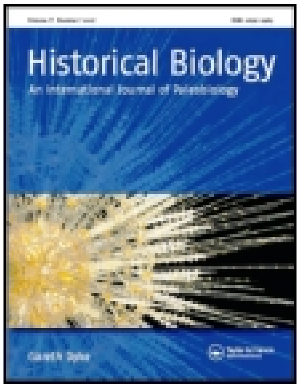


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# Bryozoa from northern Red Sea, Egypt: 1 *Crisia* (Cyclostomata)

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Seventy-five bryozoan species were picked from shallow bottom sediments (0–33 m depths) at five sites in the northern Red Sea: El Fanader, Hurghada Harbour, Makkadi Bay, Al Qweh Lagoon and El-Humrawen. *Crisia* specimens (Cyclostomata) are common and exhibit different variations. Six species were recognised among the specimens collected: *Crisia eburnea* (Linnaeus), *Crisia elongata* (Milne-Edwards), *Crisia hornesi* Reuss, *Crisia sertularoides* (Audouin), *Crisia tenuis* MacGillivray and *Crisia hurghadaensis* n. sp. The present paper deals with these *Crisia* species; other bryozoan taxa recovered will be published later. Biogeographic study reveals that three of these species are cosmopolitan, and represented by common to abundant occurrences (*C. elongata, C. eburnea* and *C. hornesi*). Two species are local endemics, and represented by only rare occurrences (*C. sertularoides* and *C. hurghadaensis* n. sp.). One species (*C. tenuis*) is Indo-Pacific, and is recorded here for the first time in equatorial waters.

**Keywords:** bryozoa; northern Red Sea; Cyclostomata; *Crisia*

## Introduction

The Red Sea (2000 km long) is a narrow semi-enclosed sea encircled by highly arid land masses. It bifurcates northward into two similarly shaped gulfs with different characteristics (Suez and Aqaba). Red Sea bryozoans have been the subject of numerous investigations since Audouin (1826), followed by others (Waters 1909; Hastings 1927; Harmer 1957; Balavoine 1959; Dumont 1981; D'Hondt 1988). Among the samples collected from the northern Red Sea, Crisiidae are common and exhibit different sizes and fine ornamentation (pseudopores), which make our treating them in one paper very appropriate.

## Material and methodology

A preliminary visual survey of the northern Red Sea coast, using snorkelling and SCUBA diving, led us to select five discrete sites along its shores. They are El Fanader, Hurghada Harbour, Makkadi Bay, Al Qweh Lagoon and El-Humrawen (Figure 1). Samples of bottom sediments were collected by the grab method at different depths (Figure 2).

| Sample locations | Latitude | Longitude |
|---|---|---|
| El Fanader | 27°/01′–27°/38′N | 33°/40′–33°/49′E |
| Hurghada Harbour | 27°/38′–27°/56′N | 33°/04′–33°/39′E |
| Makkadi Bay | 26°/59′–27°/00′N | 33°/44′–33°/54′E |
| Al Qweh | 26°/36′–26°/39′N | 34°/08′–34°/58′E |
| El-Humrawen | 26°/01′–26°/08′N | 34°/02′–34°/05′E |

### *1 El Fanader*

The region lies 10 km east of Hurghada city and consists of small islands in the sea. The surrounding water contains small reef patches, as well as a barrier arising from the seabed to a depth of about 11 m. The reef flats include some species of stony corals mixed with soft corals. The islands have been affected by the human impact of tourist activities. Samples were collected from depths of 2.5–14 m.

### *2 Hurghada harbour*

This site lies 20 km north of Hurghada city. The intertidal zone extends 50 m towards the sea, next is the reef flat 120 m wide, and finally comes the reef slope off-shore

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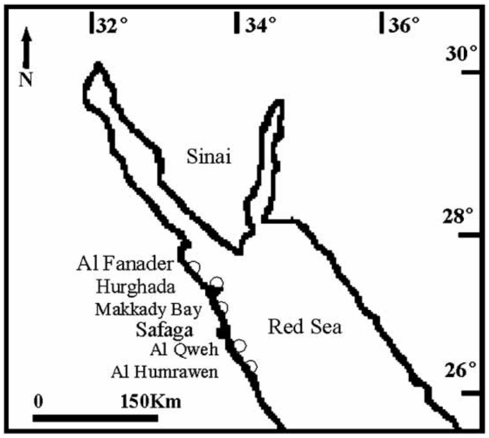


Figure 1. Location map of the bryozoan sites.

with coral growth down to 5 m depth. In general, corals and other fauna are very rare, and the biological diversity is very limited. This region can be described as the 'dustbin' of Hurghada, in view of the multiplicity of human impacts such as dumping. Samples were collected from depths of 7–33 m.

### *3 Makkadi Bay*

Makkadi Bay is one of the indentations dissecting the continuity of the Red Sea's western shoreline, and lies south of Hurghada city. The shore of the bay extends for about 12 km, 22–34 km south of the city. It has a semi-circular shape opening towards the east, and is surrounded on the west by a ridge. This ridge is made up of alluvial deposits; as a result, Makkadi Bay receives much loose clastic sediment from run-off from the adjacent land. Samples were collected from depths of 3–30 m.

### *4 Al Qweh*

Al Qweh lies along the main Safaga-El-Quseir asphalt road, about 7 km south of Safaga city. The tidal flat here is wide, extending out 2 km and composed of biogenic sand

| El-Humrawen | | Makkadi Bay | | Al Qweh | | Hurghada | | El Fanader | |
|---|---|---|---|---|---|---|---|---|---|
| Depth m | Sample No. | Depth m | Sample No. | Depth m | Sample No. | Depth m | Sample No. | Depth m | Sample No. |
| beach | W-1 | 3 m | M-1 | 1 m | Q-1 | 7 m | H-1 | 2 m | F-1 |
| 2 m | W-2 | 6 m | M-2 | 2 m | Q-2 | 8 m | H-2 | 3 m | F-2 |
| 3 m | W-3 | 7 m | M-3 | 3 m | Q-3 | 9 m | H-3 | 4 m | F-3 |
| 4 m | W-4 | 10 m | M-4 | 5 m | Q-4 | 12 m | H-4 | 5 m | F-4 |
| 6 m | W-5 | 11 m | M-5 | 7 m | Q-5 | 14m | H-5 | 6 m | F-5 |
| 13 m | W-6 | 13 m | M-6 | 9 m | Q-6 | 14 m | H-6 | 7 m | F-6 |
| 15 m | W-7 | 20 m | M-7 | 10 m | Q-7 | 16 m | H-7 | 8 m | F-7 |
| | | 23 m | M-8 | 13 m | Q-8 | 19 m | H-8 | 10 m | F-8 |
| | | 30 m | M-9 | 14 m | Q-9 | 21 m | H-9 | 14 m | F-9 |
| | | | | 16 m | Q-10 | 22 m | H-10 | | |
| | | | | | Q-11 | 28 m | H-11 | | |
| | | | | | | 32 m | H-12 | | |
| | | | | | | 33 m | H-13 | | |

Figure 2. Depths of the studied samples in the study area.

inhabited by seagrass and algae. This zone is followed by a surf zone, then by some shallow lagoons surrounded by discontinuous coral reefs and finally by a barrier reef out towards the sea. This is the cleanest site examined, the least affected by dumping, run-off or mining, unlike the other four sites. Samples were collected from beach sediments and down to a depth of 16 m.

### *5 El-Humrawen*

This site lies about 5 km north of El-Qusier city, the east margin on the open sea, the west margin along the main road. It has been affected by phosphate mining, and is a port or harbour at the mouth of Wadi El-Humrawen. Samples were collected from beach sediments and from bottom sediments at depths of 2–15 m.

## Taxonomy

The taxonomy of each crisiid species found is given. Included are a full morphologic description, micrometric measurements, distribution and habitat for each species. The illustrated types (Figure 6) are deposited in the Department of Geology, Faculty of Science, Zagazig University.

For all species treated, the abbreviations and format used are as follows: (for example)

| | | | |
|---|---|---|---|
| Lz | 125–301 | ± 22.3 | 332 µm |
| Parameter | Range | SD | Mean |

Dz, Zoarial diameter; Dp, Peristomes diameter; Do, Orifice diameter; Lz, Distance between orifices; Lgo, Gonozooid length; Igo, Gonozooid width.

Phylum: Bryozoa Ehrenberg, 1831
Class: Gymnolaemata Allman, 1856
Order: Cylostomata Busk, 1852
Suborder: Articulata Busk, 1859
Family: Crisiidae Johnston, 1847
Genus: *Crisia* Lamouroux, 1812
Type species: *Sertularia eburnea* Linnaeus, 1758

*Diagnosis*. By definition, the *Crisia* genus is very delicate, erect, articulated (jointed), branching, biserial, with three or more zooecia in sterile segments, and five or more zooecia in fertile segments. It has been documented from Eocene sediments up to the Recent (Bassler 1953).

*Red Sea materials*. The collected sediments were washed and cleaned by distilled water. The specimens studied are represented by recent fragments of white free internodes with alternating zooecia on both sides of the zoarium. Articulated internodes can seldom be recognised, being

broken into short segments, dispersed though common in the sediments. Zoaria have tiny pseudopores with different shapes, dispersion and patterns. It is worth mentioning that crisiid branch fragments have few definable characteristics, and that most segments lack a gonozooid (which is usually considered necessary for adequately defining a species); thus, the taxonomy of *Crisia* species – and indeed of most cyclostome species – is made quite difficult. Fortunately, here, the variations of zoarial pseudopores and the ratios of some measurements help greatly in clearly separating the *Crisia* species recognised.

### *Systematic list*

*Crisia eburnea* (Linnaeus, 1758), (Figure 6, 1–1a)

1758 *Sertularia eburnea* Linnaeus: 810.
1891 *C. eburnea* Harmer: 131, 154, Pl. 12, fig. 6;
1982 *C. eburnea* Winston: 155, Fig. 91.
1985 *C. eburnea*: Hayward, and Ryland: 49, Fig. 13a–c.

*Description.* Zoarium erect, flat, internodes short and composed of 5–7 zooecia, ornamented by dark common slit-like and few circular pseudopores and annual lines, pseudopores density ranges of 4.5–5.2 $mm^2$. Zooecia with a definite little salient, gently and frontally curved peristome and circular orifice. Gonozooid not observed. Non-cellular surface, gently curved, ornamented by the same pseudopores as the cellular one.

*Remarks.* The present species has a close relation with *Crisia denticulata*, but differs in having smaller size ranges and not-wedged basis rami.

*Measurements.* Dz, 184–200, 192 ± 22.3 μm; Do, 60–63, 62 ± 3.4 μm; Dp, 70–74, 72 ± 5.3 μm; Lz, 325–430, 384 ± 17.4 μm

*Occurrence.* Al Qweh Lagoon (Q-2, 4, 6, 8), Makkadi Bay (M-3, 5, 6, 9), El Fanader (F-1, 4, 7), Hurghada (H-1–8) and El-Humrawen Harbour (W-2, 6).

*Distribution.* Common in the cold waters of Europe and America and western Atlantic, Mediterranean sea and west Africa.

*Habitat.* It is always dominant at 50 m with a maximum depth of 300 m (Hayward and Ryland 1985).

*Range.* Recent.

*Crisia elongata* Milne-Edwards, 1838 (Figure 6, 2–2a)

1838 *C. elongata* Milne-Edwards: 203, Pl. 7, Fig. 2.
1975 *C. eburnea* Cuffey and Foerster: 358–366, Pl. 1.
1977 *C. elongata* Vavra: 12.
1986 *C. elongata* Cuffey and Fonda: 515–516, Fig. 170.
1988 *C. elongata* Braga and Barbin: 505, Pl. 1, Fig. 2.
1992 *C. elongata* Ziko, Hamza and El-Dera: 296, Pl. 1, Figs. 1, 2.
1995 *C. elongata* Ziko and El-Sorogy: 82, Pl. 2, Figs. 1–3.
1996 *C. elongata* Ziko: 126, Pl. 2, Figs. 1, 2.
2001 *C. elongata* El-Sorogy, Abd El-Wahab, Ziko and El-Dera: 55, Pl. 1, Fig. 3.
2002 *C. elongata* El Safori: 423, Pl. 2, Fig. 1.

*Description.* Zoarium erect, articulated, initial part tapered, with elliptical cross sections, celluliferous surface little convex, internode composed of 6–12 zooecia, ornamented by sporadic tear drops, pear-shaped pseudopores arranged in irregular manner, with density ranges of 2.3–2.5 $mm^2$. Zooecia cylindrical, only obvious near the apertures. Orifice circular, peristome slightly thin, salient, curved forward. Gonozooid inflated, pear shaped, with numerous pear and oval pseudopores and sometimes twined Gonozooids are observed.

*Measurements.* Dz, 163–170, 168 ± 25.3 μm; Do, 74–79, 76 ± 5.2 μm; Dp, 80–90, 85 ± 4.8 μm; Lz, 378–400, 388 ± 35.4 μm; Lgo, 280–310, 285 ± 22.4 μm; Igo, 164–179, 169 ± 18.3 μm.

*Occurrence.* El Fanader (F-1–7), Al Qweh Lagoon (Q-2, 6, 8), Makkadi Bay (M-3, 4, 7, 9), Hurghada (H-1, 4, 8), and El-Humrawen Hurbour (W-2, 4).

*Distribution.* Eocene of France, North America. Oligocene of Germany, France, Italy, Miocene of Egypt, France, Italy, Hungary, Poland, CSSR, Austria. Pliocene of Italy. Pleistocene of the Red Sea Coast (Ziko 1996; El-Sorogy et al. 2001).

*Habitat.* Atlantic, Mediterranean, Red Sea and Pacific, Borneo and Japan, with a profound depth range of 0–59 mm. (Vavra 1977).

*Range:* Eocene–Recent.

*Crisia hornesi* Reuss, 1847 (Figure 6, 3–3a)

1847 *C. hornesi* Reuss: 54, Pl. 7, Fig. 21.
1920 *C. hornesi* Canu and Bassler: 704, Pl. 141, Figs. 1–4.
1928 *C. hornesi* Canu and Bassler: 528, Pl. 78, Figs. 10–13.
1977 *C. hornesi* Vavra: 14.
1994 *C. hornesi* Ziko: 224.
2000 *C. hornesi* Ziko, El-Sorogy, Zalat, Eweda and Saber: 1465, Pl. 1, Fig. 1.
2002 *C. hornesi* El Safori: 426, Pl. 2, Fig. 3.

*Description.* Zoarium erect, long, flat. Internodes composed of 6–20 zooecia (with averages of 10–14 zooecia), ornamented by well arranged slit-like and few pear-shaped pseudopores arranged in lines parallel to zoarial outline,

with density ranges of 3.8–4.4 mm$^2$. Zooecia slightly distinct, orifice circular; peristome thin and rounded gently curved forward. Non-celluliferous surface, smooth, gently curved, ornamented with the same pseudopores as the celluliferous one. Gonozooid spindle shape with numerous oval pseudopores. Oecistome, short subcircular and open in the back side.

*Measurements.* Dz, 290–360, 332 ± 23.2 μm; Do, 80–85, 84 ± 4.1 μm; Dp, 95–100, 96 ± 5.2 μm; Lz, 360–410, 386 ± 28.4 μm; Lgo, 455–470, 468 ± 13.7 μm; Igo, 364–379, 370 ± 9.6 μm.

*Occurrence.* El Fanader (F-1, 5, 8), Al Qweh Lagoon (Q-2, 3, 6, 8), Makkadi Bay (M-3, 6, 6), Hurghada (H-1, 6) and El-Humrawen Harbour (W-2, 5).

*Distribution.* In Egypt, Middle Miocene north-western Desert and the western side of the Gulf of Suez. Eocene of France, Italy and North America. Oligocene of Germany, France, Italy and USA. Miocene of CSSR, Greece, Italy, Poland, Romania, Hungary, Portugal and Egypt. Pliocene–Pleistocene of Italy. Quaternary of Italy (Ziko 1973; Vavra 1977; El-Dera 1996; El-Sorogy et al. 2001).

*Habitat*. Red Sea, Philippine region at depths from 57–162 fathoms (100–300 mm), temperature: 11.2°C (Canu and Bassler 1928; Ziko et al. 2000; El-Sorogy et al. 2001).

*Range:* Eocene–Recent

*Crisia sertularoides* Audouin, 1826 (Figure 6, 4–4a)

1826 *Proboscina sertularoides* Audouin: 60, Pl. 6, Fig. 6.

*Description.* Zoarium erect, flat. Lengthy internodes composed of 6–10 zooecia, mostly branched, and ornamented by sporadic, pear-shaped and few tear drop-like pseudopores, with density ranges of 1.5–1.8 mm$^2$. Zooecia indistinct tubes, hardly distinguishable, merged almost to their tips, these are turned forwards, with frontally facing orifices and long peristomes. Gonozooid is much enlarged zooecia, attached for its full length, with a flattened distal end, ornamented by numerous oval and circular pseudopores and annular striations. Ooeciostome with elliptical opening. Gonozooid situated at the junction of two branches.

*Measurements.* Dz, 181–194, 190 ± 20.4 μm; Do, 74–77, 75 ± 2.6 μm; Dp, 75–82, 80 ± 3.1 μm; Lz, 355–387, 375 ± 43.8 μm; Lgo, 390–440, 419 ± 27.3 μm; Igo, 254–289, 274 ± 19.4 μm.

*Occurrence.* El Fanader (F-1–4), Al Qweh Lagoon (Q-2, 6), Makkadi Bay (M-2, 3, 8, 10), Hurghada (H-1, 3) and El-Humrawen Harbour (W-2, 6).

*Habitat:* Red Sea.

*Range:* Recent.

*Crisia tenuis* MacGillivray, 1879 (Figure 6, 5–5a)

1879 *C. tenuis* MacGillivray: 182, Pl. 39, Figs. 5, 6.

*Description.* Zoarium erect, small, internodes, usually composed of 6–9 zooecia, ornamented by sporadic, pear-shaped and few tear drop-like pseudopores, with density ranges of 2.3–2.5 mm$^2$. Zooecia with well definite, long peristome, gently turned to the frontal side, and circular orifice. Gonozooid is large globular, with numerous oriented pseudopores; oecipore large, elliptical, raised with thin, with little raised oecistome, oblique to the pseudopore orientation. Non-cellular surface smooth, gently curved, ornamented by the same pseudopores as the cellular one.

*Measurements.* Dz, 211–226, 220 ± 30.4 μm; Do, 58–71, 68 ± 4.7 μm; Dp, 64–85, 72 ± 7.8 μm; Lz, 390–445, 415 ± 11.8 μm; Lgo, 283–310, 300 ± 32.5 μm; Igo, 234–269, 242 ± 27.4 μm.

*Remarks.* The studied species is recognised from Australian Miocene and Recent sediments (MacGillivray 1879). This is the first time to be recognised in equatorial seas.

*Occurrence.* El Fanader (F-1, 5, 7, 8), Al Qweh Lagoon (Q-2, 5, 7), Makkadi Bay (M-3, 6), Hurghada (H-1, 6) and El-Humrawen Harbour (W-2, 6).

*Distribution:* Australia (Miocene and Recent).

*Crisia hurghadaensis* n. sp. (Figure 6, 6–8a)

Holotype: Figure 6, 8–8a.
Paratypes: Figures 6, 7–8a.
*Type locality*: Hurghada, Red Sea, Egypt.

*Diagnosis: Crisia* species with pear-shaped Gonozooid that rest upon three successive growing bundles at its basal part.

*Description.* Zoarium free, erect, flattened stems, internodes usually consist of 9–12 zooecia, ornamented by many tiny pear-shaped pseudopores that arranged in an alternating manner with respect to faint annual striations, with density ranges of 8.2–12.4 mm$^2$. Zooecia is slightly distinct, orifice circular, slightly elevated to perpendicular to zoarial surface. Peristome rounded, salient, slightly curved to the frontal side. Dorsal convex, finely reticulated. Gonozooid is pear shaped inflated distally, with narrow base started with three successive growing bundles, oecipore oval, transverse, with raised oecistome.

| Species | *Crisia eburnea* | *Crisia elongata* | *Crisia hornesi* | *Crisia sertularoides* | *Crisia tenuis* | *Crisia hurghadaensis* |
|---|---|---|---|---|---|---|
| Zoarial width | 325-430 µm | 163-170 µm | 290-360 µm | 181-194 µm | 211-226 µm | 280-300 µm |
| Zooecial length | 334-384 µm | 378-400µm | 360-410 µm | 355-387 µm | 366-402 µm | 366-420 µm |
| Orifice Diameter | 60-63 µm | 74-79 µm | 80-85 µm | 74-77 µm | 58-71 µm | 80-90 µm |
| | | | | | | |
| Zooecia per internode | 5-7 zooecia | 6-12 zooecia | 9-20 zooecia | 6-12 zooecia | 6-9 zooecia | 9-12 zooecia |
| Peristome | Little salient, gently curved forward | salient, curved forward | Short, gently curved forward | Little salient, gently curved forward | salient, gently curved forward | Little salient, gently curved forward |
| Pseudopores | common slit-like, few circular | Sporadic tear drops, pear shaped | slit like, well arranged few pear shaped | sporadic tear drops | Sporadic, pear shaped, few tear drops | Pear shaped, numerous |
| Gonozooid | Not observed | Inflated pear-shaped, with numerous pear and oval pseudopores | Spindle-shaped, with numerous oval pseudopores Oecistome, short subcircular and open in the back side. | Pear-shaped, with numerous oval and circular pseudopores anular striations, and circular oecipore | Globular shaped, with numerous oval pseudopores and elliptical transverse oecipore | Pear-shaped with bundeled base, and numerous pear and circular pseudopores basal sucessive nodes, and oval transverse oecipore |
| Range | Recent | Eocene-Recent | Eocene-Recent | Recent | Miocene-Recent | Recent |

Figure 3. Comparative diagram showing the main characteristic differences between the studied *Crisia* species.

*Measurements.* Dz, 280–310, 295 ± 15.7 µm; Do, 76–84, 80 ± 3.1 µm; Dp, 82–95, 90 ± 3.4 µm; Lz, 366–420, 370 ± 34.6 µm; Lgo, 440–460, 450 ± 32.4 µm; Igo, 315–330, 320 ± 26.8 µm.

*Affinity:* The present species is characterised by medium measurements as the rest of *Crisia* species. The zooacial tubes not salient as much as *C. elongata* and *C. sertularoides*. Pseudopores are common with pear shapes. Its characteristic bundled gonozooid is not recognised before.

*Occurrence.* El Fanader (F-1, 6, 8, 9), Al Qweh Lagoon (Q-2, 4, 6, 8), Makkadi Bay (M-3, 6, 9), Hurghada (H-2, 5, 6) and El-Humrawen Harbour (W-2, 7).

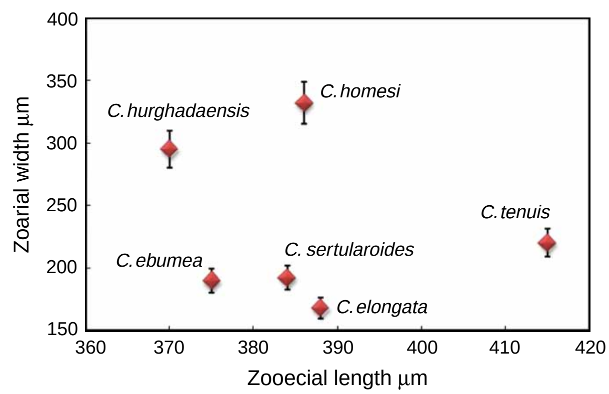


Figure 4. Comparative diagram showing the distribution of studied species according to their measurements of zooecial length and zoarial width.

## Comparative morphology

The *Crisia* species studied herein can be differentiated according to their measurements and the nature of their pseudopores.

Pseudopores are tiny pores occurring all over the zoarial skeletal surface and the gonozoids. They take different shapes: oval, pear shaped, tear drop or slit like. Also, they vary from numerous, common, few to sporadic,

| Species | Study area | | | | | Biogeography | | | | | | | Stratigraphic range | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | El-Humrawen | Al Qweh | Makkadi Bay | Hurghada | El Fanader | Adriatic | Arctic | Indian | Pacific | Atlantic | Red Sea | Mediterranean | Recent | Pleistocene | Pliocene | Miocene | Oligocene | Eocene |
| ***Crisia eburnea*** | 3 | 2 | 3 | 1 | 2 | | X | | | X | | X | X | | | | | |
| ***Crisia elongata*** | 3 | 2 | 2 | 1 | 1 | | | X | X | X | X | X | X | X | X | X | X | X |
| ***Crisia hornesi*** | 3 | 2 | 2 | 1 | 1 | | | | X | X | X | X | X | X | X | X | X | X |
| ***Crisia sertularoides*** | 1 | 3 | 3 | 2 | 2 | | | | | | X | | X | | | | | |
| ***Crisia tenuis*** | 3 | 3 | 3 | 2 | 1 | | | | X | | | | X | | | X | | |
| ***C. hurghardaensis*** | 2 | 3 | 2 | 1 | 2 | | | | | | X | | X | | | | | |

Figure 5. Location and paleobiogeography of the studied bryozaons (occurrences and stratigraphic ranges; R < 3 species; C = 3–10; A > 10 species).

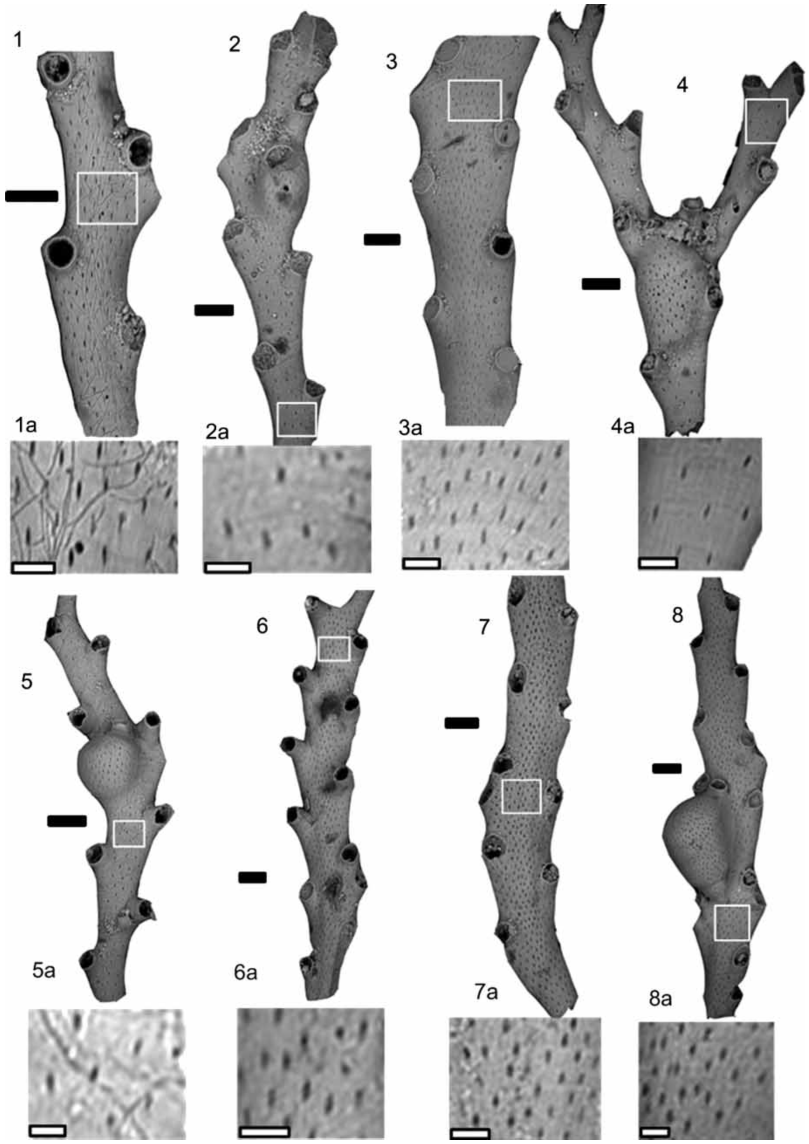


Figure 6. 1, *C. eburnea* (Linnaeus, 1816), El Fanader (F-4); 1a, Common slit-like pseudopores. El Fanader (F-4); 2, *C. elongata* Milne-Edwards 1838, El-Humrawen Harbour (M-9); 2a, Sporadic tear drops and pear-shaped pseudopores, El-Humrawen Harbour (M-9); 3, *C. hornesi* Reuss, 1847, Al Qweh Lagoon (Q-2); 3a, Common slit-like, well-arranged pseudopores, Al Qweh Lagoon (Q-2); 4, *C. sertularoides* Audouin, El-Humrawen (M-2); 4a, sporadic tear drops pseudopores, El-Humrawen (M-2); 5, *C. tenuis* MacGillivray, 1879, El Fanader (F-8); 5a, Sporadic, pear-shaped and few tear drops pseudopores, El Fanader (F-8); 6, *C. hurghadaensis* n. sp (Paratype), Hurghada (H-6); 6a, Pear-shaped, numerous pseudospores, Hurghada (H-6); 7, *C. hurghadaensis* n. sp (Paratype) Hurghada (H-6); 7a, Pear-shaped, numerous pseudospores, Hurghada (H-6); 8, *C. hurghadaensis* n. sp., (Holotype) Hurghada (H-6); 8a, Pear-shaped, numerous pseudospores, Hurghada (H-6); Scale Bar = 150 μ for the zoaria and 50 μ for the pseudopores.

and may be irregularly or well arranged. Each species was found to have distinctive appearing pseudopores, as can be seen in the comparative figure (Figure 3).

Besides the information for the sterile internodes, the fertile internodes carry gonozooids, which can often be differentiated among the species studied. They have different shapes: inflated pear shaped (sometimes twinned; *C. elongata*); pear shaped (*C. sertularoides*); large spindle shaped (*C. hornesi*); pear shaped with bundled base (*C. hurghadaensis*) and globular shaped (*C. tenuis*). Also, the gonozooids are characterised by particular pseudopore shapes and arrangements (Figure 3).

The relationship between the average zooecial lengths and zoarial widths was found to be variable, and can also be used to discriminate among the *Crisia* species studied (Figure 4).

## Red Sea occurrences

The *Crisia* zoaria were collected from modern bottom (and beach) sediments, in which they are mostly represented by skeletal internode fragments similar to fossilised fragments. Their occurrences, distributions and habitats have been affected by their taphonomic history, which may have involved breaking, rolling, washing out and re-deposition. The crisiids generally dominate the samples studied, especially the first 10 m of depth, at most of the different localities (Figure 5), except to the north at Hurghada and El Fanader sites (where both crisiids and other fauna are rare as a result of human impacts).

## Biogeography

The present study sheds light on the biogeography of the Recent *Crisia* species found in the Red Sea (Figure 6). Among the species studied, three are cosmopolitan, and represented here by common to abundant occurrences (*C. elongata, C. eburnea* and *C. hornesi*). Two are local and endemic, and represented by only rare occurrences (*C. sertularoides* and *C. hurghadaensis* n. sp.). One species is Indo-Pacific (*C. tenuis*). Only one species has been recorded before from the Red Sea (*C. sertularoides*; Figure 5). The common and abundant occurrences of the Red Sea cosmopolitan species would seem to be a direct result of between-continent ship navigation passing through the Red Sea over the years.

## Geologic history

Many of the species studied, the cosmopolitan and Indo-Pacific species, have fossil records as early as the Eocene and Miocene (*C. elongata, C. hornesi,* and *C. tenuis*). The new species (*C. hurghadaensis* n. sp.) and *C. sertularoides*, both endemics, have not yet been recorded before the Recent. This might be a good indication for their geologically recent evolution, as well as for not being fouling in ecology. On the other hand, the Recent species *C. eburnea* show fouler nature as widely distributed from Arctic to west Africa.

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