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Editorial: Seascape Ecology: from characterization to evaluation of state and change over time

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Editorial on the Research Topic
Seascape Ecology: from characterization to evaluation of state and change over time

Introduction

Landscape ecology was born in the 1930s when aerial photography was first adopted to study the spatial structure and heterogeneity of terrestrial ecosystems, in contrast to 'classical' ecology that tended to think in terms of populations and communities living in a homogeneous environment (Troll, 1939). It became a discrete, established discipline in the 1980s, with the founding of the International Association for Landscape Ecology (IALE). For long, landscape ecology remained a substantially terrestrial discipline, due to the lack of perception of submerged landscapes and the difficulty of considering the sea as territory (Bianchi et al., 2012). It has been necessary to wait for decades to see the transfer of landscape approaches and language to marine ecosystems: apart from early attempts (e.g., Cocito et al., 1991), seascape ecology became a recognized field of research only in the 2010s, when well-known marine ecological journals published Research Topics on seascape ecology (Pittman et al., 2011; Hidalgo et al., 2016), IALE chose seascape ecology as the main theme of one of its annual meetings (Liski et al., 2015) and two books dealing with seascape ecology were published (Musard et al., 2014; Pittman, 2018). Seascape is to be intended as the totality of natural and anthropogenic characters of a marine region.

As its terrestrial counterpart, seascape ecology deals with the spatial configuration of ecosystems and consider environmental heterogeneity and dynamics as the main subjects of study and the keys for ecosystem functioning and persistence. Of course, diversity patterns on land and in the sea are different (Boudouresque et al., 2014) and seascapes cannot be equated to landscapes (Manderson, 2016). Seascapes are often perceived to be in more natural conditions with respect to landscapes (Bianchi et al., 2005). However, integrated landscape-seascape spatial analyses are rarely attempted: in the case of the overcrowded Gulf of Naples (southern Italy), the landscape exhibits higher patch edge dimension, diversity and evenness, and a lower fractal dimension than the seascape (Appolloni et al., 2018). Through marine geospatial modelling, seascape approaches represent an important decision-support tool for integrated coastal zone management (Parravicini et al., 2012).

Contributions

This Research Topic makes the point of an emerging discipline that is barely a decade old. The nine research articles here included illustrate some of the latest achievements in the field. Seascape ecology relies on special technologies such as remote sensing (either acoustic or optical), robotics, and scuba diving. Consistently, a majority of articles deal with recent advances in high-resolution marine habitat mapping. Józef et al. combined hydroacoustics and inspections to compare macroalgal meadows in two contrasting climate regimes in the Svalbards. Spyksma et al. applied diver-generated photomosaics to the temperate rocky reef ecosystems of north-eastern New Zealand. Photomosaics were an output of structure-from-motion photogrammetry, a technique that utilises numerous overlapping images, well established in terrestrial applications but still comparatively little employed in the sea. Ventura et al. integrated aerial and water surface low-cost drones for the cartography of coastal benthic habitats (beach wrack deposits, hard bottoms and seagrass meadows) in central Tyrrhenian Sea, Italy. Tomasello et al. employed photogrammetry by unmanned aerial vehicles to elaborate high-resolution digital elevation model of a giant beach wrack on the westernmost coast of Sicily, adjacent to one of the largest *Posidonia oceanica* meadows in the Mediterranean Sea. de Almeida et al. mapped mixed seagrass meadows in the Mexican Caribbean using satellite imagery and supervised classification based on sea truthing. The functioning of a mixed tropical seagrass meadow was studied by Cui et al., who analyzed the food web of the meadow composed of five species (*Enhalus acoroides*, *Thalassia hemprichii*, *Cymodocea rotundata*, *Halodule uninervis*, and *Halophila ovalis*) in South China Sea, using triple stable isotopes and fatty acid signatures.

Bioconstruction is a peculiar feature of the marine environment. Vermetid reefs are an outstanding example of bioconstruction that modify coastal seascapes forming platforms in the intertidal zone of rocky coasts; with their three-dimensional and seaward-expanding structure, they support high biodiversity levels and provide important ecological functions and ecosystem services. Picone and Chemello characterized a vermetid reef in Sicily (Italy) by means of unmanned aerial vehicle imagery.

Habitat characterization, to identify types, is the first phase of the process of environmental diagnostics, a typical application of seascape ecology; the second and final phase is evaluation, to define status and values. Ecological indices are a major tool to achieve the latter target. Astruch et al. developed an ecosystem-based index to assess the health status of coastal detritic bottoms, one of the most extensive habitats of the continental shelf worldwide, in the upper levels of the circalittoral zone. The index was tested in southern France, where rhodoliths (free living coralline algae) characterizes the seascape and might be an indicator of good environmental status for this kind of marine habitat. Thanks to the availability of a large dataset encompassing a wide array of descriptors, Oprandi et al. compared the performance of eleven indices relative to three habitats/biotic components (reefs, seagrass, and fish) in a marine protected area of Sardinia, Italy.

Perspectives

Efforts on seascape ecology like those in this Research Topic should be fostered, as the acceleration of environmental crises related to climate change, widespread sea pollution, and growing ocean overexploitation represent ever growing threats to marine ecosystems. In particular, future research should aim at increasing our understanding of seascape responses to environmental change, in order to offer information useful to develop tools to mitigate human impact on the marine environment.

Author contributions

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