A5.61: Polychaete worm reefs in the Mediterranean infralittoral zone

Summary

In the Mediterranean area, worm reefs are built by the sabellarids *Sabellaria alveolata* and *S. spinulosa* and the serpulids *Hydroides dianthus* and *Ficopomatus enigmaticus.* Their development is assured by the gregarious settlement of polychaete larvae, which occurs mainly on pre-existing reefs or their dead remains. In confined brackish-water habitats, bioconstructions made by the dense accumulation of the serpulid calcareous tube builders, can occur as fringing reefs along the shoreline, or can develop as dense patch reefs growing from the bottom. The filtration activity of these worms can condition the trophic state of entire lagoon ecosystems.

Worm reefs are highly vulnerable and sensitive to direct and indirect anthropogenic disturbance. Both fishing and associated trampling and intensive mussel cultivations can seriously damage this fragile habitat. Moreover alien introduced species and acidification can have potential impact on them. Their reefs, which often act as nurseries for many coastal species, can take many years to recover, and some may never recover. Understanding those parameters that influence the reef dynamics is necessary in order to develop efficient and effective management practices and policy focusing on the conservation status of large biogenic structures.

Synthesis

At present, the knowledge of Mediterranean worm reefs in the infralittoral is too fragmentary, with little information about extent of occurrence or its area of occupancy. There have been no quantitative analysis to determine their current conservation status and to define their dynamics, in order to evaluate threats and impacts and to highlight the conservation needs or suggest management measures and protection actions. As a result, there is insufficient data to properly assess the habitat against any of the red list criteria, and the Mediterranean Polychaete worm reefs are listed as Data Deficient for both EU 28 and EU 28+.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Data Deficient	-	Data Deficient	-

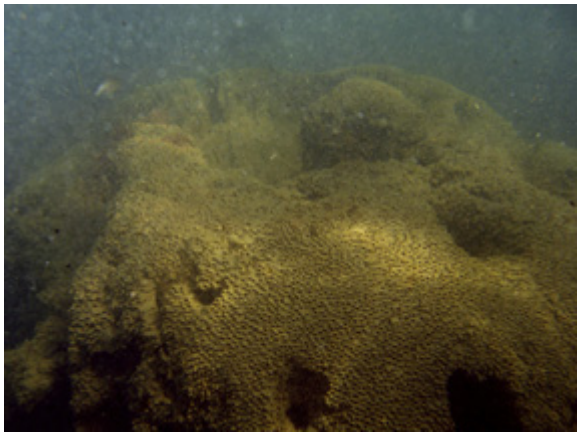
Sub-habitat types that may require further examination

Sabellaria reefs.

Habitat Type

Code and name

A5.61: Polychaete worm reefs in the Mediterranean infralittoral zone



Sabellaria spinulosa reef from Torre Mileto Adriatic Sea (© Corriero).

Sabellaria alveolata reef from the eastern Liguria Riviera (© L. Tunesi)

Habitat description

Worm reefs are large bioconstructions built by polychaetes the most important of which in the Mediterranean are the sabellarids *Sabellaria alveolata* and *S. spinulosa* and the serpulids *Hydroides dianthus* and *Ficopomatus enigmaticus.* The development of such reefs is assured by the gregarious settlement of polychaete larvae, which occurs mainly on pre-existing reefs or their dead remains.

Sabellaria bioconstructions can be relatively unstable and undergo a natural cycle of development and decay, they can form relatively quickly and may take the form of sheets, hummocks and reefs as well as evolving from globular formations into reef platforms. Reefs may persist in an area for many years although individual clumps may regularly form and disintegrate. *Sabellaria alveolata* reefs in the Mediterranean are located between 1 to 7 m of depth where can reach 60 cm thick when they are well developed. In most sites, however, they tend to be very scattered and not particularly extensive

Most serpulids are considered to be 'secondary frame builders'. *Ficopomatus enigmaticus,* typically growing in coastal lagoons and brackish water lakes, can form large reefs. They can occur as a fringing reef along the rocky shoreline, forming a continuous layer that can reach up to 3 m thick, at a depth of about 1 m, or can develop as dense patch reefs growing from the bottom, with hemispherical forms called micro atolls (over 2 m height and 4 m in diameter) and with a distribution related to the depth (from 0.5 to 1.5 m).

This habitat provides a diversity of microhabitats increasing available substrate for numerous species; sheltering both hard and soft-bottom rare species which are potential colonizers of adjacent habitats; providing refuge for invertebrates including snails and crabs that may have an impact on native species communities and are attractive for some fish such as *Sygnathus abasteri, Aphanius fasciatus* and *Knipowitschia panizzae*

Indicators of quality

The status and dynamics of the reefs must be defined integrating the physical characteristics, taking into account the degree of fragmentation of reef features (mainly produced by species which are known to degrade, smother and break up areas of *Sabellaria*, e.g. the mussel *Mytilus galloprovinciallis*), and the prevalence of different structural characteristics within the reef formations. The health of the reefs can be determined with reference to the percentage of newly settled worms, those with crisp apertures, those with worn apertures and dead worms.

Characteristic species:

The associated fauna in *S. alveolata reefs* is rich and diversified. The most abundant species are *Apseudes latreillii, Quadrimaera inaequipes, Leptochelia savignyi*, and *Monocorophium sextonae*, among crustacean

and *Striarca lactea* among mollusc. Abundant species of polychaete are *Nereis falsa* and *Eulalia ornate*.

Ficopomatus enigmaticus is the primary builder in the serpulid reefs. Its tubes form the bases of the biocontruction, but other organisms such as the barnacles *Balanus eburneus* and *B. amphitrite*, and the molluscs *Mytilaster lienatus* and *M. marioni* can contribute to the reef formation and can be treated as secondary builders. Other organisms such as the bryozoan *Conopeum seurati*, can stabilize the formation with its encrusting colonies which cementate the tubes. Other colonial organisms such as the hydroid *Cordylophora cassia*, the bryozoan *Bowerbankia gracilis*, and the tunicate *Botryllus schlosseri* can simply colonize this secondary substrate. The reef can host a lot of vagile invertebrates such as isopods (*Lekanesphaera hookeri, L. monody, Sphaeroma serratum, C. ascherusicum*) and gammarids (*Gammarus aequicauda, G. insensibilis*) and other polychaetes such as *Hediste diversicolor, Neanthes succinea*, and several polydorids

Classification

EUNIS (v1405):

Level 4. A sub-habitat of 'Mediterranean infralittoral biogenic habitat' (A5.6).

Annex 1:

1170 Reefs

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral rock and biogenic reef

Shallow sublittoral sand

EUSeaMap:

Shallow photic rock or biogenic reef

Shallow aphotic rock or biogentic reef

Shallow coarse or mixed sediments

IUCN:

9.2 Subtidal rocky and rocky reefs

9.4 Subtidal sandy

Barcelona Convention (RAC/SPA):

III. 1. 1. 2. Facies with *Ficopomatus enigmaticus*

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?

Unknown

Justification

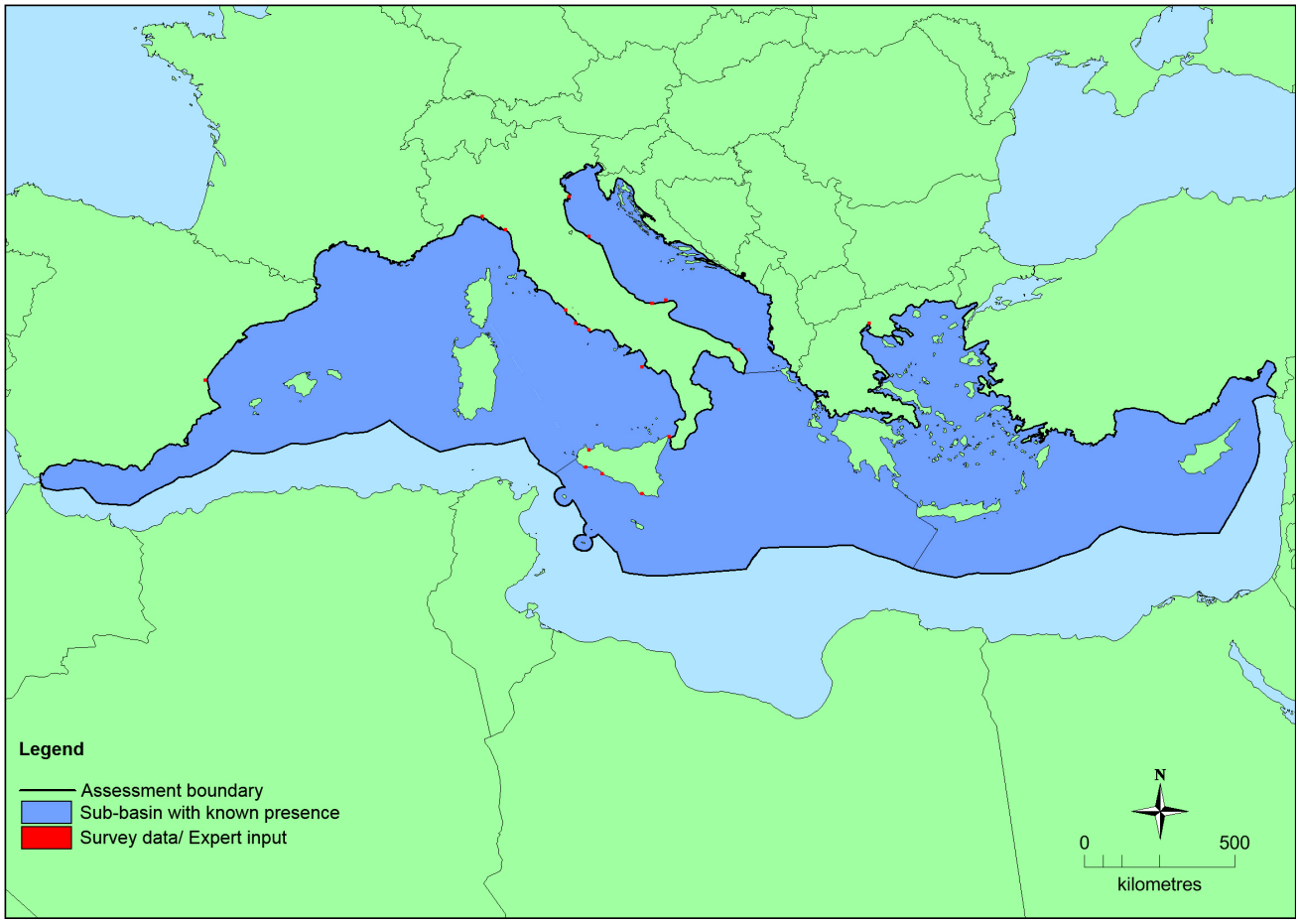
Geographic occurrence and trends

Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Mediterranean Sea	Adriatic Sea: Present Aegian-Levantine Sea: Present Ionian Sea and the Central Mediterranean Sea: Present Western Mediterranean Sea: Present	Unknown Km^2	Unknown	Unknown

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	943,913 Km^2	>19	Unknown Km^2	EOO and AOO have been calculated on the available data but this is known to be incomplete.
EU 28+	>943,913 Km^2	>19	Unknown Km^2	EOO and AOO have been calculated on the available data but this is known to be incomplete.

Distribution map



This map has been generated using data based on Bianchi et al.,1995; Giangrande, A. et al., 2012. and IUCN EOO and AOO have been calculated on the available data presented in this map however these should be treated with caution as expert opinion is that this may not indicate the full distribution of the habitat.

How much of the current distribution of the habitat type lies within the EU 28?

Unknown. Only information regarding the distribution of this habitat in EU is available. Large biogenic formations of *S. spinulosa* had been found along the Adriatic coast (from Ancona to Gargano, Italy).

Trends in quantity

The knowledge on Mediterranean reefs is too fragmentary to evaluate their distribution and quantity especially concerning *Sabellaria*. As far as *Ficopomatus* a surface area of 6 km^2 was computed along Ligurian coast.

- Average current trend in quantity (extent)
  EU 28: Unknown
  EU 28+: Unknown
- Does the habitat type have a small natural range following regression?
  No
  Justification
  The habitat has an EOO larger than 50,000 km^2.

- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No

Justification
The habitat is widespread along the Mediterranean coast.

Trends in quality

The status and dynamics of the reefs can be defined integrating the physical characteristic, taking into account the degree of fragmentation of reef features, cover by species which are known to degrade, smother and break up areas of *Sabellaria* reef (mainly by the mussel *Mytilus galloprovincialis)* and the prevalence of different structural characteristics within the reef formations. The health of the reefs is determined with reference to the percentage of newly settled worms, those with crisp apertures, those with worn apertures and dead worms. The degradation and recovery of the two builder *Sabellaria* species that occurs as a response to external environmental pressure, can be different according to the two different life-cycles. *Sabellaria alveolata* can live up to 9 years, whilst *S. spinulosa* is a fast growing annual species.

There is very limited information regarding the trends on the quality of this habitats. Present knowledge on Mediterranean reefs is too fragmentary to define their dynamics, previous knowledge allows little or no temporal comparison.

- Average current trend in quality
  EU 28: Unknown
  EU 28+: Unknown

Pressures and threats

Sabellaria reefs are highly dynamic habitats subject to numerous natural perturbations, they are also increasingly threatened by direct and indirect anthropogenic disturbances including colonization by mussels and oysters from local aquaculture, development of ephemeral green algae in response to eutrophication or physical degradation of the reef through trampling and shellfish farming. These disturbances may cause significant damages to the reef structures with also a reduction in density of new recruits. *Sabellaria* reefs are highly vulnerable and sensitive; both fishing and associated trampling can seriously damage this fragile habitat. Moreover alien introduced species have potential impact on them. *Sabellaria* reefs can take many years to recover, and some may never recover.

Ocean warming and acidification can decraese net calcification in *Ficopomatus* reef, decreasing growth and reproduction as well as reduction of abundance and diversity.

List of pressures and threats

Biological resource use other than agriculture & forestry

Marine and Freshwater Aquaculture
Intensive fish farming, intensification
Leisure fishing
Bait digging / Collection

Human intrusions and disturbances

Other human intrusions and disturbances
Trampling, overuse
Shallow surface abrasion/ Mechanical damage to seabed surface

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
- Pollution to surface waters by industrial plants
- Pollution to surface waters by storm overflows
- Other point source pollution to surface water
- Nutrient enrichment (N, P, organic matter)

Marine water pollution
- Toxic chemical discharge from material dumped at sea

Invasive, other problematic species and genes

Invasive non-native species

Climate change

Changes in abiotic conditions
- Temperature changes (e.g. rise of temperature & extremes)
- pH-changes
- Water flow changes (limnic, tidal and oceanic)
- Wave exposure changes
- Sea-level changes

Conservation and management

Knowledge of this habitat is too fragmentary to determine their current health status and to define their dynamics, in order to evaluate the most important threats and impacts, to highlight the conservation needs and suggest management measures and protection actions. Understanding those parameters that influence the reef dynamics is necessary in order to develop efficient and effective management practices and policy focusing on the conservation status of large biogenic structures.

List of conservation and management needs

Measures related to marine habitats

Other marine-related measures

Measures related to spatial planning

Establish protected areas/sites

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

Measures related to special resouce use

Regulating/Managing exploitation of natural resources on sea

Conservation status

Annex 1:

1170: MMED XX

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

Serpulid reefs built by *Ficopomatus* are extremely dynamic in both space and time, and are characterized by very short-cycles, because they form in brackish water dynamic environment. The reefs break-down under their own weight and reform continuously. Therefore *Ficopomatus* is able to respond to the environmental changes and recover from damage in relatively short time. However, important variation in water flow regime and quality (especially salinity), and high human pressure can led to the disappearance of these reefs and reduce their recover capacity.

Sabellaria reefs are extremely dynamic too, they may persist in an area long time although individual clumps may regularly form and disintegrate. Usually, reefs show a cycle of development undergoing 4 different easily determined morphologies (reef compactness, tube orientation, percentage of tubes with 'sand crown', and presence/absence of epibionts on the reef surface) and defined as 'phases'. Each phase is the result of a constantly disturbed and precarious balance between physical factors (hydrodynamic forces, temperature, and local environmental conditions, such as seabed topography and water clarity), and biological factors (reproduction and recruitment mechanism of the pelagic larvae). *Sabellaria alveolata* can live up to 9 years, whilst *S. spinulosa* is a fast growing annual species so that degradation and recovery of the reefs that occurs as a response to external environmental pressure, can be different, even if in both species recruitment rates are high and recovery could be quite rapid, the speed of changes is different according to their different life cycle. As a consequence *S. alveolata* reefs seem to be more persistent and more abundant than *S. spinulosa* which, in most parts of its geographic range, is solitary or form small groups.

The limited understanding of the factors affecting recruitment success and of the source of larval supply preclude further predictions on the potential for recovery and the rate at which it might occur. Biogenic reefs can take many years to recover, and some may never recover. For example, *Sabellaria spinulosa* reefs have failed to recover in the Wadden Sea following their dramatic decline over recent decades. According to the life-cycle knowledge it can be hypothesised that the recover of *S. alveolata* may occur within at least 10 years if condition are maintained optimal, but that can last more time naturally.

Effort required

10 years
Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %

There is insufficient information on past and any future trends on this habitat. Therefore, the habitat type is assessed as Data Deficient under Criterion A.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50,000 Km^2	Unknown	Unknown	unknown	>19	Unknown	Unknown	unknown	unknown
EU 28+	>50,000 Km^2	Unknown	Unknown	unknown	>19	Unknown	Unknown	unknown	unknown

The habitat is widespread in the Eastern and Western Mediterranean and the EOO is larger than 50,000km^2. AOO is less than 50. There is a lack of information to determine trends in the spatial extent or the biotic and abiotic quality, on whether a threatening process will likely cause continuing declines or exists at very few locations. Therefore it exceed the thresholds for a threatened Category and is assessed as Data Deficient under Criterion B1 and B3.

The AOO suggests this habitat could be Endangered under criterion B however given the lack of information on its trends in quantity and quality and the fact that its overall distribution is unknown, and the AOO presented here is likely to be an underestimate, expert opinion is this habitat should also be considered Data Deficient under criteria B2.

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%
EU 28+	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%

The assessment of reduction in abiotic and/or biotic quality is not possible due to the lack of studies and data on past state conditions especially regarding *Sabellaria* reefs. It is likely that changes along seashore due to the habitat change and exploitation, illegal buildings and development of transport systems, have highly modified the sedimentary condition that influence *Sabellaria* reef development. However, at present it is not possible to quantify this impact. Moreover, considering that the main builder species living in very shallow areas potentially subjected to ocean acidification and surface sea water warming, global climate changes could have particularly severe effect on their development, also considering the introduction of alien species, causing overgrowing of algae in the biological structures.

As it is not possible to calculate the reductions in abiotic and/or biotic quality, the habitat type is assessed as Data Deficient under Criterion C/D.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	unknown
EU 28+	unknown

There is no quantitative analysis available to estimate the probability of collapse of this habitat type. Therefore, the habitat type is assessed as Data Deficient under Criterion E.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Data Deficient	-	Data Deficient	-

Confidence in the assessment
Low (mainly based on uncertain or indirect information, inferred and suspected data values, and/or limited expert knowledge)

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References

Bianchi e Morri.2001. The Battle is not to the Strong: Serpulid Reefs in the Lagoon of Orbetello (Tuscany, Italy). *Estuarine, Coastal and Shelf Science* 53: 215-220.

Camus, P., Compere, Ch., Blanchet, A., Dimeet, J., Hamon, D., Lacotte, N., Peleau, M. et Lasalle, E., 2000. Ficopomatus enigmaticus: écologie, répartition en France et Bretagne, nuisances et moyens de lutte sur le site atelier du port de Vannes. Rapport de contrat Ifremer – Ville de Vannes, 50 p. (Thau Francia)

Cukrov, M., Despalatović, M., Žuljević, A., Cukrov, N., 2010. First record of the introduced fouling tubeworm Ficopomatus enigmaticus (Fauvel, 1923) in the Eastern Adriatic Sea, Croatia. p. 483-483. In: 39th CIESM Congress, Venice, 10-14 May 2010. CIESM, Monaco.

Delbono, I., Bianchi, C. N., Morri, C. 2003. Le biocostruzioni di *Sabellaria alveolata* come indicatori ambientali: area costiera fra Chiavari e Sestri Levante. In: Studi per la creazione di strumenti di gestione costiera: Golfo del Tigullio (O. Ferretti, ed.). ENEA, *Centro Ricerche Ambiente Marino, La Spezia*: 130-140.

Dubois, S., Retiere, C. & Olivier, F. 2002. Biodiversity associated with *Sabellaria alveolata* (Polychaeta: Sabellariidae) reefs: effects of human disturbances. *Journal Marine Biological Association U.K.*, 82: 817-826.

Ergen, Z. 1976. Investigations on the taxonomy and ecology of Polychaeta from Izmir Bay and its adjacent area. *Scientific Reports of the faculty of Science Ege University,* 209: 1-66.

European Environment Agency. 2014. EUNIS habitat type hierarchical view [online]. Available at: http://eunis.eea.europa.eu/habitats-code-browser.jsp [accessed August 2014].

Giangrande A, Cosentino A, Lo Presti C, Licciano M., 2012. Sabellidae (Annelida) from the Faro coastal lake (Messina, Ionian Sea), with the first record of the invasive *species Branchiomma bairdi* along the Italian coast. Mediterranean Marine Science 13: 283–293, http://dx.doi.org/10.12681/mms.310

Gruet, Y. 1986. Spatio-temporal changes of sabellarian reef built by the sedentary polychaete *Sabellaria alveolata* (Linné) - PSZN I: *Marine Ecology,* 7(4): 303-319.

Iaciofano, D., Musco, l., Vega, F., Lo Brutto, S. 2015. Crostacei anfipodi associati a reef di Sabellaria alveolata (L.) (Annelida) dello Stretto di Sicilia (Mar Mediterraneo): *Biologia Marina Mediterranea* 22(1):95-96.

La Porta Barbara and Nicoletti Luisa 2009. *Sabellaria alveolata* (Linnaeus) reefs in the central Tyrrhenian Sea (Italy) and associated polychaete fauna. *Zoosymposia* 2: 527–536.

Lezzi ,M. F., Cardone , B. Mikac, A. Giangrande 2015. Variation and ontogenetic changes of opercular paleae in a population of Sabellaria spinulosa (Polychaeta: Sabellaridae) from the South Adriatic Sea,with remarks on larval development. *Scientia Marina* 79 (1): 1-14.

Martinez-Taberner, A.; Forteza, V.; Fornos, J. J., 1993: Colonization, structure and growth of *Ficopomatus enigmaticus* cf. Ten Hove & Weerdenburg (Polychaeta, Serpulidae) in the Albufera of Menorca, Balearic Islands. I*nternationale Vereinigung fuer Theoretische und Angewandte Limnologie Verhandlungen.* Dezember; 252: 1031-1034.

Porras, R. J. V., Bataller, E., Murgui, M. T., Torregrosa. 1996. Trophic Structure and Community Composition of Polychaetes Inhabiting Some Sabellaria alveolata (L.) Reefs Along the Valencia Gulf Coast. *Western Mediterranean Marine Ecology* 17(4): 583-602.

Zaouali, J. and S. Baeten. 1983. Impact de l'eutrophisation dans la lagune de Tunis (partie nord). 2eme partie: analyse de correspondances. *Rapports et Proces-Verbaux des Reunions Commission Internationale pour l'Exploration Scientifique de la Mer Mediterranee Monaco* 28: 327-332.

Zibrowius, H. 1973. Serpulidae (Annelida Polychaeta) des côtes ouest de l'Afrique et des ArchipelsVoisins. Musée Royal de l'Afrique Centrale (Tervuren). Annales. Série in 8, 207:1-93.

Zibrowius, H. 1978. Quelques recoltes de Serpulidae (Annelida Polychaeta) sur les cotes nord de laTunisie. *Bulletin de l'Office National des Peches Republique Tunisienne,* 2: 221-222.

Zibrowius, H., and C. H. Thorp 1989. A review of the alien serpulid and spirorbid polychaetes in the British Isles. *Cahier Biologie Marine,* 30: 271-285.

Honeycomb worm – *Sabellaria alveolata* – General information. MarLIN website. Available at: http://www.marlin.ac.uk/speciesfullreview.php?speciesID=4277 (Accessed: 18/12/15),