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BRANCHIOSTOMA LANCEOLATUM (LEPTOCARDIA) ALONG THE ITALIAN COASTS: HISTORICAL AND NEW RECORDS

Abstract - In this paper we report a map of the distribution of *B. lanceolatum* along the Italian coasts updated with some recent records obtained partly from scientific papers (historical data), partly from grey literature and from the unpublished data collected by C.I.B.M staff and collaborators (new records). This study revealed that this species is widely distributed along the Italian coast and colonises several localities in Ligurian (Cogoleto, Corniglia, Meloria Shoals), Tyrrhenian (Carini Bay, Ischia, Piombino, Salina) and Adriatic Sea (Chioggia-Sdobba). Its finding in some new localities such as Piombino and Ostia suggests that it colonises sites where strong human impact is evident and not only areas with high naturalistic value. According to different authors coarse sediments with low percentage of silt and clay are preferred by the *Branchiostoma*, but our findings suggested that it can survive in sediment with a silt-clay fraction higher than 20% as well. In addition it was collected in a wider depth range than expected.
This paper suggests that the *B. lanceolatum* is not so rare as recently though and not strictly associated to specific ecological constraints or habitat.

Key words - *Branchiostoma lanceolatum*, distribution, Italy.

Riassunto - Branchiostoma lanceolatum *(Leptocardia) lungo le coste italiane: dati storici e nuovi ritrovamenti.* In questo lavoro viene riportata la carta di distribuzione del *B. lanceolatum* lungo le coste italiane. Essa è stata realizzata tenendo conto sia delle segnalazioni provenienti dalla letteratura pubblicata, sia dei nuovi ritrovamenti dei collaboratori del CIBM. Da questo studi emerge che l'anfiosso è ampiamente distribuito lungo le coste liguri (Cogoleto, Corniglia, Secche della Meloria), tirreniche (Baia di Carini, Ischia, Piombino, Ostia, Salina) ed adriatiche (Chioggia-Sdobba). Il suo ritrovamento in zone come Piombino ed Ostia suggerisce che questa specie è in grado di colonizzare anche siti soggetti ad impatto antropico e non solo aree di elevato valore naturalistico, come riportato in letteratura. Secondo molti autori, l'anfiosso prediligerebbe sedimenti grossolani con bassa percentuale di silt ed argilla. I nostri ritrovamenti dimostrano che questa specie colonizza anche sedimenti con una percentuale pelitica superiore al 20%. Esso, inoltre, è stato campionato in un range batimetrico più ampio di quanto ci si aspetterebbe sulla base della letteratura. Pertanto i nostri dati suggeriscono che il *B. lanceolatum* non è così raro e strettamente associato ad una ristretta nicchia ecologica come affermato da autori precedenti.

Parole chiave - *Branchiostoma lanceolatum*, distribuzione, Italia.

INTRODUCTION

Branchiostoma lanceolatum (Pallas, 1774) (ordo Leptocardia), known also as Amphioxus or lancet, is one of the most popular marine organisms because till the end of the century XIX many authors, pointed out its great scientific importance, and focused their attention to its body structure, development and phylogenetic relationship, aiming to relate the species to the vertebrate's embryology and phylogenesis (Hatschek, 1893; van Weel, 1937; Holland *et al.*, 1994). At present, one of the most widely accepted hypothesis supports that Leptocardia and Cordata originate from a common ancestral parent (Capanna & Ghirardelli, 1991). Ecological studies are very few if compared to morphological ones, although at the beginning of the last century *B. lanceolatum* was considered a species with a large distribution. In the fifties it was recorded by several authors in different sites along all coasts of the Mediterranean Sea (Istria-Croazia, Black Sea, Marmara Sea, North Africa, see Tortonese, 1956, for a review), in Sète (Spain) by Frize, (1960) in France by Monniot (1962). Monniot, in particular, studied homologous communities in Banyuls bay, Roscoff and Marsiglia comparing them to find out some relations between the clastic component of the sediment and the ecological constraints of *Branchiostoma*.
Parallel in Italy the species was found very abundant near Messina (Faro) and nearby Naples where according to Lo Bianco (cited in Tortonese, 1956) it was one of the most common animal among the local fauna. In the Adriatic sea it was rarely recorded except nearby a lagoon, from Sdobba to Chioggia (Vatova, 1949; Rossi & Orel, 1968) and off the Bari coast (Tortonese, 1956).
In the sixties Pérès & Picard (1964) proposed the first description of the ecology of this species and proposed a bionomic characterisation of the associated biocenosis. They described the biocoenoses of coarse sand and fine gravel under the bottom current (Sables Grossiers et des fins graviers sous l'influence des Courants de Fond or SGCF biocoenoses) and referred it to the *Branchiostoma lanceolatum*'s community better known as «Amphioxus sands».
These French authors described sediments associated with this community as rich in calcareous remnants of shells and algae and in microfauna but poor in macrofauna. They distinguished, in the Amphioxus'sands macrobenthos, 'exclusive species', such as *Glycera*

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lapidum, *Ophiopsila annulosa*, *Dosinia exoleta*, *Donax variegatus*, *Tellina crassa*, *Dentalium vulgare*, *Sigalion squamatum*, *Scolaricia typica*, *Armandia polyophthalma*, *Anapagurus breviaculeatus*, 'preferential species' such as *Psammobia costulata*, *Thalenessa dendrolepis*, species preferring bottom currents *i.e. Spatangus purpureus*, *Glycymeris glycymeris*, *Venus casina*, *Astarte fusca*, *Thracia papyracea*, and fine gravel sediments species (*Processa macrophthalma* and *P. elegantula*).
The ecology of the species was not studied again untill Dauvin (1988) who focused the attention on the structure and trophic organisation of the *Branchiostoma lanceolatum*'s community in the Morlaix bay (France), while in Spain Sardà (1999) described its seasonal dynamics on shallow soft bottoms in the Bay of Blanes (NW Mediterranean).
In Italy, ecological studies are scarce and obsolete or regards to abiotic features of the biocoenoses (Rossi & Orel, 1968; Albertelli & Cattaneo, 1977; De Biasi *et al.*, 1997).
In this paper we report a map of the distribution of *B. lanceolatum* along the Italian coasts updated with some recent records obtained partly from scientific papers, partly from grey literature and from the unpublished data collected by C.I.B.M staff and collaborators.

Material and methods

Study sites

Some features of the study sites (*i.e.* sampling gear, sieving mesh net) are given in Table 1.

Site 1: Meloria Shoals (Southern Ligurian Sea)
Meloria Shoals are an area located 3 miles off the Leghorn coast characterised by shallow rocky bottoms (from 2 to 25 m depth) about 30-40 km^2 wide. The sea floor is very heterogeneous: *Posidonia oceanica* meadow, dead *Posidonia* matte, and isolated *Posidonia* patches grow on rocky substrata surrounded by sandy soft bottoms (De Biasi, 1999; De Biasi & Gai, 2000). In this area peculiar semi-circular depressions inside the calcarenitic platform (beach rock), named «Catini» by the local fishermen are present (Bacci, 1969) where uncommon or rare species of meiofauna can settle (Huys & Todaro, 1997; Todaro & Kristensen, 1998).
Low turbidity waters are commonly observed in this area due to the high hydrodynamic conditions. In addition a sea-channel, 1 km large, between the Shoals and the coast creates a natural barrier contrasting the pollutants coming from the close Leghorn harbour.
Sampling. Sediment samples (3 replicates) were collected during the summer 1998 and 2000, using a squared frame sampling an area of 625 cm^2. After sorting every specimen of *B. laceolatum* was measured and wet weighed.

Site 2: Piombino (Northern Tyrrhenian Sea)
The Piombino is located between the «Gulf of Salivoli» and the delta of the river Cornia called «Tower of Sale» off the Tuscany coast. This area receives different discharges and water flows from the river Cornia. Sub-littoral sediments of the bay are also influenced by the Piombino harbour and by the sewage outfall from the town. Up to 20 m depth, the sea floor between the gulf of Salivoli and the Piombino harbour were characterised by *P. oceanica* on matte and by inter-matte channels where coarse sediments were present. The remaining part of the bay presented patches of *P. oceanica* meadow, dead matte and fine-sand sediments. From 20 to 30 m depth, only dead matte was widely observed. It is a clear indication to a larger ancient meadow regressed as a consequence of the increased anthropogenic influence. Here the sediments became poorer in sand and richer in silt.
Sampling. During the winter 2000 samples (two replicates) were collected at 6 and 30 m depth.

Site 3: Salina, Aeolian Achipelago (Southern Tyrrhenian Sea)
Salina is an extinct volcano of the Aeolian Archipelago forming a volcanic structure covering an area of about 460 km^2. It is located off the Sicilian coast near the Messina Strait.
Sampling. The samples were collected in November 2000 near the harbour in shallow waters (10 m).

Site 4: Cogoleto (Northern Ligurian Sea)
Cogoleto site is situated between Savona and Genova. The marine area in front of the Cogoleto beach was colonised by a small *Cymodocea nodosa* meadow and a wide *P. oceanica* bed located between the Torrente Arrestra and Lerone river delta (Bianchi & Peirano, 1995).
Posidonia oceanica meadow is situated between 5 and 20 m depth with an extension of about 43 hectares. It is sloughed by irregular channels, sand bare and holes. The meadow showed signs of erosion/degradation that may be a consequence of the urban sewage, industrial discharge (contaminated mainly by IPA and chrome) and terrigenous inputs.
Sampling. Samples were collected during the winter in 15 stations at increasing distance from the coast, between 5 and 50 m depth.

Site 5: Carini bay, Palermo (Southern Tyrrhenian Sea)
During May 1998 the benthic communities of the east part of the Carini bay were investigated. From the coast down to 50 meters depth sediments were composed mostly by sand. Patches of *C. nodosa* colonised the area from very shallow bottoms down to 30 meters. At increasing depth coarse sediments were progressively substituted by silt and clay.
Sampling. Samples were collected in 8 stations (two replicates) along a transects from 5 to 60 m depth. Specimens of *B. lanceolatum* were measured and wet weighted.

Site 6: Porto Torres, Sardinia (Sardinian Sea)
Porto Torres is located in the north west part of the Sardinia Island. The sea floor inside Porto Torres was characterised by sand from 3 to about 8 meters depth and by patches of muddy-sand sediments and dead matte from 8 to 20 meters depth. A small *P. oceanica*

meadow on matte was observed down to 20 meters depth.
Sampling. Samples were collected at four stations at different depth (7, 20, 28 m).

Site 7: Ostia-Rome (Middle Tyrrhenian Sea)
Ostia site is located along the Roman coast, nearby the Fiumicino Airport and the delta of the river Tevere, which convoys all sewages of Rome into the sea. All the area is characterised by soft sediments. The typical sequence SFBC (Sable Fin Bien Calibré), VTC (Vase Terrigène Côtier), VP (Vase Profond) according to Pérès & Picad (1964) was observed between 6 and 130 m depth.
Sampling. During the autumn 1999 samples were collected in 6 stations distributed along a transect at increasing distance from the coast, between 5 and 135 m depth.

In all the stations mentioned above an additional quota of sediment was sampled for particle size analyses and organic matter content.
Particle size analysis was carried out according to the Udden-Wentworth Phi classification. Each sample, after washing in 16% hydrogen peroxide for 24 hours, was wet sieved on a 63 (m mesh to sort the fine fraction. The sand fraction was sieved through a stack of geological test-sieves ranging from 0 Phi to +4 Phi. Organic matter was determined by ashing at 450°C for 4 h after removing excess carbonate with 10% HCl.

Data analysis
To compare the faunistic assemblages recorded together with the *B. lanceolatum*, all the species lists from the different locations were collected in a species-station matrix and subject to Multivariate Analysis. The data set contained a total number of 425 taxa and 30 stations. Considerable effort was made to update the taxonomic nomenclature of species, sometime very old and disomogeneous.
To standardise data obtained from several investigations with different aims and different sampling methods comparison was carried out using presence/absence data being the abundance data not comparable.
To perform the analyses of the data the *PRIMER* statistical software package was used (see Clark & Warwick, 1994, for a full description).
A large number of species occurred at very low frequency (232 specie were recorded in only one station), so we sequentially reduced the species number of the dataset and the analysis was run iteratively on the species occurring more than a single record. The reduced data set contained a total of 100 taxa. Furthermore, data were aggregated at genus level (298) and the analysis was re-run.
Cluster analysis was performed using the Bray-Curtis similarity index and dendrogram was obtained by the group average clustering method. The resultant similarity matrix was used to perform non-metric multidimensional scaling, identifying separate clusters from the dendrograms.
Species collected with *B. lanceolatum* in different sites were compared from a bionomic point of view. The bionomic features or the ecological preferences of each species were stated according to the following authors: Pérès & Picard, 1964; Amouroux, 1974; Bourcier *et al.*, 1979; Bellan *et al.*, 1980; Nodot *et al.*, 1984; Rinelli & Spanò, 1985; 1997; Salen-Picard, 1985; Augier, 1992.

RESULTS

Geographical distribution
The distribution of *B. lanceolatum* along the Italian coasts is showed in Figure 1 where records after 1968 from the literature are reported with our new records. Some information about the sampling sites were summarised in Table 1. Bedulli *et al.* (1986) recorded *B. lanceolatum* off the Puglia coasts (Ionian Sea), without reporting a full description of the sediments and associated fauna. So it was not discussed hereafter but included in the map.

Historical records: ecological remarks
Sdobba-Chioggia area (North Adriatic sea) (Rossi & Orel, 1968)
Off the coast from Punta Sdobba to Chioggia (North Adriatic Sea) *Branchiostoma* was found between 6 and 25 m depth living in sediments composed mainly by

Fig. 1 - Distribution of *Branchiostoma lanceolatum* (Pallas) along the Italian coasts. ♦: Historical records from the literature (after 1968); ♣: Our records. Map and symbols not in scale.

Tab. 1 - Locality, sampling date (month and year), depth, sampling gears and mesh size, grain size and organic carbon content of the sampling stations.

Locality	Depth (m)	Data	Sampling gear, mesh size	Sediment Grain Size	Organic matter (g/kg)	References
Chioggia-Sdobba (North Adriatic Sea)	6-25	Summer, 1967	Van Veen (0.2 m^2)	coarse sand	-	♦ Rossi & Orel, 1968
Corniglia (Ligurian Sea)	29	1977	Van Veen (12 l)	coarse/muddy sand	-	♦ Albertelli & Cattaneo, 1977
Salento Peninsula South Adriatic Sea - Ionian Sea	-	1986	Van Veen (0.3 m^2), 1 mm	-	-	♦ Bedulli *et al.*, 1986
Meloria Shoals (South Ligurian Sea)	4-12	1980	-	coarse sand	-	♦ Cognetti, 1981
Carini Bay (Tyrrhenian Sea)	37	Sept, 1995	Van Veen (16 l), 1 mm	fine sand	0.1-0.33	♦ De Biasi *et al.*, 1997
Ischia (South Tyrrhenian Sea)	8-10	May, 1994	-	coarse sand	-	♦ Gambi (pers. com.)
Carini Bay (Tyrrhenian Sea)	37, 45	May, 1998	Van Veen (16 l), 1 mm	fine sand	0.1-0.33	♣ our record
Meloria Shoals (North Tyrrhenian Sea)	6-11	June, 1998	Scuba diving (625 m^2), 0,1 mm	coarse sand	0.21-0.37	♣ our record
Porto Torres (North Sardinia)	7	July, 1999	Chaccot dredge (50l), 1 mm	-	0.28	♣ our record
Ostia (Central Tyrrhenian Sea)	5	Nov., 1999	Van Veen (0.168 m^2), 1 mm	coarse sand	0.99	♣ our record
Cogoleto (Ligurian Sea)	11, 42, 79	Dec., 1999	Van Veen (0.168 m^2), 1 mm	sandy mud muddy sand	0.17-0.28 0.79	♣ Bigongiari (pers. com.)
Meloria Shoals (South Ligurian Sea)	6	June, 2000	Scuba diving (625 m^2), 0,1 mm	coarse sand	0.9	♣ our record
Piombino (North Tyrrhenian Sea)	6, 30	Nov., 2000	Van Veen (0.168 m^2), 1 mm	fine sand	0.25-0.4	♣ our record
Salina Island (South Tyrrhenian Sea)	10	Nov., 2000	Van Veen (0.168 m^2), 1 mm	coarse sand	0.17-0.9	♣ our record

(-): Data not available.

sand and organic debris (shells of *Glycymeris glycymeris*, *Cardium* sp., *Chlamys* sp. and tallus of calcareous algae).
The commonest species recorded were *Nucula nucleus*, *Callista chione*, *Corbula gibba*, *Armandia polyophtalma*, *Eunice vittata*, *Glycera lapidum*, *G. gigantea*, *Ophiura albida.*

Corniglia (Ligurian Sea) (Albertelli & Cattaneo, 1977)
The Ampioxus was recorded off the Ligurian coast for the first time in 1977 off a small village named Corniglia (Cinque Terre) at 29 m depth. Only two specimens are reported in the literature: they were 3.55 and 3.65 cm long, and 0.40 and 0.35 cm large, respectively. These individuals were found in a stratified sediments characterised by coarse superficial sand and deeper muddy sand. The organogenus biodetritus was not consistent mainly consisting of dead molluscs and serpulid tubes.
The macrobenthic organisms collected were ascribed to different biocenoses. The most abundant were loving sand species such as *Ophiura grubei*, *Ampelisca gibba*, *A. spinipes*, *Hippomedon massiliensis*, *Donax* sp., *Nucula nucleus*, *Thracia corbuloides.*

Carini bay-Palermo (South Tyrrhenian Sea) (De Biasi *et al.*, 1997)
In 1995 this species was found at two different distance from the coast. 33 specimens were recorded at 37 m depth where the sea floor is constituted mainly by fragments and shells of bivalves, gastropods and echinoids. Sediments were composed by 99.5% in sand and 0.5% in silt/clay. In addition 6 specimens were recorded at 45 m depth where the sediments showed 92.7% of sand and 7.3% of silt/clay. According to De Biasi *et al.* (1997) this species showed a very patchy distribution: a great variability was in fact observed among the replicates.

Casamicciola, Ischia Island Gulf of Naples (Tyrrhenian Sea) (Gambi *et al.*, 1997)
According to Gambi (pers. comm.) *B. lanceolatum* was present in this area where it was collected by the fishing service of 'Stazione Zoologica di Napoli' for different aims, but actually there are not information about its presence. Infact, Gambi *et al.* (1997) described a typical '*Amphioxus*-sand' community in a very coarse sediments located at around 8-10 m depth off Casamicciola situated along the northern coast of Ischia (Middle Tyrrhenian Sea). But no speciemens of *B. lanceolatum* were collected. In this study the authors focused their attention only on interstitial polychaetes (such as *Protodorvillea kefersteini*, *Ophiodromus flexuosus*, *Saccocirrus papillocercus*), so no information exists about other macrobenthic taxa (Soldi *et al.*, 1994).

New records

Site 1: Meloria Shoals
During the summer 1998 seven specimens of *B. lanceolatum* were collected in Meloria Shoals in five «Catini» between 4 and 12 m depth. The organisms were between 1 and 4 centimetres long and between 1.5 and 4.5 millimetres large. Their wet weight ranged from 3 to 273 mg.
The organic matter of the sediments varied from 2.14 and 3.71 g/kg. The lowest value of gravel (17.1%) and the highest percentage of sand (82.9%) were recorded in the deepest «Catino». The content of gravel and sand in the shallowest «Catino» were respectively 45% and 55%, 56.2% and 45.2%, 28.3% and 71.7%. The organic matter content was 2.26% (Huys & Todaro, 1997).
The most abundant species were *Aricidea cerrutii*, *Gyptis* cfr. *propinqua*, *Odontosyllis* cfr *gibba*, *Pisione remota*, *Polygordius* cfr. *appendiculatus*, *Polyophthalmus pictus*, *Protodorvillea kefersteini*, *Pseudosyllis brevipennis*, *Saccocirrus papillocercus*, *Syllis* cfr. *hyalina*, *Syllis prolifera*, *Caprella lilliput*, *Idunella nana*, *Leptocheirus hirsutimanus*, *Stenothoe elachista*, *Amphiura cfr. cerbonnieri*, *Amphiura chiaiej.* Other characteristic species were *Eunice vittata* and *Glycera lapidum*, usually ascribed to the *B. lanceolatum*'s community.
Two years later (summer 2000) the *B. lanceolatum* was recorded again in only one *Catino* at 7 m depth. The organic matter content was 0.9 g/kg. The percentage of gravel and sand were 26.4 and 65.85 respectively. The fine grain fraction content was very low (7.75%). The most abundant species were *Stenothoe elachista*, *Caprella lilliput*, *Saccocirrus papillocercus*, *Ophiodromus pallidus*, *Protodrilus* sp., *Aspidosiphon mülleri*, *Amphiura* juv.

Site 2: Piombino
Branchiostoma lanceolatum was recently (November 2000) collected off Piombino at two different depths. At the shallowest site (6 m depth) three specimens were found. The sediment was composed by sand (69.93%), silt/clay (20.65%) and gravel (9.43%). Substratum was composed mainly by biogenic calcareous fragments of dead shells. At 30 m depth where sediments were constituted mostly by sand (94%) with a small percentage of gravel (6%) three specimens were collected. Biodetritus of shells, bioclasts of red encrusting algae (genus *Peyssonnelia* and *Lithophyllum*) and dead bryozoans were abundant. The most common recorded species were *Eunice vittata*, *Pisione remota*, *Psammechinus microtuberculatus*, *Phascolion strombi*, *Callista chione*, *Donax variegatus* and *Dosinia exoleta.*

Site 3: Salina, Aeolian Islands
In Salina Island a total of nine specimens of *Branchiostoma* were collected in two stations both located at 10 m depth characterised by coarse sediments. Nearby the dock they were constituted 19% of gravel and 80% of sand. A few meters apart, bottoms were almost pure sand (95%) with a very small percentage of gravel (3%). The clay percentage was always very low and never exceeded 4.47%. The organic matter content was 9.9 g/kg. The sand species (*Lumbrineris tetraura*, *Euclymene oerstedi* and *Echinocardium cordatum*) were very abundant. Also many interstitial

species (*Protodorvillea kefersteini*, *Exogone meridionalis*, *Sphaerosyllis taylori*, *Parapionosyllis labronica*) occurred.

Site 4: Cogoleto (Bigongiari, pers. comm.)
On May 2000 in Cogoleto site this species was recorded in three stations at 11, 42 and 79 m depth where three, six, one specimens were collected respectively. The benthic assemblage was dominated by *Phascolion strombi*, *Corbula gibba*, *Loripes lacteus*, *Amphipholis squamata* and *Turritella communis*. In addition *Eunice vittata*, *Spatangus purpureus*, and *Scolaricia typica* occurred.

Site 4: Carini bay-Palermo
In 1998, 16 specimens were found at 11 m depth in the same area investigated in 1995. Specimens were between 1 and 2.2 cm long and between 1 and 3 mm large. Their weight ranged between 2.8 and 25.5 mg. *Glycera lapidum* and *Nephtys cirrosa* were the most abundant species recorded in association.

Site 5: Porto Torres, Sardinia
At Porto Torres only one specimen was found at 7 m depth. Sediments were mostly sandy, no further information are available. The most abundant species collected together were *Dioplodonta apicalis*, *Glans trapezia*, *Corophium sextonae* and *Leptochelia savigny*. Also *Spatangus purpureus* occurred.

Site 6: Ostia-Rome
Off Ostia three specimens of the *B. lanceolatum* were found in sandy sediments at 5 m depth. Sediments were almost pure sand (96.1%) with a very small percentage of silt/clay (3.89%). The organic matter content was 0.99 g/kg. The N and P total value were 0.014 and 0.74 g/kg, respectively. Among others *Glycera rouxii*, *Protodorvillea kefersteini* and *Tellina tenuis* were recorded as the most abundant species.

Comparison among sites
A total of 425 species were listed in association with *B. lanceolatum* from the different sites studied.
They belong to Polychaeta, Mollusca, Crustacea, Echinodermata, Lophophorata, Porifera, Coelenterata, Platyhelminthes, Nematoda, Sipuncula, Pycnogonida, Tunicata and Nemertea. Polychaeta is the most abundant taxon, followed by Mollusca and Sipuncula.
The cluster analysis carried out on the total data set (425 x 30) revealed very low similarities among the sites, so it is not reported here.
Figure 2 is the dendrogram showing stations affinities based on presence/absence of 100 most important species (*i.e.* present in more than one station) using the Bray-Curtis measure of similarity and group-average sorting. Very low similarity values among the sites were recorded, anyway two clear groups were defined: the first one included Meloria sites, the second one Cogoleto sites.
Figure 3 shows the results of Multi-Dimensional Scaling. This analysis gives essentially the same picture as the dendrogram.
Both analyses suggested that it is very difficult to identify a faunistic assemblage typically associated to *B. lanceolatum*. But some species were found in almost all the lists taken into account here. These species are reported in Table 2. Most of them are polychaetes; two echinoderms, two crustaceans, two molluscs and two sipunculans. This list includes species with different ecological constraints: indicators of sedimentary instability or organic enrichment (*Corbula gibba*, *Lumbrineris latreilli*, *Glycera rouxii*), lovely sand species (*Nephtys hombergii*, *Gyptis propinqua*), LRE

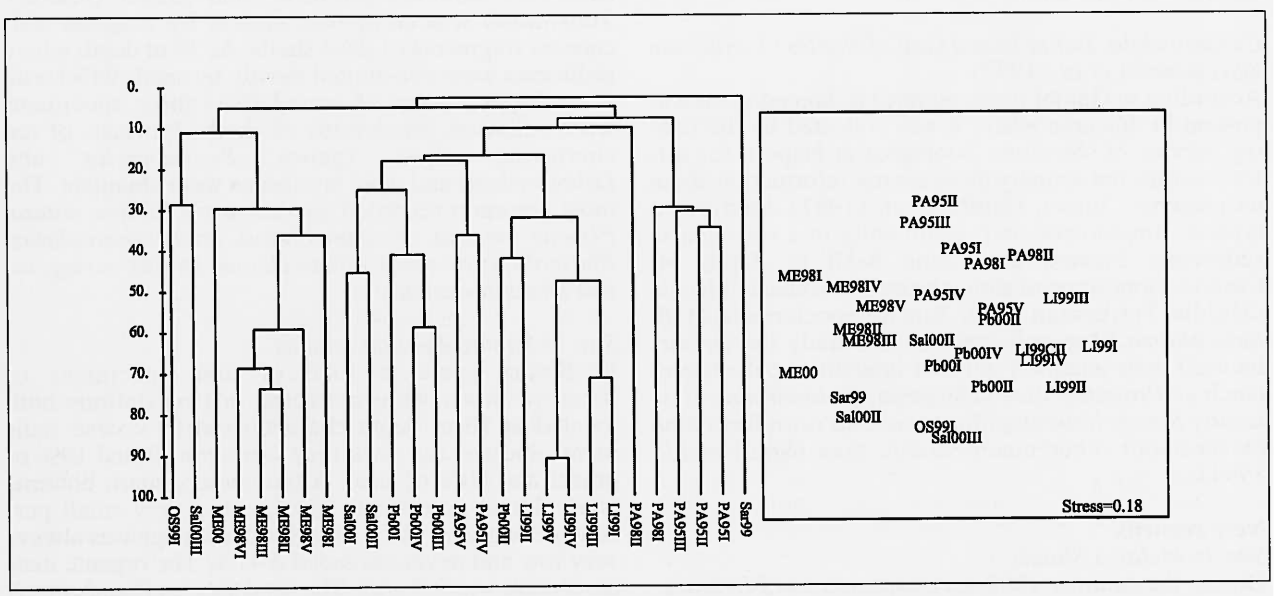

Fig. 2 - Cluster analysis (group average clustering) and nMDS on presence/absence data matrix (100 most important species). Similarity was calculated as Bray-Curtis index. PA: Palermo; LI: Cogoleto; Pb: Piombino; Sal: Salina; OS: Ostia; ME: Meloria; Sar: Porto Torres.

Tab. 2 - Most important species.

Taxon	Species	Ecology/Bionomy	Frequency (%)
Sip	*Phascolion strombi* (Montagu, 1804)	Lre	33
Pol	*Protodorvillea kefersteini* (Mc Intosh, 1879)	Mi	33
Pol	*Glycera lapidum* Quatrefages, 1865	-	30
Pol	*Glycera rouxii* Audouin & Milne - Edwards, 1833	Muddy / Mi	27
Pol	*Lumbrineris latreilli* Audouin & Milne - Edwards, 1834	Mo	27
Pol	*Polygordius appendiculatus* Fraipont, 1887	-	27
Ech	*Amphipholis squamata* (Delle Chiaje, 1828)	Lre	23
Pol	*Aponuphis (Hyalinoecia) bilineata* (Baird, 1870)	Glar	23
Pol	*Aricidea cerrutii* Laubier, 1966	Int	23
Pol	*Eunice vittata* (Delle Chiaje, 1828)	Lre	23
Cru	*Gammarus* sp.	-	23
Pol	*Nephtys hombergii* Savigny, 1818	SFBC Pref	23
Sip	*Aspidosiphon muelleri* Diesing, 1851	Lre/Mi	20
Mol	*Corbula gibba* Olivi, 1792	Mi	20
Pol	*Notomastus latericeus* M. Sars, 1851	Sm	20
Pol	*Saccocirrus papillocercus* Bobretzkty, 1871	SGBV Ex	20
Pol	*Chone duneri* Malmgren, 1867	Sandy	17
Pol	*Eteone foliosa* Quatrefagies, 1865	-	17
Pol	*Euclymene palermitana* (Grube, 1840)	DE Ex	17
Pol	*Gyptis propinqua* Marion & Bobretzky, 1875	Sandy	17
Mol	*Parvicardium exiguum* (Gmelin, 1791)	ETP	17
Pol	*Pisione remota* (Southern, 1919)	Int	17
Ech	*Psammechinus microtuberculatus* (Blainville, 1825)	Dc Pref	17
Pol	*Scolaricia typica* Eisig, 1914	SGCF Ex	17
Cru	*Stenothoe elachista* Krapp-Schickel, 1976	SGCF	17
Pol	*Syllis* sp.	-	17

Numbers indicate frequency (%). Pol: Polychaeta; Sip: Sipuncula; Cru: Crustacea; Ech: Echinodermata; Mol: Molluscha; Lre: wide ecological distribution; Mi: indicator of instability; Mo: indicator of organic enrichment; Glar: glareicolous; Int: interstitial; SFBC: well sort fine sand biocoenosis; Sm: mediolittoral sand; SGBV: coarse sand under waves action; SGCF: coarse sand under bottom currents biocoenosis; DC: coastal detritic biocoenosis; DE: muddy detritic biocoenosis; ETP: very polluted waters; Muddy/sandy: loving muddy/sandy bottoms. Ex: exclusive; Pref: preferring.

species (Large Repartition Ecologique) (*Phascolion strombi*, *Eunice vittata*).
Only one species – *Scolaricia typica* – is reported by Pérès and Picard in their classical bionomic paper as characteristic of the *B. lanceolatum* community or of the Coarse Sands under bottom currents Biocoenoses (SGCF Sable Grossiers et des fins graviers sous l'influence des Courants de Fond).
Analysis at genus level gave no additional information, so it was not reported.

DISCUSSION

This study revealed that *B. lanceolatum* is widely distributed along the Italian coast and colonises several localities in Ligurian, Tyrrhenian and Adriatic Sea.
The species was probably very abundant in the past but nowadays it is strongly reduced in some areas (*i.e.* Naples, Gambi pers. comm) or completely disappeared in others *e.g.* Messina where, according to Tortonese (1956), it used to be one of the most important and abundant species. On the contrary in other areas such as Cogoleto the *B. lanceolatum* still remains. Its finding in some new localities such as Piombino and Ostia suggests that it colonises sites where strong human impact is evident and not only areas with high naturalistic value, as pointed out by Cognetti (1990).
Grain size is one of the most compelling ecological constraint to its settlement and survival. According to different authors coarse sediments with low percentage of silt and clay are preferred by *Branchiostoma* (Rossi & Orel, 1968; Albertelli & Cattaneo, 1977; De Biasi *et al.*, 1997). Most of our findings reflect this characteristic but Piombino where *B. lanceolatum* was found in sediment with a silt-clay fraction higher than 20%.
In addition, it was recorded in a wide depth range from very shallow waters down to 80 m depth in sites with different percentage of organic matter suggesting that physical-chemical environmental factors affecting the distribution of this species act in a more complex way than expected. It is noteworthy that this species was recorded down to 100 m depth off the Atlantic coasts (Cabioch, 1961).
There is a correspondence between variability in environmental factors and the heterogeneity – in composition and bionomic characterisation – observed in the species associated with *Branchiostoma*.
In fact, although many sand species were collected, our list enumerates organisms with a wide spectrum of ecological requirements, so a peculiar faunal assemblage typically associated to *B. lanceolatum* is difficult to identify.
It is noteworthy that reducing the taxonomic resolution at genus level only 298 descriptors were obtained. This means that many species are congeneric. For example our list enumerates nine species belonging to the *Syllis* genus, three species belonging to the *Stenothoe* genus,

and so on. According to this result we can't neglect any mistakes in taxonomic identification. It is not possible to ensure that 'species' were recognised consistently across different studies. It can partly increase species variability but anyway not sufficient in explaining the sharp differences of the most sites in species composition.

This paper suggests that *B. lanceolatum* is not so rare as recently though and not strictly associated to specific ecological constraints or habitat with high naturalistic value.

Taxonomic mistakes in *Branchiostoma* identification can be excluded and for its large body size it can not be easily lost or unseen during sample sorting so two hypotheses can be advanced to explain the lack of records for many years along Italian waters.

This species can be really underestimated because it is able to burrow very fast in the sediment (Gambi pers. comm.) avoiding it to be sampled with the usual sampling gears. This behaviour is made easier in coarse sediments where it generally lives. In addition the *Branchiostoma* showed a contrasting seasonal pattern compared to many other macrofaunal species: it is much reduced in spring and summer and abundant in autumn (Sardà, 1999).

This peculiar seasonality can increase its underestimate. It is well known that benthic community investigations are often carried out during the warm seasons. Some authors argued that summer is the best season to sample both for trend detection and impact assessment (Alden, 1997), being communities well structured and macroinvertebrate generally reached their peak in abundance.

In conclusion *B. lanceolatum* showed wide distribution along Italian waters and unexpectedly it was also found in polluted area, suggesting that, despite the scientific attention about *Branchiostoma lanceolatum* ecology has been gradually increased in the last 50 years, there is still an urgent need of more focused autoecological studies.

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