



The Mediterranean  
Biodiversity  
Centre

# 3<sup>rd</sup> MEDITERRANEAN SYMPOSIUM ON THE CONSERVATION OF CORALLIGENOUS & OTHER CALCAREOUS BIO-CONCRETIONS

## BOOK OF ABSTRACTS

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**3<sup>rd</sup> Mediterranean Symposium on the  
conservation of Coralligenous & other  
Calcareous Bio-Concretions**

**Book of abstracts**



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## PROGRAMME

Tuesday 15 January 2019

- 14:00-14:15**      **Opening of the Symposium**
- 14:15-14:45**      Keynote conference: "Mediterranean gorgonian forests: distribution patterns and ecological roles" by **Massimo PONTI**, TURICCHIA E., COSTANTINI F., GORI A., BRAMANTI L., DI CAMILLO C.G., LINARES C., ROSSI S., ABBIATI M., GARRABOU J., CERRANO C.
- 14:45-15:15**      Keynote conference: "Mediterranean bioconstructions: the case of Italy" by **Gianmarco INGROSSO**, DE LEO F., FRASCHETTI S., BOERO F.
- Session 1:      Knowledge of the Coralligenous communities and other calcareous bioconstructions**
- 15:15-15:30**      "Food web structure of a Mediterranean coralligenous ecosystem" by **Bruno BELLONI**, SARTORETTO S., CRESSON P., BOUCHOUCHA M., GUILLOU G., LEBRETON B., RUITTON S., HARMELIN-VIVIEN M.
- 15:30-15:45**      "Community ecology of coralligenous assemblages using a metabarcoding approach" by **Aurélien DE JODE**, DAVID R., DUBAR J., ROSTAN J., GUILLEMAIN D., SARTORETTO S., FERAL J.-P., CHENUIL A.
- 15:45-16:00**      "Advances in the conservation of red coral populations: long-term demographic data, management tools and restoration activities" by **Cristina LINARES**, MONTERO-SERRA I., ASPILLAGA E., CABRITO A., CAPDEVILA P., LEDOUX J.B., LÓPEZ-SANZ A., LÓPEZ-SENDINO P., ROVIRA G., GARRABOU J.
- 16:00-16:15**      Discussion
- Session 2:      Impacts on the Coralligenous communities and other calcareous bioconstructions**
- 16:15-16:30**      "Ghost Med: Assessment of the impact of lost fishing gear in the French Mediterranean Sea" by **Sandrine RUITTON**, BELLONI B., MARC C., BOUDOURESQUE C.F.
- 16:30-16:45**      "A mass mortality event of the sponge *Cliona viridis* in the coralligenous outcrops in the Côte Agathoise MPA (Gulf of Lion, Northwestern Mediterranean)" by **Mathieu FOULQUIE**, BLOUET S., CHERE E., DUPUY DE LA GRANDRIVE R., GARRABOU J.
- 16:45-17:00**      "Bleaching of crustose coralline algae in the Mediterranean Sea" by **Bernat HEREU**, MATAMALAS N., ASPILLAGA E., CAPDEVILA P., ROVIRA G.
- 17:00-17:15**      "Demography and disturbance levels of the coral *Astroides calycularis* (Pallas, 1766) in the Tunisian Marine Protected Area Of Zembra (Central Mediterranean)" by **Raouia GHANEM**, SOUFI-KECHAOU E., BEN SOUISSI J., LINARES C., LEDOUX J.B., GARRABOU J.
- 17:15-17:30**      Discussion
- 17:30-18:00**      Photo Exhibition : Mediterranean Marine Key Habitats and Non-Indigenous Species

Wednesday 16 January 2019

**Session 3: Monitoring and quality assessments of the Coralligenous communities and other calcareous bioconstructions**

**8:30-8:45** "Effective SFM-Based methods supporting coralligenous benthic community assessments and monitoring" by **Marco PALMA**, PAVONI G., PANTALEO U., RIVAS CASADO M., TORSANI F., PICA D., BENELLI F., NAIR T., COLETTI A., DELLEPIANE M., CALLIERI M., SCOPIGNO R., CERRANO C.

**8:45-9:00** "Assessment of the conservation status of coastal detrital sandy bottoms in the Mediterranean Sea: An Ecosystem-Based Approach in the framework of the ACDSea Project" by **Patrick ASTRUCH.**, GOUJARD A., ROUANET E., BOUDOURESQUE C.F., VERLAQUE M., BERTHIER L., DANIEL B., HARMELIN J.G., PEIRACHE M., PETERKA A., RUITTON S., THIBAUT T.

**9:00-9:15** "Assessing the sensitivity of marine habitats to anthropogenic pressures: a key tool in evaluating risks to Mediterranean benthic habitats" by **Marie LA RIVIERE**, MICHEZ N., AISH A., BELLAN-SANTINI D., BELLAN G., CHEVALDONNE P., DAUVIN J.-C., DERRIEN-COURTEL S., GRALL J., GUERIN L., JANSON A.-L., LABRUNE C., SARTORETTO S., THIBAUT T., THIEBAUT E., VERLAQUE M.

**9:15-9:30** Discussion

**9:30-10:15** **Poster Session**

**Session 4: Restauration of the coralligenous habitats**

**10:15-10:30** "Restoration protocols for the Mediterranean coralligenous habitats" by **Carlo CERRANO**, BAKRAN-PETRICIOLI T., CARONI J., FERRETTI E., GARI A., GOMEZ-GRAS D., GORI A., HEREU B., KIPSON S., MILANESE M., LEDOUX J.B., LINARES C., LÓPEZ-SANZ S., LÓPEZ-SENDINO P., MONTERO-SERRA I., PAGÈS M., PICA D., SARÀ A., TORSANI F., VILADRICH N., GARRABOU J.

**10:30-10:45** "Enhancing the effectiveness of restoration actions in coralligenous habitats: insights from a transregional thermotolerance experiment" by **Jean-Baptiste LEDOUX**, GOMEZ GRAS D., CRUZ F., ALIOTO T.S., BAKRAN-PETRICIOLI T., BOAVIDA J., del CAMPO J., CERRANO C., FERRETTI E., GÓMEZ-GARRIDO J., GUT M., KIPSON S., LINARES C., LOPEZ-SENDINO P., LOPEZ-SANZ A., MASSANA R., MILANESE M., MONTERO-SERRA I., PAULO D., SERRAO E., GARRABOU J.

**10:45-11:00** "Can facilitation processes enhance the effectiveness of restoration actions in the coralligenous habitat?" by **Silvija KIPSON**, CERRANO C., LINARES C., BAKRAN-PETRICIOLI T., FERRETTI E., GOMEZ-GRAS D., LEDOUX JB., LÓPEZ-SANZ A., MONTERO-SERRA I., PAGÈS M., SARÀ A., TORSANI F., GARRABOU J.

**11:00-11:15** "Active restoration across marine coastal habitats: a focus on the Mediterranean Sea" by **Giuseppe GUARNIERI**, MCOWEN C., PAPA L., PAPADOPOULOU N., BILAN M., BOSTRÖM C., CAPDEVILA P., CARUGATI L., CEBRIAN E., DAILIANIS T., DANOVARO R., DE LEO F., FIORENTINO D., GAGNON K., GAMBI C., GARRABOU J., GEROVASILEIOU V., HEREU B., KIPSON S., KOTTA J., LEDOUX J.B., LINARES C., MARTIN J., MEDRANO A., MONTERO-SERRA I., MORATO T., PUSCEDDU A., SEVASTOU K., SMITH C., VERDURA J., FRACHETTI S.

**11:15-11:30** Discussion

**11:30-12:00**      **Awards for best poster**

**12:00-12:15**      **Closure of the Symposium**

**12:15-14:00**      ***Lunch***



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# **KEYNOTE CONFERENCES**

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**Massimo PONTI, TURICCHIA E., COSTANTINI F., GORI A., BRAMANTI L., DI CAMILLO C.G., LINARES C., ROSSI S., ABBIATI M., GARRABOU J., CERRANO C.**

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## **MEDITERRANEAN GORGONIAN FORESTS: DISTRIBUTION PATTERNS AND ECOLOGICAL ROLES**

*Healthy coralligenous habitats may host dense populations of gorgonians, like *Paramuricea clavata* and *Eunicella cavolini* that build marine animal forests. According to recent studies, these forests appeared able to increase the resilience of coralligenous habitats and to enhance the structural complexity and bioconstruction processes. They are also able to increase species diversity and limit the invasion of alien species. The major limitation in the conservation of these forests is the lack of knowledge on their actual distribution and the extents of their ecological roles. Nowadays, by combining information from scientific literature, citizen science projects and the World Wide Web is possible to fill part of these gaps and draw a more comprehensive picture for the Mediterranean Sea. This knowledge represents the baseline to address effective conservation measures on gorgonian forests and coralligenous accretions.*

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## **MEDITERRANEAN BIOCONSTRUCTIONS: THE CASE OF ITALY**

*Marine bioconstructions are three-dimensional structures generated by the superposition of the remains of benthic organisms that persist on site, do not decay and are overgrown by other organisms, either of the same species or of other species. Tropical coral reefs are the most famous bioconstructions, but other types of biogenic formations are also present in temperate seas. Coralligenous formations are the most prominent bioconstructions in the Mediterranean Sea together with vermetid reefs, cold water corals, *Lithophyllum byssoides* trottoirs, banks formed by the corals *Cladocora caespitosa* or *Astroides calycularis*, and sabellariid and serpulid worm reefs. Bioconstructions modify the primary substrate where they settle upon, creating new habitats for organisms that do not occur on the primary substrates, so enhancing biodiversity. A recent review on the diversity and the spatial distribution of bioconstructions in Italian waters highlighted the importance of this suite of habitats that, together, make up the core of the “reef” habitat type in the Habitats Directive of the European Union. Anthropogenic pressures (i.e. pollution, organic enrichment, fishery, coastal development, direct physical disturbance), climate change, and the spread of invasive species impact on the integrity of these habitats, whose management and conservation require holistic approaches at basin scale, within ecologically coherent units based on connectivity: the cells of ecosystem functioning.*





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# ORAL COMMUNICATIONS

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**Patrick ASTRUCH, GOUJARD A., ROUANET E., BOUDOURESQUE C.F., VERLAQUE M., BERTHIER L., DANIEL B., HARMELIN J.G., PEIRACHE M., PETERKA A., RUITTON S., THIBAUT T.**

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## **ASSESSMENT OF THE CONSERVATION STATUS OF COASTAL DETRITAL SANDY BOTTOMS IN THE MEDITERRANEAN SEA: AN ECOSYSTEM-BASED APPROACH IN THE FRAMEWORK OF THE ACDSEA PROJECT**

*Coastal detrital sandy bottoms are an ecosystem (CDE) that is widespread over the continental shelf from 30 down to 100 m depth in the Mediterranean Sea. Despite the extensive surface area it covers on the continental shelf, this key ecosystem has not been considered as a habitat of European interest by the Habitat Directive of the European Union (Natura 2000, 92/43/CEE). Since the 1960s, many studies have highlighted the high species diversity of its epiflora, epifauna and endofauna (macrophytes, including fucales and corallinales, bryozans, crustaceans, molluscans, porifera, annelids, etc.), its functional role (foraging and spawning area, nursery ground, carbon sink, key habitat for a variety of taxa) and its vulnerability to human activities and global change (trawling, dredging, anchoring, terrestrial and marine pollution, flooding, non-indigenous species, etc.). Here, a conceptual model of the functioning of the CDE is proposed. It is based on literature data, updated with the addition of recent field data collected within the new Port-Cros National Park (Provence, France, north-western Mediterranean Sea), along a gradient of human disturbance. Scuba diving (sampling and taxa identification) and an innovative tool, the BioCube (photo-quadrats, biotic covering analyses, etc.), have been implemented. The aim of the ACDSea project (Assessment of the conservation status of Coastal Detrital Sandy bottoms: an ecosystem-based approach) is to develop a method to assess the conservation status and quality of the CDE. The present study is a preliminary one, as more data, in a variety of ecoregions, is needed to improve the conceptual model and develop an Ecosystem-based Quality Index (EBQI). Subsequently, surveillance networks will have to be set up, at regional scale, enabling stakeholders and managers (MPAs, local and regional authorities) to better take into account this ecosystem in their management plans.*

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**Bruno BELLONI, SARTORETTO S., CRESSON P., BOUCHOUCHA M., GUILLOU G., LEBRETON B., RUITTON S., HARMELIN-VIVIEN M.**

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## **FOOD WEB STRUCTURE OF A MEDITERRANEAN CORALLIGENOUS ECOSYSTEM**

*The coralligenous ecosystem is one of the biodiversity hotspots in the Mediterranean Sea. This study aims at determining (i) the organic matter (OM) sources at the base of the food web in a coralligenous ecosystem near Marseille (Cap Caveau, Frioul Island) and (ii) the global functional structure of its community. For that purpose, C and N stable isotope analyses were performed on 78 compartments or species collected in this habitat between 30 and 40 m depth. Results suggested that the pelagic particulate organic matter (POM), mainly composed of phytoplankton, was the main OM source fuelling coralligenous food webs, followed by sedimented organic matter (SOM) and some macrophytes. At least three level of consumers were identified from plankton-feeding invertebrates to piscivorous teleosts. Coralligenous food webs seemed to be characterized by a high abundance and trophic diversity of plankton and filter feeders. Among them numerous sessile invertebrates, such as cnidarians, bryozoans and ascidians, were poorly directly consumed, but played an important role in POM transfer. Further studies on spatial and temporal variations of coralligenous communities would be necessary for providing a general trophic functioning model of this highly diversified ecosystem.*

**Carlo CERRANO, BAKRAN-PETRICIOLI T., CARONI J., FERRETTI E., GARI A., GOMEZ-GRAS D., GORI A., HEREU B., KIPSON S., MILANESE M., LEDOUX J.B., LINARES C., LÓPEZ-SANZ S., LÓPEZ-SENDINO P., MONTERO-SERRA I., PAGÈS M., PICA D., SARÀ A., TORSANI F., VILADRICH N., GARRABOU J.**

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## **RESTORATION PROTOCOLS FOR THE MEDITERRANEAN CORALLIGENOUS HABITATS**

*The temperate coralligenous bioconcretions harbour approximately 10% of marine Mediterranean species (about 1600 species), including long-lived algae and invertebrates. Enhanced by climate change, several pressures affect coralligenous assemblages, leading to recurrent mass mortalities and dramatic loss of habitat complexity and biodiversity.*

*The EU-funded project MERCES is developing innovative methodologies to restore macroinvertebrate habitat-forming species from three key taxonomic groups: Cnidaria/Anthozoa, Porifera/Demospongiae and Bryozoa. Restoration protocols combined transplants from donor organisms using different techniques and recruitment-enhancing devices designed for habitat-forming species. Considering the life-history traits, population dynamics and population genetics of the selected species, restoration actions should be mainly based on transplants of small to medium size collected from donor specimens. Bearing in mind that survival of transplants is higher in species with slow growth rates such as those dwelling in the coralligenous than in more dynamic species, transplantation efforts in the coralligenous will require low initial effort but a long period will be required to fully recover habitat complexity, i.e. decades. We identified survival and growth of transplants and recruitment as the most suitable short-term indicators of the success of the restoration actions.*

*Collaboration with volunteers (divers and diving operators) in several phases of field activities are being explored to cost-effective scaling up the restoration actions and to increase the sense of stewardship in a major users' segment.*

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**Aurélien DE JODE, DAVID R., DUBAR J., ROSTAN J., GUILLEMAIN D., SARTORETTO S., FERAL J.-P., CHENUIL A.**

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## **COMMUNITY ECOLOGY OF CORALLIGENOUS ASSEMBLAGES USING A METABARCODING APPROACH**

*Coralligenous habitats are bioconstructed, emblematic habitats of the Mediterranean Sea, which display a remarkably complex tridimensional structure and are considered as one of the most important biodiversity hotspots of the Mediterranean Sea. In order to assess the specific diversity of these habitats we sampled small surfaces (10 cm<sup>2</sup>) of these habitats using a suction sampler in different environmental conditions on 19 sites in the Marseilles area (France). These samples were crushed and total DNA was extracted. A small portion of the COI gene was amplified using universal primers targeting metazoans. A total of 3029 Molecular Operational Taxonomic Units (mOTUs) were found among all samples. Most of the mOTUs belong to three taxonomic groups: Rhodophyta, Arthropoda and Annelida but many other phyla were detected. Environmental factors such as depth, slope and locality influence the community composition of coralligenous habitats. This first assessment of the specific diversity of these habitats using a metabarcoding approach confirms the status of biodiversity hotspot of these habitats and underlines the importance of abiotic variables to structure the community. Methodological developments can be used to design new monitoring protocols of these habitats.*

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### **A MASS MORTALITY EVENT OF THE SPONGE *CLIONA VIRIDIS* IN THE CORALLIGENOUS OUTCROPS IN THE CÔTE AGATHOISE MPA (GULF OF LION, NORTHWESTERN MEDITERRANEAN)**

*In 2014, a mass mortality event (MME) affecting the sponge *Cliona viridis* was observed in the Côte agathoise Marine Protected Area in coralligenous outcrops dwelling at 20 m depth.*

*Previous to the necrosis, the specimens displayed a discoloration process, from green to pale yellow. Then, as necrosis progressed with the appearance of a bluish bacterial veil the internal sponge structures were exposed. At the last stage, the sponge has completely disappeared and erosion canals were visible. To monitor coralligenous outcrops, semi-permanent transects were setup in 2010 in 3 sites within the MPA. The transects were monitored using photoquadrats. Four Surveys were carried between 2010 and 2017. In November 2014, a mass mortality in *Cliona viridis* populations was observed in one site. The mortality (partial or total necrosis) affected 90% of surveyed specimens. In November 2017, the affected population showed only a partial recovery of specimens. The causes of the mortality are unknown. Unfortunately, neither necrotic tissue samples to conduct microbial analysis were available, nor the water samples to analyze potential sources of pollution. However, the mass mortality was concomitant with the occurrence of a positive thermal anomaly (at least 2 weeks > 21°C, at 20 m depth). As in other events observed in the North-Western Mediterranean, temperature conditions can be considered as a triggering factor of the observed mortality.*

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### **DEMOGRAPHY AND DISTURBANCE LEVELS OF THE CORAL *ASTROIDES CALYULARIS* (PALLAS, 1766) IN THE TUNISIAN MARINE PROTECTED AREA OF ZEMBRA (CENTRAL MEDITERRANEAN)**

*Mediterranean coral species are increasingly threatened by human activities, particularly global warming. In fact, *Astroides calyularis* populations are the focus of conservation efforts (listed in the Bern and Barcelona Conventions and the Convention on International Trade in Endangered Species of Wild Flora and Fauna). Demographic studies on coral species are able to provide information on the conservation status of populations. *Astroides calyularis* is one of the coral contributing to build coralligenous outcrops. Data regarding the demography and the state of conservation of this species is poorly studied in Tunisian coasts. In order to fill this gap scuba diving surveys were carried out between 2015 and 2016 in two sites of the MPA of Zembra. A total of 1109 colonies were surveyed randomly using photo-quadrats. Density of colonies, number of polyps and extent of injury per colony were assessed. For both sites, the upper distribution limit was at 10 - 15 m depth. Mean population density per m<sup>2</sup> was 369.03 ± 10.7 SD while the mean number of polyps per colony was 18.9 ± 21.9 SD in Capo Grosso and 20.2 ± 24.0 SD in Lamparo site. The size structure of populations was dominated by recruits and juvenile colonies (from 1 to 10 polyps). Colonies affected by injuries was very low, less than 1% of all surveyed colonies in both populations. Most colonies showed signs of partial mortality due to recent necrosis of polyps. No total mortality was observed. The results obtained in this work provide a robust baseline to evaluate future changes of populations in the MPA of Zembra and to compare the conservation status at Mediterranean scale.*

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## **ACTIVE RESTORATION ACROSS MARINE COASTAL HABITATS: A FOCUS ON THE MEDITERRANEAN SEA**

*Active restoration is considered a profitable strategy to return ecosystems to their pre-disturbance state, in a reasonable time frame. However, ecological restoration of marine ecosystems is still in its infancy if compared to the terrestrial context. A review of 498 studies published in the last 25 years was carried out within the MERCES H2020 EU project to understand the effects of marine restoration actions across coastal habitats at global scale. Here, an overview focused on the Mediterranean Sea was carried out to identify both contextual and methodological determinants of restoration success in the basin. Results show that restoration efforts across habitats are increasing, especially in seagrasses and saltmarshes, but never approached at ecosystem level. Targets, methods, response variables and standards are still very heterogeneous. Short project duration (one-two years), small restoration areas (< 1 ha), lack of controls and knowledge of baselines are still a limit for deriving generalities. Finally, restorations rarely consider future challenges linked to global change, thus impairing long-term success stories. Marine restoration is a promising approach to counteract habitat loss in coastal areas. However, restoration science needs more robust approaches leading to the development of best practices (e.g. protocols, monitoring of the effects, reasons for failure) to be applied at spatial and temporal scales so as to answer to present and future disturbance regimes.*

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## **BLEACHING OF CRUSTOSE CORALLINE ALGAE IN THE MEDITERRANEAN SEA**

*Here we report the incidence of coralline algae bleaching in the western Mediterranean Sea. In October 2015, after a summer characterized by positive thermal anomalies, we observed a spread of bleaching and mortality affecting several crustose coralline algae (CCA) species from 0 to more than 30 m depth at several sites in the NW Mediterranean Sea. We have observed this phenomenon every post-summer period from 2015 until 2017. Syndromes of CCA bleaching were characterized by a white discoloration affecting the living algal tissue. In some cases, especially at shallow depths, CCA had locally disappeared resulting in bare rock areas, with some evidence that sea urchins grazing effects may have exacerbated this process. The extent of this mortality in the Montgrí, Illes Medes i Baix Ter and Cap de Creus Natural Parks showed a heterogeneous bleaching pattern, affecting from 15% to 70% of the CCA surface, depending on the species and depth.*

*Although the causes and mechanisms of CCA bleaching are still poorly understood, diseases in coralline algae have been related with elevated seawater temperatures, and their effects may be amplified by future ocean warming and acidification. Further research is needed to confirm the nature of such mortality events, but these observations suggest that CCA bleaching may be a widespread and previously overlooked phenomenon in temperate seas, and especially in the Mediterranean Sea. Because coralline algae play key structural and ecological roles in temperate seas, the emergence of these diseases may have dramatic consequences on the structure and functioning of marine ecosystems.*

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## **CAN FACILITATION PROCESSES ENHANCE THE EFFECTIVENESS OF RESTORATION ACTIONS IN THE CORALLIGENOUS HABITAT?**

*Coralligenous outcrops are slow-dynamic habitats exhibiting high structural complexity. If these valuable habitats are degraded, relatively long time is required to recover their structure and full functionality. In order to reduce recovery times, restoration actions can focus on target habitat-forming species. Facilitation processes (i.e. positive species interactions), rarely considered to date, may be further explored to enhance the effectiveness of coralligenous restoration initiatives. Here we test if erect habitat-forming species, putatively modifying light penetration and/or water movement, can affect the survival and growth of co-occurring encrusting and massive ones. For that purpose, we designed an experiment using the red gorgonian *Paramuricea clavata* and bryozoans, important coralligenous structural animals, as model organisms. The experiment, replicated in Spain, Italy and Croatia, is based on the comparison between series of 0.25 m<sup>2</sup> experimental plots. Experimental treatments include addition of bryozoan recruitment-enhancing devices (plastic grids) with and without gorgonian colonies and controls (empty and artefact ones) for a total of 4 replicates per treatment. The hypothesis is that the erect layer (15 *P. clavata* fragments up to 20 cm in maximal height per experimental plot) could facilitate the settlement of bryozoan colonies onto grids within the experimental plots and enhance their survival and growth. The experiment was initiated in May-July 2017 within the EU Horizon 2020 project MERCES (Marine Ecosystem Restoration in Changing European Seas, <http://www.merces-project.eu/>) and it is still ongoing. In this contribution we present and discuss our preliminary experimental findings.*

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## **ASSESSING THE SENSITIVITY OF MARINE HABITATS TO ANTHROPOGENIC PRESSURES: A KEY TOOL IN EVALUATING RISKS TO MEDITERRANEAN BENTHIC HABITATS**

*Standardised sensitivity data on marine habitats is an essential support in the management of human activities at regional, national and international scales. We developed a methodology for assessing the sensitivity of marine habitats to human pressures, as well as associated guidance on how to use the resulting sensitivity assessments. The sensitivity of 41 French Mediterranean benthic habitats to 12 physical pressures was assessed as part of the first stage of this project; other physical, chemical and biological pressures will be defined and assessed shortly. Results will feed into risk assessments allowing the identification of conservation priorities and the development of spatial planning strategies. By maximising methodological consistency in the generation of sensitivity data with other Member States, and sharing the outputs of this project internationally, we hope to facilitate collective use of sensitivity information under the Habitats Directive, the Marine Strategy Framework Directive, the Marine Spatial Planning Directive and the Regional Sea Conventions (such as Barcelona Convention).*

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## **ENHANCING THE EFFECTIVENESS OF RESTORATION ACTIONS IN CORALLIGENOUS HABITATS: INSIGHTS FROM A TRANSREGIONAL THERMOTOLERANCE EXPERIMENT**

*Understanding the response of organisms facing climate change is critical to buffer the on-going biodiversity crisis. The Mediterranean coralligenous habitats are among the richest but also most threatened habitats of the Mediterranean. Indeed, coralligenous habitats, dominated by long-lived and structural species such as octocorals or sponges, have been impacted by different marine heat waves causing large-scale mortality events. Considering the slow dynamics of many impacted species, mortality events question the future of coralligenous habitats and restoration actions appeared as one of the most relevant tools to buffer biodiversity losses.*

*Effective restoration actions should rely on an understanding of the interactions among the organisms to be restored and their local environment in order to allow the identification of relevant donor populations to restore vulnerable and degraded populations.*

*The main aim of the present study was to characterize the interactions between *Paramuricea clavata*, a habitat-forming octocoral severely but differentially impacted by mortality events, and its thermal environment. We carried out a common garden experiment in aquaria focusing on the response to thermal stress of 12 populations from five different regions (Catalunya, Corsica, Northern Italy, Croatia and Southern Portugal) within the North Western Mediterranean, the Adriatic and the Atlantic. The objectives of this study were: 1) to further the acquisition of basic information about the thermotolerance features of *P. clavata*; 2) to evaluate the role of biological processes in the differential responses to thermal stress by conducting genomic analyses; 3) to characterize the micro-eukaryotic and prokaryotic communities associated to the targeted populations. Here, we will present the first results of this study. We will discuss their implications for restoration actions of the coralligenous habitats dominated by *P. clavata* in the context of on-going climate change.*



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### **ADVANCES IN THE CONSERVATION OF RED CORAL POPULATIONS: LONG-TERM DEMOGRAPHIC DATA, MANAGEMENT TOOLS AND RESTORATION ACTIVITIES**

*Coralligenous assemblages face cumulative impacts from multiple stressors acting both at local and global scales. The red coral *Corallium rubrum*, one of the most emblematic coralligenous species, is threatened by historical overharvesting and, since the last decades, by the effects of global warming. Nine red coral populations have been annually monitored during several years in different Mediterranean localities. Long-term data revealed a high vulnerability to multiple human-driven stressors with strong effects of local management and ocean warming. In addition, a regional survey along the Catalan coast performed last year within the two largest and oldest MPAs in the area showed that the conservation status of the red coral population is far from what we expect within protected areas. The goal of this presentation is to understand the main mechanisms driving the persistence and the structural simplification of red coral populations after being harvested during millennia, and to assess the current effectiveness of different conservation tools such as the fishing ban proposed recently by the Catalan Government, the role of marine protected areas (MPAs) and their interaction with other stressors, and the use of active restoration for illegally harvested colonies. The final aim is to discuss the conservation status and different management actions at the Mediterranean scale in order to ensure a solid scientific consensus on the conservation of fully functional *C. rubrum* populations.*

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### **EFFECTIVE SfM-BASED METHODS SUPPORTING CORALLIGENOUS BENTHIC COMMUNITY ASSESSMENTS AND MONITORING**

*Animal forests enhance Mediterranean coralligenous habitat biodiversity and functioning. Their monitoring is paramount to assess the conservation status of the habitat and to plan restoration actions for addressing the Good Environmental Status as required by the EU legislation. Scuba diving investigations allow fine data collection up to -70 m but are limited in small surfaces sampled as a result of the short available time. Moreover, human observations in this stressful condition are likely to be affected by errors. Structure from Motion (SfM) photogrammetry is an on-growing technology supporting rapid and accurate indirect data collection through optical scanning over organisms and habitats, thus empowering scuba diving sampling performances. A tools-set of SfM based methods using scaled point clouds, 3D models and quasi-orthorectified projected images were developed to support the study of the coralligenous benthic communities. Population structure, morphometrics, biomass and secondary production of sponges and gorgonians were calculated using real case of studies and assessed with ground truth datasets. The performances of different cameras (GoPro Hero4 and Sony NEX7) in data collection were tested. The accuracy in population density estimation were always above 70% for all the considered species. The precise measurements of the organisms morphometries supported the estimation of the average growth rate of the mapped population. These findings highlight the potential use of this technique for environmental accounting studies (emerging approaches) required by the European Marine Biodiversity Strategy Directive whilst contributing to the quantitative estimation of the organic carbon turned out by the species.*

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## **GHOST MED: ASSESSMENT OF THE IMPACT OF LOST FISHING GEAR IN THE FRENCH MEDITERRANEAN SEA**

*Lost and abandoned fishing gear affects all marine habitats, both coastal and offshore habitats such as bathyal habitats, including canyons. Not only professional fishing nets, longlines and fishing traps are concerned, but also recreational fishing tackle (fishing lines, lead weights, hooks, etc.). This lost gear causes various forms of negative impact including ghost fishing, that has been extensively studied for several decades. However, the lack of information on the quantification of lost gear and the assessment of impacts other than ghost fishing is critical worldwide. The aim of the Ghost Med program is (i) to quantify the lost fishing gear in the Mediterranean and characterise the habitats concerned, (ii) to address federate underwater observers and citizen science to better collect data on fishing gear loss events, (iii) to assess their impact on species and habitats, and (iv) to propose tools to managers in order to prioritize, or not, their removal. The protocol is based on an assessment of the environmental and seascape impact of the lost gear as well as the technical risks involved in its removal. Each of these parameters was measured using several criteria, such as the number of mobile species trapped in the gear, the number of fixed species damaged or uprooted and the alteration of the habitat relief. All these criteria are weighted by a score which will then be used to calculate the lost gear Removal Aid Index (RAI). This simple-to-use protocol should help Marine Area managers to determine whether gear removal should be considered. This protocol is currently used as a basis for the assessment and removal of fishing nets in France, and could be extended to all Mediterranean coasts.*

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# POSTERS

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### **CAP NEGRO-CAP SERRAT (TUNISIA, MEDITERRANEAN): A MARINE AREA WITH ENVIRONMENTAL VALUES OF NATIONAL AND REGIONAL INTEREST**

*The marine habitats of the future Marine and Coastal Protected Area (MCPA) of Cap Negro-Cap Serrat were investigated during 2015 -2016 within the framework of the MedKeyHabitats project to elaborate maps of the main assemblages and bottom types between 0 and 50 m in order to provide the APAL with a tool to better manage the site. The habitats and species distribution were defined based on a geophysical survey and biological studies. A monitoring network of the coralligenous biocenoses was also set-up in the study area to evaluate and track their conservation status and detect changes associated to human pressures and natural processes. The main marine key habitats of conservation interest present in the area are Posidonia oceanica meadows and Coralligenous biocenosis hosting two main facies: Eunicella singularis - Flabellia petiolata and Eunicella cavolini - Leptogorgia sarmentosa. About 37% (17.89 km<sup>2</sup>) of the total surface area (47.79 km<sup>2</sup>) surveyed were covered by coralligenous biocenosis including coralligenous platforms, mosaic of coralligenous on rocky bottoms and bio-concretion assemblages. All priority habitats cover an area of almost 30 km<sup>2</sup>. A total of 18 benthic species that are protected or considered as key species of priority habitats were found in the site. The exceptional extension of the Coralligenous Platforms is one of the main particularities of this area, which is characterized by strong currents that seem to play a key role in conditioning the environment: High presence of gorgonians; ripple marks on detritic bottoms; erosion at the base of the coralligenous platforms.*

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### **SIZE DISTRIBUTION, DENSITY AND DISTURBANCE LEVEL ON THE GORGONIAN EUNICELLA SINGULARIS (ESPER, 1791) (CNIDARIA, OCTOCORALLIA) AROUND PALOMA ISLAND, ALGERIA (SOUTHWESTERN MEDITERRANEAN)**

*Gorgonians (Cnidaria, Octocorallia) are emblematic species of sublittoral communities in the Mediterranean Sea. This taxonomic group play an important ecological role in structuring the habitats, especially in the highly diverse Mediterranean coralligenous outcrops. In the Western Mediterranean Sea Eunicella singularis is found at high densities on sublittoral rocky bottoms in shallow waters and on coralligenous formations in deeper sublittoral waters. In this study, we assess the size distribution, density and disturbance level of E. singularis. During late summer 2017, a population of E. singularis dwelling between 15 and 25 m depth was surveyed by SCUBA diving around Paloma Island (western of Algerian coast). Density ranged between 44.5 and 117 gorgonians per m<sup>2</sup> and mean colony height was 16.2 cm. The size distributions indicated the prevalence of the smaller height classes (<20 cm). The mean extent of injury was 23.1%. The size structure indicates a high level of recruitment, as well as low levels of impact suggesting a current favorable conservation status. This study provides a first baseline for the monitoring of Algerian coralligenous habitats through the survey of gorgonians populations.*

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### **SHAPE ANALYSIS OF THE MEDITERRANEAN RED CORAL *CORALLIUM RUBRUM* (LINNAEUS, 1758): COLONIES HARVESTED FROM DIFFERENT HABITATS OF THE NORTH OF TUNISIAN COMMERCIAL BANK**

*While taxonomic studies focus on species, conservation focuses on populations, which are the main conservation unit. Conservation actions, therefore, should focus on the identification and management of local populations. The aim of this study is to use a mathematical description (elliptical Fourier analysis) of the shape of *Corallium rubrum* colonies in order to discriminate their populations in the northern coast of Tunisia. The shape analysis using the elliptic Fourier descriptors had shown that the colonies coming from different populations do not have significantly different shapes. Nevertheless, this structuring has been observed for populations of different depth strata in the Bizerte zone (Wilks  $\lambda = 0$ ,  $P < 0.0001$ ) so the depth can be a criterion for population morphological differentiation. A precise characterization of the shape, combined with demographic structure and genetic analysis, could give as useful tool for stock identification and help in the development of a management plan of this precious commercial species.*

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### **PRESENCE OF TWO *PARAMURICEA MACROSPINA* DENSE POPULATIONS IN THE TYRRHENIAN SEA (MEDITERRANEAN SEA)**

*Paramuricea macrospina (Koch, 1882) is a small endemic gorgonian of the Mediterranean Sea, dwelling on rocky bottoms and maërl beds between 40–2000 m depth. Although recent investigations have highlighted a wider distribution and abundance of this species, few data are available on its presence, ecology, biology and population structure. In fact, it is classified as data deficient in the IUCN red list. Moreover, in most of the localities where it has been recorded there is evidence of damage by fishing activities, which probably causes population decline. A multi-year Remoted Operated Vehicle (ROV) investigation, allowed the identification of two new sites characterized by large *P. macrospina* populations around Italy (Tuscany Archipelago and Nord-East Sicily). Density, habitat preference and ecological observations for this species are described, adding new knowledge on deep Mediterranean gorgonian species.*

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### **DEEP POPULATION OF GIANT RED GORGONIAN (*PARAMURICEA CLAVATA*): A NATURAL HERITAGE TO KNOW AND PROTECT**

*Along the "Côte Bleue" (West of Marseille, France), a remarkable population of the red gorgonian P. clavata was discovered on a large rocky bank between 50 m and 60 m depth. High densities (20-25 colonies m<sup>-2</sup>) and giant colonies up to human size (height 1.5 m - 1.8 m) characterise this population. The origin of the gigantism is currently unknown. Two non-exclusive hypotheses were formulated to explain the gigantism: (i) an adaptation to specific local environmental conditions, such as, for example, trophic richness, constant water temperature, favourable hydrodynamism; (ii) the existence of deep populations, genetically separated from those inhabiting shallower areas. Unfortunately, a strong (and increasing) fishing pressure was observed in the area as well. Conservation measures should be considered to preserve this natural heritage.*

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### **TEMPORARY PATTERNS OF THE CORALLIGENOUS HABITAT OF THE MARINE AREA OF JBEL MOUSSA (SOUTHWEST MEDITERRANEAN)**

*The Strait of Gibraltar is considered as a vulnerable biodiversity 'hot spot'. In the marine area of Jbel Moussa, between Belyounech Bay and Tanger-Med harbour, an important shallow population of the red coral (*Corallium rubrum*) was reported in 2014. In 2015, 9 monitoring stations were placed within 3 sites to characterize the coralligenous and the colonization by exotic/invasive macroalgae species *Rugulopteryx okamurae* in this locality. Demographic results and the shallow location of these rich coralligenous communities indicate the effective protection (military in this case) for the conservation of endangered red coral populations. Nonetheless, during the 2015-2017 monitoring period, a regression in the conservation status of the coralligenous habitats highlights the urgent need to promote administrative initiatives and actions to implement protection measures of these rich habitats and endangered populations of the red coral.*

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## **TRANSPLANTATION OF YELLOW GORGONIAN FRAGMENTS FROM A HIGHLY DISTURBED AREA**

*Recently, a significant decline of benthic suspension feeders occurred in the north eastern Sea of Marmara (Prince Islands), following excessive sedimentation of anthropogenic origin. The most important source of sedimentation was the construction and land filling operations held at Yassiada Island where a population of the yellow gorgonian, Eunicella cavolini, was significantly affected with a mortality rate of 88 %. In 2019, similar construction project is known to begin at the neighbouring island, Sivriada, where the yellow gorgonian population was affected with a mortality rate of 37 %. The relatively lower mortality is due to the location of the colonies on walls, e.g. vertical substrate. However higher mortality can be expected in 2019 since the operations will be held much closer to the colonies. In order to preserve the yellow gorgonian population in the area, a transplantation project was initiated. Coral fragments from 90 colonies were transplanted to an uninhabited island (Balıkçı) 13 km SSE, in order to test the feasibility of the transplantation technique in the area. 10 cm fragments that were cut from colonies in Sivriada were put in jars with surrounding seawater and kept in coolers until Balıkçı Island. Colonies were then fixed with two-component epoxy on a vertical wall where unaffected but scarce yellow gorgonian colonies were already present. After 13 months, most transplanted fragments were still alive and showed high growth in length. Higher numbers of colonies are planned to be transplanted before the construction starts in Sivriada.*

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## **SOME PECULIARITIES OF THE HEXACORALLIA ASSEMBLAGES ALONG THE MONTENEGRIN COAST**

*In order to facilitate the creation of future MPAs, about 36 km<sup>2</sup> of seabottom were surveyed in the Montenegrin coast. This communication aims to provide a preliminary description of specific Hexacorallia assemblages found in Montenegro and discuss possible further actions to improve their knowledge. The main Hexacorallia assemblages found were: 1) Cladocora caespitosa, living colonies and huge dead colonies, along with large-sized sponges and cnidarians. 2) Savalia savaglia facies with high density of colonies dwelling in shallow water (12-25 m) within Boka Kotorska Bay, a unique assemblage at Mediterranean level. Savalia savaglia colonizes the bottom in two small spots of a specific habitat characterized by "vrulja" (submarine spring of fresh water). 3) Extraordinary large madreporaria colonies of Phyllangia americana mouchezii and Polycyathus muelleriae in the vertical walls of a semi-obscure cave, associated with three other madreporaria species and sponges. These peculiarities of the Hexacorallia assemblages along the Montenegrin coast are considered key habitats that are very rare and vulnerable, but they are also providing an important role for the ecosystem functions and biodiversity in general. Because of their rarity and their key role these assemblages should be further investigated, monitored and protected.*









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Mediterranean Action Plan  
Barcelona Convention



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