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Marine Biogeography of the Mediterranean Sea: patterns and dynamics of biodiversity

Non indigenous species settle down in the Taranto Seas

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SUMMARY

The presence and the distribution of seven exotic species (4 seaweeds and 3 animals) in the seas of Taranto are discussed. The seaweeds are: *Caulerpa racemosa* var. *cylindracea*, *Codium fragile* subsp. *tomentosoides* (Chlorophyceae), *Undaria pinnatifida* (Phaeophyceae), and *Womersleyella setacea* (Rhodophyceae), all well-known as invasive species. The animal species are: *Branchiomma luctuosum* (Polychaeta), *Microcosmus squamiger* (Ascidiacea), and *Musculista senhousia* (Bivalvia).

INTRODUCTION

In the last 30-40 years, the number of exotic species, accidentally introduced in the Mediterranean Sea, has considerably increased. This was due to both the increasing of the naval traffic (transport of fouling species and planktonic larvae in the ballast waters) (Occhipinti Ambrogi, 2001) and the aquaculture activity which, recently, went in for the breeding of non indigenous species [e.g. *Crassostrea gigas* (Thunberg, 1793); *Tapes philippinarum* (Adams and Reeve, 1850); *Penaeus japonicus* Bate, 1888; etc.] (Rossi, 1992).

In the sea basins facing the town of Taranto (i.e. the Mar Piccolo, the Mar Grande and a part of the gulf) there is a wide intercontinental naval traffic due to both the presence of the most important Italian Navy base and to the merchant harbour. Moreover, numerous mussel farms are present. The above mentioned activities together with industrial emissions and sewages, favoured

not only the decay of the local benthic communities but also the introduction of several exotic species.

This paper aims at providing a list and a short description of both the behaviour and the distribution of seven new introduced species (4 seaweeds and 3 animals), steadily established in the Taranto basins.

MATERIALS AND METHODS

The list of the non indigenous species present in the Taranto basins was compiled in the frame of the CoNISMa research project named "SPICAMAR-Studio Pilota per la Caratterizzazione di Aree Marine a Rischio" and financially supported by the Italian Ministry of University and Scientific Research.
This project allowed a direct careful observation of the benthic communities by both an underwater video camera and SCUBA diving. Both qualitative and quantitative biological samplings were carried out by a triangular dredge (with a side of 60 cm) and by a van Veen grab (with a grabbing surface of about 0.1 m^2 and a volume of about 0.02 m^3), respectively, and also by SCUBA diving. In particular, two campaigns were carried out in July 2001 and June 2002, sampling in 69 stations located in the three basins. 18 video-transects and a number of video-spots uniformly distributed in the study area, were made, for a total of 12 hours of video recording. Additionally, 37 samples were collected by dredge, 214 by grab and 6 by SCUBA.

The biological samples were preserved in 10% formalin seawater and later sorted by species, in the laboratory. The video were analysed with a high quality video recorder.

RESULTS

In the phytobenthos, observations showed the presence of several exotic species in the Taranto basins. Four of them resulted particularly interesting, because they are well-known invasive species: *Caulerpa racemosa* Forsskål (J. Agardh) var. *cylindracea* (Sonder) Verlaque, Huisman and Boudouresque, *Undaria pinnatifida* (Harvey) Suringar, *Codium fragile* (Suringar) Hariot subsp. *tomentosoides* (van Goor) Silva and *Womersleyella setacea* (Hollenberg) R.E. Norris.

Caulerpa racemosa var. *cylindracea* (Fig. 1) (Verlaque et al., 2003) is a chlorophycean seaweed native of the Gulf of Mexico, reported for the first time in the Mediterranean in Lybia (Nizamudddin, 1991) and in Italy in Sicily and Lampedusa Island (Alongi et al., 1993). At the moment, it is rapidly spreading along the Italian coasts (Piazzi et al., 1994; Bussotti et al., 1996; Cossu and Gazale, 1996; Buia et al., 1998; Gambi and Terlizzi, 1998; Cantasano, 2001; Bottalico et al., 2002; Costantino et al., 2002). In Taranto basin, *C. racemosa*

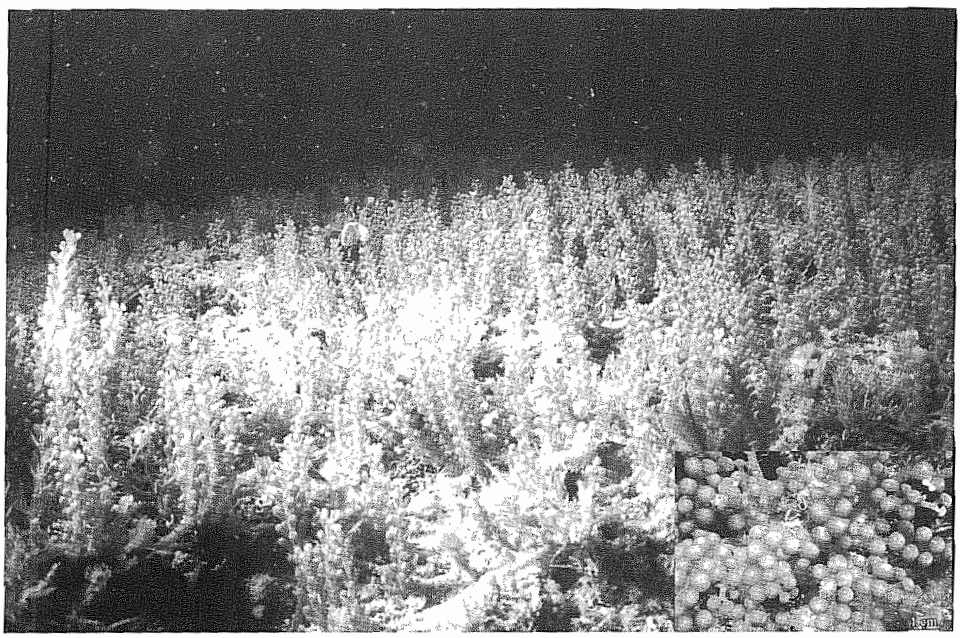
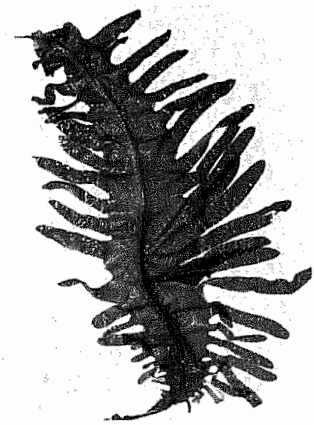


Fig. 1 - *Caulerpa racemosa* var. *cylindracea*

was found for the first time near the Cheradi Islands, scattered among dead "matte" of *Posidonia oceanica* (Linnaeus) Delile and spots of *Caulerpa prolifera* (Forsskål) J.V. Lamouroux (Buia et al., 1998). At present, *C. racemosa* is present in both the First and the Second Inlet of the Mar Piccolo, where it is colonising even the muddy bottom. This species also occurs in the Mar Grande and in the Gulf, where, it is superseding both the seagrass and the *C. prolifera* meadows in front of the industrial zone, and it is colonising a wide area of dead "matte" offshore the polysectorial dock.

The phaeophycean *Undaria pinnatifida* (Fig. 2) and the chlorophycean *Codium fragile* subsp. *tomentosoides* (Fig. 3) are native of the Japan temperate waters. They were found attached onto the dock in the First Inlet of the Mar Piccolo, where they were most likely introduced as a consequence of importation of exotic oysters. *Undaria pinnatifida* was found for the first time in the Italian seawaters at Chioggia (Venice) (Rismondo et al., 1993) and then in Taranto (Cecere et al., 2000). Here, the sporophyte is present since November to July (Cecere, unpublished data) growing up to 1 m high, similar to other Mediterranean plants (Cecere et al., 2000). Till now, no new settlement was found, neither interferences with the local benthic communities were observed.

Codium fragile subsp. *tomentosoides* was reported in the Faro Lake (Messina), as the first record for Italy (Furnari, 1974). In the Mar Piccolo, the first collection



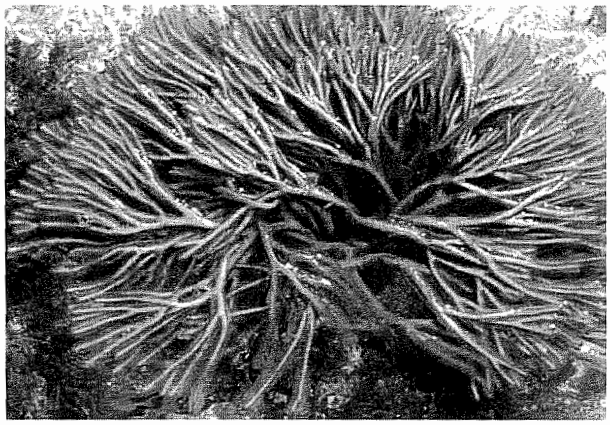


Fig. 2 - *Undaria pinnatifida* (modified from www.seaweed.ie; © G. Felicini)

Fig. 3 - *Codium fragile* ssp. *tomentosoides* (modified from www.seaweed.ie; © M.D. Guiry)

dates back to summer 2002 (Cecere and Petrocelli, this volume). At the moment, no data are available about distribution and life cycle of this species in the basin.

Womersleyella setacea (Fig. 4) is an ubiquitous rhodophycean species, native of Hawaii Islands (Pacific Ocean). This species represents a real threat for the Mediterranean coastal communities. Since *W. setacea* can impede the settlement of other species in these communities, it can be a serious cause of reduction of biodiversity (Airoldi et al., 1995; Piazzi and Cinelli, 2000). During this study, this species was collected in both the Mar Grande and the Gulf, as an epiphyte either on the rhizomes of *P. oceanica* or on its dead "matte".

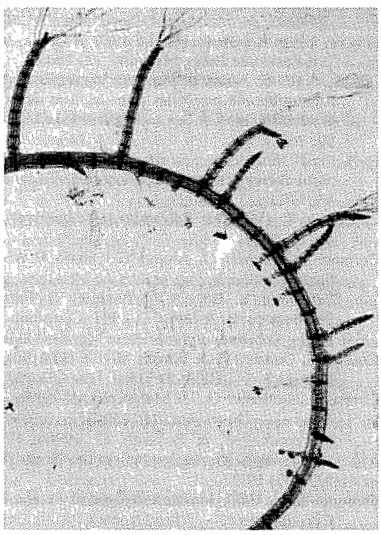


Fig. 4 - *Womersleyella setacea*

Three exotic animal species are also reported: the polichaeta *Branchiomma luctuosum* (Grube, 1869), the ascidian *Microcosmus squamiger* Hartmeier and Michaelsen, 1928 and the small mussel *Musculista senhousia* (Benson in Cantor, 1842).

Branchiomma luctuosum (Fig. 5) was found for the first time in the Mediterranean, near the Lucrino Lake (Naples) (Bianchi, 1983). Now, this species is abundant near Ischia Island and in the Gulf of Pozzuoli (Sorino and Gambi, 1992). It is a species with wide ecological valence with a short life cycle, high fecundity (simultaneous hermaphrodite, up

Fig. 5- *Branchiomma luctuosum*

to 200,000 eggs per individual) and rapid growth (Giangrande and Gambi, 1998). In the Taranto seas, a wide population of this Polychaeta is present in the Mar Piccolo and the Mar Grande, on both hard and soft bottoms, such as reduced muds and dead "matte" of *P. oceanica.*

The tunicate ascidian *Microcosmus squamiger* (Fig. 6) is a tropical species originally collected in the Jamaican Antilles (Monniot, 1981 as *Microcosmus exasperatus,* Monniot et al., 2001; Monniot, 2002). However, since this species is common in all the tropical seas and in the southern Atlantic Ocean it is rather difficult to determine its origin (Monniot, 1981). In the Mediterranean, it was found for the first time in the military harbour of Bizerte (Tunisia) by Robaux in 1963. Afterwards, it was collected in Italy, in the harbour of Genova by Zibrowius in 1971 and in the Mar Piccolo by Tursi in 1977 (Monniot, 1981). Its wide but discontinuous distribution is probably to be related to passive dispersal, via fouling. *M. squamiger* is an opportunistic species, that lives in shallow waters 0.5 to 15 m depth, preferably in eutrophic conditions, typical of harbours and river deltas. This species is often clustered in groups of 6-7 individuals of different size, as a result of an epibiotic intraspecific relationship.

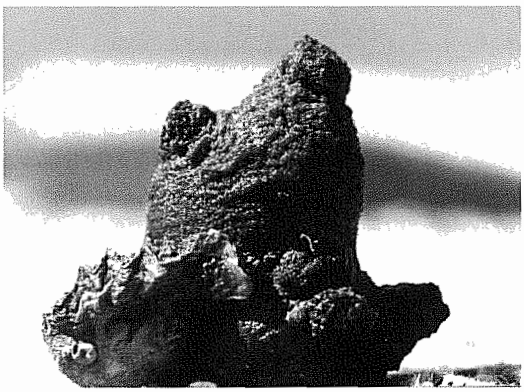


Fig. 6 - *Microcosmus squamiger*

Fig. 7 *Musculista senhousia*

At present, in the Taranto basin, *M. squamiger* occurs on hard substrata (wharfs, buoys etc.). It occurs also on soft bottoms, in particular on dead "matte" in the Mar Grande, and on reduced muds in the Mar Piccolo.

Musculista senhousia (Fig. 7), known as "Asian mussel", is a small mussel widespread throughout the world, e.g. Asia (*locus tipicus*) (Indo-China and Japan), the western coast of the USA, New Zealand, Australia, Israel, Red Sea, Zanzibar, Madagascar (Lazzari and Rinaldi, 1994). It is an opportunistic species that lives in shallow waters on every kind of substrata (Turolla, 1999). This small mussel was recorded, for the first time in the western Mediterranean, along the French coast (Hoenselaar and Hoenselaar, 1989). Afterwards, it was recorded in the Adriatic Sea, in the brackish lagoons of Ravenna (Lazzari and Rinaldi, 1994), in the Sacca di Goro and in the Comacchio marshes (Turolla, 1999; Mistri et al., 2001). It was also found in the Tyrrhenian Sea, in the Gulf of Olbia (Savarino and Turolla, 2000).

A dense population of *M. senhousia* was found in both the Mar Piccolo inlets, as an epiphyte on the unattached seaweeds *Chaetomorpha linum* (O.F. Müller) Kützing and *Cladophora hutchinsiae* (Dillwyn) Kützing (Mastrototaro et al., 2003).

DISCUSSION AND CONCLUSIONS

The introduction of non indigenous invasive species and their steady settlement represent a problem difficult to handle, throughout the world. In fact, for invasive species, it is difficult to foresee both the dynamics of their propagation and their interactions with the indigenous species.

In the Taranto basins, the presence of non indigenous species, which have colonised wide areas and compete with autochtonous species, showed that the

zone is evidently subject to the introduction of exotic species, one of the phenomena which now are serious threatens to biodiversity (Walker and Kendrik, 1998). *C. racemosa* is perhaps a particular case. On one hand it is rapidly spreading all around the Taranto Seas, superseding, onto soft bottoms, the autochtonous *C. prolifera* and *Cymodocea nodosa* (Ucria) Ascherson. On the other hand, as *C. racemosa* is also colonising the muddy polluted bottoms, the spreading of this species could also represent a way for the recovery of azoic and aphytic bottoms.

Concernig the animals, *B. luctuosum* is in competition with the native species *Sabella spallanzanii* (Gmelin, 1791) that inhabits the same habitat (Giangrande and Gambi, 1998), while *M. squamiger* competes with several Mediterranean ascidians such as *Microcosmus polymorphus*, *Pyura dura*, *Pyura microcosmus*, *Polycarpa pomaria*, *Molgula appendiculata* (Monniot, 1981). *Musculista senhousia* could compete for space with *Mytilus galloprovincialis* particularly when larvae settle down. This last competition could cause a serious impact on mussel breeding farm.

Therefore, it is evident that a continuous biological monitoring is necessary, especially in harbours and enclosed basins where mussel farms are located. In fact, it is important to immediately identify new introduced species in order to establish plans, if possible, to limit their propagation.

REFERENCES

AIROLDI L., RINDI F., CINELLI F. 1995 - Structure, seasonal dynamics and reproductive phenology of a filamentous turf assemblage on a sediment influenced, rocky subtidal shore. Bot. Mar., **38**: 227-237.

ALONGI G., CORMACI M., FURNARI G. 1993 - Prima segnalazione di *Caulerpa racemosa* (Chlorophyceae, Caulerpales) per le coste Italiane. Boll. Acc. Gioenia Sci Nat., **26**: 49-53.

ANDALORO F., RINALDI A. 1998 - Fish biodiversity change in Mediterranean Sea as tropicalisation phenomenon indicator. In: G. Enne, M. D'Angelo, C. Zanolla (eds.), Assessing Desertification in the Mediterranean. Proceedings of the International Seminar held in Porto Torres: 333 pp.

BIANCHI C. N. 1983 - Serpuloidea (Annelida, Polychaeta) delle lagune costiere laziali e campane. Ann. Mus. Civ. Stor. Nat. Genova, **84**: 231-243.

BOTTALICO A., DELLE FOGLIE C.I., LAZZO G., MANGHISI A., MILELLA P. 2002 - Nuove segnalazioni per la flora marina pugliese. In: Riunione Scientifica Annuale del Gruppo di Lavoro per l'Algologia, Chioggia (VE) 8-9 novembre 2002, Abstract book: 7.

BUIA M.C., PETROCELLI A., SARACINO O.D. 1998 - *Caulerpa racemosa* spread in the Mediterranean Sea: first record in the Gulf of Taranto. Biol. Mar. Medit., **5** (1): 527-529.

BUSSOTTI S., CONTI M., GUIDETTI P., MARTINI F., MATRICARDI G. 1996 - First record of *Caulerpa racemosa* (Forssk.) J. Agardh along the coast of Genoa (North-Western Mediterranean). Doriana, Suppl., Ann. Mus. Civ. St. Nat. "G. Doria", **6** (294): 1-5.

CANTASANO N. 2001 - Prima segnalazione di *Caulerpa racemosa* (Forsskål) J. Agardh sulla costa tirrenica calabrese. Inf. Bot. Ital., **33**: 327-329.

CECERE E., PETROCELLI A. 2004 - Floristic and biogeographic considerations about the benthic macroalgal flora in the Gulf of Taranto. In: Atti del XXXIV Congresso della Società Italiana di Biogeografia, Ischia (NA) 21-25 ottobre 2002, Biogeographia, this volume.

CECERE E., PETROCELLI A., SARACINO O.D. 2000 - *Undaria pinnatifida* (Fucophyceae, Laminariales) spread in the central Mediterranean: its occurrence in the Mar Piccolo of Taranto (Ionian Sea, southern Italy). Cryptogam. Algol., **21** (3): 305-309.

COSSU A., GAZALE V. 1996 - Sulla presenza di *Caulerpa racemosa* (Forsskål) J. Agardh in Sardegna. In: Cossu A. and

Meloni M.M. (eds.) Atti del Convegno "S.O.S. *Caulerpa*? Introduzione di nuove specie nel Mediterraneo e compatibilità con quelle presenti", Cagliari 1996: 87-97.

COSTANTINO G., QUARANTA L., DE ZIO V., PASTORELLI A. M., UNGARO N. 2002 - Sulla recente presenza di *Caulerpa racemosa* (Forsskål) J. Agardh sui fondi costieri dell'Adriatico sud-occidentale. Biol. Mar. Medit., **9** (1): 613-615.

FURNARI G. 1974 - Segnalazione di *Codium fragile* (Suringar) Hariot nel Lago di Faro (Messina). Mem. Biol. Mar. Oceanogr., **4**: 193-199.

GAMBI M.C., TERLIZZI A. 1998 - Record of a large population of *Caulerpa racemosa* (Forsskål) J. Agardh (Chlorophyceae) in the Gulf of Salerno (southern Thyrrhenian Sea, Italy). Biol. Mar. Medit., **5** (1): 553-556.

GIANGRANDE A., GAMBI M.C. 1998 - Anellidi policheti come nuova risorsa marina: un esempio con alcuni sabellidi. Biologi Italiani, Anno XXVIII (10): 13-19.

HOENSELAAR H. J., HOENSELAAR J. 1989 - *Musculista senhousia* (Benson in Cantor, 1842) in the Western Mediterranean. Basteria, **53**: 73-76.

LAZZARI G., RINALDI E. 1994 - Alcune considerazioni sulla presenza di specie extra mediterranee nelle lagune salmastre di Ravenna. Boll. Malacol., **30** (5-9): 195-202.

MASTROTOTARO F., MATARRESE A., D'ONGHIA G. 2003 - Occurrence of *Musculista senhousia* (Mollusca, Bivalvia) in the Taranto seas (Eastern-Central Mediterranean Sea). J. Mar. Biol. Ass. UK, **83**: 1279-1280.

MISTRI M., FANO E. A., ROSSI R. 2001 - Redundancy of macrobenthos from lagoonal habitats in the Adriatic Sea. Mar. Ecol. Prog. Ser., **215**: 289-296.

MONNIOT C. 1981 - Apparition de l'ascidie *Microcosmus exasperatus* dans les ports méditerranéens. Téthys, **10** (1): 59-62.

MONNIOT C. 2002 - Stolidobranch ascidians from the tropical western Indian Ocean. Zool. J. Linn. Soc., **135**: 65-120.

MONNIOT C., MONNIOT F., GRIFFITHS C., SCHLEYER M. 2001 - South African ascidians. Ann. South Africa. Mus., **108**: 1-141.

NIZAMUDDIN M. 1991 - The Green Marine Algae of Lybia. Elga Publ., Bern, 230 pp.

OCCHIPINTI AMBROGI A. 2001 - Transfer of marine organisms: a challenge to the conservation of coastal biocenoses. Aquatic Conserv.: Mar. Freshw. Ecosyst., **11**: 243-251.

PIAZZI L., CINELLI F. 2000 - Effets de l'expansion des Rhodophyceae introduites *Acrothamnion preissii* et *Womersleyella setacea* sur les communautés algales des rhizomes de *Posidonia oceanica* de Méditerranée occidentale. Cryptogam. Algol., **21**: 291-300.

PIAZZI L., BALESTRI E., CINELLI F. 1994 - Presence of *Caulerpa racemosa* in the north-western Mediterranean. Cryptogam. Algol., **15**: 183-189.

RISMONDO A., VOLPE S., CURIEL D., SOLAZZI A. 1993 - Segnalazione di *Undaria pinnatifida* (Harvey) Suringar a Chioggia (Laguna Veneta). Soc. Veneziana Sci. Nat. Lav., **18**: 329-330.

ROSSI R. 1992 - L'introduzione di specie alloctone per l'acquicoltura. Oebalia, **17** (2 Suppl.): 5-14.

SAVARINO R., TUROLLA E. 2000 - Un ospite indesiderato sbarca ad Olbia. Informare, **9**, Ed. Federcopesca: 2-3.

SORINO P., GAMBI M. C. 1992 - Prime osservazioni su biologia riproduttiva e sul ciclo vitale di *Branchiomma luctuosum* (Grube, 1869) (Polychaeta, Sabellidae). Oebalia, suppl. 17: 425-427.

TUROLLA E. 1999 - Nuovi ospiti per la sacca di Goro. Laguna, **4**: 33-35.

VERLAQUE M., DURAN C., HUISMAN J.M., BOUDOURESQUE C.-F., LE PARCO Y. 2003 - On the identity and origin of the Mediterranean invasive *Caulerpa racemosa* (Caulerpales, Chlorophyta). Eur. J. Phycol., **38**: 325-339.