Biol. Mar. Mediterr. (2010), 17 (1): 59-62

F. Roghi, V. Parravicini, M. Montefalcone, A. Rovere, C. Morri, A. Peirano[1], M. Firpo, C.N. Bianchi, E. Salvati[2]

DipTeRis, Department for the study of the Territory and its Resources, University of Genoa, Corso Europa 26 - 16132 Genoa, Italy.
fiorenzaroghi@yahoo.it
[1]ENEA, Marine Environment Research Centre, C.P. 224 - 19100 La Spezia, Italy.
[2]ISPRA, Superior Institute for Environmental Protection and Research, Via V. Brancati, 48 - 00144 Rome, Italy.

DECADAL EVOLUTION OF A CORALLIGENOUS ECOSYSTEM UNDER THE INFLUENCE OF HUMAN IMPACTS AND CLIMATE CHANGE

EVOLUZIONE DECENNALE DI UN ECOSISTEMA CORALLIGENO SOTTO L'INFLUSSO DEGLI IMPATTI ANTROPICI E DEL CAMBIAMENTO CLIMATICO

Abstract *– Long-term change in the coralligenous community of Punta Mesco (Ligurian Sea) was evaluated merging qualitative information contained in descriptive papers since 1937 with quantitative data obtained from discontinuous photographic surveys since 1961. Increased sedimentation rate and surface-water temperature were responsible for the major changes observed in benthic assemblages.*

Key-words*: coralligenous, long-term change, UW photography, Mediterranean Sea.*

Introduction - Marine coastal ecosystems are among the most vulnerable to global change. The best way to evaluate their decadal-scale variation is to monitor locations where long-term series are available (Bianchi and Morri, 2004). Yet, data sets encompassing time scales longer than a few years are scarce, especially for Mediterranean rocky benthic communities. Nevertheless it is possible to reconstruct

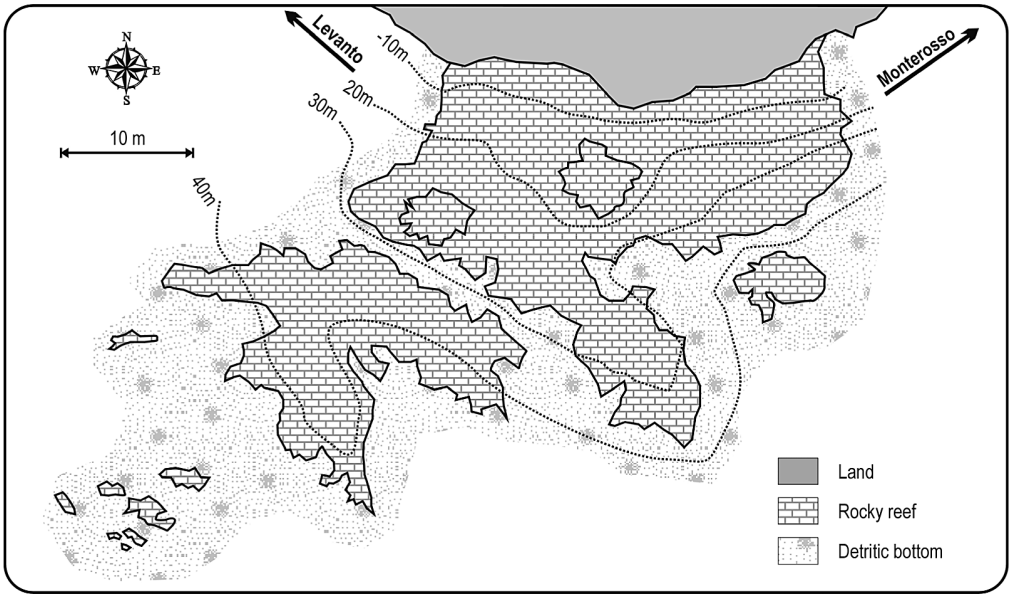

Fig. 1 - Gross morphology of the shoal off Punta Mesco (from Salvati 1997, modified).
Morfologia approssimativa della secca di Punta Mesco (da Salvati 1997, modificata).

the ecological history of an individual community revisiting a site where previous information is available, in the bibliography or in the archives of research institutes. This study explores such a possibility in the case of a coralligenous community, for which knowledge about vulnerability to human impacts and climate change is urgent (Ballesteros, 2006).

Materials and methods - We attempted to assess a 50 years time-scale change of a coralligenous community located on a shoal off Punta Mesco, Ligurian Sea (Fig. 1), comparing biotic cover data collected in 1961, 1990, 1996 and 2008 through underwater photography at about 20 to 45 m depth. These quantitative data have been supplemented with qualitative information, gathered from the analysis of several descriptive studies carried out since 1937 (Tab. 1). Merging qualitative information

Tab. 1 - Available information on Punta Mesco benthic assemblages.
Informazioni disponibili sulle comunità bentiche di Punta Mesco.

Year	References	Kind of data	Notes
1937	Tortonese and Faraggiana, 1937	Qualitative description of the bottoms off Levanto	Presence of *Eunicella verrucosa, Paramuricea chamaleon* and *Petrosia dura*
1960	Rossi, 1961	Species list, qualitative data about gorgonian assemblages	At 20-25 m abundance of *Eunicella stricta*; at 30 m dominance of *Paramuricea chamaleon*, followed by *Leptogorgia sarmentosa, Eunicella verrucosa, Gerardia savaglia*
1960	Rossi, 1965 a	Influence of environmental factors on gorgonian assemblages	Mud favours *Eunicella verrucosa, Alcyonium coralloides, Cellaria fistulosa*. Some bryozoans and corals are tolerant to mud while sciaphilic species thrive in shallower waters because of water turbidity
1960	Rossi, 1965 b	Quantitative biotic cover data from underwater photographs	Use of cover index and bottom classification based on slope and depth; abundance of gorgonians, especially *Paramuricea chameleon*, frequency of *Gerardia savaglia*
1975	Associazione Subacquea Parmasub, 1976	Photographic documentation, qualitative data, species list	Absence of pollution, clear water, scarce differences comparing to Rossi (1965 a, b)
1978	Andreoli *et al.,* 1979	Qualitative data on benthic communities off Levanto	Good state of conservation of benthic assemblages, presence of *Paramuricea clavata* at depths shallower than usual
1985	Relini *et al.*, 1986	Video of bottoms using a ROV, qualitative benthic assemblages description, comparison with Rossi, 1965 a, b	Scarcity of *Eunicella singularis*, lack of *Gerardia savaglia*, and *Paramuricea clavata* reduction especially at depth; intense turbidity from 25 m depth and high sedimentation rate at the bottom
1988	Peirano and Tunesi, 1989	Underwater photographs, quantitative data on anthozoans, comparison with Rossi, 1965 a, b	Increased *Paramuricea clavata* and *Leptopsammia pruvoti* cover, and occurrence of the latter at shallow depths; reduction in the number of scleractinian corals
1989	Tunesi *et al.,* 1989	Visual survey, gorgonian assemblages distribution	Map of gorgonian assemblages, occurrence of *Eunicella singularis*
1990	Peirano and Sassarini, 1992	Underwater photographs, quantitative cover data	Biotic cover percentage, abundance of *Paramuricea clavata, Parazoanthus axinellae* and *Leptogorgia sarmentosa*
1996	Peirano *et al.,* 2000; Bianchi *et al.,* 2001; Morri and Bianchi, 2001	Underwater photographs, quantitative cover data	Slight differences with respect to Peirano and Sassarini (1992). Compared with Rossi (1965), lack of *Lithophyllum frondosum, Peyssonnelia* sp. and increase in *Parazoanthus axinellae* and *Leptopsammia pruvoti* cover: algae diminished, while anthozoans increased and were found at shallower depths. Observed change was related to water turbidity and temperature.
2008	Present work	Underwater pictures, quantitative cover data	See text

and quantitative data allowed a conspicuous, although discontinuous, amount of information on the recent history of this coralligenous ecosystem to be analysed.

Results and conclusions - Two major factors influenced the recent evolution of the benthic community: the increased sedimentation rate, and the rising surface-water temperature. Major alterations in species composition and abundance occurred withinthe 1990s mostly due to the increased siltation of the rocky substrates, favoured by coastal works and the appearance of turfs of filamentous algae (including the alien species *Womersleyella setacea*). This altered dramatically the species composition of the understorey assemblage (disappearance of massive sponges, change in bushy bryozoan species, etc.) and reduced gorgonian cover. *Eunicella singularis* has never been found again at shallow depth after the late 1980s, whereas cover and distribution of *Paramuricea clavata* has decreased; no significant change was observed for *Leptogorgia sarmentosa*. However, interpretation of results must be cautious, since quantitative data may differ because of change in photographic techniques (Rolleimarine to Nikonos), quantitative data gathering, inhomogeneous taxonomic resolution, and lack of replication in old surveys. The most evident recent changes, occurred between 1996 and 2008, were the dramatic reduction of *Paramuricea clavata* cover and the invasion by the tropical alien *Caulerpa racemosa*, especially in depth shallower than 35 m (see also Peirano *et al*., 2009). Both changes might be related to the increase of sea-water temperature: downward lifting of the summer thermocline massively killed gorgonians, while the new environmental conditions favoured the spreading and establishment of tropical aliens to the detriment of native species.

This paper is dedicated to the memory of Gianni Roghi (1927-1967), pioneer in scuba diving and UW photography.

References

ANDREOLI M.G., LOPPEL S., ORSINI C. (1979) - *Analisi di una ricerca. Il golfo di Levanto*. Cassa di Risparmio di La Spezia.

ASSOCIAZIONE SUBACQUEA PARMA SUB, SEZ. RICERCHE (1976) - *Salviamo il mare. Documentazione scientifica e fotografica di Punta del Mesco*. Grafiche "Step", Parma: 59 pp.

BALLESTEROS E. (2006) - Mediterranean coralligenous assemblages: a synthesis of present knowledge. *Oceanography and marine Biology: an annual Review*, **44**: 123-195.

BIANCHI C.N., MORRI C. (2004) - Climate change and biological response in Mediterranean Sea ecosystems, a need for broad-scale and long-term research. *Ocean Challenge*, 2003, **13** (2): 32-36.

BIANCHI C.N., PEIRANO A., SALVATI E., MORRI C. (2001) - Assessing interannual and decadal changes in marine epibenthic assemblages through UW photography: an example from Punta Mesco, Ligurian Sea. *Archivio di Oceanografia e Limnologia,* **22**: 83-86.

MORRI C., BIANCHI C.N. (2001) - Recent changes in biodiversity in the Ligurian Sea (NW Mediterranean): is there a climatic forcing? In: F.M. Faranda, L. Guglielmo, G. Spezie (eds), *Mediterranean ecosystems: structures and processes*. Springer-Verlag, Milan: 375-384.

PEIRANO A., SALVATI E., BIANCHI C.N., MORRI C. (2000) - Long-term change in the subtidal epibenthic assemblages of Punta Mesco (Ligurian Sea, Italy) as assessed through underwater photography. *Porcupine Marine Natural History Society Newsletter*, **5**: 9-12.

PEIRANO A., SASSARINI M. (1992) - Analisi delle caratteristiche distributive di alcune *facies* di substrato duro dei fondali delle Cinque Terre (Mar Ligure). *Oebalia*, **17** (Suppl.): 523-528.

PEIRANO A., SGORBINI S., CUPIDO R., LOMBARDI C., COCITO S. (2009) - Decadal monitoring of corralligenous and bioconstruction organisms in the eastern Ligurian sea (NW Mediterraean). *Proceedings of the 1st Mediterranean Symposium on the Coralligenous and other calcareous bio-concretions of the Mediterranean Sea (Tabarka, 15-16 January 2009)*: 233-235.

PEIRANO A., TUNESI L. (1989) - Modificazioni nella composizione del popolamento ad Antozoi del coralligeno di Punta Mesco (Mar Ligure di Levante) a 30 anni dalle prime osservazioni. *Nova Thalassia*, **10**: 543-548.

RELINI G., ARDIZZONE G.D., BELLUSCIO A. (1986) - Le biocenosi bentoniche costiere delle Cinque Terre (Mar Ligure Orientale). *Bollettino dei Musei e degli Istituti Biologici dell'Università di Genova*, **52** (Suppl.): 163-195.

ROSSI L. (1961) - Sur une facies à Gorgonaires de la Pointe du Mesco (Golfe de Gênes). *Rapports et Procès-verbaux des Réunions de la C.I.E.S.M.,* **16** (2): 517-521.

ROSSI L. (1965a) - Il coralligeno di Punta Mesco (La Spezia). *Annali del Museo Civico di Storia Naturale di Genova*, **75**: 144-180.

ROSSI L. (1965b) - Influenza dei fattori ambientali delle facies a Gorgonacei di Punta del Mesco. *Bollettino di Zoologia,* **32** (2): 859-865.

SALVATI E. (1997) - *Studio del coralligeno di Punta Mesco (Mar Ligure orientale) tramite analisi di immagine e confronto con dati storici*. Università degli Studi di Roma "La Sapienza", a.a. 1996-1997: 112 pp.

TORTONESE E., FARAGGIANA R. (1937) - Osservazioni biologiche nell'insenatura di Levanto (Riviera Ligure). *Natura,* **28**: 51-72.

TUNESI L., PEIRANO A., ROMEO G., SASSARINI M. (1989) - Distribuzione delle facies a Gorgonacei sui fondali costieri delle Cinque Terre (Mar Ligure di Levante). *Nova Thalassia,* **10**: 615-616.

Research done within the frame of the project 'The impacts of biological invasions and climate change on the biodiversity of the Mediterranean Sea' (Italy–Israel co-operation) funded by the Italian Ministry of the Environment.