

Reconstructing Mediterranean historical seascapes through the analysis of archives of underwater photographs

Torsani Fabrizio¹, Frascchetti Simonetta², Micheli Fiorenza³, Pusceddu Antonio⁴ and Cerrano Carlo⁵

¹ Marine Zoology Lab, Department of Life and Environmental Science, Polytechnic University of Marche, Via Brece Bianche, 60131 Ancona, Italy
E-mail: f.torsani@univpm.it

² Department of Biological and Environmental Sciences and Technologies, S.P. 6, Lecce-Monteroni 73100, Lecce, Italy

³ Hopkins Marine Station, Stanford University, 120 Ocean View Boulevard, Pacific Grove, CA 93950, United States

⁴ Department of Life and Environmental Science, University of Cagliari, Via Fiorelli 1, 09126 Cagliari, Italy

⁵ Department of Life and Environmental Science, Polytechnic University of Marche, Via Brece Bianche, 60131 Ancona, Italy

The assessment of historical shifts in marine ecosystems' structure and functioning needs recognition and inclusion of how anthropogenic activities altered marine biodiversity in the past (Manez et al. 2014). In particular, identification of effective management and restoration strategies requires a knowledge of historical trends of change (*historical marine ecology*; Lotze and Worm 2009), which, however, is limited. Time-series are often either too short to adequately cover long-term variations (Jackson 2001) or spatially fragmented and temporally scattered. To overcome this, a possible approach consists in the selection of sites of investigation for which historical data can be mined from archives of underwater photography. Such approach appears particularly suitable for the Mediterranean Sea, where either scientific or artistic underwater photography has a long tradition, dating back to the infancy of underwater photography at the end of the 1950s.

We investigated changes occurred in the composition of hard-bottom epibenthic communities in the Marine Protected Area (MPA) of Portofino (NW Mediterranean Sea) using underwater photographs dating back to the 1980s and stored in private archives or published in the grey literature, as well as new pictures taken *ad hoc* in the same localities of the historical sites. Since the original pictures were not taken for scientific purposes, a guideline was developed to standardize the extrapolation of semi-quantitative data. Based on their persistence, disappearance or temporal invariance, the different considered taxa were assigned to one of the three following categories: "winners" (e.g. invasive algae *Caulerpa cylindracea* and *Womersleyella setacea*; encrusting and massive sponges; octocorals *Paramuricea clavata* and *Corallium rubrum*), "losers" (e.g. erect algae; gorgonian *Eunicella cavolini*) and "changeless" (e.g. seagrass *Posidonia oceanica*; gorgonian *E. singularis*) (Baskin 1998).

The qualitative nature of our data did not allow the establishment of cause-effect relationships. However, our approach allowed us to interpret changes in the epibenthic community structure considering multiple co-occurring stress factors including fishing (and its restriction after marine protected area establishment), the occurrence of heatwaves and related mass-mortality events, biological invasions, eutrophication, sedimentation and turbidity produced by coastal activities, and diving impacts. We propose this approach as a reliable semi-quantitative method for reconstructing historical baselines and describing long-term change of marine benthic communities.

References

- Baskin Y (1998) Winners and Losers in a Changing World. *Bioscience* 48: 788-792 doi: 10.2307/1313390
- Jackson JBC (2001) What was natural in the coastal oceans? *Proc Natl Acad Sci U S A* 98: 5411-5418 doi: 10.1073/pnas.091092898
- Lotze HK, Worm B (2009) Historical baselines for large marine animals. *Trends Ecol Evol* 24: 254-262 doi: 10.1016/j.tree.2008.12.004
- Manez SK, Holm P, Blight L, Coll M, MacDiarmid A, Ojaveer H, Poulsen B, Tull M (2014) The future of the oceans past: Towards a global marine historical research initiative. *PLoS One* 9: e101466 doi: 10.1371/journal.pone.0101466

Keywords: historical ecology; marine benthos; coralligenous; Mediterranean Sea