

Record of *Ellisella paraplexauroides* (Anthozoa: Alcyonacea: Ellisellidae) in Italian waters (Mediterranean Sea)

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The occurrence of the candelabrum coral Ellisella paraplexauroides in Italian waters (Sicily Strait, Mediterranean Sea), was documented during a remotely operated vehicle cruise, carried out by ISPRA in May 2010 on-board the RV 'Astrea'. Five specimens were photographed and sampled from 80 to 94 m depth on the north-east coasts of Pantelleria Island, confirming the distribution of this species in the central Mediterranean Sea. A description of the living colonies and other taxonomic and ecological characteristics is provided.

Keywords: *Ellisella paraplexauroides*, mesophotic zone, remotely operated vehicle exploration, biogeography, Pantelleria Island

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INTRODUCTION

The gorgonians of the genus *Ellisella* Gray, 1958 are widely distributed from tropical to temperate waters (Fabricius & Alderslade, 2001; Weinberg & Grasshoff, 2005). In the Mediterranean Sea, this genus is represented only by one species, *Ellisella paraplexauroides* Stiasny, 1936 (family Ellisellidae), forming brick-red candlestick colonies, up to 2 m high (Carpine & Grasshoff, 1975). The branched colonies have thin, whip-like ramifications arising from a common short stem, heading parallel upwards and dividing dichotomously (Fabricius & Alderslade, 2001). The unbranched or sparsely branched specimens of this species can be confused with *Viminella flagellum* (Johnson, 1863) (Carpine & Grasshoff, 1975; Fabricius & Alderslade, 2001; Giusti *et al.*, in press), the second ellisellid coral found in the Mediterranean basin, but are easily distinguishable by the sclerites shape and for the red colour, contrasting the white-yellow appearance of *V. flagellum*.

Ellisella paraplexauroides, similar to *V. flagellum*, has an Atlanto-Mediterranean distribution (Vafidis *et al.*, 1994), however, in contrast with this species, it has been reported in southernmost warm temperate oceanic waters along the western coasts of Africa (Table 1). The first record of *E. paraplexauroides* was made by Stiasny (1936) from Cap Blanc (Mauritania). Following this, the species was reported in several other Atlantic localities including the coasts of Portugal (Stiasny, 1939a), the Gulf of Cádiz (Arroyo Tenorio *et al.*, 2008; Aguilier *et al.*, 2010), several sites along the Moroccan coast (Stiasny, 1939b; Grasshoff, 1972, 1992) and in the whole Canary Archipelago (Brito *et al.*, 1984;

Brito, 1985; Arístegui *et al.*, 1987; Grasshoff, 1992; Ocaña *et al.*, 1992; Bianchi *et al.*, 2000; Brito & Ocaña, 2004). It also occurs further south along the African coast (apart from the type locality): in Senegal (Grasshoff, 1992; Miralles *et al.*, 1992), Ivory Coast, Ghana, Nigeria and Angola (Grasshoff, 1992). No records have been given so far for the Azores, Madeira Islands, Great Meteor and Josephine Seamounts and Cape Verde Archipelago, where, on the contrary, *V. flagellum* was found. This led Grasshoff (1972) to suppose that *E. paraplexauroides* was mainly distributed along the continental coasts, excluding the Canary Islands.

Ellisella paraplexauroides has been firstly reported in the Mediterranean Sea by Stiasny (1940), examining fragments collected along the Algerian and Tunisian coasts (Grasshoff, 1992). Most of the following records within the Mediterranean Sea came from the Gibraltar Strait (Ocaña *et al.*, 2000; Brito & Ocaña, 2004; Arroyo Tenorio *et al.*, 2008; Torres Gavilá, 2008), Alborán Island (Templado *et al.*, 1986, 2006; Aguilier *et al.*, 2008), Alborán Sea (Aguilier *et al.*, 2008) and along the Moroccan coast, in the Chafarinas Islands, where several biological observations were made by SCUBA diving on a rich shallow water population of *E. paraplexauroides* (López *et al.*, 1996; Peña Cantero & García Carrascosa, 2002; Castellanos *et al.*, 2003; González García *et al.*, 2005; Aguilier *et al.*, 2008; Torres Gavilá, 2008; Tocino *et al.*, 2009). A further record was documented from the central Mediterranean Sea, at Sidi Daoud (Tunisia) (Mustapha *et al.*, 2004). Finally, Stiasny (1942) reported *E. paraplexauroides* also from the Bay of Naples (representing the northernmost record so far) even if, on the basis of the known distribution of the species, this record was generally considered doubtful (Grasshoff, 1972) (Figure 1).

Few data are available concerning biology and ecology of *E. paraplexauroides*. This has probably resulted from the analysis of small fragments only (Carpine & Grasshoff, 1975; Ocaña

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Table 1. Biogeographical records for *Ellisella paraplexauroides*.

Locality	Depth (m)	Notes	Reference
Atlantic Ocean			
Off Sesimbra, Portugal	–	–	Stiasny, 1939a
Gulf of Cádiz	15–30	Coastline between Chipiona and Rota; on rocks off Huelva and El Terrón (Gulf of Cádiz); off la Caleta, Cádiz	Arroyo Tenorio <i>et al.</i> , 2008; Aguilier <i>et al.</i> , 2010
Morocco	–	1 specimen and various fragments (MNHN); 2 colonies (RMNH, 6136, 6142)	Stiasny, 1939b
Asilah, western Moroccan coast	125	Various fragments collected during the Dana Expedition (Station 1115, ZMUC), SeSam Senckenberg Collection	Collected in 1921
Casablanca, Morocco	110–155	Various colonies collected during the Vanneau Expedition (Stations 21, 28, 37, 43, MNHN)	Collected between 1923 and 1926
Cap Blanc du Nord, Morocco	100–195	Various fragments collected during the Dana Expedition (Station 4020, ZMUC), Meteor 1967 (Station 8-013, SMF2154), CANCAP Expedition (RMNH 17956)	Collected between 1930 and 1967
Cap Cantin, Morocco	125	1 colony and 2 fragments collected during the Vanneau Expedition (Station 11, MNHN)	Collected between 1923 and 1926
Cap Sim, Morocco	135–195	Fragments collected during the 1967 Meteor Expedition (Station 9-082, SMF 2106, 2155)	Collected in 1967
Agadir, Morocco	110–150	1–2 colonies collected during the Vanneau Expedition (Stations 79, 91, 100, 110, MNHN)	Collected between 1923 and 1926
Cap Blanco (Cap Corveiro), Mauritania	30–60	Holotype (2 colonies, Amsterdam Museum), 1 colony (5973) and 4 fragments (5940) in the RMNH; 1 colony in the MNHN; fragments collected during the 1975 Meteor Expedition (Station 36-107, SMF 6209-10; Station 118, SMF 3122)	Stiasny, 1936, 1937; collections 1975
Punta de Guimar, Las Eras and El Socorro, Tenerife, Canary Islands	63–690	Epibiontic <i>Sarcodictyon canariensis</i> encrusting a dead axis of <i>E. paraplexauroides</i> and other specimens entrapped in fishing gears. Found especially on the <i>Dendrophyllia ramea</i> 's bottoms	Brito <i>et al.</i> , 1984; Brito, 1985; Aristegui <i>et al.</i> , 1987; Grasshoff, 1992; Ocaña <i>et al.</i> , 1992; Brito & Ocaña, 2004
Puerto del Carmen, Lanzarote, Canary Islands	~50	Visual census and underwater photography	Bianchi <i>et al.</i> , 2000
Dakar, Senegal	45	Biochemical analysis on <i>E. paraplexauroides</i> 's sterols	Miralles <i>et al.</i> , 1992
Dakar, Senegal	45–50	1 colony identified by Kornprobst, 1986 (SMF 5778), 1 fragment (MNHN)	Collected in 1986
Ivory Coast (Cap Palmas, Bereby, Abidjan)	80–100	Various fragments collected during the Orstom Expedition (MNHN) and the Guinean Trawling Survey (Station 20/6, MNHN)	Collected in 1967
Ghana (Takoradi Cape Three Points, Accra, Tema)	33–48	1 colony collected during the Mercator Expedition (MNHN); 5 fragments collected during the Pillsbury Expedition (Station 17, 27 NMNH Invertebrate Zoology Collection, 85265-85266)	Collected in 1938 and 1964–1965
Bight of Benin, Lagos, Nigeria	82–97	2 fragments collected during the Pillsbury Expedition (Station 230 NMNH Invertebrate Zoology Collection, 85267)	Collected in 1964–1965
Angola (Moita Seca, Ambrizete)	100	1 colony collected during the Atlantique Sud Expedition (Station 9, MNHN) and 1 colony identified by Gofas, 1985 (SMF, 5779)	Collected in 1948–1949 and 1985
Mediterranean Sea			
Gibraltar Strait (Ceuta, Morocco; Punta Carnero, Spain)	20–38	–	Ocaña <i>et al.</i> , 2000; Brito & Ocaña, 2004; Arroyo Tenorio <i>et al.</i> , 2008; Torres Gavilá, 2008
Alborán Island	70–140	–	Templado <i>et al.</i> , 1986, 2006
Chafarinas Islands, Alborán Sea	15–35	Study through direct surveys of the associated fauna of <i>E. paraplexauroides</i> : hydroids (<i>Eudendrium rameum</i> , <i>Filellum</i> sp., <i>Aglaophenia pluma</i> , <i>Antennella secundaria</i> , <i>Sertularella polyzonias</i> , <i>Clytia linearis</i> , <i>Clytia</i> sp.), ascidians (<i>Clavelina nana</i> and <i>Pycnoclavella taureanensis</i>), syllids (<i>Syllis columbretensis</i> , <i>Syllis krohni</i> , <i>Trypanosyllis coeliaca</i>) and isopods (<i>Paranthura costana</i> and <i>P. nigropunctata</i>). Some found between mattes of <i>Posidonia oceanica</i>	López <i>et al.</i> , 1996; Peña Cantero & García Carrascosa, 2002; Castellanos <i>et al.</i> , 2003; González-García <i>et al.</i> , 2005; Torres Gavila, 2008; Aguilier <i>et al.</i> , 2008; Tocino <i>et al.</i> , 2009
Seco de los Olivos, Alborán Sea	100–200	Detritic bottom together with numerous other anthozoan corals	Aguilier <i>et al.</i> , 2008

Continued

Table 1. Continued.

Locality	Depth (m)	Notes	Reference
Oran and La Calle, Algeria	–	1 fragment collected by Milne Edwards in 1836 (MNHN) and 2 fragments identified by Lacaze-Duthiers in 1836 (MNHN and RMNH, 6081)	Stiasny, 1940
Tunisia	–	1 fragment collected during the Univers. Expedition (MNHN)	Stiasny, 1940
Algeria and Tunisia	–	2 colonies about 1 m high and 1 colony about 1.7 m high (MNHN)	Grasshoff, 1992
Sidi Daoud, Tunisia	47	SCUBA-diving surveys. <i>Ellisella</i> sp. reported on a very rich coastal detritic assemblage	Mustapha <i>et al.</i> , 2004
Naples	–	2 fragments (RMNH, 6331)	Stiasny, 1942
Pantelleria Island, Sicily Strait	80–94	5 specimens 83–173 cm high on a rocky cliff	Present study

et al., 1992) or from investigations focused on the associated fauna (López *et al.*, 1996; Peña Cantero & García Carrascosa, 2002; Aguilier *et al.*, 2008; Torres Gavilá, 2008), while *in situ* observations have been rarely dedicated to this species (Bianchi *et al.*, 2000; Mustapha *et al.*, 2004; Aguilier *et al.*, 2006, 2008, 2010).

Typical of the circalittoral plain, *E. paraplexauroides* may show a wide bathymetric distribution ranging from 15 to 690 m depth, with the shallowest records found mainly in the Mediterranean Sea and the deepest specimens found in the Atlantic Ocean. In particular, it has been reported on the shelf's edge at mesophotic depths between 50 and 150 m (Templado *et al.*, 1986, 2006; Tocino *et al.*, 2009), but it can also live at bathyal depths, like in the Canary Islands, where it was observed from 63 to 690 m, mainly associated with the assemblages of the scleractinian *Dendrophyllia ramea* (Linnaeus, 1758) (Brito & Ocaña, 2004; Arroyo Tenorio *et al.*, 2008). In the Canary Islands it has also been observed that the complexity of the branching pattern and the diameter of the ramifications depends on the

type of substrate, as a result the colonies are thinner and sparsely branched when they live on unstable bottoms (Brito & Ocaña, 2004).

In the Gulf of Cádiz, Gibraltar Strait and Alborán Sea there are some sites where *E. paraplexauroides* was observed in very shallow waters, respectively 15–30 m along the coastline of Cádiz (Aguilier *et al.*, 2010), 15–35 m depth between the *Posidonia oceanica* (L.) Delile, 1813) mattes, at Chafarinas Islands (González García *et al.*, 2005) and 20–25 m depth in Ceuta, along the Moroccan coast (Ocaña *et al.*, 2000; Brito & Ocaña, 2004).

Quantitative data on the populations of *E. paraplexauroides* have never been reported in the literature. This species has always been considered very rare and occasional (Grasshoff, 1992; Arroyo Tenorio *et al.*, 2008) and never forming dense meadows, as in the case of *V. flagellum* (Grasshoff, 1971, 1972, 1977). The richest population known so far is the one at Chafarinas Islands (González García *et al.*, 2005). The tallest colonies reported so far, are from the Mediterranean Sea (Grasshoff, 1992).



Fig. 1. Map of the geographical distribution of *Ellisella paraplexauroides* (black dots) in the Mediterranean Sea. Black triangle represents the present record.

The colonies may host numerous epibionts, especially in their basal part and on larger ramifications. The associated fauna, occupying dead portions of the colonies, is mainly composed of encrusting algae, bryozoans (González García *et al.*, 2005), hydroids (Peña Cantero & García Carrascosa, 2002), stoloniferans such as *Sarcodictyon canariensis* Ocaña, Brito & Nunez, 1992 (Ocaña *et al.*, 1992), and ascidians such as *Pycnoclavella taureanensis* Brunetti, 1991 and *Clavelina nana* Lahille, 1890 (Aguiliar, 2004; Tocino *et al.*, 2009). Crustacean isopods of the genus *Paranthura* (Castellanos *et al.*, 2003) and numerous species of polychaetes (López *et al.*, 1996; Torres Gavilá, 2008) are the main components of the vagile fauna. The number of colonies with epibionts or dead colonies of *E. paraplexauroides* tends to decrease depending on the depth (Tocino *et al.*, 2009).

The aim of this paper is to provide the first detailed record of *E. paraplexauroides* for the Italian waters. Moreover, some remarks on its distribution, biology and ecology are given on

the basis of remotely operated vehicle (ROV) video and photographic samplings and specimens collection.

MATERIALS AND METHODS

The Island of Pantelleria lies along the continental rift system of the Sicily Strait (central Mediterranean Sea). It consists exclusively of volcanic rocks (Villari, 1974) and the entire area is subjected to intensive volcano–tectonic activity. The structural setting of the island is specified by faults and fractures that follow the regional north–west–south–east and north–east–south–west trends (Civetta *et al.*, 1988).

The study site, named Cala Caruscia (locality Punta Spadillo) ($36^{\circ}49.139'N$ $12^{\circ}01.537'E$), is located on the north-east side of the island (Figure 2) and was explored through a ROV survey conducted in May 2010 on-board the RV 'Astrea'. The site is characterized by inclined rocky walls

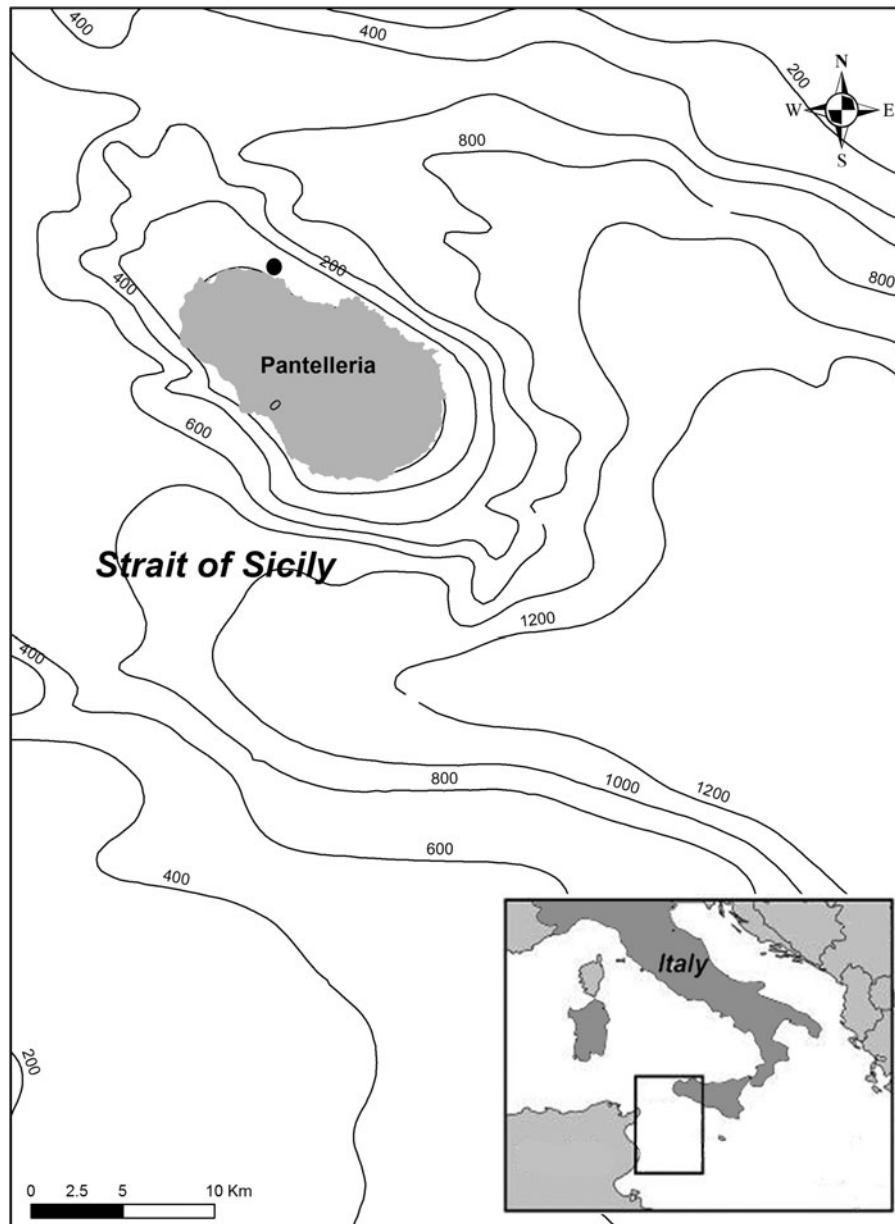


Fig. 2. Map of the sampling area (black dot) on the north-east coast of Pantelleria Island (Sicily Strait).

down to about 200 m depth with the bottom first turning into heavily silted rocky boulders and then ending in a gently inclined soft-bottom slope.

The ROV 'Polluce' was equipped with a digital camera (Nikon D80, 10 megapixel), an underwater strobe (Nikon SB 400), a high definition video camera (Sony HDR-HC7) and a 3-jaw grabber (SeaBotix Inc.) to take samples. Additionally, it had a depth sensor, a compass, and three parallel laser beams 10 cm apart used as a reference scale to assist the observers in estimating: frame area, sizes (height and width) and branching pattern of what was photographed using the software ImageJ, (Brazeau & Lasker, 1988). Colonies of *Ellisella paraplexauroides* were photographed in the mesophotic zone, between 80 and 94 m depth. Photographs were then analysed to describe the general morphology of the coral colonies and their *in vivo* appearance. Direct sampling of one specimen was carried out for the species description. Sclerites were analysed with scanning electron microscopy (SEM) after dissolving the coenenchyme in sodium hypochlorite and lastly, a fragment fixed in 95% ethanol was used for the morphological analysis of polyps carried out with SEM and stereomicroscope.

RESULTS

The coral community of Pantelleria Island is mainly composed of a mixed assemblage of three-dimensional anthozoans. The dominant species up to 80 m depth are the gorgonians *Paramuricea clavata* (Risso, 1826), *Eunicella cavolinii* (Koch, 1887), *Corallium rubrum* (Linnaeus, 1758) and, occasionally, the zoanthid *Savalia savaglia* (Bertoloni, 1819). Sparse colonies of the black coral *Antipathella subpinnata* (Ellis & Solander, 1786) were observed around 100 m depth, while the gorgonians *Viminella flagellum* and *Swiftia pallida* Madsen, 1970 were typically distributed in the deepest depth range, below 130 m depth (Giusti *et al.*, in press). In total, five red brick colonies of *Ellisella paraplexauroides* were found scattered on the explored hard substrate (Figure 3A–D), between 80 and 94 m depth.

Colonies were anchored to the substrata with a large basal plate, about 10 cm wide, sometimes covered by fine sediments and other organisms such as sponges or encrusting algae (Figure 3A). The common stem arising from the plate was about 15 cm long and showed a 2–3 cm wide basal diameter, not bearing polyps. Observed colonies reached considerable dimensions, from 83 to 173 cm in height (130 ± 35 cm average) and from 12 and 42 cm in width (25 ± 12 cm average), being taller than larger because of the typical upward arrangement of their branches (Figure 3A–D). The colonies could show up to 30 terminal branches (basal diameter around 3 mm).

Only one colony showed the basal portion of some branches partially dead (Figure 3D). The naked skeleton was covered by numerous hydroids (unidentified sertularids and eudendrids entrapping a notable quantity of sediment), a colony of *Paramuricea clavata*, the polychaete *Filograna* sp. and various encrusting sponges and bryozoans.

During the ROV survey, a sample 35 cm long was collected from a sparsely branched colony 110 cm high. Coenenchyme was red, while polyps, monomorphic and highly contractile, were crowded, cylindrical and whitish. Underwater images showed extended polyps characterized by tentacles almost

half the length of the calyxes (Figure 3E). Along the studied apical portion, polyps were arranged in a few longitudinal rows. However, photographs showed multiple rows of calyxes in the most basal parts of the colonies, as already reported in previous descriptions (Grasshoff, 1972; Carpine & Grasshoff, 1975). Polyps emerged from the branches with a sharp inclination and could show a different orientation when compared to the main stem (Figure 3F). Calyxes (up to 1.5 mm high) (Figure 3E, F) were characterized by a thin calyx wall. When contracted, the polyps formed knobs on the surface of the branches.

Surface sclerites were orange-yellow, while subsurface ones were almost colourless (Figure 3G). Sclerites included several types (Figure 3H): symmetrical double heads and thick capstans (up to 50 μ m high) (Figure 3Ha–b) were densely packed on the surface of the coenenchyme; thick highly tuberculated capstans (between 60 and 70 μ m high) (Figure 3Hc) were organized in the subsurface of the coenenchyme; spindles (between 60 and 80 μ m high) were found in the wall of calyxes (Figure 3Hd–e); and 50 μ m high rods with few tubercles were found in the pharynx of the anthocodiae (Figure 3Hf–g). Sizes of the sclerites were slightly smaller than what has already been reported for some Atlantic specimens (Carpine & Grasshoff, 1975), but quite similar to that reported for the Canary Islands (Brito & Ocaña, 2004).

DISCUSSION

The present record of *Ellisella paraplexauroides* adds a new species of alcyonacean to the Italian fauna (Morri *et al.*, 2008) (which now accounts for 27 species) and confirms the presence of this species in the central Mediterranean Sea. This record represents also the most eastern report of *E. paraplexauroides* in the Mediterranean basin. The ROV observations on the small population found in the mesophotic zone of Pantelleria Island confirm previous data regarding size, colour, branching pattern and associated fauna (Grasshoff, 1972; Carpine & Grasshoff, 1975; Arroyo Tenorio *et al.*, 2008). The colonies observed in Pantelleria are also some of the tallest reported in the literature.

Pantelleria Island is situated in a unique area of the Mediterranean Sea, both from the oceanographic and topographic point of view, leading ultimately to an important role in the composition of the benthic fauna (Manzella *et al.*, 1988; Greenpeace International, 2009). In the Sicily Strait, representing the connection between the eastern and western basins of the Mediterranean Sea, two water layers have been observed. The most superficial is composed of the surface Atlantic Waters (AW), running eastward, while the deepest one by the Levantine Intermediate Waters (LIW) flowing in the opposite direction, down to about 500 m (Napolitano *et al.*, 2003). The particular hydrographic conditions of this area probably favour the presence of rich benthic communities of filter-feeding organisms (Bianchi & Morri, 2000).

Ellisella paraplexauroides is a typical Atlanto-Mediterranean species with a wide bathymetric distribution range. The superficial variations in temperature of the Mediterranean waters probably confine this species below 50 m depth in the Sicily Strait, although some populations were locally recorded at very shallow depths (15–35 m in

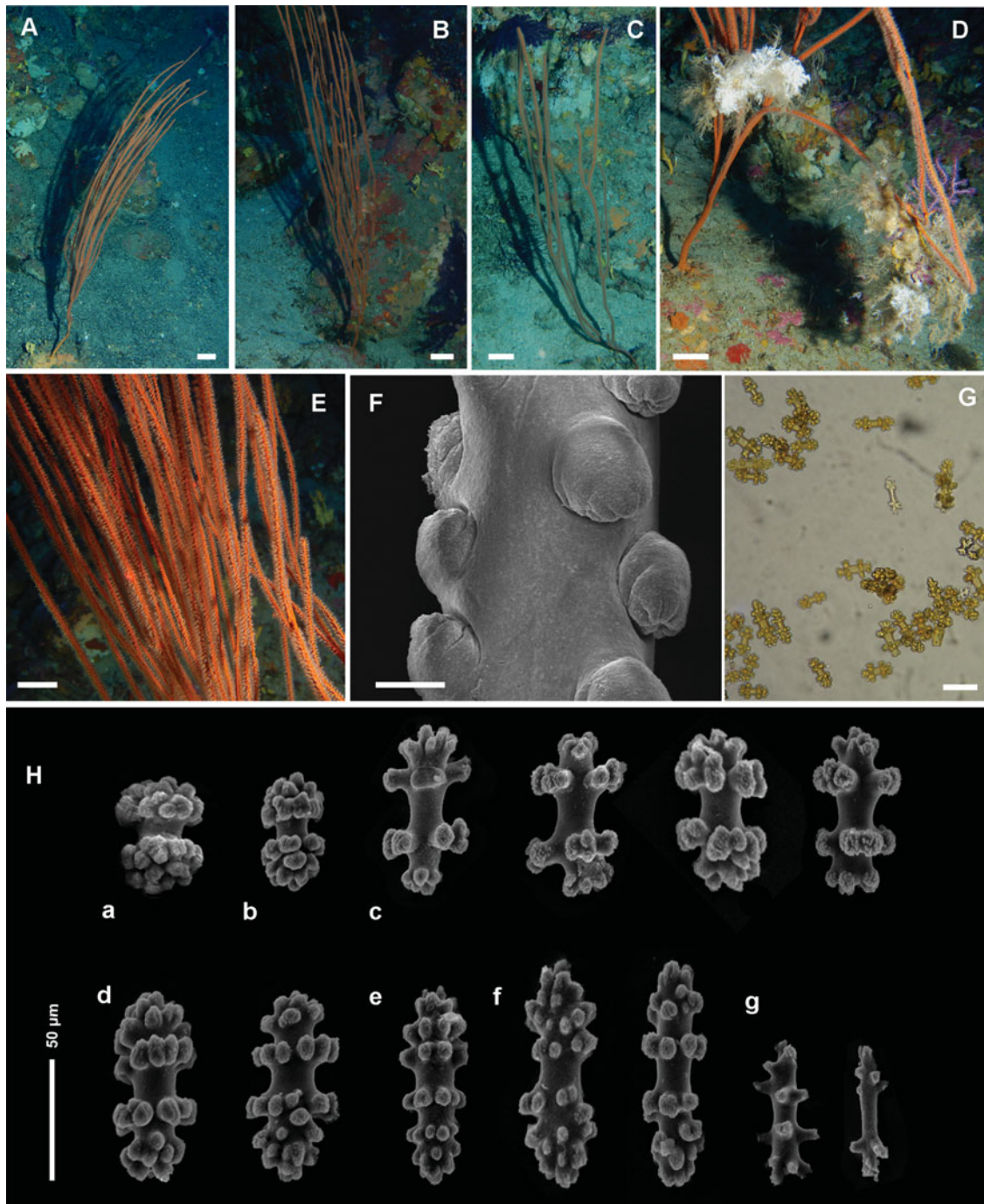


Fig. 3. *Ellisella paraplexauroides* from Pantelleria Island. (A–D) Underwater photographs of *E. paraplexauroides*. Occasionally, colonies can be colonized by sessile organisms (Figure D); (E) expanded polyps of a living colony; (F) scanning electron microscopy image of the arrangement of calyces on the apical portion of a branch; (G) stereomicroscope photograph of the sclerites, both yellow coloured and colourless; (H) sclerites of *E. paraplexauroides* composed of: a, double head from the superficial layer of coenenchyme; b, thick capstan; c, thick capstans with high tubercles; d, girdle spindles; e, slender girdle spindle; f, long rods from the deeper layer of the coenenchyme and from calyces; g, rods from the pharynx. Scale bars: A–E, 10 cm; F, 1 mm; G, 50 μm .

the Gulf of Cádiz, Strait of Gibraltar and the Alborán Sea) (Arroyo Tenorio *et al.*, 2008).

The scattered distribution of *E. paraplexauroides* in the explored area was observed in a limited depth range, being the species confined below the distribution limit of the most common gorgonians (*Paramuricea clavata* and *Eunicella cavolinii*) and above the distribution range of *Viminella flagellum* (Giusti *et al.*, in press). Although this species is occasionally considered as characterizing a facies (Gulf of Cádiz,

Atlantic Ocean) (Aguilar *et al.*, 2010), it never occurs in dense monospecific meadows and can be considered an occasional element in the lower fringe of the circalittoral assemblage.

The recorded susceptibility of *E. paraplexauroides* to epibiosis may be enhanced by mechanical injuries of the coenenchyme, as already suggested for other deep Mediterranean corals (Tocino *et al.*, 2009). Commercial fishing activities, for example through long-line fishing,

directly damage these corals that are particularly vulnerable because of their arborescent morphology, fragile construction and the general slow growth rate (Bavestrello *et al.*, 1997; Mortensen & Buhl-Mortensen, 2004; Bo *et al.*, 2009).

It is well known that assemblages of colonial anthozoans represent biodiversity hotspots (Mortensen & Buhl-Mortensen, 2004; Ballesteros, 2006; Bo *et al.*, 2009; Cerrano *et al.*, 2010), adding three-dimensional complexity to the habitat and commonly housing a rich associated fauna as well as a great abundance of fish (Tsounis *et al.*, 2006; Mortensen *et al.*, 2008). In the Mediterranean Sea, these communities have been studied mainly in shallow waters, and few data are available for deep environments (Bo *et al.*, 2009, 2010, 2011; Gori *et al.*, 2010).

The complex structure and richness of species of the assemblages hosting *E. paraplexauroides*, together with their vulnerability to human activities, should motivate the decision of including them within the Mediterranean species and habitat list of conservational relevance.

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REFERENCES

- Aguilier R.** (2004) *The corals of the Mediterranean*. Oceana, Fundación Biodiversidad, 86 pp.
- Aguilier R., Pardo E., Cornax M.J., García S. and Ubero J.** (2010) *Doñana and the Gulf of Cadiz. Marine protected area expansion proposal*. Oceana, Fundación Biodiversidad, 80 pp.
- Aguilier R., Pastor X. and Pablo M.J. de** (2006) *Habitats in danger*. Oceana, Fundación Biodiversidad, 83 pp.
- Aguilier R., Torriente A. de la and García S.** (2008) *Propuesta de áreas marinas de importancia ecológica: Atlántico sur y Mediterráneo español*. Oceana, Fundación Biodiversidad, 132 pp.
- Aristegui J., Brito A., Cruz T., Bacallado J.J., Barquin J., Nunez J. and Perez-Dionis G.** (1987) El poblamiento de los fondos de *Dedrophyllia ramea* (Antozoa: Scleractinia) en las Islas Canarias. *Cuadernos Marisqueros Publicación Técnica* 11, 163–181.
- Arroyo Tenorio M.C., Domenech A.B., Lampreave D.M. and López-González P.J.** (2008) *Ellisella paraplexauroides* Stiasny, 1936. In Barea-Azcón J.M., Ballesteros-Duperón E. and Moreno D. (eds) *Libro rojo de los invertebrados de Andalucía*. 4 Tomos. Sevilla: Consejería de Medio Ambiente, Junta de Andalucía, pp. 239–242.
- Ballesteros E.** (2006) Mediterranean coralligenous assemblages: a synthesis of present knowledge. *Oceanography and Marine Biology: an Annual Review* 44, 123–195.
- Bavestrello G., Cerrano C., Zanzi D. and Cattaneo-Vietti R.** (1997) Damage by fishing activities to the gorgonian coral *Paramuricea clavata* in the Ligurian Sea. *Aquatic Conservation: Marine and Freshwater Ecosystems* 7, 253–262.
- Bianchi C.N., Haroun R., Morri C. and Wirtz P.** (2000) The subtidal epibenthic communities off Puerto del Carmen (Lanzarote, Canary Islands). *Life and Marine Sciences* 2, 145–155.
- Bianchi C.N. and Morri C.** (2000) Marine biodiversity of the Mediterranean Sea: situation, problems and prospects for future research. *Marine Pollution Bulletin* 40, 367–376.
- Bo M., Bavestrello G., Canese S., Giusti M., Salvati E., Angiolillo M. and Greco S.** (2009) Characteristics of a black coral meadow in the twilight zone of the central Mediterranean Sea. *Marine Ecology Progress Series* 397, 53–61. [Special Theme Section: Conservation and management of deep sea corals and coral reefs.]
- Bo M., Bavestrello G., Canese S., Giusti M., Angiolillo M., Cerrano C., Salvati E. and Greco S.** (2010) Coral assemblages off the Calabrian Coast (South Italy) with new observations on living colonies of *Antipathes dichotoma*. *Italian Journal of Zoology*. doi: 10.1080/11250001003652619.
- Bo M., Bertolino M., Borghini M., Castellano M., Covazzi Harriague A., Di Camillo C.G., Gasparini G.P., Mistic C., Povero P., Schroeder K. and Bavestrello G.** (2011) Characteristics of the mesophotic megabenthic assemblage of the Vercelli Seamount (North Tyrrhenian Sea). *PLoS-One* 6, e16357.
- Brazeau D.A. and Lasker H.R.** (1988) Inter and intraspecific variation in gorgonian colony morphology: quantifying branching patterns in arborescent animals. *Coral Reefs* 7, 139–143.
- Brito A.** (1985) *Estudio taxonomico, ecologico y biogeografico de los Antozoos de la region litoral de las islas Canarias*. PhD thesis. Universidad de la Laguna, Islas Canarias, España.
- Brito A., Cruz T., Moreno E. and Pérez J.M.** (1984) Fauna marina de las Islas Canarias. In Bacallado J.J. (ed.) *Fauna marina y terrestre del Archipiélago Canario*. Las Palmas de Gran Canaria: Edirc, pp. 42–65.
- Brito A. and Ocaña O.** (2004) *Corales de las Islas Canarias. Antozoos con esqueleto de los fondos litorales y profundos*. La Laguna: Francisco Lemus Editor.
- Carpine C. and Grasshoff M.** (1975) Les gorgonaires de la Méditerranée. *Bulletin de l'Institut Océanographique* 71, 1–140.
- Castellanos C., Hernández-Vega S. and Junoy J.** (2003) Isópodos marinos (Crustacea: Isopoda) de las islas Chafarinas (Mediterráneo occidental). *Boletín del Instituto Español de Oceanografía* 19, 219–233.
- Cerrano C., Danovaro R., Gambi C., Pusceddu A., Riva A. and Schiaparelli S.** (2010) Gold coral (*Savalia savaglia*) and gorgonian forests enhance benthic biodiversity and ecosystem functioning in the mesophotic zone. *Biodiversity and Conservation* 19, 153–167.
- Civetta L., Cornette Y., Gillot P.Y. and Orsi G.** (1988) The eruptive history of Pantelleria (Sicily Channel) in the last 50 ka. *Bulletin of Volcanology* 50, 47–57.
- Fabricius K. and Alderslade P.** (2001) *Soft corals and sea fans: a comprehensive guide to the tropical shallow water genera of the central-west Pacific, the Indian Ocean and the Red Sea*. Townsville, QL: Australian Institute of Marine Science.
- Giusti M., Bo M., Bavestrello G., Angiolillo M., Salvati E. and Canese S.** (in press) Record of *Viminella flagellum* (Alcyonacea: Ellisellidae) in Italian waters (Mediterranean Sea). *Marine Biodiversity Records*.
- González García J.A., García Peña H. and Bueno del Campo I.** (2005) *Especies singulares y protegidas de la flora y fauna de Melilla e islas Chafarinas*. Melilla: Fundación Gaselec.
- Gori A., Rossi S., Berganzo E., Pretus J.L., Dale M.R.T. and Gili J.M.** (2010) Spatial distribution patterns of the gorgonians *Eunicella singularis*, *Paramuricea clavata*, and *Leptogorgia sarmentosa* (Cape of Creus, Northwestern Mediterranean Sea). *Marine Biology* 158, 143–158.
- Grasshoff M.** (1971) Intraspezifische variation und isolierte Populationen der Hornkoralle *Ellisella flagellum* (Cnidaria: Anthozoa: Gorgonaria). *Meteor Forschungsergebnisse* 10, 65–72.

- Grasshoff M.** (1972) Die Gorgonaria des östlichen Nordatlantik und des Mittelmeeres. I. Die Familie Ellisellidae (Cnidaria: Anthozoa). *Meteor Forschungsergen-Ergebnisse* 10, 73–87.
- Grasshoff M.** (1977) Die Gorgonarien des östlichen Nordatlantik und des Mittelmeeres. III. Die Familie Paramuriceidae (Cnidaria, Anthozoa). *Meteor Forschungsergen-Ergebnisse* 27, 5–76.
- Grasshoff M.** (1992) Die Flachwasser-Gorgonarien von Europa und Westafrika (Cnidaria, Anthozoa). *Courier Forschungsinstitut Senckenberg* 149, 1–135.
- Greenpeace International** (2009) *High Seas Mediterranean Marine Reserves: a case study for the Southern Balearics and the Sicilian Channel*. CBD's Expert workshop on scientific and technical guidance on the use of biogeographic classification systems and identification of marine areas beyond national jurisdiction in need of protection. Ottawa, September–October, 2009, 58 pp.
- López E., San Martín G. and Jiménez M.** (1996) Syllinae (Syllidae, Annelida, Polychaeta) Chafarinas Islands (Alborán Sea, W Mediterranean). *Miscellanea Zoologica* 19, 105–118.
- Manzella G.M.R., Gasparini G.P. and Astraldi M.** (1988) Water exchange between the eastern and western Mediterranean through the Sicily Strait. *Deep-Sea Research* 35, 1021–1035.
- Miralles J., Galonnier R., Njinkoue J.M., Samb A., Gaydou E. and Kornprobst J.M.** (1992) Sterol composition of some gorgonians from the Senegalese coast. *Comparative Physiology and Biochemistry* 103B, 1039–1041.
- Morri C., Esposito F. and Pessani D.** (2008) Anthozoa. Checklist della flora e della fauna dei mari italiani (Parte I). *Biologia Marina Mediterranea* 15, 92–101.
- Mortensen P.B. and Buhl-Mortensen L.** (2004) Distribution of deep-water gorgonian corals in relation to benthic habitat features in the Northeast Channel (Atlantic Canada). *Marine Biology* 144, 1223–1238.
- Mortensen P.B., Buhl-Mortensen L., Gebruk A.V. and Krylova E.M.** (2008) Occurrence of deep-water corals on the Mid-Atlantic Ridge based on MAR-ECO data. *Deep-Sea Research Part II* 55, 142–152.
- Mustapha K.B., Afli A., Hattour A. and El Abed A.** (2004) Sessile megabenthic species from Tunisian littoral sites. *MedSudMed Technical Documents* 2, 1–16.
- Napolitano E., Sannino G., Artale V. and Marullo S.** (2003) Modeling the baroclinic circulation in the area of the Sicily channel: the role of stratification and energy diagnostics. *Journal of Geophysical Research* 108, 1–21.
- Ocaña A., Sánchez Tocino L., López González S. and Viciano Martín F.** (2000) *Guía Submarina de Invertebrados no Artrópodos*. Granada: Comares Editor.
- Ocaña O., Brito A. and Nuñez J.** (1992) A new species of *Sarcodyction* (Anthozoa: Stolonifera) from Tenerife, Canary Islands. *Zoologische Mededelingen* 66, 423–428.
- Peña Cantero A.L. and García Carrascosa A.M.** (2002) The benthic hydroid fauna of the Chafarinas Islands (Alborán Sea, western Mediterranean). *Zoologische Verhandlungen* 337, 1–180.
- Stiasny G.** (1936) Diagnosen einiger neuer Gorgonarien-Arten von Cap Blanco (Westafrika). *Zoologische Anzeiger, Leipzig* 113, 201–206.
- Stiasny G.** (1937) Gorgonaria von Cap Blanco, gesammelt von Dr. Th. Monod. *Temminckia* 2, 297–316.
- Stiasny G.** (1939a) Gorgonaria von Portugal. *Arquivo Histórico do Museu Bocage* 10, 15–38.
- Stiasny G.** (1939b) Gorgonaires du Maroc (Côte Atlantique). Collection rassemblée par R.Ph. Dollfus. *Bulletin de la Société des Sciences Naturelles de Maroc* 19, 119–149.
- Stiasny G.** (1940) Gorgonides et Alcyonides des collections du Muséum National d'Histoire Naturelle (Première Partie). *Archives du Musée* 16, 109–145.
- Stiasny G.** (1942) Alcyonaria und Gorgonaria aus dem Golf von Neapel. *Pubblicazioni della Stazione Zoologica di Napoli* 19, 1–47.
- Templado J., Calvo M., Moreno D., Flores A., Conde F., Abad R., Rubio J., López-Fé C.M. and Ortiz M.** (2006) *Flora y fauna de la reserva marina y reserva de pesca de la Isla de Alborán*. Madrid: Secretaría General de Pesca Marítima MAPA y Museo Nacional de Ciencias Naturales CSIC.
- Templado J., García Carrascosa M., Baratech L., Capaccioni R., López Ibor A., Silvestre R. and Masso C.** (1986) Estudio preliminar de la fauna asociada a los fondos coralígenos del mar de Alborán (SE de España). *Boletín del Instituto Español de Oceanografía* 3, 93–104.
- Tocino L.S., Barahona M.M., Barranco C.N. and Velasco C.G.** (2009) *Informe de la campaña realizada en el Refugio Nacional de Caza de las Islas Chafarinas los días 07 al 26 de octubre de 2009. Documentos de interés científico-técnico y divulgativos relacionados con las Islas Chafarinas*. Ministerio de Medio Ambiente y Medio Rural y Marino, 18 pp. http://www.mma.es/secciones/el_ministerio/organismos/oapn/pdf/chaf_articulo26.pdf
- Torres Gavilá F.J.** (2008) *Estudio faunístico, ecológico y ambiental de la fauna de anélidos poliquetos de sustratos sueltos de las Islas Chafarinas (Mar de Alborán, SW Mediterráneo)*. València: Universitat de València Servei de Publicacions.
- Tsounis G., Rossi S., Aranguren M., Gili J.M. and Arntz W.** (2006) Effects of spatial variability and colony size on the reproductive output and gonadal development cycle of the Mediterranean red coral (*Corallium rubrum* L.). *Marine Biology* 148, 513–527.
- Vafidis D., Koukouras A. and Voultsiadou-Koukoura E.** (1994) Octocoral fauna of the Aegean Sea with a check list of the Mediterranean species: new information, faunal comparisons. *Annales de l'Institut Océanographique, Paris* 70, 217–229.
- Villari L.** (1974) The island of Pantelleria. *Bulletin of Volcanology* 38, 680–724.
- and
- Weinberg S. and Grasshoff M.** (2005) Gorgonias. In Hofrichter R. (ed.) *El Mar Mediterraneo. Fauna, Flora, Ecología. II/1. Guía Sistemática y de Identificación*. Ediciones Omega, pp. 428–443.

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