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Valencia (Spain), 10-12th July 2024

MESO- AND BATHYPELAGIC FISHES: CONTRIBUTION TO THE ACTIVE FLUX AND REMINERALIZATION

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Abstract:

Micronekton is a taxonomically diverse assemblage of relatively small (2-10 cm) but actively swimming organisms. Mesopelagic fishes are considered a major component in abundance and biomass of the oceanic regions. Some organisms perform diel vertical migrations (e.g., Myctophidae and Phosichthyidae families) to feed in shallower layers and to avoid predators at depth. They extend their vertical distribution from near surface to the mesopelagic (from 200 to 1000 m depth) and/or bathypelagic zones (from 1000 to 4000 m depth). Also, there are fishes remaining in deep waters during the night (*Cyclothone* spp. among other) and other carrying out partial migrations (Sternoptychidae, some Gonostomatidae). These groups have a significant contribution to the biological carbon pump transporting organic matter consumed near the surface at night to their daytime residence at depth. Also, partial- and/or non-migrant species remineralized the carbon at depth. Here, we show the active flux and carbon remineralization by meso- and bathypelagic fishes using the enzymatic activity of the electron transfer system (ETS) activity as a proxy for respiration rates. Samples from 6 cruises around the Atlantic Ocean and 2 cruises on the Gulf of California were examined. The specific ETS activity showed high values in the upper 200 m depth during the night. We observed seasonal changes in respiratory flux in the Gulf of California as the specific ETS activity was higher during the cold to warm period transition. The total active flux performed by fishes was 24.35 ± 31.96 $mgC \cdot m^{-2} \cdot d^{-1}$ and the remineralization 8.51 ± 8.05 $mgC \cdot m^{-2} \cdot d^{-1}$. The large variability found in our results was due to trawl (Mesopelagos, Multinet and IKMT) capture efficiencies applied. Results showed a relationship between active flux and remineralization with primary production.

Key words: Micronekton, migrant fish, non-migrant fish, twilight zone and biological carbon pump.

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CALYPSUS PROJECT: PROSPECTION FOR VMES IN THE ALICANTE AND BENIDORM SUBMARINE CANYONS AND SEAMOUNTS IN THE IBIZA CHANNEL

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Abstract:

The CALYPSUS project (BIODIV_A1L1 - MTC2303005) aims to investigate a large area between the Iberian Peninsula and the Balearic Islands, including the submarine canyons of Alicante and Benidorm, the escarpments on the slopes of Formentera and Ibiza, and the submarine seamounts in the Ibiza Channel. Localities of complex topography that hinder fishing operations have been the focus of much research over the last decades as priority areas for the conservation of vulnerable species and habitats.

The canyons of Alicante and Benidorm have been pointed in past IUCN workshops as sites pending protection. More recently and within one of the LIFE IP INTEMARES project actions, these canyons and a large area in the Ibiza Channel where marked as areas that would improve connectivity of the Spanish Mediterranean RN2000 after implementation of adequate protection measures.

Following in the steps of INTEMARES, the same methodologies are now being applied in the new research area with the main goal of finding as many locations hosting VMEs as possible to define future Sites of Community Importance. Two research surveys have been planned, the first of which took place recently. The preferred samplers are ROTV TASIFE and ROV LIROPUS 2000, but rock dredge and beam trawl are used as well. The multidisciplinary team includes biologists, a geographer and geologists responsible for the acquisition and processing of multibeam echosounder and TOPAS data, as well as sediment samples, to improve existing bathymetry maps and model bottom types within the study area. High resolution bathymetry and derived layers (slope, rugosity, BPI indexes) are used along geolocated faunal data to feed habitat prediction models that will allow us to estimate the extent and distribution of VMEs and provide scientific advice towards future protection of these areas.

Key words: submarine canyons, seamounts, Western Mediterranean, non-invasive sampling, VMEs

Acknowledgments: This project is financed by UE-NextGenerationEU within the frame of the Recovery, Transformation and Resilience Plan (PRTR).

References: please follow the examples below

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Callogorgia verticillata AND *Viminella flagellum* FIELDS IN THE VICINITY OF FISHING GROUNDS ON THE SECO DEL PATIBULO AND LA MUNTANYETA SUBMARINE HIGHS

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Abstract:
A very healthy field of *Callogorgia verticillata* was discovered during the course of the CALYPSUS research survey conducted in March 2024, aimed to detect vulnerable marine ecosystems (VMEs) in the Alicante and Benidorm submarine canyons. These aggregations of *C. verticillata* where often found alongside the whip-coral *Viminella flagellum*, and were remarkable due to the size of the colonies. In the course of two video transects obtained with the Remotely Operated Towed Vehicle (ROTV) TASIFE deployed from the R/V *Ramón Margalef*, density was close to 2000 colonies/ha, and specimens of very large size (up to 1 m in width and height) were abundant.

The *C. verticillata* fields were located on the Seco del Patibulo and La Muntanyeta submarine highs, both located amidst the Alicante Highs in the northern flank of the Alicante Canyon. Fishing activities mostly take place on their gentler slopes, because the rocky outcrops associated to these highs don't always allow the use of bottom trawling gear. In particular, the Seco del Patibulo is a carbonate mound, made up by corals embedded within mixed sediments. The top of the structure shows development of coarser grained sediments, mainly consisting on muddy sand containing sand-sized particles, both lithogenic and biogenic. Fossil corals emerge as rough patches only in some areas of the

carbonate mound, underlayed by very little or even absence of sediments, working as a hard substrate where *C. verticillata* can settle. On the other hand, the gentler slopes are covered by finer sediments such as clayed-mud.

Protection of this site is urgent given the proximity of fishing operations and the fact that *C. verticillata* is a protected species under several Spanish, European and international regulations, currently considered as Near Threated in the regional assessment for the Mediterranean and Black Sea Region in the IUCN Red List of Threatened Species.

Key words: *Callogorgia verticillata*, *Viminella flagellum*, Vulnerable Marine Ecosystems, Alicante Submarine Canyon

Acknowledgments: This project is funded by UE-NextGenerationEU funds within the framework of the Recovery, Transformation and Resilience Plan (PRTR). The authors wish to thank the crew of the Spanish research vessel *Ramón Margalef,* who made it possible for us to achieve our objectives despite suboptimal conditions. We also thank OCEANA and the University of Alicante for the participation of R. Aguilar, A.A. Ramos-Esplá and A. Carmona-Rodríguez.

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LIVING AMONG THE WAVES: AGE AND FEEDING HABITS OF FIVE SPECIES IN THE SURF ZONES OF THE GULF OF CÁDIZ (SW IBERIAN PENINSULA)

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Abstract: Coastal habitats serve as refuges and feeding areas in the early years of life for numerous fish species, including those of commercial interest. Among these habitats, surf zones on beaches are particularly important, hosting species such as the pompano (*Trachinotus ovatus*), sand sole (*Pegusa lascaris*), brill (*Scophthalmus rhombus*), spotted seabass (*Dicentrarchus punctatus*), and European seabass (*D. labrax*). This study aimed to investigate the age and feeding habits of these five species within the surf zones, as well as their potential relationships with environmental variables. For this purpose, five beaches along the Cádiz coast (SW Iberian Peninsula) were sampled over a period of one year using a beach seine net. The most abundant age classes for the pompano, sand sole, and brill were 0+ and 1+, while for the spotted seabass and European seabass, the most relevant age classes were 1+ and 2+. Except for the sand sole, which primarily fed on cumaceans and bivalves, the other species mainly preyed on mysidaceans and small fish, though copepods were also significant in the diet of the pompano. All species exhibited significant differences in the abundance of various age classes and in diet based on the time of day, moon phase, and season. This study provides valuable information on how these species utilize surf zones in their early years, underscoring the importance of these areas and the potential ecosystem services they offer.

Key words: Beach, Otolith, Diet, Juveniles, Nursery

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SOLVING PROBLEMS BETWEEN ARTISANAL FISHERIES AND SHARKS' INTERACTIONS

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Abstract: Elasmobranchs, a diverse group of cartilaginous fishes that includes sharks and rays, have a great portion of their populations considered as threatened species that are facing significant threats worldwide due to habitat destruction and overfishing, which often occurs as bycatch. In many cases, this accidental fishing happens when sharks attack the target species caught by fishers while they are being brought to the surface. This situation has been occurring in the Marine Reserve of La Graciosa, north of Lanzarote (Canary Islands) in the Central East Atlantic. Fishers highlight that, for several years now, they have experienced a significant decrease in their catches of target species such as sparids (Red porgy (*Pagrus pagrus*) and *Dentex spp*), European hake (*Merlucious merlucious*), groupers (*Epinephelus marginatus*), or amberjacks (*Seriola spp*) due to this negative interaction with sharks. Through diligent work involving surveys with fishers, active onboard monitoring of fishing vessels activity, and assessments of climate and catch time series, indicate the problem could be not the sharks but rather the impact generated by the fishers themselves. In this way, climatic conditions occurred, between 2014 and 2017, favoured a high recruitment or spatial concentration of the target species, resulting in greater abundance and/or accessibility to fishing, giving anormal high catches to fishers between 2018 and 2021. Probably, and due to the restabilize of previous climatic conditions, poor fishery management and excessive fishing, the catches decreased abruptly from 2021 onward, causing the current situation with much lower catches than before and the ease of blaming the first one that passes by, in this case, the sharks.

Key words: Canary Islands, Artisanal Fisheries, Elasmobranchs, Marine Reserve

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DIET COMPOSITION OF THE ATLANTIC BLUE CRAB, *CALLINECTES SAPIDUS* ACROSS INVADED AND NATIVE AREAS USING A MULTIMETHODOLOGICAL APPROACH

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Abstract: The Atlantic blue crab (Callinectes sapidus), native to the east coast of the Americas, is a portunid estuarine crab that has been considered invasive in many areas of Europe and Africa. It was first reported in the Guadalquivir estuary in 2017. This study examined the feeding habits of the Atlantic blue crab to assess its food web interactions and potential impacts in the study area using three methodological approaches: stomach content analysis, stable isotope analysis, and metabarcoding. This is the first study to examine the diet of the blue crab on the East Atlantic coast and compare it across its invaded and native ranges. In terms of frequency of occurrence (FO %), stomach content analyses revealed that the main consumed prey were fish (50%), molluscs (44%) and crabs (32%). Metabarcoding detected mainly crustaceans (73%), fish (64%) and molluscs (22%), being *Engraulis encrasicolus (35%)* and *Panopeus africanus (31%)* the most consumed species. Stable isotope analysis detected spatial variability in trophic position (2.0-4.4) across and within habitats, along with slight seasonal and sexual intraspecific variability. Overall, the *C. sapidus* diet composition was very generalist, and its omnivorous trophic behaviour was remarkably like its native zone, despite the geographical distance. The trophic role has more amplitude and lower trophic position in the Atlantic areas (invaded and native) compared with the Mediterranean range.

Metabarcoding analyses increase crustaceans' detectability while stable isotope analyses detected more seasonal and sexual intraspecific variability, compared to stomach content analyses. Nevertheless, stomach content analysis provided the most realistic picture of the diet composition of the blue crab in terms of abundance. The establishment of the blue crab in this region implies the emergence of diverse trophic interactions with the native food web, potentially resulting in various future impacts on the local community.

Key words: Crab, Alien species, Stomach, Metabarcoding, Stable isotopes

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MODELING PHYTOPLANKTON DIVERSITY, ACCLIMATION, AND EVOLUTION IN THE WATER COLUMN USING AN INDIVIDUAL-BASED MODEL

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Abstract: Over recent time, the scientific community has invested considerable effort into developing and refining numerical models that accurately depict the dynamics and diversity of phytoplankton communities. This pursuit stems from the importance of this diverse group of photosynthetic organisms; they are the foundation of the marine food web, contribute nearly half of the world's primary production (e.g., Field et al., 1998) and have a key role in the carbon cycle (e.g., Sigman and Boyle, 2000). While models with a Eulerian framework are the go-to-choice due to their relatively simplicity, individual-based models (IBM) offer greater realism and allow inclusion of potentially influential characteristics (e.g., the impact of turbulence on the dispersion of phytoplankton cells in the water column). In this study, we introduce a depth-resolved 1D IBM developed to accurately simulate phytoplankton community dynamics. Fitness, diversity, and acclimation of the phytoplankton community are determined by three main traits: size, temperature and light affinity. Thanks to the fact that IBMs 'carry a memory' (e.g., regarding the history of nutrient availability or light exposure), they can be used to gain insight into the role of past environmental conditions experienced by phytoplankton individuals on subsequent growth and adaptive responses. This IBM also includes a package that allows phytoplankton cells to mutate, facilitating simulation of community evolution. When we couple this IBM with a Eulerian model that computes vertical nitrogen concentration distributions, multiple size classes of zooplankton and detritus concentrations, the resulting 1D-hybrid model successfully replicates general seasonal trends observed in nutrient concentration, chlorophyll levels and primary production within subtropical ocean regions. The IBM model we describe will be a valuable tool for investigating phytoplankton physiology, diversity, and evolution in the ocean.

Key words: phytoplankton, ecology, diversity, model, individual-based model

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IDENTIFICATION PROCESS OF KEY ELEMENTS FOR MARINE MONITORING. THE CASE OF THE VALENCIAN COMMUNITY (EAST SPAIN)

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Abstract

The Valencian Community is located in the east of the Iberian Peninsula (Spanish coast), in the western Mediterranean sea. It is a region with numerous marine habitat types and species of community interest.

For this reason, the aim of this paper is to identify key species in order to improve the monitoring of marine areas in the area.

The methodology used has been based on a systematic analysis of the regulatory framework, and has been carried out using an approach that goes from the international guidelines to the national and local legislation From the review, the most important directives for the marine environment conservation have also been contrasted, such as the Habitats Directive, the Water Framework Directive and the Marine Strategy Framework Directive. Furthermore, it has been necessary for the Spanish legal framework to exhaustively select those regulation that provide species and habitats protection, such as the Spanish Constitution, Law 42/2007, of 13 December, Natural Heritage and Biodiversity; or Law 41/2010, of 29 December, on the Protection of the Marine Environment. The key species selected have been categorised into: protected, invasive and thermophilic species.

The regulations applicable to the identification of key elements were filtered and categorised as follows:

- systematic review of the environmental regulations (European, national and local) to select the species and habitats to be protected
- systematic review of environmental regulations (European, national and local) and experts consultation for the selection of alien and invasive species.
- By applying expert elicitation and reviewing scientific and grey literature for the selection of thermophilic species.

The analysis of the key elements in the Valencian Community shows: 5 protected hábitats, 128 protected marine species, 24 alien species, 13 thermophilic marine species
The identification of key species can serve as a useful tools for decision-making in marine management.

Key words: marine governance, key elements, monitoring, marine tools

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NORA, AN EXAMPLE OF EUROPEAN COLLABORATION IN NATURE RESTORATION

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Abstract: The Native Oyster Restoration Alliance (NORA, https://noraeurope.eu/) is a European network of more than 500 members from academia/science, governmental agencies, NGOs and private companies. NORA was established during the international workshop on oyster restoration that was held in Berlin in November 2017. This alliance supports the protection and ecological restoration of the native European oyster (*Ostrea edulis*, Linnaeus) and the habitat it creates, in areas of its current or historical distribution. It works to overcome existing barriers to the conservation, restoration and recovery of the European oyster reefs by providing a platform for the NORA community to collaborate and participate in knowledge exchange. NORA seeks to support responsible restoration practice, in compliance with biosecurity and sustainability. It's website, https:// noraeurope.eu/, is a hub of information on the alliance's activities both for the NORA community and for all those interested in nature restoration. NORA is maintaining a database of restoration projects, of partners and people with interest and expertise in all aspects of native oyster restoration. NORA currently has seven established working groups: Production, Genetics, Biosecurity, Monitoring, Outreach, Historical Ecology and Site Selection, through whose activities several handbooks and fact sheets on oyster reef restoration have been produced. Every two years, NORA holds its Conference where the latest scientific and technical advances in native oyster restoration are presented.

Key words: NORA, oyster restoration, network, *Ostrea edulis*

Acknowledgments: The NORA Secretariat is composed by Katrin Wollny-Goerke, Andreas Essenberger, Hein Sas and Philine zu Ermgassen and supports the Board and the Working Groups in all network activities.

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USE OF INFAUNAL COMMUNITIES AS BIOINDICATORS OF ENVIRONMENTAL IMPACTS BY SUBMARINE POWER CABLES

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Abstract: Thousands of kilometres of submarine power cables are currently in use around our planet and the network is expected to grow further in coming years due to the need for electric connectivity and the development of new offshore renewable energy platforms, both needed for transitioning to an electrified and carbon neutral world. The deployment of submarine power cables has raised concerns about the environmental impacts they might cause. The aim of this project is to study such impacts using infaunal communities of polychaetes, crustacea and bivalves as bioindicators. These are small organisms inhabiting within the seafloor sediment, which are considered as bioindicators of environmental quality. We focus our work on two of the least known and more controversial drivers of potential impacts around operational cables: temperature increases and electromagnetic fields. In situ measurements and sediment samples were obtained with great accuracy by scuba diving at different subseafloor depths and distances from cables. Preliminary results show no sediment temperature increase around the cables. Sediment samples are currently being processed. A final goal of our work is drawing up a protocol to assess the environmental effects due to submarine power cables.

Key words: Submarine power cables, Infauna, Temperature, Electromagnetic fields

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ACOUSTIC OBSERVATIONS UNVEIL SEASONAL FLUCTUATIONS AND REGULATION OF ZOOPLANKTON BIOMASS AND ITS VERTICAL DISTRIBUTION AT AN OPEN-OCEAN REFERENCE STATION.

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Abstract: Zooplankton play a crucial role in marine ecosystems and global biogeochemical cycles. Changes in their population and phenology affect the ecosystem structure and dynamics due to they are a key link between different trophic levels. In order to reinforce its contribution to the global ocean observing system, the Spanish Institute of Oceanography (IEO) deployed in June 2007 an oceanic-meteorological buoy (AGL Buoy) in the southern Bay of Biscay, whose mooring position at 2800 m depth was chosen to coincide with the position of a standard section – the Santander standard section - running since 1991 by the IEO. During this time, the Santander-Atlantic-Time-Series (SATS) – that includes the AGL buoy data and its oceanographic station – provide repeated high-frequency observations of interlinked meteorological, oceanographic and biogeochemical variables including plankton biomass that enable to obtain a comprehensive description of ocean processes from the seafloor to the atmosphere at a site representative of the mid-latitudes of the Eastern North Atlantic In this work, we investigate the causes and timing of changes within the annual cycle of zooplankton biomass vertical distribution in oceanic waters of the Bay of Biscay using long-term oceanographic time series from zooplankton nets and high frequency ADCP backscattering data, proxy of zooplankton biomass. Its combination enables to observe the concurrence of a strong seasonality in zooplankton biomass and its daily oscillation tightly linked to phytoplankton stock and its vertical distribution in relation with water column stability and air-sea forcing. During the spring bloom when food availability is guaranteed, zooplankton biomass increases and concentrates at the ocean surface reducing its diel vertical migration. Later in the year, zooplankton biomass concentrates above the Deep Chlorophyll Maximum increasing/reducing the depth range that it occupies as the DCM deepens/shoals.

Key words: ADCP backscatter, Zooplankton biomass, Phytoplankton bloom, air-sea exchanges, Climatological annual cycle.

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RESTORATION AND BIOEXTRACTION OF THE FLAT OYSTER *OSTREA EDULIS* IN THE EUTROPHIC MAR MENOR LAGOON

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Abstract: Over the last decades, the Mar Menor lagoon (MM) was threatened by eutrophication until 2016, when the lagoon collapsed due to an intensive microalgal bloom that disrupted and degraded the ecosystem globally (ecosystem disruptive algal blooms, EDABs) (Ruiz-Fernández et al., 2019). As a consequence, the Mar Menor Oyster Initiative was born that same year and launched in 2020 at the Native Oyster Restoration Alliance (Pogoda et al., 2019) 3rd Conference. This initiative aims to investigate the physiological capabilities of the MM flat oyster (*Ostrea edulis*) to be used for restoration and bioextraction purposes (Albentosa et al., 2023).

In this context, a total of 5,000 oysters obtained through MM broodstock reproduction from a hatchery (Hernandis et al., 2023) were placed in the entrance channel of the saltpans located in the MM north basin. For two years, these oysters were monthly monitored with biometric and physiological measurements. In addition, the channel was continuously monitored with a multiparametric probe for temperature, salinity, oxygen dissolved, pH, turbidity, and chlorophyll, as part of the collaboration between a multidisciplinary team for using Internet of Things (IoT) tools for remote observability and

real-time monitoring. The physiological measures clearance rate, ingestion rate, absorption efficiency, and respiration rate were measured monthly in 40 individuals together with height, length, width, live fresh and dry weight, and organic content.
Over the two years, individuals grew according to the expected size for their age, increasing consequently their physiological rates with the increase in size. Individuals survived (with some mortality associated) a heatwave during summer 2023 which maintained the water temperature above 28 ºC for weeks but peaked up to 34 ºC.
The obtained results show the capability of the oysters to be used in a future restoration program in the lagoon for the recovery of the population and the bioextraction of nutrients.

Key words: Eutrophication, restoration, ecosystem services, bivalves, physiology

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SPATIO-TEMPORAL VARIABILITY OF BENTHIC MACROFAUNA BIODIVERSITY ON SEDIMENTARY SHORES OF ANTARCTICA

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Abstract: Understanding Antarctic marine biodiversity patterns and conservation requirements is critical in the context of global change and accelerating biodiversity loss. Yet, knowledge of benthic biodiversity patterns on the intertidal shores of Antarctica remains limited. In this study, we investigated the abundance, structure (i.e. taxa-specific abundance), and biodiversity patterns (α-, β-, and λ-diversity) of benthic macrofauna communities on intertidal sedimentary shores of two Antarctic islands (South Shetland archipelago, N of Antarctic Peninsula): Livingston and Deception. We conducted spatial analyses at multiple scales during two austral summers (2004 and 2005), focusing on the intertidal environmental gradient, different intertidal sites within each island, and a comparison between the two islands. Our results revealed significant differences in both the abundance and structure of macrofauna communities between islands. While there were no significant differences in the number of taxa within communities (α-diversity) between islands, significant variations in community composition across sites (β-diversity) were observed. These differences explained the higher total taxa count (λ-diversity) on Livingston compared to Deception. We propose that island-specific features (e.g., sediment characteristics, geothermal activity, and ice disturbance) determine the distinctive patterns of abundance, structure, and biodiversity of local macrobenthic communities. However, other ecological processes operate on different spatial and temporal scales (e.g., biotic interactions, population dynamics, oceanographic conditions, and climate change) influencing the occurrence and abundance of taxa. The findings of this study provide valuable information to guide management decisions and conservation efforts.

Key words: Beaches, Benthic ecology, Macrofauna, Spatial variability, Southern Ocean

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ENVIRONMENTAL IMPACT ASSESSMENT OF MARINE PHOTOVOLTAICS

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European Commission stablished the objective of raising the 2030 target for renewables to 45% (European Commission, 2022), amending to the Renewable Energy Directive, introducing of 'renewables go-to areas' (locations designated as particularly suitable for renewable energy installations) and simplifying of permit granting procedures[1]. To achieve these objectives, it will be necessary to diversify the sources of renewable energy production. Uncertainties around marine photovoltaics are higher than other renewable energy technologies due to their novel development status, and the limited knowledge of the potential environmental impacts. In this context, a Systematic Literature Review (SLR) (Mengist *et al*., 2020) was performed on 29th November 2023 to produce the most updated scientific evidence on environmental impacts related to marine photovoltaics, from Web of Science, Science Direct, Scopus and Google Scholar. Firstly, a total of 593 articles were identified (dated from 1995 to 2023), and after eliminating duplicates and incomplete articles, 285 articles were pre-selected. Then, scientific evidence of environmental impacts from 36 publications was extracted in a structured way: (i) pressures and the ecosystem elements (adopted from the European Marine Strategy Framework Directive (Directive 2008/56/EC)); (ii) reported effects on the ecosystem (both positive and negative), and (iii) their magnitude. Scientific evidence results are related to the spread of invasive species, anchoring and cable impacts on the substrate, sediment resuspension and input of noise during installation, and electromagnetic field effects and net primary production disturbing during the operational phase. Finally, due to the limited scientific evidence, an expert judgement for Environmental Risk Assessment (ERA) was proposed for the analysis of the interactions between identified pressures of offshore floating photovoltaic and ecosystem, following Galparsoro et al., (2021, 2022). ERA results will imply in a high-value outcome to managers and industrial developers for its use in taking informed decisions in consenting process and location selection targeting.

Keywords: Systematic Literature Review, Environmental Risk Assessment, Marine Strategy Framework Directive, marine photovoltaic.

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BLUENETCAT: THE MARITIME NETWORK OF CATALONIA

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Abstract: BlueNetCat, the Maritime Network of Catalonia, is the innovation and transfer instrument of the Maritime Strategy of Catalonia. Born in 2018, it is now in its second period lasting till the end of 2025. The main goal of the network is to promote blue innovation and facilitate the transfer of blue research results to the markets and the society at large, thus easing the search for solutions for present and future marine and maritime challenges in a sustainable way. BlueNetCat involves seven scientific institutions — including universities and research institutes— located all along the coastline of Catalonia, which contribute with 67 research groups totaling more than 700 researchers. These figures make BlueNetCat the largest sustainable blue economy network in Europe. The network's groups and researchers encompass an enormous thematic richness, ranging from bioacoustics to aquaculture, from genetics to blue tourism, and from coastal processes to maritime transport, just to cite a few. These groups are organized around seven challenges, which are (i) Sustainability of blue economy activities; (ii) Blue innovation and society (Ocean literacy); (iii) Human health and the ocean; (iv) Marine pollution and decarbonization; (v) Valorization and regeneration of marine resources; (vi) Marine hazards, maritime safety and climate change; and (vii) Management of the marine-terrestrial area. Beyond providing continuous support to its members, every year the network carries out devoted activities and actions, such as the Maritime Hub annual meeting, the BlueNetVal program to steer the collaboration between stakehoklders while helping to identify adequate funding sources, or BlueNetOnCampus, an entrepreneur and innovation program aimed at generating synergies with the business sector. The governance of BlueNetCat is ensured by a network director (L. Reig), a business developer manager (P. Bou), a board of directors with one representative per each of the seven member institutions, and a dedicated management team.

Key words: Blue economy, Sustainability, Network, Innovation, Knowledge transfer.

Acknowledgments: The authors, on behalf of the BlueNetCat community, acknowledge *Agència de Gestió d'Ajuts Universitaris i de Recerca* (AGAUR) from *Generalitat de Catalunya* for continued support to the Maritime Network of Catalonia in the frame of public competitive calls (project references IU68-013744 and 2021 XARDI 00011).

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For more information see https://www.bluenetcat.eu/es/

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ASSESSING THE IMPACT OF OFFSHORE WIND FARMS ON MEDITERRANEAN COMMERCIAL FISHERIES: A TRAIT-BASED VULNERABILITY ANALYSIS

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Abstract: Offshore Wind Farms (OWFs) are rapidly expanding in the Mediterranean Sea, presenting challenges as they intersect with crucial fishing grounds. This paper conducts a trait-based vulnerability assessment of commercially exploited species in the Mediterranean region to understand floating OWF impact on fishery resources. Our study, centered around Cape Creus/Gulf of Roses (Spain, NW Mediterranean), examines the susceptibility of species to OWF-related stressors, crucial for sustainable energy and fisheries management decisions. Employing a vulnerability trait-based approach aligned with established categories outlined by Butt et al. (2022), we focus on movement, reproduction, specialization, spatial scale metrics, and biophysical traits of fish, decapods and cephalopods. This methodology enables a nuanced evaluation of species' vulnerability to OWF-related stressors, including sediment resuspension, habitat loss, electromagnetic fields, chemical pollution, light pollution, noise and vibration, thermal radiation, entanglement, and oceanographic changes. We identified the most important species for the area's three main fishery practices – trawling, purse seining, and small-scale fishing – representing 82.7% of total landings and 85% of economic value in the study area auctions, reflecting their pivotal role in the region's socio-economic framework. Subsequently, the trait-based vulnerability model allows us to assess which species are most at risk from OWF-related stressors. Pollution derived from OWFs emerges as the most significant stressor, followed closely by habitat loss and sediment resuspension, particularly affecting species with a benthic phase in their life cycle. Species most vulnerable to OWF stressors are undoubtedly those reliant on specific and/or benthic habitats that may be affected by OWF implementation. Through this comprehensive assessment, we aim to inform decision-makers seeking to mitigate the ecological and socio-economic impacts of OWF development on commercial fisheries. This research addresses a critical gap in understanding the potential effects of floating OWFs on fishery resources in the Mediterranean Sea, employing a trait-based approach tailored to OWF

stressors, a novel endeavor in this context.

Key words: trait-based vulnerability, marine conservation planning, floating offshore wind, fishery, conservation decision-making

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CITIZEN SCIENCE AND THE SEA: CHALLENGES AND OPPORTUNITIES

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MARINE CITIZEN SCIENCE FOR SUPPORTING EFFECTIVE CONSERVATION OF MEDITERRANEAN CORALS: A SUCCESSFUL CASE STUDY AT LOCAL SCALE

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Abstract:

Marine Citizen Science (MCS) is a growing practice in conservation biology in which scientists and citizens collaborate to produce new knowledge and achieve mutual learning outcomes that benefit both science and society. From a conservation perspective, these characteristics allow for spanning vast temporal and spatial scales, reaching areas beyond traditional scientific access, and enhancing marine knowledge and monitoring capabilities. However, MCS faces challenges regarding the credibility and quality of volunteer-collected data, which have been addressed through volunteers training, expert data validation, robust sampling protocols, and a well-structured platform. In this context, we used citizen science at the local scale of Costa Brava (NW Mediterranean) to expand the spatial resolution and knowledge on the conservation status of the coralligenous assemblages, one of the biodiversity-richest ecosystems in the Mediterranean which faces several impacts, being the most recent and severe the global warming. Our initial focus was on identifying the locations of coralligenous assemblages beyond the few scientifically studied locations. Then, we aimed to assess the conservation status of populations of key coralligenous species in this area (*Paramuricea clavata* and *Eunicella singularis*). Thus, we implemented a local ecological knowledge approach to collaborate with dive centres and locate coralligenous assemblages on the Costa Brava. We then benefited from our involvement in the Observadores del Mar platform, a well-established MCS initiative that employs robust sampling protocols, to assess the conservation status of selected populations. Considering the challenges of MCS, we trained more than 70 volunteers and assessed more than 10,000 gorgonians. Thanks to this effort, we determined that the conservation status of the shallow (10 to 25m depth) gorgonian populations on the Costa Brava is poor. This underscores the

urgent need for effective conservation measures and continued study of these species across large spatial and temporal scales, a task for which citizen science is essential.

Key words: Marine citizen science, marine conservation, Mediterranean, coastal temperate reefs, gorgonian.

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OBSERVADORES DEL MAR CONTRIBUTING TO INVASIVE SPECIES DETECTION: THE WESTERNMOST REPORT OF THE SCYPHOMEDUSA CASSIOPEA ANDROMEDA

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Abstract:
Observadores del Mar is the reference marine citizen science platform in Spain with more than 12 years of experience. It works towards ocean health and conservation by gathering data on 5 topics: biodiversity loss, climate change, vulnerable species, marine litter and invasive species. In the framework of the latter, Observadores del Mar has contributed to very important detections such as the Sergeant major *Abudefduf saxatilis* (Azzurro *et al*., 2013), and the silver-checked toadfish *Lagocephalus sceleratus* (Azzurro *et al*., 2020), and recently, the report of the invasive scyphomedusa jellyfish *Cassiopea andromeda*.
The report came from Aquatours Almeria, a Sentinel Observatory (SO) of Observadores del Mar since 2016. A first observation was reported in March 2021 and a second report in February 2023, but both were only a picture of a single specimen. However, in December 2023, the same SO detected a sizeable population of apparently the same species and following the recommendations of the Jellyfish Alert scientific team, they collected 12 individuals for DNA sequencing analysis.
The results indicated that the species corresponded to *Cassiopea andromeda*, becoming the Mediterranean westernmost report of this species so far. This finding contributes to invasive species knowledge and places *C. andromeda* as a potential species indicator of climate change due to its affinity for warmer waters, which could explain the expansion towards the western Mediterranean basin. Besides, the network of Sentinel Observatories of Observadores del Mar, demonstrates the potential of involving non-scientists citizens in reporting observations and in collecting samples when necessary, allowing a further involvement in citizen science programs and contributing with robust data for the administrations in charge of marine management.

Key words: Biological invasion, citizen science, climate change

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TOWARDS FASTER AND MORE COST-EFFECTIVE MONITORING OF THE ECOLOGICAL STATUS OF WATER: EVALUATION OF M-GAMBI IN BASQUE COUNTRY WATERS

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Abstract:
The European Water Framework Directive (WFD; European Commission, 2000) mandates monitoring the ecological status (ES) of waterbodies. Benthic invertebrates are one of the biological elements for assessing the ES of transitional and coastal waters. M-AMBI (Multivariate AZTI's Marine Biotic Index; Muxika *et al.*, 2007) is used by many member states for benthic invertebrate monitoring. However, traditional taxonomic identification required for M-AMBI and other tools' calculations is time-consuming.
Genomic methods offer a faster and more cost-effective alternative (Bourlat *et al.*, 2013), but their use remains limited. This study compared traditional and genomic approaches for calculating M-AMBI across 26 coastal and estuarine stations sampled between 2018 and 2023.
A significant correlation ($p < 0.001$) was observed between M-AMBI and M-gAMBI (genomic M-AMBI), suggesting potential comparability. However, the coefficient of determination ($r^2 = 0.37$) was relatively low. Moreover, segregating data by water body type revealed a significant correlation for just one type, highlighting limitations.
While M-gAMBI's rapid turnaround and cost-effectiveness make it attractive for large-scale ES monitoring, further development is necessary. Firstly, genetic databases require more sequences to be included, and methods for detecting false positives need improvement. Secondly, the accuracy of abundance estimates based on 'read' counts warrants investigation. Finally, establishing reference conditions and class boundaries specifically for M-gAMBI is crucial.
It is important to note that this study's limited sample size restricts extrapolation to other regions. Further research across diverse water types is required to validate M-gAMBI and establish region-specific reference and classification criteria.

Key words: Genomic M-AMBI, benthic invertebrate monitoring, ecological status assessment, Water Framework Directive

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A SOCIO-ECONOMIC MODEL OF THE EFFECTS OF THE ALIEN INVASIVE SPECIES *RUGULOPTERYX OKAMURAE*

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Abstract:
Rugulopteryx okamurae (E.Y.Dawson) is an invasive seaweed species that has recently garnered attention due to its rapid proliferation in the Mediterranean, posing significant ecological and economic threats (Faria et al., 2022; Garcia et al., 2020). Since it was found in the Strait of Gibraltar in 2015 (Terrades et al., 2023), it colonised the Andalusia coastal waters, and in 2023 was cited in Alicante Bay (Altamirano et al., 2016). This study introduces a dynamic population model to elucidate this alien invasive alga's growth, spread, and management implications. We developed a lifecycle-based model reflective of Mediterranean conditions, enabling the examination of *R. okamurae's* invasiveness. Our methodology integrates environmental variables, species-specific growth rates and reproductive strategies, providing insights into the alga's invasiveness. The model scenarios include no intervention, mechanical removal, increased currents and increased temperatures each assessed for their impact on the algae's distribution and biomass accumulation. Furthermore, the model incorporates an economic analysis module, evaluating the economic impacts for local communities e.g. beach tourism, including the costs of beach cleaning and the economic losses incurred by impacted marine industries such as artisanal fisheries. The study highlights the importance of dynamic modeling in understanding invasive species' behaviors e.g. non linearity and guiding policy-makers in allocating resources efficiently.

Key words: Rugulopteryx okamurae, Dynamic Modelling, economic,

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RATES OF CHANGE AND MID-TERM EVOLUTION OF ANTROPHISED BEACHES: FROM NULES BEACH TO THE PORT OF CANET D'EN BERENGUER

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Abstract: The coastal stretch between Nules beach and the port of Canet d'En Berenguer is one of the coastal segments of the Spanish Mediterranean with the greatest number of coastal infrastructures that mediate the natural behaviour of the beach. It is a coastal stretch in which there is a strong coastal drift towards the south, which profoundly determines its evolution.

This work analyses in detail the evolution of these pebble, gravel and sandy beaches using more than a thousand shorelines derived from Landsat (5, 7, 8, 9) and Sentinel 2 satellite images acquired from 1984 to 2023. The satellite derived shorelines (SDS) have been obtained using the SHOREX tool developed by our team. These SDS have an accuracy better than 4m (RMSE) and with them it has been possible to build Spatio-Temporal Models (STM) of beach width changes.

With all these tools, it has been possible to characterise the response that is derived, appreciating not only the evolution of the stretches directly affected by the works but, above all, the form and rate at which their effects migrate in the direction of the coastal drift. It can also be seen that many of the beaches follow very aggressive phases of change followed by periods in which the beach practically stabilises or changes at a much slower rate. This response is greatly affected by the type of sediment that makes up each beach and, logically, the type of human work carried out.

Key words: SHOREX, Satellite Derived Shorelines, Spatio-Temporal Models, Beach width changes, Mid-term coast evolution.

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NEW TOOLS AND RECOMMENDATIONS FOR A BETTER MANAGEMENT OF HARMFUL ALGAL BLOOMS UNDER THE EUROPEAN MARINE STRATEGY FRAMEWORK DIRECTIVE

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Abstract: Marine harmful algal blooms (HABs), caused by various aquatic microalgae, pose significant risks to ecosystems, some socio-economic activities and human health. Traditionally managed as a public health issue through reactive control measures such as

beach closures, seafood trade bans or closure of mollusc production areas, the multifaceted linkages of HABs with environmental and socio-economic factors require more comprehensive ecosystem-based management approach tools to support policies like the Marine Strategy Framework Directive (MSFD). This collective work introduces two novel tools: GES4HABs (GES for HABs) decision tree, and MAMBO (environMental mAtrix for the Management of BlOoms), a decision support matrix to streamline HABs reporting and prioritize resource allocation and management interventions. The GES4HABs decision tree defines a sequence of decision steps to identify HAB management strategies according to their state (evaluated against predefined baselines) and causes (anthropic or natural). MAMBO matrix utilizes two axes: natural trophic status and level of human influence. It categorizes marine regions into quadrants of varying management viability: regions with high human influence and eutrophic conditions are identified as most suitable for effective management intervention, whereas regions with minimal or mixed human influence are deemed less amenable to active management. In addition, we explore various indicators, monitoring methods and initiatives that may be relevant to support assessments of HAB status and associated pressures and impacts in the MSFD reporting and foster international and cross-sectoral coordination to optimize resources, efforts and roles.

Key words: Decision support tools, Ecosystem-based management, Indicators, Eutrophication, Marine biotoxins

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COCCIDIAN INFECTIONS IN COMMON COCKLES OF RIA DE AVEIRO, PORTUGAL

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Abstract: Coccidia are apicomplexan parasites linked to mortality events in several bivalve species. Despite this, few coccidian species have been characterized, and their taxonomy and life cycles are not well known. In the edible cockle *Cerastoderma edule*, coccidia have not been related to significant damage, however high intensities can cause functional damage. This species has been morphologically described as *Pseudoklossia* sp. The purpose of this work is to molecularly characterize the coccidia that affect *C. edule* cockles, study their spatial and temporal prevalence in the Ria de Aveiro, analyse the tissues affected, and the phases of the biological cycle of this parasite. Fifteen cockles were sampled monthly from June to September, at 15 different points and analysed histopathologically. The presence of coccidia in haemolymph was examined quarterly using monolayer smears and the tissue remains were fixed in ethanol for molecular studies. The presence of coccidia was confirmed in kidney and haemolymph of cockles without causing tissue damage or host immune reaction. In the nephridium tissue lumen, various phases of the coccidia life cycle, including gamonts, oocysts at different stages of maturation, and sporocysts, have been observed. In haemolymph, meronts has also been detected. Histological analysis detected coccidia throughout the study months in three stations. The Mira Channel station exhibited the highest prevalence (20%) of coccidian infection, occurring in two separate months. No trends related to salinity and coccidian infection were observed. Phylogenetic analysis revealed that the coccidia detected belongs to the genus *Margolisiella* and not *Pseudoklossia* as previously described. This discovery is crucial because, while *Pseudoklossia sp.* was only associated with functional anomalies, *Margolisiella sp.* has been linked to massive bivalve mortalities in recent years, and the cockle could serve as a reservoir for horizontal transmission to more vulnerable species.

Key words: *Cerastoderma edule*; Coccidia; PCR; Sequencing; Phylogeny.

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FIRST RECORDS AND TEMPORAL OCCURRENCE OF MEGALOPAE AND JUVENILE OF THE INVASIVE BLUE CRAB CALLINECTES SAPIDUS IN SE ALICANTE, SPAIN, WESTERN MEDITERRANEAN

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Abstract: The objective of the present study was to detect and provide information on the larval and juvenile distribution of the invasive crustacean *Callinectes sapidus* in Western Mediterranean Sea, where the presence of 'Atlantic blue crab' was present dates back to 2012. However, there is still a significant gap in ecological information related to complex life cycle. The present study is the first record of blue crab megalopae in the area of Alicante (SE Iberian Peninsula), where blue crab adults were first registered in 2014, and describes the annual trend of occurrence in the communication channels within wetland areas and adjacent coastal waters. After testing several sites, three stations were selected, where sampling was done weekly or biweekly using fixed collectors during the period from October 2021 to December 2022. The first megalopa found was in September 2022 at the Guardamar Port and after that a continuous presence was detected to December 2022. Two peaks were detected, one in October and another in November in two of the locations, while in the other location only juveniles were found. The juveniles were detected in the three locations between September to December. The abundance of megalopae and juveniles showed statistically significant differences in sampling sites (Kruskal-Wallis test). A general linear model (GLM) was used to test the relationship of this abundance to environmental parameters, showing relationships to temperature-salinity-barometric pressure interactions. Analysis results noticed that abundances of both megalopae and juvenile were not correlated with solar, lunar and wind speed.

Key words: *Callinectes sapidus*, megalopae, larval dispersal, marine ecology, invasive species, Mediterranean

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QUANTIFICATION OF THE THREE-DIMENSIONAL CHANGES BETWEEN 2017 AND 2022 OF THE BEACHES AND DUNES OF THE CULLERA-GANDIA COASTAL SECTOR

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Abstract: An analysis is presented of the three-dimensional evolution of the beaches and dunes over six years (2017 to 2022) in the coastal sector between the beaches located to the south of the cape of Cullera and the port of Gandia (Valencia). For this purpose, six Digital Surface Models (DSM) of one metre spatial resolution have been created, one for each of the years studied. The main novelty of this work is that the DSMs have been deduced from the aerial photographs acquired each summer by the Institut Cartogràfic Valencià to create the annual orthophoto. For this purpose, a methodology based on photogrammetric techniques and improvement processes have been developed to adjust the precision over the specific analysis area.
The accuracy of the DSMs obtained are as shown in the table below:
Three-dimensional changes have been systematically analysed on both the beach and the dune front in 100 m alongshore segments. The results allow us to conclude that during 2018 and 2019 there was an increase in beach sedimentation but that in 2020, due to the impact of the Gloria coastal storm, there was a generalised loss of sediment volume in the whole sector. In the following years (2021, 2022) the beach-dune system was recovering the volume of materials, reaching a slightly lower magnitude than in the first year studied (2017).

	DSM 17	DSM 18	DSM 19	DSM 20	DSM 21	DSM 22
Bias	-0.005	-0.001	-0.001	-0.001	-0.001	-0.001
Median	-0.014	-0.008	-0.011	-0.011	-0.007	-0.012
Standard deviation	0.182	0.124	0.138	0.127	0.128	0.146
RMSE	0.182	0.124	0.138	0.127	0.128	0.146

Key words: Photogrammetry, Dunes, Beach, Three-dimensional monotoring.

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ASSESSMENT OF PHYTOPLANKTON COMMUNITY STRUCTURE IN A COMMERCIAL ESTUARINE SYSTEM WITHIN THE BAY OF CÁDIZ (SPAIN)

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Abstract: The past saltponds within the Bay of Cádiz referred to as "esteros", represent significant sites for aquacultural endeavours (Yúfera & Arias, 2010). These areas undergo daily variations in water inflow due to tidal dynamics, thereby facilitating the proliferation of endemic phytoplankton species as well as those originating from the bay itself. Understanding the phytoplankton present in these environments is paramount for the management of associated activities. In the context of this study, phytoplankton community composition and physicochemical parameters were assessed biweekly at Estero Natural (Puerto Real, Cádiz, Spain) from February 2023 to June 2023 at two different points, one dedicated to cultivating oysters and another for fish fattening. The phytoplankton community composition was assessed by image flow cytometry (IFC) using Luminex ImageStream®X Mk II, while the physicochemical parameters were obtained using a multiparameter profiler AAQ-RINKO (176-Z106 model) (Dashkova *et al*., 2017). Statistically significant differences were observed among two different sites within the estuarine system. Pico- and nanophytoplankton, pennate and centric diatoms and dinoflagellates were the main groups identified in the estuarine system. A spring bloom was notably characterized by the prevalence of the pennate diatom *Cymbella* sp., although it wasn't the dominant species within the ecosystem. Abundance and biomass data of the different groups of phytoplankton present, as well as an analysis of the environmental factors that govern ecological succession within the estuarine environment will be presented.

Key words: estuarine, image flow cytometry (IFC), phytoplankton, saltponds.

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EFFECTS OF COASTAL ACIDIFICATION ON PHYTOPLANKTON BIOMASS, METABOLISM, AND COMMUNITY STRUCTURE OF RIAS BAIXAS

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The rise of anthropogenic CO_2 emissions is driving ocean acidification (IPCC, 2014). Coastal acidification also encompasses freshwater river inputs and nutrient runoff as drivers of pH changes in littoral areas (Hall et al., 2020). These chemical changes impact phytoplankton metabolism, biomass and community structure, impacting the marine food web and biological production (Doney et al., 2020; Kroeker et al., 2013). The Rías Baixas, are four coastal embayments located on the northwest Iberian Peninsula, influenced by the Iberian Upwelling System. Preliminary studies from 2019-2020 revealed strong influences of the upwelling-downwelling regime on CO_2 concentrations within Ría de Vigo, creating CO_2 gradients with higher levels in the inner regions compared to the ocean-estuary boundary (5429.28-713.14 ppmv Interestingly, in January 2020 a chlorophyll-CO_2 correlation was found (Pearson index = 0.99), coinciding with a steep CO_2 gradient. A new ACID project (2022-2025) aims to investigate the impact of CO_2 on microbial plankton communities along these natural gradients. Monthly samples were collected from Ría de Vigo during 2023-2024, following similar protocols as in the preceding period. Parameters including pH, temperature, salinity, nutrients, chlorophyll-a (picophytoplankton, nanophytoplankton and microphytoplankton with polycarbonate filters of 0.2, 5 and 20 µm pore size respectively), dissolved inorganic carbon, and net production were measured. Chlorophyll-a values exhibited considerable variability, primarily driven by NO_3 availability, with a peak in November, (24.7 µg/L) and a low in October (1.20 µg/L). Furthermore, no chlorophyll-CO_2 correlations surfaced in 2023-2024 when the whole transect was analyzed. This was due to a lack of steep CO_2 gradients formation that was explained by a higher precipitation, lower salinity and lower DIC concentration compared to 2019-2020. These conditions also resulted in negative net production rates during the highest precipitation events. These results revealed the importance of coastal acidification in the Rias Baixas.

Key words: coastal acidification, phytoplankton, CO_2, community structure, metabolism

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INFLUENCE OF THE INSTALLATION OF ARTIFICIAL REEFS ON THE ICHTHYOFAUNA OF THE PORT OF SAGUNTO ECOSYSTEM (VALENCIA, SPAIN).

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Abstract: Concrete-based coastal and marine infrastructures (e.g. harbours) dominate human construction in coastal areas around the world. Shorelines with a high presence of this type of infrastructure are considered sacrifice zones with little or no environmental value. Studies show that biodiversity in these areas is lower than in natural ecosystems and is commonly dominated by opportunistic species. For these reasons, it is necessary to design and develop maritime-port infrastructures from an environmental and sustainable perspective, often including artificial reefs (AR's). The composition finishes and shapes of these AR's facilitate the efficient integration of the maritime-port infrastructures in the marine habitat together with the species that inhabit it (Sedano *et al.*, 2020). Furthermore, sustainable design of these elements that replace natural habitats, including the use of AR's, can provide an ecosystem similar to that offered by undisturbed shorelines (Gopalakrishnan and Govindarajan, 2011). The fish community of Sagunto port (Valencia, Spain) has been studied for 2 years *("Livingports" and "Livingreefs" Projects, Valencian Agency for Innovation*) after the submersion of artificial reefs. Results show the ecological effectiveness of the ARs, increasing diversity and abundance of ichthyofauna, being always significantly higher than in the control points within the same port. This result is consistent with previous studies in confined water areas such as estuaries, which share certain physicochemical characteristics with harbours, where it has been observed that the abundance of typical hard substrate fishes increased in the artificial reef zone without decreasing in the natural rocky reefs (Folpp *et al.*, 2020).

Key words: Sustainability, harbor ecosystems, fish communities.

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CHRONICLES OF THE GREEK SEAFLOOR: 35 YEARS OF CORALLIGENOUS FORMATIONS MAPPING IN THE IONIAN AND AEGEAN SEAS VIA MARINE REMOTE SENSING

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Abstract:

Coralligenous and other calcareous bio-concretions grow across the Mediterranean Sea in many forms and are characterised by high species diversity second only to *Posidonia oceanica* meadows (Boudouresque, 2004; Ballesteros, 2006). The irregular morphology (branches, holes and cavities) of the coralligenous formations is the perfect living place for development of a variety of marine species (Plan et al., 2003).While the coralligenous formations of the Greek Seas, and especially the ones in the Aegean Sea, are considered as the most well-formed assemblages of the Mediterranean Sea, they are also the ones that are the least researched (Ballesteros, 2006). During the last two decades, coralligenous formations have begun to be studied and appear in publication regarding the habitats of the Greek seafloor (Martin et al., 2014; Sini et al., 2017) but only three studies are dedicated on this habitat (Georgiadis et al. 2009; Dimas et al., 2022; Fakiris et al., 2023). In this work, a map was constructed through an amalgamation of georeferenced marine remote sensing and visual census data that were collected from more than 33 mapping expeditions conducted by the Laboratory of Marine Geology and Physical Oceanography (LMGPO) of the Department of Geology, University of Patras in Greece during the last three and a half decades, with the oldest taking place in 1991 and the most recent in 2024. In total, an area of 3,197.68 km^2 was mapped and 6.62% (211.67 km^2) of this area was found to be covered by coralligenous formations. Limiting the mapped area between 40 and 120 m depth (1,051 km^2), which is the preferable depth of the coralligenous formations, the coverage rises to 169.94 km^2 (16.2%), while between 70 and 90 m depth (389.69 km^2), which is the depth that most of the reefs are formed, the percentage of coralligenous coverage reaches 24.62% (95.94 km^2). This study presents the first wide-scale presence – absence map of coralligenous formations on the Greek seafloor, yielding high importance for future marine

spatial planning and habitat protection measures.

Key words: Coralligenous formations, Greek Seas, Habitat mapping, Marine remote sensing

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THE REPRODUCTIVE BIOLOGY OF OCTOPUS VULGARIS CUVIER, 1797 IN THE VALENCIAN COMMUNITY (NW MEDITERRANEAN)

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Abstract: The Common Octopus *Octopus vulgaris* Cuvier, 1797 is the most important cephalopod species subject to intense exploitation by artisanal and bottom trawling fleets in the Mediterranean Sea and Atlantic nearby waters. It's short life span and dependence on environmental factors along the different stages of the species life cycle, result in highly variable and unstable stocks. Therefore, managing *O. vulgaris* fisheries is challenging and special attention must be paid to the optimization and actualization of the fishing closures and minimum capture weight imposed for each stock. In Spain, the regional governments are responsible of managing the species fisheries in their territory. The Valencian Community includes 3 provinces with different fishing closures. Closed periods extend from the 1st of July to 30th of November in Valencia and Alicante, while in Castellon the closure applies from 1st of March to 30th of June. These disparities in the fishing closures can be extremely dangerous, since in some cases fishermen warn that they may not align with the maximum reproductive activity period. This study examines the reproductive biology of *O. vulgaris* across the Valencian Community (NW Mediterranean, FAO 37.1.1). A total of 1163 individuals were collected via clay pots and bottom trawl fisheries during monthly samplings from September 2022 to August 2023 providing detailed data about the reproductive parameters of the species in this area. The sex ratio (males females) was biased towards males in the overall landings (1.17:1), spring season (1.25:1), September (1.58:1) and February (1.48:1). The weight and size (dorsal mantle length; DML) at maturity obtained for the species was 778 g (10.7 cm DML) and 1381 g (15.52 cm DML) for males and females, respectively. The combination of both maturity indexes calculated (Gonadosomatic and Hayashi indexes) monthly for each sex, along with the evolution of the maturity stage frequency endorsed that the maximum reproductive activity takes place between February-June for males and June-September for females. These results are in general accordance with previous studies in the area, otherwise our actualized data reveals some differences of great importance that should be taken into account to improve the fishery management of the species in the Valencian Community.

Key words: *Octopus vulgaris*, Reproduction, Maturity, Fishing closures, Valencian Community.

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AN INTEGRATIVE ASSESSMENT OF A FISH SPECIES FOR SETTING COMMERCIALISATION AND CONSUMPTION GUIDELINES: THE CASE OF THE SMALL-SPOTTED CATSHARK (*SCYLIORHINUS CANICULA*) IN THE NW MEDITERRANEAN

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Abstract: Global change and fishing pressure are causing alterations in the structure of marine ecosystems, and therefore impacting fisheries, especially at a local level. This is the case of the small-spotted catshark (*Scyliorhinus canicula*, Linnaeus, 1758), a small bottom-dwelling shark which has experienced an increasing population trend in the last 30 years. Nowadays, it represents the most common bycatch species in NW Mediterranean, thus being mainly discarded. In the present study, we present guidelines for assessing the suitability of a species to be commercialised assuring human health consumption, using the main results obtained for *S. canicula* in the NW Mediterranean as a case study. For a proper assessment, distinct indicators should be integrated, such as condition and parasitological indices, trace metal concentrations, ingested anthropogenic items (plastic and cellulose-like items) and histopathology. Concurrently, elucidating reproductive trends and length at maturity at a local level are also paramount to design appropriate fisheries management measures. Regarding outcomes for *S. canicula*, no major pathology was found and, despite high ingestion rates of fibres, they do not seem to pose a risk for human consumption. However, encysted cestode larvae in the tail musculature may reduce the fillet quality and, especially the high muscular levels of mercury (Hg), which are well over the European Commission limits, raise concerns regarding its consumption in the study region. Thus, guidelines in consumption frequency should be considered by regional authorities. Concerning reproductive traits, a decreasing trend in length at 50% maturity (L50) is appreciated in the Balearic Sea and could also be occurring in other areas. The differences observed in the present study, compared to other areas of distribution and over time, highlight the importance of establishing monitoring programs at regional scales, in order to establish proper specific measures for species commercialisation and promotion.

Key words: fisheries, trace metals, parasites, histology, management

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SHIFTING SEAS: ANALYZING DECADAL CHANGES IN ELASMOBRANCH CATCHES AND DISCARD PRACTICES BY SPANISH AND PORTUGUESE FLEETS

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Abstract: This study analyzes reconstructed elasmobranch catch data from the Canary Current, the Iberian Coast, and the Mediterranean Sea Large Marine Ecosystems (LMEs) by Spanish and Portuguese fleets from 1950 to 2019. Data obtained from the Sea Around Us project focused on industrial/professional fishing captures. The analysis involved examining the captures across different areas and countries, species ratios identified from both fleets in the three regions, temporal capture series over the historical record, and gender-disaggregated captures. For the three LMEs, results indicate a significant alternation in elasmobranch captures between the Spanish and Portuguese fleets over the decades. Spanish dominance in captures from the 1950s to the 1970s accounted for approximately 65% of total captures. From the 1970s to the 1990s, Portuguese fleets led, reaching 75% of the captured tonnage. Since 2000, Spanish captures have consistently comprised over 90% of total captures. Notably, discards have considerably decreased, from 40% in the 1950s-60s to less than 20% today. The discard proportion varies significantly with size; large sharks (over 90 cm) have seen an increase from 70% to 90% landings, whereas discards of small to medium sharks have dramatically risen, now representing around 50% of captures in this group. Predominantly, captures include *Prionace glauca* (Linnaeus, 1758), unidentified species, various rays, *Scyliorhinus canicula* (Linnaeus, 1758), *Isurus oxyrinchus* (Rafinesque, 1810), and *Galeus melastomus* (Rafinisque, 1810), with significant differences in species composition between Spanish and Portuguese fleets. The findings highlight the dynamic shifts in elasmobranch fisheries management and species composition over seven decades. These results emphasize the need for targeted conservation strategies and improved management plans to address species-specific capture and discard patterns, ensuring sustainable elasmobranch populations in these habitats.

Key words: Sharks, Rays, Sustainability, Large Marine Ecosystems, Fisheries, Europe.

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UNVEILING THE GROWTH DYNAMICS OF THE GASTROPOD *Bolinus brandaris*: IMPLICATIONS FOR FISHERIES MANAGEMENT

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Abstract: The purple dye murex, a commercially important muricid species, has shown a decrease in landings over the last decades in Spain, showing signs of unbalanced and unsustainable exploitation. Several aspects of its biology remain poorly understood, such as its growth performance, which hinders the implementation of appropriate management measures. Understanding the growth of a species is basic for future development of an age determination methodology applicable to ecology studies and fisheries management.
To this aim, we studied the growth dynamics of *B. brandari*s to identify the periodicity of the formation of external growth increment marks in shells (such us varix, sculptural elements evidence of growth halt; Leal and Matthews, 2013), both in specimens reared in captivity (N=100 for 1 year) and in individuals collected monthly in the field (Delta de l'Ebre river; ~600 individuals/month). Captive individuals were individually tagged, and the edge of the shell was painted with nail polish at the beginning of the experiment. Field and experimental individuals were monitored monthly to follow shell growth (total length, length without siphon, width, inter-varix last increment length) and total weight.
Results reveal that *B. brandaris* grows episodically, with cycles of rapid growth alternated with periods of no growth. Fast growth episodes begin with a fast elongation of a thin and delicate external shell layer (~10 mm length) culminating in the formation of a new varix and spines, to finish the process by thickening this new part.
Growth showed a high variability among individuals. The month of the year and the size of the individuals explained an important part of the observed variability.

Key words: Purple dye murex, Muricid, Small scale fisheries, Shell growth

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EXPOLORING BEHAVIOURAL AND HABITAT PREFERENCES OF JUVENILE EUROPEAN LOBSTER AND THEIR IMPLICATIONS FOR RESTORATIVE AQUACULTURE

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Abstract: The success of stock enhancement initiatives for the European lobster (*Homarus gammarus*) depends significantly on understanding the behavioural ecology of juveniles within their habitats. Integrating restorative aquaculture with commercial mussel cultivation provides a unique opportunity to employ mussel shell-enriched seabeds for both ecological restoration and commercial outputs. This study explores how these enriched habitats can support the adaptability and survival of juvenile lobsters at different life stages, optimizing restocking strategies in alignment with their natural behaviours and preferences.

Behavioural experiments were conducted on three-month-old juvenile lobsters (mean CL = 9.4 ± 0.96 mm, n = 104) and one-year-old lobsters (mean CL = 19.3 ± 1.7 mm, n = 30) to evaluate their interactions with three types of shelters: mussel shells, stones, and artificial pipe (diameter = 20 mm, length = 20 cm). The younger lobsters preferred mussel shells, which correlated with fewer transitions between shelters, reflecting consistent preferences that may facilitate adaptation to new environments. Older lobsters, showed a preference for artificial tube shelters, underscoring their distinct environmental adaptability needs. Furthermore, to explore learning effects and changes in shelter choice these trials were repeated three times using the three-month-old juvenile lobsters, revealing a faster decision-making process and a transition from exploratory to more direct sheltering

behaviours over time, maintaining a preference for mussel shells.

These results highlight the importance of developing restocking strategies that adapt to the different behavioural patterns characteristic of each developmental stage of the species. By incorporating diverse shelter types, particularly those that integrate elements of their natural ecosystems like mussel shells, we can significantly enhance the adaptability and survival of juvenile lobsters. Aligning restocking practices with the lobsters' natural preferences and behaviours would ensure the sustainability and success of European lobster populations in aquaculture-affected habitats. It could create a productive synergy between ecological restoration and aquaculture.

Key words: European Lobster, *Homarus gammarus*, Juvenile lobsters, Behavioral ecology, Restorative aquaculture

Acknowledgments: This study was funded by the EU Horizon Europe project CLIMAREST: Coastal Climate Resilience and Marine Restoration Tools for the Arctic Atlantic basin, with grant agreement 101093865.

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POTENTIAL OF *DUNALIELLA SALINA* AND *HALOCHLORELLA RUBESCENS* FOR THE PRODUCTION OF VALUABLE COMPOUNDS IN THE BAY OF CADIZ.

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Abstract: Microalgae have gained popularity due to their potential in biomass production and synthesis of valuable compounds. In this study, the growth potential of *Halochlorella rubescens* and *Dunaliella salina* was examined under light intensities typically observed in the Bay of Cadiz, as well as the feasibility of using agricultural fertilisers as a nutrient source, by determining kinetic parameters of growth [1] and contents of pigments, carbohydrates, lipids, and proteins. Subsequently, an outdoor comparison was carried out in open HRAP reactors with a 70-litre capacity, under ambient temperature and irradiance conditions. Results indicate that the agricultural fertilisers proved to be a promising alternative for both species compared to f/2 medium. Furthermore, both species demonstrated growth viability within a range of 50–800 µmol photons·$m^{-2}s^{-2}$, with highest productivity at 400 µmol photons·$m^{-2}s^{-2}$ and higher β-carotene production as light intensity increased. In the outdoor experiment, *D. salina* showed higher productivity and concentrations of pigments and proteins, while *H. rubescens* showed a higher lipid and carbohydrate content.

Key words: Microalgae, *Dunaliella salina*, *Halochlorella rubescens*

Acknowledgments: This work has been supported by the MEDARTSAL (EU ENPI-CBCMED) and GREEN-MARSHES (PCM_00041) projects.

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MICROBIAL DYNAMICS IN MICROALGAL BIOMASS PRODUCTION RACEWAYS

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Abstract: Microalgae microbiomes remain underexplored, limiting our ability to understand how they influence the performance of biomass production systems. Here, we monitored the microbial dynamics in two microalgae production raceways, during two 9-month intervals in 2021 (TS1) and 2022 (TS2), one fed with wastewater and the other with clean water plus fertilizers. The raceways were inoculated with *Desmodesmus* and sampled three times per week, yielding a total of 70-80 time points per interval. Metabarcoding analyses based on the 18S and 16S rRNA genes revealed an astounding microbial diversity throughout the time series. Around a thousand eukaryotic species were found in each time series. Likewise, about 5,000 prokaryotic species were identified in the wastewater treatment and 2,500 in the fertilizer treatment. The former reflects the input of a diverse microbiota from wastewaters. Actinobacteria, Alphaproteobacteria, Bacteroidia, and Gammaproteobacteria dominated the bacterial communities. In turn, Chlorophyta, Fungi, Ochrophyta, Cercozoa, and Streptophyta dominated the eukaryotic communities. Microbial dynamics were tremendously complex, yet network analyses enabled us to detect in the TS1, for both systems, more than 9000 associations (potential ecological interactions), of which ca. 8000 were positive and ca. 1000 negative. Negative associations in both systems point to a potentially pathogenic bacterium, Actinobacteria-Mycobacterium. In turn, positive associations in both systems highlight the presence of the fungi Chytridiomycota. Associations varied depending on the system. For instance, Rozellomycota displayed negative associations in the wastewater system, suggesting parasitism on microalgae, but exhibited a positive association in the fertilizer system.

Key words: microbiome, microalgal cultures, raceways, *Desmodesmus*, metabarcoding

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HIGH-THROUGHPUT SEQUENCING OF ENVIRONMENTAL DNA TO UNCOVER MICROORGANISMS DIVERSITY IN THE UPWELLING ECOSYSTEM OF RIA DE VIGO (NW OF SPAIN)

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Abstract:
The marine environment includes microeukaryotic and prokariotic organisms that play important functional roles in the ecosystem. The present study focused in a shallow (<5-m depth) marine area near the intertidal zone in Ría de Vigo (NW, Spain), including both the sediment and water column (meso- to picoplankton). Samples were collected from 2016 to 2018 and DNA metabarcoding was used to describe the eukaryote and prokaryote composition and diversity in sediments and plankton.
High eukaryote and prokaryote diversity were obtained in all compartments. Significant differences among microbial communities were found between sediment and plankton samples but also shared taxa between water and sediment were also obtained, suggesting a possible exchange of organisms between both environmental compartments.
A higher diversity of both eukaryotes and prokaryotes was found in sediments than in water samples but eukaryote composition showed higher temporal variability than prokaryote composition.
Invasive organisms as well as the causative agents of harmful phytoplanktonic blooms were identified in this marine ecosystem. Among these, causative agents of amnesic shellfish poisoning, paralytic shellfish poisoning, azaspiracid producers and ichthyotoxic haptophytes were identified. Moreover, some toxic microalgae were better represented in sediment or planktonic fractions confirming the importance of including both sediment and plankton fractions in eDNA monitoring studies.
Potential pathogens for the marine ecosystem and for aquaculture animals were also identified in the metabarcoding studies including putative pathogenic agents with a zoonotic concern.
Our results show that metabarcoding approaches could be useful tools for the integrative and systematic monitoring of diversity in shallow marine environments, which are some of the most endangered areas in the context of global change.

Key words: amplicon sequencing, eDNA, marine diversity.

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LOCAL MORPHOLOGICAL MODEL SET UP AT SHELLFISH SANDBANKS OF THE GALICIAN COAST

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Abstract: At shallow areas of the Galician *Rías*, communities carry out an important socioeconomic practice of shellfish harvesting on sediments. This activity is currently suffering a decline in bivalve productivity with causes not yet identified. In this context, it is known that variations in the hydrodynamics associated with climate change and human intervention can modify the substratum stability and sediment transport of the environment to an extent that needs to be explored.

In this work, we intend to improve this understanding at selected intertidal locations using the Delft3D model (modules FLOW and MOR). A regional model was set up using an orthogonal grid refined around selected sandbanks traditionally harvested in the *Ria de Arousa*. For these locations, up-to-date datasets that characterize the area are used as input into the model. Those include new bathymetries obtained through multibeam onboard campaigns complemented with topographic GPS surveys onshore and surface sediment D50 and %mud acquired over an extensive sampling strategy.

The regional model is validated based on different field time series from current and sea level instrument measurments. The presented bathymetries significantly improve the previous lower-resolution information and, consequently, the performance of the hydrodynamic model. The resulting model setting provides information on what drives the sediment in the area and its relationship with the bathymetry evolution, tidal regimes, and river discharges at a grid resolution (<20m) consistent with the shellfish sandbank extents. This local pushed-forward study demonstrates the viability of a fine-tuning model for this confined coastal zone with irregular coastlines and allows to analyze the response to multiple scenarios related to climate change and anthropogenic interventions.

Key words: Delft3D, sediment, multibeam, estuary

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PALAEOENVIRONMENTAL RECONSTRUCTION AND ANTHROPIC INFLUENCE DURING THE HOLOCENE IN SE SPAIN

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Abstract: The palaeoenvironmental conditions of SE Iberian Peninsula during the Holocene were reconstructed using sedimentological, mineralogical, trace elements and lipid biomarkers proxies which allowed the identification of natural variations and the anthropic processes of this coastal area. A 14 m-deep core was drilled in San Juan de los Terreros (Almería). The chronological framework using a bayesian age-model was established through amino acid racemization using ostracode valves and radiocarbon (^{14}C) dating of plant debris. The results reveal an age range between 0 and 7000 yr cal BP, in which some environmental periods showing changing conditions were identified. A clear human influence in the sedimentary record was also observed since the Chalcolithic, being noticeable during Phoenician and Roman times. In this regard, the lithogenic and anthropogenic Pb concentrations along the sedimentary record were calculated, together with the Pb enrichment factor using titanium (Ti) as a conservative reference element and normalized with pre-anthropogenic data. Findings showed that the influence of anthropogenic factors, including mining activities, predominated in the last four millennia, particularly fine particle deposition during flood periods from the nearby ephemeral water course (wadi) of "Rambla de los Pérez" as well as atmospheric deposition linked to mine tailings and metallurgical activities in the area. In addition, the presence of faecal stanols, such as coprostanol, corroborated the presence of human populations in the area. Therefore, these results indicated a relevant human influence in the last 4000 yr cal BP. In brief, the coastal record of San Juan de los Terreros can be considered a preserved environment, suitable to search for environmental changes and regional human activity fingerprinting, specifically that related to the deposition of heavy metals such as Pb.

Key words: Paleoenviroment, amino acid racemization, trace elements, lipid biomarkers, faecal stanols.

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MARINE GEOPHYSICAL INVESTIGATIONS FOR SUBMARINE CABLE PRE-LAY SURVEYS

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Abstract: The proliferation of offshore windfarms and the development of the intra and trans-national submarine electrical interconnections network is leading to the installation of hundreds of kilometres of submarine cables worldwide. The knowledge of the marine seabed and subsoil characteristics and properties is essential for the proper development and design of any submarine infrastructure. In this sense, marine geophysical techniques are indirect methods that allow obtaining high quality data useful to investigate the seafloor, ensuring an optimum definition of the cable route line (RPL) and suitable burial depth along the route.

Prior to the installation of a submarine cable, the predetermined cable route needs to be assessed with geophysical (and geotechnical) data to determine its suitability and to identify any potential constrains that could lead to problems or injuries during the installation works or over the cable's lifetime.

In this study, we present the marine geophysical techniques commonly used during the submarine cable pre-lay surveys, as well as the main outcomes and applications used for evaluating the cable route. The results obtained include examples of boulders, seabed mobile features, unexploded ordnance (UXO), bedrocks outcrops, utility crossings and other potential constrains that have been detected using MultiBeam Echo-Sounder (MBES), SideScan Sonar (SSS), Sub-Bottom Profiler (SBP), Magnetometry (MAG) and Remotely Operated Towed Vehicle (ROTV) techniques in several marine investigations carried out in Europe in the recent years.

Key words: subsea cable, geophysical investigation, offshore windfarm

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FINE-SCALE BEDFORM EVOLUTION ALONG A SLOPE-CONFINED SUBMARINE CANYON IN THE NORTHERN SOUTH CHINA SEA: A NOVEL LOOK FROM A MULTISENSOR DATASET

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Abstract: Mapping of submarine canyon bedforms classically utilized ship-mounted and towed sensors. However, enlightening the fine-scale geomorphology and inner configuration of these bedforms requires datasets with superior resolution than the one provided by classical approaches. To that end we have used a very high-resolution dataset gathered from an autonomous underwater vehicle (AUV) together with 2D and 3D seismic reflection profiles and sediment cores, which allowed examining bedform sets within a 25.6 km long submarine canyon (Canyon C14) in the northern South China Sea. Crescent-shaped axial steps found in the canyon floor are indicative of cyclic steps formed by supercritical turbidity currents. In the upper canyon, erosional truncations and sub-horizontal reflectors on both the lee and stoss sides of the axial steps point to erosional-depositional cyclic steps caused by confined flows. As the canyon widens downcourse the asymmetry and wavelength of the axial steps increases. Deposits on the stoss sides of these steps suggest depositional cyclic steps with significant aggradation. The sediment filling within each cyclic step points to reworking by gravity flows triggered by destabilization processes of the canyon sidewalls upstream lee faces, and possibly to shelf-edge spillover. In the lowest canyon course, cyclic steps transition into a giant furrow field, likely due to a decrease in flow velocity stemming from the canyon's widening and a reduction in slope gradient. Flow braiding and re-convergence processes, associated with the erosion of fine-grained deposits on the canyon floor, are conducive to furrow formation under supercritical conditions. These results enhance current understanding of the intricate morphology and configuration of bedforms in deep-water submarine canyons, thus providing novel insight into their genesis and evolutionary patterns.

Key words: Bedform, cyclic steps, furrows, slope-confined canyon, South China Sea

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CONGENERIC SCYPHOZOAN JELLYFISH SPECIES RESPOND DIFFERENTLY TO FUTURE WARMER AND ACIDIFIED SCENARIOS

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Abstract: Ocean acidification (OA) and warming challenge marine organisms and ecosystems worldwide. The effects of these two climate change drivers on scyphozoan jellyfish are still understudied. Here, we examine the independent and combined effects of both stressors on polyp population dynamics of the scyphozoans *Rhizostoma pulmo* and *Rhizostoma luteum*. An experiment was conducted to examine the asexual reproduction of polyps considering current and ca. 2100 winter and summer conditions under projected future climate change scenarios (SSP5-8.5, IPCC, 2021). The first part of the experiment (32 days) was conducted at 18ºC and two pH levels (ambient: 8.0 and future: 7.7). In the second part (32 days), temperatures of 24 and 30ºC were tested in combination with ambient and acidified pH (8.0 and 7.7, respectively). In *R. luteum*, warming and acidification did not significantly affect the formation and excystment of podocysts ($p > 0.05$). However, temperatures of 24 and 30ºC produced mortality of scyphistomae and loss of podocysts under both pH conditions. Furthermore, no strobilation occurred at 30ºC. *R. pulmo* podocyst formation and excystment were higher at warming conditions, and no effects of low pH were found. Our results show that *R. pulmo* scyphistomae would thrive in the Mediterranean Sea under future scenarios and generate healthy ephyrae at every tested condition. The fate of *R. luteum* scyphistomae will, however, be less prosperous under future scenarios, as the capacity of this species to undergo strobilation will cease at warmer temperatures, thereby affecting medusae recruitment and population dynamics.

Key words: pH, Temperature, Scyphozoan, Swimming pulsation, Body growth

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SEASONAL VARIABILITY OF MESO- AND BATHYPELAGIC FISH DIVERSITY IN THE NORTH ATLANTIC OCEAN DURING WINTER AND FALL

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Abstract:

Mesopelagic fish populations are characterised by high species richness and abundance and they are important contributors to the active carbon flux in the open ocean. Here, we studied their scarcely known seasonal variability of diversity and abundance in the North Atlantic Ocean. We analysed the meso- and bathypelagic fish species composition, day-night vertical distribution, and their assemblages from surface to 2000 m depth during winter and fall. Sampling was carried out covering a latitudinal (from 41ºN to 29ºN) and a longitudinal transect (from 25ºW to 13ºW) during both cruises. Temperature, salinity, dissolved oxygen, and chlorophyll *a* were also analyzed. We found lower sea surface temperature and higher productivity during winter and higher stratification and oligotrophy during fall as expected. A total of 34 families and 18 orders were identified. Species composition showed lower seasonal than spatial differences. Higher diversity was observed in the transect at 29°N, while the highest abundance was recorded at the stations close to the Canary Current

Upwelling System, associated with the higher productivity there. Myctophiformes and Stomiiformes were the most abundant orders along both transects during both cruises. The vertical distribution showed Myctophidae performing diel vertical migrations, increasing abundance near the surface at night. Non-migratory species such as those of genus *Cyclothone* exceeded the abundances of Myctophidae below 350 m, both by day and at nighttime, with conspicuous numerical dominance of *C. microdon* among any other mesopelagic fish below 1000 m. Our results provide basic information about mesopelagic and bathypelagic species in the two contrasted seasons and latitudinal zones.

Key words: Midwater fishes, micronekton, Diel vertical migration, Deep Scattering Layers.

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AREA-BASED CONSERVATION MEASURES FOR THE PROTECTION OF COLD-WATER CORALS AND SPONGE GROUNDS IN DEEP-SEA FISHERIES (NORTHWEST ATLANTIC): THE ROLE OF GROUNDFISH SURVEYS

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Abstract:

The EU-Spain and Portugal, and the Canadian bottom trawl groundfish surveys conducted in areas beyond national jurisdiction (ABNJ), Divisions 3LMNO of the Northwest Atlantic Fisheries Organization (NAFO) Regulatory Area, are relevant for providing and updating key data on the presence, distribution, and biomass of Vulnerable Marine Ecosystem (VME) indicator species, such as cold-water corals and sponge grounds. Data on VME indicator species from groundfish surveys are annually updated and presented to the NAFO Working Group on Ecosystem Science and Assessment (WG-ESA), and integrated into the NAFO ecosystem advisory cycle for management purposes. The present study aims to review and update the process of integrating VME data into the NAFO management process scheme during the last decade and its contribution to compliance with the UNGA Resolutions on sustainable fisheries and the FAO International Guidelines for the management of deep-sea fisheries in ABNJ. VME indicator biomass data from groundfish surveys provided a spatial and temporal data series that allowed the identification and spatial location of VMEs. These data have been used by NAFO to support area-based management measures aimed at avoiding significant adverse impacts of deep-sea commercial fishing on VME (e.g., areas closed to bottom fishing). Some of these closed areas are currently candidates for inclusion in the World Database on Other Effective Area-Based Conservation Measures (OECMs) in the framework of the Convention on Biological Diversity and the United Nations Environment Programme. The NAFO Commission recognized that groundfish surveys play a crucial role in providing data for the assessment of fisheries resources and the monitoring of the conservation objectives of closed areas. Data obtained have the potential to help prevent adverse

impacts through spatial management (e.g. closed areas) from other human activities of increasing concern, such as deep-sea mining and offshore oil and gas exploration and exploitation, which may affect VMEs.

Key words: Vulnerable Marine Ecosystems (VMEs), NAFO, Bottom trawl groundfish surveys, Scientific management advice.

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management, of the Recovery, Transformation and Resilience Plan of the Government of Spain. SAM and SPO are supported by the NEREIDA study, which was funded by the European Union through the NAFO Secretariat. This output reflects only the author's view (SAM; SPO; PDM & MS) and the European Union cannot be held responsible for any use that may be made of the information contained therein. BMN and VH acknowledge DFO-NL personnel and the Canadian Coast Guard captains and crew for Canadian data collection.

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¿IS A REFERENCE GENOME REALLY ESSENTIAL FOR POPULATION GENOMICS?

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Abstract: Conservation genomic studies in non-model organisms often depend on reduced representation sequencing methods such as Genotyping-by-Sequencing (GBS), which use restriction enzymes to identify population structure and candidate loci for local adaptation. While there is a growing number of high-quality reference genomes from international, national, and local initiatives, their production remains costly. Therefore, understanding how population genomic studies benefit from reference genomes is crucial. Here, we analyzed GBS genomic data of the sea urchin *Paracentrotus lividus*, an ecosystem engineer, to infer population structure and characterize candidate loci using two approaches a) a *de novo* analysis for population structure and posterior mapping to the *Strongylocentrotus purpuratus* genome for functional characterization (Carreras et al. 2020, López et al. 2023) and b) population structure and functional characterization using the recently published *P. lividus* genome (Marlétaz et al., 2023). Both approaches retrieved the same population structure. The *de novo* analysis initially reported high values for the inbreeding coefficient beyond confidence intervals, corrected by the reference genome, suggesting potential bias from *de novo* approaches in SNP calling. Importantly, genomic characterization of loci of interest significantly improved with a reference genome. Using the closest reference genome available (*S. purpuratus*), approximately 10% of loci were mapped, whereas with the *P. lividus* genome, around 90% were mapped. Despite differences in mapping rates, both cases showed an enrichment of loci in exonic regions, consistent with the GC content of the restriction site of the used enzyme, as seen in previous studies. These findings emphasize the reliability of *de novo* population genomic studies using reduced representation techniques but highlight the substantial improvement in genomic characterization with a reference genome. In addition, we confirm the biases in the genomic region amplified due to the selected restriction enzyme for reduced representation sequencing techniques.

Key words: reference genome, population genomics, population structure

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Deep learning for coral reef cover estimation in cold waters: insights from the North Atlantic demarcation

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Abstract

Although the conventional association of coral reefs is limited to warm tropical environments, it has been evidenced that cold-water species also generate reefs of notable richness and diversity. In this context, the present study focuses on the non-destructive evaluation of the coverage of cold-water coral reef species *Desmophyllum pertusum* and *Madrepora oculata* in the North Atlantic Denomination, specifically within the Natura 2000 network areas of the Bay of Biscay.

Multiple images of these reefs were acquired through oceanographic surveys using ROTV (Remote Operated Towed Vehicle), enabling multi-temporal comparisons within the region. Given the complexity and intensive labor required by manual image annotation tasks to analyze coral coverage, a strategy has been adopted based on the use of artificial intelligence models for the identification and calculation of coverage of these two key species. The CVAT annotation software was utilized for labeling during model training, with state-of-the-art instance segmentation models like YOLOv8 employed for accurate delineation of coral perimeters. This approach not only facilitates precise and efficient calculation of coral coverage but also allows for comparisons between reefs located in different geographical points.

Furthermore, this methodology has been extended to quantify the dead coral matrix on which these species settle, allowing for the automatic derivation of a live coral versus dead coral ratio. The application of these non-destructive techniques is of crucial importance, as it enables detailed information to be obtained about these valuable underwater ecosystems, without disturbing their integrity. Moreover, this methodology allows the evaluation of coral habitat in different years through temporal series of image data, providing the opportunity to understand the evolution of these ecosystems over time and their response to changing environmental factors.

This study is framed within the EU-funded project iMagine use cases, showcasing its applicability within broader research and conservation frameworks. In a world where marine ecosystems face increasing challenges, understanding and preserving the biodiversity and health of cold-water coral reefs becomes imperative. These ecosystems not only harbor a great diversity of marine life but also provide vital ecosystem services, emphasizing their importance for global sustainability and human well-being.

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DEVELOPMENT OF CRYPTOGENIC AND NON-INDIGENOUS SPECIES OVER TWO DIFFERENT SUBSTRATES IN THE PORT OF ALICANTE (WESTERN MEDITERRANEAN)

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Abstract: Biofouling and ballast waters are the main human-mediated dispersal pathways for aquatic non-indigenous species (NIS), which make port areas a hotspot for primary introduction of NIS (Marraffini et al., 2017; Outinen et al., 2021). NIS can cause both biodiversity loss and change community structure through the local elimination of native species (Albano and Obenat, 2019). In addition, artificial structures act as points of entry for NIS in port areas and may support higher abundance and richness of them (Tyrrell and Byers 2007; Dafforn et al. 2012). The studies about NIS are increasing, but studies focusing on the variation in temporal recruitment and ecological mechanisms are still scarce (Lezzi et al., 2017). Thus, the aim of this work is to determine the colonization and development of non-indigenous sessile fouling species over two types of substrates (electrolytic carbonated and steel) during 12 months of immersion in the Alicante's harbor, sampling it quarterly from October 2019 to October 2020. Biofouling community of both substrates was analyzed in terms of abundance and species richness by status (native, cryptogenic and NIS). Moreover, a multivariate analysis of only NIS assemblages of both substrates was carried out, as well as a correlation test among species. A total of 53 species were identified among substrates, 38 in steel (6 NIS and 6 cryptogenic) and 50 in the carbonated substrate (7 NIS and 9 cryptogenic). Most of NIS have a preference for the electrolytic carbonated substrate and they were more abundant and diverse after 9 months of immersion. Furthermore, most of them are positively correlated in both substrates (mainly in steel) and it is noted that the number of NIS in the port of Alicante is increasing.

Key words: Biofouling, Sessile invertebrate, Alien species, Carbonated structures

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ARTIFICIAL INTELIGENCE AS A TOOL FOR BIONOMIC TRANSECTS: THE CASE OF *Isidella elongata* (ESPER, 1788) FORESTS IN WESTERN MEDITERRANEAN

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Abstract: The deep-sea ecosystems have been mainly studied by extracting sampling procedures, but the use of underwater vehicles and video transects is increasing nowadays (Grinyó *et al*., 2016; Prado *et al.,* 2019; Mendonxa and Metaxas, 2021). However, the recorded images are mainly manually annotated for the analysis, making this process very time-consuming (Beijbom *et al*., 2012). Gorgonian forests are one of the most targeted communities as they are complex habitats with a high biodiversity (Grinyó *et al.,* 2016; Prado *et al*., 2019). A good example is the bamboo coral *Isidella elongata,* as it is a structuring species on compact muddy bottoms (Carbonara *et al*., 2020). It can form dense aggregations and it hosts some species of commercial interest such as *Aristeus antennatus,* playing an important ecological role. However, it is highly affected by trawling, and it is declining (Maynou and Cartes, 2012). During Life-INTEMARES project, the SE Spain offshore bottoms were surveyed looking for this type of habitats. The aim of this work is to find a method to automatically classify and count the *Isidella elongata* colonies recorded with video transects. For that purpose, five video transects (TR077, TR078, TR080, TR103 and TR152) by photogrammetric image sledge ("TASIFE") over muddy bottoms, between 357-640m depth, were selected and analyzed by a methodology based on deep-learning algorithms. Most of the transects have a total density of around 1000 individuals/ha, but dense aggregations of *I. elongata* colonies have been recorded (9862 individuals/ha), and local areas with around 2.5 individuals/m^2. The results obtained by artificial intelligence are similar to the ones obtained by visual census (e.g. 821 vs 876 individuals/ha, manually vs automatically), which highlights the efficiency of this method and its suitability for this

purpose.

Key words: Gorgonian forests, SE Spain, Bathyal soft bottoms, deep-learning

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REWILDING AS A NATURE BASED SOLUTION FOR ANTHROPOGENICALLY DESICCATED SALTMARSHES

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Abstract: Saltmarshes provides considerable ecosystems services: coastal protection against sea-level rise, climate change mitigation as carbon (C) sinks, are hotspot of biodiversity and provide livelihood and recreation opportunities. In Cadiz Bay (SW Spain) and in many other regions, saltmarshes have been progressively lost and anthropized resulting in their transformation to saltpans, aquaculture ponds or even desiccated. In this study, we analyze the rewilding of a saltmarsh in the Rio San Pedro tidal channel as a nature based solution for the restoration of its ecological functions and services. The rewilding process started in 2004 after the opening of the external tidal wall, and it has been monitored using remote sensing and geographic information systems tools between 2003 and 2022, plus measurements of organic C storage in the sediments. Areas with marsh vegetation and areas of the tidal flats with bare sediment were delimited, by tracing polygons on 9 Google Earth for the studied period to study the time evolution of their surfaces. The results showed a relatively quick reduction in the marsh vegetation surface (24%) and the corresponding increase of the tidal flats surface up to 2015, and the stabilization of both ecotopes surfaces up to the present. The biomass of the marsh vegetation and of microphytobenthos (MPB), in intertidal sediments, were analyzed using the Normalized Difference Vegetation Index (NDVI) in 20 Landsat satellite images between 2003 and 2022, with a spatial resolution of 30m. The mean NDVI increased in both communities, 1.9 and 1.6 times for the marsh vegetation and MPB, respectively. The C storage in the first 50 cm of rehabilitated marsh sediments ranged from 88 to 121 t CO_2 ha^{-1}, which was ~24% higher than in the natural marsh. The rewilding of this saltmarsh increased the biomass of primary producers and their potential capacity to sequester C.

Key words: restauration, saltmarsh, carbon storage, climatic regulation, earth observation technologies.

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SCIENTIFIC INTEREST IN THE IMPACT OF CLIMATE CHANGE ON MEDITERRANEAN SPECIES: A BIBLIOMETRIC ANALYSIS

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Abstract: The Mediterranean region has been considered one of the most vulnerable to climate change (Todaro et al., 2022). The progressive water warming observed in the Mediterranean Sea has been associated with mass mortality events (Garrabou et al. 2022), as well as with the invasion and spread of new warm water species, leading to a "tropicalisation" of the fauna (Bianchi and Morri, 2003). However, a quantitative assessment of these responses is still lacking to elucidate their magnitude, their relationship with warming and the warming thresholds that are alarming for the ecology of Mediterranean biota (Marbà et al., 2015). With the aim of prospecting this research need, a bibliometric study was conducted to analyse the evolution of scientific publications on species, both exotic and key species sensitive to the effects of global warming in the Mediterranean Sea.

A comprehensive and systematic search was conducted in the Scopus and Web of Science Core Collection databases using a sophisticated search strategy combining terms related to climate change, the Mediterranean Sea and the decline of species populations. Afterwards, a co-occurrence network of key terms was constructed using the VOSviewer software. This technique enabled the identification of the most relevant topics within the set of studies analysed, as well as the relationships between them.

The search generated a total of 1150 references, 507 documents and 15 preprints from the Scopus platform, and 643 documents in the Web of Science Core Collection (WOSCC). The bibliometric analysis performed with VOSviewer, revealed four main thematic clusters encapsulating the diversity of research on the impact of climate change on Mediterranean Sea species. These preliminary results provide an overview of the most relevant research areas in this field and will serve as a starting point for further detailed

analysis.

Key words: mass mortality, invasive species, bibliometric study, climate change

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MORPHOLOGICAL INSIGHTS INTO THE 3-DIMENSIONAL COMPLEXITY OF RHODOLITH BEDS

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Abstract: This study emphasizes the critical ecological role of rhodolith beds as complex, three-dimensional habitats composed of free-living red calcareous algae, which significantly enhance local biodiversity by providing numerous ecological niches and shelters for various organisms. The unique structure of rhodolith beds, characterized by a diverse array of branching morphologies, facilitates the creation of interstitial spaces, thereby augmenting surface area and habitat complexity. Our research focused on a rhodolith bed within the Menorca Channel, inhabited by various species of red calcareous algae, which collectively generate a broad and diverse habitat. We conducted a comparative analysis of morphological diversity between the central region of the rhodolith bed, which harbors the highest density of rhodoliths, and its peripheral areas, where rhodolith density diminishes. Findings reveal that the rhodoliths within the bed exhibited a diversity of growth forms (branched, pralines, and boxwork), had greater interstitial spaces, and were notably larger than those located in the peripheral zones. This work also incorporates the application of three-dimensional analytical techniques to assess morphological characteristics traditionally examined in two dimensions. Our research advances the understanding of morphological diversity of rhodolith beds from western Mediterranean continental shelves. It underscores the significance of employing three-dimensional metrics, particularly regarding the interstitial spaces of branched rhodoliths, for enhancing the accuracy of habitat complexity assessments.

Key words: Coralline algae, biodiversity, morphometrics, Mediterranean Sea.

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EFFECT OF CLIMATE VARIABILITY ON THE MIGRATION OF WHITE SHARKS (*CARCHARODON CARCHARIAS*) FROM THE NORTHWEST ATLANTIC OCEAN.

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Abstract: On a constantly evolving planet, climate variability has begun to generate significant changes in the oceans, affecting marine biodiversity, such as sharks (Lindsey, et al., 2019). This study aims to analyze the effect of climate variability on the migration of white sharks (*Carcharodon carcharias Linnaeus*) in the Northwest Atlantic Ocean.

Using Generalized Additive Models (GAM) with random effects, the relationship between latitude and sea surface temperature, among other oceanic variables such as pH, Dissolved Oxygen, and salinity, was analyzed, correlating them with temporal (year and month) and biological (sex) variables, and considering individual effects.

The results that white sharks have individual differences in their behavior and response to climate variability. Nevertheless, any general migratory pattern was revealed, with sharks moving northward in April and May, reaching higher latitudes between August and September, and returning southward from October, with significant differences between sexes in response to marine thermal conditions. Significant differences between sexes were found in the annual trend according to monthly pattern of SST (sea surface temperature). Males showed greater distribution in SST range than females, suggesting that males may be less sensitive to climate variability.

These findings offer a perspective to consider on the impact of climate variability and individual adaptation in the conservation strategies of white sharks, which may have crucial implications for their conservation.

Key words: white shark, climate variability, Northwest Atlantic Ocean, Sea surface temperature,GAM model

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DEVELOPMENT OF A LONG TERM SAMPLING PROTOCOL FOR MARINE INDICATOR SPECIES IN THE VALENCIAN COMMUNITY (EASTERN SPAIN)

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Abstract:

Long time series sampling is essential to monitor the changes on key habitat and species along our coasts, in order to improve its management (Magurran et al. 2010). Ocean is changing fast, suffering pressures such as anthropogenic impacts, climate change and the entrance of non-native species; in addition, Mediterranean sea, as a semi-enclosed basin highly frequented, is suffering a tropicalisation process (Bianchi and Morri, 2003). In order to follow up this evolution, this study summarizes the develop of a protocol to assess changes on key species in marine coastal waters of the Valencian Community.

First step on the protocol design was the selection of key elements, divided into protected species and habitats, climate change affected effects and exotic species occurring in the Valencian Community. A preliminary sampling methodology was designed, based both in a protocol revision and scientific agreement. Coordination between working groups was made and eight preliminary sites were selected to sample and test the protocol.

Protocol of visual census by transect was tested twice a year (winter and summer). Preliminary data show a fish community structure, mostly of thermophilic species, together with the occurrence of mortality and bleaching of gorgonians and hard corals in some locations, similar to other places (Garrabou et al. 2022). Algal blooms and several exotic species were observed in areas where had not previously been reported.

Long-time sampling series are essential to monitor the changes on key habitat and species along our coasts, in order to improve its management. This protocol is also useful as early warning protocol for the occurrence of massive mortalities, and the presence of new species, aiding decision making for all parties involved in the management of the

marine environment.

Key words: key species, sampling protocol, biodiversity, management

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ACCIONES DE CONSERVACIÓN EN HÁBITATS Y ESPECIES PRIORITARIOS EN ESPACIOS NATURALES PROTEGIDOS DE LA COMUNIDAD VALENCIANA

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Resumen:
El Equipo de Guardacostas de Espacios Naturales Protegidos está integrado por un equipo multidisplinar que participa en proyectos de conservación de habitats y especies en colaboración con entidades científicas y vinculadas a la conservación del medio marino.
Las funciones de este equipo comprenden la vigilancia del uso público, seguimiento de fauna marina, salvamentos, trabajos subacuaticos, divulgación, coordinación de proyectos y colaboración con otras entidades.
En el ámbito de los proyectos de conservación se han desarollado varias líneas:
(1)La restauración de praderas de *Posidonia oceanica,* para lo que se han establecido dos estaciones de muestreo en el Parque Natural de la Serra Gelada y su entorno litoral, una somera y otra profunda, en las que se han plantado 120 plántulas de Posidonia obtenidas a partir de semillas recogidas en playas y germinadas en instalaciones de vivero. Se han empleado soportes vegetales biodegradables, cianocrilato para la sujeción de las plántulas y varillas metálicas para la fijación al sustrato. La abundancia de haces existente en las zonas restauradas es superior al 70%, habiéndose observado mortalidad o pérdida de algunos haces.
(2)El estudio de la dispersion de juveniles de *Pinna nobilis* mediante instalación de colectores de nacra, en colaboración con la Red panmediterránea y el Life Pinnarca, permite evaluar el potencial de recuperación de la especie de forma natural. Desde 2022 se han obtenido 3 ejemplares de *Pinna nobilis* en Irta, 1 de *Pinna rudis* en Serra Gelada y 4 de *Pinna spp* en Cabo de San Antonio.
(3)La retirada y monitorización de artes de pesca perdidos o abandonados en zonas sensibles se ha realizado en la Zona de Especial Protección del Islote de Benidorm y ha permitido retirar 450 kg de artes de pesca perdidos y abandonados, así como monitorizar la fauna atrapada y la presencia de microplásticos en estos puntos.

Palabras clave: restauración, Posidonia, Pinna, redes, guardacostas.

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EFFECTS OF WARMING AND ACIDIFICATION ON SWIMMING ACTIVITY AND GROWTH OF *RHIZOSTOMA PULMO* EPHYRAE

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Abstract: Climate change impacts marine organisms and ecosystems through various stressors, including increasing temperatures and ocean acidification (OA). Our current understanding of how climate change affects scyphozoan jellyfish is limited. This study examines the independent and combined effects of pH and temperature on the pulsation, morphology, and growth rates of ephyrae from the barrel jellyfish *Rhizostoma pulmo*. We conducted a full-factorial experiment with eight treatments, where one-day-old ephyrae were exposed for seven days to four different temperatures (15, 18, 24, and 30ºC) and two pH levels (current pH 7.88 and projected future pH 7.65). Results indicate that these stressors significantly impact pulsation activity and ephyrae size. Pulsation rates were notably lower at 30ºC under both current and future pH conditions. Additionally, a temperature of 24ºC combined with future pH levels significantly reduced ephyrae mobility. While no ephyrae mortality occurred in any treatment, those exposed to lower pH were significantly smaller, particularly at 24 and 30ºC. In conclusion, the temperatures and pH levels tested, which simulate future scenarios, significantly influenced the activity and size of *R. pulmo* ephyrae. These effects may affect the recruitment success of this early pelagic stage, potentially altering the future dynamics of wild jellyfish populations.

Key words: climate change, scyphozoan, swimming pulsation, body growth.

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Immune and Oxidative Stress Response of the Fish *Xyrichthys novacula* Infected with the Trematode Ectoparasite *Scaphanocephalus* sp. in the Balearic Islands

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Abstract: Global change produces substantial modification to the distribution and rhythm of infection of diseases in fish, favouring the introduction of new pathogens. Recently, the presence of black spot disease, associated with a digenean fluke of the genus *Scaphanocephalus*, has been observed in specimens of *Xyrichthys novacula* on the island of Ibiza (Balearic Islands). The aim of the present study was to evaluate the antioxidant and immune response in both the skin mucus and spleen of *X. novacula* depending on the degree of infection by *Scaphanocephalus* sp. The specimens were captured in a control area, without the presence of the parasite, and in an affected area, classifying the fish as low infection (1–15 spots) and high infection (>15 spots). As the degree of infection increased, a decrease in the body condition index was observed. The activity of the antioxidant enzymes in the mucus — catalase, superoxide dismutase and glutathione peroxidase — increased progressively with the degree of infection. This activation of antioxidant defences was not enough to prevent an increase in malondialdehyde levels, an indicator of oxidative damage, in the group with the highest infection. Similarly, an increase in immunological parameters —lysozyme, alkaline phosphatase, myeloperoxidase and immunoglobulins— was observed in mucus as infection increased. Regarding the spleen, only an increase in lysozyme activity and alkaline phosphatase in fish with a greater severity of infection was observed. In conclusion, as the severity of *Scaphanocephalus* sp. infection increased, it induced an immune and oxidative stress response in skin mucus, leading to a decrease in overall body condition. The potential health effects that the ectoparasite may have on *X. novacula* populations will require follow-up studies.

Key words: oxidative stress; immune system; Balearic Islands; pearly razorfish; ectoparasite

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THE INVASIVE DECAPOD CRAB *PERCNON GIBBESI (MILNE-EDWARDS, 1853)* AS A BIOINDICATOR OF ANTHROPOGENIC POLLUTION BY ANALYZING OXIDATIVE, IMMUNE SYSTEM AND TOXICOLOGICAL STRESS BIOMARKERS

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Abstract: Bioindicators can be used to monitor the health status of an ecosystem. In this study, we aim to evaluate the potential of Percnon gibbesi as a bioindicator along the coasts of the Balearic Islands. This species is arguably one of the most invasive decapod species found in the Mediterranean region to date. It quickly spreads across the region, forming prosperous populations in within a short timeframe. The species was first observed simultaneously in the Balearic Islands and Sicily in 1999. P. gibbesi is intriguing due to its invasive nature, and despite lacking natural predators, there is no evidence of it competing with native species. Scientific evidence suggests that exposure to heavy metals or plasticizers can lead to serious problems. However, there is limited information on how such contaminants may affect decapods during critical phases such as molting. Contaminants enter the crab through water, sediment or food, and are transported through the hemolymph to accumulate in the hepatopancreas. This study aims to assess the suitability of P. gibbesi as a bioindicator on the coasts of the Balearic Islands. Specifically, we examined its response in two contaminated areas -with different level of contamination- compared with one uncontaminated areas. Different parameters including oxidative -catalase and superoxide dismutase-, immune system -lysozyme, immunoglobulins- and toxicological -acetylcholinesterase, carboxylesterase- parameters were measured. Different tissues were also analyzed: hemolymph, gills, eye and muscle. Additionally, sediment analysis were conducted to study microplastics. Our goal was to determine the appropriateness of P.

gibbesi as a bioindicator of anthropogenic pollution in coastal ecosystems, and to identify which tissue is most sensitive to pollutants.

Key words: bioindicator; oxidative stress; ecotoxicology; Balearic Islands; *Percnon gibbesi*

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MORPHOLOGICAL STUDY OF NON-INDIGENOUS COLONIAL ASCIDIANS (CHORDATA: TUNICATA) IN THE ALICANTE'S MARINA (WESTERN MEDITERRANEAN)

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Abstract: Many species have become successfully introduced around the world via anthropogenic vectors (Zhan et al. 2015). The transport of these species is associated with boating traffic, both commercial and recreational, as well as aquaculture (Wasson et al. 2001; Lin *et al*. 2015; López-Legentil *et al*. 2015; Zhan *et al*. 2015). Ascidians are sessile invertebrates ideally suited for the study of introduction processes as related to harbor dynamics (López-Legentil *et al*. 2015). Furthermore, many ascidian species are known to tolerate a wide variety of environmental conditions, including pollution (Lambert 2005; Pineda *et al*. 2012). Recently, we found three non-indigenous colonial species (*Aplidium* cf. *accarense, Didemnum* cf. *perlucidum and Botrylloides* cf. *niger*) found in the Alicante's marinas. Colonies were relaxed in menthol and preserved in 10% seawater formalin for morphological identification; subsamples were preserved frozen for genetic identification. We found a good agreement between, the morphological characters of *Aplidium* specimens and the detailed description of *Aplidium accarense*, with the exception of the color: while some of our colonies were yellowish as the previously described Mediterranean specimens (Montesanto *et al*. 2021), others had orange zooids as the Southern California specimens (Nichols et al. 2023). This is the first report of *A. accarense* in Alicante, previously reported in Catalonia in 2015 (López-Legentil *et al*. 2015). The morphological characters of our *Didemnum* specimens corresponded well with the description of *D. perlucidum* in Muñoz and McDonald (2014) and Novak and Shenkar (2020). Furthermore, spicules were seen under a scanning electron microscope (SEM). This is the first time that this specie has been reported in Spain. Finally, genetic studies are needed to confirmed the taxonomic assignation of the *Botrylloides* cf. *niger* specimens collected during this study, since this species may have been recorded in the port of Alicante in 1979 (Ramos-Esplá, 1988) as *B. leachii*.

Key words: nonindigenous species, rapid assessment survey, marinas, Western Mediterranean

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PHYSIOLOGICAL EFFECTS OF HEATWAVES AND FOOD AVAILABILITY IN *Palaemon elegans*

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Abstract

Heatwaves, characterised by prolonged periods of unusually high temperatures, have emerged as a significant environmental stressor in marine ecosystems, particularly in tropical and subtropical regions. The intensification and increased frequency of heatwaves have raised concerns about their impacts on aquatic organisms and ecosystem dynamics.
Marine organisms are interconnected within their habitats, and disruptions caused by extreme events can have cascading effects throughout the food web. Shallow marine environments harbour diverse communities of organisms, including many species of crustaceans, which play crucial roles as both predators and prey. This study analyses the effect of extreme weather temperatures and different food availability scenarios. Three levels of temperature (20, 26 and 32°C) and food situations (feeding vs starvation) were tested in a full factorial experiment for 10 days. Shrimps were sampled on the 1st, 2nd, 3rd, 4th, 7th and 10th day of exposure. The combined effect of temperatures and food availability was tested on shrimps' full body on each sampling day and cellular stress biomarkers associated with oxidative stress (ETS – Electron transport system, GST - Glutathione-S-Transferase, SOD – Superoxide Dismutase and CAT – Catalase) were used as physiological indicators of the shrimp's response to the experimental conditions. Results indicate that temperature and food availability did not significantly interact. On the other hand, our analysis reveals that temperature and biomarkers are negatively correlated in the different food conditions tested. This decrease in oxidative stress biomarkers at higher temperatures might be explained as an adaptive response, enough to protect *P.elegans* against oxidative stress; alternatively, the increase of oxidative damage could be explained by the lack of response of the antioxidant enzyme activity at higher temperatures.
By understanding these mechanisms, this study highlights the physiological resilience and vulnerabilities of these organisms, which is essential for comprehending the impact of environmental changes on marine ecosystems.

Keywords: Heatwaves, oxidative stress, biomarkers, environmental stressors, *P.elegans*

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BIODIVERSITY OF MARINE CYANOBACTERIA FROM THE CANARY ISLANDS IN THE COLLECTION OF THE SPANISH ALGAE BANK (BEA)

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Abstract:
This study presents a characterization of marine cyanobacteria bioprospected in the Canary Islands by the Spanish Algae Bank (BEA). The contribution of these cyanobacteria to national marine biodiversity is highlighted, exploring their genetic variability and environmental influence in the archipelago. New potential species are identified, enriching the understanding of biological diversity in marine environments and and the importance of cyanobacteria as bio-indicators of environmental quality. The results are compared with identifications from other overseas regions, such as the Macaronesian region, as well as cyanobacterial biodiversity in Spain with similar environmental conditions, emphasizing the importance of comparative studies in the conservation and management of marine biodiversity. The objective of this work is to revalue the cyanobacterial biodiversity of the archipelago and to contrast current bioinformatics tools for the polyphasic characterization of Cyanobacteria genetic populations.

Key words: Marine cyanobacteria, biodiversity, ecology, genetics, evolution

Acknowledgments: We would like to express our sincere gratitude to the Spanish Algae Bank and the University of Azores, which have been instrumental in this t of genetic, morphological, and ecological characterization of the biodiversity of cyanobacteria inhabiting the Canary Islands. We also appreciate the opportunity to contribute to the advancement of scientific and technological knowledge, and we hope that the results of this study will have a positive impact on various fields of biological biodiversity research and phycology taxonomy.

Finally, we extend our thanks to all those who will benefit from this work in the future, whether through practical applications in industry or through a deeper understanding of biological diversity. We believe that this project is only the beginning of a continuous journey towards discovery and innovation in the captivating realms of bioinformatics and molecular tools.
Thank you all for your support, dedication, and passion for science and exploration!

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UPWELLING DRIVES BENTHIC SPECIES TROPHODYNAMICS MORE THAN MARINE PROTECTED AREAS

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Abstract: Species trophodynamics can account for differences in marine species dynamics that result from human stressors, environmental gradients, and management actions such

as marine protected areas (MPAs). Within well-implemented MPAs, the reduction of human-derived impacts on benthic communities is expected to shift feeding resources and, therefore, increase the complexity of food web (Albouy et al. 2019; Micheli et al., 2004). However, earlier findings suggest larger influence of local environmental conditions on species trophodynamics rather than the MPA effect (Blanco et al. 2021). These findings were argued to be due to poor MPA implementation. However, the relative effect of environmental factors and management on trophodynamics is unknown. Here, we addressed the effects of upwelling on benthic species trophodynamics over six MPAs along the western Iberian Peninsula coasts. Using stable isotope analysis of C and N (δ13C and δ15N) for 17 species on 16 locations along ~550 km of coast, we compared the relative impact of local environmental processes and protection level on isotope signatures. Our results confirm that MPA effects on species trophodynamics and, by extension, food webs, may be blurred by higher nutrient availability in upwelling regions,. Yet, we discuss how MPA implementation may also represent a caveat in species trophodynamics and marine conservation outcomes. Further efforts should be directed towards improving management actions in MPAs to strengthen ecosystem functioning connectivity processes within this regional MPA network, particularly accounting for potential synergies between upwelled nutrients and MPA effect.

Key words: trophic interactions, stable isotopes, Illas Atlánticas Marine-Terrestrial National Park, ecosystem functioning, conservation

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THE BENIDORM CANYON: CRADLE OF BOTH FOSSIL AND RECENT COLD-WATER CORAL REEFS IN THE WESTERN MEDITERRANEAN.

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Abstract: Cold-water coral reefs that develop in deep-sea environments are considered as natural hotspots of biodiversity because they usually sustain a wide variety of vulnerable species and well structured benthic communities. In many cases, these are considered by the scientific community as important habitat holders that must be protected. Such is the case of the fossil cold-water coral (CWC) reef that has been documented in the Benidorm Canyon (Western Mediterranean) in March 2024. This Canyon was intensively surveyed during the oceanographic cruise CALYPSUS_0324, as a part of the investigations scheduled in the framework of the BIODIV project. To understand the link between the benthic communities and the associated substrate, the seafloor of both the southern and northern flanks of the Benidorm Canyon were sampled using Shipek, Rock dredge and Beam Trawl, enabling the recovery of surface sediment and rock samples. Preliminary results seem to indicate that both flanks are sedimentologically different. The southern flank reports higher sediment content, mostly consisting of clayed-mud rich in foraminifera and occasionally containing bioclasts, although there is presence of fossil and recent coral rubble as well. On the other hand, the northern flank reports much less sediment content, being mainly composed of rock outcrops made up by fossil and recent CWCs. Further analyses will be focused on discerning the inorganic geochemical

composition of these sediments and rocks, while studies of thin sections of rock samples will allow us to determine the facies of the two reefs. Finally, data of stable isotope geochemistry (^{14}C) of sediments and radiogenic isotope geochemistry (U/Th) of corals will be key in providing information about the timing of the CWC reef construction. All these data will contribute to understanding when and how the substrate that sustains these habitats developed, as well as how the recent environmental conditions may affect their preservation.

Key words: old-water corals, Benidorm Canyon, Western Mediterranean, Sedimentology, Geochemistry

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SATELLITE-REVEALED CHLOROPHYLL BLOOMS IN THE OLIGOTROPHIC GULF OF CHIRIQUI, PANAMA

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Abstract: Nutrient subsidies may influence all dimensions of food-web dynamics: primary producers across ecosystems often face nutrient limitations (Takahashi et al., 1973; Caraco et al., 1987; Hecky and Kilham, 1988; Petersen et al., 1997; Valiela, 1995; Allan et al., 2021), and increases in resource supply, generated by nutrient subsidies, enhance producer growth and abundance (DeAngelis et al., 1989; Elser et al., 1996). The energy produced by primary producers is then propagated through trophic linkages (Lindeman, 1942; Slobodkin and Slack, 1999), generating positive bottom-up effects on consumer populations (Iverson, 1990; Ware and Thomson, 2005; Richardson and Schoeman, 2004). The Gulf of Chiriqui (GC) in Panama, known for its warm oligotrophic waters (Kwiecinski and Chial, 1983; D'Croz and O'Dea, 2007), paradoxically supports large migratory species in the Tropical Eastern Pacific (Guzman et al., 2018; López-Angarita et al., 2021). In this study, we analyze 8-day data of satellite remote sensing, including chlorophyll α (Chl-a), sea surface temperature, wind stress, precipitation, and radiation, spanning from 2003 to 2022. We examine the variability and relationships within this data set and its correlations with El Niño Southern Oscillation (ENSO) events. Our results reveal anual blooms in Chl-a during April to June, which appear to be influenced by ENSO events. These productivity peaks occur in the area surrounding the Hannibal Bank seamount in GC. The unique morphology of this guyot, characterized by its steep sides and rugged peaks, may disrupt ocean currents, facilitating the upwelling of nutrient-rich waters (Cunningham et al., 2013). This increase in primary productivity, as revealed by satellite data, coincides with peak dolphinfish capture dates (Guzman et al., 2015). The findings of this study may not only contribute to improved fisheries management but also help to begin understanding the processes that support the biodiversity and the migration of large pelagic species in this understudied region.

Key words: Clorophyll blooms, satellite data, bottom-up, Panama, migrations.

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A MODEL TO JUSTIFY COUNTERINTUITIVE MEASURES TO RECOVER FISHERIES STOCKS: SUBSIDIES, MARINE PROTECTED AREAS, SIZE SELECTIVITY AND FISHING EFFORT

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Abstract:
The persistent issues of fishery subsidies, contributing an annual USD 35.4 billion to the industry, the lack of a consistent net of no-take marine protected areas (MPA), the fishing effort and the size overexploitation continues to fuel the depletion of fish stocks despite longstanding international and national policy debates. This study introduces a theoretical dynamicmodel which analyses a monospecific fishery, with seven distinct life stages of a model fish (*Sparus aurata*), and examines the effects of different subsidy levels (10%, 20%, and 30% of costs). The model further explores the potential of reallocating these subsidies to support fish stocks recovery measures such as no-take marine reserves and effort reduction. The results indicate that current subsidy structures, by lowering operational costs, not only inflate profits unsustainably but also postpone the onset of unprofitability, thereby undermining the efficacy of fishing at maximum sustainable yields and the implementation delay of measures to recover stocks. This misalignment exacerbates stock biomass reduction, diminishes cumulative profits for fishers, and hampers the effectiveness of measures designed to curtail fishing efforts or establish MPA. The analysis suggests that a strategic shift in subsidy allocation can transition fisheries towards biological and economical sustainability, enhancing long-term profits and supporting environmental conservation through the protection of around 30% of the area to maximise captures. The study underscores the critical need for reforming fishery subsidies, advocating for a strategic realignment towards practices that foster ecological sustainability and economic viability in the fishing industry. The findings are aligned with

the World Trade Organisation protocol on Fisheries Subsidies adopted last 17 June 2022 (https://www.wto.org/english/tratop_e/rulesneg_e/fish_e/fish_e.htm) already ratified by more than 60 countries, including the EU, China, US or Rusia.

Key words: Fisheries, Modelling, Sustainability, MPA's, Subsidies

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THE EFFECT OF MARINE PROTECTION AND HABITAT SUITABILITY ON FISH ASSEMBLAGES IN CABO DE SAN ANTONIO MARINE RESERVE

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Abstract: Visual fish censuses were carried out in 2023 at the marine protected area (MPA) of Cabo de San Antonio, SE Spain. The objective was to estimate fish populations, comparing them to the nearby Site of Community Importance (SCI) Marina Alta (Control), where sport-fishing is allowed. Habitat heterogeneity was explored as a major factor affecting fish assemblages. A total of 64 visual censuses of 50 x 5 m were carried out at 8 different sites, 4 within the MPA and 4 at the Control. For each transect, fish species, abundance, and size were noted, as well as type of bottom, number and size of boulders and depth. Biomass of fish was calculated, and univariant and multivariant analysis were performed to test the effect of protection and habitat suitability on fish assemblages. 52 species were identified, 41 at the MPA and 42 at the Control. On average, Control sites had higher abundance and biomass compared to the MPA, but without statistical significance. Aside from gregarious species such as *Chromis chromis*, *Boops boops*, or *Sarpa salpa*, the most abundant species for both areas were *Diplodus vulgaris* and *D. sargus*. In terms of biomass (excluding *S. salpa*), *Sciaena umbra* and *Epinephelus marginatus* had the highest biomass within the MPA, while *Diplodus sargus* and *Chelon labrosus* within the Control area. Only two species, *Diplodus puntazzo* and *Sciena umbra*, showed significantly higher biomass within the MPA, but other commercial species, like *Dentex dentex*, were more prominent inside the reserve. Principal Components Analysis showed that both areas had similar seabed heterogeneity, with predominantly rocky bottoms and some *Posidonia oceanica* meadows. Meanwhile, Redundancy Analysis indicated that seabed composition accounts for 83,8% of the species variance, explaining why biodiversity and abundance were so similar between areas despite protection. This showcases how the biomass of target species increases with protection, but habitat suitability is essential for fish assemblages and should be accounted during the denomination of new areas.

Key words: fish census, marine protected are, habitat suitability, fish assemblages.

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NEW STONE SPONGE FIELDS IN THE SPANISH MEDITERRANEAN

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Abstract:

Two *Leiodermatium pfeifferae* fields were found during the recent CALYPSUS Project survey, aimed to find VMEs in the Alicante and Benidorm submarine canyons and nearby seamounts. Most transects used the ROTV TASIFE with occasional use of rock dredge and beam trawl. Sampling locations were selected based on high resolution bathymetry maps obtained during the survey.

Formentera Hill is an elongated seamount SW of the Balearic Islands. Depth ranges between 600 and 1000 m, with gentler slopes in the northern side and rather more abrupt inclines on the southern side. On the top there are numerous ridges and large extensions of fossil coral framework partially covered with mud on which the stone sponges and other vulnerable species grow. Average sponge density was 155±131 individuals/Ha. They were often found closely aggregated, distanced about 2 m.

Leiodermatium pfeifferae were most abundant on a ridge in the northern side of Benidorm Canyon, also growing on dead coral framework partially covered by sediment. Their

average density was 604± 820 individuals/Ha.

A preliminary length distribution was estimated using the ROTV laser and frame width as reference. Only specimens that could be clearly seen were measured. In both locations size rangedfrom <25 cm to >100 cm along the longest axis, prevailing sponges in the range 25-50 cm.

So far 44 accompanying taxons have been identified, with clear dominance of *Podospongia lovenii*, *Muriceides* spp., *Bebryce mollis* and *Leptometra phalangium.* Their density varies greatly among transects and locations.

The full extension of these sponge gardens could not be estimated due to weather and technical limitations but they seemed to expand further than the area seen in the transects. Stone sponge records in the Spanish Mediterranean are limited to only another seamount (Maldonado et al., 2015). The relevance and good state of these new fields require protection and further exploration.

Key words: *Leiodermatium pfeifferae*, stone sponges, lithistid demosponges, Western Mediterranean.

Acknowledgments: CALYPSUS (BIODIV_A1L1, MTC2303005) is financed by UE-NextGenerationEU within the frame of the Recovery, Transformation and Resilience Plan (PRTR). The authors thank the crew of Spanish research vessel *Ramón Margalef,* who made possible to achieve our goals despite the suboptimal conditions, and Alfonso Ramos (University of Alicante) for taking part in the survey.

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ANTHROPOGENIC IMPACTS ON MEDITERRANEAN MARINE ECOSYSTEMS: INSIGHTS FROM STABLE ISOTOPE ANALYSIS OF ARCHAEOLOGICAL AND MODERN FISH BONES

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Abstract: Human activities have significantly impacted Earth's ecosystems, leading to habitat changes and species extinctions. Historically crucial for human civilization and evolution through the provision of resources, biomolecules, and transportation, the ocean is now dramatically altered by overfishing, pollution, and other stressors. The Mediterranean, home to over 7% of global marine biodiversity (Claudet & Fraschetti, 2010), has faced overexploitation for over 2,000 years (Roberts, 2007) and increasing population density. Human-induced changes to marine ecosystems extend to the essence of ecological communities, reshaping species interactions within marine food webs and significantly altering their structure, function, productivity, and resilience (Diaz Pauli & Sih, 2017).

Stable isotopes provide crucial insights into trophic pathways and feeding interactions within aquatic ecosystems. Carbon (δ13C) and nitrogen (δ15N) isotopic signatures in tissues help estimate organisms' positions within the food web and provide information on their environmental conditions. This study aimed to assess anthropogenic impact on commonly fished species over time through stable isotope analysis of archaeological and modern fish bones. Mandibular and premaxillary bones from *Sparus aurata*, *Pagrus pagrus*, *Pagellus erythrinus*, *Pagellus* sp., *Labrus* sp., and *Diplodus* sp. were collected from the Roman port city of Pollentia (archaeological samples) and the Bays of Palma and Alcúdia (modern samples). An adapted collagen extraction protocol (Craig and von Tersch, 2018) and δ13C and δ15N analysis were performed on all samples (N = 74 archaeological, 26 modern). Morphological and size-related measurements were also included in the analysis.

Despite the C:N ratio indicating substandard collagen quality, all archaeological samples

were enriched in both δ13C and δ15N compared to modern samples. Additionally, archaeological samples exhibited a greater isotopic niche and were considerably larger than modern ones. Improved conservation and sustainable management practices are urgently needed to prevent ecosystem structural and functional collapse, particularly since smaller individuals produce fewer offspring, impacting future generations.

Key words: archaeological fish, functional ecology, Mediterranean Sea, collagen stable isotopes

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VULNERABLE MARINE ECOSYSTEMS IN MOROCCAN WATERS

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Abstract: Currently, one of the most serious problems facing the conservation of biodiversity and marine ecosystems is that in many regions, basic scientific knowledge of the faunistic components and their geographical distribution is almost non-existent. This gap makes it impossible to develop strategic plans for protecting coastal and marine areas, as required by the United Nations Convention on Biological Diversity, the Aichi Targets and the latest post-2020 strategy (CBD, 2011, 2022).

For the first time, bottom-trawling surveys conducted by the Spanish Oceanographic Institute (IEO) and the University of Vigo on the Moroccan continental margin have detected the presence of important communities of sessile suspension feeders, such as cnidarians and sponges, particularly within the deep waters along the continental slope (Ramos et al., 2015).

During seven demersal surveys carried out on board the R/V *Vizconde de Eza* and *Dr Fridtjof Nansen* between 2004 and 2022, a large amount of faunistic material, and quantitative and environmental data were collected at 1100 trawl stations between 20 – 2000 m depth.

The collections of gorgonians, antipatharians, scleractinians, pennatulids, hydrozoans and sponges are currently being identified in the framework of the EcoAfrik project at the University of Vigo, as part of the PhD thesis of the first author.

The main objective of this study is to integrate taxonomic findings with geomorphological, sedimentological and water column data to characterize composition, structure, and delineate areas hosting Vulnerable Marine Ecosystems (VMEs). This will form the groundwork for preparing the first scientific proposal for areas to be protected under the figure of Marine Protected Areas (MPAs). Consequently, it will contribute to sustainable fishery management and the conservation of marine biodiversity and ecosystems, aligning with global biodiversity goals for 2030 (CBD, 2022).

Key words: Cnidaria, Porifera, Marine Protected Areas, Northwest Africa, East Atlantic

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GENETIC REFERENCE POINTS FOR FISHERIES STOCK ASSESSMENT

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Abstract: Biological metrics are central for an adequate fish stock assessment assuring its sustainability. Genetic Reference Points (GRPs) are guiding tools to evaluate the genetic status of fisheries despite they are still absent from assessment protocols. Present GRPs rely on the systematic score of the spatio-temporal genetic diversity of fisheries using classic genetic metrics, such as the effective population genetic size *Ne* or the genetic to census size ratio *Ne/Nc*. We report here the definition and significance of several GRPs such as the Basal Genetic Stock Background (BGSB), the Target Genetic Reference Point (TGRP), the Limit Genetic Reference Point (LGRP), the Trigger Genetic Reference Point (tGRP), and the Genetic Structural Reference Point (GSRP). These genetic referents can be of significant help for evaluating both, the spatial maintenance of metapopulation structures as well as the temporary stability of the fisheries genetic background under harvesting. An interdisciplinary effort is ongoing to incorporate GRPs into catch-at-age models to make them more predictive, integrative, and biologically realistic. The enforcement of robust GRPs at any historical time-point would allow the subsequent human generations to work with well-stablished management criteria to identify genetic overharvest and to invoke rebuilding plans.

Key words: Demographic metrics, Genetic diversity, Genetic metrics, Genetic Reference Points (GRP), Population effective size

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GROWTH RATE IN EARLY STAGES OF EPHYRAE OF THE BARREL JELLYFISH *RHIZOSTOMA PULMO* (MACRI, 1778)

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Abstract: The barrel jellyfish, *Rhizostoma pulmo*, inhabits in the Mediterranean and Black Seas, where their blooms have become increasingly frequent and intense over the past decade. However, the growth rate of newly released ephyrae remains unknown due to the challenges in locating polyps and ephyrae in early stages in the wild. In this study, we document the growth rate of *R. pulmo* ephyrae during their first month of life under controlled laboratory conditions. We measured the morphometric parameters including total body length, central disc diameter, and the length and width of marginal lappets. Our findings indicate that total body length is the most reliable metric for explaining the growth of *R. pulmo* ephyrae (3.89 ± 0.56 mm per month). These results provide valuable insights for future research on this jellyfish species and for management strategies aimed at understanding the population dynamics of *R. pulmo*.

Key words: mediterranean jellyfish, culture, captivity, scyphozoan.

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Infauna evolution of the invertebrate community after a severe eutrophic crisis in the coastal lagoon of the Mar Menor (W Mediterranean)

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Abstract

The Mar Menor coastal lagoon (SE Spain), has undergone a critical transformation due to eutrophication crisis as a direct consequence mainly of the super-intensive agriculture of the adjacent coast. This has compromised the ecosystem's balance, resulting in irreversible impacts such as macro and microalgae proliferation, decreased biodiversity, and the formation of dead zones. The signs of a certain resilience has been tested in the lagoon infauna, with evidence of a serious environmental degradation marked in a shift of ecological state dated at a tipping point during 2016. The analysis of the lagoon sedimentary infauna after the eutrophication crisis, revealed a total biodiversity loss below three meters depth; a crucial threshold in this eutrophication context. Two years later, a rapid recolonization of the macrophyte *Caulerpa prolifera* began on the devastated sediments. It was also detected a notable growth of invasive suspension-feeding serpulid polychaetes, in response to abundant suspended organic particles and available CO_2 dissolved for calcium carbonate fixation. In this recolonization process in the first years after the tipping point, the present study confirms the rapid recolonization of the infaunal community. Over two-year study period (2017-2018), 25 taxa belonging to 5 phyla were identified, with the phylum Annelida (class Polychaeta) being the most represented, followed by the phylum Mollusca. The benthic fauna, initially dominated by hypoxia-tolerant species, saw the emergence of more resilient species in response to eutrophication progression, including polychaetes,

indicating a complex dynamic in response to environmental changes.

The most represented families belonging to Polychaeta class (Phylum Annelida) were Spionidae, Capitellidae, Ophelidae, and Serpulidae. The most represented family, Serpulidae, which had a very high density in the 2018 samples, consists of two species: the genus Hydroides with the species *H. elegans*, Haswell, 1883, and *H. dianthus*, Verrill, 1873. These results indicate a recovery of the infauna in the Mar Menor after the massive eutrophication event of 2016.

Keywords: infauna, resilience, eutrophication, bioindicators, Mar Menor lagoon, ecological succession

Acknowledgments: University of Alicante, Marine Science department. Eleuterio Abellán Gallardo

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LINKING SPACE USE AND ENVIRONMENT IN A WILD FISH POPULATION USING HIGH-RESOLUTION ACOUSTIC TELEMETRY

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Abstract:

Behavioural variability is an intrinsic characteristic of natural populations and is key to understanding the interactions between individuals and their environment. Measuring this heterogeneity is a great challenge, especially in marine environments, because it implies the continuous observation of large numbers of free-ranging individuals. In the last few years, technological advances in acoustic telemetry have revolutionized our ability to monitor individual behaviour in the wild, making it possible to simultaneously obtain high-resolution movement data of hundreds of individuals. This work aims to study the effects of environmental conditions on the space use and the behavioural variability of fish in their natural environment. High-resolution acoustic telemetry was employed to characterize the behavior of a pearly razorfish (*Xyrichtys novacula*) population in the Bay of Palma (Mallorca, Western Mediterranean Sea). A total of 11,791 daily territory size observations from 286 individuals, along with measurements of 5 environmental variables (temperature, light, turbidity, current and wave height), were analyzed from April to October 2019. Through a mixed linear model, we obtained results relevant to the effects of environmental variables on the sampled population and at the individual level. We found clear differences between the home range sizes of different individuals, mainly driven by fish length and sex. At the individual level, the pearly razorfish expanded its territory with increasing temperature, luminosity and current intensity while displaying the opposite effect with increasing turbidity and wave height. However, we found a considerable individual responsiveness to each environmental variable. Thus, by applying high-resolution acoustic telemetry techniques, we have been able, for the first time for a marine species, to perform a population-level characterization of the space use behavior and its environmental drivers. These results improve our knowledge on the ecology of the species and hold particular applicability to improve the management of marine ecosystems.

Key words: high-resolution tracking, movement ecology, acoustic telemetry, behavioural variability, environmental drivers

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PHOTO-IDENTIFICATION OF BREEDING AGGREGATION OF THE COMMON EAGLE RAY, *Myliobatis aquila* (LINNAEUS, 1758), IN THE SOUTHWESTERN MEDITERRANEAN

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Abstract:

The decline of sharks and rays due to overfishing has drawn attention to the importance of studying their behavior and habitat utilization, particularly in areas of aggregation crucial for the survival of endangered species. Among these species, the eagle ray *Myliobatis aquila* (Linnaeus, 1758) stands out as a subject of interest. With populations facing increasing pressure from overexploitation and habitat degradation, *M. aquila* is categorized as Near Threatened according to the International Union for Conservation of Nature (IUCN) Red List. Despite being relatively widespread, localized declines in population stocks have been documented, emphasizing the need for targeted conservation efforts and comprehensive understanding of their ecological requirements. A non-intrusive methodology with individuals observed in Levante coast of Almería, during a diving trip was established, consisting of observation and collection of ethological data, in addition to other parameters such as temperature, depth and

individual counts. The present study, this study aims to determine if these aggregations have a reproductive character, as well as to predict the possible presence of eagle rays related to physical or distributional parameters. The results of the statistical analyses show that temperature and depth are factors that influence the presence of eagles. The tendency of individuals to form groups in a particular area was observed. Different courtship behaviors were observed among individuals, with adult eagles of both sexes interacting.

Keywords:

Elasmobranch, Conservation, Habitat utilization

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EFFICACY OF THE LED-UV TREATMENT TO INACTIVATE PHYTOPLANKTON IN NATURAL SEAWATER

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Abstract: The irradiation with UV-C light is one of the most common technologies used in ballast water management for preventing the spread of exogenous marine organisms via ship transport. The traditional UV-C light source are the mercury vapor lamps; however, these lamps are expected to be replaced with recently developed LEDs with emission in the UV-C range. The objective in this study is to evaluate the inactivating effect by three UV-C sources (a traditional UV lamp with emission at 254 nm, and two LEDs with emission at 265 and 275 nm) on natural phytoplankton assemblages existing in the Algeciras Port (Spain), using different approaches: a) determination of the viable organisms reduction using the Most Probable Number (MPN) method, b) calculation of the growth inhibition and study of the re-growth after the treatment, and c) observation of the changes in the species composition due to the treatment using a FlowCAM. The MPN results showed inactivation levels greater than 3 log-reductions of the initial concentration, leading to values lower than 1 cell mL^{-1}. Despite these levels in inactivation, the growth curves indicated the phytoplankton regrowth in the treater organisms are exposed to favourable environmental conditions. The growth inhibition reached values between the 95.2% and the 96.8% with UV doses as of 100 mJ cm^{-2}; however, the re-growth was indeed inhibited by applying greater UV doses. The FlowCAM images indicated a reduction on the biodiversity of the UV treated samples, even leading to cases of monocultures of potentially harmful species such as *Heterosigma akashiwo*. In conclusion, the UV treatment involves aspects aside from the reduction of the viable organisms, such as the re-growth potential and the changes in the biodiversity, which must be taken into consideration for its application as a technology for preventing the spread the exogenous phytoplankton via ballast water.

Key words: ballast water treatment, ultraviolet inactivation, light emitting diodes, phytoplankton.

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TOXICITY OF ACIDIC WASHWATER FROM SCRUBBER SYSTEMS: STUDY ON SENSITIVITY OF MARINE MICROORGANISMS

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Abstract: Marine transportation emissions, particularly sulphur dioxides (SOx), pose risks to both ecosystems and human health. To mitigate this, the International Maritime Organization (IMO) mandates sulphur content limits in ship fuel. An alternative to costly low-sulphur fuel is the use of exhaust gas cleaning systems (EGCSs), or scrubbers (Sarbanha et al. 2023). These systems use seawater to absorb SOx from exhaust gas, resulting in washwater with a pH ≈ 3.8, which can potentially harm aquatic life upon discharge (Teuchies et al. 2020). This study examines the toxicity of acidic washwater on three key marine microorganisms: the bacteria *Vibrio alginolyticus*, the microalgae *Phaeodactylum tricornutum*, and nauplii of *Artemia franciscana*. Organisms were exposed to varying ratios of seawater mixed with simulated scrubber effluent to assess their responses, including lethality or growth inhibition. Results revealed varying sensitivities among marine organisms to low pH levels, with dilution level playing a crucial role in determining the washwater's toxic potential upon discharge. The toxic effects of discharged washwater on marine organisms highlight a significant challenge: while scrubbers effectively reduce atmospheric emissions by removing SO_X from exhaust gases, they may also pose risks to marine ecosystems.

Key words: Marine pollution, Maritime transport, Scrubber, Ecotoxicity, Acidification.

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SPATIAL AND TEMPORAL VARIABILITY OF THE TWO MAIN CATCHED SPECIES OF AN ARTISANAL TRAP FISHERY IN AN OCEANIC ISLAND

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Abstract:

In the Canary Archipelago (NE Atlantic Ocean), traps serve as the predominant fishing gear due to their efficacy and ease of use. Over various periods between October 2016 and September 2020, a total of 2,587 traps with a small mesh size (31.6 mm) and 141 traps with a large mesh size (50.8 mm) were analysed across shallow areas to depths of 130 m in five ports around the island of Gran Canaria. Two species, *Dentex gibbosus* and *Stephanolepis hispidus*, are the primary targets of this fishery. In the case of large mesh sizes, the average length of *D. gibbosus* across all studied localities exceeded the size at first maturity, mirroring the pattern observed for *S. hispidus* in small mesh size traps. Both species exhibit a clustering of specimens with larger sizes during reproductive periods. Notably, for *D. gibbosus*, large mesh sizes proved particularly effective in western areas of the island at depths exceeding 30 m. The highest fishing efficiency was achieved in Mogán, recording an average CPUE of 857.7 g $trap^{-1}$ day^{-1}, where capture depths were notably greater compared to other localities. Conversely, for *S. hispidus* below a depth of 30 m, small mesh sizes demonstrated the highest fishing efficiency in southern areas of the island, particularly in habitats characterised by sandy substrates with the presence of *Caulerpa spp*. In these areas, the average catch was 124.9 g $trap^{-1}$ day^{-1} in Castillo del Romeral and 102.9 g $trap^{-1}$ day^{-1} in Arguineguín. Peak catchability values for *D. gibbosus* were recorded in April, reaching a CPUE of 962.8 g $trap^{-1}$ day^{-1}. Conversely, the catch of *S. hispidus* peaked in June, with CPUEs of 165.9 g $trap^{-1}$ day^{-1}. Small mesh sizes exhibited great selectivity of sizes for *S. hispidus*; however, they resulted in high catch rates of immature specimens for *D. gibbosus*, posing a threat to the conservation of demersal species with similar characteristics. These findings suggest the need for new management measures aimed at conserving species targeted by the fishery, including a review of minimum catch sizes for both species and proposals for depth limitations concerning trap mesh sizes.

Key words: Commercial fish, *Dentex gibbosus, Stephanolepis hispidus,* artisanal fishery, Gran Canaria, NE Atlantic Ocean.

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BLACK CORALS IN THE CANARY ISLANDS: ZONATION AND DISTRIBUTION OF ANTIPATHARIA SPECIES

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Abstract:

Within the framework of the EU Marine Strategy Framework Directive (MSFD), the Oceanographic Centre of the Canary Islands has coordinated, for the last 14 years, 13 scientific surveys around the archipelago to, amongst others, describe and monitor the existing mesophotic and deep-sea communities. The methodology followed during these surveys consisted on taking georeferenced videos and samples using two remote operated vehicles (i.e. a video camera towed from the vessel -TASIFE- and a semiautonomous video camera wired to the vessel -LIROPUS-), as well as direct sampling with rock dredge and beam trawl. Later, videos and samples were examined for taxonomic identification to the lowest possible level. Here we present the results regarding the zonation and distribution of Antipatharia species (black corals) in the archipelago. The bathymetric range of the studied species encompassed from 50 to 1500 m depth, with *Antipathella wollastoni* and *Bathypathes cf. patula* as the species appearing in the shallowest and deepest depths, respectively. Some species, such as *Stichopathes gracilis* and *Antipathes furcata* exhibited a broader spatial distribution, while other species were more spatially-restricted, like *Bathypathes cf. patula*, *Leiopathes glaberrima* or *Elatopathes abietina*. Further, this study constitutes the first validated record of *Elatopathes abietina* on Canarian bottoms.

Key words: Marine Strategy Framework Directive, black coral gardens, habitat forming species, vulnerable marine ecosystem, circalittoral, bathyal.

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RESPIRATION RATES AND ITS RELATIONSHIP WITH ETS ACTIVITY IN EUPHASIIDS: IMPLICATIONS FOR ACTIVE FLUX ESTIMATIONS

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Abstract: Euphausiids play a crucial role in the active carbon pump. These organisms contribute to the carbon export and sequestration through their diel vertical migration behavior, consuming organic matter in the epipelagic layer at nighttime and releasing inorganic carbon in the mesopelagic layer through respiration during the day. Measuring respiration in the mesopelagic layer is challenging due to the difficulties in obtaining direct measurements, as well as the lack of comprehensive data. The measurement of the electron transfer system (ETS) activity is used as a proxy to assess respiration in the mesopelagic layer. However, calibration of respiration rates and ETS activity is imperative through experimental measurements and empirical data. Here, we compared the respiration rates of different species of euphausiids captured at night in the epipelagic layer of the Atlantic Ocean from 29 to 42ºN with their respective ETS activities. We analyzed respiration rates with different environmental variables using a Generalized Additive Model, showing the influence of the oxygen concentration, chlorophyll *a*, and temperature on respiration rates. Finally, the R/ETS ratios obtained suggested that the commonly used ratio of 0.5 promotes quite conservative values of respiratory flux.

Key words: respiration rates, specific ETS activity, R/ETS ratio, mesopelagic carbon pump

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MENORCA CHANNEL HABITAT CHARACTERIZATION COMPARING PROTECTED AND TRAWLED AREAS

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Abstract: The continental shelf of the Menorca Channel, between 50 and 90 m depth, is heavily affected by strong north winds and marine currents. Located in the Balearic Islands (western Mediterranean), it presents a wide distribution of species and habitats of conservation interest, such as coralligenous platforms, rhodoliths beds, and biogenic detritic bottoms. Due to this, in 2014 it was declared Site of Community Importance (SCI) within the Natura 2000 network, covering an area of 3353 km^2 and, in 2016 two FPZ (Fishing Protection Zones) were also designated in the shallow shelf of the Menorca Channel, where trawling was banned in an area of 1959 km^2. The main objective of this study is to characterize the benthic communities of circalitoral sedimentary bottoms, in order to assess the effect of reducing and banning trawling on their benthic communities. To achieve this objective, we collected data with a beam trawl and a photogrammetric sledge to obtain samples of epi-benthic macro-flora and fauna and images of the seabed and its biota, respectively. The samples were obtained from three areas: FPZ, SCI and ADJ (an adjacent zone nearby Menorca Channel opened to bottom trawling). Six main types of habitats were identified. FPZ and SCI showed higher coverage of rhodoliths and other slow-growing species such as gorgonians (*Paramunicea* sp.) than the non-protected areas, with a higher density of small crustaceans and molluscs. Results evidence other differences between the trawled and non-trawled zones, with very low presence of the deep-water kelp *L. rodriguezii* in ADJ zone. It is important also to note that protected areas can beneficiate trawled areas located nearby and that a good scientific monitoring is necessary to better understand the recovery of these areas to implement an adaptive management. These results highlight the positive effects of protecting sensitive habitats when compared to unprotected areas.

Key words: Trawling, benthic habitats, rhodoliths, protection, Menorca Channel, Balearic Islands, western Mediterranean.

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EFECTOS DEL AUMENTO DE LA TEMPERATURA Y NUTRIENTES SOBRE EL CRECIMIENTO DE MACROALGAS EXÓTICAS

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Abstract: Las especies de macroalgas exóticas o alóctonas representan un fenómeno emergente en los ecosistemas acuáticos a nivel global. Estas especies pueden desplazar a las especies nativas, alterar los equilibrios ecológicos y afectar negativamente la salud de los ecosistemas marinos, llegando a presentar un comportamiento invasor, en algunos casos. El cambio climático combinado con la eutrofización, puede desempeñar un papel determinante para el éxito colonizador de estas especies exóticas, como, por ejemplo, el de *Rugulopteryx okamurae*, una macroalga asiática introducida en el Mediterráneo y encontrada recientemente en costas alicantinas (Terradas et al., 2023). El objetivo principal del presente estudio fue analizar si un aumento de la temperatura y/o de los nutrientes puede favorecer el crecimiento de especies alóctonas frente a las especies nativas de macroalgas. Para ello se realizaron tres experimentos en acuarios, de 15 días de duración, en los que se expusieron especies de algas exóticas frente a especies de taxones similares, pero consideradas como autóctonas, a distintos tratamientos de temperatura y/o concentración de nutrientes, evaluando los efectos de dichos tratamientos sobre el crecimiento de las especies. En el tratamiento control de todos los experimentos se observó un crecimiento positivo de las especies estudiadas, tanto de la macroalga exótica como de la autóctona, que presentaron un crecimiento similar ante el aumento de la temperatura (+ 5ºC). Sin embargo, las concentraciones elevadas de nutrientes (10 y 50 ppm de N total) provocaron una mayor mortalidad en la especie nativa, sin llegar a favorecer el crecimiento de la exótica. Según estos resultados, aunque no se pueda concluir que un aumento de temperatura y nutrientes favorezca el crecimiento de las especies invasoras estudiadas, si se observa que, en el caso de valores extremos, estos no afectan tanto su crecimiento como en el caso de las especies nativas.

Key words: Macroalgas exóticas, *Rugulopteryx okamurae*, Temperatura, Nutrientes

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BIOLOGICAL TRAITS AND DISTRIBUTION OF THE KNIFETOOTH DOGFISH *SCYMNODONS RINGENS* IN THE PORCUPINE BANK (NE ATLANTIC)

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Abstract: Elasmobranchs are particularly vulnerable to overfishing due to their slow growth, late maturity and low reproductive rates. Understanding their biology, distribution and behaviour is essential, but studying deep-sea species is challenging due to logistical, biological and taxonomic difficulties, as well as their rarity. Fishery assessment surveys provide valuable opportunities to study these species. Between 2019 and 2022, 464 specimens (210 males and 252 females) of knifetooth dogfish *Scymnodon ringens* were caught and analysed in the Spanish bottom trawl survey on Porcupine Bank. The majority were juveniles (72%), but a significant sexual dimorphism in size was found: females ranged from 25 to 134 cm and males from 29 to 91 cm in total length. The estimated size at sexual maturity (L50) was 99.87 cm for females and 62.45 cm for males. *S. ringens* is found in the southern Porcupine Bank below 500 meters depth. The study found significant differences in the distribution of individuals based on sex and maturity. Juveniles were evenly distributed between 500-800 meters regardless of sex, while adults were segregated by sex, with females predominantly at 600-700 meters and males at 700-800 meters. This study provides insight into the biology and bathymetric sex segregation of this poorly documented species.

Key words: deep-sea sharks, biological traits, sexual dimorphism, sexual segregation

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BY-CATCH MITIGATION MEASURES FOR MARINE VERTEBRATES

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Abstract: In the oceans that cover our planet, fishermen use different fishing gears that not only capture target species, but also others that are caught unintentionally, a phenomenon known as 'by-catch' [1]. This situation poses significant challenges for the fishing industry, as it has adverse effects both on the environment and on various species, such as sea turtles, marine mammals, seabirds and elasmobranchs, which can be injured or even killed [2]. To address this problem, the fishing industry has implemented regulations and mitigation measures. In this literature review, 389 articles published between 2010 and 2023 were analysed, assessing the effectiveness of these mitigation measures. The results highlight that for the protection of marine mammals, 'pingers' are highly effective, while for sea turtles it is 'Turtle Exclusion Devices' (TEDs) and ' Bird Scaring Lines' (BSLs), more commonly known as 'tori lines', for seabirds [3]. However, for elasmobranchs, the situation is more complex and the most effective measure has not yet been determined. This complexity is attributed to the targeted fishing of these species, which results in less monitoring and surveying of their catches.
In conclusion, the widespread adoption of these mitigation measures by the fishing industry globally is recommended. This will significantly contribute to reducing by-catch and preserving the future of numerous threatened species, ensuring a sustainable balance in our oceans.

Key words: Incidental fishing, cetaceans, LEDs, sea turtles, sharks

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EUKARYOTS AND PROKARYOTS PRESENT IN MUSSELS, CLAMS AND COCKLES FROM A BIVALVE PRODUCTION AREA: A COMPREHENSIVE ECOSYSTEM PERSPECTIVE

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Abstract: Microbiota alterations could affect the health status of bivalves increasing the susceptibility to certain diseases, caused by opportunistic pathogens and the transient community. Bivalves are filter feeding animals in contact with free-living microorganisms present in water column and sediment. The aim of this study was the identification of eukaryotes and prokaryotes present in mussels, clams and cockles in a three-year study in the Ria de Vigo (Spain). Amplicon sequencing of the V9 region of the 18S rRNA gene and the V4 region of the 16S rRNA gene was performed. Eukaryotic and prokaryotic community composition was significantly different among the three bivalves. In both cases, the diversity was species-specific, and the temporal and seasonal effect was almost negligible. The most abundant eukaryotic phyla in mussels and cockles were *Arthropoda* and *Platyhelminthes,* respectively. More specifically the parasitic copepod *Mytilicola intestinalis* in mussels and the parasitic trematode *Bucephalus minimus* in cockles. Regarding bacterial profile, cockles and mussels were quite similar. The most abundant prokaryote class in mussel and cockle was *Gammaproteobacteria,* in contrast, the *Mollicutes* class was the predominant in clams. Other classes as *Bacteroidia* and *Alphaproteobacteria* were also abundant in mussels. At the genus taxonomical level, *Endozoicomonas* was found to be widely distributed in the 3 bivalve species. In contrast, *Vibrio* prevailed in cockles, *Mycoplasma* in clams and *Marinifilum* was abundant in mussels. Moreover, significant differences in prokaryotic composition among bivalves, water column and sediment were observed. The diversity identified in the three bivalves was low compared to the bacterial diversity detected in the sediment and water column previously reported of the same geographical area. The results obtained allowed to understand the resident and transient microbial community in bivalves with commercial interest and verify that microorganisms found in the water column are not necessarily identical to bivalve microbiome.

Key words: amplicon sequencing, bivalves, diversity, prokaryote, eukaryote.

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THE SYSTEMATIC OF THE DEEP-SEA OCTOPUSES OF THE NORTH-WESTERN AFRICAN SEA

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Abstract: In this study, several species of the controversial of deep-sea octopuses genus *Bathypolypus* Grimpe,1921 were described in detail and their main external and internal morphological characters were studied. The specimens studied, belonging to the coasts of Mauritania, were collected by trawl nets during the IEO and IMR Maurit campaigns, carried out within the framework of the EcoAfrik project between 2007 and 2010. The specimens are currently stored in the BioCephaLab laboratory (University of Vigo). Of the 66 specimens analysed, 24 belong to the species *Bathypolypus ergasticus* (Fischer and Fischer, 1892), 30 to *B. sponsalis* (Fischer and Fischer, 1892), seven to *B. bairdii* (Verrill, 1873), and five to *B. arcticus* (Prosch, 1849). The main distinguishing characteres separating the species were: the number of suckers on the hectocotylus, the shape of the funnel organ, the presence/absence of cirri, warts and/or supraocular papillae and the number of copulatory lamellae (in mature specimens), and several morphometric indices.

Key words: Cephalopods, taxonomy, hectocotylus, funnel organ.

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VERTICAL COMPOSITION, DISTRIBUTION, ACTIVE FLUX AND CARBON REMINERALIZATION BY GELATINOUS ZOOPLANKTON IN THE NORTH ATLANTIC OCEAN

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Abstract

Gelatinous zooplankton play a crucial role in global marine ecosystems and contribute to the biological carbon pump. They are mainly represented by cnidarians, tunicates, and heteropods. These organisms are of importance as they perform a scarcely known flux of carbon in the open ocean, including vertical migration and carbon downward transport. Despite their ecological importance, limited information is available on the biomass and carbon flux of gelatinous zooplankton in the meso- and bathypelagic zones. Here, we studied the vertical distribution, composition, carbon remineralization, and active flux by gelatinous zooplankton in the North Atlantic Ocean, from the surface to 1800 m depth, using a Mesopelagos trawl during day- and nighttime. Samples were collected in an oceanographic transect at 29ºN, from the west of the Canary Islands (25ºW) to the African coast (13ºW). We found a total of 8 orders and 31 species, with 15 species being non-migratory and 16 exhibiting migratory behaviour. The order Siphonophorae accounted for 91% of the total abundance and contributed 56% of the overall biomass. The order Littorinimorpha, which includes heteropods, accounted for 21% of the overall biomass yet only 1% of the abundance, whereas ctenophores exhibited the lowest abundance, accounting for only 0.5% of the biomass. Average migrant biomass estimated in the upper 200 m depth was 0.18±0.07mgC·m^{-2}, and the average specific respiration of migrant gelatinous was 0.02±0.03 d^{-1}. The active flux by migrant gelatinous zooplankton examined was 0.005±0.0008mgC·m^{-2}·12h^{-1}, where a substantial amount of organic carbon was transported to depth via gut flux (0.002±0.0003mgC·m^{-2}·12h^{-1}), and respiratory flux (0.001±0.0002mgC·m^{-2}·12h^{-1}). The carbon remineralized by non-migrant gelatinous zooplankton was 0.24±0.3 and 0.00003mgC·m^{-2}·d^{-1} in the meso- and bathypelagic layer, respectively. This provides a first account about the role of gelatinous zooplankton in carbon cycling and highlight the importance of further research to better understand their role in the deep ecosystem.

Key words: Ecology, Electron transfer system, Migrant biomass, Biological Carbon Pump.

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TRADITIONAL EUROPEAN FISHING TECNIQUES FACE DIFFERENT CLIMATE RISK LEVELS: GALICIAN CASE

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Abstract:

Climate change poses a significant threat to the socio-ecological systems that support small-scale fisheries (SSFs) worldwide. This study conducts a climate risk assessment of the traditional fishing techniques employed in the SSFs of Galicia, Northwest Spain, through surveys carried out in the fishing sector. Galician SSFs make a substantial contribution to livelihoods and employment, with landings accounting for over 40% of the Spanish commercial fleet. However, this sector faces increasing climate risks that must be evaluated and mitigated.

The analysis follows the Intergovernmental Panel on Climate Change (IPCC) risk assessment framework to evaluate the climate risk levels across the diverse *métiers* used in Galician SSFs. Risk is assessed as a function of three dimensions: hazard, exposure, and vulnerability. Hazard scores were calculated for target species based on their biological traits, habitat specificity, and thermal safety margins. Exposure was estimated from the diversity of the catch portfolios of the *métiers*. Vulnerability integrated socioeconomic sensitivity based on fisher incomes, and adaptive capacity derived from survey responses on issues like social organization, flexibility, assets, and risk perceptions.

The results reveal hazard levels from low to high across species, resulting into varying hazard scores for the different *métiers* based on their catch compositions. Exposure tended to be low due to diversified catches, except for highly specialized *métiers*. Vulnerability was highest for *métiers* like on-foot shell fishing due to low incomes and limited adaptive capacities. The overall climate risk spanned low to high levels, being most critical for *métiers* targeting few species like on-foot shell fishing and on-boat specific resources.

These findings highlight the urgent need to implement adaptation measures tailored to the diverse realities across Galician SSF *métiers*. Priority actions include enhancing socioeconomic resilience by promoting communication and learning among other characteristics, empowering marginalized social groups, and diversifying resources by the identification of opportunities.

Key words: Climate risk, marine resources, small-scale fisheries, adaptation, social-ecological systems.

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NEW EXTENSE Isidella elongata (Esper, 1788) FIELDS FOUND IN WESTERN MEDITERRANEAN SEA: EVALUATION BASED ON VISUAL SURVEYS AND VMS DATA

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Abstract:

Extense *Isidella elongata* (Esper, 1788) fields were recently discovered during the CALYPSUS research survey, which aimed to detect vulnerable marine ecosystems in the Alicante and Benidorm canyons and nearby seamounts. The remote operated towed vehicle TASIFE was the preferred sampling equipment, but rock dredge and beam trawl were also used. Sampling localities were selected based on high resolution bathymetric maps obtained from multibeam echosounder data acquired during the survey.

Preliminary analysis of the video-transects on La Muntanyeta rocky outcrop (360 – 550 m depth) and on top of Don Juan seamount (590 – 800 m) revealed very high *I. elongata* densities, up to 5000 colonies/ha. Size range was wide, with colonies up to 30 cm width x 40 cm height, although deep water demersal fisheries have taken place for decades down to 1000 m depth on the surrounding sedimentary bottoms. In fact, spatial analysis of vessel monitoring system (VMS) data from the bottom otter trawl fleet revealed that the *I. elongata* fields found on La Muntanyeta are located within a spatial cell with moderate fishing effort (71 trawling pings/km²).

Overlap of fishing grounds and *I. elongata* fields is to be expected since this bamboo coral

prefers soft bottoms favourable to demersal fisheries and it is a key habitat forming specie, offering refuge, substrate and feeding opportunities to diverse species, including fish, elasmobranchs and crustaceans of commercial interest (e.g. *Galeus melastomus* and *Aristeus antennatus*). However, *I. elongata* is fragile and slow-growing, therefore very vulnerable. It is currently included in the List of endangered or threatened species of the SPA/BD Protocol and it is classified as Critically Endangered in the IUCN Red List of anthozoans in the Mediterranean. This scenario highlights the importance of finding large patches of healthy *I. elongata* fields such as those described here, as well as the urgent need to protect them.

Key words: *Isidella elongata*, bamboo coral, deep sea habitats, western Mediterranean Sea

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IMPACT OF *Callinectes sapidus* EXPANSION AND EUTROPHIC EVENTS IN MAR MENOR SMALL-SCALE FISHERIES

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Abstract:

American blue crab *Callinectes sapidus* is a native species of the western Atlantic coast that has spread widely in the Mediterranean Sea in recent years. One of the affected sites in the western Mediterranean is the Mar Menor lagoon, where the landed catch of *C. sapidus* increased from a few individuals in 2016 to nearly 15 tonnes in 2021.

Small-scale fisheries in the lagoon has played an important role in the local heritage and economy since historical times. The sudden and rapid expansion of *C. sapidus* concerned fishermen, as they quickly noted that it preyed on key commercial species and caused severe damage to fishing gear. One of the earliest studies carried out confirmed that *Penaeus kerathurus* (caramote prawn) is one of the preferred blue crab preys. It is also a key commercial species valued up to 150€/kg and whose population has decreased in recent years.

General additive models (GAMs) were run on standardised sales data from the fish auction of San Pedro del Pinatar in the period 2015-2022 to investigate the relationship in terms of biomass per unit effort (BPUE) between *C. sapidus* and *P. kerathurus*. Moreover, environmental variables were included to take into account the effect of extreme eutrophic events that have taken place in the lagoon. These events were associated with species mortality.

The results prove that there is a negative relationship between the BPUE of *C. sapidus* and *P. kerathurus*, as well as influences of the extreme eutrophic event of 2019 on the recent population reduction of *P. kerathurus*. Therefore, this study suggests that the expansion of *C. sapidus*, as well as the extreme eutrophic events have negatively affected *P. kerathurus*. However, multiple factors are involved in Mar Menor population dynamics and more works about this case are needed.

Key words: *Callinectes sapidus, Penaeus kerathurus*, Mar Menor, small-scale fisheries, euxinic episodes

Acknowledgments: The authors thank the San Pedro del Pinatar Fisher`s Guild and Visitación López Abellán. This analysis has been carried out within the ECESIS project (PID2020-1184476RR-C22) but it has drawn from earlier work funded by the Spanish Oceanography Institute.

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EVALUATION OF THE PROTECTION EFFECT OF TWO MARINE RESERVES IN ALICANTE ON ECHINODERMS AND ICHTHYOFAUNA

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Abstract: Marine Protected Areas (MPAs) are essential tools for biodiversity conservation and the preservation of marine habitats. In Alicante, the Tabarca Marine Reserve of Fishing Interest (RMIP) was the first MPA created in Spain in 1986, and numerous studies have been conducted there demonstrating its effects on fish fauna (Forcada et al., 2008; Valle and Bayle-Sempere, 2009; among others). The RMIP of Cabo de San Antonio is more recent, established in 2015, and thus these studies are scarcer. In both cases, there is also less information on the reserve effect on echinoderm populations. Therefore, this study aims to provide more information and compare the effects of both MPAs on the fish fauna and echinoderms present in shallow areas.

To this end, non-destructive sampling was conducted by snorkeling in shallow areas of both reserves, as well as in similar control areas. The fish fauna was characterized through visual censuses, estimating the abundance and size of each observed species. The density of echinoderms was estimated using 1x1 m quadrats, counting the number of individuals per species and their maximum size. For data analysis, univariate and multivariate analyses were used to compare and jointly evaluate the protection effect of both RMIPs on the studied communities. According to the results obtained, the fish fauna showed differences linked to the protection effect of the marine reserves. However, this effect was not as evident in the study of echinoderm communities. These results are consistent with those observed in previous studies in the Tabarca RMIP and corroborate the importance of the protection effect on fish species, even in shallow areas.

Key words: Marine reserves, Tabarca, Cabo de San Antonio, Ichthyofauna, Echinoderms

Acknowledgments: The authors would like to thank all the individuals present during the sampling conducted in Tabarca, with special gratitude to Yago Casado Molinero for his collaboration in Cabo de San Antonio. They also extend their appreciation to the Department of Marine Sciences and Applied Biology for providing the necessary equipment to carry out this work.

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ANÁLISIS DEL ESTADO DE LAS PRADERAS DE POSIDONIA OCEANICA EN EL LITORAL DE LA COMUNIDAD VALENCIANA, SE ESPAÑA

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Abstract: La *Posidonia oceanica* es una angiosperma endémica del mar Mediterráneo donde crece formando extensas praderas. Esta especie y su hábitat están protegidos a nivel europeo por la gran biodiversidad de especies que. En la Comunidad Valenciana se han cartografiado 346,7 Km^2 de praderas, mayoritariamente en las provincias de Alicante y Castellón. Mediante la metodología de Romero (1985) y Sánchez Lizaso (1993) se han analizado los valores de densidad, cobertura y densidad global de 30 estaciones de seguimiento, con períodos de seguimiento entre 6 y 20 años y, al menos un muestreo realizado en los últimos tres años, ubicadas en las praderas de *P. oceanica* a lo largo de toda la Comunidad Valenciana. El 76,67% de las estaciones presentaron tendencias positivas respecto a la densidad, mejorando el resultado de hace una década (Guillén *et al*., 2013). Los valores de densidad potencial para cada profundidad se calcularon a partir de un conjunto de 580 valores obtenidos en 74 estaciones de la región, en un período de 20 años, obteniéndose una curva ajustada a la ecuación logarítmica (R^2 0,61): densidad = -231,3. Ln (profundidad en metros) + 919,95. Respecto al parámetro de cobertura de pradera de *P. oceanica*, la pendiente obtenida fue positiva o estacionaria en la mayoría de las estaciones, pero su significación estadística, tan sólo se alcanzó en el 23,34%, siendo en tales casos pendientes positivas o estacionarias. La densidad global muestra todas las estaciones con una pendiente positiva, pero con una significación estadística del 66,67%, intermedia en cuanto a la observada respecto a la densidad y a la cobertura. Las tendencias positivas se interpretan como patrones de recuperación de las praderas debido a la puesta en marcha de medidas de gestión; mientras que, en determinadas estaciones, con tendencias negativas, se aprecia la persistencia de impactos ambientales, tales como el fondeo de embarcaciones.

Key words: Posidonia oceanica, conservación, Comunidad Valenciana, España

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CURRENT STATUS AND EVOLUTION OF DENDROPOMA LEBECHE REEFS ON THE COASTS OF THE VALENCIAN COMMUNITY

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Abstract: The vermetid mollusc *Dendropoma lebeche* is endemic to the western basin of the Mediterranean Sea, found only on the coasts of Spain, Morocco, Tunisia and Algeria (Templado *et al.*, 2015). The bioconstructions it forms are of great environmental relevance due to the habitat it generates and in which numerous species of fauna and flora live. Moreover, they can be used as indicators of anthropogenic impacts or those derived from climate change (Calvo *et al.*, 1998; Antonioli *et al.*, 1999; Tzur & Safriel, 1978; Laborel & Laborel-Deguen, 1994; Silenzi *et al.*, 2004; Milazzo *et al.*, 2014). For all these reasons, *D. lebeche* is currently protected by several national and international conventions. This study deals with the distribution and temporal dynamics of the colonies located in the Valencian Community and their potential habitat, taking into account the main environmental conditions such as wave energy and temperature, among others. For this purpose, data were taken on the density of individuals in the period 2020 to 2023 and their trend was analysed. The results showed that four of the nine colonies studied showed no significant differences in terms of the density of vermetids. However, the remaining five showed a noticeable increase in density. According to the environmental variables analysed, we have generated a potential distribution model that allows the generation of a cartography of the ideal area for the development of this species. This mapping will allow for better management and the evaluation of possible suitable sectors for the restoration of this vulnerable habitat.

Key words: Dendropoma lebeche, Mediterranean sea, vermetid reef

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MARINE BENTHIC COMMUNITIES ASSOCIATED WITH MARINAS AND THEIR POTENTIAL TO HOST INVASIVE SPECIES.

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Abstract: In the marine environment, communities of sessile organisms are often different in natural and artificial rocky habitats. Within artificial habitats, marinas and recreational boats constitute one of the main vectors for the introduction, settlement, and spread of invasive alien species into natural habitats at local and sub-regional levels. Moreover, artificial structures associated with marinas, such as floating pontoons, facilitate the settlement of communities of fouling species. Early detection of alien species and monitoring of introduction hotspots in the marine environment are a priority for the management and control of invasive alien species. In this study, an analysis of the sessile benthic community associated with two marinas in the Bay of Cádiz (Puerto América and Elcano) was carried out, as well as an evaluation of the possible transfer of alien species to the natural habitat closest to them (La Caleta). Over seven months (February-August 2021), a comparison was made between artificial habitats and the natural habitat, species diversity was evaluated, and identification of port alien species was carried out, including those that had colonized the natural habitat. Additionally, the results were compared with a previous study conducted in the same marinas in 2013. The results showed that the composition of natural communities differed from port communities in 2021, with marinas exhibiting higher specific diversity than expected due to a high percentage of alien species. In the comparison of port communities between 2013 and 2021, differences were found between marinas and between years, Puerto América marina, and the year 2021 showing the highest specific diversity. The percentage of alien species between 2013 and 2021 was very similar. Four alien species were identified in marinas that had been transferred to the natural habitat: Amathia verticillata, Schizobrachiella sanguinea, Ecteinascidia turbinata, and Branchiomma luctuosum and future monitoring and tracking of the remaining identified alien species were proposed.

Key words: Recreational marinas, pontoons, sessile epifauna, biofouling, non-indigenous species.

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BIOEXTRACTION POTENTIAL OF BIVALVES FROM THE MAR MENOR

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Abstract: The excessive release of nutrients into the Mar Menor has led to the eutrophication of the lagoon, leading to its collapse in 2016 with a massive proliferation of microalgae. Bivalves can filter water, cleaning it from particles and reducing its turbidity and the concentration of particulate organic nutrients (Petersen et al., 2019). Therefore, the use of bivalves to extract organic matter (OM) and improve water quality was proposed as a nature-based solution (NbS) (Rose et al., 2015). With this purpose, this research aims to quantify and compare the potential of three bivalve species from the Mar Menor (*Ostrea edulis*, *Ostrea stentina* and *Polititapes aureus*) to extract nutrients in different environmental scenarios observed in the lagoon: oligotrophy (0.65±0.06 mgOM/L), mixotrophy (2.68±0.30 mgOM/L) and eutrophy (4.50±0.66 mgOM/L). To this end, their feeding performance (clearance rates, ingestion rates, absorption efficiency and absorption rates) was studied under simulated laboratory conditions using a flow-through system. Absorption and respiration rates were integrated into the bivalve energy balance equation to estimate the Scope for growth (SFG). The results have shown different physiological responses in each species to the concentration of organic matter in the seawater. In general, the response of bivalves to an increase in the concentration of particulate organic matter is to reduce their clearance rate to maintain their food intake. Among the species studied, *Ostrea edulis* has shown higher clearance and ingestion rates for all conditions, standing out for its greater performance and response to eutrophication events. Which confirms the suitability of this species for restoration for bioremediation purposes of environments with high nutrient concentrations.

Key words: Eutrophication, bivalves, nutrient bioextraction, restoration

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COMUNIDADES DE INVERTEBRADOS BENTÓNICOS ASOCIADOS A *Bathopora* sp. UNA MACROALGA EXÓTICA DEL MAR MENOR (MEDITERRÁNEO OCCIDENTAL)

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Abstract: La biodiversidad de las comunidades bentónicas se encuentra determinada por una gran variedad de condiciones medioambientales naturales y antrópicas. Alteraciones en la estructura y complejidad del hábitat podrían conllevar un cambio en la composición de la comunidad de infauna asociada. En el presente contexto de cambio global, la introducción de especies y su relativa simplicidad estructural ha erosionado dicha biodiversidad en muchos casos. En el año 2016, una crisis de eutrofización permitió el crecimiento de una macroalga exótica del género *Batophora* que actualmente forma poblaciones importantes en la laguna del Mar Menor. El objetivo principal de este estudio es analizar la estructura y composición de las comunidades de invertebrados (principalmente poliquetos) asociados a diversas especies formadoras de dosel entre las que se incluye la comunidad algal del género *Batophora*. Particularmente queremos determinar si *Bathopora* presenta un rol comparable como especie fundamental al de las otras especies formadoras de dosel ya existentes desde antes del evento de eutrofización. Para ello, se obtuvieron muestras en varias épocas para los distintos hábitats que posteriormente fueron tratadas y clasificadas para su análisis estadístico mediante el software R.

Key words: Infauna, *Bathopora*, Caulerpa, Mar Menor, Comunidad

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TOLERANCE TO SALINITY OF THE EUROPEAN FLAT OYSTER FROM THE MAR MENOR LAGOON

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Abstract:
The Mar Menor lagoon has experienced a deterioration of its ecological conditions over the last decades due mainly to an eutrophication process (Ruiz-Fernández et al., 2019; Torrente et al., 2019). One of the species affected by this decline has been the native flat oyster *Ostrea edulis*, which in the 80s hosted a population over 130 million individuals in the lagoon (Rosíque, 1994). The Mar Menor Oyster Initiative (MMOI) aims to recover this species and use the ecosystem services that bivalves provide to help recover the lagoon.
Within the framework of this initiative, this research examines the acute (48-hour) and acclimated (one-month) physiological response of flat oysters from the Mar Menor lagoon when exposed to different salinities (20, 30, 40, 50, and 60 PSU). The study identified significant variations in all measured physiological parameters due to both salinity and time.
The findings indicate that flat oysters can live in a wide range of salinities (from 20 to 50 PSU). There were notable time-dependent physiological changes, with significant adjustments between the acute and acclimated observation, especially at 20 PSU. Here, harmful effects were initially observed, but an acclimation occurred after one month. Conversely, oysters at 50 PSU initially responded similarly to those at 30 and 40 PSU, yet displayed reduced fitness over a longer period. At 60 PSU, a detrimental condition was consistently observed throughout the study, suggesting a possible salinity tolerance limit for the survival of this species.
Overall, the research showed the intricate relation between salinity, time, and flat oysters' physiological and biometric responses, emphasizing the significance of both short-term and acclimated responses to environmental shifts. These insights are vital for understanding the adaptability and resilience of the species under varying salinity levels, crucial for both ecological studies and aquaculture practices.

Key words: Salinity, osmoconformers, adaptability, osmotic regulation

Acknowledgments: This study has been carried out within the framework of the project

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BIODIVERSITY AND MARINE CONSERVATION: IMPLEMENTING THE ECOSYSTEM APPROACH FRAMEWORK IN NAFO FISHERIES MANAGEMENT

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Abstract: The Northwest Atlantic Fisheries Organization (NAFO) manages fisheries in waters beyond national jurisdiction in the Northwest Atlantic. Since 2007, NAFO has been actively pursuing the development and implementation of an ecosystem-based approach to fisheries management (NAFO, 2007a; NAFO, 2007b). This framework, referred to as the NAFO Roadmap for an Ecosystem Approach to Fisheries, or simply the "Roadmap" (Koen-Alonso *et al*., 2019), serves as a guide for the organization's strategic direction in promoting sustainable fishing practices, including protecting the marine environment, conserving its marine biodiversity, minimizing the risk of long-term or irreversible adverse impacts from fishing activities, and taking into account of the relationship between all components of the ecosystem. This work summarizes how NAFO is working towards the full implementation of the Roadmap which sets out a pathway for scientific information to be integrated into the management decision-making process. The Roadmap is a dynamic framework that is constantly evolving as its various components are developed, refined, and implemented. This work illustrates some key aspects, such as: the definition of ecosystem-based management units; the establishment of a hierarchical approach to setting exploitation rates that takes into account ecosystem, multispecies, and stock-level sustainability; and the integration of considerations of impacts on benthic communities. In addition, an overview of the Roadmap's structure is provided along with the main results of its implementation: i) existing bottom fishing areas have been delineated to identify the historical fishing footprint and improve management; ii) 15 areas have been identified as vulnerable to bottom contact gear and therefore closed to bottom fishing to protect vulnerable marine ecosystems (VMEs); iii) methodologies have been developed to assess significant adverse impacts on VMEs; iv) overlap between VMEs and fisheries has been assessed; iii) an ecosystem reference point has been adopted to help inform management decisions on the potential risk of ecosystem overfishing.

In conclusion, although the Roadmap remains a complex and challenging work in progress, its modular structure has proven to be a useful framework for making significant progress towards an Ecosystem Approach to Fisheries Management within NAFO.

Key words: NAFO, Roadmap, Fisheries, Biodiversity, VMEs.

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EVALUATION OF EFFECTS OF SUMMER 2023 HEATWAVE ON *C. CAESPITOSA* COMMUNITIES

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Coral colonies have been severely impacted worldwide the last decades, due to the increasing sea temperature and the occurrence of lethal marine heatwaves (Garrabou *et al.*, 2022). Nowadays, *Cladocora caespitosa* (Cnidaria: Anthozoa), the only reef-building hard coral species endemic to the Mediterranean Sea, is one of the most threatened species in the Mediterranean basin, with significant population declines. This study focuses on the assessment of the impacts of the summer 2023 heatwaves on colonies of *C. caespitosa,* using image analysis.

C. caespitosa communities evaluated in this study were found in four different sites in the western Mediterranean Sea. In each site, transects of 25x2 m were conducted by SCUBA diving and photographs of *C. caespitosa* colonies were collected. Images analyzed using the Image J Software, while four bleaching degrees were established. The analysis focused on the quantification of bleaching extent by measuring the affected area and the number of zoids of each bleaching degree respectively.

A total of 106 colonies of the *C. caespitosa* from 14 transects were analysed in this study. At two sites, most of the coral colonies were more than 50% bleached with higher risk of mortality, while in other sites the assessment revealed that over 50% of the colony's surface was in advanced stage of bleaching. Across all sites, *C. caespitosa* communities were found to be at significant risk of mortality.

The extensive bleaching of the colonies, because of the lethal heatwaves, corresponds with previous research, both in the region of Spain (Kersting *et al*., 2014; 2023) and in other region of Mediterranean Sea (Kružić *et al*., 2014; Jiménez *et al.*, 2016). In parallel, utilizing image analysis for evaluating coral communities offers numerous advantages in assessing corals bleaching stages and saving resources in conducting in situ studies, while also facilitating revisions and improvements in bleaching assessment.

Key words: *Cladocora caespitosa*, Coral bleaching, Marine heatwaves, Mediterranean Sea, Image analysis

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BATOPHORA SP. DYNAMICS ON THE MAR MENOR LAGOON (SE SPAIN)

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Abstract: In recent years, the Mar Menor lagoon has experienced episodes of eutrophication, sediment influx, and alterations in its connection with the Mediterranean Sea, which have impacted the composition and dynamics of its resident species. These changes have facilitated the introduction of exotic species, including macroalgae from the *Batophora* genus (Terradas-Fernández et al., 2022). This study aims to monitor seasonal variations in the distribution and coverage of *Batophora* in shallow areas of the lagoon. Three sites at two different locations where this species had previously been detected were selected for monitoring. Algal distribution was estimated using 50 m transects perpendicular to the coast, while species coverage, including other dominant species such as *Caulerpa prolifera* and *Cymodocea nodosa*, was assessed using 625 cm2 quadrats. During the study period (July 2022 to June 2023), *Batophora* formed continuous patches and belts approximately 2.3-17.7 m wide in the shallowest areas, at depths of around 25-65 cm. Additionally, extensive meadows of this species were observed at depths exceeding 1 m in other samplings (personal observation). The highest *Batophora* coverage was observed in autumn (45%) and the lowest in summer (4%) in the shallowest zone. This contrasts with the peak coverage observed in spring for *C. prolifera* and *C. nodosa* (69% and 40%, respectively), which was lowest in autumn (14% and 9%, respectively). The differing temporal dynamics of *Batophora* compared to other dominant macrophyte species in the Mar Menor may result from competition and distinct phenology among species. In conclusion, this study provides evidence of the current colonization success throughout an entire annual period.

Key words: Exotic species, *Batophora*, Mar Menor lagoon, Seasonality

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MACROPHYTE DYNAMICS ON DEGRADED LITTORAL PLATFORMS IN ALICANTE (SE SPAIN)

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Abstract: Mediterranean abrasion platforms are subject to a variety of local and global anthropogenic and natural pressures, which can act synergistically to affect the structure and functionality of their resident communities. In the present work, we have monitored, on a seasonal basis from September 2021 to February 2024, the composition and structure of the benthic macrophyte community of degraded abrasion platforms near the city of Alicante. Three sites on the Agua Amarga platforms were selected for sampling, comprising four zones (adapted from Terradas-Fernández et al., 2020): i) the inner vertical zone (IVZ), ii) the inner horizontal zone (IHZ), located in the innermost part of the platforms, iii) the middle platform zone (MPZ), and iv) the outer platform zone (OPZ). Within each zone, we used three 625 cm^2 squares to estimate seasonal macroalgal cover at nine different times. Our results indicate that these degraded platforms have low richness and diversity throughout the study period, and are dominated by *Ellisolandia elongata* and *Jania* sp. The lowest diversity was observed from February to April (0.51-0.69), while higher values were recorded from June to December (0.89-1.14). *E. elongata* was the most abundant macroalgal species, with the highest cover in February-April on the OPZ (84-98%). This was followed by *Jania* sp., with peaks in October 2023 (71-85% cover on both MPZ and OPZ), and *Ulva* sp. with maximum cover observed on IVZ in March and

June 2023 (58-61%). Additionally, exotic species such as *Caulerpa cylindracea* (in 2021), *Codium fragile* (in 2022), *Asparagopsis taxiformis* (in 2023), and *Rugulopteryx okamurae* (in 2024) were also detected during our study period. These findings underscore the potential of degraded platforms as key areas for the establishment of exotic species and emphasize the importance of long-term monitoring efforts in these ecosystems.

Key words: Littoral platforms, Phytobenthos, Species diversity, Community structure, Exotic species

Acknowledgments: Thanks to all the volunteers who participate in the monitoring network from which this work arises, as well as to Rosa Canales and TRAGSATEC for their collaboration.

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BLUE ECONOMY

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NAVIGATING THE *SARGASSUM* CRISIS FOR SUSTAINABLE AGRICULTURE: A BLUE ECONOMY APPROACH IN THE CARIBBEAN

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Abstract: The Caribbean faces a complex crisis as unprecedented *Sargassum spp.* invasions, exacerbated by climate change and human activities, disrupt coastal ecosystems, tourism, and livelihoods (EUMOFA, 2023). The annual influx of millions of tons of these macroalgae poses significant environmental, economic, and social challenges to the region (Desroches *et al*., 2022). However, within this crisis lies an opportunity for innovative solutions. Previous studies have demonstrated the vast potential of similar seaweed, including applications in agriculture (Shukla *et al*., 2019). Therefore, this study explores the transformative potential of converting *Sargassum spp.* into agricultural biostimulants, offering a dual benefit of mitigating environmental degradation while fostering economic growth. Leveraging the patented SOS Carbon's Littoral Collection Module (LCM), local boats collect *Sargassum spp.*, empowering vulnerable coastal communities and managing seaweed influx. Subsequently, the harvested *Sargassum spp.* undergoes pre-treatment to eliminate waste and heavy metals before being processed into a biostimulant with polysaccharides (pentoses - 793,8 ± 17, 4 mg/L / hexoses – 628,8 ± 18,8 mg/L), proteins (212,3 ± 18,3 mg/L), polyphenols (742,2 ± 14,24 mg/L), and exhibiting high antioxidant activity (70-75 %). The product is registered as OceanSustain. Field tests conducted in the Dominican Republic demonstrate promising results, with 1400 tomato plants treated with this product, showing improved root development, enhanced growth, increased stem size and vigor. Additionally, post-transplant stress has been tested on 96 banana crops, achieving a 0% post-transplant death rate. This approach exemplifies the potential of the blue bioeconomy, seamlessly integrating biotechnology with environmental management. By valorizing *Sargassum spp.* through sustainable and industrially scalable techniques, waste is effectively converted into a valuable resource, creating essential value chains that not only mitigate environmental degradation but also promote economic prosperity.

Key words: *Sargassum spp.*, agricultural biostimulants, blue bioeconomy, sustainable agriculture.

Acknowledgments: We would like to express our sincere gratitude to the British Embassy in the Dominican Republic and the German Embassy in the Dominican Republic for their contributions to this project. We extend our heartfelt appreciation to the Dominican Republic Customs Laboratory and its dedicated staff for their unwavering assistance and support throughout the course of this project. Special thanks are also due to the local farmers for their invaluable participation in the field trials and their willingness to test the Sargassum-derived biostimulant. We also wish to acknowledge the local fishermen utilizing the LCM systems for harvesting Sargassum, whose efforts have facilitated the collection of the raw material essential for our experiments.

We are deeply grateful to all individuals and organizations who have contributed to this project, directly or indirectly, and whose support and commitment to environmental sanitation has been vital in preserving the ecological balance of the region.

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QUANTIFICATION OF THE ROLE OF BIOMASS AS A BLUE CARBON STOCK IN A SALTMARSH RESTORATION PROJECT (CÁDIZ BAY NATURAL PARK)

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Abstract: The Paris Agreement established the basis for limiting greenhouse gas emissions (GHG) with the goal of reducing global warming below 2ºC during the century. After the 28th Conference of the United Nations Framework Convention on Climate Change in 2023, the need to abandon fossil fuels to meet net zero emissions was recognized (FCCC, 2023). However, reducing GHGs to this level requires additional strategies, so COP28 delivered a mitigation work program including nature-based solutions (NBS) (UNEP, 2022). These are actions aimed at restoring, protecting, and ensuring the sustainable use and management of terrestrial, coastal, or marine ecosystems. These measures are able to mitigate up to 37% globally, in addition to contribute with other benefits such as climate adaptation, biodiversity, improved water quality, among others (Griscom et al., 2017). As a result, many restoration and conservation projects are emerging in Spain and specifically in some regions. The Andalusia Regional Government has chosen a pilot site for restoration of tidal saltmarshes in the Guadalete river. This coastal wetland within the Cadiz Bay Natural Park is degraded by different infrastructure constrains.

The objective of this study was to quantify the current carbon stored in the biomass of the degraded saltmarsh, and later to estimate the biomass carbon stock after restoration. For this purpose, different homogeneous units were defined in the area: high marsh, medium marsh with different tidal conditions and low marsh. In each homogeneous unit, aboveground and belowground biomasses were directly collected and measured, when possible, and analysed for carbon content. The area of the different units was estimated through aerial photographs and with a drone equipped with multi-spectral and LiDAR sensors. The results showed the heterogeneity of the marsh area in terms of vegetation distribution within each homogeneous unit. In addition, the amount of carbon dioxide equivalent captured by the future restoration project was estimated in the biomass reservoir. Using the calculator tool provided by the Andalusian blue carbon standard, it was estimated that biomass can be capable of sequestering a total of 8,130 tCO^2 after 50 years of restoration, equivalent to 10-20% of the total carbon that is estimated that will be sequestered in the restored site.

Key words: Blue carbon, tidal saltmarsh, coastal ecosystems, Andalusia blue carbon standard

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THE BLUE TRAINING ECOSYSTEM IN BARCELONA

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Abstract: Blue economy is a strategic line of action for the city of Barcelona, which encompasses a large number of sectors and subsectors, among which is training at various levels, from occupational to university ones.

Occupational and continuous training is offered by Escola Europea–Intermodal Transport (EE-IT) since 2006, the Nautical Institute of Barcelona (INB) since 2015-16, and the Logistics Institute of Barcelona (ILB) since 2022-2023, all of them located at the premises of Barcelona's Port. EE-IT alone had 2,100 participants in their courses and 3,400 in technical visits during the academic year 2022-23, representing peak numbers in history. In its first year ILB already had 302 registered students. The Nautical Faculty of Barcelona offers several courses framed within its "professional classroom", which 395 registered participants in 2022-23.

Barcelona provides five blue Bachelor degrees of 4 years of duration —Marine Sciences, Marine Sciences and Technologies, Marine Engineering, Systems Engineering and Naval Technology, and Nautical and Maritime Transport— given by the University of Barcelona (UB) and the Polytechnic University of Catalonia (UPC). Over 1,000 registered in these bachelors per academic year since 2018-19, peaking at about 1,200 in 2022-23, with 146 to 169 graduates per year.

UB and UPC also deliver five blue masters —Aquaculture, Management and Operation of Marine Energy Installations, Nautical and Maritime Transport Management, Naval and Ocean Engineering, and Oceanography and Marine Environmental Management—. Total

registered students oscillated from 162 to 197 per academic year since 2018-19, peaking in 2022-23, with 52 to 72 graduates per graduation round, either six-monthly or annual. There are several blue or partly blue doctorate programs in Barcelona too, with several tens of PhD students.

All of the above, totalling over 7,300 registered attendees at different levels in the last academic year, makes Barcelona one of the largest blue training ecosystems in Europe.

Key words: Blue economy, Blue training, Occupational training, University training, Barcelona.

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CITIZEN SCIENCE AND THE SEA: CHALLENGES AND OPPORTUNITIES

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CITIZEN SCIENCE AS A BASIS FOR THE BIOLOGICAL MONITORING OF ELASMOBRANCHS: THE CASE OF REDPROMAR IN CANARY ISLANDS.

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Abstract: Despite their ecological importance and the economic benefits of shark diving, ¾ of the elasmobranch species are threatened with extinction. In addition, the absence of previous protection and management measures, has resulted in large information gaps on ecological aspects that hinder efficient management. In this context, obtaining information on habitat use and seasonality, distribution zones and aggregation areas, as well as other ecological aspects is fundamental to facilitate efficient management. In this way, Marine citizen science presents a promising avenue to enhance citizen engagement in marine conservation around the globe. Based on this, The Canary Islands Marine Life Observers Network (RedPROMAR) is a network set up by the Canary Islands Gobernment for the purpose of monitoring and observing marine life in the archipelago through Citizen Science. RedPROMAR has been promoting a biological monitoring program for elasmobranchs since 2021. Its main objectives are: a- To develop, from a citizen science base, collaborative actions to strengthen knowledge on elasmobranchs; b- To identify and characterize species, seasonality and distribution zones and aggregation areas; c- To generate training and outreach workshops, contributing to the change of perception and monitoring. During the past year, four free training workshops were held and more than 60 entities and volunteers were trained. Thanks to this, more than 800 sightings of 17 species have been recorded, in which behavior was described and size was estimated; and in 50% sex was identified. Finally, 11 important aggregation areas have been suggested. Nowadays, multiple improvements are being implemented in the RedPROMAR platform to strengthen the biological monitoring program and enhance the information we have on these species in the archipelago.
If you want to be part of this project, we encourage you to take a look at the RedPROMAR platform and social networks, where we will propose new free and accessible workshops!

Key words: Citizen science, elasmobranchs, biological monitoring, RedPROMAR, Canary Islands

Acknowledgments: We extend our gratitude to all users who have actively reported and/or are currently reporting on the platform, thereby promoting knowledge and conservation of our marine ecosystems. Your engagement serves as a fundamental pillar of RedPROMAR. Special thanks to the entities and people who have been trained in this project and who, today, are a fundamental part of it. This project is co-financed by the European Union within the framework of the Canary Islands FEDER Program 2021-2027.

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FIVE YEARS OF THE SECOSTA CITIZEN SCIENCE INITIATIVE: SUCCESS AND CHALLENGES AT A GLANCE

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Abstract: Coastal regions face increasing threats from global warming, prompting the need for vulnerability assessments and adaptation strategies [Agulles, 2021; Vousdoukas, 2020]. Addressing these challenges, the SECOSTA project, a pioneering citizen science initiative since 2018, pursues a dual mission: (i) educating high school students about the climate crisis's impact on coastal regions and (ii) actively involving them in scientific research to address observational gaps in coastal oceanography.

After an initial training phase for educators to assist students in constructing low-cost devices based on ARDUINO open-source technology, teachers launch cross-disciplinary educational projects supported by SECOSTA team-curated resources. Subsequently, students actively engage in hands-on data collection, focusing on beach topography, sea level, and sea temperature.

This presentation highlights the success of the SECOSTA project and explores challenges and opportunities in involving schools, teachers and students in the Balearic context. Thus, SECOSTA has achieved remarkable success, forging a collaborative partnership among researchers, regional government bodies, and secondary schools. Involving over 4,000 students from 35 educational institutions, its impact has been profound. Milestones like the SECOSTA2022 Student Conference, featuring presentations from 140 students across 10 schools, and the subsequent SECOSTA2023 Student Conference with 170 students from 12 schools, underscore its success.

To date, students have made substantial data contributions, including topographic records for 19 Balearic beaches and time-series data on sea level and water temperature, currently under analysis by the SECOSTA team. School participation rates correlate with center proximity, with higher engagement observed in schools located in the project's headquarters city and island. Furthermore, among the three available lines of work, beach topography garners the most interest, likely due to the user-friendly nature of the devices used and the appeal of the fieldwork for students. Consequently, the immediate challenges we are facing have to do with insular geography and monitoring devices intricacy.

Key words: Citizen Science, Coastal oceanography, ARDUINO technology, Low-cost instrumentation

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RESULTS OF THE THINKINAZUL/CIMAR PROGRAMME TRANSFER ACTIONS

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Abstract:

Within the sustainable development goals of the 2030 agenda, number 14 refers to 'conserve and sustainably use the oceans, seas and marine resources for sustainable development'. In this sense, for a people, a community or a country to achieve sustainable development, there must be a shared responsibility of all actors, individual and collective, that influence its development.

As part of the CIMAR project (Awareness, Research, Monitoring and Advice on Marine Resources) of the ThinkInAzul programme (2022-2024), diverse proposals have been made, adapted to different groups, with the aim of communicating the importance of marine biodiversity and the sustainable use of marine resources to as many people as possible. To this end, the following actions have been carried out: i) *Face-to-face* activities (formal education centres, associations and other groups, private visits); ii) Publication of posts and news related to the marine environment on social networks and CIMAR website (web.ua.es/cimar). The #CIMARtes initiative has been created on social networks: publications on marine biodiversity, oceanography, scientific dissemination; iii) Organisation of marine outreach events open to the general public.

The impact record from June 2022 to April 2024 shows that the transversal activities carried out have been very well received, as well as the dissemination through social networks: 2358 people participated in 54 Marine Education activities of different typology: talks, workshops, group dynamics. Around 400 people attended 5 events where marine education merged with other disciplines such as art, gastronomy, music and astronomy. 209 publications have been made on social media, 72 of which correspond to #CIMARtes.

With the implementation of these actions, it is intended to contribute to the achievement of Goal 14 of the SDGs, as well as to implement the concept of Ocean Literacy in the citizenship. The results obtained indicate the good reception of these initiatives and the need and demand from the population for this type of transfer and awareness-raising actions on the marine environment.

Key words: Citizen Science, Marine environmental Education, Ocean Literacy, Knowledge Transfer

Acknowledgments: This study forms part of the ThinkInAzul programme and was supported by MCIN with funding from European Union NextGenerationEU (PRTR-C17.I1) and by Generalitat Valenciana.

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ECOLOGICAL TRANSITION AND COASTAL PROTECTION: INSTITUTIONAL INNOVATIONS AND PARTICIPATORY GOVERNANCE

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Abstract:

The public management of natural resources and spaces, both forest and rural as well as urban, on land, fluvial and marine, is demanding the attention of different disciplines. Consequently, scientific and institutionalized knowledge are mobilizing academic and professional sectors. The complexity of the institutional factors that intervene in the public management of decisions and coordinated actions to address the ecological transition, as well as the effects of climate change and the mitigation of its consequences, is added to elements of the administrative and institutional structure and logic involved in decision-making processes and solutions based on updated scientific evidence. Consequently, we find an arena in which multiple actors, interests, institutions and processes coexist and confront each other at different administrative scales, in different territorial entities and through sectoral policies. These circumstances require the involvement of institutions and public administrations at various levels, including, on certain occasions, numerous stakeholders, and different international networks due to the objectives and commitments set at global level. Reforms in marine governance systems (in terms of logic, policies, processes and practices) are urgently needed to improve their capacity to promote more integrated, collective and scenario-oriented decisions. In this context, the poster aims to show a governance analysis methodology applied to the Valencian Community (Spain), in the framework of the European project HORIZON: BLUEGREEN GOVERNANCE (HORIZON-BGG). The case study discusses the relevance of diverse institutional and social factors that serve as barriers, but also as facilitators, for the effective achievement of governance instruments aimed at the protection of several Valencian coastal areas. With this approach, the project responds to the need for better informed decision-making processes, social engagement and digital innovation, while promoting more harmonious and effective science-policy-society interfaces.

Key words: Innovative governance, climate change, institutions, ecological transition.

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CHALLENGES OF THE OCEAN DECADE THE VIEW FROM THE NEXT GENERATION OF OCEAN EXPERTS

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Abstract: The UN-Ocean Decade Conference celebrated in Barcelona in April 2024 brought the opportunity to organize a Satellite Event starred by undergraduate and master students on Marine Sciences from different Universities: Universidad de Alicante, de Barcelona, Católica de Valencia, Cádiz, Las Palmas de Gran Canarias, Vigo, Algarve (Portugal) y Gdansk (Polonia). This event created a discussion around selected subject of the UN-Ocean Decade Challenges. Specific targets of the event were: (i) Promoting awareness of the UN-Ocean Decade within the future generations of ocean experts; (ii) Stimulating the interaction between students from different universities; (iii) To articulate a dialogue around subjects within the "10 Challenges" chosen according to the student's interest; (iv) Bring the opportunity for a close interaction between students and reference experts in the field of the marine sustainability. This last objective was accomplished with the participation of the expert Oihane Cabezas Basurko, the first recipient of the Marine Sustainability Award from the Fundació Banc de Sabadell. The discussion was structured in broad themes: Understanding and bit marine pollution; Protect and restore ecosystem and biodiversity; Sustainable feed the global population and Climate change: Observations and risks. This presentation will summarize some worries and messages highlighted by the students. But the main objective of this contribution is to share the constructive experience of exposing the students to a challenging environment with colleagues from different centres, in public and using a foreland language. An overall uncomfortable situation for the students but at the same time, it resulted in a stimulating experience, letting them to rise their voice in a public space, free to express their own thoughts, worriers, and sharing their knowledge. It became a successful experiment of empowerment for our young generation of marine experts, recognizing that they are youth and they have a very valid speech to transfer a powerful voice that matters and they have the right to be listened..

Key words: Marine Science Students, Challenges Ocean Decade, Ocean Sustainability, Debate, Education.

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JELLYFISH SCIENCE BY CITIZENS: MEDUSAPP EFFECTIVELY MONITORS PATTERNS OF JELLYFISH POPULATIONS

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Abstract:
In the Western Mediterranean (WM) Sea, a critical habitat for diverse jellyfish species, understanding biogeographical patterns is essential for the sustainable management of marine ecosystems, fisheries, and coastal economies (Bordehore et al., 2016). The complexities of these patterns and the scarcity of comprehensive data have traditionally challenged effective management. This study employs MedusApp, a citizen science platform designed and programmed by the authors, to enhance our understanding of jellyfish distributions and trends from 2018 up to 2024, including additional species not previously monitored (Dobson et al., 2023). The application has seen an increase over the years in the number of users, however, when standardized abundances of jellyfish have remained consistent, suggesting stable jellyfish populations. Notably, updated analyses reveal changes in the distribution of key species; for example, *Pelagia noctiluca* (Forsskål, 1775) shows a northward expansion and increased encounters with *Rhizostoma luteum* (Quoy & Gaimard, 1827) near the Balearic Islands is a sign of a new geographical range for this species. These insights are vital for developing targeted management strategies to mitigate the socio-economic impacts on industries such as tourism, fishing, and aquaculture. The expanded dataset underscores the value of citizen science in marine biodiversity research (McKinley et al., 2017), offering a scalable method for tracking environmental changes and informing conservation strategies. MedusApp exemplifies the potential of community-engaged science to refine our understanding of jellyfish dynamics and support adaptive management in the WM Sea.

Key words: Jellyfish, Mediterranean, Citizen Science, Phenology

Acknowledgments: This work was supported by the project GVA-THINKINAZUL/2021 "A comprehensive marine observatory in the coast of Oliva-Dénia-Jávea for the conservation of biodiversity, observation of global change and promotion of the blue economy (OBSERMAR-CV)." to CB, supported by the Ministerio de Ciencia e Innovación of the Spanish Government and by Generalitat Valenciana-Conselleria de Innovación, Universidades, Ciencia y Sociedad Digital with the funding from European Union NextGenerationEU (PRTR-C17.I1).

Part of this research was conducted at the Marine Laboratory UA-Dénia https://web.ua.es/en/marlabdenia/ (Agreement Ajuntament de Dénia-Conselleria de Medio Ambiente, Agua, Infraestructuras y Territorio de la Generalitat Valenciana). We also thank Marina de Dénia and El Portet de Dénia for their support.

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MOBILIZING SCIENCE AND SOCIETY TO TACKLE MARINE LITTER AND MICROPLASTICS

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Abstract: Marine ecosystems are under intense pressure, with marine litter (ML) posing a major threat to both environmental and human health. Over 11 million tons of litter end up in the ocean annually, with plastic comprising about 85% of all marine debris. This plastic severely impacts biodiversity and facilitates the spread of invasive species. Microplastics (MP), tiny plastic fragments from larger debris, are ingested by various marine organisms, raising concerns about the transfer of toxic substances through the food web and potential impacts on human health via seafood consumption. The issue of ML has garnered significant attention from scientists, policymakers, and society, particularly in the last two decades. Public awareness and community involvement are crucial for driving change. Outreach initiatives can inspire individuals to adopt environmentally friendly habits and participate in local cleanup efforts. By fostering a sense of stewardship and responsibility, communities can significantly contribute to reducing ML. Present work highlights successful interdisciplinary actions developed under the European Project MAELSTROM (GA101000832). These initiatives, co-organized with multisectoral stakeholders, schools, municipalities, local and national authorities, NGOs, and outreach centres, represented a joint effort to tackle ML. Actions included multidisciplinary clean-ups, educational talks, and participant-feedback surveys revealing insights into public awareness and attitudes towards ML. In total, 8 clean-ups were carried out in northern Portugal, allowing for the engagement of over 500 people. This resulted in the collection of 600 kg ML. Outcomes highlight the value of citizen-science activities in driving support for innovative and sustainable solutions to be implemented by local, national, and European decision-makers.

Engagement efforts also enhanced Ocean Literacy within communities and stakeholders to build awareness, adopt good practices, behaviours, and consumer choices. These, alongside institutional facilitation and resourcing of technological and societal ML solutions are vital for a sustainable, clean, and healthy society.

Key words: Marine Litter, Microplastics, Stakeholder Engagement, Science and Society, Interdisciplinarity

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MESOZOOPLANKTON RESPIRATION IN THE MESO- AND BATHYPELAGIC LAYERS IN THE ATLANTIC OCEAN

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Abstract: Estimating zooplankton respiration in the mesopelagic layer is challenging but crucial for understanding carbon transport in the ocean. Daytime respiration by zooplankton vertical migrants contributes to the downward carbon flux in the oceans. Thus, zooplankton respiration directly impacts the export and sequestration of organic carbon in the mesopelagic layer, influencing global carbon dynamics. However, measuring specific values of zooplankton respiration in the meso- and bathypelagic zones is challenging. This study examines the respirations of various zooplankton groups, including copepods, euphausiids, and chaetognaths, in the meso- (200-1000 m) and bathypelagic (>1000 m) layers during winter, the most productive season in the subtropical Atlantic Ocean due to maximum water column mixing. Sampling was conducted at two latitudinal and two longitudinal stations in the North Atlantic Ocean during both day and night. Respiratory flux was assessed by measuring the enzymatic activity of the electron transfer system (ETS) in organisms from the surface to 1800 m depth. The results show the differences between the meso- and bathypelagic layers and highlight the importance of incorporating the active transport of large zooplankton migrants in the assessment of the biological carbon pump.

Keywords: Zooplankton, respiratory flux, ETS enzymatic activity, mesopelagic, bathypelagic

Acknowledgments: The study was supported by DESAFIO I and DESAFIO II. Projects financed by the Ministry of Science and Innovation. This study was conducted by M. Vargas-Ferraz as part of his work at IOCAG, in the final degree project in Marine Sciences, at the University of Las Palmas de Gran Canaria.

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THE KEY ROLE OF MARINE CITIZEN SCIENCE IN EARLY DETECTION AND MONITORING OF EXOTIC SPECIES: THE CASE OF REDPROMAR IN THE CANARY ISLANDS

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Abstract: The current state of the oceans and their biodiversity is a matter of global concern. Species introduction is considered one of the main threats, capable of generating significant ecological, economic, and social impact. In this context, data collection on the presence and distribution of these species is crucial for their management. Marine citizen science emerges as a promising global tool, capable of expanding the spatio-temporal scale of exotic species records. This study evaluates the contribution of citizen science through the Marine Environment Observers Network in the Canary Islands (RedPROMAR) as an early detection and monitoring system for exotic species in the archipelago. Over a period of 11 years, from April 2012 to April 2024, close to 90 users have documented sightings of 44 different exotics species in the Canary Islands. These records include more than 600 sightings, with 170 of them involving species classified as invasive. Tenerife accounts for the majority of sightings (~44%), followed by Gran Canaria (~28%), coinciding with the islands with the highest port facilities and maritime traffic. In addition to observing a growing trend in exotic species records in the Canary Islands, unknown and highly interesting sightings for the scientific community have been recorded. Once again reaffirming the ability of marine citizen science to significantly contribute to the understanding and monitoring marine biodiversity, particularly exotic species in this case. However, it is crucial to count with scientific support and appropriate validation mechanisms. As well as promoting outreach efforts to train users in detecting and reporting relevant information, increasing their knowledge and awareness of local marine ecosystems. If you have spotted any exotic marine species in the Canary Islands, we encourage you to report it through the RedPROMAR platform!
Simultaneously favoring the identification of needs in the scientific field based on the

changes that occur in marine ecosystems.

Key words: Citizen science, exotic species, marine conservation, RedPROMAR, Canary Islands

Acknowledgments: We extend our gratitude to all users who have actively reported and/or are currently reporting on the platform, thereby promoting knowledge and conservation of our marine ecosystems. Your engagement serves as a fundamental pillar of RedPROMAR.
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OBSERVADORES DEL MAR, THE MARINE CITIZEN SCIENCE PLATFORM BRINGING TOGETHER EFFORTS FOR OCEAN CONSERVATION

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Abstract:
Observadores del Mar is the marine citizen science platform reference in Spain devoted to ocean conservation. The platform is focused in providing quality data supporting evidence-based solutions on 5 main topics: biodiversity, climate change, vulnerable species, exotic species and marine litter.
The platform was launched in 2012 with the main activities in Catalonia and Balearic coast and since then has been expanding its activities to rest of the Mediterranean and the nearby Atlantic Spanish coasts. In these more than ten years of activity the platform has been expanding the number of projects, scientific teams (more than 100 from 40 research institutions) and consolidating a community of almost 6,000 observers and more than 500 organizations.
The main pillars of success of Observadores del Mar are i) that most of the observations are collected following standardized protocols, then they are rigorously validated by expert scientific teams behind each project, which allows an interaction between volunteers and the scientific community, and ii) that different community engagement strategies are generated, especially focused on feedback to the citizens involved, such as specific challenges, dissemination material, informative talks and training sessions, both online and in person.
In conclusion, Observadores del Mar provides robust results that have an impact on knowledge about the conservation state of the ocean, which is transferred to general public to expand ocean literacy, and to the administrations in charge of managing and making decisions about marine ecosystems, in order to contribute to effective conservation and ocean health.

Key words: Participatory science, monitoring protocols, validated data, ocean health

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NAUTICAL PRESSURES ON SEAGRASS MEADOWS PROTECTION ALONG THE WESTERN MEDITERRANEAN COAST OF SPAIN

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Abstract: The Marine Surveillance Service of the Generalitat Valenciana aims to collect information on the nautical activity in marine protected areas and to inform the public about the specific legislation, especially the prohibition of anchoring in seagrass meadows. To this perform, 18,901 nautical miles were covered in the Valencian Community from May to November 2023, mostly in Natura 2000 sites. A total amount of 23,435 anchored boats was identified; most of them were anchored on sandy bottoms (47.8%) and moored to buoys (39.7%). A minor proportion (7.8%) was detected on the seagrass meadows that include *Posidonia oceanica* and *Cymodocea nodosa* species. The boats anchored on the *P. oceanica* meadow were identified, informed of the ecological damage and, in consequence, the crime committed. A total of 41.7% searched an alternative anchoring, i.e. sand bottom, buoy, etc., while 2.3% ignored the recommendations and continued to anchor on the seagrass meadows. Due to the high number of boats and the limited working time, there is no record of the remaining boats (55.9%). The highest anchoring pressure was recorded in the marine protected area of the Marina Alta, located in the north of the Alicante province. In the previous period (year 2022), a total of 11,835 boats was registered, of which 15.6% were anchored on seagrass meadows. Therefore, illegal anchoring on seagrass has been reduced by 50.2% in only one year. This is the result of a positive change in the behaviour of nautical users. However, there are still users that ignore the legislation and continue to damage protected habitats. The illegal anchoring, currently observed in seagrass areas and generally focused on tourism purposes, has to be relocated to available buoys and sandy bottoms.

Key words: Anchoring, Coastal issues, Marine Protected Areas (MPAs), *Posidonia oceanica*

Acknowledgments: The authors wish to thank the marine crews involved in this project.

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EXTERNAL ACCESS PROGRAM TO SOCIB'S GLIDER FLEET

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Abstract: The term Singular Scientific and Technical Infrastructure (ICTS) refers to cutting-edge R&D&I infrastructures that provide services for conducting high-quality research, as well as for the transmission, exchange, and preservation of knowledge, technology transfer, and the promotion of innovation.
The ultimate goal is to make state-of-the-art scientific and technical infrastructures available to the national and international scientific, technological, and industrial communities. These infrastructures are essential for the development of competitive research, as they are unique or exceptional in their field, and their strategic importance justifies their accessibility to the entire R&D&I community.
In this context, the ICTS SOCIB offers access to its fleet of Gliders. Gliders, or underwater autonomous vehicles, are approximately 2 meters long and weigh around 60 kilograms. They are equipped with a set of sensors capable of measuring temperature, conductivity, fluorescence, chlorophyll concentration, oxygen, turbidity, and sound, among other variables, from the surface down to 1,000 meters, operating on missions lasting up to three months. The service provided consists of executing the campaign at a specified location and time, delivering oceanographic data through netCDF files with real-time reduced-resolution data and the full dataset upon completion of the campaign.
The SOCIB website outlines the necessary guidelines for submitting applications that allow for Competitive Open Access. It also details the criteria and procedures applied to ensure the scientific and technological quality of the selected projects, guaranteeing their appropriate prioritization for access based on their quality, technical and logistical feasibility, and other parameters.

Key words: Glider, operational oceanography, external access

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SUPPORTING EFFECTIVE BLUE NATURE-BASED SOLUTIONS IMPLEMENTATION: THE MACOBIOS BLUE NBS

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Abstract: Nature-based Solutions in marine and coastal environments (blue NbS) can contribute to alleviating biodiversity loss and shaping human health and wellbeing. Providing a framework to integrate actions designed to protect and restore the health of marine and coastal ecosystems, and sustainably manage human impacts on them, blue NbS embed nature and people into decision-making through multifaceted thinking. However, their implementation lags behind terrestrial NbS and advances are required to accelerate blue NbS. We introduce the MaCoBioS Blue NbS Toolbox, a collection of multidisciplinary tools and products for helping inform the design and implementation of interventions in marine and coastal environments. Tools draw on research conducted through the European Horizon 2020 project 'Marine Coastal Ecosystems Biodiversity and Services in a Changing World' (MaCoBioS). The MaCoBioS Blue NbS Toolbox includes a variety of evidence-based products and guidelines, developed with stakeholders, to help practitioners at different blue NBS implementation stages answer questions like: 'What happens to an ecosystem and its services if…?'; 'Will a community be able to adapt to change and how can we help?'; 'When, where, and how could we act?'. Accessible and well-designed tools are crucial to support stakeholders in identifying suitable interventions in the evolving blue NbS landscape.

Key words: Nature-based Solutions, biodiversity loss, climate change mitigation, climate

change adaptation, marine and coastal social-ecological systems

Acknowledgments: MaCoBioS was financially supported by the European Union's Horizon 2020 research and innovation programme under grant agreement No 869710 "Marine Coastal Ecosystems Biodiversity and Services in a Changing World" (MaCoBioS).
Content for the toolbox has been produced by the various project partners of the MaCoBioS consortium. As such, the toolbox reflects some of the scientific and engagement work of MaCoBioS and draws key messages and information from the various project outputs. Specific credit to lead authors has been provided for each tool, however work has generally been conducted as a collaborative activity across the project consortium.

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THE USE OF LOW-COST UAVS FOR PRECISE COASTAL HABITAT MAPPING

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Abstract: Unmanned aerial vehicles (UAVs) are revolutionizing the world of mapping due to integrated high-quality photographing capabilities. Photogrammetry is the process of defining and studying the shape and size of an object or landscape from 2D digital images, usually done through specialized softwares. UAVs are becoming a useful and accessible tool for comprehending and monitoring the spatio-temporal dynamics of coastal ecosystems in a changing environment (Ventura et al., 2023). In this study we use a low-cost commercial UAV to generate precise orthomosaics and 3D models of coastal habitats above and below water. For this task, a UAV is flown with a staggered flight path and a constant height over a designated area, while taking photographs every few seconds (>70% overlap between images is recommended). Ground control points (GPCs) are acquired by taking GPS positions of detectable and static objects in the area and are used for proper scaling and orthorectification during post-processing. Using AgiSoft Metashape Professional (2016) software we can generate a sparse point could of the overlapping images based on multi-view stereopsis (MVS) algorithms. This software uses SfM (Structure from Motion) techniques to estimate the three-dimensional structure of a scene from a set of 2D images, allowing it to produce a Dense 3D model, Digital Surface Model (DSM), Digital Elevation Model (DEM) and RGB Orthomosaics with ultra-fine pixel detail. Resulting models are exported as raster images into geographical information systems (GIS) to generate detailed and up-to-date maps. Models can be generated for both land and underwater shallow ecosystems. Applications of this methodology are shown with examples of monitoring the loss of sand on nourished beaches, exploring the state of vermetid reefs and measuring the coverage of shallow *Posidonia oceanica* meadows.

Key words: UAVs, Orthomosaic, 3D models, Photogrammetry.

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DEEP LEARNING FOR RECREATIONAL FISHING SPATIAL-TEMPORAL PLANNING

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Abstract: To effectively manage and conserve marine ecosystems, accurate data on marine activities is crucial. This study introduces a deep learning-based integrated system designed for real-time vessel detection and tracking in coastal maritime environments. We fine-tuned and evaluated YOLOv5 and YOLOv7 for vessel detection and classification in images, alongside optimizing Strong SORT and ByteTrack for movement tracking in sequential frames. We implemented the best combination (YOLOv5 and ByteTrack) on an NVIDIA Jetson platform, conducting thorough benchmarking across various simulated hardware configurations to determine its minimal computational and power needs. Then, we conducted field tests, positioning the system atop a coastal cliff overlooking a marine protecte area, to validate its real-time operational viability and gather accurate vessel trajectories, thereby confirming its efficacy and data collection capabilities in a real marine environment. Finally, we evaluated two camera calibration techniques for converting image trajectories to real-world coordinates: a projective transformation with homography for accurate perspective adjustment, and an innovative neural network-based approach. The system we have developed could markedly enhance the monitoring capabilities within Marine Protected Areas (MPAs), contributing significantly to marine spatial planning and ecosystem conservation. It introduces a robust tool for accurately quantifying and qualifying boat-based recreational fishing activities in both spatial and temporal dimensions, thus playing a pivotal role in fostering the sustainability and safeguarding of these marine habitats.

Key words: Artificial intelligence, deep learning, recreational fisheries, multiple object tracking, marine protected areas, recreational fishing effort.

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COASTAL MONITORING THROUGH DRONE-GENERATED DIGITAL ELEVATIONS MODELS

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Abstract: This study presents the use of drones to obtain topographic data from photogrammetry with high temporal and spatial resolution. The area analysed is the mouth of the river Vedat or Bullent, located at 38°53′54″N 0°04′20″W, in Oliva (Western Mediterranean) where two flights have been performed (29 March and 28 April) from which Digital Elevations Models (DEM) have been generated over an area of 10 Ha and with a pixel size of 5 cm. A DJI Mavic 2 Pro drone was used with a Hasselblad L1D-20c camera and a GNSS positioning system: GPS+GLONASS with a vertical accuracy of 0.1 m and a horizontal accuracy of 0.3 m. Drone photogrammetry methodology can be an alternative method for the monitoring of highly dynamic phenomena with a very detailed spatial resolution (Vecchi et al., 2021). The results indicate changes in coastal dynamics and in the evolution of a coastal arrow that migrates northwards as a consequence of sediment thrust by E-dominant waves (Puertos del Estado, SIMAR point 2083108) and a NW-SE coastal direction. An 86 m advance of the coastal arrow has been calculated between the two flights and, therefore, the location of the river mouth at the end of April is located much further north compared to the March position. The comparison of the models allows to calculate of coastal progradation and retrogradation processes, as well as calculations of volumetric mobility (Casella et al., 2019). The use of this tool makes it possible, for example, to analyse the impact of a storm on the coastal zone, to analyse the effect of river flooding, among other rapidly evolving episodes, and is, therefore, great for the management of such a dynamic environment as the coast (Konstatinos et al., 2017).

Key words: Drone, DEM, Coastal dynamics, Mouth of the Vedat River, Western Mediterranean.

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ENVIRONMENTAL MONITORING OF SHELLFISH SANDBANK SEDIMENTS IN THE *RIA DE AROUSA* (GALICIA, SPAIN).

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Abstract: The productivity of shellfish intertidal sandbanks in the *Ría de Arousa* has been declining over the last two decades. This is a multivariate problem. In recent years, the effect of temperature and salinity has been extensively studied. However, the shellfish community suggest that *(i)* a decrease in the sediment grain size and *(ii)* the presence of contaminants may also have contributed to the reduction in recruitment and increase in mortality of the target shellfish species.
To improve the geological understanding, in this study we monitored the environmental status of the sediment along different shellfish sandbanks in the southern margin of the *Ria de Arousa* which currently differ in bivalve productivity. Since 2022, we conducted a seasonal sediment sampling strategy obtaining an extensive dataset of grain size, mineralogical composition and heavy metal concentrations. Results improve the characterization of the selected intertidal sandbanks, defining 1) at high spatial resolution the seasonal variations in sediment grain size, 2) the contamination level, 3) and the main contaminants sources. Our findings provide valuable information which might help to improve the management of such productive environments, considering these traditionally overlooked geological variables.

Key words: Shellfish banks, monitoring, grain size, heavy metals

Acknowledgments: This study is part of the projects: i) “Accelerating and upscaling transformational adaptation in Europe: demonstration of water-related innovation packages (TRANSFORMAR)” coordinated by the Universiteit Antwerpen and funded by the European Union’s Horizon program (H2020_101036683) and ii) “Resilience of Commercial Bivalves against Climate Change RECOBI” (TED2021-129524B-I00) funding by the Ministerio de Ciencia e Innovación in the call of transición ecológica y digital

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COASTAL DYNAMICS AT THE MOUTH OF THE RIVER MIJARES (WESTERN MEDITERRANEAN) IN THE 21ST CENTURY

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Abstract: The Mijares River is the most important river course in the province of Castellón, both in terms of flow and length. It is mouth is formed by three channels, of which only the southernmost one is functional today. The main objective of this work is analysing the coastal changes in its mouth from 2003 until the present day. For this, images of the coastline in different years have been obtained from various sources (aerial photographs, satellite images, orthophotos) in order to estimate and compare the rates of shoreline advance and retreat. To calculate the variations of the coastline position at different times, DSAS tools for ArcGIS have been used (Himmelstoss et al., 2018). The parameters used have been Net Shoreline Movement (NSM), that is the distance (m) between the oldest and most recent line, and End Point Rate (EPR), which is the value of NSM divided by the time interval in years between those lines, expressed as the change in m/year (Thieler et al., 2009). Moreover, episodes of river flooding, sea storms, bathymetric analysis and human actions on nearby coasts have been reviewed to interpret the results in a holistic approach. The results indicate that, during the 21st century, the evolution of the mouth of the Mijares river responds to a combination of fluvial and marine processes, where anthropic action is key to explaining its current morphology. The results show -6.46 of the NSM parameter between 2003 and 2023 in the south of the current mouth while the maximum progradation is recorded at the mouth of the delta itself, with a record of 96 m in the NSM parameter. The maximum EPR is also recorded at the mouth (4.8 m). Sedimentation at the mouth is the result of storms that accumulate sediment when the river is not subject to flooding events, in which case the barrier of sediment breaks at the mouth of the river (Segura-Beltran and Marínez-Pardo, 2021). The construction of anthropogenic infrastructures in the north of the delta implies a clear alteration of the coastal dynamics.

Key words: Coastal dynamics, Mouth of the Mijares River, Western Mediterranean.

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THE APPLICATION OF SATELLITE REMOTE SENSING TO COASTAL DUNE ENVIRONMENTS: A SYSTEMATIC REVIEW

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Abstract: Sandy coasts are highly dynamic landscapes due to long-term processes and short-term events leading to changes in a variety of temporal and spatial scales. Coastal dune environments are generally well studied at a 'micro' scale, both temporal and spatial, using highly detailed and costly in-situ surveys. However, understanding the dynamics of coastal dune environments at medium and large spatial scales is fundamental for coast management and conservation. This review gathers recent progress on the use of satellite remote sensing data to study coastal dune environments at a medium and large spatial scale (from beach scale to coastal landscape scale). It is motivated by the increasing availability of satellite data, which coupled with other coastal monitoring systems, will be key for understanding coastal processes at medium and large spatial scales. The directions followed in this review include an identification of the most suitable satellite sensors for coastal studies and remote sensing methods for dune detection, characterisation and monitoring; landscape scale sandy coast mapping; and linking plot and landform observations to landscape scale. The preliminary outcomes of this review show an increasing availability of suitable satellite data that facilitates the exploration of coastal dune change at spatial and temporal resolutions that were not possible until recently. This presentation will discuss some of the benefits and challenges of using a range of satellite products to map coastal dune landscape elements (e.g., vegetation cover, topography), and how this information can be used in coastal management in general.

Key words: coastal dunes, sandy coasts, remote sensing

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BLUE CARBON STORAGE IN SALTERNS OF CADIZ BAY

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Abstract: Salt marshes are considered to potentially absorb and store large quantities of carbon dioxide from the atmosphere in the vegetation and sediments (blue carbon, BC), in addition to providing others ecosystem services, like biodiversity conservation and natural protection against sea level rise. Historically, large extensions of saltmarshes in the Cadiz Bay have been transformed to saltpans. However, little is known about the potential BC storage in saltpans. We analyzed and compared the BC stock in the sediment of three ponds (seawater storage, evaporator and crystallizer), which constitute a salinity gradient, from 35 to 285 psu, in an artisanal and in an industrial saltpan in the Cadiz Bay. In addition, we compared these values with unaltered saltmarshes in the same area. Three sediment cores up to 1 m of depth were collected from each pond and control saltmarshes, sliced every 2 cm and organic matter, dry bulk density, organic carbon and total nitrogen contents were determined. BC stocks were quantified at 30 cm (BC_{30}) and 100 cm depth (BC_{100}) showing similar trends. Overall BC_{100} stock in unvegetated sediments of the industrial saltpan (321.9 CO_2 ha^{-1}) was higher than in the artisanal saltpan (239.4 CO_2 ha^{-1}), although the differences were not statistically clear. In addition, the highest BC_{100} was measured in the evaporator and crystallizer of the industrial saltpan (449.9 and 350 t CO_2 ha^{-1}, respectively). These results indicate that active saltpans, either artisanal or industrial, may store similar quantities of BC in the sediments than pre-existing wild saltmarshes. In addition, these results open the possibility to integrate the BC storage capacity of saltpans into strategies for climate change mitigation, such as voluntary carbon credit mechanisms or carbon markets. This would help to the conservation of these human-

made environments and their important ecological, historical and sociocultural values.

Key words: saltmarsh, carbon burial, climatic regulation.

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RESILIENCE AND SEASONAL VARIABILITY OF FOUR MESOTIDAL BEACHES IN THE RÍA DE VIGO (NW SPAIN)

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Abstract: Beaches constitute a natural protective barrier between land and sea. However, their use has certain associated problems that can result in the loss of coastal functionality. The impact of beach anthropization affects their ability to recover from the repercussions of storm events. Prolonged over time, the beach would develop an erosive tendency that could culminate in its disappearance. In fact, the increase of storm events is one of several climate change-induced factors. This study analyzes the morphodynamics of four mesotidal beaches (*Barra*, *Rodeira*, *Samil* and *Ladeira*) with different degrees of anthropization and wave exposure in the middle/outer sector of the Ria de Vigo (Galicia, NW Spain). The objective is to assess their resilience to both, seasonal and storm conditions, their evolutionary tendency and their response to climate change. To achieve this, georeferenced altitude data has been taken along different transects on the four beaches from 2019 to 2023, using DGPS (*Trimble R10*). A total of 252 topographic profiles were registered. Sediment samples were also analyzed in order to complete beach characterization.

Results indicate significant differences in profile shape, seasonal condition's variability, and sediment composition within the four beaches studied. The prevalent wave direction in the area is W-WNW, affecting *Samil* the most, while extreme storm events from WSW impact on *Barra*. This pattern is clearly reflected on the development of their profiles, being the beaches with higher variability and slope range. In relation to their evolutionary tendency, all four beaches have remained stable. Their fair-weather condition's profiles in 2019 and 2023 are significantly similar, without changes in beach face slope, regardless of their degree of anthropization. It cannot be determined whether the latter has a short-term significant effect. A longer study period would be required to determine the beaches' resilience to climate change.

Key words: Beach morphodynamics, Topographic profile, Sediment characterization, Beach resilience, Ría de Vigo.

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IX INTERNATIONAL SYMPOSIUM ON MARINE SCIENCES

POSTER COMMUNICATIONS

COASTAL, ESTUARINE AND MARINE ECOSYSTEMS

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MICROBIAL ASSEMBLAGES INHABITING MICROPLASTICS IN THE RIA DE VIGO COASTAL SYSTEM

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Abstract: Marine pollution from plastic waste represents an anthropogenic threat to oceans and improper plastic disposal leads to marine contamination, impacting ecosystems, biodiversity, and, ultimately, human health. Microplastics (< 5 mm), primarily originated from degraded larger objects, due to their unique characteristics, support microbial biofilms and several factors, including salinity, nutrient availability, geography, and exposure duration, shape the microbial community structure. The interaction between plastics and microbes has ecological implications, affecting microbial growth through leachates and toxic compounds present in synthetic polymers. Despite the increasing research, there is a lack of knowledge of the microbes attached to microplastics in coastal ecosystems. Indeed, few studies have revealed the presence of microplastics in the sea surface waters and mussels reared in the Ria de Vigo ecosystem. To our knowledge, this study represents the first attempt to analyse the microbial communities of the microplastics in the Ria de Vigo coastal system, an area known for its highly productive ecosystem supported by coastal upwelling events. The goal of this study is to profile the microbiome, understand the dynamics and interactions within microplastics, and evaluate their impact on biogeochemical cycles. To this end, we took samples from the sea surface in different locations of the Ria de Vigo to obtain microplastic particles and water samples. The number, size and type of microplastics differed across the different locations, being more abundant in the central station. Flow cytometry analysis revealed that the phytoplanktonic community was dominated by *Synechococcus*, *Picophytoplankton* and *Cryptophycea.* Preliminary results on the metagenomic analysis revealed differences in the microbial community structure and diversity of the microplastics when compared to the surrounding seawater.

Key words: Microlastic, Microbial community, Metagenome.

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NUTRIENT LIMITATION AND SOURCE DEPENDENCY OF MARINE PLANKTON IN THE OFFSHORE CANARY WATERS

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The offshore waters of the Canary region experience a chronic limitation of different nutrients throughout the year, resulting in oligotrophic conditions and the predominance of small picoplanktonic organisms. Various processes, such as the late winter mixing or upwelling of deep waters driven by mesoscale features, and the deposition of atmospheric aerosols originated from the neighboring African continent, may temporally alleviate it through the supply of micro- and macronutrients. Yet, the specific contribution of each process on nutrient paucity remains unclear, as their impact relies upon which nutrient acts as the primary limiter. Here we present preliminary findings of a series of seasonal experiments aimed at elucidating micro- and macronutrient limitations and their dependency on nutrient sources in the Canary region. We conducted dissolved iron, nitrate, and phosphate full factorial bioassays to tackle potential changes in the growth and photo-physiology of bacterio- and phytoplankton. Our findings underscore significant nitrogen limitation, as evidenced by a positive response in marine bacteria and small and large phytoplankton, which exhibited up to a doubling in abundances within 48 h after nitrate repletion, while dissolved iron alone or combined with phosphate did not elicit a discernible effect. Furthermore, chlorophyll *a* concentration and gross oxygen production doubled in nitrate-replete treatments, concomitant with nearly fourfold nitrogen assimilation compared to the control. We suggest that the quasi-permanent water column stratification prevalent in the Canary region hampers nitrate availability, whereas iron and phosphate are continuously replenished via the recurrent fluxes of African dust plumes, thereby mitigating their restriction among small plankton communities.

Key words: micro-, macronutrient limitation, phytoplankton, bacterioplankton, Canary region

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CHARTING BLUE CARBON: A WETLAND ASSESSMENT PROJECT FOR NW IBERIA

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Abstract: Marine ecosystems like mangroves, seagrasses, and salt marshes are carbon sinks, trapping and storing atmospheric carbon dioxide. These systems, also referred to as blue carbon ecosystems (BCE), have the potential to mitigate climate change impacts and to support the achievement of carbon neutrality goals. At the same time, they are threatened by climate change impacts, particularly by sea level rise when habitat migration to higher grounds is impossible due to barriers and conflicting land use.
The CAPTA project aims to assess the distribution and dynamics of BCE in NW Iberia, as well as their potential for carbon storage. This is done by mapping saltmarshes and seagrass areas and estimating plant biomass through a combination of field work to collect ground-truth data on plant species and biomass and multispectral remote-sensing. The proposed methodology allows identification of wetland plant cover species and estimation of their cover area as well as above-ground biomass, based on spectral signatures and vegetation indices extracted from the multispectral imagery (Dolbeth et al. 2023; Meyer et al., 2023, 2024). The potential of imagery captured at different resolutions will also be tested, using ultra-high-resolution images captured by unoccupied aircraft systems (UAV), with a ground-sampling distance (GSD) of few centimetres, and high-resolution satellite images, with GSD of 30 cm.
The CAPTA project and the proposed methodology are presented, as well as preliminary results, demonstrating the potential of multispectral remote sensing for mapping BCE and estimating biomass.

Key words: Remote sensing, multispectral images, unoccupied aircraft systems, blue carbon ecosystems

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ASCIDIAN "GARDENS" ON SOFT CIRCALITTORAL BOTTOMS IN THE WESTERN MEDITERRANEAN (IBERIAN PENINSULA)

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Abstract: The great majority of ascidians are sessile filter-feeding and macro-epibenthic organisms, capable of forming different assemblages depending on the substratum and trophic availability. This is particularly important on soft substrates, characterized by homogeneous and poor habitats, where they can establish a new habitat known as "ascidian bottoms" in the Mediterranean Sea (Salfi 1932; Parenzan 1959; Pérès and Picard 1964; Monniot 1965), with solitary ascidians as principal element of the system. However, a large part of these soft substrates is impacted by bottom trawling in the Iberian Mediterranean (Ramos-Esplá 1988; Turón 1988; Díaz-Valdés 2009; Arroyo *et al*. 2021). During the MEDITS experimental-trawl surveys (2017-2019), with stratified random sampling between 35 and 722 m deep from Cape Palos to Portbou, 63 spp. and 9805 individuals were collected. Regarding specific richness, the order Aplousobranchia stands out with 30 spp., but with low abundance (8,2%); followed by Stolidobranchia with 22 spp. and 76.3%; and Phlebobranchia with 11 spp. and 15.5%, respectively. By family, Styelidae (9 spp., 51.9%) and Ascidiidae (8 spp., 15.4%) are the main ones. The solitary strategy is the most abundant, with 87.5% of the number of individuals and 30 spp. Although the sampling frequency of ascidians has been relatively high (54.6% of hauls), between 35 and 593 m deep, only 5.2% has exceeded 100 ind./haul (46-141 m deep). They likely form dispersed patches on rhodolith beds, coastal detrital and muddy detrital substrata. The most abundant species (>100 ind.) have been solitary forms (*Ascidia mentula, Ascidiella aspersa, Phallusia mammillata, Polycarpa gracilis, P. mamillaris, P. pomaria, Styela canopus, Halocynthia papillosa, Microcosmus savignyi, M. vulgaris, Pyura microcosmus, Molgula appendiculata*) and few colonials (*Diazona violacea, Rhopalea neapolitana, Botryllus renierii, Distomus variolosus*). The communication will present the bathymetric, habitat and geographical distribution of ascidians in the Iberian Mediterranean (Gulf of Alicante, Gulf of Valencia and Catalonia).

Key words: engineering species, invertebrate "gardens", benthic habitats, trawling

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METHODOLOGICAL DEVELOPMENT OF THE ISOTOPIC MEASUREMENT OF DISSOLVED INORGANIC CARBON IN COASTAL AND ESTUARINE SYSTEMS

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Abstract: Coastal and estuarine systems generally act as significant sources of CO2 to the atmosphere. Using the isotope ratios of dissolved inorganic carbon (δ^{13}C-DIC) enhances our understanding of the carbon cycle in these areas by providing information on the origin and processes involving DIC. δ^{13}C-DIC is used to characterize the relative contributions of organic matter degradation processes, biological production, exchange with the atmosphere and physical processes that control its dynamics in the ocean and coastal waters.

To this end, a specific methodology has been developed for the quantification of δ^{13}C-DIC in marine and estuarine water samples for DIC concentrations ranging from 2000 and 4600 µmol kg^{-1}. Using 1 mL of samples and adding 50 µL of 2 M phosphoric acid (H_3PO_4) ensures a pH below 2 and provides an adequate analytical signal. Additionally, a He flow rate of 100 mL min^{-1} produces a complete removal of air contained in the vials prior to sample introduction and acidification. A 24-hour equilibration time with constant agitation and temperature prevents isotopic fractionation. For δ^{13}C-DIC quantification, a liquid-gas equilibration system (Gas Bech Plus, Thermo) coupled to an isotope ratio mass spectrometer (Delta Q, Thermo) has been used. The equipment was calibrated with primary reference materials (solid carbonate standard, IAEA603, NBS18) and secondary standards (various DIC solutions). For each sample, ten consecutive δ^{13}C-DIC measurements were performed, presenting standard deviations lower than 0,2 ‰.

This methodology has been applied to samples from different coastal and estuarine zones. The results indicate an enrichment of lighter isotopes in the inner zones of these systems, mainly due to intensified organic matter mineralization processes.

Key words: Carbon stable isotopes, dissolved inorganic matter, isotope ratio mass spectrometer, estuaries.

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COASTAL ENVIRONMENTAL CHANGE IN THE WESTERN MEDITERRANEAN DURING THE ROMAN AGE

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Abstract:

The main objective of this study is to determine the different palaeoenvironmental episodes during the Roman Age in the Western Mediterranean coast. For this reason, mechanical cores have been carried out in coastal lagoons in Menorca (S'Albufera des Grau) and on the Valencian coast (Valencia lagoon), whose sediments have been radiocarbon (^{14}C) dated and analyzed from a sedimentary, micropalaeontological and chemical point of view. The results indicate a generalized environmental change in the western Mediterranean in Roman times involving the closure of the marine connection of the studied lagoons through coastal progradation processes made possible by the greater sedimentary availability in these times. This episode has been confirmed elsewhere the Mediterranean (Fumanal and Ferrer, 1998; Sabatier et al., 2008). The foraminifera characteristic of restricted environments found in S'Albufera des Grau and the Valencia lagoon are *Ammonia tepida* (Cushman), *Haynesina germanica* (Ehrenberg), *Elphidium excavatum* (Terquem) and *Pseudolachlanella eburnea* (d'Orbigny). In the Valencia lagoon and S'Albufera des Grau the closure is recorded at 2,240 BP, which is synchronous with the closure of other Mediterranean coastal lagoons (Sacchi et al., 2014; Dolez et al., 2015; López-Belzunce et al., 2022). This episode of sediment availability coincides with the 2.8 ka cold and arid event and the flooding events recorded at that time (Bond et al., 1997) and with a generalized progradation of the coastline.

Key words: Roman Age, Sediment progradation of the coastline, lagoon closure, Western Mediterranean.

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INCREASING SPATIAL AND TEMPORAL RESOLUTION OF SURFACE UNDERWAY BIOGEOCHEMICAL VARIABLES IN THE GALICIAN COASTAL ZONE: A PILOT APPROACH DURING WINTER 2023-2024

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Abstract: Sustained surface ocean observations are key information for society. However, data collection efforts for certain biogeochemical variables remain limited, hindering our understanding of coastal ecosystem dynamics (Roobaert et al., 2024). Furthermore, coastal areas have more variable chemical dynamics due to influence of anthropogenic and biological activity, so spatially resolving and predicting fields are challenging due to seasonality and regional heterogeneity (Dai et al., 2022). Additionally, the Galician coast is a region with recurrent upwelling events. These upwelling dynamics do not only influence the air-sea exchange of heat and carbon dioxide, but also other interlinked biogeochemical oceanographic variables such as dissolved oxygen and chlorophyll (Padin et al., 2020). The sampling density of current surface databases follows mostly marine traffic lanes, apart from the coast, and there is an urgent need for coastal and inner Ría data. Promising ongoing coastal underway campaigns like this pilot approach will increase spatial and temporal resolution.

Here we show the first experiences acquired with an own-designed autonomous underway observing system equipped with a set of sensors for temperature, salinity, dissolved oxygen, fluorescence, pH and partial pressure of CO_2 coupled through inline devices. Observations were done aboard the vessel R/V Mytilus during winter 2023-24 (from December to March) across several main bays of Galicia. The insight gleaned from this winter season underscores the value of underway measurements as a complement to discrete sampling strategies. The integration of properly calibrated sensors in the underway system enhances our understanding of surface dynamics. In addition, ecologists working in heterogeneous coastal environments can leverage the real-time underway system data, optimizing sampling site selection and improving the efficiency of surveys. Therefore, there is an urgent need to develop and implement operational strategies for systematically

collecting and delivering surface biogeochemical variables, in line with the growing societal demand for accurate and timely information on coastal ecosystem health.

Key words: biogeochemical observations, coastal ocean, sampling resolution, underway system

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EFFECT OF OCEAN ACIDIFICATION ON THE DIATOMS OF THE RÍA DE VIGO

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Ocean acidification refers to the increase of carbon dioxide (CO_2) in seawater due to anthropogenic activities (IPCC, 2014). Understanding its impact on diatoms, which are responsible for 50% of marine primary production, is crucial (Bach et al., 2019). Previous studies have hypothesized that an increase in CO_2 concentration favors the growth of diatoms (Sahabuddin et al., 2020). However, there is still a lot of variability in the results obtained (Dutkiewicz et al., 2015). This study assesses CO_2 effects on diatoms in Ría de Vigo, an estuarine system in the Northwest Iberian Peninsula and characterized by a pronounced upwelling-downwelling regime. Diatom abundance, biovolume, and biomass were analyzed from four different experiments. Three of them were conducted in microcosms and the other from samples collected in situ. The analysis was carried out using Lugol's fixed samples and microscopy. This allowed the characterization of mainly nano- and microplankton cells which have been described as the major phytoplankton assemblages responsible for the high primary production of these coastal areas. The results showed great variability regarding the effects of CO_2 on diatom abundance and biovolume which led to an absence of significant differences between the effect under future and current atmospheric CO_2 concentrations. However, significant effects were observed for some of the species that contribute most significantly to primary production in the Ría de Vigo. Among these, the response to increased CO_2 was favorable for the biomass of Leptocylindrus sp. and unfavorable for Chaetoceros sp. with a medium-sized morphotype. Among these two species, the effect of CO_2 on Leptocylindrus sp. stood out due to its high abundance and biovolume, being the species that contributed the most to the total phytoplankton biomass. In conclusion, the results showed that CO_2 effects in Ría de Vigo are heavily dependent on the response of the dominant phytoplankton species.

Key words: ocean acidification, diatoms, abundance, biovolume, biomass

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LIMITATIONS OF DESTRUCTIVE SAMPLING FOR SALTMARSH VEGETATION CHARACTERISATION.

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Abstract: Saltmarshes are highly productive coastal ecosystems, which are seriously threatened by human activities and sea level rise. Obtaining in situ data in these ecosystems presents challenges such as difficulty of access and disturbances during data collection [1]. However, better understanding the environmental conditions that influence the distribution of vegetation, as well as its spatio-temporal variations, is very necessary. Unmanned aerial vehicles (UAVs), equipped with LiDAR and multispectral (MS) sensors, open new opportunities to study this habitat, allowing estimations of species and biomass distribution with large spatial and temporal resolutions and minimal disturbance to the system [2]. A previous study [3] estimated the seasonal behaviour of plant biomass in the Boli marsh (surface area 4 ha) in the Bay of Cadiz Natural Park. During the year 2023, both in situ sampling and UAV-LiDAR and MS flights were carried out seasonally. The LiDAR and MS data showed a clear seasonality for the dominant plant species. Despite this, seasonality was not detected by analysing field data alone (4 sampling points ha^{-1} $season^{-1}$).

The present study aims to assess whether field data are sufficient to assess biomass seasonality or whether they should be combined with UAV data to understand the behavior of the system. For this purpose, 100 seasonal samplings with the same number of points and spatial density were simulated from the seasonal UAV data biomass models [3]. The results suggest that 4 sampling points ha^{-1} $season^{-1}$ are insufficient to detect the seasonality of biomass; however, they help calibrate UAV biomass models with high confidence.

Increasing the number of sampling points in the field would allow seasonality to be detected with field data, but at a high cost in human resources and impact on the system. In conclusion, UAVs will significantly improve our knowledge on the dynamics of coastal vegetated systems and their ecosystem services.

Key words: Saltmarshes, biomass, seasonality, drones, Bay of Cadiz.

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RAPID RESPONSE OF DIAZOTROPHS TO HYDROGRAPHIC CHANGES IN AN UPWELLING BAY.

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Abstract: Diazotrophs--prokaryotes able to fertilize the ocean through biological dinitrogen fixation (BNF)--are enigmatically present and active in eutrophic regions, including coastal upwelling systems. Previous studies in the upwelling off NW-Iberia showed that the diazotrophic community responds to changes in hydrodynamic forcing over seasonal scales. However, the effect of transient upwelling events, with a typical duration of a few days, remains unknown. We used a multidisciplinary dataset of weekly and higher frequency observations collected in the Galician Rías Baixas within a period of ~1.5 years, to describe changes in the abundance, composition, and activity of diazotrophs over different temporal scales. BNF exhibited a strong seasonality being, higher rates (1.1 nmol N L^{-1} d^{-1}) quantified during summer and early autumn. The diversity of the diazotrophic community was lower during this period, when UCYN-A2 was dominant, and this group increased its abundance and activity. Comparable changes in total BNF and the abundance and activity of UCYN-A2 were observed over few days during the summer period. Daily observations during a three-week cruise sampled a strong upwelling event followed by a few days of relaxation-downwelling and, soon after, another upwelling pulse. Higher N2 fixation rates (2.2 ± 0.7 nmol N L^{-1} d^{-1}) were measured during relaxation-downwelling, when the water column was nitrate depleted. During the fertilization associated with the upwelling, BNF dramatically decreased to 0.10 ± 0.09 nmol N L^{-1} d^{-1}. UCYN-A2 abundance was 4-fold higher during relaxation-

downwelling than during the upwelling period. Periods of enhanced BNF rates co-occurs with high abundances of potential hosts of Diatom diazotroph associations, likely suggesting that this symbiosis could be relevant in the system. Our results indicate that diazotrophs can respond rapidly to changes in the environment occurring over few days. This short-term variability should be considered to utterly understand the role of diazotrophs in highly dynamic coastal systems.

Key words: Biological nitrogen fixation, Upwelling bay, short-term variability, UCYN-A2, DDAs.

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AN ASSESSMENT OF THE SPATIAL AND TEMPORAL VARIBILITY OF *D. ACUMINATA*: 25-YEAR TIME SERIE IN NORTH-WESTERN IBERIAN SHELF

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Abstract:

Among the threats to which coastal areas are exposed, Harmful Algal Blooms (HABs) are one of them. The most common species, recurring every year in the Galician Rías Baixas, from spring to autumn, is *D. acuminata*. It is a significant threat to human health, causing diarrhetic shellfish poisoning (DSP), and to the economic activities of the area (i.e. mussel production, fishing, tourism). To study the temporal and spatial variability of *D. acuminata* at the Galician Rias Baixas, a 25-year time serie of counting cells data, from 1996 to 2020, recorded by Instituto Tecnolóxico para o Control do Medio Mariño de Galicia (INTECMAR) at 29 stations, was analyzed. The application of Empirical Orthogonal Functions (EOF) to the temporal and spatial interpolated time series showed the three main modes of variability, accounting for 94.75%, 95.05% and 90% at Ría de Arousa, Pontevedra and Vigo, respectively. This analysis differentiated the north-south and inner-outer zones of the Rias, which led to the selection of some representative stations. Multiparametric analyses were carried out with counting cells of *D. acuminata* at these stations, temperature, salinity, nutrients, irradiance, chlorophyll, and upwelling index. The seasonal cycle of *D. acuminata* depicted a maximum in April at Ría de Pontevedra, and in May at Ría de Vigo and Arousa, after what values decreased, increasing again in August at the three Rias to reach lowest values in December. When analyzing the number of blooms per year and stations, and the days that they last, we observed two pulses, 1998-2005 and 2011-2016. Stations at the Ría de Pontevedra stood out with a higher number of blooms and a longer duration of blooms. Future works might be aimed at the prediction of *D. acuminata* cells using machine learning techniques, that consider the relationship obtained between the analyzed variables.

Key words: HAB, *D. acuminata*, NW Iberian shelf, EOF, variability.

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A NEW ACTOR ON THE EASTERN COASTS OF THE IBERIAN PENINSULA: FIRST RECORD OF THE PRESENCE OF THE GENUS *GAMBIERDISCUS* (MIOZOA, DINOPHYCEAE)

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Abstract: *Gambierdiscus* (Miozoa, Dinophyceae) is a benthic microalgae genus that produces ciguatoxins (CTX), considered the main cause of the foodborne illness ciguatera fish poisoning (CFP), that includes gastrointestinal and neurological symptoms and affect approximately 50,000 people annually worldwide (Soliño & Reis Costa, 2020). Widely distributed throughout tropical and subtropical areas, their presence in the Mediterranean sea was first reported in 2003 in Crete (Greece)(Aligizaki & Nikolaidis, 2008), being recorded a decade later in the western basin, in Balearic Islands (Spain)(Tudó et al., 2018). Here, we present the first report of *Gambierdiscus australes* Chinain & M.A. Faust in the eastern coasts of the Iberian Peninsula, constituting the first citation of this genus in the continental coasts of the western Mediterranean. Along a survey carried out in March and September or 2023 at 12 sampling points on the Dénia-Jávea coast (Alicante province), water column samples (1:1 mixture of surface water and 5 m depth) were collected and preserved in 2% Lugol. Cellular abundance was determined according to Utermöhl's sedimentation method and species identification was performed by scanning electron microscopy. *G. australes* was detected in 100% of the samples in September and 75% in March, with a maximum concentration of 140 cell/L (although given the benthic character of this species, higher concentrations near the seabed would not be discarded). The *G. australes* cells showed morphological similarities with those of other previously described *G. australes* (Litaker et al., 2009; Bravo et al., 2019), and their size fell within the range of the first description of this species in the Pacific Ocean (Chinain et al., 1999). This study

highlights the expansion of this genus in temperate zones, as well as the importance of carrying out studies of benthic dinoflagellates in this area to know the risk that their presence may represent for public health.

Key words: phycotoxin, ciguatera, Mediterranean sea, benthic dinoflagellate.

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LIFE CYCLES OF THE SPECIES *Anomia ephippium* Linnaeus, 1758 AND *Ostrea edulis* Linnaeus, 1758: INFLUENTIAL ENVIRONMENTAL FACTORS AND CONDITIONING OF ANTIFOULING TREATMENTS IN MARINE REFRIGERATION PIPES

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Abstract: Most nuclear (coastal) power stations are strategically located close to the shore, to take advantage of seawater as a heat sink this requires of the use of chlorine for the prevention of biofouling in marine refrigeration pipes. This practice is subjected from limitations and regulatory pressure associated with its use and environmental impacts associated. This study aims to determine the annual biological cycle of the pioneer species *Anomia ephippium* Linnaeus, 1758 and *Ostrea edulis* Linnaeus, 1758 and observe the environmental parameters that affect their colonization, fixation, and survival. The study was conducted in *Posidonia oceanica* (Linnaeus) Delile, 1813meadows from Calps municipality, Alicante, Spain, between April 2017 and September 2018. Submerged terracotta roof tiles were used as artificial settlement structures and collected data on the recruitment and growth of the species at different depth ranges. The tiles were placed at 10, 15, and 20 meters depth and collected monthly, with two tiles remaining in the water for 12 months. The study found that the annual biological cycle of *A. ephippium* and *O. edulis* was affected by environmental parameters such as temperature, light intensity, and food-cell concentrations. Recruitment was found to be continuous, but its intensity varied considerably between months and depths, reaching a maximum during June 2018 at all depths. Differences in recruitment intensity at 20m between cold and warm months suggest phytoplankton abundance might be among the main factors driving this event. These results provide insights into the biology and life cycles of the most abundant species that colonize marine refrigeration pipes, which can help optimize the frequency and intensity of chlorination cycles and minimize ecological impacts.

Key words: Antifouling, Chlorination, Pioneer, Life cycle.

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DISSOLVED ORGANIC MATTER DERIVED FROM DIFFERENT PHYTOPLANKTON CULTURES: CHARACTERIZATION AND USE IN STUDIES WITH MARINE BACTERIOPLANKTON

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Abstract: A large fraction of the organic matter used by bacteria in the ocean derives from phytoplankton. It has been shown that different phytoplankton groups produce dissolved organic matter of different composition, possibly affecting the remainder of the microbial community and activity. As ocean warming should favor small coccolithophorids with respect to diatoms, we characterized the organic matter composition from one culture of each group using chromophoric and fluorescence properties. We then fed such organic matter to a natural bacterioplankton community collected at the Blanes Bay Microbial Observatory (northwestern Mediterranean). Collected water was first filtered by 0.8 µm to remove most organisms other than heterotrophic bacteria. Dissolved organic matter derived from either coccolithophorid or diatom culture was added and water was incubated under controlled temperature and light conditions. Water was monitored over one week period, analyzing dissolved and particulate nutrients and organic matter as well as the activity of bacteria on specific organic matter substances and as bulk production, and changes in bacterial community composition from metabarcoding. Results will be discussed in light of foreseen seasonal and long-term changes in the importance of coccolithophorids and diatoms.

Key words: Dissolved organic matter, coccolithophores, diatoms, bacterioplankton, ocean warming

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SENTINEL-2 FOR MAPPING MANGROVE FOREST EXTENT, COMPOSITION AND ECOLOGICAL CONDITON IN SMALL ISLANDS

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Abstract: Mangrove ecosystems suffer from high levels of degradation that inevitably reduces the provision of their ecosystem services and ultimately impacts human well-being, especially in coastal communities of Small Islands Developing States (SIDS). Here we evaluated the use of Sentinel-2 satellites to monitor mangrove extent and species distribution in Lac Bay (Bonaire-Caribbean Netherlands) testing several vegetation indices and supervised classifications (Maximum Likelihood (ML)). We also evaluated the mangrove's ecological condition through two biophysical variables 1) Effective Leaf Area Index (LAI_e) and 2) Net Primary Productivity (NPP). In the case of LAI_e, we developed a specific algorithm based on the empirical relationship between in situ LAI_e (51 measurements) and the Normalised Differenced Vegetation Index (NDVI) using band 8 and band 4 bands. We also validated the Simplified Level-2 Prototype Processor (SL2P) employing the same field measurements. Our results showed that Sentinel-2 data are a valuable tool for mapping the extent of mangrove forests in Bonaire and species composition (mean overall accuracy > 95 %). Using five Sentinel-2 images from 2021 and 2022 and ML classifications the mangrove forests extend was estimated to be on average 222.3 ha, of which 136.0 ha were classified as *Rhizophora mangle* (red mangrove) and 77.1 ha as *Avicennia germinans* (black mangrove). Mean values for predicted LAI_e ranged from 3.37 to 3.85 for Lac Bay, with significantly higher values in the wet season (3.82 ± 0.57) compared to the dry season (3.40 ± 0.56). The generic SL2P underestimated the LAI_e values, with moderate differences between SL2P and in situ data (BDE = 0.41, RMSE = 1.09). Mean NPP values were estimated to be 8.82 ± 1.46 (g Cm^{-2} d^{-1}). The method developed in this study can be used by small island states to make informed decisions

about the management and protection of mangrove ecosystems.

Key words: Leaf Area Index, Net Primary Productivity, SL2P, biodiversity, coastal management

Acknowledgments: This work was supported by the European Union's Horizon 2020 research and innovation programme under grant agreement No 869710 "Marine Coastal Ecosystems Biodiversity and Services in a Changing World" (MaCoBioS) to all authors and by the Netherlands Ministry of Agriculture, Nature and Food Quality under research project BO-43-117-007 to M. van der Geest. The authors wish to thank Femke van der Drift for helping with the collection of the 2022 field data. We further thank Sabine Engel from Mangrove Maniacs and STINAPA rangers and additional staff, for their advice, cooperation, and assistance during our field campaigns.

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ALGAL COLONIZATION DYNAMICS IN ARTIFICIAL ECOSYSTEMS: A STUDY ON ECO-CONCRETES IN CALPE, SPAIN

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Abstract: Port ecosystems have been identified as areas of low biological diversity due to anthropogenic damage, which causes significant modifications and harms these ecosystems (Yao et al. 2019). Modifying the composition and roughness of concrete in breakwaters can facilitate the colonization of marine species. The use of artificial reefs constructed with eco-concrete demonstrates potential for revitalizing biodiversity in these environments (Dennis et al., 2017; Valipour et al., 2017). The aim of the Livingreefs project is to identify the optimal blend of sustainable materials, such as rice straw or volcanic ash, with cement. This will enable the development of eco-concrete structures that facilitate the colonization of various marine species. These enhance the formation of marine ecosystems in areas where excessive human activity has diminished species diversity, such as harbours. The algal colonization dynamics were examined over a year analysing more than 200 blocks of eco-concrete of eleven different types with variable compositions and construction methods. The concrete blocks were extracted bi-monthly from the area of study to analyse them in the laboratory. Colonization was assessed using traditional methods to determine species taxonomy and the ImageJ software with Fiji package (Schindelin et al., 2012) for precise quantification of algal coverage. Results revealed a clear annual rotation among species. At the beginning of the experiment, the algae present were encrusting coralline algae, and brown algae of the genus *Dictyota.* Over the course of the year, the abundance of the latter species decreased and *Ceramiales* began to appear, representing more than 50% of the algal community for many months. Results indicated differences in coverage and algal diversity between traditional blocks and those composed of volcanic ash, rice straw, and functional bacteria, suggesting that constructing artificial reefs with these eco-concretes could enhance algal biodiversity in port ecosystems.

Key words: Eco-concrete, artificial reefs, algae colonization, algae coverage, ImageJ.

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RESPONSES OF PLANKTON AND BENTHOS COMMUNITIES TO ENVIRONMENTAL CHANGES IN A TROPICAL ESTUARY

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Abstract: Spatial-seasonal variability in planktonic and benthic communities are governed by biotic and abiotic drivers. Understanding the contribution of each driver is essential for discerning patterns and processes within the communities, particularly in tropical estuaries, where there are few studies. This study investigates the seasonal response in benthic and planktonic communities to environmental changes across the Paraguaçu River estuary (Bahia, Brazil), between 2012 and 2016. Benthic communities were sampled using a Van Veen grab, while phytoplankton and zooplankton communities were sampled using trawl nets. Water and sediment quality parameters were measured, and data on community richness, abundance, and diversity, were obtained. Species were identified to the lowest possible taxonomic level using specialized literature and quantified using a microscopic-based method. Phytoplankton analysis revealed that diatoms were the predominant group, followed by cyanophyceae, dinoflagellates, and chlorophyceae. The zooplankton communities were dominated by Copepoda (e.g., *Oithona* and *Paracalanus*) among other eight phyla. In the benthic communities, the phylum Annelida (e.g., Spionidae and Paraonidae) was the most abundant, followed by mollusks (e.g., *Nucula* and *Anachis*) and crustaceans (e.g., *Eurydice*). The planktonic and benthic communities in the Paraguaçu estuary directly responded to the strong influence of water and sediment physicochemical characteristics. Both communities were influenced by natural gradient (e.g., salinity) common to transitional zones, as well as by anthropogenic factors, resulting in significant variations. One of the causes for the changes appears to be the increased nutrient concentrations, driven especially by human activities, with diatom blooms (*Skeletonema* and *Thalassiosira*) being observed in some periods. This study highlights the significant effects of environmental changes on estuarine benthic and planktonic communities and

underscores the need for ongoing monitoring and management to mitigate these impacts.

Key words: spatial-seasonal variability, nutrient sources, Todos os Santos Bay

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MULTIDISCIPLINARY SAMPLING CAMPAIGNS FOR A COMPREHENSIVE ESTUARINE STATUS: THE AVE ESTUARY

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Abstract: Estuaries are some of the most valuable, productive environments in the world, providing numerous ecosystem services. However, as transition zones, they also act as sinks for leached contaminants from human activities and as buffer zones preventing material from reaching the sea. This retention capacity can have significant implications for both environment and human health (One Health concept). Therefore, managing and protecting estuarine environments is crucial for mitigating pollution and safeguarding ecosystem health and sustainability. Such is the main objective of the EU co-funded MAELSTROM project (www.maelstrom-h2020.eu), which aims to install an innovative technology to remove riverine litter, reducing marine litter (ML). The Ave Estuary, Portugal, is a demo site for the project technology. Dedicated multidisciplinary *in situ* campaigns were performed (2021 – 2024) to provide accurate, updated data pre- and post-implementation to evaluate any potential ecosystem impacts. Campaigns focused on understanding the hydrodynamic patterns, characterizing the ecological status, and identifying ML and microplastics (MP) transported by the river. Results reveal a highly-stratified estuary, low freshwater flow, and currents that produce high residence times. The ecological status of the estuary was classified as Bad following the Water Framework Directive for physical-chemical parameters and benthic macroinvertebrates communities. Annual mean transport rates of 22.3 h^{-1} floating ML and 5.3 MP m^{-3} were detected both with significant seasonal variations. It was demonstrated that the Ave River has a highly

anthropogenically impacted estuary in which conditions could be improved by the installation of innovative technologies such the ones proposed in MAELSTROM.

Key words: Estuaries; Multidisciplinary *in situ* campaigns, Hydrodynamics, Ecological assessment, Marine litter and microplastics.

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SPATIO-TEMPORAL HISTOLOGICAL ASSESSMENT OF COCKLE PATHOLOGIES IN RIA DE AVEIRO (PORTUGAL)

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Abstract: Bivalves hold significant ecological and socioeconomic value. They shape and sustain habitats for other species, support marine food webs and biodiversity, and make up a significant portion of the world's fishery sector. The common cockle *Cerastoderma edule* is one of the most abundantly found and exploited species in the estuaries of the Northeast Atlantic European coast. In Portugal, the commercial harvesting of cockles has noteworthy socioeconomic importance as *C. edule* is widely exploited, supporting vital commercial bivalve fisheries namely in the Ria de Aveiro coastal lagoon (NW Portugal). The increasing importance of shellfish harvesting in Portugal requires a good knowledge of the health of cockle stocks. However, there is still a large gap in the knowledge of cockle pathologies in Portugal. Aiming to assess the spatio-temporal variations in cockle pathologies in the Ria de Aveiro, 15 cockles were sampled monthly from June 2020 to September 2020, at 15 points in the cockle's distribution range in the lagoon and processed for histopathological analysis. The parasites and pathological alterations detected were hemocytosis, *Rickettesia*-like organisms (RLO), disseminated neoplasia, *Trichodina* sp., *Rynchodida*-like organisms, *Gregarina* sp., *Nematopsis* sp., coccidian, sporozoan and metazoan, namely trematodes, being RLO and *Nematopsis* sp. the most prevalent. Among the pathologies detected, disseminated neoplasia and trematodes are the most deleterious for cockles, with, respectively, 8.21% and 5.28% maximum prevalence. Results showed a general spatial and temporal homogeneity of the parasite communities. This study highlights the need for continued monitoring of cockle pathologies in Portugal. Understanding the mechanisms underlying the transmission of parasites and disease allow us to enhance monitoring practices, identify susceptible areas for disease outbreaks, and develop effective mitigation strategies. These efforts are essential for maintaining the health of estuarine ecosystems and the well-being of dependent communities.

Key words: *Cerastoderma edule*; Pathologies; Parasites; Histology.

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AEOLIAN SEDIMENT TRANSPORT AT A FOREDUNE TROUGH

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Abstract:

Coastal dunes can adapt to changes in sea-level rise and act as natural buffers against storminess. However, coastlines with blowouts at the beach-dune interface may be more prone to retreat due to enhanced sediment transport inland. While blowouts are effective pathways for this transport, the dynamics governing their evolution are not well understood. Although their topography's impact on airflow has been extensively studied (Hesp, 2002), synchronous measurements of flow and sediment movement from the beach into the dune field are rare (Smyth et al., 2014).

This study examined airflow and sediment transport dynamics at a trough blowout at Sefton Dunes, northwest England. Using a dense array of 3D sonic anemometers and transport sensors such as Laser Particle Counters (LPCs; Davidson-Arnott et al., 2009), measurements were taken during an oblique onshore wind event at the back beach, the adjacent upwind foredune, and within the blowout throat. Strong alongshore deflected airflow across the upwind foredune resulted in high-intensity sediment transport into the blowout throat, where airflow and transport showed high spatial and temporal variability. Airflow accelerated near the upwind blowout wall and decelerated near the downwind wall. Sediment transport, measured in counts per minute and using the Activity Parameter (Delgado-Fernandez et al., 2018), had low correlations with wind variables. Interestingly, transport intensity was found to be inverse to wind speeds at multiple locations, being lower near the upwind wall and higher near the downwind wall. Minor directional shifts of 10-20° caused significant variations in flux intensity within the blowout. These findings offer detailed insights into how beach sediment is transported into and through blowouts, contributing to the evolution of coastal dunes.

Key words: Beach-dune boundary, foredunes, instantaneous transport, aeolian processes, blowouts

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MICROBIAL ADAPTATION TO OCEAN DEOXYGENATION: A KINETIC ANALYSIS FROM COASTAL AND OCEANIC ZONES

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Abstract:

Oceans deoxygenation is considered one of the most important threats currently occurring in marine ecosystems. As oceanic deoxygenation expands oxygen depletion zones, the frequency of hypoxic or anoxic phenomena in coastal areas is also increasing. The study of respiratory kinetics provides insight into the adaptation of the microbial community to decreasing levels of O_2. Prokaryotes can use different types of terminal oxidases with a broad range of affinities for O_2 during aerobic respiration, thus modulating their affinity for O_2 and potentially adapting to deoxygenation events. Here we study the respiratory kinetics of natural communities on cruises exploring both coastal and oceanic environments: the seasonally anoxic water column of the Mariager Fjord, Denmark, and the oxygen minimum zone (OMZ) in the Eastern Tropical North Pacific. We measured O_2 consumption rates of water samples collected at different depths in the oxycline while exposing them to a wide range of O_2 concentrations from full saturation to nanomolar levels during on board incubations. Maximum respiration rates measured in coastal waters were higher than the ones measured in the OMZ. Notably, both locations exhibited a pattern of decreasing respiration rates with increasing depth. The half saturation constant (K_m) also decreased from oxic waters to hypoxic and anoxic depths, suggesting the dominant contribution of low affinity terminal oxidases in fully oxic waters and the adaptation of the community to low O_2 waters with increasing use of high affinity terminal oxidases. Our data show the adaptation of the microbial community in aquatic ecosystems exposed low O_2 levels, decreasing the apparent K_m to increase the respiration efficiency.

Key words: deoxygenation, aerobic respiration kinetics, oxygen minimum zones.

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OBSERVATIONS OF HYDRO AND SUSPENDED PARTICULATE MATTER DYNAMICS AT SHALLOW ESTUARIES OF AROUSA (GALICIA)

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Abstract: The inner sections of the Galician Rias feature shallow estuaries dominated by tide and fluvial forcings where sand sediment accumulations create a profitable substrate for shellfish, heavily harvested by locals. Recently, these coastal ecosystems have degraded, as observed by the lower production of commercial shellfish species. Among multiple variables, changes in suspended particulate matter trends and sediment stability, both driven by local sedimentological and hydrodynamic conditions, emerge as potential contributors. However, these factors have been barely studied, despite their susceptibility to be affected by climate change and anthropogenic interferences.

The objective of this study is to enhance our knowledge of local hydrodynamic processes by actual in situ measurements, with the aim of contributing to an efficient management of the local shellfish ecosystem. We deployed a set of mooring stations measuring turbidity, current direction and magnitude, pressure, and temperature, in three selected shallow estuaries with variable fluvial-ocean influence in the southern margin of *Ría de Arousa*. The deployment spanned a spring month with changing weather conditions. Our results are combined with measurements from meteorological and oceanographic permanent stations in the area from public institutions. The dataset is analysed in order to describe tidal and fluvial processes and to identify patterns in suspended particulate matter during the studied period that might affect the shellfish survival. Additionally, our acquired information will contribute to validate local hydrodynamic models currently under development.

Key words: turbidity, current, shellfish, estuary

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OXIDATIVE STRESS RESPONSE IN THE NATIVE ALGAE *ACETABULARIA ACETABULUM*, *DASYCLADUS VERMICULARIS* AND *CAULERPA PROLIFERA* ASSOCIATED TO THE INVASIVE *BATOPHORA OCCIDENTALIS* IN S'ESTANY DES PEIX (FORMENTERA, BALEARIC ISLANDS)

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Abstract: Algae represent more than 41% of marine biological invasions worldwide. If non-native algae become invasive and a dominant species, it will inevitably affect the characteristics of the ecosystem. The aim of the study was to evaluate the potential effect of the recently arrived *Batophora occidentalis* growing over three native algae: *Acetabularia acetabulum*, *Dasycladus vermicularis* and *Caulerpa prolifera* in S'Estany des Peix (Formentera Island), a shallow saltwater lagoon environment, by means of antioxidant-related biomarkers. The environmental conditions of lagoon favoured the extensive progression of *B. occidentalis,* which since 2020 has been progressively spreading to the entire perimeter of the lagoon where it has found a substrate to attach itself to, even epiphyting native algae. The activities of the antioxidant enzymes (catalase, superoxide dismutase, and glutathione reductase), the phase II detoxification enzyme glutathione S-transferase and levels of malondialdehyde as indicator of lipid peroxidation were evaluated. The results showed significant increases in all biomarkers monitored in the three native algae affected by *B. occidentalis*, except MDA levels in *C. prolifera.* In conclusion, the presence of the invasive alga *B. occidentalis* can induce a stressful situation in epiphyted native algae evidenced by an increase in oxidative stress biomarkers. Continued studies are necessary to determine its possible effects on the growth and survival of the affected algae, as well as its impact on the ecosystem.

Key words: *Batophora occidentalis*, invasive species, algae, oxidative stress, antioxidant enzymes

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DIEATARY AND ISOTOPIC NICHE PATTERNS ACROSS PARAMURICEA CLAVATA COLONY COLORATIONS AND FILTER FEEDING SPECIES INHABITING NEAR A FISH FARM

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Abstract: The gorgonian *Paramuricea clavata* is a keystone Mediterranean species that can exhibit a wide range of colors including red, yellow and the combination of both within the same colony. Here, we assess the isotopic ($\delta^{13}C$ and $\delta^{15}N$) and nutrient (percent C and N) composition of *P. clavata* (branch tissue and polyps), and we evaluate potential dietary contributions (plankton fractions of 1 and 20 µm and sediment) and isotopic niche for local filtration feeders such as the gorgonian *Eunicella* sp. and the mussel, *Mytilus galloprovincialis*. Samples were collected from a single population area located at ca. 50 m depth near a tuna farm where gorgonians populations were available, whereas sediment and water were sampled at increasing distances from the fish farm and in a control site to assess potential effects of the activity. Results evidence significant differences in both $\delta^{13}C$ and $\delta^{15}N$ between tissue and polyps of *P. clavata*, with higher $\delta^{13}C$, but lower $\delta^{15}N$ values in the red coloration. For species comparisons, significantly higher $\delta^{13}C$ and $\delta^{15}N$ values were observed in *P. clavata* and *Eunicella* sp. compared to mussels. Sediment samples evidenced higher $\delta^{13}C$ and $\delta^{15}N$ values near the fish farm, whereas plankton fractions showed no significant variation across sites. MixSIAR models indicated that the largest component of the *P. clavata* diet (all colors) was based on sediments available at the gorgonian site (96 to 99%) and SIBER results also evidence a similar isotopic niche with *Eunicella* sp. and a clear trophic segregation with mussels. Despite subtle differences in dietary contributions for each coloration, they not appear significant enough pinpoint diet as a determining factor. These findings provide valuable insights into the feeding ecology of these gorgonians, suggesting that the fish farm may positively affect their nutritional

status.

Key words: Trophic behavior, MixSiar, SIBER, Carbon, stable isotopes

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IMPACT OF MUSSEL RAFT ON THE ORGANIC CARBON BIOGEOCHEMISTRY IN AN UPWELLING-DRIVEN BAY

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Abstract: The main goal of the study is to find out whether suspended mussel culture affects the organic carbon biogeochemistry on seasonal time scales in the Ria de Vigo (NW Iberian Peninsula). From spring to autumn, prevailing northerly winds over the region, cause upwelling events of nutrient-rich subsurface waters that promote phytoplanktonic blooms. On the contrary, in winter, despite having a high concentration of nutrients, the lack of light limits primary production[1]. Mussels are filter feeders, diverting primary production and energy flow from planktonic to benthic food webs and altering the carbon biogeochemical routes of the ecosystem[2,3]. For the study, we'll use data from 6 oceanographic cruises covering spring, summer, autumn and winter. Water samples were taken at 5 depths at two stations: a reference station, located in the central channel of the ria, and a mussel raft station. At each depth, temperature, salinity, nutrients, oxygen, pH and chlorophyll *a* were measured, as well as dissolved and particulate organic carbon (DOC and POC).

Our results indicate differences in organic matter concentration between the reference and the raft sites. From spring to autumn, upwelling process increases the concentration of nutrients in surface waters, promoting high levels in primary production and thereby in POC. At the raft, POC concentrations were lower than at the reference station due to intense mussel filtration activity. This was especially relevant during summer, when the mussels' ingestion rate is the highest. In winter, due to intensified mixing, the concentrations of POC and DOC were homogeneous throughout the water column, with some variability associated with continental inputs. In contrast to POC, levels of DOC were very similar at both sampling sites in all seasons, pointing to different biogeochemical routes for the particulate and dissolved organic carbon forms under the raft. Overall, our results show that mussel farming activity modulates the organic carbon biogeochemistry of the ria´s pelagic domain.

Key words: organic carbon, mussel farming, upwelling, NW Iberian.

Acknowledgments: We thank the crew of the 'R/V Mytilus' and the members of the Oceanography group from the Instituto de Investigacións Mariñas de Vigo (CSIC) for their valuable help. M.Froján financial support came from MICINN RAFTING project (CTM2007e61983/MAR, CTM2007- 30624-E/MAR) and NEMUNO project (PID2021-122238OB-I00).

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CHOLOROPHYLL TRENDS IN COASTAL AREAS WITH RESPECT TO THE OPEN OCEAN

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Abstract: In the open ocean the annual chlorophyll cycle is driven mostly by seasonal overturning and the associated input of nutrients from bottom layers, especially in temperate and subtropical areas, while coastal areas show a diverse range of processes to fuel nutrients to phytoplankton, including those of anthropogenic origin. With global warming, many ocean areas show decreasing chlorophyll. This study looks into the matching or not of trends in coastal areas with respect to the open ocean.
We chose 153 coastal areas around the globe. Long-term chlorophyll trends were analyzed using Copernicus Marine satellite data and compared to trends for matching open ocean areas. We worked with log 10 transformed chlorophyll. For each area, we removed the seasonal trend using a cubic-spline fit to annually ensembled data. Then we fitted a linear trend to the residuals against actual time. Finally, this trend is represented as a Q_{10}, the exponential rate of change of chlorophyll over 10 years.
Coastal waters near cities show a generalized chlorophyll enrichment trend over time with respect to nearby open ocean areas, although we had expected a clearer decreasing trend in open ocean areas owing to climate change. Coastal population, as a proxy for anthropogenic effects, *per se* does not explain coastal chlorophyll increasing trends, although it is not easy to find clear reference areas not impacted by humans. Globally, Asia and Oceania seem to exert the largest effects on their coasts in the Indian and Pacific Oceans. Trends in specific groups of phytoplankton were also explored. We will discuss such trends also to help make informed management decisions.

Key words: Coastal ocean, primary production, long-term trends, coastal cities

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PUZZLING OUT THE ECOLOGICAL NICHE CONSTRUCTION FOR NITROGEN FIXERS IN A COASTAL UPWELLING SYSTEM

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Abstract: Diazotrophs are a diverse group of microorganisms that can fertilize the ocean using the large atmospheric dinitrogen inventory through biological dinitrogen fixation (BNF). Due to the energetical cost of this process, their presence and activity in eutrophic regions remains enigmatic. Here, we describe the environmental drivers that promote BNF in the upwelling region off NW Iberia, using a large dataset of multidisciplinary observations collected within a period of ~4.5 years. Different molecular approaches revealed that the abundance and activity of diazotrophic cyanobacteria (UCYN-A2) shows seasonality, being more abundant and active during summer and early autumn. The optimum niche for nitrogen fixers occurred at relatively high temperatures (>16ºC), concurrent with low nitrogen:phosphorus ratios (0.45) and a large fraction of the total inorganic nitrogen available in form of ammonium (>75%). Additionally, nutrient amendment experiments showed that BNF exists when phytoplankton communities are constrained by nitrogen availability. The decrease in BNF after nitrogen addition might not be due to inorganic nutrient inhibition, but related to the diazotrophy being outcompeted with respect to regular nitrogen uptake mechanisms. Our results suggest that the biogeochemical conditions setting the optimum niche for nitrogen fixers are constructed by a conjunction of seasonally recurrent biogeochemical processes driven by hydrography. During the summer upwelling the biological drawdown of nitrate by non-diazotrophs form organic matter inside the bay. Thereafter, the combined effect of an intensive remineralization at the shelf and the sustained positive circulation within the bay, conveys excess phosphate into the surface. This high N:P ratio confers a competitive advantage to diazotrophs since they are not restricted by the nitrogen supply. This mechanistic process of biogeochemical niche construction unveils the environmental control factors of diazotrophy in this system. This process could be also at play in other coastal upwelling

regions, setting the pace for future modelling approaches.

Key words: Coastal upwelling, NW Iberia , Biological Nitrogen Fixation, UCYN-A2, ecological niche

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ECOLOGICAL IMPLICATIONS OF THE INTERACTION BETWEEN COMMERCIAL SUNSCREENS AND THE SEAGRASS *CYMODOCEA NODOSA* (UCRIA) ASCH.

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Abstract: Seagrass ecosystems rank among the most threatened ecosystems on Earth, compromising the important services they provide. Seagrasses are now facing increasing pressures from a rapidly changing climate and high exposition to emergent contaminants like sunscreen pollution. However, the effect of sunscreen exposition in community responses and how this contaminant challenge may affect the carbon sequestration service on seagrasses are still disgraded. This study explores the effect of exposure to a mixture of commercialised sunscreens in the community dominated by the temperate seagrass *Cymodocea nodosa*. Responses ranging from individual (biomass and non-structural carbohydrates content) to community (carbon metabolism, organic carbon stocks and the associated microbiome) were studied in mesocosm subjected for 31 days to three levels of sunscreen exposure (control, moderate and severe concentrations). Results showed a negative correlation between sunscreen exposure and seagrass density and biomass, probably due to the improvement of light penetration within the canopy under sunscreen film in the leaves. Both sunscreen concentrations triggered an increase in starch content in belowground parts of *C. nodosa*. Moreover, moderate and severe concentration of sunscreens led to a significant decrease in the net community production from autotrophic to heterotrophic, being communities DOC consumers. The magnitude and direction (i.e., toward net DOC producer or consumer) of these changes depend on multiple factors, including the time span and/or magnitude of sunscreen exposure. Finally, this study revealed that the resistance capacity under moderate and severe and/or sunscreen exposure affecting carbon metabolism and the spread and growth of these populations. These negative results are not only referred to this seagrass species, but may also affect the community; therefore,

further research is recommended following an integrative approach considering communities with different species composition and different bioregions.

Key words: *Cymodocea nodosa*, sunscreens, non-structural carbohydrates, carbon metabolism, sensitivity.

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EFFECTS OF WARMING AND ACIDIFICATION OF THE MEDITERRANEAN SEA ON THE STATOLITHS OF THE NATIVE JELLYFISH *COTYLORHIZA TUBERCULATA*

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Abstract: Marine environment is one of the main carbon dioxide sinks in nature. However, the removal of atmospheric CO_2 has a negative impact on the aquatic system by decreasing the pH of the seawater, threatening organisms and biogeochemical cycles through the phenomenon known as ocean acidification (Doney *et al.*, 2009; Billé *et al.*, 2013). Along with the rising of seawater temperature, both are processes whose occurrence has increased alarmingly in the recent years (Flecha *et al.*, 2019). In this study, we analyze the effects of both individual and combined increases in temperature and acidification on the statoliths of newly released ephyrae of *Cotylorhiza tuberculata* Macri (1778), a native jellyfish species from the Mediterranean Sea. Statoliths are crystalline structures that constitute a fundamental part of the equilibrium organs of medusae, so their malformation could mean a decrease in their survival capacity and also could end up impacting negatively the planktonic food webs (Enrique-Navarro *et al.*, 2021). Here, six combinations of temperature and pCO_2 (18ºC, 24ºC and 30ºC with a PCO2 of 500 ppm and 1000 ppm each), according to the projections of the SSP5-8.5 (IPCC, 2021) scenario for the year 2100, were applied during 32 days to different groups of polyps. Statoliths of released ephyrae during this period were counted and their size was measured by inverted optical microscopy. Our results suggest the variation of the analyzed variables only influences the size of the structures, where the rising temperature, either on its own or accompanied by the increase in pCO2, causes the synthesis of bigger statoliths. However, the research on how the development of different sized statoliths affect the survivability of *C. tuberculata* in a warmer and more acidic Mediterranean Sea, as well as how it might ultimately impact the ecosystem, is a topic on which we are currently still working.

Key words: Jellyfish, Ephyra, Statolith, Acidification, Ocean warming

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ECOLOGICAL SIGNIFICANCE OF FATTY ACID PROFILES IN THERMOPHILIC-ASSOCIATED PELAGIC SPECIES OF THE NW MEDITERRANEAN

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Abstract: In the NW Mediterranean, rising sea temperatures have facilitated the presence and potential expansion of thermophilic-associated pelagic species, including round sardinella (*Sardinella aurita*), Atlantic chub mackerel (*Scomber colias*), and Mediterranean horse mackerel (*Trachurus mediterraneus*). These species are small and medium pelagic fish that play a significant role in the trophic web by conditioning the presence, distribution, and abundance of other small, medium, and large pelagic fishes, through the transfer of energy to higher trophic levels. Despite their ecological importance, the condition of these species in the NW Mediterranean remains largely unknown. This study aimed to assess the fatty acid content and profile of these species in relation to their respective reproductive stage and feeding behaviour for an ecological perspective. Biological parameters, including total length, weight, muscle weight, sex, and reproductive stage, were examined. Fatty acid analysis was conducted using the Folch method and gas chromatography. The results indicated a favourable profile of polyunsaturated fatty acids, particularly omega-3, which has been associated with substantial health benefits to humans. Comparative analysis of fatty acid profiles across regions, including the Atlantic and various Mediterranean areas, provided insights into regional variations. The promotion of the consumption of these species not only benefits human health but also contributes to the conservation of pelagic ecosystems by diversifying seafood consumption patterns and potentially alleviating pressure on other exploited pelagic species, such as sardine and anchovy. Furthermore, the study indicates the links between fatty acid profiles and content and environmental conditions and feeding behaviour of these species, emphasizing the need to assess the potential impacts of increasing water temperatures on omega-3 fatty acid availability and the marine food chain dynamics. In conclusion, this research emphasizes the importance of thermophilic species' fatty acid profiles in the context of climate change for maintaining ecosystem health and human well-being.

Key words: Fatty acids, small pelagic fish, medium pelagic fish, thermophilic species, NW Mediterranean

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CAN A 10-DAY HEATWAVE AFFECT THE METABOLISM OF AN INTERTIDAL CRUSTACEAN?

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Abstract:
Coastal marine ecosystems have long been vulnerable to stress caused by nutrient-limitation, but now climate change is causing additional stress by increasing the frequency of extreme events such as marine heatwaves. Thus, understanding the impact of both climate warming and nutrient availability helps to understand their effects on the community and to develop protection strategies for the marine littoral community.
In this study, we analyse the consequences of a 10 days heatwave event on both starved and well fed prawns (*Palaemon elegans*). After exposing the individuals to 3 different temperatures (20ºC, 26ºC and 32ºC), at both food-levels, we measured the respiration (R), the electron transport system (ETS), and the cytochrome-c oxidase (CCO) activities, lipids (Lip), proteins (Prot) and carbohydrates (Carb). From these measurements we calculated the CEA index, and the heterotrophic energy transformation (HET). These parameters were analysed at different times (24h, 48h, 72h, 96h, 7 and 10 days) during the exposure period. Metabolic regulation of the prawn in response to the different exposures could be seen in the variability in all parameters throughout the experiment. At the end (10 days), within a well-fed scenario, R, ETS, CCO showed higher activities at the lowest temperature. As expected, HET was also higher. The CEA index showed a strongly positive correlation with temperature, maybe due to the increase with temperature in Prot content. After 10 day of starvation, R, ETS and CCO showed different patterns. At 26ºC, R had the highest value while in CCO was the lowest. ETS was equal at 20ºC and 26ºC. In case of Prot and Carb values, after showing an uneven but decreasing trend over the exposure time, the values were equalised between the different temperatures, while Lip suffers an increase at 26ºC. Both CEA and HET were lower at 20ºC.
Results showed the adaptive and regulating capacity of the *P. elegans* for survival under stressful conditions.

Key words: *Palaemon elegans*, metabolism, heatwaves, crustacean, starvation

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SEDIMENTARY RECORD AND BENTHIC FORAMINIFERA IN THE MORO MARSH (WESTERN MEDITERRANEAN)

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The Marjal del Moro is a wetland located south of the city of Sagunto, in the province of Valencia (Spain), which is a protected area under the Natura 2000 Network. The main objective of this research is to study the evolution of this area during the Holocene. To this end, four mechanical cores of 14 m average thickness were obtained: Core Moro 1 (39º37'42"N 0º15'30"W, 790 m from the current coastline, 0.44 m asl), Core Moro 2 (39º37'32"N 0º15'16" W, 336 m from the current coastline, 0.79 m asl), Core Moro 3 (39º38'2"N 0º15'93" W, 730 m from the current coastline, 1.75 m asl) and Core Moro 5 (39º37'24"N 0º16'19" W, 1380 m from the current coastline, 1 m asl). These were sampled each 10 cm, which were studied from a sedimentary, micropalaeontological and chronological (using 14C dating) point of view. The results indicate that, due to their sedimentary characteristics, Unit I is interpreted as an alluvial environment linked to the early Holocene. Unit II is related to the Holocene marine transgression, in which abundant benthic foraminifera are recorded, mainly of the marine littoral species. Finally, in Unit III the sedimentary and micropaleontologic characteristics of the deposit suggest a sedimentary sub-environment linked to the barrier island, probably corresponding to a shoreface to foreshore transition capped by a backshore facies at the top. The foreshore of the beach begins at around 1 m b.s.l. with abundant flattened pebbles. A ^{14}C dating indicates an age of ~ 5200 cal yr BP at 1.35 m b.s.l. (Blázquez et al., 2024), which is very similar to those of the Almenara cores S-4, S-5 and S-6 (Rodríguez-Pérez et al., 2018).

Key words: Moro marsh, wetlands, Holocene evolution, Sediment, Foraminifera

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TECHNOLOGIES FOR OCEAN SENSING (TECHOCEANS PROJECT)

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Abstract: To address oceanographic community requirements for autonomous observations, new types of technology must be developed. New in-situ sensors and samplers will have to measure new parameters, reduce in size and power consumption, increase measurement traceability, improve stability, reduce mechanical engineering requirements and improve communication and automatic data transfer to data centres. TechOceanS project will fill the existing gaps by delivering sensors, samplers and improved image processing workflows capable of remotely measuring essential ocean variables (EOVs) as well as regulatory targets such as the EU Marine Strategy Framework Directive (MSFD) and The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR). To test the technology, a set of experiments and integration on a suit of platforms have been organised. The final tests were carried out in Gran Canaria in spring 2024 where at least 7 new technologies developed in this project were combined and integrated in 4 different autonomous vehicles. This unique opportunity was used to provide a multidisciplinary practical training with students directly involved in the preparation (i.e. calibration/validation of sensors, preparation of the platforms) and management of deployments and included 4 students and technicians from Official Development Assistance (ODA) recipient states.
In alignment with the objective of the UN Ocean Decade to secure "a transparent and accessible ocean", TechOceanS has joined a growing partnership of initiatives and has a repository of methodological documents and candidate best practices in both the Ocean Best Practices System (OBPS) and Better Biomolecular Ocean Protocols (BeBOP). These protocols are followed during sensor tests and are available for a community review in these platforms alongside sensor development templates developed in the project.

Key words: in-situ sensors; samplers; essential ocean variables

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INCREASE OF *SYNECHOCOCCUS* SP. SENSITIVITY TO VIRAL INFECTION UNDER OCEAN ACIDIFICATION CONDITIONS

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Abstract

Ocean acidification produces significant changes on photosynthetic microorganism metabolism that can affect photosynthesis, growth and increase the sensitivity to stressing factors, such as UV radiation. Among other naturally occurring stressors, viruses can shape microbial diversity and biomass, playing a key role in the biogeochemical cycles. However, poorly is known about the combined impacts of future CO_2 levels and viral infection on the physiology and ecology of marine photosynthetic bacteria, the most abundant group of photosynthetic organism in the modern ocean. In this study, we aimed to test whether increasing CO_2 concentrations could make photosynthetic bacteria more sensitive to virus infection. We used an experimental approach combining two different treatments of CO_2 (present (410 ppmv CO_2) vs future (1000 ppmv CO_2)) and the addition of specific viruses on two strains of *Synechococcus* sp. from different marine habitats: a *Synechococcus* coastal strain (WH7803) and a *Synechococcus* open-ocean strain (WH8102). Our results showed that after virus infection, respiration rates, mortality rates and viral abundance were higher under high CO_2 conditions in both strains However, *Synechococcus* abundance under high CO_2 levels was more sensitive to viral infection than at current levels of CO_2. Nevertheless, the response of viral abundance after lysis of *Synechococcus* sp. showed significant differences between both strains that contribute to understand the viral *Synechococcus* sp. interactions in coastal and open-ocean systems under future ocean acidification scenarios.

Key words: Ocean acidification, photosynthetic bacteria, *Synechococcus*, virus.

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PHOTOPHYSIOLOGICAL RESPONSE OF MARINE PHYTOPLANKTON UNDER OCEAN ACIDIFICATION CONDITIONS

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Abstract

Ocean acidification, due to the atmospheric CO_2 increase, produces significant changes on phytoplankton physiology that can affect the photosynthetic metabolism. Among them, a down-regulation of the enzymatic activity and the production of several metabolites, including Chl *a* and RuBisCO, have been observed in high CO_2 cultures under acclimated conditions. However, the extent of how phytoplankton photophysiology regulates under ocean acidification conditions is poorly understood. This study shows the effect of the atmospheric CO_2 increase on pigment concentration of 3 important marine primary producers: *Thalassiosira pseudonana*, *Skeletonema costatum* and *Emiliania huxleyi.* Cultures grown under saturating PAR irradiance were aerated during at least 3 weeks with current concentrations of atmospheric CO_2 (~400 ppmv CO_2) and with CO_2 concentrations expected for future scenarios of climate change (~1000 ppmv CO_2) to assess the effect of CO_2 under stable conditions and acclimated metabolism. Moreover, cultures were also subjected to a CO_2 perturbation (4 h without aeration) to assess responses under non-stable conditions. The results showed that both, light harvesting and photoprotective pigment concentrations (*i.e.* Chl *a*, Chl c_2, β-carotene, Diadinoxanthin, Diatoxanthin, Fucoxanthin and its derivatives, among others) decreased significantly under high CO_2 and acclimated conditions, but the response reversed when the metabolism was perturbed. The results also demonstrate that the CO_2 concentration can modify the photo-protective capability of the phytoplankton through changes in the photoprotective pigment content and in the deepoxidation state of the xanthophylls. They also identify Fucoxanthin and Chl c_2 as potential biomarkers of phytoplankton under ocean acidification conditions.

Key words: Ocean acidification, CO_2 acclimation, phytoplankton, pigments, photoprotection

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INTERTIDAL BIOGEOMORPHIC ECOSYSTEM SERVICES: BLUE CARBON AND RESILIENCE TO SEA LEVEL RISE IN CADIZ BAY

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Abstract: Vegetated intertidal systems, such as saltmarshes and seagrass meadows, provide important ecosystem services on coastal protection and blue carbon (BC) storage. To date, between 20% (seagrasses) and 50% (saltmarshes) of these systems have already disappeared from the planet and their future is compromised by their capacity to adapt to the consequences of climate change, especially to the Sea Level Rise (SLR). The resilience of these ecosystems will depend on their ability to maintain their elevation with respect to the SLR.

At iBESBLUE we have the objective of developing the methodology and information to evaluate what conditions are decisive for the adaptation of these ecosystems to climate change to become a reality. To achieve this objective, ecological and geomorphological approaches will be combined to quantify the most relevant ecosystem functions and the ecosystem service of Blue Carbon. As a model system we will study the intertidal areas of Cadiz Bay, which are characterized by the abundance of seagrasses and tidal marshes, and host to numerous populations of waders and migratory birds.

We believe that the iBESBLUE project will provide the basis for understanding the integrated functioning of temperate intertidal systems dominated by salt marshes and seagrasses. Visit our website or our social media to follow the results of this project. https://ibesblue.uca.es/

Key words: biogeomorphic, salt marsh, seagrass, Cadiz Bay

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SALINITY `PATTERNS AND LOCAL MIGRATION DETERMINE THE ISOTOPIC COMPOSITION OF THE INVASSIVE BLUE CRAB, CALLINECTES SAPIDUS RATHBUN, ALONG THE SPANISH MEDITERRANEAN COAST

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Abstract: The isotopic composition ($\delta^{13}C$ and $\delta^{15}N$) of the blue crab, *Callinectes sapidus* Rathbun, and its potential diets, was investigated in eleven localities along four invaded regions of the Spanish Mediterranean (Catalonia, Valencia, Alicante, and Murcia) subjected to contrasting salinity regimes and degrees of connectivity with the open sea. When available, large adults, and immature sizes of each sex were captured to evaluate possible differences associated to female migration and juvenile movement to estuarine habitats. SIBER and MixSIAR analyses were used to assess patterns of isotopic niche and dietary contributions from available food sources. Results showed significant effects for all investigated factors and interactions (except for Sex and Sex x Size in $\delta^{15}N$), but with a greater effect size in Region (η_p^2= 0.82 and 0.70, respectively for $\delta^{13}C$ and $\delta^{15}N$) and Locality (η_p^2= 0.53 and 0.46), than in Size (η_p^2= 0.37 and 0.21) and Sex (η_p^2= 0.06 and 0.02), concurring with increasing levels of isotopic niche overlap (average of the total

overlapping area of 9 and 11% in Locality and Region, 32% in Size and 44% in Sex). MixSiar results evidenced strongly variable contributions from food sources at each locality (TP ranging from 2.3 to 3.6), but with higher overall importance of fish, algae, and crustaceans (27.7, 18 and 15.1%, respectively). Importantly, dietary results showed little relation with isotopic patterns, whereas significant associations were found with local salinities (R^2= 0.518 and 0.757, for $\delta^{13}C$ and $\delta^{15}N$). Overall, our study suggest that the habitat use of blue crab in small Mediterranean estuaries might be very different from that in native areas, with movements being mostly restricted to young individuals and/ or certain localities with higher connectivity with the open sea, such as the Ebro River. In contrast, salinity conditions emerge as a major variable shaping isotopic patterns of populations at the large scale.

Key words: trophic position, omnivory, connectivity, freshwater discharge, eutrophication.

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Effects of sand burial depth on bivalve species predation by the blue crab, *Callinectes sapidus*

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Abstract: In the Ebro Delta, the abundance of several commercial, sand-burrowing bivalves has dramatically decreased in recent years, with the blue crab, *Callinectes sapidus* (captured since 2016), being blamed by shellfish collectors. The analyses of shellfish trends from 2010 evidences a decrease in the capture of clams (*Ruditapes* spp.) before the blue crab arrival, although further decline of both clam and cockle (*Cerastoderma glaucum*) occurred in 2018. In contrast, the capture of razor clam (*Ensis siliqua*) has increased by 3.6-fold since 2016. In order to assess predation risk for each of these taxa with contrasting burrowing capacities (1.7 ± 0.3 cm, 0.4 ± 0.2 cm, and 26.3 ± 0.1 cm, respectively for clam, cockle and razor clam), we conducted a predation preference experiment in the absence and in the presence of sand allowing the escape of individuals under natural conditions (N= 5 tanks; 5 individuals of each species). No-choice experiments were additionally conducted for each species to compare predation rates in the absence of other prey items (N= 5 tanks; 15 individuals). Results showed that in the absence of sand, the razor clam, featuring the most fragile shell was fully preyed in only 24 h, whereas full predation of clams took 96 h and that of cockles only reached 60% even after 144 h. Predation patterns were, however, comparable when no choice was available. In contrast, when sand was available for burrowing, only 4% of razor clams were predated over the experiment, while clams and cockles' predation reached 60-100% in 120 to 144 h, and similar results were obtained for no choice trials. Overall, our results evidence the great vulnerability of both clams and cockles to blue crab predation, whereas the razor clam may escape thanks to its great burrowing capacity and still thrives in the Ebro Delta.

Key words: *Ruditapes* spp., *Cerastoderma glaucum*, *Ensis siliqua*, predation escape, Ebro Delta

Acknowledgments: P. Prado was contracted under the INIA-CCAA research program for postdoctoral incorporation from the Spanish National Institute for Agricultural and Food Research and Technology (INIA). Predation experiments were supported by the Spanish Government (Ministry of Science and Technology) under the ECESIS project (PID2020-118476RR-C21) to P. Prado and S. Falco. We are also grateful to C. Alcaraz for advise with the experimental design of the predation experiments.

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EXPERIMENTAL PREDATION OF THE INVASIVE BLUE CRAB, CALLINECTES SAPIDUS, BY NATIVE MEDITERRANEAN SPECIES: THE OCTOPUS, OCTOPUS VULGARIS AND THE LOGGERHEAD SEA TURTLE, CARETTA CARETTA

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Abstract: The importance of top-down control of the blue crab, *Callinectes sapidus*, in invaded Mediterranean regions, was assessed using manipulative aquarium experiments with two potential native predators, the common octopus (*Octopus vulgaris*) and the loggerhead sea turtle (*Caretta caretta*). Two types of experiments were conducted: (1) size preference experiments, in which a potential predator, was offered a simultaneous combination of 4 different crab sizes depending on availability: 139 gWW (S), 214 gWW (M), 331 gWW (L), and 448 gWW (XL) and, (2) assessment of daily biomass consumption (if possible, for each crab size). For each type of experiment, different sizes of octopuses (subadults of ca. 1 kg and adults of ca. 2 kg) and sea turtles (juvenile of ca. 13 kg, subadult of ca. 29 kg, and adult of ca. 74 kg) were used. Sea turtles consumed the whole crab, and reached the highest consumption rates of up to 815 ± 592 (Total Biomass gWW.d^{-1}) in adult individuals. Octopuses, however, only consumed the soft tissues (ca. 53.9% of the crab), with rates of up to 454 ± 71 STB gWW.d^{-1} (Soft Tissue Biomass), also in adult sizes. Subadult octopuses consumed significantly smaller (329 ± 88 STB

gWW.d^{-1}) and large (299 ± 90 STB gWW.d^{-1}) crabs than extra-large ones (190 ± 51 STB gWW.d^{-1}). There were no significant differences in the preference order of blue crab sizes, suggesting that no effective protective size from predation is reached. Yet, for subadult octopuses, capture time was shorter in small, than in large and extra-large crabs (mean of 225, 479, and 925 min, respectively). Our results indicate that octopus is the predator capable of greater control over the invasive crab since its effective consumption rate is higher, in addition to being a much more abundant species in Mediterranean waters.

Key words: invasive species; Atlantic blue crab; top-down control; size-preference; capture time

Acknowledgments: P. Prado was contracted under the INIA-CCAA research program for postdoctoral incorporation from the Spanish National Institute for Agricultural and Food Research and Technology (INIA). Predation experiments were supported by the Spanish Government (Ministry of Science and Technology) under the ECESIS project (PID2020-118476RR-C21) to P. Prado and S. Falco. We are also grateful to Fundación Oceanogràfic for its collaboration in the sea turtle predation experiments.

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EFFECT OF TEMPERATURE AND UV RAYS ON DECOMPOSITION PROCESSES OF MACROALGAE FROM THE GALICIAN COAST

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Abstract: Macroalgal wracks are stranded accumulations of algae at the shore left by marine currents, tides, or the wind. They are of great importance for the coastal ecology, since they provide food and the habitat for numerous marine and terrestrial species. They are also fundamental for the biogeochemical cycles of sandy beaches, since they release nutrients when they are being decomposed by microorganisms during mineralization processes, contributing to the carbon cycle as well.
However, climate change poses a threat to this ecosystem, since the temperature increase would accelerate algal decomposition. This project was conducted in the Ladeira sandy beach, in NW coast of Spain, to study the consequences of global warming in four macroalgae: *Saccorhiza polyschides*, *Sargassum muticum*, *Undaria pinnatifida* and *Ulva* spp. The emissions of CO_2 and the variations in nutrient concentration in the sediment were measured for each alga after six days in both an unaltered environment and in an increased temperature treatment created with open-top transparent chambers. It was predicted that a temperature increase would potentiate the microbian and the fauna's activity, thus increasing the CO_2 flux to the atmosphere and nutrient concentration in the sediment. With a temperature increase of just 0,67 ºC, the CO_2 flux did significatively increase in comparison to wracks that were kept at ambient temperature.
Another experiment was also conducted during the same six days in which the same response variables were measured for *Saccorhiza polyschides* wracks, comparing between deposits where fauna was excluded and deposits where it was not excluded. It was predicted that the presence of macrofauna would increase CO_2 flux and nutrient concentration caused by its activity; the results show that the CO_2 flux was significatively greater in comparison to wracks where fauna was excluded.

Key words: Macroalgae, wrack decay, global warming, CO_2, nutrients

References: this End of Degree Project (Trabajo de Fin de Grado) is unfinished. It will be completed in June.

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EFFECT OF THERMAL RANGES ON THE PHYSIOLOGY OF *Percnon gibbesi*

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Abstract: Global change is causing alterations in the different ecosystems of the planet, including the marine environment. The main habitats undergoing these changes are the intertidal and shallow zones, areas of reduced water volume that suffer more from different abiotic stressors such as temperature. In this work we study thermal ranges in crab *Percnon gibbesi* (H. Milne Edwards, 1853) by measuring respiration and how it can affect a potentially invasive population. In order to determine the limits of thermal tolerance in the species *P. gibbesi*, an experiment was designed in which individuals were subjected to a variation of temperatures with 3 types of treatments. A control treatment (Control) at average sea water temperature (19ºC), a warm treatment (W) increasing temperatures from 19ºC up to 35ºC, and a cool treatment (C) decreasing temperatures from 19ºC up to 8ºC. This experiment was replicated 3 times. Respiration rate was measured at every 2°C increment during temperature changes. It was observed that crabs have a higher affinity to high temperatures (up to 27ºC), where their respiration reached a maximum and their activity was higher. Above 27ºC, respiration decreased notably. At low temperatures, its respiration and vital activity decreased directly, but they are able to survive up to 13 ºC. This work demonstrates the resistance of these animals to short-term thermal fluctuations.

Key words: *Percnon gibbesi*, respiration, temperature, global change.

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MICROBIAL DYNAMICS AND BIOGEOCHEMISTRY OF FISH AND OYSTER AQUAQUACULTURE PONDS IN THE SALTMARSH SYSTEM OF CÁDIZ BAY.

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Abstract: Coastal areas are highly productive systems, providing important ecosystems services. Their productivity is due to the combination of illuminated areas with significant inputs of nutrients and organic carbon from land and oceans, and the elevated sediment-water exchange rates that benefit extensive aquaculture of organisms such as fishes and oysters. Despite the evident contribution of these ecosystems, many aspects of how biogeochemistry cycles affect the higher trophic levels remains poorly described. For this purpose, we conducted an annual study in two distinct ponds located in the saltmarsh system of Cadiz Bay (SW Spain): one used for the culture of oysters and the other for fish. We evaluated diffusive and total sediment-water column fluxes of oxygen (O_2) in sediment cores and investigated sediment and water column microbial dynamics. O_2 fluxes were like those found in other natural assemblages of the Bay. Daily net community production in the oyster pond indicates an autotrophic system, while it indicates a heterotrophic system for the fish pond with no clear seasonal pattern in both systems. Benthic pigments analysis showed that chlorophyll c and ratio chlorophyll *c* to chlorophyll *a* exhibited a slight seasonal pattern, with highest values between the months of April and July. Sediment bacterial abundance did not change over seasons. In the water column, the abundance of bacteria increased during the summer months in parallel to a decrease in their cell size. Among the different picoplankton groups studied (two groups of eukaryotes and *Synechococcus*), maximum abundances also varied along the year. These findings show that differences between ponds were minimal despite the different use. The lack of clear patterns underscores the complexity of microbial interactions within these environments and highlight the need for further research to be able to improve management and conservation strategies.

Key words: Benthic metabolism, Microbial dynamics, Coastal area

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VALENCIA LAGOON: COASTAL HOLOCENE SEQUENCE

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Abstract:

The main objective of this study is to determine the Holocene evolution of the Valencia lagoon in the most coastal area. So far, several studies have been carried out in other areas of the lagoon (López-Belzunce 2020; López-Belzunce et al., 2022) that have shown its evolution over the last 8000 years. To achieve this goal, a sedimentological and micropalaeontological (fossil benthic foraminifera) analysis of new two cores (Sal5 y Sal6) located in 39º24'64"N 0º20'68"W and 39º18'80"N 0º17'43", respectively, have been carried out. These cores were sampled every 10 cm for a total of 118 samples in Sal 5 and 49 in Sal 6. The results indicate the presence of several palaeoenvironmental units. The oldest deposit is interpreted as a brackish lagoonal, inferred from its foraminiferal content consisting of euryhaline species like *Haynesina germanica* (Ehrenberg) or *Elphidium excavatum* (Terquem). Later, a mixed assemblage of foraminifera with brackish water (e.g., *Ammonia tepida* (Cushman), *Haynesina germanica* (Ehrenberg) and E. *excavatum* (Terquem) and marine species (e.g., *Ammonia beccarii* (Linné), *Miliolinella circularis* (Bornemann), *Adelosina laevigata* (d'Orbigny), among others) is found. After this washover fan episode, brackish lagoon conditions are again reflected and, later, a very well-classified, fine gray sands with well-preserved marine foraminifera allows to recognise a shoreface environment. Two radiocarbon dates indicate ages of 7,258–7,155 cal yr BP at 6.7 m b.s.l. and 6,790–6,660 cal yr BP, at 6.1 m b.s.l. Later, a mixed foraminiferal assemblage with euryhaline and littoral marine taxa evidences the formation of a coastal barrier that partially separated the lagoon from the open sea. Finally, marine conditions, interpreted as a shoreface environment, re-established in the following unit. At the tops, are recognise to the present-day freshwater lagoon.

Key words: Valencia lagoon, Holocene, Foraminifera, Western Mediterranean

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HOLOCENE STRATIPGRAHY AND FORAMINIFERA ASEMBLAGES OF THE RIVER BESÒS DELTA (BARCELONA).

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Abstract: During the Holocene, Mediterraean littoral plains were characterized by dynamic interactions between a changing environment and human societies. In fact, they are adequate spaces to analyze human responses and adaptations to past environmental change.

Starting from this approach, the PaleoBarcino project has studied the geomorphological changes of the Barcelona plain and its relation with the regional sea-level rise during the Holocene. The plain of Barcelona is a narrow space limited by littoral ranges (512 m a.s.l.) and formed by a Pleistocene alluvial fans, scattered coastal promontories and two Holocene deltas that expand northern (Besòs delta) and southern (Llobregat delta) of the town. Current communication presents the stratigraphy and changes of the river Besos delta plain during the last 10,000 years. This small delta has an extension of 18 km^2 and nowadays it is entirely urbanized.

The stratigraphy of the Besòs delta is based on the lithological description and sampling of 55 sedimentological cores, analyzing litho and biofacies and obtaining a reliable time model based on 72 radiocarbon dates. In marine and beach facies, foraminifera assemblages have been analyzed in detail. Basal unit at ca. 30 m a.s.l is formed by a gravelly fluvial level corresponding to the ravinement surface of the Holocene filling sequence. Overlaying this level, between 29 and 12 m a.s.l., two facies can be distinguished: 1) lower transgressive system tract with upper and lower shoreface facies, containing abundant marine fauna; and 2) an upper progradational prodelta wedge and delta front that formed during the high system tract. The upper layers correspond to a diversity of facies: beach ridges, backshore lagoons, washover fans, alluvial plains and fluvial channels. The inland sector of the Besòs delta plain, the sequence is mainly formed by organic muds interbedded with fluvial gravels and sands.

The littoral sequence of Gandhi Gardens, marine and coastal facies foraminiferal assemblages up to a depth of 35 m have been analysed. Foraminiferal shells are mostly recorded between -26 and -12 m, although in low density. Littoral species such as *Ammonia beccarii* (Linné), *Haynesina germanica* (Ehremberg), *Quinqueloculina oblonga* (Montagú), *Triloculina trigonula* (Lamarck), *Elphidium crispum* (Linné), *Elphidium macellum* (Fitchel and Moll), *Rosalina bradyi* (Cushman), among others, are recognised. They are poorly preserved, which allows them to be interpreted as allochthonous.

Key words: Besòs Delta, Holocene, Foraminifera, Western Mediterranean

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SPATIAL AND SEASONAL VARIATION OF MESOZOOPLANKTON COMMUNITY IN THE GULF OF CADIZ.

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Abstract: Mesozooplankton play a key role in marine food webs, linking primary producers to higher trophic levels, and are sensitive indicators of climate variability and ecosystem health due to their rapid response to environmental changes. Understanding their dynamics is crucial for ecosystem-based management. However, research on their spatio-temporal variability in the Gulf of Cádiz is limited. To address this, we studied the composition and variability of mesozooplankton using data from 21 seasonal surveys conducted between 2016 and 2021. Samples were collected from coastal (20 m depth), shelf (80 m), and slope (460 m) stations off the Guadalquivir estuary using 200 µm mesh Bongo nets. In the laboratory, samples were scanned with a ZooScan, (HYDROPTIC Inc.) and were analysed and processed using the Zooprocess software and Ecotaxa. The mean total abundance of mesozooplankton was higher in the shelf station (196,853 ind./m^2), followed by the coastal station. Copepods (44%) and cladocerans (40%) were most abundant at the coastal station, while copepods dominated the shelf and slope stations (63-87%). Spring had the highest average mesozooplankton abundance (298,762 ind./m^2) followed by summer, winter and autumn. Autumn, winter and summer were dominated by copepods (69-85%) and spring showed an increase in cladocerans (36%). At the coastal station, cladocerans dominated in spring (63%), but copepods were more abundant the rest of the year (68-76%). At the shelf station, copepods dominated in autumn and winter (70-75%), cladocerans were more abundant in spring and, both copepods and cladocerans, had similar abundances in summer (51% and 41%, respectively). The slope station was dominated by copepods during the whole year (65-89%).

Key words: mesozooplankton, abundance, community composition, spatial and seasonal variability, Gulf of Cádiz.

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EARTH OBSERVATION APPROACH TO UNDERSTAND COASTAL MORPHOLOGY, SHORELINE DYNAMICS, AND THEIR RELATIONSHIP WITH MINERAL PLACER DEPOSITS: THE CASE OF SANTA MARTA BEACH (RÍA DE VIGO, NW SPAIN)

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Abstract: Santa Marta Beach is situated in the North part of the Ría de Vigo, an estuary system in NW Spain. It is approximately 155 m long and is separated from Limens Beach by an igneous rocky outcrop in the middle part. Both beaches are enclosed and sheltered by rocky outcrops, and are sandy beaches. This study analyses the dynamics of the coastline in different seasons and spatial resolutions using PNOA (National Aerial Orthophotography Plan), Google Earth and unmanned aerial vehicle (UAV) images of Santa Marta beach, collected between 2001 and 2024, as well as field data from marine placer occurrences acquired in 2023 and 2024. Two profiles across the beach, with available PNOA LIDAR information from 2015, were studied to better understand the morphology, and to observe where the heavy mineral placer deposits occur.

Image analysis shows that the coastline is generally stable (non-erosive and non-accreting), however a large variability in the shoreline is observed, caused by low and high tides, depending on the season. During storm events, waves reach the backshore zone, covering almost the entire beach. Two types of dense mineral accumulations forming placer deposits were distinguished during the field trips in 2023 and 2024: surface occurrences, deposited by the current swell, and deeper ones up to about 80 cm depth, found in the sediment-test excavations, that formed during the last decades. The heavy mineral source, is a stream at the East of the beach with dynamic behaviour during the last two years of observation. It shows an initial period of heavy mineral input (without erosion

of the beach, as in the field trip in March 2023), an advanced period of heavy mineral input (with transverse erosion of the beach and formation of a stream that reaches the sea, as in the UAV images in March 2024), and a prolonged period of no material input (as observed in the field trip in September 2023). The same transversal erosion of the beach has been captured in Google Earth images (22 February 2020, and most probably 20 March 2011). In addition, it is possible to see some dark and reddish patches in the surf zone in other earlier Google Earth images, which could be reworking the placers along the shoreline. Another aspect is that the Google Earth images show better temporal and spatial resolution than PNOA, especially in the last years, however they lack spectral information. At the same time, the UAV images (March 2024) exhibit the best resolution and optical identification of placer deposits in relation to the in situ observations.
Thus, it may be inferred from this study that the boxed shape of the beach, the source of dense minerals and the continuous cycles of placer input and redistribution have resulted in the various levels of concentrates in the subsoil at the eastern end of the Santa Marta Beach, appearing as concentrated layers of dense minerals of mm to cm thick. Finally, this study demonstrates the importance of correlating field data with seasonal Earth Observation imagery to understand the distribution of placer minerals in coastal areas.

Key words: Beach, coastline, shoreline, marine placer deposit, heavy mineral.

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UNDERWAY CO_2 MEASUREMENTS DURING THE ARCTIC CIRCUMNAVIGATION OF THE 2013 TARA OCEANS EXPEDITION

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Abstract: In the 20th century, the Arctic Ocean was a significant sink for atmospheric carbon dioxide (CO_2), contributing 5 to 14% to the global CO_2 balance. The Arctic's capacity to absorb CO_2 is expected to increase with sea-ice loss and the growth of phytoplankton communities, although this is partly offset by surface warming, glacier melting and freshwater inputs from rivers. Whether the balance between those processes would increase Arctic Ocean CO_2 sink or would transform it into a source is still uncertain. The challenging polar environment and logistical constraints have limited comprehensive studies on the marine carbon cycle, making ongoing monitoring essential to understand changes in ocean CO_2 uptake. The Tara Oceans Polar Circle 2013 expedition, aboard R/V Tara, provided a exceptional opportunity to conduct extensive in situ pCO_2 measurements in the Arctic Ocean from July to October 2013. This quasi-synoptic survey covered the Northeast and Northwest passages, focusing on surface waters along the Arctic Ocean shelves. During the ice-free summer period, Arctic surface waters predominantly acted as CO_2 sinks, despite significant variability in surface water CO_2 levels. The Kara Sea, influenced by the Yenisey River and nearby shelves, exhibited the lowest pCO_2 values around 175 µatm. The Norwegian and Chukchi Seas, with high primary production rates, showed strong undersaturation with pCO_2 values around 210 µatm. In contrast, supersaturated CO_2 levels exceeding 600 µatm were found in the East Siberian and Beaufort Seas, due to organic matter remineralization from the Kolyma and Mackenzie Rivers. The Canadian Archipelago's seawater pCO_2 was nearly in equilibrium with the atmosphere. These findings, collected during one of the largest ice-free summer periods, are a baseline for assessing the air-sea CO_2 fluxes in future Arctic shelves. A shift towards the Arctic becoming a CO_2 source would significantly reduce the global ocean's capacity to absorb atmospheric CO_2.

Key words: Arctic Ocean, Tara Oceans Polar Circle 2013, ocean CO_2 uptake

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THE FUTURE OF *Xyrichtys novacula* IN THE BALEARIC ISLANDS: PARASITOLOGY AND SEXUAL DEVELOPMENT

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Abstract: *Xyrichtys novacula* (Linnaeus, 1758) or pearly razorfish is a fish of great importance in the Balearic Islands due to its popularity, particularly in recreational fishing, and its high price in the market. This has caused overfishing, leading to a fishing ban from April to August to protect its reproductive period. The pearly razorfish is a protogynous sequential hermaphrodite and, the sexual change occurs generally after mating has finalized. Mating arises during the warm summer months, and vitellogenesis does not necessarily develop simultaneously, with various mating periods. Warming oceans have advanced the seasons, with sea temperatures remaining warm into autumn. Altogether, this might affect the reproduction cycle of *X. novacula*, inducing longer mating cycles, with fertile females after the protective fishing ban. This would not permit the completion of the reproductive cycle therefore rendering the ban inadequate. Additionally, climate change can also alter the distribution of species, such as parasites. As of the last decade, *X. novacula* has been found to be infected by a trematode identified as *Scaphanocephalus sp.* This parasite, found more abundantly each year, can lead to oxidative stress, and therefore affect the fish in many aspects, including reproduction.
Thus, this study evaluated the maturity of males and females in the waters around the island of Ibiza from May to November. During the sampling, the presence of parasites was also considered. Results showed mature females outside of the ban period, particularly during September, after the ban has been lifted. Additionally, a greater number of parasites were found in the southern area of the island, where there is a greater presence of human impact.
These results show the effect of climate change on marine species, and additionally gives policy makers information to better manage *X. novacula* in this shifting environment.

Key words: *Xyrichtys novacula*, artisanal fishery, reproductive cycle, parasite, Balearic Islands

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IMPLEMENTATION OF THE MULTIANNUAL PLAN IN THE WESTERN MEDITERRANEAN: EFFECTS ON BOTTOM TRAWL EFFORT AND ITS SPATIAL DISTRIBUTION

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Abstract: Bottom trawling is very important in the Mediterranean, both in terms of landings and income. However, the high fishing effort of this fleet caused demersal stocks overfishing. To mitigate this problem, in 2020, the EU implemented the Multiannual plan for fisheries exploiting demersal stocks in the western Mediterranean Sea (EUMAP, (EU) 2019/1022). The EUMAP foresaw an effort regime to reduce fishing effort up to 40%, the establishment of closure areas and the application of technical measures to improve trawl selectivity. These measures intended to make fishing socially, economically and environmentally sustainable long term.

Our study assesses fishing effort trends and spatial and temporal dynamics before and after EUMAP implementation, from 2015 to 2023. We focus on four periods: reference (2015-2017), pre-plan (2018-2019) and after beginning of implementation (2020-2023; studied separately, due to varying restrictions for each year).

Due to the continuous reduction of the fishing fleet, a decrease is found between the reference period and the onset of EUMAP implementation in most geographical sub-areas (GSAs). Moreover, not all the reductions were equal: in some areas, the "natural" reduction was higher than others. However, all GSAs show an overall reduction in 2020-2023 when compared to the reference, some even higher than the proposed 40%, as are the cases of GSA 5 and 6. In addition, fishing activity in 2020 was particularly low due to the global pandemic. As for intra-annual variations, the trend indicates the highest fishing effort during the summer months. This seasonality, which seems to increase in some GSAs with the EUMAP implementation, is most certainly related to the population dynamics of the exploited species, and socioeconomic demands. This information proves the effectiveness to reduce fishing effort of EUMAP implementation, whilst suggesting the necessity of more focalized management, as GSAs have different starting points and socioeconomic situations.

Key words: bottom trawling, Mediterranean Sea, EUMAP, fishing effort

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Reproductive aspects of the Ocean Triggerfish *Canthidermis sufflamen* (Mitchill, 1815) in the Central-east Atlantic

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Abstract: The Ocean Triggerfish appeared in the Canary Islands 30 years ago and supports a small-scale fishery (Brito et al., 1995). There is no information on their reproductive characteristics anywhere in the world. Therefore, the main purpose was to assess the sex ratio, size at maturity, spawning season, and the reproductive behaviour. Specimens were collected off El Hierro island, at depths of 5-50 m by artisanal fleet. Maturity phases were assigned histologically, and the reproductive behaviour was recorded by scuba divers.
Overall, 397specimens were collected, ranging in fork length (FL) from 251 to 571 mm and ranging in total weight (TW) from 481 to 3854 g. No significant differences were observed in the mean FL and TW between sexes. Both sexes presented a negative allometric growth. The sex ratio showed that females were significantly more abundant than males (1:1.39). In both sexes the smallest mature specimens were 283 mm FL. The size at maturity was 328 mm FL for males and 326 mm FL for females. The spawning season starts in April and ends in October, with high activity between May and September. From November to March there were no specimens in inshore waters. The reproductive behaviour included territorial behaviour and nest building by males, sexual dichromatism, maternal care, and polygynous mating system. The Ocean Triggerfish is a sexually no dimorphic species in size and weight. It has a relatively large size at maturity and a spawning season distinguishable by the presence of individuals in coastal waters. In addition, this species was recorded as a batch spawner with group-synchronous oocytes development. The reproductive behaviour recorded was similar to that of other species in the family Balistidae (Kawase, 2002).

Key words: Ocean triggerfish, sex ratio, size at maturity, spawning season, reproductive behaviour.

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Reproductive features of the *Plagussia depressa* (Decapoda) in Gran Canaria (Canary Islands)

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Abstract: *Plagusia depressa* (Fabricius, 1775) has an amphi-Atlantic distribution and is exposed to shellfishing by artisanal or recreational fishermen (González, 2016). The few studies available on this species have focused on the western Atlantic. The objectives of this study were to estimate sex ratio, morphological size at maturity and spawning season. At night and at low tide specimens were collected monthly in Gran Canaria throughout 2022. Means of total weight (TW), carapace width (CW) and chela length were compared between sexes. Right chela length was used to estimate morphological size at maturity in both sexes. Ovigerous condition (OC) and gonadosomatic index (GSI) of females were used to determine the spawning season. In total, 941 crabs were collected, with a size ranging from 17.34 to 66.97 mm CW. On average, males (62.03±29.19 g TW) were significantly heavier than females (54.29±20.26 g TW) and equal in CW (Males: 46.69±8.05 mm CW; Females: 47.31±7.18 mm CW). Males had both chelae larger than females, on average by 18%. The sex ratio was 1:1.33 and significantly in favour of females. Morphometric size at maturity of males was 42.0 mm CW and that of females was 39.9 mm CW. The smallest ovigerous female was 24.3 mm CW. OC and GSI showed reproductive activity throughout the year. *P. depressa* is a sexually dimorphic species, males are heavier and have both chelae larger than females. Both sexes have similar morphometric size at maturity. In addition, this species has continuous reproductive activity throughout the year.

Key words: Brachyura, *Plagusia depressa*, sex ratio, size at maturity, spawning season.

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MEDIGITAL: A DIGITAL OBSERVATORY OF PUBLIC ATTENTION AND RECREATIONAL FISHING OF MEDITERRANEAN MARINE FISHES

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Abstract: The Mediterranean Sea, a global marine biodiversity hotspot, faces a biodiversity crisis that requires solutions supported by ecological and social information to guide decision-making. To consolidate this information and enhance its accessibility, we are developing a digital observatory (MEDigital) with two focuses: (1) public attention and (2) recreational fishing of Mediterranean marine fish species. First, understanding spatio-temporal patterns of public attention towards fish species is key for mobilising political interest and subsequently enhancing conservation efforts and success. To quantify public attention, we used Google search volume from 2013 to 2023 for 770 Mediterranean fish species and for 26 countries bordering the Mediterranean and/or the Black Sea. Preliminary results showed heterogeneity of public interest across countries and species traits. For example, invasive alien species such as lionfish showed higher public attention in countries invaded by the species. Nevertheless, temporal patterns of public attention within the same country were heterogeneous. Second, the ecological and social aspects of recreational fishing remain poorly understood due to the difficulty in obtaining reliable data. This may hinder our capacity to assess recreational fishing impacts, but also limits the use of recreational fishers' catches in contributing to monitoring marine ecosystems. We are

developing a machine-learning algorithm to automatically categorize and georeference catches from social media across the Mediterranean Sea alongside textual content (e.g., sentiment analysis). Preliminary results showed good accuracy of the algorithm in recognizing target species and recreational fishing methods from YouTube videos. Finally, we created a public interface to facilitate exploration of these data by stakeholders and others. MEDigital will contribute to characterising ecological and social dimensions of the Mediterranean biodiversity crisis in near real-time, with particular emphasis on public interest in species and recreational fisheries, and potentially unveiling impacts of climate change and biological invasions.

Key words: Mediterranean fishes, public attention, recreational fisheries, machine-learning, social media

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WEIGHT-LENGTH RELATIONSHIP OF OCTOPUS VULGARIS CUVIER, 1797 IN THE VALENCIAN COMMUNITY (NW MEDITERRANEAN)

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Abstract: Weight-Length relationship provides important insights for fisheries management and conservation. The weight (W) of most fisheries resources has an exponential relation with the length (L) that obeys the equation $W=\alpha L^{\beta}$, being α the intercept and β the slope. This type of routine analysis is of great importance in fisheries management in order to estimate weight from length, or vice versa. Likewise, these data can be applied to stock assessment models, estimating condition factor and for comparing the type of growth (β=3, isometric; $\beta < 3$ negative allometric; $\beta > 3$, positive allometric) between species or sexes within a species. In the context of declining fisheries in the Valencian Community, the case of the Common Octopus *Octopus vulgaris* Cuvier, 1797 is of special concern, previous studies demonstrate the reduction of the landings in the past decades. Otherwise, an actualization of the information is needed, information about the growth and life history that can be elucidated from W-L relationship is of great importance for future management aims. In this study, the weight and length of a total of 1163 individuals of Common Octopus *Octopus vulgaris* Cuvier, 1797 was recorded. Octopus were captured by clay pot and bottom trawling fisheries in the following localities of the Valencian Community: Benicarló, Burriana, Sagunto and Denia. After decimal logarithmic transformation, data was fitted to the classical equation for L-W relationship using FSA package in R, significant difference from isometric growth and between the slopes obtained from each sex were tested using a t-test and ANCOVA, respectively. The weight of the individuals sampled ranged between 502 and 4064 g, while the Dorsal Mantel Length (DML) ranged between 9,9 and 22,5. Both males and females showed a negative allometric growth ($\beta < 3$) and significant differences were observed between the slopes in males and females. These findings are in accordance with the results of previous studies performed in the waters of the Western Mediterranean and could be used for future management aims.

Key words: *Octopus vulgaris,* Weight-Length Relationship, Growth, Valencian

Community.

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BLUE CRAB CATCHABILITY OF COMMERCIAL FISHERIES IN DIFFERENT AREAS OF WESTERN MEDITERRANEAN SEA

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Abstract: The presence of invasive species such as the blue crab in fishing grounds of artisanal fisheries shows two scenarios in the Spanish Mediterranean: (a) mostly it is caught accidentally, and (b) a targeted incipient fishery due to its great increase in abundance. In general, the idea that the impacts of invasive species can be mitigated by controlling the species abundance through their use as food for humans has recently gained popularity. This study provides information on daily catches of commercial fisheries in different areas of Mediterranean Sea (coastal lagoons and marine areas). The objectives were obtaining trends and compare catches from commercial fisheries by area, environment, season and fishing gear. Data were obtained from fish market databases from bay and lagoon environments (Ebro Delta, Albufera of Valencia and Mar Menor) and marine areas of Cataluña, Valencia, Alicante and Murcia, from 2017 to 2023. Catch data disaggregated by day, location, ship and gear were collected, as well as the sale price, to estimate CPUE (kg/day) and sales (euros/day). Different statistical analyses were used to investigate spatio-temporal trends of *C. sapidus* catches and assess possible causes of variability: environment, locality, gear, fishing technique and seasonality. The results indicated that the fisheries were most important and regular in lagoons and estuarine areas, mainly for fishing gears such as fyke nets, trammel nets and gillnets. Catches and sales at the fish market showed a great seasonal and price fluctuation. Bycatch of blue crab with certain gears is problematic because their market price does not make up for losses in other species or for the costs of fixing the gears. The double nature of *C. sapidus* as an invasive species and fishing resource should be considered in implementing future management strategies.

Key words: *Callinectes sapidus*, fisheries, CPUE, invasive species, seasonality, Western Mediterranean.

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SHAPE AND CHEMISTRY OF FISH OTOLITHS AS A TOOL TO DIFFERENTIATE POPULATIONS OF WHITE MULLET (*MUGIL CUREMA*) FROM THREE TROPICAL ESTUARINE SYSTEMS

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Abstract: *Mugil curema* is a euryaline marine fish with ubiquitous distribution in the western and eastern Atlantic, as well as the Pacific Ocean. In Brazil, this species is abundant in inshore and estuarine waters, supporting several fisheries, although its population dynamics, habitat connectivity and fish movement are still poorly known. Individuals are found in estuarine environments, especially in the first years of life, where they benefit from the input of nutrients and protected habitats to grow. After using estuaries as a nursery, they migrate to adjacent coastal areas to reproduce, completing their life cycle. Coastal connectivity between estuarine and marine environments allows the dispersal of different stages of the species. The aim of the study was to understand the population dynamics of *Mugil curema* through otolith shape and microchemical analyses. Ninety adult individuals were collected from marine coastal areas close to three estuaries (Camaratuba, Gramame and Paraíba) located on the northeast coast of Brazil, in May of 2023. Minor and trace elements of sagittal otoliths were determined through solution-based inductively coupled plasma mass spectrometry, and the otolith contour was obtained using elliptical Fourier descriptors. Univariate and multivariate statistics of otolith chemistry and morphology were used to infer population structure, habitat use and migratory movement of individuals. The results obtained showed a scenario of differentiation of coastal populations and connectivity between marine and estuarine environments, which will contribute to the taking of rational management and conservation measures for estuarine habitats in order to guarantee the protection of adult fish stocks.

Key words: Fishes**,** Natural Tags, Hard parts, Geochemical Signatures, Contour Analyses

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REPRODUCTIVE FENOLOGY OF BLUE CRAB IN FOUR ECOSYSTEMS OF THE WESTERN MEDITERRANEAN SEA

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Abstract: This study aimed to investigate for first time the phenology of alien blue crab *Callinectes sapidus* in four different ecosystems in western Mediterranean. The analysis considered breeding season, reproductive cycles, sexual maturity, fecundity, the relationship with environmental factors such as water temperature and salinity, as well as spatial differences in gonadosomatic index (GSI) and hepatosomatic index (HSI), among other allometric indices. Crab samples were obtained with baited traps and trammel nets in four transitional ecosystems of the Spanish Mediterranean coast: Ebro Delta, Albufera lagoon, Alicante and Mar Menor. Maturity stages were determined by macroscopical and microsopical methods. Egg-carrying females were observed from April to December, peaking in September. The mean fecundity ranged from 297,442 to 3,610,158 eggs, and the mean value (±SD) was 1,261,943 ± 1,025,199 eggs. The size at first sexual maturity based on ovigerous females was estimated as 112 mm carapace width (CW). Based on abdomen morphological analysis, the smallest mature female and male crabs were 102 mm and 90 mm CW, respectively. Similarly, visual analysis of photographed gonads revealed that the smallest mature female and male were 103 mm CW and 100 mm CW, respectively. GSI and HSI have shown opposite trends, with the highest values of the GSI in summer and early autumn for both females and males in all sampling sites. This could be related to a transfer of lipids from the hepatopancreas to the ovary. The histological study reveals a north-south latitudinal gradient in oocyte development, with predominant intermediate and late vitellogenesis towards the Mar Menor. It also suggests migration to open sea of mature females in their last vitellogenic stages after mating. This study showed the relationship between environmental variables and gonad maturation.

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Keywords: *Callinectes sapidus*, allometry, fecundity, gonadosomatic index, hepatosomatic index, maturity stages, Western Mediterranean Sea

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CHEMISTRY OF FISH OTOLITHS AS A TOOL TO INFER ABOUT THE HABITAT USE AND MOVEMENT PATTERN OF THE BRAZILIAN SILVERSIDE (*ATHERINELLA BRASILIENSIS*) FROM TWO NORTHEASTERN BRAZILIAN ESTUARIES

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Abstract: Otoliths are important tools to study fish life cycles. The use of biogeochemical signatures, in particular, show a growing interest in the last years allowing to study the population structure, habitat use, movement patterns and connectivity of fish. Moreover, fish display spatial and temporal migrations in their habitats, namely for grow and reproduction purposes. Although the mechanism of deposition of minor elements and trace elements in the otoliths is still poorly understood, it is well known that this process suffers influence of exogenous and endogenous variables. The Brazilian silverside (*Atherinella brasiliensis*) can be frequently found in the northern to southeastern coastal waters of South America, namely in bays and estuaries, being classified as an estuarine-resident species. The purpose of this study was to investigate the response of the chemistry of otoliths in a resident species occupying distinct estuaries in terms of salinity and temperature. One-hundred and twenty adult individuals were collected in two estuaries (Mamanguape and Tubarão estuaries) of the Paraiba and Tio Grande do Norte states, northeast Brazil, from June to October 2016. The geochemical signatures (element:Ca ratios) of the sagittal otoliths were obtained through solution based inductively coupled plasma mass spectrometry. Multielemental signatures were assessed using univariate and multivariate statistics. The obtained results allowed to reconstruct the habitat use and fish movement along these aquatic compartments. Otolith elemental signatures revealed significant differences between and within estuaries and a high rate of correct reclassification of individuals into their original populations, suggesting some limited connectivity and distinct habitat uses. The acquired information is useful to a better understand of the movement patterns of estuarine-resident fish species and to take appropriate measures for conservation purposes.

Key words: Fishes, Life-Cycle, Natural Tags, Hard parts, Geochemical Signatures

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THE GENETIC BACKGROUND OF THE PHENOTYPIC DRIFT OF FISHERIES

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Abstract: Fishery management has not been sustainably designed for most commercial fisheries which are nowadays overexploited. In general, their census size and phenotypic diversity appear to be dramatically eroded, raising concerns on the unmeasured impact of inbreeding and reduced effective population size. Knowledge on the genetic diversity that remains in fisheries as well as its role on the reversibility of their phenotypic drift is of utmost relevance. This study explores on historical records of phenotypic and genetic changes so far reported on exploited fisheries in the last century *ca*. 1917. Mined data was classified per species and stocks, per physiological and morphological tools employed in stock assessment and the extent of the phenotypic change detected. Erosion of the reproductive structure of populations was commonplace across species, such as lower size and reduced age at maturity being the most common effects, *e.g.*, from 20% loss in length at age of first maturity in the *Melanogrammus aeglefinus* fishery from the North Sea to more than 50% loss across fisheries of *Gadus morhua*. Studies employing genetic markers on wide temporal frameworks were classified upon species, genetic tools, and the resulting post-harvesting genetic effects. That genetic sweep analysed the erosion of genetic diversity in overexploited fisheries since it first appeared in the scientific literature, *ca.*1990. Despite overharvesting, stability of diversity parameters (allelic richness, effective size, etc.) was commonplace in most studies e.g. *G. morhua*, while diversity erosion was reported in some species, *e.g. Xiphias gladius*. The capacity to detect erosion of the genetic diversity was not related to the marker employed, mostly microsatellites and SNPs. Nevertheless, more robust genetic tools are required to score erosion on functional genomic regions underlying adaptive phenotypic traits.

Key words: Fisheries-induced evolution, Phenotypic drift, Gene diversity erosion, Genetic drift

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DÉNIA BOTTOM TRAWLING ANALYSIS AND POTENTIAL STUDY PROPOSALS

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Abstract:

Bottom trawling is known as one of the most invasive fishing modalities . Moreover, most of the Mediterranean fishing grounds are known to be overexploited . The challenge is that fluctuations in effort and the price per kilogram of catch can obscure the true status of fish stocks. This is why we aim to clarify the actual state of stocks in a specific fishing zone, the trawling grounds around Dénia, Spain. We utilize data from the Ministry of Agriculture, Fisheries and Food's database (MAPA) for catch records and Global Fishing Watch (GFW) to evaluate fishing effort (measured as apparent fishing hours). This approach allows us to calculate the Catch Per Unit of Effort (CPUE) and analyze it together with the price per kilogram of catch. Once this first descriptive analysis was completed, a general overview enabled the proposal of possible mitigation strategies. Our CPUE analysis indicates a worrying trend: CPUE has significantly declined over eight years, while prices for most target species have risen, potentially masking the underlying stock depletion and encouraging continued fishing intensity. This situation could be critically detrimental to fish populations, as the economic viability of fishing remains unaffected. To address this, we propose the use of dynamic modeling to develop and test various management scenarios. This approach aims to balance economic viability for fishers with the long-term sustainability of fish stocks.

Key words: bottom trawling, apparent fishing hours, CPUE, stock status, dynamic modeling.

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MICROSTRUCTURE AND COMPOSITION OF THE SHELL OF THE GASTROPODA *BOLINUS BRANDARIS* (Linnaeus, 1758)

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Mollusk shells are composed of calcium carbonate and an organic matrix, with the calcium carbonate fraction being calcified into superposed layers of calcite or aragonite (Watabe, 1988, Checa et al 2009). The shell matrix contains oxygen isotopes ($^{18}O/^{16}O$) that reflect water temperature at the time of calcification. Analysing multiple samples from a single shell allows for the reconstruction of historical annual seawater temperature cycles, which can be used to validate growth increments and to infer age of the individual. Several equations exist to estimate temperature from shells depending on whether the calcium carbonate polymorph is calcite or aragonite (Sharp, 2017).

Bolinus brandaris is a common muricid that live between 1-100 meters deep in the Mediterranean Sea and in the NE Atlantic Ocean from Portugal to Morocco. No information on the *B. brandaris* shell properties exists, which prevents choosing the appropriate equation to reconstruct past temperature conditions. The present study investigated the microstructure and chemical composition of the shell of *B. brandaris* in order to evaluate its potential for age determination and also as a temperature proxy for paleoclimatology and archeology. Optical and electron microscopy (SEM), Raman and X-ray refraction analysis on shell sections and shell powder samples have been used.

The external surface of the shell of *B. brandaris* is pale tan color and has not periostracum; the mother-of-pearl inner layer is smooth and has glossy orange color. SEM observations showed that the shell is composed by three layers. The thickness of the layers varied depending on the area (rib or band); the outer layer width ranged 80-370 microns; the intermediate layer ranged 100-1900 microns, and the internal layer measured around 150 microns width. X-ray diffraction and Raman results indicate that the outer layer was

aragonitic, the intermediate layer calcitic and the inner layer is aragonitic.

Key words: aragonite, calcite, mollusk, shell layers

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PHENOTYPIC PLASTICITY IN THE OTOLITH CONTOUR OF BLACKBELLY ROSEFISH (*HELICOLENUS DACTYLOPTERUS* (Delaroche, 1809)) IN RESPONSE TO ENVIRONMENTAL FACTORS

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Abstract: Stock identification studies play a crucial role in grasping the structure and connectivity of fish populations across expansive geographical regions, thereby aiding in the effective management of fisheries. The blackbelly rosefish *Helicolenus dactylopterus* (Delaroche, 1809) is a benthopelagic species found across a wide range from the Northeastern Atlantic to the Mediterranean. Despite its considerable commercial value, this species is deemed vulnerable to overfishing. The lack of understanding regarding the structure and boundaries of stocks poses a challenge to fishing regulation efforts. In a recent study (Vaz et al., 2023), an analysis of 320 otoliths from the Northeastern Atlantic Ocean and the Mediterranean Sea suggested the existence of distinct population units, showing a clear separation between the Atlantic and Mediterranean populations. Although the classification accuracy for Atlantic populations was somewhat limited, the

effectiveness of analyzing otolith shape to identify stocks of the species became evident. The present study aims to explore how otolith plasticity varies under different environment conditions. In this scope, a total of 440 otoliths of *H. dactylopterus* were collected from waters of Portugal mainland, the Canary Islands, Mauritania, Morocco (NE and CE Atlantic Ocean) and Catalonia (NW Mediterranean Sea). The otolith contour was acquired and processed to obtain a normalized distance to the centroid. Afterwards, this distance was processed using a wavelet function developed by AFORO team (Lombarte et al., 2006), employing a level 4^{th}, as recommended for stocks delimitation. Our findings unveiled clear stocks separation, with classification rates exceeding 90%, while morphotypes frequencies varied among origins. The presence of shared phenotypes in differing proportions across fishing grounds may be attributed to connectivity among stocks, although it could also indicate a significant genetic influence on otolith shape. These results underscore the importance of accounting for phenotypic diversity in fisheries management.

Key words: *Helicolenus dactylopterus*, otolith shape, stocks, Northeast Atlantic, Mediterranean Sea

Acknowledgments: The samples from the Canary Islands were collected during seven scientific surveys conducted around the island of La Palma and La Graciosa, partly funded by the European Maritime and Fisheries Fund (EMFF) through a Collaboration Agreement between the Institute Spanish Oceanographic Center (IEO, CSIC) and the General Secretariat of Fisheries. The samples from northwest Africa were collected during scientific surveys conducted as part of partnership programs between the Spanish Oceanographic Institute (IEO, CSIC) and the "Institut National de Recherche Halieutique" of Morocco (INRH) as well as with the "Institut Mauritanien de Recherche Oceanographique et des Pêches" of Mauritania (IMROP). The first author (JV) was supported by the 'Grants for the Viera y Clavijo training program for researchers' of the Government of the Canary Islands (VIERA Y CLAVIJO-2022-CIENCIAS-1). This research was also funded by the Portuguese national funds through Fundação para a Ciência e a Tecnologia I.P. (FCT) in the framework of MARE grant number UIDB/ 04292/2020 and Associate Laboratory ARNET grant number LA/P/0069/2020, the National Data Collection Framework, and the University of Las Palmas of Gran Canaria (ULPGC).

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NOVEL INSIGHTS INTO THE LIFE HISTORY OF PARAPENAEUS LONGIROSTRIS: A STUDY FROM THE GUINEA-BISSAU EZZ

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Abstract: The Spanish fleet is the predominant shrimp trawl fleet in Guinea-Bissau, targeting mainly the deep water rose shrimp *Parapenaeus longirostris*, closely followed by *Penaeus notialis* and *Aristeus varidens*. *P. longirostris* constitutes 48% of the total catch from 2015 to 2023, with its densest biomass typically found between 100 and 300 meters deep. This study delves into the growth and life history of *P. longirostris* in Guinea-Bissau, filling a gap in scientific knowledge. Data length samplings by sex were carried out by scientific observers onboard this fleet during 29 months between March 2011 and December 2021, encompassing a total of 12,258 shrimp sampled individuals. This data collection was conducted as part of the EU's Data Collection Framework. Utilizing the MCCT model, shrimp growth was estimated based on size composition data obtained from catches. In contrast to traditional methods, this straightforward approach does not seek to explain modal progression but rather to determine, through maximum likelihood, the set of growth parameters and age-specific proportion of individuals that explain inter-sample variability in size compositions. Five modal components were identified for females, with an asymptotic length $L\infty$ of 40.66 mm ($k = 0.76$), and four for males with an asymptotic length $L\infty$ of 34.59 mm ($k = 0.70$). Combined sexes exhibited an asymptotic length of 40.59 mm ($k = 0.75$), with a critical length for vulnerability to fishing gear at 23.54 mm. This agrees with the known greater growth rate of females than males. Improving biological knowledge on growth patterns and life history traits of the deep water rose shrimp in Guinea-Bissau is essential for comprehending its population dynamics. This will provide better inputs for stock assessment and for tailoring conservation and management strategies adapted to the species biology.

Key words: *Parapenaeus longirostris*, Guinea Bissau, Growth, Biological parameters

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A NEW SMALL-SCALE FISHERY: A CASE STUDY OF A DATA-LIMITED MEDITERRANEAN SAND EEL BOAT SEINE FISHERY.

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Abstract: New fisheries involve new species and/or stocks that are not yet fully exploited, have no sustainable management plan and should contribute positively to the economic viability of present or future fishery commercial fleet.

The boat seine fishing gear is employed exclusively for the capture of sand eel and gobid species in Spain. The Mediterranean sand eel, *Gymnammodytes cicerelus* (Rafinesque, 1810) fishing grounds are situated in shallow waters and to the best of our knowledge, there is no information or scientific studies related to Mediterranean sand eel in Andalusia (southern Spain).

The principal objectives of this study were to analyse the growth, longevity, mortality, reproduction and other factors that could be influencing the abundance in an Andalusian fishing ground that is partially included in a Marine Protected Area (Cabo de Gata-Níjar). To estimate the prior stock status and to assess the relative vulnerability of data-limited target species and by-catch, length frequency indicators and Productivity-Susceptibility Analysis (PSA) were calculated.

Sandeels are short-lived forage fish with a high rate of natural mortality, a short life span, and according to length-based indicators, the Mediterranean sand eel population in Andalusia is in a healthy state.

A Generalised Additive Model (GAM) was developed using catch rates and meteorological and oceanographic variables as explanatory variables. The results demonstrated that wave height and temperature were significant environmental factors influencing the presence of Mediterranean sand eel in the catch. The use of GAMs as a modelling tool has the potential to enhance knowledge and the sustainable management of this emerging fishery, where the stocks are not fully exploited and lack a management plan.

Key words: New small-scale fishery, Mediterranean sand eel, GAM, Productivity-Susceptibility Analysi

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UNRAVELLING TRENDS IN EUROPEAN LOBSTER (*HOMARUS GAMMARUS*) RESEARCH AND FINDING THE GAP IN SPAIN'S CONTRIBUTIONS

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Abstract: The European lobster (*Homarus gammarus*) holds significant ecological and economic value and is distributed widely from Norway to Morocco, including the Mediterranean. This species has a high commercial interest in Spain, driven by a robust consumer demand. This has precipitated notable imports including its relative, the American lobster (Homarus americanus), to satisfy market demands. This phenomenon not only highlights a substantial trade imbalance, but also contributes to an increased carbon footprint due to the extensive transportation involved.

An extensive review was conducted through SCOPUS utilizing "*Homarus gammarus*" or "*Homarus vulgaris*" as search terms to capture its historical nomenclature. The 583 articles found reveal a significant evolution in research trends on the European lobster since the early 20th century. The 1960s marked a turning point, with a surge in studies that enhanced biological knowledge. By the mid-1990s, the focus shifted towards conservation, particularly the release of hatchery-raised juveniles. In recent decades, research has increasingly focused on genetics and climate change impacts, while continuing to explore fisheries, aquaculture, and restoration strategies.

Disparities in research contributions have been observed across Europe, with Spain's

contribution being minimal, with only 1.06% of the publications. In contrast, the United Kingdom leads with 36.4% of studies, demonstrating significant expertise across different topics. France follows with 15.3% of the research focused on neurophysiology (40.4%) and biochemistry (21.3%), while Norway accounts for 12.5%, primarily in fisheries (40.4%) and restocking (20%).

The review emphasizes the extensive global research conducted on the European lobster and advocates for Spain to prioritize additional research on this species to ensure its sustainable management. Promoting conservation efforts and sustainable aquaculture practices can address ecological challenges and enhance food production. This strategic approach would position Spain to make a more significant contribution to global knowledge and local resource management initiatives.

Key words: European Lobster, *Homarus Gammarus*, Sustainable management, International trade, Publications trend

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ANALYSIS OF CHANGES IN THE COMPOSITION OF FISHERIES LANDINGS USING THE MEAN TEMPERATURE OF THE CATCH (MTC) APPROACH: PRELIMINARY RESULTS.

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Abstract: The global ocean temperature has been studied by several authors, demonstrating that its progressive increase significantly affects population structure (Hoegh-Guldberg & Bruno, 2010). The impact of ocean warming is one of the major concerns regarding fishing performance. In this study, the composition of monthly landings from 2010 to 2021 has been analysed in six subzones of the Spanish coast: Andalusian Atlantic, Andalusian Mediterranean, Murcian Mediterranean, Valencian Mediterranean, Catalan Mediterranean, and Balearic Mediterranean, from 2010 to 2021. The mean temperature of the catch (MTC) was calculated as the main variable in this study. This index has been validated as a proxy for warming-driven changes in catch composition (Cheung et al., 2013). We analysed the MTC from all zones except the Murcian region where the availability of only annual data precluded a comprehensive analysis of this parameter. Our preliminary results show an increase in the MTC index in the time series in all zones except in the Valencian Mediterranean, where MTC change can be masked by factors unrelated to warming-driven changes in catch compositions (Alajmi et al., 2023), such as shifts in fishing policies, issues with the identification of commercialized species, or changes in market demand. Leitão et al. (2018) have demonstrated that increases in Sea Surface Temperature (SST) lead to structural changes in populations by favoring species that prefer higher temperatures, which in turn influences the MTC. Building on these findings, future studies in our work area will examine the relationship between MTC and SST to determine how similar trends affect the composition of fisheries landings as part of our ongoing research. This research contributes to existing scientific knowledge by providing insights into how rising sea temperatures affect marine ecosystems. It also supports sustainable management of marine resources by identifying trends that could guide future conservation efforts.

Key words: Commercial landings, Sea Surface Temperature, Spanish fisheries.

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DO YOU WANT TO CONDUCT MARINE RESEARCH ACTIVITIES IN OPEN WATERS OFF THE BASQUE COAST (SE BAY OF BISCAY)?

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Abstract: Since 2024, a multi-species marine area, oriented towards integrated multi-trophic aquaculture, has been established 2 miles off the Basque coast (SE Bay of Biscay), offering an excellent opportunity for open ocean research. In this highly hydrodynamic area of 8 ha and depths between 30 and 50 m, 12 longlines have been installed, far from anthropogenic pressures. Several sensors are currently deployed that continuously record data on chlorophyll, temperature, waves and currents. To date, several projects have been carried out focused on the development of an integrated marine observation system for monitoring toxic events, and studies for species diversification and the validation of sustainable aquaculture practices and circular solutions. Depending on the specific interest, the area could be adapted to other research topics and species. The area is well characterized with available information on phytoplankton communities and physicochemical parameters in the water column, microbiological parameters in molluscs and benthic macroinvertebrates on the seabed. In addition, underwater cameras and remotely operated vehicles are available for biodiversity studies through image and video recording. Those interested will be able to use the experimental area free of charge for infrastructure rental and maintenance costs until 2025. Therefore, we are looking for potential partners, such as research institutes, universities, producers or suppliers of aquaculture goods and services, willing to carry out marine research in the open waters of the Basque Country.

Key words: Aquaculture, Basque coast, Bay of Biscay, Experimental area, Open waters

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THE BASELINE ESTABLISHMENT IN THE PEARL CULTURE OF*PTERIA STERNA* (A. GOULD, 1851) IN ECUADOR

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Abstract: Globally, pearl farming is recognized as a lucrative industry. The current status of pearl farming in Latin American can be categorized into two categories: commercial andpilot-scale (Saucedo *et al.* 2023). The aim of this review is to provide an overview of the pilot-scale culture of *Pteria sterna* in Ecuador. In pursuit of this goal, we conducted experiments testing three different types of collectors, with the most favorable outcomes observed was the green meshbags deployed at depths of 5–6 meters (Gregori *et al.* 2019). The resulting spat exhibited high survival rates and demonstrated rapid growth when held in suspended culture using pearl nets and lantern nets.Under such conditions, oysters may reach 100 mm shell height 100 mm within less than a year (Freites *et al.* 2019). This indicates the potential for *Pt. sterna* to be implanted for mabé pearl production within the first year, providing a promising foundation for future sectoral development. Furthermore, we have established baseline data on the overall performance of *Pt. sterna* for mabé pearl production (Freites *et al.* 2020). Our findings reveal that oysters implanted with 9–11 mm diameter nuclei (4 to 6 mm in profile) exhibited significantly faster and larger growth in shell height compared to those implanted with 14 mm diameter nuclei (13 mm profile), albeit producing a thinner nacre coating. Similarly, larger oysters (>80 mm) were found to yield higher-quality mabé pearls due to a lower proportion experiencing over-growth of the adductor muscle on the nuclei and a higher occurrence of regularly shaped pearls (Freites *et al.* 2022). These pearls attain a nacre thickness of 0.8 to 1.0 mm within 6 to 8 months, showcasing promising results considering the Gulf of California, Mexico, typically requires up to 12 months to achieve asimilar nacre coating.
Despite this baseline establishment in pearl culture is ongoing, it is still limited to regional, pilot-scale production of mabé pearls. As well as technical constraints, impediments to regional sector development include both political and economic hurdles, and thus, a

broader, comprehensive study is required to identify key bottlenecks to sector developmentand the interventions required to enable the sector to grow.

Key words: *Pteria sterna*, Ecuador, mabé pearl, mariculture, pearl oyster.

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FEEDING HABITS OF THE INVASIVE ATLANTIC BLUE CRAB *CALLINECTES SAPIDUS* IN DIFFERENT HABITATS OF THE SOUTHEASTERN IBERIAN PENINSULA

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Abstract: Little is known about the feeding habits and ecosystem impacts of the invasive blue crab *Callinectes sapidus* in the Mediterranean Basin. The study here reported aimed at providing information on the natural diet of *C. sapidus* in Mar Menor Lagoon and Guardamar Bay (Spain), testing whether its diet changes in different seasons, elucidating if gender is effective on prey selection and, lastly, checking the hypothesis that ovigerous females exhibit limited feeding activity. A total of 258 crabs were collected using trammel nets from commercial fishers between winter 2022 and winter 2023. The results showed that in Mar Menor Lagoon the most frequently preferred prey group was Crustacea (60%) followed by fish (57%), and Mollusca (29%), whilst in Guardamar Bay, Mollusca (40%), sediment (32%), algae (24%) and Crustacea (24%) were dominant. This species has a high level of predation on *Penaues kerathurus*, an economically important shrimp species in the lagoon. According to GLM, sex, season and size class significantly influenced stomach contents. Furthermore, the content weight of non-ovigerous females was significantly higher than in ovigerous individuals. Since the population of *C. sapidus* tends to increase in the Mediterranean Basin, it is recommended to regularly monitor its feeding ecology in the future.

Key words: *Callinectes sapidus*, Invasive species, Feeding biology, *Penaeus kerathurus*, Spanish Mediterranean Sea

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STANDARDIZATION OF CPUE WITH BAYESIAN SPATIO-TEMPORAL MODELLING: CASE STUDY OF DEEP-WATER ROSE SHRIMP (*P. LONGIROSTRIS*) IN MAURITANIAN FISHING GROUND

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Abstract: In the lack of fishery-independent information, catch per unit of effort (CPUE) is the conventional abundance index used for stock assessments. However, properly accounting for the spatio-temporal distribution of both fishing effort and fish abundance has been one of the largest sources of uncertainty in using CPUE as an index of relative abundance. Of particular concern is the change in spatial distribution over time due to movement of the stock, recruitment dynamics, or local depletion. This study standardized fishery-dependent catch-per-unit- effort (CPUE) of deep-water rose shrimp from the coast of Mauritania using Bayesian hierarchical spatio-temporal Gamma regression models (BHSTM) with the integrated nested Laplace approximation (INLA). This approach provided insights on variables and corresponding modelling effects that may be relevant in spatio-temporal fishery-dependent data standardization and that could be applied to other fish species and areas.

Key words: Bayesian hierarchical spatio-temporal models (BHSTM), integrated nested Laplace approximation (INLA), relative biomass, CPUE

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COMPARATIVE GROWTH OF SOUTHERN BLUEFIN TUNA (*Thunnus maccoyii*) AND SKIPJACK TUNA LARVAE (*Katsuwonus pelamis*) IN THE EASTERN INDIAN OCEAN

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Abstract: Southern bluefin tuna (*Thunnus maccoyii*, SBT) and Skipjack tuna (*Katsuwonus pelamis*, SKJ) are economically important top predator species. SBT is distributed in temperate regions of the Southern Hemisphere, while SKJ mainly occupies tropical and subtropical waters of all major oceans. Despite their importance and long history of research, there have been few studies focused on their critical early life stages. Larval survival is strongly linked to growth potential. A comparative growth and allometric relationship between SBT and SKJ was conducted for larvae captured during the BLOOFINZ-IO study of the eastern Indian Ocean spawning region in January-March 2022. Morphological, meristic and pigmentation characters were assessed and genetic analysis conducted to distinguish between species and other co-occurring scombrids. Somatic variables, such as standard length, body width, eye diameter, lower jaw length, head height, head length, eye-head length, mouth-eye length were measured to 0.01 mm using the image analysis Image J software, and dry weights were obtained on a precision microbalance (0.01 mg) after 24h of freeze drying. For age determination, sagittae otoliths were extracted, digitalized, and their microstructure measured for radius and mean increment width by image analysis. Both species were compared as a total population and considering larval ontogenic development stage (pre-flexion, post-flexion). Age and SL at flexion stage was estimated and compared between species.

Key words: Southern bluefin tuna, Skipjack tuna, larval growth, otolith microstructure, Indian Ocean.

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DAILY GROWTH OF SOUTHERN BLUEFIN TUNA (*THUNNUS MACCOYII)* LARVAE IN THE EASTERN INDIAN OCEAN

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Abstract: Southern bluefin tuna (*Thunnus maccoyii*, SBT) is an important commercially and highly migratory species distributed in temperate regions of the Southern Hemisphere. Adults migrate to the only known spawning area in the tropical eastern Indian Ocean. Although there are several ecological and growth studies of SBT juveniles and adults, the main studies of its early life stages were in the mid-1950s to 1980s. A set of SBT larvae were collected during the peak spawning season, during BLOOFINZ-IO oceanographic survey conducted as part of the 2nd International IO Expedition (January-March 2022) and preserved on board for laboratory analysis of daily otolith growth. Taxonomic and genetic identification, distinguished SBT from other scombrid species and the larval stages were classified as pre-flexion and post-flexion. Standard lengths (SL) and body width (BD) were measured (0.01 mm) using an image analysis software, and dry weights (DW) were obtained on a precision microbalance (0.01 mg) after lyophilization. For larval aging, sagittae otoliths were extracted, digitalized and microstructure analyzed, using Leica application suite X to measure radius and mean increment width to 0.01 µm precision. Somatic variables, otolith microstructures and growth patterns along were determined for SBT larval development stages and compared to previously published data for SBT and Atlantic bluefin tuna (*Thunnus thynnus*, ABFT) larvae from the Gulf of Mexico and Mediterranean Sea spawning areas.

Key words: Indian Ocean, larval growth, otolith microstructure**,** southern bluefin tuna, *Thunnus maccoyii*

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OPTIMISATION OF THE ULTRASOUND-ASSISTED EXTRACTION VARIABLES TO OBTAIN ANTIOXIDANT EXTRACTS FROM FOUR EDIBLE BROWN ALGAE

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Abstract: Oxidative stress arises from an imbalance between the production and accumulation of reactive oxygen species (ROS) in cells and tissues, and the ability of the biological system to detoxify these reactive products (Pizzino *et al*., 2017). An excessive increase in the concentration of ROS could cause considerable damage to the organism, such as cancer, cardiovascular, neurodegenerative, and metabolic disorders (Snezhkina *et al*., 2019). Significant amounts of bioactive compounds with antioxidant activity have been found in the chemical composition of marine seaweed, such as brown algae, which could be used as a treatment for oxidative stress (Belda *et al*., 2017). Thus, the extraction conditions of four different brown macroalgae (*Laminaria sp., Himanthalia elongata, Eisenia bicyclis* and *Sargassum sp.*) have been optimised in order to obtain the highest possible antioxidant activity.
The extraction was carried out using a green of ultrasound-assisted extraction (UAE) method and the variables studied were: the amount of algae, the type, concentration and volume of the solvent, as well as the temperature, time and power of ultrasound radiation.
Antioxidant activity was determined by the DPPH free radical scavenging assay (DPPH-RSA). The results obtained showed very high values for three of the algae under study (*Himanthalia elongata, Eisenia bicyclis* and *Sargassum sp.)* with antioxidant activities between 85 and 95 %. This confirms the great potential of these algae for subsequent application as a possible treatment for oxidative stress.

Key words: Brown macroalgae, antioxidant activity, ultrasound-assisted extraction.

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OPTIMIZATION OF *DUNALIELLA SALINA* CULTIVATION: SIMULATING SALT MARSH CONDITIONS

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Abstract: Microalgae technology has gained popularity for its biotechnological value. In terms of mass production, the open-field systems are cost-effective but have drawbacks like needing large land areas or the challenge of maintaining a monoculture system. Salt marshes in Cadiz are an ideal scenario to address the potential of these areas. The following work is intended to design culture strategies to optimize the production of *Dunaliella salina* in salt marshes, as well as to evaluate the possible future applications for the produced biomass. To accomplish this, various scenarios have been designed, consisting of two experiments that replicate the natural conditions of salinity found in salt marshes. The results show that the optimal strategy for inducing saline stress involves exposing the culture to progressive stress rather than acute stress. These strategies, combined with a period of nutrient starvation when cultures have reached maximum biomass, favour the production of compounds of interest such as pigments and mycosporine-like amino acids. Regarding the operating mode, semicontinuous culture [1] is more efficient than batch culture in terms of productivity, as well as the most suitable for obtaining proteins. Finally, based on the experimental results, our preliminary cost assessment of the cultivation of *Dunaliella salina* in lands of the Bay of Cadiz shows a production and harvesting cost of 4,78 €/kg.

Key words: *Dunaliella salina*, salt marsh, stress strategies.

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COMPARATIVE GENOMICS OF *RHODOCOCCUS RUBER* C208 AND RELATED SPECIES: BIOFILM FORMATION AND METABOLIC PATHWAYS FOR PLASTIC DEGRADATION

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Abstract: Plastics are a pervasive environmental concern due to their durability and resistance to degradation. While synthetic polymers are typically considered biologically inert, certain microorganisms, including *Rhodococcus ruber*, have demonstrated the ability to degrade plastics. *R. ruber* strain C208 can degrade polyethylene and polystyrene (Gilan *et al.*, 2004; Sivan *et al.*, 2006; Santo *et al.*, 2013; Gravouil *et al.*, 2017), making it a model organism for studying plastic polymer degradation. The genetic basis of these abilities has not been thoroughly explored, prompting an exhaustive analysis of its metabolic capacities. Here, we expand on the plastic-degrading capabilities of strain C208, investigating its growth and biofilm development on the aforementioned plastics and on polystyrene, polyethylene terephthalate, and polyamide (nylon). Besides, we sequenced the genome of strain C208 and compared it with genomes of related Rhodococci species to elucidate the genetic elements involved in plastic degradation.

We found biofilms development on all tested polymers, with UV-pretreated polyethylene showing the most rapid and robust biofilm formation. The genome of *R. ruber* C208 encodes multiple enzymes related to hydrolysis and oxidation, critical for breaking down complex carbon sources such as plastics. In addition, genes encoding extracellular and intracellular enzymes were identified, including lipases, proteases, and cutinases. The presence of transporters and regulatory proteins further suggests a complex network enabling plastic degradation. Comparative genomic analysis highlighted that Rhodococci species possess extensive metabolic pathways for the degradation of aliphatic and aromatic hydrocarbons (Larkin *et al.*, 2005), with several genes potentially involved in plastic degradation, including dioxygenases, monooxygenases and esterases.

This genomic insight provides a foundation for understanding the metabolic pathways involved and identifies potential targets for enhancing biodegradation processes, suggesting that these microorganisms could serve as effective degraders of synthetic plastics.

Keywords: *Rhodococcus ruber*, plastic degradation, genome sequencing, biofilm

formation, metabolic pathways.

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OPTIMIZATION OF THE GILTHEAD SEABREAM REFERENCE MICROSATELLITE PANELS (SMA1 AND SMA2) AND EVALUATION OF THEIR POTENTIAL IN THE IV GENERATION OF SELECTION OF PROGENSA

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Abstract: This study, which includes tools to be used in the genetic improvement, reports the optimization of the existing multiplex PCRs *Sma1* and *Sma2* of microsatellite markers, with a redesigning of these primer sets in gilthead seabream (*Sparus aurata L.*). The evaluation and validation of the genetic parameters of the 22 markers included in that multiplexes were carried out upon all the genotyping data from the base population to the 4th generation of the gilthead seabream Spanish National Breeding Program (PROGENSA®).

Also, an analysis of the genetic parameters through all the generations of all those markers included in the existing multiplexes was carried out in order to select those markers suitable for the new proposal. The evolution of allele number per multiplex and generation for breeders in their microsatellite markers decreased from 11,36 to 8,45. The rest of the genetic parameters of interest: Observed heterozygosity (Ho), Expected heterozygosity (He), Polymorphic Information Content (PIC) and Null allele frequency showed similar results as other related studies and evidence of a proper breeder selection through all the generational shifts (Navarro et al., 2008; Lee-Montero et al., 2013; Negrín-Báez et al., 2015).

Two new multiplex PCR Sma3.1 and Sma3.2 were designed with the most qualified markers from Sma1 and Sma2, with 12 markers for each multiplex. 24 samples of 4th generation individuals were analysed in order to validate the adequate performance of the brand-new pair of multiplexes.

Results showed a good quality of the allelic amplification as well as their morphology. The genetic quantitative analysis showed that an automatic allele assignment for Sma3.1 of 88,38% is expected to be the highest over the other 3 ones and for Sma3.2 a 80,31%,

higher as well as the current power of Sma1 and Sma2. The mean number of alleles, Ho, He, PIC and range of null alleles did not show significant differences comparing the new redesigned panels with the already available panels.

Key words: (PCR) Protein Chain Reaction, Observed heterozygosity (Ho), Expected heterozygosity (He), Polymorphic Information Content (PIC)

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PLANT PROTEINS AND MICROALGAE-BASED NUTRACEUTICALS BIOTECHNOLOGICALLY TREATED: KEY ASPECTS FOR THE IMPROVEMENT OF *Sparus aurata* FARMING

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Abstract: The use of raw materials of vegetable origin in aquafeed production can induce some problems due to their thick cell walls, leading to digestibility problems in cultured animals. In this context, biotechnological treatments (e.g. enzymatic hydrolysis) are a promising strategy to mitigate some of the anti-nutritional effects caused by this type of raw material. This study evaluates the benefits of supplementing diets with a high content of enzymatically hydrolysed vegetable protein enriched with nutraceutical compounds extracted from microalgae in *Sparus aurata* juveniles. To do this, three experimental diets were used: i) control diet (C) with a nutritional composition based on ingredients from marine origin; ii) diet with a high percentage of substitution (75 %) of ingredients from marine origin by biotechnologically treated vegetable proteins (PP); and iii) PP diet supplemented with 2 % of the nutraceutical compound GreenGrape-LB (GG-LB) developed by Lifebioencapsulation S.L. (Almería, Spain). The inclusion of hydrolysed vegetable protein in the diet maintains growth performance in fish fed both the PP and the enriched (GG-LB) diets, without significant changes in most of the growth parameters when compared with the C group. In addition, metabolic parameters and plasma cortisol levels did not show significant differences between the experimental groups. These results suggest that the inclusion of plant proteins treated by enzymatic hydrolysis and microalgae-based nutraceutical compounds in the diet of *S. aurata* is an effective tool to mitigate several of the adverse effects caused by a high substitution of untreated plant proteins in aquaculture feeds for carnivorous species.

Keywords: aquaculture, microalgae, nutraceuticals, nutrition

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UTILIZING MICROALGAL BIOREFINERY FOR METABOLIC HEALTH IN PHENOTYPIC ASSAYS WITH ZEBRAFISH LARVAE AND HUMAN LIVER CELLS

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Abstract: Obesity, considered an epidemic, is associated with a rise in metabolic syndrome (MetS), the cause of a wide range of health problems, including type 2 diabetes, non-alcoholic fatty liver disease (NAFLD) and cancer, to which available treatments are mostly ineffective. The aquatic environment remains a poorly studied resource and has great potential for discovering new natural compounds and secondary metabolites from organisms such as microalgae with promising biotechnological and biomedical applications. Microalgal biorefinery aims to valorise lost biomass, whereby, cell components from waste products are broken down to have an economical strategy of circular economy for lipids, proteins, and carbohydrates. This study contributes to an ongoing project consortium aiming to develop novel nutraceuticals obtained from biorefined microalgae to treat obesity and associated metabolic disorders.

This work focused on the analysis of organic extracts from microalgae for their potential bioactivity on metabolic diseases. Consequently, microalgal lipid extracts as well as different fractions from stepwise extractions using water were analysed. All extracts were screened in phenotypic assays for appetite reduction, lipid reduction, and glucose uptake in zebrafish larvae, and for hepatic steatosis in HepG2 cells at a final concentration of 25 µM.

4 lipidic extracts, namely from *Pavlova gyrans*, *Chlorella vulgaris smooth*, *Phaeodactylum tricornutum* and *Nannochloropsis gaditana,* reduced neutral lipids and appetite, compared to the solvent control. 2 other lipidic extracts from *Scenedesmus obliquus*, *Chlorella vulgaris organic*, reduced only lipids, and 1 extract from *Tetraselmis chuii,* derived from the pellet of the aqueous extract after protein hydrolysis. 1 lipid extract, *Spirulina platensis,* only reduced appetite. Two extracts from *Skeletonema costatum* and *Isochrysis* proved to be toxic *in vivo* (100% mortality).

The potential of those samples in anti-steatosis and anti-diabetic effects is still under study.

Future metabolite profiling will be applied to understand compounds potentially involved in the observed bioactivities.

Key words: Phenotypic screening, Microalgae, Biorefinery, Metabolic diseases, Zebrafish

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REVEALING THE POTENTIAL OF *FUCUS VESICULOSUS* LINNAEUS FOR COSMETIC PURPOSES: CHEMICAL PROFILE AND BIOLOGICAL ACTIVITIES OF COMMERCIAL AND WILD EXTRACTS

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Abstract: Nowadays the industry of natural products is gaining interest due to the modern lifestyle, loss of efficacy and side effects of synthetic ingredients. Due to its potential, the use of natural extracts in cosmetics has been highlighted, becoming the seaweeds into focus for their wide range of bioactive compounds [1,2]. In this study, we evaluated the potential of acetone (90% and 70%) and ethanol 60% extracts of wild and commercial *Fucus vesiculosus* for skin application with focus in the field of antiaging. The extracts were chemically characterized for their phenolic content (TPC) though the colorimetric methods of Folin Ciocalteu and 2,4-dimethoxybenzaldehyde, and their pigments profile was established by High Performance Liquid Chromatography. Their antioxidant potential and ability to inhibit tyrosinase and hyaluronidase (HAase) was accessed *in vitro*, in a cell-free system, while their anti-inflammatory potential was determined in macrophages (RAW 264.7) cell line. TPC ranged from 361.2 to 1903.83μg_{GAE}/mg being phlorotannins between 0 and 15.91μg_{PhlorE}/mg. Fucoxanthin was dominant in all samples (from 3.24 to 2612.47µg/g), while a violaxanthin isomer, chlorophyll-*a*, zeaxanthin, β-carotene, phaeophytin-*a*, β-carotene derivative, and chlorophyll derivatives appeared as minor compounds. The highest antioxidant potential was found in the acetone 90% extracts of the wild *F. vesiculosus* for the scavenging of superoxide anion radical (IC50 0.30mg/mL) and nitric oxide (IC50 12.09µg/mL). The same extract was also the most effective for tyrosinase inhibition (IC50 1.23µg/mL), presenting lower values than kojic acid (IC50 4.09µg/mL). All the extracts presented anti-inflammatory potential in LPS-stimulated RAW 264.7 cells, with no cytotoxicity under the tested concentration (12.5-200µg/mL). For the first time, this original survey compares different extracts of wild and commercial *F. vesiculosus* in the field of cosmetics, demonstrating a promising, innovative, and

multifactorial nature of this species with the wild acetone 90% extract clearly being the one with highest antiaging potential.

Key words: antioxidant, anti-inflammatory, carotenoids, cosmetics, tyrosinase.

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ESTIMATING NATURAL AND FISHING-INDUCED MORTALITY AND THE BEHAVIOURAL EFFECT OF HANDLING FROM POPULATION-LEVEL HIGH-RESOLUTION ACOUSTIC TELEMETRY

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Abstract: Estimating demographic parameters, such as growth rate, fecundity, and natural mortality, is crucial for achieving sustainability in fisheries management, although it is widely recognized as a challenging task. However, new high-resolution tracking systems are proving to be a valuable tool for studying these population aspects by allowing detailed monitoring of large number of individuals. These level of detail, allows for the exploration of previously unstudied biological features, such as individual behavioural variability and its implications at the population level. In this study, we used a high-resolution telemetry system to monitor a population of pearly razorfish (*Xyrichtys novacula*; Linnaeus, 1758), a species highly valued by recreational fishermen in the Balearic Islands. This species is known for its marked diel behaviour, circadian rhythms, and a well-defined social structure in the form of harems, where one male shares territory with several females. We employed the JSATS system (Lotek Wireless Inc.), which consisted of 70 acoustic receivers and LAMT micro transmitters, to monitor 232 pearly razorfish individuals from May to October 2019. The collected data, combined with previous knowledge of this species, allowed us to estimate the behavioural effects of handling (i.e., the time it takes for individuals to exhibit consistent behaviour and activity after being caught and tagged), as well as the post-fishing mortality (i.e., individuals that fail to exhibit a consistent behaviour pattern and stop emitting signals shortly after being tagged), and natural mortality (i.e., individuals that, after exhibiting consistent behaviour, either stop emitting signals or begin to show an erratic pattern suggesting a predation event). Our study highlights the potential of high-resolution tracking systems for studying population parameters and emphasizes how the detailed data obtained can be instrumental in the effective management and conservation of marine species.

Key words: Acoustic telemetry, Natural mortality, *Xyricthys novacula*

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DAMAGE CAUSED BY CRYOPRESERVATION IN SEA URCHIN EGGS ANALYZED BY ELECTRON MICROSCOPY

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Abstract: Cryopreservation has been applied recently to aquaculture, genetic programs and conservation in marine environment. Gamete cryopreservation has been studied throughout the years, but mainly focused on sperm as many favorable results had been achieved. However, oocytes are still under research as no successful outcome has been accomplished yet.

The aim of this study is to examine the damage in *Paracentrotus lividus* oocytes caused by different cryopreservation methods and cryoprotecting agents (CPAs), using electron microscopy techniques (SEM and TEM).

Oocytes and sperm were collected from sea urchins reared in captivity. Different freezing methods (slow cooling, vitrification by contact, droplet vitrification, and straw directly into liquid nitrogen) and CPAs concentrations were used to cryopreserve unfertilized and fertilized oocytes. Samples were prepared mixing 1mL of oocytes with 1mL of CPA in one single step and equilibrating for 5 minutes. All samples were fixed with a solution of 1% glutaraldehyde in sea water and analyzed using SEM and TEM.

Results have shown that cryopreservation caused an irreparable damage on the oocytes. Membranes appeared broken and cellular material and vesicles have been extruded from the eggs and are visible on the surface. Even though damage is observed in all samples, not all methods and CPA concentrations had the same level of damage. For example, when using vitrification by contact with 1.5M of EG, the ultrastructure of the cytoplasm seemed in better conditions but not the egg surface.

The observation of the topography of the egg surface is essential to have information on the actual conditions of the eggs. Unfortunately, the egg surface is the region of the cell that is more susceptible to treatments and reacts appropriately with the sperm if the eggs. So it seems appropriate to study the damages cryopreservation causes on the egg surface to try and design successful protocols for oocyte cryopreservation.

Key words: Sea urchin, egg, cryodamage.

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Evaluation and characterization of antidiabetic activity from cyanobacteria

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Abstract:
Diabetes mellitus is a metabolic disorder characterized by high blood sugar levels or hyperglycemia that is caused by problems with insulin production, insulin action, or both and it is related to alterations in the carbohydrate, lipid, and protein metabolism [1,2,3]. The International Diabetes Federation (IDF) approximated in 2021 that 10.5% of the global population live with diabetes[4] whose prevalence is estimated to increase up to 12.2% of the population by 2045[4]. Cyanobacteria offer a promising opportunity for the discovering of bioactive compounds, since they possess a huge chemodiversity and previous works established antidiabetic properties in some strains[5,6].
The aim of this research was to evaluate the glucose uptake activity in zebrafish larvae *in vivo* of a library of cyanobacteria fractions at 10 µg/ml. For promising strains, the mRNA expression of genes regulating the glucose metabolism was analyzed, as well as the alteration of the insulin function and the proliferation of pancreatic β-cells after ablation using transgenic zebrafish lines. Metabolites presented in the active fractions were evaluated with mass spectrometry (LCMS-MS) and a bioinformatic approach, namely featured based molecular networking on the GNPS platform.
The analysis of the 248 fractions revealed three fractions with significant 2-NBDG uptake, from where sample 06144_G (an unidentified filamentous cyanobacteria) was selected for further analyses. The mRNA expression revealed that 06144_G increased significant their levels of *pepck* and *glut2*. Analyses with transgenic fish and metabolite networks are currently ongoing, and first results will be presented. This research identified the cyanobacterial strains LEGE06144 as promising strain for the production of insulin mimetic compounds, and revealed first insights into their chemical characterization of the responsible compounds, as well as biological effects, which contribute to the development of future biotechnological applications.

Key words: Diabetes, Cyanobacteria, Danio rerio, insulin mimetic compounds, molecular networks

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COASTAL STUDIES WITH A HAND-MADE USV

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Abstract: A USV (Uncrewed Surface Vessel or Unmanned Surface Vehicle) is a robotic vehicle that navigates remotely without crew. The development and testing of a catamaran-type platform is described in the work by Ronda et al. (2023a). A second phase with new features is described in Ronda et al. (2023b). The USV is equipped with a Lowrance 3 in 1 side-scan-sonar and 2 video cameras, one looking down and the other looking forward. Real-time visualization in a land-based monitor by radio frequency at 5.8 GHz is implemented for one of the two cameras and there is the option to switch between them. The picture below shows the hand-made USV.



Key words: USV, Alicante, coastal studies.

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IMPACT OF BEACH REGENERATION ON THE GROWTH OF COASTAL DUNES, CASE STUDY: CAMPOSOTO BEACH, SAN FERNANDO (CADIZ).

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Abstract: Coastal dunes are one of the key elements within barrier systems; identified by the Habitats Directive as "natural habitat types of Community interest", they are valued for their important ecosystem services (Chica *et al.,* 2011). Sandy coasts are often subject to different types of anthropogenic pressures worldwide (Cabrera *et al.,* 2012). The loss of coastal systems has resulted in the artificial regeneration of beaches in order to protect human infrastructures, especially in urban areas of high tourist interest (Monge-Ganuzas *et al.,* 2003). Although it might initially be thought that beach regeneration would supply sedimentary material to the dunes, empirical evidence for this idea is limited. Observations such as those made at ZandMotor (The Netherlands) suggest that nourished beaches are often associated with limited supply conditions, leading to relatively low dune growth rates (Hoonhout and De Vries, 2017; Nolet, 2020).
The purpose of this study is to examine variations in the growth of dune ridges along the coast, backing up a section partially affected by regeneration. The research focused on the Camposoto Barrier (San Fernando, Cádiz), starting southwards from the point where the last regeneration took place in 2018. Five topographic surveys were carried out from October 2022 to February 2023, consisting of 7 beach-dune transects, including the collection of beach sediment samples at all 7 transects during 3 of these surveys. The results indicate that dune growth rates were low during the period studied, even in favourable wind conditions. The dry beach instead showed distinctive characteristics, with coarse and poorly sorted sediments, which differentiated it from the dune and intertidal sediments. The role of coarse sand and pebbles as the main supply constraint to the dunes is discussed, along with other possible local controls on dune growth.
In conclusion, it can be said that beach regeneration does not contribute significantly to dune growth, although some aspects such as the wind dynamics of the site or the influence of berms on wind processes should be studied.

Key words: Aeolian sand transport rates, airflow, coastal dunes, beach-dune interaction.

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IX International Symposium on Marine Sciences
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CONTOURITE EROSIVE FEATURES ON THE ALICANTE PROMONTORY (SE IBERIAN PENINSULA)

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Abstract: The Alicante Promontory protrudes as a 45 km long complex rocky area named Alicante Highs (Catafau-Alcántara et al., 1994). It is affected by E-W compressive active faults and the NW-SE Don Juan Fault Zone (Acosta et al., 2013).

A multibeam bathymetry dataset recently acquired during CIRCALEBA_1121 and CALYPSUS_0324 cruises allows updating current knowledge on the Alicante Highs, which comprises five different seamounts, namely from E to W: (a) a 10.5 km long and 1 km wide seamount, with its summit at 134 m depth, known as El Cantil by local fishermen; (b) a 10 km long and 2 km wide bulky seamount with two summits at 122 m (Seco del Patíbulo) and 129 m depth (known as La Muntanyeta by local fishermen) separated by a 30 m deeper, and 1 km wide through; (c) an 8 km long and <1 km wide sinuous outcrop with its summit at 357 m depth; and (d) a 9.5 km long and 2.7 km wide seamount adjacent to Benidorm Canyon, with its summit at 419 m depth.

The Alicante Highs show evidence of contourite moats (Catafau-Alcántara et al., 1994), as well as associated contourite drifts. Except for 5 km on its northern slope, El Cantil is surrounded by a 18 km long and >50 m deep large-scale moat. The drift associated to this moat has been identified as an elongated separated drift based on seismic profiles published in the area (Catafau-Alcántara et al., 1994). The easternmost highs –both still unnamed- also show moats on their southern slopes, the first —annex to high "c"— reaching 8 km long, >700 m wide and locally surpassing 70 m deep, and the second —annex to high "d"— reaching 8,5 km long, about 1 km wide and 80 m deep.

The presence of contourite moats and drifts implies a long-term interaction between bottom currents and the Alicante Highs. Identifying these features contributes to a better

understanding of near-bottom circulation and provides insightful information to understand the past and present distribution of benthic communities.

Key words: Alicante, Seamounts, Contourites, Moats, Near-bottom currents

Acknowledgments: To the CIRCALEBA_1121 team and ESMARES project for sharing the Seco del Patíbulo and La Muntanyeta data.

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RECORD OF A HIGH ENERGY EVENT IN THE COASTAL PLAIN OF GUARDAMAR DE SEGURA (ALICANTE, SE SPAIN)

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Abstract: High-energy events (storms/tsunamis/floods) are recorded as thicker, poorly sorted sediment levels. This work seeks to identify possible high-energy events in the Holocene sedimentary record of Guardamar del Segura in the vicinity of the phoenician harbour site of *Cabezo Pequeño del Estaño* from the VIII century BC located in an ancient gulf inlet, today a landfill valley nearby the Segura River. The laser diffraction granulometry of the 5.50 m (GM1) and 4.00 m (GM2) deep boreholes show a predominance of fine silt. At a depth of 3.80 m in both boreholes contain a level of bimodal sediments (fine sand and coarse silt) that are very poorly selected. The positive asymmetry of the sand pattern indicates that they could be sediments transported by an overflow of storm waves, tsunami, or flood towards the ancient marine inlet, now buried. However, the result of the FTIR analysis indicates around 4.00-m-depth a predominance of iron-rich dolomites, from inland, thus could indicate the high energy event that arrived from the interior, or reworked from an interior source, pointing for a flood. Since dating is not possible due to lack of preservation of datable materials, a sedimentation rate already described in the bibliography of 1.9 mm/year has been considered, from which it is deduced that the high-energy event occurred around 2000 years ago.

Key words: River flooding, sediment, FTIR, Cabezo Pequeño del Estaño, Guardamar, Bajo Segura

Acknowledgments: GVA-THINKINAZUL/2021/039; CA2/RSUE/2021-00418.

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ENHANCING SEAFLOOR GEOMORPHOLOGY DETECTION: THE SIGNIFICANCE OF STRUCTURAL ELEMENT DESIGN

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Abstract:

In the field of marine geology, precise detection of submarine landforms is essential. Currently, existing automated methods consist of toolboxes based on ArcGIS (Gafeira et al., 2012; Gafeira et al., 2018) or the application of a deep learning procedure after segmentation (Lundine et al., 2023). However, most algorithms for automatic feature identification require a clear boundary between these features and the background (Cao et al., 2008). Since gradient lines between landforms are often not well defined, they are not applicable. One tool aimed at addressing this challenge, currently under development, is the POSIT program. Its design and search strategy focus on constructing a structural element, a matrix that defines the neighborhood and shape of the objects to be processed in the dataset. Subsequently, this element is convolved over different bathymetric mosaics of the Alboran Sea. During this process, various forms on the seabed have been analyzed, including pockmarks and mounds.

Exploring how the design of the structural element represents a significant advancement, its size influences the sensitivity of detection, and shape and orientation are also critical for detecting irregular landforms. Simple structures like circles are useful for detecting circular mounds, while more complex structures such as ellipsoidal or conical ones are essential for identifying pockmarks with diffuse contours or other irregular shapes. These findings underscore the need to adjust the size and shape of the element according to specific features to be detected to enhance the sensitivity and accuracy of the automated detection process.

The results highlight the necessity of adjusting both the size and shape of the element according to the specific features to be detected, in order to improve the sensitivity and

precision of the automated detection process.

Key words: Structural element, Automatic detection, Geomorphological detection.

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THE CHARLIE-GIBBS FRACTURE ZONE (N ATLANTIC): STRUCTURE AND SEDIMENTARY PROCESSES

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Abstract: The Charlie-Gibbs Fracture Zone (CGFZ) is the longest fault in the North Atlantic (1442 km) and laterally displaces the Mid-Atlantic Ridge spreading zone by 342 km. This fracture zone consists of two parallel main faults (Charlie-Gibbs N and S), which give rise to two E-W corridors connecting both sides of the Mid-Atlantic Ridge. This configuration facilitates the westward circulation of the Iceland-Scotland Overflow Water (ISOW). This deep-water current is a part of the Atlantic Meridional Overturning Circulation (AMOC), which plays a crucial role in regulating global climate. The BOCATS2 project addresses the study of temporal and spatial variations of ISOW in the CGFZ area with the aim of understanding its past trend and predicting its future evolution. During August 2023, the BOCATS2-2023 campaign was conducted in the CGFZ area in order to image acoustically the seafloor and near surface as well as recover sediment cores. The present study aims to characterize the geomorphological context where sediment cores were recovered through analysis of multibeam bathymetry and parametric profiles. Preliminary results indicate that CGFZ consist of several terraced sub-basins with rhomboidal geometry flanked by faults and volcanic edifices. Mapping of the recent faults reveals segmented tectonic activity within the CGFZ, mainly concentrating on the northern fault and, to a lesser extent, on the eastern end of the southern fault. The sedimentary fill in the basins and terraced areas consists of parallel stratified facies with intercalations of high-amplitude reflectors and sporadic landslides within. Moreover, contouritic deposits have been identified on the margins and basins mainly in the eastern sector, likely related to ISOW.

Key words: Faults, mid-ocean ridge, contourites.

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SEDIMENTARY INFILL OF THE CHARLIE-GIBBS FRACTURE ZONE (NORTH ATLANTIC)

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Abstract: The Charlie-Gibbs Fracture Zone (CGFZ) plays a crucial role in the Atlantic Meridional Overturning Circulation (AMOC) because it is the main deep oceanic passage for bottom waters, mainly ISOW, that crosses the Reykjanes Ridge, communicating the eastern and western basins of the North Atlantic. We hypothesize that submillennial-scale palaeoceanographic changes associated with the migration of the Polar Front can be deciphered from the analysis of the contouritic bodies related to the bottom currents circulating along the CGFZ.

The core CGFZ23-GC-04 (450 cm length) was retrieved from the eastern end of the north corridor of CGFZ (52º19.19'N/29º50.37'W) at 3564 m below the present sea level. Its lithology consists of very poorly sorted sandy mud with variable amounts of quartz and volcanic and biogenic grains. The core records the last ~140 ka according to the chronostratigraphic framework based on 6 AMS^{14}C analyses and graphical correlation with the Ca/Fe record of core IODP-U1314.

Physical properties, elemental composition and grain-size analyses reveal, in general terms, that warmer intervals (MIS5 and MIS1 and, to a lesser extent, the interstadial of MIS3) are characterized by higher values of the ratios Ca/Fe, Sr/Ti, Zr/Rb. On the contrary, cold stadials from MIS 3 and 2 show an opposite pattern. Heinrich stadials (HS2, HS3, HS4, and HS5) also show relatively high magnetic susceptibility values. The conspicuous silty laminated interval 130-150 cm with anomalous high magnetic susceptibility values, very low percentage of sand and Fe/Ti and K/Ti suggest a tephra deposited around 34-31.5 ka.

Key words: Charlie-Gibbs Fracture Zone, North Atlantic, Contourites, Last glacial cycle.

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MORRO DE TOIX RECENT NOTCH (ALICANTE, SE SPAIN)

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Abstract: The Morro de Toix massif, located between Altea and Calpe on the Alicante coast in southeastern Spain, features a seacliff coinciding with a vertical fault plane of more than 2 km-long. A marine tidal notch extends all the seacliff, with a maximum incision in some places of more than 2 m. The Alicante sea-level have been monitored since 1870 with a local sea-level-change less than 20 cm, as the Alicante harbor tide-gauge is the stable level reference for the Spain topographic maps. The sea-level change obtained from the tide-gauge dataset is inside the tidal range of about 40 cm, so the marine tidal notch is in equilibrium with the sea-level dataset. The Morro de Toix notch depth is similar to the highest incision (2 m depth) for the Mediterranean Sea notches described by Antonioli et al. (2015). The increased development of the Morro de Toix notch can be explained by the ancient high phreatic karstic freshwater discharge mentioned by the XVII-century chroniques (Escolano, 1611), as the lime unsaturated freshwater increase the notch development. Nowadays, the karstics conduit do not discharge freshwater rather they sink sea-water due to the extensive human use of groundwater. The massif during recent times elevated, as deduced by the major Salado River incision in the near area (Moseley, 1990), so do not can be ruled out that the sea-level rise can be compensated by the tectonic uplift.

Key words: *Morro de Toix, Seacliff evolution, Alicante Coast, notch*

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GEOMORPHOLOGICAL ANALYSIS OF THE INNER CONTINENTAL SHELF OF THE PREBETIC SYSTEM (SOUTHEAST IBERIAN PENINSULA)

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Abstract: The objective of this study is the geomorphological analysis of the inner continental shelf of the Prebetic System in the southeast of the Iberian Peninsula (western Mediterranean). The analysis of the high-resolution bathymetry obtained from the Ecocartographic Study of the Alicante Province, up to 40 m depth, allows us to identify and accurately map the main geomorphological features of the inner shelf. The digital elevation model and the digital slope model have been computed with a grid resolution of 1x1 m. The structural control is manifested in the presence of faults, especially evident south of Huertas Cape, on the three flanks of Serra Gelada Mountain, on Morro de Toix Headland, between Ifach Rock and Blanc Cape, and west of Moraira Point. Associated with them, sunken and terraced blocks are identified north of Ifach Roch, south of Serra Gelada (with Benidorm Island as an isolated peak) and south of Huertas Cape. The smaller widths of the inner platform are associated with the fault on the southeastern flank of Serra Gelada and the Calpe olistolith, while the greatest widths of the inner shelf are located northeast of Huertas Cape and between Moraira Headland and La Nao Cape. An ancient barrier, with NW-SE orientation and its top at 37 m depth, is located north of San Antonio Cape, entering the Gulf of Valencia. The abundant gullies and fluvial courses in the emerged littoral zone are filled by sediments, thus not evident in the present morphology of the inner shelf.

Key words: digital elevation model, structural control, faults, coastal barrier.

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COUPLED NATURAL AND HUMAN INDUCED ENVIRONMENTAL HISTORY DURING THE HOLOCENE IN UTICA (TUNISIA): LIPID BIOMARKERS AND METAL POLLUTION

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Abstract: The coastal palaeoenvironmental conditions of Utica ancient gulf area during the Holocene were reconstructed after a multidisciplinary study to identify natural variations and the anthropic processes of this coastal area. For this purpose, two ca. 15 m-deep cores formerly drilled in the surroundings were studied. Amino acid racemization in ostracode valves and previously published radiocarbon (^{14}C) datings of plant debris and charcoal were used for constructing the chronological scale using a bayesian age-model. Based on the sedimentological, lipid biomarkers and trace elements quantification both natural and anthropogenic variations were identified. The results reveal an age range between 0 and 7000 yr cal BP, in which marine and continental inputs occurred marking variations in the palaeoenvironmental conditions, being able to differentiate some units. The human influence since the Chalcolithic, being noticeable during Phoenician and Roman times was also observed in the geological record. Based on previously published data, the lithogenic and anthropogenic lead, copper, cinc and silver concentrations along the sedimentary record were calculated, together with their enrichment factors using titanium (Ti) as a conservative reference element and normalized with pre-anthropogenic data. Findings showed that the influence of anthropogenic factors predominated in the last four millennia, particularly aerosol deposition linked to mining and metallurgical activities in the area especially in Phoenician and mainly during Roman times. In addition, the presence of faecal stanols, such as coprostanol, corroborated the presence of human populations in the area. Thus, these results indicated a relevant human influence in the last 3500 yr cal BP. Thus, the coastal record of Utica revealed environmental changes and

anthropic activity mainly related to ancient mining.

Key words: Paleoenviroment, amino acid racemization, trace elements, lipid biomarkers, faecal stanols.

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PALAEOCEANOGRAPHIC EVOLUTION OF THE TROPICAL INDIAN OCEAN THROUGH THE LAST INTERGLACIAL PERIOD AND PENULTIMATE TERMINATION

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Abstract:

The tropical Indian Ocean is a key region for ocean-atmosphere interactions, whereby the exchange of heat and moisture between the ocean and the atmosphere has regional to global impacts. For example, the Indian summer monsoon (ISM) in the northern sector of the basin represents the strongest expression of the Earth's hydroclimate. The ISM as part of the boreal summer monsoon intensified during the last interglacial period, likely in response to the strong insolation forcing. However, most of the reconstructions of the ISM during this interval are from the southern margin of India, while information about the evolution of the tropical Indian Ocean is sparse.

To fill this gap in our knowledge we present new palaeoceanographic time series spanning the last interglacial period and penultimate termination from International Ocean Discovery Program (IODP) U1443, in the southernmost Bay of Bengal (5°23.05' N, 90°21.67' E, 2,924 m water depth). We measured the stable oxygen and carbon isotope composition in the planktic foraminifera *Globigerinoides ruber* (surface dwelling) and *Neogloboquadrina dutertrei* (sub-thermocline dwelling) and computed their isotopic gradient, which has been proposed as a proxy of upper water column stratification in response to a weakening of the monsoon winds (Bolton et al., 2013). We will discuss these data in the context of contemporaneous reconstructions of monsoon-fuelled run-off to evaluate the response of the ISM to insolation (and other) forcing during the last interglacial period.

Key words: monsoon, ocean stratification, stable isotopes, foraminifera.

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ASSESSING CHANGES OF DEEP WATER VENTILATION CONDITIONS IN THE ALBORAN BASIN DURING THE LAST 22.000 YEARS

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Abstract: Major changes in the thermohaline circulation of the Mediterranean Sea have been described during the last glacial-interglacial transition and the Holocene period (Cacho et al., 2002; Frigola et al., 2008). However, there is still concern about the re-organization of water masses that took place in the western Mediterranean due to this major climate transition and its link with the Eastern Mediterranean Basin. This study focuses on the top 6 meters of ALB-CL16 sediment core recovered at 1189 m in the Alboran Sea, aiming to investigate changes in deep water circulation and climate conditions in the Western Mediterranean Basin over the last termination.

A very high-resolution oxygen isotope record performed in *G. bulloides* foraminifera has been correlated with previously studied nearby cores, showing that the top 6 m of ALB-CL16 covers the last 22 kyr, thus resulting in an average sedimentation rate of 30 cm/kyr. Sedimentation rates peaked during the Bolling-Allerod (B-A) and the Younger Dryas (YD) (~60cm/kyr), during the formation of the first phase of the Organic Rich Layer (ORL) (Cacho et al., 2002). In addition, the elemental geochemical composition performed by means of XRF core scanning reveal important changes occurring between 17-11 ka, including the Heinrich Stadial 1, the B-A, and the YD events. By one hand, elements related to export and preservation of organic matter on the seafloor (e.g. Ba, Br and S) present marked oscillations during this time interval. By other hand, and contrary to what could be expected, elements related to deep-water currents intensity (i.e. Zr) present some similarities with organic matter proxies, especially during the YD.
In addition, analyses for determination of grain-size distribution from the non-carbonate sediment fraction and U/Mn in planktonic foraminifera, in progress, will help us to better understand the processes controlling variability of deep-water currents intensity and ventilation conditions, respectively.

Key words: Mediterranean Thermohaline Circulation, Organic Rich Layer, deep-water currents intensity, ventilation conditions

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INFLUENCE OF BEACH WIDTH VARIABILITY ON COASTAL ARTISANAL FISHERIES (*PRAIA DA VAGUEIRA* AND *ILLA DE AROUSA*, NW IBERIA)

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Abstract: Fishing and shellfishing on beaches and intertidal sandbanks are crucial for society, playing a pivotal role in the coastal regions positively impacting multiple economic sectors. However, those activities are increasingly threatened by climate change and human impacts in a degree that remain largely unassessed. Among multiple variables, it is urgent to explore the potential relationship between the morphological variations of beaches and sandbanks and the variations in the shellfish and fish captures. In this study, we aim to address this lack of information at two locations in the Atlantic coast of Portugal and Spain (Vagueira Beach and Arousa Island, respectively). We integrated the fishing practices with beach morphological variability through a review of the traditional extraction practices and a data compilation using local high-resolution monitoring surveys and satellite images, offering means to assess and quantify parameters influencing the mentioned activities. We analyse the temporal variability of the main beach morphological parameters (elevation, width, slope), obtaining a range of values beyond which sustainable resource exploitation may be compromised. To ensure the local impact and contribution of our findings on beach management strategies, this study suggest an engagement plan involving continuous interaction with fishing local associations. This study plan and followed methods arise as blueprint for addressing similar challenges in other coastal areas.

Key words: morphodynamics, sandbanks, beach, shellfishing, management

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IDENTIFICATION AND MAPPING OF TECTONIC STRUCTURES IN THE BAY OF ALMERIA AND ASSOCIATED GEOLOGICAL HAZARDS

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Abstract: Marine geohazards are considered as major factor that seriously interferes with economy, society, and environment, especially on the coast, where anthropogenic pressure is predominant. Focusing on marine geohazards, the knowledge of geological and geomorphological characteristics of marine areas is the first step for their identification and early warning (Ercilla et al.,2021). The aim of this work is, therefore, the identification and mapping of tectonic structures in the Bay of Almeria, located in the SE margin of the Iberian Peninsula, in the Alboran Sea. As secondary objectives, the study of the influence of tectonic activity on the morphostructure and the geological processes has been carried out. Data were acquired in the RIGEL_2_AGORA_0820 oceanographic expedition, on board the R/V Ramón Margalef. Very high-resolution parametric profiles (TOPAS PS18) have been interpreted using the *IHS Kingdom* software. ArcMap, belonging to the ArcGIS software package for georeferenced information, has been used to carry out the mapping of structures and shapes. The main structures identified have been: 1) inverse faults with a NW-SW direction where their lengths range between 1km and 4 km 2) gullies 3) channels and 4) paleochannels. Some faults present fractures that top the sea bottom surface. Two areas have been mapping of paleochannels where one in the SW matched with recent morphology and another one, in the North of the central part of the study area, were relics. Preliminary interpretations indicate a concentration of tectonic structures in the south-southwest region, showing superficial deformation and fractures in the most distal part of the study area, associated with recent tectonic activity. Likewise, in the central zone a slight elevation of the bottom is observed, which could also be caused by tectonic activity. In conclusion, the interpretation of the seismic profiles allows an evaluation of geological risks associated with the tectonic structures identified.

Key words: Marine Geohazards, Mapping, Tectonic Activity, Bay of Almeria, Alboran Sea

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EXTREME VALUES OF SATELLITE CHLOROPHYLL-A AND HABS IN THE BAY OF BISCAY BETWEEN 2003 AND 2021

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Abstract: The occurrence of extreme chlorophyll-a values is related to intense phytoplankton blooms that may entail higher productivity rates or adverse events such as eutrophication or toxic events produced by Harmful Algae Blooms (HABs).
Two novel, complementary and non-overlapping statistical extreme indices combining the 90th percentile (P90) and the monthly 90th percentiles (mP90) from the satellite MODIS-AQUA v2018 reprocessed dataset for the period 2003-2021 have been calculated: The "Extreme Highest" (EH) exceedances (bigger than P90 and MP90)and the "Extreme Anomalous" (EA) (bigger than mP90 and lower than P90) The first one gather the extreme observations mostly produced during the interannual spring growing season, and the EA exceedances are found during low phytoplankton growing dates. The last ones reflect different types of extreme events such as unexpected episodic anomalous blooms, extreme values occurring during the autumn secondary seasonal bloom, or extremes registered earlier or later than the expected spring season timing. Our results show that EH prevail in coastal areas of the Bay of Biscay, but the EA prevail in offshore areas. While EH are observed from February to May, coinciding with the climatological spring bloom, the EA are recorded in January, and in summer-autumn months (June to November). The yearly trends are significatively increasing for EA in offshore areas. These results suggest the effects of the strong variability of the oceano-meteorological conditions that affect the Bay of Biscay during the last decades. A comparison between the EA events and the toxic Harmful algal blooms episodes registered in the coastal waters of the Basque coast (SE corner of the Bay of Biscay) has been made to assess the relationship and correlation between the EA and HABs.

Key words: Bay of Biscay, extreme chlorophyll-a, Harmful Algal Blooms, climate change, marine biotoxins.

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DRAINAGE NETWORK AND LONG-PROFILE EVOLUTION OF 30 ADJACENT SUBMARINE CANYONS IN THE NORTHERN SOUTH CHINA SEA

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Abstract: Submarine canyons form drainage networks carrying sediments from shallow to deep. Submarine drainage networks and associated morphological features result from erosional and sedimentary processes. The canyons' long-profiles and the morphosedimentary landforms they contain record the evolution of regional sedimentary environments. An extensive geophysical dataset allowed investigating thirty 10.1-41 km long neighboring submarine canyons (C1-C30) in the northwestern South China Sea. Sedimentary processes have been assessed by combining longitudinal profile morphodynamic analysis and Horton-Strahler drainage network morphometrics. Two types of canyons, A (C1-C9) and B (C10-C30) are identified. Type A canyons are smaller in size and display less extensive drainage networks, with an average drainage density of 0.67 and a normalized concavity index (NCI) of -0.19 in average. Type B canyons are larger and feature higher drainage densities (0.81 in average), with an averaged NCI of -0.26. The positive correlation between the number of streams and canyon concavity suggests that the smaller branches within the canyons, especially canyon head gullies, may effectively collect sediments exiting the continental shelf, thereby increasing transport within the canyons. Under similar background sedimentation rates, higher flow flux typically implies stronger erosion capabilities and increased sediment transport efficiency for both canyon types. To maintain steady sediment transport, as flow flux increases, Type B canyons must significantly reduce their slope gradient downcanyon, thus enhancing the concavity of the longitudinal profile. In contrast, due to less developed internal drainage networks and lower flow flux, Type A canyons require increased downstream slopes to augment transport efficiency, which results in a lower concavity of the long-profile. Otherwise, canyons would suffer from reduced sediment transport efficiency, eventually leading to deposition and burial. This study provides new insights into how submarine canyon drainage networks influence sediment transportation to the deep and how canyons respond

to intertwined sedimentation and erosion processes.

Key words: Drainage networks, long-profile, morphodynamic analysis, shelf-incised canyon, South China Sea

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