal disc diameter (PDD) is considered a reliable measure for anemone body size, both the long and short axis were measured with calipers to determine the average PDD. Wet weight was recorded to the nearest 0.1 g to assess potential correlation between size and weight.

A Chi-square test was used to compare the distribution of morphotypes between sites. Differences in size and weight among colour morphs were analyzed using one-way ANOVA, and the relationship between size and weight was assesed using a Spearman´s rank correlation.

Results and Discussion

A total of 240 specimens of *A. viridis* were analyzed. Four of the five previously described morphs were identified: var. *rustica*, *vulgaris*, *smaradigna* and *rufescens*. The *viridis* morph was not observed at either study site. However, a previously undescribed colour pattern was recorded at both locations. This new morphotype exhibits tentacle coloration similar to var. *vulgaris*, with coloured tips, but also shows an orange-red fluorescence on the underside of the tentacles, as in var. *rufescens*.

Anemonia viridis var. *rufescens* was the most abundant morphotype (52.5%), whereas the new morph (6.3%) and var. *vulgaris* (2.9%) were the least abundant. Morphotype distribution differed significantly between the two sites (χ^2= 24.92, df= 4, p˂ 0.001).

The mean PDD ranged from 14.0 to 41.0 mm, with an average size of 27.4 mm, while the wet weight ranged from 2.1 to 43.6 g, with an average weight of 16.1 g. No significant differences in size or weight were found among morphotypes (ANOVA, p˃ 0.05). A moderate, positive and significant correlation was observed between pedal disc diameter and weight (r_s= 0.425, p˂ 0.001).

Consistent with previous studies (Mallien et al. 2017; Porro et al. 2019), the three most frequent morphotypes were var. *rustica*, *smaradigna* and *rufescens*. In intertidal environments, var. *rustica* exhibited tentacle colours ranging from pale pink to brown. The green tones of var. *smaradigna* and *rufescens* appeared duller, sometimes even yellowish, during summer months. Also, two white specimens belonging to var. *smaradigna* and *rufescens* were collected at Santa Gadea in December, coinciding with a marked decrease in mean monthly weight and the lowest annual weight values. White-tentacled specimens of *A. viridis* have been previously described as aposimbiontic clones of var. *vulgaris* (*alabastrina*) and var. *rustica* (*albida*) (Wiedenmann et al. 2000). Then, this raises the question of wheter bleaching may also occur in *A. viridis* morphs with green fluorescent pigments.

Differences in morphotype distribution between sites were mainly driven by the higher abundance of var. *rustica* at Santa Gadea. Morphotypes containing ectodermal fluorescent pigments, such as var. *rufescens* and *smaradigna*, are more common in shallow areas, whereas var. *rustica*, which lacks ectodermal pigments, predominates in deeper areas (Wiedenmann et al. 1999). The geomorphology of Santa Gadea, an intertidal zone situated between the mainland and small rocky islets, facilitate the presence of nearby deep pools that host dense populations of var. *rustica*, contributing to its higher abundance in this intertidal area.

Morphotypes can also differ in reproductive strategies. Asexual reproduction has been reported to be absent in var. *rufescens*, *viridis* and *smaradigna* ecotype II (Wiedenmann et al. 1999, 2000). However, in the present study, individuals of var. *rufescens* were occasionally observed in direct contact within clusters. As direct contact is tipically tolerated only among genetically identical individuals, this may indicate clonal propagation via asexual reproduction in this morphotype.

The main finding of the present study is the identification of a previously undescribed morphotype of *A. viridis*, characterized by the presence of a non-fluorescent red pigment at the tentacles tips and an orange fluorescent pigment on the underside of the tentacles.

Referencias

[1] Mallien C., Porro B., Zamoum T., Olivier C., Wiedenmann J., Furla P. & Forcioli D. 2017. Conspicuous morphological differentiation without speciation in Anemonia viridis (Cnidaria, Actiniaria). Systematics and Biodiversity, 0: 1-16.
[2] Porro B., Mallien C., Hume B.C.C., Pey A., Aubin E., Christen R., Voolstra C.R., Furla P. & Forcioli D. 2019. The many faced symbiotic snakelocks anemone (Anemonia viridis, Anthozoa): host and symbiont genetic differentiation among colour morphs. Heredity, 124(2): 351-366.
[3] Wiedenmann J., Rocker C. & Funke W. 1999. The morphs of Anemonia aff. sulcata (Cnidaria, Anthozoa) in particular consideration of the ectodermal pigments. In: Pfadenhauer J (ed) Verhandlungen der Gesellschaft für Ökologie, vol. 29. Heidelberg Berlin, pp 497-503.
[4] Wiedenmann J., Kraus P., Funke W. & Vogel W. 2000. The relationship between different morphs of Anemonia aff. sulcata evaluated by DNA fingerprinting (Anthozoa, Cnidaria). Ophelia 52: 57-64.

Adaptation of the EBQI approach to the Bay of Biscay to characterize the ecological status of the “underwater cave” habitat. Marine Protected Area case FR7200813 “ Rocky Basque coast and offshore extension”

Antoine Laudet (1), Stéphane Sartoretto (2), Marie-Noëlle De Casamajor (1), Benoît Gouillieux (3)

(1) IFREMER – Département Océanographie et Dynamiques de Écosystèmes ODE/LITTORAL/LERAR – 1 allée du Parc Montaury, 64600 Anglet, France, (2) IFREMER – Département Océanographie et Dynamiques de Écosystèmes ODE/LITTORAL/LERPAC – Zone Portuaire de Brégaillon, CS20 330, 83507 La Seyne-sur-Mer Cedex, France, (3) Université de Bordeaux, EPOC, UMR 5805, Station Marine d’Arcachon, F-33120 Arcachon, France

Poster

Marine cave, EBQI, biodiversity, conservation index, Marine Protected Area

European directives, such as the MSFD, highlight a lack of knowledge about the biological diversity of remarkable circalittoral caves and overhangs in the southern Bay of Biscay. Biological and ecological data on this habitat for the Atlantic coast are particularly scarce, whereas coastal caves are better known in the Mediterranean Sea. Based on initial work carried out on two caves along the Basque coast in the early 2020s, using a biodiversity inventory and adapting the Mediterranean EBQIindex, about ten caves were sampled between 2024 and 2025. The aim was to characterize their biodiversity and acquire the data necessary to calculate the EBQI index. These 10 caves are located within the N2000 area n°FR7200813, between Biarritz and Hendaye zone, along a north-south gradient. Most of them are located in the circalittoral zone. Nevertheless some of them are in the lower part of infralittoral zone. For each cave, a geomorphological characterization was carried out: depth, number and size of entrances, ceiling height, orientation. Species were sampled using several sampling techniques in order to obtain the most representative picture benthic communities: hand sampling, air suction, scraping/brushing, photo quadrats, visual counts. All of these techniques provide useful information to estimate the different EBQI metrics. In this work, we present the results of the EBQIcav applied to characterize the conservation state of the different caves. Based on these results, emphasis will be placed on the conservation interest for managers of the N2000 area, both in terms of the presence of remarkable species and the complexity of the communities present. This work should contribute to providing managers with the knowledge they need to establish criteria for selecting caves to be placed in high protection zones.

Morphological and Developmental Stages of Embryogenesis and Larval Growth in Postenterogonia orbicularis

Emma Shorter-Rodríguez (1)

(1) University of Oviedo

Poster

Biological Invasions, Reproduction, Larval Development, Aquaculture, Mussel Farming

Introduction

Morphological and Developmental Stages of Embryogenesis and Larval Growth in Postenterogonia orbicularis

Emma Shorter-Rodríguez[1], Ricardo López-Alonso[1], Pelayo Rico-Fernández[1], José Manuel Rico[1]

[1]Department of Organisms and Systems Biology, University of Oviedo, Oviedo, Spain

Invasive species, defined as organisms introduced beyond their native range through human activities that cause ecological or economic harm, pose a growing threat to marine ecosystems. Quantifying the impact that these species can have is difficult, delaying management actions. Within this context, the recent detection of the Pacific flatworm Postenterogonia orbicularis along the Spanish coast represents a significant ecological concern for the Bay of Biscay and Europe. This species, a carnivorous polyclad flatworm, preys on commercially important bivalves such as mussels, oysters and clams. Its documented impact on aquaculture in New Zealand, its native range, highlights its potential to disrupt both ecosystem stability and local economies. The presence of sexually mature individuals in the Bay of Biscay indicates that a reproducing population is already established, increasing the likelihood of further spread. The aim of this study is to determine the embryological development of P. orbicularis under controlled laboratory conditions. Results revealed a rapid developmental timeline of approximately 12 days from egg to free-swimming larva. The species exhibits conserved spiralian developmental features, including spiral cleavage and determinate mosaic development, culminating in a highly mobile larval form (Müller's larvae). These traits contribute to its invasive success by enabling efficient reproduction and dispersal. Understanding the developmental biology of P. orbicularis is essential for predicting its spread and identifying vulnerable stages for intervention. Such knowledge is crucial for designing early detection and management strategies, particularly in sensitive and economically significant regions.

Methods

Specimes of postenterogonia orbicularis were kept under lab conditions and every stage of the larval development was stuidied fixing the eggs withe EUKITT and observing them at the microscope.

Results and Discussion

Results revealed a rapid developmental timeline of approximately 12 days from egg to free-swimming larva. The species exhibits conserved spiralian developmental features, including spiral cleavage and determinate mosaic development, culminating in a highly mobile larval form (Müller's larvae). These traits contribute to its invasive success by enabling efficient reproduction and dispersal. Understanding the developmental biology of P. orbicularis is essential for predicting its spread and identifying vulnerable stages for intervention. Such knowledge is crucial for designing early detection and management strategies, particularly in sensitive and economically significant regions.

Allometric scaling of biological sailing in Physalia physalis

Fernando Taboada (1), Ángel López-Urrutia (1), Gemma Capeans (2), YAgo Ivan (2), Carlos Guardado (2), Pili Fernandez (1), Alejandro Isla (1), Verónica Soto (2), Deva Menéndez (2), Susana Acle (3), Antonio Domínguez (4), Jorge Cabrera (4), Carlos Caceres (5), Axayacatl Molina (6), Laura Prieto (7), May Gómez (4), Jose Luis Acuña (2)

(1) Centro Oceanográfico de Gijón, IEO-CSIC, (2) Universidad de Oviedo, (3) BIOPARC Acuario de Gijón, (4) Universidad de Las Palmas de Gran Canaria, (5) University of Perpignan, (6) CEFAS, (7) ICMAN

Poster

biomechanics, coastal management, dispersal, Physalia physalis, strandings

Strandings of the Portuguese Man-of-War, the colonial siphonophore *Physalis physalis*, have become increasingly common in the southern Bay of Biscay. A key aspect to anticipate the arrival of this organism to the shoreline lies in understanding how the colonies approach the coast propelled by surface winds and currents. Here, we extend an analytical hydrodynamic model of *P. physalis* navigation to assess how colony size affects sailing speed and course in relation to winds. First, we characterized the allometric scaling of colony morphology based on measurements of freshly recovered specimens. Then, we conducted a series of field experiments to measure sailing trajectories under increasing wind magnitudes. Finally, we combined the resulting allometric relationships and field measurements to calibrate the analytical navigation model. Analyses and simulations based on the resulting model indicate that *P. physalis* colony size affects sailing speed, but not course. We discuss the implications for dispersal and aggregation patterns in the open ocean, as well as the likelihood of drifting ashore.

Uncovering overlooked biodiversity in the Bay of Biscay: Cycliophora in two decapod species

Sergi Crespo (1), Omar Sánchez (1), Andrés Arias (1)

(1) University of Oviedo

Poster

Symbion pandora; simbiosis; lobsters; Cantabrian Sea; Nephropidae

Introduction

Cycliophora is a phylum of marine, microscopic animals found as epizoans on the mouthparts of northern hemisphere lobsters (Decapoda: Nephropidae). This relatively recent group was formally described in 1995, although it had been previously observed in the 1960s (Funch and Kristensen, 1995). The first described species, *Symbion pandora*, was collected in the mid-1990s on *Nephrops norvegicus* from Danish waters, while a similar cycliophoran had earlier been reported on the mouthparts of *Homarus gammarus* (Andersen, 1992; Funch and Kristensen, 1995). More recently, cycliophorans have also been reported on harpacticoid copepods associated with *H. gammarus*, suggesting potential secondary hosts (Neves et al., 2014). Cycliophorans exhibit a complex life cycle involving metagenesis, with multiple morphologically distinct stages and alternation between sessile forms ('feeding-individuals' and 'chordoid-cysts') and free motile stages, including both sexual and asexual phases (Funch and Kristensen, 1995; Funch, 2021). They are known from coastal waters of the North Atlantic Ocean, as far north as the Faroe Islands, and the Mediterranean Sea, coinciding with the distribution of their hosts (Funch, 2021). Although recorded in nearby areas such as Vigo (Galicia) and Roscoff (Brittany), they have not been previously reported from the Bay of Biscay. The conducted study of *N. norvegicus* and *H. gammarus* specimens from the Cantabrian Sea (northern Spain) in 2019 and 2020 revealed numerous cycliophoran specimens on the mouthparts of both hosts. Two stages, 'feeding-individuals' and 'chordoid-cysts', were present on all mouth appendages, both on the setae and directly on the appendages. The 'feeding-individuals' were dominant in all mouth appendages except in the third maxillipeds, where the 'chordoid-cysts' were the most abundant stage. Microscopical analyses confirmed that specimens from *N. norvegicus* matched *S. pandora*, whereas those from *H. gammarus* likely represent an undescribed species. This constitutes the first confirmed and explicitly documented record of Cycliophora in this region.

Referencias

[1] Andersen, P.F. (1992): Beskrivelse af en ny klasse – Mesoprocta. Master's thesis. University of Copenhagen, 70 pp.

[2] Funch, P. and Kristensen, R.M. 1995. Cycliophora is a new phylum with affinities to Entoprocta and Ectoprocta. Nature 378 : 711–714.

[3] Neves, R. C., X. Bailly, and H. Reichert. 2014. Are copepods secondary hosts of Cycliophora? Organisms Diversity & Evolution 14 (4):363–367.

[4] Funch, P. 2021. Cycliophora: An Emergent Model Organism for Life Cycle Studies. in A Boutet & S Bernd (eds), Handbook of Marine Model Organisms. CRC Press.

Exploring changes in the distribution of seabirds and cetaceans in the Bay of Biscay: relationship with local climate changes and regime shift.

Emilie MILON (1), CASTEGE Iker (1), D'ELBEE Jean (2), DOUSSET Caroline (1), D'AMICO Frank (3)

(1) Centre de la Mer de Biarritz, (2) LAPHY, (3) 3 UNIVERSITE DE PAU & PAYS ADOUR, Laboratoire de Mathématiques et de leurs Applications de Pau UMR CNRS 5142 (FED 4155 MIRA)

Poster

regime shift, seabirds, climate change, cetaceans, spatial distribution

Introduction

Oceano-climate changes have been demonstrated to affect marine populations, resulting in shifts in distribution or changes in abundance. Marine regime shifts have been detected in all ocean basins, particularly in the late 1980s. These shifts are likely to cause permanent changes in ecosystems.

The Bay of Biscay is an important hotspot for marine biodiversity encompassing both cold and warm-temperate water species. A multivariate oceano-climatic index, called the South Biscay Climate (SBC), has been developed to study climate variations in the southern Bay of Biscay. In addition to demonstrating a significant increase between 1974 and 2023, the index also indicated a regime shift that occurred in the late 1980s.

In this study, we examined changes in the spatial distribution and relative abundance of 10 species (seabirds and cetaceans) in relation to climate changes and regime shift. Over a period of 48 years (1976-2023), data on the abundance of seabirds and cetaceans were collected using a standardized ship-based line transect monitoring. The distribution of species has been analyzed both prior to (1976-1989) and following (1990-2023) the regime shift detected in the SBC index.

The results indicated a significant increase in species with affinities to warm-temperate waters (e.g. *Delphinus delphis, Tursiops truncatus*) including the critically endangered Balearic shearwater (*Puffinus mauretanicus*). These species have also expanded their spatial occupancy into the southern part of the Bay of Biscay. By contrast, the relative abundances of boreal species have decreased significantly (e.g. *Hydrobates pelagicus, Rissa tridactyla*). However, these species demonstrated a spatial fidelity within specific areas, especially the Capbreton Canyon.

These findings provide insight into the responses of top predators to ecosystem changes in the southern Bay of Biscay. These data are essential to enhance the management of marine protected areas and demonstrate the necessity to update them in light of climate change impacts. Our results also emphasise the importance of areas such as the Capbreton Canyon for marine megafauna, highlighting the urgent need to establish Highly Protected Marine Areas.

Gaining perspective: Lessons learnt from three decades of trophic sampling in the Bay of Biscay

Goméz-Serna Saúl (1), Merino González-Pardo Lucia (2), Garcia-Aguilar Oscar (1), Ortiz Juan Jose (1), PRECIADO IZASKUN (1), Rabanal Irene (1), Lopéz-Lopéz Lucía (3)

(1) Spanish Institute of Oceanography, (2) Spanish Institute, (3) Spanish Institute of Oceanography

Poster

Stomach content analysis, Feeding strategy, Trophic niche breadth, Sampling effort, Marine ecosystems

Introduction

Stomach content analysis is a standardized approach in marine trophic ecology, yet sampling effort is rarely evaluated. In this study, we use an extended time series (1999–2024) of stomach content data from demersal surveys conducted in the southern Bay of Biscay to characterize interannual variability in diet composition across predator species. Based on a standardized protocol, stomach contents are analysed onboard (typically ~10 individuals per haul, totalling several hundred individuals per target species annually), and cumulative prey curves are calculated. Following previous approaches, 90% of asymptotic prey richness was considered sufficient to define diet composition. However, as prey richness fluctuated among years, the number of predators required to reach this asymptote also differed interannually. To better understand these fluctuations, we explored their relationship with trophic metrics describing predator feeding strategies, including prey richness, prey frequency per stomach, proportion of empty stomachs, mean stomach fullness, and trophic niche breadth. These metrics were estimated using a bootstrap resampling approach at the predator level, allowing quantification of uncertainty. Interannual differences were particularly pronounced in species with low abundance, high stomach vacuity, or strong ontogenetic dietary shifts, which reduced the robustness of diet characterization. In contrast, species with consistent occurrence and lower variation showed more stable and well-defined diet patterns over time. Overall, this study highlights the value of long-term diet datasets for understanding trophic dynamics and temporal changes in benthic ecosystems. The observed patterns underscore the importance of incorporating temporal perspectives when assessing trophic structure. Furthermore, our results suggest that current sampling effort under the standardized protocol often exceeds the minimum number of individuals required for reliable diet characterization, indicating that onboard sampling effort could be reduced without compromising data quality, thereby improving survey efficiency and reducing processing time.

Life-history migrations through the eyes of Atlantic mackerel

Ortiz García Juan José (1), Kallergis Georgios (2), Canceso José (3), Rabanal Irene (4), Diez María (1), Merino Lucía (1), Preciado Izaskun (1), López Lucía (1)

(1) Spanish Institute of Oceanography (IEO-CSIC), C.O. Santander, (2) University of the Aegean, Department of marine sciences, (3) Spanish Institute of Oceanography (IEO-CSIC), C.O. Cádiz, (4) Spanish Institute of Oceanography (IEO-CSIC), C.O. Coruña

Poster

The Atlantic mackerel (Scomber scombrus) is an abundant mesopredator with complex stock dynamics. In the Northeast Atlantic, the stock is divided into three spawning components, the southern of which spawns in the Cantabrian Sea and joins the adult seasonal migration along the continental slope at 2-3 years of age, moving towards the Norwegian Sea feeding grounds in late summer and autumn. Understanding the connectivity and life-history movements of Atlantic mackerel between its stock subunits and how/if these are changing under current ocean warming trends is essential for effective management of stocks. To this aim, eye lenses provide a unique ecological record, acting as chronological archives and recording the individual's life history through continuous concentric layers. In this study, we investigate the isotopic signature of S.scombrus eye lenses by applying an innovative analytical framework that combines stable isotope Bayesian ellipses and trajectory analysis.

Our analyses identified two clusters with distinct isotopic signatures during early life stages, followed by a convergent directional movement during the adult stages. While δ13C variability decreases with growth, the δ15N variability increased along the individual isotopic record, with the highest variability in the outermost layers of crystalline (adult stage). These ontogenetic trajectories reflect a clear transition from diverse juvenile nursery origins toward shared, high-trophic offshore feeding grounds. This evidence of diverse natal homing for a single spawning stock supports the hypothesis of Atlantic mackerel not being a strongly philopatric species, but instead showing a well-mixed population along the North East Atlantic. However, higher variability of nitrogen ratios in the outermost layers suggests that some cluster-specific differences persist through adulthood. Our research proves the usefulness of eye lenses isotopic analysis to estimate the mobility and connectivity of the Northeast Atlantic mackerel stock, particularly regarding the early life history of the species and the onset of its migratory behaviour.

AZTI

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

/ **HEADQUARTERS**

Txatxarramendi Ugartea z/g
E-48395 Sukarrieta - BIZKAIA (Spain)

Parque Tecnológico de Bizkaia
Astondo Bidea, Edificio 609
E-48160 Derio - BIZKAIA (Spain)

Herrera Kaia - Portualdea z/g
E-20110 Pasaia - GIPUZKOA (Spain)

/ **t.** (+34) 946 574 000

/ **e**-mail: info@azti.es

/ www.**azti**.es