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Predictive habitat modeling in two Mediterranean canyons including hydrodynamic variables

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ABSTRACT

Madrepora oculata and *Lophelia pertusa* are the two main ecosystem engineering, scleractinian cold-water corals (CWC) found in Mediterranean canyons. Factors controlling CWC distribution in the Mediterranean Sea are not yet fully understood in spite of such ecosystems being recognized as sensitive habitats by the General Fisheries Commission for the Mediterranean. As they are threatened by fishery activity, they are subject to management and protection measures. In order to contribute towards identifying the major drivers governing CWC distribution at local scale, which is a prerequisite for proper management, we focused our attention on two canyons: (1) the Cassidaigne canyon, located in the eastern part of the Gulf of Lion, in which CWC ecosystems have settled in an upwelling environment and form large colonies, and (2) the Bari Canyon System, in the southwestern Adriatic, a site of coral growth that has been hypothesized to respond to hydrographic processes, including the cascading of North Adriatic Dense Water.

The objective of our study was to combine several ecological variables to describe the environmental conditions in favor of CWC settlement and growth: (1) CWC observations, extracted from geo-referenced underwater videos, (2) seafloor characteristics derived from high-resolution bathymetry, (3) data on local hydrodynamic conditions (from high resolution hydrodynamic models). Habitat suitability models were used to identify the main variables driving CWC distribution. Models based on presence-only data (Maxent and ENFA) and on presence-absence data (GLMs) were fitted and compared.

Seafloor ruggedness was identified to be the major factor driving CWC distribution in both canyons with the three methods. Two hydrodynamic variables (mean temperature and current velocity) were the second most important predictors for explaining CWC settlement and growth. Suitable areas for CWC habitat occurrence were mapped for both canyons. Spatial distributions were generally predicted at the same locations, although the GLM gave less realistic results in the Bari canyon system probably due to the limited range cover of the entire environmental conditions by the absence points, suggesting that the Maxent and ENFA models were more efficient.

These theoretical distributions will help in the assessment of potential habitat extent in the deep-sea and also in the scheme of the Marine Strategy Framework Directive (MSFD).

1. Introduction

The sustainable management and conservation of Cold-Water Corals (CWC) have constituted one of the main subjects of many studies for the last 15 years. To this end, understanding their global distribution has become one of the major goals, in order to implement efficient marine spatial planning (Fernandez-Arcaya et al., 2017; Vierod et al., 2014). Consequently, correlative species distribution models, called Habitat Suitability Models (HSM), have rapidly gained in popularity (Brown et al., 2011; Pearson, 2008; Vierod et al., 2014). These statistical models characterize the environmental conditions suitable for a species and then identify where adequate environments are distributed in space (Pearson, 2008), allowing for the extrapolation of the results to non-surveyed areas. Using predictive habitat modeling is therefore an

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