

Benthos communities of Vendicari and Capo Passero, two potential MPA's in South Eastern Sicily (Italy)

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ABSTRACT

In the present paper a bionomic study and cartography of the benthos of two potential MPAs in South Eastern Sicily, S.C.I. ITA 090027 “Fondali di Vendicari” and the S.C.I. ITA 090028 “Fondali dell’Isola di Capo Passero”, and surrounding areas are presented. The goals of this particular survey can be summarized as follows: 1) to chart the benthic communities (and the area of each one); 2) to evaluate the benthic diversity of the areas; 3) to produce visual documentation of the distributions of the benthic organisms; 4) to identify human-induced pressures on the benthic environment; 5) to make recommendations for future management based on the visual assessment; and 6) to set up a new methodology for making large biocenosis maps that would help to manage marine protected and non-protected areas. The fauna and flora of the meso- and macrobenthos were studied by a triple sampling procedure: standard, visual and photographic samples were simultaneously taken along underwater transects. These, together with the floristic and faunistic study of each algal and invertebrate group, served as the basis for the bionomic survey of the Vendicari and Capo Passero Island sea bottoms. In a first approach, the supra- and mediolittoral communities were studied. Further work were focused on the infralittoral stages and their communities along representative transects. The survey was conducted from surface (+0.50 m) to 40 metres of depth that is the limit of the study site. During this study were found, also, 41 benthic species and many biocoenoses of high naturalistic value protected by many international law agreements. The study led to a comprehensive review of the main biotope systems of this coastal area, as well as their environmental condition, and this will be an essential element for their future management.

KEY WORDS

marine protected areas; benthos communities; biocenotic map; SE Sicily; endangered species.

Received 09.12.2016; accepted 02.02.2017; printed 30.03.2017

Proceedings of the 3rd International Congress “Biodiversity, Mediterranean, Society”, September 4th-6th 2015, Noto-Vendicari (Italy)

INTRODUCTION

Natural ecosystems and landscapes that provide benefits to human society are of great ecological, socio-cultural and economic value (Costanza et al., 1997; de Groot et al., 2002). All these benefits, together with their support

structure, constitute an ecosystem's natural capital. However, the benefits of natural capital have been ignored in land-use and marine planning and in decision-making processes.

Vendicari and Capo Passero are two high naturalistic values areas along south eastern sicilian shoreline.

Vendicari area falls within the territory of the municipality of Noto and includes a vast wetland separated from the sea by coastal dunes and a coastline characterized by sandy beaches that form rocky shores; little off there is a small island. Throughout this area in 1978 was declared a protected area by the Sicilian Region Law and was called "Riserva Naturale Orientata Oasi Faunistica di Vendicari". The bottom facing the coastal stretch of the protected area to a depth of 40 meters is the S.C.I. "ITA090027".

The Capo Passero Island is a small island located few hundred meters from the coast in front of the town of Porto Palo di Capo Passero (South of Siracusa) in the extreme south east of Sicily. The environment emerged of the Capo Passero Island is extremely rich in botanical species endemic and/or rarities such as the Italian Botanical Society has placed the island in the list of botanical habitats of particular value in Sicily. As a further demonstration of the importance of the environment emerged of the island it must be said that the entire emerged part of the island is the S.C.I. ITA090001. Are no exceptions the bottoms around the island, i.e. S.C.I. "ITA090028" characterized by the presence of large stands of *Pinna nobilis* (Linnaeus, 1758) and *Posidonia* beds. These two sites are among those set out in Italian Law 394/91, which contains the list of Italian areas that could become protected areas, marine and / or land, or national parks.

MATERIALS AND METHODS

Previous studies

The literature data on the marine surrounding areas near the natural riserve of S.C.I. ITA 090027 "Fondali di Vendicari" and the S.C.I. ITA 090028 "Fondali dell'Isola di Capo Passero" are very poor and incomplete.

In the past decades many studies were carried out on marine environment of nearby areas but no study was carried out, in particular, for the areas. The first paper on the Hyblaean coast was published by Battiatto et al. (1980). In this study were examined only the floristic aspects on this marine environment. They founded 340 algal taxa.

Later, Giaccone et al. (1985a, 1985b; 1992) conducted studies on the marine vegetation present

along coastline between Gela (South Sicily - Mediterranean Sea) and Capo Passero Island and between Capo Passero Island and Ognina di Siracusa (near Siracusa, southeastern Sicily - Ionian Sea). While Buia et al. (1985) published a study on epiphyte vegetation of *Posidonia* leaves present in the seabed of Capo Passero.

In the first '90th Scammacca et al. (1996 - internal report) conducted a research aimed at studying the effects of human activities related to land use and their effects on the coastal environments as part of the "P.O.P. - Sicilia 1990-93" research project.

Giaccone & Di Martino (1996) published the results of their research as updating of knowledge on the marine flora and vegetation along the Hyblean coast line.

Only in the 1999, Blundo et al. (1999 a, b) and Di Martino & Blundo (1999) published the results of their research aimed at the knowledge of the marine flora and vegetation of the marine sea bottoms of Vendicari.

Cantone (1997) published the first study on marine biocoenosis of the Vendicari marine sea bottoms with the grant by Sicilian Region and two year after Cantone et al. (1999) published the biocoenotic map of the Gulf of Noto (S-E Sicily - Ionian Sea). But in this map only two transects were carried out within the Vendicari marine area. The same data were analyzed by Cantone et al. (2000) with particular attention on muddy bottoms benthos.

Sampling methods and mapping

The benthic cartography of the two S.C.I. ITA090027 (Fig. 1) and ITA090028 (Fig. 2) was obtained by combining classical grabbing methods with more recent imaging methods (Bianchi et al., 2004). The grabbing methods were also used to collect biological material that was studied thoroughly in the laboratory to identify its components. Imaging methods allowed a much larger amount of information to be processed in the time available, and also permitted the quantification of some key landscape species (epibenthic organisms).

The benthic cartography presented in this paper includes information starting with supralittoral environments (30 cm above the mean sea level) down to a depth of 40 m in the circalittoral environment, and provides data for the distribution of the main benthic habitats found in the area. Additional

information on species composition for these communities can be obtained from the cited literature.

The study of the benthos of Vendicari and of Capo Passero Island sea bottoms was carried out by underwater surveys. According to Tunesi & Vacchi (1993), Tunesi et al. (2001), Tunesi & Salvati (2002) and considering the type of coastal development of the two sites studied, it was decided to operate following the methodological approach commonly applied in similar studies to increase the knowledge of the sites for which it is proposed the establishment of a marine protected area.

To characterize the benthos of "Fondali di Vendicari" (S.I.C. ITA090027) were studied 20 transects orthogonal to the coastline. The spatial distribution of transects in the the coastline-sea direction was made in accordance with the homogeneity of benthic site as well as in consideration of the homogeneity of the coastline that has no major structural eminences if not in its portion to the north. In fact, in the most northern portion of this site transects were nearest to one another to better characterize the greater variety of biological submerged environments falling in this portion of the study area. Finally, to interpolate and enrich the data obtained was carried out the study of the biological communities present in a further 5 transects with orientation parallel to the coastline and long enough to intersect the largest possible number of the 20 transects orthogonal to the coast. In total for the seabed of Vendicari 100 surveys were carried out during the dive. 40 of these were made with the technique of "snorkeling" to study supralittoral, mediolittoral and fringe assemblages. The remaining 60 surveys were conducted by diving.

For the S.C.I. ITA090028 ("Fondali dell'Isola di Capo Passero") characterization were performed 12 transects orthogonal to the Island coastline and 15 transects with orientation parallel to the Island coastline to intersect the orthogonal transects. In total were performed 95 surveys of which 15 with the technique of "snorkeling" aimed at the study of the supralittoral and mediolittoral, the remaining 80 surveys have been conducted by diving with air breathing apparatus (SCUBA).

During all dives were carried out video and photographic surveys through the use of underwater digital and / or analog cameras and videocameras.

The information collected allowed to obtain the biocenotic map of the two S.C.I. ITA090027 and

ITA090028 based on the IGM (Istituto Geografico Militare - Italian Army Geographical Institute) maps, at the 1:25,000 scale, suitably modified (Fig. 1). Similarly, it is made use of toponymy reported in the same maps. Each unit was represented by a bionomic campiture that, using different color layers defined by a code, refers to the RGB color scale graphics as proposed by Meinesz et al. (1983), implemented by Vaugelas et al. (1998) and, recently, enhanced by Tunesi et al. (2002) with those bionomic units that at the time of the realization of the two previous papers were not present.

The positioning of each transect in the two study areas was obtained through a GPS and using the geographic coordinate datum WGS 84.

RESULTS

Over the visual surveys were collected data on the presence of protected marine species and/or assemblages in the studied areas. The species considered were those receiving strict protection status according to Directive 79/409/CEE; Law 503, 5.10.81, Directive 92/43 CEE, 21.05.92, Presidential Decree 357, 8.09.1997, Law 157, 11.02.1992, and Law 175, 27.05.99. The marine habitats considered were those identified as "*determinant*" by UNEP (1999), which defines them as "*habitats for which conservation is considered indispensable*" (Amore et al., 1992; Relini, 2002; Furnari et al., 2003; Tunesi et al., 2008).

The census of protected species present in the studied areas was conducted by recording the presence of these species during the dives for the study of benthos integrated with the bibliographic data. It was also verified the presence of the species and/or marine benthic assemblages worthy of protection already reported in previous research (Cantone et al., 1993; Cantone, 1996, 2001; Blundo et al., 1999a, b; Di Martino & Blundo, 1999).

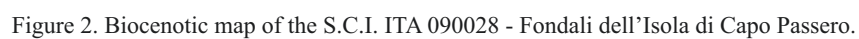
S.C.I. ITA090027 - Fondali di Vendicari

Due to the tipology of the coastal development of this site was made a division into three sectors (A, B and C) of the entire coastline.

The section "A" includes the northernmost portion of the site where the coastline is characterized



Figure 1. Biocenotic map of the SCI ITA 090027 - Fondali di Vendicari.



TAXA	ASPIM	HABITAT	BERN	BONN	CITES
MAGNOLIOPHYTA					
<i>Cymodocea nodosa</i> (Ucria) Ascherson			B1		
<i>Posidonia oceanica</i> (Linnaeus) Delile	P2		B1		
CHLOROPHYTA					
<i>Caulerpa ollivieri</i> Dostal	P2		B1		
HETEROKONTOPHYTA					
<i>Cystoseira amentacea</i> (C. Agardh) Bory var. <i>stricta</i> Montagne	P2		B1		
<i>Cystoseira mediterranea</i> Sauvageau	P2		B1		
RHODOPHYTA					
<i>Lithophyllum byssoides</i> (Lamarck) Foslie	P2		B1		
<i>Ptilophora mediterranea</i> (H. Huvé) Norris	P2		B1		
<i>Schimmelmannia schousboei</i> (J. Agardh) J. Agardh	P2		B1		
PORIFERA					
<i>Aplysina aerophoba</i> Schmidt, 1862	P2				
<i>Ircinia foetida</i> (Schmidt, 1862)	P2				
<i>Sarcotragus</i> (<i>Ircinia</i>) <i>pipetta</i> (Schmidt, 1868)	P2				
<i>Spongia officinalis</i> Linnaeus, 1759	P2		B3		
CNIDARIA					
<i>Astroides calycularis</i> (Pallas, 1766)	P2		B2		
BRYOZOA					
<i>Hornera lichenoides</i> (Linnaeus, 1758)	P2				
MOLLUSCA					
<i>Charonia nodifera</i> (Lamarck, 1822)	P2		B2		
<i>Erosaria spurca</i> (Linnaeus, 1758)	P2		B2		
<i>Dendropoma petraeum</i> (Monterosato, 1884)	P2		B2		
<i>Gibbula</i> sp.	P2		B2		
<i>Lithophaga lithophaga</i> (Linnaeus, 1758)	P2	H4	B2		
<i>Luria lurida</i> (Linnaeus, 1758)	P2		B2		
<i>Mitra zonata</i> Marryat, 1818	P2		B2		
<i>Patella ferruginea</i> Gmelin, 1791	P2	H4	B2		
<i>Pinna nobilis</i> (Linnaeus, 1758)	P2	H4			
<i>Pinna rudis</i> Linnaeus, 1758	P2				
<i>Tonna galea</i> (Linnaeus, 1758)	P2		B2		
<i>Zonaria pyrum</i> (Gmelin, 1791)	P2		B2		
CRUSTACEA					
<i>Homarus gammarus</i> (Linnaeus, 1758)	P3		B3		
<i>Maja squinado</i> (Herbst, 1788)	P3		B3		
<i>Palinurus elephas</i> (Fabricius, 1787)	P3		B3		
<i>Scyllarides latus</i> (Latreille, 1803)	P3	H5	B3		
<i>Scyllarus arctus</i> (Linnaeus, 1758)	P3		B3		
<i>Scyllarus pygmaeus</i> (Bate, 1888)	P3		B3		
ECHINODERMATA					
<i>Ophidiaster ophidianus</i> (Lamarck, 1816)	P2		B2		
<i>Paracentrotus lividus</i> (Lamarck, 1816)	P3				

TAXA	ASPIM	HABITAT	BERN	BONN	CITES
OSTEICHTHYES					
<i>Epinephelus marginatus</i> (Lowe, 1834)	P3				
<i>Hippocampus hippocampus</i> (Linnaeus, 1758)	P2				CD
<i>Hippocampus ramulosus</i> Leach, 1814	P2				CD
<i>Pomatoschistus marmoratus</i> (Risso, 1810)			B2		
<i>Pomatoschistus tortonesei</i> Miller, 1968	P2				
<i>Syngnathus abaster</i> Risso, 1826			B3		
<i>Sciaena umbra</i> Linnaeus, 1758	P3		B3		
REPTILIA					
<i>Caretta caretta</i> (Linnaeus, 1758)	P2	H2, H4	B2	D1	CA

Table 1. Protected species present in the study sites. Keys to abbreviations: B1 = BERN Ap. 1; B2 = BERN Ap.2; B3 = BERN Ap.3; D2 = BONN Ap.2; CA = CITES All. A; CB = CITES All. B; CD = CITES All. D; D1 = BONN Ap. 1; H2 = HABITAT Ap. 2; H4 = HABITAT Ap. 4; H5 = HABITAT Ap. 5; P2 = Annex II by ASPIM; P3 = Annex III by ASPIM.

by rocky outcrops a few meters from the sea surface. The northern limits of the area "A" is the location called "Eloro", which is the limit of the same S.C.I. "Fondali di Vendicari" while the southern boundary has been identified with the stretch of coast where there is the building known as "Torre Vendicari".

The sector "B" corresponds to the seabed in front to the long beach that characterizes the central portion of the site. This sector also includes the small island that rises a few meters above mean sea level.

The sector "C" corresponds to the stretch of rocky coastline that follows the beach and finishes with the southern border of the S.C.I. "Fondali di Vendicari".

In Table 1 are reported the high naturalistic value species found in this site.

In the seabed of the "S.C.I. ITA090027" were identified habitats of remarkable natural value of those listed in the document UNEP (OCA)/MEDWG.154/7,27 and also reported in Relini (2002). These are all included in the ASPIM Protocol of the Barcelona Convention and are, also, habitat considered relevant to the choice of sites at which to establish Marine Protected Areas.

In particular in the "A" sector was censused *Lithophyllum byssoides* Assemblage Giaccone 1993, in the central area of the sector, assemblage with *Cystoseira amentacea* (C. Agardh) Bory var. *stricta* Montagne (as facies of *Cystoseira stricatea* Molinier, 1958) and *Posidonia oceanica* meadow (as *Posidonietum oceanicae* Molinier, 1958).

In the sector "B" seabottoms was censused trochus at *Lithophyllum byssoides* (Lamarck) Foslie (Giaccone, 1993), along the coast of the Isle of Vendicari, and *Posidonia oceanica* (Linnaeus) Delile meadow. While, in the seabottoms of "C" sector was censused assemblage with *Lithophyllum byssoides*, assemblage with *Cystoseira brachycarpa* J. Agardh emend. Giaccone var. *brachycarpa*, *Posidonia* meadow and two facies of the biocenoses of coral reefs: the facies at *Eunicella singularis* Esper, 1791 and the facies at *E. verrucosa* Pallas, 1766.

S.C.I. ITA090028 - Fondali dell'Isola di Capo Passero

In relation to the shape of the Capo Passero Island, it was decided to divide the perimeter of the island into two sectors. This division was made according to a hypothetical line oriented NE - SW, which ideally joins the northern tip and the southern tip of the island. On the basis of this assumption have been identified the two sectors. The area "A", which includes the coast of the island having western exposure and the sector "B" which includes the coast of the island having east facing. Also, have been investigated, as distinct, the two underwater caves present on the Capo Passero Island, the "Betsabea Cave" which opens along the coast of the sector "B" and "Enfasi Cave" located at the base of a small stack rock off the southern tip of the island.

The area "A" is placed along the side of the island less exposed to wave action because facing

the Sicilian coast from here is just a few hundred meters. Under the “A” sector was made a further division into two sub-sectors “A1” and “A2”. The subsector “A1” is characterized by lower gradient of depths and high geomorphological homogeneity. The sub-sector “A2”, however, is characterized by coasts quite high that at some point take on characteristics of the cliff.

The sector “B” comprises the eastern and south-eastern coasts of the island exposed to the open sea and, therefore, particularly susceptible to wave motion, that at certain times of the year is very intense. The coastline of this area of the island are characterized by a wide geomorphological variability both above and below sea level, showing a discrete heterogeneity of the populations living therein.

The sector “B” has been divided into a further two sub-sectors, “B1” and “B2”. The first is characterized by high rocky shores, with characteristics of the cliff, and uneven along which there are a couple of deep inlets. The sub-sector “B2” is characterized by a trend of the coast line that describes two half moons separated by a small tip that stretches to a few tens of meters into the sea. Here the coast, always rocky, is low and heavily eroded by waves and atmospheric agents.

The species of high naturalistic value censused in the S.C.I. ITA 090028 are listed in Table 1.

Also in the “S.C.I. ITA090028” have been counted several habitats of high naturalistic value and all included in the list of Document UNEP (OCA)/MEDWG.154/7,27 and also reported in Relini (2002). All Habitats mentioned by experts as relevant to the choice of sites worthy of being identified as marine and coastal protected areas that could be included in the SPAMI list (Special Protected Areas of Mediterranean Importance).

In particular the habitats of high conservation interest, which have been recorded in the depths of this site are Association with *Lithophyllum byssoides*, *Posidonia oceanica* meadows, Association with *Sargassum vulgare* C. Agardh, Association with *Cystoseira compressa* (Esper) Gerloff et Nizamuddin f. *compressa*, Association with *Cystoseira amentacea* (C. Agardh) Bory v. *amentacea*, two Facies of the coralligenous biocoenoses: facies at *Eunicella singularis* and the facies at *E. verrucosa*, Biocenosis of mediolittoral caves and Caves and ducts in total darkness.

CONCLUSIONS

Research conducted during the course of this study has allowed an initial framework for the knowledge about the entire benthic component of the marine environment of Vendicari and Capo Passero Island (South Eastern Sicilian shoreline). These bottoms, in fact, though regarded by many of high conservation value and deserving of special protection measures, before this study, had never been investigated systematically and thoroughly. For this reason it's impossible to make a comparison with previous studies in order to analyze the changes of benthic assemblages over time.

Benthic cartography is a prerequisite for suitable planning and management of the marine environment; allocating human activities for reaching certain objectives should be based on correct knowledge of its structure, as well as its functions. The main goal of the newly developed Marine Strategy Framework Directive of the European Union is to achieve a good environmental status (GENS) of the marine environment (Tunesi, 2012).

This study confirms the importance of the environment and the need to preserve these environments for the great richness of species and habitats of high naturalistic value. The authors, in fact, advance the hypothesis of safeguarding these two, “S.C.I.” together with the other “S.C.I.” marine life along the south-eastern coast of Sicily by the establishment of a “multi-spot” Marine Protected Area.

The proposed framework can improve the generation and dissemination of cartographic and visual data, and allow for management approaches based on scientific knowledge and EBM principles, taking into account stakeholders needs. This is in order to achieve a unique governance capable of managing organically all the natural emergencies present along the southeastern sicilian coastlines.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to the Ente Fauna Siciliana - onlus (Sicilian Wildlife Authority - non-profit organization), Prof. Bruno Ragonese (Noto, Italy), Mr. Corrado Bianca (Noto, Italy) for their logistical support and Dr. Leonardo Tunesi (Rome, Italy) for his valuable advice.

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