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Fouling Bryozoa from some Alexandria harbours, EGYPT. (I) Erect species

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Abstract

The fouling erect Bryozoa settled on polystyrene test panels immersed half a meter deep in the water of Abu Qir Harbour, the Eastern Harbour and El-Dekheila Harbour were studied. The present study yields 5 species of erect bryozoa. These are Amathia pruvoti, Zoobotryon verticillatum, Bowerbankia gracilis, Bugula neritina and Bugula stolonifera. The first three ones pertain to 3 genera of the family Vesiculariidae belonging to suborder the Stolonifera; while the other two species affiliate to the genus Bugula belonging to the family Bugulidae of suborder Anasca. The present record of Amathia pruvoti is the first from the Egyptian Mediterranean waters. A re-description, supplied with full structural illustrations of the recorded species is given. Moreover, the temporal and spatial distributions of the species recorded are encountered.

Keywords: Bryozoa; Systematics; Erect species; Marine fouling; Harbours.

Introduction

Bryozoans are benthic colonial invertebrates in marine hard-bottom environments and some of them occur in the fouling communities (LEWIS *et al.,* 2004; CARLTON, 1985; GOLLASCH, 2002). Several studies have been conducted on the bryozoan species collected from the Levantine Sea including the coasts of Israel (POWELL, 1969; HONDT, 1988), Lebanon (BITAR & BITAR, 2001), Turkey (ÜNSAL & HONDT, 1979) and Cyprus (KOÇAK *et al.,* 2002). NOVOSEL & POŽAR-DOMAC (2001) gave a checklist of the Bryozoa of the Eastern Adriatic Sea; meanwhile, HAYWARD & MCKINNEY (2002) studied the northern Adriatic Bryozoa from the vicinity of Rovenj, Croatia. Bryozoan fauna are included in the studies of biodiversity of marine sessile epifauna in the eastern Mediterranean (MORRI *et al.,* 1999 and ANTONIADOU & CHINTIROGLOU, 2005) and studies of invasive alien species at the Mediterranean Sea (ZENETOS, 2005; STREFTARIS & ZENETOS, 2006). Bryozoan assemblages developed on panels submerged at five marinas located along

the Turkish Aegean coast, were estimated by KOÇAK (2007). ZABALA & MALUQUER (1988) provided classification keys on Mediterranean Bryozoa.

As opposed to diversity studies on Bryozoa in Egypt, it is worth mentioning that taxonomic studies on Bryozoa in Alexandria waters have received little attention. AUDOUIN (1826) named 67 species of Bryozoa collected by SAVIGNY in Egypt. Ten of them were described from the Mediterranean and 17 from the Red Sea, whereas no localities were given for the remaining 40 species (DUMONT, 1981). O'DONOGHUE & DE WATTEVILLE (1939) gave the distributional pattern of 62 species of Bryozoa in the fishery grounds near Alexandria, two of which (*Vibracellina mediterraneae* & *Schizomavella alexandriae*) were new to science. Recent studies dealing with the ecology of fouling organisms in Alexandria waters (BANOUB, 1960; MEGALLY, 1970; GHOBASHY, 1976; RAMADAN, 1986; EL-KOMI, 1991, 1992, 1998a, b; RAMADAN *et al.,* 2006a, b) provide check-lists that include Bryozoa. HONDT (2006) gives a new explanation of the plates of 'Polyps-Bryozoa' in the book describing Egypt presented by AUDOUIN (1826).

The present work deals with the redescription and temporal & spatial distributions of the erect fouling bryozoans recorded from three harbours in Alexandria (Egypt), namely Abu Qir Harbour, the Eastern Harbour and El-Dekheila Harbour.

Materials and Methods

Using roughened white polystyrene test panels (12.5x12.5 cm), the fouling samples were collected from three harbours along Alexandria city, namely, from East to West, Abu Qir Harbour (A.H.), the Eastern Harbour (E.H.) and El-Dekheila Harbour (D.H.) (Fig.1).

Abu Qir Harbour:

This is a military harbour situated nearly at the head of the Abu Qir bay between the dead and open seas. The bay is a shallow semi-circular basin, east of Alexandria city. It has an area of 500 Km_2 with an average depth of 12 m, maximum depth of 16 m and a shoreline of 50 Km long (NESSIM & EL-DEEK, 1993). The water of Abu Qir bay is affected by three continental discharges. These are the Boughaz El-Maadia opening, the El-Tabia pumping station and the opening of the Rashid Nile branch. These discharges are mainly drainage and freshwater.

The Eastern Harbour of Alexandria:

This is a relatively shallow semi-circular bay surrounded by the city except on its northern side, where it communicates with the sea through two outlets. The average water depth of the bay is about 6.0 m and it receives many kinds of vessels, especially fishing boats (AL SAYES & SHAKWEER, 1997). LABIB (2002) mentioned that due to water circulation the harbour is subjected to an amount of municipal wastewater from the main sewer of Alexandria (Kayet Bey), located in its western vicinity.

El-Dekheila Harbour:

This is a commercial harbour. El-Dekheila Harbour is a semi-enclosed basin constructed recently, after 1986, on the western side of El-Mex bay (FAHMY *et al.,* 1997). According to ABDALLA *et al.* (1995) and FAHMY *et al.* (1997), the harbour's water is subjected to several sources

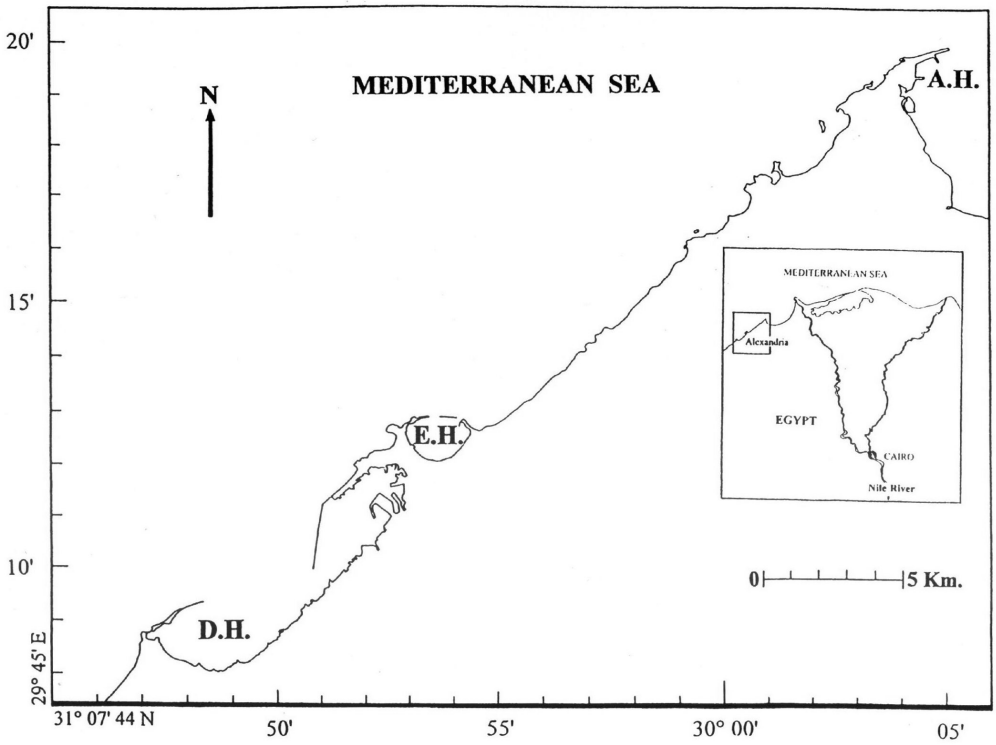

Fig. 1: The area investigated: positions of the three sampled harbours along the Alexandria coast.

of wastewater. A huge volume of brackish water is discharged into El-Mex bay through the El-Umoum drain. On its western side, near the harbour, this bay also receives industrial wastes from several sources. The degree of water contamination of the harbour water from the above mentioned sources depends on water circulation in the bay. El-Dekheila Harbour, like other harbours, is affected by shipping activities. Its water depth ranges between 6 and 19 m with an average of 12.4 m. The exposed panels were dangled at the container pier.

Sampling of the fouling biota was carried out at Abu Qir Harbour during November 1998 through October 1999 while at the Eastern Harbour of Alexandria and at El-Dekheila Harbour from October 1998 through to September 1999.

The exposed panels, 36 at each harbour, depending on their immersion time, are divided into two series:

- Short-term panels: immersed for one month. Replaced every month.
- Long-term panels: Sets of panels representing immersion periods of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 months, respectively

Using a binocular zoom stereo-microscope (20X), the fouling community was investigated to identify the fouler and associated organisms. Samples of erect Bryozoa were recorded and isolated for identification. Illustrative drawings of the recorded bryozoan species were carried out by means of a zoom stereoscopic microscope provided with its special cam-

era lucida drawing tube; as well as this the full structural re-description of different species was provided. The taxonomic order is based on that adopted by HONDT (1983, 1997 and 2001). All materials are deposited in the laboratory of Taxonomy and Aquatic Biodiversity, National Institute of Oceanography & Fisheries, Alexandria, Egypt.

Results

The Present study yields 5 species of erect bryozoa, affiliating to 4 genera of two families and two suborders of the orders Ctenostomata and Cheilostomata, belonging to the class Gymnolaemata, as follows:

Phylum: BRYOZOA
Class: GYMNOLAEMATA
Order: CTENOSTOMATA
Suborder: STOLONIFERA

Family: VESICULARIIDAE

Colony erect, tufted, or creeping. Autozooids budded singly or in groups from a kenozooidal stolon, radially symmetrical. Embryos brooded within the tentacle sheath. In the present study, this family was represented by three genera. These include *Amathia* Lamouroux, 1812; *Zoobotryon* Ehrenberg, 1831 and *Bowerbankia* Farre, 1837.

Amathia pruvoti Calvet, 1911

Amathia pruvoti PRENANT & BOBIN, 1956, p. 287; HAYWARD, 1985, p. 136; CHIMONIDES, 1987, p. 336; ZABALA & MALUQUER, 1988, p. 73, figs. 50, 53, 54.

Colony form: Erect, branching form.

Size: Branches attain about 3-4 cm long.

Description: (Fig. 2)

Colony transparent, of a pale brownish colouration, rampant over the substratum,

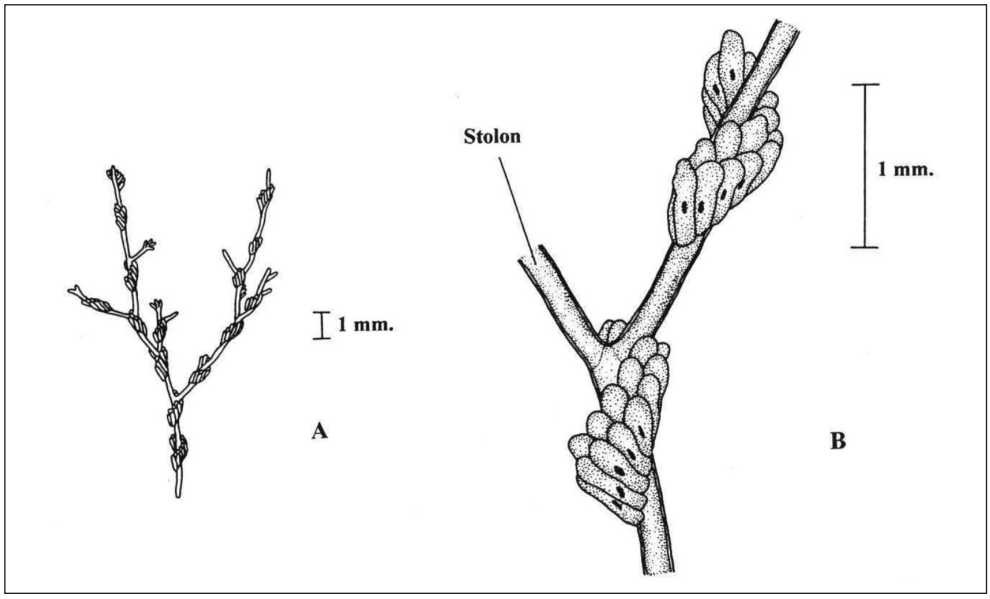

Fig. 2: *Amathia pruvoti.* A. Part of colony. B. Enlarged part of colony showing the arrangement of zooids per group.

with many free branches. Stolon axis about 0.18 mm in diameter with paired clusters of zooids arranged spirally around the axis without completing a whorl. There are 1-3 groups of more or less tubular zooids per branch. Markedly, a group of zooids just precedes the bifurcation and sometimes other group of zooids, on the internode. There are from 8-11 pairs of zooids per group. Zooids are usually 0.36-0.54 mm long and 0.13-0.16 mm wide.

Remarks: CHIMONIDES (1987) and ZABALA & MALUQUER (1988) provided a detailed analysis of colony morphology in this and several other species of *Amathia,* stressing the significance of growth pattern for discriminating between them.

General distribution and habitat: This species was recorded in Turkey (ÜNSAL & HONDT, 1979) and on Milos Island, Greece (MORRI *et al.,* 1999). HAYWARD & MCKINNEY (2002) indicated that *Amathia pruvoti* is widespread and common in shallow coastal waters throughout the Mediterranean, as well as on the southwest coasts of the British Isles.

Local distribution and association: The present record of the species is the first from the Egyptian Mediterranean waters. It was restricted to the Eastern Harbour of Alexandria during March 1999, attached to the iron frame.

***Zoobotryon verticillatum* (Delle Chiaje, 1822)**

Hydra verticillata Delle Chiaje, 1822

Zoobotryon pellucidum GORDON, 1967; MORTON & MILLER, 1968.

Zoobotryon pellucidus EHRENBERG, 1831; O'DONOGHUE & DE WATTEVILLE, 1939.

Zoobotryon verticillatum PRENANT & BOBIN, 1956, p.288; RYLAND, 1965, fig.38; ZABALA & MALUQUER, 1988, P.74, fig.55.

Colony form: Freely branched tuft.

Size: Up to 25 cm long.

Description: (Fig. 3)

Colony forming long tufts of 0.25 m, repeatedly and densely branched; translucent. The length of the internodes varied and decreased towards the extremities of the colony. Branching dichotomous to verticillate, with as many as 4 branches arising from a node. Stolons about 0.1- 0.2 mm in diameter at the extremities of the colony, much wider in the main axis and principal branches of the colony. Zooecia ovoid or sub-cylindrical measuring about 0.5-1.0 mm long and 0.2 mm in diameter, arranged in helix pattern at the branch ends, clearly in two rows on the internodes. Each zooecium has 8 tentacles. Stomach gizzard present.

Remarks: This species was not recorded on the coasts of Israel, Lebanon, Turkey and Cyprus (HONDT, 1988; BITAR & BITAR, 2001; ÜNSAL & HONDT, 1979; KOÇAK *et al.,* 2002).

Colony measurements of the present material differ from those given by previous authors. RYLAND (1965) reported that this species forms long tufts of 0.5 m or more in size. GORDON & MAWATARI (1992) mentioned that this species is up to 1 m long. This difference may be attributed to incomplete growth of the procured specimens.

General distribution and habitat: Especially characteristic of ports and harbours; growing in festoons on any submerged object. It sometimes causes great nuisance by clogging the intake pipes of ships (RYLAND, 1965).

It is a subtropical species occurring in warm to temperate seas: Mediterranean, West Africa, Caribbean, Brazil, California,

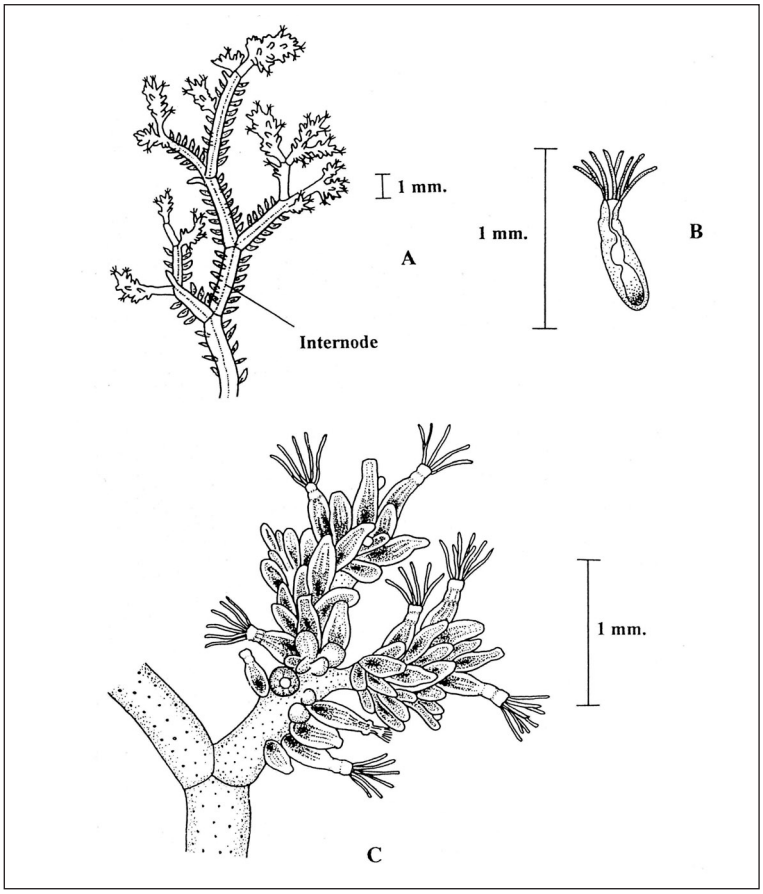

Fig. 3: *Zoobotryon verticillatum.* A. Part of colony. B. Zooecium. C. Enlarged part of colony.

Hawaii, Japan, India, New Caledonia, Australia (PRENANT & BOBIN, 1956; BROCK, 1982; WINSTON, 1982; MAWATARI & MAWATARI, 1986), and New Zealand (GORDON & MAWATARI, 1992).

Local distribution and association: This species was previously recorded in Alexandria (O'DONOGHUE & DE WATTEVILLE, 1939; MEGALLY, 1970; EL-KOMI, 1992 and 1998b) and in the Suez Canal (RAMADAN, 1986).

During the present survey, this species disappeared from the short-term panels at the three harbours. On the long-term panels, it appeared only on panels immersed for 12 months at the Eastern Harbour of Alexandria, where the fouling community is mainly composed of a large number of long calcareous tubes of the polychaete (*Hydroides elegans*) covering almost the whole panel area, some moderate sized barnacles, and a very large number of associated amphipods and isopods. Colonies of *Zoobotryon verticillatum* partly overgrow other sessile organisms. It has been demonstrated by VAIL & WASS (1981) for Port Hacking (Australia) that

the appearance of *Zoobotryon verticillatum* is seasonal and sudden in the latter part of the year, growing rapidly to cover most other sessile organisms and then disappearing as rapidly as it appeared.

***Bowerbankia gracilis* Leidy, 1855**

Bowerbankia gracilis PRENANT & BOBIN, 1956, p.303; RYLAND, 1965, fig. 36a and b; ZABALA & MALUQUER, 1988, P.74, fig. 57; GORDON & MAWATARI, 1992, P.13, fig. 2, D.

Bowerbankia caudata HINCKS, 1880.

Colony form: Creeping, ramifying, uncalcified.

Size: Several centimetres long.

Description: (Fig. 4)

Stolon slender, irregularly branching. Zooids borne in clusters of different ages and sizes at irregular intervals along the thread-like stolons. Stolons typically narrower than the zooids being 0.05 mm in diameter. Zooids more or less transparent, 0.2-0.9 mm long when extended and 0.06-0.15 mm wide. Polypide with 8 tentacles.

Remarks: HONDT (1983) and ZABALA & MALUQUER (1988) provided a detailed analysis of colony morphology in this and other species of *Bowerbankia,* stressing the significance of diameter of stolon, shape of the lophophore and the number of tentacles, for discriminating between them. HONDT & GUSSO (2006) indicated that the ctenostomatan *Bowerbankia gracilis* is considered as a complex of various species and until recently 3 species were known in the Mediterranean Sea. However, a fourth species, namely *Bowerbankia gracillima,* which is an alien, recorded for the first time from the Italian coast, has been recently added to the list of Mediterranean Bryozoa (HONDT & GUSSO, 2006).

General distribution and habitat: This species may be found on any submerged substratum, in brackish as well as marine waters (RYLAND, 1965).

B. gracilis has a wide distribution from the Arctic through Western Europe into the Mediterranean Adriatic and Black seas (RYLAND, 1965). Also widely distributed around the world-Europe, Britain, Greenland, eastern United States, Washington State to Mexico, South

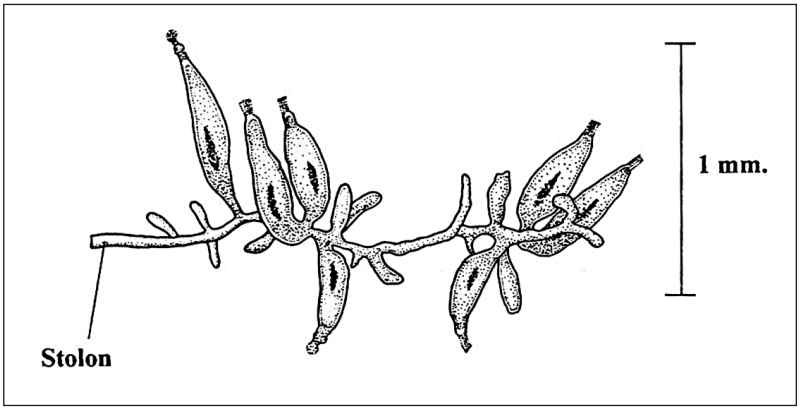

Fig. 4: *Bowerbankia gracilis.* Group of zooecia.

Africa, India, Japan, South Australia (BOBIN & PRENANT, 1954; PRENANT & BOBIN, 1956; BROCK, 1982; WINSTON, 1982; HAYWARD, 1985) and New Zealand waters (GORDON & MAWATARI, 1992).

Local distribution and association: This species was previously recorded at the Eastern Harbour of Alexandria (EL-KOMI, 1992, 1998a) and at Abu Qir harbour (EL-KOMI, 1998b).

In the present survey, *Bowerbankia gracilis* was dominant on short-term panels at Abu Qir Harbour during November 1998, covering 63% of the panel area, but weakly represented at El-Dekheila Harbour during September 1999, covering only 2% of the panel area. The fouling community at Abu Qir Harbour mainly consisted of the hydroid *Obelia geniculata* and a large number of very small individuals of the polychaete *Hydroides elegans* and the barnacle *Balanus amphitrite.* In contrast, at El-Dekheila Harbour the community is mainly composed of a relatively small number of small-sized *H. elegans , B. amphitrite* and the encrusting bryozoan *Conopeum reticulum,* covering about 4% of the panel area.

It is noteworthy that *B. gracilis* was more frequent on the long-term panels.

At Abu Qir Harbour, it appeared on panels immersed for 11 and 12 months covering respectively about 13% and 16% of the panel area. The eleven and twelve months fouling communities are mainly composed of abundant specimens of the polychaetes *Hydroides elegans* and *Spirorbis* sp., some moderate sized barnacles, and some encrusting bryozoans which covered collectively about 40% of the eleven month panel and 46% of the twelve month panel.

At the Eastern Harbour of Alexandria, it appeared only on panels immersed for 11 months, covering about 3% of the panel area where the fouling community mainly consisted of large number of long calcareous tubes of the polychaete *Hydroides elegans,* large numbers of moderate sized barnacles, and a very large number of associated amphipods and isopods.

At El-Dekheila Harbour, this species was observed on panels immersed for 8-12 months, but appearing more frequently on panels immersed for 10 and 11 month durations, covering respectively about 72.5% and 92.5% of the panel area. The ten and eleven month fouling communities were mainly composed of large numbers of moderate sized barnacles, some polychaete tubes (*Hydroides elegans*), large numbers of associated amphipods and isopods, and the encrusting bryozoan *Conopeum reticulum* which covered about 85% and 77.5% of the panel area during the ten and eleven month durations, respectively.

Order: CHEILOSTOMATA

Suborder: ANASCA

Family: BUGULIDAE

Colony erect and branched, unjoined, unilaminar, attached by rhizoids. Autozooids long, parallel-sided, with almost the entire frontal surface membranous; lateral walls lightly calcified; marginal spines usually present. Pedunculate 'bird's head' avicularia characteristically present. Ovicells independent and hyperstomial, the ectooecium membranous. This family is represented by Genus Bugula OKEN, 1815.

***Bugula neritina* (Linnaeus, 1758)**

Bugula neritina RYLAND, 1965, fig.23a and b; PRENANT & BOBIN,

1966, p. 492; ZABALA, 1986; ZABALA & MALUQUER, 1988, P.102, fig. 179.

Colony form: Erect, bushy.

Size: Up to 9 cm high.

Description: (Fig. 5)

Flexible bushy colonies, purplish-brown in colour. Branches composed of zooecia in two series. Zooids large-sized, narrowing proximally. The membranous frontal wall (opesia) extending more or less to the proximal end of the zooids. No spines, but the free outer distal corner projects slightly. No avicularia, ovicell large, white, globular, attached at the inner distal corner of the zooids. Zooids 0.55-0.75 mm long and 0.18-0.25 mm wide. About 20 tentacles.

Remarks: Measures largely overlap with those (0.6-0.8 in length and 0.18-0.22 in width) reported by ZABALA (1986) for western Mediterranean specimens. No taxonomical details were provided in other studies of the coasts of Israel, Lebanon and Turkey (HONDT, 1988; BITAR & BITAR, 2001; KOÇAK, 2007). RYLAND (1965) and HAYWARD & RYLAND (1998) reported that the length of zooecia is 0.6-0.8 mm, width 0.2-0.3 mm while, GORDON & MAWATARI (1992) indicated that zooids are 0.66-1.07 mm long and 0.28-0.34 mm wide. Regarding these measures slight differences do exist in present specimens. These differences can be attributed to the prevailing environmental conditions at each habitat.

General distribution and habitat: It is a species that mainly dwells in ports and harbours, growing in abundance on pier piles, ships' hulls, buoys and similar submerged structures. It is worth noting that this species is one of the most serious fouling organisms, even growing freely in ships' intake pipes and condenser chambers (RYLAND, 1965).

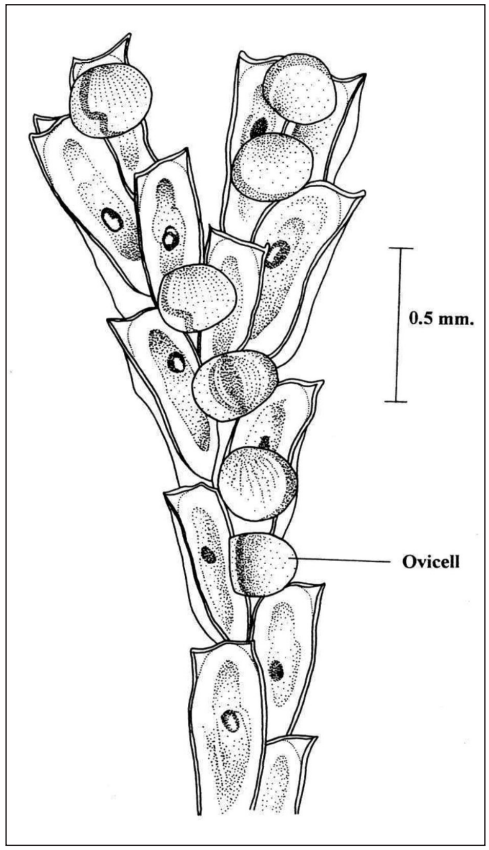

Fig. 5: *Bugula neritina.* Zooecia at a branch bifurcation in frontal view.

Bugula neritina is widely distributed throughout the warmer waters of the world (RYLAND, 1965). Also nearly cosmopolitan except in cold polar and subarctic/subantarctic regions (PRENANT & BOBIN, 1966; RYLAND & HAYWARD, 1977; MAWATARI & MAWATARI, 1986; GORDON & MAWATARI, 1992).

Local distribution and association: The species was previously recorded from Alexandria (O'DONOGHUE & DE WATTEVILLE, 1939; BANOUB, 1960; MEGALLY, 1970; GHOBASHY, 1976; EL-KOMI, 1991, 1992, 1998a and b), from the Suez Canal (GHOBASHY *et al.,* 1980;

GHOBASHY & EL-KOMY, 1981a, b; RAMADAN, 1986) and from the Suez Bay (EL-KOMI *et al.,* 1998 and EMARA, 2002).

In the present survey *Bugula neritina* is one of the main fouling organisms at Abu Qir Harbour.

It is worth mentioning that the colony size (number of bifurcations) of the long-term panels is bigger than that of the short-term panels.

As regards the short-term panels, at Abu Qir Harbour, *Bugula neritina* was procured during the period February 1999 to July 1999 and October 1999 and it was well represented during spring (April and May, 1999) giving rise to 329 and 485 colonies, respectively. The fouling communities during April and May mainly consist of the calcareous tubes of the polychaete (*Hydroides elegans*), some small sized barnacles, and some associated amphipods and isopods. At the Eastern Harbour of Alexandria, it was also recorded in limited quantities during the whole period of the study; disappearing during October 1998 and July 1999.

As regards the long-term panels, at Abu Qir Harbour, it appeared during different periods of study except on the 2 and 11 month duration panels. The maximum settlement was recorded after 6 and 7 months of immersion. The six and seven month fouling communities are mainly composed of the calcareous tubes of the polychaetes (*Hydroides elegans* and *Spirorbis* sp.), some associated amphipods and isopods, and some encrusting bryozoans which covered collectively about 70.3% of the six month panel and 46.5% of the seven month panel. At the Eastern Harbour of Alexandria, it appeared also during different periods of study except on the surfaces of the 9 month duration panels. The maximum settlement was recorded after 4 and 5 months of immersion. The four and five month fouling communities mainly consist of large numbers of the calcareous tubes of the polychaete (*Hydroides elegans*), some moderate sized barnacles, and a very large number of associated amphipods and isopods. At El-Dekheila Harbour, this species was weakly represented, only on the 6 month duration panels.

Bugula stolonifera Ryland, 1960

Bugula stolonifera RYLAND, 1965, fig. 26a, b, and c; PRENANT & BOBIN, 1966, p. 541; ZABALA, 1986; GORDON & MAWATARI, 1992, p.23, plate 6, A.

Colony form: Erect, bushy.

Size: Up to 3-4 cm high.

Description: (Fig. 6)

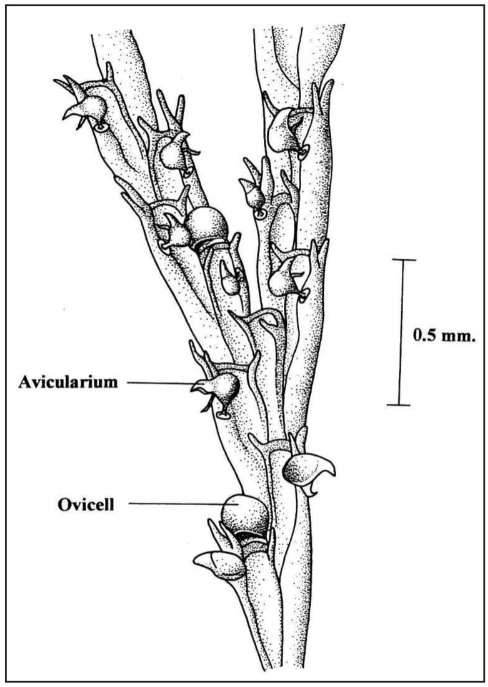

Fig. 6: *Bugula stolonifera.* Zooecia at a branch bifurcation in frontal view.

Flexible bushy colonies, greyish-buff in colour. Branches consisting of zooecia in two series. Zooecia long, slender and narrower proximally. The membranous frontal wall (opesia) extending one-half to three quarters of the total zooecium length. Zooids 0.47-0.62 mm long and 0.12-0.17 mm wide, the outer distal corner with a pair of short spines, the inner distal corner with a single spine. A pedunculate bird's head avicularium attached to the outer margin of each zooid, a little below the spines, its length nearly equal to zooidal width. Ovicells nearly hemispherical, their openings conspicuous.

Remarks: This species was not recorded on the coasts of Lebanon, Greece and Cyprus (BITAR & BITAR, 2001; MORRI *et al.,* 1999 and KOÇAK *et al.,* 2002). No taxonomical details were provided in other studies off the coasts of Israel and Turkey (HONDT, 1988 and KOÇAK, 2007). RYLAND (1965) mentioned that the length of zooecia was 0.6-0.7 mm and width 0.1-0.2 mm while measurements by GORDON & MAWATARI (1992) were 0.47-0.77 mm long and about 0.19 mm wide. The latter measurements are nearly the same as the present specimens.

General distribution and habitat: Mainly a species of ports and harbours, growing on submerged structures, including ships' hulls. In Europe generally found with *B.neritina* (RYLAND, 1965).

The species is found in the Mediterranean Sea, Adriatic Sea, southern Britain, Ireland, Ghana, Massachusetts to Florida, the Gulf of Mexico, Brazil, the Panama canal, South Australia and New Zealand (POWELL, 1971; RYLAND & HAYWARD, 1977; BROCK, 1982; WINSTON, 1982; RYLAND & HAYWARD, 1991; GORDON & MAWATARI, 1992).

Local distribution and association: *B. stolonifera* was previously recorded in the Suez Canal (GHOBASHY & EL-KOMY, 1981b; RAMADAN, 1986). This species is always associated with colonies of *Bugula neritina.*

In the present work the species was represented by few colonies on long-term panels at Abu Qir Harbour and the Eastern Harbour of Alexandria. At Abu Qir Harbour, it appeared on panels immersed for 6, 9 and 10 months while at the Eastern Harbour of Alexandria it appeared only on panels immersed for 12 months.

Discussion

It is well known that morphological measures are important criteria in taxonomical studies. It has been found that morphological differences are often, but not always consistent with taxonomical differences (MACKIE *et al.,* 2002). SCHOLZ *et al.* (2003) indicated that we should carefully consider both re-illustration of morphology, and geographical range. Specimens may not always be assigned unequivocally to a known species based on the holotype only. There is a need to understand the morphological plasticity of species throughout their range of distribution. Regarding the morphological measures of the recorded species, slight differences may exist with specimens collected from other locations within their range of distribution. These differences can be attributed to the prevailing environmental conditions at each habitat or incomplete growth of the procured specimens.

Results of occurrence of the erect fouling Bryozoa at the studied harbours indicated that all five species are at the

Eastern Harbour of Alexandria; Only *Bowerbankia gracilis* and *Bugula neritina* at El-Dekheila Harbour, while, *Bowerbankia gracilis, Bugula neritina* and *Bugula stolonifera* occur at Abu Qir Harbour. This is mainly correlated with the degree of disturbance at each harbour. RAMADAN *et al.* (2006b) studied the factors controlling the marine fouling at the three harbours and they indicated that diversity indices are related to degrees of eutrophication and/or industrial pollution at each harbour.

Indeed, in the environments under various degrees of disturbance, bryozoan colonies show differences both in the number of individuals and the colony size (MORAN & GRANT, 1993). Their larval settlements are partly affected by organic and microbial film and they may respond differently to changing environmental conditions (MIHM & WILLIAM, 1981; PATZKOWSKY, 1988). Sometimes they can even be completely eliminated from a community (KOÇAK, 2007).

The Eastern Harbour, which is a mesotrophic basin and almost without any industrial source of pollution, presents the highest diversity indices (with monthly average of H=1.39, D=0.6). This indicates higher species richness (RAMADAN *et al.,* 2006b) including more bryozoan species than the other harbours.

El-Dekheila Harbour is a eutrophic, polluted, semi-enclosed basin, with the highest concentrations of nitrite, total nitrogen, phosphate, zinc, lead and chromium, and has intermediate values of diversity indices (with monthly average of H=1.23, D=0.6). This harbour is mainly affected by the El-Umoum drain which discharges about $7.7X10^6$ m^3/day of brackish water loaded with domestic, agricultural and industrial wastes, and by industrial wastes from a chloro-alkali plant, cement plant, oil refinery and other sources (ABDALLA *et al.,* 1995; FAHMY *et al.,* 1997).

Abu Qir Harbour represents a eutrophic, polluted, exposed harbour, with the highest concentrations of nitrate, ammonia, total phosphorus, copper and cadmium, and has the lowest values of diversity indices (with monthly average of H=0.99, D=0.42). MOHAMED & EL-MARADNY (2001) indicate that the water of the Abu Qir Bay is affected by continental discharges. They mentioned that the most important of these discharges is the slightly brackish water flowing from Edku Lake via the Boughaz El-Maadia opening at a rate of about $6X10^6$ m^3/day.

It is clear from the results that eutrophication and/or industrial pollution at both Abu Qir and El-Dekheila harbours may support the occurrence of *Bowerbankia gracilis, Bugula neritina* and *Bugula stolonifera* at these habitats. This finding is in accordance with KOÇAK (2007) who concluded that some bryozoan species such as *Bowerbankia gracilis, Bugula neritina, Bugula stolonifera, Schizoporella errata, Watersipora complanata, Cryptosula pallasiana* were found to tolerate high organic input.

The occurrence of *Zoobotryon verticillatum,* a tropical species known in the area since 1939 (O'DONOGHUE & DE WATTEVILLE, 1939), seemed occasional. *Z. verticillatum* appeared only on panels immersed for 12 months at the Eastern Harbour of Alexandria. The finding of *Amathia pruvoti,* at the Eastern Harbour of Alexandria during March 1999 is the first record from the Egyptian Mediterranean waters and thus an addition to the biodiversity of the Egyptian waters.

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