*Biol. Mar. Mediterr.* (2026), 30 (1): 116-119 www.biologiamarinamediterranea.it

54° Congresso SIBM: Benthos

I. MANCINI[1], C.N. BIANCHI[2], C. MORRI[2], A. AZZOLA[1,3], A. OPRANDI[1], F. MASSA[1], P. POVERO[1], L. CUTRONEO[4], M. CAPELLO[4], M. VACCARI[5], M. MONTEFALCONE[1,3]

[1] Department of Earth, Environment and Life Sciences (DiSTAV), University of Genova, Genova, Italy
[2] GMC, Stazione Zoologica Anton Dohrn, Genova, Italy
[3] NBFC, Palermo, Italy
[4] Physical Oceanography Laboratory, DiSTAV, University of Genoa
[5] ADSP del Mar Ligure Occidentale, Genova, Italy
corresponding author: ilamancini@yahoo.it

# UPDATED THEMATIC MAP OF BENTHIC HABITATS IN THE URBAN COASTAL AREA: NOVEL DISCOVERIES AND CONSERVATION IMPLICATIONS

## *AGGIORNAMENTO CARTOGRAFICO DEGLI HABITAT MARINI BENTONICI IN UN'AREA URBANA COSTIERA: NUOVE SCOPERTE E IMPLICAZIONI PER LA CONSERVAZIONE*

**Abstract** - *Effective management and long-term conservation of coastal marine ecosystems require detailed knowledge of habitat distribution. Thematic environmental mapping is essential for monitoring and managing these areas. In 2023 the 'Atlas of marine habitat of Liguria' was updated in the urban area of Genoa city (Ligurian Sea), thanks to sea-truthing surveys. This work was aimed at evaluating the extent, integrity, and distribution of benthic habitats before construction of the new Genoa breakwater. Previously unmapped coralligenous outcrops have been identified and rhodolith beds have been found in the study area for the first time. The occurrence of the alien alga* Caulerpa cylindracea *has been reported on the updated maps, although its distribution has reduced in recent years. An unknown submarine cave has been discovered. Updating and integrating seafloor maps with sea-truth are indispensable for the identification of valuable and/or vulnerable habitats in need of protection in a urban context.*

**Keywords**: *environmental maps; ROV diving; sea-truthing; port of Genoa; Ligurian Sea.*

**Introduction** – Urban infrastructures to support commercial, residential, and tourist activities affect coastal environments, exposing natural habitats along with their associated species and ecological processes to multifarious and profound changes. It is well known that biodiversity is increasingly threatened worldwide by pollution, habitat alteration, and climate change; global assessments show that no ecosystem remains pristine (Halpern *et al.*, 2008). The implementation of effective management tools is necessary to ensure the long-term conservation of coastal marine ecosystems, the goods and services they provide (Bianchi *et al*., 2012). The development of thematic environmental mapping plays a key role, both for fundamental aspects related to the knowledge of ecosystems and for issues linked to the need for intervention and territorial management (Bianchi *et al*., 1996). Environmental mapping is also an essential tool for assessing change over time, understanding the general distribution of ecosystems and their spatial dynamics. Therefore, a diagnostic approach is required for the management of coastal marine ecosystems, based on two phases: (1) characterization, which involves the analysis of the abiotic and biotic features of the environment and is carried out through thematic maps; and (2) evaluation, based on the analysis of ecosystem health and the definition of scores capable of quantifying ecological status (Bianchi *et al.*, 2012).

The Ligurian Sea is among the most anthropized areas of the Mediterranean, with the coastal stretch of the city of Genoa (NW Italy) being particularly urbanized and subjected to intense maritime activities. Within this framework, the construction of a new breakwater in the port of Genoa, one of the largest in the Mediterranean Sea and a major hub of maritime traffic, represents a threat for marine coastal benthic habitats. In view of this major coastal construction, the update of the *Atlas of Marine Habitats of Liguria* (Coppo *et al.*, 2020) was planned as part of an Environmental Impact Assessment. This work aims at evaluating the detailed distribution and extent of benthic habitats and the integrity of the seafloor, prior to the start of construction works, highlighting how the availability of thematic mapping represents an essential management tool.

**Materials and methods** – Field activities were conducted along 7 km of the eastern coast of Genoa, within a bathymetric range from 1 to 40 m. For the cartography, the most recent maps available in the *Atlas of Marine Habitats of Liguria* (Coppo *et al.*, 2020) were first analyzed. The digital information on the distribution of coastal marine habitats in the study area was used as the base map and subsequently updated with all data collected during sea-truthing activities, carried out through Remotely Operated Vehicles (ROVs) video surveys and scuba diving, using the software QGIS Desktop 3.10 (Ltr) (QGIS Development Team, 2019; available from: www.qgis.org). Any discrepancies with respect to the original maps, identified during the sea-truthing activities, were manually digitized using geoprocessing tools, and the surface area of the new polygons was calculated.

**Results** – Monitoring activities led to the identification, at depths between 25 and 40 m in the area near the port, of new coralligenous outcrops featuring a thick layer of coralline algal bioconcretions but lacking an upper layer and characterized by the dominance of *Zanardinia typus* (Nardo) P.C.Silva, 2000 in the basal layer (Fig. 1a). The presence of a submarine cave was also reported and mapped. This is a wedge-shaped cavity located between 30 and 32 m depth, approximately 10 m long, with a pavement of fine sand and mud (Fig. 1b). Its ceiling is covered by *Leptopsammia pruvoti* Lacaze-Duthiers, 1897, which is replaced by *Petrosia ficiformis* (Poiret, 1789) and other sponges further inside. The presence of the alien alga *Caulerpa cylindracea* Sonder, 1845 was recorded mainly on biodetritic bottoms (Fig. 1c). For the first time in the study area, "rhodolith beds" were reported on a coastal detritic bottom mixed with dead matte of *Posidonia oceanica* (L.) Delile, 1813 (Fig. 1d), at depths ranging from 25 to 35 m. This newly identified habitat "Mosaic of dead matte of *Posidonia oceanica* and coastal detritic bottoms with rhodoliths" replaced the previously mapped "dead matte" habitat across the entire study area on the updated map, as shown in the pie charts (Fig. 2). The comparison between the area of habitats in 2020 and 2023 revealed no significant differences in the *P. oceanica* habitat, whereas the newly identified coralligenous outcrops, mapped through ROV surveys, led to a 25% increase in the extent of this habitat (Fig. 2).

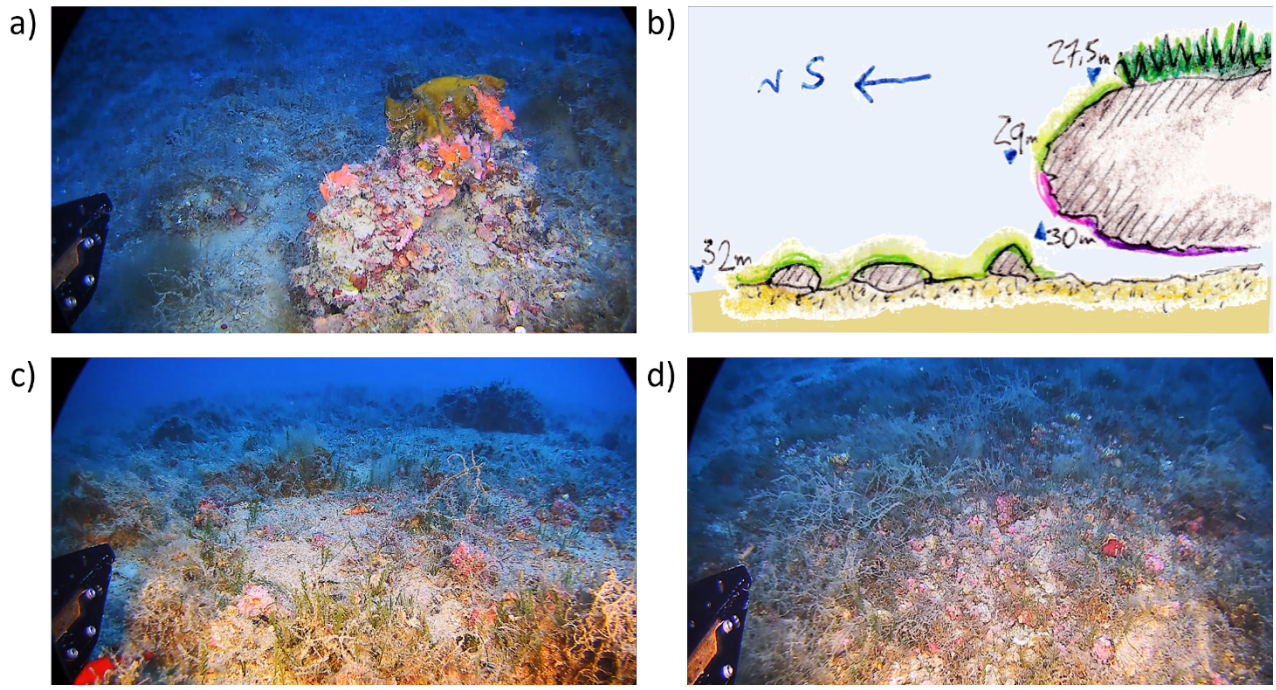


Fig. 1 – (a) Coralligenous outcrop; (b) Schematic section of the submerged cave; (c) *Caulerpa cylindracea* on dead matte and coastal detritic bottom with rhodoliths; (d) Rhodolith beds on detritic bottoms. *(a) Affioramento coralligeno; (b) Sezione schematica della grotta sommersa; (c)* Caulerpa cylindracea *su matte morta e fondo detritico costiero con rodoliti; (d) Letto a rodoliti su un fondale detritico.*

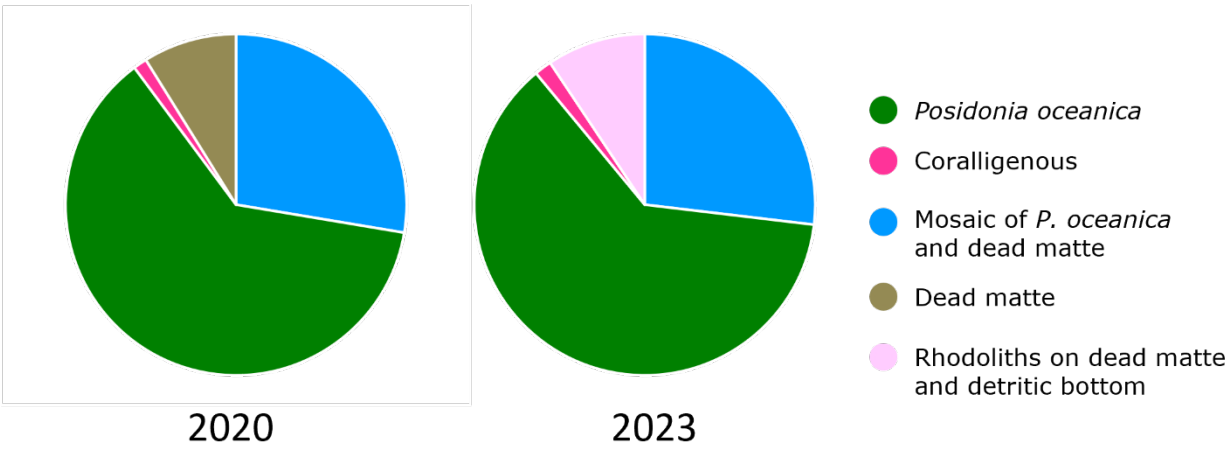


Fig. 2 – Comparison of the areas of the main benthic marine habitats in the 2020 *Atlas of Marine Habitats of Liguria* and the new 2023 cartographic update.
*Confronto tra le aree dei principali habitat marini bentonici* nell'Atlante degli Habitat Marini della Liguria *del 2020 e il nuovo aggiornamento cartografico del 2023.*

**Conclusions** – Through the integration of ROV video surveys with visual observations conducted by scuba diving, this study enabled the identification of previously undocumented habitat areas, thereby allowing the refinement and redefinition of the boundaries of several habitats already mapped in the *Atlas of Marine Habitats of Liguria*. The coralligenous outcrops identified in the area near the port were characterized by a thick basal layer of encrusting coralline algae but lacked an upper layer, indicating low

three-dimensionality and limited structural complexity. These features could make them more vulnerable to the potential impacts associated with the construction of the new breakwater, reducing their resilience to additional local anthropogenic pressures.
One of the most significant findings from the ROV video analyses is the discovery of the "Coastal detritic bottom with rhodoliths habitat", never reported before in the study area. Rhodolith beds are characterized by the accumulation, on mobile substrates, of living and dead thalli of calcareous red algae, which form biogenic habitats with high species diversity and structural complexity (Bianchi & Morri, 2025). Over time, this accumulation can lead to the development of a three-dimensional structure that hosts high biodiversity. Rhodolith beds exhibit low resilience to both direct disturbances, such as bottom trawling, and indirect impacts from reduced water quality (Steller *et al*., 2003). Owing to this susceptibility and the high biodiversity they support, rhodolith beds have been recognized as a threatened coastal habitat in need of protection. On this habitat, and along nearly all transects deeper than 22 m and down to approximately 40 m, the alien alga *C. cylindracea* was detected with an average cover of about 15%; however, its abundance has significantly decreased in recent years (Mancini *et al*., 2024). Managing priority habitats in a highly urbanized area represents a major challenge for biodiversity conservation (Parravicini *et al.*, 2013). Updating marine habitat maps, integrated with sea-truthing, is an essential tool for identifying and managing these valuable habitats, which require protection and continuous long-term monitoring.

**References**

BIANCHI C.N., MORRI C. (2025) - Different rhodolith assemblages host distinct associated species but similar ecological groups: A case study in NW Mediterranean Sea. *Aquat. Bot.*, **196**: 103826.

BIANCHI C.N., PARRAVICINI V., MONTEFALCONE M., ROVERE A., MORRI C. (2012) - The challenge of managing marine biodiversity: a practical toolkit for a cartographic, territorial approach. *Diversity*, **4**: 419-452.

BIANCHI C.N., CINELLI F., MORRI C. (1996) - La carta bionomica dei mari toscani: introduzione, criteri informativi e note esplicative. *Atti Soc. Tosc. Sci. Nat. Mem., Ser. A*., **102**: 255-270.

COPPO S., DIVIACCO G., MONTEPAGANO E. (2020) - *Nuovo atlante degli habitat marini della Liguria: cartografia delle praterie di* Posidonia oceanica *e dei principali popolamenti marini costieri*. Regione Liguria, Genova: 244 pp.

HALPERN B.S., WALBRIDGE S., SELKOE K.A., KAPPEL C.V., MICHELI F., D'AGROSA C., BRUNO J.F., CASEY K.S., EBERT C., FOX H.E., FUJITA R. (2008) - A global map of human impact on marine ecosystems. *Science*, **319**(5865): 948-952.

MANCINI I., BIANCHI C.N., MORRI C., AZZOLA A., OPRANDI A., ROBELLO C., MONTEFALCONE M. (2024) - A marine invasion story: *Caulerpa cylindracea* (Chlorophyta, Ulvophyceae) in the marine protected area of Portofino (Ligurian Sea). *Biol. Mar. Mediterr.,* **28**(1): 83-86.

PARRAVICINI V., MICHELI F., MONTEFALCONE M., MORRI C., VILLA E., CASTELLANO M., POVERO P., BIANCHI C.N. (2013) - Conserving biodiversity in a human-dominated world: degradation of marine sessile communities within a protected area with conflicting human uses. *PLoS One*, **8**(10): e75767.

STELLER D.L., RIOSMENA-RODRÍGUEZ R., FOSTER M.S., ROBERTS C.A. (2003) - Rhodolith bed diversity in the Gulf of California: the importance of rhodolith structure and consequences of disturbance. *Aquat. Conserv. Mar. Freshw. Ecosyst.,* **13**(S1): S5-S20.

**Acknowledgement**
This research was funded by the Port System Authority of Genoa in the framework of the research agreement between PSA and DiSTAV for the study and monitoring of the construction activity impact of the new breakwater of the port on the marine–maritime environment of the Genoese coast (CUP DiSTAV D33C2200098—CUP PSA C39B1800060006).