Cold-water corals of the Azores: preliminary assessment of distribution, diversity and associated fauna

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Introduction

On-going scientific missions carried out in the Azores by IMAR/DOP-UAç are uncovering the extent and ecological importance of cold-water coral communities in the region. A large and dense gorgonian forest dominated by *Dentomuricea* sp. and *Viminella flagellum* was recently discovered at the Condor de Terra seamount [1]. Reef-building corals associated with gorgonians were also recorded at the Menez Gwen hydrothermal field. Additionally, in a recent EMEPC expedition (Task Group for the Extension of the Continental Shelf, Portugal) *Chrysogorgia* gorgonians covering all available hard bottoms were observed at the Hirondelle Basin (Figure 1). The purpose of this work was to assess the present-day distribution and the diversity of cold-water corals that occur in the Azores region.

Table 1. List of coral taxa recorded over the last 4 years at the Azores region, with reference to the number of specimens per taxon and depth range.

TAXA	Number	Depth range (m)
ANTHOZOA		
Order ALCYONACEA		
Family Acanthogorgiidae		
Acanthogorgia sp.	1	-
Acanthogorgia armata	19	256-1153
Acanthogorgia hirsuta	9	203-819
Family Alcyoniidae		
Alcyonium sp.	6	200-347
Anthomastus cf. *agaricus*	1	238-329
Alcyonium cf. *manisterebrosi*	9	329-365
Alcyonium rubrum	9	249-365
Pseudoalcyonium novum	4	1062-1100
Other spp.	2	293-700
Family Chrysogorgiidae		
Chrysogorgia sp.	1	1000-1163
Chrysogorgia agassizi	2	823-1097
Other spp.	2	2800-3000
Family Clavulariidae		
Clavularia sp.	3	435-1100
Family Coralliidae		
Corallium sp.	1	-
Corallium niobe	2	-
Family Ellisellidae		
Ellisella flagellum	1	501-550
Viminella flagellum	33	168-790
Family Isididae		
Acanella arbuscula	1	1000-1228
Keratoisis grayi	3	1069-1156
Lepidisis longiflora	7	1032-1156
Family Organidae		
Schizophytum echinatum	1	292
Family Paragorgiidae		
Paragorgia arborea	3	293-728
Paragorgia johnsoni	4	657-728
Family Plexauridae		
Bebryce mollis	22	109-830
Dentomuricea sp.	24	184-790
Dentomuricea meteor	3	238-293
Echinomuricea sp.	1	274-439
Muricoides sp. 1	1	293
Muricoides sp. 2	1	379
Muricoides paucituberculata	1	67-768
Paramuricea sp.	2	843-1156
Paramuricea cf. *biscaya*	1	184-790
Paramuricea candida	2	184-790
Placogorgia terceira	3	238-347
Swiftia sp.	1	307
Swiftia pallida	2	70-1228
Villogorgia bebrycoides	4	219-384
Other spp.	4	-
Family Primnoidae		
Callogorgia verticillata	30	168-600
Candidella imbricata	5	210-1237
Narella sp.	1	-
Narella versluysi	1	475
Paracalyptrophora josephinae	15	184-843
Thouarella sp.	2	384
Thouarella hilgendorfi	1	200-1237
Other spp.	1	
Other alcyoneans	5	202-1550
Order ZOANTHIDEA		
Family Epizoanthidae		
Epizoanthus sp. 1	16	307-366
Epizoanthus sp. 2	1	-
Epizoanthus sp. 3	1	1062-1100
Epizoanthus sp. 4	3	435
Family Parazoanthidae		
Gerardia macaronesica	4	22-28
Order ANTIPATHARIA		
Family Antipathidae		
Stichopathes gravieri	1	-
Family Aphanipathidae		
Aphanipathes sp.	8	329-366
Elatopathes sp.	1	355-399
Pharaopathes sp.	3	1062-1100
Family Leiopathidae		
Leiopathes sp.	47	160-1100
Family Myriopathidae		
Antipathella wollastoni	22	25-457
Plumapathes sp.	2	38-790
Family Schizopathidae		
Parantipathes sp.	4	316-457
Other antipatharians	3	229-1100
Order SCLERACTINIA		
Family Caryophylliidae		
Caryophyllia sp.	22	200-1097
Caryophyllia abyssorum	2	1142-1153
Caryophyllia ambrosia	5	2000-2100
Caryophyllia cf. *calveri*	1	274
Caryophyllia cyathus	24	210-549
Caryophyllia cf. *cyathus*	1	304-346
Caryophyllia foresti	3	238-329
Caryophyllia smithii	1	-
Coenocyathus cf. *cylindricus*	2	238-293
Coenosmilia fecunda	3	274-439
Desmophyllum cristagalli	17	366-1550
Lophelia pertusa	11	511-1028
Paracyathus pulchellus	2	
Solenosmilia variabilis	6	
Other spp.	6	211-366
Family Dendrophylliidae		
Dendrophyllia sp. 1	28	146-417
Dendrophyllia sp. 2	7	274-439
Dendrophyllia cornigera	22	200-546
Dendrophyllia ramea	1	
Enallopsammia sp.	2	352-448
Enallopsammia cf. *amphelioides*	1	402-438
Enallopsammia rostrata	2	759-1758
Leptosammia sp.	1	823-1097
Family Flabellidae		
Flabellum chunii	4	379-525
Javania cailleti	1	201
Family Guyniidae		
Stenocyathus vermiformis	2	229-384
Family Oculinidae		
Madrepora oculata	19	210-1237
Family Pocilloporidae		
Madracis pharensis	5	9
Other scleractinians	9	19-1137
HYDROZOA		
Family Stylasteridae		
Errina sp.	49	192-1100
Errina atlantica	4	274-365
Errina dabneyi	29	201-1097
Lepidopora eburnea	2	511-1028
Other spp.	6	269-1550

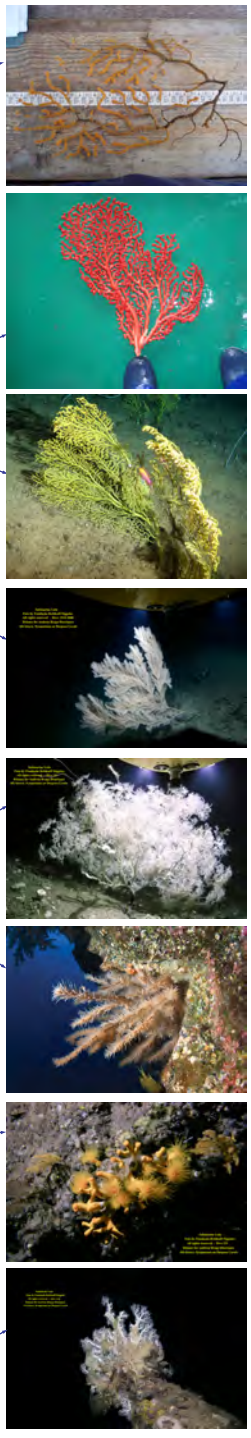

Figure 1. Some of the cold-water coral communities that occur in the Azores region. A) Condor de Terra seamount (@Gavin Newman/Greenpeace); B) Menez Gwen (@Seahma mission); C) Hirondelle Basin (@EMEPC).

Methods

A total of 643 coral specimens were recorded in the Azores region over the last 4 years based on scientific expeditions and longline bycatch data (local fishing fleet and experimental fishing surveys). The specimens were collected at depths between 25 and 3000 m, with the bulk of specimens coming from 200 to 600 m depths, which is the main operation range of the local fishing fleet. All corals were identified to the lowest possible taxon based on morphological and anatomical characters, using light and dissecting microscopes and supported by available literature [2 to 10]. Taxonomic procedures have included observation of the general morphology of the corallum or skeleton, pattern of ramification and polyp morphology. Distinctive characters only present in black corals were also studied, such as the morphology of the spines arising on the surface of the axis. For examination of gorgonian sclerites, several polyps and small pieces of coenenchyme were digested with bleach and washed with distilled water. Scleractinian corals were immersed in bleach for a better observation of the morphology of calyces, septa cicles and columella.

Results and discussion

The high number of coral species recorded in the Azores region over the last 4 years (85 species) provides a strong indication of the diversity exhibited by those communities (Table 1 and Figure 2). The most represented Order, Alcyonacea, includes corals of the families Plexauridae (14 species), Primnoidae (7 species) and Acanthogorgiidae (3 species). The majority of the antipatharians recorded belongs to the families Leiopathidae and Myriopathidae, with *Antipathella wollastonii* and *Leiopathes* sp. being the predominant species and occuring at considerably different depth ranges. Hydrocorals (4 Stylasteridae species) and stony corals (13 Caryophyllidae species and 8 Dendrophyllidae species) were also very abundant. Additionally those communities host an abundant and diversified associated fauna, such as decapods and cirripedes, bryozoans, echinoderms, caprellids, barnacles, sponges, hydroids and polychaets, among others (Figure 3).

The species *Paragorgia arborea* and *Dendrophyllia ramea* are new records for the Azores, and *Dentomuricea* sp. seems to be a new species (work in progress) accordingly to the recent results of taxonomic work carried out by IMAR/DOP-UAç. With only a fraction of the habitat explored so far, the number of coral species known to occur in the Azores will most likely increase. Given the isolated nature of the islands, which possibly imposes restrictions to gene flow, the level of endemism reported for the region [11] may have been under-estimated. Current research being developed in the region will contribute to a better understanding of cold-water coral communities, in terms of species composition, ecology and also demographic and genetic scales of connectivity.

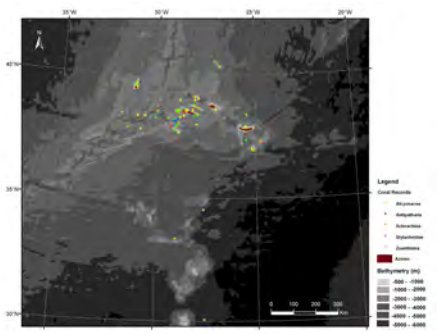

Figure 2. Distribution of coral specimens recorded over the last 4 years in the Azores region by taxonomic group.

Figure 3. Some examples of epibiont fauna found on cold-water corals of the Azores region.

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References

[1] Braga-Henriques A, Cardigos F, Menezes G, Ocaña O, Porteiro FM, Tempera F, Gonçalves J (2006). Recent observations of cold-water coral communities on the Condor de Terra Seamount, Azores. 41st European Marine Biology Symposium, Cork, Ireland.

[2] Grasshoff M. 1972. The Gorgonia of the eastern North Atlantic and Mediterranean. I. Family Ellisellidae (Cnidaria: Anthozoa). Results of the Atlantic Seamount Cruises 1967 with RV Meteor. Meteor Forsch. Ergebnisse 10: 73–87.

[3]_____. 1973. Die Gorgonaria des östlichen Nordatlantik und des Mittelmeeres II. Die Gattung Acanthogorgia (Cnidaria: Anthozoa) Auswertung der Atlantischen Kuppenfahrten 1967 von FS Meteor. Meteor Forsch.Ergebnisse 13: 1–10.

[4]_____. 1977. Die Gorgonarien des östlichen Nordatlantik und des Mittelmeeres. III Die Familie Paramuriceidae (Cnidaria, Anthozoa). Meteor Forsch. Ergebnisse 27: 5–76.

[5]_____. 1981a. Gorgonaria und Pennatularia (Cnidaria: Anthozoa) vom Mittelatlantischen Rucken SW der Azoren. Steenstrupia 7: 213–230.

[6]_____. 1985a. Die Gorgonaria und Antipatharia der Großen Meteor-Bank und der Josephine-Bank (Cnidaria: Anthozoa). Senckenbergiana Marit. 17: 65-67.

[7] Opresko DM. 2001. Revision of the Antipatharia (Cnidaria: Anthozoa). Part I. Establishment of a new family, Myriopathidae. Zool. Med. Leiden 75: 343-370.

[8]_____. 2002. Revision of the Antipatharia (Cnidaria: Anthozoa). Part II. Schizopathidae. Zool. Med. Leiden 76: 411-442.

[9]_____. 2003. Revision of the Antipatharia (Cnidaria: Anthozoa). Part III. Cladopathidae. Zool. Med. Leiden 77: 495-536.

[10]_____. 2004. Revision of the Antipatharia (Cnidaria: Anthozoa). Part IV. Establishment of a new family, Aphanipathidae. Zool. Med. Leiden 78: 209-240.

[11] Hall-Spencer J, Rogers A, Davies J, Foggo A. (2008). Deep-sea coral distribution on seamounts, oceanic islands, and continental slopes in the Northeast Atlantic. Bulletin of Marine Science 1-12.