

# Underwater itineraries at Egadi Islands: Marine biodiversity protection through actions for sustainable tourism

Sustainable tourism is recognized as a high priority for environmental and biological conservation. Promoting protection of local biological and environmental resources is a useful action for conservation of marine biodiversity in Marine Protected Areas and for stimulating awareness among residents and visitors. The publication of two books dedicated to the description of 28 selected underwater itineraries, for divers and snorkelers, and a website with underwater videos represent concrete actions by ENEA for the promotion of sustainable tourism at the Marine Protected Area of Egadi Islands (Sicily, Italy). 177 species were recorded at Favignana, and around the same number at Marettimo and Levanzo islands: among those species, some of them are important for conservation and protection (e.g. *Astrospartus mediterraneus*), some of them are rare (i.e. *Anthipatella subpinnata*) and with a high aesthetic value (e.g. *Paramuricea clavata*, *Savalia savaglia*), while others are invasive (e.g. *Caulerpa cylindracea*)

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## Introduction

Sustainable tourism represents an important reason for promoting historical, cultural and environmental features of countries where those features are not promoted and popularized enough. This situation typically occurs in Italy and especially in remote areas, such as small islands, which suffer high pressures acting on vulnerable terrestrial and marine environments, usually caused by a mass and aggressive tourism for limited periods of the year. Seasonal anthropogenic pressures due to beach resort activities, illegal practise of professional and sport fisheries, and domestic pollution as consequence of urbanization are all factors affecting marine ecosystems and thus threatening biological resources.

The Marine Protected Area (MPA) of Egadi Islands, including Favignana, Marettimo and Levanzo islands, is the target area for ENEA project “Ecoinnovazione Sicilia”, funded by the Italian financial act in 2010, which aimed to define specific actions for promoting sustainable

tourism (<http://egadi.santateresa.enea.it/>). The MPA was originally established by the Italian Government in 1991 and then its management transferred from the Ministry of Environment to Favignana municipality in 2001. In recent years, the MPA has realized important actions on conservation and promotion of the coastal marine environment, with particular attention to environmental education, research and promotion of sustainable development for all economic local activities.

The main tool for conservation of marine biodiversity is to promote the importance of protection of local biological and environmental resources so that there is co-operation from all users in preventing or

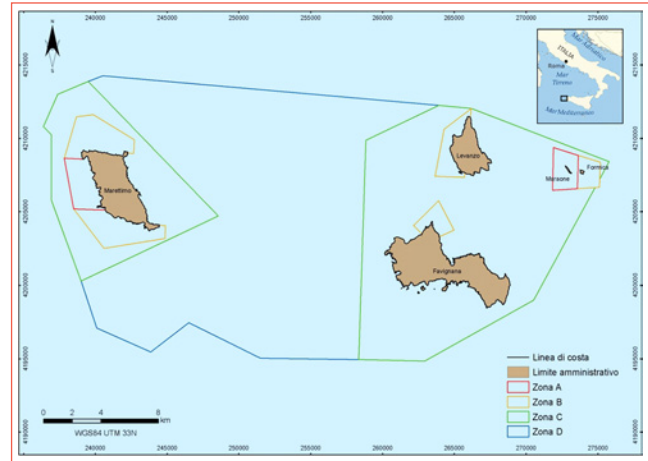
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minimising potentially adverse activities. Within this context, ENEA aims to develop and realize actions for sustainable tourism. By popularizing marine biological and environmental special features, knowledge will be increased thus generating further awareness among residents and nearby populations and visitors, making the marine resources more easy to protect against non-sustainable tourism.

Among the special underwater features of the Egadi Islands, *Posidonia oceanica* meadows, included in the Habitat Directive (43/92/CEE), are one of the most important biocoenoses for their abundance and distribution all around the shallow seabed of the islands (~7.700 ha). In addition, on the deep rocky outcrops and shoals, the coralligenous community represents a Mediterranean habitat of high ecological importance. For its richness of species, the coralligenous community is well known both by fishermen, who have eligible sites for fishing on coastal and offshore rocky shoals, and by diving centres that often promote their activities in these habitats. However, the biodiversity associated with the coralligenous community and its landscape value, as well as the presence of species of aesthetic and conservation interest are not well known from either a scientific point of view or by the resident population. Here, we present the project carried out by some researchers of the Marine Environment Research Centre (La Spezia, Italy) of ENEA aimed to realize actions for disseminating the knowledge on coralligenous and marine coastal rocky communities characterizing underwater habitats at Egadi Islands. The ultimate purpose of the work was to protect biological and environmental resources, promote awareness of the value of marine biodiversity among residents and encourage sustainable tourism around Egadi Islands.

**Study area:  
The Marine Protected Area (MPA) of Egadi Islands**

The Egadi archipelago, located a few km far from the west coast of Sicily, comprises three main islands, Favignana, Levanzo and Marettimo, and some minor islands (Formica and Maraone); at present it is the largest MPA in the Mediterranean, covering around 54 thousand hectares (Figure 1).



**FIGURE 1** Map of the Marine Protected Area of Egadi Islands, with an indication of the different zones (A, B, C and D) of protection  
 Source: AA.VV. (2009), "Relazione finale. Analisi e valutazione dello stato degli ecosistemi marini delle zone A e B in 4 Aree Marine Protette anche al fine di valutare l'efficacia delle misure di gestione delle stesse", CoNISMa e Ministero dell'Ambiente e della Tutela del Territorio e del Mare

The archipelago includes an area of high natural-environmental interest, in particular the underwater environment has a high biodiversity due to its particular geographical position and hydrological conditions. Moreover, the coastal and underwater geomorphology shows peculiar features deserving protection. The seabed morphology of the inner continental shelf is characterized by the presence of topographical highs and submarine valleys as the results of tectonics, Holocene eustatic sea-level changes, subaerial (during Holocene high stand phases) and marine erosion processes [1, 2]. These processes are very active and influential around Egadi Islands where the sea currents are very high, especially along the submarine valleys [3]. The submerged caves and other topographical features caused by intense erosion mechanisms following storms and strong seabed currents are one of the most peculiar aspects that characterise the coastal area and the seabed of Egadi Islands. Around the archipelago there are several submerged rocky outcrops and wave-cut terraces generally limited by faults, with almost vertical sides and shaped by hydrodynamics [4]. Those morphologies are

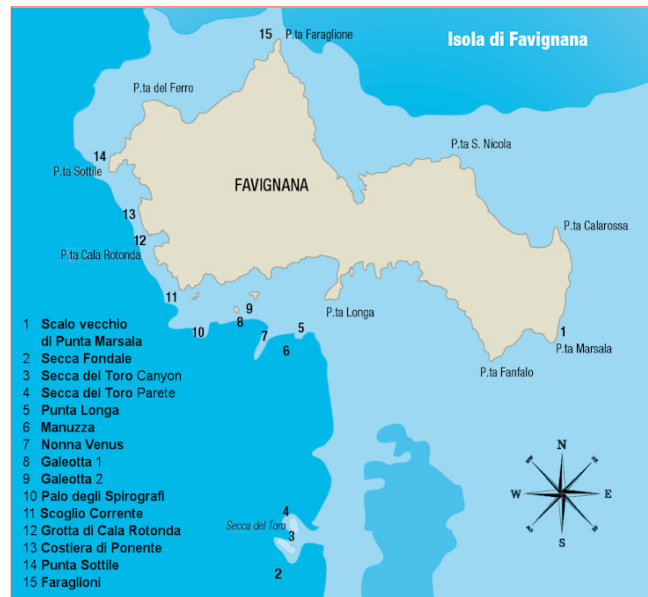
located on the inner continental shelf between 19 and 50 m depth; they represent very interesting features from an environmental and geological point of view and also for the ecology and marine biology of benthos. Seabed sediments on the continental shelf around Egadi Islands are mainly constituted by heterogeneous mixtures composed by pebbles and gravels with medium to coarse sands, rich in bioclasts [5].

Among natural features of the sea bottom, as already mentioned, *Posidonia oceanica* meadows are the most important biocoenoses for their abundance and distribution all around the islands. *P. oceanica* meadows are one of the most important Mediterranean ecosystems and represent a high-value habitat for both their ecological role and the associated biodiversity. Seagrass beds are a high-productivity ecosystem: they produce oxygen, represent a reproductive and nursery area for several species, reduce the energy of the currents and waves on the submerged beach, and contribute to the stability of the sea bottom and beach protection [6, 7]. Moreover, the coralligenous community represents a habitat of high ecological importance for the richness of associated biodiversity and landscape value, as well as the presence of valuable species of natural and conservation interest.

### Field work at Egadi Islands' MPA

In 2012 and 2013 some ENEA researchers explored 15 underwater pathways at Favignana Island (Figure 2), 11 at Marettimo (Figure 3) and two at Levanzo (Figure 4) by means of scuba diving.

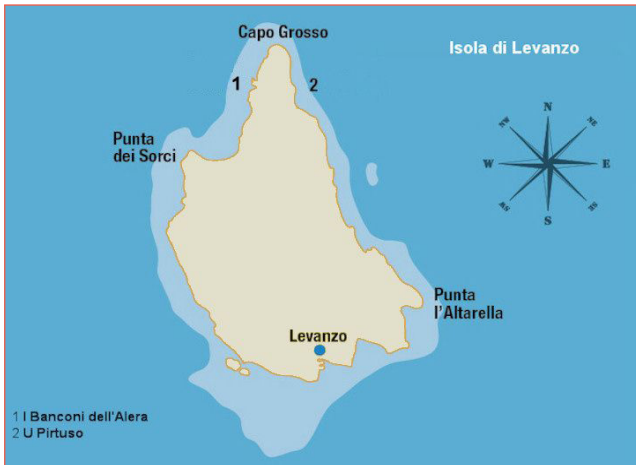
For each pathway, underwater photographs were taken by using a NIKON D80 digital camera with SEA&SEA housing equipped with two SEA&SEA strobes. Underwater videos were recorded using a Sony full-HD video camera enclosed in an underwater housing with a wide-angle lens and two lamps. Information about species presence and distribution was recorded on underwater tablets. Only the conspicuous species visually recognized during diving inspections were reported; while diving, voucher specimens were collected to help their identification. Sea temperature, depth, orientation and a sketch of each path were recorded too.



**FIGURE 2** Location of 15 underwater itineraries at Favignana Island



**FIGURE 3** Location of 11 underwater itineraries at Marettimo Island



**FIGURE 4** Location of 2 underwater itineraries at Levanzo Island

### Two illustrated books dedicated to underwater itineraries at Egadi Islands' MPA

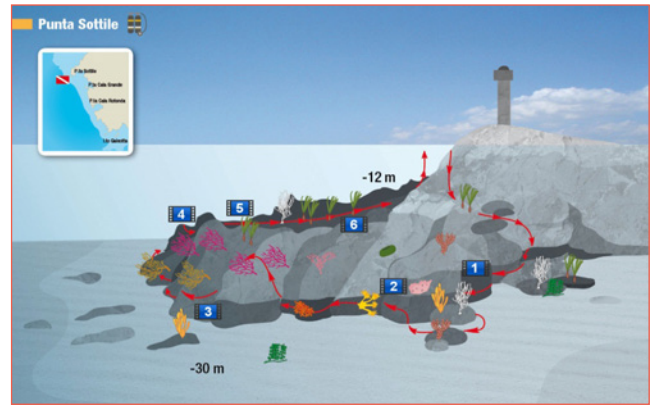
All the information collected on each underwater itinerary (i.e., a list of species, bathymetric distribution of species, type of seabed, depth, orientation, and morphology of the path) were combined in a digital format and published [8, 9], (Figures 5, 6).



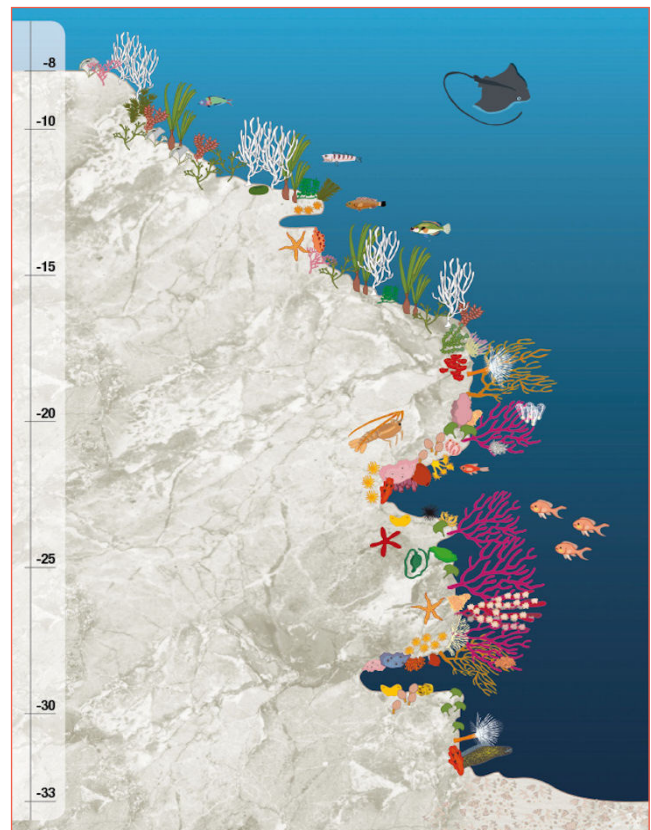
**FIGURE 5** The book of underwater itineraries at Favignana Island  
Source: Cocito et al., 2012



**FIGURE 6** The book of underwater itineraries at Marettimo and Levanzo Islands  
Source: Cocito et al., 2014



**FIGURE 7** Example of an underwater path for divers, with icons of most relevant species and videos  
Source: <http://egadi.santateresa.enea.it>



**FIGURE 8** Example of an underwater transect, where all main species and features of the seabed are indicated  
Source: Cocito et al., 2012

ENEA researchers provided all of the scientific content of the books by describing the coastal environment of Egadi Islands, the itineraries in terms of ecological and geological characteristics, and produced a comprehensive species

list. A 3D drawing indicated with arrows the directions followed by divers and the presence of main, relevant species (Figure 7).

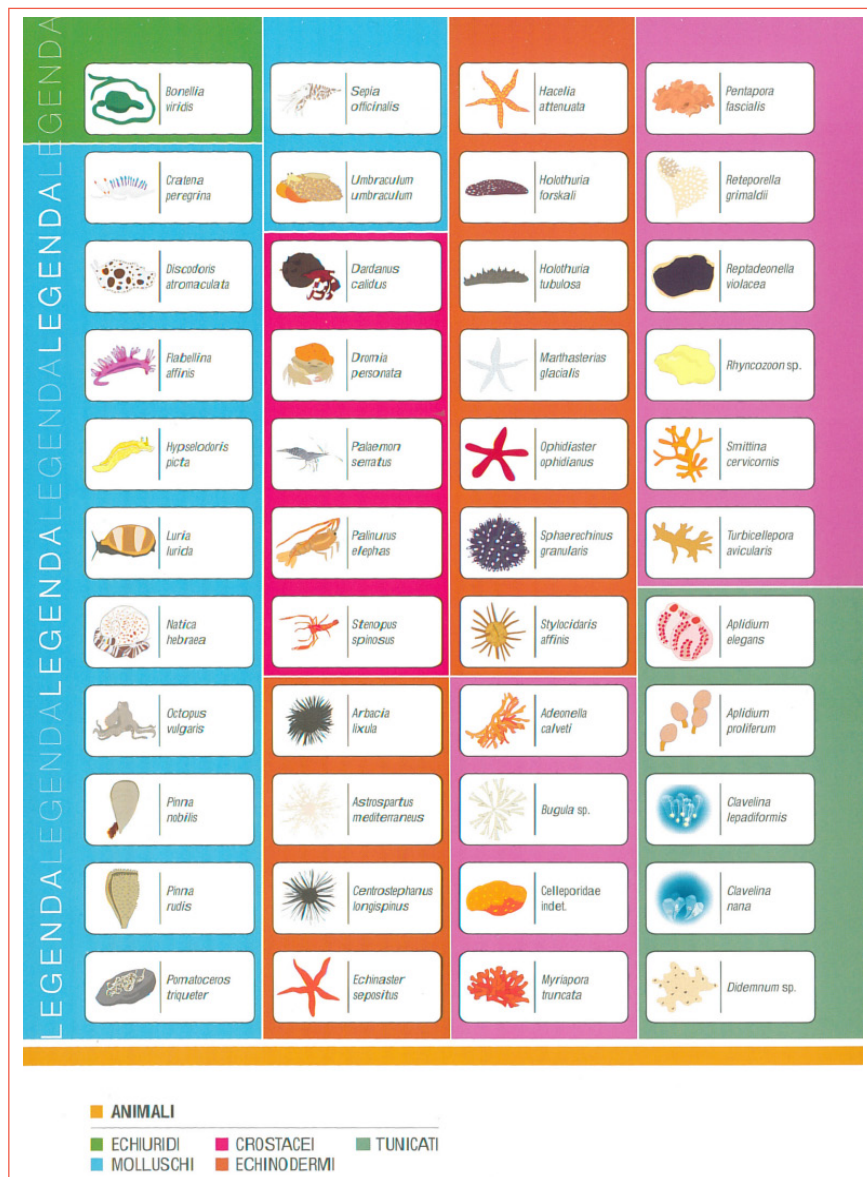
A further 2D drawing, representing a cross section of the itinerary, was realised with the aim of providing a detailed illustration of geomorphology of the site and presence and distribution along depth of the species characterizing that specific site (Figure 8).

Particular attention was paid to the legend with a detailed list of species, seabed characteristics and icons with fine morphologic details illustrating species. Different colours in the legend were used to represent different taxa (Figure 9). Those icons were used in the maps of paths and transects showing the dive observations.

Each underwater itinerary was described in detail from surface to bottom and information about the principal morphological characteristics (i.e. rock, shoal, cave or rocky wall), and other features (such as depth, current, exposure to adverse sea-weather conditions, visibility), useful to evaluate the difficulty level of dive, were provided.

Each itinerary was also provided with a score represented by stars: the score, from one to four stars, from low to excellent, was based on nature conservation relevance, thus considering biological relevance, species and habitat presence, geomorphologic characteristics, aesthetic view of the itinerary.

Among the itineraries, the most common topographies observed are almost vertical rocky walls, together with rocks and shoals, reaching a maximum depth of



**FIGURE 9** Example of legend, showing the detailed list of species and icons used in maps of paths and transects, representing species. Different colours in the legend were used to represent different taxa  
 Source: Cocito et al., 2014

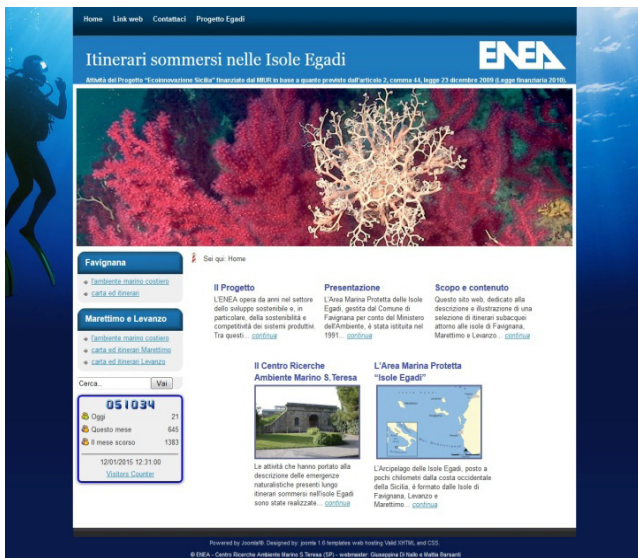
42 m. More than half of the itineraries are of easy or medium difficulty, so open to a wide range of divers and snorkelers too.

Almost all underwater itineraries (22 out of a total of 28) are of high nature conservation relevance, rating them from good to excellent.

A total of 177 species (39 of algae and plants and 138 of animals) was recorded at Favignana, and 172 species (32 of algae and plants and 140 of animals) was found at Marettimo and Levanzo islands. Among the species found across the pathways, some of them are important for conservation and protection (i.e. *Astrospartus mediterraneus*), others are rare (i.e. *Anthipatella subpinnata*) and with a high aesthetic value (i.e. *Paramuricea clavata*, *Savalia savaglia*), while others are invasive (i.e. *Caulerpa racemosa*).

### The Website dedicated to underwater itineraries at Egadi Islands' MPA

The two illustrated books [8, 9] were published in a website (<http://egadi.santateresa.enea.it/>) which was built using Joomla!® software (<http://www.joomla.org>), an open-source Content Management System (CMS)



**FIGURE 10** The ENEA website (<http://egadi.santateresa.enea.it/>) dedicated to underwater itineraries at Egadi Islands

written in PHP (PHP: Hypertext Preprocessor) which uses MySQL or PostgreSQL database. The website, in addition to the content of the books, shows more photos and videos for each underwater path. The videos can be displayed both in low and in high resolution (1080p FHD) on any mobile device (iPad, iPhone, Android & Windows) (Figure 10).



The QR (Quick Response) codes were printed in the two illustrated books (Figure 11), linking them to the website <http://egadi.santateresa.enea.it/>, thus enabling to connect and display each underwater itinerary on mobile accessories.

**FIGURE 11** The QR code shown in the two illustrated books, linking to the website and videos of underwater itineraries

Since its date of publication in 2013, the website, has been visited by more than 50 thousand visitors, meaning around 2000 visitors/month (with peaks during the summer period) and indicating a high interest of the underwater environment, having the possibility of getting a closer knowledge of it.

### Final considerations

The publication of two books dedicated to the description and illustration of selected underwater itineraries, for divers and snorkelers, at Favignana, Marettimo and Levanzo Islands, and a dedicated website with underwater videos around selected sites of the archipelago, represent concrete actions by ENEA for the promotion of sustainable tourism. The main tool for the protection of the submerged environment is knowledge. The two illustrated guides and the website, based on easy and popular communication tools, aim to disseminate knowledge on the marine environment, which is often known by specialists only. These diving and snorkeling itineraries of Favignana, Marettimo and Levanzo islands highlight the beauty and special features of underwater environments. Addressed to locals, tourists and divers, and all people who love the

Egadi archipelago, these dive guides represent useful tools for professionals who work in and with the MPA of Egadi Islands. The list of marine sites of interest has been recently implemented through the publication of a diving guide also reporting archaeological itineraries around the Egadi Islands [10]. Sustainable tourism is recognized as a high priority tool for environmental and biological conservation. This project has been developed for residents, tourists and general users who wish to know more about marine biological resources,

understand their importance and thus act for their conservation. Books and the website are therefore a tool for dissemination which stimulates the observation of the underwater environment, its natural features, as well as providing information to people who wish to undertake snorkeling and diving in a beautiful marine environment. ●

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references

- [1] Agnesi V., Macaluso T., Orrù P., Ulzega A. (1993), "Paleogeografia dell'Arcipelago delle Egadi (Sicilia) nel Pleistocene sup. - Olocene", *Naturalista siciliano*, supplemento 4, 17(1-2), p. 3-22
- [2] AA.VV. (2009), "Relazione finale. Analisi e valutazione dello stato degli ecosistemi marini delle zone A e B in 4 Aree Marine Protette anche al fine di valutare l'efficacia delle misure di gestione delle stesse", CoNISMa e Ministero dell'Ambiente e della Tutela del Territorio e del Mare
- [3] Colantoni P., Ligi M., Morsiani M. P., Penitenti D. (1993), "Morphology and recent sedimentary evolution of the western Sicilian Continental Shelf", Geological development of the Sicilian-Tunisian Platform. *Unesco reports in marine science*, 58, 93-98
- [4] Lo Iacono C., Guillén J. (2008), "Environmental conditions for gravelly and pebbly dunes and sorted bedforms on a moderate-energy inner shelf (Marettimo Island, Italy, western Mediterranean)", *Continental Shelf Research* 28 (2008), 245-256
- [5] Lo Iacono C. (2004), "Geomorphologic, sedimentological and ecological aspects of Egadi Islands offshore (NW Tyrrhenian Sea)", Università di Napoli "Federico II", Naples, Italy. PhD Thesis, 150 pp., unpublished
- [6] Boudouresque C.F., Bernard G., Bonhomme P., Charbonnel E., Diviacco G., Meisnesz A., Pergent G., Pergent-Martini C., Ruitton S., Tunesi L. 2012. *Protection and conservation of Posidonia oceanica meadows*. Ramoge and RAC/SPA publisher, Tunis: 1-202
- [7] Duarte C.M. (2002) The future of seagrass meadows. *Environmental Conservation* 29(2): 192-206
- [8] Cocito S., Barsanti M., Delbono I., Lombardi C., Peirano A. (2012), *Itinerari sommersi nell'Isola di Favignana, Isole Egadi*, RES Edizioni, Sarzana (SP), 80 pp
- [9] Cocito S., Barsanti M., Delbono I., Lombardi C., Peirano A. (2014), *Itinerari sommersi nelle isole di Marettimo e Levanzo, Isole Egadi*", RES Edizioni, Sarzana (SP), 72 pp
- [10] Tomasello A., Calvo S., La Rocca R., Di Maida G., Pirrotta M., Donati S., Russo M., Sieli G. (2014), "Area marina protetta Isole Egadi. Percorsi Naturalistici e Archeologici". Dipartimento di Scienze della Terra e del Mare, Università degli Studi di Palermo, 167 pp. ISBN: 9788894004908