

TOWARDS NEW MARINE-COASTAL NATURA 2000 SITES IN THE CENTRAL ADRIATIC SEA

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Abstract – The Abruzzo coast is a particularly heterogeneous environment that host high levels of biodiversity to be preserved, that need of innovative sustainable management strategies. In that context, the project CALLIOPE (LIFE17 NAT/IT/000565) aims to improve the marine-coastal Natura 2000 Network in Abruzzo region (Italy). The main objectives of CALLIOPE are: improving the biodiversity knowledge of marine environments (Habitats and species of European Conservation concern – Habitat Directive-HD), testing integrated management strategies to increase the conservation of coastal-marine biodiversity and supporting the preparation of a Coastal Action Plan for the Abruzzo Region.

In this context this work presents the results of a study aimed at describing and mapping the marine-coastal habitats of conservation concern (according with Habitat Directive) in the central Adriatic coast (Abruzzo region).

This new information will support the proposal of two new Natura 2000 sites (pSIC Punta dell’Acquabella and the pSIC Ripari di Giobbe) and the extension of the perimeter of a ZSC towards the respective marine-coastal area (ZSC IT7140108 Punta Aderci-Punta della Penna). We identified and mapped the habitat “Sandbanks slightly covered by sea water all the time (HD-1110)” here dominated by the phanerogama *Cymodocea nodosa*, the habitat “Large shallow inlets and bays (HD-1160)” with the presence of phanerogama *Zostera noltii* inside a largest prairie of *Cymodocetum* association and in correspondence of rocky environments the habitat “Reefs (HD-1170) with several associated species.

The implementation of Natura 2000 Network in marine habitats seems the better way to protect these important and fragile environments and to enhance a sustainable development of Abruzzo coast.

Introduction

The Adriatic Sea is an important basin hosting numerous endemic species including marine mammals, sea turtles, sea birds, fish and invertebrates and its natural ecosystems have a key role on human well-being [18]. Due to its shallow water it represents an important nursery, reproduction and foraging habitats even on areas distant to the seashore [15]. It also hosts several benthic ecosystems included in the Habitat Directive (92/43/EEC, Annex) and most of them are seriously impinged by human activities as illegal fishing and commercial exploitation [9, 13, 16].

The global decline of marine ecosystems may be partially ascribed to a poor governance and to the lack of a consistent marine conservation policy [18]. Despite their

great biodiversity and ecosystems value and the need of protecting them, just the 5% of the Adriatic Sea is included in Marine Protected Areas. MPAs are an effective instrument for preserving marine habitats and related fauna as well as for protecting cetaceans' populations [3]. In this context, new actions and instruments aimed at improving and conserving marine ecosystems to maintain and promote their sustainability in the Adriatic Sea are urgently needed [28]. To propose and implement a Marine Protected Areas (MPAs) or a marine SCI's several issues must be assembled. First a good scientific knowledge supporting management planners are needed. In particular, the delineation of critical habitats represents an important step [4, 17]. Besides ecological knowledge, to preserve marine environments and to develop sustainable activities it is also necessary to engage some focused communities and stakeholders in the process of safeguarding activities [29, 30].

In order to meet these needs, the project CALLIOPE (LIFE17 NAT/IT/000565) aims to improve the coast-sea regional natural connectivity by improving the Natura 2000 Network. In particular, the presented research focuses on improving knowledge about marine habitats in three target sites along the southern Abruzzo coast. Such new information is essential for proposing and implementing integrated coastal-marine Natura 2000 sites in the Abruzzo coast. Based on such new data we also offer the bases for improving public awareness on environmental protection all necessary for delineating a Regional Action Plan for the marine-coastal habitats.

The description and distribution of the Adriatic benthic communities have been studied at coarse scale [31, 32, 33, 34]; and large scale benthic surveys in the northern Adriatic soft bottoms were carried out in the '60s and '90s. The analysis of this data over time evidenced a reduction of benthic community's spatial heterogeneity (i.e. a reduction in diversity from local to medium scale) and such results were related with the increased trawling fishing pressure and with a variation in sedimentation patterns [27]. Shallow inshore sandy bottoms are often dominated by the suspension-feeding bivalve *Lentidium mediterraneum*, which seasonally can reach very high densities (300 000 ind. m² [1, 2]. The eastern coasts of Adriatic Sea, dominated by rocky shores are covered by benthic assemblages of photophilic algae, including *Cystoseira spp.* belts, and sea urchin barrens. Near the rocky shores, especially in shallow bays, there are seagrass meadows, as deeper subtidal rocky cliffs are covered by peculiar coralligenous habitats and by date mussel *Lithophaga lithophaga*. The principal reef-forming organisms in these coasts are algae as *Lithophyllum incrustans*, *Lithothamnion spp.* and *Peyssonnelia spp.* communities. Reefs are dominated by algal turfs and boring sponges close to the seashore, while offshore by benthic communities with high biodiversity values. The composition of the reef benthic communities is heterogeneous and varies over time and across sites in correspondence with different geo-morphological features and local environmental variables [12, 24, 25]. Instead, the Central Adriatic area is less investigated and a unified framework describing the benthic communities living on soft bottoms is still necessary.

In this context this work presents the results of a preliminary study aimed at describing and mapping the marine-coastal habitats of conservation concern (according with Habitat Directive 92/43/EEC) in the central Adriatic coast (Abruzzo region). This new information will support the proposal of two new Natura 2000 sites (pSIC Punta dell'Acquabella-Foce fiume Moro and the pSIC Ripari di Giobbe-Foce fiume Foro) and the extension of the perimeter of ZSC towards the respective marine-coastal area (ZSC IT7140108 Punta Aderci-Punta della Penna).

Materials and Methods

The Abruzzo coast (central Adriatic sub-basin) is a particularly heterogeneous environment characterized by sandy beaches and dune habitats in the northern and in the southern sectors, and shallow rocky cliffs and pebbly beaches in the central-southern part. The main promontories are Punta Ferruccio and Ripari di Giobbe (within the Ripari di Giobbe Regional Nature Reserve), Punta Acquabella (within the Punta dell'Acquabella Regional Nature Reserve) and Punta Aderci (within the ZSC IT7140108 Punta Aderci-Punta della Penna) [22]. Information on marine biocoenoses and local biodiversity along the Abruzzo coast, with the exception of the AMP Torre del Cerrano (ZSC IT7120215) seabed, are poor and not exhaustive for structuring management programs [10, 11, 16]. This work focused on the marine-coastal areas that are facing the Regional Natural Reserves Punta dell'Acquabella and Ripari di Giobbe in Ortona (CH) and the ZSC IT7140108 "Punta Aderci-Punta della Penna" in Vasto (CH) (Figure 1).

Before collecting new data and planning an updated biodiversity survey we gathered existing information and official documents describing naturalistic value of the analysed areas. We systematized biodiversity information reported on Management Plans; Scientific-Technical reports; Natura 2000 Standard Forms; maps included in the Management Plans and Scientific publications.

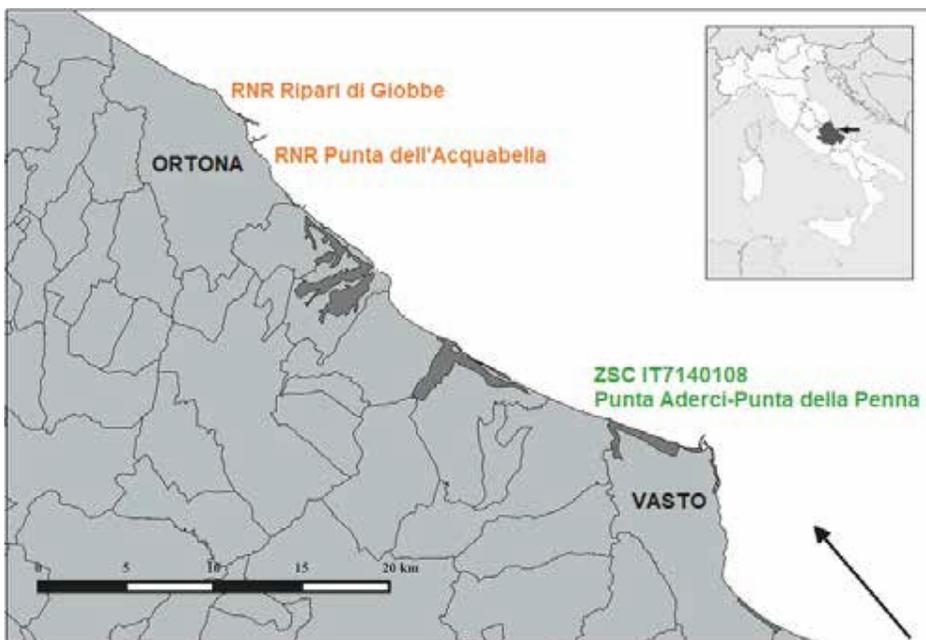


Figure 1 - Ripari di Giobbe Regional Natural Reserve, Punta dell'Acquabella Regional Natural Reserve in Ortona (CH) and Punta Aderci-Punta della Penna SAC (ZSC IT7140108) in Vasto (CH). In dark grey the current N2000 regional network.

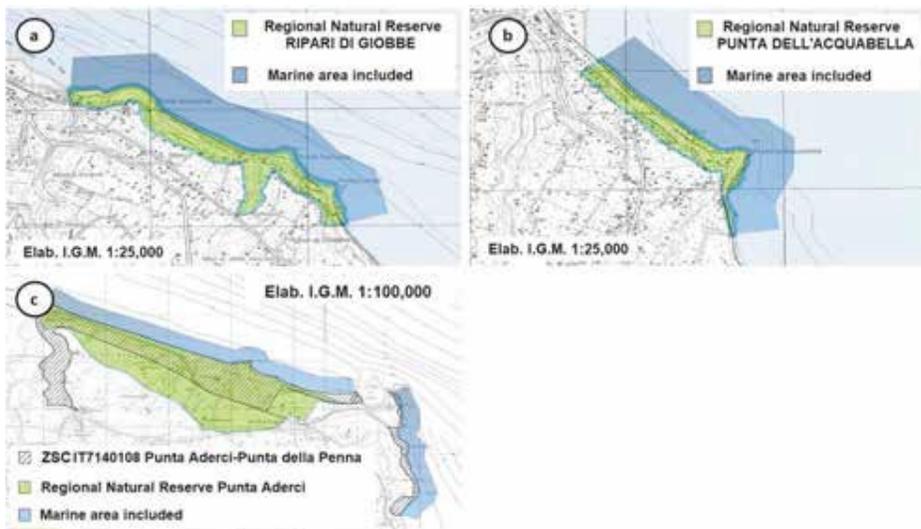


Figure 2 - Localization of marine-coastal pSCI's a) Ripari di Giobbe; b) Punta dell'Acquabella in Ortona (Ch) Protected Areas and c) the Punta Aderci-Punta della Penna site (ZSC IT7140108).

We defined the sampling area for each site as a 500 m buffer from the shore to the open sea (Figure 2). The sampling area was defined in a GIS environment (QGIS 3.8.3) based on the "AreeProtette" layer made available by the Abruzzo Region (Web Map Service in EPSG 4326 - WGS 84 – Geographic). To better analyze the stratification of marine associations [19], we also considered bathymetric information extracted from bathymetry map of the Adriatic Sea (contour 1m) – ISMAR CNR, 2016 (WMS).

A preliminary map of the of EU (92/43/EEC) marine habitats distribution in the analyzed coastal area was prepared using orthophotos and images available in the various specialized web services, including: Google Earth Pro; Google Maps; National Cartographic Portal; ADRIPLAN; SHAPE Adriatic Atlas; COPERNICUS Marine Environment Monitoring Service; E-Geos Realvista 1.0.

For the detailed identification and assignment of EU habitats, scuba diving was carried out following the guidelines of the Italian Habitats Manual [5]. Based on such information we also prepared a checklists of EU habitats and of associated fauna occurring in the target areas. Such information was georeferenced and established as monitoring sites (10 in Punta dell'Acquabella, 10 in Ripari di Giobbe, 19 in Punta Aderci).

Results

The survey on marine sea floor at -7÷-10 m depth, up to 300÷500 m from the seashore, evidenced a fine sand well calibrated bank with marine phanerogams. Specifically, we identified the EU habitat 1110 (Sandbanks which are slightly covered by sea water all

the time) with seabed without vegetation or with marine phanerogama *Cymodocea nodosa* (Figure 3a) for a total coverage of 347,6 ha. The most important species of fauna occurring in these sandbanks are *Hippocampus hippocampus*, the short snouted seahorse, and benthic species as bivalves *Chamelea gallina*, *Lentidium mediterraneum*, gasteropods *Nassarius mutabilis*, *N. reticulatus*, *Bolinus brandaris*, *Aporrhais pespelecani*, echinoderms *Atropecten irregularis*, *Holoturia tubulosa*, and crustaceans *Diogenes pugilator*, *Illia nucleus*, *Liocarcinus vernalis*.



Figure 3 - (a) EU 1160 with *Zostera noltii*; (b) EU 1110 with *Cymodocea nodosa*.

We also registered the presence of the EU habitat 1160 (Large shallow inlets and bays) with the marine phanerogama *Zostera noltii* with a total coverage of 0,61 ha (Figure 3b) occurring within a larger prairie of *Cymodocetum nodosae*. This habitat was observed only on the Punta Aderci site. The association *Zosterion marinae* includes the phanerogamic vegetation that develops on banks of muddy sands in calm, shallow and low salinity waters. This habitat is very important, because it represents a coastal nursery area where the juveniles of numerous necto-benthic fish species converge during the early stages of growth before spreading along the coast and then reaching sexual maturity [20]. In fact, the shallow waters allow the concentration of *Sparidae* (*Diplodus vulgaris*, *Diplodus annularis*, *Lythognathus mormyrus*, *Dicentrarchus labrax*), *Serranids* (*Epinephelus* sp., *Serranus scriba* and *Serranus cabrilla*) and red mullets *Mullus barbatus*.

The EU habitat 1110 and 1160 represent important fish nursery areas. As fish and several marine species depend on those habitats to survive and to reproduce, they are essential for preserving both: biodiversity and fishery activities [26].

Concerning the sampled rocky environments that characterize the cliffs we have registered the presence of the Reefs EU habitat (code 1170) with that has an estimated cover of 36,63 ha.

This cliffs host colonies of *Sabellaria spinulosa* (Figure 4), that forms bio-constructions on the rocks, and of various associated species including *Leptogorgia sarmentosa*, *Cladocora coespitosa* (Figure 5a, b), *Balanophyllia europea*, the bryozoo *Schizoporella errata*, the sea urchins *Aracia lixula* and *Paracentrodus lividus*, the bivalve common piddock *Pholas dactylus* and the bivalve species in Annex IV of the Habitats Directive (92/43/EEC) date mussel *Lithophaga lithophaga* (Figure 5c) and *Pinna nobilis* (Figure 5d).



Figure 4 - Bio-construction with *Sabellaria spinulosa*.

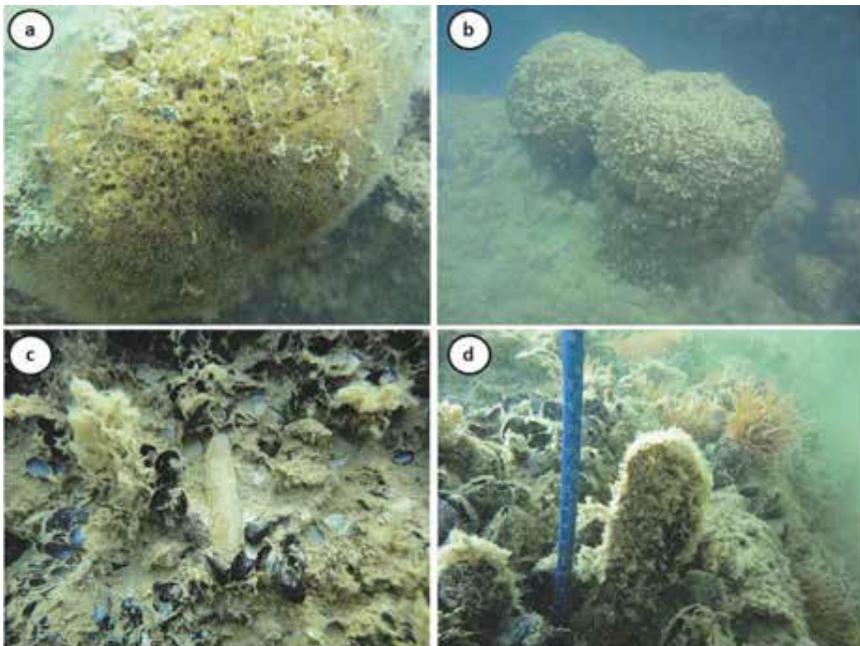


Figure 5 - a) and b) *Cladocora coespitosa* specimens; c) *Lithophaga lithophaga*; d) *Pinna nobilis*.

There are also numerous seaweeds including *Peyssonelia sp.* (Figure 6a), *Dictyopteris membracea*, *Dictyota dichotoma* and, only for the Punta Aderci site, of the rhodophytic *Halymenia floresia* (Figure 6b), which forms real grasslands on the seabed.



Figure 6 - (a) *Peyssonelia* sp., (b), *Halymenia floresia*.

All the produced georeferenced information was included in the Integrated Territorial Information System of LIFE17 CALLIOPE project¹ that, together with other cartographic information, will contribute to the comprehensive vision of the Abruzzo coast biodiversity and will support the definition of an Integrated Coastal Management Plan.

Discussion

As seen in other site of Adriatic coasts [8], the analyzed areas host a significant level of biodiversity with high number of benthic species living in shallow waters. We found and mapped several species protected by national or international Directives, and as observed in other areas such variability is most likely related with a high heterogeneity of bottom sediments [12, 24, 25]. The predominant seabed sediments are sandy-muddy [6, 7] with short sections where rocks form promontories in the southern tract of Abruzzo coast [21, 22]. As observed in the northern Adriatic coast also in the Abruzzo region we found sandbanks (EU habitat 1110) mainly with sandy sediments intermingled in some areas with large grain sediments as boulders and cobbles, and with small grained ones including mud in other. Such conditions allow the presence of EU habitat 1110 which hosts the typical “Biocoenosis of fine sands” (SFBC, well calibrated fine sands, code III.2.2) and EU habitat 1170, hosting the “Biocoenosis of infralittoral algae” (code III.6.1). Our results confirm the presence of a marine environments mosaic with sandbanks and reefs.

Our first results about LIFE17 NAT/IT/000565 CALLIOPE represent an important step for collecting data and information useful for implementing the marine-coastal Natura 2000 Network in central Adriatic basin.

Conclusion

The observed marine habitats in the analysed coast are of considerable importance for the maintenance of marine biodiversity supplying several ecological functions as

¹ <http://envixlab.unimol.it/life-calliope-il-sistema-informativo-integrato/>
https://drive.google.com/drive/folders/1wzlmHvEOamveKUIHo53e3c52UN_sxXIC

nursery for fish food, phytopurification capacity of marine waters, containment of storm surges, for increasing the landscape-perceptive value and tourism appeal, among others [29, 30]. Reducing the loss of natural habitats cover and quality represent, here and in general, a huge challenge in science, conservation and management [23], and this work support effective conservation measures.

The implementation of Natura 2000 Network in marine habitats seems the better way to protect these important and fragile environments, combining the conservation of biodiversity with sustainable tourism and sustainable utilization of resources. The here reported information may help to identify adequate measures for reducing the negative effects of several activities impinging coastal integrity over time as those derived from the destruction of the environment, the unauthorized removal of marine species and the construction of artificial artifacts for tourism.

The next step of LIFE17 NAT/IT/000565 CALLIOPE project will be a realization of a Regional Management Plan for implementing conservation actions and socio-economic strategies to preserve all Natura 2000 Network sites along Abruzzo coast. The Plan will be realized through a participative process, which will involve citizens and local stakeholders, according to the UN 2030 Agenda for Sustainable Development.

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