

SESSION

**FLORA AND FAUNA  
OF THE LITTORAL SYSTEM:  
DYNAMICS AND PROTECTION**

# **ORAL PRESENTATIONS**



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** ARE *CAULERPA* SPECIES ABLE TO SETTLE AND DEVELOP ON DEEP RHODOLITE BEDS? THE STUDY CASE OF CAPO CARBONARA MARINE PROTECTED AREA

**SESSION:** FLORA AND FAUNA (ORAL PRESENTATION)

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*The two green algae Caulerpa taxifolia (M.Vahl) C. Agardh and Caulerpa cylindracea Sonder; (Chlorophyta; Bryopsidales) are currently considered among the most invasive alien macroalgae in the Mediterranean Sea, where they have spread very quickly in the last three decades, with severe effects on biodiversity conservation (Streftaris and Zenetos, 2006). C. cylindracea was initially considered as a Lessepsian migrant in the basin but, recently, its south-western Australian origin has been proved. C. taxifolia, instead, is native to the Caribbean Sea and was accidentally released from the Oceanographic Museum of Monaco into the Mediterranean Sea. Both the species are able to colonize any type of substratum at depths ranging from the intertidal zone down to almost 90 m and to actively compete with the endemic seagrass Posidonia oceanica (L.) Delile. Besides C. taxifolia and C. cylindracea, also their congeneric Caulerpa prolifera (Forsskål) J.V. Lamouroux, that is currently considered as native in The Mediterranean Sea, appears to be particularly abundant all over the basin. Although numerous studies have been conducted in the last decades on the three species, little is still known about the competitive relationships that are established between them and on their presence in relatively deep environments. Here they possibly compete with other organisms, such as rhodoliths, which are mobile structures made of calcareous red algae, producing beds with a high living coverage of the substratum.*

*The aim of this study, that was conducted in the framework of the Marine Strategy European Directive, was to investigate the presence and abundance of C. prolifera, C. taxifolia and C. cylindracea on deep rhodolite beds of the Capo Carbonara Marine Protected Area, along the Southern Sardinian Coasts (Italy), where, according to some preliminary data, all the three Caulerpa species appear to be present.*

*To evaluate the abundance of the three seaweeds, their percent cover of the substratum was estimated by image analysis (sub-squared method, according to Dethier et al., 1993) on photo-frames extracted from videos obtained by means of a ROV (Remotely Operated Vehicle) at 40-50 m of depth. In particular, three different sites were considered in the MPA (Santa Caterina slope, Serpentara Island and Is Piscadeddus); in each, three transects of 200 m were individuated on the substratum. Finally, from each video, 20 frames (6m<sup>2</sup> of substratum for each) were obtained (Fig. 1).*

*Data regarding the percent cover of the substratum by each species were then analyzed by means of univariate statistical analysis techniques (ANOVA and SNK test), considering as factors both the site and the transect.*

*The analysis of data collected during the study provided several quite interesting results. First of all significant differences in the percent cover of the substratum by the three species were highlighted among sampling sites. Indeed, while the presence of all the three was significant at Santa Caterina slope (>25% of mean cover), they appeared to be almost absent at both Serpentara Island and Is Piscadeddus (<1% of mean cover). Moreover, focusing on Santa Caterina slope, some quite interesting differences were observed among the considered species. The most abundant species in all transects appeared to be C. cylindracea, for which the mean percent cover of the substratum reached 24%. On the contrary, significantly lower percent covers were on the whole recorded for both C. prolifera and especially for C. taxifolia. The latter, in particular, was scarcely present in all the transects with a mean cover of 0.08%.*



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Even if preliminary, these results appear to be particularly interesting from both an ecological and a management point of view. According to the obtained data, indeed, the three species are all able to settle also in deep and particular habitats such as rhodolith beds, representing a possible threat for their conservation. However, only *C. cylindracea* seems to find there the right conditions to diffuse significantly and, thus, must be monitored with particular attention, as highlighted at the end of other studies on the ability of the above mentioned species to develop on different types of substrata and at different depths (Capiomont et al., 2005). Moreover, the significant differences in the percent cover of the substratum by all the considered species among sampling sites prove that the peculiar geomorphological features of sites can play a key role for the successful establishment and expansion of these species. Indeed, Santa Caterina slope, due to its position and substratum morphology, is characterized by clear waters that favor the penetration of light and is interested by currents that avoid the presence of muddy sediments typical of deep environments, that usually don't favor *Caulerpa* species development.

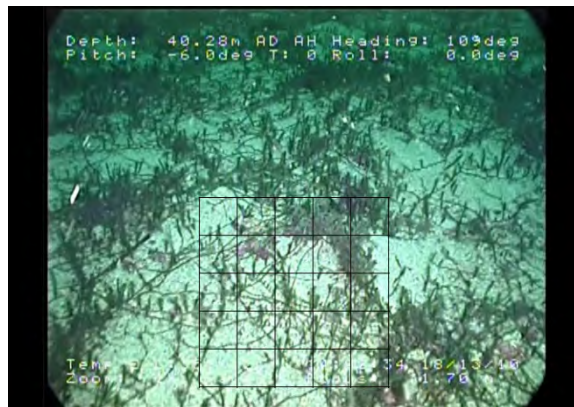


Figure 1. Example of the analyzed frames.

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

TITLE: USING DIVER-OPERATED STEREO-VIDEO TO MONITOR JUVENILE FISH ASSEMBLAGES IN MEDITERRANEAN COASTAL HABITATS FORMED BY MACROPHYTES

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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#### ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Mediterranean coastal ecosystems formed by marine macrophytes are structurally diverse, ranging from seagrass meadows (e.g. *Posidonia oceanica*, bathymetric distribution range, z=0-40m) to macroalgae forests (e.g. *Cystoseira* sp., z=0-40m). These systems provide numerous ecosystem services and, although they are highly valuable as recruitment areas for many fish species (Cheminée et al., 2021; Hinz et al., 2019), the patterns of habitat use by juveniles have not been studied in detail. In addition, these habitats are under increasing pressure due to overfishing, pollution, mechanical disturbance, climate change, or the introduction of invasive species, among others. Several studies recognize the high productivity, diversity, and macrophyte morphological variability that characterize these habitats and suggest a positive relationship between habitat structural complexity and its role for fish recruitment by providing more refuge from predators and increased potential prey for juveniles (Gratwicke & Speight, 2005; Ventura et al., 2015). The objective of our study is to collect long-term data of the Mediterranean coastal fish species' recruitment seasonal patterns depending on habitat morphological characteristics, depth, and temperature in 6 previously mapped areas of Majorca (Balearic Islands, Spain), including various coastal habitats formed by macrophytes of different complexities: a *P. oceanica* undisturbed meadow (sandy bottom); a *P. oceanica* dead matte area; an area covered by transplanted *P. oceanica* rhizome fragments; and three rocky reefs covered by macroalgae (mainly *Cystoseira* sp.). For that purpose, we are regularly performing 7 transects (7 minutes per transect) at different depths (z=0-7m) in each study area, by using calibrated, unbaited, diver-operated stereo-video (DOV) and their associated GPS data taken on the surface so that each fish observed can be geo-localized in its precise habitat; a pioneer methodology for mapping and studying juvenile fish assemblages in the Mediterranean Sea. The total area sampled per zone varied between 4000 and 8000 m<sup>2</sup>. Data on species composition, abundances, and mean lengths of the juvenile (and adult) fish assemblages from each habitat type are obtained from the stereo-videos by using SeaGIS EventMeasure software ([www.seagis.com.au](http://www.seagis.com.au), specific software to count and identify fish), and then geo-referenced in the sampling sites with QGIS software, mapping the fish distribution in space and time to understand habitat use of juvenile fish in a defined area. The benefits of using DOV and EventMeasure for monitoring fish assemblages in comparison with traditional methods used for fish count, such as Underwater Visual Census (UVC), are: a) videos are permanent, so that they can be reanalyzed if necessary; b) divers don't have to be experts in fish identification, as pictures of fish can



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be consulted with experts if verification is needed; c) inter-observer variability is eliminated; d) precise measurements of fish lengths can be made independently of the diver experience; e) it decreases field sampling time and costs; f) fish are generally integrated over the whole transect while with this methodology the observation of fish and habitat can be geo-localized on an individual level. However, there are also some disadvantages: a) cameras have a limited field of view; b) cryptic species may be difficult to observe with this methodology. Introducing this new and effective methodology for monitoring and mapping the recruitment periods and habitats of juvenile fish assemblages of these areas is of great importance to better assess the resources and services associated with the studied ecosystems and in particular, for an important activity for the economy of coastal areas (e.g. the Balearic Islands) such as fishing.

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

TITLE: SEAGRASS DETRITUS AS MARINE MACROINVERTEBRATES ATTRACTOR

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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#### ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Seagrasses colonise coastal areas worldwide (Assis et al., 2020). Despite some recovery trends reported along the Atlantic coast, a worldwide decline of these crucial species is well-documented as a response to numerous threats (e.g. eutrophication, invasive species, urbanization, etc) (Orth et al., 2006). A considerable proportion of seagrass production becomes detritus that can be used as food, physical habitat and occasional or permanent shelter by several benthic invertebrates. In turn, invertebrates can contribute to regulating seagrass decomposition (Costa et al., 2019), and represent an important trophic link between primary producers and higher consumers. Nonetheless, several factors could modify invertebrate responses to this habitat.

In this study, we tested if epifaunal colonisation of the seagrass detritus of *Zostera noltei* Hornemann, 1832 was related to substrate availability rather than food and whether colonising assemblages were similar according to the structural complexity of the meadow. Therefore, we used artificial seagrass detritus to mimic the physical structure of the natural detritus while disentangling the effect of food attractiveness vs. physical habitat availability.

Litterbags (15 x 10 cm) were filled with natural (NSD) or artificial detritus (ASD) or left empty (EMPTY) and deployed within a seagrass meadow in Thau lagoon (Étang de thau, France) in 3 areas of different structural complexity: Low Complexity (LC), Medium Complexity (MC) and High Complexity (HC) (Fig. 1). During two field experiments, carried out in April and May 2018 (22 and 19 days, respectively), the detritus decomposition and the litterbag colonisation by invertebrates were analysed.

Seagrass decomposition was faster in April than in May ( $0.0259 \pm 0.0107$  and  $0.0176 \pm 0.0084$  day<sup>-1</sup>, respectively). A total of 11,270 individuals belonging to 26 taxa were identified (including polychaetes, crustaceans, molluscs and chironomidae larvae), with a higher number in April than in May. Habitat structural complexity shows no effects on the colonisation of the detritus, but there were clear differences between empty and filled litterbags, which had a higher number of species and individuals (Fig. 2). Among all the species identified, only a few showed a preference for one substrate or another but without a general pattern.

In conclusion, the colonisation appeared to be driven by the presence of detritus itself, with similar assemblages in the natural and artificial substrate, but with more individuals than the empty bags, used as controls. Therefore, the detritus contained in the litterbag is acting as an attractor for invertebrates (Duggins et al., 2016), which use



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*opportunistically one or the other type of detritus. There were no differences according to habitat complexity, probably indicating a supply of individuals from further distances.*

*These findings show that the detritus, acting as a faunal magnet, can be colonised by a rich and diverse benthic community, even in a short period of time, highlighting its important role in maintaining the biodiversity within the seagrass meadows.*

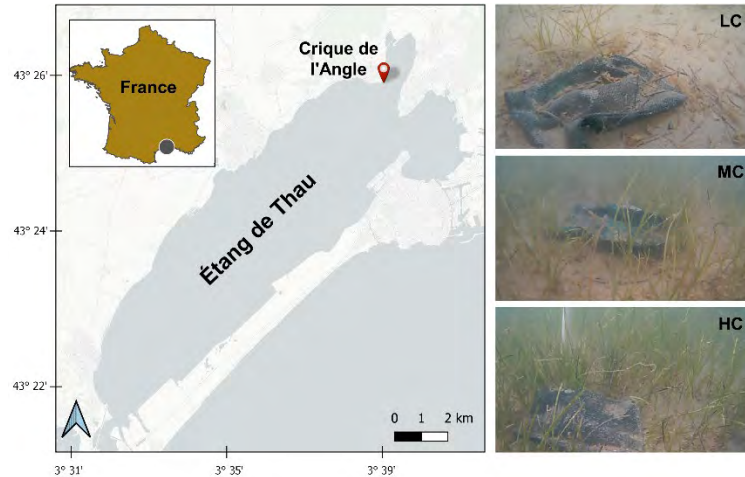


Fig. 1. Left side: Map of the study area *Crique de l'Angle*, Thau Lagoon (*Etang de Thau*, France). Right side: litterbag photo examples in the three Habitat Complexity levels, Low Complexity (LC), Medium Complexity (MC) and High Complexity (HC)

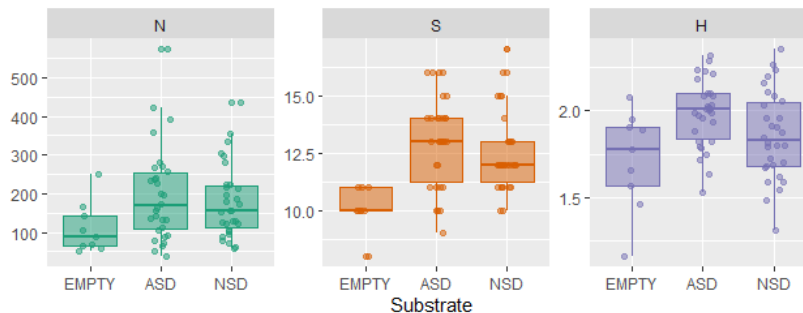


Fig. 2. Diversity Indices (N, S, H') calculated for the Empty and filled litterbags (ASD and NSD).

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

TITLE: MERCURY CONCENTRATIONS AND TRANSFERS IN PHYTO- AND ZOOPLANKTON COMMUNITIES IN A COASTAL MEDITERRANEAN ECOSYSTEM (BAY OF TOULON, FRANCE)
SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):  <i>General frameworks and Objectives</i>  <i>Planktonic organisms are at the basis of marine trophic networks and play an essential role in the organic matter and energy transfers in marine ecosystems. The structure, composition, abundance and diversity of planktonic communities may be greatly affected by variations of their environment such as climatic and hydrological conditions or concentrations in chemical contaminants. These variations may significantly affect the functioning of marine ecosystems and induce modifications in marine trophic networks. Zooplanktonic organisms have widely been used as models of metal transfers in the environment but few studies equally included micro-phytoplanktonic, pico- and nano-phytoplanktonic organisms (Battuello et al., 2016). The Mediterranean Sea is known for its history of mercury inputs simultaneously from natural and anthropic origins. The accumulation of mercury and more specifically methylmercury is known to cause organisms numerous health problems when exposed to higher concentrations. As such the mercury contamination of the environment is one of the great challenges of today's society, it has widely been studied for its properties of bioaccumulation and biomagnification in marine ecosystems especially towards fishes destined to human consumption (Chouvelon et al., 2018) but fewer studies focused on the first trophic levels and their role in mercury intake and transfers (Buckman et al., 2018). The Bay of Toulon is known to present high levels of metallic trace elements and especially high concentrations of mercury in sediments (Tessier et al., 2011), thus it is a perfect site to focus on mercury contamination of the planktonic compartment. The aim of this study was to characterize mercury concentration in planktonic communities and its transfer between trophic levels. To achieve these objectives, monthly samples of the planktonic compartments (i. e. meso-zooplanktonic, micro-phytoplanktonic, pico- and nano-phytoplanktonic organisms) were collected during an annual cycle (from September 2020 to September 2021). Samples were collected in the Bay of Toulon at the sampling stations of the Little Bay (LiB, 43° 06' 30" N - 05° 55' 00" E) and the Large Bay (LaB, 43°05'45" N - 05°56'30" E).</i>



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The LiB, at the West of the Bay, is a semi-closed system characterized by high levels of anthropic activities (with the presence of military, leisure and commercial harbors as well as shipyards and aquaculture activities). The LaB is a system open on the Mediterranean Sea, less impacted by anthropic activities and influenced by the Liguro-Provençal current. The time of residency of the water is shorter in the LaB (1 to 2 days in the LaB vs 3 to 6 days in the LiB). Samples were collected using a plankton net (with a mesh-size of 80  $\mu\text{m}$ , 50 cm wide and 2,5 m long) horizontally hauled outside of the wake of the boat at a speed of 1,8 knots for at least 45 minutes. Samples were then sieved through different mesh size (500  $\mu\text{m}$ , 200  $\mu\text{m}$ , 100  $\mu\text{m}$  and 20 $\mu\text{m}$ ) allowing to collect 4 size classes (> 500  $\mu\text{m}$ ; 500 – 200  $\mu\text{m}$ ; 200 – 100  $\mu\text{m}$  and 100 – 20  $\mu\text{m}$ ). After the last separation (20  $\mu\text{m}$ ), the remaining fraction was centrifuged at 3000 rpm for 15 minutes in order to eliminate the excess sea water and retrieve the fifth fraction (<20  $\mu\text{m}$ ). Samples were frozen at -80°C for conservation, then freeze dried and homogenized by grinding before analysis. Previously, taxonomic analysis were carried out for every size classes to identify and number the different species present in the samples. Mercury analysis were carried out using a semi-automatic mercury analyzer AMA 254. Preliminary results showed an overall higher mercury concentration in the LiB than in the LaB. Contrarily to the standard bioaccumulation pattern of mercury commonly observed in higher trophic levels, in this study the smaller size classes (<20  $\mu\text{m}$  and 100 – 20  $\mu\text{m}$ ) presented higher mercury concentrations decreasing while size classes increased. But an increase of the mercury concentration was observed between the two largest size classes (500 – 200  $\mu\text{m}$  and >500  $\mu\text{m}$ ).

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** PHYTOPLANKTON AND BACTERIAL RESPONSE TO DRY AND WET DEPOSITION IN THE COASTAL WATERS OF THE SOUTHEASTERN MEDITERRANEAN SEA: LESSONS FROM HIGH-RESOLUTION MONITORING

**SESSION:** FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:** RAHAV EYAL AND HERUT BARAK

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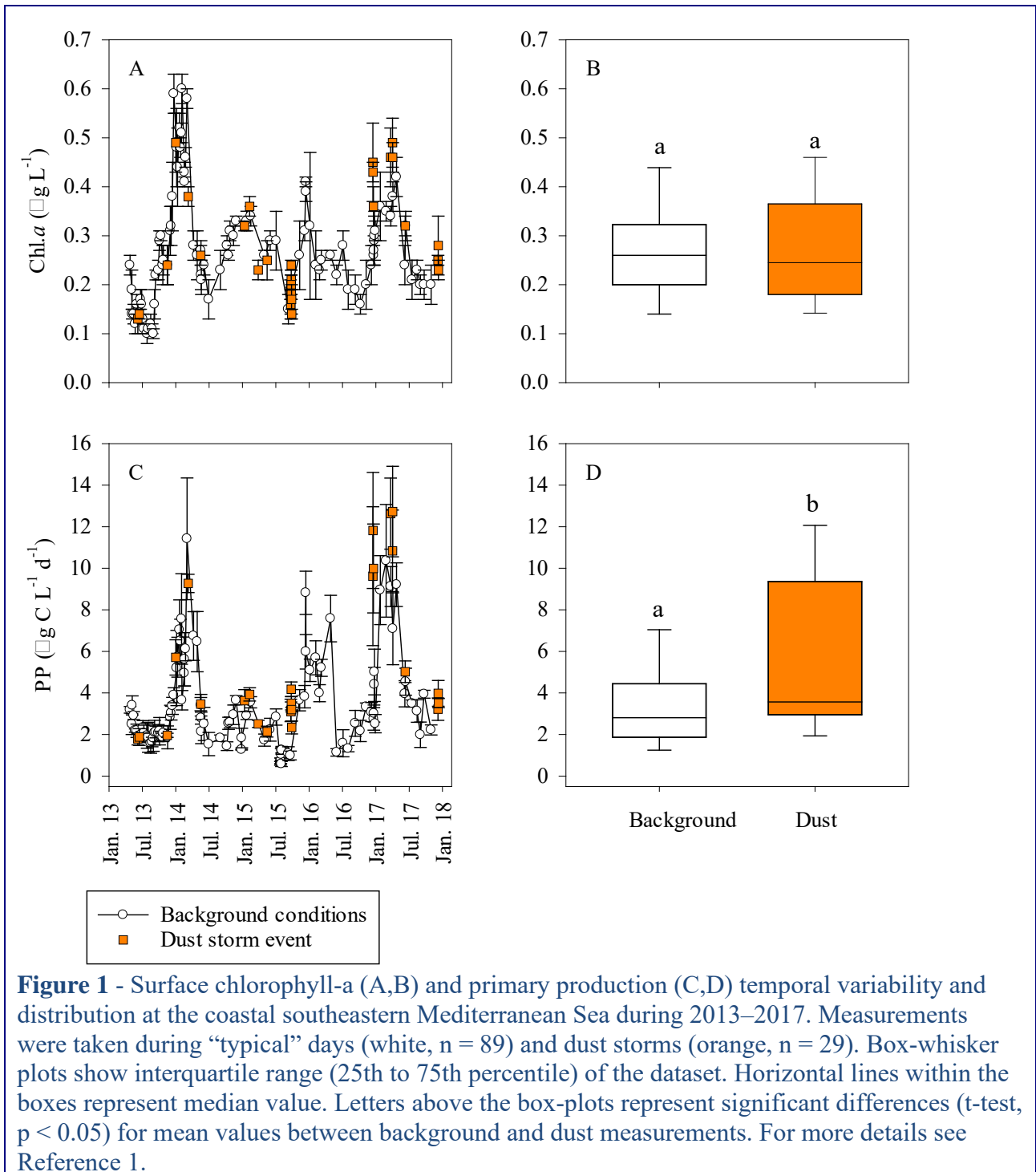
**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

Wet and dry aerosol deposition are important sources of external macronutrients (e.g., NO<sub>3</sub>, PO<sub>4</sub>) and micronutrients (e.g., Fe) to the surface of the ocean, especially in oligotrophic areas such as the southeastern Mediterranean Sea. The overarching goal of this study was to monitor if and how dry and wet deposition affect ‘bottom of the food-web’ microbial communities in the oligotrophic low nutrient low chlorophyll coastal southeastern Mediterranean Sea. To this end, we monitored in high-resolution over several years the bacterial and phytoplankton abundance and activity during dry (n=126) and wet (n=68) aerosol deposition events. Dry deposition triggered moderate responses in chlorophyll-*a* (an estimate for phytoplankton biomass) and bacterial biomass (10% and +20%, respectively), while rate measurements such as primary production, bacterial production and N<sub>2</sub> fixation were all significantly and positively affected (+25 to +40%) by dry deposition (Figure 1). Wet deposition (rain) relieved N limitation to phytoplankton, but not of P (Figure 2), resulting in enhanced abundance (average ~75%) of autotrophic microbial communities (mostly pico-eukaryotes) and primary production (~110%). The changes in phytoplankton biomass following rainwater deposition was observed only after 24-48 h and not sooner, in accordance with the relatively slow growth rates of most marine microorganisms (typically ≥1 day). We also show that the rapid changes in bacterial and/or phytoplankton rate parameters suggest that the released nutrients from dry or wet atmospheric depositions are tunneled directly in metabolic processes and, to a lesser extent, for biomass accumulation or growth. Our results emphasize the importance of short-term episodic deposition events to primary and bacterial production and to bacterioplankton temporal variability in the low nutrient low chlorophyll southeastern Mediterranean Sea coast. Given that the oceans are likely to become nutrients poorer and more stratified due to climate changes, and the projected increase in dust emission due to desertification, the role of wet and dry deposition may be of a special importance to new primary productivity.



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

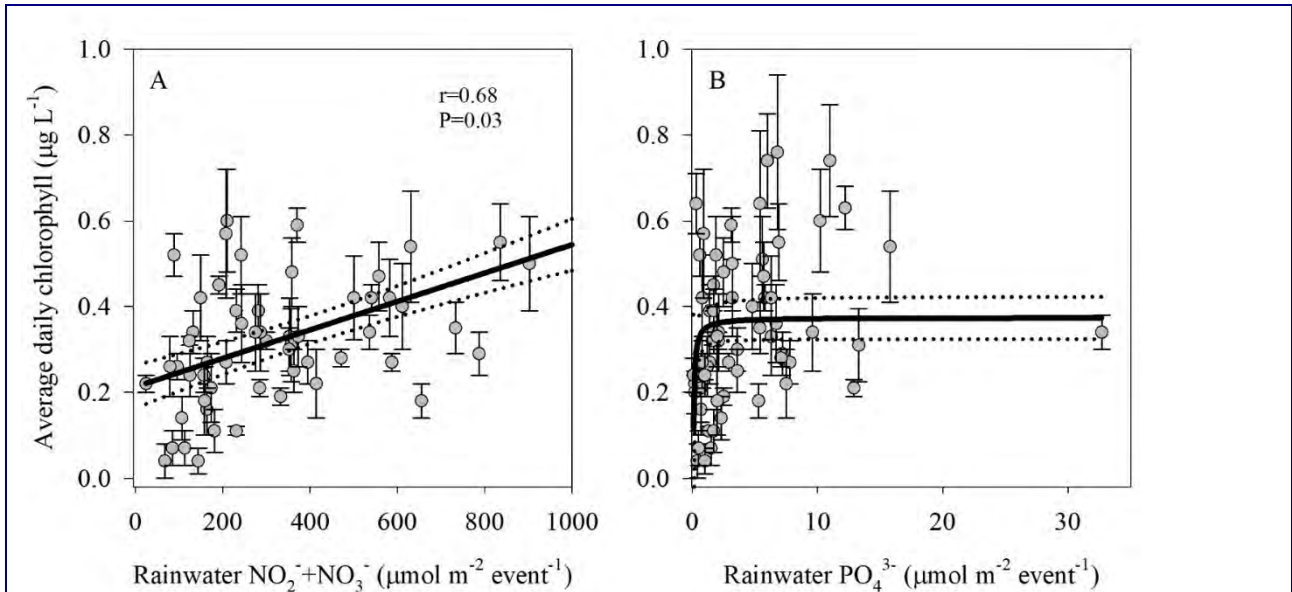
Livorno (Italy), June 2022





## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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**Figure 2** – Relationship between average daily chlorophyll-*a* fluorescence (measured the following day of the event) and rainwater  $\text{NO}_2^- + \text{NO}_3^-$  (A) and rainwater  $\text{PO}_4^{3-}$  (B) between 2014-2017 from a coastal station at the southeastern Mediterranean Sea. The solid line shows the correlation trend-line and the dotted lines show the 95% confidence. For more details see Reference 2.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

COLONIZATION OF TRANSPLANTED POSIDONIA OCEANICA:  
UNDERSTANDING THE SPATIAL DYNAMICS THROUGH HIGH-SPATIAL  
RESOLUTION UNDERWATER PHOTOMOSAICS

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

The present contribution aims at examining the colonization process and the spatial dynamic of transplanted *Posidonia oceanica* fragments, through the analysis of high-spatial resolution (centimetre scale) underwater photomosaics. *P. oceanica* is the most important and widespread endemic seagrass in the Mediterranean Sea and for its ecological, physical, economic, and bio-indicator roles is protected at both species and habitat level by national laws and EU legislations. Although the legal framework and protection measures established for Mediterranean seagrasses, since the end of last century *P. oceanica* meadows are facing with a rapid decline mainly due to human activities and climate changes (Telesca et al., 2015).

Due to the slow growth rate and the rarely sexual reproduction, the damaged meadows are unlikely to recolonize naturally and, for this reason, when the pre-disturbance environmental features are re-established, transplanting represent an appropriate intervention to restore the seagrass and speed up the recovery process. Monitoring of *P. oceanica* transplanting activities has been so far performed through the structural and functional features of the phanerogam, such as the cuttings' survival rate, shoot density and leaves lengthening, whereas no research deepened the potential resource of using underwater high spatial resolution images to highlight the colonization patters and the spatial dynamics (Boudouresque et al., 2021). For this reason, during a 2-year period, we evaluated over 524 m<sup>2</sup>, using high-spatial resolution pictures, the suitability of a recently employed protocol measuring the i) number of patches, ii) mean patch size and iii) total cover of *P. oceanica* transplants.

Transplanting activities were performed from June to October 2019 inside the Concordia shipwreck area, in the east side of Giglio Island (central Tyrrhenian Sea, Italy), on a dead *matte* substrate from 18 to 23 meters depth previously colonized by a healthy *P. oceanica* meadow which showed a strong regression due to the shipwreck and its removal activities (**Fig.1 panel a**) (Mancini et al., 2019). Underwater photomosaics were performed in i) June 2019, ii) October



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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2019, iii) October 2020, iv) October 2021 respectively before, after, 1 year later and 2 years later the transplanting activities (**Fig. 1b-c**). The high resolution photomosaics were imported and analyzed through Geographical Information System (GIS) software to evaluate the seagrass development and the spatial dynamic over time. The transplanted *P. oceanica* patches, represented by a single cutting if separated at least 5 cm from the surrounding fragments or aggregation of cuttings instead, were manually outlined over the whole transplanted area of 524 m<sup>2</sup> (**Fig. 1d**). With fixed scale, patches boundaries were outlined by the freehand drawing tool in ArcGIS10.2.2 and the spatial metrics i) number of patches (NumP), ii) mean patch size (MPS) and iii) total cover (TC) were calculated in ESRI ArcMap 10.2.2 by using the Attribute Table and the Calculate area tool included in the Spatial statistic toolbox. NumP and MPS represented respectively the amount of *P. oceanica* patches and their average size (expressed in m<sup>2</sup>), TC is defined as the sum of all the patches size (in m<sup>2</sup>). The spatial metrics were calculated every year from the photomosaic performed in October.

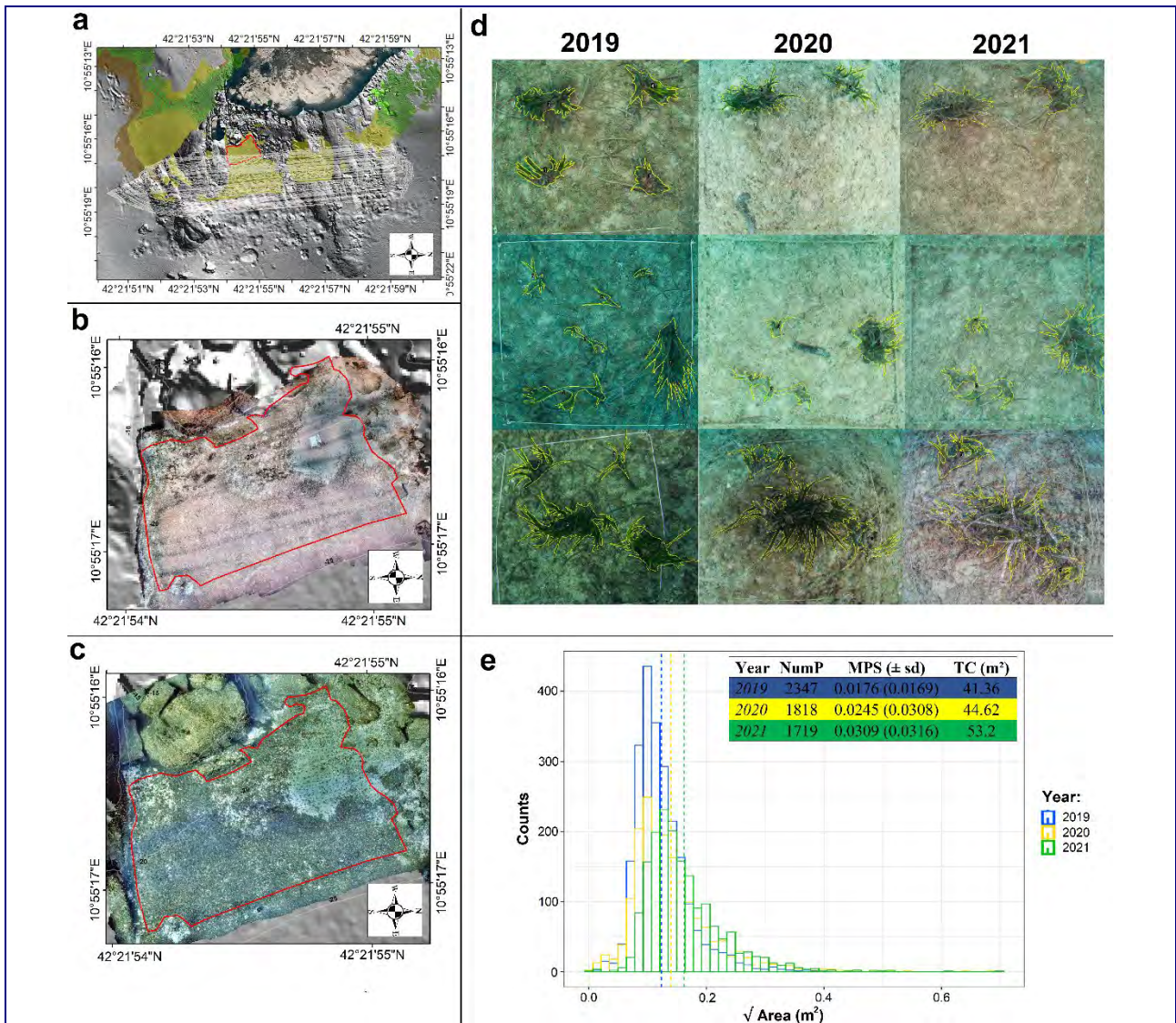
During the study period, the NumP diminished, especially due to the disappearance of the smallest ones; on the other hand, MPS and the TC increased (**Fig. 1e**). At the end of the transplantation, in October 2019, the transplanted area was characterized by 2347 patches (NumP) of *P. oceanica* with a MPS ( $\pm$  SD) of  $0.0176 \pm 0.0169$  m<sup>2</sup> for a TC of 41.36 m<sup>2</sup>. In October 2020, 1 year later, NumP decreased showing 1818 patches whereas both MPS and TC were higher if compared with the previous year, with values of  $0.0245 \pm 0.0308$  m<sup>2</sup> and 44.62 m<sup>2</sup> respectively. In October 2021, after 2 years from the transplantation, the transplanted area was characterized by 1719 patches with a MPS of  $0.0309 \pm 0.0316$  m<sup>2</sup> and a TC of 53.20 m<sup>2</sup>.

The present study shows that, despite *P. oceanica* is a slow-growth species, the colonization of transplanted patches occurs since the first year probably driven by the higher leaves lengthening compared to the natural plants and the shoot density increase (Mancini et al., 2021). Applying this rapid, efficient, and low-cost technique to seagrass restoration management could result in new insights on colonization processes and spatial dynamics of transplants.



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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**Fig.1** The study area, underwater photomosaics, transplanted patches and spatial metrics.

Panel **a** shows the study area where the Concordia sunk in 2012 leading to *P. oceanica* regression. A restoration project, based on vegetative fragments transplantation, started in June 2019 over 524 m<sup>2</sup> on the unvegetated dead *matte* substrate (red polygon in panel **a**) and was accomplished in October 2019 (panel **b**). High-spatial resolution underwater photomosaics allowed us to highlight the colonization process of transplanted *P. oceanica* (three fixed plots used to monitor the transplant progress status in panel **d**) and to describe the spatial dynamics over the years (panel **e**).

### REFERENCES: (MAX 4)

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

**First investigation of per-and poly fluoroalkylsubstances (PFAS) in striped dolphin *Stenella coeruleoalba* stranded along Tuscany coast (North Western Mediterranean Sea)**

**SESSION:**

FLORA E FAUNA

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

Per- and poly fluoroalkylsubstances (PFAS) are a group of organic molecules synthetically produced and used in a wide range of commercial and industrial applications. Two well-studied groups include the perfluoroalkyl sulfonates (PFSA) and perfluoroalkyl carboxylates (PFCA).

Perfluorooctanesulfonic acid (PFOS) is the most known PFAS. Due to his toxicity and bioaccumulability, in May 2009, PFOS and its related compounds were added to the Annex B "Restriction" of the Stockholm Convention on Persistent Organic Pollutants and they were also included in the list of priority hazardous substances which must be monitored in EU water bodies as stated by the Marine Strategy Framework Directive (2008/56/CE).

Global distribution of PFAS in waters (1) and in aquatic organisms (2; 3), have been documented in many studies, demonstrating their persistence in the environment and their bioaccumulation and biomagnification.

According to the scenario reported above, PFAS represent emerging chemicals that are of environmental concern for marine mammals (4). At the same time, marine mammals share the coastal environment with humans and consume similar food, thus they may also serve as indicators for environmental change and ecosystem health (5).

ARPAT AVL (Environmental Protection Agency for Tuscany Region) is accredited in accordance with UNI EN ISO 17025 for the determination of PFOS in whole fish samples. In the same analysis, other PFAS, namely short- and long-chain PFCA and PFSA and sulphonamides, are analyzed and quantified.

In this study we have used the analytical method based on an extraction step QuEChERS and on a subsequent revelation step based on ultra-high performance liquid chromatography coupled with high resolution mass spectrometry (UHPLC-HRMS Orbitrap). In this way we were able to detect, confirm and quantify a pool of 18 target PFAS (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrDA, PFTeDA, PFBS, PFHxS,



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PFOS, PFDS, PFHpS, PFPeS, FOSA) on samples of striped dolphin's tissue.

The sets of tissue samples (blood, liver and muscle) were taken from 21 striped dolphins (*Stenella coeruleoalba*, Meyen 1833) stranded along Tuscany coast between 2020 and 2021. For each specimen date, exact localization of stranding, status of conservation of the dolphin and, when possible, total length, weight and sex were recorded.

PFOS, PFHxS and FOSA were found in all samples with PFOS blood concentration level ranging from some tens to some hundreds of  $\mu\text{g}/\text{Kg}$ .

The concentrations follow the trend  $\text{PFOS} > \text{FOSA} > \text{PFHxS}$  and the PFOS concentration appears to be inversely proportional to the animals' mass, as reported in the most recent literature (6). The PFOS/FOSA blood concentration ratio has a threshold at about 20 Kg, with two distinct numerical intervals related to the age of the animals (younger or older than 1 yr).

PFNA, PFDA and PFUnA are the perfluorinated carboxylic acids (PFCA) that are present in greater concentrations in analyzed samples with maximum concentrations of few tens of  $\mu\text{g}/\text{Kg}$ .

The presence of these high concern substances in striped dolphins underlines a remarkable impact of anthropic activities on wildlife, and prompts further researches about the impact of PFAS on marine mammal conservation and health.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

TITLE: MONITORING CHANGES OVER A 10-YEAR PERIOD, THROUGH VEGETATION MAPS, IN A COASTAL SITE IN PUGLIA REGION (SOUTH-EASTERN ITALY)

SESSION: FLORA E FAUNA DEL SISTEMA LITORALE: DINAMICHE E PROTEZIONE

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

Coastal ecosystems are among the most threatened environments worldwide. In the Mediterranean Region coastal areas are undergoing rapid anthropogenic development. The increasing of human pressures, such as land reclamation for farming, building up, and exploitation of water resources, along with coastal erosion, is causing a decreasing surface of these environments and the resulting habitat degradation, fragmentation, and isolation. Thus, a systematic monitoring of the status of coastal ecosystems is fundamental to detect changes and the underlying pressures and to support a dynamic habitat management.

Zone Umide della Capitanata e Paludi presso il Golfo di Manfredonia [Site of Community Importance (SCI) IT9110005; Special Protection Area (SPA) IT9110038], located in the northeastern part of the Puglia Region and partially included in the Gargano National Park, is one of the most extensive coastal wetlands of the Italian peninsula and one of the largest components of the Mediterranean wetland system. The site has been suffering numerous exploitation activities for a long time, mainly for agricultural purposes, resulting in the conversion of large part of the wetland areas into cultivated lands and the subsequent reduction and fragmentation of the original natural habitats; moreover, the coastal zone is undergoing important erosion of the dune belt (Tomaselli et al. 2016). In this study we analyzed and evaluated the changes occurred in this area, covering a time frame of about 10 years, from 2010 to 2020. For the detection of such changes, we used aerial orthophotos by visual interpretation. Changes were detected by comparing map pairs; trends were quantified on the basis of the detected changes and of the expert knowledge of natural scientists, experienced on the area under study. In situ measurements were also performed, including vegetation survey (in terms of both morphological-structural characteristics and



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qualitative-quantitative composition by means of phytosociological analyses) and periodic assessment of land use, and possible variations in anthropic activities. A post-mapping method was adopted to detect the habitat/LC changes that occurred in the study period. Starting from the vegetation maps, habitat and then land cover/land use maps were obtained. Habitat classes were labelled according to the European Habitats Directive (92/43 EEC Directive) Annex I habitat types and EUNIS habitat classification. Land Cover classes were labelled according to the FAO-LCCS taxonomy, a very flexible Land Cover taxonomy which allows the identification and representation of intraclass modifications (Tomaselli et al. 2013; Adamo et al. 2016; Tomaselli et al 2021). Various changes were identified, both inter-class changes (class conversions) and intra-class changes (class modifications) and quantified by means of transition matrices. Finally, the detected changes were related to proximate pressures and drivers of changes.

In detecting and monitoring these processes, in addition to a correct spatial scale of observation, the choice of appropriate thematic resolution and an appropriate taxonomy (or more than one) is a crucial issue. While EUNIS allows the detailed definition of many natural and seminatural habitat types, LCCS turns out to be a valid tool for identifying and representing of intraclass modifications.

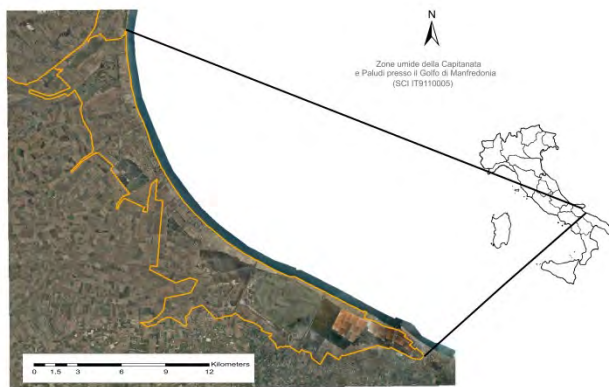


Fig. 1 - Study area (SCI IT9110005)



Fig. 2 – Palude Frattarolo



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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:** “FILLING THE GAP BETWEEN MARINE CITIZEN SCIENCE AND COASTAL MANAGEMENT: THE *MEDSENS INDEX*”

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:**

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

In the Mediterranean Sea, subtidal rocky shore and coralligenous reefs are among the most threatened marine habitats. Environmental quality assessment tools for these habitats, based on the integrity of marine communities, are not only urgent but also essential to answer to the European Marine Strategy Framework Directive (MSFD, 2008/56/EC). Citizen science (CS) projects may provide community-based ecosystem monitoring, expanding our ability to collect data across space and time. However, the data from CS are often not effectively integrated into institutional monitoring programs, especially in marine conservation. This limitation is partially due to difficulties in accessing the data and the lack of tools and indices for proper management at intended spatial and temporal scales. The growing need to assess the environmental status of Mediterranean habitats and the large availability of data collected by Reef Check Mediterranean Sea volunteers along subtidal rocky shores and coralligenous habitats [1] suggest the possibility to develop innovative and reliable indices that may support decision-makers in applying conservation strategies, particularly important for Marine Protected Areas (MPAs).

*MedSens* is a biotic index developed to provide information on the environmental status of subtidal rocky coastal habitats, filling a gap between marine CS and coastal management in the Mediterranean Sea [2]. The *MedSens* index is based on 25 selected species, incorporating their sensitivities to the pressures indicated by the European Union's MSFD and open data on their distributions and abundances, collected by trained volunteers (scuba divers, free divers, and snorkelers) using the Reef Check Mediterranean Underwater Coastal Environment Monitoring (RCMed U-CEM) protocol [1,3,4]. The species sensitivities were assessed relative to their resistance and resilience against physical, chemical, and biological pressures, according to benchmark levels and a literature review. The *MedSens* index was calibrated on a dataset of 33,021 observations from 569 volunteers (2001–2019), along six countries' coasts. A free and user-friendly QGIS plugin allows easy index calculation for areas and time frames of interest ([www.reefcheckmed.org/english/underwater-monitoring-protocol/medsens-index/](http://www.reefcheckmed.org/english/underwater-monitoring-protocol/medsens-index/)).

The *MedSens* index was calculated for 22 management zones belonging to 12 Italian MPAs. As case study, at Portofino MPA (Fig. 1a), the assemblage sensitivities ranged from moderate to very high. Overall, the mean species sensitivities increased in the west and consistently with distance from the Tigullio Gulf, located upstream of the dominant currents. This is the source of the main local physical and chemical pressures due to increasing urbanization and the fluvial transport of sediments and pollutants. At Tavolara – Punta Coda Cavallo MPA (Fig. 1b), the assemblage sensitivities ranged from high to very high. This is consistent with limited anthropic impacts inside the MPA. Pressure gradients cannot be uniquely defined in this area, but the B zone performed better than the C zone in terms of assemblage sensitivity, as expected from the management and conservation plan.

At the Isole Tremiti MPA (Fig. 1c), the assemblage sensitivities ranged from low to moderate. The B zone had the lowest mean species sensitivity, especially for biological pressures. This may be related to a decline in the algal assemblages due to increasing pollution and the growing number of non-indigenous species, such as the invasive algae *Womersleyella setacea* and *Caulerpa cylindracea*.

The *MedSens* index can be calculated for specific time frames too. An example is represented by the mass mortality of the gorgonian *Paramuricea clavata* at Secca del Papa, Tavolara Island, in the late summer 2008 heatwave. Data collected in 2007, before the crisis, showed a very high mean sensitivity of the assemblages, especially to the chemical and physical pressures. Data collected between 2015 and 2017 indicated a drastic reduction in the sensitivity of the assemblages. Indeed, the loss of *P. clavata* may affect the structure of benthic communities (Fig. 2).

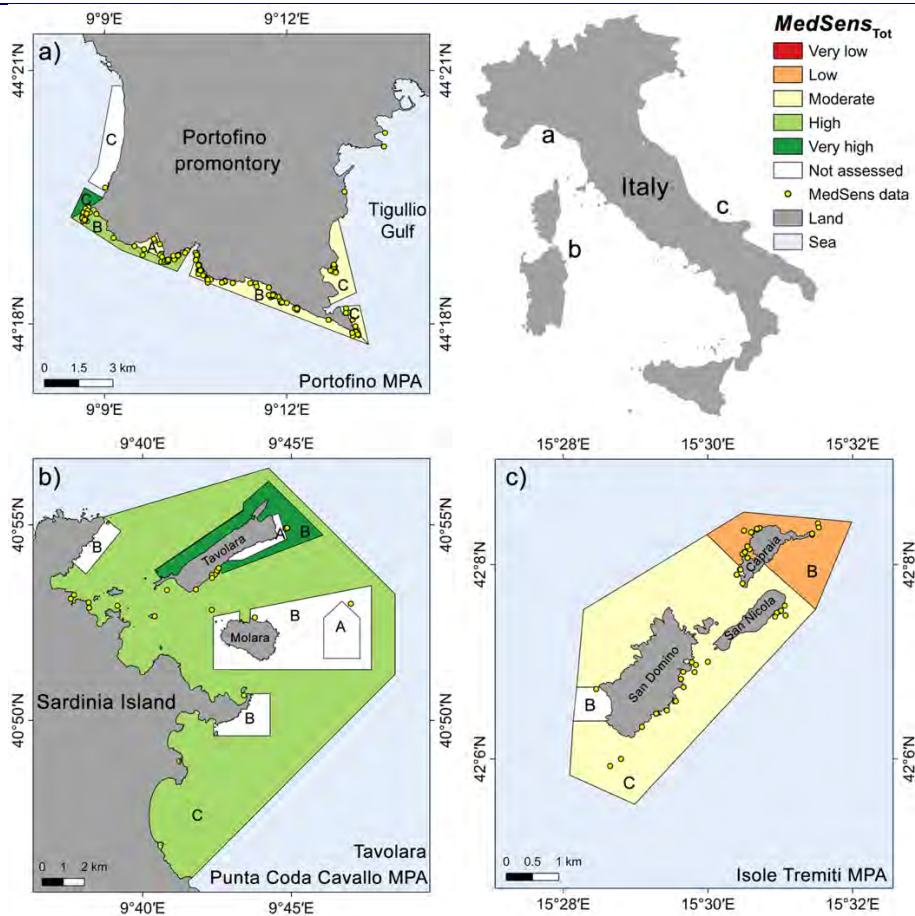
*MedSens* converts the data collected by trained volunteers into an effective monitoring tool for the Mediterranean subtidal rocky coastal habitats. It can help conservationists and decision-makers identify the main pressures acting in these habitats, as required by the MSFD, supporting them in the implementation of appropriate marine biodiversity conservation measures and better communicating the results of their actions.



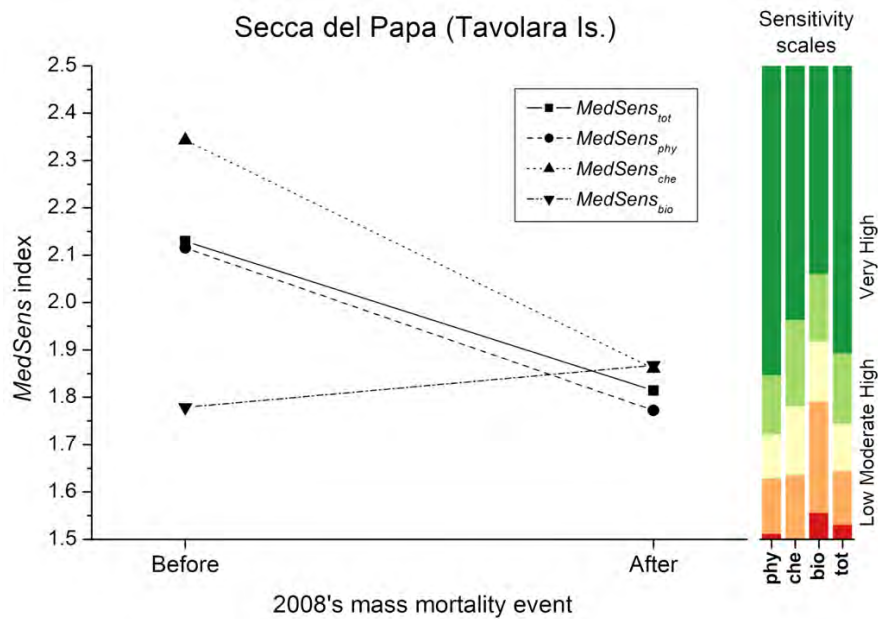


# MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022



**Fig. 1** Examples of sensitivity assessments ( $MedSens_{tot}$  index) applied to MPAs management zones: a) Portofino, b) Tavolara – Punta Coda Cavallo, and c) Isole Tremiti. Yellow dots display  $MedSens$  data points. Letters indicate protection levels (Mercator projection, WGS84) [2]



**Fig. 2** Temporal change in the  $MedSens$  index at Secca del Papa, Tavolara Island before and after the 2008 mass mortality of *Paramuricea clavata* [2]



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4. Turicchia, E., Ponti, M., Rossi, G., Milanese, M., Di Camillo, C.G., and Cerrano, C. (2021). The Reef Check Mediterranean Underwater Coastal Environment Monitoring protocol. *Frontiers in Marine Science* 8, 620368. DOI: 10.3389/fmars.2021.620368

# **POSTER PRESENTATIONS**



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**Title:**

Effect of Climate Change and anthropogenic pressures on the European eel *Anguilla anguilla* from Ramsar Wetland Ichkeul Lake: Prediction from the Random Forest model.

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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### ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

*In northern Tunisia, near the shore of the Mediterranean Sea, the Ichkeul Lake is among the most productive ecosystems in Tunisia. The lake is registered in multiple international conventions due to its great fauna and flora biodiversity. However, this wetland is an example of an impacted lake due to the effect of climate change and the expansion of human activities. Therefore, the main objectives of the present study are to assess the trophic level of the Ichkeul ecosystem and, to predict the effect of climate change and anthropogenic pressures on European eels. The latter are the most pertinent bioindicator that describe the ecological state of wetlands as they represent the link between the sea (reproduction) and fresh water (growth).*

*A gathering of historical data complemented by a sampling campaign (which covered 14 stations in the lake and its watershed during the year 2020) was conducted to obtain a dataset consisting by 422 sampling observations and 14 parameters for the period 1995-2020 (eels landing, depth, temperature (T), salinity (S), Dissolved Oxygen (DO), Turbidity (Tr), Ammonium (NH<sub>4</sub>), Nitrate (NO<sub>3</sub>), Nitrite (NO<sub>2</sub>), Phosphate (PO<sub>4</sub>), Total Nitrogen (TN), Total Phosphorus (TP), Silicate (Si) and Chlorophyll a (Chla)).*

*Multimetric trophic index (TRIX), the most recent approach applied in ecology, was used to provide the degree of trophic status of the lake by integrating nutrient concentrations (nitrogen and phosphorus) and productivity (oxygen saturation and Chla) as factors.*

*To build a predictive model of eels in the coastal area, Random Forest (RF) modeling, which is a machine learning method recently proposed and applied in several Mediterranean lagoons (Bejaoui et al., 2018), was trained using 13 predictors. Model runs was performed with the R software version 2.0.1 (R Core Team, 2016) using the Random Forest package (Liaw and Wiener, 2002) and was evaluated by the increment of the Mean of Squared Error (MSE) and coefficient of determination (R<sup>2</sup>). Moreover, the link between eel's landing and input variables was also studied using multivariate analysis, Pearson correlation and the non-parametric tests of Spearman and Kendall.*

*The observed TRIX values inside the lake show a non-uniform distribution and a variation between seasons. The eastern and the north-western sides recorded the highest values (from 4 to 6) especially during the spring and summer period, reflecting waters ranging from moderate to poor quality. While the lowest values (below 5) were observed in the center and the south-western sectors of the lake during the fall and winter seasons, corresponding to medium level of eutrophication. The calculation of the TRIX index in the main rivers of the lake's watershed (Douimis, El Melah, Joumine, Sejnene and Tinja rivers) demonstrates their eutrophication status, particularly the Tinja river where the TRIX values were above 6. The other rivers are in mesotrophic conditions.*

*Figure 1 shows that the most important predictors of eels landing according to the RF model appear to be depth, followed by turbidity and nutrients. RF model gives an R<sup>2</sup> of 45.95 and for comparison, we performed a multivariate linear regression on the same data, obtaining R<sup>2</sup> of 0.34. After 10-fold cross-validations, the linear model achieves an R<sup>2</sup> of 0.27 only. Furthermore, the model was tested on the OOB (out of bag) data which is similar to the cross-validation and the predictions were like the original data without risk of overfitting. We can, thus, confirm that RF model is significantly better than multivariate linear regression and the model predictions are statistically reliable.*

*Univariate pairwise correlations between predictors and eels landing highlight a high correlation between eels landing and depth, turbidity and nutrient and an opposite correlation with temperature, which are consistent with the*



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relationships found with the RF model.

This study demonstrated the performance of the approach and have also confirmed the results of previous studies (Lagarde et al., 2021) showing that the presence of European eels in coastal ecosystems is principally dependent on water depth and that the lake has reached a mesotrophic status due to the organic waste that receives from its tributaries. In the broader context of the coastal wetlands' studies, this sustainable approach, which combines RF model and TRIX index, could be used to assess the evolution of the trophic status and improve our understanding of effect anthropogenic pressures and climate change on biological status of these ecosystems. It can be used in decision making by civil authorities and other interested stakeholders.

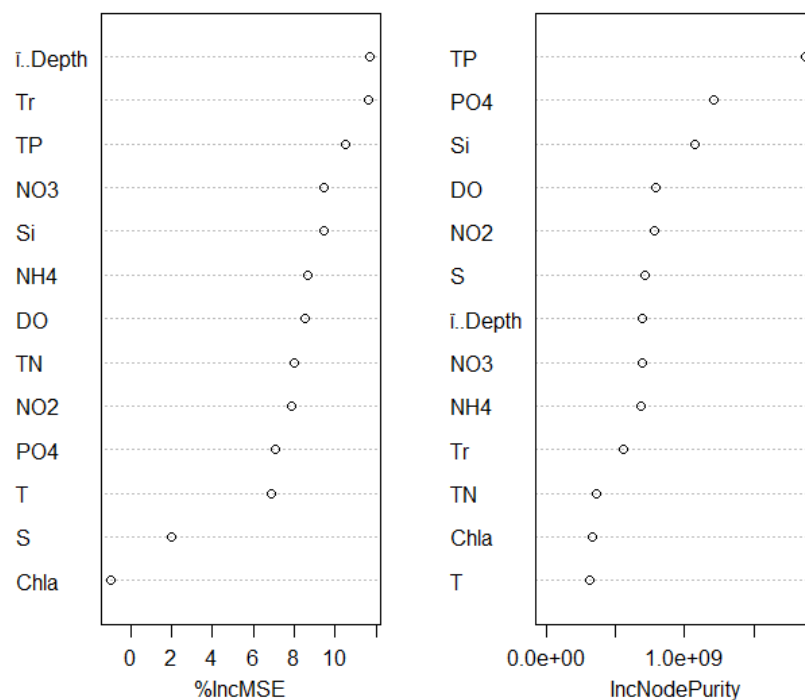


Figure 1: Predictor's importance ranking for the RF model. Importance is measured during RF model building by increment in MSR (left) and node purity (right) due to each predictor.

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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

**STUDIES ON THE CHANGES IN FLORA AND FAUNA OF OUR COAST**

**SESSION:**

**FLORA AND FAUNA OF THE LITORAL SYSTEM: DYNAMICS AND PROTECTION**

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

*For many years we have been carrying out researches on the ecological situation of the coastal strip of some regions, in collaboration with Italian and foreign institutes and universities, and we have documented a continuous change in the presence of animals and plants. The arrival of many "alien" species in the Mediterranean sea has been made possible largely by the rise in water temperature and some highly invasive algal species, such as *Caulerpa cylindracea* Sonder, 1845 which, in some areas, have taken over indigenous species. The changes which are instead induced by human activities involve alterations especially on sessile and sedentary species which can be controlled and contained with specific protective activities.*

*Our researches have always been carried out on both Italian and foreign coastal strips, especially to assess their ecological situation. Only with sampling carried out on every type of substrate and marine environment, in many years of field research, it has been possible to capture thousands of marine species that have been taxonomically determined with the help of colleagues specialized in the various phyla. Many species, whose life is closely linked to the environment in which they live, have disappeared as they cannot bear the often relevant changes. An example is the disappearance, along the coast of Tuscany, of the gastropod Opisthobranch *Aplysia depilans* Gmelin, 1791 due to the dissolution of the green seaweed *Ulva lactuca* Linnaeus, 1753 in the area where it lived. The decrease of many species that inhabit the sandy bottoms, for example the Crangon crangon (Linnaeus, 1758) shrimp, is very often linked to human activities that take place on the nearby mainland. For these reasons to solve the problems, or at least control and protect the coastal environment, it is necessary to understand what changes are taking place and what they are produced from.*

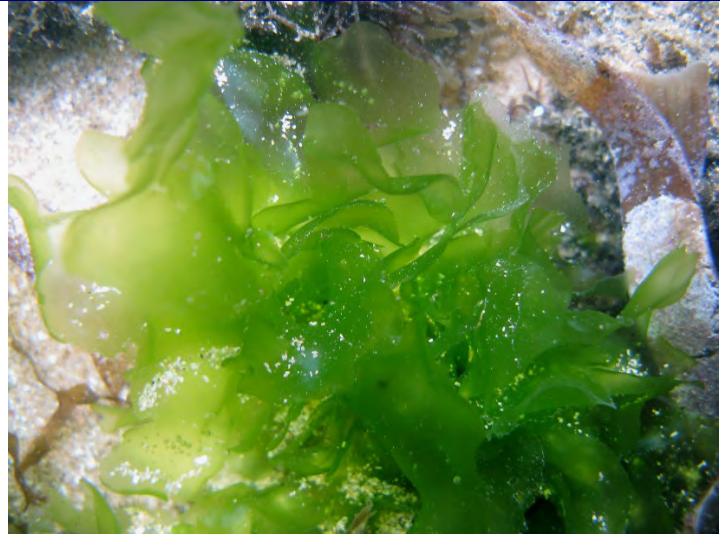


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Livorno (Italy), June 2022



*Aplysia depilans* Gmelin, 1791



*Ulva lactuca* Linnaeus, 1753

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**MONITORING OF MEDITERRANEAN COASTAL AREAS:  
PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

**FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

**A MUSEUM OF MARINE ANIMALS TO LEARN THE LIFE IN THE  
MEDITERRANEAN SEA**

**SESSION:**

**FLORA AND FAUNA OF THE LITORAL SYSTEM: DYNAMICS AND PROTECTION**

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

*Very important, as a cultural contribution to the knowledge of the marine environment, are the museums organized in order to show and explain visitors what can be seen if we swim in the sea or walk along the coast. Our museum is exclusively about the sea and its inhabitants but the peculiarity is that a specialized marine biologist accompanies the visitors and explains the anatomical, physiological and ethological characteristics of the observed species that are exclusively Mediterranean with the exception of a crab, *Percnon gibbesi* (H. Milne Edwards, 1853), native to the Atlantic and Pacific oceans, and a small flying fish *Cheilopogon exsiliensis* (Linnaeus, 1771), native to the Red Sea. These species arrived alive in our laboratories and were used, passed to the museum, to explain to visitors, and schoolchildren, that with climatic changes, and the sea temperature rise, non-native species continually arrive from tropical seas. In the museum there are also many objects collected from our coasts such as egagropile, similar to soft little brown balls, the so called sea olives, fruits of the seagrass meadows of *Posidonia oceanica* (Linnaeus) Delile, 1813. Large photos of coastal erosion along the coasts serve to explain what caused it. Very often it happens to meet, on the litoral, objects that we do not know what they are. We meet jellyfish while taking a bath but we do not know how they reproduce and why in recent years they have increased in number every summer. We do not know how fish or sharks reproduce, what the dolphin looked like when it lived on land 58 millions years ago, and had four legs, tail, ears and a beautiful fur. In our museum you will have the answers to your questions of all species you are observing. To increase the cultural and cognitive importance of about 1700 species that are organized in the rooms of the museum in a systematic order from sponges to marine mammals. A museum that makes people know the life and the animal species that live in our seas and offer a great cultural heritage to all visitors.*



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*Eggs and sand ribbon constructed by Naticarius stercusmuscarum (Gmelin, 1791).*

### REFERENCES: (MAX 4)

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE: BREEDING BIOLOGY OF THE ELEONORA'S FALCON WITHIN THE GALITE ARCHIPELAGO**

**BIOLOGIE DE REPRODUCTION DE FAUCON D'ELEONORE AU SEIN DE L'ARCHIPEL DE LA GALITE**

**SESSION:**

**FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*The Mediterranean Sea accounts for 0.8% of the total surface oceans. Despite its small size, it is one of the 34 hotspots of global biodiversity (Myers 1996). There are more than 15,000 islands and islets in the Mediterranean basin serving as refuges for many endemic species. Around thirty islands in the Mediterranean basin are the subject of a project to monitor changes that may affect this area. This project was launched by the Coastal Conservation Agency of France with the help of the Small Islands Initiative of the Mediterranean (PIM), among the concerned islands is the Tunisian archipelago "La Galite". This archipelago considered as a marine protected area; a privileged environment for many animal and plant species, rare and endangered as the monk seal, the endemic brown algae, bio indicative of pure water, the red algae very threatened in the Mediterranean (Abbes et al. 2007). Still difficult to access, this bears witness to an incredible wealth and biodiversity that is one of the main migratory routes two and nesting sites for many seabirds, most of which are endemic to the Mediterranean, such as Falco eleonorae ) (Yannick and Eric 2007).*

*Falco eleonorae is known by a delayed nesting, adjusted with the peak of passerine migration flow between July and the end of September and an endemism to small Mediterranean islands during the reproduction season; the total population winters in the highland of the oriental Africa from Madagascar to la Reunion (Gensbol 1988).*

*The objective of this work was therefore to contribute to a better understanding of the ecology of Eleonora's falcon population breeding in Galite archipelago, by providing detailed data on its breeding biology and assessing the nesting parameters.*

*This study was carried out at Galite archipelago over two consecutive breeding seasons (2014 and 2015). We investigated the breeding ecology of Eleonora's falcon population in Galite archipelago, by providing detailed data on its breeding biology and assessing the nesting parameters. Overall, 127 Eleonora's falcon breeding pairs were recorded in all six islets of the archipelago. The eastern part of the archipelago hosted the highest number of breeding pairs with highest density recorded at Gallo island (5.93 pairs/Ha). Eleonora's falcon breeding pairs mainly used the protected crevices non-exposed to sun and wind. The overall mean clutch size (mean  $\pm$  SE) was  $1.78 \pm 0.10$  eggs per clutch. Clutches of two eggs and one egg were the most frequent at Gallo and Fauchelle, respectively. The average hatched eggs per clutch and fledglings per brood were  $1.29 \pm 0.10$  and  $1.24 \pm 0.10$ , respectively. The brood size varied significantly with clutch size and nest exposition being higher related to not*



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*exposed nest and two as the clutch category was greater. Likewise, the number of fledglings significantly increased with increasing clutch category and was higher in not exposed nests. In fact, hatching or fledging probability increased significantly as nests were not exposed.*

### **REFERENCES: (MAX 4)**

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** INFLUENCE OF SEABIRD COLONIES ON THE DIVERSITY AND ORGANIZATION OF PLANT COMMUNITIES IN SMALL ISLANDS ON THE ALGERIAN EAST COAST

**SESSION:** FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:** BOUYAHMED<sup>1</sup> HANI ET MOULAI<sup>2</sup> RIADH

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

**Abstract**

Island phytocenoses isolated for a long time live in special conditions in the absence of selection pressure and vulnerable to disturbance, this vulnerability is important in the Mediterranean (Vidal et al. 2002). The nuisance caused by nesting seabirds on Mediterranean island flora has so far been the subject of very little research. In Algeria, apart from a few studies which characterize the island flora in relation to the presence of the leucophée gull colonies, which were carried out in Jijel (Bouyahmed and Moulai, 2018) and in Béjaia (Benhamiche-Hanifi and Moulai, 2012). Very few studies, which are in fact, interested in the influence of seabird colonies on Algerian, island phytocenoses. The use of appropriate statistical tools (generalized linear mixed models and a canonical correspondence analysis) allowed us to research the explanatory factors of the patterns of organization of the vegetation of the island environments studied, the emphasis is on the role played by the colonies of the nesting yellow legged Gull. The physic-chemical analyzes of the soil allowed us to observe acidic to very acidic pH levels, often very high nitrogen contents and sometimes excessive salinity values. These results are due to the modification of the substrate which probably corresponds to an enrichment of the substrate by nitrogenous and phosphoric compounds caused by the colonies of the Yellow-legged Gull. This species has an unfavorable action on xero-halophilic species, but it favors halo-nitrophiles and phospho-nitrophiles to the detriment of native species.

In addition, the present study carried out on eight small islands in Algeria consisted in making almost exhaustive inventories of the islands, then we proceeded to treatments which consist of an analysis of certain parameters including the overall composition (specific richness, families identified) and the functional analysis of the vegetation, this through the search for the vital attributes of each inventoried taxon. Namely, endemism, geographical distribution, biological type, mode of dissemination as well as the Grime strategy. Taxonomically, 44 families have been inventoried, five of which clearly dominate the flora of the sites; they alone account for nearly half of the total specific population. The other families are represented by only a few species, and the majority have only one species each. On the other hand, the analysis of the species richness revealed the existence of 164 species belonging to 52 botanical families.



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

The flora of the sites appears to be characterized by therophytes. The latter are widely represented among invasive plant species, particularly in the Mediterranean basin, this is supported by the dominance of the ruderal strategy, and the establishment of this type of vegetation is favored by the high degrees of disturbance. The latter are usually caused by nesting seabirds, which however disseminate most of the flora of the islands; the large number of colonies of Yellow-legged Gulls that constantly frequent these island environments can explain this. Invasive species are slightly represented on our sites. Nevertheless, the proliferation of annuals with ruderal affinities generated by seabirds and exasperated by the drastic Mediterranean climate are alarming and to be controlled in the future.

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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

MSPMED Case Study: Characterizing the ecological stakes and their interactions with offshore activities in the Gulf of Lion to support the Maritime Spatial Planning processes in the Mediterranean Sea

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM:  
DYNAMICS AND PROTECTION - Poster Session

**AUTHORS:**

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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

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### **ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

#### *General frameworks and Objectives*

The Gulf of Lion is a cross-border area between France and Spain that extends from Cap de Creus in Spain to Toulon in France, being an outstanding area for marine biodiversity (e.g. seabirds, cetaceans, marine turtles and benthic habitats) as well as an economic development area for the maritime sector such as fisheries, maritime traffic and new activities as windfarms. Although Spain and France have carried out considerable researches and projects in the Gulf of Lion, there is still a lack of knowledge concerning ecological stakes and their interactions with human activities. For this purpose, and in the framework of MSPMED project (Towards the operational implementation of Maritime Spatial Planning in our common Mediterranean Sea) cofunded by the European Commission, a transboundary case study is being developed between Spain and France in an extended area of the Gulf of Lion comprised from the city of Barcelona to Marseille, whose main objective is focused in assessing the knowledge available regarding the marine environment of the area and the identification and characterization of the interactions between maritime uses (especially offshore floating windfarms) and marine ecosystem components in the context of marine spatial planning (MSP). The resulting outcomes are expected to feed MSP national processes for both countries in which concerns to the identification of gaps in knowledge and the development of methodologies to address impacts of Offshore floating Wind Farms (OWF). In this sense, the Gulf of Lion case study is being developed in 3 parts: desk analysis of ecological stakes in the area regarding seabirds, cetaceans, marine turtles and deep habitats; experts' technical workshops to analyze potential interactions of OWF with them; and underwater noise analysis. At the transboundary level, 8 technical meetings, in relation to cetaceans, marine turtles and seabirds and their interactions with offshore floating windfarms, have been held, with the aim to (i) boosting knowledge and methodology sharing so as to complete an updated view of ecological stakes in the study area on the basis of the previous desk analysis, (ii) highlighting important gaps of knowledge to be addressed, and (iii) providing knowledge on the potential risks of interactions between ecosystems and future OWF and building recommendations to improve their monitoring. The results of these workshops will be shared in a final technical meeting to the competent authorities (January 2022) to provide valuable information to Maritime Spatial Planning. Additionally, to complete this work, and in order to evaluate the cumulative effects over the marine ecosystem, an underwater noise analysis is being developed in the Gulf of Lion in 2 steps: 1. elaboration of underwater noise propagation models of maritime traffic in the Gulf of Lions between Spain and France; and 2. overlapping distribution data of cetaceans that are present in the Gulf of Lion, such as fin whale or common dolphin, with underwater noise models obtained, to identify potential areas of high pressure, as well as to try to identify how new activities in the marine environment, as offshore windfarms (that also generate noise) could also have an effect on the marine environment. By the end of all analysis made in the case study, results could help to support the establishment and implementation of Maritime Spatial Plans elaborated in each country. It is important to highlight that EU MSP transboundary projects are the best opportunity to create a first link between countries at the technical level, which in the long term may lead to real cooperation at joint decision levels, and integrate results (coming from case studies) as recommendations into MSP national processes.

### **REFERENCES: (MAX 4)**

- 1.
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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

CORALLIGENOUS CLIFFS IN TUSCANY: DISTRIBUTION, EXTENSION OF THE HABITAT AND STRUCTURE OF ASSEMBLAGES

**SESSION:** FLORA E FAUNA

**AUTHORS:** CECCHI E., PIAZZI L., RIA M., MARINO G. E NICASTRO A.

**AFFILIATIONS:** ARPAT SETTORE MARE LIVORNO

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**ABSTRACT**

Coralligenous reefs are the main biogenic constructions of the Mediterranean Sea which are considered indicators of the ecological quality of coastal systems and of “seafloor integrity” by the Marine Strategy Framework Directive. The two main coralligenous morphologies are the coralligenous cliffs and platforms, the former developing in shallow waters (about 20-50 m) on vertical/subvertical rocky substrate and the latter built over horizontal substrates below 50 m depth also on detritic bottoms. The present study aims at assessing the distribution and extension of the coralligenous cliffs in Tuscany and describing the structure and the patterns of spatial variability. The mapping of seabed was obtained through Multibeam echosounder (MBES) data coupled with video images recorded by using a Remote Operating Vehicle (ROV) equipped with a high-resolution camera. Data were collected along the coasts and continental shelf of Tuscany for a total of 261 km of coastline corresponding to the 87 % of the rocky coasts in the region. Coralligenous cliffs were sampled by SCUBA divers in 11 sites (sectors of rocky coasts) following the STAR procedure (Piazzi et al., 2019). In each site, two areas several kms apart were chosen. At each area, three plots of about 4 m<sup>2</sup> were randomly selected on a vertical rocky substrate at 35 m depth. In each plot, ten photographs of 0.2 m<sup>2</sup> areas were collected by a framed camera. The percentage cover of the main groups was assessed by manual contour technique using the ImageJ software. Data were analysed through PERMANOVA with a multi-factorial model including the factors Site (Livorno, Argentario, Gorgona, Capraia, Elba nord, Elba est, Pianosa, Montecristo, Giglio, Giannutri and Formiche di Grosseto) as fixed, Area (2 levels) as random and nested in Site, and Plot (3 levels) as random and nested in Area.

The surface extension of the Coralligenous cliffs may be estimated about the 60% of Tuscany rocky coast. PERMANOVA detected a significant variability at all examined spatial scales. The assemblages of continental coasts segregated from those of islands and were mostly characterized by algal turf, encrusting sponges and *Corallium rubrum* (Fig. 1). The southern islands (Giglio, Montecristo and Formiche) were separated from the others and mostly characterized by terete and flattened Rhodophyta, *Eunicella* spp., *Paramuricea clavata* and erect bryozoans. The other Island had high abundance of *Flabellia petiolata*, *Halimeda tuna* and massive sponges (Fig. 1). Gorgona was separated from all others sites and showed a high abundance of *Peyssonnelia* spp.

The assemblages mostly varied at large (among sites) and small (among samples) spatial scales (Fig. 2), confirming a pattern already highlighted in previous studies (Piazzi et al. 2016). The variability at small scale may be attributed to the patch distribution of assemblages mostly due to the high heterogeneity of biogenic substrate (Piazzi et al. 2016).



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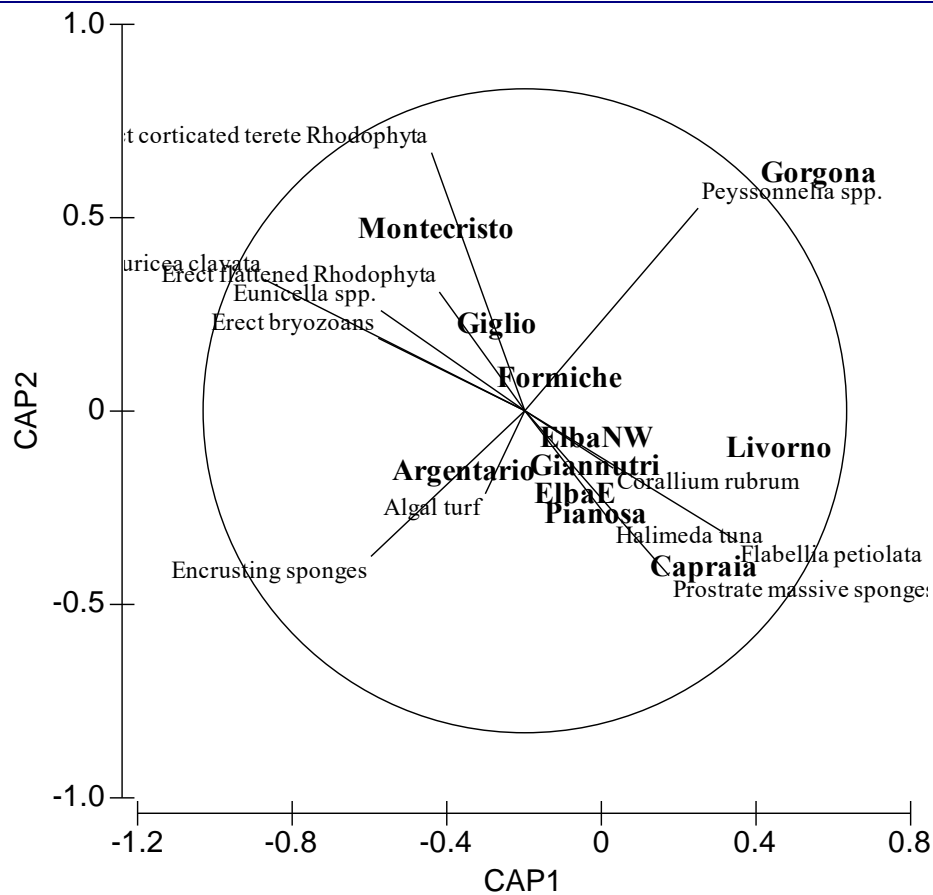


Figure 1. CAP analysis on Tuscany coralligenous assemblages

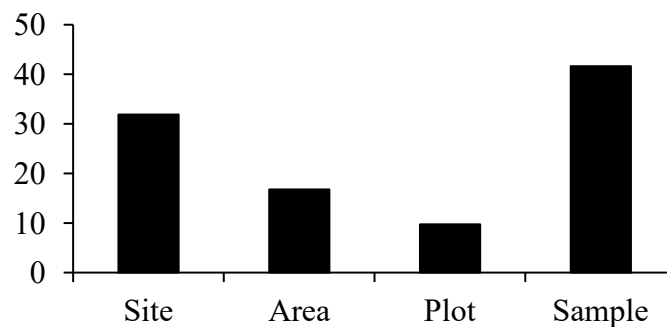


Figure 2. Pseudo-variance components at the examined spatial scales of the Tuscany coralligenous assemblages

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

Title: New reports on the presence of *Callinectes sapidus* (Rathbun, 1896) along the Calabrian coasts

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

Authors: Giulia Cecchi, Gioia Burini, Antonella Giglio, Rosario Giglio, Martina Fustolo, Alessandro Zito, Domenico Asprea, Elena Madeo, Stefania Giglio

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This work, carried out in collaboration with professional fishing operators, aims to indicate new areas of settlement of the species *Callinectes sapidus* (Rathbun, 1896) present both in the Tyrrhenian Sea and in the Ionian Sea along the coast of Calabria. Part of the individuals of *C. sapidus* sampled were taken at the mouths of the rivers and part in the salt lakes. For each individual caught, biometrics, weight, specific areas and distribution periods, as well as fertility or the presence of eggs (if female) were recorded. The captured individuals have been housed in aquariums to monitor and study their social behavior, predation techniques and food preferences for about six months.

The sampled individuals of the species *C. sapidus* were found for the most part in the Ionian Sea and, more precisely, in the surroundings of the mouth of the river Corace in the direction of Catanzaro Lido (CZ), in the area of Steccato di Cutro where the river Tacina flows into the Gulf of Squillace and within the lakes of Sibari (artificial lakes), in whose area are currently also used as a food resource. Other specimens have been found in the Tyrrhenian Sea in the lakes La Vota of Gizzeria (CZ).

*C. sapidus* is a decapod crustacean of the Portunidae family, native to the Atlantic Ocean. Its introduction in the Mediterranean took place by means of the ballast waters present in the ships coming from the Atlantic calling at the ports of our coasts (ISPRA, Quaderni- ricerca marina, 2016).

*C. sapidus* is considered an invasive alien species because, by settling outside its home range, it has overcome biotic and abiotic obstacles that have favored its settlement. This species has generated a negative impact both on the ecological and quantitative level of the number of native species present (Carlton, 1989).

*C. sapidus* tolerates large temperature and salinity variations, bearing values of less than 0,08 mg/l dissolved oxygen. The capture of mature females and males reveals a possible settlement of the species in the reference area even if no juvenile or post-larval stages have been observed. An ovigera female specimen was captured at a depth of about 20 meters in front of one of the rivers in which its presence was confirmed. It is assumed that the fecundated females head towards the open sea for the release of the eggs (Gennaio et al., 2006).

The monitoring of the species *C. sapidus* is of fundamental importance to try to mitigate the impact that it is generating on the ecosystem and biodiversity of native species and to look for future models of containment and use. The specimens monitored in controlled environment had a remarkable aggressiveness among the individuals of the same species and of both sexes, with a greater aggressiveness of the females than the males. No examples of cannibalism have been found.



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They are on average omnivorous and feed on fresh algae, small echinoderms, fish, molluscs and organic debris of all kinds, with a marked preference for fish.

The results obtained have shown a rapid expansion of their distribution area, but also a correspondingly greater attention of the operators of the ichthyic system towards the species, as well as towards other potentially impacting species, but with a great potential of exploitation for food purposes.

In conclusion, considering the numerous new reports of the presence of *C. sapidus* in the Tyrrhenian Sea, we wonder if the individuals sampled in the Tyrrhenian Sea come from the Ionian Sea and, if so, if this is the result of a spontaneous migration or due to a voluntary anthropic activity. A first answer could be provided by an environmental DNA analysis, which, through molecular methodologies is able to reveal information on the presence of a given species in a target area, on the extent of the invasion and on its relative abundance (Mandrioli, 2017).



Figura: Esempio (A) *Callinectes sapidus* (Da MUPEM, 2021)

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

Title: Spatial displacement of nearshore vegetation in response to artificial changes in coastal morphology

SESSION: Flora and fauna of the littoral system: dynamics and protection

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The species composition of nearshore plant communities represents a continuous biological response to environmental gradients perpendicular to a marine shoreline. This response integrates individual adaptations, competition, abiotic variability, and chance events resulting in a definite 'optimum' band where a particular species attains highest density. The variation in selection pressure perpendicular to the shoreline creates distinct vegetation zones where groups of species coincide in their optimum density. This vegetation sequence, in terms of lifeform and adaptations, is broadly present throughout the Mediterranean littoral and differs from site to site in terms of species richness, identity of the specific species present, substratum, and rate of change in abiotic gradients. The relative position and compression of the sequence is directly related to effective distance from the shoreline and sequence displacement has been observed or inferred following changes in coastal morphology.

This study evaluated possible changes to nearshore plant communities in response to a change in shoreline. This was done in the context of recent proposals for anthropogenic land reclamation in Malta. Surveys of the vegetation assemblages in six coastal sites were carried out from the air using a Mavic 2 Pro drone flying at approximately 30m above ground level. A succession of photographs was taken during each drone flight, and these were combined into an orthophoto which was calibrated using ground-based markers and through ground-truthing. The spatial extent and composition of the coastal vegetation was then derived from analysis of the orthophotos. Measurements of soil salinity and exposure to wind were taken from each site. All six sites outcropped on the same bedrock (Lower Coralline Limestone, Oligocene) and had a comparable overall seaward slope (4.0° to 8.6°).

The vegetation sequence in Malta, syntaxonomically within the *Crithmo maritimi-Limonietea* alliance (Brullo S., Brullo, C., Cambria, S., Giusso Del Galdo, G., 2020), occurs along much of the rocky coastline of the island. The band closest to the shore is colonised by halophytes and small chasmophytes whilst with increasing perpendicular distance this assemblage is replaced by a subhalophilous pulvinate assemblage. A review of previous studies indicated that the species sequence was predictable: *Arthrocnemum macrostachyum* colonising rock closest to the shoreline, with a *Limonium-Crithmum maritimum* zone



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adjacent in the inland direction. This was succeeded by a broader band of *Limbarda crithmoides* subsp. *longifolia*. Further inland, the subhalophilous assemblage dominated by *Thymbra capitata*, accompanied by *Crucianella rupestris*, *Cichorium spinosum* and other sprawling forms was the dominant cover. The nearshore community comprises several species with a restricted distribution including endemics (*Limonium zeraphae*, *L. melitense*, *Anthemis urvilleana*).

The perpendicular distance from the shoreline at which peak density of *L. crithmoides* was recorded, was taken as an indicator of the 'location' of the vegetation sequence. This species was selected as it was the most abundant in the zone proximal to the coast and is also sufficiently large and distinctive to be recognised reliably from aerial photographs. Distance of peak *Limbarda* density ranged from 27.8m to 51.9m. The variation in density of *L. crithmoides* perpendicular to the shoreline was unimodal and was modelled using a Gaussian 3-parameter distribution. This was repeated in six study sites, after which the model parameters were correlated with environmental variables. The distance of the peak *Limbarda* density was mainly dependent on soil salinity (adjusted  $R^2 = 0.421$ ) and exposure to wind (adjusted  $R^2 = 0.563$ ). These models were subsequently used to simulate the predicted shift of the vegetation sequence towards the modified shoreline after land reclamation would have occurred.

The displacement in vegetation distribution following land reclamation is not necessarily subject to linear predictability. The relatively abrupt change in shoreline morphology would modify the effects of environmental stressors, driving a displacement of nearshore plant communities towards the new shoreline. This displacement is unlikely to be either uniform or symmetrical, as the infill may have different sedimentological characteristics from the original substratum and initially will not have a persistent soil seed bank. The authors observed *Limbarda crithmoides* subsp. *longifolia* colonising fresh unconsolidated sediment suggesting that the *Limbarda* 'peak' will displace towards the shore within a relatively brief time. However, in the absence of a suitable substratum or a seed bank, the accompanying species, including those with a restricted distribution, may not disperse as easily, and the complexity of the present communities may not be replicated on the infill.

(4922 characters, including spaces)

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# MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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## Figures

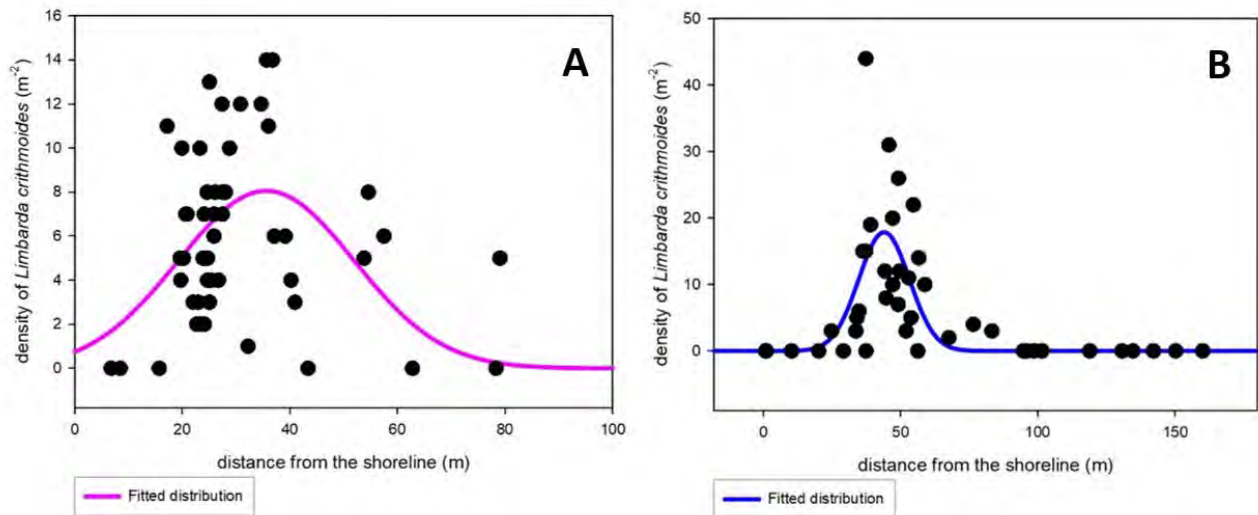


Figure 1: The density of *L. crithmoides* ( $m^{-2}$ ) against distance from the shoreline from two of the six study sites. The points represent density measurements, and the solid line is the fitted model. Plot 'A' represents the 'Ghallis NorthWest' site and Plot 'B' shows the 'Ghallis East' site.



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Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

ON THE RECREATIONAL FISHING IN THE REGION OF MOSTAGANEM

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

According to FAO (2016), the situation of fishing in the Mediterranean is alarming, as catches have fallen by a third since 2007, reflecting a situation of over-exploitation for most of the most productive stocks, following pressure mainly from professional fishing, which accounts for most of the fishing at sea. However, the share exploited and harvested by more or less organized recreational fishing remains poorly known and therefore very little taken into account.

It is within this framework that this study was carried out, which aims to give a picture of the situation of recreational fishing in the region of Mostaganem, and its evolution over time. The study was carried out on the basis of observations of activities, conducted on the ground as well as the analysis of data from the Directorate of Fisheries and Fisheries Resources (DPRH) of Mostaganem during the period from 2005 to 2018, targeting the fishery production landed by recreational vessels, and the species caught as well as the techniques and gears used. The results show a remarkable evolution of recreational fishing over time, recording a strong increase in the number of vessels practising this category of fishing, which has generated the evolution of fishery production of 200% during the last decade, following the remarkable evolution of the recreational fleet representing 76% of the overall fleet of the Mostaganem area with 776 vessels out of a total





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of 1023 units, or the number of trips at sea and per year, shows the evolution of 200% in 10 years. According to the regulations, recreational fishing is defined as a sport or leisure activity with a non-lucrative aim using a maximum of 10 hooks per person; however, pleasure boaters do not respect the regulations and use different fishing gears and techniques. However, boaters do not respect the regulations and use different fishing gears and techniques, such as drift nets, trammel nets, longlines and octopus traps, targeting a variety of marine species, some of which have protected species status in the Mediterranean, and belonging to different zoological groups such as molluscs, bony fish and cartilaginous fish.

In 2019, the recreational fishery recorded a fishery production of more than 350 t per year, half of which is composed of demersal fish (white fish) with a rate of 52%, and 30% of the blue fish of which 5% is reserved for large pelagic, with 18% of this production represented by cephalopod molluscs (octopus, squid and sepia).

The production per unit of effort CPUE is very fluctuating over time, with a minimum of 230 kg/unit/year and a maximum of 1200 kg/unit/year, with a downward trend over time despite the considerable increase in the number of vessels, which suggests a depletion of the stock. Particular attention and monitoring of the recreational activity in the region of Mostaganem are necessary to avoid unfair competition with professional fishing, through the excessive and uncontrolled exploitation of certain fish stocks by recreational vessels whose contribution to fish products is far from negligible and often goes unnoticed by the inspectors and the services of the maritime fisheries administration.

**Keywords:** recreational fishing, Mostaganem, fishing gear, fisheries production

### *General frameworks and Objectives*

#### **REFERENCES: (MAX 4)**

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** ARPA PUGLIA UNDERWATER SCIENTIFIC ACTIVITIES: ESDS CONTRIBUTION IN THE ADRIREEF PROJECT (INTERREG ITALY-CROATIA 2014-2020)

**SESSION:** FLORA E FAUNA DEL SISTEMA LITORALE: DINAMICHE E PROTEZIONE

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

ADRIREEF project, started in 2019, is an Interreg between Italy-Croatia (Interreg Italy-Croatia 2014-2020), aimed to promote the sustainable exploitation of Adriatic reefs along the coast of the two Countries. In order to strengthen the Blue economic development through the attractiveness of the existing marine resources, both natural and artificial reef were considered. Reefs are attractive for the scientific community and for tourism compart because it is possible to practice and develop several activities such as scientific studies, fishing or nautical tourism, diving and aquaculture. In particular, the project aims to satisfy the specific need of a territorial development transferring the knowledge acquired from research to business. Through an in-depth analysis of the Adriatic reefs and a specific monitoring phase, testing also new environmental methods, it will be possible for the project partner to define Guidelines and Code of conduct for the stakeholders and to produce innovative promotional outputs.

With the term "Artificial reef" are identified all the human-created underwater structure designed for a specific role and submerged for different scope for example to restore and/or enhance fish and others organism communities of an area (i.e. concrete reef, shipwrecks) and at the same time to create new diving opportunities. "Natural reefs" are identified as all the relatively stable material resulting from natural, abiotic (i.e. ridge or shoal of rock) or biotic process (i.e. coral reef). In terms of biodiversity, Mediterranean Sea coralligenous bioconcretion could be compared with tropical coral reef because of the greater spatial complexity created by bioconstruction leads to the creation of numerous microhabitats that determine an increase in biodiversity. In fact, coralligenous habitat is considered the second most important subtidal "hot spot" of species diversity in the Mediterranean Sea after the *Posidonia oceanica* meadows (Boudouresque 2004). It is defined as a typical Mediterranean hard bottom of biogenic origin, mainly produced by the accumulation of calcareous encrusting algae, that can be colonized by other sciaphilic organisms, forming an intricate assemblage of species able to transform it in a multidimensional habitat with a high microspatial variability (Ballesteros 2006). For the numerous associated environmental and biological advantages provided by this habitat, it has been included in the Habitat Directive (EEC Reg. 1992/43, Annex I; Habitat code: 1170 Reefs) and more recently monitored by the Marine Strategy Framework Directive (EC Reg. 2008/56). Coralligenous bioconstructions could build ups into two main different geo-morphologies: rims-structures on submarine vertical cliffs and banks-flat frameworks over horizontal substrata.



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The Apulia continental shelf are characterized mostly by the second morphologies that develops on a horizontal substratum, small coralligenous outcrops distributed between 30 and 100 m of depth on coarse detritic or muddy bottom (Piazzì et al. 2019). This kind of bioconstruction, correspond to the so-called bank-type coralligenous biogenic reefs. Chimienti et al. (2017) give a first economic value to the apulian's coralligenous habitat that attracts divers at national and international level, besides local customers, due to its high aesthetic value as a seascape. Considering SCUBA diving frequentation in the Apulia region and the generated revenue related to the existence of this habitat, a market impact of about €4.7 M in 2014 was estimated through a survey questionnaire distributed to diving centers across the region (Chimienti et al. 2017). Thus, in a project as ADRIREEF, where the emphasis would be given also to recreational diving activities, such as SCUBA diving, and the potential economic flow inside a region coming from natural reefs, coralligenous habitat is an important reef to focus.

Following the environmental monitoring goals of the project, ARPA Puglia identified as study case the MPA (Marine Protected Area) of Torre Guaceto. After a preliminary phase to understand where the coralligenous outcrops were located inside the MPA, a bank-type coralligenous biogenic reef was identified. Taking into account the restrictions present inside an MPA, different non-destructive technologies and monitoring methods were selected by ARPA Puglia, among them standardized by the scientific community. In particular, scientific divers (SD) team applicated a photographic samplings of standard areas frame method to describe the benthic community status and a Stationary Point Count method to describe the fish community. Data collected across four scientific monitoring surveys were achieved and analyzed.

ROV (Remote Operative Vehicle) was used to test a new environmental monitoring method for the fish community assessment, as required by the project.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

Title: **Spatial distribution patterns of the striped venus clam (*Chamelea gallina*, L. 1758) natural beds in the Gulf of Cádiz (SW Spain)**

SESSION: FLORA AND FAUNA

Authors: Delgado, M., Román, S., Silva, L., Llorens, S., Rodríguez-Rua, A., Cojan, M., Marco, E.

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

#### **General frameworks and Objectives**

The striped venus *Chamelea gallina* (Linnaeus, 1758) is a filter-feeding bivalve widely distributed in northeast (NE) Atlantic waters, the Mediterranean Sea and the Black Sea, inhabiting sandy-muddy bottoms at depths ranging between 5 and 20 m. *C. gallina* is the target-species of an important hydraulic dredge fishery in the Gulf of Cádiz (SW Spain; Fig. 1). The volume of catches exceeds 3,000 tons/year but has dramatically decreased in recent years threatening the biological and economic sustainability of the fishery (1). The objective of this study was to understand the distribution pattern of *C. gallina* and its spatial variability in order to help to take spatial management decisions.

#### **Material and Methods**

The study area (Fig. 1) is located in Southern Spain and includes the subtidal area of the Gulf of Cádiz, from the mouth of the Guadiana River to the mouth of the Guadalquivir River. Along this coast there are several Rivers mouths and waste water treatment plants (WWTP). A sampling survey has been carried out for 20 days (ACUVEN-3, May-June 2019) using a commercial hydraulic dredge. Sampling was conducted following a systematic scheme where stations were located every 1 nautical mile and covering 3 depth strata [3-6m] [7-9m] [9-12m]. In every station the dredge was deployed and towed parallel to the coast during 5 minutes. Each transect was also geo-referenced by means of a GPS in order to calculate the sampled area (m<sup>2</sup>). 5 l. samples were randomly collected and sent to the laboratory and *C. gallina* individuals were counted and weighed. Shell length was measured to the lowest mm using calipers.

Estimates of the density, biomass and mean size of *C. gallina* and their distribution in the bottom have been obtained using the ordinary kriging technique (OK;  $\ln$ -transformation =  $\ln(\text{variable}+1)$ ), by kriging observations on the nodes of a 0.25 Nm square-mesh grid. The average values over the domain were estimated by OK as well as the global estimations. Cross-validation procedure was performed to assure the best prediction. Geostatistical analyses were conducted using RGeostats (2, 3). The density index (N.m<sup>-2</sup>) was also modeled using generalized additive model (GAM; 4). The explanatory variables considered in the model were: depth (m), sea bottom temperature (°C), bottom sea salinity (psu), bottom chlorophyll-a concentration (mg.m<sup>-3</sup>), turbidity (NTU), total dissolved solids (mg/l), mean grain size of sediment (GS, phi), sediment organic matter (%), distance to the nearest river mouth and WWTP (DRT, m).

#### **Results and Discussion**

The empirical variogram on density, biomass and mean size showed a clear spatial structure. Their shapes were dominated by a large-scale structure with a radius of about (5 Nm) giving an idea of the average diameter of patches.



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The amplitude of the discontinuity at the origin of the variogram represented an unresolved small-scale variability. This geostatistical approach showed that Rivers mouths and WWTP plays an important role on density and biomass spatial distribution of *C. gallina*. Three important spots were identified along the coast mainly related to rivers mouths except for Guadiana River, and a smaller spot was also observed near to WWTP in Matalascañas (Fig. 2). The lowest values were predicted near Guadiana River and in the deepest areas of the easternmost area. The global estimation of the kriged mean and variance was  $1.96 \pm 0.048 \text{ ind/m}^2$  and  $2.88 \pm 0.06 \text{ g/m}^2$  for ln-density and ln-biomass, respectively. Regarding mean size results, the global estimation of kriged mean size was  $18.54 \pm 0.03 \text{ mm}$ . Recruits were concentrated mostly in two zones: near the WWTP in Matalascañas and to the east of Guadiana River mouth, while adults appeared in the west of Guadalquivir River mouth and around Odiel-Tinto River mouth.



Figure 1. The study area in the SW Spanish coast (blue box). Sampling stations (ACUVEN-3 survey, blue points). WWTP (light blue triangles).

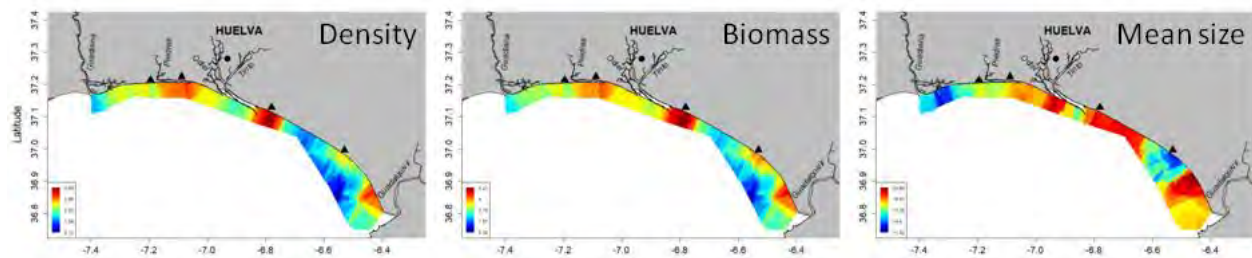


Figure 2. Kriged maps for density, biomass and mean size of *C. gallina* in the subtidal area of SW Spain. WWTP (black triangles)

The best GAM explained 48.3% of the deviance for ln-density included depth, DRT and GS as factors. The depth effect showed a non-linear pattern, with ln-density peaking at 6-7 m. Ln-density showed a direct linear pattern with GS, i.e. density increased parallel to grain mean size decreased. Regarding DRT, ln-density declined as the distance to the River mouth or WWTP increased.

### Acknowledgements

The present study was developed within the framework of the project “VENUS” (Estudio integral de los bancos naturales de moluscos bivalvos en el Golfo de Cádiz para su gestión sostenible y la conservación de sus hábitats asociados) (0139\_VENUS\_5\_E).

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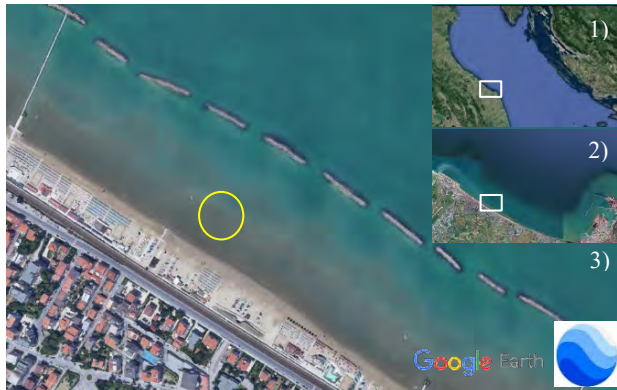
<b>TITLE:</b> <b>Water column phosphatase activity assessment in a marine coastal environment and its relationship with rain events</b>
<b>SESSION:</b> FLORA E FAUNA DEL SISTEMA LITORALE: DINAMICHE E PROTEZIONE
<b>AUTHORS:</b> M.FANELLI, F.GIROLAMETTI, B.AJDINI, C.TRUZZI, S.ILLUMINATI, A.ANNIBALDI, C.TOTTI, S.ACCORONI
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<b>ABSTRACT:</b> Nowadays the monitoring of marine coastal ecosystems is crucial to understand the ecosystem state and to face important challenges incoming for the future, such as the prevention of coastal eutrophication often driving the Harmful Algae Blooms. Phytoplankton blooms in coastal marine areas are often affected by high nutrient loads from river run-off and inopportune sewage discharges (i.e. bypassed or bad depuration treatment). Almost all phytoplankton prefer inorganic nutrients for their growth, but it is becoming increasingly evident that the use of organic nutrients is widespread among many aquatic phototrophic organisms. On the basis of the Redfield ratio of inorganic nutrients, the Adriatic Sea results markedly phosphorus limited. However, despite this, the northern Adriatic Sea results a high primary production basin where algal blooms are common. This apparent paradox has been explained by (i) the fast P regeneration processes in the water column, (ii) the resuspension from bottom sediments and (iii) the role of Dissolved Organic Phosphorus (DOP) that occur with high concentrations especially in proximity of rivers or sewage discharge [1]. The aim of this study is to determine inorganic nutrient concentrations and bioavailability of DOP through the activity of the phosphomonoesterase (PMEase) in a coastal site close to a sewage discharge, after intense rain events. Sampling site (bottom depth ~ 1 m) is located along the coast of Falconara Marittima (Ancona, Marche, Italy) ( <b>Fig. 1</b> ) characterized by sandy bottom, low hydrodynamics and the proximity of sewage points discharging their untreated effluents directly into the sea when intense rain events occur. The study was focused on three rain events occurred on May and November 2019 and September 2020. Sampling was carried out before and after each rain event. Samples were manually collected at the surface by using polyethylene bottles previously decontaminated [2] and immediately transferred to the laboratory for analyses. The procedure used for the alkaline phosphatase activity assay broadly followed that of Turner et al. [3]. Seawater samples (1 L) were filtered with 0.45 µm nitrocellulose filters, then filters were placed into 15 ml tubes in a solution of filtered seawater and 1000 µM <i>para</i> -nitrophenyl phosphate ( <i>p</i> NPP). After the addition of <i>p</i> NPP, tubes were placed into a shaking bath at 25 °C for 1 hour and the absorbance at 405 nm was made using a spectrophotometer. Alkaline phosphatase activity is expressed in µmol <i>p</i> NP L <sup>-1</sup> h <sup>-1</sup> . Nutrients (N-NO <sub>3</sub> , N-NO <sub>2</sub> , N-NH <sub>3</sub> , DIP, Si-SiO <sub>2</sub> ) analysis were performed by colorimeter Systema EasyChem Plus, following EPA or APHA certified methods. Autoclave persulfate digestion for the evaluation of TP was performed following Langner & Hendrix [4]. DOP was calculated as the difference between Total P (TP) and DIP. Dissolved Inorganic Nitrogen (DIN) was calculated as sum of N-NO <sub>3</sub> , N-NO <sub>2</sub> , N-NH <sub>3</sub> . Preliminary results demonstrated the presence of PMEase activity, ranging from 0.13 to 6.7 µmol <i>p</i> NP L <sup>-1</sup> h <sup>-1</sup> (mean= 2.34±2.12 µmol <i>p</i> NP L <sup>-1</sup> h <sup>-1</sup> ) in Falconara coastal area. Salinity, DIN, DIP, DOP and Si-SiO <sub>2</sub> ranged from



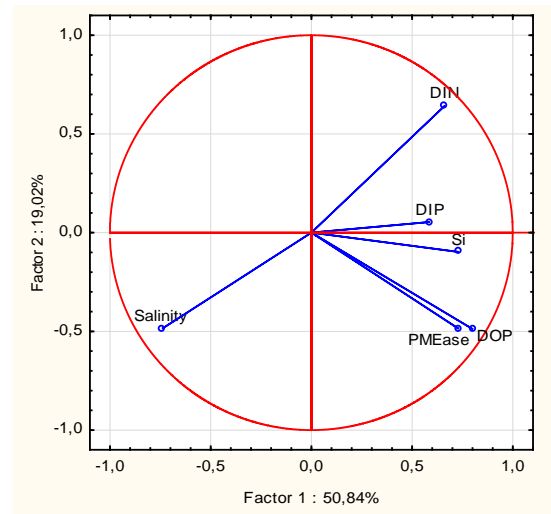
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28.1 to 40 (mean=  $33.7 \pm 2.7$ ), from 2.2 to 27  $\mu\text{M}$  (mean =  $7.7 \pm 6.1$   $\mu\text{M}$ ), from 0.01 to 0.47  $\mu\text{M}$  (mean =  $0.14 \pm 0.11$   $\mu\text{M}$ ) from 0.58 to 2.8  $\mu\text{M}$  (mean=  $1.34 \pm 0.58$   $\mu\text{M}$ ) and from 2.5 to 22.8  $\mu\text{M}$  (mean=  $9.29 \pm 5.24$   $\mu\text{M}$ ), respectively. Rainy events showed similar patterns: the salinity decrease was usually followed by an increase of all nutrient concentrations and PMEase activity. The strongest influence of the rainy events was observed on DIN concentrations that showed a significant negative correlation with the salinity ( $r = -0.70$ ,  $p < 0.05$ ). The PMEase activity was significantly related to the increase of DOP concentrations ( $r = 0.71$ ,  $p < 0.05$ ) (Fig. 2). The results of this study suggest that the measure of PMEase activity should be included in coastal monitoring to assess the actual bioavailability of DOP which generally exceeded the DIP concentrations.



**Fig. 1:** Sampling site. 1) Ancona, Adriatic Sea, 2) coast of Falconara M., 3) Sampling point:  $43^{\circ}37'32''$  N,  $13^{\circ}24'37''$  E.



**Fig. 2:** PCA analysis performed with StatSoft.

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

**Re-naturalization interventions within a Regional Forest complex located in the countryside of Frassanito (Otranto - Le) characterized by a high forest mainly of Stone Pine, with the presence of Aleppo Pine, with incipient undergrowth, occasionally affirmed of evergreen sclerophylls.**

**SESSION:**

FLORA E FAUNA

**AUTHORS:** FRANCESCO FERRARO, ANTONIO LONGO, CRISTINA RUGGE

**AFFILIATIONS:** ARIF PUGLIA (AGENZIA REGIONALE ATTIVITÀ IRRIGUE E FORESTALI PUGLIA)

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*The spontaneous vegetation of the Alimini district, which includes the aim of the study areas, is represented by plant communities that vary in relation to geology and distance from the coastline. Proceeding from the sea towards the inland, the vegetation landscape changes continuously, due to natural facts, or caused by anthropozoogenic actions. In fact, you can find natural origin entities (garrigue, scrub, scrub forest and Holm Oak forest) to reforestation of Aleppo Pine (*Pinus halepensis* Miller) and Stone Pine (*Pinus pinea* L.). The vegetation of natural origin is attributable to what remains of the Great forest of Lecce, which in the Fourteenth Century stretched for 75 km along the Adriatic Coast of Salento proceeding from North to South, between the locality Fontanelle (Brindisi) and the northern outskirts of Otranto, pushing itself inside and including also pastures and swamps (MAINARDI, 1989). In the following centuries the ancient forest was affected by a series of vicissitudes that reduces its surface and consistency. The "Frassanito" forest complex is currently consisting of Mediterranean conifer forests, deriving from planting, mainly composed of Aleppo pine, or Stone pine. The reforestation activities in the area behind the dunes, for about one km and for an average depth of about 700 m towards the hinterland, began in 1930 on land mainly consisting of xeric grasslands, created by the Ripartimental Inspectorate of Forests of the State Forestry Corps (CFS), with funding from the Ministry of Agriculture and Forests and the Fund for the South. The studies carried out show that once, very probably, the Alimini district was characterized by the presence of extensive scrub-forests, mainly of Kermes Oaks (*Quercus coccifera* L.), alternating with Holm Oak forests (*Quercus ilex* L.), limited to microenvironments marked by stationary conditions, mostly of a pedogeological nature, which satisfied the temperament and needs of the Holm Oak and its companion species. The remarkable diffusion of the Kermes Oak, typical of mesomediterranean plain, is due to the high elasticity of adaptation of the ontogenetic cycle of the species to the bioclimatic one (BIANCO, 1960). The silvicultural interventions outlined in the study are aimed at bringing the artificial population, represented by an adult high forest mainly of Stipe Pine with the presence of Aleppo Pine, towards more natural and resilient structural settings, simultaneously reducing the amount of necromass in the woods. Analysing the distribution of the number of trees in the diameter classes, it's clear that this is a pine forest of the same age mainly of Stone Pine with presence of Aleppo Pine. In order to normalize the distribution curve, it is necessary to perform moderate cutting operations from below, mainly affecting the smaller diameter classes, 10-15 and 20 cm, represented by arboreal elements denominated dry and with no future. The various forms of cultivation for the improvement and conservation of the few Mediterranean forest realities must therefore be differentiated in relation to the aims to be pursued, avoiding all sorts of generalization (GUALDI, 1998). So, in the definition of the thinning treatment to be proposed, the identification of the chosen trees*



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*for the cutting was done not only based on their vegetational, morphological and phytosanitary features of the single plant, but, primarily keeping in mind the influence exerted by each arboreal element, in terms of biospace, to the underlying layers. As a consequence, the thinning treatment proposed in favor of the arboreal layer elements fell back almost exclusively on dominated elements and on a few intermediates affected by pathogen or mechanical trauma due to the strong action of sea winds. As regards the intensity and frequency of the interventions in question, a moderate intensity intervention was planned. Silvicultural interventions have also been defined to contrast the drought phenomenon, desertification and fires, through the planting of broadleaved trees, providing more species, both indigenous primary (arboreal) and secondary (shrub-like), suitable for the environmental and climatic conditions of the intervention area (Regional area of the Salento Peninsula). The intervention will affect the areas of the pine forest characterized by an incipient or almost completely absent undergrowth, foreseeing the planting of 150 elements per hectare. The chosen species for thickening are evergreen, xerophilous and reproductive, therefore able to better withstand fires, represented both by arboreal species of sclerophyll, with a percentage of about 70%, and by shrub species, for the remaining 30%. The aim of this intervention was to obtain: balanced and adequate distribution of the used species, regular lighting of the plants, easy management of the forest. Considering the purposes of the thickening interventions that were proposed, mainly based on environment, landscape and contrast to the propagation of fires, it was planned an irregular arrangement of the plants, by groups, using native species, coming from propagation material originated from seed woods of Puglia Region, in the following percentage: Holm oak 70%, Strawberry tree 15%, Mastic tree 15%.*

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

**The marine mycobiota of plastisphere: a focus on the harbor of Livorno and the Meloria shoals**

**SESSION:**

FLORA E FAUNA DEL SISTEMA LITORALE: DINAMICHE E PROTEZIONE

**AUTHORS:**

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**E-MAIL ADDRESS:** MATTEO.FLORIOFURNO@UNITO.IT

**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):***General frameworks and Objectives*

The environment most affected by the accumulation and permanence of microplastics (MPs) is certainly the marine one: it is estimated that up to 92% of the plastic present in the sea is represented by MPs<sup>1</sup>. MPs accumulate in sediments and in the water column causing several problems: they can go up the food chain, also carrying chemical pollutants, or can constitute a new ecological niche for microorganisms, including pathogens. Among the different microorganisms present on MPs there are also fungi<sup>2</sup>. Fungi are present in all ecosystems, including the marine one, where they also play a fundamental role in the decomposition of organic matter and in the recycling of elements. Indeed, the production of non-specific extracellular enzymes (e.g., oxidoreductases and hydrolases) allows several fungi to degrade very recalcitrant molecules<sup>3</sup> (e.g., lignin). This enzymatic characteristic allows to attack very complex and degradation-resistant xenobiotic molecules such as plastics.

Despite the exceptional progresses obtained in the study of marine fungi, the biotechnological potential of these microorganisms still remains largely unexplored. The study of marine fungal biodiversity, including that associated with MPs, is therefore of fundamental importance for expanding knowledge and developing new technologies useful for reducing the environmental impact caused by MPs.

The aim of this work was to study the mycobiota associated with the MPs sampled in the sediments of three sites characterized by different degrees of anthropic impact (the harbor of Livorno, the the Marine Protected Area "Secche della Meloria" (MPA) and an intermediate area of the transept), using a culturomic approach. In order to maximize fungal biodiversity, the isolation phase was carried out in solid, through the use of three different media: Corn Meal Agar, Malt Extract and Syntetic Nutrient-Poor Agar, respectively. Samples were incubated at 15 °C for 4 weeks.

In order to compare the MPs mycobiota to those present in the surrounding environment, isolation from sediments and water sediments were also carried out. Subsequently, a polyphasic approach was used to identify the isolated strains, which involves the combination of molecular analysis with specific markers and the evaluation of morpho-physiological characteristics.

The results show that the mycobiota of all three matrices (MPs, sediment and water sediment) is dominated by the Ascomycota Phylum: *Penicillium* and *Cladosporium* are among the most abundant genera, followed by the Basidiomycota yeast-like *Sporobolomyces*. The sediments and the water sediment showed a greater specific richness than MPs, in fact were found species belonging to the Phylum Mucoromycota and exclusive genera, including *Rhizopus*, *Trichoderma*, *Aspergillus*, *Fusarium* spp. Noteworthy is the presence of several species with eco-physiological adaptations typical of the different matrices and putative new *taxa*.

Moreover, the two driving forces of the fungal biodiversity are both the site specificity and matrix specificity: the fungal community shows a strong adaptation to the three different matrices in the different sampling site, sharing very few *taxa*.



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Focusing on the plastisphere, a total of 60 fungal strains (17 *taxa*) were isolated from MPs; most of them are Ascomycota, while about 30% of the remaining are Basidiomycota (yeast species only). The abundant presence of Basidiomycota in marine environment is little known in literature (generally are about 9%) and probably these yeasts could play an active role in the colonization of MPs.

The nature and biodiversity of filamentous fungi, especially those associated with MPs, in the marine environment is still poorly understood; this study therefore contributes to a greater understanding of the marine mycobiota associated with them, opening new scenarios on their possible exploitation in different biotechnological areas, including bioremediation.

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**MONITORING OF MEDITERRANEAN COASTAL AREAS:  
PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

**FORM FOR ABSTRACTS PRESENTATION**

Title: **Mapping the *Posidonia oceanica* (Linnaeus) Delile, 1813 meadow of Erimitis, northeast Corfu, Greece**

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM

AUTHORS: Gkikas, R., Naasan Aga Spyridopoulou, R., Giovos, I.,

AFFILIATIONS: ISEA

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*Posidonia oceanica* is a species of seagrass endemic to the Mediterranean Sea constituting one of the most essential marine ecosystems in the region, often compared to rainforests in terms of diversity and productivity (Boudouresque et al. 2006). Although *P. oceanica* is classified as Least Concern (by the IUCN Red List of Threatened Species), its general population is decreasing rapidly. For these reasons *P. oceanica* meadows are a protected habitat across the EU (Habitat Directive (92/43/EEC)), with legal frameworks being implemented at EU and national level (Pergent et al. 2016). In context with the above a survey to assess the state of the *Posidonia oceanica* meadow in the Erimitis peninsula was conducted to evaluate its health and status. The location was chosen due to development plans proposed for the area. Erimitis is located near the Straits of Corfu, in the island's northeast coast, an area with little to no human intervention. The study area had a surface of 25.436 hectares. The effort was focused into mapping the extent of the meadow and recording the diversity and the species composition within it. In addition, *P. oceanica* leaves were collected for estimating the total blue carbon stock stored. Five dives were conducted, to determine the extent of the meadow. The coordinates of the meadow borders were extracted via GPS, by following a buoy attached to the diver. In addition, the team isolated the center coordinates and noted the size of patches lacking coverage of *P. oceanica* within the area in order to exclude them from the final map. Also, four 100-meter transects were marked in different locations of the meadow for recording the biodiversity surveys. The divers were swimming using a 25m tape and were recording all species observed 2.5 meter away from each side of each transect. All data imported in a GIS software. The total area covered by the meadow is estimated 15.7465 hectares, or 61.84% of the total study area. Eighty-two different species recorded belonging to 9 different taxa. More specifically the meadows accommodated 10 species of plants, 8 species of sponges, 3 species of anemones and hydrozoa 3 species of annelids, 7 species of echinoderms, 6 species of mollusks, 1 tunicate and 44 species of fish. The list of species was crossed with the general list of species composition from meadows across the Mediterranean and with a list from previous surveys conducted in the same region, in early 2020, in order to verify the results (Papadopoulou, 2020). In general, the observed anthropogenic disturbances during the surveys were limited in the region.



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A good proportion of the species observed could be found in the Natura 2000, Habitats Management guide for Posidonia beds (Díaz-Almela et al. 2008) adding to the impression that the meadows are healthy and undisturbed. It is worth mentioning that no alien species were observed during the surveys. More research is required for analyzing leaf samples and estimating the blue carbon storage of the meadow in Erimitis, while future steps include the estimation of the fish biomass that the meadow sustains, the mapping of the ecosystem services provided by the meadow to the local community and the monetizing of these services to determine the real value of the ecosystem.

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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

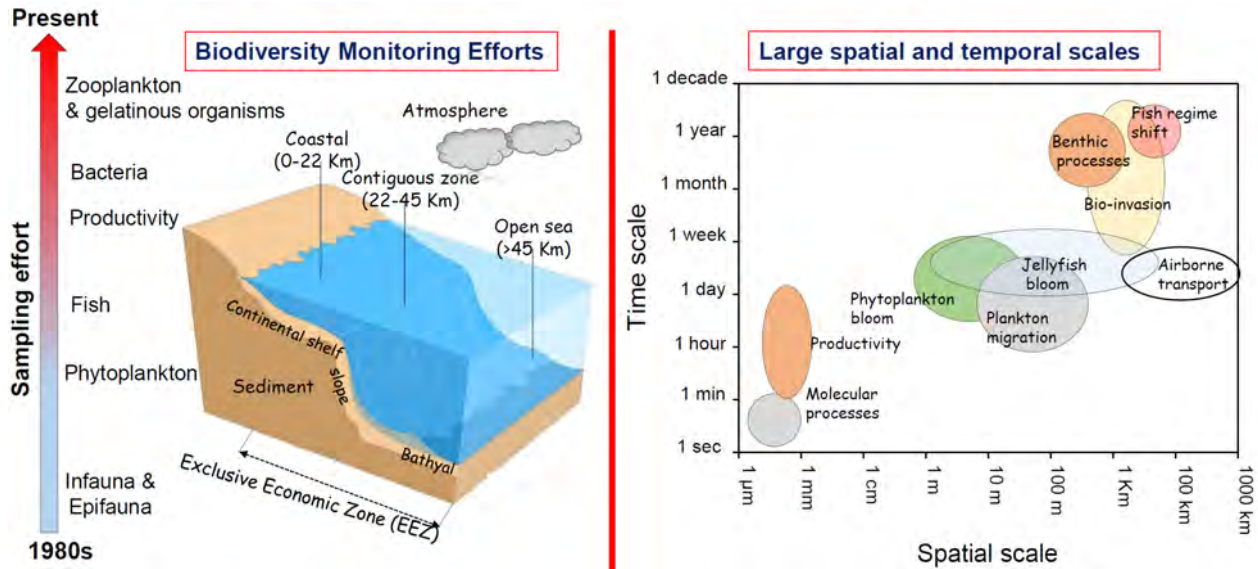
<b>Title:</b> THE NATIONAL MONITORING PROGRAM OF ISRAEL'S MEDITERRANEAN WATERS – SCIENTIFIC PERSPECTIVES
<b>SESSION:</b> FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION
<b>AUTHORS</b> HERUT BARAK AND IOLR SCIENTISTS
<b>AFFILIATIONS:</b> ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH  <b>E-MAIL ADDRESSES:</b> <a href="mailto:BARAK@OCEAN.ORG.IL">BARAK@OCEAN.ORG.IL</a>
<b>ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):</b>  The Levantine Basin is considered an impoverished and sensitive ecosystem in the Mediterranean Sea. Since the beginning of the industrial revolution this sea has been influenced by increasing global, regional and local anthropogenic pressures. The Levantine basin is at the eastern most terminus of the Mediterranean Sea with relatively long residence time of water subject to warming, salinization and acidification. The opening of the Suez Canal in 1864 linking the Red Sea with the Mediterranean has facilitated the migration and settling of hundreds of Eritrean species along the Levantine coasts at the expense of native species and irreversibly altering the ecosystem. The damming of the Nile at Aswan in the mid 1960's reduced freshwater, nutrients and sediment fluxes into the Levantine basin resulting in probably reduced primary productivity, increased salinity and shore erosion along the Mediterranean coast of Israel. Locally, intense human activity including ports expansion, development of desalination plants, gas drilling, power plants, increase in maritime transportation and more impose heavy pressure on the coastal and deep-water ecosystems. The National Monitoring Program of Israel's Mediterranean Waters show significant signals of changes in the marine ecosystem off the shore of Israel, corresponding to the above. In December 2018, a government decision on expanding the National Monitoring Program of Israel's Mediterranean waters was adopted in line with the United Nations Environmental Program's (UNEP) Integrated Monitoring and Assessment Program (IMAP) under the Barcelona Convention and aligned with climate change perspectives. The program is implemented based on the Ecosystem Approach (EcAp) for Good Environmental Status (GES) of the Mediterranean Sea by Ecological Objectives and indicators (in line with the Marine Strategy Framework Directive, MSFD) and on Climate Change indicators. The program covers large spatial (up to ~24,000 km <sup>2</sup> ) and temporal scales (several orders of magnitude) (Fig. 1) and implement diverse monitoring methodologies and infrastructures (from molecular to RVs) and complex logistics. These includes: molecular tools, barcoding and meta-barcoding, imaging using AI, radioisotopes (rates measurements), diverse sampling (box and piston corers; nets; diving; etc.), autonomous vehicles/measurements (mooring, gliders), remote sensing, operational/ecological models. This presentation will show significant signals of changes in the SE Mediterranean marine ecosystem



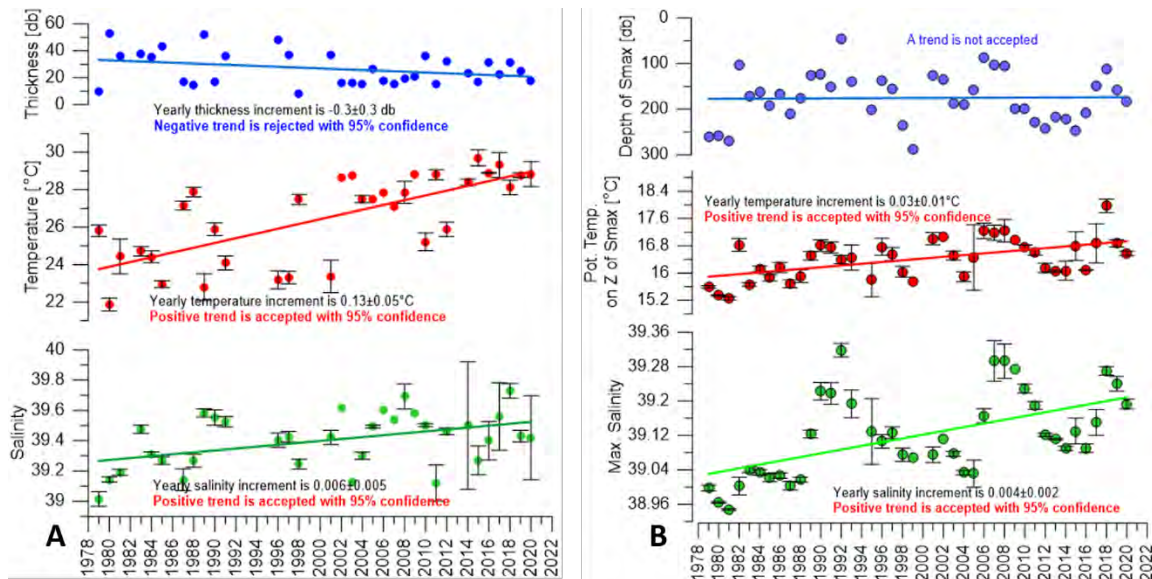
# MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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off the shore of Israel (e.g. Fig. 2), corresponding to the above activities.



**Figure 1** –The scales of spatial and temporal trends and the evolution of biodiversity monitoring efforts in the National Monitoring Program of Israel’s Mediterranean Waters.



**Figure 2** – Inter-annual and long-term changes of temperature and salinity in the Levantine Surface Water (LSW) and Levantine Intermediate Water (LIW), derived from 30 years of CTD profile measurements (Ozer et al., 2022). For the LSW only observations performed during the warm period (July-October) presented. For more details see Reference 4.

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*Nineth International Symposium*

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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

Title: **Assessment of the Trophic Status of the Boughrara Lagoon (Southeast of Tunisia) : Geochemical and Statistical Approach**

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

AUTHORS: GHADA LAJMI ET RIM BEN AMOR

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

*General frameworks and Objectives*

Coastal lagoons are very important for the ecological preservation of biodiversity. However, they are fast turning into threatened ecosystems around the world. The intense anthropogenic development around this area also has negative effects. Recently, the water quality of coastal lagoons in many areas of the world has deteriorated due to massive discharge of nitrogen and phosphorous from domestic and industrial wastewater as well as urban drainage. Consequently, there has been a growing interest in eutrophication as one of the most pertinent disturbance processes on aquatic ecosystems caused by humans. Due to increasing human pressure including fisheries, tourism, demographic expansion, and global climate change, the preservation of biodiversity and natural processes in coastal lagoons has become a challenge in recent decades. The Tunisian coastline on the Mediterranean Sea is about 1300 km long. Because of the development of its industrial, touristic, and agricultural activities, Tunisian marine resources began to get contaminated. These activities, together with the expansion of its population had affected the quality of the aquatic environment in the long term. The present study is integrated in this framework. The Boughrara lagoon, one of the four major lagoon of Tunisia, is subject to ever-increasing anthropogenic pressure leading to the degradation of the quality of its waters and fairly frequent eutrophication processes.

Furthermore, we attempt to evaluate the trophic state of lagoon water for eutrophication's risk analysis. Surface water samples were collected in wet and dry seasons and then were analyzed. Distribution maps and plots of chemical parameters were used to determine the geochemical characteristics of the lagoon water and to identify major natural and anthropogenic processes governing water geochemistry. In addition, multivariate statistical analysis, such as principal



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component analysis (PCA) and hierarchical cluster analysis (HCA) were used, in order to help interpreting the complex data matrices for better understanding of the water quality and to allow the identification of possible factors that influence the water system.

It is widely recognized that the water quality assessment in coastal ecosystems is complicated since a great number of variables, including cause (nutrients) and response (chlorophyll a) variables are interrelated. Several methods are thus used to characterize water quality and to assess eutrophication. In this study, the TRIX index is used to estimate the trophic status of the lagoon water.

The purpose of this study was to give an assessment of the lagoon status using geochemical and statistical approaches. The results indicate that the spatial distribution of temperature, salinity, and pH is under the control of water circulation in the Boughrara lagoon. They show a slight increase from the east to the west. The lagoon water shows a high level of nutrients ( $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ,  $\text{NH}_4^-$ , and ortho-P) compared to the incoming water from the sea. This is essentially due to natural (nitrification, release from the sediments, and primary production) and anthropogenic (wastewater and runoff) sources.

Based on nutrient contents, DO, and chlorophyll a, TRIX index was calculated. It demonstrated that the lagoon has reached the eutrophic status with a poor water quality index. The trophic status of the Boughrara Lagoon is worrying and requires a serious intervention. The status of the lagoon requires serious interest, given its vulnerability and fragile balance.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

TITLE: : IN SITU RARE LONG TERM OBSERVATIONS OF THE DOGTOOTH GROUPER EPINEPHELUS CANINUS IN ARTIFICIAL REEFS RECENTLY IMMersed IN THE NATIONAL PARK OF THE CALANQUES (NORTH-WESTERN MEDITERRANEAN SEA, FRANCE)

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

AUTHORS: M. LAPINSKI<sup>1</sup>, M. PERROT<sup>1</sup>, J. DALLE 1, A. GUILBERT, F. HOLON, P. BOISSERY, E. CLAMAGIRAND, P. THIEVENT, N. CHARDIN, AND M. BOUCHOUCHA<sup>2</sup>

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

*General frameworks and Objectives*

On winter 2017, biomimetic designs of porous concrete artificial reefs (Ragues® modules of 3m in height for 12 tons in weight, Fig 1a) targeting different high-value and rare rocky species such as groupers were immersed between -19 and -22m in the National Park of the Calanques (French Mediterranean coast - 43° 12.679'N / 5° 23.485'E) as part of an experimental ecological restoration project called REXCOR. Still ongoing, the main objective of the REXCOR project is to study the capacity of innovative designs of artificial reefs to restore altered ecological functions of the rocky coastline (shelter, breeding, feeding, nursery grounds) historically impacted by the sewage outflow of the city of Marseilles (second largest town in France). During the first summer after their deployment, one specimen of the dogtooth grouper, *Epinephelus caninus*, (Valenciennes, 1843) estimated to 65 cm was observed by scubadivers during three consecutive months (June, July and August 2018) and then in December 2018 inside the artificial reefs (Fig. 1b, 1c). Thanks to photoidentification [1] and to the analysis of the different characteristic dark bands of the dogtooth grouper radiating posteriorly from the eye and associated cephalic blotches, it was determined as a unique individual. The specimen (Fig. 1b) was a gravid female estimated between four to more than eight years old [2]. If intensive research have been conducted on the dusky grouper, *Epinephelus marginatus* informations on other

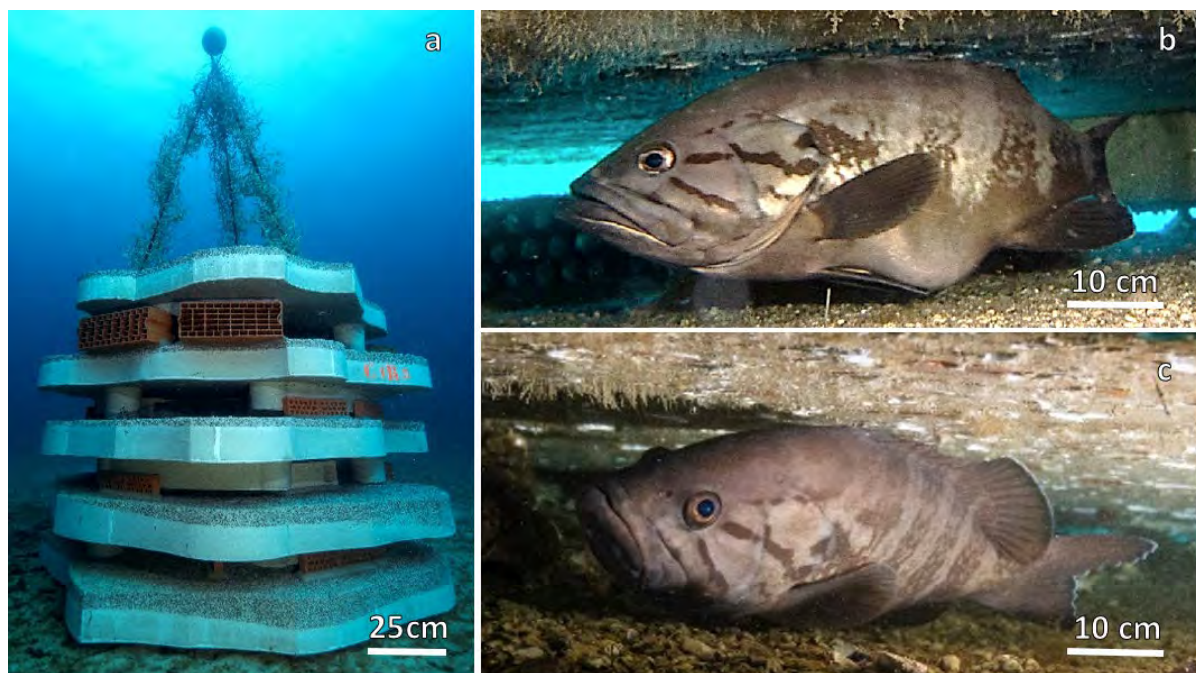


## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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groupers of the Mediterranean sea are still needed as most of these species are considered as endangered due to a high market value despite protection measures applied in some countries such as France. Available published datas on the biology, the ecology and the distribution of *E. caninus* are globally scarce [3]. As most of the groupers, *E. caninus* is a protogynous hermaphrodites and it is expected to be bottom-dwelling lie-in-wait predators that ambush their prey as it passes nearby. Widely distributed in the Eastern Atlantic from Portugal to Angola, this sub-tropical species is uncommon in the Mediterranean Sea especially in its north-western shore. It is mostly found in deep areas from 30 to 300-400 m both occurring on sandy mud and hard substrate. To our knowledge, this is the first documented record of high site fidelity (at least 5 months) for *E. caninus* found in North-western Mediterranean coastal habitats. It is also the first record in the National Park of the Calanques since its creation in 2012 and the first record in artificial reefs in France, especially at such a low depth. Interestingly, 400 other artificial reefs were immersed for ten years in a nearby but deeper area and unprotected area (but no *E. caninus* were observed. These observations suggest that using more biomimetic artificial reefs to create new hard substrates in degraded coastal shorelines in the Mediterranean Marine Protected Areas could be an efficient additional tool to sustainably shelter rare and high trophic level species such as *E. caninus* and support ecological functions including reproduction, shelter and food resources for such species.

Figure 1: **a** Artificial reef (Ragues® module) dogtooth grouper (*Epinephelus caninus*) inside the habitats in **b** July 2018 and **c** August 2018





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**REFERENCES: (MAX 4)**

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**Feeding ecology of common dolphin (*Delphinus delphis*) and Bottlenose dolphin (*Tursiops truncatus*) from the Algerian west coasts**

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**Abstract.**

The present study investigates the variations in the feeding ecology of two small dolphin's (*Delphinus delphis*, *Tursiops truncatus*).

We examined the stomach contents of 11 bottlenose dolphins and 7 common dolphins stranded in the Algerian west coasts.

The index of relative importance indicated opportunistic feeding on Mesopelagic species.

Seventeen species of fish (of eleven families), five species of cephalopods (of five families) were identified as prey.

The most frequently occurring species were the *Conger conger*, *Pagellus sp.*, *Dentex dentex*, *Merluccius merluccius*.

The biggest specimens recovered intact belonging to the family of the Congridae (*Conger conger*) whose length reaches 75 cm, other prey included the *Todarodes sagittatus* and *Loligo vulgaris*.

**Key words:** *Delphinus delphis*, *Tursiops truncatus*, stranded, feeding ecology, Algerian west coasts.



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE: EFFECTS OF PETROLEUM HYDROCARBONS ON SALICORNIA PERENNANS GERMINATION AND GROWTH UNDER SALINE CONDITIONS**

**SESSION: FLORA E FAUNA DEL SISTEMA LITORALE: DINAMICHE E PROTEZIONE**

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

Total petroleum hydrocarbons (TPHs), often spilled by the petrochemical industry itself or by accidents, are among the most concerning pollutants, especially for wetlands. Besides entailing the modification of some physical and chemical properties of water and soils, TPHs are considered toxic for plants, animals and microbes (1). Coastal wetlands are unique environments that usually have a relatively limited distribution and are inhabited by several specialized species. Moreover, they often encompass habitats of conservation interest such as those of the Natura 2000 network. *Salicornia perennans* Willd. (Chenopodiaceae) is an annual succulent halophyte inhabiting brackish and saline environments. The research aimed at studying the effects of two TPHs concentrations (600 and 6000 mg/L) on: 1) *S. perennans* in vitro germination and seedlings growth under saline conditions (0; 7,5; 15; 30; 50 and 70 NaCl g/l); 2) growth, nutrients uptake and photosynthetic performance of adult plants grown in hydroponics with or without NaCl. Fifty fruits (collected at Calambrone on the coastal area of Tuscany, Italy) were seeded in each petri dish and germination was monitored daily. When germination did not occur anymore, non-germinated seeds were washed and transferred in petri dishes containing distilled water for the recovery experiment and then germination was monitored. In order to evaluate the effects of TPHs on seedling growth, 30 fruits were grown in the same conditions of salinity and TPHs, after having been germinated in distilled water. After 10 days, radicle, hypocotyl and cotyledons were measured under stereomicroscope. Finally, fresh weight: dry weight ratio (FW:DW) was measured on the same seedlings. TPHs, together with salinity, strongly affected germination kinetic. In freshwater TPHs-treated fruits germinated faster while final germination did not differ between control and treated plants. Under saline conditions, TPHs generally stimulated germination making it occur faster and at a higher final rate, especially at the highest concentration (6000 ppm). Germination did not occur at 50 and 70 NaCl g/l. The subsequent recovery experiment showed that ungerminated fruits retained vitality as those that were previously treated with 50 and 70 NaCl g/l





## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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displayed final germination rates ranging from ca. 50% to ca. 100%. Interestingly, again TPHs affected germination also in the recovery experiment with TPHs-treated fruits germinating at a higher rate even when previously treated with high salt concentrations. TPHs and salinity strongly affected radicle growth. As regards, the growth of the radicle of seedlings grown in 0 to 15 NaCl g/l was negatively affected by both TPHs treatments, while at higher salinity no statistically significant differences were observed. Finally, FW:DW resulted affected by TPHs only in freshwater with a decrease in TPHs-treated seedlings. Regarding the effects on adult plants, the photosynthetic performance was little affected by the treatments, showing only a slight decrease in the plants treated with TPHs in the absence of NaCl. On the contrary, plants grown in saline conditions were more tolerant towards TPHs. Similarly  $\text{Ca}^{2+}$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$  and  $\text{Na}^+$  accumulation was much more influenced by salinity with minor effects exerted by TPHs for  $\text{K}^+$  in roots. Differently, TPHs determined a slight, despite still significant, reduction in growth of both roots and above-ground plant organs. The obtained results show that TPHs can enhance germination in *S. perennans* seedlings under saline conditions. This is in contrast with what reported for a different species of the same genus: *Salicaria persica* grown in soil (2). The recovery experiment shows that TPHs can exert their effects even after their removal suggesting that hydrocarbons can possibly cross fruit teguments and directly interact with the embryo. The measurements on germinated seedlings show that TPHs, despite enhancing germination under saline conditions, at the same time exert important detrimental effects on radicle growth. This latter result can be only partially explained by the water stress while the toxicity of TPHs should be accounted for the reduction of the radicle growth. Taken together, our results show that TPHs are toxic for the seedlings of *S. perennans* and that this species reacts with an increase in germination. On the contrary, adult plants have turned out to be much more resistant and only slightly affected by TPHs, depending on the saline conditions. Further studies would be necessary to elucidate if the increased germination with TPHs depends on the possible disruption of the mechanism of seed dormancy under saline conditions exerted by the hydrocarbons. Alternatively, the increased germination could be an embryo reaction to avoid the stress exerted by TPHs.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

MORE THAN 28 YEARS OF PROTECTION MEASURES TO RESTORE FRENCH MEDITERRANEAN POPULATIONS OF THE BROWN GROUPER, *EPINEPHELUS MARGINATUS*: TOOLS, POPULATION EVOLUTION AND PROSPECTS

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:**

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

Abstract (min 3000 max 5000 characters):

General frameworks and Objectives

In the 1960s / 1970s, the brown grouper *Epinephelus marginatus* suffered a huge decline in numbers when it was a common species in the French Mediterranean waters. When the Réserve Naturelle Marine de Cerbère Banyuls (RNMCB) was created in 1974, scientists numbered no more than 10 individuals in the area. The same order of magnitude of grouper observations was done on the older French Mediterranean marine protected areas (MPAs) (Parc National de Port-Cros - PNPC, and for Corsica: Réserve Naturelle de Scandola and Réserve Naturelle des Bouches de Bonifacio). More generally, MPAs have shown their efficiency to protect the brown grouper (Hackradt et al, 2014). However, given the importance of this species from an ecological point of view (a top predatory species and an indicator of the good ecological status of an area) (Condini et al., 2018) but also from a socio-economical and recreational point of view, a moratorium was established since 1980 in Corsica and since 1993 for the French Mediterranean continental coasts to protect it over the whole French waters in addition to the MPAs. Their main objective was to drastically reduce harvest and avoid targeted fishing on this species. All fishing types were prohibited (e.g. spearfishing, line fishing, and artisanal longline fishing, except gillnet fishing for professional fishermen).

At the same time, assessments of the grouper populations were carried out by the Groupe d'Etude du Mérou (GEM), a non for profit association bringing together academic scientists, managers and people from civil society. Since 1990s, GEM members carried out these survey every 3 years at various sites along the French coast (in protected and non-protected areas). We have developed and validated the same methodology for underwater visual census in diving based on the deployment of freedivers and scuba divers. The studied site is divided into zones which can be covered by all observers previously trained in the visual census method. Deployed on wide corridors where divers swim slowly, the individual size to the nearest 5 cm is noted as well as the time of the observation, the fish color pattern and behavior (fixed, mobile, coming from the right or the left, moving towards the right or left...). This latter information is important to avoid double counting.

We present here the principal results of the different observation sites monitored during more than 35 years for some of them. Over the years, we observed an increase in the numbers of brown groupers. Initially, this increasing trend was very clear in strong protection zones (no take zone) (less than 20 individuals in each MPAs in the 1970s / 1980s, and more than several hundreds groupers of different sizes after the 2010s in the same MPAs). This increase then reached the partial protection zones where diving and fishing (in accordance with the rules of the moratorium) were authorized but regulated. The monitoring of the size class structure also showed an increase of small individuals, suggesting a renewal of populations. Outside, sightings were still limited, but in some place as La Ciotat, the grouper population has quadrupled. For about 5 years, diving clubs have been reporting increasing numbers of sightings that remain however to be quantified. For this, citizen science initiatives have recently been launched to cover more surface area outside marine protected areas (e.g. Poctefa RESMED project on the RNMCB).

While the results are very encouraging, it should also be noted that this is a slow dynamic and still requires effort. The importance of organizing management and protection at a supra-national scale between the different countries bordering the Mediterranean is also emerging. At this aim, this type of monitoring should also be considered in other countries, with the possible help of GEM. Other complementary methods should also be considered, which make it possible to work on a larger scale, namely the entire Mediterranean littoral: biophony (Bertucci et al., 2015), environmental DNA, possibly deployed by divers or autonomous vehicles (e.g. gliders).



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## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

*The protection of Posidonia oceanica (L.) Delile and the management of the so called banquette. The juridical framework.*

**SESSION:**

FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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**ABSTRACT:**

The endemic *Posidonia oceanica (L.) Delile* is the dominant seagrass in the Mediterranean Sea, where it forms extensive meadows that provide the main carbon sink in the Mediterranean, sustains coastal ecosystems, and plays a key role in preventing coastal erosion.

The relevance of *P. oceanica* is undeniable. Aside from indirect protection ensured, for example, by the legislation on the exploitation of natural resources, living and non-living, of marine waters and of the seabed and its subsoil, as an endangered species it enjoys special protection at international, European and national level.

For instance, it has been included among the *Strictly protected flora species* (cf. Appendix I, as updated in 1996) of the *Bern Convention* (1979). It also figures in the *List of the endangered or threatened species* (cf. Annex II) of the so called *SPA/BD Protocol* (1995). Both the *Bern Convention* and the *SPA/BD Protocol* have been ratified and implemented by Italy.

*Posidonia* beds (\*1120) are also (cf. Annex I) a natural habitat type protected under the *Habitats Directive* (1992), implemented in Italy by D.P.R. 357/1997, the conservation of which requires the designation of Special Conservation Zones (SCZs); moreover, they are classified as a priority habitat.

*P. oceanica* is also used as a general indicator in the assessment of the environmental status of marine and coastal waters, and its preservation is usually related to the quality goals required by both the *Water Framework Directive (WFD, 2000)* and the *Marine Strategy Framework Directive (MSFD, 2008)*, implemented by Lg.D. 152/2006 and Lg.D. 190/2010, respectively.

Nevertheless, according to many commentators, these provisions are still plainly inadequate in offering effective protection for *Posidonia*.

Due to it being committed to a congeries of rules, which build up an exceedingly fragmentary framework, the protection is even less effective for beach-cast leaves of *Posidonia*, the so called *banquette*, which can be found in coastal areas where extensive seagrass meadows occur.

In spite of it being recognised as an important resource for coastal ecosystems, whilst its removal could influence the sediment budget of the beach, *banquette* is often removed, primarily because it is believed to reduce the touristic appeal of the beach, and it is managed as waste.



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With regional law no.1/2020, Sardegna recognised the importance of beach-cast *Posidonia* in contrasting coastal erosion, and allowed municipalities to keep *in loco* the *banquette* or to move it temporarily, bringing it back on the sea shore at the end of the summer season. Nevertheless, the Constitutional Court declared (decision no.86/2021) the unconstitutionality of the law, basing its decision on the State's exclusive competence over the protection of the environment and the ecosystems, and specifically over waste management.

However, as mentioned earlier, the management of *banquette* is still lacking an organic discipline. In fact we have (except if others):

- a) Article 183 (1) (n) of Lg.D. 152/2006, which specifies that operations *in situ* concerning natural materials deriving from coastal storms, even if mixed with materials of anthropic origin, do not fall under the purview of waste management activities;
- b) Article 39 (11) of Lg.D. 205/2010, according to which, and in any case in line with the rules on the protection of the marine environment and on by-products, *Posidonia* can be buried on site on the conditions that it certainly originates from coastal storms and that no further transport or treatment occur;
- c) Annex 5 to Lg.D. 75/2010, regulating fertilizers, which includes *Posidonia* among the organic matrices that can be used in the production of organo-mineral fertilizers;
- d) Article 185 (1) (f) of Lg.D. 152/2006, as modified by Article 39-*quater* (1) of Decree Law 41/2021, which specifies that «beach-cast *posidonia*, whenever released into the same marine environment or re-used for agronomic purposes or in substitution of raw materials in productive cycles, through processes or methods which do not harm the environment or endanger human health» is excluded from the application field of waste management rules.

The provisions of Article 5 of draft law S 1571 (already approved by the Chamber of Deputies and currently – November 2021 – pending at the Senate) appear as little more than a mere review of the extant laws. Referring to «vegetable biomass deriving from sea plants or algae» naturally laid down on the seashore, the article just limits itself to list, in a non-exhaustive manner and without any indication of priorities, a series of possible destination: a) on-site preservation; b) removal to waste management facilities; c) repositioning in the environment – i.e. in the sea itself or in retrodunal areas (in the latter case, after sieving the sand and removing anthropic waste from the organic material, with recovered sand being potentially reused for beach nourishment)

This work aims at reconstructing the juridical framework which regulates the protection of *Posidonia* in the multilevel governance system, both in the sea and as *banquette*, while highlighting the many unsolved, highly problematic knots.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

ON PHENOLOGY CHANGES OF TWO JELLYFISH SPECIES (*AEQUOREA FORSKALEA*,  
*COTYLORHIZA TUBERCULATA*) IN THE NORTHERN ADRIATIC: COMPARISON OF RECENT  
AND EARLY 20<sup>TH</sup> CENTURY DATA

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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*In recent decades, the occurrence of jellyfish in many marine habitats has increased, with significant ecological and socioeconomic consequences (Graham et al. 2014). There are also few comprehensive datasets with temporal and spatial data on jellyfish in the Adriatic Sea that confirm this. Pestorić et al. (2021) noted in their review that pelagic Scyphozoa and Ctenophora taxa are significantly more abundant in the northern part of the Adriatic than in the rest of the Adriatic Sea. However, the differences between the subregions have become less pronounced in recent years. Therefore, it is reasonable to assume that the results of our analysis for the northern Adriatic can serve as projections for the whole Adriatic.*

*The Adriatic Sea, especially its northernmost part, is warming. Raicich and Colucci (2021) estimated a mean temperature increase of  $1.1 \pm 0.3^\circ\text{C}$  using time series from 1899-2015. In addition, several articles have been published based on monthly semi-quantitative data on plankton community composition between 1900 and 1911 (e.g., Stiasny 1911). Data for sea temperature and gelatinous plankton have been available since the early 20<sup>th</sup> century. Therefore, our aim was to compare the historical data (H) with the current state (R) of the jellyfish community in the last decade. For this purpose, we selected two macrogelatinous species with a bipartite life cycle (benthic polyps and planktonic medusae): the temperate cold-water species *Aequorea forskalea* (Hydrozoa: Leptothecata) and the temperate warm-water species *Cotylorhiza tuberculata* (Scyphozoa: Rhizostomeae), for both of which semi-quantitative datasets are available (historical 1900-1911 and recent 2010-2019).*

*The following procedure was performed to obtain monthly semi-quantitative values for the recent period: (I) if no jellyfish were observed in a month, a value of 0 was assigned; (II) if individual organisms were sporadically present, a value of 1 was assigned; (III) a value of 2 was assigned to the month in which we frequently observed small jellyfish aggregations and/or individual organisms and (IV) a value of 3 was assigned to the month in which we frequently observed large aggregations. These values correspond to the frequencies of jellyfish occurrence as absent, rare (r), common (c) and very common (cc), that were previously reported in early 20<sup>th</sup> century publications.*

*Descriptive statistics for temperature in four seasons and two selected periods (historical, H and recent, R) can be found in Table 1:*

T (°C)	Winter H	Winter R	Spring H	Spring R	Summer H	Summer R	Autumn H	Autumn R
Minimum	5.99	7.44	8.38	11.47	21.1	21.78	9.25	11.26
Maximum	9.65	12.46	20.93	24.88	23.97	27.03	19.19	20.67
Median	7.59	9.93	15.71	17.86	23.19	24.97	14.34	16.33
Mean	7.64	10.04	15.36	18.17	22.64	24.75	14.74	16.25
SD	1.11	1.01	4.24	4.03	1.04	1.38	3.71	2.89



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The ANOSIM test of the temperature dataset for historical and recent periods confirmed significant differences between all seasons ( $p=0.001$ ), except for spring and autumn of the historical data. In addition, the SIMPER analysis revealed the largest differences between historical and recent data in spring and autumn, with an average square distance of 40.3 and 22.8, respectively, while differences in winter and summer temperatures were less pronounced, with average squared distances of 8.02 and 7.29, respectively.

The cold-water affinity of *Aequorea forskalea* was confirmed by a significant negative correlation with temperature ( $r=-0.614$ ,  $p=0.001$ ). Compared to the historical dataset, the recent occurrence of *A. forskalea* is significantly different (Mann-Whitney test  $U=13673.5$ ,  $p=0.011$ ), especially in autumn ( $p=0.0001$ ). This can be explained by the frequent occurrence of large aggregations and/or single organisms in autumn in the early 20<sup>th</sup> century and the only sporadic occurrence or complete absence in the recent autumn dataset (Figure 1, top).

On the other hand, *Cotylorhiza tuberculata* is a typical warm-water species ( $r=0.622$ ,  $p=0.001$ ). Although the difference between the historical and recent datasets is not statistically significant (M-W test), the discrepancies were striking for summer ( $p=0.0001$ ) and manifest in the frequent occurrence of large aggregation and/or individual organisms during recent (summer) period (Figure 1, bottom).

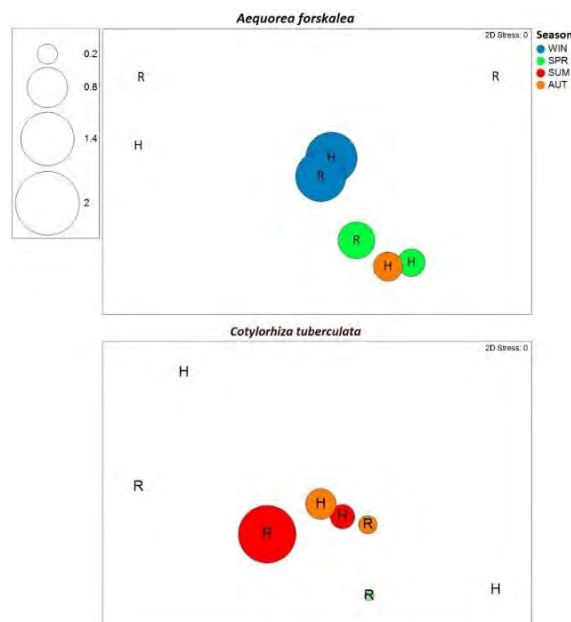


Figure 1. Multidimensional scaling (MDS) ordination of seasons for historical (H) and recent (R) datasets based on Bray-Curtis similarities of semi-quantitative abundance values of *Aequorea forskalea* (top) and *Cotylorhiza tuberculata* (bottom).

These two examples show that with the warming of the northern Adriatic, the phenology of meroplanktonic jellyfish has also changed significantly since the beginning of the 20<sup>th</sup> century. It is unclear whether these changes are due to the effects of higher temperatures on the benthic phase (polyps) and their asexual reproduction or are related to the restructuring of the whole plankton community. The latter could be associated with the recent oligotrophication of the northern Adriatic and the introduction of a non-native gelatinous predator (*Mnemiopsis leidyi*), whose abundance peaks in autumn.

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**MONITORING OF MEDITERRANEAN COASTAL AREAS:  
PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

**FORM FOR ABSTRACTS PRESENTATION**

TITLE: LARVAL RECRUITMENT OF OSTREA SPP. IN THE MAR MENOR LAGOON (SE SPAIN) AND USE FOR RESTOCKING AND BIOREMEDIATION

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The Mar Menor lagoon is a hypersaline coastal lagoon in South-Eastern Spain and is one of the most emblematic natural areas due to its high ecological interest. The anthropic pressure to which it has been subjected for years caused its collapse in 2015. From then until now, there have been a series of catastrophic events that have led to the eutrophication of the lagoon, one of which is a stormy meteorological phenomenon known as DANA (Isolated High Level Depression) that has turned the seabed into an anoxic layer in 2019. The present year (2021) started the Decade of Ecosystem Restoration at the United Nations (<https://www.decadeonrestoration.org/es>) promoting nature-based solutions (NBS) for the recovery of ecosystems degraded by human action. In this sense, the filtering action of bivalves is well known to improve water quality. Oysters are ecosystem engineers, anchoring species for other organisms, generating habitats and thus increasing the biodiversity of the ecosystems they constitute. *O. edulis* is one of the most widespread and studied oyster species in Europe, but since the last century it has been gradually disappearing from European coasts mainly due to overfishing, habitat degradation and diseases. For this reason, the Native Oyster Restoration Alliance (NORA) consortium (<https://nora-europe.eu/nora-mission-statement/>) has been set up in Europe to protect and restore populations of flat oysters (*O. edulis*) for both species conservation and the ecosystem services it provides. The first assessment of the oyster beds in the Mar Menor was carried out in 1985 (García García et al. 1989), estimating a population of 100 million individuals with an average density of 1 oyster/m<sup>2</sup> in the soft bottoms and 9.28 oysters/m<sup>2</sup> in the hard bottoms. In addition, another sympatric species, *O. stentina*, is present in the lagoon (Rosique et al., 1997). The last assessment of the oyster beds in the Mar Menor was carried out in 2006 and recorded an almost 10-fold reduction in the population compared to the 1992 census (Rosique, 2006). The current status of oyster populations in the lagoon is currently unknown. Therefore, the aim of this work was to evaluate the Ostreidae population present in the Mar Menor lagoon, focusing on their recruitment potential, and to evaluate their potential use as biomediators. A total of 45 larval settlement devices (collectors) were placed in the Mar Menor lagoon in June 2020 and removed in October of the same year. Once in the laboratory, oyster larvae were separated, counted and measured in height (ImageJ), allowing the identification of recruits from 0.3 cm in length. Genetic identification of the species was also carried out on 90 recruits. In addition, a total of 661 individuals were kept for 6 months under laboratory conditions to obtain growth and clearance rates. Of the 45 collectors, 41 were found (4 were lost) with a total of 3431 oyster recruits, recruitment varies from 0 to 1212 individuals per collector. Recruitment was highest in the north-western part of the lagoon, while 7 collectors in the eastern part of the lagoon recorded no recruits. In terms of size structure, the smallest individual measured 0.33 cm and the largest 3.11 cm in height. Size classes showed a unimodal distribution with a predominance of individuals of 0.9-1.09 cm in length. Genetic analysis revealed that 85 of the 90 individuals corresponded



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to *O. stentina*; the other 5 showed DNA degradation; none of the tested recruits corresponded to *O. edulis*. The daily growth rates, obtained from the change in live weight (in mg ind<sup>-1</sup>), versus time (in days), under optimal growth conditions were about 0.005, a much lower value than those described for seeds of other bivalve species. Furthermore, the efficiency with which ingested food is converted into growth (gross growth efficiency K1) is also much lower than that observed for other species. Mass-specific clearance rates under standardised laboratory conditions averaged 2 L h<sup>-1</sup> per 1 g dry weight of oyster meat, and in line with growth, the clearance values recorded were lower than for other bivalves.

The oyster recruitment obtained belonged to *O. stentina*, not observing the settlement of *O. edulis* in any of the collectors. The bioextractive potential of *O. stentina* seed is lower than that of other oyster species, so its use in bioremediation actions is less profitable. In addition, a new genetic tool was developed to differentiate the two oyster species.

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Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE: SPATIO-TEMPORAL CHARACTERIZATION OF NATURAL BEDS OF BIVALVE MOLLUSCS IN THE INTERTIDIAL AREAS OF THE GULF OF CÁDIZ (SW IBERIAN PENINSULA)**

**SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION**

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The Gulf of Cádiz is dominated by extensive sandy beaches and estuarine zones, especially in the western area of the gulf, where important rivers flow into them. Sandy beaches provide several ecosystem services where the benthic macrofauna plays a pivotal role and is also vulnerable to the current impact of climate change. One of the most pressing impacts of global warming is forecast to be sea-level rise and large changes in the world's coastlines. Sea-level rise with combinations of storms will affect future shoreline change to varying extents around the world beside the intense rainfall and onshore winds, which may induce alterations in the abiotic factors of coastal areas and consequently on benthic communities. Bivalve molluscs are one of the most important taxa in the benthic system because of their feeding activity and they represent an important food source for higher trophic levels. Therefore, it is crucial to describe biodiversity patterns in marine ecosystems as well as observe changes in its community composition and structure.

The aim of the study was to characterize and to analyse spatio-temporal changes in structure and composition of the bivalve fauna inhabiting intertidal areas of sandy beaches in south west Iberian margin in the Gulf of Cádiz.

Bivalve natural beds were monitored from January 2019 to September 2021 to assess temporal variations, where fixed stations were visited on a monthly basis on several beaches distributed in two areas of the Gulf of Cádiz; one an area called HUELVA (beaches near to the influence of the Guadiana, Tinto and Odiel Rivers), and DOÑANA (beaches of the marine protected area of the Doñana national park near to the Guadalquivir River). Additionally, the spatial distribution was also addressed in a specific survey performed in June 2018, covering the intertidal areas along the littoral of Huelva. In each haul, sampling was performed using a hand-dredge similar to those used by local bivalve harvesters i.e. having an iron structure with a 44.5 cm wide opening that digs deeply into the sediment (upper 15 cm), using hand-dredge with experimental mesh size (3 × 3 mm). The use of an experimental mesh size allowed for the collection of the smallest individual and juveniles. At each sampling site, and at the maximum low tide and on the lower part of the intertidal area of the beach, hand-dredges were towed diagonally to the shoreline for 5 min, each transect being geo-referenced by means of a GPS. A total of 201 samples were collected. The number of retained individuals was recorded to estimate population density (ind. m<sup>-2</sup>) and biomass (g m<sup>-2</sup>). For obtaining abiotic factors data on surface seawater temperature, salinity and oxygen were collected monthly in situ at the sampling sites using a YSI professional probe, and surface sediment samples were also collected.

A total of 16 species of bivalve molluscs were identified in the two areas, Doñana and Huelva, respectively. *Donax trunculus* was dominant in both density and biomass in assemblages (Table 1). Assemblage was characterised by the



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

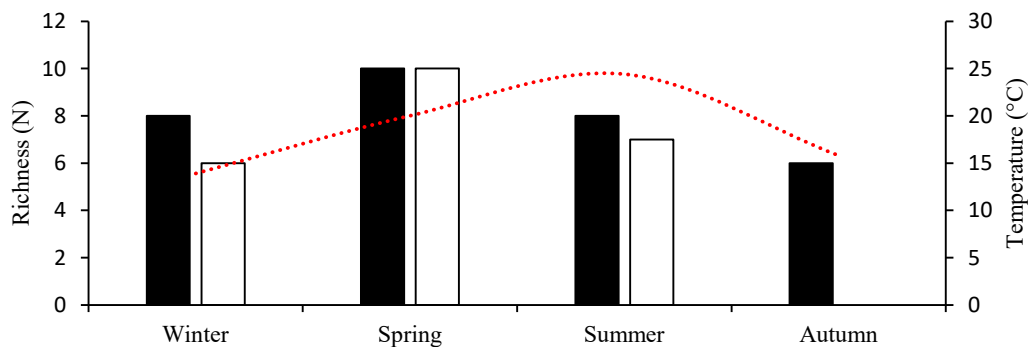
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codominance of the bivalves *Mactra stultorum* whitish and brownish variants in Doñana area and *Chamelea gallina* in the Huelva area. The species *Mytilus* sp., *Solen marginatus*, *Dosina exoleta* and *Pharus legume* are considered rare specimens (only one specimen was collected). According to the results, the highest diversity in the two areas of the study was found in spring and a significant decrease in biodiversity was observed in summer coinciding with the highest temperature values (Fig. 1).

Biodiversity monitoring studies of coastal ecosystems at regional level are of great importance to increase knowledge and to understand its seasonal dynamics. Moreover, this baseline information will be very valuable to analyse and/or predict the effects of climate change in future studies at global level.

**Table 1.** Mean density (ind. m<sup>-2</sup> ± SE) and biomass (g m<sup>-2</sup> ± SE) of bivalves collected with hand-dredge in the Huelva and Doñana area between January 2019 and September 2021.

Species	Doñana area		Huelva area	
	Density	Biomass	Density	Biomass
<i>Chamelea gallina</i> (Linnaeus, 1758)	0,31 ± 0,5	1,18 ± 3,75	2,48 ± 9,99	4,84 ± 19,10
<i>Donax semistriatus</i> Poli, 1795	0,76 ± 1,36	0,32 ± 0,48	-	-
<i>Donax trunculus</i> Linnaeus, 1758	23,29 ± 25,19	28,86 ± 25,15	23,34 ± 36,32	19,72 ± 25,24
<i>Dosinia exoleta</i> (Linnaeus, 1758)	-	-	0,04	0,70
<i>Dosinia lupinus</i> (Linnaeus, 1758)	0,07 ± 0,02	0,71 ± 0,02	-	-
<i>Ensis minor</i> (Chenu, 1843)	-	-	0,11 ± 0,07	0,13 ± 0,07
<i>Macomangulus tenuis</i> (da Costa, 1778)	0,09 ± 0,07	0,04 ± 0,07	0,16 ± 0,15	0,07 ± 0,04
<i>Macomopsis melo</i> (G. B. Sowerby II, 1866)	0,07 ± 0,03	0,043 ± 0,02	0,06	0,04
<i>Mactra stultorum</i> whitish variant (Linnaeus, 1758)	2,48 ± 4,80	7,50 ± 15,72	0,47 ± 0,98	0,96 ± 1,68
<i>Mactra stultorum</i> brownish variant (Linnaeus, 1758)	2,92 ± 5,22	9,0 ± 17,97	0,57 ± 1,21	0,91 ± 0,95
<i>Mytilus</i> sp.	0,03	0,08	-	-
<i>Pharus legumen</i> (Linnaeus, 1758)	0,04	0,05	-	-
<i>Peronidia albicans</i> (Gmelin, 1791)	-	-	0,14 ± 0,10	0,06 ± 0,05
<i>Solen marginatus</i> Pulteney, 1799	-	-	0,04	0,08
<i>Spisula solida</i> (Linnaeus, 1758)	0,12 ± 0,06	0,04 ± 0,01	0,15 ± 0,11	0,17 ± 0,12
<i>Spisula subtruncata</i> (da Costa, 1778)	0,10 ± 0,07	0,08 ± 0,07	0,11 ± 0,08	0,15 ± 0,12



**Figure 1.** Seasonal variation of the richness with the temperature (red line) in two areas of the gulf of Cádiz: Doñana, black bars; Huelva, white bars.



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### Acknowledgements

The present study was funded within the framework of the Project “FEMP\_AND\_04” (Programa plurianual en el ámbito de la recopilación de datos de la comunidad autónoma de Andalucía: Análisis de la pesquería de coquina en el caladero del Golfo de Cádiz) and the Project “VENUS” (Estudio integral de los bancos naturales de moluscos bivalvos en el Golfo de Cádiz para su gestión sostenible y la conservación de sus hábitats asociados) (0139\_VENUS\_5\_E; INTERREG-POCTEP).

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**FORM FOR ABSTRACTS PRESENTATION**

**TITLE:** PSII Photochemistry and the metabolome of *Limbarda crithmoides* (L.) Dumort. in a Mediterranean salt marsh: seasonal and annual variations.

**SESSION:** FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

The areas of vegetation transitions are well known to be highly sensitive to climate fluctuations. Salt meadows spread over narrow transitional areas between sea and terrestrial environments which are considered as high-risk zones subject to climate change impacts (Thorne et al., 2012). Wetlands are among the most productive ecosystems, retaining more than 1/3 of the carbon fixed and providing important ecosystem services to the estuarine system (Caçador et al., 2009). The conservation of such ecosystems first requires a good knowledge of the adaptation strategies of the species that inhabit these environments.

The objective of this work was to understand the adaptive response of a halophyte like *Limbarda crithmoides* to the environmental conditions of the salt meadows. For this, the studies were carried out firstly in situ and then in the laboratory. The field studies consisted of measurements of the photochemical performance in spring and summer for 3 years to try to understand how the energy demand for summer flowering was covered. For this purpose, a fluorometer was used. During these same periods, leaf, flower, and root samples were harvested for metabolomic analyzes in GC / MS and UPLC-Q-Tof.

The analysis of the light response curves showed that the actual quantum yield of PSII photochemistry ( $\Psi_{PSII}$ ) was the same in spring as in summer. However, the non-photochemical quenching (NPQ) data were more important in the summer, suggesting the establishment of a photoprotection mechanism aimed at preserving the reaction center of the PSII during intense summer solar radiation. In addition to the effects of solar radiation, the elevated salt concentrations could generate the formation of free radicals which are particularly harmful for the photosynthetic machinery and cell metabolism in general. The Fv/Fm ratios were similar between the two periods as well as the photochemical quenching coefficient (qP).



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GC/MS analysis led to the identification of several phenolic compounds related to the plant defense mechanisms. In particular, a triterpenoid,  $\alpha$ -amyrin was identified among the dominant components. Multivariate analysis was set up in order to characterize the metabolomic fingerprint of *L. crithmoides*. The PCA analysis of the metabolome shows a very marked organ, year, and season effects. This was confirmed through the Ascending Hierarchical Classification (AHC). UPLC-Q-ToF data reveal similar patterns (figure 1). The enrichment of the differential metabolites allows to identify the key metabolic pathways of the phenology and the adaptation of *L. crithmoides* to the summer drought in salt meadows.

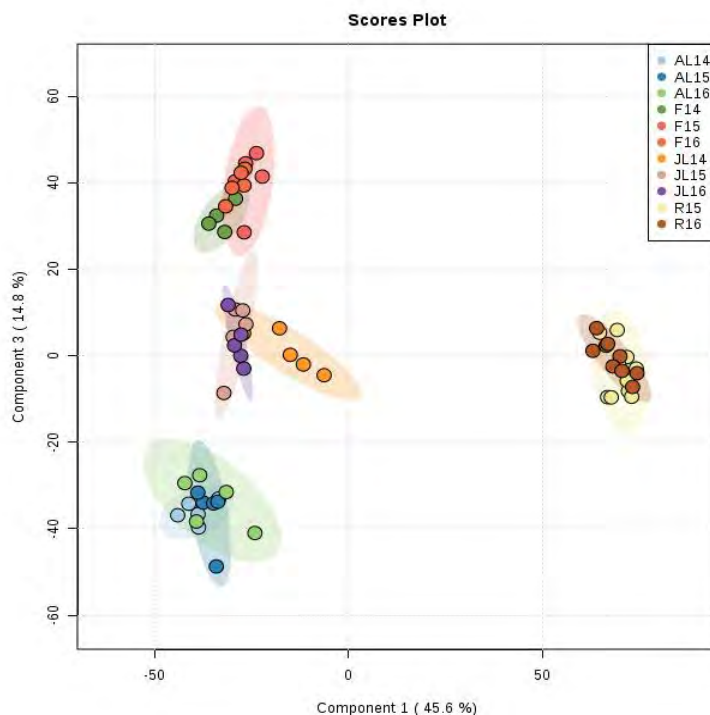


Figure 1: Chemical metabolic fingerprints obtained from extracts of leaves (L = Leaves), flowers (F = Flowers) and roots (R = Roots) of *Limbarda crithmoides* in June (J) and August (A) 2014, 2015 and 2016 by UPLC-Q-ToF (PCA : principal component analysis).

### REFERENCES: (MAX 4)

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### FORM FOR ABSTRACTS PRESENTATION

Title: Epifaunal assemblages associated with the introduced alga *Agarophytum vermiculophyllum* and native macrophytes in the Atlantic Oualidia lagoon (NW Morocco)

SESSION: FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

Algae and seagrasses are important components of coastal systems, and are known among the true autogenic epibenthic ecosystem engineers. They are regarded as important habitat-formers in shallow coastal zones, providing food and shelter for a large number of small motile invertebrates. In the marine environment, macrophytes present a great variability in terms of morphology and complexity inducing the establishment, in general, of rich and diverse assemblages of associated macro-epifauna. Therefore, macrophytes are ideal systems to examine the relationship between habitat complexity and the structure of their associated epifaunal assemblages. The objective of this study is to evaluate the ecological impacts of the introduction of an invasive alga based on the assemblages of the associated macroepifauna as a study model and to compensate the lack of fundamental knowledge on the structure of the benthic macroinvertebrate assemblages of the Oualidia lagoon

The introduced macroalga *Agarophyton vermiculophyllum* and native macrophytes (5 algae: *Gracilariopsis longissima*, *Ulva lactuca*, *Enteromorpha* spp., *Fucus* sp., *Fucus vesiculosus* f. *volubilis*), and 2 seagrass species, *Ruppia* cf. *maritima* and *Zostera marina* were studied in the Oualidia lagoon located along the Atlantic coast of Morocco. This Atlantic lagoon is recognized as RAMSAR site providing a valuable refuge to a rich variety of birds, fish, plants and other wildlife northwest in Morocco.

The sampling was conducted along a transect of the lagoon at low tide in the winter season. A total of 108 taxa belonging to 8 phyla were recorded. Species diversity showed the highest and the most dominant zoological groups values for molluscs and crustaceans were among the most dominant zoological groups, notably the gastropod *Peringia ulvae* (76% of the total abundance), *Scrobicularia plana*, *Steromphala umbilicalis*, and *S. pennanti*, as well as amphipods *Photis*



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*longicaudata*, *Lysianassa ceratina*, *Ampithoe valida*, and *Melita palmata*.

Results revealed that epifaunal assemblages within macrophytic habitats were significantly different (one-way ANOVA, PERMANOVA, nMDS). The species contributing the most to the similarity within and dissimilarity among assemblages were identified through similarity percentage procedure (SIMPER) showed that the species responsible for the dissimilarity observed between assemblages macrophytes were *P. ulvae*, *Cerastoderma edule*, *Lacuna parva* and *P. longicaudata*.

The trophic structure of epifaunal assemblages was dominated, in terms of abundance, by micrograzers i.e., *P. ulvae*, while detritivores predominated in terms of species in all macrophytic habitats. Habitat structure is a primary factor determining the structure and distribution patterns as suitable and additional habitat for epifaunal species and supports a more diverse epifaunal assemblage in the Moroccan coast

Results suggested that the habitat architecture also seemed to play a significant role in shaping epifaunal assemblages. Therefore, our findings suggest that the invasive macroalga, if structurally different from native species, induces changes in the associated epifauna.

KEYWORDS: *AGAROPHYTON VERMICULOPHYLLUM*, BIODIVERSITY, EPIFAUNAL ASSEMBLAGE, FUNCTIONAL DIVERSITY, OUALIDIA LAGOON, MOROCCO.



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

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### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** STOMACH CONTENTS ANALYSIS OF BOTTLENOSE DOLPHINS *TURSIOPS TRUNCATUS* (MONTAGU, 1821) STRANDED IN THE TUSCANY ARCHIPELAGO IN THE PERIOD 1990–2021

**SESSION:** FLORA E FAUNA

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*Bottlenose dolphin* *Tursiops truncatus* (Montagu, 1821) is a cosmopolitan species and it is found in all tropical and temperate coastal waters of the world (2). The bottlenose dolphins in the Mediterranean Sea mainly show coastal habits (3), which often lead it to interact with fishing activities, such as opportunistic feeding from set nets. In this study, first data on the diet from specimens of *T. truncatus* stranded in Tuscany, north-western Mediterranean, are shown. The stomachs contents of thirty-five bottlenose dolphins were analyzed.

The specimens examined come from a collection of forty-seven individuals of *T. truncatus* stranded along the Tuscany coasts between 1990 and August 2021 and collected by the Regional Agency for Environmental Protection of Livorno (Tuscany, Italy). The identification of the prey was carried out using specific guides and comparing the undigested remains found in the stomachs with original samples. The prey was identified at the lowest possible taxonomic level, evaluating the percentage frequency (F%), that is the percentage of stomachs in which at least one individual of a given prey was found.

Thirty-five bottlenose dolphin stomachs (17 males and 18 females) showed some food remain, while the other stomachs were empty or belonged of young individuals still in the lactating phase. From the analysis of the stomach contents 2792 prey items were identified, classified into 2358 fishes and 434 cephalopods. The results show an abundant and frequent presence of Osteichthyes, with a numerical percentage (n%) of 84.5% and a percentage frequency of 97.1%. However, cephalopods were less abundant than fishes (n% = 15.5), while their frequency among the dolphins examined was found to be quite high (F% = 74.3). *Merluccius merluccius* (n = 612; n% = 21.9) and *Conger conger* (n = 345; n% = 12.4), followed by *Ophidion barbatum* (n = 191; n% = 6.8), *Diplodus annularis* (n = 143; n% = 5.1), *Illex coindetii* (n = 130; n% = 4.7) and *Pagellus erythrinus* (n = 110; n% = 3.9) (Fig. 1) were the species most abundant. *C. conger* (F% = 80.0), *M. merluccius* (F% = 48.6), *I. coindetii* (F% = 45.7) and *O. barbatum* (F% = 37.1) were the species most frequent. *Congridae* (F% = 82.9), *Sparidae* (F% = 65.7), *Gobiidae* (F% = 57.1) and *Merlucciidae* (F% = 48.6) were the most frequent bony fish Families, while *Ommastrephidae* (F% = 45.7) and *Octopodidae* (F% = 42.9) were the most frequent cephalopods Families.



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*Most of the prey identified from the analysis of the stomach contents of *T. truncatus* are species with demersal and/or benthic habits, as reported by (4) for this same study area and by (1) for the western Mediterranean Sea. Many of the prey found in the stomachs of the examined specimens are species of considerable commercial importance, such as *M. merluccius*, *I. coindetii* and some species of *Sparidae* and *Octopodidae*. Furthermore, confirming the numerous observation of opportunistic interaction with fishing activities, the remains of artisanal fishing nets were found in the stomachs of two recently beached bottlenose dolphins; the presence of pieces of net combined with the great abundance of fresh or undigested prey indicates that the dolphins died trapped in the nets in an attempt to feed. The results obtained confirm that the feeding behavior of this predator are mainly coastal.*

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# **Spatial variation in density of the endangered marine mollusc *Patella ferruginea* Gmelin, 1791 in the West coast of Algeria.**

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## **Abstract**

*Patella ferruginea* is an endemic in the western Mediterranean. According to the European Council Directive 92/43/EEC, the species has the most endangered endemic marine invertebrate on the Western Mediterranean coasts.

Over the past decade, the range of the giant limpet becomes highly localized, where she was once widely distributed in Algeria.

During the period of our study (2007-2010), the systematic identification has been carried out on two sites in the west coast of Algeria: a continental (Cap Falcon) and the other island (Habibas islands), with the goal main measurement of the abundance of this limpet in coastal regions, as well as biometrics for their shells.

A total of 1040 individuals were recorded in this study in Habibas Island and Cap Falcon coast, with mean densities ranging from 0 to 29 ind/m per linear transect, averages of 1,9 ind/m per linear transect for Cap Falcon coast, in Habibas Island the mean densities is ranging from 0 to 30 ind/m averages of 3,8 ind/m.

The mean size of *P. ferruginea* on the Habibas Islands (6,13 cm) was significantly ( $p < 0.001$ ) greater than on Cap Falcon coast (3,85 cm).

Indeed, the abundance viewpoint, the site of the Habibas islands hosts most of individuals with significant size in the continental site of Cap Falcon because this Islands is a marine reserve.

**Keywords:** *Patella ferruginea*, Endemic, Biometrics, Habibas Islands, Cap Falcon, Algeria.



## **MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

**Monitoring biodiversity in the Capo Testa-Punta Falcone Marine Protected Area (Santa Teresa Gallura, Sardinia)**

**SESSION:**

Flora e Fauna del sistema litorale: dinamiche e protezione

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

The Rio de Janeiro Conference (1992) and the consequent multilateral agreements have overcome the old concept of environmental protection, aimed almost exclusively at the protection of habitats and species, to move to a dynamic defense of nature, based on the principles of the sustainable development (1) and, as regards the protection of the coasts, to a management that aims not only at preventing the degradation of these environments, but also at strengthening the defenses against the dangers that threaten them. We thus move to an approach based on ecosystems, in which coastal protection measures must be preferred, appropriate and responsible from an ecological point of view, as well as the use of natural processes and respect for the absorption capacity of ecosystems to make human activities more environmentally friendly (2).

The protection of coastal ecosystems and the erosion of coastal areas are intimately linked topics if one thinks of integrated management logic of coastal areas.

For example, the *Posidonia oceanica* habitat, the dunes or the coastal wetlands play a fundamental role in accompanying the progressive movements of the stretch of coast: these transition areas in fact contribute to the conservation of sedimentary stocks, on land and at sea, to the attenuation of the impact of wave motion and also to the absorption of water flows in the event of flooding of the coastal area. Their protection therefore appears fundamental, although complex in relation to the development of the various terrestrial and maritime human activities: an assessment of the pressures and impact exerted by human activities therefore proves to be a necessary premise for the adoption of effective protection measures.

According to the principles of integrated management, it is no longer necessary to think only in terms of coastal defense, but of conservation and restoration of those natural habitats that hinder erosive phenomena in a natural way.

This type of approach, successfully addressed for many years in other countries, such as the United States, Spain, France and the Netherlands, is slowly spreading in Italy, especially within Protected Areas, which therefore become



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promoters and managers of actions that experiment all within the Parks and Natural Reserves, forms of solution to problems that can later be transferred elsewhere, as examples of sustainable development.

The Capo Testa - Punta Falcone Marine Protected Area (Santa Teresa Gallura, Sardinia) is located in north-eastern Sardinia, covering an area of over 5,000 hectares.

During 2021, the first comprehensive monitoring of plant and faunal species of community importance was undertaken for the Habitat Directive 92/43 / EEC and Birds 2009/147 / EEC. The marine area, whose territory partly coincides with the Capo Testa SCI (Site of Community Importance), has planned monitoring as part of the management of the marine and coastal sites of the Natura 2000 Network and the functioning of the network of protected marine areas.

In the studied area there are a total of 18 habitats of conservation interest for the Habitat Directive (Annex II): the spontaneous flora is made up of about 320 entities, 10% of which are plant species worthy of protection either because they are endemic or because they are of phytogeographic importance; among the animal species 3 species of Amphibians, 9 of Reptiles, 74 of Birds are included in the lists of species worthy of conservation and protection, some listed in the various annexes of the Birds Directive; among the different marine species they are important from a conservation point of view, such as *Patella ferruginea*, *Posidonia oceanica*, *Cystoseira* spp., either because in the annexes of the European Directives or because they are indicators of threatened habitats and towards which the priorities of active management of the MPA. Fragmentation and alteration of habitats, loss of animal and plant biodiversity following the presence and spread of exotic species, anthropic disturbance and, in general, non-management and poor knowledge of habitats and species are some of the threats and pressures in progress that emerged in the course of monitoring and to the detriment of the species and habitats in which they live in the MPA and SCI territory. The MPA has started monitoring thanks to the close collaboration of experts with diversified skills but integrated in the perspective of a systemic vision. The results of the monitoring activities must guide the decisions of the managers in a systemic way and not just species-specific or habitat-specific, highlighting the importance of having a study / monitoring / management approach that includes these various levels and being able to make more effective decisions at various levels, analyzing the intervention priorities.

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# Ecological monitoring of the brown algae of the genus *Cystoseira* on the Cap of tree Forks for a possible integration of this cape into the Mediterranean network of Marine Protected Areas

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**Abstract:** The Cap des tree Forks (C3F) on the Moroccan Mediterranean is classified as SIBE of priority 2 since 1991. In fact, its biodiversity, on the land side as on the marine side, is so rich; but, the increase in human activity in the surrounding area requires its protection as a Marine Protected Area (MPA). Our study supports this observation, via the monitoring of an organic quality indicator species on the marine side of the cape: the alga *Cystoseira mediterranea*. During one year, and on a monthly basis, several biotic parameters (algae) were measured: size and diameter of branches, fertility, density, and specific diversity, interaction in the ecosystem and chlorophyll concentration (a and c). In addition, abiotic parameters (sea water) were also measured: water temperature ( $T^{\circ}$ ), dissolved oxygen (DO), pH, salinity, turbidity, suspended solids, conductivity, nitrite concentration, and concentration nitrate and orthophosphate concentration. The monitoring began in January 2020 and will end in December 2021. The results obtained so far show the ecosystem role that this engineering algae plays in the biodiversity of the infralittoral. Thanks to its durability, *C. mediterranea* constitutes a shelter for several crustaceans, annelids, sponges, epiphytic algae and encrusting algae; as well as a nursery for several benthic communities, herbivorous fish, sea urchins and other macro invertebrates. In general, its density is 15 ind/25 cm<sup>2</sup>, its primary branches length is 18 cm with a diameter of 1.5 mm, its secondary branches length is 10 cm with a diameter of 1 cm, a specific diversity with 10 species of flora and 8 species of fauna, a strong predation by the sea urchin *Paracentrotus lividus* and the encrusting coralinaceae. The fertile period of the algae extends from July to October, its concentration of chlorophylls (a and c) with a minimum of 200 µg/g FW and a maximum of 500 µg/g FW of the algae.

As for the environmental parameters, the average  $T^{\circ}$  of the water is 22 °C, the concentration of OD Min is 10 mg /L, the Max is 17 mg/L, the Min salinity is 35 ‰, the Max is 46 ‰, Min conductivity is 48 mS/cm the max is 59 mS/cm, the Min turbidity is 0.1 FNU the Max is 1.5 FNU. Nutrients are in the normal range: Min nitrite concentration of 0.4 µmol/L, the Max of 1.2 µmol/L, the Min nitrate concentration of 1.3 µmol/L, the Max is 14 µmol/L, the concentration of orthophosphates Min is 0.1 µmol/L the Max is 0.9 µmol/L. On the other hand, our results show the good state of *Cystoseira* and its medium on C3F, hence the need to preserve this state by the establishment of an MPA.

**Keywords:** *Cystoseira mediterranea*; C3F; AMP; Monitoring; biotic parameter; abiotic parameter; engineer species; Mediterranean.





## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

A PHOTOGRAMMETRIC UNDERWATER APPROACH FOR 3D RECONSTRUCTION AND MONITORING OF HABITAT-FORMERS

**SESSION:**

FLORA E FAUNA DEL SISTEMA LITORALE: DINAMICHE E PROTEZIONE

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*General frameworks and Objectives*

The Mediterranean Sea is one of the most affected areas by the underway climate alterations, with marine communities facing global changes and the subsequent spread of invasive species (Gómez-Gras et al., 2018). In particular, impacts on benthic habitats threaten a large number of habitat-forming organisms that play important ecological roles in generating and maintaining marine biodiversity, provide ecosystem services and are of relevant ecological and conservation interest. However, despite the creation of products with accurate metric and colorimetric content through image analyses and photogrammetry could offer new tools for monitoring activities in underwater environments, its use is still rudimentary in these contexts (Rossi et al., 2021). Photogrammetric methods allow a precise mapping of the underwater landscape as well as a detailed three-dimensional (3D) reconstruction of marine structures, improving the study of complex marine ecosystems, and of direct and indirect effects of climate change on biodiversity. These applications provide very useful data to evaluate the health state of biodiversity-rich 3D biogenic structures and make measurements of fine-scale changes, with greater precision than existing methodologies (Ferrari et al., 2017). In this framework, the research group is pursuing the development of a technological solution consisting of a remotely operating platform and a measuring system, including RGB and fluorescence optical sensors.

The innovative measuring system, based on the use of a high-resolution Canon EOS 2000D in an underwater housing equipped with a dome port, has been employed in preliminary tests for the 3D reconstruction and estimation of habitat-forming anthozoan morphometries and physiological conditions (i.e. responses to different stresses induced by climate changes). The attention was focused on a case-study endemic stony coral of relevant conservation interest and widely distributed in infralittoral rocky areas of the Mediterranean Sea.



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First, high resolution images were acquired in controlled laboratory conditions to assess the design of proper calibration frames, and the combination of metric and colorimetric results for the monitoring of changes in coral health status. The calibration frame consisted of coded targets positioned both on a plate and on a vertical bar. High-density point clouds were generated for the 3D reconstruction of corals, and further surface modeling was performed introducing interpolation and smoothing effects on the reconstruction (Rossi et al., 2020). The images acquired allowed to validate the accuracy of the computed 3D point clouds by comparing the real biometric parameters of coral morphology (corallite diameter about 0.5 cm) and colony size, and the information provided by the 3D models. Single corallites were well represented in the models, and even the elongation of tentacles could be appreciated. Color variability in healthy and diseased corals, and changes in colony health status before and after the exposure to environmental stress and/or interaction with a Mediterranean range-expanding generalist predator were assessed positioning a color checker inside the aquarium tank. In particular, coral bleaching phenomena and the damaged areas of colonies were investigated.

The measuring system was also implemented on a customized Remotely Operating Vehicle for a preliminary field survey to test in-site image acquisition.

Overall, the proposed solution aspires to improve the standardization of monitoring plans through non-destructive fine-scale accurate data collection for image analysis and multi-temporal comparisons, providing challenging stepping-stones for habitat-forming anthozoan management and restoration activities.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** ISOLATION AND MOLECULAR CHARACTERIZATION OF *FUSARIUM* SPECIES (FUNGI, ASCOMYCOTA) FROM UNHATCHED EGGS OF *CARETTA CARETTA* IN TUSCANY (ITALY)

**SESSION:** FLORA AND FAUNA OF THE LITTORAL SYSTEM: DYNAMICS AND PROTECTION

**AUTHORS:** SAMUELE RISOLI<sup>1,2\*</sup>, SABRINA SARROCCO<sup>1</sup>, GIULIANA TERRACCIANO<sup>3</sup>, RICCARDO BARONCELLI<sup>4</sup>, MARCO A.L. ZUFFI<sup>5</sup>, CECILIA MANCUSI<sup>6</sup>, CRISTINA NALI<sup>1</sup>

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

Fungal infectious diseases have dramatically increased in marine ecosystems during the past two decades and actually represent one of the main threats to biodiversity, likely due to the occurrence of emerging pathogens in new environments and the stress conditions induced by global climate change. In this context, the loggerhead sea turtle (*Caretta caretta* L.) is a vulnerable species according to the International Union for Conservation of Nature (IUCN) and is included as a protected species under several international conventions. Sea Turtle Egg Fusariosis (STEF) is a worldwide emergent fungal disease associated with egg and embryos mortality in endangered sea turtle nests such as those of *C. caretta*. The disease can lead to a significant mass mortality in the infected nests and is caused by a complex of species belonging to *Fusarium* genus with isolates included in the *Fusarium Solani* Species Complex (FSSC) (Sarmiento-Ramírez *et al.*, 2010).

Pathogenic fungi can infect and grow within *C. caretta* nests by first creating a mycelial network on eggs, whose surface results completely covered; to follow they produce enzymes and organic acids that destroy the shells by dissolving organic substrates and calcium carbonate. Eggs show colored infection zones, which can turn into necrotic lesions and kills the surviving embryos (Gleason *et al.*, 2020). However, many questions regarding the etiology and epidemiology of these diseases as well as the biology and ecology of the causal agents are still open. As example, it is unclear whether these pathogens are invasive species or natural nest inhabitants able to cause disease under a changing environmental scenario.

*C. caretta* is the only sea turtle species nesting along the Tuscan coastline and the Tuscan archipelago where nests are becoming more numerous and widespread. At the same time, in the recent years a continuous monitoring of nesting and hatching sites allowed to record an increased number of affected nests, presumably due to STEF. During the samplings carried out in 2019-2020 in several localities on the Tuscan coast (province of Grosseto), a large number of eggs showing symptoms resembling those caused by STEF were found. Symptomatic eggs, characterized by an unusual coloured area compared with healthy ones and/or covered with mycelium, were collected from nests located in three beaches along the coast. Eggs portions were plated on a selective growth medium in order to isolate associated fungi. Following the



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development of fungal colonies, a total of 33 isolates were obtained and submitted to a morphological identification followed by a molecular characterization. gDNA extracted from single spore cultures was used to amplify the elongation-factor (TEF-1 $\alpha$ ) gene, a useful region for fungal taxonomic and phylogenetic studies (Baroncelli *et al.*, 2014). Amplicons were sequenced and used to assign the species, thus allowing to identify our isolates as *Fusarium solani*, *Fusarium oxysporum* and *Fusarium nodosum*. While *F. solani* and *F. oxysporum* have been already associated with *C. caretta* eggs showing symptoms of fungal infection, as far as we know, this is the first time that *F. nodosum* was isolated from affected eggs. This is a noteworthy result, since *F. nodosum* is a mycotoxigenic plant pathogenic fungus, belonging to the complex of *Fusarium* species causal agents of Fusarium head blight of wheat, recently reported for the first time in Italy on *Triticum durum* (Felici *et al.*, 2021).

This work represents the first report of STEF on Tuscan coast. Although Tuscany does not represent a primary nesting area of *C. caretta* in Italy and in the Mediterranean, the record of the disease on this coastline, in line with what is happening across the globe, confirms that STEF may represent a major risk for the conservation of the loggerhead sea turtle also on our geographical area (Gleason *et al.*, 2020), also taking into account how natural systems can be affected by the present climate change perspective.

For these reasons, isolation and characterization of fungal isolates will help us to decipher their biology and epidemiology and will allow a better management of disease prevention strategies. Further studies need to be focused on pathogens phylo-biogeography, mechanisms of dispersion and colonization of coastal habitat, and environmental and physiological parameters for infection, to better understand the current and future impact of STEF on sea turtles' conservation worldwide.

Acknowledgements: Authors are grateful to "Associazione tartAmare" (Grosseto, Italy) for active nests monitoring and for providing affected eggs.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### ABSTRACTS PRESENTATION

**TITLE: Effects of hand-dredge fishery on intertidal megabenthic fauna on the southwestern Spanish coast: Damage and discards**

**SESSION:** Flora and Fauna of the littoral system: dynamics and protection

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

#### **General frameworks and Objectives**

The wedge clam *Donax trunculus* is widely distributed in moderately exposed beaches at depths ranging between 0 and 6 m along the Mediterranean, Black Sea and Atlantic Ocean, from France to Senegal. *D. trunculus* is an important commercial species mostly caught by authorized fishermen using individual hand-dredges in shallow waters throughout the littoral of Huelva (SW Spain). Biological or fishery aspects of *D. trunculus* have been widely studied throughout European coasts. Nevertheless, information regarding the damage inflicted by fishing gears on this species is scarce (Baeta *et al.*, 2021; Urra *et al.*, 2021). Particularly, there is not information about discard composition and the effects of hand-dredge on the whole intertidal megabenthic fauna. This type of information is crucial for the improvement of fisheries management, as it is established in the Common Fisheries Policy (EU Regulation N° 1380/2013).

The aim of this study was to assess the discards and define the effects of hand-dredge fishery on the intertidal megabenthic fauna inhabiting the area of the SW Spanish coast.

#### **Material and Methods**

The study area covers the intertidal area from the mouth of the Guadiana River in Ayamonte (Huelva coast) to the Guadalquivir River mouth. Samples were collected on a monthly basis from January 2019 to September 2021, using an experimental hand-dredge similar to those used by local bivalve harvesters. The hand-dredge had an iron structure with a 44.5 cm wide opening that digs deeply into the sediment, using a commercial mesh size (7 x 7 mm). At each sampling site, hand-dredges were towed diagonally to the shoreline for 5 min, each transect being geo-referenced. The number of retained individuals was recorder to estimate population density (ind.m<sup>-2</sup>) and biomass (g.m<sup>-2</sup>). All specimens were identified to the lowest possible taxonomic level. Damage was assessed using a scale proposing by Gaspar *et al.* (2003) with a few modifications, where D0 correspond to individuals in perfect condition, D1 individuals with low damage, D2 individuals with intermediate and D3 with severe damage. Foot damage were analysed in 700 *D. trunculus* individuals randomly selected.

#### **Results and Discussion**

*D. trunculus* represented the 83.63% of total catches. Discards were composed of more than 60 taxa, with molluscs being the best represented group (94.67%) followed by crustaceans (4.72%) (Table 1). The sea urchin *Echinocardium mediterraneum* (69.16%) and the bivalve *Macomopsis melo* (48.72%) were the most affected, with both species showed intermediate or severe damage. Data suggests that species with soft-body or fragile shells were the most impacted by hand-dredging activity (Table 2).

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71.492 *D. trunculus* individuals were analysed and 289 (0.4%) suffered some type of shell damage, with 0.05% of individuals displaying D1, 0.02% D2 and 0.33% D3. Overall, 8.49% of analysed individuals showed foot damage. These results were lower than those obtained by Urrea *et al.* (2021) in populations of wedge clam caught by mechanical dredging in the Alboran Sea (2.4% with shell damage and 15.9 % with food damage). According to our results, *D. trunculus* displayed a high proportion of undamaged individuals and suggest a good resistance to hand-dredge fishery, which promotes the survival of discarded undersized individuals. In agreement with studies about the effects of mechanized dredging (Urrea *et al.*, 2019, Baeta *et al.*, 2021) the level and type of damage was dependent on the biological characteristics of the species such as morphology, body size and structure.

Table 1. Mean density and biomass of the ten most abundant discarded species

Taxa	Density (ind.m <sup>-2</sup> )	Biomass (g.m <sup>-2</sup> )
<i>Macra stultorum</i> (brownish variant)	2.69	8.94
<i>Macra stultorum</i> (whitish variant)	2.64	8.75
<i>Diogenes pugilator</i>	1.95	0.54
<i>Echinocardium cordatum</i>	0.99	14.59
<i>Tritia vaucheri</i>	0.63	0.07
<i>Donax semistriatus</i>	0.62	0.54
<i>Echinocardium mediterraneum</i>	0.54	2.69
<i>Macomangulus tenuis</i>	0.44	0.42
<i>Liocarcinus</i> sp.	0.27	0.45
<i>Chamelea gallina</i>	0.27	0.84

Table 2. Proportion of the most damaged species in discards of the *D. trunculus* hand-dredge fishery

Taxa	%D1	%D2	%D3
<i>Echinocardium mediterraneum</i>	4.67	35.51	28.97
<i>Macomopsis melo</i>	0	0	48.72
<i>Ophiura ophiura</i>	30.50	4.50	6.50
<i>Macomangulus tenuis</i>	0.47	0	24.41
<i>Echinocardium cordatum</i>	13.33	0	10.00
<i>Echiichthys vipera</i>	0	0	20.00
<i>Macra stultorum</i> (whitish variant)	0.49	0.24	13.61
<i>Liocarcinus</i> sp.	9.19	2.53	2.53
<i>Macra stultorum</i> (brownish variant)	0.64	0.05	13.55
<i>Portunus latipes</i>	3.92	2.85	4.28

**Acknowledgements**

The study was funded within the framework of the projects “VENUS” (Estudio integral de los bancos naturales de moluscos bivalvos en el Golfo de Cádiz para su gestión sostenible y la conservación de sus hábitats asociados) (0139\_VENUS\_5\_E; INTERREG-POCTEP) and “FEMP\_AND\_04” (Programa plurianual en el ámbito de la recopilación de datos de la comunidad autónoma de Andalucía: Análisis de la pesquería de coquina en el caladero del Golfo de Cádiz).

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### ABSTRACTS PRESENTATION

**TITLE: SPATIAL DISTRIBUTION AND COMMUNITY STRUCTURE OF MEGABENTHIC BIVALVES IN THE SUBTIDAL AREA OF THE GULF OF CÁDIZ (SW SPAIN)**

**SESSION:** Flora and Fauna of the littoral system: dynamics and protection

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

The Gulf of Cadiz (GoC) is an exploited ecosystem of the Iberian Peninsula characterized by high marine biodiversity and productivity. Amongst the bottom fishing activities conducted in the GoC the hydraulic dredging targets the clam *Chamelea gallina*, which has a high socioeconomic importance in subtidal soft bottoms. Thus, knowledge about the bivalve assemblages and distribution associated to natural beds of the striped clam *C. gallina* claim to be necessary in order to improve the sustainable and efficient management of this fishery resource. Previous studies of bivalves in the subtidal area of the GoC have been focused on soft bottoms from Bay of Cádiz (1), annual reports about the fishing grounds of *C. Gallina* (2), including discard and by-catch of the fishery (3), but scarce studies addressing diversity and spatial distribution.

The objective of this study was to analyse spatial diversity and species distribution of bivalve (> 2 mm) communities off the Spanish coast of the GoC and to relate the observed patterns to depth, sediment, water (temperature, salinity) characteristics, proximity of river outflows and wastewater treatment plants (regional scale). A sampling survey was conducted (ACUVEN-3, May-June 2019) using a commercial hydraulic dredge and following a systematic scheme where stations were located every 1 nautical mile and covering 3 depth strata [3-6m] [7-9m] [9-12m] from the mouth of the Guadiana River to the mouth of the Guadalquivir River including the Marine Protected Area of Doñana. In every station the dredge was deployed and towed parallel to the coast during 5 minutes and each transect was also geo-referenced by means of a GPS (GPSMAP 64s) in order to calculate the sampled area (m<sup>2</sup>). The resuspended bottom material (sand and organisms) retained in the dredge was poured into a hopper. 5 l. samples were randomly collected from the hopper and sent to the laboratory to be examined and sorted. All organisms were taxonomically identified, counted and weighed. Density and diversity (produced with multivariate universal kriging) and species distribution (based on presence and absence) maps were performed. Five geographic zones were defined according to influence of River influence and wastewater treatment plants: GUAD (Guadiana River), PIED (Piedras River), ODI (Tinto and Odiel Rivers), EMAT (EDAR and Matalascañas) and GUAQ (Guadalquivir River).

A total of 49,624 megabenthic bivalves from 112 samples were identified alive belonging to 42 species and 18 families. The most dominant species in terms of density (ind m<sup>-2</sup>) was *Chamelea gallina* (59.5%) followed by *Spisula solida* (13.3%). Total densities of bivalves reached higher values between the depth ranges of 7-8 m surrounding Tinto and Guadalquivir Rivers mainly due to the high dominance of *C. gallina* (Fig.1A)

The most frequent species were *C. gallina* (97%), followed by *Macra stultorum* (72%). Of the total identified



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species, 26 occurred less than 10% and thus were considered very rare in the area. The maps of species distribution based on presence and absence illustrated/revealed differences between species. The bivalves *C. gallina*, *M. stultorum*, *Pandora inaequalis*, *Corbula gibba*, *Spisula subtruncata*, *Donax semistriatus* and *Dosinia lupinus* showed wide spread distribution. On the other hand, there were species only found in the GUAD and GUAQ zones, respectively. Diversity and evenness analysis revealed significant differences among zones, mainly observed between western (GUAD and PIED) and eastern (EMAT and TODI) zones. The maps indicated greater diversity around the Guadiana and Piedras Rivers outflows showing a clear decrease in bivalve diversity from western to eastern where the EMAT zone exhibit the lowest diversity (Fig. 1B-C). Overall, the EMAT zone showed lower diversity and lower evenness (i.e. assemblages dominated by few species) (Fig.1D). On the other hand, GUAQ zone displayed in general low diversity and high evenness in the deeper areas but no clear trend was observed in the other zones. The analyses of bivalve assemblages also revealed significant differences between zones with an average dissimilarity of 60.27 %. Despite these differences, twelve species were shared between the four zones.

Results of this set of analyses enhanced the knowledge of diversity and spatial distribution of bivalves in the subtidal area of the GoC. Additionally, River outflows or marine reserve effect seemed to play a notable role in their settlement and the location of density spots. This information should be taken into consideration in commercial marine resources management's strategy.

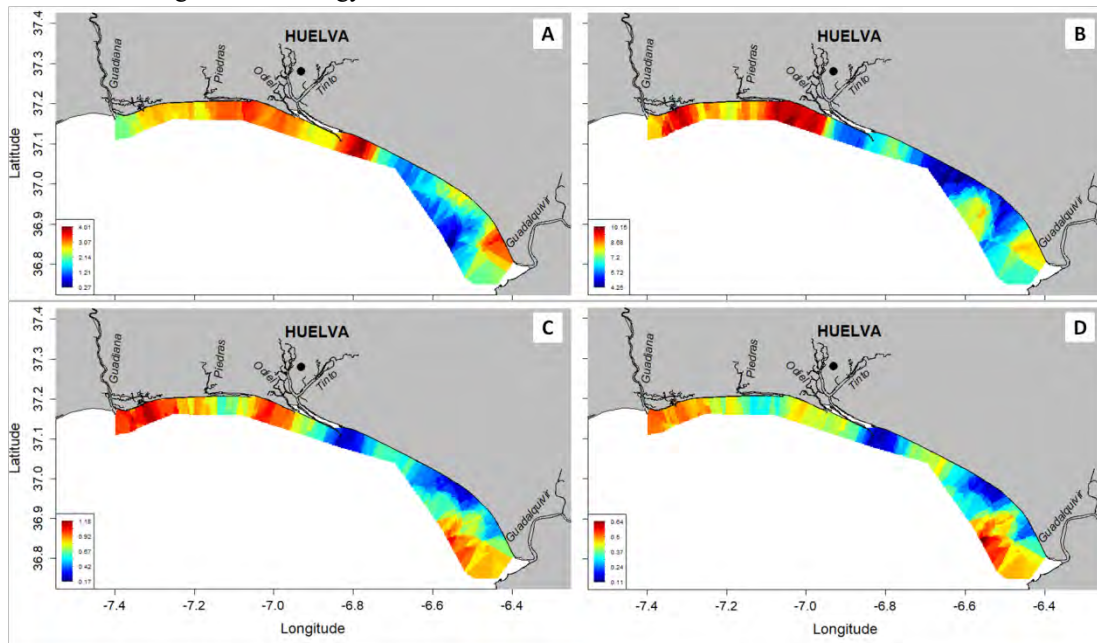


Figure 1. Kriged maps for density ( $\text{ind m}^{-2}$ ) (A), species richness (B), Shannon index (C) and evenness (D).

### Acknowledgements

The present study was developed within the framework of the project VENUS (Estudio integral de los bancos naturales de moluscos bivalvos en el Golfo de Cádiz para su gestión sostenible y la conservación de sus hábitats asociados) (0139\_VENUS\_5\_E).

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** Stand structure and natural regeneration in a coastal stone pine forest (*Pinus pinea* L.) in central Italy

**SESSION:** Flora and Fauna of the littoral system: dynamics and protection

**AUTHORS:** Davide Travaglini<sup>1</sup>, Cesare Garosi<sup>1</sup>, Francesca Logli<sup>2</sup>, Francesco Parisi<sup>1</sup>, Ilaria Ursumando<sup>1</sup>, Cristina Vettori<sup>3</sup>, Donatella Paffetti<sup>1</sup>

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

In Italy stone pine forests (*Pinus pinea* L.) have traditionally been cultivated for the production of both wood and pine nuts. To accomplish these objectives forest management generally prescribes even-aged stands and the clear cutting system with artificial regeneration.

In the last decades pine forests have become even more important for their social and cultural role, as well as for landscape conservation, especially those included within protected areas along coastal districts. For this reason, it is important to investigate whether the classic silvicultural system is the most appropriate to achieve the current public needs or if there is a need to shift to more sustainable and close-to-nature silvicultural methods. Despite the relevance of this topic, in Italy few studies have focused on natural regeneration of stone pine forests and their management as uneven-aged systems.

This study was carried out in the Regional Park of Migliarino, San Rossore and Massaciuccoli (Tuscany, central Italy). The Park hosts historical coastal stone pine forests which are included within the Natura 2000 site Selva Pisana (Site code: IT5170002). Forest structure consists of a composite of even-aged pine stands with a vertical structure comprising one or two strata. In a stone pine stand located in the Tenuta di San Rossore we found an interesting case of natural regeneration of pine, which was selected as Demonstration site within the LIFE SySTEMiC project: Close-to-nature forest Sustainable Management under Climate Changes (LIFE18 ENV/IT/000124). According to the project HASCITu (Habitat in the Site of Community Importance in Tuscany), the selected pine stand is classified as habitat 2270 - Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*.

The objectives of our study were (1) to characterize the forest structure of the selected stone pine stand and (2) to quantify the natural regeneration of pine.

Fieldworks were carried out in three experimental plots (50 x 100 m). In each plot, the x,y coordinates of all trees with a height greater than 20 cm were recorded. For trees with a diameter



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at breast height (dbh) greater than 2.5 cm the dbh, tree height, crown length and crown projection were measured. For trees with a dbh less than 2.5 cm the diameter at the base of the stem and the tree height were collected. The data were processed using quantitative structural indexes and spatial statistical analyses.

Our results show that stem density varied between 64 and 84 trees per hectares and the wood volume varied between 283 m<sup>3</sup>/ha and 366 m<sup>3</sup>/ha. The vertical distribution of crowns in the stand assessed using the TSTRAT function ranged between one and two layers. The stem density of the natural regeneration of pine varied between 362 and 688 trees per hectares. Most of the regeneration was represented by seedlings (82-90 %, height < 130 cm) and the remaining by saplings (10-18 %, height ≥ 130 cm).

The results were finally discussed and forest management guidelines based on silvicultural systems as alternative options for the management of coastal stone pine forests were presented.

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**SESSION**

**UNDERWATER AND COASTAL  
CULTURAL HERITAGE**

# **ORAL PRESENTATIONS**



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE: Territorial transformations, landscape and architectural features of the “Tenuta di Isola Sacra” in the reclamation of the early 1900s.**

SESSION: Cultural heritage

KEYWORD: History of the coastal territory

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

***General frameworks and Objectives***

The contribution presents the first acquisitions relating to the transformations of the territory of *Isola Sacra*, in the *Agro Romano*, between the end of the 19th century and the first half of the 20th century, implemented through the land reclamation and enhancement work initiated by the Genius Civil, by the first reclamation cooperatives and definitively completed by the National Opera for Fighters - *Opera Nazionale Combattenti*.

The intent is to return, also through the graphic and photographic documentation preserved in the archives, a crucial phase of the territorial development of the area, which has left deep traces, but not easily recognizable, and to recompose the overall image of a context that more quickly than others, in the course of the last decades, have suffered the effects of often uncontrolled transformations and in which it is difficult, today, to identify the signs of a past as recent and significant as it has been obliterated in many of its architectural and landscape features.

At the basis of the work is the deep conviction that the protection and enhancement of this territory, today appreciated and known above all for its immeasurable archaeological treasures, including the *Necropolis*, the *Matidia Baths*, the *Portuense Iseo*, the early Christian *Basilica of S. Ippolito*, witnesses of an importance that lasted until centuries, but also bound by its landscape values since the years 1985 with a *Statement of significant public interest*, must also pass through the rediscovery of historical events and landscape features that have identified the most recent structure, strongly determined by the presence of waterways and the combination of reclamation infrastructures, agricultural fabric and rural construction, now incorporated into recent building fabrics to the point of being almost no longer recognizable. Rediscovery necessary to give comprehensibility, meaning and future, in terms of conservation and continuity, through knowledge and a path of cultural re-appropriation, to the architectural and landscape values still strongly present in this territory.



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### ***The territory and recent events***

The Sacred Island - *Isola Sacra*, (this is how the strip of land between the Tiber and the artificial canal called *Fossa Traiana* was called in ancient times), was in the Imperial era a prosperous and populous territory between Ostia and Portus, overlooking the line of the coast; in the centuries following the decline of the two cities it slowly transformed into one of the many marshy and malarial areas, sparsely inhabited, along the Tyrrhenian coast. After centuries of neglect, similarly to many other areas, left to large estates and scarcely cultivated, it was affected by massive reclamation and infrastructural interventions to bring it back to agricultural productivity, in particular in the context of the huge economic and social reconstruction effort of the Country that followed the conclusion of the Great War. Not a secondary intent, but a declared priority in the interventions, was the reintegration of veterans into society and the productive life of the Country, which at the time meant, above all, agriculture.

The study examines the period between the first reclamation actions, started around 1885 by the Civil Engineers, and the vast transformation work for agricultural use carried out between 1920 and 1950 by the “Opera Nazionale Combattenti”, with the creation, in the “Tenuta di Isola Sacra”, of an articulated system of farms and gardens, each with its own farmhouse, and of an equipped Direction Center with Management and supporting buildings, still present today, although used for different purposes, not always adapted to the architectural characteristics of the buildings.

Particular attention is paid, in the study, to the activities carried out between 1920 and 1950 by the Opera Nazionale Combattenti, which were decisive for the structure of the area, analyzing the road infrastructures, reclamation and architectural artefacts, some of which are really valuable despite their simplicity.

Particular attention is also paid to the architectural aspects by identifying, through the archive sources and the original projects, the architectural typologies of rural buildings adopted in this area, with the different “models” of rural houses that are repeated in the farms, together to the agricultural annexes functional to the activities, also in order to be able today to identify the buildings that still exist despite extensions and transformations.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** THE PORT OF NEAPOLIS: MEMORIES AND TRACES OF THE COASTAL LANDSCAPE IN ANCIENT TIMES

**SESSION:** UNDERWATER AND COASTAL CULTURAL HERITAGE

**AUTHORS:** CLELIA CIRILLO, GIOVANNA ACAMPORA, LUIGI SCARPA, MARINA RUSSO, BARBARA BERTOLI, LOREDANA MARCOLONGO

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**ABSTRACT:**

*The excavations carried out for the construction of the new subway, in line with the activities of "preventive archaeology" carried out by the Superintendence "Archaeology, Fine Arts and Landscape" of the City of Naples, have allowed an exploration of the stratification of the subsoil that has clarified the difficult topographical problem on the location of the port of the Greek-Roman Naples. For the reconstruction of the ancient coastal landscape and the profile of the bay of Neapolis, the excavations for the construction of the city subway provided a fundamental contribution. Most of the traces of the ancient coast have been found during the works for the realization of the lines 1 and 6 of the subway, that run respectively along the Rettifilo and the Riviera di Chiaia. Furthermore, the archaeological findings within the excavation of the Municipio station have made it possible to identify precisely the ancient inlet where the port of Greek-Roman Naples was located. Along the stretch of the subway that runs along the Riviera di Chiaia stratified deposits have emerged referable to a coastal environment, leading to identify in ancient times the existence of a transition zone between submerged and emerged beach. Thanks to geo-archaeological research carried out during the completion of the Duomo and Garibaldi stations, which fall in the area between the sea and the plain on which Neapolis was founded, it has been possible to shed light on many useful testimonies to reconstruct the coastal landscape. Important findings during the archaeological explorations conducted between Piazza Nicola Amore and Piazza Garibaldi, have ascertained the previous existence of a beach, in a context of coastal environment predominately emerged. As mentioned above, in Piazza Municipio the geo-archaeological studies have ascertained the presence of the port obtained in an inlet maybe used as a landing place already in the most ancient phases of the settlement of Greek colonists; a port used first by Parthenope and then by Neapolis, and that was used certainly in the Roman age and until the late ancient age. During the excavation work for the two subway lines, traces and memories of the ancient coastal landscape emerged, which helped to outline not only the profile of the port inlet of Neapolis, but also that of a large cove located in the area excavated to build the station Università in Piazza della Borsa. The researchers considered this inlet to be a marginal area of the ancient port basin that remained in function even in late ancient times, and geomorphological analyses have revealed the formation of an emerged beach that after years returned to be entirely submerged. A further indentation of the ancient coast has been identified in an area in front of the hills of Monterone and San Marcellino, adjacent to the fortifications that once surrounded the plain where Neapolis was built. Outside the southern section of the city walls, which ran along the northern front of Corso Umberto up to Forcella, geo-archaeological surveys have identify geological sections structured by more ancient levels, corresponding to an emerged beach environment in which ceramic materials of protohistoric age have been found. The transformations undergone by the shorelines of the bay of Neapolis depended on anthropic and natural phenomena due to bradyseism, the silting up of the coastline and the accumulation of debris transported by the basin collecting*



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*waters of the hills surrounding the plains of Parthenope and Neapolis. Therefore, the ancient landscape of the bay had to present stretches of high coastline alternating with beaches and coves, such as that discovered in the basement of Piazza Municipio, chosen as a landing place by the Greeks and Romans. From the exceptional amount of traces and finds, it has been possible to reconstruct the urban layout of the ancient port that has re-emerged with its docks and its ships. The work and the studies of archaeologists and geologists, through the reconstruction and the connection of the stratigraphy and the data of the geoarchaeological prospecting campaigns, have clarified how the inlet has been disappearing during the centuries due to the overlapping of natural phenomena, such as subsidence, swamping, cover-ups, and anthropic phenomena, until the complete transformation of the coastline by the casting of the modern port.*

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*...in finibus Lucaniae.*

The drawing of tyrrhenian coast and its demographyc fluctuations

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In 1928, Raffaele Ciasca published a volume entitled "History of the reclamation of the Kingdom of Naples" and, in the first part of the work, reports a clear analysis of the reasons that led the South of Italy to be "hydraulically disordered". To the causes of natural origin, such as malaria, he added the historical causes such as the abandonment of lands and all the obstacles that, still in 1928, made the territory disordered. Water, through rivers, lakes and seas, draws the territory, draws its boundaries: cities are born near the largest and smallest watercourses but the swamping of a stretch of coast represented the loss of population and also of markets and trade. The fluidity of the water, the natural variations of the river beds and mouths of the rivers, the geomorphological transformations make us understand that the design of the coastal territory must be approached with great caution, especially if one intends to use historical cartography as the main source of a study : these cards, in some cases, have the same value as an instant photograph and only draw the territory at a precise moment. Instead, in maps of a more general nature and where larger territories are drawn, there is greater reliability also in reference to the physical borders of a particular region but also to the political ones. On the maps, depopulation is highlighted with different cartographic symbols according to the period in which the map was drawn: for a long time there are two Maratea, the one above and the one below, only since 1881 the construction of the port and, therefore, the birth of a nearby village and, to the south, Castrocuoco perched on a motta that was depopulated and never rebuilt. The nearby towns of Calabria such as Tortora, Aieta and Praia a mare with the Dino island and the Fiuzzi village gravitated towards Castrocuoco and Maratea and are an integral part of this study. Although divided by the Noce river they are *in finibus Lucaniae* and up to Borgo Fiuzzi they seem to belong to the same conformation as Castrocuoco with vast coasts and beaches of very large dimensions and steep rocky walls full of caves. In fact, the Angevin focatic taxation of 1276 and 1443 included Castrocuoco in the Jordanian land and Val di Crati and not in the Giustizierato di Basilicata, in other documents, however, Aieta, Tortora and Praia a mare are listed among the centers of Basilicata. In this stretch of coast beyond the fortifications of Castrocuoco rise the Torre di Tortora, the Torre del Fortino or del Fumarolo, the Torre di Fiuzzi and the Torre dell'Isola Dino. Historical cartography reports information on these watchtowers built in the sixteenth century with the great project of militarization of the coasts of the Kingdom of Naples to defend themselves from the invasions of the Turks with the order of Pietro da Toledo of 1532 and that of Pedro Afan de Ribera del 1563. Over the centuries, on the border between Basilicata and Calabria we have witnessed very particular demographic variations and fluctuations. The city of Blanda identified in recent archaeological excavations in the territory of Tortora which disappears in the 5th century AD, the birth of Tortora and Aieta in the Apennine mountains according to that typical name of the castle of the early medieval period, the settlement in the Fiuzzi district of Praia a Mare and on its rocky pediment and full of caves, settlements of Italian-Greek monks. With the arrival of the great migrations of Albanians after the advance of the Turks, villages with the presence of these populations were born in this area too: in the territory of Praia that belonged to Aieta the village of Plaga Sclavorum was born, most likely in the area located between Torre Fortino and Fiuzzi. With the twentieth century and the mass tourism of the 60s, Aieta and Tortora begin a slow process of depopulation that leads to the birth of settlements towards the sea with Tortora marina and Praia a mare which had already become an autonomous municipality in 1928. settlements on the coasts also take effect with the repopulation of the new Castrocuoco located on the sea near the area of great tourist attraction called the Secca, in Aieta there are about 750 inhabitants and in Tortora, a town about 500 inhabitants.



Foto 2 - Atlante del Regno di Napoli ridotto in 6 fogli da Giovanni Ant. Rizzi-Zannoni, XIX secolo. Particolare.



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Livorno (Italy), June 2022

### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

Protecting the landscape and cultural heritage of Salento to safeguard the sustainable development of its coastal areas

**SESSION:**

UNDERWATER AND COASTAL CULTURAL HERITAGE

**AUTHORS:**

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The remarkable development of the tourism sector and the economic growth that has characterised Salento in recent years have been accompanied by unregulated use of its land. The obvious consequence of this is the degradation of the landscape and cultural heritage of Salento, particularly in its coastal areas that are most vulnerable.

Coastal areas are particularly important for both trade and tourism in Salento and need to be adequately protected while pursuing the desired development of the local economy. Protection of the coastal areas is made more challenging by the seasonal nature and complexity of the economic activities taking place, and by the different roles and responsibilities of the national government, the regional government and the local authorities from both the administrative and legislative standpoints.

Striking a balance between safeguarding the landscape and cultural heritage of Salento and continuing to develop the local economy is critical to its future prosperity. In fact, it is the exceptional landscape and cultural heritage of Salento that is driving its economic growth and therefore protecting them both is paramount. Economic growth and protection of the landscape and cultural heritage of Salento need to go hand in hand, and be based on models of development that are specifically designed around its unique attributes rather than borrowed from other areas. The protection of the landscape and cultural heritage are considered by the Italian constitutional jurisprudence a primary and absolute value and, therefore, they fall within the exclusive competence of the State. On these grounds, protection of the landscape and cultural heritage takes priority over other public interests that fall within the remit of the Regional and local authorities. The Italian Constitutional Court has repeatedly expressed the view that the provisions of the Code of Cultural Heritage and Landscape have both economic and social value and, as such, it is in the collective interest of society to ensure that landscape and cultural heritage is duly protected.



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Developing a sustainable model for social and economic development of Salento requires, first and foremost, moving away from the simplistic perspective that sees landscape protection and economic development as antagonistic, and that the protection of the landscape is mainly motivated by aesthetic reasons. Such a perspective often originates from the lack of local development strategies characterised by well-defined objectives. On the contrary, a sound development strategy is one that recognises that protecting the coastal landscape is not for its own sake, but rather it is intended to ensure that the relationship between man and the environment continues to evolve in harmony as it has done in the past, shaping the landscape and the cultural heritage of Salento into what it is today. As human activity continues to shape the landscape of Salento, it is therefore paramount that the value of the latter does not degrade. Building such a strategy requires the development of a constructive dialogue involving the national, regional and local institutions. Such a dialogue can also help resolve disputes, should they arise, among different parties in the public and private sectors.

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## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

TITLE: THE TORRE DEL MARZOCCO AND THE WIDENING OF ACCESS TO THE INDUSTRIAL CHANNEL OF LIVORNO

SESSION: UNDERWATER AND COASTAL CULTURAL HERITAGE

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

*General frameworks and Objectives:*

Located in the core of Livorno port, inside the area to the north of the city, the Torre del Marzocco symbolizes the past, the present and the future of the city, rooted in port activities and its traffic.

The Torre is an ancient watchtower, dating back to the 15<sup>th</sup> century, that owes its name to the presence of the “Marzocco”, the rampant heraldic lion symbol of Florence, apparently the first piece of public secular sculpture commissioned by the Republic of Florence. After the decline of Pisa and its port, the *Porto Pisano*, in 1421 the Republic of Florence gained full control over Livorno’s fortress, located in a cove south of the *Porto Pisano*, inside of which a small village resided. As one of the first major construction projects carried out by the Florentine government in Livorno, the tower became an emblem of the early Renaissance. It remained at the heart of the port and was restored several times. Since the early decades of the twentieth century, it has been incorporated into the new commercial port amidst its expansion. Finally, in the 1970s it was embedded in the new “Darsena Toscana” container terminal, remaining, as in the past, witness to the port’s development.

Today, the *Torre del Marzocco*, still located inside the container terminal, bears witness to the enormous expansion the port is going through. In fact, it stands proud between the two most important infrastructural projects that will give a new dimension to Livorno port: the so-called “Piattaforma Europa- Europe platform”, the seaward expansion facility next to the “Darsena Toscana” terminal and the widening of the bottleneck of the industrial channel known as the ‘micro-tunnel’.

The micro-tunnel involves creating a 234 m tunnel at a depth of over 20 m below sea level to cross the entire Industrial Channel, starting from the *Darsena Toscana* dock, where the pressure shaft is located, and arriving at *Calata del Magnale*, where the reception shaft has recently been constructed. The shafts will be buried once the new pipelines for oil pipes, power



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lines, optical fibres and industrial water have been installed. The work is of vital importance for the port: in fact, once the new underground tunnel has been created, it will be possible to eliminate the old pipes that currently cross the access channel and cut back the second part of the bank of the narrow passage on the *Torre del Marzocco* side, adding a quayside area and deepening the seabed.

This will therefore conclude the cutting back and quaying operations on the bank of the narrow passage on the *Torre del Marzocco* side. The first phase, carried out in 2011, made it possible to partially widen the navigable section and to deepen the channel bed.

The aim of this second phase of work is to widen the navigable channel to 125 m, and to take it to a depth of between -13 and -15 m, therefore finally making it possible for container ships of up to 10000 TEU to transit in any weather conditions.

It is expected that the work to remove the existing pipes from the seabed (to be performed by ENI S.p.A.), and the initial deepening of the access channel bed will be completed by 2022. The second phase, which consists in the quaying of the narrow passage on the *Torre del Marzocco* side, including the restoration of the original water surroundings of the Tower itself, will begin in 2022.

All levels of legislation, from the national "Code of cultural and landscape heritage" of 2004, to the Regional Territorial Address Plan (PIT), the Provincial Territorial Plan (PTC), and the Municipal Strategic Plan (PS) and Urban Planning Regulations (RU), through to recently approved urban planning instruments such as the Master Plan for Livorno and Piombino, clearly underline the importance of safeguarding and enhancing cultural heritage. The new trend clearly shows the essential role that this heritage plays in the sustainable development of ports and in the resolution of conflicts in the port-territory relationship.

In this respect, the work planned in Livorno for the next three years involves a number of interventions, such as restoring the original moat around the Old Fortress, the renovation for new functional use of the Livorno grain silo or the restoration of the harbour defence fort. In this context, restoring the original moat and turning Livorno's Torre del Marzocco into a museum represent one of the most important safeguarding, restoration and reuse projects.

This article aims to explain the technical aspects of the Torre del Marzocco operation, presenting the two directives followed: safeguarding the construction; the enhancement and provision of new purposes, with an impact not only on the asset itself, but also on its context.

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**MONITORING OF MEDITERRANEAN COASTAL AREAS:  
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Livorno (Italy), June 2022

**FORM FOR ABSTRACTS PRESENTATION**

TITLE: THE COASTAL AND UNDERWATER CULTURAL HERITAGE OF CALABRIA. CASE STUDIES IN THE PROVINCES OF REGGIO CALABRIA AND VIBO VALENTIA

SESSION: PATRIMONIO CULTURALE COSTIERO E SUBACQUEO

AUTHORS: ALFREDO RUGA- ALESSANDRA GHELLI- ANDREA MARIA GENNARO- MICHELE MAZZA- MARCO STEFANO SCARAVILLI

AFFILIATIONS: SOPRINTENDENZA ARCHEOLOGIA BELLE ARTI E PAESAGGIO PER LA CITTÀ METROPOLITANA DI REGGIO CALABRIA E LA PROVINCIA DI VIBO VALENTIA  
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

THE CALABRIAN COASTS ARE RICH, ON LAND AND ON THE SEABED, OF ARCHAEOLOGICAL EVIDENCE THAT TELLS THE WAYS, FORMS AND PHASES OF ANCIENT POPULATION AND THE RELATIONSHIP BETWEEN MAN AND THE ENVIRONMENT.

WITH THIS CONTRIBUTION WE WANT, THEREFORE, TO PRESENT THE ACTIVITIES IN THE FIELD OF PROTECTION, SAFEGUARDING AND ENHANCEMENT OF THE COASTAL AND UNDERWATER CULTURAL HERITAGE CONDUCTED BY THE ABAP SUPERINTENDENCE FOR THE METROPOLITAN CITY OF REGGIO CALABRIE THE PROVINCE OF VIBO VALENTIA.

THE EVIDENCE IN QUESTION IS ARCHITECTURAL ELEMENTS PERTINENT TO BUILDINGS OF CULTS, SUNK AS A RESULT OF PHENOMENA OF BRADYSEISM, PORT INFRASTRUCTURES, FISH PONDS AND COASTAL QUARRIES. BUT ALSO WRECKS AND NAVAL ELEMENTS THAT NARRATE, IN THE DAILY LIFE OF MARITIME ACTIVITIES (FOR TRADE, TRANSPORT OF MEN AND TROOPS, FISHING), THE TRAGEDY OF UNFORESEEN NATURAL EVENTS (STORMS, STORM SURGES, BUMPS AGAINST OUTCROPPING ROCKS .. ) OR, EXCEPTIONALLY, HUMAN EVENTS SUCH AS CLASHES AND ASSAULTS.

THE CURRENT MORPHOLOGICAL CONFORMATION OF THE CALABRIAN COASTS IS COMPLETELY DIFFERENT FROM HOW IT APPEARED IN ANTIQUITY AND STILL UNTIL A FEW CENTURIES AGO.

IF AT THE TIME OF THE GREEK COLONISTS AND IN ROMAN TIMES BEFORE, AND AGAIN IN THE EARLY MIDDLE AGES AND UNTIL THE SIXTEENTH CENTURY, ON THE IONIAN BELT, FOR EXAMPLE, WERE ATTESTED PORTS AND / OR LANDINGS OF A CERTAIN IMPORTANCE, MADE IN CORRESPONDENCE OF PROMONTORIES DESTROYED BY CATAclysms OR AT THE MOUTH OF THE WATERWAYS, AT WHICH, IN MEDIEVAL TIMES AND ON THE THRESHOLD OF THE MODERN AGE THEY WERE BUILT, FOR DEFENSIVE PURPOSES, COASTAL TOWERS OR FONDACI, TODAY OF THESE ANCIENT LANDINGS ONLY



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FAINT TRACES HAVE REMAINED ON THE SEABED OR EVIDENCE OF DEFENSIVE WORKS ON THE COASTAL STRIP.

THE COASTS, REGGIO AND VIBONESE, ALSO DIFFER IN THE GEOLOGICAL NATURE OF THE SOIL, CHARACTERIZED BY OUTCROPS OF DIFFERENT LITHOLOGICAL CONFORMATION, SANDS AND GRAVELS ON THE IONIAN BELT, GRANITE, LIMESTONE AND SANDSTONE ROCKS ON THE TYRRHENIAN ONE. THESE LAST LITHOLOGICAL CONFORMATIONS WILL BE THE SUBJECT OF MINING ACTIVITY FOR A WIDE CHRONOLOGICAL PERIOD. THE OPENING OF COASTAL QUARRIES WAS PRIVILEGED TO OVERCOME TRANSPORT PROBLEMS. FOR PARTICULARLY HEAVY LOADS, SUCH AS THOSE OF BUILDING MATERIALS, WATERWAYS WERE PREFERRED.

PRIVILEGED WAY, ON THE OTHER HAND, FOR THE WOOD OF THE WOODS THAT ARRIVED ON THE COAST THANKS TO THE INTERNAL WATERS AND THAT FED SHIPYARDS AND CRAFT ACTIVITIES THAT PRODUCED CARPENTRY THAT REACHED FOR EXAMPLE ROME STILL BETWEEN THE SIXTH AND SEVENTH CENTURIES A.D.

ANOTHER IMPORTANT TESTIMONY OF THE PARTICULAR RELATIONSHIP WITH THE SEA are the fish PONDS, OF WHICH WE HAVE TWO WELL-DOCUMENTED CASES ON THE VIBONESE COASTAL STRIP.

THAT IN THE GULF OF HIPPONION/ VIBO tuna fishing was practiced in an industrial way, ATTESTS BOTH TO THE ANCIENT SOURCES, ATHENEO (DEIPNOSOPHISTAE, VII, 302) AND AELIANO (DE NATURA ANIMALIUM, XV, 3) THAT ENHANCE THE QUALITY OF THE HIPPONIAE FISH, DECLARING IT THE BEST IN THE MEDITERRANEAN, AND THOSE OF LOCAL SCHOLARS, WHO OFTEN, IN THE WAKE OF CLASSICAL AUTHORS, PROVIDE INFORMATION ON THE CONTINUATION OF FISHING IN MORE RECENT TIMES; BUT ABOVE ALL IT IS ATTESTED BY THE CONTINUITY OF THIS PRODUCTIVE ACTIVITY THAT REMAINED ALIVE IN THIS TERRITORY, EVEN IN LATER AGES, ALMOST WITHOUT ANY CHRONOLOGICAL BREAK.

REFERENCES: (MAX 4)

1. Calabria
2. Landings
3. Cave
4. Fish ponds

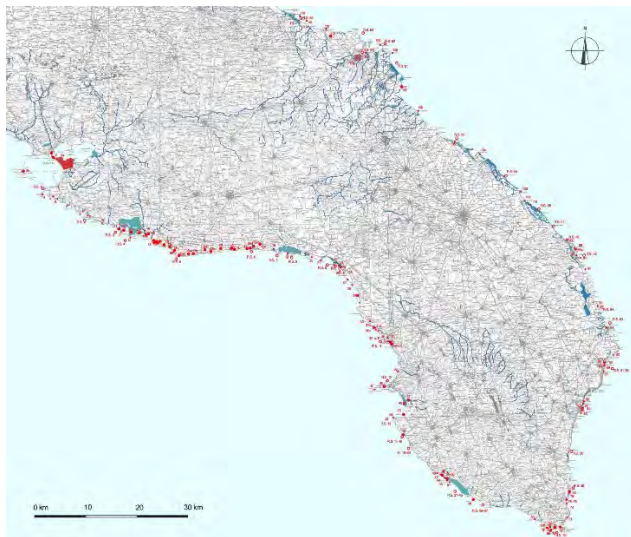


## Natural resources and coastal productive settlements in southern Puglia

Patrizia Tartara, CNR-IASI, Laboratorio Sistemi Informativi Territoriali per i Beni Culturali del territorio nazionale, session Patrimonio culturale costiero e subacqueo [patrizia.tartara@cnr.it](mailto:patrizia.tartara@cnr.it), tel. 06-49937505.

The systematic topographic researches conducted for many years by the CNR and by the Ancient Topography Laboratory of the University of Salento in Puglia, in particular in the Salento peninsula and in the Tavoliere, have led to an exponential increase in the knowledge of archaeological evidences and consequently to the analysis and reconstruction of the evolution of human settlement in the territory in the different phases, from prehistoric times to the medieval phase. The data collected with a detailed survey and the use of various traditional and advanced technologies are collected in the "Territorial Information System of Cultural Heritage of the Italian territory" of the CNR. The systematic analysis also involved the coastal strip, both Adriatic and Ionian; both have an uninterrupted sequence of settlements, often with a continuity of life from the Ancient Bronze Age to the Modern Age. During the second millennium BC there is a continuous chain of large settlements often provided with fortifications, often located on promontories or reliefs in relation to deep inlets or forms of landing of different types. The few cases of regular excavations have revealed large quantities of imported materials, which attest, already in the ancient phases of the Bronze Age, continuous contacts with the Aegean world. The topographical positions of these dominant sites after nearly three millennia will be replicated by the coastal watchtower and defense system. A particular type of settlements of limited size and in the past not identified, deserves particular attention: in different points of the coast there are very consistent heaps of whole and fragmented shells belonging to different species, but mainly of murex (*Phyllonotus trunculus*); heaps, even extensive, of shells are associated with large quantities of ancient ceramic fragments: table and fire pottery, especially amphorae and various materials related to fishing (net weights, nails, bronze sheets, etc.). Evidently they are very simple preparations for the collection of molluscs and the subsequent processing for the production of purple, essentially allocations of *purpurarii*, documented by ancient sources in this sector of the territory. The obtained product, extracting the dye base from a mollusk gland, was then sent to the dry cleaners (*bafii*); that in classical and Roman times they were mainly found in Taranto; still at the end of the third century AD. C. Taranto was the production center of the imperial purple (*NOTITIA DIGNITATUM*, Occ. XI, 1: *Procurator bafii Tarentini, Calabriae*). The war events of the following centuries caused the transfer of the *bafii* to Otranto but the production somehow continued until the Middle Ages; Taranto was certainly the site of settlements of *purpurarii* along the coast, then obliterated by modern urbanization; in the historical cartography an heaps of shells located on the coast of the Mar Piccolo is documented, however, still clearly visible at the end of the last century, known by the local toponym of "Monte dei Coccioi", attestation of a collection site, probably connected to the purple that various ancient sources place in this sector of the city. from the mollusk. The chronological span of the settlements recorded so far is very broad, but varies greatly as a result of the situation of the various sites; at last, it is possible to rely only on what is visible on the surface; mainly the materials show continuity of use of the sites from the late archaic and classical age to the late imperial age, but in at least two of the surveyed settlements the presence of Bronze Age materials is documented, always associated with murex shells and other ancient ceramic fragments of different chronology. In some cases, remains of masonry tanks with cocciopesto hydraulic coating are preserved, evidently functional to the

processing of the product. The settlements detected in all cases develop in situations of small pools, always associated with the presence of fresh water, small streams, springs, including underwater springs, small lagoons; evidently the contribution of fresh water in the sea creates favorable conditions for the proliferation of molluscs and therefore favors the quantity and quality of the kept. The settlements identified to date are all on the Ionian coast, where there are many springs and wetlands. The only presence of mounds of murexes in the Adriatic is for now that of Coppa Navigata (FG), however, dated to different phases of the Bronze Age. The study - and the protection - of the identified sites and the increase in research is important because they affect the coastal strip which is particularly at risk for seaside tourism and uncontrolled urbanization.





## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### ABSTRACT

TITLE:

**TUNA: UNDERWATER NATURAL AND CULTURAL HERITAGE.  
THE *TUNÈA* CASE STUDY, A PROJECT FOR THE RE-CONNECTION BETWEEN COASTAL  
COMMUNITY AND MARINE ECOSYSTEM**

SESSION: UNDERWATER AND COASTAL CULTURAL HERITAGE

AUTHORS: MARIA PINA USAI

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

*General frameworks and Objectives*

Understanding how marine nature and coastal culture intersect and how humans and non-humans have lived and live their interdependent relationship is a basis for sustainable coastal development.

Since ancient times, the resources coming from the sea have represented a primary source of wealth for coastal regions, but also an underwater cultural heritage, which has influenced the community's lifestyle and identity, as the landscape and architectural development of territories.

Among all, the one represented by tuna fish is particularly significant: the depiction of some tuna in the graffiti inside *Grotta dei Genovesi* in Levanzo testifies that the fishing of this species was practiced in Sicily already in Neolithic times; later on the Phoenician navigation routes that followed the tuna routes to the extreme coastal regions of the Atlantic made men and fish real 'travel companions', linking the Mediterranean and Atlantic regions in a cultural continuum until the threshold of the Roman age and beyond (Guirguis, 2017).

In this context, the Carloforte case study is particularly significant.

Carloforte is a small village located on San Pietro Island, Sardinia. The history, the culture and the physical conformation of the architecture on this little island are strongly linked to the submerged nature of its sea: San Pietro is in fact located along the route of passage of the Eastern Atlantic Bluefin Tuna (*Thunnus thynnus*), that at the beginning of each summer enters the Mediterranean to reproduce. Founded in the second half of the 1600s, the Carloforte *tonnara* is one of the last places in the Mediterranean that uses the fixed tuna trap, a traditional eco-sustainable fishing system which, by selecting only adult fishes, contributes to the repopulation of this endangered species. Until about thirty years ago, the life of Carloforte inhabitants was closely linked to the fishing activities, but then the evolution of the fish market has radically changed this relationship: the private part of the buildings complex is still in part active, while the public one is abandoned, and the ancient connection between the community and its *tonnara* is now interrupted.

In 2021 the author of this contribution started working on *Tunèa*, an interdisciplinary 'research in



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action' project developed in the frame of her PhD research at the University of Cagliari and within the U-BOOT Lab cultural association, which the author is co-founder.

Aim of *Tunèa*<sup>1</sup> is to study the dis-connection between Carloforte community and its *tonnara* through the activation of cultural actions that actively involve the community, the Municipality and the *tonnara* property, in order to understand if it is possible to re-create the lost relationship and, eventually, in which forms. Starting from June 2021 the project has been carried out together with a photographer and visual artist, with the contribution of an anthropologist and a landscape architect, involving marine researchers, biologists and community in a process aimed to discover and understand the local maritime identity linked to the tuna fishing tradition, opening the *tonnara* to the public for the first time and organizing visits, readings, sound suggestions, and an open dialogue between artists, researchers, inhabitants and visitors with the *Rais* (the fishing leader of the crew). The second phase of the project is dedicated to the reorganization process of some unused areas of the *tonnara* and to their reopening as cultural spaces, made accessible through co-design and self-construction activities with the active involvement of the community, in a shared process with the local administration, associations and stakeholders.

The project actions are intended to be preparatory to the development of a planning strategy shared between public administration, economic stakeholders and population through an informal participatory process with an art-based approach. *Tunèa* has been in fact recognized by the Carloforte Municipality as the basis of the path of reflection that the local administration is developing in order to identify new functions for the part of the *tonnara* now dismissed and in a state of ruins.

In October 2021 the *Tunèa* project was ranked among the winners of the Creative Living Lab call promoted by the General Direction for Contemporary Creativity of the Ministry of Culture for the support of multidisciplinary social innovation projects, dedicated to the redevelopment of proximity spaces within peripheral territorial areas through the active involvement of citizens.

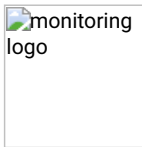
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<sup>1</sup> *Tunèa*, *tonnara* in Italian language, means tuna fishery in *tabarchino*, the dialect of the Ligurian language spoken by the community of San Pietro Island.

# **POSTER PRESENTATIONS**



**MONITORING OF MEDITERRANEAN COASTAL AREAS:  
PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

**FORM FOR ABSTRACTS PRESENTATION**

TITLE: FROM THE COAST TO THE INSIDE. ROUTES OF MEGALITHISM IN THE PREHISTORY OF CENTRAL-NORTHERN SARDINIA.
SESSION: COASTAL AND UNDERWATER CULTURAL HERITAGE
AUTHORS: PAOLA BASOLI
AFFILIATIONS: FORMER ARCHAEOLOGIST SUPERINTENDENT OF ARCHAEOLOGICAL HERITAGE OF SASSARI AND NUORO E-MAIL ADDRESS: BASOLI.PAOLA@TISCALI.IT
ABSTRACT (MIN 3000 MAX 5000 CHARACTERS): The coastal caves, the islands, the monuments, the artifacts, the engraved and painted representations on rock shelters, in hypogea and on outdoor rocks document forms of contact between the end of the Neolithic and the beginning of the Copper Age with the Mediterranean West (V-III millennium BC). The northern coastal areas included in the Gulf of Asina and in the archipelago of La Maddalena, the eastern ones represented by the inlets of Orosei and Arbatax and the western ones indicated by the bays of Capocaccia-Alghero and the Gulf of Oristano fit into this context . These inlets lead to important river routes, in particular the rio Mannu-Coghinas and the Tirso which, marked by megalithic monuments such as above all <i>dolmens</i> and <i>menhirs</i> , have formed passageways towards the interior of the island. In this panorama, significant places of worship in coastal caves are highlighted, such as the representations engraved on a rock of the Verde-Alghero grotto, where anthropomorphs intent on their hunting and daily life are represented; in the cave of the Pope on the island of Tavolara-Olbia the anthropomorphs painted in red ocher in the position of the praying person invoke or the graces to the divinities; in grott in the the engraved anthropomorphic Bue Marino Dorgali they are engrossed in a scene of worship to a solar deity and maybe the moon. Along the river routes there are cultural centers such as the prehistoric altar of Monte d'Accoddi-Sassari, a unique monument in the Mediterranean West. The monument, consisting of an elevated truncated pramide structure, which is accessed via a ramp, inside which a similar monument plastered in red was found , surrounded by <i>menhirs</i> , a village and hypogean necropolis, is the oldest building in the western Mediterranean. Megalithic complexes made up of aniconic, proto-anthropomorphic and anthropomorphic <i>menhirs</i> are arranged, individually or in alignment, at strategic points throughout the island. An exceptional aspect of megalithism is represented in Sardinia by the <i>menhir</i> statues of Laconi (OR) and the district of Allai (OR), Samugheo (OR), Senis (OR). These megaliths mainly depict male characters armed with the characteristic daggers of the Copper Age, erected near megalithic burials, but also female ones and with characteristic symbols elaborated in Sardinia. They are part of that vast cultural current that affects Corsica, Lunigiana, the Alpine Arc and the Midi of France. The complex megalithic framework of Sardinia includes imposing sepulchres. The dolmen of Monte Acuto-Berchidda (OT), with a simple rectangular plan, has the sides modeled in the rock, surmounted by two slabs of coverage; inside on the right wall a cupella is hollowed out, other cupels can be found on the ceiling, in correspondence with the back wall, made with large stones; the area in front of the monument is marked by a <i>menhir</i> and bounded by a wall. The DOLMEN DI LADAS-Luras (OT) is of the "corridor" type with a short anteroom. The DOLMEN DI SA COVECCADA-Mores (SS) is of a simple rectangular type with imposing lateral slabs, inserted in grooves dug into the rock, surmounted by a large covering space, and a front slab with a hatch; the left orthostat has a cupella on the outside and a rectangular storage compartment on the inside, dug into the rock; the sacredness of the place is indicated by a pillar <i>menhir</i> , defined on one face by lateral folds. Significant are the historiatiions in the open rock shelters of PUNTA ISTEDEDDI'-Padru (OT), in which mammellary forms of the natural rock have been outlined, and of Luzzanas-Ozieri (SS) where the anthropomorphic itiphallic with arms and

legs lower, associated in the pictorial composition in red ocher with an evident circular motif with a central point, they seem intent on a ritual dance propitiating fertility; in the polymazone stele of, Serra Is Araus-San Vero Milis (OR) which has eyes and mouth marked by cupels and four breasts in relief; in the statue-stele of Boeli-Mamoiada (NU), depicting concentric circles with a cup in the center, from which *crosse* sticks *branch off*, and numerous cupels of different sizes, variously articulated; in the engravings on the slab of the megalithic tomb of Monte Paza-Sedilo (OR), which are divided into cupels, also concentric circles with a central cup, from which vertical segments *branch off*, also *crosse*, to which are added a female figurine with raised arms and bell skirt and an overturned anchor-like motif; in the engravings on the rocks of Othierie-Irgoli (NU) depicting spindle-shaped signs, cupels and cruciform motifs; in Tortoli (OG) on the Lido di Orri, in a context characterized by the alignment of the *menhirs* of San Salvatore, the male and female anthropomorphs are associated with the solar disc.

#### *General framework and Objectives*

On the basis of the methodological guidelines developed on the subject and through the analysis of the data regarding the topographical structure of the sites, the typology of the monuments and materials, the comparisons, the chronology, this research aims to identify the development lines of this cultural process that affected Sardinia during the Copper Age, determining forms of integration and conflicting elements already highlighted in specific studies.

#### REFERENCES: (MAX 4)

- 1.
- 2.
- 3.
- 4.



## MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

### FORM FOR ABSTRACTS PRESENTATION

**TITLE:** THE COAST OF MASSA LUBRENSE AND ITS MODIFICATIONS DURING THE TWENTIETH CENTURY

**SESSION:** UNDERWATER AND COASTAL CULTURAL HERITAGE

**AUTHORS:** BARBARA BERTOLI, CLELIA CIRILLO, MARINA RUSSO, LOREDANA MARCOLONGO

**AFFILIATIONS:** RESEARCH INSTITUTE ON TERRESTRIAL ECOSYSTEM (IRET-CNR)  
**E-MAIL ADDRESS:** BARBARA.BERTOLI@CNR.IT

**ABSTRACT:**

*This contribution, which comes from the study experiences of the research group The Landscape in Laboratory (Il Paesaggio in Laboratorio) (CNR – IRET), aims to analyse the stages of the anthropogenic activities that have marked and modified the image of some stretches of the coast of Massa Lubrense during the twentieth century. The natural theatre that includes the twenty kilometers of this evocative coast is that of a varied hilly landscape, with olive and citrus groves degrading towards the sea, sometimes rocky with wild and spontaneous vegetation typical of the Mediterranean that is reflected in the blue sea. The gradual impoverishment of the identity matrices of this “enchanted” place, the land of Ulysses and the mermaids, the destination of travelers and writers of every age, is the result of the progressive affirmation of new models of economic development. At the beginning of the twentieth century, the strong landscape values that through the centuries had defined the originality and uniqueness of this territory began to be altered; following the mining activities, the coast was literally devoured and modified in its secular structure. In the twenty kilometers of Lubrense coast, from Puolo to the fjord of Crapolla, six quarries were opened for limestone extraction. Strategically, the quarries arose in the most sheltered bays and easily accessible by cargo boats that coincide with some of the most beautiful coves of this coastal stretch. Just the most protected bays, subsequently reconverted for new activities related to the increase of tourism, changed again their identity and image. We intend to analyze, both through the rich archival documentation, partly found during the research in the Historical Archives of the Municipality of Massa Lubrense, and through the vast repertoire of stereotyped images related to the phenomenon of mass tourism, situations and cases that in the second half of the twentieth century changed the coastline in the two sides of Sorrento and Salerno. The construction of bathing establishments, hotel complexes, private parks for second residences, not regulated by careful planning, in fact changed during the second century definitively the environmental and landscape parameters of this wonderful coast, which embraces the two sides of the gulfs: that of Naples and that of Salerno, naturally divided by Punta Campanella, deeply different from the morphological point of view. It should be remembered that, starting from the 1950s, there were several historical, cultural and socio-economic factors that determined the assault on the Italian coastline. The progressive occupation of coastal areas was defined during the second half of the twentieth century through unsustainable models of development, which led to a growing consumption of soil and natural resources; also the Lubrense coast, as well as the more general case of the Italian coasts, as previously described, it was not spared from such complex dynamics. Several are the parcel along the coast, which resulted in cases of building speculation. It must be said that the intensification of building phenomena along the coast, consequently resulted in the opening of new roads, which in many cases were configured as reckless interventions that altered the high landscape values of the entire coastal stretch of the Peninsula. First the activities related to limestone extraction, then the progressive degradation resulting from a building disorder generated by the exploitation of the tourist vocation of the place in the years of the economic boom, then the intrusiveness of the many private initiatives and the lack of adequate urban tools, during the twentieth century have contributed to a progressive and irreversible*





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*degradation and modification, even morphological of the valuable coastal landscape. Nevertheless, it still preserves natural and scenic beauty, as well as a dense and stratified cultural heritage to be valued and protected.*



*Fig. 1 - The explosion of 1925 in the Vitale quarry, Massa Lubrense.*



*Fig. 2 - San Montano parceling, the first villas under construction, vintage photos from Archeoclub of Massa Lubrense.*

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## The building materials of “Torre Vecchia” (Old Tower) in the Gorgona island

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### Abstract

The ancient fortress commonly known as Torre Vecchia (Old Tower), dominates the Gorgona island from a rocky spur on the western side, at about 200 m s.l.m. It was built by the Republic of Pisa and commonly dated to the XIII<sup>th</sup> century, but it seems that the settlement was originally represented by a single tower dating back to the XI century, erected above semi hypogeous, probably Roman elements. Around the Pisan structure, still identifiable in the current structure, few parts were added, up to give it a polygonal and asymmetrical plan, with three quarters of the perimeter exposed on a cliff overlooking the sea.

The building materials are the local stone (calc-schists) and the bricks: generally the batter and the corners are in stone while in the overhanging wall the bricks are more present, with different distributions depending on the sides. Widespread interventions are visible on the masonry, carried out at different times. The part leaning against the eastern wall, in brick, is probably the oldest and shows, even if in presence of successive interventions, arched windows and, above the single access door, a machicolation. The most recent Renaissance-style windows are finished in Pietra Serena (frequently used in Medici buildings), as well as two fire mouths realized in the thickness of the east and north-east perimeter walls. The interior of this structure is characterized by a barrel-vaulted roof, at the apex of which a square trap door opens, probably usable as a defensive hallway in the event of an enemy invasion. It is conceivable that this structure derives from the most ancient Pisan tower. Leaning against this building is another, a multi-storey building of more recent age, with a primary and secondary wooden bearing structure and a double-pitched upper part with a tile roof. This part of the building, which also shows a sort of battlements, has unfortunately collapsed in the early 90's, and rebuilt. Outside the building, on the south-western side of the wall and leaning against it, there is a cistern, and a large basin, probably dug in the early 60's of the last century, which would have involved the demolition of another cistern of ancient origins and, probably, other volumes also present, as can be seen from the old floor plans, below the current floor level.

The whole structure is currently in a severe conservative state. The collapses are evident with the fall of some roofs and most of the summit ridges and structural lesions. The action of the marine aerosol, in particular on the seafront, has caused extensive phenomena of alveolization in the bricks and in the stone ashlar with erosion of the plasters and bedding mortars. On the walls less subjected to the wind action (N, NE, SE) a thick vegetation has grown with particularly aggressive tree species such as the fig trees.

The research will examine in particular the study of the composition of the artificial stone materials (bricks, bedding mortars, plasters and renders) in order to better understand and define the different construction phases. The results will be useful from the historical point of view (origin of the raw materials from inside or outside the island) and for the future conservation intervention which, under the auspices of the former director of the jailhouse, will have to involve a group of prisoners who will also have the task of the subsequent maintenance.

**Key words:** surfaces, costal towers, mortars, bricks, conservation

**Sessione:** Patrimonio culturale costiero e subacqueo



**MONITORING OF MEDITERRANEAN COASTAL AREAS:  
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Livorno (Italy), June 2022

**FORM FOR ABSTRACTS PRESENTATION**

**TITLE:** THE FORTE DI BOCCA OF LIVORNO'S MOLO MEDICEO

**SESSION:** UNDERWATER AND COASTAL CULTURAL HERITAGE

**Keywords:** Cultural heritage of the coasts, Enhancement and protect.

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### ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

#### *General frameworks*

The fort of the Molo Mediceo is in the core of Livorno port, in front of its south entrance.

Once called Forte della Punta, today more simply Forte di Bocca, it was built at the end of 17<sup>th</sup> century to complete the top of Cosimo mole (1609-1621), to preserve and guarantee safety and security inside and outside of the port itself.

The complex, able to control both port and open sea, was connected to the Cosimo Mole by a drawbridge. It was constituted by a platform towards the sea, with a multi-level support structure for the gun battery rises and by two trapezoidal buildings that incorporate the building already present in 1675 on the port side.

In 1716, under Cosimo III de' Medici, during the filling and refilling of the caves formed by the waves's action on the cliff and under the platform, it was decided to increase the Fort of Punta del Molo, especially towards the open sea., building a gallery for the musketry surmounted by another raised platform for the heavy artillery closed by a parapet.

At the end of 19<sup>th</sup> and beginning of 20<sup>th</sup> century new factories were built close to the ancient port defensive structures posing a threat to their correct conservation.

Due to the bombings of second world war the fortified complex of the Punta del Molo Fort suffered extensive damage to the structures and most of the factories built at the beginning of the 1900s were destroyed.

In the postwar period, the fort's esplanade, was involuntarily freed from almost all the twentieth-century superfetation. Starting from the end of the 1950s, the gallery and the vaulted spaces under the platform were filled by the construction waste of the upper floor. For safety reasons, they made inaccessible by closing the basement windows, the access stairs and creating internal compartmental partitions.

At beginning of 2018 the Port Network Authority of The North Tyrrhenian Sea decided to remove the discarded building materials and rubble. This removal and cleaning discovered an objective situation of public danger.

In 09.05.2018 a radical work of securing of the most compromised part of the structures was decided with the utmost urgency, in *somma urgenza*, with the purpose of restoration and maintenance of gallery and upper platform.

The main building works for the consolidation of the gallery were:

- Securing the structures relating to the tunnels at the lower level by provisional means;
- Lightening the structures by removing the vegetal soil above the gallery;
- Continuation of the removal of the rubble found in the inaccessible parts of the tunnels/gallery;
- Punctual consolidation of the cross vaults of the lower level and barrel vaults of the tunnels using the "cuci e scuci" technique;
- Ventilation of the tunnel environments by demolishing the fillings in correspondence with the riflehouses and the accesses present as well as the compartments containing the vertical connections, such as stairs, hatches and more, in order to make the underlying environments



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healthy;

- Restoration of the vertical connections that lead from the tunnel level to the services / garden level.

The structural failures discovered during those works on the vaults of the tunnels of the Forte di Bocca near the Maritime Adviser made it necessary to:

- Stop the building works for a few months;
- call a technician specialized in structures for the consolidation of the vaults of the tunnel;
- make a three-dimensional survey of the all fort, in order to verify the state of conservation of the structures of the Medici era.

In 2019 it was identified the portion of vaults of the fusiliers' gallery where the subsidence, the sliding of the wall structures, the cracks were such that they had to be inserted in the intervention in urgency, with the aim of safeguarding the most compromised parts in danger of collapse.

At the same time an innovative intervention technique of structural works was developed to consolidate the all structures of Forte di Bocca.

### *Objectives*

This article aims to explain the importance of interdisciplinary approach to safeguard the port cultural heritage. As the survey made it possible to identify the criticalities in detail, the successive structural evaluation has permitted to find the most suitable solutions for the restoration. A structural and architectural point of view of the building works have reached a methodology that have respect the cultural heritage, conforming to the most appropriate techniques of conservation and protection.

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### FORM FOR ABSTRACTS PRESENTATION

**TITLE:**

*Making a site otherwise inaccessible accessible: 3D laser scanner scanning of the Grotta dei Cervi di Porto Badisco in Otranto (Le).*

**SESSION:** Patrimonio culturale costiero e subacqueo

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

The extensive karst system of Grotta dei Cervi and Cunicoli dei Diavoli located in Porto Badisco in the south of the city of Otranto (Le) represents an archaeological site of great interest as it has been frequented by the prehistoric man since the Upper Palaeolithic. On the oldest Paleolithic levels of Grotta dei Cervi, discovered in 1970, the archaeological layers of the Neolithic (VI-IV millennium BC) and the Metal Age (late IV-III millennium BC) are set, when the caves were frequented for cultural, initiatory and funerary reasons. The important and numerous pictograms of the Grotta dei Cervi are datable to the Neolithic of the V-IV millennium BC. And they are on the rock walls of Corridor 2, made in red with the use of ocher and in black with the use of bat guano. They are strongly symbolic pictograms, which have determined the name of the karst complex as "Sanctuary of prehistory in the Mediterranean". The representations on the walls of the Grotte dei Cervi refers to propitiatory scenes of deer hunting, individual or collective anthropomorphic ritual representations, to initiation rituals and religious ones. Along the corridors, at the foot of the walls with paintings, there are numerous evidence of religious, ritual and funerary practices of the first agricultural communities of Salento and beyond, often represented by circles of stones, inside which were found vases containing offerings to chthonic divinities and to Mother Earth to propitiate agricultural crops. As part of the Progetto per la valorizzazione (enhancement project) of the area promoted by the Comune di Otranto, implemented in collaboration with the Soprintendenza Archeologica della Puglia and the Università del Salento, in 2015 the integrated survey was carried out for the first time with high-definition color 3D laser scanner technology of the entire corridor 2 of the Grotta dei Cervi aimed at the knowledge and morphological study of the cave and the pictograms in it; a fundamental step for the enhancement of the monumental rock complex that allows you to make visible a site otherwise not open to visitors. The use of 3D scanning technology has offered, as a result of the knowledge process, a three-dimensional model inspectable and measurable that proposes the reality



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detected with a considerable level of detail and completeness, from which it is possible to obtain not only the desired volumetric graphic representations, with geometric lobal information, but the possibility of understanding the morphological characteristics of the asset, the overall size, the relief reports, the abachi of the materials, the colors, and carry out the study and the monitoring of the cave and the cave paintings present. In order to achieve a correct intervention methodology, the survey operations were structured and carried out in different phases: topographical survey, as a geometric reference scaffolding in which to identify the supporting points for the detailed surveys, 3D laser scanner survey and post-processing operations. Topographic survey with high-precision total station provided for the positioning and materialization of the vertices of the polygonal uniquely recognizable at different moments of the survey. The framing network, inside and outside the cave, constituted the framework for the measurement of the points of support for the following topographical surveys, 3D laser scanners and photogrameters, in order to meet the topographical and cartographic requirements in the pre-established reference system. The cave reliefs, integrated with a GPS relief on the outside, allowed to frame the area detected and to re-position and orient the caves with respect to the surrounding environment. The elaboration of the findings, the subsequent realization of a virtual tour designed within the three-dimensional model resulting from the 3D laser scanner survey, allows an integral digital use of the geometric and morphological components of the rock complex through a cloud of points that at the same time remains a unique database from which to extract many other information. The pictograms represent an enormous patrimony, but because of the climatic condition present inside the rupestrian environments they are constantly in danger of being cancelled or ruined forever and with them the story they narrate and their meaning still to be explored, the result of the experiences and thought of men who lived in the Neolithic, who with their representations have transmitted and made us share, consciously or unconsciously, of their lives. The digital mapping in progress and the consequent cataloging allows to record in a definitive way the representations to make them visible to the community and available for the study of professionals in the sector, without the need to physically enter the cave and finally make it possible to visit a site otherwise inaccessible.



**Fig. 1** Grotta dei Cervi. Corridoio 2. Elaborazione da Rilievo Laser scanner 3D delle pareti rocciose e dei pittogrammi (rilievo ed elaborazione C. Mitello e G. Muscatello, 2015)



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**REFERENCES: (MAX 4)**

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2. Otranto
3. Laser scanner 3D
4. Fruizione virtuale





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**FORM FOR ABSTRACTS PRESENTATION**

**TITLE: CAPO COLONNA (KR). WORKS FOR THE PROTECTION OF THE  
ARCHAEOLOGICAL REMAINS PRESENT ON A PORTION OF THE EDGE  
OF THE CLIFF.**

SESSION: PATRIMONIO CULTURALE COSTIERO E SUBACQUEO/MORFOLOGIA ED  
EVOLUZIONE DELLE COSTE E DEI FONDALI

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The contribution aims to present to the specialist public the works that the Ministero della Cultura has arranged, in a procedure of great urgency (*somma urgenza*), for the protection of the archaeological remains present on a portion of the edge of the cliff of Capo Colonna (KR).

The area subject to intervention overlooks the Ionian Sea and is located in the central part of the Calabria Region, in the southern part of the municipal territory of Crotona, on the border with the municipality of Isola Capo Rizzuto.

The Promontory "Lacinio" or Capo Colonna, conjunction between two coastal areas differently exposed to the meteo-marine climate: the Gulf of Taranto to the North, and the Gulf of Squillace to the South, is characterized by important and extensive archaeological evidence of the Magno-Greek and Roman era up to the sixteenth-century coastal fortifications and the most recent religious and civil settlements.

The provisional intervention - necessary and cannot be postponed due to the violent storm that hit the promontory in November 2020 - precedes the larger and more definitive one to be carried out by the *Regione Calabria* and provides for the installation of boulders, of various sizes, in order to protect the walls of the cliff and the wall remains at the top from marine erosion but also the Sanctuary of S. Maria di Capo Colonna.

The inspections carried out following this event have highlighted serious critical



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issues for some of the archaeological evidence placed on the edge of the cliff, behind the Church of S. Maria di Capo Colonna.

The cliff of Capo Colonna is strongly subject to coastal erosion, the monitoring carried out has calculated an average annual retreat of 0.60 m.

The comparison between the photographic documentation of the archive and the recent one carried out during the numerous inspections with helicopter shots, with drones and from the ground, have revealed a worsening of the conservation of the archaeological remains located on the outer edge of the cliff.

The critical issues highlighted by the numerous inspections, which were attended by central and peripheral offices of the *Ministero della Cultura* in agreement with the *Comando Carabinieri Tutela Patrimonio Culturale-Nucleo Cosenza*, led to the execution of an intervention of the utmost urgency through the realization of provisional, reversible and removable works, consisting of the installation of boulders of various sizes. These works were preceded by preventive underwater prospecting activities aimed at protecting the submerged cultural heritage, possibly present on the seabed affected by the installation of the boulders and the processes related to it, and by the recovery of the historicized materials precipitated at the base of the cliff.

All work activities, from the recovery of cultural heritage to the laying of boulders, were carried out from the sea.

The implementing subject is the *Segretariato Regionale del Ministero della Cultura per la Calabria* on the disposition of the utmost urgency (*somma urgenza*) of the *Soprintendenza Archeologia Belle Arti e Paesaggio per le province di Catanzaro e Crotona*.

### REFERENCES: (MAX 4)

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2. Capo Colonna
3. Falesia/Cliff
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### **FORM FOR ABSTRACTS PRESENTATION**

**TITLE:**

SUSTAINABLE AND ECOSYSTEM SERVICES BASED TOURISM IN ASINARA'S MARINE PROTECTED AREA (SARDINIA, ITALY).

**SESSION:**

UNDERWATER AND COASTAL CULTURAL HERITAGE

**AUTHORS:**

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**ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):**

*In latest decade the Ecosystem Services ) approach became more than a framework to assessing, accounting and monitoring ecosystem processes, functions and "goods": what humankind benefits from Nature could be also intended as a proper environmental communication perspective to act towards post normal science insights (PSN)<sup>1</sup>. This vision can greatly contribute to rise the general public awareness on (i) environment impacts of human activities and nature conservation goals, (ii) the need to preserve the so-called Natural Capital (stocks of natural assets which include geology, soil, air, water and all living things) for ensuring the flows of ES functions during time, and (iii), the urgent need to guarantee the sustainable use of natural resources. A consolidated methodological approach to measure sustainability is the Life Cycle Assessment (LCA), which analyzes "from cradle to grave" the environmental impacts of economic sectors, summarized in terms of indicators such as the Carbon footprint. These two approaches, Ecosystem Services assessment and LCA represent relevant methodologies, in particular when applied to Marine Protected Areas which are, at the same time, elected places of high nature conservation values and also targeted tourist destinations. Marine Protected Areas tradeoffs between nature conservation and human activities, in particular those related to the tourism sector, are still an open issue. Mapping and assessing cultural ecosystem services seems to be a useful approach to face these aspects. assessments are often inventoried by maps – water basin, land uses, Carbon stocks and other spatial units - in order to be also evaluated in monetary terms at geographical scales. Baseline of these outputs depends on data availability and Ecosystem Services monitoring during times. Still few scientific works developed LCA analysis of tourism activities in Marine Protected Areas facing Ecosystem Services approach for a comprehensive accountability. Marine Cultural Ecosystem Services are also particularly suitable for immersive experiences in direct and indirect ways, for different target of tourists: from young to elderly people, including people with disabilities. Sustainable and accessible tourism practices linked to Cultural Ecosystem Services experiences in Marine Protected Areas, are also the framework of NEPTUNE project (PatrimoNio naturalE e cultUrale sommerso e gestione sosteNibile della subacquEa ricreativa), funded by the INTERREG Francia Italia Marittimo Programme, under the coordination of MPA of Portofino (Liguria, Italy). In our work we discuss about how to harmonize sustainable and accessible tourism practices in Marine Protected Areas of Asinara's national Park (Sardinia, Italy), related to diving and snorkeling activities, evaluating their environmental impacts by LCA approach. We also contribute for a Marine Cultural Ecosystem Services assessment for Neptune project purposes by no conventional mapping products, focusing on touristic submarine diving paths,*



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