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MARINE PROTECTED SPECIES AND HABITATS OF CONSERVATION INTEREST IN THE GALLINARIA ISLAND (LIGURIAN SEA): A STUDY FOR THE ESTABLISHMENT OF THE MARINE PROTECTED AREA

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RIASSUNTO

Specie ed habitat marini protetti di interesse conservazionistico nelle acque dell'Isola Gallinaria (Mar Ligure): uno studio per l'istituzione dell'area marina protetta

Una delle principali finalità delle aree marine protette è la conservazione delle specie protette e minacciate, e degli habitat sensibili; quindi la progettazione di una nuova area protetta richiede la conoscenza puntuale della distribuzione di queste specie e di questi habitat. Il presente lavoro descrive lo studio condotto per valutare la distribuzione di specie protette ed habitat sensibili nelle acque costiere dell'Isola Gallinaria, futura area marina protetta nazionale, e il metodo originale messo a punto per identificare le principali categorie di vincoli necessari per la loro salvaguardia.

ABSTRACT

The conservation of endangered and protected species and sensitive habitats is amongst the primary objectives of Marine Protected Areas (MPAs) whose zoning should be conceived through a process which identifies appropriate protection regimes directed at areas characterised by such species and habitats. The present study, describes the distribution of protected species and sensitive habitats in the coastal waters of the future Italian MPA of the Gallinaria Island and illustrates the method used to identify the main categories of restrictions crucial to respect the specific sensitivities of species and habitats.

1. INTRODUCTION

The conservation of threatened and protected species and sensitive habitats is amongst the primary objectives of marine protected areas (MPAs) (Salm *et al*., 2000; Friedlander *et al*., 2003), and most of the management of an MPA involves human activities (Kelleher, 1999). The latter generally fall within two categories: those involving extractive use (fishing, amateur collection, etc.), and those involving non-

extractive use (scuba diving, swimming, nautical activities, etc.). Both categories may induce harmful effects if their activities are not properly managed (Hawkins & Roberts, 1997; Roberts & Hawkins, 2000; Milazzo *et al*., 2002; Tunesi *et al*., in press). The zoning of an MPA should therefore be defined on the basis of studies involving human activities and conservation needs (Tunesi *et al*., 2005) and particularly so in the Mediterranean where human coastal encroachment is high.

The feasibility studies for the zoning of future MPAs should clearly identify the areas of highest environmental value, proposing appropriate protection regimes capable of guaranteeing the conservation of critical environmental elements (Salm *et al*., 2000; Tunesi *et al.*, 2005; 2006). More specifically, the protection regimes need to guarantee species and habitat survival through the identification and limitation of specific access (non-extractive use) and take (extractive use) activities. Furthermore, the specific identification of conservation hot spots allows to identify, from the onset, the sites requiring specific monitoring in order to evaluate the effectiveness of the new MPA, after its institution (Pomeroy *et al*., 2005).

The Italian Central Institute for Marine Research (ICRAM) was commissioned by the Italian Ministry of the Environment to conduct environmental and socio-economic studies for the establishment of the national MPA of the Gallinaria Island (Western Ligurian Sea). The present study describes the field activities carried out to evaluate the distribution of marine protected species and habitats of conservation interest, and the approach applied to identify their specific protection requirements in relation to their sensitivity to human activities. This approach was defined in order to support the zoning of the new MPA.

2. MATERIALS AND METHODS

The field activities were focused on the study of the presence and the distribution of marine protected species and habitats of conservation interest. 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".

The study area encompasses the coastal waters of the Gallinaria island up to 30 meters depth. The island has a sub-triangular shape whose northern tip hosts a small port. The shape of the island allows to identify three main coastal sectors, clearly different both from a geomorphologic point of view and for their oceanographic characteristics. Consequently the sampling activities were planned on the basis of these three coastal sectors (Fig. 1), using an approach commonly applied in the zoning of new MPAs in Italy (Tunesi & Vacchi, 1993; Tunesi & Salvati, 2002): Sector I, between Punta Falconara and the port; Sector II, between the port and Punta Sciusciaù; Sector III, between Punta Sciusciaù and Punta Falconara.

Species and habitat distribution in the study area were collected through scuba and snorkelling dives conducted during the summer 2005. Eight main radial scuba-diving

transects, 100 meters long, were carried out replicating those conducted in a previous study (Balduzzi *et al*., 1994). This allowed to compare the benthic assemblages distribution after a period of more than 10 years. Furthermore, 60 free dive paths, randomly distributed between the 8 radial transects, were generally conducted following the natural contour of the seafloor, parallel to the coast, in the 1-30 meter depth range. The positioning of each transect was obtained through a GPS and using the geographic coordinate *datum* WGS 84. Snorkelling bouts along the entire island's coast were conducted in order to collect data on the medio-infralittoral algal belt and on the coastal presence of marine birds. Visual censuses were carried out during the scuba and snorkelling bouts in order to collect quali-quantitative data on phyto and zoobenthic species presence in the 5 meter wide strip observed along the course of each dive. Photographic documentation was collected during each transect/path.

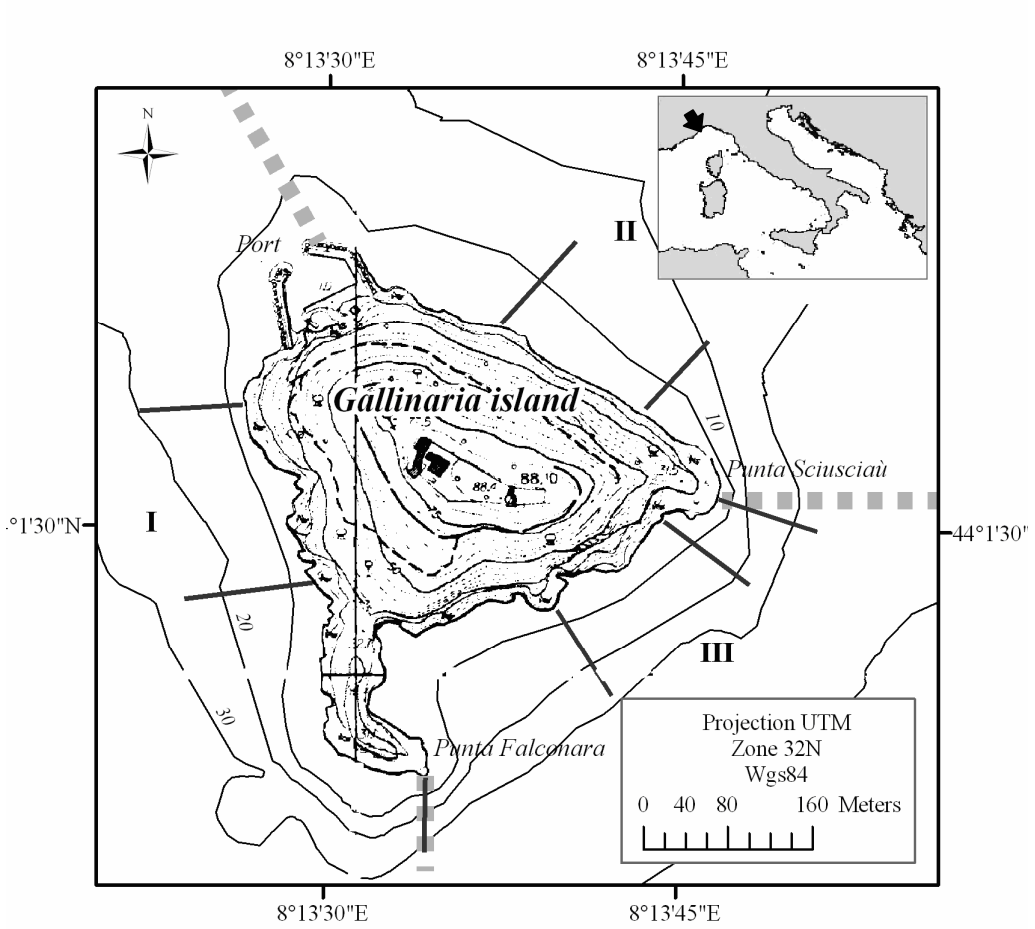


Fig. 1 - The study area, the three identified coastal sectors (delimited by the dotted lines) and the location of the 8 radial dive transects (full line).

The data collected on the distribution of protected species and determinant habitats was stored and analysed through a geographic information system (GIS),

containing the biocoenotic and bathymetric data. The recorded species were classified according to their vulnerability to activities involving human access and take, on the basis of the criteria described by Tunesi *et al.* (2006). The vulnerability of the observed determinant habitats to activities involving human access, take and environmental habitat degradation, was identified on the basis of available bibliographic data (Bellan Santini *et al.*, 2002), and successively classified according to the three categories proposed by Tunesi *et al.* (2006) (PA= threat deriving from human presence/access in the habitat area; PR= threat deriving from take activities conducted in the habitat area, DA = threat derived from environmental degradation insisting on the habitat). The cartographic information on the vulnerability was collated and elaborated so as to yield two thematic maps: "sensitivity to human access" and "sensitivity to take activities" Each map shows the areas hosting protected species and determinant habitats, classified according to their vulnerability to human access and to take activities

3. RESULTS

The study allowed to record the presence of specimens belonging to 18 marine protected species (Tab. 1; 2 Phanerogams, 1 Rhodophyte, 2 Heterokontophytes, 5 Porifera, 5 Molluscs, 1 Echinoderm, 2 Birds). Seven of these species had previously been recorded in the area (Morri, 1992; ICRAM, 1993; Balduzzi *et al.*, 1994; Bianchi & Morri, 1994), while 11 were observed for the first time in the present study (3 Porifera, 5 Molluscs, 1 Echinoderm, 2 Birds). The highest number of protected species was found in sector III, followed by sector II and I. Eight marine habitats of conservation interest were identified in the study area (Tab. 2; 2 in the Mediolittoral zone, 6 in the Infralittoral zone). These habitats are distributed differently throughout the island's sectors. The majority of habitats was found in sector III (n=6), while sector I and II are each characterised by the presence of fewer habitats (n=3). This distribution implies differences in vulnerability of the different sectors. Sector II in fact is characterised by habitats vulnerable to the DA category (habitat degradation) while sectors III and I host habitats vulnerable to all three categories (PA, PR and DA).

Figure 2 illustrates the result of the spatial analysis of the distribution of habitat and species in relation to their sensitivities to human access and take. Although all sectors are characterised by the presence of protected species and determinant habitats (Tab. 1 and 2), figure 2 indicates that sectors I and III are mainly hosting areas sensitive to access and take activities, while sector II is characterised by a small and limited number of sensitive areas.

4. CONCLUSIONS

The study confirms the environmental and the conservation importance of the Gallinaria island (Balduzzi *et al*., 1994) and improves the information on the presence and the distribution of protected species and sensitive habitats in its coastal waters. All sectors of the island host species and habitats worthy of protection and sensitive to

human access, although the sensitivity of sector II seems to be mainly due to the presence of a short stretch of *Litophyllum trottoir*. In particular the regulation of activities involving human access could contemplate the following measures: an appropriate management of the diving activities in marine caves and forbidding boat anchoring on *Posidonia oceanica* as well as trampling and landing on *Litophyllum trottoir*. Furthermore, sectors I and III are also hosting species sensitive to various take activities requiring the enactment of specific restrictions. In particular, these regulations should contemplate the prohibition to use nets on coralligenous bottoms, the collection of protected marine gastropods and the respect of the prohibition to trawl on depths below 50 meters and in particular on *Posidonia oceanica* beds.

The sensitivity maps created by applying the proposed approach allow to synthesize the information collected on protected species and habitats, thereby visualizing the most vulnerable areas and providing information about the main categories of sensitivity (Tunesi *et al*., 2006).

This methodological approach was envisaged so as to support the zoning process, both in the application of spatial multi-criteria analysis, and to facilitate the meetings with the stakeholders (Villa *et al.*, 2002; Tunesi *et al*., 2005). At the same time it also provides support in the regulation-making of activities that may threaten species and habitats that are worthy of protection and conservation efforts (Roberts & Hawkins, 2000).

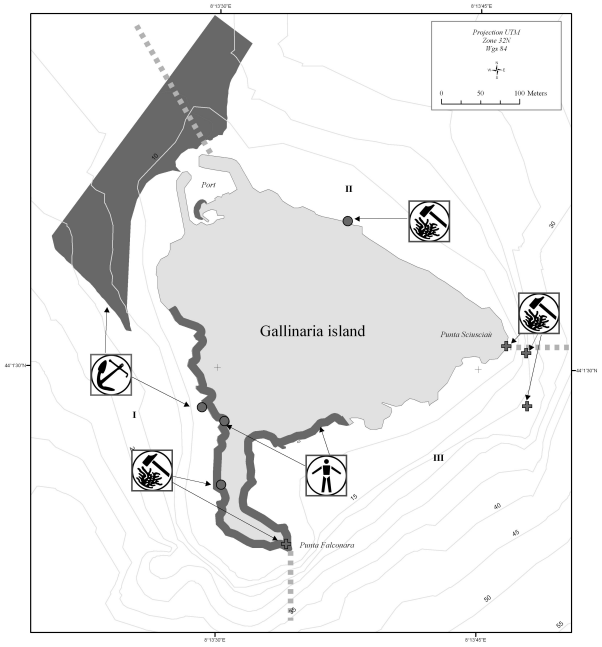
Tab. 1 - List of the marine protected species recorded in the Gallinaria Island waters during the ICRAM 2005 research campaign and their distribution in the coastal sectors.

	List of marine protected species	**Presence in the sectors**		
		I	**II**	**III**
Vegetal	*Cymodocea nodosa* (Ucria) Ascherson	●		
	Posidonia oceanica (L.) Delile	●	●	●
	Lithophyllum byssoides (Lamouroux) Foslie	●	●	●
	Cystoseira amentacea Bory var. *stricta* Montagne	●	●	●
	Cystoseira zosteroides C. Agardh	●		●
Invertebrates	*Aplysina aerophoba* Schmidt	●		
	Aplysina cavernicola Vacelet			●
	Axinella polypoides Schmidt			●
	Axinella cannabina (Esper) Schmidt, 1862			●
	Sarcotragus foetidus Schmidt, 1862	●		●
	Erosaria spurca (L.)			●
	Luria lurida (L.)			●
	Patella ferruginea Gmelin			●
	Pinna nobilis L.	●		
	Lithophaga lithophaga Linnaeus,, 1758	●		●
	Ophidiaster ophidianus (Lamarck)			●
Vertebrates	*Phalacrocorax aristotelis* (Linnaeus, 1761)	●		●
	Somateria mollissima (Linnaeus, 1758)	●		

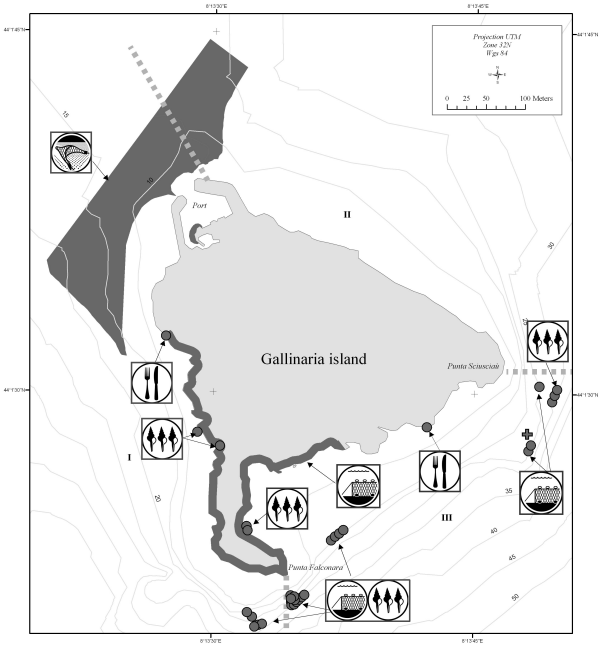
The method thereby provides decision makers with a support tool capable of indicating the activities that should be appropriately conducted or avoided in the future establishment of the MPA, on the basis of the specific sensitivities of those species and habitats that are present in the various sectors composing the new MPA.

Tab. 2 - List of the determinant habitats, their vulnerability to the threat categories according Tunesi *et al.* (2006), and their distribution in the coastal sectors.

Habitat name	**Habitat code (UNEP, 1996)**	**Threat category (in capital letters)and typology of activity**	**Presence in the sectors**		
			I	**II**	**III**
Association with *Lithophyllum byssoides: Lithophylletum byssoidis* Giaccone 1993	II.4.2.1	**PA**: trampling; **DA**: increase in sediment suspension, hydrocarbon pollution, urban and industrial pollution	●	●	●
Biocenosis of mediolittoral caves	II.4.3.1	**PA**: access by bathers; **DA**: reduction in chemical-physical water quality			●
Posidonia oceanica meadows (= Association with *P. oceanica*), Molinier 1958	III.5.1	**PR**: trawling; **PA**: anchoring; **DA**: increase in sediment suspension	●		
Association with *Sargassum vulgare: Sargassetum vulgaris* Mayhoub 1976	III.6.1.20	**DA**: increase in sediment suspension, hydrocarbon pollution, reduction in salinity due to freshwater input, introduction of alien species	●		●
Association with *Cystoseira compressa*: *Cystoseiretum crinitae* Molinier 1958 subass. *Cystoseiretosum compressae* Molinier 1958	III.6.1.25	**DA**: urban and industrial pollution		●	
Association with *Cystoseira amentacea*: *Cystoseiretum strictae* Molinier 1958	III.6.1.2	**DA**: agricultural, urban and industrial pollution		●	●
Facies of the coralligenous biocoenoses: *Facies* with *Eunicella singularis*	IV.3.1.11	**PR**: physical damage by contact with set nets, use of illegal fishing methods such as explosives; **DA**: increase in water temperature			●
Caves and ducts in total darkness (*biocenoses* that are present in *enclave* at superior levels such as the infra and circalittoral)	V.3.2	**PA**: access by divers; **DA**: reduction in chemical-physical water quality			●



a)



b)

Fig. 2 - Map of the areas sensitive to human access (**a**) and map of the areas sensitive to take activities (**b**). Key: Physical damage due to human presence; Physical damage due to anchoring; Disturbance from recreational activities; Trawling Static nets; Amateur fishing for recreational/consumption purposes; Collection.

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