ISMS 2018

VI International Symposium on Marine Sciences

VI INTERNATIONAL SYMPOSIUM ON MARINE SCIENCES

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DYNAMICS OF PARTICLE FLUXES OFF NORTHWESTERN AFRICA: INFLUENCE OF ATMOSPHERIC DUST AND EFFECT OF LATERAL TRANSPORT

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Abstract

Eastern Boundary Upwelling Ecosystems (EBUEs) cover only about 1% of the total ocean area but contribute with about 15% of the total marine primary production (Carr, 2002). Roughly, 20% of the marine global fish catch is provided by the four major EBUEs: the Canary, the Benguela, the Californian and the Humboldt Current Systems (Freon et al., 2009). EBUEs may be responsible for >40% of the carbon sequestration in the ocean (Muller-Karger et al., 2005) and are thus relevant for the global carbon cycle. The Canary EBUE along the Northwestern African margin extends approximately between 12° and 35°N and is affected by diverse factors (trade winds, chlorophyll filament, nutrient availability, lateral advection). These factors influence the productivity in surface waters in different ways, depending on the intensity of each factor and each particular area along margin.

This conference will address the seasonal and multiannual variability of particles fluxes dynamics, with particular focus on the Mauritanian upwelling. In this coastal area, the University of Bremen maintains a continuous monitoring program of particle dynamics using moorings since 1988. Our observations reveal strong interannual fluctuations, superimposed on a decadal fluctuation pattern. Distinct dust outbreaks and deposition in winter enhances particle sedimentation and carbon export on short timescales via the ballasting effect. Episodic perturbations of the marine carbon cycle by dust outbreaks might have weakened the relationships between fluxes and large-scale climatic oscillations. A significant amount of diatoms, biogenic silica (opal) and organic carbon produced in waters overlying the Mauritanian shelf is effectively transported in intermediate waters at the outer slope. The impact of the intermediate and bottom-near nepheloid layers-driven transport in the transfer of valves and bulk particulates and its potential contribution to the export of biogenic materials from the shelf and uppermost slope might play a significant role in hemipelagial fluxes off Mauritania.

Key words: coastal upwelling, diatoms, nepheloid layers, NW Africa, particle fluxes.

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CONFERENCIA PLENARIA

MONITORING COASTAL WATER QUALITY

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Abstract: Coastal environments are vulnerable ecosystems providing a variety of unique services. However, coastal water bodies, including transition waters and the coastal ocean, also face increasing pressure due to worldwide demographic trends and industrial development. Nutrient and contaminant inputs from continental sources may undergo rapid changes and their superposition with other environmental stressors (e.g. temperature, pH, parasites, etc.) may cause adverse effects on coastal ecosystem health and productivity. Water quality monitoring is part of the ecological status assessment of transition waters and the coastal ocean, supported by regulations such as the European Water Framework Directive and the Marine Strategy Framework Directive. Monitoring efficiency, related understanding of biogeochemical cycles and risk assessment depends on various factors, such as analytical limitations, observation strategies, regulation, etc., leaving room for improvement and challenging perspectives, not only for emerging contaminants.
Perspectives of using examples of traditional monitoring tools and such recently under development, as well their combination with different approaches, including exposure experiments, are addressed.

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OCEAN REANALYSIS FOR THE STUDY OF THE EVOLUTION OF THE STATE OF THE OCEAN OVER THE LAST DECADES

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Abstract: Assessing the role of the ocean and sea ice on climate variability is critical for understanding global climate change. The oceans have the largest heat capacity in the climate system, and ocean circulation redistributes this heat. Moreover, variability in ocean circulation determines seasonal to decadal variability in climate. Ocean synthesis products are extensively used for this purpose. Ocean syntheses are comprehensive estimations of the ocean state over the last decades (mainly temperature, salinity, sea level and currents) calculated by merging hydrodynamic ocean models and all available observations using data assimilation. Ocean syntheses are used as initial conditions for operational estimations of the ocean state, for short-term predictions aiming at studying specific processes, for seasonal and decadal predictions, and for climate-related activities. They can be also used to estimate the interaction between the ocean and the atmosphere, needed to assess the role of the ocean in the heat balance of the Earth and its influence in the global water cycle. Ocean syntheses are necessary to compute transports across ocean basins and key straits, in order to understand how heat is transported across the ocean.

The COST Action "Evaluation of Ocean Syntheses" (EOS) is an initiative aiming at promoting the use of ocean syntheses and reanalyses among the scientific community, by raising awareness of these products and promoting their use. A series of networks have been created to inter-compare several ocean syntheses in different regions, with the aim of providing a well-documented quality assessment on the various products that will allow the end user to choose the ocean synthesis that is more appropriate for their intended use. After an introduction to ocean syntheses, the main advancements achieved through the COST Action EOS and the main conclusions reached will be presented to the audience.

CONFERENCIA PLENARIA

"THE SECRET LIFE OF DIATOMS: FASCINATING QUESTIONS FROM UNICELLULAR MICROALGAE"

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Abstract: Diatoms, as many unicellular eukaryotes, have life histories that include different phases: a growth phase in which they divide and increase their numbers, a resting phase in which they can withstand adverse environmental conditions, a sexual phase in which genetic recombination occurs. Diatom cells progressively decrease in size following cell division and large cells are produced during the sexual cycle, thus counteracting the miniaturization process.
I will illustrate examples of research on diatom life histories including observations at the Long Term Ecological Research site in the Gulf of Naples, experimental investigations carried out in the laboratory and molecular studies aimed at detecting the molecular mechanisms regulating diatom sexual phase. I will outline the implications that different aspects of life histories have for population dynamics and micro-evolution of this group of microalgae.

CONFERENCIA PLENARIA

RIA DE VIGO: WHEN THE ATLANTIC KNOCKS ON YOUR DOOR

Ricardo Torres

Plymouth Marine Laboratory

Abstract: The Ria de Vigo is one of the four semi-enclosed and elongated bays of the Rias Baixas system situated at the northern limit of the Iberian-Canary Current Eastern Boundary Upwelling Ecosystem. The Ria de Vigo has one of the most important mariculture industries in Europe and a rich history of oceanographic research spanning the last seven decades. In this talk I will review how our understanding of the circulation of the Ria de Vigo has evolved, from the pioneering work in the 50s through to the 80s from such scientists like Fernando Fraga and Ramon Margalef to the subsequent substantial contributions of Ricardo Prego, Francisco Figueiras, Xose Alvarez-Salgado, Fiz Perez and todays' efforts led by Gabriel Roson, Miguel Gilcoto and Eric Desmond Barton and of course many others. The talk will trace the evolution over the years of our understanding of how Atlantic wind patterns and the circulation on the adjacent shelf (namely upwelling and downwelling events) shape the circulation inside the Ria.

CONFERENCIA PLENARIA

LA ISLA DE COCO Y LA IMPORTANCIA DE SER PATRIMONIO NATURAL DE LA HUMANIDAD

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Abstract: La Isla del Coco, Costa Rica, está ubicada a 500 km de la costa en el Pacífico Tropical Oriental (PTO). Es una isla oceánica con un alto endemismo terrestre (~35%) y una alta diversidad marina (más de 1700 especies). Se diferencia de otras islas oceánicas del PTO por ser muy húmeda y estar cubierta de vegetación, es por eso que ha sido visitada y estudiad desde el Siglo XVI. A finales del Siglo XIX un gran número de expediciones empiezan a desarrollar investigaciones en el Isla y se ha generado gran cantidad de información, sin embargo, se continúa descubriendo nuevas especies. Geopolíticamente es muy importante para Costa Rica ya que le genera más del 50% de su mar patrimonial. La Isla del Coco fue declara Parque Nacional en 1978, Patrimonio Natural de la Humanidad de la UNESCO en 1997 y Humedal de Importancia Internacional Ramsar en 1998. La Isla del Coco se ha llamado la Isla del Tesoro, porque hay leyendas de varios tesoros enterrados allí, siendo el más grande el Tesoro de Lima. El Parque Nacional Isla del Coco (PNIC) es de los sitios mejor protegidos, sin embargo, sufre el embate de la pesca ilegal y anteriormente el de la búsqueda de tesoros. Con la declaratorio del PNIC como Patrimonio de la Humanidad se detuvo totalmente todo intento de búsqueda del tesoro. Esta declaratoria también ha servido internacionalmente para resaltar la importancia del PNIC en el PTO y a nivel mundial como uno de los últimos refugios de grandes pelágicos (tiburones, atunes, picudos, entre otros). Además, la destaca como un sitio especial, principalmente para el turismo de buceo. Localmente, la declaratoria de Patrimonio de la Humanidad, ha servido para aumentar la conciencia sobre la importancia de ambientes naturales bien protegidos y ha generado interés nacional por su conservación, principalmente marina.

Key words: Isla de Coco, Patrimonio Natural, UNESCO

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MARINE ECOSYSTEMS' HEALTH: CONTAMINATION AND BIODIVERSITY

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ARE MICROPLASTICS A REAL ENVIRONMENTAL THREAT? – IMPACT ON MARINE INVERTEBRATE EMBRYOS AND LARVAE

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Abstract:
The ubiquitous presence of microplastics in the marine environment has raised an increasing scientific concern during the last decade. However, their potential impact in marine ecosystems is still poorly understood. In order to contribute to this subject, this work investigated the effects of virgin and spiked microplastics on the embryonic and larval development of the mussel *Mytilus galloprovincialis* and the sea-urchin *Paracentrotus lividus*. The toxicity of the following materials was tested: low-density polyethylene microparticles purchased from Micro Powders Inc. (MPP-635XF 4-6 µm, MPP-635G 11-13 µm, Aquatex-325 11-15 µm, Aquamatte 6-8.5 µm), fluorescent red microspheres purchased from Cospheric (FMR-1.3, 1-5 µm) and polyvinylchloride (PVC, 30-230 µm). Non significant effects of the tested microplastics were observed on the embryonic development of mussels and sea-urchins. In order to test the hypothesis that microplastics may act as vectors of pollutants, mussel and sea-urchin embryos were exposed to FMR-1.3 and MPP-635XF loaded with substances of different hydrophobicity: the benzophenone derivative, oxybenzone (log K_{ow}=3.71), the polycyclic aromatic hydrocarbons phenanthrene (log K_{ow}=4.53) and fluoranthene (log K_{ow}=5.16), and the organophosphate pesticide chlorpyrifos (log K_{ow}=4.96). Microplastics spiked with phenanthrene or with oxybenzone were not toxic to mussels at the tested concentrations (0.004-10 mg microplastics/L), with respect to water or microplastics controls. However, microplastics spiked with chlorpyrifos and fluoranthene (0.1-0.6 mg microplastics/L) significantly increased the percentage of abnormal mussel embryos and larvae and inhibited sea-urchin larval growth (LOEC= 0.2 mg microplastics/L). The remarkable toxicity of microplastics spiked with chlorpyrifos could be either attributed to the desorption of chlorpyrifos from plastics to seawater, as it was recently confirmed from littoral plastics (León et al., 2018), or to the bioavailability of chlorpyrifos adsorbed to the microplastics. Moreover, the presence of virgin microplastics in the experimental vials was found to significantly increase the toxicity of dissolved chlorpyrifos to mussel and sea-urchin embryos (LOEC= 200 µg/L).

Key words: marine pollution, microplastics, toxicity, larvae, marine invertebrates

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THE CANARY ISLANDS: A HOT SPOT OF MICROPLASTIC POLLUTION

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Abstract:

Marine ecosystems are being polluted by wastes of anthropogenic origin, mostly plastics. In recent decades a new threat from plastic, microplastics, has been detected. These microplastics, smaller than 5 mm, are ingested by fish, zooplankton, and other organisms and transferred through the food chain. In addition to the physical hazards associated with ingestion, there are also biochemical hazards because microplastics adsorb persistent chemical contaminants (POPs) that bioaccumulate and biomagnify in the food chain.

The Canary Current flows through the Canary Islands in a south-southwest direction. The prevailing north-northeast winds and surface currents transport wastes and deposit them on the northern beaches. The MICROTROFIC project carried out an annual study of microplastic contamination on three of these beaches and developed novel sampling methodologies to isolate the microplastics from associated organic matter (Herrera et al., 2018). The results confirmed high levels of pollution on these Canary Islands beaches with concentrations reaching 300 g/m^2 (Herrera et al., *in press*.). Among the debris found, on two of the beaches, there were also high levels of tar pollution.

The MICROTROFIC project also made the first ingestion study of microplastics in the pelagic coastal fish, *Scomber colias.* It found that 78.3% of the fish were impacted. The microplastics found were mainly synthetic fibers (74.2%), plastic fragments (11.9%) and boat paint-chips (11.5%).

In summary, due the high levels of microplastic pollution found, future research is needed to determine the impact of microplastic and their associated chemical contaminants on marine organisms and ecosystems.

Key words: microplastics, marine debris, tar, pollution, Canary Islands

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ARE WE FINDING PLASTIC DEBRIS EVERYWHERE? QUANTIFYING ABUNDANCE OF FLOATING PLASTIC DEBRIS IN THE RED SEA

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Abstract: Marine plastic debris has been detected throughout the aquatic habitats worldwide, being its abundance and accumulation an emerging concern. During 2016 and 2017, a total of 120 samples were collected along the Arabian coast of the Red Sea by using surface-trawling plankton nets. Plastic debris concentration were relatively low all over the Red Sea (<50,000 items km−2; mean ± SD = 3,546 ± 8,154 items km−2, 1.1 ± 3.0 g km−2) showing no clear spatial relationship with the distribution of coastal population. Results contrast with those found in other semi-closed seas, such as the neighboring Mediterranean. This remarkable low concentration in abundance and weight of plastic debris in the surface waters of the Red Sea, orders of magnitude below that reported for other aquatic habtats, suggest low inputs of plastic waste into the Red Sea and/or additional intervention of particular processes of surface plastic removal. The Red Sea has extensive shallow areas supporting mangroves, seagrass beds and one of the most extensive coral reef systems in the world, which could act as large filters of particulate materials and as important microplastic sinks.

Key words: Floating plastic debris, Red Sea, Mediterranean Sea, surface waters

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FROM LAND TO WATER: HOW AGRICULTURAL CHANGES CAN IMPACT ON COASTAL WATERS QUALITY

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Abstract: the search and need of "water" has always been a constant in the history of human evolution, taking into account that society's development is in part based on it.
From this point of view estuaries represent one of the most important water sources, allowing the populations settled nearby to develop, among other things, the art of agriculture. On the other hand, history has also taught us that a large part of the environmental problems are related to agriculture itself.
Intensive crops and the use of fertilizers can cause an excess of nitrogen and phosphates, which can be dragged into water courses and cause an overload of nutrients in coastal waters at mouths of rivers.
Over time, especially after European Directives in the field of water policy, the concern about pollution and loss of biodiversity in coastal ecosystems is increasing, and with it the search for ever more effective remedies, such as the use of different crops and / or organic crops.
This study intends to evaluate, through the use of a catchment model and its boundaries, the consequences on the ecological status of the coastal waters about a possible change in the crops using as test case the Guadiana river basin.
According to the surveillance control program (Royal Decree 817/2015) which aims to "obtain a general and complete overview of the state of the surface water masses", it is important to have a general control of the long-term changes experienced by these water masses as a consequence of anthropogenic activities.
The aim of this work is to develop a tool applicable to different river basins to control and evaluate the ecological state of surface waters and thus maintaining the Environmental Quality Standards (EQS) required by the European Community in the Water Framework Directive (WFD).

Key words: Environmental Quality Standard, Coastal water masses, Agriculture, Water Pollution

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DISINFECTION OF SEAWATER: AN APPROACH OF BACTERIAL COMMUNITY DINAMICS IN A POST-TREATMENT SCENARIO

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Abstract: Seawater treatment is increasingly required due to industrial activities that use large volumes of seawater in their processes. The shipping industry and the associated management of a ship´s ballast water are currently considered a global challenge for the sea (Werschkun et al., 2014). Related to that, the suitability of an Electrochemical Advanced Oxidation Process (EAOP) has been assessed on a laboratory scale for the disinfection of seawater. Natural marine heterotrophic bacteria (MHB) were used as an indicator of disinfection efficiency. Next evaluation of all disinfection phases, special attention had been paid to several issues, such as recolonization capacity or bacterial community dynamics after treatment (Hess-Erga et al., 2010). In this sense, survival and repair capacity of MHB was investigated after disinfection procedures by replicating a system of ballast water treatment, in which water will be stored in ballast tanks during a voyage. According to the data obtained, it suggests that a monopolization of rapidly growing bacteria dominates the system (treated samples), at least during the first days. It implies low diversity and may also enhance the invasive potential of aquatic invasive microbes, which could lead to serious ecological, economic, and health consequences (Litchman, 2010). It was concluded that, despite disinfection processes being effective, there is not only a possibility for regrowth after treatment but also a change on bacterial population diversity produced by the treatment.

Key words: Seawater disinfection, marine bacteria, recolonization, bacterial diversity

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PREDICTING THE SPREAD OF THE INVASIVE PUFFERFISH *Lagocephalus sceleratus* IN THE MEDITERRANEAN SEA

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Abstract: The rapid spread of the silver cheeked toad-fish *Lagocephalus sceleratus* (Gmelin, 1789), an invasive species of Indo-Pacific origin, in the eastern Mediterranean basin has raised a great concern because of its potential impact on not only the native biological diversity but also the economy and human health. In this work, we propose a method based on ecological niche models to evaluate the future impact of this pufferfish in the Mediterranean Sea. Seven probability distributions derived from four modeling techniques, i.e. AquaMaps, artificial neural networks, maximum entropy and support vector machines, were trained and merged together to produce both an overall habitat suitability map and an effective geographical spread map. Our results predict high risk zones in the middle and in the south of the Mediterranean Sea (e.g. Sicily, Malta, Tunisia) and the invasion of the Bosporus with a potential spread in the Black Sea. Thus, strategies to control its population should be considered to prevent future ecological and economic damages. The present approach is generic and it could be applied to other invasive fishes.

Key words: ecological niche models, invasive species, *Lagocephalus sceleratus*

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ENVIRONMENTAL ASSESSMENT METHODOLOGIES FOR COASTAL AREAS: MARINE LITTER AND SCENERY AT ALICANTE (WESTERN MEDITERRANEAN SEA).

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Abstract: The coast of Alicante (Costa Blanca) was evaluated at 56 different beach locations in remote (10), rural (9), village (15) and urban (22) areas. Litter presence was assessed using the EA/NALG (2000) methodology, which allowed classifying each site in four grades: A: very good (40 sites); B: good (14); C: fair (1) and D: poor (1). Generally, in natural sites with low human presence, marine litter came from sea-based sources related to fishing activities while, in most urbanized sites, litter was composed by small items from land-based sources, essentially beach use activities. Coastal scenic value (Ergin et al. 2004) was evaluated using a checklist table with 18 physical and 8 anthropogenic parameters. Sites were categorized into 5 classes, from Class I (top grade scenery) to Class V (poor scenery): 2 sites belonged to Class I, 6 to Class II, 14 to Class III, 20 to Class IV and 14 to Class V. The sector analysis methodology highlighted 33 coastal sites with good litter grades (A, B) and low scenic classes (IV, V), these sites also presented the largest numbers of Blue Flag, the most common beach award in Spain. Used methodologies are easy to apply to any site and allowed to develop a database that constitutes a very useful tool for sound coastal management. The improvement of scenic quality strongly depends on beach typology. At urban sites efforts must be focused on the improvement of human parameters by removing unnecessary, oversized and visual impacting infrastructures. Cleaning operations, actually concentrated in urban areas and focused on tourism purposes more than environmental issues, have to be extended to remote and rural areas.

Key words: Coastal management, Beach, Physical and human parameters, Spain.

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AGGREGATING MULTIPLE INDICATORS FOR AN INTEGRATED APPROACH, IN ASSESSING THE ENVIRONMENTAL STATUS OF THE BASQUE COAST (BAY OF BISCAY)

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Abstract: According to the Marine Strategy Framework Directive (European Union, 2008), the ecosystem-based management of marine systems requires the use of multiple indicators from different ecosystem components. One of the challenges of this use is how to aggregate them to produce a holistic integrative health assessment of large marine areas (Uusitalo *et al*., 2016). A method to undertake it is the Nested Environmental status Assessment Tool (NEAT) (Borja *et al*., 2016), but it needs testing it in areas with pressure gradients, spatial and/or temporal.

The Basque coast (Southeastern Bay of Biscay) was selected as case-study and divided into Marine Reporting Units (MRU) (European Commission, 2018), including data from coastal and offshore marine monitoring, within the framework of European, national and regional projects, during the past 25–30 years. Overall, there is a distinct pressure gradient within the area from land to the offshore waters (Borja *et al.*, 2011), with most human pressures on land (i.e. treated waste discharges) and additional pressures in offshore waters (i.e. dredged sediment disposal sites, trawling and traditional fishing areas). For the analysis, different indicators have been used, covering several components: fish, alien species, phytoplankton, benthic fauna and flora, physico-chemistry of sediments and waters, and litter. The analyses include spatial (weighting and no weighting) and temporal scenarios, as well as filtering by different descriptors (i.e. biodiversity, alien species, eutrophication, sea floor integrity and contamination).

NEAT classified the Basque coast into good status (no weighting and weighting), with no clear spatial gradient in the status. In addition, it is evident that the more indicators are used, the more representative is the assessment of the area. As conclusion, NEAT is an adequate and efficient tool to aggregate multiple indicators from different ecosystem components to assess the health status of marine waters.

Key words: Marine Strategy Framework Directive, Nested Environmental status Assessment Tool (NEAT), holistic integrated approach

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ASSESING THE ENVIRONMENTAL QUALITY OF EL CONFITAL BEACH (GRAN CANARIA, SPAIN) THROUGH FLOW CYTOMETRY INDICES

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Abstract: The waters of El Confital Beach in Las Palmas de Gran Canaria (Canary Islands, Spain) have suffered from faecal contamination events since 2015 due to unknown causes. Intestinal enterococcal levels exceeded at times the threshold value of water quality established at <185 CFU / 100 mL. Moreover, untreated organic discharges in the coast had frequently led to higher than regular microbial outbursts. In order to quantify the impact of these discharges, we have studied the spatio-temporal variability of autotrophic and heterotrophic microbial populations. Ten sampling points were chosen throughout the beach and in its surroundings, and samples were taken on different days, as well as along a day with an interval of 3 hours between samples. Using flow cytometry, we determined the abundance and viability of heterotrophic bacteria, as well as the abundance of unicellular cyanobacteria and small eukaryotic phytoplankton in order to look for indices that can be used as proxies for organic matter contamination. Our results show sharp spatial changes in bacterial viability and microbial indices that reveal a source of contamination in an area south of the beach, presumably affected by human dumping. Likewise, a temporal variation has been observed in the different sampling points that may be due to the effect of the tide that acts as a homogenizing element. This set of results, in addition to helping to locate the possible source of pollution, highlights the use of flow cytometry to assess the quality of marine waters.

Key words: Bacteria, Flow cytometry, Pollution, Tides

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OCEANOGRAPHIC PARAMETERS RELATED TO THE DISTRIBUTION OF BALEARIC SHEARWATER IN THE GULF OF CADIZ

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Abstract: The design and management of Marine Protected Areas (MPAs) requires the understanding of the habitats and changing distributions of far-ranging organisms at sea, which arise from a complex system of interacting oceanographic features. Niche modelling techniques, able to identify and weigh main drivers controlling seabird occurrence, are used to the spatial design of MPAs. This is the case of the recent Special Protection Area (SPA) established to protect the endangered Balearic Shearwater *Puffinus mauretanicus*. This migratory species, regarded as one of the most threatened seabirds in the world, spends important time periods in the productive waters of Gulf of Cádiz for foraging. To analyse the distribution of Balearic Shearwaters in the Gulf of Cádiz and the oceanographic features related to, we conducted 9 summer surveys between 2006 and 2017 to systematically monitor its occurrence in the Gulf of Cadiz through transect count visual census. Balearic Shearwater was mainly found near Cadiz Bay and the mouths of the Guadalquivir and Guadiana rivers, in shallow (0-500 meters) waters close to coast but showing significant differences between years. In this first approach, bathymetry, distance to Guadiana river mouth and turbidity were revealed as the main factors influencing the spatial distribution. The results could contribute to better predict the occurrence of the Balearic Shearwater in the dynamic Gulf of Cádiz, thus helping to define more suitable SPAs.

Key words: Balearic Shearwater, Marine Protected Areas, Gulf of Cádiz, MaxEnt, Distribution Modelling.

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BIOMARKERS OF PHYSIOLOGICAL RESPONSES OF *OCTOPUS VULGARIS* TO DIFFERENT COASTAL ENVIRONMENTS IN THE WESTERN MEDITERRANEAN SEA

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Abstract: The increase of pollutants in coastal seawater could produce several harmful biological effects on marine organisms related to the production of reactive oxygen species (ROS) causing cellular and tissue damages through oxidative stress mechanisms. Common octopuses (*Octopus vulgaris*) inhabiting coastal areas under high anthropogenic activity of Mallorca (W-Mediterranean Sea) have the ability to control oxidative damage by triggering antioxidant enzyme responses (Semedo et al. 2012). Analyzing the digestive glands, octopuses from human-altered coastal areas showed higher activity of superoxide dismutase (SOD), catalase (CAT) and glutathione S-transferase (GST) compared to octopuses from non-influenced coastal waters (i.e. marine reserve area). Higher metallothionein (MT) concentrations and lack of malondialdehyde (MDA) variations also reflect adaptations of *O. vulgaris* to polluted areas. These biomarkers allowed us to compare the physiological status of *O. vulgaris* individuals from three different coastal areas of Mallorca with different degree of human activities or impacts (i.e one marine reserve area and two anthropogenic areas) (Sillero-Rios et al. 2018). This is the first study assessing the levels of the oxidative stress biomarkers on *O. vulgaris* in the Mediterranean Sea, revealing their usefulness to assess diverse environmental pollution effects on this relevant ecological and commercial species.

Key words: Antioxidant enzymes, anthropogenic impact, oxidative stress, *Octopus vulgaris,* Western Mediterranean Sea.

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SEA OF GIANTS: A HOT-SPOT OF GIANT CEPHALOPODS IN THE CANARY ISLANDS

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Abstract: The distribution of non-commercial large cephalopods is still largely unknown in spite of their important ecological role as top-predators in the oceans. Here we compile a large dataset of opportunistic findings of more than fifty giant/large cephalopods in the Canary Islands showing that the archipelago holds one of the highest rates of occurrence of giant squid reports known to date worldwide, with more than 47 specimens of *Architeuthis* recorded in a period of 24 years. Further, a spatial analysis of the findings show that they concentrate in the channel between the islands of La Gomera and Tenerife in an area with a steep deep-water canyon that also hosts a resident population of shortfin pilot whales. The high abundance of large squid in the area may be a key resource for this teuthophagus cetacean, while predation by whales might explain the high rate of findings of drifting giant squids. Further, here we present also the first attempt of video recording of live giant cephalopods in the Canary Islands including a probable footage of *Architeuthis*, which would be the second ever video recording of the species in its deep water habitat.

Key words: *Architeuthis*, *Haliphron*, Distribution, Canary Islands.

Acknowledgments: This work has been supported by the project 'Comunidades biológicas de aguas profundas mesopelágicas de Canarias' funded by the Ministry of Economy, Industry and Competitiveness of the Spanish Government (code nº: DEEPCOM- CTM2017-88686-P).

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ANALYSIS OF MIÑO PLUME INTRUSION INTO THE *RIA DE VIGO* THROUGH *IN SITU* DATA AND NUMERICAL MODELING

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Abstract: The *Rias Baixas* (NW coast of the Iberian Peninsula) are one of the most important marine aquaculture areas in Europe. Hydrographically, they are partially-mixed estuaries, whose normal residual circulation is fresh water flowing out through the surface layer and oceanic water entering through deeper ones. This pattern is enhanced by upwelling (northerly) winds and can be reversed by downwelling (southerly) winds. Minho River debouches 30km to the south of the *Rias Baixas*. Downwelling winds move Minho River plume northward, and it can intrude into the rias of Vigo, Pontevedra and Arousa, affecting its productivity. Under Minho plume intrusion the salinity pattern of the rias is characterized by surface salinity higher inside the ria than at the mouth. By means of weekly surface salinity data from INTECMAR from late 2006 to 2017, this salinity pattern was detected in a 9% of the available measurements in the *Ria de Vigo*, 8.5% in the *Ria de Pontevedra* and 4.5% in the *Ria de Arousa*. Additionally, several intrusions were detected for the *Ria de Vigo* in January and February 2010. To analyze and characterize these intrusions, the hydrography and thermohaline properties of the *Ria de Vigo* were modeled using Delft3D. From 7th January to 11th February 2010 seven favorable wind periods were detected, all of them associated with a reversal of the normal estuarine circulation and low salinity peaks in the middle part of the ria. It was observed that the intrusion of fresh water from Minho River is able to reach the inner part of the *Ria de Vigo*, while the influence of the inner river (Verdugo-Oitabén) is restricted to the innermost part of the ria, even under high river discharges.

Key words: Rias Baixas, Minho River, estuarine circulation, downwelling, plume intrusion.

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TRANSPORT OF TRACE METALS WITHIN THE GULF OF CADIZ AND THE MEDITERRANEAN SEA

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Abstract:

The Gulf of Cadiz (GoC) is a semi-enclosed basin that connects the Atlantic Ocean with the Mediterranean Sea through the Strait of Gibraltar, and plays a key role in the exchanges of biogeochemical fluxes between both basins. Its eastern shelf is subject to discharges from the Guadiana, Tinto-Odiel and Guadalquivir rivers that supply metals-enriched waters to the basin. In fact, the Tinto-Odiel estuary is one of the world's most contaminated regions (Sainz and Ruiz, 2006). The objectives of this work were (1) to quantify, through the collection of in situ data, the concentration of trace metals at the three estuarine systems as well as along the GoC, Strait of Gibraltar and Alboran Sea (AS), and (2) to model the transport of trace metals from their sources and their flux across the Strait of Gibraltar. The surface (1-5 m) concentrations of 9 trace metals (Ag, Cd, Co, Cu, Fe, Mo, Ni, Pb and Zn) were measured in February and June 2016 within the three estuaries and during twelve cruises carried out between 2014 and 2017 along the GoC, Strait of Gibraltar and AS. The Regional Ocean Modeling System (ROMS) was implemented for the GoC and AS for 2016 because each of the estuary cruises was shortly followed by two offshore cruises that covered the whole domain. The atmospheric forcing was obtained from the Weather Research and Forecasting Model (WRF) for the same period. The surface currents obtained with ROMS were compared with in situ data for validation purposes. A lagrangian transport model was coupled offline to the modelled hydrodynamic field to study the transport of passive tracers discharged from the three

estuaries. Results show that, although most of the particles remained within the inner shelf, part of the trace metals measured within the AS could have originated at the estuaries.

Key words: Gulf of Cadiz, trace metals, ROMS

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PHYSICAL CONNECTIVITY BETWEEN THE NE ATLANTIC SEAMOUNTS

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Abstract: The ocean is a highly complex circulation system that allows the dispersal of organisms among marine populations, affecting their dynamics and resilience. Understand the connectivity patterns between distant populations is essential to their effective management and conservation. Seamounts are prominent underwater features characterized by a great productivity and food availability, being considered hotspots for several benthic communities. Within the Portuguese Exclusive Economic Zone, the Great Meteor and Madeira-Tore complexes are highly productive areas, which are likely to be classified as Marine Protected Areas due to their ecological vulnerability. Although in this region, previous studies analysed the oceanographic phenomena that influence the transport and retention mechanisms around the Macaronesian Islands, none was focused on the connectivity between submarine mountains. Therefore, the aim of the present study is to investigate the physical connectivity between these two seamount groups. To achieve this goal, the Hybrid Coordinate Ocean Model was coupled with the Connectivity Modeling System (a lagrangian tool) to simulate particles dispersal for 9 years (2004-2012), over four different depth ranges: 1-10 m; 20-200 m; 300-500 m, and 600-2000 m. In the upper mixed layer, the Azores Current (AzC) and its associated eddies were the predominant regional feature responsible for the higher interaction between the seamounts from the western complex (Great Meteor). At deeper waters, there was a clear increase in the particle exchange between seamounts from the eastern complex (Madeira-Tore), meaning that eddies have less effect when compared to the predominant ocean current (i.e. AzC). These evidences were partially supported by results from previous biological studies on seamounts marine populations. Nonetheless, this study represents a physical perspective of the degree of connectivity between these seamounts. Therefore, to further understand these connectivity patterns, the application of this lagrangian tool to a selection of key species would be desirable.

Key words: Lagrangian transport, drifting, physical connectivity, seamounts

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NUMERICAL MODEL ENSEMBLE FOR ESTUARINE FLOODS FORECASTING

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Abstract: Estuarine areas have been intensively studied due to their complex physical processes and the societal importance of their ecosystem services. In the context of climate change, an increase of frequency and intensity of extreme events is expected for the next decades (IPCC, 2018). For estuarine regions, floods are one of the most harmful and complex extreme events. To predict their effects, characterize risk areas, create impact assessment tools and promote population safety, accurate numerical modelling tools are essential.

This work presents a comparison and a combination of two 2DH depth averaged estuarine models implemented with the hydrodynamic software packages openTELEMAC-MASCARET and Delft3D. Based on these modelling suites, a two-model ensemble methodology was developed improving the forecasts robustness and accuracy when compared to a single model-based approach.

The ensemble was constructed using the Douro river estuary as test case. This is a region that is periodically under heavy flooding, which implies economic losses and damage to protected landscape areas and hydraulic structures. In the now-a-days estuarine configuration, and due to the new breakwaters construction that interfered with local sedimentary and hydrodynamic patterns, the dynamic sand spit located at the mouth of the estuarine region has increased its area and volume. Historical records reveal ruptures of the sandbar for river flows above 10 000 m^3/s, reducing the risk of flooding (Bastos et al. 2012). Now, with a stronger sandbar, the flooding effects can be harsher.

Both models were configured with the same initial and boundary conditions and similar bathymetries, accurately reproducing water levels and currents. The two-model ensemble results revealed that the present-day estuarine mouth configuration will produce harsher effects for the riverine populations, increasing flooding areas, economic losses and structural damages.

Key words: Estuarine modelling, Models ensemble, Hydrodynamics, Floods, Douro estuary

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OBSERVATIONS AND MODELLING OF SUSPENDED SEDIMENT AND CHLOROPHYLL-A RELATIONSHIP AT TIDAL SCALES IN THE GUADALQUIVIR ESTUARY

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Abstract: The Guadalquivir estuary is a high-nutrient, low-productivity environment in which suspended sediment attenuation of light limits phytoplankton growth at long time scales [Ruiz et al., 2013]. Recent analysis of high-resolution observations shows also a strong connection at tidal scale between Suspended Sediment Concentration (SSC) and Chlorophyll-a (Chla) concentration. Most of the time, SSC and Chla concentrations exhibit in-phase oscillations during the tidal cycle. Both SSC and Chla peak at maximum ebb and flood. This suggests that intratidal Chla concentrations are related to resuspension by tides of phytoplanktonic micro-organisms attached to sediment particles and/or flocculation of suspended sediments with Chla-containing biomass. Only when SSC in the water column is very low and the light availability increases, the in-phase oscillation of SSC and Chla is lost. In that case, Chla observations follow the day-night cycle. Similar variability in Chla concentrations was also reported (e.g.) for the North Sea by Blauw et al. [2012]. To gain insight into the SSC and Chla concentration variability, a new idealized model is proposed. The model accounts for vertical advection of Chla and SSC, resuspension by tidal shear stress, vertical mixing processes, and light-induced growth. Results for several spring-neap cycles show that the idealized model is capable of reproducing the observed in-phase oscillations of SSC and Chla at tidal scale, and their decoupling when a strong decline in SSC occurs.

Key words: suspended sediment, phytoplankton, idealized model, tides, Guadalquivir

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3D MORPHODYNAMIC MODELLING OF A WESTERN MEDITERRANEAN BEACH WITH *POSIDONIA OCEANICA* BANQUETTES USING TERRESTIAL LIDAR

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Abstract: The detached seagrass material of *Posidonia oceanica* conforms characteristics beach-cast accumulations (*banquettes*) which predetermine the structure and morphodynamics of the sandy beaches in many Mediterranean coasts (Vacchi *et al*., 2016). The aim of this contribution is to examine the evolution of a microtidal pocket-beach with these characteristics geomorphic structures after a heavy sea storms period. Terrestrial-LiDAR remote sensing data together with field observations and images acquired with Remotely Piloted Aircraft System were used in order to examine the structural and morphodynamics changes during winter time. We propose a methodology, which considers the sand-dominated and beach-cast parts as two independent elements, in order to estimate the volumetric change of sand (accretion/erosion) of these type of representative beaches. The 3D morphological analysis also evidences the shorter-term variations in beach profile changes and the impact of storms in morphology modelling of the beach. The new technique developed in this study represents an inexpensive, accurate and quick tool to survey the sand volume in natural and artificial replenished beaches.

Key words: terrestrial-LIDAR, coastal geomorphology, erosion, storms, western Mediterranean

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ESTUDIO DEL EFECTO DE TEMPORALES EN LA PLAYA DE LA VICTORIA (CÁDIZ) MEDIANTE UN SISTEMA DE VIDEO-MONITORIZACIÓN COSTERA

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Abstract: La playa urbana de La Victoria (Cádiz) se encuentra en un delicado equilibrio entre su dinámica natural, la elevada presencia de estructuras antrópicas y la gran afluencia de visitantes, lo que hace necesario entender la respuesta de la playa ante las distintas condiciones energéticas del oleaje. Para ello, en este trabajo se analiza el efecto de diferentes temporales a partir del seguimiento realizado mediante un sistema de video-monitorización costera durante el periodo 2013-2018.

El sistema de video-monitorización está compuesto por tres cámaras, ubicadas a unos 40 metros de altura, que obtienen diferentes tipos de imágenes cada hora durante el día mediante el *software* Orasis (Vousdoukas et al., 2011). Éstas son imágenes promediadas (timex), imágenes de la varianza (sigma) e instantáneas. Posteriormente, a través de una modificación del *software* Ulises (Simarro et al., 2017) se han realizado las calibraciones intrínsecas, las calibraciones extrínsecas y la detección de la línea de costa. Ulises permite una reducción de las complicaciones derivadas del proceso de calibración del sistema al realizar ambas (intrínseca y extrínseca) de forma conjunta. A su vez, emplea los orto-mosaicos de las imágenes timex y sigma para la detección automática de la línea de costa (Simarro et al., 2015).

Los resultados muestran una reducción significativa de la superficie de la playa en condiciones de alta energía y una gran variabilidad en la posición de la línea de costa debido al efecto del runup. También se observan las condiciones hidrodinámicas con las que se produce una afectación a diferentes estructuras ubicadas en la zona y una inundación de las áreas colindantes. Finalmente, este trabajo contribuye a poner en valor los sistemas de video-monitorización costera, ya que frente a otros métodos de seguimiento suponen inversiones relativamente pequeñas que proporcionan resultados en tiempo real y con una alta frecuencia espacio-temporal.

Key words: Video-monitorización costera, temporales marítimos, inundación costera, Cádiz.

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MEASURING ORGANIC CARBON SINKS AND STOCKS OF ODIEL AND CADIZ (ANDALUCÍA) TIDAL SALTMARSHES

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Abstract: The role of two coastal Andalusian saltmarshes (Marismas del Odiel and Bahía de Cádiz) as blue carbon sinks is being studied within the project Life Blue Natura. The carbon flux and stock into the sediment and living-plant compartments have been measured on 37 (60-120 cm long) manual cores and 21 biomass samples, respectively, collected in low, mid, and high salt-marsh at both sites. In Odiel, the carbon sinks and stocks of dessicated and re-wetted saltmarshes, as well as a revegetated saltmarsh after sediment movements were also analyzed. Non-destructive scanning of sediment cores by means of XRF core scanner and magnetic susceptibility were performed in order to analyze temporal and spatial variations in diagnostic elemental contents (e.g. Al, Si, S, K, Ca, Ti, Fe, Ni, Cu, Zn, As, Br, Rb, Sr, Zr and Pb) and the ferromagnetic mineral abundance, as indicators of changes in the sedimentation regime. Sediment organic matter content, C_{org}, C_i, and particle grain-size were measured at 2-cm resolution. Sediments were dated with ^{210}Pb and ^{14}C, in order to estimate sediment accretion rates and carbon fluxes. Actual areas of different saltmarsh types (low, mid, high) and of healthy and degraded marsh were measured using GIS-tools, aerial pictures and google maps, in order to scale-up station estimates to both saltmarsh systems, and to estimate their potential area. The heavy metal content was greater in Odiel saltmarsh than in Cadiz saltmarsh, and was specially high in the Odiel stations closer to the river. The organic carbon content varied more among stations than between sites, and was greater at the mid-marsh. Stations where regeneration has been done showed a recovery of the sink function. We also provide

estimates of actual and potential organic carbon stocks and fluxes for Odiel and Bahía de Cadiz saltmarsh systems.

Key words: Coastal saltmarshes, Blue Carbon, Restoration

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BEHAVIOUR OF RARE - EARTH - ELEMENTS IN A ESTUARY AFFECTED BY ACID MINE DRAINAGE

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Abstract:

REEs are sensitive to changes in environmental conditions and they have been widely used as tracers of geochemical processes in a large variety of sedimentary environments. In estuaries, these elements exhibit a considerable separation of REEs, which occurs due to mixing processes involving water bodies with different characteristics (fluvial, estuarine and ocean waters). This study describes the results of a recent investigation into such processes in a estuary affected by acid mine drainage, where processes of seawater dilution and acid neutralization cause significant effects upon REE fractionation between the aqueous solution, suspended matter and sediments. The results show differences in behavior between light REEs (LREEs) and middle and heavy REEs (MREEs and HREEs). A relative depletion in La is observed in sediments and dissolved phase as a consequence of the low pH values, which prevents the separation of LREEs from solution to the suspended matter. When acid neutralization occurs, on the other hand, an increase in the La content is related to the preferential separation of LREEs compared to MREEs and HREEs. In such conditions, they have distinguished three models of main fractionation with respect to pH and zoning within the estuary. According to these standard patterns fractionation evolution of this model, the pH is the key variable that controls the REE fractionation in environments affected by acid mine drainage.

Key words: Acid and saline mixing, rare-earth elements, sediments, suspended matter and dissolved phase.

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DEPOSITION STUDY OF SOLUBLE AEROSOL-DERIVED IRON AND NUTRIENTS TO THE CANARY BASIN

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Abstract: African dust inputs have important effects on climate and the marine biogeochemistry of the subtropical North Atlantic Ocean (Jickells and Moore, 2015). Aerosol inputs to the Canary Basin are among the highest in the world, due to the region's proximity to the Sahara and Sahel desert regions of Africa. Some studies have observed a significant increase in primary production and a change in diatom and mesozooplankton biomasses in the oligotrophic waters to the north of the Canary Islands after a Saharan dust storm (Franchy et al., 2013). This is in agreement with dust addition experiments in which a wide range of impacts was observed across different microbial groups, including phytoplankton, heterotrophic bacteria, and diazotrophs (e.g. Guieu et al., 2014).
Total suspended particle (TSP) concentrations have been monitored continuously since 2002 and wet and dry deposition samples since 2004 on the island of Gran Canaria, Spain (Gelado-Caballero et al., 2012; López-García et al., 2013). In this work, we present fluxes of soluble elements (H^+, major ions, Fe and organic ions) in dry deposition (DD) and wet deposition (WD) samples collected between September 2012 and April 2016. WD corresponded to ~12% of the total particle flux collected.
Principal component analysis (PCA) indicated three dominant factors influencing the elemental concentrations: marine, crustal and anthropogenic (Fe and organic components were related with this factor also). Soluble Fe fluxes appear to be affected predominantly by aerosol particle type, with higher values observed at low dust loading. Although WD fluxes made up only a small fraction of total particle fluxes, they represented an important input of soluble Fe and other nutrients such as nitrate (more than 50% of total amount deposited).This significant contribution to total deposition fluxes may have important consequences for primary production in the surface ocean.
Mineral dust is the primary source of soluble atmospheric P to the north Atlantic region, which is already P stressed. Our data show that DD dominates the total flux of soluble P to this area (~87% of the total flux) and it may have a bigger impact during the summer months

when the water column is more stratified and nutrients inputs from deeper water are restricted.

Key words: Aerosol, Dust, Deposition fluxes, soluble nutrients and trace metals.

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ALDEHÍDOS POLI-INSATURADOS EN EL MAR DE ALBORÁN

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Abstract: Los aldehídos poliinsaturados (PUAs) son compuestos orgánicos volátiles derivados de ácidos grasos poliinsaturados, producidos y liberados al medio marino por diferentes grupos fitoplanctónicos. Experimentalmente se han propuesto diferentes funciones biológicas de dichos compuestos, como de defensa química frente a depredadores (Caldwell, 2009), o de señal infoquímica intracelular en periodos de bloom (Vardi et al., 2006). El conocimiento de los rangos de concentraciones de estos compuestos en el medio marino, y su variación en la columna de agua es vital para entender el papel que juegan en las interacciones entre distintos grupos del plancton. Hasta ahora, se ha visto que los PUAs más representativos en el medio natural son el 2*E*,4*Z*- Heptadienal (HEPTA), 2*E*,4E/*Z*-Octadienal (OCTA) y 2*E*,4E/*Z*-Decadienal (DECA) (Morillo-García et al., 2014; Bartual et al., 2014). Se ha observado que se produce una mayor cantidad en condiciones de estrés fisiológico por nutrientes tanto experimentalmente como en el medio natural (Ribalet et al., 2007; Morillo-García et al., 2014). Se sabe poco de la distribución de los PUAs disueltos en el medio, así como de los factores que regulan su concentración, por lo que, para dar respuesta a estas cuestiones, en este estudio se analizó la distribución espacio-temporal de PUA disuelto (dPUA), así como de PUA particulado (pPUA) en tres estaciones ubicadas en el Mar de Alborán en condiciones post-estivales. La fracción particulada consiste en los PUA liberados después de la disrupción mecánica de las células de fitoplancton recolectado en superficie. Los resultados mostraron que las concentraciones totales variaron de 0.20 a 5.30 pmol de células contenidas en 1 L. Respecto a dPUA, sus concentraciones variaron entre 1.33 y 38.19 pM, mostrando también una gran variabilidad temporal. Además, se diferenció entre HEPTA, OCTA y DECA, siendo el OCTA el PUA minoritario durante todo el muestreo.

Key words: Aldehídos poliinsaturados, HEPTA, OCTA, DECA, Mar de Alborán.

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SPATIAL SHIFTS IN MICROBIAL COMMUNITY COMPOSITION IN RELATION TO THE QUALITY OF DISSOLVED ORGANIC MATTER IN THE NORTH ATLANTIC WATERS

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Abstract: Dissolved organic matter (DOM) constitutes the main substrate and energy source for heterotrophic microorganism, but the role of DOM quality in shaping microbial communities is quite unknown yet. The aim of this study is to investigate how the diversity and composition of marine microbial communities (Archaea and Bacteria) is affected by the optical properties of DOM in the water column (0 – 5000 m) along two transects off the Galicia and Cantabria coasts (Fisterra and Santander sections). Microbial community composition and diversity were determined using Illumina sequencing of the 16S rDNA gene, and DOM optical indices were calculated from fluorescence and absorbance spectra. Cluster analysis showed that overall microbial community composition was not significantly different between Santander and Fisterra, instead, communities changed through the water column and along each transects. Thus, microbial (Bacteria and Archaea) diversity increased from coastal to open ocean stations at both sections. Bacterial diversity was higher in epi- than in meso- and bathypelagic waters, while Archaea diversity increased with depth. In epipelagic waters, microbial diversity was associated to protein-like substances (fluorescence peak T), while in meso- and bathy-pelagic zones it was linked to humic-like substances (fluorescence peak M), considered to be photo-labile and bio-refractory. Besides, in surface waters both fluorescence peaks decreased from coastal to open ocean stations, likely associated to primary production gradients but also to changes in the taxonomic composition and/or in the relative contribution of specific phylotypes to community composition. DOM absorption coefficients at 240, 340 and 365 nm and the spectral slope were negatively correlated with depth, with maximum values in epipelagic waters. All together, these results suggest a strong link between the optical properties and thus the molecular composition of DOM, and the different patterns of diversity for Archaea and Bacteria, providing support for the functional classification of microbial communities.

Key words: dissolved organic matter, optical properties of DOM, microbial diversity, North

Atlantic ocean.

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BEACH MORPHODYNAMICS AND STRANDED MACROALGAE CONTRIBUTIONS: IMPACT ON PRODUCTIVITY OF THE BEACH

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Abstract: The study of CO_2 fluxes from the degradation of macroalgae stranded on beaches is an indicator of their metabolic activity. Three exposed sandy beaches, from reflective to dissipative, on the Rías Baixas in Galicia (NW Spain) were sampled monthly for a year. Field sampling was carried out during low spring tides. The samplings were performed at three tidal levels (high, medium and low). The beaches were characterized by their different magnitude of the wrack subsidies. The CO_2 fluxes (these measurements were carried out using the "accumulation chamber" method with an IR LI-COR detector), inorganic nutrients (NH_4^+, NO_3^- and PO_4^{-3}) and the edible C in the sediment, (sum of lipids, proteins and carbohydrates concentrations) were measured. In addition, the effects of seasonality on metabolic activity were interpreted in relation to temperature and moisture sediment variations. Also the biological effects defined as the number of individuals of the macrofauna were analyzed. Data on CO_2 fluxes in algal patches fluctuated from 0.35 to 13.26 µmol m^{-2} s^{-1} whereas in bare sand averaged 0.21µmol C m^{-2} s^{-1}. In the same way, total inorganic N (TIN) released is related with the magnitude of wrack. Data on TIN ranged from 0.21 to 234.25 µM in the interstitial pore water and ranged from 14.99 to 476.19 µM g^{-1} of sediment. The values of edible C (biopolimeric carbon) in the sediment were between 13.77 and 418.69 µg g^{-1} of sediment. This study showed a spatial and seasonal variability: high temperature intensifies the degradation activity of the macrofauna giving rise to a greater speed of the organic matter decomposition. There is a trend towards increased metabolism from the low and high wrack inputs and to the medium tidal level. The results highlight the importance of the metabolic rates of the beaches confirming its role as a major recycler of organic matter and nutrients cycling.

Key words: CO_2 fluxes, nutrients, biochemical sediment composition, wrack, beach morphodynamic.

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ESTUARINE-DEPENDENT LIFE-CYCLE OF THE EUROPEAN ANCHOVY (*ENGRAULIS ENCRASICOLUS*) IN THE GULF OF CADIZ (SW SPAIN)

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Abstract: Most fish species have complex life-cycles, in which they pass through different levels of the food web and occupy different habitats. Fishery management requires accurate knowledge of these life-cycles, particularly in the case of small pelagic fish. In the Gulf of Cadiz, European anchovy spawns mainly from April to September preferentially in the coastal fringe between the mouths of the Guadiana and the Guadalquivir Rivers over the 50 m to 100 m isobaths, where eggs are found in large concentrations and adults are mainly fished. Early larvae, which feed on phytoplankton and zooplankton, are primarily found close to the Guadalquivir River mouth, showing high nutritional condition (RNA:DNA ratio and Fulton index) in late spring (June) but not in summer (August). During the fall period, late larvae and juveniles are found mainly into the Guadalquivir estuary with a high nutritional condition. Stable isotopes identified copepods (*Acartia* spp) and mysids (*Mesopodopsis slabberi*) as the main contributors to their diet. In fact, the larvae feed on copepods but as they grow into juveniles they shift to mysids. Inside the estuary, warm water and high food availability promote faster grow of larvae than in open waters. In autumn, juveniles migrate offshore, where the anchovy

fishery is highly dependent on these age-0 recruits. It is considered that mortality of early life stages is strongly affected by environmental variables, such as sea temperature, wind regime and freshwater discharges, whereas mortality sources for adults respond mainly to fishing (main target species for the purse seine fleet) and natural predation (key species). Stable isotopes identified anchovy as the main contributor of several fish species, such as sparids and hake, being zooplanktonic species from both nekton and suprabenthos the main contributors to anchovy´diet. Therefore, our data highlights that this species links lower and upper trophic levels, being a keystone in the Gulf of Cadiz.

Key words: small pelagic fish, life-cycle, estuary, nutritional condition, fishery assessment

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FEMALE-EMBRYO RELATIONSHIP IN THE ESTUARINE OYSTER *OSTREA CHILENSIS*: RELATING BROODING PROCESS, EMBRYONIC RECOGNITION AND LARVAL HATCHING MECHANISM

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Abstract: Flat oysters brood its embryos into female pallial cavity. There is established a relationship female/embryo in the gill/palps mouth complex, without a clear understanding on the level of that relationship (Mardones-Toledo *et al*. 2015). By transplantation of embryos and using endoscopy observations we studied the capability of embryonic recognition by brooding oysters, the ability to clear up the pallial cavity of dead embryos, and using continuous videotape images of brooding oysters we identified the mechanism by which the larvae carried out the hatching process.
In the Chilean oyster *Ostrea chilensis*, neither non-brooding individuals (> 4 cm) nor smaller oysters (males) do not retain the transplanted embryos into their pallial cavity. However, brooding oysters were able to retain in the pallial cavity transplanted, outsider larvae, and they developed like the receiving mother's own larvae. The dead larvae can be identified by brooding oysters and eliminated to outside pallial cavity through the formation of pseudofeces. This selection of dead larvae capability is effective but not completely efficient, in consideration along with the dead ones, incorporated into the pseudofeces own larvae are also lost (Chaparro *et al*. 1993). Recognition would be by larval inactivity rather than by the dead larva condition. During hatching process, brooded larvae are released to the outside environment by maternal action, in consideration to the high speed with which the larvae leave the female pallial cavity. This velocity exceeds by far the larval swimming ability and the female counter current speeds with which mothers make the larval dispersal inside the pallial cavity, during the brooding period. The larval hatching process is driven out by the mother, through flows of larval hatching to outside. It is unknown if embryos participation possibly can trigger hatching process by some kind of embryonic stimulus towards the brooding female.

Key words: Brooding, embryo recognition, pallial cavity, hatching, *Ostrea*

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BIODIVERSITY AND DISTRIBUTION OF PROSOBRANCH MOLLUSCS FROM NORTHWEST AFRICA

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This work is based on the study of the prosobranch's collections and the analysis of quantitative and environmental data gathered during seven surveys carried out in the CCLME region (Canary Current Large Marine Ecosystem), from Tangier (35º43' N) to Guinea (8º58' N), between 20 and 2000 m depth.

A total of 31,893 specimens belonging to 141 species, 79 genera and 34 families were collected. Density and biomass showed a similar bathymetric trend, with a pick at 300 m depth, followed by an abrupt drop to near zero below 600 m. Species richness reach its maximum in the coastal area (20-100 m), sharply decreasing in the deep-shelf (100-200 m) and being prosobranchs practically absent on the slope, below 500 m. The latitudinal distribution of both, density and biomass, did not shows a clear pattern along the Northwest African coast, while maximum richness values were located in the tropical zone (21º-12ºN).

The analysis of the biogeographic affinities of Northwest Africa gastropods showed that 47.7% of the species have a restricted distribution to the Tropical Eastern Atlantic, while 31.2% occurs in the Mediterranean Sea. Related with their bathymetric distribution, 43.3% of species are restricted to the coastal shelf (0 to 100 m) and 39.1% reach the deep-shelf and upper slope (100 to 500 m). At deeper waters (more than 500 m) only inhabit the 18.0% of the species.

The multivariate analysis based on mean gastropod densities identified two main latitudinal assemblages, northern and southern Cape Blanc, and three main bathymetric groups, located in the shelf (20–200 m), upper-slope (200–600 m) and mid-slope (600–1000 m).

Key words: gastropod, biodiversity, distribution, assemblages, Northwest Africa

SIX YEARS MONITORING INTERTIDAL GASTROPODS: THE BOREAL, THE TEMPERATE AND THE SUBTROPICAL

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Abstract: Intertidal rocky shore gastropods are showing changes in abundance and geographic range in response to global warming. For instance, Rubal et al. (2013; 2014) showed shifts on distribution range of Boreal and Subtropical gastropod species along the Atlantic coast of the Iberian Peninsula. Intertidal species have long been proved as excellent sentinels for detecting changes in biodiversity; therefore, we have been monitoring the abundance of the most common intertidal gastropods on one Galician (Oia) and two North Portugal (Viana and Moledo) rocky shores from summer 2012 to winter 2018. We included four Boreal species: *Patella vulgata*, *Nucella lapillus*, *Littorina littorea* and *Littorina saxatilis*, two Subtropical species: *Siphonaria pectinata* and *Phorcus sauciatus* and four temperate-water species: *Gibbula umbilicalis*, *Phorcus lineatus*, *Melarhaphe neritoides* and *Patella depressa*. Analyses of abundance showed significant variability among dates and shores for most species. Only three species showed significant differences on their abundance among years: the boreal *P. vulgata*, the temperate *G. umbilicalis* and the subtropical *S. pectinata*. For the boreal *L. Littorea* the scarce number of individuals prevented a formal analysis. Results for *P. vulgata* were very variable among shores, ranging from no significant differences among years at Viana to significant differences at different years at Moledo and Oia. For *S. pectinata* no significant differences among years were found at Oia and similar pattern of abundance was found for Viana and Moledo. Finally, regarding *G. umbilicalis* there were no significant differences among shores but the annual variability was similar to that of *S. pectinata*. Changes in temperature and wave regimen seem to be responsible for the detected differences but the response of each species could be being modulated by local drivers.

Key words: Gastropods, Intertidal, Rocky shore, Long-term data

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FEEDING ECOLOGY OF THE BERMUDA LANTERNFISH *Hygophum hygomii* (Lütken, 1892) THROUGHOUT ITS ONTOGENETIC DEVELOPMENT IN THE CENTRAL-EAST ATLANTIC REGION

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Lanternfishes are the mesopelagic community most abundant worldwide, making the largest migratory movement on the planet. *Hygophum hygomii* is one of the most abundant species and performs extensive diel vertical migrations across the water column, between the surface to 1000 m of depth, interacting with plankton and micronekton at multiple depths, and generally feeding in the epipelagic layers at night. So, determining their feeding habits and trophic positions of lanternfishes are essential for a better understanding of the functioning of theses pelagic ecosystems. This work, provides information on the feeding ecology of the Bermuda lanternfish in the Central-east Atlantic, off the Canary Islands, and to study ontogenetic changes that occur in the diet associated to morphological adaptations along life cycle. The diet composition was determined by juvenile and adult individuals, but also by sex, from samples obtained during cruises done by the B/E "La Bocaina" off the Canary Islands (Central-East Atlantic) from 1997 to 2002. Diet analysis revealed a shift in the prey preferences throughout ontogenetic development, at the time that ontogenetic changes occur in the relationship between head and body lengths, probably associated to a change of habitat and/or a larger vertical migration, an increase on their digestive capacity or visual acuity. *Hygophum hygomii* showed a positive selection for copepods (26.01%), but also they fed on mysids (11.20%), euphausiids (13.72%), decapod larvae (32.28%), other zooplankton components (such as chaetognats (0.35%), amphipods (6.05%), polychaetes (3.78%), isopods (2.40%), and gastropods larvae (0.39%)), and fishes (3.81%) (importance by wet mass). Knowledge about the Bermuda lanternfish life story will provide information not only as a potential exploitable fishing resource, but also for a better understanding of the pelagic ecosystem.

Keywords: Mesopelagic fishes, *Myctophidae*, Bermuda lanternfish, Canarian waters, food web.

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MEASURING RECRUITMENT OF THE STALKED BARNACLE *Pollicipes pollicipes*: A CRITICAL ANALYSIS ON THE USE OF DIFFERENT INDEXES

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Abstract

In the past, recruitment of *Pollicipes pollicipes* has been studied using adult individuals as a recruitment substratum, and through two types of indexes: number of recruits (cyprids and juveniles) per adult (NR) and percentage of adults with at least one recruit (PR). Recently, a new artificial substratum ("barticle") has been developed, making possible to quantify recruitment to an exact period of time. In this study, a new index of recruitment - number of recruits per "barticle" (BR) - was analyzed during 15 days, 1, 2, 3 and 6 months. Recruitment to adults was measured using NR and PR on a semimonthly scale, and considering different sizes of juveniles (RC, rostro-carinal length): RC<0.6 mm; and RC<1 mm.

BR during 1, 2 and 3 months was always higher than the sum of the respective semimonthly BR. BR during 2 and 3 months was similar to the respective sum of BR during 1 month. BR during 6 months was lower than the respective sum of BR during 1, 2 and 3 months.

Recruitment season started in July (all indexes), but ended in October (BR)/December (NR), or lasted all year (PR). From July to December, the value of PR was ~100%, indicating that PR is not a good index to detect variability of recruitment.

BR during 15 days was stronger correlated to NR (cyprids), while BR during 1 month was stronger correlated to NR (RC<0.6mm).

BR was considered to be the best index to measure recruitment during 15 days, although BR underestimates recruitment at this scale.

BR or NR (RC<0.6mm) had shown to be the best indexes to measure recruitment during 1 month, although a more extended recruitment season might be defined using NR.

BR is a good index to measure recruitment during 2 or 3 months, but not during 6 months.

Acknowledgments

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Key words

Recruitment, artificial substratum, Cirripedia, *Pollicipes pollicipes*, Sines (Portugal)

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FISHING AND FOOD WEB STRUCTURE IN MEDITERRANEAN INFRALITTORAL ROCKY BOTTOMS

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Abstract: Fishing has been suggested to modify the structure of marine food webs because of the removal of top predators and the simplification of the size spectrum of animal communities, but little empirical evidence exists. To test this hypothesis, we surveyed four sites with contrasting fishing pressure in the Balearic Islands; Dragonera Island and Cala en Basset are open to both professional and recreational fishing, whereas Estells Islands and Rates Island, both included into the MPA Cabrera Archipelago Maritime-Terrestrial National Park, are closed to fishing. Underwater visual censuses were conducted at each site to characterize the fish community and samples form 24 ecosystem compartments, from POM to large carnivorous fishes, were collected for stable isotope analysis. Results confirmed a much higher biomass of demersal fishes in the MPA sites, mainly because of a much higher abundance of specimens > 30 cm. Stable isotope analysis revealed statistically significant differences in the $\delta^{13}C$ values of macroinvertebrates from MPA and control sites, but no differences in $\delta^{15}N$ values, thus suggesting differences in carbon sources but not in trophic level. Conversely, fishes from the MPA and control sites did not differ in $\delta^{13}C$ values, but those from the MPA sites had significantly lower $\delta^{15}N$ values. Such a difference was particularly relevant for groupers (*Epinephelus marginatus*) and white sea breams (*Diplodus sargus*), the two species dominating the size class > 30 cm. Layman metrics revealed changes in the nitrogen range, the diversity of carbon sources and the trophic redundancy of the food webs, but those changes were not consistent across areas open to fishing, maybe related to other different environmental factors such as wave exposure. The overall evidence reveals density dependent changes in the trophic level in predatory fishes, as well as changes in food web topology as a result of fishing.

Key words: food web structure, Layman metrics, stable isotope analysis, trophic level

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MARINE GEOLOGY: CONTINENTAL SHELF AND DEEP OCEAN

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SUBMARINE GLACIAL LANDFORMS: A GLOBAL ATLAS

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The glacial imprint on the seabed and subseabed can now be imaged better than ever before thanks to a number of novel techniques which use became more and more common since the early 1990's, such as high resolution multibeam bathymetry, new 2D and 3D seismic reflection systems and ROV-mounted cameras. This imagery provides novel insights into present and past environmental conditions and sedimentary architecture, which are critical for understanding the dynamics of Polar Regions and their changing ice cover, and feedbacks with the global climate system. Beyond academia, industry is increasingly interested on the dimensions and architecture of glacial sedimentary depocentres on present and past continental margins because of the hydrocarbon potential of some glacial-sedimentary systems.

With the above in mind, a group of experts from different countries and institutions concluded in 2016 an eight years effort, starting in a meeting in May 2008 in Barcelona, to compile the largest ever compilation on submarine glacial landforms high-quality imagery, covering all glacial and glacial-influenced marine environments and the full range of time and space scales involved, which represents a novel and unique achievement by itself as it encompasses from coastal and fjord settings to deep basins, and from days to millions years of formation time. This resulted in the "Atlas of Submarine Glacial Landforms: Modern, Quaternary and Ancient", of which an excerpt with astounding imagery will be presented at ISMS 2018.

Key words: Glacial, Landform, Submarine, Global, Atlas

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3-D SUBMARINE GEOMORPHOLOGY OF THE GALICIA CONTINENTAL MARGIN AND ADJACENT ABYSSAL PLAINS

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Abstract: Submarine geomorphology is the study of landforms and processes in the underwater domain. The ocean hosts a tremendous variety of forms that reflect the action of a range of tectonic, sedimentary, oceanographic, chemical and biological processes at multiple spatio-temporal scales. Submarine geomorphological mapping provides fundamental and effective means to characterize the seabed, an important interface between the geological substrate and the water column, where a range of biological, chemical and hydrodynamic phenomena are dependent on both the morphological and geological character of the seabed.

In this way, a new extensive data set acquired of late-particularly for the Law of the Sea extended continental shelf (ECS) in the area of Galicia mapping purposes- provided the opportunity to analyse the 3D submarine geomorphology of the Galicia margin. We use artificial sun-illumination, shading and 3D rendering with digital bathymetric data (DTM's) to form natural looking and easily interpretable submarine landscapes of the main architectural elements that compose the submarine landscapes along the Galicia Margin. This seabed geomorphological mapping of the Galicia Margin allows us to establish the relationship between the processes (tectonic and sedimentary/oceanographic) and the resulting landforms.

The submarine geomorphology of the Galicia Margin is inherited from former tectonic stages i.e. Variscan heritage as the Ibero-Armorican Arc, Mesozoic hyperextension of the Iberian-Newfoundland Atlantic conjugate margin, and Cenozoic convergence with subduction of the Bay of Biscay oceanic crust.

Otherwise, the main oceanographic morphologies identified in the Galicia Margin related to sedimentary/oceanographic processes are: (i) System of gullies, canyons, channels and

deep-sea fans related to turbidity currents/dense shelf water cascading; (ii) Drifts, moats and abyssal channels driven by geostrophic ocean circulations, (iii) giant rotational and translational deep-seated landslides triggered by slope instability and mass-transport; (iv) pockmarks and giant craters associated with deep-seated seabed fluid-flow processes.

Key words: Seabed Mapping, Submarine Geomorphology, Galicia Margin, UNCLOS, Multibeam echosounders.

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EROSIVE FEATURES IN THE TRANSITIONAL ZONE OF THE GALICIAN CONTINENTAL MARGIN

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Abstract: We present the tectono-sedimentary evolution of the Transitional Zone (TZ) in the Galician continental margin during the last 170 kyr BP. Three textural and magnetochemical facies representing pelagic, hemipelagic and IRD/detrital dominated sedimentation are defined upon grain size, elementary XRF analyses, magnetic susceptibility measurements and TOPAS seismic profiles. The detection of important erosive features in the TZ indicates the occurrence of abrupt changes in the area hydrodynamics during this period. Most of these changes are the expression of glacial/ interglacial dynamics conditioned by the relative bathymetrical elevation of the TZ over the Galician Interior Basin, which hydraulically conditions the intensity of bottom currents and sediment provenance and availability. Sedimentation rates during cold periods show an average value of 2.9 cm ky^{-1}, with minimums of 0.1 - 1 cm ky^{-1}, meanwhile warm periods have a value of 5.9 cm ky^{-1}, with maximums ranging 14 - 16 cm ky^{-1}.The low sedimentation rates during cold periods could be related to the low marine productivity/pelagic deposition and the intensification of a geostrophic bottom current due to density instabilities between deep water masses during cold phases.

Keywords: sedimentology, TOPAS, erosion, Galicia continental margin

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MORPHOSEDIMENTARY CHARACTERIZATION OF THE ENSENADA OF MARBELLA CONTINENTAL SHELF AND ITS RELATION WITH THE RELATIVE SEA LEVEL CHANGES

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Abstract: This study shows a morphosedimentary characterization of the continental shelf between Punta de Baños and Punta de Torrenueva (Ensenada of Marbella, Málaga), on the northwestern of the Alboran Sea. Multibeam bathymetry and backscatter data, very high resolution seismic profiles and surficial sediment samples were used for this purpose. Three groups of morphological features have been identified according to their origin: a) Depositional: infralittoral prograding wedge (IPW) formed by the transport of sediments offshore from the present wave zone and/or from lateral sedimentation processes; submarine fluvial fans, formed for accumulation of sediments off the river mouths; shelf-edge wedges and relict wedges on medium-outer shelf, formed during low sea-level periods; mid-shelf sedimentary body generated by accumulation of fine material suspended by currents and waves; and sorted bedforms, whose origin is primarily driven by interactions between the current and the substrate; b) Erosive: escarpments related to ancient coastal cliffs; rocky outcrops linked to areas with predominance of erosive processes; ridges related to barrier islands or sand bars formed in coastal paleoenvironments; gullies and channels originated by the current coastal dynamics; and paleochannels that were previously fluvial channels; c) Gravitational: submarine landslides on the shelf break and upper slope. The geological evolution of the continental shelf on the northern margin of the Alboran Sea, from the Last Glacial Maximum to the present time, has been made take into account the bathymetric positions, the sedimentological characteristics and the processes that originate these morphological types and their relation with the sea level change curves during the Upper Pleistocene-Holocene.

Keywords: continental shelf; morphological features; geological evolution, morphosedimentary characterization.

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STUDY OF THE SEISMIC-TIDAL CORRELATIONS FOR PRE-ERUPTIVE, ERUPTIVE AND POST-ERUPTIVE STAGES OF THE SUBMARINE VOLCANO TAGORO, EL HIERRO ISLAND.

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Abstract: During the seism-eruptive process that took place at the island of El Hierro (Canary Island) between 01/01/2011-31/07/2012(Fraile-Nuez et al., 2012), more that 15,000 earthquakes distributed during the different stages (pre-eruptive, eruptive and post-eruptive), were registered. This eruptive process gave the opportunity to analyzed the possible existence of any relation between earthquakes and tide for each stages of the process (Ide et al., 2016; McNutt and Beavan, 1981). In order to verify that, several earthquakes swarm were selected from each stage (Figure 1). Subsequently, each swarm was subjected to different spectral analysis techniques. The results obtained in this work, demonstrated the existence of a strong influence of the tide with earthquakes, especially in the pre-eruptive stage and the reactivation swarm of the post-eruptive stage, It is also noteworthy, that the influence of the semi-diurnal tide respect to the probability of the occurrence of the earthquakes is more significant than the diurnal tide. Moreover, this study also demonstrated the existence of higher occurrence of earthquakes during phases of low tide respect phases of high tide.

Key words: Earthquakes, tide, correlation, El Hierro Island, Canary Island.

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FOSSIL COLD-WATER CORALS (SCLERACTINIA AND GORGONACEA) FROM THE BURDWOOD REEF, ARGENTINA

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Abstract: The Burdwood Bank is a rocky platform emerging from abyssal plains to depths of 50-100 m between the South Atlantic Ocean and the Drake Passage. Regarding its geological affinity, it has a composition similar to the Staten Island (Isla de los Estados), aligned to the Andes-Darwin Cordillera. It is crossed from south to north by oceanic currents very cold and rich in nutrients. Rocks dredged from the shallower portions of its western portion are composed of carbonatic blocks. The analyses indicate fossil specimens of *Desmophyllum* sp. (Order Scleractinia) and *Gorgonacea palmatum* (Order Alcyonacea or Gorgonacea), genera living today in the region. In this sense, sectors of this western portion should be considered as an ancient reef composed mostly of cold-water corals. The major consequences are assigned to oceanographic and climatic implications. During the Upper-Pleistocene lowstand, sunlight was more available at the shallower depths and therefore corals were very frequent at the former wave-dominated areas. Sea-level variations have therefore strong influence on cold-water coral growths in the sense that nutrient availability by currents can significantly changed between glacial and interglacial periods.

Key words: cold-water corals, Burdwood Bank, South Atlantic

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LOOKING FOR INDICATORS OF CLIMATE CHANGE: PALYTHOA SPECIES IN THE CANARY ISLANDS

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Abstract: Ocean warming is the most evident effect of climate change in the marine environment. It causes the displacement of many species beyond their normal limit of distribution but also autochthonous marine species with tropical habits are favoured. Zoantharians are colonial cnidarians common in shallow waters of tropical and subtropical areas. In some regions they are able to cover huge extensions, forming a distinctive ecosystem. In the Canary Islands two zoanthids species of the genus *Palythoa* are known, *P. caribaeorum* and *P. canariensis*. Given corals´ sensitivity to temperature changes, these species are ideal indicators of tropicalization processes and the expansion of their populations may potentially greatly affect local ecosystems. In order to determinate the temperature affinity and the current expansion of *P. canariensis* and *P. caribaeorum* in the Canary Islands, the 6 largest rocky intertidal platforms and 6 subtidal zones off three islands throughout the temperature gradient of the Archipelago were explored. Despite both *Palythoa* species occurred in the three islands analysed, the highest densities of both species were found in the warmest Island of El Hierro. *P. caribaeorum* was more frequently found inhabiting the subtidal zone, whereas *P. canariensis* was more abundant at intertidal habitats. Our results showed that both species have tropical affinities and annual monitoring of colonies throughout the Archipelago will allow us to evaluate the tropicalization process. Owing to the temperature gradient along the islands and the presence of these zoanthids that are sensitivity to temperature changes, we conclude that the Canaries constitute a perfect climate change observatory.

Key words: Tropicalization, *P. canariensis*, *P. caribaeorum*, Climate Change Observatory, Indicator species

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MILLENNIAL-SCALE *Posidonia oceanica* (L. DELILE) ECOSYSTEM PRODUCTIVITY RECONSTRUCTED USING A PALAEOECOLOGICAL APPROACH

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Abstract

Posidonia oceanica is a long-living marine phanerogam that buries a significant part of the belowground production forming an organic bioconstruction known as mat. Seagrass mats have been proven to be reliable archives of long-term environmental change, despite palaeoecological approches using approach seagrass archives areis still scarce. Here we reconstruct 4000 years of environmental dynamics in the NE coast of Spain (Portlligat Bay) by analysing biological proxies such as carbon and nitrogen stable isotopic composition of *Posidonia* sheaths and the proportion of different seagrass organs (sheath, root and rhizome), along with sedimentological proxies. The long-term environmental records obtained showed seagrass ecosystem stability from 4 to 3 cal. kyr BP. After reaching a high productivity status between 0.8 and 1.4 cal. kyr BP, the nutrient inputs increased and total solar irradiation significantly decreased, the combination of both factor was probably the cause of the abrupt decline in the productivity recorded thereafter, reaching unprecedented low values. Early anthropogenic impacts in the NE Iberian coastal ecosystems might be associated with large- and short-scale cultural and technological development during and beyond Greek-Roman times. The reconstructed changes in ecosystem production and nutrient loadings are related to the effect and variability of global (e.g. solar irradiation) and local factors (e.g. anthropogenic land-use changes). Cumulative anthropogenic stressors after Roman times may have affected seagrass ecosystem dynamics and productivity at Portlligat Bay, with more abrupt and closer in time regime shifts during the last millennium. Past human impact in coastal areas may have caused significant shifts in ecosystem dynamics elsewhere, and the results presented here demonstrate the power of seagrass archives to reconstruct environmental trajectories after disturbance, which can improve the capacity to understand and better manage these ecosystems.

Key words: seagrass archive, environmental reconstruction, regime shifts,

palaeoproduction, Holocene.

Acknowledgements

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ORAL COMMUNICATIONS

METADATA MANAGEMENT AND OCEAN OBSERVATION TECHNOLOGIES

EMODNET: YOUR GATEWAY TO MARINE DATA IN EUROPE

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Abstract: Marine data are needed for many purposes: for acquiring a better scientific understanding of the marine environment, but also, increasingly, for decision making as well as supporting economic growth. Data must be of sufficient quality to meet the specific users' needs. It must also be accessible in a timely manner.

And yet, despite being critical, this timely access to high-quality data proves challenging. Europe's marine data have traditionally been collected by a myriad of entities with the result that much of our data are scattered throughout unconnected databases and repositories. Even when data are available, often they are not compatible, making the sharing of the information and data-aggregation impossible. To tackle those problems in 2007 the European Commission through its Directorate General for Maritime Affairs and Fisheries (DG MARE) initiated the development of the European Marine Observation and Data network, EMODnet, in the framework of the EU's Integrated Maritime Policy and Marine Knowledge 2020 Strategy (2014). Today EMODnet is comprised of more than 150 organisations which gather marine data, metadata and data products and work together to make them more easily accessible for a wider range of users.

We will present how EMODnet has developed, currently consisting of seven sub-portals providing access to marine data from the following themes: bathymetry, geology, physics, chemistry, biology, seabed habitats and human activities. In addition, six sea-basin checkpoints have been established to assess the observation capacity in the North Sea, the Mediterranean, the Atlantic, the Baltic, the Artic and the Black Sea. This exciting and innovative attempts to identify whether the present observation infrastructure in Europe is the most effective possible, and whether it meets the needs of public or private users. To complement this, a Data Ingestion Service has been set up to tackle the problem of the wealth of marine data that remain hidden or unusable, by reaching out to data holders, explaining the benefits of sharing their data and offering a support service to assist them in releasing their data for subsequent processing and quality control.

Key words: EMODnet, Data management, marine data portal, open access

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THE EUROPEAN MULTIDISCIPLINARY SEAFLOOR AND WATER-COLUMN OBSERVATORY: A PAN EUROPEAN LARGE SCALE RESEARCH INFRASTRUCTRE (EMSO-ERIC)

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Abstract: The European Multidisciplinary Seafloor and water-column Observatory (EMSO) is a large scale, distributed, marine Research Infrastructure (RI) of fixed-point observatories serving marine science researchers, marine technology engineers, policy makers, and the public. Since 29th September 2016, EMSO is an ERIC (European Research Infrastructure Consortium). This specific legal form is designed to facilitate the Member States to jointly establish and operate research infrastructures (RIs) of European interest.
RIs play an increasingly important role in the advancement of knowledge and technology. They are a key instrument in bringing together a wide diversity of stakeholders to look for solutions to many of the problems society is facing today. RIs offer unique research services to users from different countries, attract and retain young people in science, and help to shape scientific communities. The European Strategy Forum on Research Infrastructures Roadmap (ESFRI) has supported a coherent and strategy-led approach to eight member states to create and implement EMSO. Furthermore, different EU projects funded by Framework programmes have also been crucial for its development. As examples, ESONET and ESONET-NoE (European Seafloor Observatory NETwork (of Excellence)) in the FP6 or the Fixed point Open Ocean Observatory network (FixO3) in the FP7. Currently, coordination among nodes is being strengthened through EMSODEV and the EMSO-Link funded H2020 projects. These initiatives contribute to catalyze the observation of physical, biogeochemical and ecological parameters through the development and deployment of the EMSO Generic Instrument Module (EGIM). In addition, they are adding value to the EMSO Regional Facilities through the introduction of a new integrated observing system delivering standardised services, data, process, and scientific results. This communication will contribute to update on the progress of EMSO overall activities, relevant projects (EMSODEV and EMSO-Link) as well as to inform of the advancements of the creation of a Spanish Joint Research Unit to coordinate EMSO participation and activities at national level, among relevant oceanographic and marine science and technology institutions of the country.

Key words: Seafloor, Observatory, RIs, Infrastructure, ESFRI, ERIC

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EMSO: The European Multidisciplinary Seafloor and water-column Observatory WebSite: http://www.emso-eu.org/

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GOVERNANCE OF THE OCEANS, CONSERVATION AND MANAGEMENT OF GEOLOGICAL AND LIVING RESOURCES

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MULTISPECIES POPULATION MODELLING OF THE COMMON DOLPHIN (*DELPHINUS DELPHIS*), THE BOTTLENOSE DOLPHIN (*Tursiops truncatus*) AND THE SOUTHERN STOCK OF EUROPEAN HAKE (*Merluccius merluccius*), IN ATLANTIC WATERS OF THE IBERIAN PENINSULA

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Abstract: A multi-species model, including the southern stock of European hake (*Merluccius merluccius*), the fisheries targeting hake, the common dolphin (*Delphinus delphis*) and the bottlenose dolphin (*Tursiops truncatus*) was developed. The aim of this model was to assess the status of the hake stock and estimate the impact of these two cetacean species on the hake population and the impact of the fisheries targeting hake on the cetacean populations. The composition of the diet and the prey consumption of the most abundant cetaceans of the Atlantic coast of the Iberian Peninsula were also evaluated. Trends in the abundance of common dolphins using the data collected from dedicated and multidisciplinary research surveys carried out in northern and north-western Iberian Peninsula waters were estimated. The mortality at age of the common dolphin (total, natural and bycatch mortality) was determined using the information obtained from stranded animals. A R library was created to perform these analyses. Species-specific reference points for bycatch were calculated to determine safe bycatch limits for the common and bottlenose dolphin populations. The parameters obtained from these analyses made possible to construct a Gadget multi-species model (from 1982 to 2014) for exploring the effects of fisheries management measures and the trade-offs between two different management targets, i.e. maximize the fisheries yield and keep dolphin populations in a healthy state under the criteria considered by the Common Fishing Policy and the European Marine Strategy Framework Directive. The results highlight the potential negative consequences of using single-species models for fisheries management, which do not take into account interactions with other ecosystem components. This approach can lead to inappropriate management measures such as allowing too high catch levels or too optimistic recovery scenarios.

Key words: Multi-species modelling, Fisheries assessment, Bycatch, Cetaceans, European Hake.

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INTEGRATED SYSTEM FOR THE ASSESSMENT AND MONITORING OF SHELLFISH RESOURCES

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Abstract: The assessment of the stocks of shellfish resources and the monitoring of their exploitation are key aspects for the management and sustainability of shellfish stocks, which require actions for improvement, modernisation and collaboration between all the sectors involved (production, technical, managers and scientific community). To this end, a simple and effective system has been developed based on the use of ICT technologies (tracking systems, artificial vision, exploitation of databases, etc.) to acquire, telematically send and automatically integrate biological information on resources, knowledge of fishermen and extractive activity.

With this ICT system, it is possible to obtain updated and geo-referenced information on the state of the stocks and the strategy of exploitation of the different resources at all times, which is of great interest to compare production data with the effort made. The information is sent telematically to a centralized database where it can be easily managed and analyzed by fishery technicians and managers through a web application.

The ICT system allows the quantity and quality of information to be improved in order to analyse the state of the stocks, based on biological sampling data and a more exhaustive characterisation of catches and the effort made to obtain them. This system is the first step in designing a predictive model to aid decision-making for the development of exploitation plans.

Key words: ICT, web application, management, shellfishing

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ORDENACIÓN DEL TERRITORIO Y CAMBIO CLIMÁTICO EN EL LITORAL DE ANDALUCÍA

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Abstract: Es un hecho constatado que la zona costera de Andalucía, por su situación geográfica y sus características socioeconómicas, constituye un espacio muy vulnerable al cambio climático. Los efectos sobre estos ecosistemas son la pérdida o disminución de los servicios que nos provee el litoral. Con objeto de paliar esta situación, las distintas administraciones con competencias en la materia han ido elaborando instrumentos tendentes a mitigar en lo posible ese cambio, y adelantarse o adaptarse a las consecuencias y efectos que tendrán gran impacto a escala global.

Este trabajo tiene dos objetivos: 1º analizar el tratamiento que se da a la adaptación al cambio climático en los diferentes instrumentos de planificación territorial en la zona costera de Andalucía; 2º establecer si dichos instrumentos contribuyen a hacer frente a retos de tanta trascendencia como los que plantea el cambio climático; y, por último, comprobar, a partir del anterior análisis, si para la administración andaluza es una prioridad dar solución a los problemas derivados de dicho impulsor directo de cambio en el litoral de la comunidad autónoma. Las conclusiones revelan en qué grado este asunto de política pública es una prioridad para el gobierno regional. A raíz del análisis de dichos instrumentos se desarrollan unas conclusiones muy reveladoras. Aun constatando los duros efectos que sobre las zonas costeras tiene el cambio climático, la administración pública no le ha prestado la suficiente atención a estos espacios, comprobando que en España no existe todavía una política de gestión integrada en los asuntos costeros.

Key words: zonas costeras, cambio climático, adaptación, Andalucía.

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ECOLOGICAL, SOCIOECONOMIC AND INSTITUTIONAL RESILIENCE TO SHIFTING FISH STOCKS

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Abstract: Climate change is already impacting fisheries with stocks moving from one fishing area to another, creating conflicts related to institutional settings such as access rights. In this scenario, scholars agree that adaptation to climate change requires that fisheries increase their social, institutional and ecological resilience. The resilience or capacity of a fishery to be maintained without shifting to a different state (e.g. collapse) is at stake under climate change impacts and overexploitation. Despite this urgent need, applying the resilience concept in a spatially explicit and quantitative manner to inform policy remains poorly explored. We take a resilience approach and operationalize the concept in industrial fisheries in two species that have been observed to significantly shift distribution in European waters: hake (Merluccius merluccius) and cod (Gadus morhua), in the context of the European Union institutional setting. With a set of resilience factors from the literature and by means of contemporary and historic data, we compute indicators that are combined into an index that measures resilience on the ecologic, socioeconomic and institutional dimensions of the fishery. We find that ecological resilience increases with latitude for both species, as species move poleward, but institutional resilience operates counterwords. We also find that social and institutional resilience are related in countries suggesting the potential to address both with the adequate policies. The index evidences the multiple dimensions of climate change adaptation in fisheries and the need to conciliate the efforts in all dimensions.

Key words: Climate Change, Adaptation, Fisheries, Management, Index.

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PHYTOPLANKTON COMMUNITY STRUCTURE IN A STRATIFIED OLIGOTROPHIC SEA: THE IMPORTANCE OF PICOEUKARYOTES

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Abstract: Climate models predict a general increase in water column stratification, affecting light and nutrients availability to phytoplankton communities. The ocean trophic regimes and carbon fluxes are modulated by phytoplankton community size-structure. Therefore, to decipher how this community responds in regions with strong thermal vertical gradients, such as the Balearic Sea (NW Mediterranean) in summer, can help us to forecast future scenarios of the predicted climate change.

We measured abundance, biomass and chlorophyll-*a* (Chl-*a*) of size-fractionated phytoplankton groups over three years in the Balearic sea. This strongly stratified area comprised a surface mixed layer (ML) ranging between 10-20 m depth, characterized by nutrient depletion and 0.07±0.02 μgL^{-1} Chl-*a* concentration. The deep chlorophyll maximum layer (DCML), with NO^3+NO^2 ranging between 0.011-8.751 µM, showed a Chl-*a* maximum (0.73±0.49 μgL^{-1}) at 50-100 m. Picoplankton (<2 µm) abundances were higher at the DCML, whereas carbon biomass estimates were significantly higher at the ML. Picoplankton accounted for most of both the phytoplankton carbon biomass (84%) and total Chl-*a* (62%), with the highest relative contributions at the ML. Picoeukaryotes exhibited a significant increase in cell size at the surface waters and dominated the picoplankton biomass. Micro- (>20 µm) and nanoplankton (2-20 µm) abundance or biomass did not vary significantly with depth. However, they slightly increased their relative contributions to total biomass and Chl-*a* (+8.5%) at DCML. Higher carbon to Chl-*a* ratios for total phytoplankton at the ML evidences the light and nutrient availability effect.

Taken together, the contrasting depth distribution of phytoplankton biomass and Chl-*a* emphasizes the inappropriate use of Chl-*a* as indicator of phytoplankton biomass. Overall, the dominance of picoplankton suggests a main role of the microbial food web in thermally stratified oligotrophic oceans. Moreover, our results highlight the importance of the largest picoeukaryotic cells as key players in the fate of carbon fluxes in these areas, with important consequences for the future ocean.

Key words: Phytoplankton biomass, Size structure, Chlorophyll, NW Mediterranean

Acknowledgments: This work was partly funded by the *Bluefin* project, from the Spanish Institute of Oceanography and ICTS-SOCIB partnership, and by ATHAPOC project (CTM2014-54374-R) funded by the Spanish Ministry of Economy and Competitiveness. C. M. was supported by pre-doctoral FPI fellowship from Conselleria d'Innovació, Recerca i Turisme of the regional Government of the Balearic Islands, co-financed by the European Social Fund as part of the FSE 2014-2020 operational program.

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TEMPORAL VARIABILITY OF DIAZOTROPH COMMUNITY COMPOSITION IN THE UPWELLING REGION OFF NW IBERIA

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Abstract: Knowledge of the diversity, activity and ecology of diazotrophic plankton is mainly limited to oligotrophic (sub)tropical regions of the open ocean. However, diazotrophs are widely distributed and potentially active over the global ocean. Between February 2014 and December 2015, we carried out 10 one-day samplings in the temperate NW Iberian upwelling system in order to investigate the temporal variability of the diversity of the diazotrophic community and its relationship with the hydrodynamic forcing. During downwelling conditions, characterised by deeper mixed layers and homogeneous hydrographic conditions, heterotrophs belonging mainly to nifH subcluster 1G (Gammaproteobacteria), dominated the community. Whereas during upwelling and relaxation, affected by more intense vertical stratification and larger hydrographic variability, we observed a larger heterogeneity in the diazotrophic community composition, with prevalence of UCYN-A (unicellular cyanobacterial diazotroph of subcluster 1B) and heterotrophs from subclusters 3E (Verrucomicrobia and Deltaproteobacteria) and 1G. The dominance of UCYN-A in terms of relative and absolute abundances, mainly UCYN-A2 sublineage based on oligotyping analysis and qPCR abundances, was observed in general in stratified waters associated with relatively low nitrate to phosphate ratios. Our findings demonstrate the presence of a diverse and temporally variable diazotrophic community driven by the hydrodynamic forcing, and reveal the environmental conditions that may outline the ecological niche of UCYN-A.

Key words: *nifH* diversity, UCYN-A, heterotrophic diazotrophs, oligotyping, NW Iberian upwelling

CONTRASTING PHYTOPLANKTON COMMUNITIES IN THE NW IBERIAN UPWELLING

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Abstract:

Hydrographic conditions determine in large extent the structure and dynamics of marine ecosystems, the composition of the microbial community and accordingly the levels of primary production.

Near the NW Iberian margin two different marine systems were deeply studied during July 2009, in order to analyze their characteristic features and describe the microbial community associated to each one. Two lagrangian experiments were performed, one along the coast in front of Cabo Silleiro (Galicia) and the other one at oceanic conditions. This lagrangian approach consisted on following a water parcel for a period of time using drifters to register its thermohaline properties and to collect water samples every 24 hours for measuring inorganic nutrients concentrations and determine size-fractioned (micro-, nano-, pico-) chlorophyll-a concentration, phytoplankton biomass and primary production. Hydrographic conditions showed a more stratified water column in the oceanic regime, while in the coastal experiment temperature profiles showed a more mixed water column with lower temperatures, resembling the upwelling conditions typical from this zone.

Inorganic nutrients also reflected this difference between the two environments. Thus, concentrations of total inorganic nitrogen were considerably higher in coastal stations when compared to oceanic values. The phytoplankton community was consistent with this division between environments: the micro- fraction represented more than the 60% of total chlorophyll-a in the euphotic zone of coastal stations, accounting for 48±16% of the total phytoplankton biomass measured and also leading to primary production levels up to five times higher than in the oceanic regime. In contrast, the oligotrophic situation showed considerably lower primary production, less chlorophyll-a concentration and low phytoplankton biomass, which was mainly found in the pico- fraction.

Under the effect of climate change, these results have to be taken into account, since oligotrophic conditions can invade the continental shelf making this coastal zone, now

sustaining important fisheries, less productive.

Key words: Microbial community, size structure, coastal–ocean domains, coastal upwelling and NW Iberian

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PHYTOPLANKTON PRODUCTION IS UNCOUPLED FROM UPWELLING INTENSITY AT LARGE TIME SCALES OFF A CORUÑA (NW SPAIN)

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Abstract: Large changes in phytoplankton production and biomass of upwelling ecosystems are expected as the result of climate fluctuations. The analysis of a 28 yr long series of monthly measurements of chlorophyll concentration and primary production rates at a shelf station off A Coruña (NW Spain) provided evidence of changes at several time scales that were only partly related to upwelling intensity. Chlorophyll determinations were made in acetonic extracts and primary production rates by the measurement of ^{14}C-uptake by natural populations in simulated in situ conditions. Wavelet analysis revealed multiple modes of variation, particularly at high frequencies, but some were only significant for part of the series. For instance, the seasonal cycle was not uniform through the series despite the annual repetition of maxima and minima. At multi-annual time scales, both series were divided in three quasi-decadal periods characterized by significant increases in mean values. Upwelling intensity fluctuations matched those of chlorophyll and primary production only at the annual mode but annual means showed low correlation. Changes in dissolved nutrient ratios, rather than changes in single environmental variables, were the likely drivers of the observed changes in productivity at large time–scales. The increase in the production to chlorophyll ratio was accompanied by a decrease in the diatom to dinoflagellate ratio. This study illustrates the complexity of interactions in coastal upwelling areas at large time-scales, where factors unrelated to upwelling may modify nutrient ratios and then phytoplankton composition and production. For instance, year-to-year variations in continental inputs and in the origin of upwelled waters can override the effects of upwelling intensity on primary production rates.

Key words: primary production, upwelling, nutrients, quasi-decadal variability, NW Spain

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MODELLING EXERCISE SUPPORTS THE IMPORTANCE OF TIDES IN THE HIGH PRODUCTIVITY AREA OF CAPE TRAFALGAR (SW IBERIAN PENINSULA)

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Abstract: Cape Trafalgar is a hotspot of high chlorophyll concentration (chl) located between the Gulf of Cádiz, mainly characterised by long-term seasonal variability, and the Strait of Gibraltar, highly influenced by the tidal cycle (SW Iberian Peninsula). Here, the interaction between along-shore tidal currents and the bathymetry brings cool and nutrient-rich deep waters to surface layers (Vargas-Yáñez et al. 2002). This effect could be enhanced by other mechanisms, such as easterly winds (Vargas et al. 2003). To better understand the chl dynamics in this region, 10-years of ocean colour observations using the MEdium Resolution Imaging Spectrometer (MERIS) were analysed through different approaches (Sala et al. 2018). Cape Trafalgar stood out as a very productive region, although due to the high complexity of the system a wavelet power spectrum analysis did not evidence a clear pattern of variability. Moreover, a wavelet coherence analysis between chl and several environmental variables (i.e. wind, Guadalquivir river discharges and tidal current) showed the strongest correlation with the tidal current at a fortnightly scale. A deeper analysis of the tidal influence in this productive region was performed by using a high-resolution circulation model (MITgcm) coupled to an ecosystem model (DARWIN). Phytoplankton biomass, as well as nutrient concentration, temperature and salinity, showed a clear pattern of variability mediated by tidal dynamics, with a strong influence of the diurnal component. During spring tides the intrusion of saltier waters was stronger than during neap tides Although for the other variables a fortnightly cycle was not that apparent, a greater accumulation of nutrients and biomass was observed during neap tides.

Key words: Cape Trafalgar; tidal-topography interaction; high productivity; MERIS sensor; MITgcm

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IMPACT OF A CYCLONIC MESOSCALE EDDY ON THE STRUCTURE OF THE PLANKTONIC COMMUNITY AT THE SUBMESOSCALE RANGE

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Mesoscale and submesoscale features, associated with the eddy field located downstream of the island of Gran Canaria, are studied to assess their impact on the structure and distribution of the planktonic community. This study shows hydrographic and biological information based on XBT (Expendable Bathythermographs) and biogeochemical Rosette-CTD casts at a high resolution (near submesoscale) crossing a cyclonic eddy and its marginal frontal regions. Along the transect 4 main features were monitored: the margin of a large anticyclonic eddy, a large cyclonic eddy (affected by a filament from the North Africa Upwelling System), the sharp front between these two eddies, and a small submesoscale anticyclonic eddy close to the cyclone. The "Vertical Oceanic Pump" (VOP) in the zone is typified by two main mechanisms: eddy-pumping, generated by the cyclonic eddy, and ASC (ageostrophic secondary circulation), produced at the fronts. Both processes affect the physicochemical nature of the water column, encompassing nutrient distribution. The planktonic community, which includes bacteria, cyanobacteria *(Synechococcus* and *Prochlorococcus*), autotrophic picoeukaryotes, and heterotrophic and autotrophic nanoflagellates, show a heterogeneous distribution close to the submesoscale range. The analysis suggests that physical forcing (eddy pumping and ASC) is the main reason for the distribution of organisms, together with the filament, which introduces upwelled waters modifying the concentration of nutrients and organisms. The greatest accomplishment of this study -compared with other eddy field studies- is that we have used a smaller scale resolution to look in detail and understand the physical forcing on the planktonic community distribution, and hence in the VOP associated with mesoscale features. Our results suggest that processes at submesocale have a large effect on biogeochemical processes in the ocean, where eddies and frontal structures are dominant.

Key words: Phytoplankton community, Mesoscale, Submesoscale, Vertical Oceanic Pump

CO_2 DISTRIBUTION AND TRENDS IN THE SOUTH AFRICAN CONTINENTAL SHELF FROM 2005 TO 2012

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Abstract: The air-sea exchange of CO_2, its distribution and trends in the South African continental shelf over 8 years (2005–2012) has been studied using data from 28 journeys of a volunteer observing ship (VOS). Sea water properties, strongly controlled by the oceanographic dynamic, showed a complex distribution pattern between Cape Town and Durban. Three different upwelling cells were identified, which dominated the regional variability, together with the presence of eddies, filaments and the core of the Agulhas Current. From west to east the variation in CO_2 fugacity (fCO_2) followed the temperature increase, resulting in oversaturated (> 600 μatm) or undersaturated (~215 μatm) waters. After removing seasonality (Astor et al., 2013), seawater fCO_2 decreased while sea surface temperature (SST) and salinity did not show a clear trend. From 18°25′E to 20°00′E (the west region), surface water was undersaturated and presented an averaged flux of -4.27 ± 0.07 mol m^{-2} $year^{-1}$. The south region (20°00′E-25°30′E) reached a value of -4.39 ± 0.08 mol m^{-2} $year^{-1}$, while between 25°30′E and 28°30′E (the south-east region) the averaged flux was -5.03 ± 0.11 mol m^{-2} $year^{-1}$. Between 28°30′E and 31°15′E (the east region) the flux was the lowest (-1.65 ± 0.04 mol m^{-2} $year^{-1}$). Salinity and fCO_2 (atmospheric and oceanic) data were fitted to harmonic functions (Kim et al., 2014; Lüger et al., 2004) in order to obtain the climatological cycles and estimate trends. The full studied area acted as a sink with a mean value of -3.83 ± 0.04 mol m^{-2} $year^{-1}$, decreasing at an annual rate of 0.13 ± 0.16 mol m^{-2} $year^{-1}$ from 2005 to 2012 related to the highest rate of increase in $fCO_{2,sw}$ over that in $fCO_{2,atm}$. The estimated carbon uptake by the coastal region with a surface area of 99×10^9 m^2 was -4.6 ± 0.1 TgC $year^{-1}$.

Key words: carbon fluxes, South Africa, upwelling, volunteer observing lines, interannual variability

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INTELIGENCIA ARTIFICIAL CONTRA EL CAMBIO CLIMÁTICO

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Abstract: El ciclo del carbono inorgánico en el océano juega un papel fundamental en el cambio climático. La necesidad de conocer con detalle su funcionamiento es esencial para realizar evaluaciones con rigor. Las climatologías globales de las variables de este sistema son una herramienta básica para conocer el estado del problema, principalmente de la acidificación oceánica. En este trabajo se ha utilizado el potencial de las redes neuronales y las bases de datos Global Ocean Data Project Version 2 (GLODAPv2; Key et al. 2015; Olsen et al. 2016) y Lamont-Doherty Earth Observatory database (LDEO; Takahashi et al., 2017) para generar climatologías mensuales de alcalinidad total (A_T) y carbono inorgánico disuelto total (TCO_2). Una red neuronal feed-forward con una arquitectura de dos capas y 128 neuronas fue entrenada para cada variable con los datos de GLODAPv2 y LDEO para aprender las relaciones entre predictores relacionados con las variables y éstas. Una función sigmoidal y una lineal fueron utilizadas en cada capa para modelar la variabilidad no lineal. El comportamiento de cada red fue testado en un set independiente extraído de las bases de datos y en las diversas series temporales de las estaciones fijas de medida distribuidas por el océano global. Las climatologías de A_T y TCO_2 fueron diseñadas sobre las climatologías de los predictores utilizados en el entrenamiento que ofrece el World Ocean Atlas 2013 (WOA13) en una malla global de 1ºx1º y 102 niveles de profundidad. La red mostró un buen comportamiento al modelar los datos de los sets independientes y de las series temporales con errores cercanos a la incertidumbre de las medidas. La capacidad de la red para modelar el ciclo estacional en las series temporales permitió generar climatologías mensuales supeditadas a la calidad del diseño de WOA13. Este producto se ofrece para ser introducido en futuros modelos.

Key words: Cambio Climático, Climatologías Mensuales, Sistema del Carbono Inorgánico, Inteligencia Artificial, Redes Neuronales

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ANTIFOULING ACTIVITY OF MARINE BACTERIA

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Abstract: In the marine environment, the substrata (natural or artificial) are rapidly colonized by marine micro and macro-organisms in a process known as biofouling. This phenomenon causes problems and economic losses to marine and shipping industries. Natural compounds from marine bacteria are emerging as potential sources for novel metabolites. The aim of this study was to evaluate the antifouling activity of marine bacteria from sponges and marine sediment of coasts from Baja California Sur, México against eight bacteria involved in the biofilm formation processes. Preliminary inhibition assays against biofilm-forming bacteria were performed by cross streak and disk diffusion assay. The most active strains were cultured to obtained ethyl acetate extracts. The toxicity and activity of the extracts in the growth and adhesion inhibition of the bacteria forming biofouling were evaluated. The extracts were added in matrix paint and evaluate their effectiveness in field experiments. The results showed that the most active strains were *Halobacillus trueperi, Bacillus licheniformis* (sponge isolates), *Vibrio harveyi* and *Halobacillus* sp. (marine sediment isolates) that inhibited the growth and adhesion of the most biofilm-forming strains tested. The extracts were not toxic in none of the tested concentrations. In field experiments, the paint with extracts reduced the coverage in the tiles. These bacteria could be used as non-toxic antifouling agents.

Key words: Antifouling, Bacteria, Paint.

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GENETIC STRUCTURE OF THE EUROPEAN HAKE *Merluccius merluccius*: FUNCTIONAL TAGS *VERSUS* NEUTRAL MARKERS

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Abstract: Knowledge of genetic structuring is a prior for the effective management of marine fisheries The genetic representativeness of the tools applied to unveil population structure is currently unwarranted so new genetic tools are welcome to deal with new challenges. We report the screening of 476,747 sequences from a transcriptome library of the European hake (*Merluccius merluccius*), containing 17,655 simple repeated regions, 3,495 non-redundant contigs and 1,483 microsatellite sequences. Twenty-three EST-microsatellites and five neutral ones were multiplexed to genotype 192 hake samples from the species range. We show a high similarity of population structures recovered either with transcriptomic microsatellites or with strictly neutral ones. Therefore, allopatry and gene flow restriction rather than selective scenarios, can explain the split maintenance between the two European hake subpopulations, the Atlantic and the Mediterranean as well as the neutral genetic divergence of their genomes.

Key words: European hake, *Merluccius merluccius*, transciptomic EST-microsatellites, fisheries structure, fisheries genetics.

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COMPARATIVE TRANSCRIPTOMICS OF PHOTOSYNTHETIC SEA SLUGS FROM GENUS *ELYSIA*

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Abstract: Many species of sacoglossan sea slugs, especially those belonging to genus *Elysia*, are able to sequester functional plastids inside their digestive glands (keptoplastids) in different periods of time, depending on each species[1]. This phenomenon was explained for almost twenty years using the lateral gene transfer hypothesis i.e. "photosynthetic" sea slugs had incorporated into their nuclear genome chloroplast genes[2,3]. Proteins encoded by these genes might help into the maintenance of the sequestered algae chloroplasts. However, transcriptomic and genomic analysis in these species have shown so far no evidence of horizontal gene transfer[4,5]. In this work, transcriptomes of different species of genus *Elysia* (*E. cornigera*, *E. timida*, and *E. viridis*) have been compared to identify transcripts of algae origin that are been expressed in sea slug and could be involved in chloroplasts retention at different lengths of time. These analyses were done using a *de novo* assembly approach and using a reference transcriptome. In addition, we included into our analysis the transcriptome of the sea hare *Aplysia californica* for comparative purposes. We expect that these comparative analyses may shed more light on this phenomenon.

Key words: kleptoplastics, *Elysia*, sea slug, photosynthetic animal

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MOLECULAR CYTOGENETIC ANALYSIS OF BIVALVE TUMORS

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Abstract Disseminated neoplasia in bivalves has become a paradigm in oncogenic research because they are, together with Tasmanian devil facial tumour disease (DFTD) and canine transmissible venereal tumour (CTVT) the only known naturally occurring clonally transmissible cancers. Previous studies have described major structural alterations on the karyotypes of these cancers, but they are restricted to the description of the chromosome size and morphology obtained from Giemsa-stained metaphase plates. Although the aforementioned studies allowed detecting both alterations in the ploidy level and presence of abnormal chromosomes, detailed chromosomal mapping has yet to be performed. In this work we report molecular cytogenetic results of disseminated neoplasias in *Polititapes aureus* and *Cerastoderma edule*. Following colchicine treatment, gills were dissected and received a hypotonic treatment prior to fixation in ethanol /acetic acid. Chromosome preparations were fluorescent *in situ* hybridized to detect telomeres and histone gene and ribosomal DNA clusters in both healthy and affected specimens. Our results indicate certain differences between the tumours of these species. Although the telomeres in the neoplasic cells are exclusively located at the ends of the chromosomal arms for both species, these signals are magnified with respect to normal cells in *C. edule*, while in *Polititapes aureus* they show much lower intensity. In both species, the location and number of signals of the analysed markers in the neoplastic metaphases is altered with respect to the usual karyotypes for these species. These results indicate that both duplication events and major structural reorganizations are operating in tumours from both species, therefore demonstrating that this technique could be employed in the characterization of bivalve cancerous karyotypes.

Key words: Disseminated neoplasia, Bivalves, Cytogenetics

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FIELD CULTURES OF MACROALGAE IN CADIZ BAY: NUTRITIONAL POTENTIAL AND ENVIRONMENTAL IMPLICATIONS. THE EALGA PROJECT

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Abstract: The Ealga project (RNM 1235) has addressed the cultures in the field of several edible macroalgal species of interest for the food industry, particularly *Gracilariopsis longissima* and *Chondracanthus teedei*. The research has been carried out in Cadiz Bay and in earthen ponds also used for marine salt extraction, and included the cultivation of macroalgae in ropes under different environmental variables (season, seedling densities and flow). The effect of irradiance, temperature, salinity and nutrient levels in the growth rate of these species has also been tested in laboratory cultures, rendering thallus with very different nutritional properties and colors, which can be of interest for the food industry. The project also include numerous activity for the dissemination of the use of macroalgae as a food resource. The promising results pointed out the posibilities of macroalgal cultures in earthen ponds of Cadiz Bay, especially as part of future initiatives based on integrated multitrophic aquaculture.

Key words: Cadiz Bay, *Chondracanthus, Gracilariopsis*, Macroalgal culture

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MICRO-COMPUTED TOMOGRAPHY AS A TOOL TO INVESTIGATE THE DIGESTIVE SYSTEM IN SEAHORSES

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Abstract: X-Ray micro-computed tomography (µ-CT) is a modern and cost-effective tool, which allow producing 3D images from small samples. We applied X-ray µ-CT to investigate the development of the digestive system in juveniles of the seahorse *Hippocampus guttulatus*. Juveniles were 5 ± 1 mg in weight and 15 ± 1 mm in length after male's pouch release. The digestive tract developed during the ontogeny from a short and straight tube to a long and segmented duct. It is possible to observe the formation of convolutions in the digestive tract by means of conventional histological techniques, but only a 3D reconstruction allowed to identify the convolution as intestinal loops and determine the developmental stage at which the absorptive surface increase (digestion capabilities improved). Microcomputed tomographies (µ-CT) were performed with a Higher Energy CT scan Optimized for Research (HECTOR). High-resolution three-dimensional (3D) images of seahorse juveniles consisted of two-dimensional (2D) trans-axial projections of a target specimen. HECTOR was set at 80 kV tube voltage and 1501 projections over 360°. Reconstruction of a 3D image was performed by rotating either the sample to generate a series of 2D projections that have been transformed to a 3D representation by using a digital process. By using this technique, it was possible to: i) determine the structure of the digestive system during the ontogeny; ii) observe the formation of a first intestinal loop at 20 days and a second loop at 30 days. A general increase in digestive surface was detected throughout ontogeny, appearing the increased intestinal coil at 60 days, accommodated in a double eight shape. According to histological and biochemical studies, it was possible to establish that the digestive system in this species is able to better adsorb and digest the nutrients from the diet from 20 days after birth.

Key words: *Hippocampus guttulatus*, digestive system, µ-CT, ontogenetic development, X-rays.

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MORPHOLOGICAL PLASTICITY AND TROPHIC NICHE OVERLAPPING OF SEA BREAM (*Sparus aurata*) ESCAPED FROM AQUACULTURE FACILITES IN THE CANARY ISLANDS.

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Abstract:

One of the main concerns related to aquaculture is the escape of farmed fish from net-pens, which is considered a threat to natural biodiversity in aquatic ecosystems (Arechavala-Lopez et al., 2017) just as in the case of gilthead seabream (*Sparus aurata*) in central and western Canary Islands, where there are not self-sustained wild populations. The impact of fish escaping in natural environment will be higher when species are able to adapt to the natural environment, resemble wild conspecifics and become feral (Toledo-Guedes, 2014). To carry out this study, 71 escaped seabream individuals were captured by spearfishing, while twenty of them where collected from aquaculture cages. Stomach contents were sorted, identified and compared with the diets of other sparids, which were obtained through a literature review focused on the Canary Islands and the Mediterranean. Moreover, we studied phenotypic changes in the morphology of escapees once in the wild; for that, we compared morphometry of escaped and cultured sea bream. The stomach content analyses showed that escaped sea bream feed on natural preys (mainly mollusks, crustaceans and plants), sharing trophic niche with other cohabiting sparids species. What is more, morphometric differences suggested that escaped individuals are able to adapt to the environment, adopting more fusiform body morphology, similar to wild individuals. According to the size-age relationship escaped individuals ranged from recent escapees to an individual of 42.9 cm (far from common market size) that had been in the wild as much as 6 years. In conclusion, escaped sea bream, once in the wild, is able to forage over natural preys and adapt its external morphology to the new environmental conditions, which could pose a problem of trophic niche overlapping, with unforeseen consequences for their preys and other competitor fish species.

Key words: Gilthead seabream, Trophic niche overlapping, Morphometry, Escapees, Aquaculture.

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ANÁLISIS MORFOMÉTRICO DE OTOLITOS COMO HERRAMIENTA DE TRAZABILIDAD DE DORADAS (*Sparus aurata*) ESCAPADAS EN CANARIAS

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Resumen: Los escapes producidos en jaulas de cultivo flotantes preocupan al sector acuicultor, tanto por las pérdidas económicas generadas como por las posibles interacciones ambientales que pueden producir. En el caso de Canarias, la dorada (*Sparus aurata*) era una especie ausente en las islas centrales, que introdujo la actividad acuícola y cuyas poblaciones dependen de nuevos escapes. Aunque se ha abordado el estudio de estructuras duras (escamas y otolitos) para discriminar entre individuos cultivados y salvajes (Arechavala-Lopez et al., 2012), nada se sabe de la plasticidad morfométrica de estas estructuras una vez el pez se introduce en el medio natural. Con el fin de comprobar las diferencias morfológicas entre otolitos de individuos de cultivo frente a escapados y su posible uso como herrmienta de trazabilidad, se capturaron 20 ejemplares de *S. aurata* de jaulas de cultivo y 40 escapados (desde escapes recientes a 6 años de vida libre) en Tenerife, Islas Canarias. A las capturas se les extrajo la fracción de mayor tamaño de los otolitos, par de sagittae. El ejemplar izquierdo de cada par fue pesado y se midieron sus descriptores de contorno: área, perímetro, redondez, circularidad, longitud de los ejes mayor y menor e índice de aspecto. Además, se realizó un análisis de Fourier de la imagen de la cara interna del otolito y de su surco, lo que proporcionó una serie de funciones capaces de describir un patrón de las irregularidades en el contorno del sagittae de la especie. Los resultados obtenidos indican que los otolitos de doradas asilvestradas conservan su apariencia tras escapar. Sin embargo, los otolitos provenientes de distintas instalaciones de cultivo poseen índices morfométricos diferentes. La solidez y estabilidad de los otolitos, respecto a otros indicadores biológicos, apoyan su posible uso como trazador, permitiendo diferenciar incluso individuos cultivados en diferentes instalaciones de una misma región geográfica.

Palabras clave: Acuicultura, escapes, otolito, contorno, Islas Canarias.

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LIMB AUTOTOMY IN *PORTUNUS HASTATUS* POPULATION: TEMPORAL, SEXUAL AND ONTOGENIC VARIATION

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Abstract: *Portunus hastatus* populations were examined at two localities in Gran Canaria Island (Canary Islands). The aim were to assess the incidence of limb autonomy and to determine whether injury patterns varied temporally (summer and winter), between sexes and across ontogeny. These data, makes this study the first insight in to ecology of *Portunus hastatus*. A substantial percentage (16.5-20%) of the *Portunus hastatus* population were either missing or regeneration one or more limbs, suggesting on one side that autotomy is an important mechanism for their survival and agonistic behaviour and territorialism are traits of this species on the other. The frequency of limb autotomy varied, both between sexes and within ontogeny. The most frequent injury involved loss of a single cheliped, being the right cheliped the most frequently loss for both sexes. High frequency of limb losses in to the specific sampling technique, portunid traps, indicating that intraspecific interactions may be a major cause of limb autotomy.

Key words: *Portunus hastatus*, limb autotomy, crab trap, Gran Canaria

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TAXONOMIC STUDY OF SOME RARE SPONGES FROM THE BALEARIC ISLANDS

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Abstract: The Mediterranean Sea is considered a hotspot of sponge diversity, with more than 629 cited species. Since its shallower fauna is well-known, information about depths beyond 100 meters is scarce and fragmentary. The number of species living in those habitats is expected to increase as it does the interest for the exploration of deep water communities. In this work, we describe some rare sponge species from samples obtained during the MEDITS survey carried out in the Balearic Islands in the years 2016 and 2017. Two *Characella* species represent first cites for the Mediterranean Sea, the species *Axinella* cf *vellerea* is cited for the first time beyond the Alboran domain and the rare species *Acarnus* cf. *levii* is cited for the third time. The skeletal elements of those species are illustrated and compared with those of other congeneric taxa.

Key words: Porifera, Western Mediterranean, taxonomy

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PYCNOGONIDS FROM DEEP-SEA WATERS OFF MAURITANIA (NORTHWEST AFRICA)

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Abstract: Pycnogonids, also called as sea spiders, are marine arthropods belonging to class Pycnogonida or Pantopoda, found in all oceans around the world. Most of species have small size and live in relatively shallow depths, although some of them can reach to 70 cm leg span in Antarctic and deep waters.
During the *Maurit* surveys, pycnogonids were collected in 95 of the 291 trawl stations (occurrence = 32.6%) carried out in deep-shelf and slope off Mauritania (80 – 2000 m) between 2007 and 2010. Hauls were deployed with a commercial bottom trawl, monithorized with SCANMAR and following a randomized swept area method (Ramos *et al.*, 2017).
As occurs in other marine region, diversity and abundance of pycnogonids were low, being represented by only 815 specimens belonging to 10-12 species and 6 families. Nevertheless, its distribution presented characteristic latitudinal and bathymetric patterns in Mauritania.
At geographic level, main total densities were observed in the Banc d'Arguin area, north of Cape Timiris (about 19º N latitude), while at bathymetric level, we found two abundance picks. The first, in the continental shelf (<200 m depth), was due to Nymphonidae species, and the second one, was located in deep waters, after 1700 m, where Colossendeidae family was dominant. This features was also reflected in the structure and composition of the assemblages obtained through the multivariate analysis (MDS plot) which offered a clear separation in two main groups mainly determined by depth.
Although we still need to clarify some identification problems of *Nymphon* genus, the dominance of Colossendeidae in Mauritanian deep-shelf and slope is evident (49% of total abundance), followed by Nymphonidae (31%), Ascorhynchidae (13%) and Ammotheidae (6%). *Colossendeis angusta* 32%) and *Colossendeis macerrima* (19%) seem the dominant species, being also noticeable the abundance of *Ascorhynchus armatus* (15%) and *Achelia setulosa* (6%).

Key words: biodiversity, distribution patterns, assemblages, Pycnogonida, Mauritania

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ECHINODERMATA (OPHIUROIDEA AND HOLOTHUROIDEA) FROM NORTHWEST AFRICA

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Abstract: The present work shows the results on biodiversity and distribution of Northwest African Ophiuroidea and Holothuroidea at regional level. Specimens were collected during 10 multidisciplinary surveys carried out along Northwest Africa, using three different samplers: bottom trawls, beam trawls and rock dredge.
Fifty-seven ophiuroid species were identified being Ophiacanthidae, by far, the richest and numerical dominant family with 19 species and the 90% of the total abundance.
Concerning Holothuroidea, forty-nine species belonging to 15 families were identified. Cucumariidae, Phyllophoridae, Synallactidae and Mesothuriidae were the richest families with 12, 9, 6 and 5 species each. We also highlight the high species richness over hard bottoms habitats off Mauritania.
Pelagothuriidae, represented by a single species (*Enypniastes eximia*), was the dominant family, constituting the 75% of the total abundance. In addition, and together with Synallactidae, reached the 86% of the total Holothuroidea biomass.
The latitudinal distribution patterns of Ophiuroidea show a clear dominance of suspension feeder species in the upper slope of Western Sahara, where the upwelling conditions are intense and permanent through the year. Nevertheless, along Mauritanian coast, despite its elevated productivity, suspensivorous were scarce in soft bottoms, probably related to the sedimentary dynamics in this area.
Regarding to Holothuroidea, the highest values of both, abundance and biomass, occurred in southern Mauritania, between 1500 and 1800 m, due to the absolute dominance of *Enypniastes eximia*, *Benthothuria funebris* and *Paelopatides grisea*.
The multivariate analyses clearly differentiated three latitudinal assemblages for Ophiuroidea: Morocco (27º-33ºN); northern Morocco and Western Sahara; and from northern Mauritania to Guinea Bissau. The bathymetric analyses also showed three assemblages: Shelf-Upper Slope (21-600m); Slope (600-1300m); and Deep Slope (1300-1900m).
Holothuroids assemblages showed more complex latitudinal and bathymetric patterns, with two main groups, which in turn split into minor ones.

Key words: biodiversity, Ophiuroidea, Holothuroidea, Northwest Africa

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HYDROIDS (CNIDARIA, HYDROZOA) FROM NORTHWEST AFRICA

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Abstract: This work deals with the study of the taxonomy, distribution and biogeography of the hydroids collected during 12 international surveys (2005 – 2012) carried out along the Northwest African coast, from 18 m to 1835 m depth. Most of samples were collected with a bottom trawl, but other sampling gears (beam trawl, grabs, dredges and a ROV) were also deployed.

A total of 133 species belonging to 22 families were identified. Eleven species and 5 families belong to Anthoathecata and 123 species and 17 families to Leptothecata. The family Sertulariidae was dominant in abundance, whereas Campanulariidae showed the highest occurrence value. The most specious families were Sertulariidae, Aglaopheniidae, Campanulariidae and Plumulariidae.

The occurrence and abundance of hydroids in NW Africa seems related with their ability to colonize soft-bottoms through two different strategies: hydrorhizal modifications for anchoring the colony to sediment and epizoism. The most abundant and widespread species were those displaying both strategies. The spatial distribution pattern also suggest that submarine canyons and cold-water coral mounds harbor the source populations that allow recolonize and maintain the hydroid abundance and diversity in soft-bottoms after impacts caused by demersal fisheries in this area.

Analysis of bathymetric distributions revealed higher diversity on the shelf than on the slope and emphasizes the eurybathic condition of the hydroid fauna of Northwest Africa. Biogeographical components included two main groups: species with a wide distribution (58%) and species with Atlantic distribution (40%). Endemic species were only represented by *Zygophylax parabiarmata* and *Streptocaulus caboverdensis*, collected exclusively in Cape Verde Islands. Species with strictly tropical distribution were collected south to Mauritania, supporting the idea that, at least for hydroids, the boundary between Lusitanian and Tropical East Atlantic provinces seems located along Senegalese coast.

Key words: Cnidaria, Hydrozoa, Northwest Africa, deep waters.

ANGELSHARK BREEDING AREAS AND NEW TECHNOLOGIES IN CANARY ISLANDS

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Abstract: The Angelshark (*Squatina squatina*) is one of the most endangered fish in European waters; listed as Critically Endangered on the IUCN Red List based on declines of at least 80% over three generations. The angel shark family is also identified as the second most threatened sharks and ray taxa after a global review of extinction risk by the IUCN Shark Specialist Group. Even in their last stronghold, the Canary Islands, Angelsharks are under significant threat from incidental catch through poorly-managed fisheries; habitat degradation through pollution, coastal development and marine infrastructure; and disturbance by divers and beach users.

In 2013, the University of Las Palmas de Gran Canaria, the Zoological Research Museum Alexander Koenig and the Zoological Society of London set up the **Angel Shark Project** with the overall goal to safeguard the future of Critically Endangered angel sharks throughout their natural range.

One of the major research lines is the study of juvenile Angelsharks in the first confirmed nursery area identified for this species in the Canary Islands; Las Teresitas (Tenerife). In addition, we used the results obtained from this area to identify potential new breeding areas around the Archipelago. Furthermore, we will provide an overview of acoustic telemetry work, including development of an ethically approved tag attachment methodology and use of automatic underwater vehicles, to provide improved understanding of adult Angelshark habitat use and fine-scale movement.

Key words: Angelshark, Critically Endangered, Breading areas, New technologies, Canary Island.

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RAYS OF PARADISE: ECOLOGY AND DISTRIBUTION OF SPINY BUTTERFLY RAY IN GRAN CANARIA, CANARY ISLAND.

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Abstract: The Vulnerable (IUCN Red List) Spiny Butterfly Ray (*Gymnura altavela*) has been severely depleted, due to professional and recreational fisheries across the entire Atlantic including the Canary Islands. However, in Gran Canaria, Canary Islands, an important aggregation and reproduction hotspots for the Spiny Butterfly Ray has been identified. Despite being regularly sighted by divers and beach users, there is still a lack of information on the spatial distribution patterns, population structure and abundance of these rays. Consequently, in 2017, the project Rays of Paradise was launched by the University of Las Palmas of Gran Canaria with the aim of expanding the existing knowledge of this species in the Canary Islands. More precisely, this project aims at better understanding the patterns of distribution and abundance in shallow coastal of the island. Data has been gathered using established citizen science programmes, coupled with regular visual underwater surveys that provide basic insights into the ecology of these rays in Gran Canaria.
This information is vital to improve and inform conservation and habitat management of this species, which may be reclassified as endangered or critically endangered in a near future in the Atlantic.

Key words: Spiny Butterfly Ray, Ecology, Canary Islands, Conservation, Fisheries, Vulnerable.

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INTERACCIONES ENTRE LOS CETÁCEOS Y LAS ACTIVIDADES ANTROPOGÉNICAS EN AGUAS ESPAÑOLAS

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Abstract:

Los cetáceos son animales emblemáticos, son depredadores apicales y por ello juegan un papel muy relevante como reguladores en los ecosistemas marinos. Además son k-estrategas extremos razón por la cual las poblaciones de cetáceos son muy vulnerables a impactos o cambios en su medio. Sobre la base de una amplia recopilación bibliográfica, detallamos la situación de las 16 especies de cetáceos más comunes en aguas españolas y las principales actividades humanas que les afectan. Constatamos que el conocimiento disponible sobre alguna de las especies es insuficiente para determinar el grado de afección de las actividades humanas en el estado de sus poblaciones. En general, las especies más estudiadas de odontocetos costeros (como los delfines mular, común y listado y las marsopas) están principalmente afectadas por la pesca, tanto captura accidental como competición por recursos, y por la importante carga de contaminantes que soportan, mientras que los odontocetos de profundidad (como los calderones común y gris, los cachalotes y los zifios de Cuvier) están afectados sobremanera por las basuras marinas y el ruido submarino. Los principales impactos sobre los misticetos se deben al ruido submarino, a las basuras marinas y al cambio climático. Existen grandes diferencias geográficas, por ejemplo, las colisiones con embarcaciones y el turismo de avistamiento son uno de los principales problemas en las Islas Canarias.

Mediante la divulgación de este estudio bibliográfico, identificamos una ventana de oportunidad para acercar problemáticas ambientales del medio marino en un sentido amplio a través de sus efectos concretos sobre los cetáceos. Por ejemplo, las basuras marinas, la masificación del turismo, el cambio climático, o la necesidad de planificar el desarrollo eólico marino o la acuicultura marina desde una perspectiva de sostenibilidad ambiental han resultado ser problemáticas mucho más tangibles para el público cuando son explicadas a través de sus efectos sobre estos emblemáticos animales.

Key words: cetáceos, pesca, tráfico marítimo, turismo de avistamiento, educación ambiental.

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Durante la elaboración de este informe hemos contactado a expertos de distintas organizaciones que han contribuido al proyecto aportando sus visiones sobre la problemática u ofreciéndonos información sobre bibliografía referente a las poblaciones de cetáceos y las interacciones con actividades humanas en sus áreas de actuación. A todos ellos les estamos inmensamente agradecidos por su tiempo y su ayuda desinteresada.

ANNUAL STOMACH CONTENTS OF THE CUTTLEFISH *Sepia officinalis*, L.,1758 OF ALGERIA CENTER COASTS

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Abstract: The gastric contents of 284 common cuttlefish *Sepia officinalis*, Linné 1758 with 145 females and 139 males were sampled from the commercial catches of the trawl fishery in the central the Algerian coast during 2011. This study, carried out for the first time in this country, is based on a qualitative analysis listing the prey ingested in the natural conditions and a quantitative analysis by calculating the frequencies of prey and the seasonal repletion index. Prey frequencies were used to study changes in diet between the sexes and size and its seasonal evolution. Crustaceans and fish would be preferential prey with a slight predominance of the second category for females. Mollusks and worms would be secondary prey throughout the year. Females have a larger repletion index than males. The results of this study are correlated with the life cycle of the cuttlefish and its sexual maturity.

Key words:*Sepia officinalis*, Diet, season, maturity, Algeria

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NEW RECORDS OF TWO INTRODUCED AND POTENTIALLY INVASIVE TROPICAL SCLERACTINIAN CORALS IN THE CANARY ISLANDS AND THEIR POPULATION EXPANSION

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The occurrence of two new scleratinians corals of the genus Tubastraea and Oculina has been recorded for the first time in the coasts of the Canary Islands. Both specimens were found in the main port of Gran Canaria Island, constituting their northernmost location recorded in the East Atlantic. Whereas Oculina sp. has not been registered in other locations of the Island, high densities of Tubastraea sp. were observed in natural environments 11 km to the southeast and some specimens 30 km away from the port, showing their rapid expansion ability. Maritime transport has clearly been the route of introduction of the species and, combined with the rising of seawater temperatures due to the Climate Change, these tropical species have been able to establish in a new environment beyond their normal limit of distribution. Available data have allowed a preliminary identification of T. coccinea. This species is well known for its ability to associate with oil platforms and it is considered to have a huge invasive capacity. Although new species of tropical corals can be somehow attractive for diving activities in the Archipelago, this biological invasion can risk the health of native species such as the scleractinians Madracis asperula and Phyllangia mouchezii, which share the same environment. Further studies are needed to elucidate any potential consequences of the expansion of the populations of these invasive corals in the Canary Islands' biodiversity.

Key words: Oculina sp., Tubastrea sp., oil platforms, invasive species, Canary Islands

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CONTRIBUTION TO THE BIOECOLOGICAL KNOWLEDGE OF THE ORANGE-BACK SQUID *Sthenoteuhtis pteropus* IN CANARY WATERS

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The presence of *Sthenoteuthis pteropus* in the Canary waters (between 27º5N-20ºN and 13ºW-18º5W) is related to migratory aspects in the months of July and November, according with an increase in sea surface temperature. The range of sizes found in the study area is associated with a part of the life cycle of the squid, not finding small size or large reproductive specimens. Nevertheless, a clear development of the pigmentation of the beaks was observed, where the individuals began to show a pigmentation change around 270-300 mm of Dorsal Mantle Length, which coincides with the beginning of gonadal development (i.e sizes to which developed ovaries were started). It should be noted that the presence of males was scarce, with a total of 4 males in relation to 138 females. Feeding was similar that described by other authors, where the fishes presented the greatest numerical importance in the stomach contents.

Keywords: *Sthenoteuthis pteropus,* Orange-back squid, darkening process, migration, feeding.

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CONOCER AL INVASOR: DISPERSIÓN DEL DECÁPODO NO-NATIVO *CRONIUS RUBER* EN LOS ECOSISTEMAS MARINOS DE GRAN CANARIA (ISLAS CANARIAS)

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Resumen: El cangrejo remador (*Cronius ruber*), dadas sus características biológicas y su comportamiento, es una especie susceptible de convertirse en invasora en los ecosistemas en los que se asienta. Desde su primer avistamiento en dos localidades de Gran canaria en 2016, se ha confirmado la presencia de esta especie en prácticamente todo el litoral de Gran Canaria y en algunas localidades de Tenerife. Mediante buceadores científicos se realizaron buceos nocturnos de reconocimiento con el objetivo de determinar la ausencia/presencia de *C. ruber* en la costa de Gran Canaria, con especial atención a los hábitats naturales de interés comunitario (Red Natura 2000). Se confirmó la presencia de *C. ruber* en cinco de las ocho zonas de especial conservación (ZEC), no pudiendo descartar la presencia de esta especie en las zonas restantes. *Cronius ruber* estuvo presente en todos y cada uno de los hábitats especiales de conservación: cuevas marinas sumergidas, arrecifes rocosos y bancos de arena cubiertos permanentemente por agua marina poco profunda con presencia de *Cymodocea nodosa*. Además, se constató la pesca accidental continuada por parte de la flota artesanal de trasmallo y nasa en La Isla de Gran Canaria. La presencia de hembras ovígeras, en todos los meses de observación, confirmó el nivel de asentamiento de esta especie. En Canarias, los efectos del cangrejo remador sobre la biodiversidad y los hábitats marinos de interés comunitario están por cuantificar.

Palabras clave: *Cronius ruber*, especie no-nativa, red natura 2000, dispersión, Gran Canaria

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EFFECTS OF THE INVASIVE MACROALGA *RUGULOPTERIX OKAMURAE* ON AMPHIPOD ASSEMBLAGES IN THE STRAIT OF GIBRALTAR

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Abstract: Marine macroalgae support much of the biodiversity in coastal habitats by providing a range of essential resources such as food and habitat. Thus, it is expected that changes in their species composition (either the addition or removing of seaweed species) would lead to major consequences on the ecosystem integrity and functioning (Crooks et al. 2002; Gribben et al. 2009). In this sense, although the establishment of non-native seaweed often entails negative effects on biodiversity at the same trophic level, their impact on higher trophic levels is hardly predictable, being dependent on both the native assemblage and the identity of the invader species (Thomsen et al. 2014; Maggi et al. 2015). In this study we aim to evaluate the effects of the macroalga *Rugulopterix okamurae,* a recent and successful invader in the coast of the Strait of Gibraltar, on amphipod assemblages associated to shallow water macroalgae. Samples of both *R. okamurae* and a native dominant Dyctiotacea with similar morphology were collected in four different sites in the northern coast of Ceuta, an area where the invasive macroalga has become dominant. Four replicates of each algae were collected per station and washed through a 0.5 mm mesh to retain all mobile macrofauna; amphipods were further identified to species level. The most abundant amphipod families in both macroalgae were Hyalidae, Photidae, Stenothoidae, Ischyroceridae, Dexaminidae, Caprellidae and Calliopiidae. Multivariate analyses do not reveal clear differences in amphipod composition between the native and invasive macroalgae. These results agree with previous studies which suggest that morphological complexity of the alga (rather than their taxonomic identity) may be the key factor to predicting the impacts of invasive seaweed on epifaunal assemblages (Suárez-Jiménez et al. 2017). Therefore, consequences (positive, neutral or negative) of macroalgae invasions on mobile associated assemblages would be determined mainly by the complexity of the invasive macroalgae.

Key words: Biological invasions, Non-native macroalgae, Amphipoda, *Rugulopterix okamurae*

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IMPACTS OF THE INVASIVE MARINE MACROALGA *ASPARAGOPSIS ARMATA* IN THE AZORES. PRELIMINARY RESULTS

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Abstract: Invasions of non-indigenous species (NIS) represent a serious threat to marine biodiversity, posing significant changes to the ecology of coastal communities. Established NIS can alter biodiversity levels, structure, organization and functioning of ecosystems and can severally affect local marine resources, quality of life, economy and/or human health (Vitousek 1988, Scalera 2010). Understanding the biological and ecological factors responsible for a successful invasive process, the dynamics underlying biological invasions and the magnitude of stress a NIS may deliver to the local community, represent necessary information for implementing efficient control, monitoring and management programs for the effective mitigation of already established invasive taxa (Thompson et al. 2002). The cold-temperate *Asparagopsis armata* Harvey 1855 is considered one of the most invasive species in European subtropical and temperate waters (Andreakis et al. 2007). It was originally described from Western Australia, first recorded in Europe almost 100 years ago, it is now well established in the Azores Archipelago, although there is virtually no information about its ecology (Cardigos et al. 2006). Experimental work showed strong effects of *A. armata* on ecosystem services and biodiversity worldwide, where it has been negatively impacting coastal fisheries (Katsanevakis et al. 2014). We will present here preliminary results of a project that focus on understanding the effects of *A. armata* on the Azorean littoral communities to predict how it will influence their coastal biodiversity under future scenarios of climate change.

Key words: Non-indigenous species, benthic assemblages, hard bottoms, oceanic islands

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STATUS OF THE POPULATIONS OF *PINNA NOBILIS* L. (1758) IN THE VALENCIAN COMMUNITY AFTER A MASSIVE MORTALITY EVENT

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A high mortality of the endemic bivalve species *Pinna nobilis* was detected in the Spanish Mediterranean coast in October 2016, spreading rapidly from Andalusia to the region of Murcia, the Valencian Community and the Balearic Islands. The cause of this mortality is attributed to a protozoan sporulated parasite of the genus *Haplosporidium*, that attacks the hepatopancreas of individuals, dying by starvation The haplosporidan parasite was detected by using light and transmission electron microscopy and PCR amplification. This work analyzes the effect that this pandemic has had in waters of the province of Alicante (South East of Spain) comparing previous data of the state of *P. nobilis* populations and the current state after the mortality event. In the rest of the Valencian Community, data were obtained once the mortality event began. Samplings were carried out by SCUBA divers at depth of 10 m. In each locality, sampling sites were randomly selected in *Posidonia oceanica* meadows with a minimum of 3 transects in each of them, counting and measuring all the individuals. 15 localities were sampled distributed from North to South of the Valencian Community. Differences between the two sampling years (2016/17) were clear in the province of Alicante, where natural mortality did not exceed 15% during the first year, while it was 100% in 2017. Mortality reached 100% in the province of Valencia, while living individuals (50%) were detected in the SCI "Prat de Cabanes-Torreblanca", in the province of Castellon. The results show the severity of this mortality event in the Valencian Community. It would be advisable to monitor the living populations in order to find out wether the survival is due to the pandemic has not yet reached that area or individuals are resistant to the disease and, therefore, capable of reproducing by themselves in the future.

Key words: *Pinna nobilis*, mortality, *Haplosporidium*, Alicante, Valencian Community.

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MONITORING OF SOFT-BOTTOM MACROFAUNA IN THE HIGHLY URBANIZED RÍA DE FERROL (GALICIA)

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Abstract: Spatial and temporal variability of marine benthic assemblages depends on several abiotic factors and biotic interactions, that shape their composition and structure. Thus, soft-bottom faunas are conditioned by hydrodynamic patterns which, in turn, determine sedimentation, granulometry and organic matter content (Pearson and Rosenberg, 1978). Furthermore, anthropogenic activities and urbanization may strongly affect these parameters and therefore benthic faunas. For example, breakwaters usually alter patterns of local currents thus resulting in higher sedimentation in sheltered areas (i.e. increase in silt/clay). This is a common feature in the urbanized coastline of the Galician rías (NW Iberian Peninsula), where this often translates in an empoverishment of the fauna and proliferation of opportunistic species such as some polychaete annelids. In this context, an extensive breakwater (>1000 m) was built at the mouth of the Ría de Ferrol (construction began in 2001) and this was expected to modify nearby sedimentary bottoms. To test any potential change in sediments and benthic fauna, the Estación de Bioloxía Mariña da Graña began a monitoring program at the Ensenada de San Cristobo (northern outer margin of the ría). In this communication, we present the dynamics of the annelid assemblage during a three-year period (2008-2010). Sampling was done bimonthly at two subtidal fine sand sites (7-10 m deep) with a Van-Veen grab; five replicate samples (0.28 m^2) were taken each sampling event per site. Sediment composition did not vary substantially along time and there were no increase in silt/clay content. The polychaete dynamics showed a consistent seasonal pattern, as expected in temperate soft bottoms, i.e. higher abundance and species diversity in summer-autumn (Van Hoey *et al*., 2007). Species composition and richness did not show symptoms of impoverishment. However, this area might be subjected to other potential perturbations due to harbour activities that could be detected by the ongoing sampling monitoring.

Key words: Atlantic Ocean, Polychaeta, Subtidal, Dynamics, Breakwater

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SOME ASPECTS OF REPRODUCTIVE BIOLOGY OF ALFONSINO BERYX SPLENDENS FROM THE SIERRA LEONE RISE (AFRICA)

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Abstract: Alfonsino (Beryx splendens Lowe, 1834) is a species of fish extremely vulnerable, being one of the best-known representatives of 'seamount-aggregating fishes'. This species forms aggregations with commercially valuable over seamounts. The low productivity of many seamount species limits the prospects for the large-scale exploitation of fish resources on seamounts . Based on life history and ecological characteristics, several authors suggest that this species are more susceptible to growth overfishing and population depletion. The Instituto Español de Oceanografía carried out a experimental survey (PALGUINEA2001) onboard Spanish bottom longliners between January to July in 2001 in four little Seamounts of Sierra Leone Rise (coordinates: 9.22º-9.31º N, 21.30-21.35º W, 200-926 m in depth). This work provides information on the biological parameters (Sexuality, Maturity and Spawning season) in a vulnerable species in an unexploited, isolated and fragile ecosystem.

Key words: Beryx splendens, Seamount, biology, fisheries

Acknowledgments: We thank ORPAL, the Longline Ship owners' Association from Riveira (A Coruña), particularly to captains of 'Emanón', 'Sevilla Uno', 'BermarPrimero' and 'Noruego Cuarto' for their logistical support.

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REPRODUCTIVE BIOLOGY OF THE SEA CUCUMBER PARASTICHOPUS TREMULUS (HOLOTHUROIDEA) FROM EUROPEAN TRAWL FISHERIES

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Abstract: The sea cucumber *Parastichopus tremulus* (Gunnerus, 1767) is a common echinoderm of the class Holothuroidea. The Spanish trawl fisheries at European waters catch the sea cucumber as a bycatch species.

A monthly sampling of the species *P. tremulus* provided by fishing vessels were analyzed in the laboratories of the IEO in Vigo. A sample of sizes, weights and biology of the species was carried out to obtain information throughout the annual cycle.

The size distributions of the samples collected by the fishing vessels indicate a range of sizes between 70 and 230 mm and the average size corresponds to 158.1 mm.

P. tremulus is a dioecious species, without external sexual dimorphism. Biological sampling was carried out to differentiate sexes and gonad development was observed. Maturity state was classified based on morphological and histological analyses of the gonads. A four-stage maturity scale was defined by observation of tubule growth and oocyte frequency. Inmature/resting (1), maturation (2), pre-spawning (3) and post-spawning (4). Reproductive season occurs between January to May.

The good knowledge of reproduction annual cycle could be used to propose fishery management measures such as a close fishing season to protect the species during reproduction.

Key words: Sea cucumbers, *Parastichopus tremulus*, reproduction, fishing discards.

Acknowledgments: We would like to thank skippers and crew of fishing vessels for kindly collaborate during IEO samplings. This work was made within the HOLOPLUS Project CDTi-CONECTA PEME and DESCARSEL FEMP Project. The authors acknowledge ARVI and partners of HOLOPLUS.

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ANALYSIS OF DISCARDS IN THE SPANISH BLACK HAKE FISHERY IN MAURITANIAN WATERS AND ITS IMPACT IN THE BIODIVERSITY OF BOTTOM COMMUNITY

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Abstract: Discarding is one of the most important issues in current commercial fisheries. The Spanish black hake fishery in Mauritanian waters, from Cape Blanc (21° N) to the Senegalese border (16° N), has been monitored by scientific observers of the Instituto Español de Oceanografía (IEO) on board the bottom trawl vessels throughout 2016. During this period, we sampled a total of 7 trips, accounting for 147 hauls. The Spanish black hake trawlers performs two types of fishing operations, carried out at two depth ranges: typical deep water trawls (350-815 m), targeting the two species of black hake (*Merluccius polli* and *Merluccius senegalensis*), and shallower trawls (100-270 m) targeting other finfish species. Black hake also occurs frequently in discards, mostly in deep-water trawls.

From the data collected, this study examines the discards in this fleet to identify spatial, temporal, environmental and operational factors significantly affecting to each hake species discards. A negative correlation of hake fleet discards with latitude and bottom depth was found.

The abundance and species composition by depth was also significantly different. Some examples of global biodiversity indicators obtained so far are given. A total of 188 species were identified, being the diversity higher in the deeper trawls (>350 m) targeting black hakes. Percentages by groups were: 68% fish, followed by crustaceans (16%), molluscs (8%), echinoderms (5%) and other invertebrates (2%).

This statistical analysis may help to look at the factors influencing the discarding practices, but also to predict discards in an area of great fishing importance and specific richness, such Mauritanian waters, and its impact on the bottom communities' biodiversity. Knowledge of the spatial distribution of discards and their characterization according to the fishing strategy of this fleet is of potential relevance for future stock assessments and to implement fisheries management strategies in waters off Northwest Africa.

Key words: Discard, Biodiversity, Fishery-Bottom Trawl, Black Hake, Mauritanian

Acknowledgments: The authors would like to sincerely thank the crews of the commercial vessels for their collaboration during the fishing trips. We are also grateful to the shipowner, Eladio Rosales, for his kindness and facilities to host research observers onboard.

Austrominius modestus IN NORTH PORTUGAL 60 YEARS AFTER FISCHER-PIETTE

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Abstract: *Austrominius modestus* (Darwin) is native from New Zealand and Australia coasts and was first recorded in European waters, in West Sussex, in 1945 by Bishop (1947). From there it quickly spread around the British Isles and soon reached continental European coast. In 1956 Fischer-Piette and Prenant recorded *A. modestus* for the first time in Portugal. From initial localities of discovery it expanded its range both north to merge with *A. modestus* population on the Spanish coast, and to the south.
Several later studies show that the species has expanded its range and can be found as far south as Faro in Southern Portugal, but since 1963 no further studies have been carried out in North Portugal where it was recorded for the first time. In this study we revisited the suitable habitats for *A. modestus* in North Portugal to update information on its distribution and collect quantitative data that can be used in future studies to track possible changes in its abundance. We found *A. modestus* to be more abundant than in Fischer-Piette's publications. In addition it was present in places where it was not recorded before and therefore more widespread than previous papers would indicate. Most specimens were on estuaries on artificial vertical surfaces among *Fucus*. Therefore, we carried out an experimental study to look at the role of *Fucus* in hindering the establishment of *A. modestus*.

Key words: *Austrominius modestus,* non-indigenous species, distribution

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CHEMICAL COMPOSITION OF MARITIME HALOPHYTE SPECIES CULTIVATED IN HYDROPONICS

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Abstract:
Halophyte plants grow in areas of strong marine influence subjected to environmental pressures that lead them to produce antioxidant compounds such as phenolic compounds and vitamins A and E (Barreira et al., 2017). Due to its high nutritional and functional value, halophytes present additional benefits to our health due to their antioxidant, anti-inflammatory, neuroprotective and antitumor activity (Custódio et al., 2012; Rodrigues et., 2017). The objective of this work is to study the chemical composition of halophytes (*Salicornia ramosissima* and *Inula crithmoides*) industrially cultivated in hydroponic systems. Plants were produced by Agro-On, reproducing the natural conditions of the plants original habitat, the Ria Formosa lagoon (south of Portugal). Production took place in greenhouses protected from extreme variations in temperature and from chemical or microbiological contamination, which can damage the final quality of the produced plant (Glenn, Brown, & Blumwald, 1999). To determine the best cultivation conditions for optimum nutritional composition, plants were grown at different salinities, since salinity can enhance the production of phenolic compounds and therefore improve the nutritional value of plants (Boestfleisch et al., 2014). Collected plants were lyophilised and analysed for moist content (gravimetry), ash (gravimetry after muffle furnace burning), minerals (by microwave plasma atomic emission spectrometry), and total proteins (e.g. N content by elemental analysis). Acetone extracts (80% in water) were prepared and their content in phenolic compounds (including flavonoids and condensed tannins) evaluated using spectrophotometric methods. Results show that at higher salinity halophyte plants are more bioactive but have less moisture hence less succulent. They have also higher ash contents,

retaining more minerals. Therefore, we consider necessary the study of the chemical and the nutritional composition, but also the bioactivities of halophytes cultivated by hydroponics.

Key words: Chemical composition, hydroponics, halophyte, *Salicornia ramosissima*, *Inula crithmoides*

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ALGARED+: AISLAMIENTO DE MICROALGAS

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Abstract: ALGARED+, es un proyecto enmarcado dentro del Programa de Cooperación Transfronteriza España-Portugal (POCTEP), busca la optimización de la producción y mejora del aprovechamiento de las microalgas para sectores como salud, cosmética y acuicultura. La primera fase de este proyecto ha consistido en el cultivo de diferentes algas previamente aisladas y mantenidas, con alta tasa de crecimiento (cianofitas, haptofitas, etc.), así como aislamientos a partir de muestras naturales (Andersen y Kawachi, 2005). Los aislamientos han consistido en la toma de muestras de diferentes ambientes naturales (rías, charcas, zonas costeras, caños, etc.), creando un amplio abanico de especies con características diferentes. La identificación y posterior aislamiento de las microalgas de interés se ha llevado a cabo mediante el cultivo de muestras naturales en diferentes medios, triplicando así el número de muestras obtenidas, creando ambientes diferenciales y aumentando la posibilidad de crecimiento de diversos tipos de células. Las observaciones en microscopio han permitido la identificación de especie o grupo de algas, pudiendo así determinar el ambiente de cultivo apropiado para cada cepa de microalga así como el mejor método de aislamiento. Se ha diseñado un protocolo de aislamiento, paso a paso, para microalgas presentes en muestras naturales.

Key words: Microalgas, cultivo, aislamiento, ALGARED, micromanipulación

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IONIC SOLVENT BAR MICRO-EXTRACTION FOR THE DETERMINATION OF CADMIUM IN MARINE WATERS

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Abstract: Despite the advance made on liquid-phase micro-extraction as a tool for sample preparation in determination of Cd and other metals, there are still some limitations in the case of seawater samples, as the need of a support for the fiber and the availability of extractants that can transport Cd from high salinity samples in natural conditions. Cadmium appears in seawaters in form of chloro-complexes, mainly $CdCl_3^-$. In this work, solvent bar micro-extraction configuration with the ionic liquid trioctylmethylammonium chloride (Aliquat® 336) has been used as a carrier from Cd from seawater samples due to its ability for ionic exchange of $CdCl_n^{(n-2)-}$. In this configuration, the fiber ends are thermally sealed, and the fiber can left immersed free in the sample during the extraction. The metal is transported from the sample through an organic solution inmobilized in the pores of the hollow fiber and stripped into an acceptor aqueous phase inside the fiber. The system was optimized to work at the natural pH and salinity of seawater, and operational conditions for application real samples were 7.5% Aliquat dissolved in kerosene and 5% dodecan-1-ol in the organic solution, 1.5 M HNO_3 as acceptor solution, 60 min time of extraction, and 900 rpm stirring speed. Cadmium was pre-concentrated 65 times in samples containing Cd 10-100 ngL-^{1}. The limit of detection of the method was 4.8 ngL^{-1} using GFAAS for instrumental determination, intra-day and inter-say standard deviations were 11% and 13% respectively. Finally, the accuracy of the method was evaluated measuring Cd in a certified reference material BCR-403, showing its applicability for a simple, low-cost and environmental friendly monitoring of cadmium ultra-traces in seawater analysis.

Key words: Solvent bar micro-extraction, Cadmium, Ultra-trace analysis, Seawater, Ionic liquid, Hollow fiber

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MONITORING BENZOTRIAZOLE ULTRAVIOLET STABILIZERS (BUVS) COMPOUNDS IN MARINE SAMPLES OF GRAN CANARIA ISLAND (CANARY ISLANDS, SPAIN)

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Abstract: Benzotriazole UV stabilizers (BUVSs) are emerging contaminants used in different personal care products such as sunscreens and cosmetics to absorb ultraviolet light (Tousova et al, 2017). These compounds have been described as bioaccumulative, pseudo-persistent and mutagenic. Associated with coastal tourism activities (beach, aquatic sports activities, etc.), the use of selected compounds have increased but their implications as a source of new chemicals into the coastal marine system have been poorly evaluated (Sánchez-Quiles and Tovar-Sánchez, 2015). For that, knowing their presence and distribution in the environment is of great interest. Since their concentrations are very low in complex matrices, it is necessary to employ extraction and preconcentration procedures besides sensible methods to determine them.

In this work, two treatment methods based on microwave assisted extraction (MAE) and on-line solid phase extraction (SPE) coupled to ultra high performance liquid chromatography with tandem mass spectrometry (UHPLC-MS/MS) were applied. We carried out a one-year monitoring study to determine six BUVSs compounds (UV-P, UV-326, UV-327, UV-328, UV-329 and UV-360) in different environmental compartments from Gran Canaria island (Canary Islands, Spain): input and output samples from five wastewater treatment plants as well as seawater and sediments from three areas influenced by discharges of marine outfalls. The target compounds shown different trends of accumulation in aqueous or solid samples, probably due to their coefficient of hydrophobicity. The majority of the positive samples belonged to the southernmost sampling point, which is in the most touristic location of the island. The continuity of the monitoring will allow us to establish the trends regarding the spatial and temporal distribution of the target compounds in the environment.

Key words: Benzotriazole UV stabilizers (BUVSs), microwave assisted extraction (MAE), solid phase extraction (SPE), ultra high performance liquid chromatography with tandem mass spectrometry (UHPLC-MS/MS)

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IMPLEMENTATING A SEAWATER TOXICOLOGY ASSAYS PROTOCOL WITH MEDAKA AND ZEBRAFISH

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Abstract:

Freshwater toxicity tests with vertebrates are solidly standardised, but this is not the case for seawater assays. This research proposes the development of a protocol for acute toxicity assays in seawater for japanese medaka (*Oryzias latipes*) and zebrafish (*Danio rerio*), as a model fishes species. We have chosen these species due to their easy and cheap maintenance, as well as their fast and high rate reproduction.
Our final goal is to acclimate both species, closing their life cycle, and demonstrating that their sensitivity is not increased or altered due to the change in environmental conditions to which have they previously been exposed and adapted. Prior studies have shown a good adaptability of medaka to different salinities, and a remarkable resistance of zebrafish embryos and larvae in diluted seawater, therefore these species can be used for seawater assays, especially compared to other model organisms commonly used. In the tests carried out so far, these species are able to tolerate a limited range of salinity (16,85 g/l for zebrafish adults and 27,42 g/l for medaka adults). So we also want to develop a new method in order to acclimate medaka to seawater, since it seems to be the most euryhaline species of both tested in previous assays, and in this manner we achieve our main objective.

Key words: toxicology, protocol, medaka, zebrafish, seawater.

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LIMPETS AS INDICATOR OF TRACE METALS POLLUTION IN THE SPANISH MONITORING PROGRAMS

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Abstract: The objective of this study was to compare the trace metals levels in limpets (*Patella spp.*) collected in different sampling sites from the Spanish Marine Pollution Monitoring Programme (North and South Atlantic coasts and Canary Islands).
Samples collection was performed manually, during low tide, in the sampling sites selected. The analysis includes a nitric acid digestion in a microwave oven. Metals were analyzed by Atomic Absorption Spectrometry (F-AAS, GF-AAS, CV-AAS) (Besada et al., 2011).
Comparing areas, metals concentrations in limpets were clearly lower in samples from the Canarian Archipelago, except for Cd. This metal show a different behavior from the rest of the metals, since the prevalent upwelling on some areas (Galicia and Canary Island) transports high quantities of this metal to the surface. Cr and Ni were higher in the samples from the South Atlantic coast.
It can be concluded that limpets can be used as an indicator species of metals. However, more research is needed to determine the spatial distribution and seasonal variation.

Key words: Metals, limpets, monitoring, Spain

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METAL DISTRIBUTION IN THE MAIN ESTUARIES OF THE GULF OF CADIZ

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Abstract: When studying marine pollution, it is important to analyze the concentration and distribution of metals since they can be toxic and cause harmful effects in the marine and estuarine fauna even at trace levels. Estuaries in the Gulf of Cadiz (Guadiana, Tinto-Odiel and Guadalquivir) provide shelter and food for larvae and juveniles of marine species such as the European anchovy. Concentrations and bioavailabilities of metals in estuarine waters depend on many chemical biological and physical processes (e.g.: reactivity/complexation, bioaccumulation, adsorption, etc.). When we compared the pool of trace metal concentrations at the three main estuaries of the Gulf of Cadiz, multivariate analysis showed clear differences among them. The highest average concentrations of Pb, Zn, Co and Cd were measured in the Tinto-Odiel estuary (2.3±1.2 pM, 232.8±211 pM, 6.8±7.9 pM and 2.1±1.8 pM, respectively), whilst the lowest ones were measured in the Guadiana Estuary (0.2±0.2, 13.9±3.7, 1.1±0.3 and 0.2±0.1 pM, respectively). On the other hand, the highest concentration of Ni was found in the Guadalquivir estuary (17.2±7.5 pM). Pairwise comparison based on permutations showed clear differences among the three studied estuaries and, lesser, but significant, among the studied months (February and June). Main differences among all three estuaries occurred especially in June.

Key words: Estuaries, trace metals, Gulf of Cadiz, Biogeochemical cycles

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FIRST MEASUREMENTS OF PCBS, OCPS AND PBDES IN SEA CUCUMBER

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Abstract: The sea cucumbers *Parastichopus regalis* and *Parastichopus tremulus* are echinoderms of the class Holothuroidea which ingest sediment as primarily deposit feeders. Both species are a bycatch of by trawl fishing vessels at sand and muddy bottoms of European waters. *P. regalis* is distributed from shallow waters up to 400 m deep, *and P. tremulus* is distributed from 400 m depth and reaches deeper than 800 m.
Sea cucumber samples of both species were analysed for polychlorobiphenyls (PCBs), organochlorine pesticides (OCPs) and polybrominated diphenyl ethers (PBDEs) compounds. Both groups of pollutants were determined in 7 samples of soft tissue of sea cucumbers from Grand Sole fishing grounds (North Eastern Atlantic waters). The analytical methodologies, previously applied to other biota samples, included the use of GC-ECD for PCBs and organochlorine pesticides (Gonzalez-Quijano and Fumega, 1996) and GC-MS for PBDEs (Bellas et al., 2014).
The concentrations were very low for PCBs and OCPs, being most of the levels below the limits of detection.
In the case of PBDEs the values were in the range of those found in mussels from the Spanish coastline. These data show the ability of these organisms to accumulate PBDEs even in areas not near the known terrestrial sources.

These results make these species quite promising as a bioindicator for PBDEs in offshore waters.

Key words: Sea cucumber, PCBs, OCPs, PBDEs, offshore areas

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TRACE METALS AND PAHS IN SEA CUCUMBER, FIRST RESULTS.

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Abstract: The sea cucumbers *Parastichopus regalis* and *Parastichopus tremulus* are echinoderms of the class Holothuroidea which ingest sediment as primarily deposit feeders. Both species are a bycatch of trawl fishing vessels at sand and muddy bottoms of European waters. P. *regalis* is distributed from shallow waters up to 400 m deep, and *P. tremulus* is distributed from 400 m depth and reaches deeper than 800 m.
Sea cucumber samples of both species were analysed for trace metals and polycyclic aromatic hydrocarbons (PAHs) content (Besada et al., 2014; Viñas et al., 2009). Both groups of pollutants were determined in 6 samples of soft tissue of sea cucumbers from Grand Sole fishing grounds (North Eastern Atlantic waters). The analytical methodologies included the use of Atomic Absortion Spectrometry (for metals) and HPLC-fluorescence (for PAHs).
Eight trace metals (Cd, Cu, Hg, Pb, Zn, As, Cr and Ni) were determined in sea cucumber. For some of the metals the concentration levels were in the range normally observed in coastal filter feeders such as wild mussels, while for others such as Hg, Cd, Pb the lower values found in sea cucumber could be reflecting the metal content in areas far from the coastline.
With regard to PAHs the concentrations measured in sea cucumber are in the low range of values normally detected in wild mussels.
These findings present the sea cucumber as a promising bioindicator of metals and PAHs for offshore areas.

Key words: sea cucumber, trace metals, PAHs, offshore areas

Acknowledgments: This work was made within the HOLOPLUS Project CDTi-CONECTA PEME and DESCARSEL FEMP Project. The authors acknowledge to fishing and research vessels involved in sampling.

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MICROPLASTIC POLLUTION ON GRAN CANARIA ISLAND BEACHES

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In recent decades, plastic pollution in the ocean has increased exponentially. With an estimation of 270 thousand tons of plastics floating in the marine environment where they tend to migrate to the oceanic margins, accumulating in convective zones. The Canary Islands, located on the eastern margin of the Atlantic Ocean, are an obstacle to the Canary Current. There, it is of great interest to study the amount and type of plastic that migrates around the archipelago, as well as the proportion of plastic that washes up on the coast. This study of microplastic pollution on Canary Island beaches is a starting point for future research that will aim to explain the consequences that this marine litter can have on marine ecosystems.

Here, six beaches around Gran Canaria island have been selected to study the accumulation and seasonal variability of micro and meso-plastics. Two fractions of microplastic were classified and quantified (0.01-1 mm; 1-5 mm), and one of mesoplastic from 5 to 25 mm. In addition, a review of the existent sampling and processing methodologies was done.

The majority of the items observed were fragments from bigger plastic objects, such as polystyrenes, polyethylenes and PVCs. Even, the transparent pellets or nurdles, the semispherical items used in both the manufacturing and transport stages of plastic production, were found on most beaches. How these were lost during the manufacturing process is unknown. The Canary Islands do not have a plastics industry, so the origin of this marine debris is due to ocean circulation. However, many debris items of endogenous origin, such as wooden sticks or cigarette butts were also sampled, suggesting that local contamination does add to the exogenous litter.

Key words: marine debris, microplastic, beaches, Canary Islands

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ASSESSING THE IMPACT OF WASTEWATER FROM A CANNING INDUSTRY ON BENTHIC ECOSYSTEM

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Abstract: The Galician Rías Baixas host a great marine biodiversity. They also host 80 % of the fish canning industries in Spain. These industries are characterized by high water consumption and the subsequent emission of large quantities of wastewater. The project LIFE-SEACAN (LIFE14 ENV/ES/000852) was designed with the aim of demonstrating the potential of two innovative biofilm-based technologies (aerobic granular sludge and hybrid bioreactors) to decrease the impact of this industrial activity on marine ecosystems. This project includes a monitoring of the impact of the wastewater from a canning industry on benthic ecosystem before and after the installation of the biofilm-based technology prototypes. Here we present the results of an initial assessment of the wastewater impact. With that purpose, samples were taken at 6 sites at each of the 4 sampling stations (2 potentially impacted by wastewater and 2 controls). Sampling at each site included taking 6 samples with a Van-Veen grab, 5 for the study of the fauna and 1 for the study of the sediment, plus water samples for the study of its physical-chemical characteristics. Furthermore, sediment traps were installed at each sampling station to measure matter fluxes towards the sediment. One of the control stations was discarded from this study because of its major differences with the three remaining stations regarding sediment type. Benthic assemblages and physical-chemical characteristics in the area under the influence of the wastewater discharge were found to be different from those in the control area. The composition of the assemblages was significantly related to redox potential and mean grain size of the sediment. The preliminary results show that wastewater seems to have low to moderate impact on benthic ecosystems taking in consideration that at the impacted stations, taxa richness and H´ were significantly lower than at control station, but benthic indicators (AMBI and M-AMBI) showed a good ecological status.

Key words: canning industry, wastewater, biofilm-based technologies, benthic ecosystem.

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EXPRESSION ANALYSIS OF STRESS RELATED GENES IN THE CLAM *Ruditapes philippinarum* AFTER EXPOSURE TO LOW CONCENTRATIONS OF THE EMERGING CONTAMINANT 4- METHYLBENZYLIDENE CAMPHOR (4MBC)

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Abstract:
With the growing concern of the damage of human health caused by ultraviolet radiation, there has been an increase in use of sunscreen products containing (usually) three to eight UV filters. It is estimated that 10000 tons of UV filters are produced annually in the world (Danovaro et al., 2014). This converts UV filters into a class of emerging contaminants that continuously enter aquatic environments (Gao et al., 2013), with little information available about the effects of these substances on non-target organisms (Giokas et al., 2007, Balmer et al., 2005).The objective of this study was to investigate the effects of exposure to the UV filter 4- methylbenzylidene camphor (4MBC) on the marine clam Ruditapes philippinarum. Using a semi-static exposure system, clams were exposed for 7 days to different concentrations of 4MBC (0, 1, 10, 100 ppb) followed by a 3-day depuration period (total 10d). Digestive glands were collected at days 0, 7 and 10 to extract RNA. Expression of biomarker enzyme encoding genes (copper/zinc superoxide dismutase (Cu/Zn SOD), metallothionein (MT), pi-class glutathione S-transferase (GST), elongation factor 1 (EIF1), B cell lymphoma2 (BCL-2), tumor protein P53 (TP53), catalase (CAT), 18S rRNA ribosomal protein S18, glyceraldehyde-3-phospathe dehydrogenase (GADPH), glutathione peroxidase (GPX), growth arrest and DNA-damage-inducible protein (GADD45G), thioredoxin reductase (THIO9)) as well as two housekeeping genes (40S ribosomal protein S20 (RPS 20) and β-actin 2) have been analysed by RT qPCR for differential expression analysis. Results showed that the presence of 4MBC at environmentally relevant concentrations induced the expression of genes that encode for antioxidant enzymes (GST) and for proteins related to inhibition of apoptosis (BCL2). The data also revealed significant ($p < 0.05$) effects of 4MBC exposure on GADD gene expression, suggesting a response on growth conditions. This information suggests potential effects of exposure to 4MBC at gene expression level and these preliminary results confirm the need to conduct more research on the potential effects of exposure to environmentally relevant concentrations of UV filters.

Keywords: 4- methylbenzylidene camphor (4MBC), UV filters, *Ruditapes philippinarum*, gene expression.

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EXPRESSION ANALYSIS OF STRESS RELATED GENES IN THE CLAM Ruditapes philippinarum AFTER EXPOSURE TO LOW CONCENTRATIONS OF THE ARTIFICIAL SWEETENER ACESULFAME-K.

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Abstract: Artificial sweeteners have been introduced into the market in 1983 (Lipinski, 1985) and their production and consumption has increased up to levels of 4.0 metric tons in 2005, worldwide (Subedi & Kannan, 2014). Despite being acknowledged as save for human consumption within recommended average acceptable daily intake (ADI) (Viberg et al., 2011), concern has been risen about the chronic effects of exposure to environmentally relevant concentrations in non-target organisms (Kokotou et al., 2012). The objective of this study was to identify the effects of exposure to environmentally relevant concentrations of the artificial sweetener Acesulfame-K (ACE) and the stress responses in the Manila clam *Ruditapes philippinarum*. Clams were exposed to 1, 10 and 100 ppb of ACE for 7 days, followed by a depuration of three days, where no ACE was supplied to the tanks. At days 0, 7 and 10, RNA was extracted from digestive glands of exposed organisms and expression of selected genes was analyzed using quantitative real-time PCR. Results showed that the presence of ACE at environmentally relevant concentrations induced the expression of genes that encode for antioxidant enzymes (Catalase and Glutathione Peroxidase), for proteins related to inhibition of apoptosis (B cell lymphoma 2), as well as for energy production (Glyceraldehyde-3-Phosphate Dehydrogenase). However, expression of constitutive genes (Elongation Factor 1 Alpha and 18S Ribosomal RNA) was reduced after exposure to ACE. This information suggests potential effects of exposure to ACE at gene expression level in contrast with previously observed results that indicated the absence of environmental risk of ACE.

Key words: Artificial sweeteners, Acesulfame-K, Ruditapes philippinarum, gene expression.

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ASSESSMENT OF IMPOSEX IN *PERSISTISTROMBUS LATUS* (GMELIN, 1791) FROM SÃO VICENTE ISLAND, CABO VERDE, WEST AFRICA

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Abstract: Tributyltin compounds (TBT) due to their biocidal properties, since 1950 have been used for various purposes, highlighting their use in antifouling paints applied in boats. The use of TBT as antifouling consumes 70% of world TBT production and is the main means of entry into the marine and coastal system. However, their high toxicity over non-target organisms led to a progressive restriction of their use, culminating with the global ban at 2008. The imposex (superimposition of male sexual characters in females of prosobranch gastropods) is an effective biomarker of exposure to TBT and is therefore widely used in environmental monitoring programs. The objective of this study is to evaluate the imposex in *Persististrombus latus* (n=305) at four sampling stations along coastal of São Vicente island, namely: Cabnave (n=79), Galé (n=77), João Ribeiro (n=75) and the Islet of Pássaros (n=74). The I% at Cabnave was 46.3% and at the other sampling stations were less than 30%. These results corroborate with Lopes-dos-Santos (2014), clearly showing the effect of the waste from the shipyard, the Cabnave, and may also be associated with the deteriorated vessels observed in the area of Porto Grande and Cabnave. Affected females with imposex present a mean shell length of 113.45 mm and a mean shell thickness of 13.71 mm. However, juvenile female with a shell thickness of 1.22 mm and a mean female penis length (FPL) of 1.88 mm were observed in the João Ribeiro station. Imposex is already reported for more than 260 species of gastropods around the world, but with little information in Cabo Verde and Africa, and with the results of this study, *P.latus* can be considered as a bioindicator in monitoring programs on Cabo Verde and the west coast of Africa for being a transboundary species with a wide distribution along the West African coast.

Key words: Imposex, *Persististrombus latus*, Cabo Verde

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TRENDS IN THE LEVELS OF IMPOSEX IN *NASSARIUS RETICULATUS* FOR GALICIA AND CANTABRIAN COAST

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Abstract:

Imposex is a disorder caused by organotins, mainly tributyltin (TBT), which results in the appearance of male sexual characteristics in females of gastropod mollusks. Percentage of Females displaying Imposex (IMPF), Vas Deferens Sequence Index (VDSI) and Relative Penis Length Index (RPLI), were determined in specimens of *Nassarius reticulatus* sampled along Galicia and Cantabrian coast in 2014, 2015 and 2016. Additional information covering from 2005 to 2011 was retrieved from scientific publications. The sensitivity of the indices was in all cases: IMPF> VDSI> RPLI. The temporal evolution of Imposex in *N. reticulatus* followed a sigmoidal pattern and was related to the concentration of TBT in tissue. Imposex levels in the Cantabrian coast progressively declined from 2006 to 2015. A downward trend for Imposex values can also be observed in Galicia from 2005 to 2016, with the exception of the site of Canido where a recent input of TBT is suspected. Imposex values are still high in some locations of Galicia.

Key words: marine pollution, imposex monitoring, gastropods, *Nassarius reticulatus*, tributyltin

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POSSIBLE ESTROGENIC EFFECTS OF ETHINYL ESTRADIOL ON GONADAL MADURATION IN EDIBLE SEA URCHIN *Paracentrotus lividus* L.

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Abstract: 17α-Ethinylestradiol (EE2) is a synthetic estrogen widely used in combination with other steroid hormones in contraceptives. EE2 has been detected in sewage treatment plant effluents in the low ng/L range and occasionally in surface waters. The main objective of this study was to test the possible effects of exposure to 10 ng/L EE2 on edible sea urchins, since echinoderms are considered valuable test species in marine ecotoxicology.
110 adult individuals of *Paracentrotus lividus*, with a diameter ranging between 4 and 6 cm were used under experimental conditions. These organisms were maintained in aquaria by controlled conditions in Toralla Marine Science Station (ECIMAT) at University of Vigo. The sea urchins were distributed in three groups: Seawater Control, Solvent Control (Acetone), and EE2. Finally, gonad samples were collected and analized by histology and Gonad Index (GI). Samples were obtained after 7 and 28 days of exposure. The method described by Byrne (1990) was followed to characterize gonadal stages and classify organisms by sex. Data were statistically analysed with Graph Pad Prism software and a one-way ANOVA was performed.
EE2 exposure did not cause histological damages in gonads. Preliminary results of the GI analyses suggest the idea of a possible disruptive endocrine action of EE2 in females exposed to the compound.
To confirm these preliminary data, proteomic analyses will be performed, to evaluate the presence of alterations in composition and quantity of proteins in gonads of individuals exposed to EE2 compared to control.

Key words: *Paracentrotus lividus*, Ethinylestradiol, Endocrine disruption, Proteomics.

Acknowledgments: The authors thank the technical assistance of the staff from ECIMAT. This research was supported by MINECO (Research Project PCIN-2015-187-C03-03) and Xunta de Galicia (FEDER-GALICIA 2014-20 DOG31).

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EVOLUTION OF THE PARTICULATE MATTER IN THE MAR MENOR LAGOON AFTER THE 2016 BLOOM

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Abstract:

Coastal lagoons are considered vulnerable to eutrophication due to their shallow depth and restricted exchange with the adjacent ocean. The Mar Menor lagoon has received large amounts of organic and mineral nutrients for many years due to the growth of intensive agriculture and urban development in the surrounding area. Despite this, the system was remaining relatively stable until the summer of 2015 when a great increase of phytoplankton was observed. Main plankton bloom took place in 2016 when the Mar Menor became a 'green soup' causing a great social alarm. As part of the IEO Monitoring Program to assess the magnitude of the bloom, total particulate matter (TPM) was measured in samples of the water column collected from the lagoon. Lagoon was divided into 3 parts: the northern basin (A), which shows a higher Mediterranean influence; the southern basin (C), which is the most confined area; and the intermediate central basin (B), corresponding to the mixing area. Triplicate samples from 2 stations at each basin were collected monthly from May 2016 until February 2018. TPM (mg L^{-1}) was determined as the dry weight of the suspension filtered and PIM (particulate inorganic matter) was given as the weight remaining after ignition. Particulate organic matter (POM) was calculated as the difference between TPM and PIM, and food organic matter content was calculated as POM/TPM. Particle concentration and size distribution were obtained by the Coulter Counter Multisizer III. Temporal variations in the TPM, related mainly with the POM, were observed with two blooms registered from May-16 to January-17 the first one, and from August-17 to November-17 the second one. Highest POM concentrations were observed during the 2016 bloom achieving values of 6 mg L^{-1} which are 10-fold higher than those observed during the inter-bloom periods. All sampling sites showed a similar behavior.

Key words: eutrophication, Mar Menor, lagoon, particulate matter

Acknowledgments: This research has been supported by the IEO project MMEM, "Monitoring Program of the eutrophication of the Mar Menor Coastal Lagoon". The authors wish to acknowledge F. Gómez for his assistance during the experiments.

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PRELIMINARY RESULTS ON THE CADMIUM EFFECTS ON THE BENTHIC FORAMINIFERAL SPECIES *AMMONIA TEPIDA* (CUSHMAN, 1926)

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Abstract: Heavy metals are among the most threatening pollutants to marine environments, as they do not degrade and undergo bioaccumulation and biomagnification through the trophic chain. Benthic foraminifera have been used as bioindicators of environmental quality over the last few decades. They have been widely used in field studies mostly focusing on the effect that pollutants have on foraminiferal assemblages (Armynot du Châtelet and Debenay, 2010). Although this approach provides good information, environments are affected by more than one pollutant and by natural fluctuation of physico-chemical parameters. This variability hampers the identification of the foraminiferal response to pollution (Frontalini *et al*., 2018). In light of it, the present research focuses on the effect of cadmium (Cd), a known heavy metal, has on benthic foraminiferal survival ratio through a culture experiment. Here it is set a culture experiment in which specimens of *Ammonia tepida* (Cushman, 1926) are treated with 6 different concentrations of $CdCl_2$. The viability of foraminiferal specimens has been checked at 6 h, 12 h, 24 h and 48 h. Our preliminary results show a decline on the number of living specimens over time for all treatments, being this decline more pronounced for the treatments with higher concentrations of $CdCl_2$.

Key words: Foraminifera, Cadmium, Survival ratio

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HOT SPOTS DE SEDIMENTOS CONTAMINADOS EN LA RÍA DE BILBAO

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Abstract: El estuario del río Nervión-Ibaizabal fue el mayor de la costa cantábrica, pero la industrialización del Gran Bilbao (finales del siglo XIX) trajo consigo la total ocupación de los dominios estuarinos, la contaminación de sus aguas y sedimentos, y un fuerte deterioro de sus características biológicas (Cearreta *et al*., 2000, 2002). Desde 1997 el grupo de investigación Harea-Geología Litoral lleva realizando un trabajo de monitorización de la calidad ambiental de la Ría basado en el estudio de las asociaciones de foraminíferos y de las concentraciones de metales pesados en los sedimentos. Los resultados obtenidos muestran una disminución de los niveles de estos contaminantes a partir de 2003, acompañada de una incipiente recuperación de la microfauna a partir de 2006 que es consecuencia de la reconversión industrial y de las medidas de control de contaminación tomadas (Leorri *et al*., 2008). Sin embargo, hay excepciones a esta tendencia general, tales como la desembocaduras de los ríos Galindo y Gobelas (López, 2015). El presente trabajo se centra en el estudio de muestras superficiales de ambos ríos y de las procedentes de un sondeo corto (20 cm) extraído en una de las desembocaduras. A

pesar de que los resultados obtenidos reflejan una mejoría faunística especialmente relevante en Gobelas, las concentraciones de metales pesados siguen siendo muy altas, confirmando que ambas zonas constituyen potenciales 'hot spots' de contaminación.

Key words: Bilbao estuary, Hot spot, Heavy metals, Benthic foraminifera, Anthropogenic transformation.

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ASSESSING SOME HEAVY METAL POLLUTIONS IN SEDIMENTS OF WEST PERSIAN GULF

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Abstract: The contents of ten elements (As, Cd, Cr, Cu, Al, Fe, Ni, Pb, Sb and Zn) were determined in the sediments of four shoreline stations including Emam Hassan port, Ameri port, Bushehr port, Nayband Bay at west Persian Gulf from March through December 2017. The elements were measured by Coupled Plasma Atomic Emission Spectrometry (ICP-AES). The contamination of the sediments was assessed on the basis of geoaccumulation index and enrichment factor. Spearman correlation matrix were calculated between all the trace metals and major elements as well as corresponding sampling regions. Significant inter-elemental correlations (e.g. Cr-Fe, Cr-Al, Cr-Ni, Cr-Zn, Cr-Cu) were found between some metals. High EF level for Fe, Al and Pb suggests that metal levels in sediments of the west Persian Gulf could have originated from anthropogenic sources.

Key words: ICP-AES, Bushehr port, Nayband Bay, Persian Gulf

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BIOINDICATOR POTENTIAL OF THE SMALL SPOTTED DOGFISH (*Scyliorhinus canicula)* FOR LOCAL HEAVY METAL POLLUTION IN THE WESTERN MEDITERRANEAN

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Abstract: The *Scyliorhinus canicula* (Family Scyliorhinidae), is an elasmobranch fish commonly caught as bycatch by non-selective fishing gear, such as bottom trawl nets. This demersal species can be found throughout the North Eastern Atlantic and the Mediterranean Sea, down to the Canary Islands. Adult females tend to inhabit relatively shallow waters of the continental platform and have been found to display philopatric behaviour by several authors while sex biased dispersal affects mainly males. Considering these behavioural traits and the current availability of this species in bottom trawl fisheries, the bioindicator potential of female *Scyliorhinus canicula* for local heavy metal pollution will be assessed. By relying fishermen efforts, a total of 45 specimens will be sampled from 3 different sample areas with exponentially increasing distance between each other. These have been defined within fishermen usual routes along the Valencian community waters. Total concentrations of Cu, Pb and Hg from muscle tissue and liver will be determined using AAS/GFAAS and Hg by CVAAS. Samples will be dried in an oven at 65ºC till constant weight and digested with a mixture of 6mL HNO_3 (65%) and 2mL H_2O_2 (30%) in a MARS 5 microwave oven. Digestion and analysis tests carried out using Dogfish liver (DOLT-5) and mussel tissue (ERM-CE278k) reference materials have been satisfactory. Heavy metal concentrations are expected to vary between liver and muscle samples as well as between sample areas, mainly due to anthropic factors.

Key words: bioindicator, Heavy metals, Elasmobranch

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MONITOOL: NEW TOOLS FOR MONITORING THE CHEMICAL STATUS IN TRANSITIONAL AND COASTAL WATERS UNDER THE WATER FRAMEWORK DIRECTIVE

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Abstract: MONITOOL is a European project formed by 16 Partners covering the Atlantic region from the Canary Islands to the Scottish Highlands and Islands. The main driver of this project is to respond to European Directive demands for the assessment of the chemical status of transitional and coastal waters. *Diffusive Gradient in Thin Films* (DGT), and passive samplers (PS), in general, are already widely used in investigative monitoring and there is an increasing interest in their use for the environmental assessment of water bodies, within European policies requirements. The main barrier hindering the regulatory acceptance of PS for compliance checking is the lack of appropriate Environmental Quality Standards (EQS). EQSs for metals are defined in the dissolved fraction, preventing the use of DGT-labile concentrations for the establishment of the chemical status of water bodies. Thus, the main objective of MONITOOL is to adapt the already existing EQSs for DGTs, enabling their use for regulatory monitoring. The fulfillment of the overall objective will be achieved by organizing two different campaigns, in winter and summer, which consist in the simultaneous deployment of DGTs and the high-frequency collection of spot water samples. The first sampling campaigns were performed during winter 2018 in 4 selected sites (transitional and coastal sites) in each consortium region (8 regions). All partners followed the same protocol for sampling and analysis to minimize the operational variability. Priority metals (Cd, Ni, Pb) and other specific metals (Al, Ag, Cu, Cr, Co, Fe, Mn, Zn) will be analysed in waters and in the DGT resins. Statistical analysis will be applied to study relations between metal concentrations in DGT with spot water samples. In a final step, suitable EQS for DGTs will be calculated on basis the of statistical relations obtained previously. An efficient communication and cooperation between partners is relevant to achieve the main goal of this project.

Key words: Passive samplers, DGT, Environmental Quality Standards, metals, marine waters

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INGESTION OF FIBERS AND MICROPLASTICS IN COMMERCIAL FISH SPECIES IN THE WESTERN MEDITERRANEAN SEA

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Abstract: The Mediterranean Sea contains an elevated percentage of the worldwide marine debris. The transfer of fibers and microplastics from the marine environment to biota has been already documented, and to determine the interaction with species of commercial interest we have analyzed 197 stomach contents belonging to four fish species: *Trachurus mediterraneus*, *Boops boops*, *Sardina pilchardus* and *Engraulis encrasicolus*. Using standardized visual sorting methods, we found 127 items in the gastrointestinal tract of 28.43% of the total samples with significant differences between areas and between species. Geographically, ingestion was found in 36.43% of the samples from the Iberian Peninsula coast and in 12.31% of the individuals from samples from the Balearic Islands. *T. mediterraneus* was the most affected species with 48.05% of individuals surveyed had ingested fibers and microplastics, while *E. encrasicolus* was the least affected with only 2.56% of the individuals. Several factors are considered that determine the ingestion of anthropogenic marine debris in marine organisms such as the geographic location, the trophic level and the ecological behavior. Our results provide further evidence that the ingestion of plastics by commercial fish species is a reality along the Western Mediterranean Sea and the Balearic Islands and could be used to study trends in the amount of litter ingested by marine animals in accordance with descriptor 10 of the Marine Strategy Framework Directive.

Key words: Marine litter, plastic pollution, feeding, fish, MSFD

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SYNTHETIC MICROFIBERS IN SEAWATER AND SEDIMENTS

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Abstract: Microplastics are an emerging pollutant in the marine environment. Among them, fibers are the most prevalent types of microplastic debris (synthetic polymers measuring <5 mm in diameter) observed in the natural environment. Based on the fact that fibers are found in worldwide oceans it is important to understand their distribution in the marine environment compartments. With this objective, synthetic microfiber information in seawater and sediments was summarized through available scientific information.

Microfibers in sediments range from 1.4 to 40 items per 50 mL or 13.15 to 39.48 items per 250 g dry weight. In the case of water, microfibers values ranges from 0 to 450 items·m^{-3} or from 503 to 459,681 items·km^{-2}. Blue is the most common color in seawater and sediments, followed by transparent and black in the case of seawater, and black and colorful in sediments.

Related with polymer type, polypropylene is the most common in water and sediments, followed by polyethylene in water and polyester in water and sediments. Some polymers were described only in water samples: high-density polyethylene, low-density polyethylene and cellophane, whilst only rayon was reported in sediments.

Key words: Microplastics, Microfibers, Seawater, Sediments, Polymers

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UPTAKE AND DISTRIBUTION OF MERCURY IN TISSUES OF MUSSELS EXPOSED TO METAL-LOADED MICROPLASTICS

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Abstract:

The research about role of microplastics (MPs) as a vehicle for the transport and accumulation of metallic contaminants in the marine environment is limited. In this context, this work was aimed to investigate and compare the uptake and accumulation of a metal (Hg) within mussel tissues when this metal is transported throughout microalgae (MA) and throughout MPs. Previously, the kinetic of sorption and desorption of Hg onto MP and MA particles was investigated. The mussel, *Mytilus galloprovincialis,* was selected as biological model, as it is a susceptible species to MP ingestion. High density (HD) plastics tend to float in the water column and are especially available to filter feeders. In this context, the MP investigated was a HD polyethylene (PE), as PE is one of the principal plastics marketed and it has been frequently found in marine biota. Specifically, the MP was a virgin oxidized HDPE powder composed by a heterogeneous mixture of non-uniform particles sized from 0 to 30 µm (mean 10-15 µm). Mercury was selected as the model metal due to their high toxicity and ability to bio-magnify throughout all the thropic levels of the aquatic ecosystems. The MA *Isochrysis galbana* was used as a representative species of marine algae, a primary source of bulk nutrients in the aquatic food chain. The experiment was performed by exposing individual mussels into 1-liter glass beakers to a single dose of solutions of MA and MPs loaded in Hg, to a metal concentration of 2.0µg Hg l^{-1}. The uptake of MP and MA particles by mussel was investigated (0-60 minutes) by using the Multisizer Coulter Counter Analyzer. The distribution of Hg within mussel tissues (digestive gland, gill, mantle and remaining tissues) was investigated (4, 24, 48, 96 and 168 hours) during a seven days period by using a LecoAMA254 mercury analyzer.

Key words: microplastic, mercury, mussel, marine environment

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ECOTOXICOLOGICAL EVALUATION OF MICROPLASTICS AND HYDROPHOBIC ORGANIC POLLUTANTS BY SURVIVAL BIOASSAYS WITH THE MARINE COPEPOD *Acartia clausi*

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Abstract: Plastic pollution represents a problem of concern in marine ecosystems. For this reason, there are so many studies headed to quantify and evaluate their possible effects in the biota. This work focus on determining the impact of microplastics in marine zooplankton, an essential piece in the base of the trophic chain. In order to achieve this purpose, a series of experiments were carried out with the marine copepod *Acartia clausi*, in nauplius larvae stage, particularly sensitive to toxicity. The microplastics utilised came from consumer products, marine plastic debris and commercial polymers without additives. These polymers, made of polyethylene (PE) and polyvinyl chloride (PVC), were also combined with hydrophobic organic compounds (HOC) that are commonly used: oxybenzone (BP-3), 4-nonylphenol (4-NP) and 3-(4-methylbenzilidene) camphor (4-MBC). Feeding rates were measured. The bioassays were performed using a rotatory plankton wheel. Microplastic ingestion was documented, as well as the lack of toxicity of pure polymers. However, the organic pollutants and manufactured products with additives resulted to be toxic for the population. The HOC toxicity values did not increase with the presence of pure microplastics, but were even reduced. These results reveal the important role of microplastic additives in their toxicity and the influence of pure microplastics on the HOC bioavailability. Therefore, this study complements the groundwork research of the ecotoxicological effect of microplastics in the marine environment.

Key words: *Acartia clausi*, copepods, hydrophobic organic compounds (HOC), microplastics, toxicity, zooplankton.

Acknowledgments: This study was supported by the European Project EPHEMARE and Project Repesca_Plas, funded by the platform JPI Oceans and the Spanish Ministry of Agriculture, Food and Environment, respectively.

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UNDERWAY WATER SYSTEM OF RESEARCH VESSELS: OPTIMIZATION OF A METHOD FOR SMALL MICROPLASTICS SAMPLING IN OCEANIC WATERS

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Abstract:

Broad scale monitoring efforts and microplastic sampling in open ocean waters are required to understand distribution, abundance and fate of these particles in the environment. For surface seawaters, towing a neuston net is the most common sampling method; however, the deployment of this infrastructure is not always an opportunity when at sea, and the underway water system of research vessels (RVs) has been tried for this purpose in several studies to date. Method validation and recovery checks have not been thoroughly applied, which may be resulting in wrong estimations. In this study, we investigated abundance, distribution and type of small microplastics (0,05-1 mm) sampled from subsurface waters using the underway system of RV Ángeles Alvariño and RV Sarmiento de Gamboa in NE Atlantic. Method validation was performed in order to compare the effectiveness for microplastic research comparing the samples taken through the intake system and samples filtered from the Rosetta. Sampling methods standardization and validation are essential to ensure the intercomparability of the data reported in the different sampling efforts worldwide concerning distribution and abundance of microplastics in marine open waters environments.

Key words: marine plastic pollution, seawater sampling, continuous monitoring, small-microplastics, method validation.

Acknowledgments: We thank to the Oceanic Platform of the Canary Islands (PLOCAN) for the logistics and organization of the expeditions to ESTOC onboard the RV Ángeles Alvariño, and the FLUXES Project (CMT2015-69392-C3-1-R) for the campaign onboard the RV Sarmiento de Gamboa. We also thank the crew of both of the RVs for facilitating the research onboard and all the technical information provided for the design of the continuous microplastic sampler and the helpful suggestions of Patricia López. This study was supported by the MARCET Project (MAC 1.1b/149), funded by the Territorial Co-operation Programme INTERREG V Spain – Portugal.

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LIQUID-LIQUID MICROEXTRACTION FOR PERSISTANT ORGANIC POLLUTANT ANALYSIS AT MARINE MICROPLASTIC

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Abstract: Microplastics (MP) are in number the most abundant category inside the marine garbages. Considering its ubiquity and persistence at the ocean, they are an increasing threat for marine environment (Cole *et al.*, 2011). MP are present at the food chain (Andrady, 2011), but also they do like pollution vector of persistent organic pollutants (POPs) at the marine environment (Mato and Isobe, 2001). POPs include polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides and polychlorinated biphenyls (PCBs) (Jones and de Voogt, 1999). There is an interest on the development of different extraction methods for these pollutants on plastic debris. One of them is detail on the project *International Pellet Watch* (Ogata *et al.*, 2009), but it is of great interest to do a simple one-step methodology.

In this study it has been developed a method for the extraction, preconcentration and analysis of POPs adhered to marine microplastic, specifically high density polyethene pellets (HDPE). This methodology is based on a solid-liquid extraction followed by a miniaturized liquid-liquid extraction, using methanol and n-hexane as extractants and analyzed by gas chromatography with mass detection (GC-MS).

To the method optimization 1 gram of HDPE virgin pellets were used, they were spiked with 100 $ng \cdot mL^{-1}$ of PAH, organochloride pesticides and PCBs mix, analyzing a total of 14 compounds. For POPs extraction there were used a volume of 5 mL of methanol with 100 µl de n-hexane (including internal standards necessary for the analysis). N-hexane volume is separated from the rest of the solution by micro-liquid-liquid extraction and analyzed by GC-MS.

The method was applied to spiked samples at different physical-chemical conditions to evaluate the POPs adsorption rates on microplastic. It was also applied to marine HDPE pellets (real samples, non spiked) founded at different beaches of Gran Canaria and Fuerteventura (Canary Islands, Spain).

Key words: Persistent organic pollutants (POPs), Microplastics, polyethylene (PE), liquid-liquid microextraction.

Acknowledgments: This work is based on the MACMAR project (Miniaturised embedded analytical chemistry in submarine robotics), C2016/90. ULPGC15_06, funded by the University of Las Palmas de Gran Canaria.

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A NOVEL INEXPENSIVE METHOD FOR THE SAMPLING OF MICROPLASTICS IN SHELTERED WATERS

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Abstract: Eliminating plastic waste in the environment is difficult and its accumulation in the marine environment is problematic. Over time, larger plastics degrade into smaller pieces, termed microplastics (<5mm). Currently, microplastics are a serious threat to marine ecosystems. Due to the increasing environmental concern, microplastic research and sampling efforts are on the rise globally. Little information exists on the abundance, size distribution and characteristics of plastic pollution in port areas, being the interface between land-based sources, human activities and the sea. For this study, we use a pioneer, commercially available autonomous floating debris interception device (to quantitatively and qualitatively characterise floating plastic debris in a sheltered port area. Furthermore, we compare two methods for the quantification and characterisation of microplastics; 1) a manta trawl net as a standard scientific research tool (M) and 2) an adaptation of the commercial FDID for the recollection of microplastics (PT335). Plastic items increased over the summer months and microplastic particles were ubiquitous in the port, with abundances comparable to those of the nearby open waters. Both methods (M and PT335) collect similar microplastics according to colour, shape, type of microplastic and size distribution, with a correlation of 99%, 90%, 97% and 96% respectively. However, PT335 captures more microplastic items (item/m^3) than M. Consequently, this new inexpensive sampling method can be easily integrated into other science monitoring initiatives in ports, due to its cost effectiveness and wide geographical distribution.

Key words: microplastic, plastic, pollution, marinas, methodology

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MICROPLASTICS AND METALS IN COMMERCIAL FISH SPECIES FROM THE MOROCCAN COAST

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Abstract: In general, coastal areas can be considered under an important anthropogenic pressure due to human settlements are often more concentrated in these areas. As consequence, high levels of some pollutants derived from different human activities can be found in coastal waters. In the last years, many studies have been focused to the evaluation of microplastics in marine ecosystems due to the increase of the daily use of these materials in our life. These studies suggest several negative effects on marine biota caused by the ingestion of microplastics. After their ingestion, other toxins can be leach out from the microplastics during the digestion process in the organism, as additives presented on their composition or other contaminants, including aqueous metals, that can be previously absorbed onto their surface. These contaminants can be bioaccumulated through the food chain become an important problem to human population.
In this work, microplastics and metals concentration have been evaluated in four commercial fish species (sardine, bogue, mackerel and mullet) from M´diq area, a Mediterranean coastal fringe in the North of Morocco. Ten sampling stations were selected in the area in relation to different human activities developed in the area, including one relatively free of anthropogenic influence. Two sampling campaigns were carried out (March 2007 and July 2017), and a variable amount of individuals of different species and sizes was collected at each time. After sampling, each individual was measured and weighed. Stomachs were removed and examined in laboratory in order to detect the presence of microplastics. Plastic debris were counted, weighed and measured. Finally, each individual was freeze-dryer and digested before analysis of metals by inductively coupled mass spectrometry (ICP–MS).
Relationships were stablished between biometric parameter, metals concentration and presence of plastic debris, although few differences were found between species, sampling stations or sampling campaigns.

Key words: microplastics, metals, commercial fish, coastal areas

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CHEMICAL AND MICROBIOLOGICAL CHARACTERIZATION OF CRUISE VESSEL WASTEWATER DISCHARGES

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Abstract: Cruise tourism has experienced in recent years an important growth both in the size of its ships and in the number of transported passengers (Cruise Market Watch, 2015). These vessels produce a large amount of wastewater that has not been studied in depth. International convention MARPOL (IMO 73/78), allow the discharges to the ocean of these wastewater if they are treated (3 nm from the coast) or untreated (12 nm from the coast), in addition to other regional and local regulations (Butt, 2007). Therefore, its management should deserve special attention due to environmental impacts in marine environments. In this study, wastewater samples from four cruise ships have been obtained during repair works in a shipyard with their crew on board and producing similar flows of waste than in normal operations. The chemical and microbiological characterization of these wastewaters creates a scientific opportunity to know the pollutant presence and their concentrations, helping local port authorities, scientists and receivers to improve its management. In this study, among the different organic micropollutants encountered (Pintado-Herrera et al., 2014) (pharmaceuticals, fragrances, UV Filters and PAHs), the microbiological load was higher than 10^4 CFU·100 mL^{-1}, which together with antibiotic compounds and other substances could lead to the generation of super-resistant bacteria (Davies and Davies, 2010; Rizzo et al., 2013), very harmful to the environment and human health.

Key words: Cruise, ship, AIS, wastewater, emerging pollutants

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MERCURY IN THE SEDIMENTARY RECORD OF GALICIA CONTINENTAL SHELF (NW SPAIN)

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Abstract: Mercury is an important trace element to assess the environmental quality of ecosystems. Over the last decade considerable scientific effort was dedicated to the study of its complex biogeochemistry but despite significant advancements, research on mercury in the Galicia Continental Shelf is still scarce.

Here we have measured the total Hg content in eight box-cores of recent sediments from the Galicia continental shelf, between North latitudes of 41 and 43.

Mercury was analyzed on freeze-dried samples using a DMA-80 analyzer from MLS Company. Data calibration was done with CRM (BCR) 142R certified reference material and MBSS sediment standard. The detection limit of this analyzer is about 0.15 ng g^{-1}, four orders of magnitude below the Hg concentration found in local recent marine sediments, and below the reference generic levels that guarantee the protection of these galician environments (DOGA 57/60/2009). Aditionally we have also measured total CNS, Total Organic Carbon and Total Reduced Inorganic Sulfur.

Hg values ranged between 3.5 and 29.8 ng g^{-1} for sand dominated cores and between 10 and 72 ng g^{-1} for mud dominated cores. The highest concentrations were detected at the uppermost 25 cm and 15 cm, respectively. We found Hg positive correlations with TOC and C/S and C/N ratios and negative correlations with total S, reflecting its relationship with organic matter. Peaks values of 72 ng g^{-1} and 29.8 ng g^{-1} are attributed to the influence of the Miño River. Core by core correlations show the interplay of anthropogenic influence and sedimentary processes.

Key words: mercury, sediments, anthropogenic marker, Galicia Continental Shelf.

TOXICITY TESTS OF CRYOPROTECTING AGENTS FOR *Mytilus galloprovincialis* (LAMARK, 1819) EARLY DEVELOPMENTAL STAGES

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Abstract: Mussel aquaculture production has increased worldwide during last years. Barriers associated to marine invertebrate breeding diminish economical benefits. Experimental lines try to develop a method to establish a sustainable broodstock reducing economic costs. Cryopreservation techniques are being studied due to potential application in aquaculture industry. When developing a cryopreservation protocol, it is crucial to locate the suitable cryoprotectant agent (CPA) and its optimal concentration to protect cells from freezing damage meanwhile minimizing toxic effects.
The aim was to test the toxicity of the 4 most-used cryoprotecting agents to different blue mussel development stages: fertilized egg, trochophore larvae (18-20h) and D-larvae (48 and 72h), as a start point to review the preliminary protocol developed by Paredes *et al.* (2013) for trochophore larvae. No cryopreservation protocol has ever been described for mussel oocytes or embryos with successful results.
Percentage of abnormal D-larvae was calculated as an indicator of toxicity of individual CPAs and to calculate NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration) levels.
Results evidenced that ethylene glycol (EG) and propylene glycol (PG) were the least toxic at fertilized egg stage. No significant differences were observed for fertilized eggs at 0,5M PG and 0.5M EG. In contrast, for trochophore larvae, significant perturbations in development were only found by using 3M GLY and 3M Me_2SO.
Toxicity tests of D-larvae did not show expected increase in the percentage of abnormality with increasing concentration of any of the CPAs tested and results were inconclusive. Toxicity tolerance was higher in later developmental stages, according with other tests in molluscs (Chao *et al.,* 1994; Gwo, 1994; Lin and Chao, 2011; Sansone *et al.,* 2005). Considering present results, we suggest the use of PG or EG with concentrations lower than 1M for fertilized egg and equal or less than 3M of EG or PG for trochophore larvae cryopreservation.

Key words: mussel, cryopreservation, cryoprotecting agents, marine invertebrates, *Mytilus galloprovincialis*

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SEABED LITTER DISTRIBUTION IN THE HIGH-SEAS OF THE FLEMISH PASS (NW ATLANTIC)

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Abstract: Seabed litter of the Flemish Pass was spatially analyzed and described using data from the EU-Spain groundfish survey (NAFO Div 3L, outside the Canadian EEZ) in the 2006-2017 period. Flemish Pass is a channel of ~1,200 m deep which separates Flemish Cap offshore Bank and the Grand Banks of Newfoundland. It is an Area Beyond National Jurisdiction (ABNJ), within the Northwest Atlantic Fisheries Organization (NAFO) Regulatory Area.
A total of 1,169 tows were analyzed. Litter was found in the 8.3% of the total tows (97). Analysis of composition, spatial distribution and sources of litter were done. Data was categorized in 7 categories: fishing gears, organic debris, glass, plastics, metal, wood and other anthropogenic litter. Each item was counted and weighted onboard. Fishing was found as the main source of marine litter. 61,9 % of the tows with litter presence showed litter included in the fishing gear category. Whereas in most cases litter was composed by small fragments of rope, in other cases was composed by entire fishing gears such as traps. Then, plastics, metal and other anthropogenic litter were the next abundant categories, with 18.6%, 16.5% and 12,4%, respectively.
This study presents baseline information on seabed litter in this area, taking advantage of annual groundfish surveys. Thus, annotated additional data on the aforementioned surveys allows monitoring seabed litter. Integrate standardized protocols for marine litter data collection in NAFO groundfish surveys, could be an important contribution to improve marine litter knowledge in the high-seas.

Key words: Marine litter, seabed litter, Fishing, Flemish Pass, Northwest Atlantic

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INDICATORS OF GOOD ENVIRONMENTAL STATUS IN MACROALGAL COMMUNITIES AT INFRALITTORAL ROCKY BOTTOMS

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Abstract: The European Marine Strategy Framework Directive (MSFD) proposes the use of coverage and species composition of the infralittoral rocky-shore for ecological classification of habitats to assess the good environmental status. The study of the marine benthic macrophyte communities in western Mediterranean coastal waters among a gradient of impact was the basis to assess several ecological indicators based on macroalgae as a biological quality element. The main aim of this study was to estimate the most appropriate indicators to establish the environmental status of macroalgal communities in the infralittoral rocky communities among a geographic gradient.
We analyzed several macroalgal functional group classification (crustose, foliose, articulated, filamentous, corticated), some biodiversity indices (Shannon-Weaver, Simpson, Margalef, etc.), and additional indices used in other geographical areas. As a result each community with different composition of species, functional groups and ecological state groups (ESG) was given an ecological category from bad to high in several grades for each index applied. Significant differences between isolated communities (in Balearic Island) and continental communities (in the Catalan Coast) were found (PERMANOVA, $p<0.05$). This fact can be explained by both the theory of island biogeography, and the existence of a latitudinal gradient. Finally, a gradient in anthropic impact is reflected by differences among coverage and species composition in protected and non-protected areas.
Key words: Macroalgal communities, Functional Group, Marine Strategy Framework Directive, Good Environmental Status, infralittoral rocky bottom.

EVOLUCIÓN Y ESTADO ACTUAL DE LAS PRADERAS DE *Posidonia oceanica* EN LA PROVINCIA DE ALICANTE (MEDITERRÁNEO OCCIDENTAL)

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Abstract:
Las praderas de fanerógamas son ecosistemas de enorme importancia en franjas litorales de todo el mundo y en el caso del mar Mediterráneo, *Posidonia oceanica* es la especie formadora de praderas con mayor relevancia ecológica. Esta planta, endémica del Mediterráneo, es una excelente especie bioindicadora gracias a su alta sensibilidad a factores físico-químicos como la luz o la salinidad, y a su lento crecimiento. Por ello, esta especie es uno de los elementos de calidad biológica (BQE) que se utilizan para evaluar el estado de los ecosistemas marinos de acuerdo con la Directiva Marco del Agua. Esta directiva europea busca determinar el estado de los ecosistemas marinos de todos los países pertenecientes a la UE y, en caso de que este estado no fuera calificado como "bueno", se deberán iniciar medidas para su recuperación. Para la evaluación de este complejo ecosistema se han medido en éste 9 variables diferentes para determinar un índice de calidad ambiental específico para esta especie, el POMI (*Posidonia oceanica* Multivariate Index) definido por Romero *et al.*, 2007, en 6 localidades dentro de la provincia de Alicante a dos profundidades: 5-7 y 10-12 metros con el objetivo de detectar diferencias en función de la profundidad. Además utilizando las medidas de densidad y cobertura, se ha observado la evolución de estas praderas en los últimos 5 años con el objetivo de determinar si su estado continúa mejorando a lo largo del tiempo (Guillén *et al.*, 2013). Las localidades con valores más altos en el POMI fueron las estaciones someras de Tabarca y Benidorm, mientras que la que mostró un peor estado fue Cala Mina. En general, los valores del POMI fueron mayores en las estaciones de menor profundidad. En cuanto a la evolución temporal, en las 6 localidades se observó una gran variabilidad interanual en ambas profundidades, siendo la tendencia mayoritaria a mantenerse o aumentar. Se ha podido observar que las estaciones con praderas en mejor estado son aquellas sobre las que existen políticas ambientales de protección, mostrándose el efecto positivo de éstas sobre los ecosistemas de pradera.

Key words: *Posidonia* oceanica, monitoreo ambiental, evolución de praderas, Mediterráneo

occidental.

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EFECTOS DEL ANCLAJE DE EMBARCACIONES DEPORTIVAS EN LAS PRADERAS DE *POSIDONIA OCEANICA* EN DIFERENTES ESPACIOS MARINOS PROTEGIDOS DE LA COMUNIDAD VALENCIANA

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Abstract: Se ha evaluado el posible impacto del fondeo de embarcaciones deportivas sobre la pradera de *Posidonia oceanica* en cuatro espacios de la Red Natura 2000 de la Comunidad Valenciana mediante comparaciones entre estaciones con praderas de *Posidonia oceanica* en zonas control, donde no se produce el fondeo, y estaciones en las que éste se produce o se ha producido. Para la caracterización del estado de las praderas de *P. oceanica*, se han analizado los descriptores de cobertura, densidad y mata muerta. Los datos obtenidos se han evaluado empleando métodos univariantes de análisis de la varianza (ANOVAs).

Los resultados demostraron impactos por anclaje de embarcaciones sobre las praderas de *P. oceanica* en 2 de los 4 espacios estudiados. En los que no se detectaron impactos, las pequeñas variaciones observadas han sido atribuidas a impactos naturales, en concreto, temporales. En estos espacios, en uno de ellos el fondeo está prohibido, y en el otro hay un escaso número de embarcaciones en la zona y, no hay tradición de fondeo en el espacio protegido.

En los espacios con impactos detectados, en uno el fondeo está regulado desde hace 30 años y en el otro, no. En ambos casos, se ha apreciado cómo la instalación de trenes de fondeo y/o la vigilancia activa, han contribuido a minimizar los efectos de los anclajes sobre las praderas de *P. oceanica.*

La conclusión de este trabajo abunda en la necesidad de establecer medidas para evitar el anclaje indiscriminado de embarcaciones, pese a lo cual los efectos de los anclajes ya producidos perduran durante décadas.

Key words: Posidonia oceanica, impactos, anclaje

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USO DE PATELLA SPP. COMO INDICADORES DE PRESIÓN HUMANA EN EL MEDITERRÁNEO: PRECAUCIONES Y RECOMENDACIONES.

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Abstract: Las lapas (*Patella* spp.) son especies características de la biocenosis de la roca medio litoral inferior en el Mediterráneo (Hábitat EUNIS A1.14), y a menudo son objeto de recolección ilegal por parte de los bañistas. Es por ello que en numerosos planes de gestión de los espacios marinos protegidos sean empleadas como bioindicador de presión antrópica, basándose en la estimación de abundancias y tallas, comparadas entre diferentes zonas en el tiempo, o con respecto a zonas control. El método habitual que se sigue es el conteo y medición de las tallas de los ejemplares incluidos en una determinada superficie de muestreo que generalmente, en el Mediterráneo, es un cuadrado de 40 x 40 cm ubicado a partir del cero biológico.

Sin embargo, al ubicar tales cuadrados en zonas con una pendiente elevada, es frecuente que el área muestral supere la amplitud de la biocenosis de la roca mediolitoral inferior, donde se ubican las lapas, produciéndose un efecto de infravaloración de la abundancia. En este trabajo se ha evaluado la abundancia y tamaños de lapas en 5 espacios de la Red Natura 2000 de la Comunidad Valenciana, valorándose las abundancias obtenidas por el método descrito y posteriormente, recalculándose éstas al considerar únicamente la superficie de biocenosis con presencia de lapas. Los resultados demuestran un error importante de subestimación que a la hora de efectuar comparaciones hacen valorar el resultado de los ANOVAs practicados.

Por ello se propone incluir en los estudios de abundacias de lapas, el empleo de la fotografía de los cuadrados para estimar las superficies reales de biocenosis donde estas especies están presentes.

Key words: Lapas, Patella spp., Metodología

Acknowledgments: Al Servicio de Pesca de la Generalitat Valenciana por su apoyo y colaboración en este trabajo.

INDICATORS OF GOOD ENVIRONMENTAL STATUS IN FISH COMMUNITIES AT INFRALITORAL ROCKY BOTTOMS

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Abstract: The assessment of the European marine environment has made a progress with the implementation of a European legal framework and the adoption of different directives such as the recently Marine Strategy Framework Directive (MSFD; 2008/56/EC). It requires the assessment of the ecological status of the marine fish communities and it pretends to achieve a ‘’good environmental status’’ of the marine waters until 2020 (MSFD, 2008). In this research, we wanted to determinate the state of the fish communities from rocky infralitoral of the coasts of Balearic Islands and Catalonia. A several indices and indicators (Species richness, Shannon’s index, Jaccard’s similarity, Margalef’s richness, Pielou’s evennes, biomass, abundance, taxonomic distincness and trophic guilds) has been used in order to stablish conservation status of fish communities. The sampling was carried out by scuba diving (visual census) in localities with a gradient of protection level in order to check differences among fish communities. Permutational multivariate analysis of variance (PERMANOVA) were used to evaluate the differences in communities between protected and not protected areas, as well as to determine differences between geographical areas. Significant differences of fish abundance were found in geographical areas for the protection level ($p < 0.01$). Catalonia’s coast present significant differences of fish abundance regarding protection level ($p < 0.01$). Best preserved areas present structured communities at the trophic level with higher abundances of apex predators. Fish communities are good biological tools to stablish the state of our coasts. Moreover, a comparison of indices for fish communities is provided.

Key words: MSFD, Fish communities, Infralittoral rocky, Biological indicators, Good Enviromental Status (GES).

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BENTHIC HABITATS INDICATORS OF GOOD ECOLOGICAL STATUS IN THE MSFD

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Abstract: The Marine Strategy Framework Directive (MSFD) requires an evaluation of the ecological status of benthic habitats related to biodiversity (D1) and sea-floor integrity (D6) descriptors. Five benthic habitat indicators have been developed and tested by the OSPAR habitat working group. Benthos, environmental and anthropogenic pressure data are required. These state indicators are assessed along a gradient of pressure to facilitate threshold values to be quantified and to provide advice on management measures. BH1 indicator uses a set of sentinel species which vary their presence due to changes in the environment. The set is selected including i) species which are "typical" (characteristics) of each habitat, and ii) detecting those typical species that are sensitive to each pressure. BH2 measures changes in the condition of benthic communities through biological diversity indices (e.g. Shannon-Wiener or Margalef), biological traits indices (e.g. Infaunal Trophic Index, fuzzy correspondence analysis) or multivariate community composition changes. BH3 assesses the extent and degree of potential physical disturbance on benthic broad-scale habitats caused by anthropogenic pressures by combining data of anthropogenic activities with the sensitivities of underlying benthic habitats mapped. BH4 determines the proportion of the area of benthic habitats that are permanently, or for a long-lasting period lost due to anthropogenic pressures. BH5 evaluates the effects of pressures in the size spectra of sensitive benthic species.
This set of integrated benthic indicators could be applied to monitoring requirements under other Directives such as the Habitat or Water Framework Directive.

Key words: MSFD, state indicators, benthic habitats, typical species composition, pressures

DEVELOPING TOOLS FOR FINANCING EUROPEAN COASTAL HABITATS RESTORATION AND CONSERVATION THROUGH CLIMATE CHANGE MITIGATION: LIFE BLUE NATURA AND ANDALUSIAN SALTMARSHES

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Abstract:
Three blue carbon coastal habitats (mangroves, saltmarshes and seagrasses), cover less than 0.2% of the seafloor, but contribute about 50% of organic carbon burial in ocean sediments. Nevertheless they have been neglected from national and global inventories of natural carbon sinks, and are being lost 4 times faster than terrestrial forests (Nelleman et al, 2009). Recently the UNFCCC[1] included these 3 coastal habitats in the IPCC[2] Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC, 2013), allowing countries to include LULUCF[3] activities on these habitats in their national greenhouse accounting. Adequate conservation and restoration programs of blue carbon habitats could enhance their GHG[4] absorption up to 10% of the Kioto emission reductions targets (Pergent et al, 2012).
Life Blue Natura is a demonstrative project, aiming to produce new financing tools, based in climate-change mitigation funds, for protecting European saltmarshes and seagrasses. Apart from measuring these habitats carbon stocks and fluxes in Andalucía, and their enhancement potential, Life Blue Natura is producing carbon credit verification standards

and pilot restoration projects, to be financed through voluntary carbon markets and the SACE[5]. Finally Life Blue Natura seeks to increase general public, politicians and journalists awareness on climate-change mitigation, and to transfer to environmental managers and NGO officers these new financing tools, which could contribute to enhance green-blue infrastructure and sustainable economy, specially within the Natura 2000 network.

We will discuss the preliminary results obtained for saltmarshes: from 116.141 ha identified in Andalucía in 1956, the 40% (47.008 ha) were lost in 2013, implying a carbon sink loss of 224.313 tCO_2 $year^{-1}$. The main causes of Andalusian saltmarsh loss have been agriculture (75%), salt industry (10%) and urban sprawl (5%). We identified 3.849 ha of unexploited degraded saltmarsh that, if restored, could generate carbon credits for an approximate value of 7.883.022 € $year^{-1}$.

1. UNFCCC: United Nations Framework Convention on Climate Change
2. IPCC: Intergovernmental Panel on Climate Change
3. LULUCF: Land-Use, Land-Use Change and Forestry
4. GHG: GreenHouse Gas
5. SACE: Sistema Andaluz de Compensación de Emisiones

Key words: Carbon credit, blue carbon, Natural Capital, climate change mitigation, restoration

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MONITORING THE MARINE RESERVE OF FISHING INTEREST OF SERRA D'IRTA (SPAIN) USING MARINE MACROPHYTES

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Abstract: Serra d'Irta (Castellón, Spain) was declared marine reserve of fishing interest (MRFI) in 2003 with the objective of favouring the regeneration of marine resources. This work presents the results obtained in the monitoring studies carried out in this reserve during summer 2017 using different marine macrophytes indexes. The aim of this study was to evaluate the ecological status of the macrophytes as a biological quality element, as a proxy of the water quality of the marine reserve in the contex of the Water Framework Directive (WFD) and to detect anthropogenic pressures. Two species of seagrasses, *Posidonia oceanica* and *Cymodocea nodosa* are found in the reserve. To estimate their conservation status, 9 localities were sampled and structural and morphological descriptors were analized. After a multifactorial analysis, results showed that the two localities studied with *Posidonia oceanica* meadows showed a good ecological status (EQR>0,55). In the case of *Cymodocea nodosa* only 4 of the 7 localities sampled presented living plants probably as a result of intense storms ocorred in autumn 2016 that altered sedementary bottoms of areas below 10m. The ecological status for the localities with meadows was moderate (EQR>0,41) except for one of them that was good (EQR>0,61).

Environmental quality of the marine reserve waters was also estimated using macroalgal littoral community by means of the application of the CARLIT index. Two sectors were distinguished in the reserve costal: a North Sector dominated by *Corallina elongata* and other opportunistic species favoured by the nutrients provided by freshwater upwellings and limited by the coastal nature of the cliff; and a South Sector dominated by *Laurencia spp.* that proliferates through all the extensive coastal platforms battered by waves and sprinkled by fronds of *Cystoseira spp.* indicating a very good water quality. The EQR obtained for the entire extension analized (86,4% of the total coast) was of 0,769 indicating a very good ecological status for the studied area.

Key words: Macroalgae, Seagrasses, CARLIT, Bioindicators, Water Framework Directive (WFD)

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DEEP-SEA MINING: THE IMPORTANCE OF IMPACT ASSESSMENT TOOLS FOR A SUSTAINABLE EXPLOITATION OF DEEP-SEA NON-LIVING RESOURCES

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Abstract: Deep-sea mining has become an attractive solution to provide metals for several industry applications. European oceans, and particularly the Portuguese Exclusive Economic Zone, present extensive deep-sea areas rich in non-living resources that can be used, among others, in green technologies, biomedical devices, communication systems and high-tech and military applications. However, many of these resources are located in the vicinity of sensitive ecosystems. The generated sediment-laden plumes and consequently released trace elements can cause negative impacts that may persist over time.
To reproduce deep-sea dynamics and evaluate the impact of the mining activities in the biome, reliable numerical modelling tools should be build up. In the frame of the project CORAL, a numerical modelling tool for deep-sea mining risk assessment was developed and tested for the North Mid-Atlantic Ridge (NMAR) considering the existence of polymetallic sulphides deposits close to hydrothermal fields. This tool integrates the oceanic circulation model ROMS-Agrif and the semi-Lagrangian model (ICHTHYOP), allowing the representation of the deep-sea dynamics and the particles trajectories taking into account the sediments physical properties (e.g size, density and settling velocity). The oceanic model was calibrated/validated with in-situ data from ARGO profiles and MOMARSAT campaigns (IFREMER). Then, a set of simulations combining different sediment properties and different release depths were performed. Numerical results evidence the ability of ROMS-Agrif simulating the NMAR oceanic dynamics, presenting maximum root mean square errors of 0.2 PSU and 1.5ºC for salinity and temperature profiles, respectively. Regarding plume trajectories, particles with lower dimensions released close the bottom can remain suspended up to 40 days, settling 50 km away. As the release depth decreases the residence time increases as well as the particles travel distance. Finally, our results highlight the potential use of this model tool in forecasting laden plume trajectories that may allow building risk scenarios during deep-sea mining activities.

Key words: Deep-sea mining, Numerical models, Risk assessment, Environmental impacts

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CHARACTERIZATION OF ECOSYSTEM SERVICES BY A HYDROLOGICAL BASIN MODEL: A CASE STUDY IN THE GUADALETE RIVER ESTUARY

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Abstract: identification and characterization of ecosystem services are essential for the correct integrated management of estuarine and coastal areas. The high difficulty of this task is due to the complexity of the natural systems and their interactions with the inhabiting societies. This study constitutes a first attempt to face such a challenge by analyzing data from available geographical information systems, and by implementing them into a hydrological basin model (SWAT), to identify and evaluate the use of the output model data for qualifying and quantifying diverse aspects of the ecosystem services in estuarine environments. The methodology is elaborated from the study of the Guadalete river estuary as a case study, due to its representativeness and regional socio-ecological importance, and the diverse uses and interests related to its ecosystem services. Preliminary results show the ability of hydrological models to provide useful information and resources for the characterization of certain ecosystem services of estuarine systems, especially those related to water supply.

Key words: ecosystem services, hydrological model, Guadalete river estuary

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CALIBRATION AND VALIDATION OF A CATCHMENT MODEL TO SIMULATE THE D.B.O., DISSOLVED OXYGEN, AND NITRATES IN AN ESTUARY. CASE STUDY: GUADALQUIVIR RIVER BASIN.

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A change in river flows is expected as a consequence of future new scenarios due to climate change. Previous studies claim that this will have a significant impact on the downstream and estuarine environment (Khoroshevskaya, 2011). In general, hydrological and thermal regimes of rivers are expected to change, directly affecting freshwater ecosystems, water quality and human water use (Van Vliet et al., 2013).

With the premise to have knowledge about the "health" of the waters in the mouth of the estuaries that drain to the coastal waters, it is important to develop hydrological models from the born to the mouth in order to have an esteem of the water quality that reach our coasts. Therefore, a first step to can reach this goal, the development of a hydrological model for the river basin it is necessary.

In this work is presented the Guadalquivir River Basin as case study to be able to assess the impact on the estuary. The Guadalquivir estuary is a unique space located in the south west of Spain that possesses extraordinary natural, cultural, historical and economic values, where human activities have coexisted with the rich biodiversity of the Natural and National Park of Doñana, an UNESCO heritage.

As result has been obtained a good correlation between the observed river flow in different stations along the river basin and the presented by the model both for the calibration (NSE=0.95, PBIAS=6.53%, and R^2=0.96) and on the validation period (NSE=0.96, PBIAS=7.71%, and R^2=0.98) (Gomiz-Pascual et al., 2016). Also, will be shown how the model is able to reproduce the behavior of the D.B.O., dissolved oxygen and the nitrates, for both periods too.

Key words: Guadalquivir estuary, water quality, catchment model, Gulf of Cadiz, climate change

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POSTERS

COASTAL AND ESTUARY SYSTEMS: ECOLOGY, SEDIMENTARY PROCESSES, NERITIC AND BENTHIC COMMUNITIES

VI INTERNATIONAL SYMPOSIUM ON MARINE SCIENCES 2018

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INVERTEBRADOS COSTEROS ASOCIADOS A ARRIBAZONES DE *POSIDONIA OCEANICA* EN EL SUDESTE DE ESPAÑA

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Resumen: Los arribazones son estructuras procedentes del desprendimiento de las hojas y rizomas de la fanerógama marina *Posidonia oceanica*, que se acumulan a modo de barrera en gran parte de las playas del mar Mediterráneo (Vacchi *et al*., 2016). Estas estructuras contienen agua y nutrientes, y son capaces de fertilizar el complejo arenoso y dunar, además de ofrecer alimento y refugio a especies de invertebrados costeros (Boudouresque *et al*., 2015). El objetivo de este trabajo es caracterizar la macrofauna de invertebrados asociada a estos entornos a lo largo de un año, así como su variabilidad espacio-temporal, empleando para ello la metodología de captura por caída (Deidun *et al*., 2009). Se compararon dos playas situadas en Santa Pola, Alicante (SE de España), de tamaño similar, una con retirada constante de arribazones por parte de maquinaria pesada, y otra sin retirada de éstos. Se obtuvieron un total de 19 especies distribuidas en ambas playas, pertenecientes a dos subclases y cuatro órdenes taxonómicos de Arthropoda: Crustacea (Isopoda y Amphipoda) y Hexapoda (Dermaptera y Coleoptera). La playa sin retirada de arribazones, mostró significativamente mayor abundancia de ejemplares a lo largo de todo el año. Espacialmente, la franja con arribazones, contenía mayor abundancia de organismos que el resto de terreno arenoso; temporalmente, la mayor abundancia de organismos se dio en invierno, época de mayor acúmulo de arribazones. De los cuatro órdenes, Amphipoda fue el más abundante en las inmediaciones de los arribazones, y Coleoptera en el estrato supralitoral. Los resultados obtenidos infieren que la conservación de los arribazones repercute en la estabilidad de las playas, permitiendo una comunidad de invertebrados más estructurada y superior a aquellas playas que son limpiadas regularmente. Se desprende que la retirada de estas estructuras debido a la presión turística, afecta negativamente a la diversidad de nuestras costas.

Palabras clave: arribazones, *Posidonia oceanica*, invertebrados marinos, playas Mediterráneo

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ASCIDIANS ON CIRCALITTORAL SOFT BOTTONS IN THE WESTERN MEDITERRANEAN (IBERIAN PENINSULA SECTOR).

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Abstract: Ascidians form complex habitats on soft circalittoral bottoms, as octocorals and sponges, and create new substrate for the settlement of other species. These biogenic habitats are affected by trawling which destroy them and increase the muddy fraction; therefore only particular species can colonize this type of bottom. In this regard, the ascidian taxocenosis has been studied from 6 stations from the MEDITS-2010 cruise in three different Iberian Mediterranean Areas (around Cape of Palos in Murcia, Gulf of Valencia and south of Catalonian), between 37 and 85 meters deph. A total of 848 ascidians have been classified belonging to 20 spp., which 12 are solitary and 8 colonial. The highest abundance percentages are from the Stolidobranchia order with Styelidae (*Polycarpa pomaria*), Molgulidae (*Molgula appendiculata)* and Pyuridae (*Microcosmus vulgaris*), followed by Phlebobranchia with Ascidiidae (*Ascidia mentula* and *Ascidiella aspersa*). Regarding the specific composition compared with other Mediterranean studies, it has been found that there is a high ascidiofauna homogeneity on Mediterranean circalittoral soft substrates.
Ascidians in Murcia and Catalonian have presented a relative high specific richness and abundance both in colonial and solitary ascidians. On the other hand, the Gulf of Valencia shows a very low species richness and no colonial species have been sampled. The possible explanations for these differences may be due to steeper continental shelf of Murcia and Catalonian (in front of Vilanova i Geltrú), in contrast to the wide continental shelf of gulf of Valencia, which is more favorable to bottom trawling. Moreover, there have also been differences in depth, where shallow stations (≤50m) have higher specific richness and abundance. In that regard, Spanish legislation bans trawling on bottoms less than 50m depth.

Key words: Ascidians, circalittoral soft bottoms, Mediterranean Sea, trawling

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BENTHIC FAUNA DISTRIBUTION IN 'RÍA DE VIGO' (NW IBERIAN PENINSULA)

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Abstract: Benthos is one of the largest and diverse communities in Ría de Vigo. The main goal was to study the fauna of these environments. Sampling was carried out the 1st and 2nd of February 2018. Therefore, results may be biased to the fauna which inhabits these soft bottoms in winter.

Sampling was performed on board of the RV *Mytilus* in eight localities along the Ría de Vigo (Galicia, NW Iberian Peninsula) using a rectangular dredge (type Charcot) 45 cm wide and 19 cm high, provided with a burlap cod-end. The working time on the bottom for each sampling was 5 minutes. The sampling methodology on board followed a semi-quantitative approach: a subsample of 10 L was taken randomly from each catch and then sieved. The material retained in 10 mm and 5 mm meshes was sorted in order to differentiate high range taxa and it was preserved in 70% ethanol. The 1 mm fraction was fixed directly using 4% formaldehyde stained with rose bengal, for later identification at the laboratory.

The main conclusions of this study are: (1) The groups that dominates in number of species are mollusca, polychaetes and cnidarians. (2) The most abundant groups are ophiuroids, polychaetes (families Maldanidae and Nereidae), and ascidians.

The study was performed by second year students' in the subject of Marine Zoology, corresponding to Sea Science degree in 'Universidade de Vigo'.

Key words: benthic fauna, rectangular dredge, Ría de Vigo.

Acknowledgments: We express our gratitude to the *Mytilus* crew for their invaluable help as well as, to our professors F. Ramil and E. Vázquez and to the rest of Marine Zoology students for taking part in sampling and identification of the fauna.

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ON THE QUANTIFICATION OF BLUE CARBON IN SEAGRASS MEADOWS.

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Abstract: the potential of marine environments for the retention of pollutants has long been studied as the dilution of those compounds in the oceans. Over the last decade efforts have been devoted to study those pollutants retained in a particulate stable phase with longer residence times. Current policies are highly concerned about CO_2 sequestration and long-term stabilization due to its role in global warming. The organic carbon stocked in coastal vegetated ecosystems, as seagrass meadows, is referred to as Blue Carbon.
Attempts to measure Blue Carbon have not been systematic and several key issues remain unclear: the suitability of expressing it as stocks (kg/m^2) or fluxes ($kg/m^2 \cdot y^1$) over a certain soil thickness or period of accumulation or encompassing spatial and temporal variability in Blue Carbon estimates are two of them. The authors aim at triggering some debate about the current objectives of Blue Carbon quantification, in order to develop a consensual and useful methodology for environmental management. From the experience of three projects focused on seagrass soil biogeochemistry and carbon accumulation, a protocol is proposed. Several methods have been tested to try to adapt the sampling, analytical and scaling strategies to robustly measure Blue Carbon, thereby capturing the variability in stock, fluxes and carbon degradation across meadows. The two main issues identified are 1) The stock (kg/m^2) is limited as a criteria, as it fails in accounting for the actual specific accumulation efficiency of the meadow; and 2) The total amount of carbon sequestered might have been overestimated when calculating stocks, as the bulky labile pool in the upper layers has too fast a turnover to be considered a refractory pool. The protocol presented here has the potential to standardize Blue Carbon assessments, and facilitate the implementation of Blue Carbon strategies to contribute to mitigate climate change.

Key words: Blue Carbon, Marine Meadows, Seagrass, Methodology, Quantification

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CARACTERIZACIÓN DE LA COMUNIDAD DE ORGANISMOS MACROBENTÓNICOS EN UNA COMPUERTA DE LA SALINA DE LA ESPERANZA

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Abstract: Las macroalgas poseen un gran valor en los ecosistemas litorales de todo el mundo por el conjunto de bienes y servicios ecológicos que suministran. Pese a ello el conocimiento de las comunidades bentónicas de numerosos ecosistemas de la Península es aún escaso. En este estudio se han caracterizado la comunidad de macroalgas e invertebrados sésiles en una compuerta de la Salina de la Esperanza (Puerto Real, Cádiz) con el fin de conocer el patrón de biodiversidad en el área estudiada y las variables que intervienen en dicho patrón.

Se muestrearon superficies de 25 cm^2 tomadas al azar en la base de una compuerta caracterizada por un marcado gradiente de luz y caudal. Para la obtención de los datos se realizaron cinco salidas de campo a la salina. Adicionalmente se registraron medidas de temperatura, pH, sólidos en suspensión, oxígeno disuelto e intensidad de luz y se calculó el caudal a partir de datos estimados de la velocidad de la corriente en el área de estudio.

Se estimó la biomasa por especie y la biodiversidad de la comunidad (a partir del índice de Shannon). Los resultados mostraron un gradiente muy claro desde la base de la compuerta hacia el exterior, tanto en biomasa como el biodiversidad. Este gradiente está muy condicionado por el diferente caudal en distintos muntos de la compuerta y por las diferencias en la intensidad de luz. Además del gradiente longitudinal, existen cambios estacionales muy marcados en las especies que predominan en la comunidad a lo largo del año.

El estudio pone de manifiesto la influencia de las variables fisico-químicas en la heterogeneidad de la comunidad de macroalgas bentónicas durante el periodo de mayor desarrollo de dichas comunidades en un ecosistema sometido a condiciones extremas.

Key words: heterogeneidad, macroalgas, biomasa.

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EFFECT OF PHOSPHORUS AND IRON ON THE ALKALINE PHOSPHATASE ACTIVITY IN *Posidonia oceanica*

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Abstract:

*Posidonia oceanic*a is an endemic seagrass of the Mediterranean Sea with various ecological services. The meadows are sites of high rates of biological nitrogen fixation (Agawin *et al*., 2016), a process that is carried out by microorganisms called diazotrophs. These diazotrophs need dissolved inorganic phosphorus (DIP) for the nitrogen fixation process and as a consequence they have to activate different mechanisms to obtain it when the concentration of DIP is low. One of these mechanisms is to metabolize the dissolved organic phosphorus (DOP), a process in which alkaline phosphatases (Apases) are essential and in which metal cofactors are indispensable (Browning *et al*., 2017). The plant itself also has on the surfaces APases (Martínez-Crego, Romero, & Alcoverro, 2006), and may have a role in providing DIP to the diazotrophs. The main objective of this study is to determinate the role of phosphorus (P) and iron (Fe), the nutrients considered to be the main limiting nutrients to nitrogen fixation, on the Apases activities (APA) on the different parts of *P. oceanica*. The experiments were conducted with four nutrient conditions (control, addition of P, addition of Fe and addition of P/Fe) in triplicate aquaria during summer and APA was measured indirectly by a espectrofluorometric method. The results showed significant rates of APA in the different parts of *P. oceanica*, except on rhizomes in which the rates were minimal but detectable. With no nutrients added, new leaves had higher APA. The addition of high P and high P/Fe had a negative impact in APA. Surprisingly, Fe, which is usually a cofactor of APases, had a negative effect on leaves (old and new), meanwhile in root and rhizome, it had a positive impact. These results highlight the importance of P and Fe in APA, but their effect varies depending on the part of *P. oceanica* studied.

Key words: *Posidonia oceanica*, Phosphorus (P), Iron (Fe), Alkaline phosphatase (APase) activity (APA).

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DIEL PATTERNS OF MICROPHYTOBENTHIC PRIMARY PRODUCTION IN INTERTIDAL SEDIMENTS

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Abstract

Circadian rhythms are metabolic, physiological or behavioural changes which allow organisms to adjust their activity to the daily light and dark cycle. Circadian rhythms have usually an endogenous component, so that they persist for some time in the absence of the stimulus that generates them. In microphytobenthos (MPB), the photosynthetic microalgal community living on the surface of photic sediments, the daily photosynthetic rhythm has been attributed to physiological changes and the vertical migration of benthic microalgae induced by the interaction between light-dark and tidal cycles. Given the importance of MPB primary production in estuarine zones, it is essential to determine what factors control its daily changes. To determine this, sediment cores from an intertidal flat were incubated in aquaria under immersion in two different light treatments for up to 10 days: in situ photoperiod cycles or continuous light. The effect of tides was eliminated to test for the existence of a diel photosynthetic rhythm exclusively driven by the photoperiod. Net primary production (P_N) was calculated from O_2 vertical profiles measured every 30 minutes at the sediment-water interphase with microsensors. The amount and spectral composition of the reflected light was also measured as a proxy of MPB abundance. The results showed that the vertical migration of microalgae is the main driver of the changes in the photosynthesis rate during the light period. Under continuous light, an endogenous driver is able to maintain the oscillation in P_N for up to three days. However, once the photoperiod was restored, the circadian rhythm immediately resumed after the first dark period. In addition to the changes in P_N, the large oscillations in sediment O_2 concentration and the daily vertical migration of microalgae are likely to have profound biogeochemical consequences in photic intertidal sediments.

Keywords: microphytobenthos, photoperiod, oxygen microsensor, benthic production, diel patterns

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MICROPHYTOBENTHIC PRIMARY PRODUCTION IN THE INTERTIDAL SEDIMENTS OF CÁDIZ BAY

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Abstract:

Microphytobenthos (MPB) plays a key role in the cycling of carbon and nitrogen in shallow estuaries and intertidal areas, contributing up to 50% of primary production. In the inner Cadiz Bay, the intertidal zone covers ~60% of its surface. Therefore, it is important to study the spatial and seasonal variability of microphytobenthic net primary production (NPP), as well as to identify the variables which control it. Sediment cores were collected using a Kajak sediment sampler during immersion from five sampling stations along two transects with different sediment grain size distribution, a muddy and a muddy-sandy. NPP and respiration rates were estimated using oxygen microelectrodes. Chlorophyll a (chl a) was used as a proxy variable of MPB abundance. Although, no clear patterns were observed along each transect, noticeable differences were observed seasonally in the two transects. In the muddy transect, NPP showed a seasonal pattern with highest NPP during winter (transect average 7.2 mmol O_2 m^{-2} h^{-1}) and lowest during summer (2.3 mmol O_2 m^{-2} h^{-1}). Hours of daytime explained about 40 % of NPP spatiotemporal variability in this transect. In the muddy-sandy transect, NPP did not show any seasonal pattern (1.9 and 1.6 mmol O_2 m^{-2} h^{-1} in winter and summer, respectively). Hours of emersion explained 20 % of NPP variability in this transect. Interestingly, in the muddy transect, MPB biomass was rather stable over time (1.8 µg chl cm^{-2} in winter and 2.0 µg chl cm^{-2} in spring), whereas in the muddy-sandy transect MPB values were more variable (4.0 and 1.3 µg chl cm^{-2}). MPB biomass was twice as high in the muddy-sandy than muddy sediment transect. The different patterns of NPP observed between transects and their dependence on different environmental variables highlight the importance of considering the spatial heterogeneity of our system to estimate the MPB contribution to the inner Cadiz Bay productivity.

Key words: microphytobenthos, net production, oxygen sensor, chlorophyll**.**

Acknowledgments: This work was funded by the Spanish MINECO through projects: "Ecología microbiana y biogeoquímica de los sedimentos intermareales en la bahía de Cádiz: efectos del forzamiento físico de las mareas y el fotoperiodo (MICROBAHÍA)" (CTM2013-43857-R), and "Ecología microbiana y biogeoquímica de los sedimentos intermareales: efectos del forzamiento físico de las mareas, el fotoperiodo y los eventos climáticos extremos" (CTM2017-82274-R).

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PRELIMINARY STUDY OF FISH FAUNA IN FIVE BEACHES OF GULF OF CADIZ

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Abstract: Sandy beaches, despite of not having a high complexity of habitat, they are used as nurseries by juvenile fishes due to the availability of food. The aim of this work is to study the fish fauna at five beaches on the coast of the Gulf of Cadiz. For this purpose were surveys between December 2016 and November 2017 using a beach seine net in five samples separate 25 meter each other. The size range of the fish found was, mostly, between 2 and 6 cm. The most abundant species were *Atherina presbyter*, *Dicentrarchus punctatus*, *Engraulis encrasicolus*, *Sardina pilchardus* and *Trachinotus ovatus.* The abundance of the most important groups of fish is correlated with the season and the water temperature. In three of the beaches the highest values of diversity occurred in the summer season. Monitoring and conducting samplings with a larger beach seine would better determine the fish community in the area.

Key words: Gulf of Cadiz, beach seine, fish fauna, nurseries, abundance.

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ZOOPLANKTON DISTRIBUTION IN RIA DE VIGO UNDER WINTER CONDITIONS

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Abstract: Abundance and composition of zooplankton in the Ría de Vigo (NW, Iberian Peninsula) is well known: Copepods as *Acartia clausi*, *Temora longicornis* and *Oithona plumifera* are the most abundant taxa, followed by Larvaceans, which are mainly represented by two genera: *Oikopleura* and *Fritillaria,* being the first the most abundant. Cirripedia nauplii and Cladocera are also present but in a lower proportion (Figueiras et al 2008). The objective of this study was to describe the composition and abundance of zooplankton in Ria de Vigo. Sampling was carried out onboard of the RV *Mytilus* between the 1st and 2nd of February 2018. Samples were taken in four localities along the Ria de Vigo using a 80 μm plankton net at two depth ranges (0-15 m and 0-30 m), anaesthetized and fixed in formaldehyde. Calanoid copepods, were the most abundant taxa, followed by Larvaceans and decapod larvae. However, the abundance and composition varied along the ria. This study was performed by second-year Marine Sciences Degree students of the Universidade de Vigo (Marine Zoology course).

Key words: Zooplankton, composition, abundance, Ría de Vigo.

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THE DINOFLAGELLATE GROUP ON THE CENTRAL ALGERIAN COAST: INVENTORY, DISTRIBUTION AND STRUCTURE

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Abstarct : A central goal in ecology is to understand the effects of environmental change on biodiversity of phytoplankton and the consequences of biodiversity changes for ecosystem functioning. In fact, this paper was to explore the variability of phytoplankton comunities during the period 2013-2016, in the central Algerian coast, in relation to physico-chemical parameters. The total number of taxonomic units recorded in this area is 55 Genus. The spatial distribution of cell densities revealed a heterogeneous phytoplankton composition dominated by Dinoflagellates which represent more than 60 % of the total concentration followed by Diatoms, which represent 25 %. The average values recorded concentrations of phosphates, nitrites and nitrates are respectively 0.43, 2.03 and 48.50 mg.l^{-1}. The peak of dinoflgellates in this period (2.45 x10^6 cell.l^{-1} at surface) was due to a *Prorocentrum* and *Ceratium* genus concentration. In reference to the values of the equitability index, we have noted that there is dominance of a dinoflagellate species; giving an image of a phytoplankton population at the beginning of maturity, diversified with unbalanced distribution,
.

Keywords: *Phytoplancton, Biodiversity, Dinoflagellates, Algerian coast.*

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SPECIES COMPOSITION AND DAILY VERTICAL MIGRATION OF THE DEEP SCATTERING LAYER OFF NORTHWEST MEXICO (JULY-SEPTEMBER 2014)

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Abstract:
The Deep Scattering Layer (DSL) is formed by organisms that comprise the mesopelagic domain and are important scatterers as detected by echo sounders and sonars. By using these instruments, it is possible to comprehend the vertical movements of the DSL, which during the day is located between 300-500 m deep and at night moves to the first 100 m from the surface. In this work, we analyse data from an acoustic survey conducted in the Economic Exclusive Zone of the Mexican Pacific along the coast of Baja California peninsula. Digital echograms were recorded with a Simrad EK60 scientific echo sounder with 5 split beam transducers (18, 38, 70, 120 and 200 kHz). In addition, for a series of stations, environmental data were obtained with a CTD (temperature, salinity and dissolved oxygen) and fishing trawls were done with a BONGO net, through which the composition of zooplankton groups was determined with the purpose of giving identity to the echoes observed in the sounder. Stations were classified according to diurnal, nocturnal or twilight period. The area was divided into three zones (northern, transition and southern) according to the existence of oceanographic processes characteristic of each one of them. The Copepoda, Chaetognata, Euphausiacea, Pteropoda and Thaliacea groups were the most abundant and their highest values were observed at night. In contrast, the fish larvae had lower abundances, being the dominant species from the orders Stomiiformes (*V. lucetia*) and Myctophiformes (*T. mexicanus, D. laternatus, C. towsendi, C. signata, C. acclinidens, P. crockery, N. resplendens, L. urophaos, H. atratum, M. nitidulum, A. sladeni, G. tenuiculus* and *A. affinis*). Through the multifrequency analysis of echograms, together with the environmental variables obtained in situ, the pattern of daily vertical migration of the most abundant groups in the DSL is described.

Key words: Hydroacoustics, DSL, mesopelagic domain, zooplankton.

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CEPHALOPOD PARALARVAL DIVERSITY IN THE RÍA DE VIGO

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Abstract: Cephalopod paralarvae present morphological similarities that difficult their accurate identification to the species level, which is essential to unravel their ecology. Consequently, wild paralarvae were previously often classified to the family level. High cephalopod diversity has been previously reported in Galician waters and Cíes Islands in particular, include important spawning areas for different cephalopod species. Therefore, it is expected that inaccurate classification of paralarvae could have underestimated the species richness in this area. Barcoding has proved to be a useful tool to differentiate closely related species, including cephalopods. We undertook 30 surveys at night-time and 4 surveys during daytime in summer and early autumn from 2012 to 2014 to untangle the diversity of cephalopod paralarvae inhabiting the Ría de Vigo. Zooplankton was captured by towing a Multinet and filtering water through up to 7 depth layers. Mantles of each individual loliginid, sepiolid and ommastrephid paralarvae were dissected ($N = 333$). Afterwards, DNA from each mantle was extracted, amplified by PCR and sequenced. Additionally, octopus paralarvae ($N = 996$) were easily identified as *Octopus vulgaris* using taxonomic guides. These analyses revealed the presence of paralarvae belonging to 12 cephalopod species in the Ría de Vigo. Furthermore, Generalized Additive Models (GAMs) were fitted to the species diversity data to evaluate the influence of hydrographical variability and to evaluate spatial-temporal differences in richness. These analyses revealed that temperature, oxygen and nitrate were the oceanographic parameters that better explained the paralarval diversity. Higher diversity was expected in the inner part of the Ría, in September and in intermediate waters (10 - 20 m). This study revealed a realistic scenario of the paralarval diversity in the Ría de Vigo, which would be remarkably difficult using only visual identification. Additionally, we also showed differences in spatio-temporal variability and oceanographic influence on cephalopod paralarval richness.

Key words: Multinet, biodiversity, barcoding, zooplankton

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CEPHALOPOD PARALARVAE DISTRIBUTION AND VERTICAL BEHAVIOUR AT THE "ATLANTIC ISLANDS OF GALICIA NATIONAL PARK"

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Abstract: Diel vertical migration and distribution of cephalopod paralarvae was investigated for the first time at Cíes and Ons Islands of the "Atlantic Islands of Galicia National Park, PNIAG". Four 24h oceanographic surveys - two in summer (June and July) and two in autumn (October) - were carried out along six transects surrounding both islands. A multinet trawl gear with 200 µm mesh size was used to get mesozooplankton samples at defined depths (55 to 35m, 35-20, 20-10, 10-5 and 5 to 0 m) through the water column, filtering 200 m^3 in each strata. A total of 216 samples were studied. Three cephalopod families were found, the octopods being the most abundant (n=379; 72%), followed by loliginids (n=119; 22%) and sepiolids (n=31; 6%). Cephalopod paralarvae were more abundant in autumn (n=356) than in summer (n=173). Overall, the presence of all paralarvae families was higher around the Ons Island (67.3% vs 32.7% in Cíes). Loliginid and sepiolid abundances were higher in summer (63%), while most of the octopods appeared during autumn (83%). Paralarvae catches were higher at night (n=369) than during the day (n=160), and diel vertical migrations were detected in the three families. Most of octopus paralarvae (~68%) were caught at surface waters (from 0 to 10 m) at night, whereas they were mostly found around 45 m during the day. Loliginids displayed a similar vertical pattern but slightly deeper (around 15 m) than octopus during the night. Additionally, sepiolids were mainly caught at night (only one paralarvae was taken during the day) and located from 10 to 15 m depth. These results show the vertical and horizontal changes in the cephalopod assemblage around the PNIAG, highlighting the contribution of Ons Islands to paralarval abundance.

Key words: Paralarvae, Cephalopods, Diel Vertical Migration, Atlantic Islands of Galicia National Park

Acknowledgments: This work was supported by the project CALECO (CTM2015-69519-R) funded by the Spanish Ministry of Economy and Competitiveness. Thanks to the captain, crew and technicians of R/V *Mytilus* (IIM, CSIC Vigo) for their assistance in collecting the zooplankton samples. We are grateful to Lara García Alves for her assistance in collecting the samples and sorting the samples in the laboratory.

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ESTRATEGIAS ADAPTATIVAS DE LA VIDA TEMPRANA DE TRES ESPECIES DE CEFALÓPODOS.

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Abstract:

Los cefalópodos son un grupo de moluscos de gran importancia, tanto por su valor ecológico como por ser un recurso pesquero de gran valor (Hunsicker et al., 2010). Su abundancia depende en gran medida de la supervivencia de sus primeras fases de vida después de la eclosión, ya que es durante este periodo cuando se produce la mayor tasa de mortalidad en los cefalópodos. A este respecto, los individuos recién nacidos son muy semejantes al adulto, por lo que su desarrollo es directo, sin una verdadera etapa larval que implique una metamorfosis. Por eso, Young y Harman (1988) adoptaron el término "paralarva" para los cefalópodos recién nacidos que, siendo muy parecidos a los adultos y careciendo de metamorfosis propiamente tal, no tienen el mismo hábitat que los adultos.
Sin embargo, existen diferencias entre los recién eclosionados: algunas especies poseen huevos grandes de los cuales surgen individuos que se pueden considerar juveniles, como en el caso de *Sepia officinalis*, que adoptan directamente la forma de vida del adulto. Pero, la gran mayoría de las especies poseen huevos pequeños de los que nace una paralarva planctónica que luego, al crecer lo suficiente, adoptará la vida de un juvenil. En este sentido, destacan la paralarva "típica" cazadora desde el primer momento, como en el caso del pulpo *Octopus vulgaris*, y la paralarva tipo Rhynchoteuthion, característica de los Omastréfidos como *Illex coindetii*, que es detritívora y está muy poco desarrollada en el momento de eclosionar (Sweeney et al., 1992; Domingues et al., 2001; Fernández-Álvarez et al., 2018).
En este estudio se realizó una comparación de las características morfológicas y ecológicas de estos tres tipos de fases tempranas, con objeto de establecer sus diferencias y adaptaciones a sus hábitats. Se observó que especies con huevos y recién eclosionados "grandes" suelen tener un menor número de huevos, pero tasas de supervivencia altas; mientras que las especies con paralarvas típicas y Rhynchoteuthion producen gran cantidad de huevos y poseen altas tasas de mortalidad larvaria, aun cuando pueden mantener poblaciones muy abundantes. Las implicaciones de estas características son discutidas.

Key words*:* *Octopus vulgaris*, *Illex coindetii*, *Sepia officinalis*, paralarvas, ecología.

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CARACTERIZACIÓN DE ESPECIES ASOCIADAS AL CULTIVO DE MEJILLÓN

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Resumen: La Ría de Arousa presenta la mayor concentración de bateas en Galicia, conocer exhaustivamente el conjunto de epibiontes que habitan en las cuerdas de cultivo puede ser de relevancia para el cultivo de *Mytilus galloprovincialis*.

La abundancia de especies móviles (*Caprellidae spp.*, *Pisidia longicornis*) y sésiles (*Ciona intestinalis*, *Tubularia larynx*, *Actinothoe sphyrodeta* y *Balanus spp*) se determinó durante el período 2015-2017 a través de imágenes digitales tomadas mensualmente a diferentes profundidades de 5 bateas de la Ría de Arousa como parte del seguimiento del ciclo productivo del mejillón del proyecto MYTIGA. Las variaciones espaciales y temporales de la epifauna se analizó a escala estacional e interanual en relación a condiciones oceanográficas (temperatura, salinidad, disponibilidad de alimento, corrientes...) tanto medidas semanalmente en las estaciones de control monitorizadas por el INTECMAR como reproducidas por el modelo hidrodinámico ROMS.

Las consecuencias de la competencia por espacio y alimento de los epibiontes se valoró en relación a las características del cultivo en su rendimiento, fortaleza de fijación y su tasa de desprendimientos. El análisis preliminar de esta información apunta que la presencia de *Actinothoe sphyrodeta*, principalmente localizada en el margen sur de la ría, impide el desarrollo normal del biso y siendo un factor decisivo en el incremento de desprendimientos en las bateas controlando el 40% de la variabilidad de las pérdidas de producción mientras que *Balanus spp*., abundante en la boca norte, contrariamente ocasiona un incremento en la sujeción de los mejillones a la cuerda.

Palabras clave: *Mytilus galloprovincialis*, batea, miticultura, epibionte

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DIFERENCIAS EN LA CONDICIÓN SOMÁTICA DEL TIBURÓN DEL TALUD CONTINENTAL *Galeus melastomus* ENTRE EL MAR DE ALBORÁN Y BALEARES: RELACIÓN CON LA DIETA Y FACTORES AMBIENTALES

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Abstract: En el presente trabajo se compara la condición somática del tiburón del talud continental *Galeus melastomus* entre el mar de Alborán y las Islas Baleares, dos áreas con distintas características oceanográficas. En Alborán se consideraron dos zonas diferenciadas por la influencia de la entrada de agua atlántica a través del Estrecho de Gibraltar, Estrecho a Cabo de Gata y Golfo de Vera, separadas por el frente de Almería-Orán. Las muestras se obtuvieron durante la campaña MEDITS 2016 en fondos entre 50 y 800 m de profundidad mediante arte de arrastre. Se realizaron análisis biológicos de un total de 1391 individuos, incluyendo longitud total, peso total, eviscerado y del hígado, y análisis de contenido estomacal. A partir de estos datos se calcularon dos índices de condición somática basados en los residuos entre el peso real y teórico calculado a partir de i) relaciones talla-peso total (CS_{Wtotal}), y ii) talla-peso eviscerado (CS_{Wevis}). Para evitar el efecto del desarrollo gonadal sobre la condición somática, sólo se muestreó la fracción de individuos inmaduros. A partir de los datos de contenido estomacal se calculó el índice de importancia relativa de las presas (%IRI) para cada área. Los valores medios de los índices de condición fueron comparados entre áreas mediante ANOVA. Tanto CS_{Wtotal} como CS_{Wevis} mostraron valores más elevados en Baleares que en Alborán y Golfo de Vera. En Baleares y Alborán la dieta de *G. melastomus* se basó en crustáceos (eufausiáceos y decápodos), que representaron el 50 y 56% del IRI de ambas áreas, respectivamente, mientras que el resto consistió en cefalópodos (31 y 12%, respectivamente) y peces osteíctios (19 y 31%, respectivamente). En el Golfo de Vera, crustáceos y peces representaron el 35% del IRI, mientras que los cefalópodos representaron el 27% restante. Las diferencias en la dieta y condiciones ambientales entre las áreas analizadas, y la presencia en Alborán de la especie cogenérica *Galeus atlanticus*, con distribución batimétrica y dieta similares a *G. melastomus*, podrían ser las causas de las diferencias observadas en la condición somática.

Keywords: Mediterráneo Occidental, *Galeus melastomus*, condición, trofismo, factores ambientales, valor nutricional.

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EFFECTS OF ENVIRONMENTAL CONSTRAINTS ON THE OXIDATIVE STATUS OF A*scophylum nodosum* AND *Fucus serratus*

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Being organisms of the intertidal, several species of macroalgae are periodically exposed to different environment constraints, including extreme temperatures, high UV radiation and desiccation. As a consequence of these fluctuations, the normal metabolism of the cells can be disrupted, favoring the occurrence of oxidative stress, by an overproduction of reactive oxygen species (ROS). However, up to date, little is acknowledged regarding the physiological responses of macroalgae to environmental factors and their contribution to the vertical distribution of the species. In this way, the present study intents to understand the effects of environmental factors (UV radiation, dissection and high temperatures) on the physiological performance of two macroalgae species found in the North coast of Portugal: *Ascophyllum nodosum* and *Fucus serratus*. For this purpose, samples of each macroalgae were randomly collected at both high and low tide in a rockyshore, immediately frozen under liquid N_2, and used for the assessment of several biomarkers of oxidative stress: hydrogen peroxide (H_2O_2), lipid peroxidation, total thiols and the accumulation of proline. Results showed that both H_2O_2 and lipid peroxidation contents were species-dependent, but did not change between tides, while proline accumulation was dependent of both factors. Regarding total thiols content, no significant changes were recorded. Moreover, it was noticed that *F. serratus* had consistently higher levels of all studied parameters compared to *A. nosodum*, suggesting the existence of different threshold levels for environmental agents. Altogether, our results suggested that *A. nosodum* and *F. serratus* differently cope with environmental constraints, though further research is needed to adequately address this question.

Key words:macroalgae; intertidal zone; oxidative stress; environmental constraints

FEEDING ECOLOGY OF SIGNATHIDS INHABITING MEDITERRANEAN SEAGRASSES

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Abstract: Syngnathids are an emblematic, vulnerable and diverse group of the ichthyofauna associated to vegetated coastal and estuarine habitats. Seagrass meadows, where pipefish aspect and behavior makes them mimetic, provide shelter and food, and seem to be preferred habitats. However, syngnathid population dynamics and feeding habits are poorly known, especially in Mediterranean coastal waters (Vizzini and Mazzola, 2004). In order to understand syngnathid population dynamics and feeding ecology, we studied pipefish assemblages from two seagrass habitats in the Balearic Islands: *Posidonia oceanica* and *Cymodocea nodosa* meadows. We sampled pipefish community using an artisanal epibenthic trawl and associated epifauna (i.e. potential preys) in warm and cold season. Syngnathids were identified and measured (n=73), stomach content and sexual maturity were also studied (n=41). Epifauna samples were identified to main taxon. A total of 4 pipefish species were found: *Syngnathus typhle, S. abaster, Nerophis ophidion* and *N. maculatus*. The most abundant species found in *C. nodosa* meadows was *S. abaster*, while in *P. oceanica* meadows was *S. typhle*. Individuals captured in *P. oceanica* were significantly larger in size than those living in *C. nodosa*. Main prey items observed in stomach contents analyses were amphipods and copepods. Copepods and amphipods were also the most abundant groups in epifaunal samples and in both habitats, along with gastropods and polychaetes in *P. oceanica*. While abundance of invertebrates was higher in *P. oceanica*, diversity of epifaunal communities was similar in both types of habitats. Although observed prey items were in accordance with epifaunal communities, variations were detected among pipefish species, sizes and habitats. Additionally, large individuals and some species (i.e. *S. tyhple*) have wider snouts and mouth openings and larger digestive tracts, which allow them to catch and ingest larger preys such as decapods and even small teleost (i.e *Symphodus ocellatus* juveniles).

Key words: Syngnathid, seagrass, feeding habits, population, Mediterranean.

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EFFECTS OF TISSUE PRESERVATION ON CARBON AND NITROGEN STABLE ISOTOPE SIGNATURES IN SYNGNATHID FISHES

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Abstract: The analysis of stable isotopes (SIA) is a useful non-invasive tool to infer the composition of natural diets in fishes. However, the method of preservation applied to samples may affect the results of SIA. In the present study, stable isotope signatures were assessed for $\delta^{13}C$ or $\delta^{15}N$ in adults (dorsal fin clipping) (Valladares and Planas, 2012) or juveniles (entire individuals) of four species of Syngnathidae fishes: reared seahorses *Hippocampus abdominalis, H. guttulatus, H. hippocampus* and *H. reidi*, and wild caught (Ría de Vigo, NW Spain) pipefishes *Syngnathus acus* and *S. typhle.* Three types of preservation (>2 weeks) procedures were compared: 95% Ethanol, 4% Formaldehyde and freezing at -80 °C. In adults (n=21), isotopic signatures for $\delta^{13}C$ or $\delta^{15}N$ in seahorses and pipefishes differed significantly (Kruskal-Wallis test, $p<0.05$) due to differences in their diets but no significant differences were observed when comparing the three preservation procedures. In juveniles (23 batches of seahorse newborn), *H. reidi* and *H. abdominalis* showed similar signatures, differing from those of *H. guttulatus.* As for adults, signatures in juveniles were not significantly affected by the preservation methodology applied. Useful conversion factors of signatures in Syngnathids for the three preservation methods tested are provided. The results achieved in this study may be helpful for comparative purposes and in field sampling when immediate freezing of samples is not available.

Key words: Stable isotopes, preservation, live prey, Syngnathids.

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DAILY AND SEASONAL CHANGES IN ENVIRONMENTAL STRESSORS IN AN ESTUARY: MOLECULAR RESPONSES OF THE ANEMONE *Anthopleura hermaphroditica*

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Abstract: The molecular response of the estuarine anemone *Anthopleura hermaphroditica* was assessed during a tidal cycle and compared between organisms acclimated to summer and winter environmental conditions. Anemones were gathered every two hours between 8:00 - 20:00 h (intertidal area / Quempillén estuary) in order to quantify oxidative damage levels (lipid peroxidation (Salama and Pearce, 1993), protein carbonyls (Mesquita et al., 2014)) and total antioxidant capacity (Brand-Williams et al., 1995). Photo-protective compounds (MAA; (Cubillos et al., 2015) and phenolic compounds (Koivikko, 2008)) with antioxidant capacity were also estimated. Environmental parameters (UV-B radiation, salinity and water temperature) were recorded. During summer, lipid peroxidation and protein carbonyl levels in *A. hermaphroditica* were 3.72-fold and 16.51-fold higher than in winter, respectively. Lipid peroxidation during summer showed a daily peak after maximum UV-B and temperature levels; during winter their levels remained almost constant. Protein carbonyls during summer and winter, increased through the study period exhibiting its maximum levels at the end of the day. Total antioxidant capacity was 1.7-fold higher during winter. A principal component analysis indicates that during summer, antioxidant defenses are mostly triggered by high levels of UV-B and temperature; whereas during winter, salinity is responsible to display an elevated cellular defense potential. Phenolic compounds levels were 1.34-fold higher during winter than in summer, a situation that is positively correlated with total antioxidant capacity. MAA showed similar levels between anemones of each season. Low tide at noon during summer exposes anemones to high levels of UV-B and water temperature, a situation that increase oxidative damage by photosensitization and thermal shock. During winter, salinity reduction increase osmotic stress through the tidal cycle. However, use of phenolic compounds can increase the antioxidant strategy. Temporal changes in environmental conditions in the estuary can force *A. hermaphroditica* to display different defensive strategies to succeed in this habitat.

Key words: Oxidative damage, antioxidant defenses, estuary, UV-B radiation, salinity.

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USING STABLE ISOTOPE ANALYSIS TO ASSESS TROPHIC RELATIONSHIPS BETWEEN ATLANTIC BLUEFIN TUNA (*Thunnus thynnus*) AND STRIPED DOLPHIN (*Stenella coeruleoalba*) IN THE STRAIT OF GIBRALTAR

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Abstract: Stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$ from liver and muscle) was used to assess trophic relationships between Atlantic bluefin tuna (ABFT) (*Thunnus thynnus*) and striped dolphin (SC) (*Stenella coeruleoalbla*) in the Strait of Gibraltar (SoG). $\delta^{15}N$ values of ABFT muscle and liver tissues (n=30) were significantly different from those of dolphin samples (n=7), but no for $\delta^{13}C$ values. Diet estimation by SIAR mixing-models from muscle revealed that ABFT fed mainly on squids (*Todaropsis eblanae* and *Illex coindetii*), whereas liver data suggested that the Atlantic horse mackerel (*Trachurus trachurus*) was also an important dietary component. Regarding the SC, the shrimps *Acanthephyra pelagica* and *Sergia robusta* were estimated to be the main components in the diet. Trophic positions estimated from muscle and liver isotopic data suggested that ABFT occupy higher trophic levels than SC. Estimations of trophic niche, as measured by the standard ellipse corrected for sample size (SEAc), indicated that ABFT show a broader trophic niche than SC; furthermore, SEAc did not show trophic overlap between both predators. The results of this study suggest that resource partitioning occurs between ABFT and SC in the SoG ecosystem.

Key words: $\delta^{13}C$, $\delta^{15}N$, Trophic biology, Scombridae, Delphinidae

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MACROFAUNA ASSOCIATED TO THE BLUE MUSSEL (*Mytilus galloprovincialis* LAMARCK, 1818) ON SEAWALLS AND NATURAL ROCKY SHORES AT THE RÍA DE FERROL (GALICIA)

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Abstract: Urbanization of marine shoreline is resulting in fragmentation and loss of natural habitats, including proliferation of new landscape features such as breakwaters and seawalls. Seawalls made of granite blocks are common in many Galician rias (NW Iberian Peninsula); these structures are usually built vertically and support a number of macroalgae and mobile and sessile invertebrate taxa (Bulleri and Chapman, 2004). However, recent work has shown that assemblages settled in these novel habitats differ from those in natural rocky shores in terms of diversity and species occurrence (e.g. Chapman, 2003). Furthermore, there is still little knowdlege about the role of ecosystem engineers (e.g. mussels) as habitat on seawalls. Therefore, we studied the macrofauna associated to the blue mussel, *Mytilus galloprovincialis*, on vertical seawalls and natural rocky substrata (horizontal and vertical) across the Ría de Ferrol. We specifically tested the hypothesis predicting that there will be fewer species on seawalls and assemblages will differ among natural and artificial habitats. Sampling was done in summer 2008 in four locations where vertical seawalls and natural horizontal and vertical rocky shores were present with mussel patches. On each habitat, two sites were selected about 5 m long and separated by 10 m; five replicate samples were taken in the mussel belt in each site with a 10-cm diameter metallic core. Fauna was sorted in the laboratory and identified to the species level whenever possible. In total, ca. 30,000 specimens and 100 different taxa were identified in samples. There were no consistent differences among habitats according to the hypothesis and differences were mostly detected by univariate/multivariate analyses at the scale of site and/or location. There were, however, differences in abundance or presence for some species that seem worth of further research to fully assess whether mussels on seawalls provide the same habitat as on natural substrata.

Key words: Atlantic Ocean, Artificial structures, Ecosystem engineers, Diversity, Intertidal

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Zostera marina HABITATS ARE RESILIENT TO THE PHYSICAL DISTURBANCE CAUSED BY CLAM HARVESTING BUT REDUCES THEIR CARBON STORAGE CAPACITY

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Abstract: Seagrass meadows are capable of modifying biological processes and physico-chemical conditions of the surrounding water column and sediments, providing critical ecosystem services to coastal zones, being identify as "engineering species". Despite so, seagrasses are declining worldwide at alarming rates, with estimates of 30% loss of seagrass extent worldwide since 1980. The aim of this study was to investigate the temporal change of Zostera marina density and biomass and carbon storage at two sites with different intensity of physical disturbance caused by clam harvesting. The meadow under study is located at the Toralla island, Vigo (Spain). Although above ground biomass was significantly higher in the control than in the impact site at the beginning of the study, the increase in above-ground biomass from May to September of this species was significantly higher at the impacted site than in the area not affected by the disturbance. Four months after cessation of the extraction activity, the biomass and density values of Z. marina reached similar values to those measured in the non-impacted site. However, clam harvesting significantly reduced the sedimentary carbon stock reaching similar levels to those recorded in un-vegetated areas. The current closure season established for the recovery of the exploited stocks of bivalves allowed the recovery of Z. marina density and biomass. Nevertheless, other population properties, such as the reproductive patterns and the sedimentary carbon storage capacity were significantly affected by the disturbance

Key words: carbon stock, physical disturbance, resilience, seagrass.

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DETERRENT ROLE OF THE NATURAL PRODUCTS IN TWO TEMPERATE SEAGRASSES

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Abstract:

Marine angiosperms are the only higher plants inhabiting marine environments, where they form extensive meadows in shallow coastal waters. Seagrass meadows are one of the most important coastal habitats of the biosphere, bearing a great ecological value because of the services and functions they provide, both to the humans and marine ecosystems.

Marine angiosperms possess a secondary metabolism that synthetizes specific organic compounds known as natural products. These compounds play important roles in the survival of the plants, including their involvement in chemical defence mechanisms. One of the ecological functions played by these natural products could be their deterrent capacity against herbivores. The consumption preference of a herbivore of one or another species, is determined by the palatability of the plant tissues. Plants can modify this palatability through different strategies that are based on chemical, nutritional, and mechanical adaptations. Strategies based on chemical adaptations, that is, on the synthesis of natural products, have an important function in restricting the taste quality of marine plants, but also can make these tissues toxic for consumers.

In order to demonstrate that temperate seagrasses (*Zostera noltei* and *Cymodocea nodosa*) bear natural products and their deterrent capacity, we conducted a set of trials where various diets included in blocks of agar, composed either of: 1) seagrass lyophilized tissues, 2) extracts of plants or 3) natural products isolated from *Z. noltei* (rosmarinic acid and flavonoids) were used to feed to a generalist herbivore (*Paracentrotus lividus*). Our results showed that there was a clear decrease in the consumption of those diets containing few sugars and a high percentage of natural products, which clearly indicated that both the presence of these natural products and the absence of sugars greatly influence the palatability of the tissues and the feeding behaviour of the herbivore.

Key words: *Zostera noltei*, *Cymodocea nodosa*, rosmarinic acid, flavonoids.

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STUDIES ON THE ANTIFOULING ACTIVITY OF NATURAL PRODUCTS IN TWO SEAGRASSES FROM THE BAY OF CADIZ

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Abstract:

The term fouling describes the accumulation of macromolecules, microorganisms and epiphytic fauna and flora on surfaces in the aquatic environment. This process occurs naturally due to the need of many organisms to join surfaces to carry out their life cycle.

The fouling on the leaves of marine angiosperms reduces the light intensity that reaches the plant, thus decreasing the photosynthetic activity. One of the ecological functions of the natural products biosynthesized by these plants could be the inhibition of the settlement and growing of organisms on their leaves.

In this work, we carried out an *in situ* combined with a mesocosm experiment to study the antifouling role of the natural products of the species *Zostera noltei* and *Cymodocea nodosa*. We used seagrass "mimics" that were designed to imitate the leaves of the plants and their content in natural products. The length and flexibility of the mimics were similar to that of the studied species in order to simulate the natural response that plants have against hydrodynamics.

Results demonstrated that the extracts of both *Z. noltei* and *C. nodosa*, as well as the products isolated from *Z. noltei* (rosmarinic acid and flavonoids) reduced the biomass of epiphytic algae when compared with the control treatments. These results suggested that phenolic products could play an antifouling role in marine angiosperms.

Key words: *Zostera noltei*, *Cymodocea nodosa*, rosmarinic acid, flavonoids.

Acknowledgments: Financial support from MINECO (Spain), research project CTM2017-85365-R, is acknowledged.

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EFFECT OF UPPER-BEACH MACROFAUNA ON METABOLIC RATES DURING WRACK DECAY

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Abstract: Sandy beaches constitute a dynamic interface between marine and terrestrial environments, where inflows of organic matter occur mainly in the form of beach-cast wrack (Rossi and Underwood 2002). Decomposition and processing of these inputs stand out as central components of ecosystem functioning and the biogeochemical processes associated with nutrients and carbon cycling (Swift et al. 1979; Moore et al. 2004; Barton et al. 2013). To investigate the effect of upper beach macrofauna in wrack decomposition and carbon cycling, a manipulative experiment was carried out on Ladeira beach (42° 34.33" N; 9° 3.16" W - NW Spain), where wrack decomposition rates and metabolism in the presence or absence of invertebrate macrofauna were assessed. The results have proved that activities carried out by macrofauna inhabiting the upper beach are relevant in the decomposition of wrack deposits. Both the weight losses and the degradation rates were significantly higher in treatments with macrofauna access. CO_2 fluxes measured throughout the experiment have shown that wrack patches act as `hot spots´ of biogeochemical activity, supporting higher metabolic rates with maximum values of CO_2 flux recorded in this study ~ 12 µmol C m^{-2} s^{-1}. Microbial activity was estimated as being the main contributor to the respiration measured during wrack decay, but fragmentation and activities carried out by the macrofauna have significant effects on both the mass loss, degradation rates and carbon fluxes associated with wrack decay process.

Key words: sandy beaches, wrack decay, upper beach macrofauna, metabolism

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DETERMINATION OF ORGANIC MATTER BURIAL RATES AND SOURCES IN A COASTAL WETLAND

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Abstract: Salt marshes, mangroves, and sea grasses have a high capacity to store carbon. Still, information is relatively sparse about the influence of diversity, and anthropogenic impacts in these key 'Blue Carbon' habitats. Thus, we set out to examine long-term organic matter (OM) burial rates in a coastal wetland with both a high diversity, and long history of human impacts, Cádiz Bay (SW Spain).Using replicate sediment cores we examined profiles of biogeochemical properties, and quantified long-term fluxes of organic carbon (OC), nitrogen (ON), and total sulfur (TS) over a transect consisting of 4 sites; extending from the lower salt marsh (covered by *Spartina maritima*, ~ 0.3 m mean sea level, MSL) to the lower intertidal region (dominated by *Zostera noltei*, ~ -0.7 m MSL). We also examined the sediment OM sources in each site using an extensive dataset on the carbon and nitrogen stable isotopes ($\delta^{13}C$ and $\delta^{15}N$), and C/N molar ratios of primary producers in the region. The OC burial rates decreased from ~80 gC m^{-2} y^{-1} at the sites below MSL to ~ 50 gC m^{-2} y^{-1} in the lower salt marsh. ON burial rates showed an opposite pattern, with values of ~ 3 gN m^{-2} y^{-1} and ~ 4 gN m^{-2} y^{-1} observed below and above MSL, respectively. TS burial rates were highest at the seaward bare sediment site (~ 35 gS m^{-2} y^{-1}) and substantially lower at the salt marsh site (~ 11 gS m^{-2} y^{-1}). Analysis of potential OM sources to the surface sediments suggested a well-mixed combination of subtidal and terrestrial/high-marsh sources, with no clear indication of an increased contribution from the particular vegetation species inhabiting the sediments. In addition, the indication that there is substantial transport, remineralization and cycling of OM between habitats, suggests diversity may play an important role in maintaining this function.

Key words: Blue carbon, burial, Salt marsh, Seagrass, Cádiz Bay

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TEMPORAL AND SPATIAL DISTRIBUTION OF CETACEANS IN THE AZORES USING ECOLOGICAL NICHE MODELS

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Abstract: The archipelago of the Azores is an important cetacean habitat where have been sighted at least 28 different species, including resident, seasonal and occasional species. During the last years, an increasing attention has been paid to address the impact of the environmental variability on cetaceans and other highly mobile pelagic organisms (Prieto *et al*., 2017; Tobeña *et al*., 2016). In this study, we propose a method to study the habitat preferences and the temporal distribution of cetaceans in the Azores area based on integrating daily prediction maps built with ecological niche models (ENM). They relate species occurrences to environmental conditions at known locations and dates. ENM were first developed using both presence/pseudo-absence data extracted from a sightings database collected between 2008 and 2014, comprising 7721 sightings of 20 different species and a set of environmental variables based on daily composites of oceanographic data derived from satellite images, i.e. temperature, chlorophyll and currents, and bathymetry. Then, environmental data were integrated in a regular geographical grid (0.25º x 0.25º) and used as input of ENM to produce daily distribution maps across the complete period and study area. Finally, these maps were combined in monthly, weekly and yearly composites in order to analyze the temporal distribution. Results show distribution anomalies related to the ocean variability in both resident and seasonal species. For instance, common dolphin (*Delphinus delphis*) was the most sighted species with 1601 records. It is spread all over the year with maximum between June and August (36.6% of total sightings). Between March and April 2012, higher sighting frequencies were recorded and related to temperature and chlorophyll anomalies. Despite of limitations due to data quality or availability, this approach could provide important information for conservation and/or management studies.

Key words: Azores, Ecological Niche Models, cetacean distribution

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NOVEL TECHNICS FOR HABITAT DISTRIBUTION MODELING IN MARINE MAMMALS

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The study of species distribution has been greatly improved in the last decades with the use of powerful statistical techniques and Artificial Intelligence algorithms. Those models relate the distribution of a given species with its surrounding environment, providing therefore a better understanding of their habitat requirements. This kind of analyses becomes particularly important when dealing with environmental changes such as climate change or anthropogenic impacts, or to implement effective management and conservation plans to protect species and ecosystems. In the Azores, 28 different species of whales and dolphins have been sighted so far. Some of them are resident in the archipelago, such as the common dolphin or the emblematic sperm whale. Others are sighted seasonally every year, such as the spotted dolphins or the big baleen whales; and others like killer whales or beaked whales, are sighted only occasionally. We have analyzed cetacean occurrence data registered from whale watching platforms off São Miguel (Azores) with the aim of testing different novel methodologies to study habitat preferences of several cetacean species. We applied Generalized Additive Models (GAMs), Support Vector Machines (SVMs) and AdaBoost models, and compared their results. We used a presence/pseudo-absence approach, and a set of environmental predictors, both physiographic (depth, slope and distance to the coast) and oceanographic remotely-sensed variables (sea surface temperature, chlorophyll concentration or ocean altimetry data).

Key words: species distribution models, Azores, marine mammals

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COMPARISON OF HABITAT STRUCTURE OF 4 DENSE POPULATIONS OF THE CRITICALLY ENDANGERED FAN MUSSEL (*PINNA NOBILIS*)

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Abstract: In order to improve the knowledge of the environmental factors promoting the development of dense fan mussel (*Pinna nobilis*) populations, a three year's project has been undertaken. Oceanographic parameters (Dissolved Oxygen, pH, Chlorophyll *a*, turbidity, salinity and temperature), granulometry, organic matter, sedimentation rate –monthly to bimonthly– and seagrass status –annually– are being studied in 4 locations situated in Calpe (Alicante, Spain) and Boka Kotorska Bay (Montenegro). All locations hosted dense populations of *P. nobilis* and were selected as models to study the optimum environment for the development of dense fan mussel populations.
Pinna nobilis is an endemic Mediterranean species that can reach more than one meter in shell length, being the largest bivalve of the Mediterranean and one of the largest in the world. It is known that the main habitat are the seagrass (*Posidonia oceanica*) meadows, but it can develop dense populations in other habitats such as maërl beds, marine coastal lagoons and *Cymodocea nodosa* meadows. Few studies have undertaken the task of studying the fine features of its optimum habitats in the context of *the* species autoecology. The fan mussels are in critical status after the massive mortality occurred in 2016 and 2017 in the western Mediterranean. The preliminary results of the first year of studies are presented. The data will serve to plan better protection strategies and to improve the selection of habitats for the reintroduction of *P. nobilis*.

Key words: *Pinna nobilis*, ecology, populations, endangered.

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BEST CHOICE OF COASTAL DEFENCES FOR INCREASING INTERTIDAL BIODIVERSITY IN THE AZORES

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Abstract: Coastal urbanisation is increasing worldwide (Bulleri, & Chapman, 2010). However, most man-made structures are poor surrogates for the habitats they replace and can strongly impact the diversity and functioning of coastal habitats. The value of coastal engineering can be enhanced by the provision of microhabitats that facilitate colonisation by marine life (Martins et al. 2010). Here we move one step forward by combining species coexistence theory, resource patchiness, and applied ecology in order to find ways that maximise the biological diversity of coastal defence structures. Featureless areas of a seawall were modified by the addition of microhabitats (resource) that were distributed in different configurations. We focus on three gastropod species abundant in the intertidal rocky shores of Azorean Archipelago, the limpet *Patella candei* and the littorinids *Tectarius striatus* and *Melarhaphe neritoides*. We found that patchiness in microhabitat distribution affects biodiversity, and gastropod diversity peaked at intermediate levels of microhabitat patchiness. This appeared to be driven by different patterns of resource use among species. Moreover, the ability to find microhabitats differed among species; Dispersal of gastropods was greater on unmodified seawalls than on natural rocky shores but when microhabitats were added dispersal decreased. Therefore, we conclude that the extent of microhabitat patchiness could potentially be tailored by coastal engineers to meet specific conservation priorities: increasing diversity vs. increasing number of individuals.

Key words: Coastal urbanization, benthic assemblages, hard bottoms, oceanic islands

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TROPHIC BIOLOGY OF AGE-0 ATLANTIC BLUEFIN TUNA IN THE WESTERN MEDITERRANEAN SEA: NEW INSIGHTS FROM STOMACH CONTENT AND STABLE ISOTOPE ANALYSES

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Abstract: The trophic biology of age-0 *Thunnus thynnus* (ABFT) was investigated at two locations off the Iberian Mediterranean coast (Cambrils and Valencia) between 2012 and 2014 using stomach content analysis (SCA), and stable isotope analyses of bulk-tissue (BSIA) and individual amino acids (AA-CSIA). A total number of 324 stomachs were analysed for prey identification and over 160 samples from muscle and liver tissue were used for BSIA. Liver and muscle samples of 5 of the ABFT individuals caught at each location in 2013 were subjected to AA-CSIA. Interannual and geographic differences were observed in diet and isotopic compositions. Although SCA showed the diet to include a great diversity of pelagic prey, anchovy (*Engraulis encrasicolus*) and Clupeidae were by far the major food resources of the juvenile ABFT, underlining the important role of these small pelagics in supporting upper levels of the food web in nearshore waters of the western Mediterranean. SCA and BSIA results suggest a wider trophic niche for ABFT from Valencia, where the proportions of prey items were more homogeneous than in Cambrils. Beside differences in diet composition, bulk and amino acid (AA) isotopic spatial and temporal variations may also reflect shifts in the isotopic baselines. $\delta^{13}C$ values of essential AAs may be good tracers of carbon sources, though clear patterns relative to primary consumers were not found in this study. Patterns of $\delta^{15}N$ values of trophic relative to source AAs reflected differential fractionation rates, underpinning their usefulness as trophic position (TP) indicators. The TP was estimated from SCA, BSIA and AA-CSIA. Overall, the TPs estimated from the three data sources were similar and lay about 4, with higher values in Valencia. TP values calculated using the AA pair glutamic acid (trophic AA) and phenylalanine (source AA) were close, though lower than, TP estimates derived from SCA and BSIA.

Key words: *Thunnus*, feeding ecology, stomach content analysis (SCA), bulk stable isotope

analysis (BSIA), amino acid stable isotope analysis (AA-CSIA)

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EARLY LIFE TROPHIC INTERACTION OF BLUEFIN (THUNNUS THYNNUS) AND BULLET (AUXIS ROCHEY) TUNAS BY STABLE ISOTOPES ANALYSES

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Abstract: The trophic ecology of bluefin tuna, *Thunnus thynnus* (BFT) and bullet tuna, *Auxis rochei* (BT) larvae from the Spanish Levantine shelf were studied by analyzing nitrogen and carbon stable isotopes ($\delta^{15}N$ and $\delta^{13}C$). Studied larvae were collected during the larval survey of the 2011 MEDIAS acoustic survey off the Spanish Levantine shelf. A total of 179 larvae were analyzed: 109 BFT ranging 3.7-10.5 SL and 70 BT ranging 4.5 to 9.5 mm SL. Differences in the BFT larvae showed significantly lower DW in relation to SL than the BT, implying species-specific differences in larval growth or condition patterns within the same feeding scenario. Previous trophic studies on larvae of apex predators, including BFT and other scombrids, have mainly relied on stomach content analysis, which only records the recently ingested prey. The heavy isotope of nitrogen $\delta^{15}N$ is enriched as it is transferred to higher trophic levels (TL), thereby providing an indicator of the trophic position of an organism. In addition, the heavy isotope of carbon can be used for determining the energy sources of larvae, since it varies significantly among primary producers that have different photosynthetic pathways. The BFT and BT species' signatures of $\check{u}^{15}N$ and $\check{u}^{13}C$ indicate differentiated early life trophic niches utilization. The present study uses $\check{u}^{15}N$ and $\check{u}^{13}C$ as trophic indicators for BFT and the inter-comparison of apex species will provide a solid understanding to the comparative ecology of BFT larvae with direct implication on larval survival and consequent recruitment processes and management strategies repercussion.

Key words: Bluefin tuna, Bullet tuna, Larval trophic ecology, Stable isotopes.

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EFFECT OF PHOSPHORUS AND IRON AVAILABILITY IN A UNICELLULAR CYANOBACTERIA *Halothece* sp. ASSOCIATED TO *Posidonia oceanica*

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Abstract:

Recently, it has been reported that *Posidonia oceanica* meadows are sites of high rates of nitrogen fixation (Agawin et al. 2007). The nitrogen fixation process is carried out by microorganisms called diazotrophs, which converts di-nitrogen (N_2) gas into inorganic nitrogen (Hoffman et al. 2014; Zehr 2011), and it is suggested to play a key role in the sustenance of *P. oceanica* meadows (Agawin et al. 2016, 2017). Phosphorus (P) and iron (Fe) can be important factors controlling the process, however information on this is scarce. This study reports the effect of P and Fe availability in a unicellular cyanobacteria, *Halothece* sp. PCC 7418, whose presence in *P. oceanica* meadows was detected in a previous study using *nifH* gene sequencing. Nine experimental conditions were established (under and without nitrogen deprivation), in which different concentrations of P and Fe were combined. The response variables measured were (1) abundance and growth of bacteria (2) their P-status through measurements of alkaline phosphatase (APase) activity (APA), and (3) their stress response through measurements of reactive oxygen species (ROS) production. The first results without nitrogen deprivation revealed a clear effect of P and Fe availabilities, mainly in the APA and in the production of ROS, in which deprivation of P and Fe induced a dramatic increase in ROS production suggesting stressful conditions for the cyanobacterial nitrogen fixer. APA results revealed decreased activity with increasing P availability while increasing Fe availability had a positive impact in APA. In terms of growth, there were only slight differences among the different P and Fe experimental conditions, suggesting that *Halothece* sp. PCC 7418 may be capable to activate mechanisms to adapt to the environment. These findings have significant implications for the understanding of how P and Fe interact, and their role in the survival and adaptation of this particular species of unicellular nitrogen fixing cyanobacteria associated to *P. oceanica*, at expense of deprivation nitrogen results.

Key words: Nitrogen fixing cyanobacteria, *Posidonia oceanica*, Phosphorus (P), Iron (Fe), Alkaline phosphatase (APase) activity (APA), Reactive oxygen species (ROS).

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RESPONSE OF *Posidonia oceanica* AND THEIR ASSOCIATED MICROBIAL N_2 FIXERS TO PHOSPHORUS (P) AND IRON (Fe) LOADING

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Abstract:

Posidonia oceanica forms extensive meadows in the Mediterranean and serve a number of ecological services. They exhibit high levels of primary production and is considered one of the most productive seagrass populations in the world. Consequently, it should have a high demand for nitrogen (N) to support their production. Recent studies reveal a high diversity of microbes, particulary the "N_2 fixers" capable of converting N_2 gas in the atmosphere into usable forms of new nitrogen (inorganic) that *P. oceanica* can use. Previous estimates suggest that N_2 fixation may contribute up to 100% of the total N demand of the plant. Given the importance of these N_2 fixers, it is necessary to investigate the factors that may control their activities because whatever changes on the N_2 fixation community associated with *P. oceanica* may experience, would consequently affect the health of the *seagrass* meadows and consequently the numerous ecological services they offer. Here we investigate the effects of short term enrichment of two nutrients, such as phosphorus (P) and iron (Fe), considered to be the two most important limiting nutrients for biological N_2 fixation. The study was done during summer 2017 in 100 - L aquaria containing whole *P. oceanica* shoots which received water column loadings of Fe [-Fe, + High Fe] and P [-P, +high P] availabilities, and interactions of these. The N_2 fixation activities associated to the different plant parts were measured as well as the response of the plants themselves in terms of metabolic rates (primary production). Initial results indicate that high P loadings can be detrimental to leaf primary production and response in terms of N_2 fixation can vary according to different plant parts.

Key words: *Posidonia oceanica, N_2 fixation, Phosphorus and Iron enrichment*

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IDENTIFYING SEA SURFACE DYNAMICS PROCESSES DRIVING SPAWNING ECOLOGY OF TUNAS IN THE BALEARIC SEA, APPLICATION TO FISHERIES ASSESSMENT

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Abstract: Marine species adapt their reproductive strategies to spawn in favorable habitats that maximize survival of early life stages (Ciannelli et al. 2015). Identifying those habitats and characterizing their particular environmental conditions allow understanding species ecology and habitat relationships. Among other factors, surface hydrodynamic processes are major drivers during early life stages forcing larval retention and dispersion patterns and shaping trophic and predation ecology. It is well known that mesoscale oceanography plays a key role in the reproductive ecology of big migratory top predators such as tunas, but it is still poorly understood how the dispersion/retention patterns and the surface mixing processes shape spawning and larval habitats (Reglero et al. 2014; Muhling et al. 2017). The Balearic Sea, in the Western Mediterranean, is a hot-spot in marine biodiversity and a major spawning ground of tuna species (Alemany et al. 2010). Here we investigate which are the particularities of the oceanographic conditions in this region affecting the spawning ecology of pelagic species, and how this information could be applied to better characterize the larval habitats of Bluefin tuna (*Thunnus thynnus*). Using a high resolution hydrodynamic model and the Finite Size Lyapunov Exponents we analyze the dispersion/retention patterns and the surface mixing processes in the region. We find that during spring-summer, when most tuna species spawn, the Balearic Sea presents higher retention ratios and lower surface mixing than other areas in the Western Mediterranean. We also show that identification of larval habitats of Bluefin tuna, used for fisheries assessment (Ingram et al. 2017; Alemany et al. 2010) , improves when seascapes

of surface mixing are considered. This study is an example of the relevance of linking species ecology and oceanography to advance on fisheries sustainability and conservation, and it would be applicable to improve the assessment of tuna species in other geographical areas.

Key words: Larval habitats, Balearic sea, fisheries, dispersion/retention patterns, Lyapunov Exponents.

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MATERNAL ISOTOPIC NICHE ESTIMATED IN ATLANTIC BLUEFIN TUNA LARVAE (THUNNUS THYNNUS) OF THE NW-MEDITERRANEAN SPAWNING AREA

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Abstract: Atlantic bluefin tuna (ABT, *Thunnus thynnus* Linnaeus, 1758) mainly reproduces in the NW Mediterranean Sea (MED) and the Gulf of Mexico (GOM), being categorically differentiated for fisheries assessment and management in Western and Eastern ABFT stocks. Stable isotope analysis (SIA) has proven useful in evaluating the diet and trophic relationships in marine ecosystems. The current study shows that the ontogenetic evolution of the stable isotope content in fish early life stages can also be used to infer isotopic information from the breeders. Studied larvae were collected from two distinguished hydrological sites, the Spanish Levantine shelf and Balearic Island spawning area. An isotopic maternal transmission model for ABT was used to provide estimates of maternal isotopic signatures from nitrogen and carbon isotopes values analyzed in preflexion larval stages from aquaculture facilities. Maternal isotopic trophic widths have been estimated using SIBER package (Stable isotope Bayesian ellipses in R) of SIAR (Stable Isotope Analysis in R). Maternal isotopic niche are discussed under a comparative ecosystem approach. This pioneering methodology will allow estimates of the nutritional status of the spawners through the $\delta^{15}N$ and $\delta^{13}C$ signature of their offspring opening new research horizons that can begin to estimate the maternal trophic characteristics that influence larval survival, growth and condition with a direct effect on recruitment.

Key words: Bluefin tuna larvae, Stable isotopes, Trophic ecology, Isotopic niche.

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SPATIALLY EXPLICIT CAPTURE-RECAPTURE MODEL ON COMMON OCTOPUS: HOME RANGE AND POPULATION DYNAMICS.

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Abstract: A spatially explicit capture-recapture (SCR) model was applied to estimate simultaneously population parameters and individual activity (i.e. home range size) of *O. vulgaris* inhabiting human-altered coastal waters in the W-Mediterranean, based on experimental mark-recapture data. Seventy-two octopuses were captured by baited traps and plastic pots, tagged with subcutaneous PIT-tags and released. Nineteen tagged individuals were recaptured (recapture rate: 26.4%) in the same area over the study period, which spanned from September (just before/during juveniles had been reported to recruit to coastal waters) to March (just before the spawning season). Population sizes and densities decreased over the four fishing periods in which the study period has been divided, from 337 octopuses (8 ind. ha-1) in September-October to 105 octopuses (2.5 ind. ha-1) in February-March. The highest recruitment probability during a fishing period was estimated to occur at the beginning of the study (γT1-T2 = 0.878) but it clearly decreased over time, while mortality probability during a fishing period slightly increased (range: 0.267-0.463). Mean specific growth rate (SGR) was 0.82 ± 0.11 day-1. Individual home range or activity area ranged from 2.8 ha to 7.3 ha (median home range radius: 121.8 m). Overall, these results suggest that human-altered coastal habitats, which are characterized by abundant shelters, abundant food and absence of predators, can act as settlement and growth areas for juveniles and adults of *O. vulgaris*. Furthermore, the methodologies applied in this study (tagging and SCR models) are recommended as innovative tools to improve management actions of coastal resources (Arechavala-Lopez et al. 2018)

Key words: *Octopus vulgaris*, population parameters, demography, activity area, coastal management.

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MICROBIAL PLANKTON IN THE NW IBERIAN COAST: EXPLORING TEMPORAL VARIABILITY IN SIZE STRUCTURE AND COMMUNITY COMPOSITION

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Abstract: This study offers a characterization of the microbial plankton community in the NW Iberian coast by analyzing the size structure and composition of all members of the microbial community in terms of biomass. From November 2008 to December 2009, monthly water samples were collected at a fixed station off Cape Silleiro (NW Spain). Results indicate that changes in environmental forcings had strong impact on microbial plankton distribution. Three main contrasting situations were identified: (1) winter mixing, (2) spring-summer upwelling and (3) the arrival of the warm and salty Iberian Poleward Current waters (IPC) in late autumn. Microbial plankton biomass (TC) fluctuated around a mean annual value of 4.6 ± 2.8 g C m^{-2}. Autotrophic plankton dominated during the spring-summer upwelling. Instead, heterotrophy and trophic balance appears to be a distinctive feature for the IPC and winter mixing, respectively. Size-fractionated analyses indicated that pico- and nanoplankton accounted for a large fraction of TC (64 ± 19%). Nanoplankton variability throughout the year (1.03 ± 0.53 g C m^{-2}) was barely noticed. The same can be said for heterotrophic picoplankton (1.33 ± 0.47 g C m^{-2}), mainly composed of bacterias (> 90%). Within autotrophs, picophytoplankton (0.27 ± 0.23 g C m^{-2}) and particularly *Synechococcus* varied widely, attaining higher importance during the IPC and winter mixing. By contrast, microplankton (2.01 ± 2.21 g C m^{-2}) followed just the opposite trend, being its dominance restricted to events of intense upwelling. In this size class, chain-forming diatoms (*Leptocylindrus danicus)* and dinoflagellates (*Ceratium fusus)* were responsible for the maximum biomass accumulation during summer stratification. Overall, coastal waters analyzed in this study showed greater autotrophy than nearby waters on the shelf (Espinoza-González et al. 2012) but lower than those from the neighbouring Ría (Froján et al. 2014).

Key words: Microbial plankton, Size structure, Trophic composition, Upwelling, NW Iberia

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IDENTIFICATION OF OVER-PRESSURE PRODUCED BY INDUSTRIAL WASTES STOCKPILED ON THE SALT MARSH (TINTO RIVER ESTUARY, SW SPAIN)

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Abstract:
The effect of lithostatic pressure produced by a stockpile of phosphogypsum deposited anthropically directly on the Tinto Estuary salt marshes has been evaluated in this work. Geophisical, bathymetrical and sedimentological studies of vibracores obtained in the subtidal and intertidal area surrounding these wastes. The whole area covered of wastes is around 240 ha and reaches about 30 m average height. Theoretical lithostatic pressure produced by this stacking has been calculated from the data of average density of the phosphate and the estuarine filling materials (1.3 and 1.1 gr/cm^3, respectively). These have evidenced that values are reaches of up to 415 Tn/m2.

The seismic analysis allowed the identification of injections of fluidized sediments from the lower units that completely destroy the internal ordering of the supper units.
These ascensional mouvements of sediments have a bathyimetric response in the intertidal and subtidal areas. The main expressions of these bathymetric changes are mud volcanoes, Mud diapiric and pockmarks (Canet et al., 2010). Mud volcanoes are the surficial expression of the extrusion of a mud diapire to the water environment. Pockmarks and mud diapiric are vertical channels of escape of this fluidized sediments in response to over-pressure caused by the sockpiling.
The presence of these structures in the suroundings of the industrial wastes is an evidence of unstability processes in the base of these anthropic deposits that could culminate in a final collapse. This possibility make necessary more intensive studies about the geothechnical properties of the sediments that support the weight of the stokpile.

Key words: Lithostatic pressure, mud diapiric, industrial wastes stockpiled and Tinto river estuary.

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NEARSHORE SEDIMENT TRANSPORT OF GRADED SEDIMENTS USING FLUORESCENT TRACERS IN PATOS BEACH, SPAIN

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Abstract: Accurate measurement of sediment transport in a natural environment is not currently possible. However, it is achievable to have global information on its movement, transport rate and dispersion (Ingle and Gorsline, 1973). Tracers sands is a widely used field methodology to estimate sedimentary dynamics.

At a beach, the sediment grain size shows a horizontal and vertical variability, and the grain size distribution is one of the factors that affect the sediment behaviour. The mechanisms involved in the sediment transport of heterogeneous sands are not well understood. The uncertainties in practical sediment formulations to describe the selective sediment transport, added to the difficulties of having good quality field data sets (e.g., frequent sediment bed samples) implies gaps in our current knowledge on the morphodynamics of very dynamic coastal systems (e.g., tidal inlets, and beaches).

The beach of Patos (Ría de Vigo, NW Spain) is a favourable environment for a controlled experiment with fluorescent tracers. It is protected from the intense agitation of the Atlantic Ocean by the presence of the Cíes Islands as well as the Monte Ferro Peninsula. According to the study of Rey et al. (2004), performed on the same beach, it is possible to expect a cross-shore movement, since the longshore transport is negligible. In this way, the objective of this work is to characterize the sedimentary dynamics in the beach of Patos from the observation of the sediment tracer behaviour of different grain size, at a depth in which it is not affected by the surf and swash processes. With the results of the current work, it will be possible to obtain the behavior and the tendency of the different fractions of the grain in a natural environment and with local data of agitation. This information will be very important to improve the existing transport formulations.

Key words: Sediment tracer, Northwest Spain, Different grain-size fractions.

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CHANGES IN SEDIMENT BUDGET AT LAS CANTERAS BEACH AT DIFERENT TIME SCALES

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Abstract: Topographic studies and Digital Terrain Models (DTMs) have been largely used to account for the volume of sediments on beaches. In this work, we present how these techniques can be used to either understand seasonal changes as well as longer term variability. The study area is Las Canteras beach (Gran Canaria, Spain), a rather uncommon beach that presents a semi-natural trend to accumulate sediments in its northern sector. Due to the mentioned accumulative trend, the volume of sediments has become so high that in 2003 and 2009 different amounts of sand were removed from the beach. Use of several DTMs carried out since 1996 has allowed determining the accumulation rate in different periods. Accumulation trends values ranges from 1200 to 8300m^3/year. Such big difference is explained by recurrent stormy periods.
Regarding the seasonal changes in sediment volume, a set of DTMs were carried out monthly since July 2014 to July 2015. From these data, we have obtained two clearly distinctive patterns along the beach: while the northern sector shows a steady trend to accumulate sediments, the southern sector shows a clear seasonal variability, with erosion in the period December-April and accretion the rest of the year. This variability is clearly related to wave energy.

Key words: Wave climate, Sediment transport, Seasonal changes, Accumulation rate, Digital Terrain Models

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ESTUDIO SOBRE LA VARIABILIDAD EN EL VOLUMEN DE SEDIMENTOS EN LA PLAYA DA MACUMBA (RÍO DE JANEIRO, BRASIL)

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Abstract: La Playa da Macumba se encuentra en la zona oeste de la ciudad de Rio de Janeiro. Presenta aproximadamente 2,4 Km de longitud y orientación general NE-SW, quedando limitada por un tómbolo arenoso al Este y el Canal de Sernambetiba al Oeste. Se trata de una playa reflectiva, de ambiente mesomareal y expuesta al oleaje del Suroeste formada por arenas cuarcíticas de arena gruesa.
En este trabajo se analizó la variabilidad en el volumen de sedimentos, considerando que en algunos puntos ha sido necesario realizar diversas obras de reconstrucción del paseo marítimo en la última década. A partir de los datos recogidos con levantamientos topográficos de perfiles de playa (Muehe, 1996) en siete estaciones de monitoreo desde Julio de 2015 hasta Enero de 2016, se construyeron mapas de los distintos perfiles morfológicos y se calculó el área de sedimentos (m^2) de cada perfil usando el software Origin 8.
Los resultados obtenidos muestran que las estaciones 4 y 5 presentaron mayores variaciones en los perfiles y pérdidas de sedimentos en el período estudiado, con variaciones estacionales de anchura de aproximadamente 30 m y variación máxima de volumen de sedimento de 40%. De hecho, ocho meses después del estudio tuvo lugar un fuerte temporal que destruyó por completo el paseo marítimo de la estación 5. En la estación 7, cerca del Canal de Sernambetiba, también se observaron grandes variaciones del área de sedimentos. En dicho canal se realizan periódicamente obras de dragado, donde se retiran grandes cantidades de arena que no son reincorporadas al sistema, lo que altera el balance de sedimentos de la playa. En conclusión, es necesario un control del volumen de sedimentos dragados y el seguimiento de la hidrodinámica de la zona (olas y corrientes) para una mejor gestión de la playa y una planificación adecuada para su conservación.

Key words: Erosión costera, perfiles de playa, Playa da Macumba

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THE SINGING SANDS OF "LA LLORONA" BEACH (WESTERN MEXICO): SPECTRAL, TEXTURAL AND MINERALOGICAL CHARACTERIZATION

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Abstract: Sound-producing sands, also known as musical sands or booming sands can be found in deserts and beaches on earth (Lindsay et al., 1976; Nori et al., 1997; Hunt et al., 2010). This research studies, for the first time, the characteristic singing or squeaking sand of La Llorona beach, located in the western part of Mexico (Michoacán, Pacific Ocean). An integrated analysis were performed, which includes: i) spectral analysis of the sound showing the dominant frequency as well as the higher harmonics; ii) grain size distribution (components and curves); iii) petrographical analysis based on thin sheets of the sand and in representative rocks, which outcrops surround the beach; iv) mineralogical analysis performed with X-ray diffractrometer; v) particle roundness and sphericity parameters using charts and image analysis program; and vi) recognition of microfeatures on sand particles surfaces. All of these particular sound, textural and mineralogical characteristics has been compared and discussed with other representative squeaking sands, in order to clasify, and stablise similarities and differences of this representative Mexican singing sand. Additionally, this contribution highlight that the singing sand also has a high potential to disseminate earth science (in particular sedimentology) in non-formal education scenarios, which can be integrated in, for example, artistic exhibitions and installations (Villanueva-Marañón, 2015).

Key words: sedimentology, outreach, education, sandy beach, Pacific Ocean.

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TRACE ELEMENT FLUXES DURING THE LAST 60 YEARS IN A TROPICAL ESTUARY, CARAVELAS, BAHIA, BRAZIL

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Abstract: The Caravelas estuary located in the Brazilian coast (south of Bahia) has an important ecological role, due to its mangroves and its location, next to Abrolhos coral reef, the most important one in the Southern Atlantic Ocean. During the last 60 years, the estuary has been subjected to the natural widening of a new inlet and land use changes, especially due to the development of the eucalyptus monoculture. To evaluate the fluxes and mobilization of trace elements due to natural changes and anthropogenic activities in the area, three dated sediment cores from the middle estuary (T2) and from the estuary mouth (T5 and T8) were analyzed. Mass accumulation rates (MAR) were calculated based on the data for the excess ^{210}Pb ($^{210}Pb_{xs}$) for these cores from Angeli et al. (2016), whereas trace elements (As, Cr, Cu, Ni, Pb and Zn) were analyzed by ICP-OES. The depth profiles of the element fluxes in the sediment cores reflected the effects of the interconnecting channel and its influence on trace element inputs. Moreover, in general, all sediment cores showed marked increases in trace element fluxes corresponding to maximum average discharges of the Peruipe river through this interconnecting channel, confirming the significant role of this river in the sediment supply of the Caravelas estuary. Finally, the increasing trend of trace element fluxes in recent years supports the idea of land use change, that the region has been subjected, primarily due to the monoculture of eucalyptus development, which has enhanced the erosion and runoff of the contaminated soils from the catchment. Such information is vital for the effective management of coastal systems, mainly when considering natural and anthropogenic ongoing changes in its forcing conditions.

Key words: Trace elements, fluxes, Caravelas estuary, Brazil.

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FORCINGS AND ORIGIN OF SEDIMENTARY INPUTS IN THE RÍA DE VIGO

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Abstract:
The objective of this work is the evaluation of the forcing mechanism that control the sedimentary dynamics in a ria environment. The concentration of particles in suspension (SPM) is a determining variable for understanding the functioning of coastal environments. In the case of the Galician Rias, where intense economic activity is associated with high productivity, it is even more important.

The study of sediment transport and, in particular of SPM, requires analyzing two aspects fundamentals: the forcing and sources of sediment available. The forcing (tides, waves, wind and fluvial discharge) and their relative influence are very diverse, varying from one coastal medium to another. In the case of the Rias, the middle and outer zone is controlled by the combination of waves, currents and tide, while the inner part is conditioned by tidal currents and fluvial discharge. The sources of SPM are also diverse in the Rias, being able to discriminate between local and external sources. Among local sources, bottom erosion, fluvial discharge, human activities or biological sources are identified. Among the external sources, the SPM reaches the rías primarily by advection from the open ocean, identifying the upwelling and the Minho plume as possible sediment inputs.

In this work, from data measured in two deployments located in the Ría de Vigo, the characteristics and sedimentary dynamics have been studied, deepening in the relative influence of the forcing and identifying the sedimentary contributions. Time series of speed and direction of current, turbidity, temperature and salinity have been analyzed. In addition, monthly samples have been collected with sediment traps. These deployments were located at the southern entrance of the ría and in the middle zone and lasted for 6 months.

First data have shown the negative correlation between the turbidity signal in the water column and the sediment deposition on the sediment traps. This reveals the influence of current system in the behaviour of the SPM, since high velocities are able to keep great concentrations of sediment in suspension.

Key words: SPM, Rias, forcing processes, sediment sources, upwelling, fluvial plume, deployments

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SERIE DE TIEMPO CARIACO: ANALISIS DE 17 ANOS DE MEDICIONES DEL FLUJO DE PARTICULAS.

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La Fosa de Cariaco (plataforma continental Venezolana) posee peculiares características bio-geoquímicas ideales para el estudio del flujo de partículas. Además, su anoxia (>250m) preserva un registro sedimentario que permite estimar los climas pasados. Desde 1995 se colocaron trampas de sedimentos a 250, 410, 810, 1310 m, en la estación CARIACO (10.5° N, 64,67°W). Cuantificando el flujo total de partículas; de carbono y nitrógeno orgánicos; ópalo; carbonatos y materia mineral terrígena. Se examinaron 17 años de mediciones del flujo, determinando cambios dependientes de la profundidad y del tiempo, variaciones estacionales, tendencias, y la relación con variables ambientales en aguas superficiales (clorofila, producción primaria, C orgánico particulado, biomasa zooplancton). La disminución del flujo con la profundidad mostró anomalías relacionadas con la época del año. Solo el 1% del Corg fijado en superficie enriquece los sedimentos del fondo. La anoxia no parece promover un mayor aporte de Corg a las partículas y los sedimentos. La composición y compuestos presentes en las partículas señalan al fitoplancton como la génesis de la materia orgánica, manifestándose en la estacionalidad de los componentes del flujo, con máximos en marzo y mayo (final surgencia) y mínimos en septiembre y octubre, presentándose flujos más elevados de C, N orgánicos y ópalo durante la surgencia y de CaCO3 en la época de estabilidad. Las mejores correlaciones entre las variables ambientales y las del flujo se observaron con el ópalo, Corg, producción primaria y el zooplancton. Lo que sugiere que el ópalo funciona como lastre mejor que el CaCO3 controlando el flujo de Corg, y la biomasa de zooplancton muestra un importante papel en la generación de partículas y su traslado hacia aguas profundas. A largo plazo el flujo total mostró tendencia a incrementarse, mientras el flujo Corg y ópalo se mantuvieron estables, el incremento es causado por CaCO3 y terrígenos.

Key words: Fosa de Cariaco, oceanografía, sedimentos, ecología, biogeoquímica.

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GEOMETRY OF THE SEISMIC UNITS OF THE TINTO RIVER ESTUARY (HUELVA, SW SPAIN)

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Abstract: The estuary of the Tinto River is located on the southwest coast of the Iberian Peninsula, in the northwestern sector of the Gulf of Cádiz. This river, born in the range of Huelva and its fluvial course cross this province until flowing into the Atlantic Ocean, in an estuarine system known as "*Ría de Huelva*".

During the month of November 2016, a geophisical survey was carried out using seismic reflection. A parametric profiler INNOMAR SES2000 was employed, using a frequency of 6 KHz that permit a penetration in the underground greater than 3 meters. The purpose of this geophysical campaign is the realization of a three-dimensional model of the sedimentary units that constitute the most recent infilling of the Tinto River. For that, a net of profiles along and across the estuarine channel was surveyed in order to get the three-dimensional geometry of the sequences.

The arrangement of the reflecting surfaces in the records allowed distinguishing the sedimentary units and determining the geometrical relationship between them. Non conformities are useful to identify the high-energy events that have taken place in this estuary in the most recent period.

The Tinto River channel has areas where the units do not have very noticeable discordant surfaces, however there are others in which the units overlap discordantly and eroding almost complete lower units, thus exposing others deposited centuries ago. On the other hand, the records show that the upper units have a sigmoidal geometry and are arranged in an aggrading and southeastward prograding direction. These geometries are evidence of a migration of the present channel at the same time that other structures are visible to the northwest.

Key words: Estuary, Tinto River, seismic-reflection profiling, litho-seismic units.

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EFFECTS OF THE STORMS EMMA AND GISELE IN WINTER 2018 ON THE HUELVA COAST (SW SPAIN)

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Abstract:
From the 1st of March three successive storms affected directly the Huelva Coast in three weeks. Two of these storms, named Emma and Gisele coincided with spring tides. The coincidence of high astronomic tides and a storm surge of 0.60 m, elevated the sea altitude to unusual levels. The duration of various days of these storms provoked also the coincidence on the coast of sea waves and strong winds. In the case of Emma, the 1st of March, wind reached velocities upper than 30 knots, that incremented the wave dimensions to reach Hs of 6.40 m.
The coastline, mainly composed by sandy beaches, received these storms in different ways. Those beaches with a natural profile and well developed foredunes suffered moderate erosion. In some localities like Isla Canela, the dunes were overwashed creating sandy fans on the back salt marshes. In other beaches, like Playa del Hoyo (Isla Cristina), the sand eroded from the dunes migrated to lower areas of the beach. In this case, the beach slope became minor evolving to dissipative conditions to the breaking waves.
The main part of damages was experienced by urban beaches. Every urban structure located in places where the foredune was eliminated suffered a severe destruction. So, the sand of beaches like La Antilla (Lepe), Nuevo Portil (Punta Umbría), Mazagón and Matalascañas was completely transported to the shoreface, disappearing at all from the foreshore and digging out concrete foundations. In consequence, the waves swash directly on the rigid structures and destroyed entire promenades and buildings of the first line.
The arrival of Gisele, two weeks later, again during spring tide conditions increased the damages in the urban beaches previously dismantled by Emma. The arrival of two severe storms is exceptional and occurred last time in 1996 (Ballesta et al., 1998).

Key words: Emma storm, Gisele storm, Huelva Beaches, damage.

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ARENARIO COSTERO

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Abstract: El proyecto "Arenario costero" busca la creación de un archivo y una base de datos representativo de los diferentes tipos de arena que podemos encontrar a lo largo de las costas de Península Ibérica y de algunas regiones significativas de ultramar.

Su objetivo general es contribuir a mejorar la educación científico–técnica de la sociedad en todos los niveles, apoyando en especial la enseñanza de las ciencias desde las primeras etapas escolares hasta la universidad y así impulsar la participación activa de la sociedad en actividades de divulgación científica y en las actividades de investigación. Se realizará a través de una recogida de muestras en la que podrán participar todas las personas interesadas de dentro y fuera del ámbito académico. El proyecto comprende la recolección y envío de la muestra junto con datos básicos de la zona de recogida por parte el público participante en esta actividad. Su recepción, análisis, interpretación y archivo será llevado a cabo por los alumnos de CC do Mar, quienes se encargarán de determinar su tamaño y composición y de generar un informe explicativo en el que se infieran las principales características de la playa (i.e. energía de playa, procedencia de la arena) a partir de los datos de las muestras.

Una vez puesto en marcha el proyecto, el siguiente objetivo será divulgativo y tecnológico, se creará una página web oficial en la que podrán acceder a los datos de las muestras, su ubicación y su interpretación. Las muestras serán archivadas en la futura Litoteca de la Universidad de Vigo, donde estarán disponibles para referencia y consulta y en donde además se expondrán de forma permanente las más representativas.

Key words: Arenario, playas, Universidad de Vigo

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MARRISK: IMPROVING THE RESILIENCE OF COASTAL AREAS OF GALICIA-NORTH PORTUGAL

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Abstract: The main objective of MarRISK project (0262_MARRISK_1_E) is to ensure smart and sustainable growth of coastal areas of Galicia and Northern Portugal by assessing the most important coastal risks in a climate change scenario. Flooding, intensification of extreme events, episodes of toxic algae or coastal erosion are examples of risks that are necessary to take into account in order to improve the resilience of traditional economic sectors and other emergent sectors as marine renewable energies.
In this way, different climate services will be developed with the aim of better adapt its strategic economic such as tourism, traffic maritime and port sector, fisheries and shellfish sector, including off-shore aquaculture and energy marine renewable energies to climate change. To achieve these goals the project is divided into different activities. The first one is devoted to the consolidation and strengthening of observational capability, essential to follow different variables and indicators and to quantify changes and trends associated with climate change. Hydrodynamic, wave and biogeochemical modelling is the second activity that will produce the future scenarios for coastal areas, taking into account two different climate change scenarios (RCP4.5 and RCP8.5). With these scenarios different climate services will be produced to translate outputs of the models to specific riks related to floods, erosion or life resources. All the results of the project will be disseminated to the specialist and general public with a special focus on stakeholders.

Key words: Coastal Observatories, Coastal risks, Global change, Galicia – North Portugal Euroregion.

Acknowledgments: This contribution has been funded by the European Union MarRISK project: Adaptación costera ante el Cambio Climático: conocer los riesgos y aumentar la resiliencia (0262_MarRISK_1_E), through EP-INTERREG V A España-Portugal (POCTEP) program.
www.poctep.eu/es/2014-2020/marrisk

EFFECTS OF THE ATMOSPHERIC CO2 INCREASE ON PIGMENT CONCENTRATION IN THE CYANOBACTERIA SYNECHOCOCCUS SPP. FROM TWO DIFFERENT MARINE HABITATS

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ABSTRACT

Previous studies have shown that high CO_2 levels expected for future scenarios of global change might result in phytoplankton with higher sensitivity to photoinhibitory conditions than those exposed to present CO_2 levels. This response, mainly observed in diatoms, has been attributed to a decrease in the repair rates caused by the lower levels of enzymatic activity and cellular pools observed, but could also be attributed to greater damage related to decreased protection. In this study, we will focus on the effects of elevated CO_2 on the components of the xanthophyll cycle, a pigment cycle involved in the dissipation of excessive energy in the cell. The CO_2 effect will be tested on a globally distributed cyanobacteria species, *Synechococcus* spp., isolated from two different marine habitats: the strain WH7803, typical from coastal areas, is observed during transition periods between mixing and stratification, while the strain WH8102 is adapted to oligotrophic environments and appears in open-ocean waters. The cultures were acclimated during at least 3 weeks with current concentrations of atmospheric CO_2 (400 ppmv CO_2 = Low CO_2) and with concentrations expected for future scenarios of climate change (1000 ppmv CO_2 = High CO_2). HPLC results showed that in *Synechococcus* spp. violaxanthin was first de-epoxidated to antheraxanthin and then to zeaxanthin, which relates to cell protection. Chlorophyll *a* and β-carotene concentrations were lower than zeaxanthin concentration in both strains. However, zeaxanthin concentration increased significantly under high CO_2 conditions in the coastal strain after a perturbation but did not change in the open-ocean strain under similar conditions. The results from the coastal strain were more similar to those observed in coastal diatoms, which might imply that differences in functional traits between phytoplankton assemblages from open-ocean vs. coastal waters are more significant than their taxonomic features regarding responses to ocean acidification.

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SEARCHING FOR THIN LAYERS OF PHYTOPLANKTON IN THE UPWELLING REGION OFF NW IBERIA

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Abstract:
Thin layers of phytoplankton (TLP) are a particular case of blooms where high-cell densities are located within a narrow depth interval. They are believed to play an important role in the formation and maintenance of harmful algae blooms. Today we have a limited understanding about the role that these features have in the growth of toxic phytoplankton in the Galician Rías (NW Spain), one of the three larger producers of Mediterranean mussels in the world. We combined field observations, time series analysis, and numerical modelling in order to: 1) describe the characteristics and investigate the mechanisms of TLP formation in the Galician Rías, and 2) to analyze the relationship between the occurrence of TLP and harmful phytoplankton densities. The analysis of the dataset collected by the weekly monitoring between 2012-2015 showed that the frequency of occurrence of TLP was, on average, 3%. TLP were associated with the base of shallow pycnoclines and more frequent from late spring to early summer. High frequency observations of microstructure turbulence indicate that the weekly monitoring probably underestimate the frequency of these events, as these features form and disappear over short periods of time, in response to changes in mixing. Results from a coupled ROMS-PISCES circulation-biogeochemical model indicate that large-spatial events of TLP co-occurred with the intrusion of fresh water into the Rías. The monitoring dataset showed that TLP were more frequently observed in Ría de Pontevedra, also characterized for longer periods of shellfish harvesting closure due to species of the genus *Dinophysis*. In this Ría about 40% of TLP were associated with *D. acuminata* densities above the median;

20% above the third quartile; and 15% with outliers. These results suggest that the occurrence of TLP could be related with the growth or accumulation of certain phytoplankton species, including the main toxin producers in the region.

Key words: Thin layers of phytoplankton, *Dinophysis acuminata*, ocean model, Galician Rías, NW Iberian Peninsula

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VARIABILIDAD DE LAS PROPIEDADES FÍSICAS Y SU INFLUENCIA EN EL ECOSISTEMA DE LA PLATAFORMA CONTINENTAL DE A CORUÑA

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Abstract.

El proyecto RADIALES del Instituto Español de Oceanografía (IEO) constituye un observatorio del ecosistema pelágico en la plataforma continental y océano adyacente del NO de España. A través de este proyecto se obtienen mediciones de variables oceanográficas como la temperatura, salinidad, oxígeno y de las comunidades planctónicas en cinco transectos localizados a lo largo de la costa cantábrica, concretamente en Santander, Gijón, Cudillero, Vigo y A Coruña. Estos muestreos se llevan a cabo con una periodicidad mensual y siguiendo protocolos de trabajo comunes en todos los transectos. En cada uno de ellos se establece la situación de una serie de estaciones en las que se realizará la toma de muestras y la medición de variables oceanográficas. La finalidad de dichos muestreos es la de obtener una serie histórica de datos oceanográficos con el fin de estudiar la evolución temporal de las variables objeto de estudio [1].

Para realizar nuestro estudio contamos con una serie histórica de datos desde 1989 hasta la actualidad tomados con periodicidad mensual en el transecto de A Coruña. Además de esto, desde el año 2012 se realiza para una de las estaciones de este transecto una toma de datos con periodicidad semanal.

El objetivo de este estudio es el de realizar un análisis comparativo de la variabilidad temporal entre el “radial mensual” y el “radial semanal”. Los datos muestran variabilidad a distintas escalas temporales: interanual, estacional y a eventos meteorológicos como por ejemplo los pulsos de afloramiento [2]. Con la serie mensual podemos captar la variabilidad interanual mientras que la serie semanal permite que podamos captar eventos que tienen lugar a escalas más pequeñas como puede ser el afloramiento. También se presentarán resultados de la variabilidad espacial muestreada con el termosalinómetro que realiza medidas de la temperatura y la salinidad superficiales durante la navegación.

Palabras clave: Series temporales, variabilidad espacial, variabilidad temporal.

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INTERACTIVE EFFECTS OF TEMPERATURE AND NUTRIENT SUPPLY ON THE PHOTOSYNTHETIC MACHINERY OF A MARINE CYANOBACTERIUM (*SYNECHOCOCCUS* SPP.)

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Abstract: Phytoplankton physiology is highly variable and responsive to environmental conditions. Nutrient supply and temperature are two of the critical factors that control phytoplankton growth rates and resource allocation into subcellular components. To understand the interactive effect of nutrients and temperature on resource allocation into photosynthetic machinery we grew up a marine cyanobacterium (*Synechococcus* sp.) under various combinations of temperature (18, 22, 26 and 30ºC) and nutrient availability (nutrient-limited chemostats at dilution rates of 0.1 and 0.3 d^{-1} and nutrient-replete batch cultures). We measured some constituents of elemental composition, carbon (C) and nitrogen (N), as well as the concentration of chlorophyll-*a* (Chl*a*) and the abundance of two key proteins of oxygenic photosynthesis, Rubisco (Rcbl) and D1 protein (Psba). We found that the C:Chl*a* ratio decreased with increasing temperature and N availability, which suggests the cells invested more energy in the synthesis of pigment-protein complexes. Furthermore, the C:N ratio was relatively constant with temperature under a N-limited growth rate of 0.1 d^{-1}, but increased with temperature at 0.3 d^{-1}.We found an increase in the concentration of Rcbla and Psba with increasing temperature and decreasing nitrogen limitation. We also observed an interactive effect between these two drivers, as the impact of temperature on protein abundance was modest under strongly nutrient limited conditions but became stronger when nutrient supply was higher. These findings help us understand the strategies for photosynthetic energy allocation in phytoplankton experiencing contrasting environmental conditions, which has implications for ocean productivity and biogeochemical cycling.

Key words: Phytoplankton, temperature, nutrient supply, photosynthetic energy allocation.

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CAMBIOS DEL NIVEL DEL MAR DEL HOLOCENO EN LA COSTA ARGENTINA

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Los cambios del nivel del mar ocurridos durante el Holoceno han influido en la evolución de los ambientes costeros y fluviales asociados. Estos sistemas son muy sensibles y de rápida respuesta frente a la acción de forzamientos eustáticos, climáticos y antrópicos. Dicha respuesta queda archivada en los sedimentos y puede ser estudiada a través de indicadores indirectos o *proxies* como las diatomeas. El objetivo del presente trabajo es reconstruir las condiciones ambientales de sistemas costeros micro y mesomareales de Argentina en relación a los cambios del nivel del mar del Holoceno. A tal fin, se estudiaron las diatomeas de sucesiones sedimentarias obtenidas por técnicas de vibracoring y perfiles expuestos en planicies costeras y cuencas fluviales de Buenos Aires y norte de Patagonia. Además se analizó el contenido en diatomeas de muestras actuales en relación a las diferentes variables ambientales que condicionan la distribución de los taxones. Esta información es necesaria para construir los modelos de calibración utilizados para inferir los cambios ambientales del pasado. Las sucesiones sedimentarias estudiadas desde la región de Mar Chiquita hasta la Bahía San Blas en Buenos Aires y en Patagonia (Río Colorado, Río Negro y Río Chubut) cuentan con control cronológico que completa la información necesaria para reconstruir la variabilidad ambiental del pasado. La identificación de asociaciones características de ambientes marginales costeros, lagunas costeras y marismas en las sucesiones sedimentarias estudiadas permitió ajustar los datos obtenidos a las curvas del nivel del mar postuladas hasta el momento para la región. El máximo transgresivo del nivel del mar ocurrido entre los 6500 y 5500 años AP quedó registrado en sedimentos con diatomeas típicas de cada uno de los subambientes. Depósitos costeros: *Actinoptychus* spp. y *Paralia sulcata*, canales de mareas: *Cymatosira belgica* y *Delphineis surirella*, lagunas costeras: *Planothidium delicatulum* y *Hippodonta hungarica* y marismas: *Diploneis interrupta* y fragilarioides

Key words: Diatomeas, Estuarios, Nivel del Mar, Holoceno, Argentina

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FORO OCÉANOS: POR UNA MAYOR RESILIENCIA DE LOS OCÉANOS FRENTE AL CAMBIO CLIMÁTICO EN CANARIAS

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Abstract: Las islas oceánicas son los ecosistemas más vulnerables ante las alteraciones a escala global contemplados en los diferentes escenarios de Cambio Climático. Esto se suma a graves problemas medioambientales de origen antropogénico como la contaminación local por vertidos urbanos costeros, la presencia creciente de plásticos y microplásticos en el mar y redes tróficas o la sobrepesca, factor que en algunas islas del Archipiélago Canario ha provocado una reducción de la biomasa de las especies objetivo entorno al 90% en los últimos 50 años.
En respuesta a todo esto, desde la Sociedad Atlánticas de Oceanógrafos (SAO) se apuesta por el desarrollo en Canarias de estrategias locales. Así, entre el 5 y 7 de septiembre de 2017 se desarrolló el primer Foro Océanos en la Facultad de Ciencias del Mar de la Universidad de Las Palmas de Gran Canaria. Este foro actúa como un punto de encuentro entre profesionales, investigadores, empresas, entidades, organismos públicos y representantes sociales en torno a 5 grandes áreas temáticas: Pesquerías y Acuicultura, Biodiversidad, Contaminación, Educación e I+D+I y Gestión del Litoral. Como resultado se definen 62 acciones que pretenden ser la base de un documento de compromisos públicos de los diferentes actores sociales de las islas. Estos compromisos estarán centrados en líneas de trabajo como la mayor inversión en investigación y desarrollo, educación, divulgación, sensibilización y participación ciudadana. Entre los compromisos destacan realizar censos y control de puntos de vertido de aguas residuales urbanas e industriales a lo largo del litoral, establecimiento da tallas mínimas de captura para todas las especies objeto de pesca, fijar periodos cortos de veda acordes a los periodos reproductivos de cada especie, la monitorización de la presencia de especies exóticas/invasoras marinas en aguas canarias, etc. Tras este primer foro, desde la SAO se trabaja tanto en los mecanismos de revisión y seguimiento de los compromisos alcanzados.

Key words: Islas Canarias, Atlántico Norte, Contaminación, Biodiversidad, Resiliencia

Acknowledgments: Los autores agradecen su colaboración y compromiso a todos los participantes en el Foro Océanos, especialmente a la Universidad de las Palmas de Gran Canaria, Obra Social "la Caixa" Proyecto MIMAR, desarrollado con el apoyo de la Unión Europea (UE) y cofinanciado por el Fondo Europeo de Desarrollo Regional (FEDER) y el Programa de Cooperación INTERREG V-A España-Portugal MAC 2014-2020 (Madeira-Azores-Canarias)" and Gobierno de Canarias.

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EFFECTS OF THE ADDITION OF POLYUNSATURATED ALDEHYDES ON THE CYANOBACTERIA *Synechococcus sp.* IN AN OCEAN ACIDIFICATION SCENARIO

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Abstract: Picoplanktonic cyanobacteria and diatoms are one of the most widespread phytoplankton functional groups in the world oceans. Usually, when the resources are limiting, diatoms start to disappear and small phytoplankton become dominant. Among them, one of the most usual species is *Synechococcus*. Some diatom species, such as *Skeletonema costatum*, produce a kind of bioactive molecules called polyunsaturated aldehydes (PUAs). These molecules can play an important role during diatom bloom collapse, affecting the viability of the coexisting phytoplanktonic species and consumers. Ocean acidification is a well-known process caused by the increasing CO_2 concentration in the atmosphere, which can reach values up to 1200 ppm for the end of the century. Under these conditions, several studies have shown a down-regulation of the production of different cellular metabolites, including PUAs precursors (i.e. fatty acids). In this study, we investigated the effect of dissolved PUAs on a coastal *Synechococcus* species (WH 7803) under present and future CO_2 conditions. *Synechococcus* cultures were acclimated during 1 month to ambient CO_2 (410 ppmv) and high CO_2 concentrations (1000 ppmv). After acclimation, a mix of two common aldehydes (2E,4E-Heptadienal and 2E,4E-Octadienal), was added at five concentrations (0 to 1600 nM) during a short-term experiment (3 days). These concentrations are in agreement with observed ranges in a parallel experiment with *Skeletonema costatum.* The results showed that *Synechococcus* was highly sensitive to dissolved PUAs compared to other published species, with EC50 values of 125 nM. Additionally, a long term experiment with batch cultures under high and low CO_2 conditions (8 days) was carried out under sublethal PUAs concentrations to assess the interactive effects between ocean acidification and PUAs effect on *Synechococcus* metabolism and growth. The results showed that toxicity of PUAs´ under future scenarios of global change was related to *Synechococcus* capability to acclimate its metabolism to high CO_2 concentrations.

Key words: Ocean acidification, global change, Synechococcus, polyunsaturated aldehydes, down-regulation.

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GENE EXPRESSION AND PHYSIOLOGICAL RESPONSES RELATED TO CARBON CONCENTRATION AND FIXATION IN THE COCCOLITHOPHORE *Emiliania huxleyi* UNDER HIGH CO_2 LEVELS AND DIFFERENT METABOLIC STATES

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Abstract: *Emiliania huxleyi,* the most abundant coccolithophorid species, significantly affects atmospheric CO_2 levels through its ability to capture and release CO_2 associated to photosynthetic processes and coccolith formation. Previous studies revealed a down-regulation of the phytoplankton CO_2 Concentrating Mechanisms (CCMs) under CO_2 concentrations expected for future scenarios of climate change. CCMs are responsible for maintaining a constant pool of inorganic carbon close to RUBISCO in most phytoplankton, relying on energy expenditure. This work aims to study the role of CCMs activity on *Emiliania huxleyi* metabolism under future projected high CO_2 concentrations and acclimated steady-state metabolic conditions, that should rely on passive CO_2 uptake, and perturbed, non steady-state metabolism based on CCMs activity, and therefore, on energy demand. *Emiliania huxleyi* was acclimated for 20 days (between 8-16 generations) to future CO_2 concentrations (1000 ppmv, High Carbon: HC) and present CO_2

concentrations (406 ppmv, Low Carbon: LC, Control). qRT-PCR was used to quantify the expression of three genes related to CCMs (Carbonic anhydrase (CA): αCA 1, αCA 2) and carbon fixation (RUBISCO: rbcL). *E. huxleyi* abundance, carbon fixation and respiration rates were also assessed. The results revealed different molecular and physiological responses depending on the metabolic state and CO_2 treatment. In acclimated steady-state conditions, HC cells performed a down-regulation of the CCMs gene expression and carbon fixation metabolism. By contrast, under perturbed non steady-state metabolism, HC cells showed an up-regulation of the CCMs, carbon fixation metabolism and respiration. Changes in the energy budget of the cell under the different metabolic conditions resulted in 33% higher growth rates under HC compared to LC in the previous conditions (i.e. down-regulated) and 68% lower growth rates in the later (i.e. up-regulated). The results show the relevance of CCM activity for the metabolic status of *Emiliania huxleyi* and its consequences for phytoplankton growth and production under future projected CO_2 scenarios.

Key words: Carbon Concentrating Mechanisms, *Emiliania huxleyi*, gene expression, ocean acidification.

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MODELIZACIÓN DEL OLEAJE INCIDENTE Y CORRIENTES GENERADAS EN LA ZONA DE ROTURA, EN LA RESERVA MARINA DE LA ISLA DE TABARCA

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Abstract: Se ha aplicado el conjunto de modelos numéricos del software Sistema de Modelado Costero (SMC), para conocer los procesos de dinámica litoral que tienen lugar en la Reserva Marina de la Isla de Tabarca. Los procesos de oleaje reproducidos, son el asomeramiento, refracción, difracción, reflexión y disipación de la energía, analizando la transformación del oleaje desde profundidades indefinidas hasta la zona de rotura. Para la modelización numérica, se digitalizó la batimetría de detalle procedente del Estudio Ecocartográfico de la Provincia de Alicante. Se han seleccionado los oleajes más relevantes en el área de estudio, analizando la información de Clíma Marítimo proporcionada por Puertos del Estado. Una vez escogidos los oleajes más significativos, se propaga la incidencia de régimen de oleajes medios y extremales, variando las características de altura de ola significativa, dirección y periodo. Como resultado se han obtenido las distribuciones de corrientes asociadas al oleaje en la zona de rotura, isolíneas de altura de ola, vectores de magnitud e intensidad de corrientes y vectores de transporte sedimentario a lo largo de toda la isla de Tabarca. Se han identificado las áreas más hidrodinámicas, para cada una de las direcciones de oleaje con mayor porcentaje de presentación. Como resultado, se han establecido relaciones entre los patrones de altura de ola y corrientes asociadas al oleaje en la zona de rotura, con la distribución de varias especies de invertebrados bentónicos indicadores de condiciones hidrodinámicas.

Key words: modelización oleaje, Sistema de Modelado Costero , Reserva Marina Tabarca

TEMPORAL VARIATIONS IN THE MEAN TROPHIC LEVEL OF THE CATCHES REPORTED BY THE SMALL-SCALE FISHERY OF THE CANARY ISLANDS (CENTRAL-EAST ATLANTIC)

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Abstract: The mean trophic level of the catches (Pauly et al., 1998) is an ecological index based on catch data, which combined with other indicators can provide information on health condition of the fishery. The decline of this index is largely a result of the overharvest of fish at higher trophic levels. In order to check if there are differences between the different fishing areas within the Canary Islands, the time series of capture have been analyzed and the mean trophic level of the catches for each zone has been estimated. The landings in all areas have shown a slight increase over the last decade; however their composition and, particularly, the medium trophic level of the catches show different behaviours. Thus, whereas the eastern and western islands the mean trophic level of catches have increased slightly, probably due to a greater contribution of tuna in the volume of catches, different values have been found in the central islands. On Tenerife, this index shows a stable value during the period analyzed; however in Gran Canaria it shows a sharp oscillation between 2010 and 2012, going from a level of 3.5 to almost 4. In all cases, the highest values were recorded during the spring and summer months, being this increase more remarkable from 2012. The lowest values take place during the winter months, mainly in the fisheries developed in the central islands where the purse-seine fleet dedicated to pelagic-coastal species is more important. Increases in the mean trophic level of catches have been assumed to indicate improving health in marine ecosystems. However, the abundant seasonal tuna catches in conjunction with relatively short time series of catches, make it difficult to adequately describe the current state of this fishery as a whole since the overfishing of benthic-demersal species can be masked.

Key words: Small-scale fishery, trophic level, Canary Islands, tuna, middle-sized pelagic fish.

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POSTERS

ATMOSPHERE-OCEAN INTERACTIONS, OCEAN CIRCULATION AND PELAGIC SYSTEMS

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HYDROGRAPHICAL FRAMEWORK AROUND CVFZ DURING JULY AND NOVEMBER 2017

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Abstract: During July and November 2017, the multidisciplinary cruises FLUXES I and FLUXES II were carried out in the Cape Verde Frontal Zone (CVFZ). This work describes the conditions and hydrographic structures present in both cruises and discusses the different behavior of the CFVZ in both periods, showing a high spatio-temporal variability. This thermohaline frontal zone, with fronts compensated in density, by the coexistence at similar depths of NACW and SACW, presents numerous mesoscale and submesoscale structures, and close to African coast interacts with the Cape Blanc filament. While in fluxes I the physical variables have basically been obtained with CTD, in Fluxes II have also been provided with SEASOAR and gliders. The availability of a greater number of physical instruments during the survey FLUXES II has permitted a more detailed description of physical conditions during FLUXES II, with spatial resolution of submesoescale level. This hydrographical description is the oceanographical framework for the biogeochemical parameter distribution during both cruises.

Key words: Cape Verde Frontal Zone, fronts, mesoscale processes, interleaving process, FLUXES project

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PHYSICAL AND BIOCHEMICAL RESPONSES TO THE SOUTHERN ANNULAR MODE EVENTS IN THE PACIFIC CENTRAL BASIN OF SOUTHERN OCEAN

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Abstract: The Southern Annular Mode (SAM) is the interannual dominant mode in the Southern Hemisphere atmosphere[1] responsible of changes in the strength of westerlies winds, which drive the deep water upwelling[2] and are essential for the meridional overturning circulation. Mechanical stirring by the wind stress and buoyancy during these events, forces zonal responses of the mixed-layer depth (MLD) reaching anomalies of ±50 m depth in summer[3]. Its depth can determine the nutrient supply[4], having significant implications for biochemical processes[3] and affect the ACC transport[5]. SAM impacts in the upper ocean have been widely investigated[3], however remarkable SAM indexes have been recently observed (trend attributed to loss of ozone), even though the start of Antarctic ozone recovery[6].

The main objective of this study was to quantify the magnitude of MLD variations in the austral summer due to these intense positive and negative SAM events in the Pacific central zone of the Southern Ocean (100º–140ºW transect) and, thus, define the physical and biochemical impacts, and the link between them. The methodology consisted in modelling daily and weekly climatological values of MLD, nutrient and chlorophyll concentrations during the 2014/2015 (SAM+) and 2016/2017 (SAM-) summers from Copernicus database. The results obtained show significant differences between SAM events in MLD (27.25 ± 17.19 m), silicates (0.47 ± 0.097 $\mu g \cdot m^{-3}$) and chlorophyll (0.012 ± 0.011 $mg \cdot m^{-3}$) concentration being higher with an extensive shallow distribution during the negative SAM phase. Negative correlations (-0.44 to -0.55) between MLD and biochemical parameters were also registered. Moreover, changes in the temperature of Antarctic Intermediate Water were observed, being more scattered and colder during the SAM+ event and standing out the absence of Subantarctic Mode Water in both events. In conclusion, SAM indexes can slightly influence the magnitude of primary production in austral summer altering the physical and chemical properties of water masses in the region.

Key words: *Southern Annular Mode; Interannual variability; Southern Ocean mixed-layer depth;*

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STUDY OF THE PHYSICAL-CHEMICAL ANOMALIES OVER THE MAIN CRATER OF TAGORO SUBMARINE VOLCANO, EL HIERRO ISLAND

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Abstract: Five years after the Tagoro submarine volcano eruption, 1.8 kilometres south of El Hierro Island, degassing emissions may still persist in the surrounding area of the main crater, providing a significant amount of heat, CO_2 and reduced species as Fe(II) that alter local physical-chemical seawater conditions[12]. These disturbances consist of a general increase in ocean acidification as well as decreases in oxidation-reduction potential, pH[1] and in the quantity of dissolved oxygen present in the system[3]. Moreover, discharges affect the potential temperature[4], turbidity and salinity, being the magnitude, evolution and temporal continuity of these anomalies not determined yet.

The present study intends to enhance the knowledge about the effects caused by the hydrothermal discharges from the submarine volcano Tagoro through characterize and quantify the set of physical-chemical anomalies observed and establish their correlation and variability patterns in time. To achieve these objectives, in October 2016, a multidisciplinary oceanographic cruise was carried out using a pioneer methodology which consisted in lowering the oceanographic rosette inside the main crater, close to the seafloor and monitor statically the variations of seawater parameters obtaining three-time series of excellent accurate measurements.

During this three-time series, maximum potential temperature anomalies of 1.19±0.38 ºC, maximum pH anomalies of -0.47±0.08 units, maximum salinity anomalies of -0.14±0.03, maximum turbidity anomalies of 7.71±0.12 NTUs and maximum oxygen difference of -9.07±0.83 $\mu mol \cdot kg^{-1}$ were determined. The variability anomalies patterns have allowed to stablish a lineal positive correlation between potential temperature and salinity of 0.93 to 0.95 which match inversely with a significant descending of pH and oxygen with -0.80 to -0.89 correlations coefficients. Finally, ADCP velocities ensured that the variations in anomalies registered correspond only to the nature of hydrothermal discharges, concluding that the degasification post-eruptive phase over the main crater remain active with the presence of interrupted physical-chemical seawater anomalies.

Key words: *Tagoro submarine volcano; hydrothermal emissions; physical-chemical anomalies.*

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STUDY OF THE SIGNIFICANT RELEASE OF INORGANIC NUTRIENTS DURING MAGMATIC AND DEGASIFICATION STAGES BY THE SUBMARINE VOLCANO TAGORO, EL HIERRO ISLAND.

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Abstract: In October 10th 2011 a shallow submarine volcanic eruption south of El Hierro (Canary Islands) gave rise to a drastic physical and chemical changes in the water column. The initial eruptive phase affected a wide area south of the island, along with a plume that was observed to be transported northward during November 2011. From March 2012 the volcanic activity shifted towards a degasification stage, during which the emissions were affected a smaller area surrounding Tagoro submarine volcano and quite close to the seabed (Fraile-Nuez, et al., 2012, Santana-Casiano et al., 2013, 2016). Periodic multidisciplinary oceanographic cruises were carried out in order to monitor the impacts of these emissions. Discrete water samples were collected for analysis of inorganic macronutrients (NO_2^-, NO_3^-, PO_4^{3-}, $Si(OH)_4$). Here, we present the spatial and temporal distribution of these nutrients from November 2011 to March 2014 with the data of 8 different cruises in the area affected by the volcano. Significant nutrient emissions were found in both the eruptive and the degasification stages, with maximum concentrations of 8.1 (NO_2^-+NO_3^-), 0.8 (PO_4^{3-}) and 21.8 ($Si(OH)_4$) μmol kg^{-1}. These high nutrient inputs may suggest a natural fertilization process that could have a drastically impact on the marine ecosystem surrounding Tagoro submarine volcano. Furthermore, N:P ratio was found to be 3 for stations affected during the eruptive phase and 11 for the degasification stage, in contrast to the 16:1 ratio found in the reference stations.

Key words: Submarine volcano Tagoro, hydrothermal emissions, nutrient emissions, natural fertilization

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RARE EARTH ELEMENTS AND ND ISOTOPES TRACING MODERN CIRCULATION IN THE CENTRAL MEDITERRANEAN SEA

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Abstract:

The purpose of this study is to use dissolved Rare Earth Elements (dREE) and Nd isotopes (ε_{Nd}) in seawater to better understand water-mass exchange and pathways in the Central Mediterranean (CM) Sea. We have analyzed 9 hydrographic stations around the Tyrrhenian Sea, Strait of Sicily and Ionian Sea (NextData2016 Cruise). Pre-concentrated and purified dREE were measured with an Agilent 7500 quadrupole ICP-MS while Nd isotopes (ε_{Nd}) were determined using a Nu Plasma III Multicollector ICP-MS.
In general, dREE abundances in the CM are similar to the western Mediterranean [1] but clearly lower than in the eastern basin [2] pointing to an eastward enrichment of Atlantic Waters, as for other trace metals. In addition, inflowing Atlantic Waters ($\varepsilon_{Nd}\approx$-10) become more radiogenic within its circulation (ε_{Nd} up to -6).
Light REE (LREE) present highest concentrations at surface waters, probably indicating lithogenic inputs. This is specially marked at the station closest to the continental margin with LREE enrichments relative to the other stations of 20-50%, with no significant ε_{Nd} modification. Far from continental margins and below the surface, well-developed oceanic dREE patterns are found displaying negative cerium anomalies (Ce*=0.20-0.30) and enrichment of Heavy REE (HREE) demonstrating that water mass mixing governs the REE distribution below the permanent thermocline. Levantine Intermediate Waters (LIW) can be traced through a substantial HREE peak and distinctive radiogenic neodymium signature (ε_{Nd} =-6.4). This is coherent with older waters enhanced with conservative HREE. Concerning ε_{Nd}, the radiogenic imprint of LIW is in accordance with either the influence of partially dissolved Nile river particles [2] or the rock signature in the LIW formation zone [3]. Finally, both dHREE and ε_{Nd} can be used to distinguish deep water masses: EMDW present $\varepsilon_{Nd}\approx$-6.7 and WMDW show ε_{Nd} of -8.5, with the first being 13% more enriched in dHREE than the later.

Key words: Central Mediterranean, Rare Earth Elements, Nd isotopes, water mass advection

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IMPLICATIONS OF PHYTOPLANKTON PHYSIOLOGY ON BIOLOGICAL CARBON SEQUESTRATION IN A HIGH CO_2 WORLD

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Abstract: The oceans play a major role as a sink for up to 26% of the anthropogenic CO_2. Most marine phytoplankton species have active, energy-dependent, Carbon Concentrating Mechanisms (CCMs) that mantain a constant pool of inorganic carbon close to RUBISCO under present CO_2 concentrations. However, under high CO_2 levels, CCMs activity down-regulates, CO_2 uptake relies on passive difussion and phytoplankton undergo changes in energy demand that may imply significant changes on phytoplankton metabolism. In this study, the results from 6 marine species belonging to 3 different functional groups (2 diatoms (*Thalassiosira pseudonana*, *Skeletonema costatum*), 2 cocolithophorids (*Emiliania huxleyi*, *Gephyrocapsa oceanica*) and 2 cyanobacteria from coastal and open ocean waters (*Synechococcus sp.* WH-7803, *Synechococcus sp.* WH-8102)) acclimated during at least three weeks to CO_2 concentrations predicted for future scenarios of global change (1000 ppmv, High Carbon: HC) and to present CO_2 concentrations (405 ppmv CO_2, Low Carbon: LC) are shown. CCMs expression, metabolic rates and concentration of several important cell metabolites were measured in HC and LC cultures under two different metabolic conditions: under aclimated steady-state metabolic conditions that promoted the down-regulation of the CCMs, and under perturbed metabolism that triggered the up-regulation of the CCMs. For diatoms and cocolithophorids, the CCMs down-regulation under acclimated steady-state conditions was also linked to significant decreases in the intracellular pools and respiration rates, that increased the resource use efficiency, finally resulting in similar or higher production and growth rates than under present CO_2 levels. However, the opposite was observed after perturbing the cultures and promoting the up-regulation of the metabolism. For cyanobacteria, the results were quite simmilar between strains but showed opposite responses compared to that observed in the eukaryotes. The study demonstrates that phytoplankton carbon sequestration under high CO_2 conditions depends on cell metabolism and might differ between cyanobacteria and other functional groups.

Key words: Phytoplankton, ocean acidification, CO_2, carbon concentrating mechanisms.

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DYNAMICS OF OXYGEN EXCHANGE IN A COASTAL UPWELLING SYSTEM

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Abstract:

Water column stratification and oceanic deoxygenation are ones of the most extensive impacts of Climate Change [1]. Deoxygenation is intensified in coastal areas, where there are large inputs of nutrients caused by anthropogenic activity producing oxygen decrease and eutrophication which affect benthic communities. Coastal upwelling regions are ones of the most vulnerable ecosystems.

The Ría de Vigo is located in NW Iberian coastal upwelling system where there is a weakening of the upwelling favourable winds [2, 3]. Moreover, this ecosystem is under a huge anthropogenic pressure. Therefore, it is very important to measure the oxygen benthic fluxes to assess the environmental health of the ecosystem [4].

In the present research the novel Eddy Covariance technique has been used to measure the oxygen benthic fluxes. This technique allows us to obtain a better spatial and temporal resolution than the other methods used in most studies [5]. In this sense, our main objective is to determine the oxygen benthic fluxes in the Ría de Vigo during the transition from upwelling to downwelling season, and in this way to estimate its environmental status.

For obtain that, we carried out a cruise in October 2017, in which we observed different hydrodynamic forcings. In the first days there was a strong thermal stratification of the water column under an upwelling situation with low oxygen levels in subsurface waters, followed by a wind relaxation and a relative mixing of the water column with an oxygen level increase. During the last days, the hurricane Ofelia forced a downwelling situation followed by an haline stratification. The hurricane produced a strong mixing of the water column and an intense ventilation of bottom waters. The benthic fluxes will respond to these different hydrodynamic conditions.

Key words: Deoxygenation, Climate Change, stratification, coastal upwelling, benthic fluxes

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CO_2 FLUX VARIABILITY IN THE GALICIAN AND CALIFORNIAN UPWELLING SYSTEMS

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Abstract: Coastal upwelling occurs along the eastern ocean margins (EBUS), take place at the four major eastern boundary current regions of the World Ocean: California, Canary, Benguela and Peru/Humboldt. The upwelling is induced by offshore surface Ekman Transport and promotes the rise of nutrients and CO_2-rich water into the euphotic zones. How these coastal upwelling systems will behave in the coming years due to climate change is something that scientists still do not understand. Within this context, Bakun in 1973 published a theory explaining why climate change will promote an intensification of upwelling. The aim of this work was to approach this topic by comparing Galician and Californian coasts using data collected between 1997 and 2017 by the Marine Research Institute in Vigo (Spain) and by the Monterey Bay Aquarium Research Institute in California (USA). The database from both places included CO_2 partial pressure at sea surface (pCO_2^{sw}), sea surface temperature (SST) and sea surface salinity (SSS). It included remotely sensed net ecosystem production as a proxy of the biological activity, and the monthly averaged upwelling index over five and four regions in the Galician and Californian upwellings, respectively. The upwelling index was four times higher in California, where the upwelling systems seem to be increasing, while downwelling events were more frequent and variable in Galicia where the upwelling trend was not clear. Galicia showed an average value of ΔfCO_2 of -30±28 µatm and a role as a net sink of CO_2 of -2±2 $mmolCm^{-2}d^{-1}$ in the studied stations while California waters were closer to the equilibrium with the atmosphere with an average ΔfCO_2 value of -8±26 µatm and an air-sea CO_2 exchange of 0±1 $mmolCm^{-2}d^{-1}$. This study is one of the first efforts to compare sea-air CO_2 fluxes at long temporal scales between upwellings in Galicia and California.

Key words: Upwelling System, Air-sea CO_2 fluxes, California, NW Iberian Peninsula, Climate Change.

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VARIABILIDAD DEL SEDIMENTO DEL BANCO INTERMAREAL DE LA PLAYA DE VILARRUBE (A CORUÑA)

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Resumen: Dentro de la Acción de Investigación de la Consellería del Mar de la Xunta de Galicia titulada, "Determinación das causas da diminución dos Bancos de coquina. Condicións naturais e antropoxénicas", se han estudiado las características texturales de los sedimentos del banco marisquero de la Playa de Vilarrube (A Coruña). Este es el único banco en el que actualmente se explota la coquina o cadelucha (*Donax trunculus*), desde que a principios de los años 2000 prácticamente desapareciera el recurso en los bancos de Playa América (Ría de Vigo, Pontevedra) y O Lombo das Navallas (Ría do Barqueiro, A Coruña).

Se seleccionaron 42 muestras homogéneamente distribuidas que coinciden con las estaciones en las que se hacen muestreos de poblaciones de cadelucha. Los sedimentos fueron recogidos mediante un cilindro de 15 cm de longitud y 9 cm de diámetro. El muestreo se inició en septiembre de 2014, y desde septiembre de 2016 se está llevando un seguimiento trimestral. Tras eliminar la materia orgánica y los cloruros, las muestras fueron tamizadas por vía seca y los datos fueron procesados en el programa Gradistat (Blott y Pye, 2001).

Los resultados preliminares muestran que se tratan de sedimentos arenosos unimodales, con una media y una mediana (D50) entorno a las 200 micras (arenas finas), el grado de selección es de bueno a moderadamente bueno, las curvas de distribuciones granulométricas que presentan son simétricas y de tipo picuda o leptocúrtica. Estos resultados concuerdan con los aportados por Nombela et al (2017) para tres playas de la costa gallega, y con los de Le Valle et al (2011) para la costa occidental de Italia, en los que se indica que los sedimentos preferidos por *Donax trunculus* son de arenas con tamaño de grano entre 2 y 2,5 phi con un grado de selcción de bueno a moderado.

Palabras clave: Variabilidad sedimentaria, Banco intermareal, Coquina, Galicia.

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IS THE *GABRIEL DE CASTILLA* BASE (DECEPTION ISLAND, ANTARTICA) UNDER A COASTAL EROSION RISK?

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Abstract: The *Gabriel de Castilla* Antarctic Base is located in Deception Island (South Shetland Islands, Antarctica). Along the last decades, the distance between the base modules and the coastline has reduced. The coastal front of this emplacement showed a retreating trend and an erosional escarpment appeared, with the aspect of a cliff and increasing height over the last years. In order to identify coastal behaviour in this area during the 2017–18 Spanish Antarctic campaign, a beach monitoring program was carried out over three months. The zone is located in the internal shore of Foster Bay, so it is a fetch-limited coast, exposed to low energy levels. The monitoring has been carried out through topographic surveys on a beach profile located in front of the base, by means of a total station. Besides, a pressure transducer and an electromagnetic current meter were deployed at the end of the aforementioned transect, which allowed to obtain both wave and current data. The deployment period covered nearly two months, allowing to relate the topographic changes with the variations of incident energy. The data showed the scarce energy received by this beach, where despite 3 episodes of blizzard being recorded over the monitoring period, with strong winds close to 100 km/h, recorded wave heights did not exceed 50 cm. Regarding topographic changes, they were of little relevance although some accreting episodes related to high-energy events were observed. These preliminary results, given the short period of monitoring, seem to indicate that the possible coastal retreat is not actually related to oceanographic conditions during the periods in which the bay lacks a fronting ice shelf (Antarctic summer). On the other hand, the melting processes in the continental area that lead to the formation of gullies and piping processes seem to be the main drivers of cliff erosion.

Key words: Beach erosion, coastal hazard, Antarctica

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MORPHODYNAMICS OF A MESOTIDAL BEACH (PLAYA DE VILARRUBE, A CORUÑA)

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Abstract: This study analyzes the morphological variability of a beach located in the inner part of Ría de Cedeira, on the North Coast of Galicia. Its intertidal zone is the only shellfish bank which is currently exploited *Donax trunculus* (bivalve locally known as Coquina or Cadelucha) on the Galician coast. *D. trunculus* virtually disappeared from the rest of the intertidal areas in Galicia at the beginning of the year 2000.
This work is part of a multicisciplinary research action from the Consellería del Mar-Xunta de Galicia focused on determining the causes of reduction of this shellfish resource. Topography seasonal monitoring, sediment analysis and quantification of *D. trunculus* populations were carried out since September 2016. In this study we will focus on the morphodynamics results coupled with wave propagation models. Also, available aerial photographs since 1956 were analyzed to the temporal scale of analysis.
The beach and associated dune system has 1.5 km long with an intertidal area of 800 m wide and a river inlet at both sides. Maximum tidal ranges reach 4 m and prevalent wave conditions are 2.75m (Hs) and 11 s of period reaching 9 m during storms. Preliminary results show a highly dynamic area where the intertidal presents a complex pattern with up to three bars in the centre of the beach. In addition, several bars at each side are associated to the river-inlets' ebb-tide deltas which are strongly modified by the flow of rivers as well as wave pattern approach. Evolution trend analysis since 2016 shows an increase of volume sediment of the intertidal area associated with a continuous retreat of the dune. This retreat trend is also registered since 1956 (40 m average).
Further studies will be carried out to identify how the morphodynamics affects the population of *D. trunculus* pattern.

Key words: Morphodynamics, mesotidal beach, Shellfish bank, Galician Coast.

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IMPORTANCE OF THE SMALL IN A CHANGING OCEAN: UNDERSTANDING SHORT TERM VARIABILITY AND ROLE OF SMALL PLANKTON (i-SMALL)

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Abstract: Coastal regions face strong and rapid changes forced by anthropogenic and natural variability with unknown implications for biogeochemical cycling and food webs. In this changing ocean, coastal upwelling systems are critical regions due to their extremely high productivity. The NW Iberian coast, including the Rías Baixas, is one of these systems. An increasing trend in water column stratification and a decrease in intensity and frequency of coastal upwelling would be translated in a diminishing of the input of nutrient-rich upwelled water into the rías, a larger contribution of nutrient provided by benthic remineralization and a microbial community shifted towards nano and picoplankton dominance.

Being aware of all these changes, we have embarked on the i-SMALL project to understand the short scale variability of the advection of upwelled waters, assessing the importance of nutrient supply by benthic remineralization and unlocking the compartment of small plankton community. The i-SMALL campaigns in July and October 2017 allowed us to study (1) short term variability of the hydrodynamic conditions, based on the velocity field by ADPC measurements and the hydrographic field by the deployment over a tidal cycle of continuously profiling CTDs (2) benthic remineralization through the eddy covariance technique, and (3) to explore the nano- and pico plankton community by implementing complementary approaches as microscopic and flow citometry determinations, chromatographic analysis of algal pigments and next generation sequencing tools.

An overview of available results from i-SMALL campaigns will be presented. A strong summer thermohaline stratification was registered in July 2017, while the Ophelia storm clearly modified the hydrodynamics conditions in October 2017. The eddy covariance technique resolved intra-daily variability of benthic fluxes, which were largely modulated by hydrodynamics and biogeochemical conditions. Masive paralell sequencing of 18sRNA from nano and picoplankton fractions will be used to reveal which species dominate the different oceanographic scenarios

Key words: short-scale_variability, nano_and_picoplankton, hydrodynamics, benthic_fluxes, molecular_tecnhinques, coastal_upwelling.

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A SURVEY OF TINTINNIDS DISTRIBUTION IN ALBORAN SEA

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Abstract: Presence, abundance, diversity, distribution and biometric measurements of tintinnids ciliates were investigated in western Alboran Sea in the early autumn of 2015.

Samples were collected on board the Research Vessel "Sarmiento de Gamboa" (framework of Project “MEGAN”). The study included three different environments in Alboran Sea: (1) a coastal water station with frequent upwelling near Estepona, (2) the Atlantic water jet entering Alboran Sea and (3) the centre of the western Alboran anticyclonic gyre usually considered as a stable, more oligotrophic habitat.

Basic oceanographic variables were analysed (salinity, temperature, chlorophyll fluorescence, turbidity and nutrient concentration) aiming to characterise habitats, identify water masses and investigate relation with distributions.

Microplanktonic (20-200 microns) Tintinnids were identified, measured and counted by using Utermöhl method (1931) assisted by image analysis. Main focus was on inventories analysed at DCM close to midnight and midday for each station. The objective was to compare the structure of species among habitats assessing day/night changes.

Some 49% of tintinnid species were found to be associated exclusively to the Atlantic jet, a very dynamic zone closely associated to pulsating events and undulatory processes due to internal waves generated at Camarinal Sill. The anticyclonic gyre presented also a lower but rather high diversity and abundance of tintinnids, being the coastal station associated to the lowest diversity.

Some biometric data on the more abundant species have been investigated. Significant differences among stations were found for *Eutintinnus macilentus*, with a higher length in the coastal station, compared to the gyre and, then, jet. Average aboral diameter presented three dominant sizes classes: around 20 µm for 44% of species, 16 µm for 30% and 28 µm for 15%. Some consequences for its role as predators were discussed.

In general, we found more abundance and diversity during night and more deeper water masses.

Key words: Tintinnids, Alboran Sea, Strait of Gibraltar, microplankton

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EFFECTS OF ENSO VARIABILITY ON PHYTOPLANKTON COMMUNITY COMPOSITION IN THE CHILEAN UPWELLING DURING 1997-1998 AND 2000

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Abstract: The Chilean upwelling, located in the eastern South Pacific, is one of the EBUS (Eastern Boundary Upwelling Systems), which constitute the highest productivity regions of the oceans[1].

The Chilean upwelling is subject to strong interannual variability due to the presence of El Niño–Southern Oscillation (ENSO). During the warm ENSO phase (El Niño), the upwelling and nutrient availability is greatly reduced, causing a significant reduction in primary production. By contrast, in La Niña events (cold ENSO phase), the opposite behaviour is observed[2].

During the period covered between 1997 to 2000, one of the strongest ENSO's was registered, reaching its maximum intensity in early 1997-1998 (El Niño) and sea surface anomalies persisted until the end of 2000 (La Niña)[3].

We used the Copernicus and Giovanni databases to obtain daily and monthly values of nutrient concentration (silicate, nitrate and iron) and abundance of four phytoplankton functional groups (diatoms, coccolithophores, chlorophytes and cyanobacteria). Phytoplankton community composition has been estimated from remote measurements of surface ocean colour. A nonparametric Kruskal-Wallis test was used to determine significant differences in phytoplankton abundance between ENSO phases. Finally, to establish the relation between microorganism abundance and nutrient concentration Pearson's correlation coefficients was determined.

The results obtained show an increase of the nutrient concentration during La Niña event, with the exception of iron, which exhibits a higher concentration in El Niño, possibly associated with an iron input from Equatorial Undercurrent (EUC)[4].

During El Niño, cyanobacteria concentration increases while diatoms concentration decreases, however coccolithophores and chlorophytes rest equal in abundance. During la Niña, the results obtained show the opposite response probably due to the fact that NO_3 concentration was lower during El Niño than during La Niña. Microalgae dominate in both

scenarios in Chilean upwelling.

Key words: Chilean upwelling; El Niño 1997-1998; Interannual variation; phytoplankton communities; La Niña 2000

Acknowledgments This study has been developed within the framework of Ecosystem Oceanography subject, part of the Oceanography Master's degree in Las Palmas of Gran Canaria University. We would like to thank our professor Dr. Antonio Juan González Ramos who has encouraged us to present this study.

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SEASONAL VARIATION OF PICOPLANKTON ABUNDANCE AND COMMUNITY COMPOSITION IN THE COASTAL UPWELLING OFF GALICIA (NW IBERIAN PENINSULA)

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Abstract: Autotrophic and heterotrophic picoplankton plays an important role in the functioning of the microbial loop, with the former regarded as important actor of assimilable carbon biomass at the base of the microbial food web, while the latter acts as both remineralizers and trophic intermediaries within marine ecosystems. We combined flow cytometry and catalyzed reported deposition (CARD-FISH) to investigate the seasonality of the picoplankton abundance and community composition at two contrasting sites within the coastal upwelling off Galicia (in front of A Coruña and Vigo). Autotrophic picoplankton abundance (particularly *Synechococcus*) was strongly influenced by seasonality at both sites, showing their maximum concentration in summer and early autumn at surface waters. Hetetrotrophic picoplankton was most abundant between spring and late summer at both coastal ecosystems, when also showed a significantly increase the contribution of the high nucleid acid content cells (HNA) and actively respiring cells. Catalyzed reporter deposition (CARD-FISH), within the Eubacteria domain, evidenced the dominance of members of the phyla Alphaproteobacteria, with a strong contribution of SAR11 peaking during the summer (>30 % of total DAPI [4`, 6-diamidino-2-phenylindole] counts) period off A Coruña. By contrast, Cytophaga-Flabacterium was the most abundant group off Vigo on an annual basis, showing a peak during summer (>50% of the DAPI counts). Overall, Gammaproteobacteria account for 11% and 6% of the DAPI counts off A Coruña and Vigo, respectively, but do not show any obvious seasonal structure. Finally, CARD-FISH failed to detect SAR86. Taken together, this study documents an active heterotrophic component of picoplankton, particularly the summer period, with substantial changes in the contribution of major phylogenetic groups of bacteria occurring through the year. Also, autotrophic phytoplankton change substantially year-round for this site, suggesting that light availability and water temperature were very important regulating factors.

Key words: Picoplankton, seasonal variation, autotrophs, bacteria, flow cytometry, CARD-FISH, upwelling

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THE SPATIO-TEMPORAL VARIATION OF PHYTOPLANKTON AROUND THE CANARY ISLANDS

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Abstract: The temporal and spatial variability in the structure and abundance of small planktonic communities (<20 μm) was studied during two seasonal cruises (autumn and spring) along coastal-ocean and north-south gradients in the Canary Islands region. Synechococcus type cyanobacteria (Syn), picoeukaryotes (PE), nanoeukaryotes (NE) and heterotrophic bacteria (B) were significantly more abundant in spring, presumably due to the lower temperatures that induced the erosion of the thermocline enhancing nutrient diffusion to the surface layer. On the contrary, Prochlorococcus type cyanobacteria (Pro) was more abundant during autumn season, when a strong stratification and higher temperatures typified this period. Downstream of the islands –a region of intense mesoscale variability- phytoplankton was higher throughout the year. PE, Syn, NE and B communities were more abundant in the eastern region influenced by the upwelling during both seasons, while Pro showed the highest abundances in oceanic waters. In spring, the entrainment of a major upwelling filament channeled by a recurrent cyclonic eddy placed in the trough between south of Fuerteventura and Gran Canaria islands generated the increase of phytoplanktonic communities abundances over the surroundings waters. Chlorophyll a and phytoplankton were distributed along the filament and at the boundaries of the eddy. In summary, although seasonal changes in the hydrographic field affect phytoplankton communities, mesoscale variability due to island-generated eddies and coastal upwelling filaments are greatly responsible for their abundance and distribution in the Canary region throughout the year.

Key words: Phytoplankton abundance; Phytoplankton community structure; Chlorophyll a; Mesoscale activity; Canary Islands region

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SEASONAL DYNAMICS OF PICO- AND NANOPLANKTON IN THE NW IBERIAN UPWELLING SYSTEM: A METABARCODING APPROACH

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Abstract: The diversity and variability of the small size fraction of the marine eukaryotic microbial plankton community was studied through the use of high throughput sequencing (HTS) in the NW Iberian upwelling system. The use of molecular tools enabled to identify and characterise the pico- (0.2-2 µm) and nanoplankton (2-20 µm) components in that region, which remains underexplored owing to the difficulty of traditional methods such as microscopy to resolve the taxonomic structure of the smallest sized plankton. To this end, 8 seawater samples were taken from March to November 2012 in the Ría de Vigo. For each sample, between 1 - 1.5 L of seawater was filtered sequentially through 20, 2 and 0.2 µm. From the 0.2 and 2 µm filters, DNA was extracted and the V4 region of the 18S rDNA genes was amplified by PCR and analyzed by Illumina sequencing. On each sampling day, data on hydrography, nutrients and microplankton were also taken, which allowed us to determine accompanying environmental conditions.
The most abundant OTUs corresponded to organisms belonging to the following classes: Chlorophyta, Dinophyta, Ciliophora, Picozoa and Cryptophyta. The differential distribution of the organisms identified and the absence of some groups in some months suggest a remarkable seasonal distribution.
The metabarcoding approach through HTS is a valuable tool to study pico- and nanoplankton, allowing their identification and determination of temporal variability. This kind of knowledge allows a better understanding of the biological communities and their ecology in this coastal upwelling region, providing key information on the lower trophic levels necessary for predicting how the system could react to future climate changes.

Key words: Microbial plankton, High Throughput Sequencing, Upwelling, NW Iberia

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NEW PRODUCTION MODELED FROM NITRATE REDUCTASE ACTIVITY IN THE PERU CURRENT UPWELLING

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Abstract: We have developed a light-dependent, nitrate and ammonium independent model of New Production based on phytoplankton nitrate reductase (NR) activity that predicts strong New Production off Peru. The model is based on measurements from the Coastal Upwelling Ecosystem Analysis (CUEA) JASON expedition from September 1976. The samples were taken along a transect line (C-Line) across the Peru current at 15°S, which extended from the coast, at position C-1, across the Peru trench to position C-14, 200 km offshore. Sampling depths were established according to light penetration; euphotic zone samples were taken at depths where the light was 100, 50, 30, 15, 5, 1 and 0.1% of the surface incident radiation. The model responded to the equation:

$$New\ Production = \frac{[NR] \cdot [hv]}{K_{LT} + [hv]}$$

which depends on the NR activity [NR] expressed in µM h^{-1}, the amount of light [hv] expressed in % of incident radiation (I_0) and the Michaelis-Menten constant (K_{LT}), the amount of light $[hv]$ at which half of the maximum NR activity is reached, which took a value of 2.4% of I_0. The developed model showed that the New Production at the 50% light level in the euphotic zone ranged from 3.49 µM C h^{-1}, 12 km downstream from the upwelling center to 0.15 µM C h^{-1}, 46 km further downstream over the 4000 m deep Peru Trench where the upwelling was relatively weak. It compared well with ^{14}C carbon productivity measurements whose range was 0-4.2 µM C h^{-1} and 0-1.5 µM C h^{-1} for the 6 h (gross) and 24 h (net) productivity, respectively. In nitrogen units, the overall New Production ranged from 4 to 510 nM of N h^{-1}. The oceanographic conditions found during September 1976 made this site in the Peruvian upwelling an ideal one to model new production. Temperature in the center of the upwelling in September of 1976 reached 14.07°C, while NO_3^- and NO_2^- ranged from

6.65 to 7.5 and 0.51 to 1.6 µM respectively. Chlorophyll, averaging 3.85 µg L^{-1} for the section stations in September 1976, was similar to what it was for all the stations 6 months later in March 1977 (3.23 µg L^{-1}). NR, averaging 0.20 µM N h^{-1} for the section stations in September 1976, was twice what it was for all stations, 6 month later in March 1977 (0.09 µM N h^{-1}).

Key words: Primary production, nitrogen uptake, nitrate, light, phytoplankton

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THE SUPPLY OF VITAMIN B12 BY ROSEOBACTER LINEAGE BACTERIA FAVORS GROWTH OF THE TOXIC DINOFLAGELLATE *GYMNODINIUM CATENATUM.*

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Abstract: Harmful algal Blooms (HAB) involves significant risks to public health, fisheries, ecosystems and economies in coastal areas. Most of the microalgal species associated with HABs are auxotrophic for vitamins B1 (thiamine) and B12 (cobalamin) (Tang et al., 2010). *Gymnodinium catenatum* is a cosmopolitan dinoflagellate and one of the main generators of PSP (paralyzing shellfish poisoning). This species is auxotrophic for cobalamin (Croft et al. 2005) and grows associated with a specific bacterial assemblage, dominated by Alphaproteobacteria and being *Roseobacter* clearly dominant (Green et al., 2004). All known members of Roseobacter lineage have a demonstrated ability to synthesize cobalamin (Newton et al., 2010). In the present work, the ability of *Roseobacter* (MED 193) to promote the growth of *G. catenatum* in absence of cobalamin is tested. For this, the growth of *G. catenatum* was followed along an incubation in GSe / 10, medium using an inoculum previously deprived of cobalamin. The treatments applied were the following: A) cobalamin + antibiotic mix + amphotericin, B) antibiotic mix + amphotericin, C) *Roseobacter*, D) amphotericin. Previously, the capacity of *Roseobacter* to grow in GSe/10 and the effect of *G. catenatum* exudates in the growth of bacteria were tested. The results showed the ability of *Roseobacter* to grow in the GSe / 10 medium, this growth was increased with *G. catenatum* exudates addition. Likewise, *G. catenatum* incubations lacking cobalamin and including *Roseobacter* (treatment C) showed significant increases in growth, duration of the growth phase and accumulated biomass. Therefore, it is concluded that *Roseobacter* is able to supply cobalamin for *G. catenatum* survival and growth and, in turn, *G. catenatum* generates exudates that optimize the growth of *Roseobacter.*

Key words: HAB, dinoflagellate, cobalamin, bacteria.

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INVESTIGATING THE ENVIRONMENTAL CONDITIONS FAVORABLE FOR THE OCCURRENCE OF THIN LAYERS OF PHYTOPLANKTON IN THE GALICIAN RÍAS

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Abstract: The Galician Rías, located in the NW of the Iberian Peninsula, are a highly productive ecosystem under the influence of the Coastal upwelling. This region sustains an important shellfish activity, which every year is threatened by episodes of harmful phytoplankton. A particular case of microalgae bloom, named thin layers of phytoplankton (TLP), occurs when high-cell densities are located within a narrow depth interval. These features are believed to play an important role in the sudden formation and maintenance of harmful algae blooms. Previous analysis of the dataset collected by the INTECMAR monitoring program (http://www.intecmar.org) in the Galician Rías, weekly between 2012-2015, showed that the occurrence of TLP was higher between May and July, associated with the base of shallow pycnoclines (Mouriño et al., this issue). Despite this evidence, the mechanisms responsible for the formation of TLP in the Galician Rías remains unknown. Here we investigate the environmental conditions favorable for the formation of TLP in the Galician Rías during the period of 2012-2015. For that we first built a database containing the meteorological and hydrographic information corresponding to the INTECMAR weekly sampling. Statistical procedures based on principal component and cluster analysis were used to investigate the relationship between the occurrence of TLP and the favorable environmental conditions.

Key words: Thin layers of phytoplankton, harmful phytoplankton, river plume, Galician Rías, NW Iberian upwelling ecosystem.

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LEUCINE-TO-CARBON CONVERSION FACTORS EXPERIMENTS: RELATIONSHIP WITH MICROBIAL DIVERSITY AND QUALITY OF ORGANIC MATTER

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Abstract: Leucine-to-carbon conversion factors (CF's) in marine ecosystems have shown a high variability compared to the theoretical ones (Calvo-Díaz 2009). These sources of variability can include culture design, the calculation method or physiological state. However, it has been scarcely explored whether differences in CF´s are driven by changes in community composition and/or DOM composition. We performed seawater cultures during the MODUPLAN cruise carried out in the north Atlantic ocean to (i) determine CFs empirically (eCFs) in order to obtain reliable values for epi-, meso- and bathypelagic waters, which allow us the conversion of leucine incorporation rates into biomass production and (ii) explore the link between those eCFs and microbial community composition and DOM optical properties. Microbial community composition was determined using Illumina sequencing of the 16S rDNA gene and DOM optical indices were calculated from fluorescence and absorbance spectra. Empirical CFs values (3.2 to 0.4 kg C per mol of leucine) showed maxima in epi- and minima in bathypelagic waters. Our results demonstrate that the use of the systematically applied theorical CFs (1.55 kg of C per mol of leucine; Simon and Azam 1989) led to an underestimation of microbial biomass production in the epipelagic waters, while causing an overestimation of the rates of microbial biomass in the meso- and bathypelagic waters. We found that the microbial (Bacteria and Archaea) community structure was vertically stratified and shaped by the quality of organic matter. Taken together, our results indicate that differences in the calculated eCFs through the water column, can be associated to the phylogenetic composition of the microbial communities interacting with the DOM features.

Key words: leucine incorporation, carbon biomass, CFs, microbial diversity, DOM optical properties, Atlantic Ocean

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SEASONAL AND SHORT-TERM VARIATION OF THE VERTICAL DISTRIBUTION OF CHLOROPHYL IN THE 'RÍA DE VIGO'

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Abstract: The concentration of chlorophyll *a*, *b* and *c* has been monitored weekly during a complete seasonal cycle (from March 2017 to March 2018) in the Ría de Vigo, a highly productive embayment influenced by coastal upwelling dynamics. Water samples for the determination of chlorophyll *a*, *b* and *c* by spectrofluorometry were acquired every 5 meters from the surface down to 40m depth in an oceanographic station located in the main channel, at the middle part of the ría, where the influences of both upwelling-downwelling events and continental runoff are noticeable. The values of analytic chlorophyll were compared with the values of *in situ* fluorescence obtained with fluorescence probes mounted on multi-parametric profilers (and MSS micro-scale and a CTD SBE25) to assess the comparability among analytical chlorophyll values and automatic probes, necessary for sensor calibration, and to assess the effect of quenching of chlorophyll fluorescence in the surface layer. The temporal variation of the vertical distribution of chlorophyll *a*, *b* and *c*, for the whole (particles retained through GFF, 0.6µ) and size fractionated (membrane filters of 0.2, 3 and 20µM) phytoplankton community, was described, showing that both chlorophyll and *in situ* fluorescence varied at seasonal and short-term scales and may be correlated with the variability of meteorological and hydrographic drivers.

Key words: Chlorophyll *a*, *b* and *c*; *in situ* fluorescence; photochemical quenching; phytoplankton biomass; Ría de Vigo.

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VARIACIONES FITOPLANTÓNICAS ANUALES EN EL GOLFO DE CÁDIZ

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Abstract: El Golfo de Cádiz es un ambiente caracterizado por la estacionalidad en donde las comunidades de fitoplancton y las concentraciones de clorofila no solo experimentan variaciones a lo largo del año, también muestran heterogeneidad espacial. Durante el año 2016 se participó en el proyecto OCAL (Integrated Oceanography of the Gulf of Cádiz in a context of global change) (CTM2014-5944-C3) de la Universidad de Cádiz, en el cual se recogieron muestras para determinar la concentración de clorofila y realizar análisis por citometría de flujo a lo largo de cinco transectos perpendiculares a los ríos Tinto y Odiel, Guadiana, Guadalquivir y Sacti Petri, así como en las inmediaciones del Cabo Trafalgar. Se ha tenido especial interés en el estudio fraccionado de la clorofila, lo que nos ha permitido valorar la contribución de los diferentes grupos de fitoplancton a la clorofila total. Por análisis de citometría se ha conseguido diferenciar dentro del espectro de tamaño del pico y nanofitoplancton, obteniendo resultados de abundancia y distribución de los dos grupos más influyentes en el océano como son *Prochlorococcus* y *Synechococcus*. Se ha determinado que *Prochlorococcus* muestra sus máximos valores durante verano y otoño (117 células L^{-1}) a profundidades superiores a los 50 metros, mientras que *Synechococcus* tiene valores más altos en superficie (5-25m) en invierno y principios de primavera, cuando la temperatura del agua no supera los 17ºC (74 células L^{-1}). Se ha podido concluir que la estacionalidad es el principal factor de cambio en las aguas de todo el Golfo, siendo especialmente evidente en los cambios de temperatura, salinidad y turbulencia. En 2017 se realizaron pequeñas campañas en zonas de estuario para determinar la relación entre ciclo mareal y concentración de clorofila total, relación que nos había llamado la atención en campañas anteriores. La concentración de clorofila en zonas cercanas a los estuarios en el Golfo de Cádiz varía casi 1mg m^{-3} dependiendo si la marea es saliente o entrante, esto nos ayuda a entender las diferencias entre concentraciones obtenidas a lo largo de los muestreos, dependiendo del momento de marea en el que son tomadas.

Key words: Clorofila, Citometría, Picofitoplancton, Estacionalidad, Golfo de Cádiz

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NEUSTONIC ICHTHYOPLANKTON IN THE GULF OF CADIZ (SW SPAIN)

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Abstract: Seasonal neustonic ichthyoplankton surveys have been conducted in the Spanish waters of the Gulf of Cadiz in 2016. A grid of 24 stations (from 20 to 600 m) distributed in 5 radials perpendicular to the coastline were sampled in March, June, September and December. In each station, superficial tows of 10 min of duration using a neuston net (80 x 30 cm, 200 µm mesh size) were carried out at a vessel speed of 2-3 knots. A total of 178,145 fish eggs and 7,558 fish larvae were sorted out. A clear seasonal pattern was observed in eggs and larvae abundances, with the highest values recorded in June, and the lowest in December. Anchovy (*Engraulis encrasicolus*) eggs were, by far, the most abundant in the study area, representing 64% of the total fish eggs. The major concentrations were found off Guadiana and Tinto-Odiel River mouths over the 70 to 100 m isobaths. On the other hand, the highest larval abundances were found in the shallowest waters (> 60 m) mainly close to Guadalquivir River mouth. In total, 59 larvae *taxa* (42 at species level) belonging to 32 fish families were identified. At family level, fish larval community were mainly composed by *Sparidae* (38%) and *Engraulidae* (17%) and to a lesser extent by *Cupleidae*, *Bleniidae*, *Mugilidae* and *Gobiidae*.

Key words: neuston, fish eggs, fish larvae, spatio-temporal distribution

DISTRIBUCIÓN DE GASES INVERNADERO EN DOS SISTEMAS COSTEROS DEL PARQUE NATURAL BAHÍA DE CÁDIZ

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Abstract: Las zonas costeras constituyen las áreas geoquímica y biológicamente más activas de la biosfera e intercambian importantes cantidades de materia y energía con los océanos[1]. En estos sistemas se produce entre el 35 y 60% de las emisiones de N_2O. Además, las plataformas continentales y los estuarios son responsables de más del 75% de las emisiones globales oceánicas[2,3,4,5].

Dado el interés que tiene el estudio del comportamiento y flujo de los gases invernadero en zonas costeras, en mayo de 2016 se realizó un muestreo longitudinal en dos sistemas costeros del Parque Natural Bahía de Cádiz: estuario del Guadalete y caño de Sancti Petri. Se tomaron muestras de agua en las que se midió CO_2, N_2O, CH_4, nutrientes (NO_3, NO_2, Si, NH_4, PO_4), clorofila, salinidad, COD y oxígeno disuelto.

Las concentraciones de CO_2, N_2O y CH_4 en el caño de Sancti Petri aumentan desde sus dos desembocaduras hasta alcanzar un máximo en la zona central, donde se produce la entrada de aguas ricas en materia orgánica y nutrientes provenientes del río Iro y de las marismas próximas. En el estuario del Guadalete, hay un incremento en las concentraciones de los tres gases invernadero estudiados a medida que nos adentramos en el río relacionados con vertidos provenientes de la planta depuradora de la ciudad de Jerez. Ambos sistemas actúan como fuente de gases invernadero a la atmósfera con flujos medios de 6,4 mmol m^{-2} d^{-1} de CO_2, 23,9 µmol m^{-2} d^{-1} de CH_4 y 0,8 µmol m^{-2} d^{-1} de N_2O, para el Guadalete, y de 62 mmol m^{-2} d^{-1} de CO_2, 376,9 µmol m^{-2} d^{-1} de CH_4 y 60,4 µmol m^{-2} d^{-1} de N_2O para el caño de Sancti Petri. Este último sistema es el que presenta emisiones más elevadas debido a su mayor superficie.

Key words: Gases invernadero, Bahía de Cádiz, Flujos de gases, Emisiones, Sistemas costeros

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STUDY OF DISSOLVED OXYGEN ANOMALIES DURING THE ERUPTIVE STAGE OF THE SUBMARINE VOLCANO TAGORO, EL HIERRO ISLAND

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Abstract: The eruptive process that took place in October 10th 2011 at the island of El Hierro (Canary Islands), gave rise to the novel submarine volcano Tagoro, at 1.8 km south of the island of El Hierro in the marine reserve of "El Mar de las Calmas" (Canary Islands). In order to monitor the impact of the eruption on the marine ecosystem, several multidisciplinary oceanographic cruises were carried out in the affected area (Fraile-Nuez, et al., 2012, Santana-Casiano et al., 2013, 2016). Here we present a detailed study of the dissolved oxygen parameter with data collected in two oceanographic cruises during the eruptive stage. The findings highlight how the emission of reduced species produced by the submarine volcano Tagoro during the eruptive stage generated dissolved oxygen concentrations close to anoxic levels. Maximum oxygen depletion of 86.2% and 92.4% were found in Leg3 and Leg5 cruises respectively. These perturbations affected not only the marine reserve off El Hierro Island but also affected further areas, as it was transported by local currents to the north of the island producing a depletion of 17.7%. Moreover, our results showed a volcanic plume with low dissolved oxygen concentration being trapped and transported by an anticyclonic eddy for tens of kilometers (oxygen depletion of approximately 5%). The parameter that has been used to describe the low oxygen concentrations is the Differential Oxygen Anomaly (DOA). The Apparent Oxygen Utilization (AOU) values obtained in this study do not represent the age and biological response the water mass in the study area can have. Therefore, the AOU parameter by definition should not be taken into account regarding submarine volcanic areas and the interpretation of this parameter should be made with caution.

Key words: Dissolved oxygen, hydrothermal vent, submarine volcano, Tagoro submarine volcano.

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DOES NUCLEI SILVER STAINING ALLOW IDENTIFYING TRIPLOID AMERICAN OYSTERS?

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Abstract: The American oyster *Crassostrea virginica* (Gmelin, 1791) is a bivalve mollusk of great economic importance that has been fished and reared for centuries in the Atlantic coast of North America. As sterile triploid oysters grow faster and have meat of better quality than diploids, a variety of methods have been assayed to generate triploids since 1960s. Estimating the proportions of triploid oysters obtained with each method is a fundamental part of the process. Although this can be established using different techniques, most of them either require equipment not usually available in shellfish farms (flow citometry) or are highly time consuming (mitotic chromosome counts). A possible simple alternative that gave good results in other species is counting nucleoli in interphase nuclei after silver staining. In this work we analyzed the possible utility of applying this technique to the American oyster. For this, five presumably diploid oysters sampled in a natural population (Rookery Bay, Florida) and 56 presumably triploid oysters obtained from a shellfish farm (Cedar Key, Florida) were analyzed. After colchicine treatment, the gills were excised and subjected to a hypotonic treatment and fixed with ethanol /acetic acid. Nuclei were extended on chromosome slides and stained with silver nitrate and subsequently analyzed microscopically to determine both the number of chromosomes in mitotic metaphase plates and the number of nucleoli in interphase nuclei. All specimens with 2n = 20 chromosomes were characterized by presenting nuclei showing 1 or 2 nucleoli whereas those specimens with 3n = 30 chromosomes additionally presented a proportion of nuclei showing 3 nucleoli, therefore demonstrating that this technique can be useful in ploidy determination in American oysters.

Key words: ***Crassostrea virginica*, Poliploidy, Nucleolus, Silver-staining**

IDENTIFICATION OF VIRULENCE FACTORS DIFFERENTIALLY EXPRESSED WHEN *Vibrio anguillarum* INFECTS WARM- OR COLD-WATER FISH SPECIES

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Abstract: The fish pathogen *Vibrio anguillarum* is a mesophile bacterium usually found in estuarine and marine coastal ecosystems worldwide. It is considered the most important causative agent of vibriosis in warm- and cold-water fish of high economic importance. As an inhabitant of the natural marine environment, *V. anguillarum* must adapt its physiology to the fluctuations in environmental factors such as temperature and availability of iron. It grows from 5 ºC to 35-42 ºC with the optimal temperature about 25-30 ºC. However, it is able to cause disease at low temperatures (5–18 °C)(Ma et al., 2017). Notably, some high virulence strains are able to produce simultaneously piscibactin, a salicylate-type siderophore, and a catechol siderophore, either anguibactin or vanchrobactin. To date, works focused into adaptative response of *V. anguillarum* to temperature and iron deficiency have been done mainly by monitoring growth performance (Larsen et al., 2004) or by real time PCR measuring expression changes of concrete genes (Crisafi et al., 2014). In the present work, it was evaluated the dual effect of temperature and iron starvation in the transcriptome profile of *V. anguillarum*. It was compared by RNAseq the expression levels of the whole genome under iron starvation at 25 °C and at 15 °C. The results showed deep changes in the expression levels of metabolic genes, but also in some virulence factors. More notably, it was found that piscibactin genes are highly expressed when *V. anguillarum* grows under restriction of iron at 15°C compared to the same conditions at 25°C. This finding provides new insights about the relative importance of a virulence factor like piscibactin during the infection of cold-water fish species.

Key words: *Vibrio anguillarum*, siderophores, vanchrobactin, piscibactin, virulence regulation

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NEW INSIGHTS IN THE DIGESTIVE SYSTEM OF THE EUROPEAN LONG SNOUTED SEAHORSE *HIPPOCAMPUS GUTTULATUS*

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Abstract: The long snouted seahorse *Hippocampus guttulatus* is a recent candidate in the ornamental trade and its rearing will help in both the experimental assessment of ecological hypothesis and further development of conservational plans. Since there is a lack of information on many biological and physiological subjects, including developmental features, we assessed the ontogenetic development and functionality of the digestive system in this species by means of conventional and innovative techniques.
The digestive tract of *H. guttulatus* develops with age from a short and straight tube to a long and segmented duct. Histological techniques showed a general increase in the intestinal absorptive surface close to 15 and 30 days, with the formation of intestinal loops. The liver parenchyma showed a significant increase in lipid deposits in early stages, which persisted until day 15. From 20 days onwards, lipid deposits were no longer observed in liver.
The effect of the diet was assayed in juveniles submitted to three different diets (copepods, *Artemia* nauplii or both). Liver biochemical composition was analysed by means of Focal Plane Array-Fourier Transform Infra-Red (FPA-FTIR) spectroscopy. The results achieved evidenced changes in liver biochemical composition when challenged with different type of diet, prior to day 20, depending on the type of diet. Phospholipids increased with copepods administration whereas *Artemia* mainly provided higher content in carbohydrates and lipids.
The digestive system of *H. guttulatus* was functional at first feeding, although not fully developed. As in adults, the liver plays a key role as energy reservoir in juveniles and its macromolecular composition may depend on both the diet provided and the digestive

capabilities of fish. Inadequate diets delivered to fish when the gastrointestinal motility, digestion and absorption are not fully developed, might influence growth and survival rates with development.

Key words: *Hippocampus guttulatus*, digestive system, liver, ontogenetic development, FPA-FTIR spectroscopy.

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THE EFFECT OF DIFFERENT DIETS ON BROODSTOCK REPRODUCTION AND NEWBORN QUALITY IN THE SEAHORSE HIPPOCAMPUS GUTTULATUS

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Abstract: Results of breeding in captivity of the threatened seahorse *Hippocampus guttulatus* have highlighted the importance of the quality of parental feeding in breeding success and newborn viability. In nature, changes in prey availability are frequently related to antropogenical activities and in the presence of macrophytes. The objective of this study, through simulation in captivity, was to assess the effect of food quality of breeders on survival, growth, isotopic signatures ($\delta^{15}N$ and $\delta^{13}C$) and fatty acids in newborn and juveniles. For that 3 groups of breeders were maintained for a whole breeding season and fed on three different diets (A- Adult non-enriched *Artemia*, M- Mysidaceans; AM- mixture of both prey). The type of food offered was reflected in the final stable isotopes signatures in breeders at the end of the experiment. The best and worse overall results (batch produced, batch size, survival, growth) regarding quality and early development of newborn were obtained in the groups fed on the mixed diet or on Mysidaceans alone, respectively. Newborn from group A showed higher levels in 20:5n-3 but lower 22:6n-3 levels than juveniles from the other groups. At day 7, fatty acids profiles did not differ notoriously among treatments but significant differences were detected in isotopic signatures in individuals from treatment A. While the results achieved are not absolutely conclusive, they seem to support the idea that a mixed diet would result advantageous, at least on reproductive success. Supplementary information on energetic status and oxidative stress (analysis in progress) will support or reject such statement.

Key words: Seahorse, diet, reproduction, *Hippocampus guttulatus*, offspring quality.

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ANÁLISIS TÉCNICO ECONÓMICO Y LEGISLATIVO DE BIOACTIVOS PARA CONSUMO HUMANO DE ORIGEN MICROALGAL

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Abstract:

Las microalgas despiertan un considerable interés biotecnológico debido a su amplia distribución, su metabolismo y su composición bioquímica rica en moléculas de interés industrial. El propósito de este trabajo, es ofrecer un análisis técnico-económico y legislativo de los principales bioactivos de origen microalgal para consumo humano en general. El análisis se llevó a cabo mediante la revisión sistemática de literatura de artículos indexados en las principales bases de datos, así como también la consulta en centros de investigación y empresas vinculadas al estudio y explotación de microalgas.

Los principales resultados del estudio, señalan que los productos derivados o suplementados con biomasa microalgal para consumo humano directo, está dirigidos principalmente al sector alimenticio (pastas, salsas, barras energéticas, etc.) cosmético (cremas faciales, protectores solares), farmacológico (comprimidos de biomasa, antioxidantes, ácidos grasos DHA), y que está limitado a pocos géneros microalgales principalmente *Arthrospira*, *Chlorella* y *Dunaliella*.

El análisis de este estudio constató que, en relación con los aspectos técnico-económicos acerca de la mayoría de los bioactivos derivados de microalgas, los procesos de recuperación de biomasa suelen superar los costos de producción de las sustancias activas, convirtiéndose hasta el momento en el principal obstáculo a la implementación de estos sistemas. En cuanto a la legislación aplicada a este material biológico, el uso de

microalgas y sus derivados se encuentran regularizados dentro del Reglamento 2015/2283 del 01 Enero de 2018, del Parlamento Europeo y del Consejo, relativo a los nuevos alimentos.

Este trabajo permite establecer que, los sistemas productivos basados en microalgas son muy prometedores, aunque (principalmente, pero no exclusivamente) los procesos de separación de la biomasa desde los medios acuosos, suponen un serio obstáculo económico para la viabilidad de estas industrias: los casos en los que este coste se ha superado se han relacionado siempre con productos innovadores o excelentes y adecuadas estrategias de márquetin.

Key words: Microalgas, bioactivos, consumo humano, legislación.

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EVALUATION OF PLASTIC SKIRT USED AS MANAGEMENT MEASURE AGAINST SEALICE INFESTION IN NORWEGIAN ATLANTIC SALMON FATTENING CAGES.

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Abstract:

The study of the pelagic zooplankton community in the surrounding of fish farms is necessary to understand what is the mechanism of aggregation of the parasitic copepod (sealices), in order to reduce the incidence of these parasites in the salmon fattening cages. The use of physical barriers, such as plastic skirts, is already applied as a mitigation measure for avoiding sealices infestation. A study was proposed with the general hypothesis that the existence of the Atlantic salmon facilities affects the abundance of zooplankton, being an important factor affecting zooplankton abundances the use of plastic skirts to avoid the infestation of parasite copepods (*Lepeophtheirus salmonis salmonis* Krøyer, 1837). Two aquaculture facilities were sampled in the Norwegian fjords, at 1 and 3 m deep, with only one which had a plastic skirt inside each of the cages up to 6 meters depth. The nauplii of sealices did not show statistical differences between treatments due to low abundance and high spatial variability, but they seem to be abundant inside the cages with skirts and around the cages without skirt, mainly at 1 m. The abundance of zooplankton was greater in cages with skirt. The most abundant taxonomic groups were Ciclopoida (43.1%) and Calanoida (36%). This marked increase of some taxa in the cages, both inside and outside, was consistent regardless of depth. The reasons for the increased abundance of zooplankton both within and near the cages are discussed and a retention effect is suggested by skirts placed on cage structures possibly due to the physical reduction of currents and migrations of the zooplankton community.

Key words: Sealices; plastic skirt; zooplankton; aquaculture impact.

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EFFECT OF TRIPLOIDY ON HUMORAL IMMUNE RESPONSE IN TURBOT (*Scophthalmus maximus L.*)

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Abstract

Turbot (*Scophthalmus maximus L.*) represents the main marine flatfish being cultured in Europe and Galicia region is the production leader with approximately 60% of the total production. The success of fish farming is supported by deep knowledge of the biology and nutritional requirements of fish during their life cycle, as well as, by a good understanding of their immune response against different kinds of pathogens.

To improve fish culture new methodologies have been developed. Among them, the production of sterile populations by chromosome set manipulation is a research line of interest for improving turbot farming. In this sense, triploidy induction offers several advantages, since most of fishes are sterile and females, allowing larger sizes of high commercial value and preventing the genetic contamination of wild stocks by potential escapees. Although the current literature suggests that triploidy does not affect vital aspects of fish physiology, we must perform more studies to clarify if the ploidy status could compromise the performance of complex processes such innate and adaptive immune response. The present work shows the results obtained after vaccination of diploid and triploid turbots with the commercial ICTHIOVAC-VR vaccine. Data obtained by ELISA and molecular (qRT-PCR) techniques suggest that expression and activity of innate and adaptive immunity components, like levels of oxidative enzymes and immunoglobulins, may be affected in the triploids. Based on these results, further studies are required to clarify if the triploidy status could compromise the immune function in this species.

Keywords: *Scophthalmus maximus*, triploidy, immune response.

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METHODOLOGY FOR THE RESCUE AND TRANSPORT OF *P. NOBILIS* INDIVIDUALS

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Abstract: The fan mussel *P. nobilis* is a subtidal bivalve from the Mediterranean Sea, typical inhabitant of *Posidonia oceanica* meadows. *P. nobilis* populations in the western Mediterranean have been recently affected by a mass mortality event (MME). This MME, provoked by what seems to be a new species of an Haplosporidian protozoan, has affected to almost all the Spanish Mediterranean, causing high mortality rates reaching up to 100%. The Ministerio de Agricultura, Pesca, Alimentación y Medio Ambiente (MAPAMA) from Spanish Government declared in October 2017 the Emergency Rescue Status. A survey was performed to rescue 115 individuals from Portlligat bay (Cabo de Creus) in Cataluña, Spain, to maintain them in controlled tanks to ensure their survival. This area presented a large population established in a dense *P. oceanica* meadow and was one of the few that remained unaffected by the MME, which spreads unstoppable since its beginning early autumn 2016.
A diving extraction protocol was designed to ensure the survival of individuals. Fan mussels are strongly attached by their byssus to the seabed and to *P. oceanica* roots. The byssus was severed and the individuals carefully unburied to avoid breaking the soft tissues by excessive tension on the byssus during the extraction. Two 350L tanks subdivided by a network of cages were used to transport the individuals, taking care of water quality conditions during the process. Individuals were distributed among four different specialised institutions. The results were positive with a 100% of individuals' reaching their tanks alive, only one with weakness signs.
This project shows a way to preserve the species in views of the high virulence shown by the MME and serves to maintain a genetic reservoir of those populations. This rescue is a

first step in the recovery of the *P. nobilis* populations. Captivity breeding of the fan mussel and studies of the ecology of the new *Haplosporidium* species along with mapping its spread to other Mediterranean areas are the next steps for *P. nobilis* preservation.

Key words: *P. nobilis*, rescue, mass mortality event.

Acknowledgments: The work was funded by the Spanish "Ministerio de Agricultura, Pesca, Alimentación y Medio Ambiente" to the project "Rescate de 215 ejemplares de nacra (*Pinna nobilis*) y su mantenimiento en 5 centros especializados en el marco del Proyecto LIFE IP-PAF INTEMARES (LIFE15 IPE ES 012), (Gestión integrada, innovadora y participativa de la Red Natura 2000 en el medio marino español)". The work was also accomplished thank you to the funding of the Prince Albert II of Monaco Foundation through the project "The study, protection and possible breeding of pen shell (*Pinna nobilis*) in the Boka Kotorska Bay".

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GROWTH OF THE SURFER CLAM *DONAX TRUNCULUS* IN THE SHELLFISH BANK OF THE MARINE RESERVE OF FISHING INTEREST RÍA DE CEDEIRA (NW GALICIA, NE ATLANTIC)

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Abstract: The shellfish bank of Vilarrube beach, located within the Marine Reserve of Fishing Interest Ría de Cedeira, is the only production area of the surfer clam *Donax trunculus* in Galicia (NW Spain). For this reason, aspects of population dynamics such as size structure, recruitment and growth were studied in order to accurately evaluate the state of the resource.

A monthly monitoring of the clams population in the intertidal zone was carried out from May 2014 to April 2015, collecting a total of 3128 specimens in the size range from 3.3 to 44.1 mm shell length (SL).

The growth parameters were estimated using three different methods: the shell length-frequency distributions, the quantification of surface growth rings and internal shell microgrowth bands. Analysis of the monthly distribution of length frequencies showed a single recruitment period in October. The growth pattern presented two phases, one with higher growth rates between March and December, characterized by the formation of opaque wide bands, and another with lower growth rates between December and March, presenting narrow and translucent bands. The maximum life span estimated was 6.6 years (44.1 mm SL), although only a few specimens sampled (0.3%) exceeded 6 years (40 mm SL).

Key words: Bivalve, *Donax trunculus*, Growth

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RECRUITMENT AND GROWTH OF *ANOMIA EPHIPPIUM* AND *OSTREA EDULIS* IN ARTIFICIAL HARD STRUCTURES.

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Abstract: Settlement of bivalves of the family *Anomiidae* and *Ostreidae* was found as main components of the fouling in the refrigeration systems of Vandellós II nuclear power plant (Tarragona). The present study has been carried out with the aim of knowing the life cycle of the species *Anomia ephippium* and *Ostrea edulis* in order to plan the best methodologies to minimize their presence in the fouling. At the foot of the Peñón de Ifach (Calpe), a one-year experiment was planned in three sampling stations situated at 10, 15 and 20 m depth. A total of 72 construction tiles were placed at each station to serve as substrate for the settlement of marine fauna. Commencing 45 days after the first installation, 6 tiles were collected and two more were deployed monthly. In this way, it was possible to study the cumulative settlement and growth in 4 tiles and the peaks of monthly settlement in the other two tiles. Both, *A. ephippium* and *O. edulis* were found to be predominant in the macrofauna assemblage. Their presence was concentrated in the sciaphilic side of the tiles. Each individual of these two species was identified, numbered, photographed and measured. With regard to the results, we compared the abundance of individuals between the different depths and it was observed a trend toward an increase in the number of individuals with increasing depth. The size of the individuals increased fast, some specimens reaching 30 mm in 4 months. Furthermore, it was noted that there was a peak of recruitment between September and October, and a pronounced valley in January and February. The settlement values were moderate the rest of the year.

Key words: Benthic assemblages, fouling organisms, life cycle, Anomia Ephippium, Ostrea Edulis

Acknowledgments: This study was conducted with financial support from the Asociación Nuclear Ascó-Vandellós II (ANAV).

CRYOPRESERVATION OF BLUE MUSSEL (*Mytilus galloprovincialis*) TROCHOPHORE LARVAE AND LARVAL REARING DEVELOPMENT

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Abstract: The aim of this study was the development of a cryopreservation protocol for the larvae of *Mytilus galloprovincialis*. Post-freezing survival and resistance to the toxicity of cryoprotective agents are higher in advanced stages of development, so we chose throcophore larvae for the experiment [2]. We evaluated the effect of Ethylene Glycol (EG) for cryopreservation of trochophore larvae 48h old, following the preliminary protocol that E. Paredes used for *M. galloprovicialis* mussel trochophores in 2013 [2]. The freezing rate chosen was: holding at 4ºC for 2 min, then cooling at 1ºC / min to -10ºC, holding for 5 min, then cooling at -35ºC with a rate of 1ºC / min, then plunging into liquid nitrogen and thawing at 28ºC water bath. With this protocol E. Paredes reached a D-larvae (48 hours incubation) of 48.9 ± 7.6% with 10% EG + 0.2 M Trehalose (TRE). The initial test of 2013 only studied the trochophore larvae until they reached the D-stage (48h old), in our study we also carried out a larval rearing with cryopreserved trochophore larvae in comparison to fresh larvae, using 10% EG + 0.4 M TRE. This experiment allowed a comparative post-freezing study of both larval development and survival. Larvae settlement was also characterized after 13 days. The data revealed that until settling, the survival of the cryopreserved larvae (27.74%) was much higher than the 2,8% in the larval rearing of 2012 obtained for Greenshell mussel [1]. Over time, growing-of control larvae was faster than growth of cryopreserved larvae, but from day 17 the size between both types of larvae began to stabilize, with a percentage of length reduction compared to control of 3,91%. Attending to settlement, we obtained a 64% of success of cryopreserved larvae respect to the control.

Key words: *Mytilus galloprovincialis*, Trochophore larvae, Cryopreservation, Larval rearing.

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COMPARATIVE ANALYSIS OF DIFFERENT PROTEIN ASSAYS IN MARINE ORGANISMS

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The measurement of protein is an important and critical assay for determining specific enzyme activities in marine organisms. For this reason, understanding the nuances of the methodology is crucial. There are several methods for determining total protein content that are based on nitrogen analysis or on dye-based absorbance measurements like the Lowry, Bradford and Smith methods. However, their application is limited by interferences with chemicals widely used in many biological buffer preparation. Accordingly, we compared and analyzed seven protein assays (Rutter, Rutter-SDS, Markwell, BCA, microBCA, Bradford and microBradford) in different organisms (*Leptomysis lingvura* and *Pelagia noctiluca*) and in different marine samples (0.7-50, 50-200 and 200-2000µm plankton sizes). Furthermore, because they are not real endpoint assays, we have evaluated the time-dependant behaviour of these seven assays, after the incubation time, in low and medium pure-protein samples. In addition, we determined their limit of detection (LOD).

Comparing methods, we found significant differences between them in all organisms. Testing the differences between theoretical and measured values, we found that the mBCA method was the most accurate for all organisms except in the case of *Leptomysis lingvura.* In contrast, the Rutter method was the least accurate in all organisms with the exception of 0.7-50µm size. In relation to their behaviour, the microBCA method drifted the least, over time, in both low and medium concentration samples (0.0269 and 0.1532µg/mL/min respectively). As for LOD, the most sensitive method for low protein levels was the microBCA one (7.2µg protein). The LOD for higher levels of protein was with Bradford method (0.4715mg protein). In all cases, protein is most accurately determined if the analysis is carried out as fast and as consistently as possible.

In summary, the results showed that, for protein determinations in the organisms studied, the microBCA method is the most useful.

Key words: Protein, specific enzyme activities, Lowry, Bradford, Bicinchoninc acid

QUALITY INDICATORS AND NUTRITIONAL VALUES OF COMMON OCTOPUS IN THE W-MEDITERRANEAN SEA

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Abstract: In the last decades, nutritional values and quality indicators are gaining importance in society leading to a better and healthier lifestyle. Seafood is known to provide high content of n-3 polyunsaturated fatty acids (PUFAs) which have a positive effect in body development and preventing human diseases (Valfré et al. 2003). The main objective of the study was to evaluate the nutritional value of *Octopus vulgaris* inhabiting coastal waters of Mallorca by analysing the fatty acid compositions in the mantle of sampled individuals from four different coastal areas with different characteristics (Sillero-Rios et al. 2018). *O. vulgaris* were sampled from coastal-marine protected area (Cap de S´Enderrocat), two human-altered coastal areas (Andratx harbor and Magaluf) and one deep-waters fishing ground of interest for commercial trawling. Fatty acids from the mantle were determined by Gas Chromatography. Differences on some fatty acids among sampled individuals were found. For instance, a higher proportion of the n-3 PUFA docosahexaenoic acid (DHA, C22:6n-3) was detected in octopus sampled within marine reserve, compared to other human-altered areas. Moreover, lower proportions of PUFAs, Omega-3 acids (n-3) and saturated fatty acids (SFAs) were detected in areas out of the Bay of Palma (Andratx and trawling areas). In conclusion, environmental characteristics and the specific human activities determined the lipid profile in *O. vulgaris*, with special relevance the omega 3 fatty acids for their nutritional importance.

Key words: Fatty acids, *Octopus vulgaris*, coastal resources, human consumption, anthropogenic impacts.

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ECOLOGICAL ROLE OF *Pisidia longicornis (DECAPODA, PORCELLANIDAE)* IN ACCUMULATION OF MUSSEL SHELLS ON BENTHIC HABITATS DUE TO AQUACULTURE ACTIVITIES

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Abstract: Spain is the second largest producer of mussel in the world and most of this production is located in the NW. High production levels leads to shell accumulation, modifying the complexity of benthic habitats, forcing changes on benthos, and favouring the massive increase in abundance of Pisidia longicornis, when compare to distant areas from mussel production units (bateas). The objective of the present study was to estimate the population increase of P. longicornis due to mussel shells accumulation on the benthos, using experimental units distributed under the influence of bateas, compared with bare sediment without mussel shells (control). The experimental were deployed for 5 months and consisted of mesh bags with mussel shells (30 l), which simulate the existing substrate under the bateas. Additionally, the metabolic rate of this species was estimated using respiration. The experiment was conducted by measuring the rate of oxygen consumption and the production of CO_2 by organisms of two different sizes, using closed containers to measure the consumption of both parameters in one hour. Oxygen was measured through an oximeter, and the production CO_2 was measured using a total carbon titration with Titrisol HCl at two pH ranges. The results showed a significant increase of P. longicornis abundance, up to 10,000 ind/m^2 at the zones with mussel shells accumulations, being the abundance around 20 ind/m^2 in control sediment. The metabolic rate was strongly dependent on temperature, size and natural feeding, with values of O_2 consumption between 15.04 and 796 mmol/g/day. The effects of valves accumulation produce an increase in the abundance of invertebrates such as P. longicornis, which find it as an optimal habitat. The high metabolic rate and very high abundances may increase the consumption of organic matter and prevent its accumulation on benthic habitat affected by mussel aquaculture, increasing the carrying capacity of benthic habitats.

Key words: benthos impact, respiration rate, sustainable aquaculture

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ESTUDIO DE LOS BANCOS DE COQUINA (*Donax sp.*) EN GALICIA: BANCO DE VILARRUBE

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Abstract: Primeros resultados de la Acción de investigación "Determinación de las causas de la disminución de los bancos de coquina. Condicionantes naturales y antropogénicos". El objetivo es determinar las causas naturales que afectan a los bancos de coquina y los efectos que sobre ellos tiene la actividad humana. Las causas naturales pueden estar vinculadas a la naturaleza de los sedimentos, a la topografía de las playas, a diferentes toxicidades, a cambios por causas hidrológicas o climáticas y a diversas patologías.
Este estudio interdisciplinar es una continuidad de otro, en la que se estudiaron en Galicia los bancos naturales donde existía esta especie. Se concluyó que el único banco productivo era el de Vilarrube y en él se estaba produciendo un continuo descenso de las densidades de población reflejado en las extracciones. También que la escasez de los individuos, en las principales playas, no se debía a la contaminación química en los sedimentos ni agua, ni a la reducción de la diversidad genética, ni a mortalidades por patologías.
A partir de esto, en el banco de Vilarrube se hacen muestreos trimestrales, en puntos marcados en todo el banco, de la población y del sedimento para ver sus características y relacionarlos entre sí. También se estudia el perfil de la playa y sus variaciones. La influencia meteorológica y de la hidrología se está estudiando en base a la recopilación, tanto de datos históricos como los recogidos actualmente. Además se continúa con el control de las patologías y de su reproducción.
Hasta ahora se puede decir que la población se está recuperando ligeramente, aunque sigue habiendo escasez de individuos de talla comercial, que el banco es una zona muy dinámica, con gran variabilidad de barras arenosas, canales de desagüe y estructuras sedimentarias, registrándose importantes variaciones en la altura topográfica de cada estación. La zona tiene una mayor influencia oceánica que continental. En cuanto a las patologías, no se detecta ninguna de interés. En su ciclo reproductivo los resultados eran coincidentes con otros anteriores de la población.

Key words: Donax trunculus, bancos marisqueros, factores naturales, actividad humana.

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INTEGRATED COASTAL ZONE MANAGEMENT: WATER QUALITY

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Abstract: Water coastal cycle involve the analysis of water quality of marine environment, which could be affected by anthropogenic sources. Anthropogenic sources, as wastewater, could be introduced, through submarine discharges in marine habitats. Furthermore, the reuse of wastewater has a positive contribution to society and environment, improving integrated coastal management. The establishment of eco-sustainable systems as constructed wetlands (CWs) favours water treatment and the validation of bioremediation through the effluent quality.
The aim of this work is to value the bioremediation capability of constructed wetlands by comparing two types of reactors. Specifically two vertical primary reactors with organic substrates (palm tree mulch), one of them containing growing-plants such as *Canna indica* and *Xanthosoma sagittifolium* and another without plants, were separately sampled. Fecal indicator bacteria (FIB) were analysed through molecular probes referenced by *lacZ*-*Escherichia coli* and 16s rRNA-*Enterococcus intestinalis*. Terminal restriction fragment length polymorphism (T-RFLP) analysis were performed in a time course. T-RFLP patterns were analysed using the GeneMarker v1.85 and T-Align softwares. Results show a diminution of restriction fragments for both *lacZ* and 16s rRNA as time progressed in the two reactors. Likewise, in plant-containing reactor, a decrease in fragments number was reported and a change in the T-RFLP profile was also observed compared to those in without plants reactor. This diminution was related to the presence of roots-associated microbiota.
We conclude molecular probes allow validation of water quality by comparing CW reactors. In addition, this open an important network to study bioremediation based on organic substrates-containing reactors.

Key words: ICZM, water quality, CWs, FIB, T-RFLP

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Ulva intestinalis MEDIATED SYNTHESIS OF GOLD AND SILVER NANOPARTICLES. EVALUATION OF THEIR TOXICITY AND CELL ACTIVATION

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Abstract: In the last years, there has been a trend towards greener and more environmentally-friendly processes for the synthesis of nanomaterials. Among these methods, the use of seaweeds emerged as a promising field in nanotechnology (González-Ballesteros et al. 2017). Here, the cosmopolitan green seaweed *Ulva intestinalis* (UI) was used to obtain gold and silver nanoparticles. *Ulva intestinalis* belong to the Family Ulvaceae, and is characterized by its fast growth rate and for being a rich source of sulphated polysaccharides. Firstly, an aqueous extract of UI was prepared and its reducing activity, total phenolic content and DPPH scavenging activity were determined. The results confirmed the presence of reducing components within the aqueous extract. Follow, the synthesis was performed and the obtained nanoparticles were fully characterized by UV-Vis spectroscopy, Transmission Electron Microscopy (TEM), High Resolution Transmission Electron Microscopy (HRTEM) and Scanning Transmission Electron Microscopy (STEM); these technics allow us to confirm the formation of spherical polycrystalline nanoparticles with mean diameter of 17 ± 3 nm for Au@UI and 14 ± 2 nm for Ag@UI. Moreover, Fourier transform infrared spectra (FTIR) of UI extract, Au@UI and Ag@UI were measured in order to identify the functional groups of biomolecules that could be involved in the formation and stabilization of the nanoparticles.

The potential toxicity of UL extract, Au@UI and Ag@UI were tested in macrophage and lung epithelial cell lines at different doses. The results indicate that all were safe at all the concentrations tested, except for Au@UI at 50 µM and the UL extract at 0.1g/mL which induce some decrease in cell viability. In addition, the release of reactive oxygen species (ROS) and the cell activation will be also evaluated in vitro.

Key words: *Ulva intestinalis*, AuNP, AgNP, Cytotoxicity, Immunogenicity

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ANTIBACTERIAL ACTIVITY AGAINST CLINICAL PATHOGENS OF SILVER AND GOLD NANOPARTICLES SYNTHESIZED BY *SARGASSUM MUTICUM* EXTRACT

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Abstract: Despite the numerous existing antibiotics and other antimicrobial drugs, bacterial infections are still a major cause of morbidity worldwide. There is an urgent need in developing potent antibacterial agents due to the growing concern on multi drug resistant bacterial strains. We present here the antimicrobial activity of gold and silver nanoparticles synthesized by an aqueous extract of the brown algae *Sargassum muticum* (Yendo) (SM). Originally from Japan, *S. muticum* is one of the most aggressive and invasive macroalgae, associated with changes in biodiversity in rocky shores from warm and temperate latitudes. Initially, an aqueous extract of SM was prepared and characterized according to its reducing power, total phenolic content and DPPH scavenging activity. Then, gold and silver nanoparticles were synthesized and fully characterized by UV-Vis spectroscopy, High Resolution Transmission Electron Microscopy and Scanning Transmission Electron Microscopy; these technics allow to confirm the formation of spherical nanoparticles with mean diameter of 10.4±1.2 nm for Au@SM and 41.0±5.7 nm for Ag@SM. Lastly, the antimicrobial activity of the samples was tested. Three different models of bacterial structure were chosen. *S. aureus* for Gram+ bacteria. *K. pneumoniae* for Gram- bacteria and *M. chelonae* and *M. abscesus* as a model of Mycobacteria, which also have the feature of being fast growing. The assays were conducted by broth macrodilution following the CLSI standards. The results showed that SM extract had no inhibitory effect on any of the 4 species tested, whereas Au@SM showed inhibitory activity on *S. aureus* at a concentration above 0.05mM, and no activity on *K. pneumoniae.* Ag@SM did not presented activity neither against *K. pneumoniae* nor *S. aureus*. With regard *M. chelonae* and *M. abscesus,* both Au@SM and Ag@SM produced little inhibition; these results deserve new trials to be conducted in further studies in searching of the mechanism that justifies the observed behavior.

Key words: *Sargassum muticum, gold nanoparticles, silver nanoparticles, antimicrobial activity, chronic* respiratory *infections*

EPIGENETIC DNA METHYLATION STUDY OF BIVALVE TUMORS

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Abstract: DNA methylation, the best studied epigenetic mechanism, is essential in regulating gene expression and gene silencing in the eukaryotic genome. Different cell types have specific and pre-established DNA methylation profiles. Alterations in those profiles may lead to cell malfunction, illness and, ultimately, tumorigenic events. DNA methylation is known to be abnormal in most cancer types, either being the cause behind these tumorigenic events or just a byproduct. Recent studies suggest for a crucial role of epigenetic marks on both bivalve early development and their adaptation to environmental stressors, but the involvement of DNA methylation in bivalve tumorigenesis is far from understood. In this work we tested out the global methylation profiles in healthy and neoplastic golden carpet shell, *Polititapes aureus*, and cockles, *Cerastoderma edule*, by means of a Methyl-Sensitive Amplification Polymorphism (MSAP) approach. This assay, based on differential cleavage reactivity of *Hpa*II and *Msp*I to cytosine methylation, allows assessment of differences in methylation profiles among experimental groups. Each genomic DNA sample was digested in parallel with *Eco*RI + *Hpa*II and *Eco*RI + *Msp*I. Following AFLP reading by capillary electrophoresis the resulting restriction profiles were scored for all samples and analysed. The results suggest that the largest contribution to the differences are due to genomic rearrangements, with a small contribution of methylation to the overall MSAP variation.

Key words: Disseminated neoplasia, Bivalves, Methylation

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PHILOGEOGRAPHIC ANALYSIS OF THE BALTIC PRAWN Palaemon adspersus TOWARDS UNDERSTANDING THE INTRODUCTION IN NORTHWEST ATLANTIC WATERS

Inés González-Castellano*[1], Enrique González-Ortegón[2,3], Philip Sargent[4], Gerhard Pohle[5], Ana M. González-Tizón[1] and Andrés Martínez-Lage[1]

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Abstract:

The Baltic prawn *Palaemon adspersus* Rathke 1837, is a crustacean decapod native in European waters from the Baltic Sea to the Mediterranean Sea (González-Ortegón and Cuesta 2006). This prawn was recorded in 2015 as an introduced species in the west coast of Newfoundland and the Magdalen Islands, Canada (González-Ortegón et al. 2015). The most likely vector for the *P. adspersus* introduction is via ship ballast water from European waters. Here a phylogeographic analysis was carried out in order to identify the European source population for *P. adspersus* introduction in Atlantic Canadian waters. Mitochondrial marker cytochrome c oxidase subunit I (COI) was sequenced in 134 individuals collected from 5 localities: St. George's Bay (Newfoundland and Labrador), Limfjorden (Denmark), Gydinia (Poland), Venetian Lagoon (Italy) and Aegean Sea (Turkey). Statistical parsimony haplotype network, spatial analysis of molecular variance (SAMOVA), F_{ST} pairwise and principal coordinate analysis (PCoA) were performed. Diversity indices were obtained to estimate genetic variability and demographic changes were evaluated by Tajima's *D* and Fu's F_S statistics. Results revealed that St. George's Bay is more related with Atlantic localities than with Mediterranean localities. Specifically, F_{ST} values supported that St. George's Bay and Limfjorden are the less differentiated or more connected localities (F_{ST} = 0.02392, P-value = 0.04). Accordingly, Limfjorden is the more likely source from which *P. adspersus* was introduced into Canadian waters. Neutrality

test suggested a population expansion in St. George's Bay. It is noteworthy that results also showed certain genetic differentiation between Atlantic (including the Canadian one) and Mediterranean localities, a common population genetic structure pattern found in several crustacean species. In conclusion, this study highlights the need of reconsider the effectiveness of ballast water regulations between Atlantic Canadian and northern European regions.

Key words: prawn, source, ballast water, locality, cytochrome c oxidase I.

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ISOLATION AND CHARACTERIZATION OF 21 POLYMORPHIC MICROSATELLITE LOCI FOR THE ROCKPOOL PRAWN *Palaemon elegans*

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Abstract:

The rockpool prawn *Palaemon elegans* Rathke, 1873 is a crustacean decapod distributed throughout the Atlantic Ocean and Mediterranean, Black, Caspian and Baltic Seas (Udenken d'Acoz 1999; Grabowski 2006). This species is characterized by its capability to adapt to highly variable environmental conditions. Although this prawn is considered an important species within European coastal fauna due to its broad ecological niche and recent geographic expansion, population genetics analyses are scarce. Phylogeographic analyses with mitochondrial markers (Reuschel et al. 2010; Deli et al. 2017) revealed the existence of genetic differentiation between Atlantic and Mediterranean populations and the presence of a cryptic species in the Mediterranean Sea. These results highlighted the need to carry out further fine-scale studies with polymorphic nuclear markers, such as microsatellites. We developed the first microsatellite loci for this species using next-generation sequencing technology. An enriched library for microsatellite motifs was prepared from an individual prawn and it was sequenced in the Illumina MiSeq platform. A total of 3902540 reads were produced, tandem repeats were identified and primers for its amplification were designed. A panel of 94 primer pairs was screened in individuals from five Atlantic and Mediterranean localities. Twenty-one microsatellite loci (perfect tri- and tetranucleotide) yielded consistent amplification and reliable polymorphism and were used to make a preliminary assessment of the genetic diversity of the Santoña locality (Cantabria, Spain) by genotyping 30 individuals. The number of alleles per locus ranged from 2 to 12 and observed and expected heterozygosity ranged from 0.033 to 0.833 and from 0.033 to 0.869 respectively. No significant departure from Hardy-Weinberg equilibrium was detected in most of the loci. Linkage disequilibrium and null allele presence were also checked. This set of 21 microsatellite loci will provide useful polymorphic molecular markers for future genetic analyses in *P. elegans*.

Key words: microsatellite marker, next-generation sequencing, population genetics.

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DISTRIBUTION AND GENETIC DIVERSITY OF SYNGNATHIDS WITHIN SPANISH MARINE NATIONAL PARKS

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Abstract: Spanish National Parks (PNs) are areas of special interest for conservation purposes, which include two Marine PNs (Atlantic Islands, NW Spain; Cabrera, Balearic Islands). This study was aimed to characterize genetically the syngnathid species (i.e. seahorses and pipefish) identified within PNs, as valuable genetic resources within vulnerable ecosystems. Non-lethal samples of sighted individuals were analyzed by means of mitochondrial DNA (mtDNA) markers (cytochrome b (cytb) and 16S rDNA) and microsatellite loci, using primers previously reported in syngnathids (Wilson et al., 2001; Monteiro et al., 2014; López et al., 2015; Bouzas et al. 2017). Different species were detected and evaluated with the cytb and 10-12 microsatellite markers for *genera Syngnathus* and *Hippocampus,* while 16S rDNA and 7-8 microsatellite markers were used for *genera Nerophis* and *Enterulus*. Congruence between morphological and genetic data was detected, although a few discrepancies (1.6% of specimens) were found, and used to revise potential misidentifications, as reported for some pipefish (Hablützel and Wilson, 2011). Phylogenetic analyses grouped the mtDNA haplotypes found for each species in monophyletic groups, according with previous studies (Wilson et al., 2001; Hamilton et al., 2017). Microsatellite loci were assayed for population analyses and individual traceability. Intraespecific genetic diversity was estimated using spatial/temporal population samples from field surveys (2-20 m depth) performed along West and East coasts of Cíes and Cabrera Islands, respectively, in 2016 and 2017. Data agree with previous reports on European syngnathids (Monteiro et al., 2014; López et al., 2015; Bouzas et al., 2017). Genetic data revealed differences between Atlantic and Mediterranean populations for the species present in both PNs, congruent with phylogeographic reports. Molecular markers in this study provide useful data to support species identification and to analyze genetic variability of syngnathids in Spanish Marine PNs, which are biodiversity reservoirs for these emblematic species and valuable associated habitats and ecosystems.

Key words: Syngnathids, Marine Spanish National Parks, genetic diversity, conservation

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NEW INSIGHTS IN CRISPR-CAS OF *Pseudomonas balearica*

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Abstract:

Pseudomonas balearica DSM 6083^T is a Gram-negative bacterium, originally isolated from water of a wastewater treatment plant lagoon (Bennasar et al. 1996). This strain tolerates up to 8.5% NaCl and in fact is considered as true *Pseudomonas* marine denitrifier. The complete genome sequence of this strain was published recently (2016), and revealed a complete clustered regularly interspaced short palindromic repeat (CRISPR)-associated (Cas) system type I-E (Bennasar-Figueras et al. 2016). CRISPR-Cas are dynamics systems that work as an adaptive immune system (Wright, Nuñez, and Doudna 2016). The isolation of the complete system and its introduction in a simpler model study such as *Escherichia coli* would constitute a controlled model to simplify the characterization of the CRISPR-Cas system I-E of *P. balearica*. In the present study, the *cas* locus type I-E and the complete CRISPR-Cas system were cloned. Briefly, two amplicons, the *cas* locus (10 Kb) and the complete CRISPR-Cas system (14.5 Kb), were PCR amplified. These amplicons were cloned to obtain pCR-XL-TopoCas and pCR-XL-TopoCRISPR-Cas constructions, which finally were transformed in *E. coli* BL21 DE3. Besides the above described CRISPR-Cas system, the use of new CRISPR annotation bioinformatics tools (CRISPRone) (Zhang and Ye 2017), allowed us the detection in *P. balearica* DSM 6083^T of two new loci potentially related to CRISPR-Cas systems. These new loci were composed of types I, IV, V or unclassified. Furthermore, CRISPRone annotated additional hypothetic genes and among these only one could be analysed in depth. This gene was localised in locus *cas* I-E and *in silico* it was determined both, the nuclease activity of the potential product and the key functional amino acids. In our knowledge, this is the first work in which it has been cloned a complete CRISPR-Cas system I-E (Gleditzsch et al. 2016; Sinkunas et al. 2013). These results provide the bases for future studies of characterisation and functionality of CRISPR-Cas systems of *P. balearica* DSM 6083^T and for other marine microorganisms containing CRISPR-Cas systems of class I.

Key words: *Pseudomonas balearica* DSM 6083^T, Locus *cas*, CRISPR-Cas, Class I, Type I-E.

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THE IMPACT OF OVERFISHING ON THE GENETIC EFFECTIVE POPULATION SIZE OF THE EUROPEAN HAKE *Merluccius merluccius*

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Abstract: The historical analysis of genetic diversity in the southern European hake fishery allows to measuring its remnant genetic background. This study comprises the fishing period 1975-2014 and the molecular analyses employing microsatellites and mitochondrial DNA suggest that there has been a significant decrease of the expected effective population size of the species after decades of overexploitation. The historical bottleneck is not patent in all diversity parameters, due in part to the nature of the markers applied and also to the limited sample size. Nevertheless, no deep and irreversible erosion of the allelic richness has been detected in this fishery as to compromising its biomass recovery and continuous sustained exploitation. In addition, both, the genetic effective size maintenance observed after the EU recovery plans for this stock implemented in the last decade as well as other genetic diversity indexes, assure that there is enough genetic potential in the southern hake stock to undertake its domestication without the associated risk of a low genetic diversity.

Key words: European hake, *Merluccius merluccius*, genetic effective population size, fisheries sustainability, mitochondrial DNA.

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DEMERSALES on the Iberian Atlantic coast, for their commitment at supplying some of the samples analyzed in this study. This work has been supported with personal funds from the authors and co-funded with contract LETSHAKE (AGL2013- 48468-R) from Ministerio Español de Economía y Competitividad and EU-FEDER.

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GENETIC DIVERSITY OF ATLANTIC BLUEFIN TUNA IN THE SPANISH MEDITERRANEAN SEA

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Atlantic bluefin tuna (ABFT), *Thunnus thynnus*, is a highly migratory species of interest to fisheries and aquaculture. Spawning of ABFT occurs in oligotrophic open waters with two well established spawning areas, the Gulf of Mexico (GOM) and the Mediterranean Sea (MED). Western and Eastern ABFT stocks are segregated for fisheries management purposes. In the last two decades, ecosystem-based fisheries management and heavy exploitation rates of ABFT have promoted tuna ichthyoplankton research and the discovery of new spawning areas. An ichthyoplankton sampling scheme was implemented during 2009 to 2011 within small pelagic resources acoustic surveys off the Spanish Mediterranean coasts, from Cape Creus to the bordering waters of the Alboran Sea. High ABFT larval concentrations were collected in 2011 off the shelf/slope area in the Spanish Levantine coasts suggesting stock recovery and possible extension of the spawning area (García et al., 2013). To assess connectivity these ABFT larvae were genetically characterized and compared to ABFT juveniles collected from sport fishing samplings carried out in the Balearic Sea in autumn 2011. Genetic diversity was estimated through the characterization of polymorphisms in neutral microsatellite loci including loci Ttho-1, Ttho-4, Ttho-7 (Takagi et al., 1999), Tth-34 (McDowell et al., 2002), Tth16-2, Tth 1-31, Tth 157, and Tth 208 (Clark et al., 2004). Results are discussed outlining the value of genetic characterization of specimens of certain stock assignment (larvae and young-of-the-year juveniles) for molecular ecology studies and given the current interest in the incorporation of larval indices into the stock assessment process.

Key words: Atlantic bluefin tuna, Larvae, Juveniles, Microsatellites, Mediterranean Sea.

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ANALYSIS OF THE GENETIC CONNECTIVITY OF ANCHOVY POPULATIONS FROM THE CANTABRIAN AND ATLANTIC COASTS OF THE IBERIAN PENINSULA

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Abstract:
The evaluation of present-day connectivity and the mechanisms maintaining stock structures are paramount to the management of marine resources.
In this work we aimed to provide insights into connectivity among anchovy populations in Atlantic waters of the Iberian Peninsula. The specific objective was to identify if the emergent high added-value anchovy fishery located in both north Portugal and south Galicia waters, started in 2011 is supported by the outburst of local residual populations or this is mainly due by the expansion of surrounding populations either the Bay of Biscay (8abc) or/and the Gulf of Cadiz. To achieve this goal, data from seven microsatellite markers analysed in 483 samples was obtained. A high degree of polymorphism, allelic richness and genetic diversity has been observed in the microsatellites analyzed, in several cases greater than expected. A large number of migrants were observed but there is no evidence of isolation by distance, which may be due to the pelagic migratory nature of the species or particular oceanographic conditions. The consequences of these findings about the anchovy stock dynamics on management strategies are also discussed.

Key words: European anchovy, *Engraulis encrasicolus*, genetic diversity, stocks, fisheries management, fisheries genetics.

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IDENTIFICATION OF VIRULENCE FACTORS DIFFERENTIALLY EXPRESSED WHEN *Vibrio anguillarum* INFECTS WARM- OR COLD-WATER FISH SPECIES

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Abstract: The fish pathogen *Vibrio anguillarum* is a mesophile bacterium usually found in estuarine and marine coastal ecosystems worldwide. It is considered the most important causative agent of vibriosis in warm- and cold-water fish of high economic importance. As an inhabitant of the natural marine environment, *V. anguillarum* must adapt its physiology to the fluctuations in environmental factors such as temperature and availability of iron. It grows from 5 ºC to 35-42 ºC with the optimal temperature about 25-30 ºC. However, it is able to cause disease at low temperatures (5–18 °C)(Ma et al., 2017). Notably, some high virulence strains are able to produce simultaneously piscibactin, a salicylate-type siderophore, and a catechol siderophore, either anguibactin or vanchrobactin. To date, works focused into adaptative response of *V. anguillarum* to temperature and iron deficiency have been done mainly by monitoring growth performance (Larsen et al., 2004) or by real time PCR measuring expression changes of concrete genes (Crisafi et al., 2014). In the present work, it was evaluated the dual effect of temperature and iron starvation in the transcriptome profile of *V. anguillarum*. It was compared by RNAseq the expression levels of the whole genome under iron starvation at 25 °C and at 15 °C. The results showed deep changes in the expression levels of metabolic genes, but also in some virulence factors. More notably, it was found that piscibactin genes are highly expressed when *V. anguillarum* grows under restriction of iron at 15°C compared to the same conditions at 25°C. This finding provides new insights about the relative importance of a virulence factor like piscibactin during the infection of cold-water fish species.

Key words: *Vibrio anguillarum*, siderophores, vanchrobactin, piscibactin, virulence regulation

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SEARCH FOR AN ASSAY MODEL FOR MARINE POTENTIAL MICROBIAL PATHOGENS: THE CASE OF *PINNA NOBILIS*

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Abstract: Marine communities are affected by pathogens that constitutes one of the main threats for conservation. Climate change and human modification of coastal habitats, as well as introduction/ invasion of allochthonous species, together with the appearance of new microbial pathogens for marine animal are of concern for the biodiversity and aquaculture production. In order to try to implement corrective procedures, its necessary to adopt a holistic approach using a mixture of classic (histopathology, bacteria and virus isolation) and molecular tools (PCR, qtPCR, in situ hybridization, WGS…) to be able to detect the possible pathogen/s.

Since the only identification does not grant the virulence of the putative pathogen, due the high intra-specific variability of the pathogenic capacity (Austin and Zhang 2006), and the key role of the environmental conditions as a trigger of disease (Vezzulli et al. 2010), it is necessary to carry out other supplementary assays that reveals the real pathogenicity.

One example of the above mentioned are the mortalities in the Mediterranean population of *Pinna nobilis* (Vázquez-Luis et al. 2017). While a parasitology study (Darriba 2017) found an unidentified Haplosporidium, we have reported the presence of *Vibrio shiloi* (=*V. mediterranei*) as a possible etiological agent, by mean of a multidisciplinary approach where virus and parasites were not found (Rodríguez et al. 2017).

Hence, we have tested a group of *P. nobilis* isolates of *V. shiloi* in a series of *in vivo* (by experimental infection, using juveniles of Manila clam and turbot), and *in vitro* (cytotoxic assays). Some strains of *V. shiloi* obtained from diseased *P. nobilis* has demonstrated virulence in the assays carried out at temperatures over 25 ºC.

The procedure presented here can be extended to other different pathogens and hosts.

Key words: Vibrio, Pinna, pathogen

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ORGANIC GEOCHEMISTRY OF THE "SUBVENT" MUD VOLCANO (GULF OF CADIZ, NE ATLANTIC OCEAN): EVIDENCE FOR RECENT SUBMARINE ERUPTIONS OF HYDROCARBON-ENRICHED MUDS

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Abstract: This work presents biomarker content of sediments obtained from a new mud volcano, Subvent MV, in the Gulf of Cádiz. This mud volcano located in the Moroccan margin was discovered, surveyed and sampled during the SUBVENT2.

A gravity core (SUBVENT2-TG02) recovered from the top of this mud volcano, at 434 m water depth, consists of recent mud breccia over the seafloor with indications of gas-saturation, and strong H_2S smell.

Nine sediment samples were studied, resulting rich in organic matter content. The presence of biomarkers was detected based on quantitative analyses, over crushed-powered about 5 g of freeze-fried sediment per sample. Gas Chromatography-Mass Spectrometry (GC-MS) of the total hydrocarbon fraction showed similar patterns in all the samples. The presence of the Unresolved Complex Mixture (UCM) in the chromatograms, indicated bio-degradation and thermal maturation, common feature in hydrocarbon-rich samples.

The *n*-alkane distribution, which ranged between 14 and 33 carbon atoms, maximizing at homologues $\leq$n-C_{21}, and the ACL values (22.9-20.2) suggested the input of algal-derived organic matter. In addition, the presence of high molecular weight *n*-alkanes (from C_{27} to C_{31}) indicated also the presence of organic matter from terrestrial origin. It must be highlighted that the *n*-alkane distribution (similar odd and even chain lengths) and CPI index, which ranged between 1.2 and 2.1, were characteristic of mature samples.

n-Alkanoic acids were detected in all the samples, showing a bimodal distribution ranging between C_8 and C_{28} homologues, with maxima at C_{16} and C_{24}, which indicated microbial degradation.

Pristane and phytane and/or crocetane were detected in all the samples, and together with other compounds indicated hydrocarbon emissions. These compounds were 28-Nor-17α(H)-hopane, 14β pregnane, 9-methyl anthracene and 1-methyl phenanthrene.

The mud breccias recovered and the abundance and nature of the organic compounds evidence the recent activity of this mud volcano originated by extrusion of hydrocarbon-enriched muds and fluids.

Key words: biomarkers, mud volcano, Gulf of Cadiz, hydrocarbons, gas chromatography-mass spectrometry.

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SEDIMENT TRANSPORT TIME IN THE GALICIA INTERIOR BASIN (NW IBERIA) CONTROLLED BY CLIMATE-DRIVEN CHANGES IN PROVENANCE.

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Abstract: Understanding past climate and oceanographic changes is a challenging task. Many different processes interact to produce a given state in any of Earth's systems, with both positive and negative feedbacks, all acting on many different timescales. The latter is particularly important if we are to understand past changes and try to project likely future outcomes. Sediment transport time is one of those magnitudes yet difficult to obtain. Sensitive mass spectrometry has fostered progress in this area, by allowing accurate measurement of U-234 depletion relative to U-238 in sediment particles, a time-dependent process caused by alfa-recoil ejection of this isotope from the sediment grains after their production, known as comminution.

Our contribution presents results using this approach to study the evolution of the Galicia Interior Basin sedimentary system (NW Iberia), over the last 75,5 kyr. By measuring transport time, and with the support of ancillary data including sedimentological, Nd and Sr isotopic fingerprinting, and anisotropy of magnetic susceptibility, a detailed picture of changes in the provenance of these sediments emerges, which improves our knowledge of climate variability and its imprint on the sedimentary record of this region.

We found that these sediments are a mixture of at least local pelagic/hemipelagic, and exotic ice-rafted debris (IRD)/meltwater sediments. Furthermore, the 234U/238U comminution ages suggest that sediments reach our study area faster during Heinrich Stadials, which agrees with a larger contribution of IRD and to more proximal local sources as a result of lower sea levels during cold periods. However, further analysis is yet needed to untangle how changes in the provenance of IRD and ice meltwater plumes control the fine-scale variability observed in our proxies

Keywords: 234U/238U, Galicia Interior Basin, Comminution Age, Ice-rafted debris, Meltwater

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REASSESSMENT OF THE GALICIA INTERIOR BASIN STRUCTURE, WEST IBERIA MARGIN, FROM NEW SEISMIC IMAGES

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Abstract: The Galicia Interior Basin (GIB) is a ~3 km deep bathymetric trough located at the non-volcanic margin off West Iberia. It is considered as an aborted rift in the context of the opening of the North Atlantic rift system, one of the best studied non-volcanic margins. However, most of the works have focused on the Deep Galicia Margin and Iberian Abyssal Plain segments, and the role of the GIB in the regional geodynamic framework remains poorly understood. In this sense, GIB represents the necessary link to understand the mechanisms of extension from the little extended shelf to the areas where continental breakup finally occurs.

We present a series of reprocessed vintage multichannel seismic profiles collected across the GIB. Using state-of-the-art techniques, we have improved the entire crustal structure and the resulting image is far superior to original processing. We applied Tau-P and Wiener predictive deconvolution and multiple attenuation by both radon filtering and wave-equation-based surface-related multiple elimination (SRME) to increase the signal to noise ratio. Post-stack time migration improved the image of the complex basement structure and deep sedimentary units, which was unclear in previous publications.

The reprocessed seismic lines run perpendicular to the margin's trend from the continental shelf across the GIB to the Galicia Bank, providing the opportunity to study the 3D tectonic structure of the GIB. The resulting high-quality images show syn - and post -rift sediment, tilted fault blocks, clear top-of-the-basement reflections, and also intra-basement and Moho reflections that offer new information about the tectonic structural style during rifting. The data display variation in the amount and distribution of crustal extension along the basin that permits to speculate on the reasons for the rift failure at the GIB in the context of the opening of the West Iberia margin.

Key words: Rifted continental margins, Tectonic structure, Seismic, Galicia Interior Basin, West Iberia margin

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CRUSTAL STRUCTURE OF THE SOUTH CHINA SEA RIFTED MARGINS: THE FORMATION OF AN ASYMMETRIC WIDE RIFT

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Abstract: Rifted continental margins result from extension of continental lithosphere, breakup and subsequent seafloor spreading. Here, we examine the rifting evolution of the South China Sea (SCS) from geophysical and geological observations. We analyze the tectonic structure of the entire rift system from a > 1000 km long seismic transect and study the mechanisms for crustal extension and final breakup.
Our observations show the SCS rifted continental margins characterized by a series of ~100 km wide segments that underwent largely simultaneous extensional deformation from early Eocene to late Oligocene – early Miocene. The resulting tectonic structure of the SCS rift system is a ~850 km-wide area of stretched continental crust abutting ~200 km of oceanic crust. The seismic profiles show several areas where continental crust is thinned down to <10 km (ß ~3.3 – 6.6), alternated with areas where continental crust is comparatively little or very little thinned (ß ~1.4 – 2). No signs of significant melt production even in highly stretched areas, nor evidence for mantle exhumation is observed. The final morphology and structure of the rifted crust is asymmetric straddling the axis of final breakup.
We interpret the final tectonic structure of the SCS rifted system as the product of continuous wide-rift mode of extension from the early rifting to breakup. We suggest that final continental breakup was not a consequence of lithospheric thinning during rifting, but resulted from the spreading ridge propagation from the NE. We examined the final structure of the conjugate margins and interpret the observed asymmetry as a secondary consequence of the course followed by the ridge propagator.

Key words: Rifted continental margins, Breakup, South China Sea

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SUBMARINE GEOMORPHOLOGY OF THE PASSAGE OF LANZAROTE (EAST CANARY ISLANDS REGION)

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Abstract: The seabed geomorphology of the Passage of Lanzarote (PoL), between the Lanzarote and Fuerteventura islands and the West Africa Continental Margin (WACM), has been considered with the aim to improve the knowledge of the main active processes working on the seafloor. We have analyzed the acoustic data obtained in the oceanographic cruise SUBVENT2 carried out on board the R/V Sarmiento de Gamboa, that included multibeam bathymetry (ATLAS Hydrosweep-DS), very high resolution parametric profiles (ATLAS Parasound) and high resolution seismic profiles. A previous multibeam bathymetric model (90x90m) from the Instituto Hidrográfico de la Marina (Ministerio de Defensa, Spain) has also been used.
Five main morphological groups were differentiated: (a) Volcanic or diapiric submarine hills are the highest relieves of the central part of the PoL; (b) Tectonic features on the continental slope (linear scarps and a rhomboid-like shaped depression) related to normal faults at the top of buried diapirs on the West African continental slope; (c) Giant circular depressions triggered by submarine venting at the top of buried diapirs and later reworked by bottom currents; (d) Sedimentary instabilities, mass transport deposits, canyons and gullies located both on the Fuerteventura-Lanzarote ridge where they must be associated to volcanism in relation to the evolution of the Canary Volcanic Province and on the WACM where they are related to diapirism; and (e) Bottom current features occur in the central part of the PoL that are mainly produced by erosive processes (Central channel and channels around submarine hills), and minor deposition (Mounded and Plastered drifts). Both processes must be related to the dynamic of the Mediterranean and Antarctic Intermediate Waters in the PoL and their interaction with the seabed.

Key words: Geomorphology, Submarine hills, West Africa Continental Margin, Canary Islands

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MORPHO-STRUCTURAL AND SEDIMENTARY CHARACTERIZATION OF A NEW SEEPAGE FEATURE IN THE GULF OF CADIZ: HENRIET MUD VOLCANO

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Abstract: High-resolution multibeam bathymetry, seismic reflection data, sediment core and water samples were used to first detail the morpho-sedimentary structure and seepage environment of a recently discovered mud volcano (MV) in the Atlantic Moroccan margin during the SUBVENT-2 cruise. Henriet MV is the most eastern edifice of the Gulf of Cadiz, located at 320 m water depth poorly rising 20 m high and circular in shape with a diameter of 630 m. Its summit has a pronounced crater like depression of 15 m deep, 180 m long and a maximum slope of 12º. A half moon shaped 575 m-long rim depression surrounds the edifice. The seismic character of this feature exhibits chaotic sub-bottom reflectors, small overlapped hyperbolae at the bottom of the crater and adjacent coherent reflectors bent slightly downward suggesting a possible subsidence or collapse. Parallel lateral truncated reflectors do appear in the adjacent host sediment of the outer rim depression indicating erosion possibly related to instabilities whereas the chaotic bodies correspond to mass transport deposits (MTD). Plastered and mounded contourite drifts overlap the NE flank and SW adjacent seafloor respectively, in relation to the bottom currents interaction. Buried mud flows can be seen above and below this contourite drift indicating previous mud outflow episodes. A 182 cm long core recovered over the flank consists of foraminiferal sandy mud up to the 140 cm long interpreted as hemipelagic sediments. Its last section consists of a 50 cm layer of mud breccias corresponding to a mud extrusion episode. Mud breccia layer displays low Ca/Al ratio. Henriet MV presents a high methane concentration in the water column above crater-seafloor reaching up to 118 nM. Based on these observations Henriet MV is considered an episodic mud volcano currently characterised by diffuse venting and affected by bottom currents.

Key words: Mud volcano, Geomorphology, Mud breccia, Methane seepage

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MODELLING COMPLEX SUBMARINE TOPOGRAPHY IN THE CONTINENTAL SLOPE OF EASTERN MURCIA (SE SPAIN)

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Abstract: A more detail and accurate information on the geomorphology characteristics of the seafloor is becoming more necessary by the day. High-resolution multibeam data provide an unprecedented resolution of the seabed morphologies types, but nowadays, they are not fully exploited due to the large amount of data. In this work, ArcGis Benthic Terrain Modeler (BTM) was applied to multibeam data of the continental slope of eastern Murcia between 220 m and 800 m water depth in order to obtain the classification of the seabed environment into several geomorphology classes. This tool includes the process of calculation the bathymetric position index (BPI), the calculation of seabed slope and the classification of seabed features. For this study, the input radii were of 10 and 20 pixels for large scale BPI and of 5 and 10 pixels for fine scale BPI. Geomorphology classes for classifying seabed characteristics were following Erdey-Heydorn (2008), the visual appearance of the digital seafloor model, and expertise judgement, thus 6 classes of geomorphological features were identified: Abrupt ridges, smooth ridges, foot of ridges, flat plains, depressions and pockmarks. This semi-automatic methodology has obtained a completely detailed geomorphological map, which even still needs from the trial-and-error proofs, but is more exact and detail that if the morphological interpretation is performed manually.

Key words: Benthic Terrain Modeler, Geomorphological classes, Multibeam bathymetric, Continental slope

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MULTI-PROXY CHARACTERIZATION OF THE COASTAL MINE TAILINGS DEPOSIT OF PORTMÁN BAY, SE SPAIN

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Scanning of sediment cores by means of high-resolution non-destructive techniques allowed a comprehensive characterization of the metal-enriched deposit in Portmán Bay, SE Spain, resulting from 33 years of direct discharge into the sea of mine tailings produced by the exploitation of Pb and Zn ores. 58 sediment cores from the submerged extension of the mine tailings deposit were analysed at the CORELAB Laboratory of the Earth Sciences Faculty at the University of Barcelona. All cores were scanned by means of X-ray micro Computed Tomography (micro-CT) for 3D high-resolution characterization of density properties, X-ray fluorescence (XRF) core scanner for elemental chemical composition, and multi-sensor core logger (MSCL) for physical properties. The multi-proxy study allowed differentiating the main tailings from deposits formed after disposal cessation. Tailings show higher-density values and enhanced element intensities corresponding to metal enrichments (e.g., Fe, Zn, As and Pb). The lower part of the mine tailings recovered in the cores consists of highly laminated interbedded low/high density layers with large variability in metal concentrations while the uppermost part is characterized by rather uniform high relative densities and a general upward decreasing trend of metal content. The limit between tailings and younger deposits is defined by a sharp decrease in densities and metal contents. Post-mining deposits show frequent bioturbation marks, which lack in the tailings unit, and abundant organic matter patches and carbonate particles, which parallel higher Ca contents. Integration of micro CT scans together with XRF core scanner and MSCL data allows a better characterization of the metal concentrations and their distribution within the deposit, directly demonstrating the great value of non-destructive techniques for high-resolution sedimentological studies.

Key words: non-destructive measurements, sediment cores, mine tailings, Portmán Bay
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LARGE EUROPEAN ICE SHEET-DERIVED FRESHWATER DISCHARGES DURING THE HEINRICH STADIALS

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Abstract: Reconstruction of circum-Atlantic ice-sheets motions and instabilities is crucial to understanding the mechanisms that triggered and enhanced abrupt climate changes. Using enviromagnetic and geochemical data, a continuous and well-dated record of the sedimentary evolution of the last ~75.5 ka BP on the Galicia Interior Basin (Northwest Iberian Margin) during the last glacial period, covering the last six Heinrich Stadials (HSs) is provided. The record shows European sediments that were related to meltwater pre-events during the initial stages of HS1, HS2, and HS4 that corroborate the Channel River depositional history. The record also includes Ice Rafted Debris (IRD) from the Laurentide Ice Sheet (LIS) and the European Ice Sheet (EIS) during the final stages of these stadials, *i.e.*, Heinrich Events (HEs), which supports the idea of the synchronous collapse of the EIS and LIS. Therefore, this study provides insight into one of the potential forcing mechanisms for Heinrich Events and, by inference, for Heinrich Stadials.

Keywords: Neodymium and Strontium isotopes, Magnetic Properties, Heinrich Stadials, Ice Rafted Detritus, Meltwater, Last Glacial Period.

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NORTHERNMOST EVIDENCE OF MEDITERRANEAN OUTFLOW INTENSIFICATION DURING THE HEINRICH STADIALS

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Abstract: Using anisotropy of magnetic susceptibility and grain size data, a continuous high-resolution record of the evolution of bottom current vigour on the Northwest Iberian Margin since the last 75.5 ka is provided. The record exhibits intensifications of the current velocities during the Heinrich Stadials (HS) 1, HS2, HS3, HS4,HS5, HS6 and Last Glacial Maximum. These changes in vigour are interpreted as very likely driven by the Mediterranean Outflow Water (MOW). MOW intensification and deepening during these cold phases, which have been described in the southern sector of the Iberian Continental Margin, would have reached the latitudes and depths of the study area because of the hydrographic reorganisations that took place during abrupt climatic changes. The presence of an intensified MOW in the Northwest Iberian Margin would support the hypothesis of MOW's salt injection into the intermediate North Atlantic waters preconditioned the thermohaline circulation (THC) to switch from the stadial to the interstadial mode.

Keywords: Anisotropy of Magnetic Susceptibility, Magnetic fabric, Sortable Silt, Heinrich Stadials, Mediterranean Outflow Water, Last Glacial Period.

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FACIES CHARACTERIZATION OF THE TRANSITIONAL ZONE OF THE GALICIA CONTINENTAL MARGIN AND THE GIANT POCKMARK *GRAN BURATO*

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Abstract: Five piston cores extracted from the Transitional Zone (TZ) of the Galicia continental margin and six TOPAS seismic profiles, allowed the definition of five main sedimentary facies and their west to east correlation across the giant pockmark *Gran Burato* structure. This pockmark shows a circular morphology of 4 km of diameter and a maximum depth of 375 m, and high slopes characterize it. Facies classification was performed using grain size, magnetic susceptibility, and high-resolution XRF, RGB colour and grey line data obtained by an *ITRAX*^{TM} corer scanner. A set of multivariate statistical analyses confirmed the facies classification.

Pelagic, hemipelagic and IRD/detrital facies were dominant in the study area, where is remarkable the decrease of the sand fraction content from west to east. The sea-bottom at the *Gran Burato* structure showed fragments of pteropods and angular clasts with an 88.4 % of sand, also confirmed by ROV images. These characteristics allowed defining this facies as a debrite, result of instabilities processes provoke by the high slopes of the Gran Burato structure. A core studied at the northeast slope of the *Gran Burato* pockmark presents two contrasting facies attending to variations in geochemical, grain size, RGB colour and grey line (parameter related to the density) properties. These contrasted facies could be related to erosion processes, as shown the truncated reflectors in the slopes of the pockmark in the TOPAS seismic lines.

Keywords: sedimentology, facies, pockmark, Transitional Zone, Galicia continental margin

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EARLY DIAGENESIS OF SULFUR IN THE GALICIA CONTINENTAL SHELF (NW SPAIN)

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Abstract: Early diagenesis in marine sediments can be characterized through the study of sedimentary sulfur (S), organic carbon (OC) and iron (Fe) contents. Moreover, the stable isotope signatures of sedimentary S species help to illustrate processes in the sulfur cycle.

Therefore, contents of total reducible inorganic sulfur (TRIS), TOC, reactive iron and the stable sulfur isotope ratios of TRIS were analyzed in six box-cores of modern sediments from the Galicia Continental Shelf, between North latitudes of 41° and 43°.

Sedimentary sulfur species were determined by a two-step distillation following Fossing & Jørgensen (1989) and reactive iron phases extracted according to Canfield (1989). The stable S isotopes were measured by means of combustion isotope-ratio-monitoring gas mass spectrometry coupled to an elemental analyzer.

δ34S values of TRIS (-29‰ to -44‰) at sandy and muddy sites are at the isotopically lighter end of typical marine sediments, close to results in bioturbated upwelling areas (e.g., Diaz et al., 2012). The impact of bioturbation is further supported by the TS-TOC relationship and AVS and CRS contents, the two latter show low values in the top 10 cm below which values increase downwards until the bottom of the short sediment cores. All sites showed a downcore decrease of the δ34S which may suggest that the upper layers of the sediments support higher microbial sulfate reduction rates (e.g., Böttcher et al., 2000).

Key words: diagenesis, sulfur cycle, biogeochemistry, sulfur isotopes, Galicia Continental Shelf.

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SEDIMENTOLOGY AND STRATIGRAPHY OF THE GALICIA INTERIOR BASIN: FROM A PALAEOCLIMATIC PERSPECTIVE

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Abstract: High-resolution magnetic and geochemical measurements and grain size data, supported by scanning electron microscopy and statistical analyses were carried out on five sediment cores recovered from the Galicia Interior Basin. These data have allowed defining four texture and magnetochemical facies characterised by different sediment types. The integration of these sedimentary facies and the robust age models for the cores have provided a detail inter-core correlation of the GIB depositional subunits and units. All these data have allowed reconstructing the late Quaternary sedimentary evolution of the study area, suggesting sedimentary variations associated to Milankovitch (Milankovitch, 1941) and Dansgaard- Oeschger (Dansgaard *et al.*, 1993) cycles.

Keywords: Magnetochemical Facies, Sedimentary Pattern, Sedimentary Evolution, Galicia Interior Basin, late Quaternary.

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PRIMARY PRODUCER PIGMENTS IN POSIDONIA OCEANICA (L. DELILE) SEDIMENTARY ARCHIVES: LONG-TERM TEMPORAL TRENDS IN A COASTAL AREA

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Abstract: Seagrass organic sediments have been proven to be reliable archives of long-term environmental changes, although the potential of pigments in palaeoecological approaches using seagrass archives have not been proved. With the aim of knowing more about changes in seagrass community production and in primary producers composition, seagrass sediment cores from two bays of Cabrera island (Santa Maria and Es Port bays, Balearic islands, Spain), were analysed for marker pigment composition using high performance liquid chromatography (HPLC). Diverse pigments derived from cyanobacteria, diatoms, chlorophytes, cryptophytes and dynoflagellates were observed. Results showed low concentrations of pigments with a tendency to decline with depth, which could be explained by a combination of very poor preservation and a recent increase in production. The index of total abundance (beta-carotene) shows a decreasing trend towards present throughout the last 4000 years. However, during the last 100 years (when it is observed a land-use change towards reforestation), beta-carotene shows opposite trends in the bays, increasing in Santa María and decreasing in Es Port. Pigment composition patterns in each core are similar, with diatoms and cyanobacterias exhibiting opposite dynamics as well as dyanoflagellates and cryptophytes against cyanobacterias. These opposite dynamics are also observed in seagrass epiphytic algae, and their composition is known to be influenced by several factors like nutrients or light amongst others. Abrupt changes in pigments compositions towards more diatoms together with a beta carotene decrease during the last 100 years in Es Port bay, could be therefore indicative of a change in nutrient inputs in this bay because of eutrophication, which could be explained by its higher water residence time and the higher anthropogenic impact.

Key words: ecosystem change, seagrass archive, environmental reconstruction, fossil pigments, Holocene.

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ACTUAL SEISMIC CHARACTERIZATION AND ACTIVE RELATED STRUCTURES IN THE NE SECTOR OF THE GULF OF CADIZ CONTINENTAL SHELF

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Abstract:

The recent and contemporary tectonic activity along the Gulf of Cadiz continental shelf has been the subject of numerous geological projects, highlighting the mapping of faults and folds mainly related to diapiric structures identified in seismic profiles of different resolutions (Vázquez et al., 2010; Fernández-Puga et al, 2014; Sánchez-Guillamón et al., 2014). The main objective of this paper is attempt to correlate the actual seismicity with the activity of the geological structures along the northeastern sector of the continental shelf of the Gulf of Cádiz, located from the vicinity of Mazagón in the north to the Strait of Gibraltar in the south. The seismicity in this sector of the margin is concentrated in two well differentiated areas. The main one is located in the offshore extension of the Guadalquivir basin with a NE-SW trend, extended from the external shelf towards the slope. The magnitude of the most events ranges from M = 2 to 4 The epicentral zone is about 45 km wide and the hypocenters are located about 10 km depth along the internal and middle shelf, that could be related to the west displacement of Betic System and deformation of the Gulf of Cadiz Allochthonous Unit, and between 40-50 km depth probably related to upper mantle levels. The second actual seismic events area is located between Cadiz Bay and Punta Paloma, near Gibraltar Strait. This area, located along the middle shelf, has a minor number of seismic events, their magnitude ranges also between 2 and 4. The epicenters are distributed in diffuse NE-SW alignments of shallow (<20 km) hypocenters related to halokynetic structures and the deformation of the Betic External Units triggered by the westwards Gibraltar Arc displacement. Also a NW-SE alignment of seismic events of around 40 km depth has been differentiated that must be related to deformation in the base of the crust or upper mantle levels.

Key words: continental shelf, tectonics, seismicity, Gulf of Cádiz.

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PLIOCENE SEAGRASS IN THE CANARY ISLAND: FIRST RECORD OF HALODULE CF. IN THE PLIOCENE OF THE NORTH ATLANTIC ISLANDS

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Abstract:

The Pliocene sedimentary marine deposits located in the western Canary Island (Gran Canaria, Fuerteventura and Lanzarote) are an open window to the Neogene ecological and climatic conditions in the North Western Atlantic, a crucial moment in the Earth's evolution. The marine fauna present in the coastal outcrops from this age shows a climate conditions warmer than current ones. Some of those fossils works as paleoecological indicators, as the genus of marine gastropods *Persististrombus* and *Nerita* or the coral *Siderastrae*a currently living in the tropical waters of eastern and western Atlantic,

In Gran Canaria, Pliocene beaches appear associated with pillow lavas in the sites of Barranco de Tamaraceite and La Esfinge, dated in 4.8 and 4.2 million years respectivelly (Meco et al., 2015). In Barranco Seco outcrops, at about 95 m above the current sea level, within medium to fine grain size grey sands, with abundant bioturbation, fossilized seagrass remains have been found. Those fossil samples, the first from the West Africa coast, have been conferred to the genus *Halodule*. This genus of seagrass is currently confined to tropical waters of the eastern Atlantic: Nigeria, Benin, Ghana, Sierra Leone, Guinea, Guinea Bissau, Sao Tomé and Principe and Cape Verde Island (Green and Short, 2003), same current locations of others Pliocene Canary Island's climatic paleoindicators.

Key words: *Angiosperms, Paleoclimate, Paleodistribution, Canary Island.*

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HOLOCENE ACTIVITY OF THE LIQUIÑE-OFQUI FAULT ZONE NEAR AYSÉN FJORD (CHILEAN PATAGONIA)

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In the first months of 2007, the Aysén region in southern Chile was affected by a seismic swarm occurring on the large strike-slip fault system in southern Chile (Liquiñe-Ofqui Fault Zone, LOFZ). The largest earthquake (M 6.2) of the swarm occurred in April, and had its epicenter in Aysén fjord. Ground shaking intensities became so high (up to MMI IX) that hundreds of onshore mass movements were triggered, several of which entered into the fjord, resulting in mass-transport deposits (MTDs) preserved at the bottom. Here we present a Holocene record of past earthquakes in the, up to now, unstudied Patagonian fjord region based on MTD stratigraphy. High-resolution seismic data retrieved using two different seismic sources (sparker and TOPAS) revealed multiple older MTDs on different stratigraphic levels. Correlation of the seismic stratigraphy with sedimentological data obtained from a long Calypso core (MD07-3117) provided conclusive identification of these deposits as to whether or not they were seismically triggered. Additionally, radiocarbon dating allowed reconstructing an age model, which was validated by tephrochronology, providing an age for the different MTD levels. We thus present a highly detailed paleoseismological history of the Aysén region, including at least six major Holocene earthquakes. One of these is interpreted as the result of a megathrust earthquake along the Chilean subduction zone, the others are interpreted as related to the LOFZ. The main source of seismic hazard in the region thus originates from the LOFZ, with a rough estimate of one earthquake every 2,100 years and clusters of events occurring during the early and late Holocene.

Key words: paleoseismology, fjord, earthquake, Holocene, Chile

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CAN WE TRACE MEDITERRANEAN WATER MASSES WITH NEODYMIUM ISOTOPES? Fe-Mn ENCRUSTED FORAMINIFERA ε_{Nd} RESULTS OF MODERN AND PAST CONDITIONS

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The Mediterranean Sea is a source of salt and heat into the North Atlantic (NA) region and changes in Mediterranean Outflow Water (MOW) export rates through time can have a profound impact on the global thermohaline circulation. However, tracing Mediterranean waters signal and impacts into the NA becomes a challenge, especially beyond the exchange location at the Strait of Gibraltar and in the vicinity of the Gulf of Cadiz.
In this work we present neodymium isotopic ratios (ε_{Nd}) measured on Fe-Mn encrusted planktonic foraminifera from Mediterranean samples as indicator of deep water masses through time. First, coretop samples from different locations of the western and eastern Mediterranean were analyzed in order to determine the ε_{Nd} signal of the modern surface, intermediate and deep water masses (AW, LIW and WMDW). The obtained ε_{Nd} depth profile precisely matches previously reported seawater ε_{Nd} values, thus supporting the use of Fe-Mn encrusted foraminifera ε_{Nd} as a good tracer of the Mediterranean water masses. Subsequently, down-core samples from the Alboran Sea and the Eivissa Channel covering the last 21 ka were analyzed in order to investigate rapid circulation changes in the recent past of LIW. The obtained results indicate that intermediate waters in the western Mediterranean have maintained constant ε_{Nd} values comparable to those of modern LIW. Considering that MOW is mainly fed by Mediterranean intermediate waters, our results suggests that it would be possible to trace the unchanged MOW ε_{Nd} signal into the North Atlantic and thus, quantify its impact on the global thermohaline circulation. Additional ε_{Nd} results from a Minorca drift deep sediment core show significant oscillations during the last 38 ka supporting changes in the mixing proportions of the WMDW and likely indicating variable contribution of different source water masses.

Key words: Neodymium isotopes, Mediterranean water masses, thermohaline circulation, North Atlantic.
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INTER-BASIN DIFFERENCES IN THE CARBON COMPOSITION OF SUPERFICIAL SEDIMENTS ACROSS THE SUBPOLAR NORTH ATLANTIC

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Abstract: During the BOCATS 2016 cruise an exhaustive sampling of superficial sediments were done across the transect of the OVIDE/A25 transoceanic section in the North Atlantic. OVIDE section spans from subtropical to subpolar latitudes, crossing several ocean basins where presumably different pelagic-sedimentation processes take place. Here, we report the carbon elemental composition for box-corer samples from the subpolar basins Irminger and Iceland. Quantitative analysis of the carbon composition has been done on dried sub-samples with a LECO CN system analyzer. After a first determination of total carbon, the aliquot is heated under 400ºC during 3h in order to remove the organic fraction prior to a second analysis. The second determination represents the total inorganic carbon fraction. Total organic carbon is the difference between the two measurements. Carbon elemental composition was obtained at centimetric resolution from top to bottom.

The preliminary results show that as a general rule, the amount of total carbon is dominated by the inorganic fraction. In all the cores, the organic fraction is always less than 1% in mass. While the carbon composition is consistent between nearby cores, there are also inter-basin differences. The inter-basin differences are mainly based in the relative contribution of the inorganic carbon, with the Iceland Basin showing the greatest fractions. The inter-basin differences remains in the inorganic:organic ratios. This basin-scale preliminary analysis suggest that significant relationships between the inorganic:organic ratio and the location of the samples exists. In the Iceland Basin the inorganic:organic ratio is statistically significant with the depth. In both subpolar basins the existence of strong western boundary bottom currents is hypothesized as a main factor underlying the inorganic:organic ratio distribution.

Key words: carbon, sedimentation, North Atlantic, deep-sea

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THREE-PHASE EQUILIBRIUM CURVE SHIFT FOR METHANE HYDRATE IN OCEANIC CONDITIONS CALCULATED FROM MOLECULAR DINAMIC SIMULATIONS

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Abstract: Gas hydrates or water clathrates are non-stoichiometric crystalline inclusion compounds in which water molecules form a lattice structure like ice and the gas molecules are trapped within this framework[1]. Large quantities of natural gas –mainly methane- can be trapped in sediments in the form of gas hydrates and they are relevant for energetic purposes and also due to their potential impact on global climate change[2]. Molecular simulation is used as valuable estimation tool to guess molecular scale mechanisms in hydrates. Phase equilibria determination has been one of the most remarkable applications of MD to the study of hydrates[3,4]. Nevertheless, none of these studies deal with the particular conditions of gas hydrates in the seabed strata, which impose well defined ranges of temperature and pressure, and the presence of ionic species in solution. Our aim is to contribute to fill this gap in the gas hydrate literature, and thus we have included NaCl in the simulation box in realistic concentrations. The simple addition of NaCl ions to pure water, with the concentration limited by salt solubility, will be shown to suffice for a fairly correct description of the S-L-G coexistence curves when comparing our results with other literature computational works, or even experimental studies using synthetic seawater. The good agreement is indicative of a satisfactory molecular model choice and simulation technique strategy.

Keywords: Methane Hydrates, Molecular Simulation, Phase equilibria.

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SEDIMENTARY WAVE FIELD IN THE CADIZ CONTOURITE CHANNEL, GULF OF CADIZ

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Abstract: The middle slope of the Spanish margin of the gulf of Cádiz is characterized by the presence of diapiric ridges and contourite channels. The Mediterranean Outflow Water (MOW) on its way out from the Strait of Gibraltar flows to the W and NW reaching the highest velocity (up to 1 m/s) on the channels (Sánchez-Leal et al., 2017). Diverse bedforms located on the outer zones of the contourite channels have been documented (i.e. Fernández-Salas et al., 2017). In this work a recently discovered sedimentary wave field in the Cádiz contourite channel has been studied. Data set has been acquired during ISUNEPCA expedition and comprise: multibeam echosounder data (15 m grid resolution); submarine videos from a photogrammetric sled TST-HORUS; current velocity data obtained from a Lowered Acoustic Doppler Current Profiler (LADCP). Waves are located between 655 and 775 m water depth and show varied sizes related to the bottom current velocity. The biggest waves are located to the east, with a maximun wavelenght of 350 m and 16 m height and the measured current velocity is 0.36-0.33 m/s; while the smallest waves are located at the south and west of the study area, with a mean wavelength of 150 m and 7 m height and they are coincident with the minimum velocity (0.25 m/s). Small furrows in the NW and SW have been identified and they are coindicent with the areas of maximum current velocity (0.45 m/s). Based on the dimensions of the waves and current velocity, a grain size of 0.5-1 mm is expected (Flemming, 2000) and it correspond to the sizes observed in the submarine videos. The results presented in this work show an important relationship between bottom current velocity and size and type of the bedforms and highlights the role of the MOW in modeling the seafloor morphology.

Key words: Sedimentary waves, Contourite channel, Bottom currents, Gulf of Cádiz

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MAIN CHARACTERISTICS OF BEACHES AT GRAN CANARIA AND TENERIFE

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Abstract: Gran Canaria and Tenerife are the two most populated islands in the canaries and where the number of tourists is higher. Therefore, there is a big pressure for beaches as recreational areas. This paper makes an inventory of all beaches larger than 100m in both islands, and puts some light in the distribution and characteristics of these beaches. To carry out this task, the beaches have firstly been geolocated and then classified according to their nature (natural or artificial) and the dominant sediments (sandy beaches, mixed beaches and pebble-cobble beaches). Basic characteristics at these beaches (length and width of each beach) have also been measured.
In Gran Canaria there are 62 beaches larger than 100m, which extend over nearly 35km (13.6% of the island perimeter). The most abundant ones are the natural sandy beaches, (14km in total and 700m average length), followed by the pebble and cobble beaches (10km and 830m average length). Mixed and artificial beaches are much shorter, since they extend for only roughly 350m. On the other hand, at Tenerife Island there are 93 beaches larger than 100m. These beaches cover a total length of nearly 32km (9.3% of the coastline) and there is a clear difference between natural and artificial beaches. While the first ones have average length of roughly 300m and widths around 15m, the average values for artificial beaches reach 550m length and 35m width. The spatial distribution of the different type of beaches generally responds to factors such as wave climate, geology and tourist infrastructures.

Key words: Beach classification, sediments, tourism, Canary Islands

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PROYECTO PAMEV: A NEW VIRTUAL AND FREE ACCESS TOOL FOR THE STUDY OF THE CIMATIC EVOLUTION OF THE NORTH ATLANTIC

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Abstract: The Project: Paleontología de la Macaronesia, Espacio Virtual, PAME, is a new and free access tool for the study and the understanding of the climatic and ecological evolution of the north western Atlantic, thought the virtual musealisation of singular outcrops and fossil remains from the Canary Island and the region of Macaronesica. In the Canaries, those materials represent the last 20 millions of years of the Earth's history, which had been reflected the most important climatic milestones from the Pliocene, Pleistocene and Holocene of the north hemisphere.
After two years, with the support of Ministerio de Economía y Competitividad del Gobierno de España and Biblioteca de la Universidad de Las Palmas de Gran Canaria, the working group of the Project PAMEV have developed the virtual museum PAMEV, hosted in the web page of Biblioteca de la Universidad de Las Palmas de Gran Canaria (https://biblioteca.ulpgc.es/proyecto_pamev). Those results are based on

- Sistematic and Taxonomical Studies on the marine and terrestrial fossil collections of the Universidad de Las Palmas de Gran Canaria and Museo Canario
- Paleoecological reconstructions of the most representative paleoecosistems
- Development of a fund o paleontological bibliographic references
- 3D modeling of fossil specimen and outcrops

This web tool is aimed to the dissemination of the scientific knowledge in the areas of palaeontology, palaeoclimatology and palaeoceanography, between professional researchers and the general public.

Key words: Palaeontology, Paleeoclimatology, Palaeoceanography, Virtual Museum, western Atlantic

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EL PROYECTO EMODNET-GEOLOGY: UNA INICIATIVA PARA EXTENDER EL ACCESO A LOS DATOS GEOLÓGICOS DE LOS OCÉANOS Y MARES EUROPEOS

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Abstract: La Comisión Europea propuso en 2007 la iniciativa European Marine Observation and Data Network (EMODnet, http://www.emodnet.eu/) en el marco de la Estrategia para el conocimiento marino 2020, para desarrollar una infraestructura europea de datos marinos y cartografía (Batimetría, Geología, Habitats, Química, Física, Biología y Actividades Humanas) y facilitar el acceso a la información a organismos gubernamentales, la industria y centros de investigación.
El objetivo del proyecto EMODNET-GEOLOGY en el que participan 36 servicios geológicos europeos, es la compilación de información geológica marina y la creación de una base cartográfica a escala 1:1.000.000, 1:250.000, 1:100.000 y multiescala de los mares europeos (Mar Mediterráneo, Mar Báltico, Mar del Norte, Mar Negro, Mar Céltico, Golfo de Vizcaya y margen de Iberia y Macaronesia). Los mapas temáticos realizados incluyen mapas de sedimentos superficiales y tasas de sedimentación reciente, mapas geológicos y tectónicos, mapas de eventos geológicos (deslizamientos, volcanes, emisiones de fluidos, terremotos, tsunamis), mapas de recursos marinos (depósitos minerales, hidrocarburos y áridos) y mapas de comportamiento de la línea de costa (acrección y erosión costera). Los mapas de los diferentes países se han homogeneizado utilizando vocabularios de términos geológicos establecidos en el proyecto, de acuerdo con los estándares de la directiva europea INSPIRE. Todos los mapas, datos y metadatos asociados elaborados se han incorporado a un Sistema de Información Geográfico y son actualmente de acceso público a través del portal: http://www.emodnet.eu/geology. Los mapas van acompañados de información sobre la fuente, así como de información asociada que permiten al usuario controlar la calidad del mapa teniendo en cuenta factores tales como densidad de muestras y perfiles sísmicos, datos batimétricos digitales, etc. Es importante resaltar que toda la información generada podrá combinarse con la proporcionada por otros portales de EMODnet, que abordan otros aspectos del medio marino: EMODnet-Química, EMODnet-Biología, EMODnet-Batimetría, EMODnet - Hábitats, EMODnet-Física y EMODnet-Actividades Humanas.

Palabras clave: Cartografía geológica marina, márgenes continentales, fondos marinos, Océano Atlántico, Mar Mediterráneo, Emodnet

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HARMONIZATION OF DATA TIME SERIES FOR THE EVALUATION OF COASTAL RISKS IN THE GALICIA-NORTH PORTUGAL EUROREGION

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Abstract: Coastal and Oceanic Observatories are important infrastructures to provide information about ocean state, phenomena and processes. In order to evaluate the potential marine risks in the Galicia-North Portugal Euroregion, the MarRISK project (0262_MARRISK_1_E) expects to use physical, chemical, biological and geological data collected by consolidated observatories such as the RAIA Observatory, Copernicus or EMODnet. MarRISK project joins experts in Marine Sciences from MeteoGalicia, APA, CETMAR, CIIMAR, IEO, IH, IIM-CSIC, INTECMAR, IPMA, LMAG, UAveiro, UMinho and UVigo. This multi-disciplinary consortium has put more than 200 variables at

the disposal of the project for a better understanding of coastal and oceanic characteristics and vulnerabilities. However the collection of observations does not present homogeneity due to the complexity of the ocean-atmosphere environment. There is a great heterogeneity in the spatio-temporal distributions, methods of data acquisition, quality control procedures and precision of measurements. Therefore, under the umbrella of this project it is intended to update and consolidate the dataset provided by the different partners by firstly improving the quality of the series, and subsequently harmonizing them following established protocols.
Through the process of updating and consolidating this extensive dataset, we will also identify potential environmental risks that are not covered by the available variables. This analysis will highlight the need of implementing new set of observations, reinforcing the coordinated response to new scenarios under global change conditions based on this transboundary approach.

Key words: Coastal Observatories, Coastal risks, Global change, Galicia – North Portugal Euroregion.

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SPATIAL DATA INFRASTRUCTURE OF THE SPANISH INSTITUTE OF OCEANOGRAPHY & EMODNET HRSM (IEO)

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Abstract: The Spanish Institute of Oceanography (IEO) performs multidisciplinary studies of the marine environment as well as systematic studies and specific studies for special requirements since its first beginnings in 1914. Some examples are the studies of the sea level of the Spain coastline since 1944, the El Hierro submarine volcanic episode in 2014 or the Prestige oil spill in Galician waters in 2002. Different methodologies and data acquisition techniques are used depending on the studies requirements. The acquired data are stored and presented in different formats and thus, the information is organized into different databases according to the subject and the variables represented (geology, fisheries, aquaculture, pollution, habitats, etc.). The DATA CENTER of IEO (CEDO), was created in 1964 in order to organize the data about physical and chemical oceanographic variables, to standardize this information and to serve the international data network SeaDataNet (www.seadatanet.org). On the other hand, the SIRENO DATABASE was created in 1999 to organize and compile data from marine species. Thus, all data about the species collected in oceanographic surveys carried out by the IEO as well as data from observers on commercial fishing vessels are incorporated into the SIRENO database (catch data, biomass, abundance, etc).

Due to the large amount of information collected over more than 100 years of IEO history, there is a clear need to organize, standardize, integrate and relate the different databases and information, and to provide interoperability and access to this information. Consequently, in 2000 it emerged the first initiative to organize the IEO spatial information in an Oceanography Information System, based on a Geographical Information System (GIS). The GIS was consolidated as IEO institutional GIS and the Spatial Data Infrastructure of IEO (IDEO) was created following the trends of INSPIRE. www.geoideo.ieo.es/geoportalideo/catalog/main/home.page.

All data included in the GIS have their corresponding metadata about ISO19115 and INSPIRE. IDEO is based on Web services, Quality of Services, Open standards, ISO (OGC) and INSPIRE standards, and both provide access to the geographical marine information of IEO.

Currently the IEO is participating in many European initiatives, especially in several lots of EMODNET and marine spatial planning projects among others. From GIS department it is working on EMODNET High Resolution Seabed Mapping http://www.emodnet-bathymetry.eu/.

Key words: IEO, GIS, SPATIAL DATA INFRASTRUCTURE, IDEO.

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RELEVANCE OF INDIVIDUAL FISH DETECTABILITY USING UNDERWATER CAMERAS

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Abstract: Obtaining accurate and precise estimates of animal abundance has an essential relevance in marine science but is often challenging. Most methods rely on fisheries dependent data, catch and effort, but tend to be biased. Underwater visual monitoring by scuba diving has been applied in several contexts but it is costly and often unviable due to diving limitations. Contrasting, the technological advances have provided affordable alternative methods based on high-quality underwater cameras. Moreover, a recent analytical strategy has been proposed for estimating absolute density (ind/m^3) of particular species, whose behavior is in home-range, by unbaited cameras (Campos-Candela et al., 2017). However, one of the assumption is that the probability of detection at individual level (the probability of counting it when it is indeed within the area surveyed) by the camera is absolute. Here we propose to enlarge this method to concurrently estimate abundance and detectability. The present research claims to assess the individual detectability using a coastal marine, conspicuous specie, *Serranus scriba* for demonstrating such a methodological improvement. Counts per frame from ten stereoscopic cameras were combined with scuba-diver censuses, specifically designed for this purpose, in a coastal area of Mallorca Island (NW Mediterranean). The study yields good results and strongly suggest that after accounting for individual detectability, underwater cameras could be extensively used for accurately and precisely describing spatial-temporal patters in the abundance of coastal fish, and therefore, they can be useful as a tool for fish stocks conservation and management.

Key words: Absolute density, detectability, unbaited underwater camera, home-range.

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A NEW SYSTEMATIC JELLYFISH MONITORING SYSTEM IN THE BALEARIC ISLANDS: A JOINT SCIENCE-SOCIETY APPROACH

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Abstract: Jellyfish swarms in the Mediterranean coasts are a recurrent phenomenon of high scientific interest and with relevant implications at the touristic and socio-economic level. Merged strategies among tools available to scientist, administration and the stakeholders can optimize the cost of obtaining these *in situ* data and the benefit achieved from its scientific analysis. This joint stakeholder and scientist strategy was designed and tested in the Balearic Island during Summer 2014 and it's operative up to now. It involves the regional environmental and emergency administrations, charter associations as well as CSIC institutes and SOCIB. For the first time, a program of routine surveillance of jellyfish observations is established with qualified and trained personal at high spatial and temporal resolution. The system includes a web platform (GRUMERS) and an associated database that compiles the daily sightings in beaches and natural reserves coastal areas at specific locations. The system includes 5 sites in Marine Protected Areas and 66 sites in 33 routes from the boat cleaning services. Also, at the beaches, monitoring is carried out by lifeguards from the DG Emergency available at 120 sites. All observations are performed following established protocols to obtain a systematic, periodic, routine monitoring. The total number of observations registered on the web-site right now is close to 85.000. The most abundant specie is *Pelagia noctiluca* and the most active users are from the routes of

the boat cleaning services. This is the first time that all the workers involved in coastal services in Balearic Islands can upload their jellyfish observations in real time, constituting a important data base generated under scientific standards to allow a solid understanding of the episodes and the implementation of appropriate knowledge-based future mitigation actions.

Key words: *Pelagia noctiluca*, marine stakeholders, Mediterranean Sea

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FIRST AUTOMATIC pH MEASUREMENTS IN THE BOTTOM LAYER OF THE RÍA DE VIGO (NW SPAIN)

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Abstract: In the framework of A.RIOS Project, with the main goal of monitoring, modeling and quantifying the impacts of acidification in the Galician Rías and shelf, the first up to date automatic in situ measurements of pH were made in the central segment of Ría de Vigo (42.24ºN, 8.76ºW). Two time series measurements (60 days long during autumn 2017, the later 45 days long during winter 2018, both at 1/2 hour sampling period) has been obtained with moored (at ~40 m depth, 2 m above bottom) ocean pH sensor (*SAMI-pH*) in total hydrogen scale, with a highly accurate (±0.003 pH units) automated colorimetric reagent addition. Before the mooring, the SAMI-pH was deployed at the University of Vigo Marine Research Centre (ECIMAT) dock during 35 days in order to check in situ measurements with samples taken every 2-3 days (r=0.97, n=15, $p<0.01$). During the first mooring, in situ measurements were also checked twice by Niskin bottle sampling at similar mooring location and depth, with an average bias between both methods of 0.033 pH units. In both cases, water samples were measured in laboratory also by standard colorimetric pH method (total scale, Clyton and Byrne 1993). The SAMI device was found to be very suitable to capture the variability of different kinds of oceanographic processes, from tides (~12 h) to meteorological-induced (upwelling/downwelling events, several days): amplitude of tidal cycle resulted to be 0.02-0.04 pH units, (lower pH during rising tide) whereas the effects due to changes in upwelling/downwelling cycle was stronger (0.06-0.08), with lower pH during upwelling. In both cases it is due to the advection of remineralized and low pH Eastern North Atlantic Central Water (ENACW) from the shelf. Our aim is to use this device in longer sampling periods (*i.e.*, several years) in order to capture a coherent signal of acidification of the Rías, not masked with other coastal processes.

Key words: ocean pH, Ría de Vigo, operational oceanography

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VALIDATION OF HF RADAR OCEAN SURFACE CURRENTS IN THE RÍA DE VIGO USING LAGRANGIAN DRIFTERS

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Abstract:

High-Frequency radars (HFR) are an effective tool to monitor sea-surface currents remotely. HFR current velocity can be validated by means of Eulerian velocity data (usually obtained by surface currentmeters attached on moorings) or through Lagrangian velocity fields (recorded by surface drifters).

Surface currents of the outer third of the Ría de Vigo were obtained using HF radar data derived from two short range SeaSonde CODAR radar antennas installed at Toralla Island (TORA) and Punta Subrido (SUBR).

A set of 7 GPS tracked drifters were deployed in the Ría de Vigo (NW) over two 12 hour experiments in April and June 2011. These short experiments have provided sea-truth data for validating the performance of this HF radar system.

Direct comparison between both radial surface currents from each radar antenna against drifter's velocities facilitates an assessment of the HF radar data quality in these two periods. All comparisons were performed, considering both ideal and antenna pattern corrected fields. Statistics from these comparisons give good correlation and low root-mean-square deviation proving the high precision of this HF radar system.

Key words: HF radar, drifter, validation, Ría de Vigo

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DOS AÑOS DE TRABAJOS CON EL "UCADIZ", EL PRIMER BUQUE OCEANOGRÁFICO DE ANDALUCÍA

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Resumen: La remodelación y puesta en marcha del UCADIZ fue una aspiración histórica de las universidades andaluzas. Ha supuesto un fortalecimiento de las infraestructuras científicas del Campus de Excelencia Internacional del Mar, convirtiéndose en una herramienta imprescindible para el avance de los estudios en Oceanografía, Arqueología Subacuática y en gestión del litoral y del agua, entre otros ámbitos de conocimiento relacionados con la investigación marina. Los proyectos de investigación y los trabajos de fin de máster han sido los principales usuarios del buque, aunque recientemente ha sido contratado por una empresa privada externa, lo que contribuye en gran medida a que la financiación del buque sea sostenible.

Palabras clave: Buque Oceanográfico, Infraestructuras.

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FIRST-LINE RESPONSE TO OIL SPILLS USING AUTONOMOUS VEHICLES: DEFINITION OF OPERATIONAL CONDITIONS

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Abstract: The aim of the **SpilLess project** is the implementation of an innovative laboratory to pilot new and viable solutions to tackle with maritime pollution. These solutions will be based on the production of native microbial consortia with bioremediation capacity, and the adaptation of unmanned and autonomous vehicles (ASV) for in-situ release (aerial, surface and underwater) of autochthonous microorganisms and nutrients.

One of the main activities of the project have been the definition of the operational conditions to ensure that marine operations are performed within defined and recognised safety levels. Two different types of ASVs have been considered: a) a surficial device (ASV ROAZ II) and; b) subsea device (ROV). The ASV ROAZ II was developed by INESC TEC and designed for different ocean operations. The ROVs, managed by ACSM, are a worldwide proven equipment well recognized for its capability to operate in demanding subsea applications. Both equipment present operational limits related to environmental conditions, being the most relevant the wind (maximum wind speed) and waves/swell (maximum wave height and period).

The definition of operating conditions is based on the SIMAR dataset consists of time series of wind and wave parameters from numerical modeling of high resolution of atmosphere, sea level and waves that covers the Spanish and Portuguese coast. The SIMAR dataset offers information from 1958 to the present, with a wide spatial coverage. The average and extremal regime was analysed. The operability has been assessed using seasonal environmental data together with the operational limits of the ASVs and established as the number of annual and monthly hours of no operating conditions.

Based on the marine climate study, the suitable periods to operate in this area are May and July. On the contrary, winter and the months of seasonal change like March and

September are the worst period to the oil spill response with ASVs.

Key words: Oil Spill, ASVs, wind, waves, operating conditions

Acknowledgments: This contribution has been funding by the EU SpilLess project: First-line response to oil spills based on native microorganism cooperation, through Blue Labs: innovative solutions for maritime challenges program. (EASME/EMFF/2016/1.2.1.4/02/SI2.749374 - SpilLess)

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SATELLITE TECHNOLOGY FOR THE MONITORING AND CONTROL IN THE MEDITERRANEAN SEA

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Abstract: This study presents a general evaluation of the Monitoring Control and Surveillance of vessels (hereinafter MCS) in the Mediterranean Sea. The MCS, with satellite technology, was applied to the whole Mediterranean, in order to achieve a global state of the maritime traffic and presence of fishing vessels over an annual period. Furthermore, a different technology for the artisanal fishery and other fleets can be applied since this fleet does not have satellite technology on its ships.

Satellite technology was applied for the study, in order to carry out the monitoring and control of the area. Data, as AIS, was reviewed for the entire Mediterranean Sea for the period between 1st April 2015 to the 1st April 2016. Updated databases with information concerning vessels, IUU lists and other fisheries regulations completed the analysis. Enforcement and regulatory expertise together with machine learning, 3D gaming and cyber security were used to empower fisheries enforcement and compliance. As a result of the analysis, a total of 41519 unique AIS vessel ID´s were detected in the Mediterranean area of interest during the review period and an intense traffic area, with shipping lanes running across the western Mediterranean from the Strait of Gibraltar to Italy, south of Italy and Greece and between Italy and Egypt. Another intense traffic area was detected during the analysis between Greece and Turkey. AIS activity of ship type 'fishing' suggested fishing vessels commonly transit the area to fish on the coastal areas surrounding the Adriatic, Spanish coast, South Sicily and Greece. Maps are presented using QGIS software.

Results highlighted that satellite monitoring technology can drastically reduce the time and cost associated with traditional means of surveillance at sea. It significantly improves the chances of detecting illegal fishing and serves to supplement patrol activities, through planning recommendations, based on the identification of targets and areas of investigation.

Key words: Mediterranean Sea, Geographic Information Systems, AIS, Monitoring Control and Surveillance, satellite technology.

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PREDICTIVE COMMERCIAL SERVICE PLATFORM FOR USER-RELEVANT COASTAL WATER MONITORING SERVICES BASED ON EARTH OBSERVATION (COASTOBS)

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Coastal zones are very productive areas, offering many valuable habitats and ecosystems services and attracting human settlements and activities. The intensive concentration of population and excessive exploitation of natural resources puts high pressure on coastal ecosystems leading to biodiversity loss, habitat destruction, pollution as well as conflicts between potential uses and space competition. Several European directives aim at sustainable management of coastal waters, retaining or restoring a high ecological status and safeguarding ecosystem services. Increasing pressure and stricter regulations increase the need for efficient monitoring solutions. Where traditional in situ sampling is insufficient to characterise the highly dynamic coastal environments, Earth Observation (EO) provides a synoptic view and frequent coverage. With the launch of the Copernicus Sentinel satellites, operational water quality services become a business opportunity. CoastObs will develop a service platform for coastal water monitoring with validated products derived from EO. In dialogue with users from various sectors, CoastObs will develop innovative EO-based products: monitoring of seagrass and macroalgae, phytoplankton size classes, primary production, and harmful algae as well as higher level products such as indicators and integration with predictive models. CoastObs will establish sustainable supply chains that can be directly integrated into the users' systems. The CoastObs consortium has the knowledge and ambition to develop services that are commercially viable, grow in capacity and thus create new jobs. The business case is to define user groups with common requirements, so tailored products can be developed at highly reduced costs per user. Setup of efficient data structures (array database) for smart (re)processing of data is part of this ambition. The commitment of 13 users to CoastObs demonstrates the need for such user-friendly and affordable coastal water services.

Key words: Coastal Zones, Water Monitoring, Earth Observation products, Sentinel satellites

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POSTERS

GOVERNANCE OF THE OCEANS, CONSERVATION AND MANAGEMENT OF GEOLOGICAL AND LIVING RESOURCES

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DISCARDING AND FISHERIES ECOLOGY OF SEA CUCUMBERS IN NORTH ATLANTIC SPANISH TRAWL FISHERIES

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Abstract: During the last years a rising trend on landings of sea cucumbers indicates that these species have been increasingly valued by the fishing sector of Galicia, beginning to be species of commercial interest for the fishers. Traditionally, sea cucumbers had been discarded overboard because of the lack of price.

The species are poor studied and the stock trends are unknown. In this work we studied the fisheries ecology of the species captured by the Spanish fleet in the Cantabrian and Galician fishing grounds and West Ireland European fishing grounds where the Spanish fleet catch and discard these species. The sampling of the holothurian species has been carried out during the IBTS (International Bottom Trawl Survey) scientific surveys PORCUPINE and DEMERSALES, and onboard commercial trawl fishing vessels.

The spatial distribution of *Parastichopus regalis* and *P. tremulus* showed differences in abundance in relation to geographic longitude with interannual variations. *P. regalis* is distributed up to 400 m deep, with a maximum abundance between 100 and 200 m. On the other hand, *P. tremulus* is distributed from 400 m depth and reaches deeper than 800 m. This species has the highest abundance between 600 and 700 m. The bathymetric segregation between both species remains constant over the years, highlighting the abundances of *P. regalis* in the continental shelf and the abundances of *P. tremulus* in the upper slope.

A total of 28 *P. regalis* and 747 *P. tremulus* were biologically sampled from fishing commercial catches. During the research surveys, a total of 965 specimens of *P. regalis* and 472 specimens of *P. tremulus* were measured. The size distribution ranging from 77 to 342 mm, (mean 201 mm) for the first species, and from 37 to 270 mm (mean 132 mm) for the second one.

Key words: Sea cucumbers, *Parastichopus*, fishing discards, trawl fisheries.

Acknowledgments: This work was made within the HOLOPLUS Project CDTi-CONECTA PEME and DESCARSEL FEMP Project. The authors acknowledge ARVI and partners of HOLOPLUS, specially to P. Estevez and crew of vessel 'Skellig Light II'.

OTOLITH MICROCHEMISTRY APPROACH TO DETERMINE CONNECTIVITY OF ANCHOVY POPULATIONS (*ENGRAULIS ENCRASICOLUS*) ALONG THE ATLANTIC COAST OF IBERIAN PENINSULA

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Abstract: In order to implement proper fishery management strategies, information about connectivity among stocks and populations is critically required. The present study investigated population structure of the European Anchovy (*Engraulis encrasicolus*) along the Atlantic Coast of Iberian Peninsula using otolith chemical composition. The specific objective of this work is to analyze the phenomenon of sporadic increases in the availability of anchovy in Galician waters (northern part of the ICES Division 9a). We analyze the spatial variation of trace elements in the anchovy otoliths in ICES Division 9a and Subarea 8 to investigate natal origins and population movements of European anchovy in the Atlantic waters of the Iberian Peninsula. The elemental composition of 270 anchovy otoliths was analyzed at the core and otolith edge. Lithium, Na, Mg, K, Ca, Mn, Sr and Ba were measured using LA-ICPMS on the saggita otoliths of anchovy sampled in 6 different areas. Univariate and multivariate analyses of trace element concentrations in the otolith edges, which relate to the adult life of fish, could distinguish between the different analyzed areas. The otolith edge, which should have incorporated the water mass signal of sampling area, did not show overlap between geographical areas. Cluster analysis of trace element concentrations in the otolith cores, relating to juvenile and larval life stages,

produced also different clusters. The results suggest the discrimination of geographically distinct groups.

Key words: Anchovy, *Engraulis encrasicolus*, Otolith microchemistry, Natal origin, Atlantic Coast of Iberian Peninsula

Acknowledgments: This study was supported by the Instituto Español de Oceanografía (BIOPEL and PELASSES projects). These projects has been funded by the EU through the European Maritime and Fisheries Fund (EMFF) within the National Program of collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy. We thank to the people who collaborated in IEO and IPMA research surveys (PELACUS, ECOCADIZ and PELAGO surveys).

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¿ES POSIBLE DETECTAR CAMBIOS LEGISLATIVOS SOBRE LA SERIE HISTÓRICA DE CPUE DEL HALIBUT DEL PACÍFICO (1998-2016) MEDIANTE LA APLICACIÓN DE MODELOS ARIMA?

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En el presente estudio, se evaluó la capacidad de modelar la serie histórica de CPUEs (1998-2016) del Halibut del (*Hippoglossus stenolepis*, Schmidt 1904) mediante una técnica estadística univariante basada en la metodología Box-Jenkins (Modelos ARIMA, modelos autoregresivos intregados de media móvil). El mejor modelo evaluado fue ARIMA (111)(011)^{13} explicando un 63.49 % de la variabilidad de los datos. La eficiencia de la pesquería del halibut y su marco legislativo, han ido progresando positivamente desde el inicio de la década de los 90 hasta la actualidad (Gilroy *et al*., 2011). Estos avances en la industria pesquera causan cambios que se ven reflejados directamente sobre la pesca, como por ejemplo, la disminución o aumento en las capturas totales, en el esfuerzo, o en el tamaño de la flota. Tras la aplicación de los modelos ARIMA ha sido posible detectar estos cambios históricos en su pesquería, además de demostrar un continuo declive de CPUEs a lo largo de nuestro periodo de estudio, lo cual hace posible pensar que la pesquería ha sido sometida a una situación de explotación excesiva a lo largo del tiempo. Por tanto, el modelado del recurso pesquero es una herramienta útil para comprender la dinámica de la población y puede permitir establecer recomendaciones o medidas encaminadas a evitar el posible colapso de la pesquería.

Key words: Modelos ARIMA, series temporales, *Hippoglossus stenolepis*, gestión pesquera, CPUE.

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CEPHALOPOD BYCATCH AND DISCARDS IN FISHING GROUNDS OF GALICIAN AND CANTABRIAN SEA

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Abstract: Cephalopod species are an important marine resource in the Northern Spain fisheries. Several species are landed by both commercial and artisanal fleets. The main species in biomass terms are the common octopus (*Octopus vulgaris*), curled octopus (*Eledone cirrhosa*), broadtail shortfin squid (*Illex coindetii*), lesser flying squid (*Todaropsis eblanae*), long finned squid (*Loligo forbesi*), common squid (*Loligo vulgaris*), European flying squid (*Todarodes sagittatus*), pink cuttlefish (*Sepia orbignyana*), common cuttlefish (*Sepia officinalis*) and elegant cuttlefish (*Sepia elegans*).

In the Cantabrian Sea the most exploited and commercially valued species are members of the Loliginidae (long-finned squid) whereas the importance of the Ommastrephid (short-finned squid) family increases westwards towards Galicia, decreasing to the southern latitudes. Members of Sepiidae (cuttlefish) family and the Octopodidae (octopus) family are commercially important from Asturias (western Cantabrian) increasing towards Galicia and southern latitudes. The latter is the most important family in the region in terms of abundance, fishery landings and commercial value, attracting a large small-scale fishery effort, with social relevance and consequently greater management commitment.

Many species are by-caught by trawl fisheries along the area. Discards data indicates ratios of 12.0-60.4% of short-finned squid discarded, 22.5% of curled octopus and 17.4% of common squid. Two of the main causes of discarding are cephalopods discarded below the legal minimum landing size and discards that can be attributed to fishers' responses to low or no market value. To develop successful discard mitigation measures, it is necessary to better identify the reasons for discarding.

Key words: cephalopods, octopus, squids, fishing discards, trawl fisheries.

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SURVIVABILITY OF SEA CUCUMBERS *Parastichopus regalis* AND *Parastichopus tremulus* (HOLOTHUROIDEA) IN THE TRAWL FISHERIES AT GALICIAN WATERS.

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Abstract: Survival experiments were carried out during the DESCARSEL0917 from 30th August to 10th September research survey along the continental shelf and upper slope of Galicia. The objective was to determine survival rates of sea cucumbers *Parastichopus tremulus* and *P. regalis* to the processes of discarding and handling in trawl fishing.

The individuals who arrived with signs of vitality to the fishing deck were collected and placed in tanks. The specimens were measured and marked individually. The monitoring of the mortality was carried out by continuous observation to monitor survival times and patterns of behaviour of the species.

The time of survival and physical condition seem to depend on several variables, such as the used fishing gear, the state in which they arrived on board, the time of exposure to air, the air temperature and the species. The results indicate that a significant number of the sea cucumbers could survive in the short term (3.5 days) to the discarding process when throwback them into the sea. *P. regalis* had a higher survival rate, possibly because inhabits shallower waters and therefore suffers less variation in the hydrostatic pressure conditions. Three *P. regalis* survived until the end of the survey and have remained alive for 5 months in the facilities of the Aquaculture Plant of the IEO in Vigo, continuing with the experiment. The sea cucumbers showed mobility and feeding behaviour inside the experimental tanks.

The evidence presented here shows survivability of caught sea cucumbers. In case of a TAC (Total Allowable Catches) regulation of the species in the future in Europe waters, the high survivability exemption could be applied, taking into consideration the provision detailed in Article 15 of PPC Regulation which establishes exemptions to the landing obligation for species in which “scientific evidence demonstrates high survival rates”.

Key words: Sea cucumbers, *Parastichopus*, survivability, fishing discards, landing obligation.

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ANÁLISIS DE LA PESQUERÍA DE LA GAMBA ROJA *Aristeus antennatus* (RISSO, 1816) QUE SE DESARROLLA EN EL LITORAL ALMERIENSE

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Abstract: The red shrimp (*Aristeus antennatus*) is the target species to some of the commercial bottomtrawlers that operate off the coast of Almeria (easternmost province in Andalusia). The aim of this paper is to provide information on the red shrimp fishery by analyzing catch data recorded from 2001 through 2016. Catch data was compiled from fishing statistics provided by the Andalusian Fisheries Information System (IDAPES) hosted by the Regional Administration "*Dirección General de Pesca y Acuicultura de la Junta de Andalucía"* and calculated using the sales notes submitted by fish market operators. The analysis of the data provided the main landing ports for this species and revealed a seasonal pattern in catch rate as well as a total annual catch decrease over the study period. In addition, errors on the fish size were detected on the data entry while registering catches – sorting of red shrimp by size is made by hand- which prevented a further analysis of the market prices and the size structure of the exploited stocks. Seeing how important the fish size is to these fisheries and how prices vary with fish size, a further study on fish sorting techniques that increase reliability of sorting and data registry is highly recommended.

Key words: red shrimp, *Aristeus antennatus*, coast of Almeria, bottom-trawl.

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THE STALKED BARNACLE IN SOUTHERN EUROPE: A COMPARISON OF BOTTOM-UP AND TOP-DOWN MANAGEMENT SYSTEMS OF A BENTHIC RESOURCE

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Fisheries management has been shifting globally from the classic top-down approach towards bottom-up efforts as a new paradigm emerges based on the principles of exclusive fishing rights, fishers participation and adaptive management. In this paper we discuss these principles in the context of the stalked barnacle (*Pollicipes pollicipes*) fisheries in Southern Europe. This barnacle is heavily exploited by artisanal and recreational fishers, and it is the most important economic resource in the intertidal rocky shores of Northern Spain and continental Portugal. Fisheries management systems greatly differ along the European coast, from bottom-up approaches in Galicia and Asturias (NW Spain) based on TURF systems, to a diverse set of top-down approaches in Portugal and France. In this study we analyse trends in catches, fishing participation and regulatory measures under the different management systems as factors defining their effectiveness. We find common problems such as overexploitation, poaching and competition between fleets in all study areas. Co-managed areas in Galicia and Asturias present major advances to overcome these challenges. In Asturias, the incorporation of fishers' knowledge has led to the fragmentation of the management units down to single rocks. In Galicia, harvesters count with internal technical advice from biologists that provide good quality fishery data and acts as a link between stakeholders. However, top-down approaches in Portugal and France are precluding fisheries to solve these problems. Our results show the potential of co-management for the sustainable use of the resource providing general pathways to improve governance in other benthic fisheries.

Key words: Co-management, small-scale fisheries, invertebrates, sustainable use.

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FORMAN ANILLOS DE PERIODICIDAD DIARIA LOS OTOLITOS DE LA MERLUZA EUROPEA?

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En las campañas de marcado de merluza europea (*Merluccius merluccius*) realizadas entre los años 2004 y 2006, en aguas de Galicia (NW Península Ibérica), se marcaron 1741 ejemplares (11-61 cm) de los que se recapturaron 27. El estudio del crecimiento somático de estos individuos recapturados, así como los llevados a cabo en otras zonas geográficas (Golfo de Vizcaya y Golfo de León) demostraron que el crecimiento de esta especie es dos veces superior al considerado hasta entonces. Ahora en este trabajo se estudia la microestructura de los otolitos marcados con Oxitetraciclina (N=22) y su crecimiento. El número y el ancho de los anillos de crecimiento formados entre la marca de Oxitetraciclina y el borde del otolito (fecha de recaptura del individuo) son analizados comparativamente con el número de días transcurridos en el mar (14 - 378 días) para determinar los anillos de periodicidad diaria y validar así la formación de anillos diarios en el otolito de esta especie. Los resultados proporcionan nuevos conocimientos sobre un tema de permanente debate como es la determinación de la edad de la merluza.

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UNDERSTANDING ADAPTATION TO CLIMATE CHANGE IN SMALL-SCALE FISHERIES

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Abstract:

There is broad scientific evidence on the observed impacts of climate change on marine systems, but less so about how these impacts affect small-scale fisheries and its adaptation process. To cover this gap, we need to better understand the components of a social-ecological system (SES) that compromise this process. A SES approach allows to understand interactions between ecological and social dimensions at different scales and from a complex and transdisciplinary perspective, which is much needed for small-scale fisheries (SSF) adaptation to climate change. This paper goes a step further and compiles the available scientific knowledge on adaptation in SSF facing climate change, and evaluates to what extent existing studies have addressed the complexity of SES. To do this, we conduct a systematic comparison of different approaches including social-ecological systems theory and practice, vulnerability assessments, adaptive capacity, resilience and adaptation and transformation actions in SSF. All the variables considered in theory and measured in different case study applications (collected data and further data production) are compared, contrasting their definitions, classifications, gaps, mismatches and implications. A regional stakeholder interviews and questionnaires are also developed (sampled data) to test the relevant variables for adaptation. As a result of the qualitative and quantitative analysis, we find that studies on adaptation process need to consider the interactions between social and ecological dimensions of SSF, as well as context settings and governance variables. We conclude with a list of recommendations for measuring and better understanding of adaptation of SSF that is relevant for future research, practitioners and participants of decision-making processes.

Key words: Social-ecological system, Galician small-scale-fisheries, adaptation, climate change, resilience.

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CONTRASTING OTOLITH SECTIONS AND READING MAGNIFICATIONS: ESTABLISHING THE BEST METHOD FOR AGEING ANCHOVY, *Engraulis encrasicolus*

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Abstract: Several studies on anchovy age and growth based on otolith microstructure have been published recently, although methodologies used were not analogous or easily reproducible. Otoliths three-dimensional complexity and heterogeneity make difficult to establish common interpretation criteria on a daily basis. In order to set up a simple and reproducible reading process this study contrast several otoliths sections (frontal and sagittal) and magnifications (x400 and x200), with those currently used and recommended by other authors. A selection of 53 pairs of otoliths were embedded in polyester resin. Left otoliths were polished with a Metaserv 250 Grinder-Polisher equipment, on the sagittal plane until primary growth increments were visible. Right otoliths were polished similarly until the centre was reached on the frontal plane. Image acquisition was carried out using a microscope to obtain a final single panoramic view of the full otolith. The new and free image tool OTOlab was used to assist otolith microstructure analysis. After total ages were obtained for the two sections at two different magnifications, four growth model were elaborated in order to assess which of the methods fitted better to explain the anchovy growth.

Greater difficulties were found to achieve legible samples of the sagittal sections. Moreover, when comparing the number of otoliths discarded, sagittal sections doubled in

number the rejected frontal sections. The ANOVA test showed that section had a very significant effect on age reading (number of rings counted), while magnification did not show significant differences in rings count.

The results of this study point to otolith frontal plane at x200 magnification as the best method to age anchovy on a daily basis, both in reproducibility and accuracy perspective.

Key words: Age determination, otoliths section and magnification, *Engraulis encrasicolus*

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PROPUESTA DE POLÍTICA PÚBLICA PARA EL MANEJO Y CONSERVACIÓN DE ECOSISTEMAS CORALINOS MESOFÓTICOS MEXICANOS

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Resumen: Las políticas públicas son procesos de comunicación, decisión y ejecución de las acciones del gobierno que varían entre países de acuerdo al sistema político, tradición, cultura, objetivos y metas a lograr. Son de gran relevancia para el manejo y conservación de los recursos naturales debido a que generan cambios y progresos positivos, los cuales se ven fortalecidos por la bioética ya que, con ésta se identifica un nuevo marco ético que permite maximizar el aprovechamiento, la administración y la sostenibilidad de los recursos naturales, logrando con esto concebir a la protección ambiental, los derechos humanos, el desarrollo humano equitativo y la paz como elementos interdependientes e indivisibles. Así, los Ecosistemas Coralinos Mesofóticos (ECM), al igual que el resto de los ecosistemas naturales, no son ajenos a estas acciones y dado que proporcionan una amplia gama de servicios ecosistémicos y que en México, particularmente en la zona del Golfo de México, la riqueza de estos ecosistemas es muy amplia y desconocida, en el presente estudio se generó una propuesta de política pública basada en la opinión de diversos expertos del tema a nivel nacional y un meta análisis de los documentos legislativos y políticos generados a nivel mundial, con el fin de gestionar formas integrales de conservación que prevengan daños irreversibles a estos ecosistemas.

Palabras clave: Ecosistemas coralinos mesofóticos, arrecifes coralinos, políticas públicas, Bioética.

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LÍMITES DE LA ZONA COSTERA. DE LA TEORÍA A LA PRÁCTICA

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Abstract: En la gestión de las zonas costeras la definición del ámbito geográfico ha sido concebida a lo largo de los años de una forma imprecisa. Diversos autores y organismos internacionales han definido este concepto, aunque de distinta forma y utilizando criterios muy diferentes. En los años 90, se proponía dividir el espacio litoral en unidades geográficas funcionales (UNESCO/COI, 1997; UNEP/MAP/PAP, 1999). Pero también, se desarrollaron distintas tipologías de criterios: arbitrarios; físicos; económicos o jurídico-administrativos. Según Nagasaka (2016), son habituales los métodos basados en la equidistancia. La tendencia y las recomendaciones, de la última década, están enfocadas a la gestión basada en ecosistemas (Domínguez-Tejo, 2016). El objetivo del presente trabajo es hacer un análisis sobre cómo se define y delimita, en la práctica, en la normativa. Para ello, se han seleccionado los países Iberoamericanos con legislación general o específica que defina, explícitamente, el término costa. De dicha selección,11 países, se hace un estudio en detalle de: designación, límites y criterios de delimitación, competencias y motivos. De este análisis se desprende, entre otras ideas, que se define de forma más precisa el ámbito geográfico en la zona terrestre que en el territorio marino. En el medio marino se suele utilizar el límite del mar territorial. Según Kastrisios y Tsoulos (2016), se puede considerar un factor de crecimiento económico, que ha facilitado la gestión del medio costero-marino y que ha sido la piedra angular de la ordenación del espacio marítimo. No obstante, en la parte emergida no se suelen utilizar criterios ecosistémicos y se aplican longitudes arbitrarias, generalmente medidas desde el límite de la pleamar máxima viva equinoccial.

Key words: zonas costeras, ámbito geográfico, criterios de delimitación.

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EMODNET AND ITS HUMAN ACTIVITIES PORTAL: ACCESS TO MARINE GEO-REFERENCED INFORMATION

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Abstract: Concerning ocean governance, a joint agenda for the future of our oceans was set out in 2016 (European Commission, 2016). Of the 50 actions that were proposed for safe, secure, clean and sustainably managed oceans, action 12 refers to the European Marine Observation and Data Network (EMODnet), an initiative from the European Commission that aims to facilitate access to existing marine data on bathymetry, geology, seabed habitats, physics, chemistry, biology and human activitites, since the study and management of seas heavily relies on the availability of information. In fact, several organisations (e.g.: ICES, OSPAR, HELCOM, MEDPOL Convention) have made notable efforts to collect large-scale datasets. However, differences in the accessibility and the quality of these datasets makes it extremely difficult to conduct large-scale assessments.

In this context, the Human Activities portal of EMODnet provides available and harmonized data on different human activities carried out in all European seas, and includes geo-referenced information and additional attributes, when such information is provided. All this data is of public access and free of any restrictions to ensure their use from a multitude of stakeholders (policy makers, researchers, students, spatial planners, etc.). In order to provide users with complete information on the way data are processed, all datasets available on the portal are complemented with INSPIRE-compliant metadata.

All this information can indeed be relevant for several purposes such as management of sectorial activities, marine spatial planning, socio-economic and environmental risk assessment, legislation implementation and compliance (especially the European Marine Strategy Framework Directive), etc.

In this presentation, the information currently available in EMODnet-Human Activities Portal will be described as well as some examples of the methodologies used to harmonize it , the encountered problems, and the potentialities of all this information to support ocean governance.

Key words: Human activities, geographic information, European seas

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MARINE SPATIAL PLANNING IN MACARONESIA. MAR-SP PROJECT (IEO)

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Abstract: Marine Spatial Planning (MSP) is a process that brings together multiple users of the ocean – including energy, industry, government, conservation and recreation – to make informed and coordinated decisions about how to use marine resources sustainably. Through the planning and mapping process of a marine ecosystem, planners can consider the cumulative effect of maritime industries on our seas, seek to make industries more sustainable and proactively minimize conflicts between industries seeking to utilize the same sea area. The intended result of MSP is a more coordinated and sustainable approach to how our oceans are used – ensuring that marine resources and services are utilized, but within clear environmental limits to ensure marine ecosystems remain healthy and biodiversity is conserved.

Thus, this proposal aims to strengthen maritime spatial planning in the Macaronesian archipelagos of the Azores, Madeira and the Canary Islands. Some of the European regions for which the MSP processes have been well developed are located in continental Europe, so they do not share the main challenges that characterize the Macaronesia, such as its remoteness and its oceanic conditions and with a recognized economic potential and growing demands, from various sectors of the Blue Growth (tourism, biotechnology, scientific research, others), as well as potential activities that can be considered threatening (deep-water mining, drilling, prospecting of resources) and require special attention. To ensure that the maritime spatial planning proposal plan is consistent and conforms to one of the key pillars of the European MSP Directive and this EASME call, it is important that the cross-border regions of the Macaronesia Member States participate together in this call. This implies cooperation within the three regions of Macaronesia: the Azores, Madeira and the Canary Islands. Currently, each archipelago is in a different stage of development of the MSP implementation. For that reason, a complete harmonization of approaches for the three regions is neither possible nor desirable. On the other hand, such discrepancy may represent a strength of this proposal, given that facing different MSP processes, designed to treat similar problems, due to the same geographical context, but which are in different stages of development, will undoubtedly bring a dimension of Test this work proposal that is not insignificant.

Key words: Marine Spatial Planning, Macaronesia, GIS, Blue Growth.

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SYSTEMATIC CONSERVATION PLANNING BASED ON ECOSYSTEM CHARACTERISTICS AND SERVICES PROVIDED: THE BASQUE COUNTRY (SE BAY OF BISCAY) EXPERIENCE

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Abstract: Systematic Conservation Planning (SCP) is a structured, quantitative approach to the planning of both single Marine Protected Areas and networks of reserves (Ball *et al*., 2009). It can be used to identify reserve networks that capture the most biodiversity whilst reducing area or other costs, and it will, in theory, allow for the more effective protection of biodiversity (Smith *et al*., 2009).
The main objective of the research presented here was to produce information that could potentially be used in the designation of management plans in the continental shelf in front of the Basque Country. The proposed space ordination should fulfil the established environmental targets and, at the same time, the minimization of conflicts with the existing socioeconomic activities; as well as the possibility of designing scenarios adding future new activities foreseen to be implemented in the area (renewable energy production and aquaculture) (Galparsoro *et al*., 2012).
When implementing the tool, the biodiversity surrogate elements used were the distribution of benthic habitats (Galparsoro *et al*., 2010, 2012, 2015), the biological value of different ecosystem components (i.e. cetaceans, seabirds, macrobenthos and macroalgae) (Pascual *et al*., 2011) and the already existing protected areas. Besides, when considering the existing socioeconomical activities in the area, the total fishing pressure produced by artisanal fisheries was used as a proxy for the characterization of the spatial distribution of such activity (Pascual *et al*., 2013).
The obtained results show the flexibility and the potential use of systematic planning as a decision supporting tool within a transparent process that could help the achievement of both, environmental and socioeconomic targets (Pınarbaşı *et al*., 2017). The implementation of such kind of approaches could be considered as being of high relevance towards the Ecosystem-based Marine Spatial Planning.

Key words: Marine Protected Area, Marine Ecosystem Services, Marxan, artisanal fishery

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SELECTING ENVIRONMENTAL INDICATORS FOR THE EVALUATION OF COASTAL RISKS IN THE GALICIA-NORTH PORTUGAL EUROREGION

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Abstract: Coastal regions are among the most productive and valued ecosystems in relation to their ecosystem services (Millenium Ecosystem Assessment 2005; Hattam *et al.*, 2015). However, their degradation is dramatically growing due to the increase of human pressure on coastlines that can negatively impact or threaten marine habitats. The evaluation of potential marine risks (Crain *et al*, 2009) emerges in response to the growing concern of the society about increase of frequency and intensity of natural disasters and environmental problems associated with the socio-economic development, such as pollution, resources depletion and climate change. In this context, the MarRISK project (0262_MARRISK_1_E) focuses on the consolidation of a knowledge infrastructure for evaluating coastal risks in the Galicia-North Portugal Euroregion. This EU project joins experts in Marine Sciences from MeteoGalicia, APA, CETMAR, CIIMAR, IEO, IH, IIM-CSIC, INTECMAR, IPMA, LMAG, UAveiro, UMinho and UVigo. This multi-

disciplinary partnership constitutes an optimum platform to achieve the proposed objective.

The MarRISK team has identified forty-two environmental indicators (EEA, 2014) of coastal risks that threaten the ecosystem services of the Galicia-North Portugal Euroregion. In the Galician region, emerging identified risks (eutrophication, hydrodynamic alteration, oceanic warming, algal blooms regime changes and ocean acidification) directly affect supporting and provisioning services. In contrast, for the Northern Portuguese region, coastal erosion and flooding have been identified as the most pressing risks, impacting regulating and cultural services. As a first step to assess coastal risks, environmental indicators have been established, integrating information from different environmental concerns. The proposed environmental indicator list represents a useful tool not only to evaluate environmental trends, but also to assure a coordinated response to new scenarios under global change conditions based on a transboundary approach.

Key words: Environmental indicator, Coastal risks, Global change, Ecosystem services, Galicia – North Portugal Euroregion.

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ECOAREAS-MARDETODOS: A CANARIAN PROPOSAL FOR SUSTAINABLE COASTAL MANAGEMENT

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Abstract: The Ecoareas-mardetodos project is an innovative and interdisciplinary Blue Economy initiative that, with a set of integrated actions, aims to dinamize coastal spaces trying to preserve their environmental values and pursue sustainable development. It is based on a collective work method that involves various beneficiaries: citizens, administrations, researchers, NGOs, companies and other entities. Therefore, it relies on active participation of civil society (public and private), generating processes of collaboration and consensus for a more solid and durable governance.The objective of this project is to contribute to the coastal sustainability of the Canary Islands in ecological, economic, social and ethical-political terms.

For the implementation of this model, a methodology developed by a scientific-technical team that evaluates the environmental, social, economic-tourism and management aspects is proposed. This methodology makes possible the coordinated participation of the groups of users interested in the littoral (beneficiaries), favoring synergies between uses and the sustainability of the activities that are carried out.

An initial evaluation and pilot implementation of the Ecoarea model in the Canary Islands is presented. This allowed the evaluation of the sustainability and the establishment of dynamics of continuous improvement.

The ultimate goal is to create an Ecoareas Network throughout the Canary Islands, following this innovative scientific and participatory methodology. The purpose of this Network is to value coastal potentialities and encourage progress towards environmental, socio-cultural and economic sustainability.

Key words: Ecoarea, sustainability, participation.

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BLUE GROWTH IN THE CANARY ISLANDS: IS IT POSSIBLE TO KNOW TRENDS THROUGH OPEN DATA?

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Abstract: Blue Growth is the EU's long-term strategy to support sustainable growth of the marine and maritime sectors. It is the contribution of the Integrated Maritime Policy (IMP) in achieving the objectives of the EU Strategy 2020. The purpose of this work was to contribute to assess the current situation and trends of the main sectors related to blue growth in the Canary Islands (Spain) by reviewing open data, reports, publications, etc. Eleven sectors have been analyzed: Aquaculture; Marine biotechnology; Desalination; Marine renewable energies; Seabed mining; Nautical recreation and sports; Oil & Gas; Fishing; Naval Repair, Infrastructure and Port Services, Maritime Safety, Services to Offshore Platforms and Supplies; Maritime transport and coastal tourism. The main conclusion of this analysis is the enormous difficulty involved in obtaining basic data - economic and employment - for the correct monitoring of these sectors. In general, there are few useful open data resources that cover reasonable periods of time. In other cases, data are only accessible after its request-delivery, and this procedure may be too long. In addition, it usually happens that official statistics are not offered disaggregated (by sectors of interest) and free. Sometimes, although specific NACE codes for subsectors exist, data is not collected at source in a disaggregated manner, which makes any detailed analyses impossible. On the other hand, there are statistics of interest that are collected by institutes, associations, clusters, etc. but availability needs to be agree prior to access to data. Finally, we believe that it is necessary to implement a tool (e.g. observatory) to collect, process and disseminate basic data in order to carry out the necessary monitoring of regional, national and EU policies related to blue growth.

Key words: Blue growth, open data, Canary Islands

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Las áreas protegidas costero-marinas en el siglo XXI: situación y tendencias

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Abstract: En los últimos años, la crisis ambiental ha provocado la degradación de los océanos y una gran pérdida de biodiversidad. Como respuesta a estos cambios, el número y la extensión de las áreas protegidas costero-marinas (APCMs) se ha incrementado, poniendo en valor la protección como uno de los instrumentos más eficaces para conservar la biodiversidad y sus recursos (Cifuentes *et al.,* 2000). En este trabajo se ha analizado la evolución y la situación actual de las APCMs en el marco internacional, mediante el análisis de la información extraída de las bases de datos de Naciones Unidas y el estudio de casos concretos. Para ello se ha dividido el planeta en 8 regiones (acorde con Naciones Unidas) y se han evaluado dos APCMs en cada una de ellas, declaradas en periodos diferentes. Los resultados revelan que, desde comienzos de siglo, los criterios utilizados para declarar APCMs se están unificando en todo el planeta. No obstante, la planificación y gestión de estos espacios difiere entre las distintas regiones (Tiquio *et al.,* 2017). Se han identificado tres avances principales desde la última década: 1) se tiende a implementar el enfoque ecosistémico, ampliamente extendido en el medio terrestre, en el medio marino, dando mayor importancia al mantenimiento de los servicios ecosistémicos (Hill *et al.,* 2016); 2) se reconoce que las APCMs son una herramienta eficaz para mitigar los efectos del cambio climático; 3) para lograr una protección efectiva, se recomienda establecer APCMs más allá de las aguas bajo jurisdicción nacional, donde se concentran hoy en día la mayoría (Druel y Gjerde, 2014). Aún con todo, pese a las recomendaciones internacionales y los esfuerzos llevados a cabo por los gobiernos e instituciones, los océanos siguen siendo uno de los ecosistemas más afectados por las actividades humanas.

Key words: Área protegida costero-marina, conservación, enfoque ecosistémico, gestión.

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DIDÁCTICA DE LAS CIENCIAS DEL MAR. PROGRAMA DE PRÁCTICAS DE CIENCIAS PARA ALUMNOS Y ALUMNAS DE4º DE E.S.O. DE GRAN CANARIA: DESPERTANDO VOCACIONES CIENTÍFICAS

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Abstract: Desde la Sociedad Atlántica de Oceanógrafos, con el apoyo de la Conserjería de Educación y Juventud del Cabildo de Gran Canaria y la cooperación de la Consejería de Universidades y Educación del Gobierno de Canarias y la Universidad de las Palmas de Gran Canaria, hemos ejecutado un proyecto de prácticas en el ámbito científico cuyo objetivo principal es el de promover vocaciones científicas a edad temprana. A lo largo del mes de enero y durante dos jornadas diarias, los alumnos y alumnas participantes han sido los protagonistas de una serie de actividades relacionadas con los currículos oficiales de 4º curso de E.S.O., en las áreas fundamentales de química, física, biología y geología. Desde la SAO se han orientado estas experiencias hacia nuestras áreas de conocimiento: las ciencias marinas, trabajando en los laboratorios de la Facultad de Ciencias del Mar del Campus Universitarios de Tafira, aspectos fundamentales como la contaminación costera, la contaminación por microplásticos, pH marino, la importancia de la densidad en la columna del agua y en la circulación termohalina, cambio climático, gestión pesquera, etc. En su cuarta edición, durante el año 2018, participaron en este proyecto un total de 1150 alumnos y alumnas de 40 centros de enseñanza secundaria de Gran Canaria, suponiendo un total de participación acumulada durante estos 4 años de cerca de 4.000 participantes.

Key words: Secundaria, Ciencias del Mar, vocaciones científicas, practicas

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