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## Sabellidae (Annelida) from the Faro coastal lake (Messina, Ionian Sea), with the first record of the invasive species *Branchiomma bairdi* along the Italian coast

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### Abstract

In the present paper, morphological and ecological observations on 4 sabellid taxa, *Branchiomma bairdi*, *B. luctuosum*, *Megalomma lanigera* and *Myxicola* sp., collected from the coastal lake of Faro (Messina, Ionian Sea) (26-36 psu), are reported. *Megalomma lanigera*, *Myxicola* sp. and *B. luctuosum* were collected from the soft bottom in shallow water and *B. bairdi* from the hard bottom of an internal channel. The presence of the latter is remarkable, as there is no previous record of this species along the Italian coast, and it confirms the lake of Faro as a very favourable environment for the introduction of alien species, which has occurred frequently as a result of aquaculture. High intraspecific variation was observed for *M. lanigera*, whilst more extensive analysis is required to ascertain the taxonomic status of the *Myxicola* specimens, including a review of all Mediterranean data currently attributed to *M. infundibulum*.

**Keywords:** Annelida, Sabellidae, morphological variation, alien species, *Branchiomma bairdi*.

### Introduction

Lake Faro, located within the SCI of Capo Peloro – Lago di Ganzirri (Ionian Sea), is a brackish water environment connected to the Strait of Messina through open channels which is exploited for mollusc aquaculture. Although the main purpose of SCIs is to conserve native biodiversity, as in other transitional waters the environment of the lake is very favourable to the settlement and successful establishment of invasive alien species, which are frequently introduced through aquaculture. Indeed, it shows ecoclines and environmental patchiness that make it highly exposed and attractive for allochthonous marine species. In addition, anthropogenic impacts arising from extensive urbanization along the shore and the presence of mollusc aquaculture farms are sources of habitat modification and the introduction of highly competitive alien species (Minchin, 2007).

The area has therefore been cited as a hot-spot for the entry and spread of alien marine species in the Central Mediterranean (Cosentino *et al.*, 2009). By now a total of eleven non-indigenous benthic invertebrates are considered to be established (Zenetos *et al.*, 2010).

Among the polychaetes colonizing the lake, intro-

duced species (Zenetos *et al.*, 2010) are frequently sampled: the serpulids *Hydroides dianthus* (Verrill, 1873) and *Hydroides elegans* (Haswell, 1883), the Amphinomidae *Linopherus canariensis* Langerhans, 1881 (Cosentino & Giacobbe, 2011) and the Syllidae *Syllis hyllebergi* Licher, 1999 (Cosentino, 2011). However, the lake seems to be particularly suitable for filter feeder sabellid colonization, of which the only example reported to date is a large population of *Branchiomma luctuosum* Grube, 1869 (Cosentino *et al.*, 2009).

Here we report the presence of other large-sized sabellid species: *Megalomma lanigera* and *Myxicola* sp., inhabiting the soft bottom at low depth; *Branchiomma bairdi* (Mc Intosh, 1885), inhabiting the hard bottom of the Lake's two seaward inlets and of the channel which connects the basin with the neighbouring lake of Ganzirri; and further observations of *B. luctuosum*.

All the species were observed to form dense populations. This investigation highlights the intraspecific variability for some of them. Intraspecific variability has already been reported in other sabellids as the main bias in establishment of species boundaries (Capa *et al.*, 2010). Small-scale spatial distribution and ecological notes for each species are also reported.

## Material and Methods

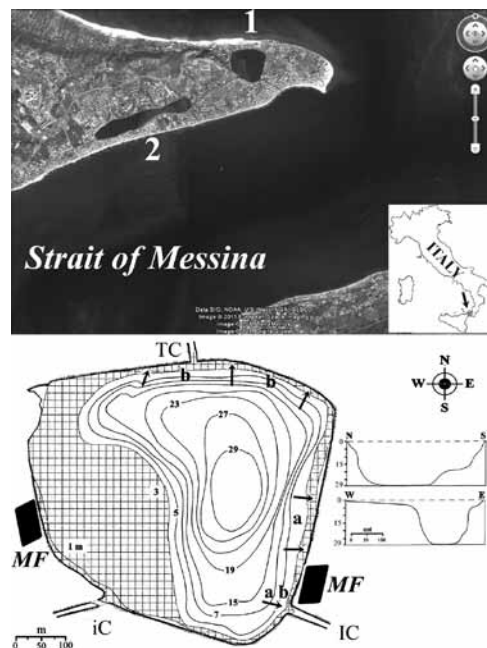
**Study Area.** Lake Faro ( $38^{\circ}16'07''\text{N}$ ,  $15^{\circ}38'13''\text{E}$ ;  $0.26 \text{ km}^2$  surface area; maximum depth 29 m) is a small temperate meromictic marine basin located in the Oriented Natural Reserve of Capo Peloro, NE Sicily (Fig. 1). Its hydrodynamic exchanges are driven by the tidal regime of the Messina Strait through two small channels connecting the lake with the sea; a third narrow channel connects the Faro basin to the nearby Ganzirri coastal lake. The Faro water body is almost permanently stratified, the first 10-15 metres being well mixed and the deeper layer having much lower hydrodynamism. Salinity ranges from 26 to 36 psu, and temperature from 10 to  $30^{\circ}\text{C}$  in the first 10-15 m of depth. Below 15 m, these parameters appear more constant with a salinity of about 38 psu and temperature of about  $15^{\circ}\text{C}$ . Similarly, pH is 7.9-8.6 in the shallow waters, and 7.0-7.4 below 20 m. The surface water redox potential varies from +120 mV to +190 mV, and deeper waters from -300 mV to -360 mV. (Saccà *et al.*, 2008). Both water column and sediments are classified as mesotrophic and support significant microbial productivity (Maugeri *et al.*, 2000; Leonardi *et al.*, 2009).

### Sampling procedures and analysis

For true soft bottom species such as *Myxicola* sp. and *Megalomma lanigera*, but also for *B. luctuosum*, specimen density was assessed along the eastern shore (Fig. 1) at depths of 0.5 m to 2 m using a plastic square of 1 m by 1 m, subdivided into four sectors of  $0.25 \text{ m}^2$ . After positioning the device over the selected sabellid field (bottom slope from 3% to 20%) and after the emergence of the branchial crowns from tubes, a direct visual census was carried out. For *B. bairdi*, which is associated with hard substrata, density was determined along the northern shore (Fig. 1) at 1 m depth by counting the specimens which fell within a standard  $20 \times 20 \text{ cm}$  square.

Photographs of some square fields were also carried out with a Nikon COOLPIX 7009 camera, in order to check *in situ* sabellid counting by divers. All density assessments were executed from late spring (May) till early autumn (October), from 2008 to 2011. Given the extreme variability in patch density for all these species, assessments were carried out at a large number of comparable sites.

After density assessment, some specimens were directly gathered from the substrate. For the morphological analysis, specimens were fixed in 4% formalin. In the laboratory, the material was washed and preserved in 70% alcohol. Polychaetes were analyzed using stereo- and compound microscopes. Biometric measurements such as body length, thorax width, crown length and the number of thoracic and abdominal chaetigers were made. Some specimens were drawn by camera lucida. Photographs were taken using a digital camera (COOLPIX) attached to the stereo- and compound microscopes.



**Fig. 1:** Study area showing (top) the Strait of Messina, Capo Peloro and the lagoon system of Faro (1) and Ganzirri (2); (bottom) the bathymetry and the bottom profile (two vertical sections on the right side) of Lake Faro. The distribution of *Branchiomma luctuosum*, *Megalomma lanigera*, and *Myxicola* sp. is within the reticulate area. Arrows indicate the records of *Branchiomma bairdi* since 2007 (a) and blooms in 2010-2011 (b, c). MF: mollusc fishery farms; IC: channel to the Ionian Sea; TC: channel to the Tyrrhenian Sea; iC: channel to Ganzirri.

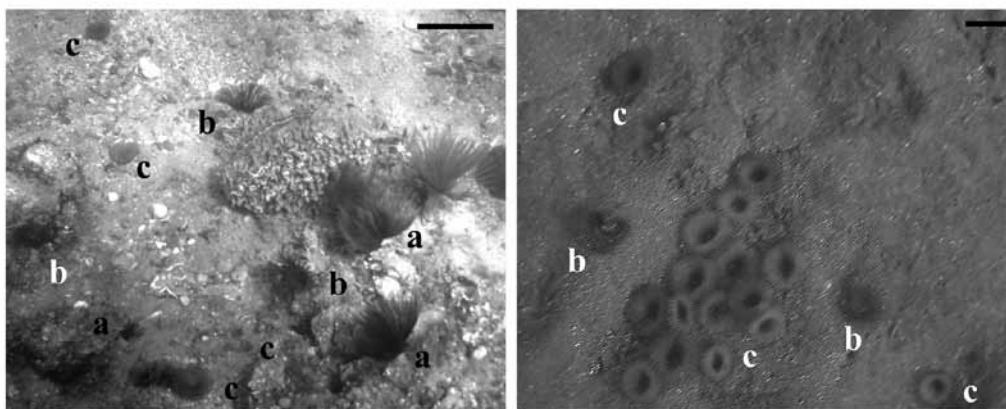
## Results

The distribution of the four Sabellidae species found in the area is shown in Figure 1. At the small scale, species have a patchy distribution. *M. lanigera* and *Myxicola* sp. inhabit soft substrates with mud and debris and can be observed aggregated with *B. luctuosum*, which however needs hard material to fix its tube and can be found on other hard substrates within the lake (Fig. 2). By contrast, specimens of *B. bairdi* were collected only on hard substrates.

Information on species' morphological features is based on the mean values of measurable variables. Correlations between different body parts of morphological parameters (body length and crown length, total length and number of abdominal chaetigers) were low for all examined species, probably due to the varying degree of body contraction in response to fixation. For this reason they are not shown.

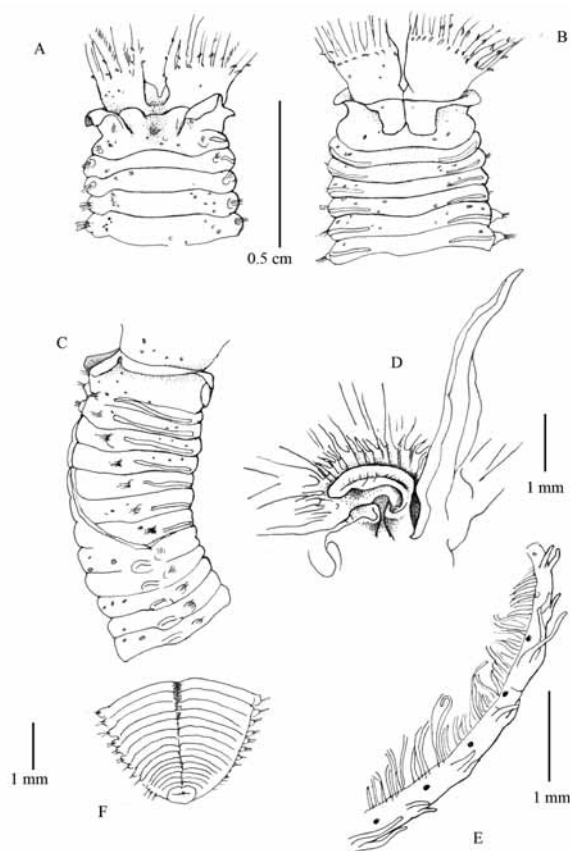
GENUS *Branchiomma* K lliker, 1858  
*Branchiomma bairdi* (McIntosh, 1885)

*Dasychone bairdi* McIntosh, 1885: 495-497, pl. 30A, Figures 13-15; pl. 39A, Figures 2, 9  
Monro, 1933: 267; Rioja, 1951: 513-516: pl. 1, Figures 1-7; Rioja, 1958:



**Fig. 2:** Sabellid patches in Lake Faro soft bottom (May 2010). On the left, mixed assemblage of *B. luctuosum* (a), *M. lanigera* (b) and *Myxicola* sp. (c); bar = 5 cm. Shell debris, coarse sediments and a young specimen of *Pinna nobilis* (centre) are also distinguishable. On the right, bouquet-shaped aggregation of *Myxicola* sp. (c) and two *M. lanigera* specimens (b) in finer, well sorted sands; bar = 1 cm.

286-287. *Branchiomma* cf. *bairdi* Capa & López, 2003: 370, Figures 5A–I. *Branchiomma bairdi* Tovar-Hernández & Knight-Jones, 2006: 13-17, Figures 3A–D, H–K, 9C–D, 10C, 11B; Tovar-Hernández *et al.* 2009: 3–8, Figures 2–4. Çinar, 2009: 2320, Figure 13 A-B-C. *Branchiomma bohollense* Çinar, 2005: 151 (not Grube, 1878 ).



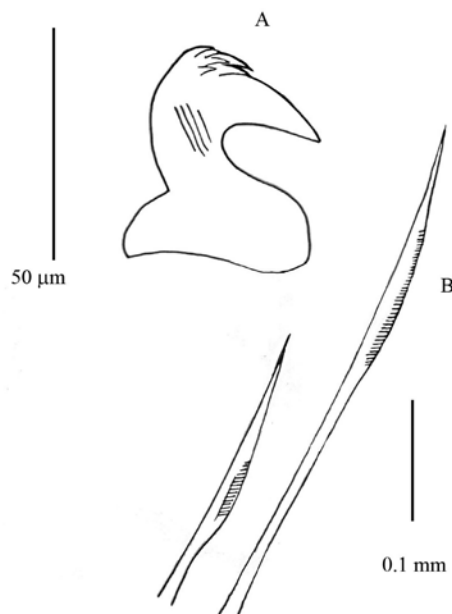
**Fig. 3:** *Branchiomma bairdi*: A) anterior part dorsal view; B) anterior part ventral view; C) anterior part lateral view; D) internal structures of the crown showing the dorsal radiolar appendage; E) radioles with stylodes; F) Pygidium.

**Material studied.** A total of 50 individuals collected at different times from 2007-2011 years were examined.

**Taxonomic remarks.** Dorsal collar with well separated margins (Fig. 3A), well developed triangular or rounded ventral lappets and rectangular but poorly visible ventral shields (Fig. 3B, C). Dorsal lips about half the length of the radiole, supported by a longitudinal ridge or mid-rib (Fig. 3D). Crown united at the base by a low web, and 20-26 pairs of radioles on each side. Radioles have apinnulate tips and stylodes. Macrostylodes strap-like, two or three to each radiole, randomly alternating and mostly in distal half of radioles. Remaining stylodes digitiform (Fig. 3E). Up to 20 pairs of stylodes in each radiole. Thoracic tori abutting ventral shields composed of avicular uncini with the crest surmounted by two or three rows of teeth (Fig. 4A). Collar chaetae slender, weakly geniculate, arranged in compact fascicles. Thoracic notochaetae arranged in irregular oblique rows of superior and inferior chaetae, the superior ones slender and weakly geniculate (Fig. 4B). Fascicles of abdominal chaetae forming compact tufts, with outer geniculate chaetae arranged in C-shaped arcs. Abdominal uncini similar to those in thorax. Pygidium rounded (Fig. 3F).

The materials from Lake Faro correspond quite well to the descriptions by Çinar (2009) for specimens collected along the coast of Turkey and Cyprus, and by Tovar-Hernández *et al.* (2009) for specimens collected in the south-eastern Gulf of California.

*Branchiomma bairdi* is very similar to *B. bohollense*, another alien species previously reported in both the eastern and western basins (Knight-Jones *et al.* 1991; Roman *et al.*, 2009). Both species have macrostylodes on radioles. According to Tovar-Hernández *et al.* (2009), in both species the macrostylodes vary in size among themselves, somewhat irregularly, but in *B. bohollense* they differ sharply from all the other stylodes, being tongue-like (flattened), while in *B. bairdi* the macrostylodes are



**Fig. 4:** *Branchiomma bairdi*: A) thoracic uncinus; B) thoracic chaetae.

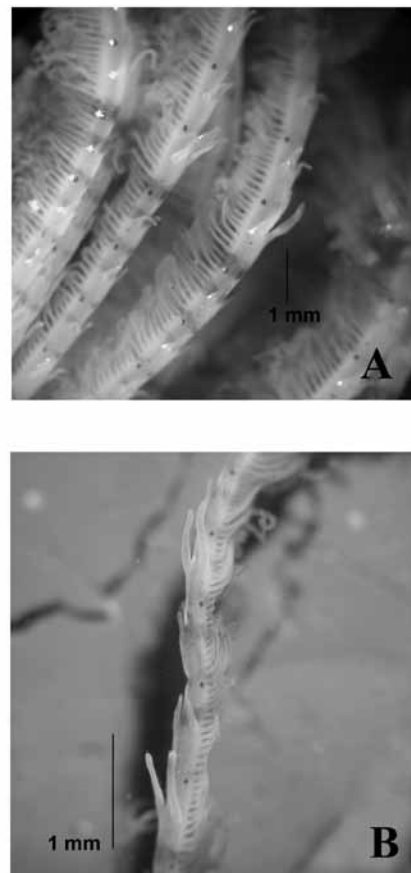
strap-like, including their immediate neighbours. The main difference between these two species is, however, the morphology of the thoracic uncini, which in *B. bairdi* have two or three rows of teeth and in *B. boholense* only one large tooth (Tovar-Hernández *et al.* (2009).

**Variations.** Total length is  $3.61 \pm 1.2$  cm, body length (thorax and abdomen) is  $2.7 \pm 0.8$  cm and thorax width is 0.4 cm. Branchial crown length is  $1.09 \pm 0.3$  cm. The average crown to body ratio is 0.29. Specimens have 4-8 thoracic chaetigers (most frequently seven), with inter-ramal dark spots. The number of abdominal chaetigers varies from 30 to 60.

Specimens appeared highly homogeneous in morphology, all having a yellow-green coloured body with small brown and white spots over the whole surface, and a crown with darker bands alternating with white bands around radioles with interramal dark spots. Variability was observed in few individuals, in which the macrostylodes appeared more flattened (Fig. 5B, C).

**Distribution and ecology.** *Branchiomma bairdi* was originally described in Bermuda as *Dasychone bairdi* by McIntosh in 1885. Up to now, the species has been reported for the western Atlantic (from Bermuda to the Caribbean Sea) and eastern Pacific Ocean (Pacific coast of Panama and Mexico) (Tovar-Hernández *et al.* 2009). It was then recorded in the eastern Mediterranean (Çinar, 2009) and now it is found in the Central Mediterranean. Therefore it seems that the species' range is expanding fast, as occurred for *B. luctuosum* (Licciano *et al.*, 2002; Licciano & Giangrande, 2008).

In Lake Faro *B. bairdi* was recorded first during summer 2007 and 2008 with a small number of individuals found on vertical walls, among photophilic algae, along the eastern shore and in the southern seaward channel

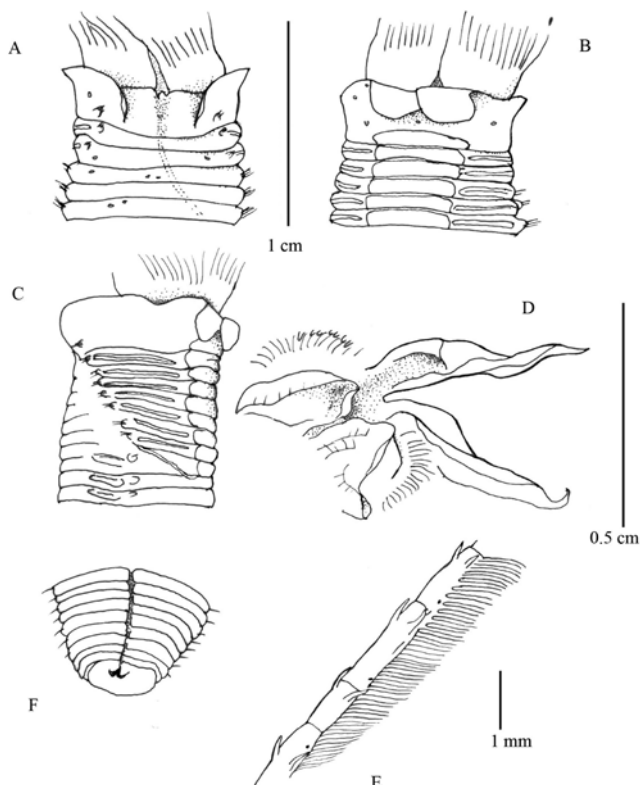


**Fig. 5:** *Branchiomma bairdi*: photographs from different individuals showing stylode variability A) radioles with more flattened stylodes; B) radiole with strap-like stylodes.

near the mollusc farm. Further sightings were made in 2010 and 2011, when very dense populations were found both at the inlet of this channel (mainly on the leaves of a *Cymodocea nodosa* patch) and in the proximity of the northern seaward channel, where the natural substratum was replaced by rocks and boulders in 2007 for restoration purposes. The approximate number of living tubes varied from 2-3 individuals to 30-35 individuals per boulder. On vertical walls, often associated with branched algal turfs, abundance varied from 2 to 16 individuals. The estimated density thus ranged from a minimum of 35 up to 400 ind/m<sup>2</sup>. At higher densities, the tubes formed clusters of different sizes; some were also found associated with common solitary tunicates (*Ascidia*, *Ciona*), which covered the basal and middle part of the tubes.

#### *Branchiomma luctuosum* (Grube, 1869)

*Sabella (Dasychone) luctuosa* Grube, 1869: 517; *Dasychone luctuosa* Gravier, 1906a: 41; 1906b: pl. 7 Figures 271-273; Gravier, 1908: 98; *Branchiomma luctuosa* Hartman, 1959: 538; 1974: 631; Wehe & Fiege, 2002: 117; *Branchiomma luctuosum* Knight-Jones *et al.*, 1991: 854 Figure 6; Arvanitidis, 2000: 82; Simboura & Nicolaidou, 2001: 361; Castelli *et al.*, 1995: 31; Çinar *et al.*,



**Fig. 6:** *Branchiomma luctuosum*: A) anterior part dorsal view; B) anterior part ventral view; C) anterior part lateral view; D) internal structures of the crown showing the dorsal radiolar appendages; E) radioles with stylodes; F) Pygidium.

2006: 86 Figure 4; Licciano & Giangrande, 2008: 386 Figures 3 A-E; El Haddad *et al.*, 2008: 3-4 Figures 3 A-I.

**Material examined.** A total of 30 specimens collected in 2010 were examined.

**Taxonomic remarks.** Dorsal collar has well separated margins (Fig. 6A), well developed rounded ventral lap-pets and a rectangular ventral shield (Fig. 6B, C). Dorsal lips are about half the length of radioles and supported by a longitudinal ridge or mid-rib (Fig. 6D). The crown has 27-35 pairs of radioles on each side, with apinnulate tips. The radioles are linked to each other by a low web. Up to 28 pairs of thin, pinnulate stylodes are present in each radiole (Fig. 6E) except ventralmost radioles. Pygidium rounded (Fig. 6F).

The description of *B. luctuosum* in the Mediterranean is already available in papers by Licciano & Giangrande (2008) and El Haddad *et al.* (2008). The features of specimens from Lake Faro are identical to those reported in Licciano & Giangrande (2008) for material collected around the Italian coast and to those in El Haddad *et al.* (2008), for material collected in the Port of Valencia. The description of the species given in both these papers agrees with the original description (Grube, 1869) and the one provided by Knight-Jones *et al.* (1991), except for the uncinal shape. Specifically, these authors reported their material as having a single row of secondary teeth

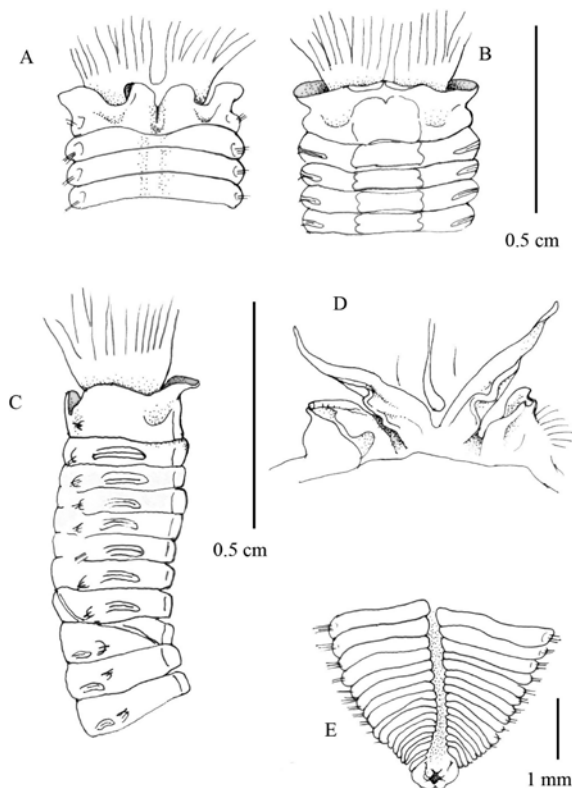
on the main fang of the thoracic uncini, contrasting with the 2 rows observed in the Italian and Spanish specimens, and the 2-3 rows found in the Brazilian material examined by Nogueira *et al.* (2006).

**Variations.** The mean total length of specimens collected from Lake Faro is  $7.2 \pm 0.6$  cm and the thorax width is 0.8 cm. The body length (thorax and abdomen) is  $5.2 \pm 0.3$  cm and the branchial crown length is  $1.96 \pm 0.4$  cm. The average crown to body ratio is 0.37. The number of thoracic chaetigers varies from 7 to 8 (mostly 7). In the studied populations colouration of the crown varied among individuals from brown-velvet to white. Stylodes also varied, being smaller in some specimens. This intra-specific variability has previously been observed in a population from the Taranto area (Ionian Sea), but has never been discussed.

**Distribution and ecology.** *Branchiomma luctuosum* was originally described for the Red Sea as *Sabella (Dasychone) luctuosa* by Grube (1869). This species represents a possible Lessepsian migrant. The first record of it in the Mediterranean is relative to the western basin (Tyrrhenian Sea) (Bianchi, 1983). Since then, its presence in Italian waters has been reported many times (Sordino & Gambi, 1992; Licciano & Giangrande, 2008), in addition to reports from the eastern basin (Knight-Jones *et al.*, 1991; Simboura & Nicolaidou, 2001; Arvanitidis, 2000; Çinar *et al.*, 2006). It should be pointed out that although this species is reported as invasive only for the Eastern and the Central sectors (Zenetos *et al.*, 2010), it must now be considered established and invasive throughout the Mediterranean. The species has expanded rapidly and at present it seems to have invaded most of the Italian coast (Licciano & Giangrande, 2008). More recently, it was collected in the Port of Valencia (El Haddad *et al.*, 2008), and also outside the Mediterranean in the eastern Atlantic (Daniel Martin, pers. com.), as well as along the coast of Brazil (Nogueira *et al.*, 2006), where it seems to have been recently introduced.

In the Red Sea, this species has been found mainly in the more sheltered areas of coral reefs (Grube, 1869). In the Aegean Sea it has been found associated with sponges (Arvanitidis, 2000), while its presence in Italian waters has mostly been recorded in lagoon environments (Sordino & Gambi, 1992; Knight-Jones *et al.*, 1991) or sheltered marine areas (Sordino & Gambi, 1992; Licciano *et al.*, 2002; Matarrese *et al.*, 2004). In Valencia Port, El Haddad *et al.* (2008) found specimens of *B. luctuosum* mostly on the rocky substrate, grouped in small aggregates of specimens or more rarely isolated. Specimens were present in practically all orientations of the substrate, but especially on the vertical surfaces of the docks where densities reached 320–370 ind/m<sup>2</sup>.

In Lake Faro *B. luctuosum* was found to be distributed all around the lake perimeter, from 0.2 m to about 3 m depth (Fig. 1). The base of its parchment-like tube, consolidated by fine pelitic sediment, is attached to any



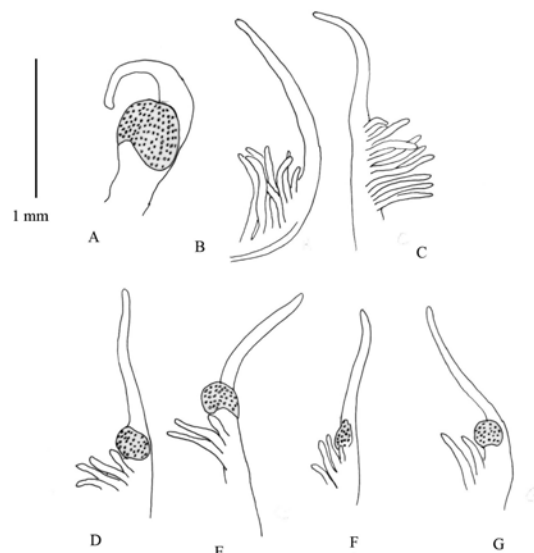
**Fig. 7:** *Megalomma lanigera*: A) anterior part dorsal view; B) anterior part ventral view; C) anterior part lateral view; D) internal structures of the crown showing the dorsal radiolar appendages; E) Pygidium.

suitable kind of natural or man-made substratum, generally buried in the sediment. For this reason, most of specimens are observed to inhabit coarse and mixed sands, with up to 3-4 cm of distal tube emerging from the sediment. However, numerous individuals also colonize artificial brick walls as well as wood and metallic pilings, along their whole vertical extension, and in less impacted areas clusters of individuals (up to about ten) frequently colonize the valves of the lamellibranch *Pinna nobilis* L. In the soft mixed sediments the species reaches an average density of  $4.9 \pm 2.1$  ind/m<sup>2</sup>; the distribution is quite patchy, from a minimum of 1.2 ind/m<sup>2</sup> to a maximum of 19 ind/m<sup>2</sup>. Direct emission of gamete clouds in the sea water was observed from September to November in 2010 and 2011.

#### GENUS *Megalomma* Johansson, 1925

##### *Megalomma lanigera* (Grube, 1846)

*Branchiomma vesiculosum neapolitana* Claparède, 1868: 164-166, pl 22, Figure 5 *fide* Giangrande & Licciano, 2008: 209. *Branchiomma köllikeri* Claparède, 1869: 163-164, pl 22, Figure 4 *fide* Giangrande & Licciano, 2008: 209. *Megalomma neapolitana* Knight-Jones, 1997: 314. *Megalomma lanigera* Giangrande & Licciano, 2008: 209-213, Figures 2-4, 5C-D. Tovar-Hernández & Carrera-Parra, 2011: 37, Figure 15 A-J.

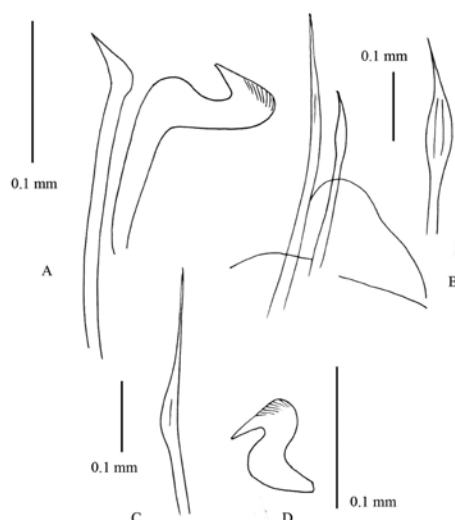


**Fig. 8:** *Megalomma lanigera*: Tips of radioles with and without terminal eye: A) dorsalmost radiole; B) second radiole C) third radiole; D) fourth radiole; E) fifth radiole; F) sixth radiole; G) seventh radiole.

**Material examined.** A total of 22 specimens collected in different periods from 2007 to 2011 were examined.

**Taxonomic remarks.** Dorsal collar margin diagonal, fused to faecal groove, with well developed dorsal lappets, dorsal pockets present (Fig. 7A). Ventral lappets with triangular anterior margins, not overlapping and slightly longer than the ventral shield of the collar (Fig. 7B). Anterior peristomial ring not exposed dorsally (Fig. 7B), and lateral collar margins covering the basal union of radioles (Fig. 7C). Dorsal lips triangular with mid-rib and dorsal pinnular appendages. Ventral lips about a half as long as dorsal lips, broadly rounded (Fig. 7D). Ventral sacs present. Caruncle absent. Keel absent. Thoracic tori not contacting ventral shields (Fig. 7B). Outer surfaces of radioles quadrangular basally, and rounded distally. Sub-distal compound eyes present in most radioles with dorsalmost radioles bearing large spherical eyes (Fig. 8A). Other dorsal and lateral radioles with spherical eyes distinctly smaller than dorsalmost ones and with a longer tip. Often the second and third radioles are without eyes (Fig. 8B, C, D, E, F, G). Ventral radioles with only ocular spots and radiolar tip becoming longer gradually towards ventral radioles. Notopodial fascicles with a superior group of elongate, narrowly hooded chaetae (Fig. 9A) and an inferior group of chaetae (Fig. 9B). Thoracic uncini with main fang surmounted by 9-10 rows of numerous minute teeth, handles twice the length of the crest (Fig. 9C). Companion chaetae with teardrop-shaped membranes. Abdominal chaetae narrowly hooded (Fig. 9D). Abdominal uncini with main fang surmounted by 8-10 rows of numerous minute teeth; handles reduced, less than half the length of thoracic uncini handles (Fig. 9E). Pygidium bilobed without eyespots (Fig. 7E). Tube at least three quarters of worm length and buried in incoher-





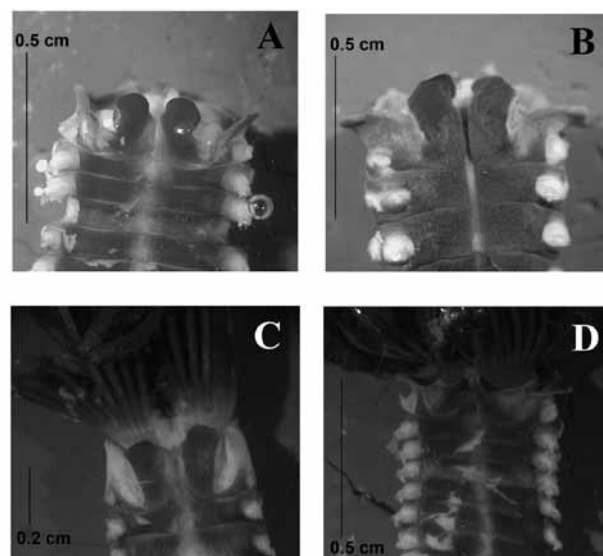
**Fig. 9:** *Megalomma lanigera*: A) superior thoracic chaeta; B) Inferior thoracic chaeta; C) thoracic uncinus; D) abdominal chaeta; E) abdominal uncinus.

ent heterogeneous sediment, constituted by medium and coarse sands mixed with gravels and pebbles to which it is frequently anchored.

**Variations.** Specimens have a total length of  $12.39 \pm 2.1$  cm (maximum width 0.5 cm for most of the thorax). The body (thorax and abdomen) is  $10.45 \pm 2.1$  cm, and the branchial crown  $1.94 \pm 0.19$  cm, with an average crown to body ratio of 0.37. All the specimens have eight thoracic chaetigers and a branchial crown longer than the thorax with 19-26 pairs of radioles. Abdominal segments number  $106 \pm 16$ . The shape of the collar appears extremely variable. True morphological variability cannot be excluded, but it is also possible that it depends on the fixation of the material (with animals dying inside or outside the tube). In some specimens the collar has longer dorsal lappets (Fig. 10A, B) while in others they seem to be at the same level as the collar's lateral margin (Fig. 10 C, D). The arrangement of the eyes and the tip length of the dorsalmost radioles are also highly variable. The most common pattern is the one described above and shown in Fig. 7. Although *M. lanigera* is reported to have shorter tips in the dorsalmost radioles (Giangrande & Licciano, 2008; Tovar-Hernández & Carrera-Parra, 2011), short tips were also found in the examined population of Lake Faro. This is probably due to the fact that description of *M. lanigera* was based on very few individuals, sometimes only one, without detecting this variability.

**Distribution and ecology.** *Megalomma lanigera* is a very common species in sandy mud sediments in Italian coastal environments. Giangrande & Licciano (2008) clarified the status of *M. vesiculosum* in the Mediterranean basin, stating that this is a species with a more northerly distribution, and all the Mediterranean records of *M. vesiculosum* must therefore be considered *M. lanigera*.

In Lake Faro *M. lanigera* is found in incoherent sedi-



**Fig. 10:** *Megalomma lanigera*: variability of collar shape in different specimens. A,B) individuals fixed with the crown completely outside the tube; C) individual fixed inside the tube; D) individual fixed with only the collar margin outside the tube.

ment at depths of 0.5 m up to a maximum of 3.0 m (Fig. 1B), decreasing sharply thereafter, similar to other sympatric macrobenthic suspension-feeding sabellids (*Branchiomma*, *Myxicola*), bivalves (*Pinna*) and ascidians (*Styela*), whose distribution may be affected by the shallow seasonal oxycline and periodic hypoxic deep water upwelling.

Population density ranges from 0.40 ind/m<sup>2</sup> to a maximum of 17 ind/m<sup>2</sup> (mean =  $4.30 \pm 1.9$  ind/m<sup>2</sup>). Distribution is only moderately patchy, less aggregated than the other species.

#### GENUS *Myxicola* Koch, 1874

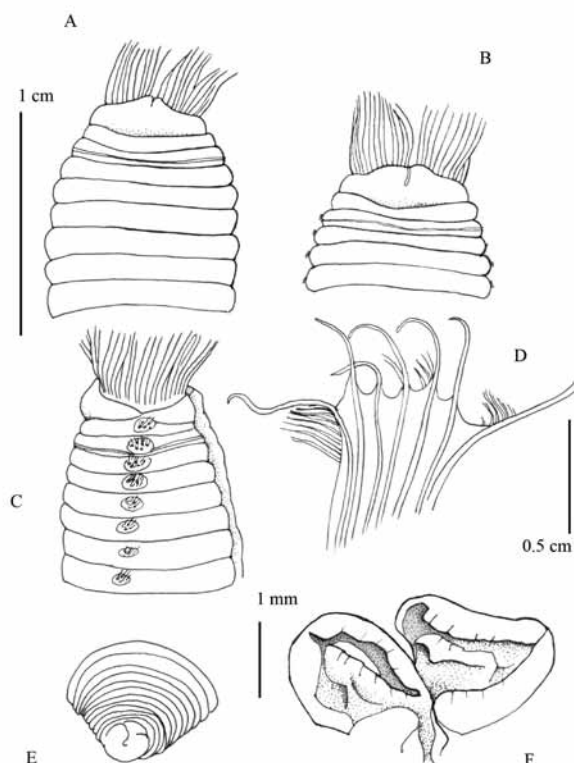
##### *Myxicola* sp.

**Material examined.** A total of 15 specimens collected from 2007 to 2011 were examined.

**Taxonomic remarks.** Crown with fused lobes and with radioles webbed for most of their length. Dorsal collar lobe bilobed (Fig. 11 A). Ventral collar low (Fig. 11B, C). Dorsal lips located on the inner margin of well developed ventral lips, extending almost from one side of the crown to another, between the dorsal and the ventralmost radiole (Fig. 11D). Thoracic notopodial fascicles bearing elongate, narrowly hooded chaetae (Fig. 12A), neuropodial fascicle with uncini with long handles (Fig. 12B). Abdominal uncini showing a main fang surmounted by a large tooth (Fig. 12C). Pygidium rounded (Fig. 11E). Tube gelatinous.

**Variations.** Specimens measure  $7.84 \pm 3$  cm in total length of which  $6.38 \pm 1.5$  is the body (thorax and abdomen). The branchial crown is longer than the thorax, measuring  $1.8 \pm 0.7$  cm, with 16-23 pairs of radioles in each lobe.

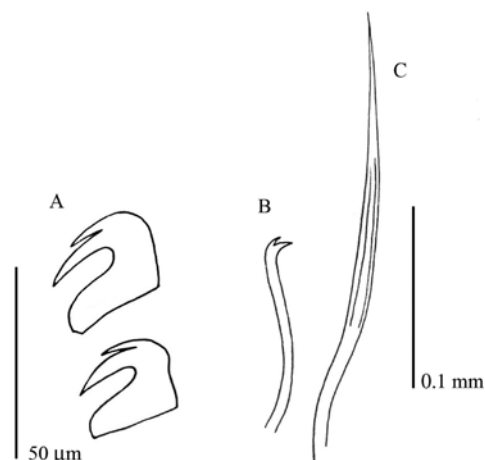




**Fig. 11:** *Myxicola* sp.: A) anterior part dorsal view; B) anterior part ventral view; C) anterior part lateral view; D) radioles showing web and free tips; E) Pygidium; F) internal structures of the crown.

Radioles are connected by a web which leaves a free tips measuring  $0.42 \pm 0.1$  cm (Fig. 11F). The average crown to body ratio is 0.37. All specimens have eight thoracic chaetigers, while abdominal segments number  $125 \pm 46$ . Overall, the examined individuals showed homogeneous morphology.

**Comparison with other Mediterranean material.** Despite resembling the most common Mediterranean species *M. infundibulum* (Renier, 1804), the individuals from Lake Faro do not correspond entirely to the description of this species reported by Fauvel (1927), being smaller in size with a small number of radioles in each lobe and a bilobed ventral collar. In contrast they are very similar to some specimens in the collection of the Laboratory of Zoology of Salento University, collected in the Gulf of Naples and identified as *M. infundibulum*. Moreover, the specimens from Lake Faro differ from specimens collected in the Northern Adriatic, which is the type locality of *M. infundibulum*. The latter are similar to *M. infundibulum* sensu Fauvel (1927) only in the shape of the collar, whilst they differ in having a smaller size and a longer crown, resulting in a crown/body ratio of 0.44, as well as longer free tips of radioles, so that these are also probably a different species from *M. infundibulum*. Unfortunately type material for the species is lacking and the poor description present in Renier (1804) does not



**Fig. 12:** *Myxicola* sp.: A) abdominal uncini; B) thoracic uncini; C) thoracic chaeta.

allow a good comparison. Therefore, before attempting to identify the taxon from Lake Faro a revision of all the Mediterranean material and especially that of the Adriatic area is needed.

The Mediterranean material shows a similar shape for the abdominal uncini, a feature which distinguishes it from the North American specimens (Dane, 2008). Moreover the Mediterranean material also shows similarity of the crown's internal structures. The internal structures of the crown in *Myxicola* resemble those of *Chone*, *Dyalichone* and *Euchone* in the unusual position of the dorsal lips, which are not directly attached to the dorsalmost radioles (Fitzhugh, 2003). According to Capa *et al.* (2011), in the dorsal lips of *Myxicola*, the dorsal radiolar appendages are supported by an acellular axis, while a blood vessel surrounded by the coelom is present between the acellular axis and the outer epithelium, surrounded by a hyaline cartilage.

**Distribution and ecology.** In the soft bottom of Lake Faro, *Myxicola* sp. shows a patchy distribution similar to that of *B. luctuosum* and *M. lanigera* (Fig. 1). Density ranges from a minimum of 1 ind/m<sup>2</sup> to a maximum of 22 ind/m<sup>2</sup>; the mean density is  $5.5 \pm 2.6$  ind/m<sup>2</sup> and the SD is 6.1. Some patches show thick clusters of ten to fifteen individuals, each cluster thus forming a peculiar bouquet-shaped colony.

## Discussion

Lake Faro seems to be a suitable environment for the establishment of large-sized filter feeder sabellids, which are present at high densities on both soft and hard substrates. Of these, the occurrence of the non-indigenous fouling sabellid polychaete *B. bairdi*, which is reported for the first time along the Italian coast, must be stressed. Like *B. luctuosum*, *B. bairdi* can be considered a primary colonizer due to its hermaphrodite reproduction and its

short pelagic phase, which may produce high population densities starting from few individuals. Moreover, *B. bairdi* is also reported to reproduce asexually (Tovar-Hernández *et al.*, 2011). The high densities recorded, coupled with its reproductive strategy, anti-predation strategies and feeding mode, suggest that this species is a potential invader. The introduction of *B. bairdi* to Lake Faro could be associated with aquaculture, although the possibility of its introduction on the hulls of ships or in their ballast waters cannot be excluded. Çinar (2009) suggested re-examining all the Mediterranean material identified as *B. bohollense*, the other tropical *Branchiomma* species introduced to the Mediterranean area (Knight-Jones *et al.*, 1991), since some material previously identified as *B. bohollense* (Çinar 2005) actually proved to be *B. bairdi*. In addition, the examination of some material used in the work of Roman *et al.* (2009), collected in the Western Mediterranean and kindly made available by the authors, was found to have thoracic uncini similar to *B. bairdi*, moreover, the shape of the stylodes seemed to be more strap-like than tongue-like. It is therefore possible that *B. bohollense* is not yet present in the West Mediterranean area.

Another interesting aspect of the data reported here is the high intraspecific variability recorded in *M. lanigera*, revealed by the large amount of material examined, which highlights how some features used in diagnoses, particularly the shape and measurement of soft structures, are inconsistent, probably reflecting different degrees of deformation due to fixation and preservation.

This has already been pointed out for the *Sabellastarte* genus by Capa *et al.* (2010), who state that some of the features that have traditionally been used to distinguish species change during development, growth and regeneration, and should not be considered as diagnostic. These include the number of chaetae in a fascicle and the presence of spiralling radioles of the crown lobes, which are both known to vary with age. Other features, such as the relative length of the branchial crown, the shape of the radiolar tip, and the number of thoracic or abdominal chaetigers, are also known to be insufficient for species identification as they can change due to regeneration.

Finally the status of the taxon here identified as *Myxicola* sp. needs to be elucidated, with the re-examination of all the material previously synonymized with *M. infundibulum*, which is at present the most commonly reported species in various localities around the world including Europe, South Africa, North America, Japan and Australia (Fauvel, 1927; Day, 1961; Imajima, 1968; Goldman & Chandler, 1986; Høisæter, 1989; Langton & Robinson, 1990; Hayward & Ryland, 1995).

Although 20 nominal *Myxicola* species are listed by Hartman (1959), only 7 are at present considered valid taxa because most of them have been synonymized with *M. infundibulum*, leading to this species being considered a cosmopolitan taxon and generating confusion about its

status. Indeed, Dane (2008) recently suggested that *M. infundibulum* is a complex of species that are very difficult to distinguish on the basis of morphological features alone. Analysing specimens collected from the East coast of North America, France, Italy, Croatia and southern Australia that were all identified as *M. infundibulum*, this author found that North American specimens are genetically and morphologically different from Australian and European specimens. It is therefore probable that in the Mediterranean and elsewhere, several different taxa are at present identified as *M. infundibulum*.

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## References

- Arvanitidis, C., 2000. Polychaete fauna of the Aegean Sea: inventory and new information. *Bulletin of Marine Science*, 66 (1): 73-96.
- Bianchi, C.N., 1983. Serpuloidea (Annelida, Polychaeta) delle lagune costiere laziali e campane. *Annali del Museo Civico di Storia Naturale "Giacomo Doria"*, 84: 231-243.
- Capa, M., Bybee, D.R. & Bybee, S.M., 2010. Establishing species and species boundaries in *Sabellastarte* Krøyer, 1856 (Annelida: Sabellidae): an integrative approach. *Organisms Diversity & Evolution*, 10 (5): 351-371.
- Capa, M. & López, E., 2003. Sabellidae (Annelida: Polychaeta) living in blocks of dead coral in the Coiba National Park, Panamá. *Journal of the Marine Biological Association of the UK*, 84 (1): 63-72.
- Capa, M., Nogueira, J.M. & Rossi, M.C., 2011. Comparative internal structure of dorsal lips and radiolar appendages in Sabellidae (Polychaeta) and phylogenetic implications. *Journal of Morphology*, 272 (3): 302-319.
- Castelli, A., Bianchi, C.N., Cantone, G., Cinar, M.E., Gambi, M.C. *et al.*, 2008. Annelida Polychaeta. *Biologia Marina Mediterranea*, 15 (Suppl. 1): 323-373.
- Çinar, M.E., 2005. Polychaetes from the coast of northern Cyprus (Eastern Mediterranean Sea), with two new records from the Mediterranean Sea. *Cahiers de Biologie Marine*, 46 (2): 143-159.
- Çinar, M.E., 2009. Alien polychaete species (Annelida: Polychaeta) on the southern coast of Turkey (Levantine Sea, eastern Mediterranean), with 13 new records for the Mediterranean Sea. *Journal of Natural History*, 43 (37-38): 2283-2328.
- Çinar, M.E., Bilecenoglu, M., Öztürk, B. & Can, A., 2006. New records of alien species on the Levantine coast of Turkey. *Aquatic Invasions*, 1 (2): 84-90.
- Claparède, E., 1868. Les annélides chétopodes du Golfe de Naples. *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, 19: 313-584.
- Cosentino, A., 2011. Microhabitat selection in a local syllid assemblage with the first record of *Syllis hyllebergi* (Syllinae) in the central Mediterranean. *Italian Journal of Zoology*, 78 (Suppl. 1): 267-279.

- Cosentino, A. & Giacobbe, S., 2011. The new potential invader *Linopherus canariensis* (Polychaeta: Amphinomidae) in a Mediterranean coastal lake: colonization dynamics and morphological remarks. *Marine Pollution Bulletin*, 62 (2): 236-245.
- Cosentino, A., Giacobbe, S. & Potoschi, A., 2009. The CSI of Faro coastal lake (Messina): a natural observatory for the incoming of marine alien species. *Biologia Marina Mediterranea*, 16 (1): 132-133.
- Dane, L., 2008. Morphological and genetic variation in the cryptic species complex *Myxicola infundibulum* (Polychaeta, Sabellidae), and its introduction to Australia. University of Melbourne
- Day, J.H., 1961. The polychaete fauna of South Africa. Part 6. Sedentary species dredged off Cape coasts with a few new records from the shore. *Journal of the Linnean Society of London*, 44 (299): 463-560.
- El Haddad, M., Capaccioni Azzati, R., & García-Carrascosa, A.M., 2008. *Branchiomma luctuosum* (Polychaeta: Sabellidae): a non-indigenous species at Valencia Port (western Mediterranean Sea, Spain). *Marine Biodiversity Records*, 1 (e61). doi:10.1017/S1755267207006604
- Fauvel, P., 1927. *Faune de France. Vol. 16. Polychètes sédentaires: addenda aux errantes, archiannélides, myzostomaires*. Paris, Paul Lechevalier, 494 pp.
- Fitzhugh, K., 2003. A new species of *Megalomma* Johansson, 1927 (Polychaeta: Sabellidae: Sabellinae) from Taiwan, with comments on Sabellidae dorsal lip classification. *Zoological Studies*, 42 (1): 106-134.
- Giangrande, A. & Licciano, M., 2008. Revision of the species of *Megalomma* (Polychaeta: Sabellidae) from the Mediterranean Sea, with the description of *M. messapicum* n. sp. *Italian Journal of Zoology*, 75 (2): 207-217.
- Goldman, L. & Chandler, R.E., 1986. Geographical distribution and inactivation kinetics in internally perfused *Myxicola* giant axons. *Biophysical Journal*, 49 (3): 761-766.
- Gravier, C., 1908. Contribution a l'étude des annélides polychètes de la Mer Rouge. *Nouvelles Archives du Muséum d'Histoire Naturelle de Paris*, 10: 67-168.
- Grube, E., 1869. Beschreibungen neuer oder weniger bekannter von Hr. Ehrenberg gesammelter Anneliden des rothen Meeres. *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin aus dem Jahre*, 484-521.
- Hartman, O., 1959. Catalogue of the Polychaetous Annelids of the World. Parts 1 & 2. *Occasional Papers of the Allan Hancock Foundation*, No.23, 628 pp.
- Hartman, O., 1974. Polychaetous annelids of the Indian Ocean including an account of species collected by members of the International Indian Ocean Expeditions, 1963-1964, and a catalogue and bibliography of the species from India. Part II. *Journal of the Marine Biological Association of India*, 16: 609-644.
- Hayward, P.J. & Ryland, J.S., 1995. *Handbook of the marine fauna of north-west Europe*. Oxford, Oxford University Press, 800 pp.
- Høisæter, T., 1989. Biological notes on some pyramidellidae (Gastropoda: Opisthobranchia) from Norway. *Sarsia*, 74 (4): 283-297.
- Knight-Jones, P., 1994. Two new species of *Branchiomma* (Sabellidae) with descriptions of closely related species and comments on *Pseudobranchiomma* and *Sabellastarte*. *Memoires du Museum National d'Histoire Naturelle*, 162: 191-198.
- Knight-Jones, P., 1997. Two new species of *Megalomma* (Sabellidae) from Sinai and New Zealand with redescrptions of some types and a new genus. *Bulletin of Marine Science*, 60 (2): 313-323.
- Knight-Jones, P., Knight-Jones, W. & Ergen, Z., 1991. Sabelliform polychaetes, mostly from Turkey's Aegean coast. *Journal of Natural History*, 25 (4): 837-858.
- Langton, R.W. & Robinson, W.E., 1990. Faunal associations on scallop grounds in the western Gulf of Maine. *Journal of Experimental Marine Biology & Ecology*, 144 (2-3): 157-171.
- Leonardi, M., Azzaro, F., Azzaro, M., Caruso, G., Mancuso, M. et al., 2009. A multidisciplinary study of the Cape Peloro brackish area (Messina, Italy): Characterization of trophic conditions, microbial abundances and activities. *Marine Ecology*, 30 (Suppl.1): 32-42.
- Licciano, M. & Giangrande, A., (2008). The genus *Branchiomma* within the Mediterranean Sea with description of the new species *B. maerli*. *Scientia Marina*, 72 (2): 383-391.
- Licciano, M., Giangrande, A. & Gambi, M.C., 2002. Reproduction and simultaneous hermaphroditism in *Branchiomma luctuosum* (Grube) (Polychaeta, Sabellidae) from Mediterranean Sea. *Invertebrate Biology*, 121 (1): 55-65.
- Matarrese, A., Mastrototaro, F., D'onghia, G., Maiorano, P. & Tursi, A., 2004. Mapping of the benthic communities in the Taranto seas using side-scan sonar and an underwater video camera. *Chemistry & Ecology*, 20 (5): 377-386.
- Maugeri, T.L., Gugliandolo, C., Caccamo, D. & La Rosa, T., 2001. Biomass and productivity of microbial communities in the brackish environments of Ganzirri and Faro (Messina). *Biologia Marina Mediterranea*, 8 (1): 316-321.
- McIntosh, W.C., 1885. Report on the Annelida Polychaeta collected by H. M. S. Challenger during the years 1873-76. *Report of the Scientific Results of the Voyage of H. M. S. Challenger London, Zoology*, 12: 1-554.
- Minchin, D., 2007. Aquaculture and transport in a changing environment: overlap and links in the spread of alien biota. *Marine Pollution Bulletin*, 55 (7-9): 302-313.
- Monro, C.C.A., 1933. On a collection of Polychaeta from Dry Tortugas, Florida. *Annals and Magazine of Natural History, London*, 10: 244-269.
- Nogueira De Matos, M.J., Silva Rossi, M.C. & López, E., 2006. Intertidal species of *Branchiomma* kölliker and *Pseudobranchiomma* jones (Polychaeta: Sabellidae: Sabellinae) occurring on rocky shores along the State of São Paulo, Southeastern Brazil. *Zoological Studies*, 45 (4): 586-610.
- Parentan, P., 1979. Fauna malacologica dei laghi di Ganzirri e del Faro (Messina). *Thalassia Salentina*, 9: 67-78.
- Perkins, T.H., 1984. Revision of *Demonax* Kinberg, *Hipsicomus* Grube, and *Notaulax* Tauber, with a review of *Megalomma* Johansson from Florida (Polychaeta: (Sabellidae). *Proceedings of the Biological Society of Washington*, 97 (2): 285-368.
- Rioja, E., 1951. Estudios Anelidológicos, 20. Observaciones acerca del *Dasychone bairdi* McIntosh (Poliqueto sabélido). *Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología*, 22: 513-516.
- Rioja, E., 1958. Estudios Anelidológicos, 22. Datos para el conocimiento de la fauna de anélidos poliquetos de las costas orientales de México. *Anales del Instituto de Bi-*

- ología, Universidad Nacional Autónoma de México, Serie Zoología, 29: 219-301.
- Román, S., Pérez-Ruzafa, Á. & López, E., 2009. First record in the Western Mediterranean Sea of *Branchiomma boholense* (Grube, 1878) (Polychaeta: Sabellidae), an alien species of Indo-Pacific origin. *Cahiers de Biologie Marine*, 50 (3): 241-250.
- Saccà, A., Guglielmo, L. & Bruni, V., 2008. Vertical and temporal microbial community patterns in a meromictic coastal lake influenced by the Straits of Messina up-welling system. *Hydrobiologia*, 600 (1): 89-104.
- Simboura, N. & Nicolaidou, A., 2001. The Polychaetes (Annelida, Polychaeta) of Greece: checklist, distribution and ecological characteristics. *Monographs on Marine Sciences, Series no. 4*. Athens, NCMR, 115 pp.
- Sordino, P. & Gambi, M.C., 1992. Prime osservazioni sulla biologia riproduttiva e sul ciclo vitale di *Branchiomma luctuosum* (Grube 1869) (Polychaeta Sabellidae). *Oebalia*, 17: 425-427.
- Tovar-Hernández, M. & Carrera-Parra, L.F., 2011. *Megalomma* Johansson, 1925 (Polychaeta: Sabellidae) from America and other world-wide localities, and phylogenetic relationships within the genus. *Zootaxa*, 2861: 1-71.
- Tovar-Hernández, M.A. & Knight-Jones, P., 2006. Species of *Branchiomma* (Polychaeta: Sabellidae) from the Caribbean Sea and Pacific coast of Panama. *Zootaxa*, 1189: 1-37.
- Tovar-Hernández, M.A. & Salazar-Vallejo, S.I., 2006. Sabellids (Polychaeta: Sabellidae) from the Grand Caribbean. *Zoological Studies*, 45 (1): 24-66.
- Tovar-Hernández, M.A., Méndez, N. & Salgado-Barragán, J., 2009. *Branchiomma bairdi*: a Caribbean hermaphrodite fan worm in the south-eastern Gulf of California (Polychaeta: Sabellidae). *Marine Biodiversity Records*, 2 (e43): 1-10.
- Tovar-Hernández, M.A., Yáñez-Rivera, B. & Bortolini-Rosales, J.L., 2011. Reproduction of the invasive fan worm *Branchiomma bairdi* (Polychaeta: Sabellidae) *Marine Biology Research*, 7 (1): 710-718.
- Wehe, T. & Fiege, D., 2002. Annotated checklist of the polychaete species of the seas surrounding the Arabian Peninsula: Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman, Arabian Gulf. *Fauna of Arabia*, 19: 7-238.
- Zenetos, A., Gofas, S., Verlaque, M., Çinar, M.E., García Raso, J.E. et al., 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterranean Marine Science*, 11 (2): 381-493.