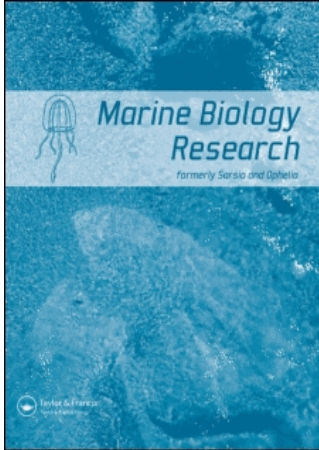


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Anthozoa from the northern Mid-Atlantic Ridge and Charlie-Gibbs Fracture Zone

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ORIGINAL ARTICLE

Anthozoa from the northern Mid-Atlantic Ridge and Charlie-Gibbs Fracture Zone

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Abstract

An annotated list of deep-sea Anthozoa of the orders Actiniaria, Antipatharia, Scleractinia, Alcyonacea and Pennatulacea collected on the *G.O. Sars* MAR-ECO cruise to the Mid-Atlantic Ridge between the Azores and the southern tip of the Reykjanes Ridge is given. A total of 33 species is reported of which 32 were identified to species or genus level. The groups most rich in species were Actiniaria (nine species), Scleractinia (eight species) and Pennatulacea (eight species). Scleractinia, Antipatharia and Pennatulacea were mainly represented by species with a wide or cosmopolitan geographical distribution. In contrast, most of the actinarians had been rarely recorded in the North Atlantic. Three species, *Schizopathes affinis* Brook, 1889 (Antipatharia), *Dendrobrachia multispina* Opresko & Bayer, 1991 and *Heteropolypus* cf. *insolitus* Tixier-Durivault, 1964 (Alcyonacea) are reported from the North Atlantic for the first time.

Key words: *Anthozoa, distribution, Mid-Atlantic Ridge, North Atlantic*

Introduction

The North Atlantic can be considered as one of the best studied areas of the world ocean. However, most studies in this region have been made on the shelf and continental slope, and also on upper slopes of islands and a limited number of seamounts. Studies of open oceanic fauna are limited to upper slopes of islands and a limited number of seamounts. The fauna of depths below 2000 m is still poorly known. Our knowledge of the Mid-Atlantic Ridge fauna is restricted to the periphery of hydrothermal vents and some data on non-vent fauna of the northern part of the Mid-Atlantic Ridge south of Iceland (Reykjanes Ridge) (Copley et al. 1996; Mironov & Gebruk 2006).

The general distribution of deep-sea anthozoans in the North Atlantic is poorly known. The only taxon where distributional data is available for most regions of the North Atlantic is the Scleractinia (Zibrowius 1980; Keller 1985a,b; Cairns & Chapman 2001). In a recent detailed analysis of the biogeographic relationships of the bathyal Reykjanes

Ridge fauna (Mironov & Gebruk 2006), only scleractinians were considered. Data on distribution of deep-sea non-scleractinian anthozoans (Actiniaria, Alcyonacea, Pennatulacea, Antipatharia) in the North Atlantic are available for a limited number of regions (Grasshoff 1981a,b, 1985, 1989; Pasternak 1985; Riemann-Zürneck 1986; Fautin et al. 2005; Watling & Auster 2005) with only a few papers summarizing patterns of distribution of non-scleractinian anthozoans at the Mid-Atlantic Ridge (Grasshoff 1981a; Keller & Pasternak 2001; Molodtsova 2006).

On the MAR-ECO cruise of the RV *G.O. Sars* (www.mar-eco.no), deep-sea anthozoans of the orders Actiniaria, Scleractinia, Antipatharia, Alcyonacea and Pennatulacea were collected from 17 trawl stations (Table I) including 13 stations below 2000 m. Of 33 anthozoan taxa encountered in the MAR-ECO collections, 32 were determined to the genus or species level. The only undetermined species was represented by a single specimen of an actinarian that could not be assigned to any known genus. Here

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Table I. MAR-ECO trawl stations on which anthozoans were sampled.

Areas sampled	Super station	Trawl station	Date	Sampling location		Trawling depth (m)		
				Latitude	Longitude	Mean	Max.	Min.
North of the Azores	40	367	7 July 2004	42°55'N	30°20'W	2961	2968	2954
	42	368	8 July 2004	42°48'N	29°38'W	2078	2107	2063
	44	369	9 July 2004	42°55'N	29°32'W	1742	1767	1702
	46	372	11 July 2004	42°46'N	29°16'W	3031	3050	3005
	50	373	12 July 2004	43°01'N	28°33'W	2600	2607	2593
	52	374	13 July 2004	42°55'N	28°08'W	2977	2979	2973
Faraday seamount	53	375	15 July 2004	49°51'N	29°37'W	990	1003	981
South-east of Charlie-Gibbs Fracture Zone	54	377	16 July 2004	51°19'N	28°52'W	3512	3527	3505
	56	378	17 July 2004	51°45'N	29°33'W	1916	1950	1872
	60	379	19 July 2004	51°33'N	30°18'W	1263	1296	1237
	62	380	20 July 2004	51°55'N	30°25'W	1910	1959	1872
	64	381	21 July 2004	51°32'N	30°58'W	3461	3465	3452
	66	383	24 July 2004	53°01'N	33°36'W	3030	3071	2995
North-west of Charlie-Gibbs Fracture Zone	68	384	25 July 2004	53°08'N	34°46'W	2350	2374	2306
	70	385	26 July 2004	52°58'N	34°52'W	1650	1670	1630
	72	386	27 July 2004	53°16'N	35°31'W	2548	2567	2522
	74	387	28 July 2004	53°17'N	36°46'W	3055	3063	3048

we provide an annotated list of species from the MAR-ECO collection and discuss some aspects of their geographical distribution.

Material and methods

All material described in the present paper was obtained on the MAR-ECO cruise of the RV *G.O. Sars* to the northern Mid-Atlantic Ridge in July 2004 (Bergstad & Gebruk 2008). Samples were taken using a modification of a semi-commercial otter trawl (the Campelen 1800 shrimp trawl), with mouth opening $17 \times 12 \times 4.5$ m, with a 5 mm mesh liner at the cod end. Specimens were fixed in 4% buffered formalin or preserved directly in 80% alcohol. Formalin-fixed materials were transferred to 80% alcohol within one month. For species determination normal procedures for each taxonomic group were followed (Stephenson 1928; Bayer 1961; Opresko 1972; Zibrowius 1980). All measurements were made on preserved specimens.

Systematic account

Hexacorallia

Order Actiniaria

Family Actinostolidae Carlgren, 1932

Sicyonis Hertwig, 1882

Sicyonis ingolfi Carlgren, 1921

(Figure 1D)

Sicyonis ingolfi Carlgren 1921: 217.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 50/373, one specimen; St. 73/386, one specimen.

Remarks

The genus *Sicyonis* comprises several species of large deep-water sea anemones most of which are poorly known. In most features including the number (58 and 68) and arrangement of tentacles (close to the margin) the present specimens resemble *S. ingolfi* and *S. biotrans* Riemann-Zürneck, 1991. The developed mesogloal thickenings around the tentacle bases of the specimens examined differ from *S. ingolfi* and resemble *S. biotrans*. However, the tentacular basitrichs are about the same size as in *S. ingolfi* (smaller than in *S. biotrans*) and the unevenly developed longitudinal muscles in the tentacles also resemble *S. ingolfi* rather than *S. biotrans*. The variability of these mentioned features in *Sicyonis* is not well established and the validity of these species is not clear.

Distribution

South of Greenland, Mid-Atlantic Ridge, Reykjanes Ridge, depth 2517–3085 m.

Family Hormathiidae Carlgren, 1932

Amphianthus Hertwig, 1882

Amphianthus inornata (Gravier, 1918)

(Figure 1F)

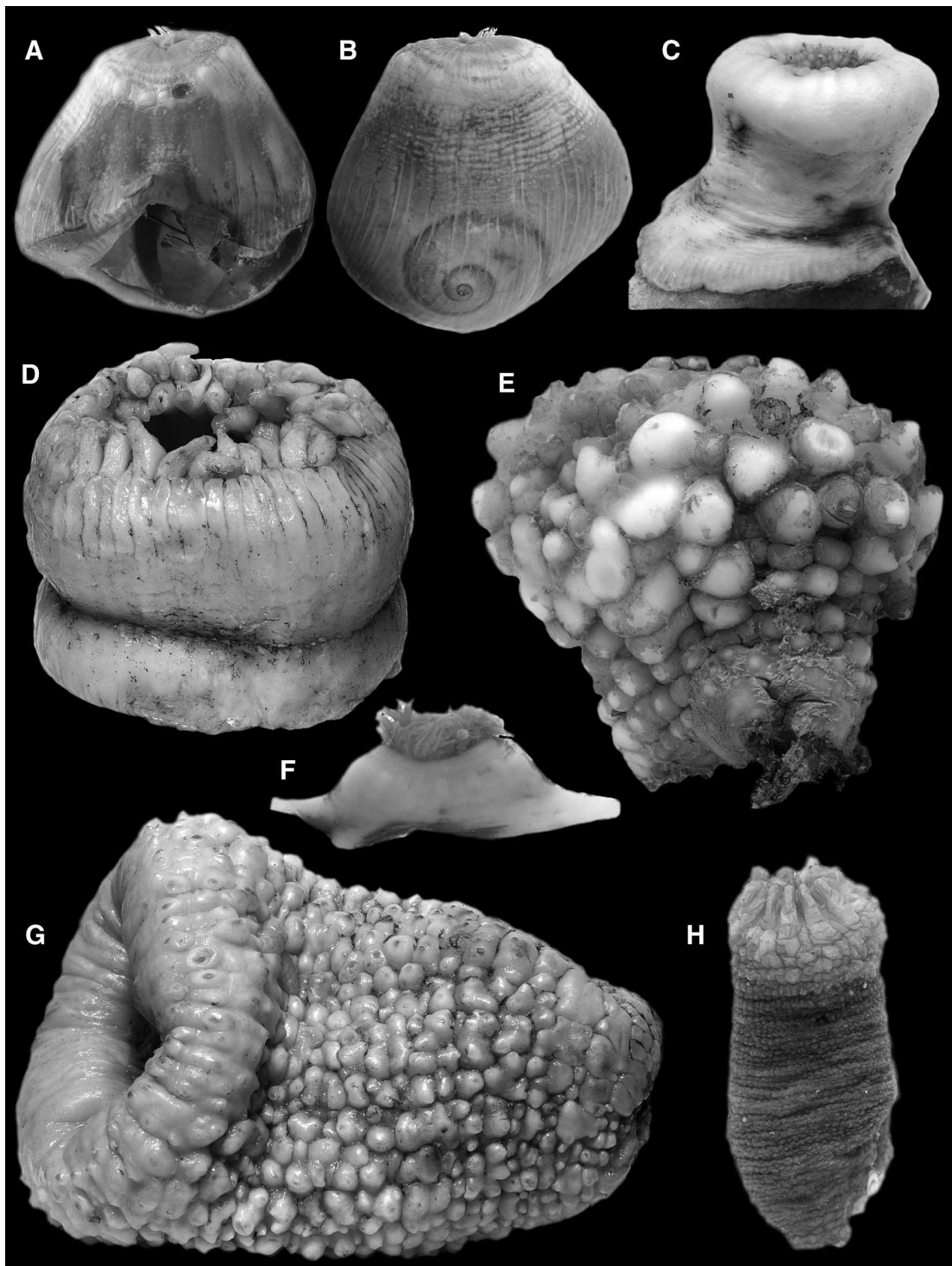


Figure 1. Actiniaria. (A, B) *Paracalliactis consors* ($\times 1.6$); (C) *Amphianthus michaelsarsi* ($\times 2.1$); (D) *Sicyonis ingolfi* ($\times 0.8$); (E) *Phelliactis robusta* ($\times 1.3$); (F) *Amphianthus inornata* ($\times 3.5$); (G) *Phelliactis michaelsarsi* ($\times 0.7$); (H) *Chondrophellia coronata* ($\times 2.0$).

Stephanactis inornata Gravier 1918: 17; 1922: 74.
Amphianthus inornata Carlgren 1949: 99.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 50/373, two specimens.

Remarks

Two specimens 4.5 and 5.5 mm high were attached to *Acanella arbuscula* branches; the pedal disc of each was elongated. The species is characterized by a smooth column, two cinclides on small papillae in each directive compartment, and rather numerous tentacles (about 60 in the larger specimen). This species probably always lives on *Acanella*.

Distribution

Casablanca (Morocco), Mid-Atlantic Ridge, depth 2165–2598 m.

Amphianthus michaelsarsi Carlgren, 1934
 (Figure 1C)

Amphianthus michaelsarsi Carlgren 1934: 12.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 42/368, one specimen; St. 50/373, three specimens; St. 52/374, one specimen; St. 62/380, one specimen.

Remarks

The specimens agree well with the original description. Each has a wide circular (not elongated) base; the distal part of the column has 24 longitudinal rows of larger tubercles alternating with 24 rows of smaller tubercles, and one cinclis in each directive endocoel.

Distribution

Mid-Atlantic Ridge, depth 1179–2977 m.

***Amphianthus* sp.**

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 52/374, two specimens.

Remarks

Each specimen has an elongated pedal disk and radial rows of tubercles. The material is insufficient for precise identification.

Distribution

Mid-Atlantic Ridge, 2974–2977 m.

Chondrophellia Carlgren, 1925

Chondrophellia coronata (Verrill, 1883)
 (Figure 1H)

Actinauge nodosa var. *coronata* Verrill 1883: 53.
Actinauge fastigata McMurrich 1893: 187 (nom. nov. for *Actinauge nodosa* var. *coronata* Verrill).
Hormatia elongata Gravier 1918: 14.
Chondrophellia coronata Carlgren 1928: 289; 1942: 32; Doumenc & Van-Praët 1988: 63.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 70/385, two specimens.

Remarks

The species can be easily identified by the characteristic shape and texture of the body, well-developed acontia with hormathiid nematocysts, and fertile mesenteries of the first cycle.

Distribution

Widely distributed in the North Atlantic, depth 599–2448 m. Two dubious records in SE Pacific: coastal Chile, 677 m (the specimens described by McMurrich 1893 and re-examined by Carlgren 1942), and East Pacific Rise, 11°S hydrothermal vent, about 2000 m (Doumenc & Van-Praët 1988).

Paracalliactis Carlgren, 1928

Paracalliactis consors (Verrill, 1882)
 (Figure 1A, B)

Urticina consors Verrill 1882: 225; 1883: 49.
Actinauge consors Verrill 1885: 534.
 ? *Adamsia involvens* McMurrich 1893: 182.
 ? *Paracalliactis involvens* Carlgren 1947: 104; Sebens 1998: 53.
 [partim?] *Paracalliactis consors* Daly et al. 2004: 392.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 40/367, one specimen; St. 42/368, two specimens.

Remarks

Two of the better preserved specimens have a crown of small tubercles covered by a cuticle similar to Atlantic specimens of *Urticina consors* (syntypes redescribed by Daly et al. 2004: 393, Figure 5B) suggesting that this feature is rather stable and characteristic for the species. Tubercles were not reported in the Pacific specimens of *Paracalliactis involvens* (synonymized with *P. consors* by Daly et al. 2004) and may constitute a valid feature distinguishing Atlantic and Pacific species.

Distribution

North-west Atlantic (Cape Cod), Mid-Atlantic Ridge, depth 291–2960 m. *Paracalliactis involvens* recorded in the east Pacific, Ecuador, 1349 m (McMurrich 1893; the depth of this record erroneously reported as 132 m by Daly et al. 2004: 387, Table 1).

***Phelliactis* Simon, 1892**

Phelliactis michaelsarsi (Carlgren, 1934)
(Figure 1G)

Paraphelliactis michaelsarsi Carlgren 1934: 13.
Phelliactis michaelsarsi Riemann-Zürneck 1973: 312;
1986: 16.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 54/377, one specimen.

Remarks

The specimen is very large, 138 mm high and 101 mm at greatest diameter. Many columnar tubercles have pointed tips made of dense mesogloea, darker than the rest of the tubercle, and the mesogloea of the column has a spongy structure, both features characteristic of this species (Riemann-Zürneck 1986). Unlike the type specimens described by Carlgren (1934) the present specimen has almost the same number of mesenteries distally and proximally (152 tentacles, 156 mesenteries distally, 160 mesenteries proximally).

Distribution

North-east Atlantic, north-west Africa and north Spain, Mid-Atlantic Ridge, depth 2603–4160 m.

Phelliactis robusta Carlgren, 1928
(Figure 1E)

Phelliactis robusta Carlgren 1928: 290; 1934: 14;
1942: 40; Riemann-Zürneck 1973: 311; Doumenc
1975: 173; Fautin et al. 2005: 78.
[partim] *Phelliactis hertwigi* Carlgren 1928: 290.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 42/368, one specimen; St. 62/380, one specimen.

Remarks

The specimens have large irregularly distributed tubercles on the column characteristic for this species. The larger specimen has 158 mesenteries distally (but only 121 tentacles were counted) and 178 mesenteries proximally, supporting Carlgren's (1942) statement that in this species the tentacles are always fewer than the mesenteries at the limbus.

Distribution

North Atlantic, Davis Strait, Denmark Strait, SW Ireland, west off Faroe Islands, Bay of Biscay, south off Greenland, Faroe Islands, Mid-Atlantic Ridge, depth 599–2448 m.

Order Antipatharia

Family Schizopathidae Brook, 1889

Schizopathes Brook, 1889

Schizopathes affinis Brook, 1889

Schizopathes affinis Brook 1889: 148; Cooper 1909:
310; Opresko 1997: 161; Loiola & Castro 2001: 6.
[partim] *Bathypathus (Schizopathes) affinis* van Pesch
1914: 27.

Bathypathes affinis Zhou & Zou 1992: 46.
[partim] *Bathypathes patula* Pasternak 1958: 181;
1964: 201; 1976: 47; 1977: 157; Grasshoff 1981b:
961 (synonymy).

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 42/368, two specimens.

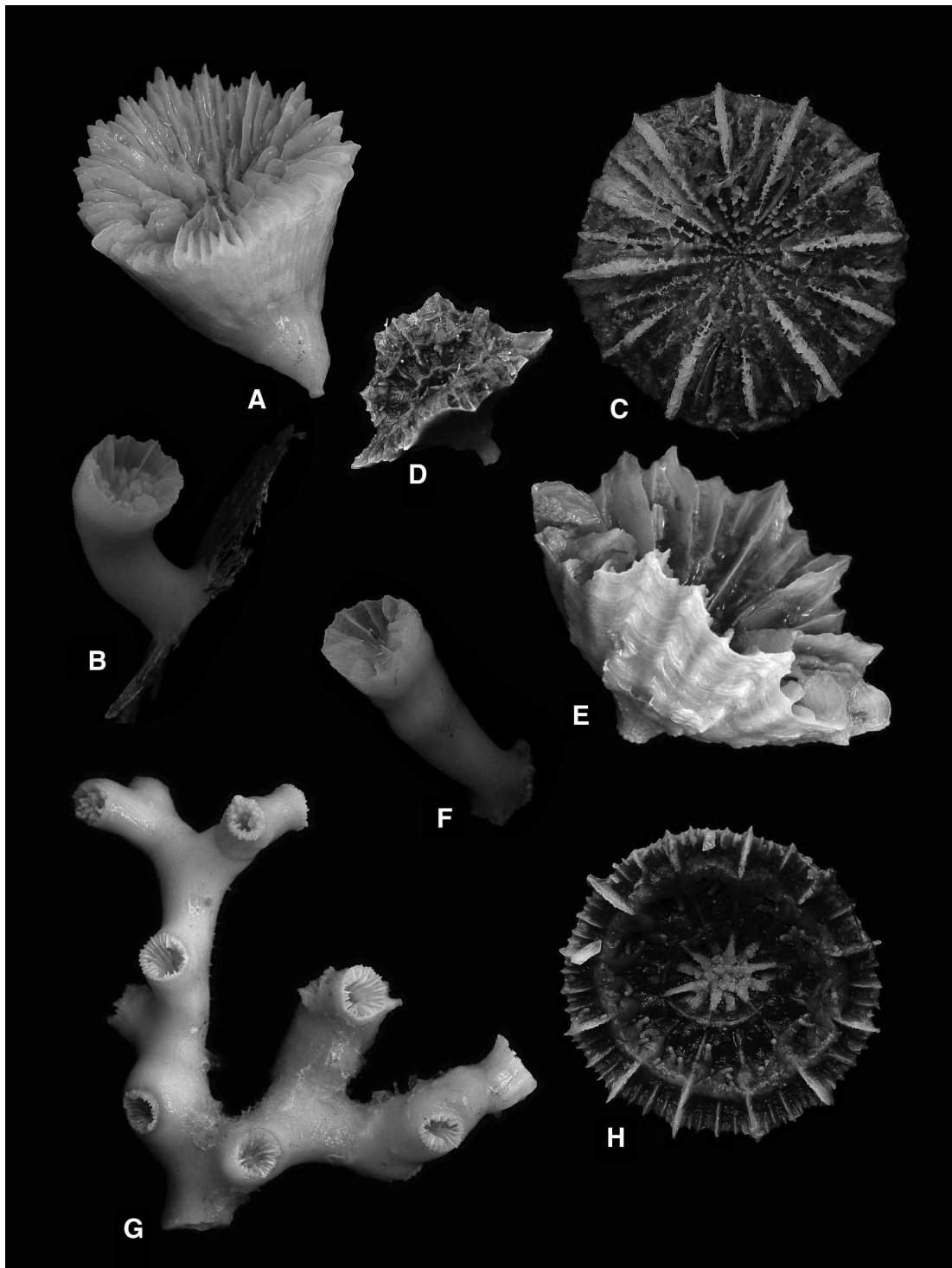


Figure 2. Scleractinia. (A) *Caryophyllia ambrosia* ($\times 2.1$); (B) *Caryophyllia cornuformis* ($\times 3.4$); (C) *Fungiacyathus fragilis* ($\times 1.7$); (D) *Flabellum angulare* ($\times 1.6$); (E) *Flabellum alabastrum* ($\times 1.6$); (F) *Placotrochides frustra* ($\times 3.1$); (G) *Lophelia pertusa* ($\times 1.6$); (H) *Stephanocyathus moseleyanus* ($\times 1.7$).

Remarks

Pasternak (1958), based on material from the North Pacific, considered *S. affinis* Brook together with *Schizopathes crassa* Brook as junior synonyms of *Bathypathes patula* Brook. However, re-examination of Pasternak's material revealed that these species belong to two genera clearly differentiated by the arrangement of pinnules (Molodtsova 2006). Both specimens from the Mid-Atlantic Ridge agree with the description of *S. affinis* with respect to the general form of the colony, size of polyps and long unpinnulated stalk. However, the pinnular spines in specimens from the Mid-Atlantic Ridge are slightly higher (0.04–0.06 mm vs. 0.03–0.04 mm) and more loosely arranged (four or five vs. five or six per mm) than reported by Opresko (1997).

Distribution

North Pacific, Banda Is., west off Admiralty I., the South China Sea, Indian Ocean, Brazil, Bahama Is., Mid-Atlantic Ridge, depth 1900–8900 m.

Order Scleractinia

Suborder Fungiina Verrill, 1865

Family Fungiacyathidae Chevalier, 1987

Fungiacyathus G.O. Sars, 1872

Fungiacyathus (Fungiacyathus) Sars, 1872

Fungiacyathus fragilis G.O. Sars, 1872

(Figure 2C)

Fungiacyathus fragilis Zibrowius 1980: 23 (synonymy); Cairns 1982: 7; 1999: 55; Keller 1985b: 39; Cairns & Chapman 2001: 36, 42; Keller & Pasternak 2001: 557.

Bathyactis hawaiiensis Vaughan 1907: 145.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 40/367, one specimen; St. 42/368, one specimen; St. 50/374, one specimen; St. 56/378, one specimen; St. 70/385, one specimen.

Remarks

This is the first record of this species below 2200 m.

Distribution

Arctic, the Norwegian Sea, the Greenland Sea, south of Iceland, Azores, Cape Verde Is., Hawaii Is., New Zealand, Macquarie Ridge, depth 250–2960 m.

Suborder Caryophylliina Vaughan & Wells, 1943

Family Caryophylliidae Gray, 1846

Caryophyllia Lamarck, 1801

Caryophyllia (Caryophyllia) Lamarck, 1801

Caryophyllia ambrosia Alcock, 1898

(Figure 2A)

Caryophyllia ambrosia Zibrowius 1980: 63; Keller 1985b: 39.

Caryophyllia ambrosia ambrosia Cairns 1979: 59; Keller 1985b: 39; Cairns & Keller 1993: 234; Cairns 1994: 48; 1995: 5; Cairns & Zibrowius 1997: 95; Cairns & Chapman 2001: 34, 40; Keller & Pasternak 2001: 557.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 42/368, one specimen; St. 70/385, two specimens.

Distribution

Atlantic Ocean, Indian Ocean, temperate North Pacific, Philippines, Indonesia, South-west Australia, depth 311–2670 m.

Caryophyllia cornuformis Pourtalès, 1868

(Figure 2B)

Caryophyllia cornuformis Pourtalès 1868: 133; Cairns 1979: 49; Zibrowius 1980: 66; Keller 1985b: 39; Keller & Pasternak 2001: 557.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 62/380, one specimen.

Distribution

West Atlantic from Brazil to 63°N, East Atlantic (limited by the Celtic Sea, Azores, Morocco), Indian Ocean (Mozambique, Tanzania, Gulf of Aden), depth 37–2200 m.

Stephanocyathus Seguenza, 1864

Stephanocyathus (Stephanocyathus) Seguenza, 1864

Stephanocyathus moseleyanus (Sclater, 1886)

(Figure 2H)

Stephanocyathus moseleyanus Zibrowius 1980: 98, Plate 49; Cairns & Chapman 2001: 37, 43.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 44/369, four specimens.

Distribution

East Atlantic from Faeroes to Guinea; south off Iceland, depth 600–2200 m (mainly 1000–2000 m).

Subfamily Desmophyllinae Vaughan & Wells, 1943

Lophelia Milne-Edwards & Haime, 1849

Lophelia pertusa (Linnaeus, 1758)

(Figure 2G)

Lophelia pertusa Zibrowius 1980: 126 (synonymy and discussion); Keller 1985a: 61; Cairns 1995: 27; 1999: 105; Copley et al. 1996: 553; Cairns & Chapman 2001: 36, 42; Keller & Pasternak 2001: 557.

Lophelia prolifera Cairns 1979: 125 (synonymy and discussion); 1982: 30; 1991:17.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 58/382, one fragment.

Distribution

Cosmopolitan species, except for near-continental Antarctic; common in the Atlantic, rarely collected in the Indo-West Pacific, depth 60–2170 m.

Family Flabellidae Bourne, 1905

Flabellum Lesson, 1831

Flabellum (Flabellum) Lesson, 1831

Flabellum alabastrum Moseley, 1873

(Figure 2E)

Flabellum alabastrum Zibrowius 1980: 148 (synonymy); Keller 1985b: 40; Cairns & Chapman 2001: 36, 41; Keller & Pasternak 2001: 557.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 44/369, two specimens; St. 70/385, one specimen.

Distribution

Atlantic Ocean, depth 1200–2000 m.

Flabellum angulare Moseley, 1876

(Figure 2D)

Flabellum angulare Moseley 1876: 547; Zibrowius 1980: 152; Keller 1985b: 40; Cairns & Chapman 2001: 36, 41; Keller & Pasternak 2001: 557.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 40/367, one specimen; St. 50/373, two specimens; St. 72/386, two specimens.

Remarks

It is the first report of the species below 2800 m.

Distribution

East and West Atlantic, depth 1647–2960 m.

Placotrochides Alcock, 1902

Placotrochides frustra Cairns, 1979

(Figure 2F)

Placotrochides frustra Cairns 1979: 152; Zibrowius 1980: 159, Plate 81.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 70/385, one specimen.

Remarks

This is the northernmost record of the species (53°N) and the first record below 1300 m.

Distribution

West Atlantic; Lesser Antilles, Brazil, Morocco, depth 423–1860 m.

Octocorallia

Order Alcyonacea

Family Alcyoniidae Lamouroux, 1812

Anthomastus Verrill, 1878

Anthomastus agaricus Studer, 1890

(Figure 3E)

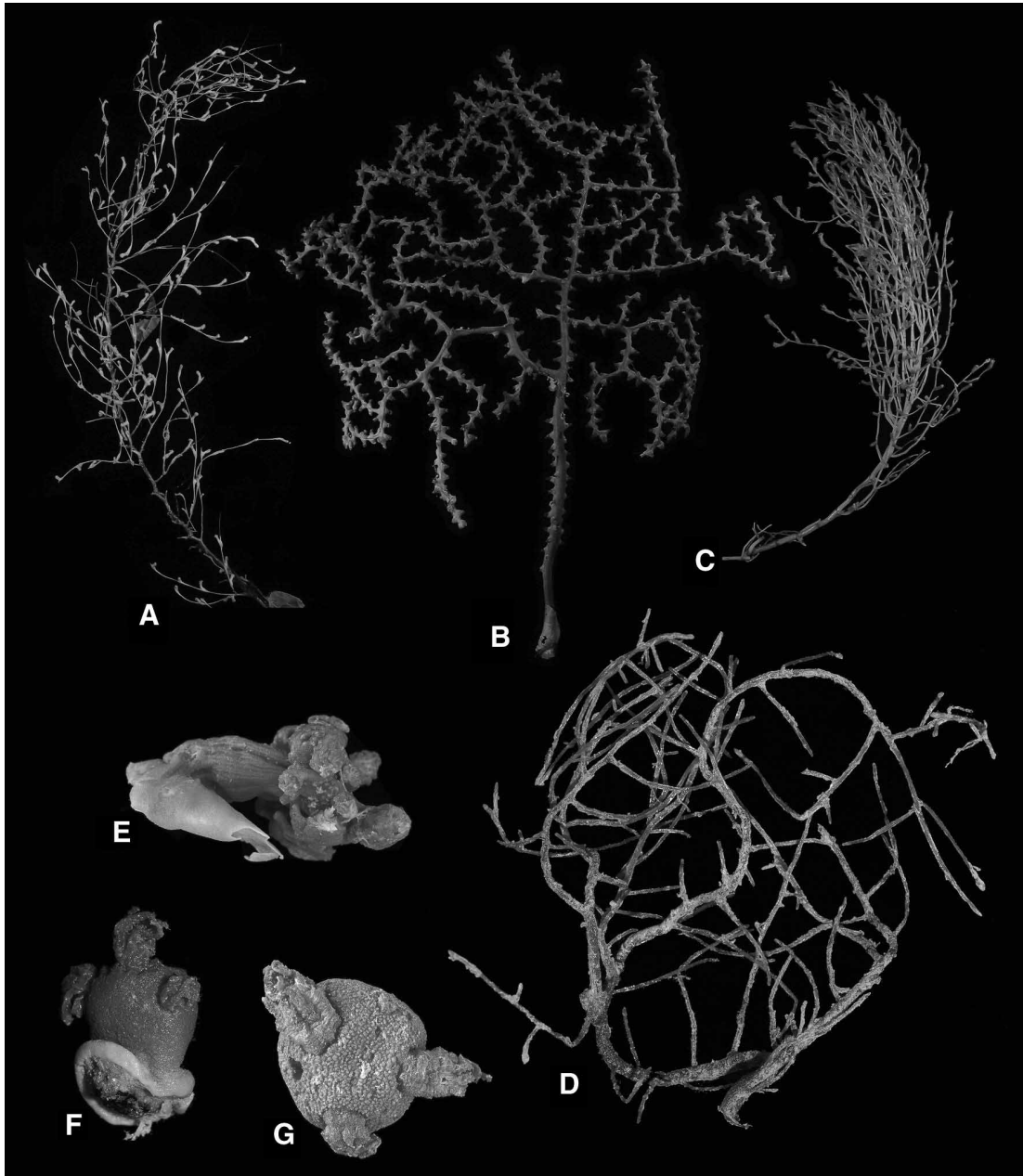


Figure 3. Alcyonaria. (A) *Chrysogorgia agassizi* ($\times 0.7$); (B) *Paramuricea biscaya* ($\times 0.4$); (C) *Acanella arbuscula* ($\times 0.5$); (D) *Dendrobrachia multispina* ($\times 0.6$); (E) *Anthomastus agaricus* ($\times 0.7$); (F) *Anthomastus* cf. *canariensis* ($\times 0.8$); (G) *Heteropolypus* cf. *insolitus* ($\times 0.8$).

Anthomastus agaricus Studer 1891: 88; 1901: 27; Kükenthal 1910: 6; Thomson 1927: 12; Tixier-Durivault & d'Hondt 1974: 1388; Keller & Pasternak 2001: 557.

[partim] *Anthomastus grandiflorus* Jungersen 1927: 5; Deichmann 1936: 52 (synonymy).

[partim] *Anthomastus agassizi* Deichmann 1936: 54 (synonymy).

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 72/386, one specimen.

Remarks

The specimen from the Reykjanes Ridge agrees with the original description in the form of the colony and of the sclerites. The specimen has a characteristic mushroom shape with long sterile stalk clearly separated from the capitulum by a deep narrow groove. The rim of the capitulum is irregular with numerous flat projections 2–4 mm long. Autozooids are 10 in number, evenly distributed over the capitulum. A re-description of this and other *Anthomastus* species encountered in the MAR-ECO material will be published elsewhere.

Distribution

Newfoundland, Azores, Reykjanes Ridge, depth 1095–2555 m.

Anthomastus cf. canariensis Wright & Studer, 1899
(Figure 3F)

Anthomastus canariensis Wright & Studer 1899: 242; Kükenthal 1910: 6; Tixier-Durivault & d'Hondt 1974: 1388; d'Hondt 1992: 631–4.
[partim] *Anthomastus grandiflorus* Jungersen 1927: 5; Deichmann 1936: 55.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 70/385, one specimen.

Remarks

Small capitate colony 15 mm high with hemispherical capitulum (15 mm in diameter) and feebly marked sterile stalk (4 mm long, 12 mm in diameter just above the capitulum). Seven autozooids (3–3.5 mm in diameter) are evenly distributed over the upper surface of the capitulum. Numerous siphonozooids (0.15–0.2 mm in diameter) scattered between autozooids. The specimen from the Reykjanes Ridge agrees well with the redescription of the type material (d'Hondt 1992) both in the form of the colony and form and distribution of sclerites.

Distribution

Canaries, Azores, Reykjanes Ridge, depth 130–2164 m.

Heteropolypus cf. insolitus Tixier-Durivault, 1964
(Figure 3G)

Heteropolypus insolitus Tixier-Durivault 1964: 49.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 50/373, one specimen.

Remarks

The specimen collected north of the Azores is a small obconic colony 14 mm high with broad flat capitulum 21 mm in diameter and with diameter of attachment 8 mm. Three large autozooids up to 11

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mm long and 8 mm in diameter and a smaller one about one-half of the former are arranged at the periphery of the capitulum. Several mesozooids (0.7–1.1 mm in diameter) are scattered among numerous siphonozooids (0.25–0.35 in diameter) at the top of the capitulum. From the form and distribution of sclerites the specimen is close to *H. insolitus* (Tixier-Durivault 1964) described from the Great Australian Bight. However, there are some minor differences in the form and distribution pattern of radiate sclerites. Comparison with the type material of *H. insolitus* Tixier-Durivault, 1964 before a definitive identification can be made.

Distribution

The Great Australian Bight, Azores, depth 1320–2598 m.

Family Plexauridae Gray, 1859

Paramuricea Kölliker, 1880

Paramuricea biscaya Grasshoff, 1977
(Figure 3B)

Paramuricea biscaya Grasshoff 1977: 18; 1981b: 945; 1985: 303.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 56/378, one specimen.

Remarks

The only colony present in the collection is branched in one plane, 25 cm high and 22 cm wide, with the length of the unbranched part of the main stalk being 11 cm. The species can easily be distinguished from the related *P. grandis* Verrill by the characteristic form of the colony and larger number of polyp neck-rings (six to nine vs. three to five).

Distribution

Bay of Biscay, Mid-Atlantic Ridge, depth 1895–4152 m.

Family Crysozorgiidae Verrill, 1883

Chrysogorgia Duchassaing & Michelotti, 1864

Chrysogorgia agassizi (Verrill, 1883)
(Figure 3A)

Dasygorgia agassizii Verrill 1883: 22.

Chrysogorgia agassizii Versluys 1902: 60; Kükenthal 1919: 530; 1924: 403; Deichmann 1936: 233;

Madsen 1944: 49; Cairns 2001: 779; Keller & Pasternak 2001: 557; Watling & Auster 2005: 284. *Chrysogorgia agassizi* Tixier-Durivault & d'Hondt 1974: 1409; Grasshoff 1981a: 222–3; 1981b: 949; 1985: 303; Pasternak 1985: 32. non *Chrysogorgia agassizi* Keller & Pasternak 2001: 562; Vinogradov 2000: 101.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 72/386, one specimen + two fragments.

Remarks

The species is widely distributed in the North Atlantic. However, the specimen reported from the shipwreck of RMS *Titanic* (south-east of Newfoundland, north-west Atlantic) (Vinogradov 2000) appears to be *C. campanula* Madsen, 1944 (TNM, original data), not *C. agassizii* as reported by Keller & Pasternak (2001).

Distribution

North Atlantic, Iceland, Reykjanes Ridge, Bay of Biscay, north-east slope of North America, depth 600–2800 m.

Family Isididae Lamouroux, 1812

Acanella Gray, 1870

Acanella arbuscula (Johnson, 1862)
(Figure 3C)

Acanella arbuscula Deichmann 1936: 243; Madsen 1944: 56; Broch 1955: 30; Tixier-Durivault & d'Hondt 1974: 1413 (synonymy); Grasshoff 1981a: 226; 1981b: 951; 1985: 303; 1986: 34; 1989: 210; Keller & Pasternak 2001: 557; Watling & Auster 2005: 284.

[partim] *Acanella arbuscula* Pasternak 1985.

[partim] *Acanella eburnea* Thomson 1927: 26.

Acanella eburnea Tixier-Durivault & d'Hondt 1974: 1414.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 50/373.

Remarks

Numerous colonies of *A. arbuscula* were observed during the ROV *Bathysaurus* Dive 3/5 (at the same site as trawl St. 50/373) (A. Gebruk, personal communication).

Distribution

NE America, Greenland, Antilles, Azores, Canaries, Mid-Atlantic Ridge, Madeira, Bay of Biscay, Portugal, Morocco, depth 500–4800 m.

Family Dendrobrachiidae Brook, 1889

Dendrobrachia Brook, 1889

Dendrobrachia multispina Opresko & Bayer, 1991
(Figure 3D)

Dendrobrachia multispina Opresko & Bayer 1991: 5, 10–2.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 46/372, one specimen.

Remarks

The only colony present in the MAR-ECO collection is a sparsely branched specimen without attachment, 9.5 cm high and 7 cm wide. The main stem is sinuous and can be hardly distinguished in the middle and upper part of the colony. The diameter of the main stem at the base is 4 mm. The colony is branched to fourth and fifth order. Average length of terminal branchlets 0.7–0.8 cm, but they can be up to 3.5 cm. Branchlets are oval in the cross-section 0.9–0.95 mm × 0.5–0.6 mm near the tip, where they generally have six longitudinal ridges (five according to Opresko & Bayer 1991). The number of longitudinal ridges increases on thicker branchlets. This species can be distinguished from other known species of *Dendrobrachia* by having more than one row of spines along each longitudinal rib on the thicker branchlets. The polyps of this specimen were badly preserved but are estimated to be about 1.2–1.5 mm high. This is the first report of the genus *Dendrobrachia* in the North Atlantic.

Distribution

Straits of Florida, Mid-Atlantic Ridge, depth 1080–3036 m.

Order Pennatulacea

Family Kophobellemnidae Gray, 1860

Kophobelemnon Abjörnsen, 1856

Kophobelemnon macrospinosum Thomson, 1927

(Figure 4B)



Figure 4. Pennatulacea. (A) *Anthoptilum murrayi* ($\times 0.6$); (B) *Kophobelemnon macrospinosum* ($\times 0.9$); (C) *Scleroptilum grandiflorum* ($\times 0.7$); (D) *Funiculina quadrangularis* ($\times 0.4$); (E) *Umbellula durissima* ($\times 0.6$); (F) *Umbellula durissima* ($\times 2.1$); (G) *Umbellula thompsoni* ($\times 0.5$); (H) *Umbellula encrinus* ($\times 0.4$); (I) *Pennatula phosphorea* ($\times 0.7$).

Kophobelemnion macrospinosum Thomson 1927: 60; Grasshoff 1981b: 953; 1985: 303; Pasternak 1989: 166; Williams 1995: 109.

Kophobelemnion biflorum Pasternak 1960: 329; 1973: 109.

Kophobelemnion (Eukophobelemnion) biflorum Pasternak 1961a: 242.

? *Kophobelemnion biflorum* Pasternak 1975b: 103.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 54/377, one specimen; St. 56/378, one specimen.

Remarks

Grasshoff (1981b) considered *K. biflorum* Pasternak to be a junior synonym of *K. macrospinosum*, however, it is hard to determine whether all specimens identified by F. Pasternak as *K. biflorum* belong in fact to one species. Additional studies are required to assess whether specimens reported from the Panama Basin and the South Sandwich Trench represent this one species.

Distribution

Bay of Biscay, Mid-Atlantic Ridge, North Pacific, (?) East Pacific, depth 1900–6000 m.

Family Anthoptilidae K lliker, 1880

Anthoptilum K lliker, 1880

Anthoptilum murrayi K lliker, 1880

(Figure 4A)

Anthoptilum murrayi K lliker 1880: 14; Jungersen 1904: 63; Deichmann 1936: 277; Tixier-Durivault & d'Hondt 1974: 1415; Grasshoff 1981b: 954; 1985: 303; Williams 1995: 120.

[partim] *Anthoptilum grandiflorum* K kenthal & Broch 1911: 233.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 56/378, two specimens.

Distribution

Nova Scotia, south off Iceland, north-east of the North America, Mid-Atlantic Ridge, Bay of Biscay, depth 1000–2500 m.

Family Funiculinidae Gray, 1870

Funiculina Lamark, 1816

Funiculina quadrangularis (Pall.)

(Figure 4D)

Funiculina quadrangularis Jungersen 1904: 49; K kenthal & Broch 1911: 243; Thomson 1927: 58; Tixier-Durivault & d'Hondt 1974: 1416 (synonymy); Grasshoff 1981a: 227; 1981b: 965; 1985: 303; 1989: 212; Williams 1995: 111; Keller & Pasternak 2001: 557.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 62/380, three specimens.

Distribution

Cosmopolitan species, depth 0–3500 m.

Family Scleroptilidae Jungersten, 1904

Scleroptilum K lliker, 1880

Scleroptilum grandiflorum K lliker, 1880

(Figure 4C)

Scleroptilum grandiflorum K lliker 1880: 30; K kenthal & Broch 1911: 268; K kenthal 1915: 43; Deichmann 1936: 266; Grasshoff 1981b: 956; 1985: 303; Williams 1995: 115.

Scleroptilum durissimum K lliker 1880: 31.

Scleroptilum gracile Verrill 1883: 8; 1885: 510; K kenthal 1915: 43.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 50/373, five specimens; St. 52/374, one specimen.

Distribution

Atlantic, Indo-Pacific, depth 820–4300 m.

Family Umbellulidae K lliker, 1880

Umbellula Cuvier, 1798

Umbellula durissima K lliker, 1880

(Figure 4E)

Umbellula durissima K lliker 1880: 16; Pasternak 1964: 191; Grasshoff 1972: 3; Pasternak 1975a: 162; Grasshoff 1981b: 957; 1985: 303.

Umbellula dura Thomson & Henderson 1906: 92.

Umbellula eloisia Nutting 1912: 43.

Ombellula durissima Williams 1995: 119.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 64/381, one specimen.

Remarks

This species seems to have a rather wide geographical distribution and is only sporadically found at abyssal depth. In the collection of the P.P. Shirshov Institute of Oceanology there is a specimen of *U. durissima* taken in the Western Atlantic in the vicinity of the *Titanic* shipwreck.

Distribution

Bay of Biscay, Mid-Atlantic Ridge, South Atlantic, Bay of Bengal, Brazil, Laccadives, west off Sumatra, south-east of Japan, depth 567–4400 m.

***Umbellula thompsoni* Kölliker, 1874**
(Figure 4G)

Umbellula thompsonii Kölliker 1874; Broch 1958: 253; Pasternak 1961b: 221.

Umbellula thompsoni Pasternak 1964: 192; 1975a: 161; 1975b: 101; Grasshoff 1972: 2; 1985: 303; 1989: 213.

Umbellula guentheri Tixier-Durivault & d'Hondt 1974: 1417.

Ombellula thompsoni Williams 1995: 119.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 54/377, eight specimens; St. 56/378, three specimens.

Distribution

Atlantic, Indo-Pacific, East Pacific, depth 1300–5900 m.

***Umbellula encrinus* (L.)**
(Figure 4H)

Umbellula encrinus Jungersten 1904: 75; Kükenthal 1915: 49; Broch 1955: 30; Pasternak 1980: 236.

Ombellula encrinus Williams 1995: 119.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 53/375, one specimen; St. 56/378, one specimen.

Remarks

Both MAR-ECO specimens were collected on the Mid-Atlantic Ridge south of the Charlie-Gibbs Fracture Zone at bathyal depths (1000–2000 m). This is one of the most southern and deepest records of the species. *U. encrinus* can be distinguished from the closely related *U. lindhali* (Kölliker, 1874) by shorter tentacles and thicker stem, however, the distinctness of these two species has been questioned (Broch 1958; Pasternak 1980). Shallow-water Arctic *U. encrinus* (100–200 m depths) can reach a considerable size, up to 2.0 m (Pasternak 1980), so the MAR-ECO specimens can be considered as rather small representatives of the species (60 and 62 cm, respectively).

Distribution

Arctic, North Atlantic, depth 100–2000 m.

Family Pennatulidae Ehrenberg, 1834

***Pennatula* Linnaeus, 1758**

***Pennatula phosphorea* Linnaeus, 1758**
(Figure 4I)

Pennatula phosphorea Roule 1896: 307; Studer 1901: 36; Thomson 1927: 57; Kükenthal 1915: 87; Tixier-Durivault & d'Hondt 1974: 1419; Grasshoff 1981b: 965; Grasshoff 1989: 214; Williams 1995: 126; Keller & Pasternak 2001: 557.

Material

RV *G.O. Sars*, MAR-ECO cruise, St. 54/377, three specimens; St. 66/383, eight specimens.

Remarks

The species *P. phosphorea* in its current interpretation is a cosmopolitan species inhabiting a wide depth range, from littoral to abyssal depths. In the colony form, and also form and distribution of the sclerites, the MAR-ECO specimens are similar to the deep-sea subspecies *P. phosphorea* var. *candida*. However, comparative study of the deep-water variety *P. phosphorea* var. *candida* and the shallow-water variety *P. phosphorea* var. *variegata* from the Bergen Museum showed that these two forms are significantly different in the form of siphonozooids and polyp leaves, and also in the sclerite arrangement. Further comparative study of *P. phosphorea* (L.) varieties is required.

Table II. Geographical distribution of anthozoans from the MAR-ECO material.

Species	Depth (m)	Regions														
		Arc	Re	IcGr	Eu	Mo	Az	Ca	Cv	Me	NWA	NEAm	SAtl	NP	IWP	EP
<i>Sicyonis ingolfi</i>	2517–3085	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Amphianthus inornata</i>	2165–2598	-	-	-	-	-	-	-	-	-	+	-	-	-	-	
<i>Amphianthus michaelisarsii</i>	1179–2977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Amphianthus</i> sp.	2974–2977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Chondrophellia coronata</i>	599–2448	-	+	+	+	-	+	-	-	-	+	+	-	-	?	
<i>Paracalliactis consors</i>	291–2960	-	-	-	-	-	-	-	-	-	-	+	-	-	-	
<i>Phelliactis michaelisarsii</i>	2603–4160	-	-	-	+	-	-	+	-	-	+	-	-	-	-	
<i>Phelliactis robusta</i>	599–2448	-	+	+	+	-	-	-	-	-	-	-	-	-	-	
<i>Schizopathes affinis</i>	1900–8900	-	-	-	-	-	-	-	-	-	-	+	+	+	+	
<i>Fungiacyathus fragilis</i>	200–2960	+	+	+	+	-	+	-	+	-	+	-	-	-	+	
<i>Caryophyllia ambrosia</i>	311–2670	-	+	+	+	+	+	-	-	+	+	+	+	-	+	
<i>Caryophyllia cornuformis</i>	37–2200	-	+	+	+	+	+	-	-	-	+	+	-	-	+	
<i>Stephanocyathus moseleyanus</i>	600–2200	+	-	+	+	+	+	+	+	+	+	-	-	-	-	
<i>Lophelia pertusa</i>	60–2170	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Flabellum alabastrum</i>	1200–2000	-	+	+	+	+	+	+	+	+	+	+	-	-	-	
<i>Flabellum angulare</i>	1647–2960	-	+	+	+	+	+	-	-	-	+	+	-	-	-	
<i>Placotrochides frustra</i>	423–1860	-	+	-	-	-	+	-	-	-	+	+	-	-	-	
<i>Anthomastus agaricus</i>	1095–2555	-	+	+	-	-	+	-	-	-	-	+	-	-	-	
<i>Anthomastus</i> cf. <i>canariensis</i>	130–2164	-	-	+	-	-	+	-	+	-	-	-	-	-	-	
<i>Heteropolypus</i> cf. <i>insolitus</i>	1320–2598	-	-	-	-	-	-	-	-	-	-	-	-	+	-	
<i>Paramuricea biscaya</i>	1895–4152	-	-	-	+	-	-	-	-	-	-	-	-	-	-	
<i>Chrysogorgia agassizi</i>	600–2800	+	+	+	+	-	-	-	-	-	-	+	-	-	-	
<i>Acanella arbuscula</i>	500–4800	+	+	+	+	+	+	+	+	-	+	+	-	-	-	
<i>Dendrobrachia multispina</i>	1080–3036	-	-	-	-	-	-	-	-	-	-	+	-	-	-	
<i>Kophobelemnion macrospinosum</i>	1900–6135	-	-	-	+	-	-	-	-	-	-	-	-	+	-	
<i>Anthoptilum murrayi</i>	1000–2500	-	+	+	+	-	+	-	-	-	-	+	+	-	-	
<i>Funiculina quadrangularis</i>	0–3500	-	-	+	+	+	+	-	-	+	+	+	+	+	+	
<i>Scleroptilum grandiflorum</i>	820–4300	-	-	-	+	-	-	-	-	-	+	+	-	+	-	
<i>Umbellula durissima</i>	580–4400	-	-	-	+	-	-	-	-	-	-	+	+	+	+	
<i>Umbellula thompsoni</i>	1300–6240	+	+	+	+	-	-	-	-	-	+	+	-	-	+	
<i>Umbellula encrinurus</i>	100–2000	+	-	+	-	-	-	-	-	-	-	-	-	-	-	
<i>Pennatulula phosphorea</i>	n/a	+	+	+	+	+	+	-	-	+	+	+	+	+	-	
Total number of species		8	15	17	20	9	15	5	5	4	16	19	7	7	11	
% of total		25.0	46.9	53.1	62.5	28.1	46.9	15.6	15.6	12.5	50.0	59.4	21.9	21.9	34.4	

Arc, Arctic; Re, Reykjanes Ridge; IcGr, Iceland and Greenland; Eu, Atlantic slope of Europe; Mo, oceanic rises of NE Atlantic (Madeira, Seine seamount group); Az, Azores; Ca, Canaries; Cv, Cape Verde Is.; Me, Mediterranean Sea; NWA, North Atlantic slope of Africa; NEAm, North-East America; SAtl, South Atlantic; NP, North Pacific; IWP, Indo-West Pacific; EP, East Pacific.

Distribution

Cosmopolitan species, from littoral to abyssal.

Discussion

So far 32 anthozoan species were identified in the MAR-ECO collection, including eight species of Actiniaria (Thenaria only), eight species of Scleractinia, one species of Antipatharia, eight species of Pennatulacea and seven species of Alcyonacea. Three species, *Schizopathes affinis* Brook (Antipatharia), *Dendrobrachia multispina* Opresko & Bayer (Alcyonacea: Dendrobrachiidae) and *Heteropolypus insolitus* Tixier-Durivault (Alcyonacea: Alcyoniidae) are reported for the first time in the North Atlantic. The only undetermined species was represented by a single young specimen of an actinarian that could not be assigned to any known genus. Most of the examined species were restricted to one station. Only 13 species were reported from more than one station and only three species (*Amphianthus michael-sarsi*, *Fungiacyathus fragilis* and *Flabellum angulare*) were reported from more than two stations.

In the MAR-ECO cruise anthozoans were obtained from the following three geographical areas: (I) Mid-Atlantic Ridge north of the Azores [super stations (the first figure before slash in the station number) 40–52, 16 species]; (II) Mid-Atlantic Ridge just south of the Charlie-Gibbs Fracture Zone (super stations 54–64, 14 species); and (III) the Reykjanes Ridge just north of the Charlie-Gibbs Fracture Zone (super stations 66–76, 11 species). Additionally, a single specimen of Pennatulacea was obtained from super station 53 located on the slope of an isolated seamount (Faraday), halfway between areas I and II.

There is very little overlap in the species composition of the three areas studied. Only one species, *Fungiacyathus fragilis* (Scleractinia), was reported from all three areas and six species were reported from two areas. Three species were common between areas I and II, two species occurred in areas II and III, and four species in areas I and III.

The geographical distribution of identified species is summarized in Table II. The anthozoan fauna of the northern Mid-Atlantic Ridge can be seen to have high affinities with the faunas of the Atlantic slope of Europe (59.4%), the Atlantic slope of North America (59.4%) and the Atlantic slope of northern Africa (50%). There is also a high percentage of species in common with the Azores (46.9%) and the Reykjanes Ridge (43.8%).

However, species from the three studied areas show different patterns. Among 16 species from the southernmost area I, only six (37.53%) were re-

ported from the Azores, the region closest to area I. However, around the Azores there are limited samples below 2000 m. Area I had a high affinity with the Atlantic slope of North America and Europe (50%), the Atlantic slope of North Africa (46.7%) and also the Reykjanes Ridge (43.8%).

The fauna in area II had more species in common with the Atlantic slope of Europe (12 species or 85.7%) and also with Iceland and Greenland (nine species or 64.3%). There was a similar affinity (50%) with the Western Atlantic, Atlantic slope of Africa and the Indo-West Pacific. The affinity of this area to the Azores is higher than for the previous area but still quite low (42.9% vs. 37.5%).

Surprisingly, the highest affinity to the fauna of the Azores (90.9%) was found in the northernmost area III. This area also has a very high affinity to Iceland and Greenland (81.8%) and the North-West Atlantic (81.8%); 63% of the species were similar to the Atlantic slope of Europe and North-West Africa.

In sum, the Mid-Atlantic Ridge anthozoan fauna has a much closer relationship to the fauna of the northern and western Atlantic. Another striking characteristic of this fauna is the high number of widely distributed and cosmopolitan species. Thirteen species (40.6% of total) in the MAR-ECO collection are reported from outside the Atlantic. The ratio of widely distributed species varies from 100% (in Antipatharia) to 14.3% (Alcyonacea). However, as noted in the remarks for several of the species, the possibility of misidentification, and the need for more detailed study of these widely distributed species, may result in lowering the percentage of these cosmopolitan species.

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