

Black Coral Distribution in Italian

Subjects: [Environmental Sciences](#) | [Marine & Freshwater Biology](#)

Contributor: Michela Ingrassia

The aim of this entry is to present a review of the knowledge on the occurrence of black corals in the Italian seas, providing the first comprehensive distribution map of these species. The distribution of black corals may be considered the first step towards defining a more complete overview regarding the present knowledge on these vulnerable species. This study also highlights the need for the conservation programs protecting black corals in the Italian seas.

Antipatharia

vulnerable marine ecosystems

anthropogenic impact

1. Introduction

Black corals (Cnidaria: Anthozoa: Hexacorallia: Antipatharia) are characterized by arborescent vertical or monopodial growth forming three-dimensional habitats supporting high levels of biodiversity [\[1\]](#)[\[2\]](#). Antipatharian corals have been considered for a long time to be among the rarest and sporadic coral species in the Mediterranean Sea [\[3\]](#). To date, it is well known that these corals are able to form dense aggregations forming pristine underwater forests [\[4\]](#).

Because of their rarity, black corals low growth rates, and low recovery ability, are considered extremely sensitive and listed as indicator species of vulnerable marine ecosystems (VMEs). For this reason, they are mentioned in several international agreements concerning marine ecosystem conservation (CITES Appendix II [available at <http://www.cites.org>]; European Community 1999), in Annex III of the Berna Convention, in Annex II of the Barcelona Convention for the Mediterranean species, and are also categorized as “threatened” by the International Union for Conservation of Nature (IUCN) Red List of Mediterranean Anthozoa [\[5\]](#) (with the millennial life span *L. glaberrima* being the only one listed as “endangered”). The main anthropogenic impact affecting these corals is represented by fishing as artisanal and recreational activities and bottom trawling, which may cause the resuspension of fine sediments [\[4\]](#)[\[6\]](#)[\[7\]](#). Rare activities related to the commercial fisheries of precious corals for the jewelry industry is also reported [\[8\]](#).

Review studies on deep coral assemblages in the Mediterranean Sea have mainly been limited to scleractinian corals (i.e., *Lophelia* and *Madrepora* [\[9\]](#)[\[10\]](#)), while few studies were exclusively focused on the distribution of black corals in the Italian seas [\[4\]](#)[\[11\]](#)[\[12\]](#)[\[13\]](#)[\[14\]](#)[\[15\]](#). The Italian seas have an average depth of about 1500 m, and a maximum depth of about 5000 m. The main Italian seas are the Tyrrhenian, Adriatic, and Ionian, and the other seas are represented by the Ligurian and Corsica seas, and the Otranto, Messina, and Sicily straits. The seawater temperatures range from 12 °C to 13 °C during the cold season, and from 26 °C to 28 °C in the warm season.

Temperatures at the seafloor are constant and range from 12 °C to 13 °C [16]. During the last decades, the temperatures of the Italian seas have significantly increased [17], which resulted in dramatic changes in biodiversity composition [16]. To date, 29 Italian Marine Protected Areas (MPAs) have been established, but this number strongly needs to be updated [18].

The aim of this study is to present a review of the knowledge on the occurrence of black corals in the Italian seas, providing the first comprehensive distribution map of these species. The distribution of black corals may be considered the first step towards defining a more complete overview regarding the present knowledge on these vulnerable species. This study also highlights the need for the conservation programs protecting black corals in the Italian seas.

2. Distribution Dataset and Methods

Table 1 shows dataset of black coral distribution in the Italian Seas. This dataset was created using all the available scientific literature and reports, starting from 1973 until today. For each site, when available, the following information was reported: region, ID (number code referred to the code reported in **Figure 1**), sites, sea, coral species, minimum and maximum depth, setting, substrate, anthropogenic impact, reference. The type of setting is based on the classification used by Gori et al. [19], whereas the substrate types were referred to those reported in the related scientific articles. The categories related to anthropogenic impact are represented by fishing activity (trawl and ghost nets, longlines, lines, ropes, other fishing gear) and lost garbage (e.g., plastic and metal objects).

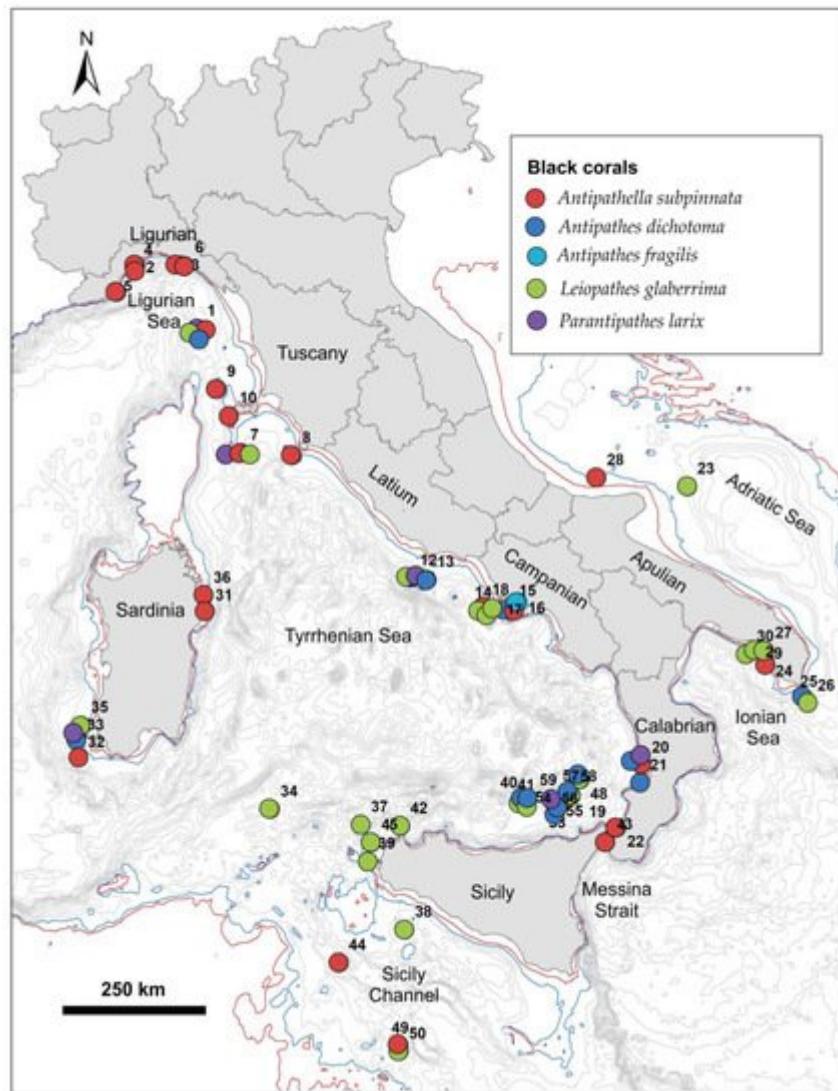


Figure 1. Distribution map of black corals in the Italian seas (red lines: 50-m isobaths; blue lines: 100-m isobaths; grey lines: isobaths of each 200 m interval). Number codes refer to the ID codes reported in **Table 1**.

Table 1. Dataset of the Italian submarine sites associated with black corals reported in the available scientific literature. Codes used for the black corals: AS, *Antipathella subpinnata*; AD, *Antipathes dichotoma*; AF, *Antipathes fragilis*; LG, *Leiopathes glaberrima*; PL, *Parantipathes larix*. Code nd means “no data”.

Region	ID	Site	Sea	Coral	Min Depth	Max Depth	Setting	Substrate	Anthropogenic Impact	Reference
Ligurian	1	Banco di S. Lucia	SE Ligurian Sea	AS, AD, LG, PL	140	210	Offshore banks and seamounts	Deep rocky banks	Fishing activity	[4][20]
Sicily	2	Mantice Shoal	Western Ligurian Sea	AS	70	150	Shelf edge and upper slope	Deep rocky banks	Fishing activity	[4]

Region	ID	Site	Sea	Coral	Min Depth	Max Depth	Setting	Substrate	Anthropogenic Impact	Reference
	3	Portofino Secca dell'Isuella	Ligurian Sea	AS	56	60	Shelf	Shoal	nd	[15][21][22]
	4	Bordighera	West Ligurian Sea	AS	63	63	Shelf	nd	nd	[21]
	5	Wreck Ravenna	Ligurian Sea	AS	75	90	Shelf	Rocky bottom	nd	[18]
	6	Punta Faro	Ligurian Sea	AS	63	77	Shelf	Shoal	nd	[22]
	37	Marco Bank	Western Sicily	LG	240	260	Offshore banks and seamounts	Deep rocky banks	Fishing activity	[23]
	38	Graham Shoal	Strait of Sicily	LG	95	150	Offshore banks and seamounts	Shoal	nd	[24]
	39	Favignana and Talbot Shoal	Strait of Sicily	LG	100	100	Offshore banks and seamounts	Shoal	nd	[25]
	40	Filicudi Aeolian islands	Tyrrhenian Sea	AD	75	300	Shelf edge and upper slope	Rocks encrusted by coralline algae	nd	[26][27]
	41	Filicudi Aeolian islands	Tyrrhenian Sea	LG	300	300	Deep areas	Rocky bottom	nd	[26][27]
	42	Cape San Vito Sicily	Tyrrhenian Sea	LG	275	286	Deep areas	nd	nd	[25][26]
	43	Messina Strait	Secche di Favazzina	AS	55	70		Rocky bottom	nd	[18]
	44	Pantelleria		AS	70	100	Offshore banks and seamounts	nd	nd	[18]
	45	Northern Levanzo Island	Tyrrhenian Sea	AS	235	250	Deep areas	nd	nd	[28]
	46	Stromboli	Tyrrhenian	AS	52	58	Shelf	Rocky	nd	[18]

Region	ID	Site	Sea	Coral	Min Depth	Max Depth	Setting	Substrate	Anthropogenic Impact	Reference
			Sea					bottom		
	47	Stromboli	Tyrrhenian Sea	LG	187	345	Deep areas	Rocky bottom	nd	[29]
	48	NE Stromboli	Tyrrhenian Sea	AD, PL	129,202	349, 202	Shelf edge and upper slope	Rocky bottom	nd	[29]
	49	Linosa	Sicily channel	AS	160	160	Shelf	Bench terrace	nd	[30]
	50	Linosa	Sicily channel	LG	200	200	Shelf edge and upper slope	Bench terrace	nd	[30]
	51	NE Lipari	Tyrrhenian Sea	AS	83	130	Shelf	Rocks encrusted by coralline algae	nd	[29]
	52	NE Lipari	Tyrrhenian Sea	AS	612	612	Deep areas	Rocky bottom	nd	[29]
	53	NE Lipari	Tyrrhenian Sea	PL	129	158	Shelf	Rocks encrusted by coralline algae	nd	[29]
	54	NE Lipari	Tyrrhenian Sea	AD	129	218	Shelf edge and upper slope	Rocks encrusted by coralline algae	nd	[29]
	55	SW Lipari	Tyrrhenian Sea	AD	207	298	Shelf edge and upper slope	Rocky bottom	nd	[29]
	56	Salina	Tyrrhenian Sea	PL	129	345	Shelf edge and upper slope, deep areas	Rocky bottom	nd	[29]
	57	Panarea	Tyrrhenian Sea	LG	187	345	Deep areas	Vertical rocky walls	nd	[29]

Region	ID	Site	Sea	Coral	Min Depth	Max Depth	Setting	Substrate	Anthropogenic Impact	Reference
Campanian	58	SE Panarea	Tyrrhenian Sea	AD, PL	351,349	351,349	Deep areas	Vertical rocky walls	nd	[29]
	59	NW Filicudi	Tyrrhenian Sea	AD, LG	647	647	Deep areas	Rocky bottom	nd	[29]
	14	Vedove Shoal (Capri)	Tyrrhenian Sea	LG	240	260	Deep areas	Deep rocky banks	Lost garbage	[23]
	15	Bay of Naples	Tyrrhenian Sea	AD, AS	200	200	Shelf edge and upper slope	Rocks encrusted by coralline algae	nd	[15][26]
	16	Naple Gulf	Tyrrhenian Sea	AF, AS	80	100	Shelf	Rocky bottom	nd	[15][31]
	17	Capri Island	Tyrrhenian Sea	AS	70	70	Shelf	Shoal	Fishing activity	[15][26]
Latium	18	Capri Island	Tyrrhenian Sea	LG	160	260	Shelf edge and upper slope	Rocky bottom	nd	[15][26]
	11	Western Pontine Archipelago	Tyrrhenian sea	LG, PL	194	220	Offshore banks and seamounts	Rocky bottom	Fishing activity	[32]
	12	Western Pontine Archipelago	Tyrrhenian sea	AD, LG, PL	145	155	Shelf edge and upper slope	Rocky bottom	Fishing activity	[32]
Tuscany	13	Western Pontine Archipelago	Tyrrhenian sea	LG, PL	130	138	Shelf	Rocky bottom	Fishing activity and lost garbage	[32]
	7	Montecristo Natural reserve	Tyrrhenian sea	AS, PL, LG	108	200	Shelf edge and upper slope	Shoal	nd	[4]
	8	Mezzo Canale	Tyrrhenian Sea	AS	70	70	Shelf	nd	nd	[33]
	9	Capraia Island	Tyrrhenian Sea	AS	75	90	Shelf	Rocky bottom	nd	[15]

Region	ID	Site	Sea	Coral	Min Depth	Max Depth	Setting	Substrate	Anthropogenic Impact	Reference
Calabrian	10	Elba	Tyrrhenian Sea	AS	60	94	Shelf	Rocks encrusted by coralline algae	nd	[34]
	[4][11][12][13][14][15]		Tyrrhenian Sea	AS	50	100	Shelf	Rocky bottom	nd	[1]
	20	Golfo di S. Eufemia	Tyrrhenian Sea	AD PL AS	70	120	Shelf	Shoal	nd	[2]
	21	Vibo Marina	Tyrrhenian Sea	AD	90	132	Shelf	Shoal	Fishing activity	[26]
	22	Favazzina	Tyrrhenian sea northern border Messina Strait	AS	62	72	Shelf	Rocky bottom	nd	[35]
	23	Vieste	Adriatic sea	LG	350	350	Deep areas	Rocky bottom	Fishing activity	[36]
	24	Gallipoli	Adriatic sea	AS	70	70	Shelf	Rocky bottom	nd	[15]
	25	S. Maria di Leuca	Ionian Sea	LG	671	790	Deep areas	Rocky bottom	Fishing activity	[9][26][37] [38]
	26	S. Maria di Leuca	Ionian Sea	AD	630	640	Deep areas	Rocky bottom	Fishing activity	[38][39]
	27	Torre Inserraglio	Ionian Sea	LG	45	45	Shelf	nd	Fishing activity	[36]
Apulia	28	Tremiti Islands	Adriatic Sea	AS	51	80	Shelf	nd	nd	[40][33][41]
	29	Porto cesareo	Ionian sea	LG	100	236	Shelf edge and upper slope	Rocky bottom	Fishing activity	[36]
	30	Porto cesareo	Ionian sea	LG	50	50	Shelf	Rocky bottom	Fishing activity	[36]
	31	Capo Comino	Eastern coasts of Sardinia	AS	54	54	Shelf	nd	nd	[15]

Region	ID	Site	Sea	Coral	Min Depth	Max Depth	Setting	Substrate	Anthropogenic Impact	Reference
Sardinia	32	SW coasts of Sardinia	Western Mediterranean Sea	AD, PL, LG	210	210	Shelf edge and upper slope	Shoal	Fishing activity	[42]
	33	Rocky pinnacles off Carloforte	Sardinian Sea	AD, AS, LG, PL	120	170	Shelf edge and upper slope	Rocky bottom	Fishing activity and lost garbage	[43]
	34	Northern edge of Skerki Bank	Sardinian Channel	LG	520	650	Deep areas	nd	nd	[28]
	35	Western Carloforte Island	Sardinian Sea	LG	70	130	Shelf	nd	nd	[34]
	36	Posada canyon	Sardinian Sea	AS	152	156	Deep areas	nd	nd	[20]

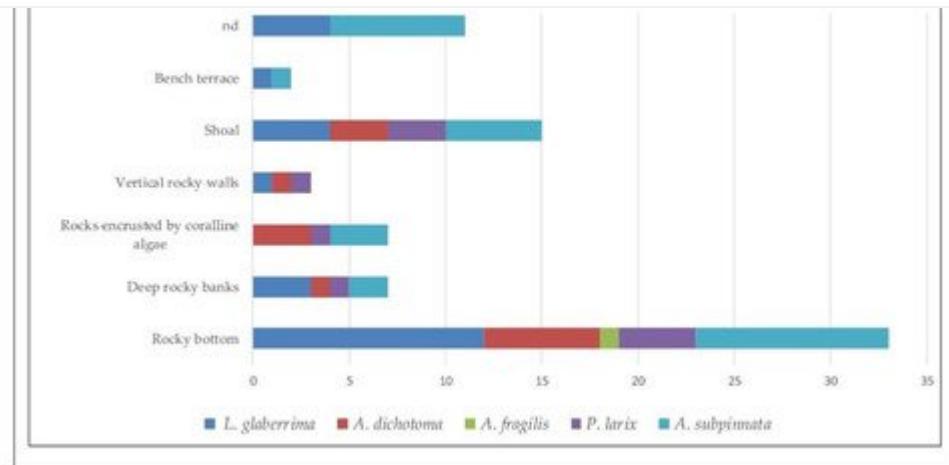


Figure 2. (a) Different settings and **(b)** substrate types where black corals were observed in the Italian seas.

The analysis of all the reported sites (**Table 1**) has permitted the identification of the different anthropogenic impacts affecting the Italian sites where the black corals are settled (**Figure 3**).

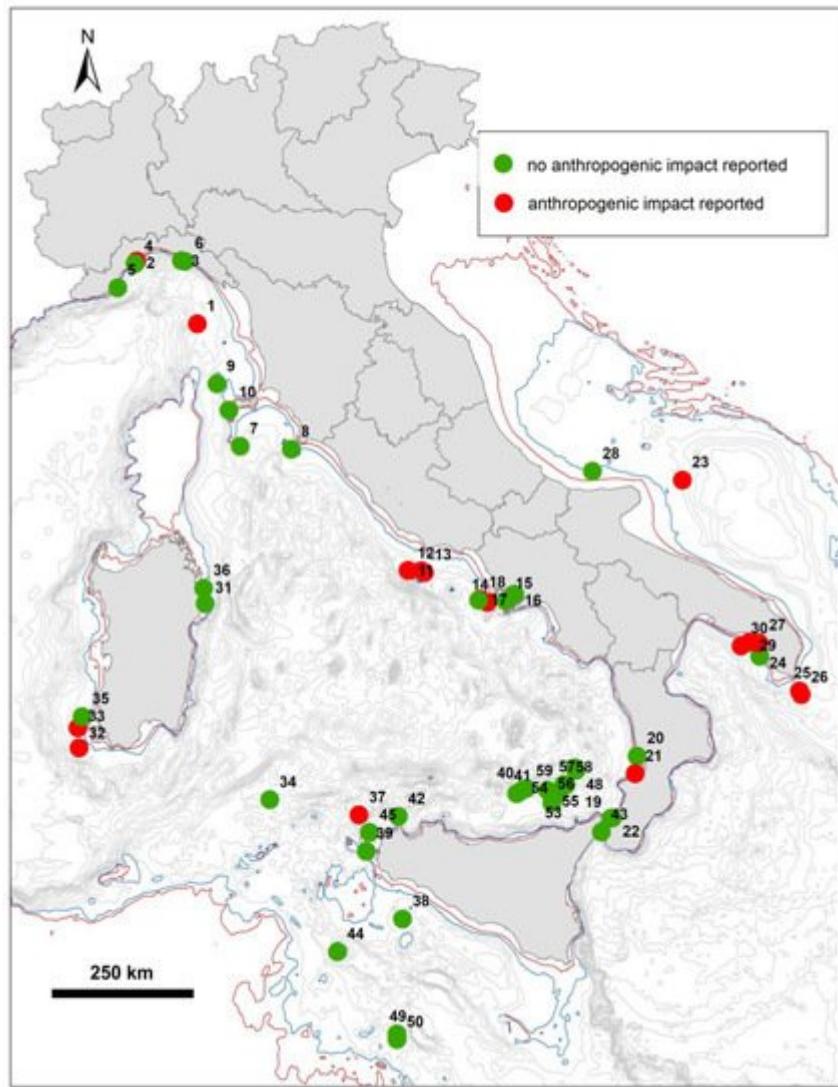


Figure 3. Map of the Italian black coral communities that are affected or unaffected by anthropogenic impact.

These sites, representing 29% of the total, are found in water depths ranging from 45 m to 730.5 m (with a medium depth of 200 m), and are associated with the rocky bottom, deep rocky banks, and shoal substrates. The items affecting the black coral communities are represented by two main categories (**Table 1**): fishing activity (trawl and ghost nets, longlines, lines, ropes, other fishing litter) and lost garbage (e.g., plastic and metal objects). A total of 83% of debris impacting the Italian sites is associated with fishing activity, whereas a few exceptions are related to lost garbage (**Table 1**).

4. Discussion

Black corals have for a long time been considered to be rarest corals in the Mediterranean Sea [3]. The recent increase in the use of modern technological tools, such as ROVs, has permitted the documentation of the great variability of the coral communities occurring in Mediterranean environments e.g., [2][26][44][45]. Exploration of the submarine environment by ROV has represented a turning point in the updating knowledge on benthic

communities, providing a valuable tool for the understanding of their geographical and bathymetrical distribution, and their morphological description and ecological aspects [15][46].

Our study is focused on the distribution analysis of the antipatharian corals already reported in the Italian seas. This first step highlighting the presence of the black corals should be considered more common than what supposed. The present review strongly supports the idea proposed by Bo et al. [47], that black corals are among the most conspicuous and widely distributed organisms of mesophotic Mediterranean coral communities (especially in a depth range from 60 m to 150 m). It is also confirmed that the majority occur on rocky bottom and shoals [45]. This statement could be due to the occurrence, in the mesophotic zone, of more favorable environmental factors able to enhance coral growth (which are lower levels of competition for space, food supply, temperature, currents rich in suspended matter, heterogeneity of substrate, rate of sedimentation [47]). According to present knowledge e.g., [1][45][47][48][49], currents rich in suspended matter are probably the major environmental factor influencing black coral settlement and composition in the Italian seas.

Probably, the occurrence of black corals in Italy on specific types of substrate (mainly rocky bottoms and isolated shoals) as well as their bathymetric distribution (within 50 m and 300 m depth), makes them more exposed to fishing activities, causing damage to vulnerable marine ecosystems. Furthermore, this impact represents a considerable concern, considering their specific characteristics such as 3D structure, long lived species, slow growth rates, and recovery ability [23][50][51]. Fishing impacts (including ghost nets) can lead to the direct removal or partial damage to coral colonies. The skeletons of the damaged corals may become overgrown by various fast growing organisms [4][52]. This kind of damage can have far-reaching and long lasting effects on the population dynamics of Mediterranean black corals, especially when their low growth rates are considered [42]. Despite of the distance from the coast, it is well known that rocky bottoms and isolated shoals are considered important targets for fishermen [23]. In addition, other factors are well known to influence fishing efforts [23][53][54], such as their depth, topography, and the fact that they could represent a refuge for many commercial species. The different entities of fishing disturbance could also be linked to different coral morphologies. In fact, the morphological characteristics (arborescent and erect structures) and the grade of flexibility of black corals may increase their resistance to mechanical friction, showing different mechanical responses to their entanglement [23][43][55].

Despite all this evidence, the only Italian MPA, containing black coral forests, is the Tremiti Islands Marine Protected Area [40]. All these findings indicate the need for actions focused on the implementation of effective management and proper conservation measures to preserve the Italian antipatharian corals.

References

1. Bo, M.; Bavestrello, G.; Canese, S.; Giusti, M.; Salvati, E.; Angiolillo, M.; Greco, S. Characteristics of a black coral meadow in the twilight zone of the central Mediterranean Sea. *Mar. Ecol. Prog. Ser.* 2009, 397, 53–61.

2. Bo, M.; Canese, S.; Spaggiari, C.; Pusceddu, A.; Bertolino, M.; Angiolillo, M.; Giusti, M.; Loreto, M.F.; Salvati, E.; Greco, S.; et al. Deep Coral Oases in the South Tyrrhenian Sea. *PLoS ONE* 2012, 7, e49870.
3. Opresko, D.M.; Försterra, G.; Hofrichter, R. *Orden Antipatharia (corales negros o espinosos). El Mar Mediterraneo (Fauna, Flora, Ecología)*; Hofrichter, R., Ed.; Omega: Barcelona, Spain, 2004; pp. 506–509.
4. Bo, M.; Canese, S.; Bavestrello, G. Discovering Mediterranean black coral forests: *Parantipathes larix* (Anthozoa: Hexacorallia) in the Tuscan Archipelago, Italy. *Ital. J. Zool.* 2013, 81, 112–125.
5. Bo, M.; Numa, C.; Otero, M.D.M.; Orejas, C.; Garrabou, J.; Cerrano, C.; Kružić, P.; Antoniadou, C.; Aguilar, R.; Kipson, S.; et al. Overview of the Conservation Status of Mediterranean Anthozoa; IUCN: Gland, Switzerland, 2017.
6. Deidun, A.; Tsounis, G.; Balzan, F.; Micallef, A. Records of black coral (Antipatharia) and red coral (*Corallium rubrum*) fishing activities in the Maltese Islands. *Mar. Biodivers. Rec.* 2010, 3.
7. Bo, M.; Barucca, M.; Biscotti, M.A.; Brugler, M.R.; Canapa, A.; Canese, S.; Bavestrello, G. Phylogenetic relationships of Medi-terranean black corals (Cnidaria: Anthozoa: Hexacorallia) and implications for classification within the order Antipatharia. *Invertebr. Syst.* 2018, 32, 1102–1110.
8. Opresko, D.M. Three new species of *Leiopathes* (Cnidaria: Anthozoa: Antipatharia) from Southern Australia. *Rec. Aust. Mus.* 1998, 31, 99–111.
9. Tursi, A.; Mastrototaro, F.; Matarrese, A.; Maiorano, P.; D’Onghia, G. Biodiversity of the white coral reefs in the Ionian Sea (Central Mediterranean). *Chem. Ecol.* 2004, 20, 107–116.
10. Taviani, M.; Freiwald, A.; Zibrowius, H. Deep Coral Growth in the Mediterranean Sea: An overview. *Erlangen Earth Conference Series*; Springer: Berlin/Heidelberg, Germany, 2006; pp. 137–156.
11. Bo, M.; Bavestrello, G. Mediterranean Black Coral Communities. In *Mediterranean Cold-Water Corals: Past, Present and Future*; Springer: Cham, Switzerland, 2019; pp. 249–251.
12. Vafidis, D.; Koukouras, A. Antipatharia, Ceriantharia and Zoantharia (Hexacorallia, Anthozoa) of the Aegean Sea with a check list of the Mediterranean and Black Sea Species. *Ann. Inst. Oceanogr.* 1998, 74, 115–126.
13. Opresko, D.M. Redescription of *Antipathes dichotoma* Pallas, 1766 (Cnidaria: Anthozoa: Antipatharia). *Zool. Med. Leiden* 2003, 77, 481–493.
14. Morri, C.; Esposito, F.; Pessani, D. Checklist della flora e della fauna dei mari italiani (Parte I). *Anthozoa Biol. Mar. Mediterr.* 2008, 15, 92–101.
15. Bo, M.; Tazioli, S.; Spanò, N.; Bavestrello, G. *Antipathella subpinnata* (Antipatharia, Myriopathidae) in Italian seas. *Ital. J. Zool.* 2008, 75, 185–195.

16. Danovaro, R.; Boero, F. Italian Seas. In *World Seas: An Environmental Evaluation*; Elsevier BV: Amsterdam, The Netherlands, 2019; pp. 283–306.
17. Bianchi, C.N.; Morri, C. Marine Biodiversity of the Mediterranean Sea: Situation, Problems and Prospects for Future Research. *Mar. Pollut. Bull.* 2000, 40, 367–376.
18. Villa, F.; Tunesi, L.; Agardy, T. Zoning Marine Protected Areas through Spatial Multiple-Criteria Analysis: The Case of the Asinara Island National Marine Reserve of Italy. *Conserv. Biol.* 2002, 16, 515–526.
19. Gori, A.; Bavestrello, G.; Grinyó, J.; Dominguez-Carrió, C.; Ambroso, S.; Bo, M. Animal forests in deep coastal bottoms and continental shelf of the Mediterranean Sea. In *Marine Animal Forests: The Ecology of Benthic Biodiversity Hotspots*; Springer: Berlin/Heidelberg, Germany, 2017; pp. 207–233.
20. Terzin, M.M.G.; Matterson, K.; Coppari, M.; Bavestrello, G.; Abbiati, M.; Costantini, F. Population genomic structure of the black coral *Antipathella subpinnata* in Mediterranean Vulnerable Marine Ecosystems. In *Coral Reefs*; Springer: Berlin/Heidelberg, Germany, 2021; pp. 1–16.
21. Coppari, M.; Mestice, F.; Betti, F.; Bavestrello, G.; Castellano, L.; Bo, M. Fragmentation, re-attachment ability and growth rate of the Mediterranean black coral *Antipathella subpinnata*. *Coral Reefs* 2019, 38, 1–14.
22. Coppari, M.; Ferrier-Pagès, C.; Castellano, M.; Massa, F.; Olivari, E.; Bavestrello, G.; Povero, P.; Bo, M. Seasonal variation of the stable C and N isotopic composition of the mesophotic black coral *Antipathella subpinnata* (Ellis & Solander, 1786). *Estuarine Coast. Shelf Sci.* 2020, 233, 106520.
23. Bo, M.; Bava, S.; Canese, S.; Angiolillo, M.; Cattaneo-Vietti, R.; Bavestrello, G. Fishing impact on deep Mediterranean rocky habitats as revealed by ROV investigation. *Biol. Conserv.* 2014, 171, 167–176.
24. Greenpeace. I tesori sommersi del Canale di Sicilia. NO TRIVELLE TOUR 2012. 2012. Available online: (accessed on 21 June 2021).
25. Massi, D.; Vitale, S.; Titone, A.; Milisenda, G.; Gristina, M.; Fiorentino, F. Spatial distribution of the black coral *Leiopathes glaberrima* (Esper, 1788) (Antipatharia: Leiopathidae) in the Mediterranean: A prerequisite for protection of Vulnerable Marine Ecosystems (VMEs). *Eur. Zool. J.* 2018, 85, 169–178.
26. Bo, M.; Bavestrello, G.; Canese, S.; Giusti, M.; Angiolillo, M.; Cerrano, C.; Salvati, E.; Greco, S. Coral assemblage off the Calabrian Coast (South Italy) with new observations on living colonies of *Antipathes dichotoma*. *Ital. J. Zool.* 2011, 78, 231–242.
27. Aguilar, R.; Pastor, X.; Garcia, S.; Marin, P.; Ubero, J. Importance of seamounts-like features for Mediterranean marine habitats and threatened species. *Rapp. Comm. Int. Mer Méditerr.* 2013, 40,

716.

28. Arena, P.; Li Greci, F. Indagine sulle condizioni faunistiche e sui rendimenti di pesca dei fondali batiali della Sicilia occidentale e della bordura settentrionale dei banchi della soglia Sicul-Tunisina. *Quad. Lab. Tecnol. Pesca* 1973, 1, 157–201.

29. Santin, A.; Aguilar, R.; Akyol, O.; Begburs, C.R.; Benoit, L.; Chimienti, G.; Tiralongo, F. New records of rare species in the Mediterranean Sea (March 2021). *Mediterr. Mar. Sci.* 2021, 22, 199–217.

30. Romagnoli, B.; Grasselli, F.; Costantini, F.; Abbiati, M.; Romagnoli, C.; Innangi, S.; Di Martino, G.; Tonielli, R. Evaluating the distribution of priority benthic habitats through a remotely operated vehicle to support conservation measures off Linosa Island (Sicily Channel, Mediterranean Sea). *Aquat. Conserv. Mar. Freshw. Ecosyst.* 2021.

31. Bo, M.; Bavestrello, G. *Distribuzione, Ecologia e conservazione dei coralli neri (Anthozoa, Antipatharia) del Mediterraneo*; BMIB: Genova, Italy, 2013; p. 75.

32. Ingrassia, M.; Macelloni, L.; Bosman, A.; Chiocci, F.L.; Cerrano, C.; Martorelli, E. Black coral (Anthozoa, Antipatharia) forest near the western Pontine Islands (Tyrrhenian Sea). *Mar. Biodivers.* 2016, 46, 285–290.

33. Gaino, E.; Scoccia, F. Gamete spawning in *Antipathella subpinnata* (Anthozoa, Antipatharia): A structural and ultrastructural investigation. *Zoomorphology* 2010, 129, 213–219.

34. Angiolillo, M.; Gori, A.; Canese, S.; Bo, M.; Priori, C.; Bavestrello, G.; Salvati, E.; Erra, F.; Greenacre, M.; Santangelo, G. Distribution and population structure of deep-dwelling red coral in the Northwest Mediterranean. *Mar. Ecol.* 2016, 37, 294–310.

35. Giusti, M.; Innocenti, C.; Canese, S. Predicting suitable habitat for the gold coral *Savalia savaglia* (Bertoloni, 1819) (Cnidaria, Zoantharia) in the South Tyrrhenian Sea. *Cont. Shelf Res.* 2014, 81, 19–28.

36. D’Onghia, G.; Calcutti, C.; Capezzuto, F.; Carlucci, R.; Carluccio, A.; Maiorano, P.; Pollice, A.; Ricci, P.; Sion, L.; Tursi, A. New records of cold-water coral sites and fish fauna characterization of a potential network existing in the Mediterranean Sea. *Mar. Ecol.* 2016, 37, 1398–1422.

37. Carlier, A.; Le Guilloux, E.; Olu, K.; Sarrazin, J.; Mastrototaro, F.; Taviani, M.; Clavier, J. Trophic relationships in a deep Mediterranean cold-water coral bank (Santa Maria di Leuca, Ionian Sea). *Mar. Ecol. Prog. Ser.* 2009, 397, 125–137.

38. Mastrototaro, F.; D’Onghia, G.; Corriero, G.; Matarrese, A.; Maiorano, P.; Panetta, P.; Gherardi, M.; Longo, C.; Rosso, M.A.; Sciuto, F.; et al. Biodiversity of the white coral bank off Cape Santa Maria di Leuca (Mediterranean Sea): An update. *Deep Sea Res. Part II Top. Stud. Oceanogr.* 2010, 57, 412–430.

39. Vertino, A.; Savini, A.; Rosso, A.; Di Geronimo, I.; Mastrototaro, F.; Sanfilippo, R.; Gay, G.; Etiope, G. Benthic habitat characterization and distribution from two representative sites of the deep-water SML Coral Province (Mediterranean). *Deep Sea Res. Part II Top. Stud. Oceanogr.* 2010, 57, 380–396.

40. Chimienti, G.; De Padova, D.; Mossa, M.; Mastrototaro, F. A mesophotic black coral forest in the Adriatic Sea. *Sci. Rep.* 2020, 10, 1–15.

41. Chimienti, G.; Mastrototaro, F. Searching for black corals: The exploration of Tremiti islands MPA. *Rapp. Comm. Mer. Médit.* 2019, 42, 268.

42. Bo, M.; Bavestrello, G.; Angiolillo, M.; Calcagnile, L.; Canese, S.; Cannas, R.; Cau, A.; D'Elia, M.; D'Oriano, F.; Follesa, M.C.; et al. Persistence of Pristine Deep-Sea Coral Gardens in the Mediterranean Sea (SW Sardinia). *PLoS ONE* 2015, 10, e0119393.

43. Cau, A.; Follesa, M.C.; Moccia, D.; Alvito, A.; Bo, M.; Angiolillo, M.; Canese, S.; Paliaga, E.M.; Orrù, P.E.; Sacco, F.; et al. Deepwater corals biodiversity along roche du large ecosystems with different habitat complexity along the south Sardinia continental margin (CW Mediterranean Sea). *Mar. Biol.* 2015, 162, 1865–1878.

44. Gori, A.; Rossi, S.; Linares, C.; Berganzo, E.; Orejas, C.; Dale, M.R.; Gili, J.-M. Size and spatial structure in deep versus shallow populations of the Mediterranean gorgonian *Eunicella singularis* (Cap de Creus, northwestern Mediterranean Sea). *Mar. Biol.* 2011, 158, 1721–1732.

45. Angiolillo, M.; Canese, S. Deep Gorgonians and Corals of the Mediterranean Sea. In *Corals in a Changing World*; IntechOpen: London, UK, 2018.

46. Tazioli, S.; Bo, M.; Boyer, M.; Rotinsulu, H.; Bavestrello, G. Ecological observations of some common antipatharian corals in the marine park of Bunaken (North Sulawesi, Indonesia). *Zool. Stud.* 2007, 46, 227–241.

47. Bo, M.; Montgomery, A.D.; Opresko, D.M.; Wagner, D.; Bavestrello, G. Antipatharians of the Mesophotic Zone: Four Case Studies. In *Coral Reefs of the Eastern Tropical Pacific*; Springer: Berlin/Heidelberg, Germany, 2019; pp. 683–708.

48. Genin, A.; Dayton, P.K.; Lonsdale, P.F.; Spiess, F.N. Corals on seamount peaks provide evidence of current acceleration over deep-sea topography. *Nat. Cell Biol.* 1986, 322, 59–61.

49. Bo, M.; Di Camillo, C.G.; Addamo, A.M.; Valisano, L.; Bavestrello, G. Growth strategies of whip black corals (Cnidaria: An-tipatharia) in the Bunaken Marine Park (Celebes, Indonesia). *Mar. Biodivers. Rec.* 2009, 2e54, 1–6.

50. Prouty, N.; Roark, E.; Buster, N.; Ross, S. Growth rate and age distribution of deep-sea black corals in the Gulf of Mexico. *Mar. Ecol. Prog. Ser.* 2011, 423, 101–115.

51. Roark, E.B.; Guilderson, T.P.; Dunbar, R.B.; Fallon, S.; Mucciarone, D.A. Extreme longevity in proteinaceous deep-sea corals. *Proc. Natl. Acad. Sci. USA* 2009, 106, 5204–5208.
52. Mortensen, P.; Buhl-Mortensen, L. Deep-water corals and their habitats in The Gully, a submarine canyon off Atlantic Canada. *Erlangen Earth Conf. Ser.* 2006, 247–277.
53. Purroy, A.; Requena, S.; Gili, J.M.; Canepa, A.; Sardá, R. Spatial assessment of artisanal fisheries and their potential impact on the seabed: The Cap de Creus regional case study (northwestern Mediterranean Sea). *Sci. Mar.* 2014, 78, 449–459.
54. Deidun, A.; Andaloro, F.; Bavestrello, G.; Canese, S.; Consoli, P.; Micallef, A.; Romeo, T.; Bo, M. First characterisation of a *Leiopathes glaberrima* (Cnidaria: Anthozoa: Antipatharia) forest in Maltese exploited fishing grounds. *Ital. J. Zool.* 2014, 1–10.
55. Van De Water, J.A.; Coppari, M.; Enrichetti, F.; Ferrier-Pagès, C.; Bo, M. Local Conditions Influence the Prokaryotic Com-mu-nities Associated With the Mesophotic Black Coral *Antipathella subpinnata*. *Front. Microbiol.* 2020, 11, 2423.

Retrieved from <https://encyclopedia.pub/entry/history/show/29483>