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Spatial variation of intertidal assemblages at Tavolara-Capo Coda Cavallo MPA (NE Sardinia): geographical vs. protection effect

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Abstract

Marine protected areas (MPAs) represent a potentially useful management tool to preserve biodiversity. Protection effectiveness was investigated at Tavolara-Capo Coda Cavallo MPA by comparing assemblages of rocky shores at a location 'A' level of protection (island), with those at two locations at 'B' level of protection (one on an island and one on the mainland coast) and two at 'C' level of protection (one on an island and one on the mainland coast).

Results did not indicate significant differences in structure of intertidal assemblages among locations under different levels of protection ('A', 'B' and 'C'). Protection was not found to be a significant source of variation to low-shore assemblages investigated. In contrast, assemblages seemed to be more dependent on the geographical location within the MPA. Results have important implications for conservation of marine coastal assemblages and would indicate that inclusion of representative assemblages within systems of marine protected areas should target rocky shores both on the mainland and on islands.

Keywords: Island biogeography; MPAs; Protection effectiveness; Rocky shores

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1. Introduction

Marine reserves have been proposed as an efficient way to maintain and manage fisheries while simultaneously preserving biodiversity and meeting other conservation objectives as well as human needs (Allison, Lubchenco, & Carr, 1998; Dugan & Davis, 1993; Halpern, 2003). Marine reserves can have a variety of effects on biological resources depending on many variables: species composition, fishing intensity around the reserve, adult mobility or home range size of fish within the reserve and types of habitats both inside and outside the reserve (Halpern, 2003 and references therein). In addition, size of a reserve can influence its success: in order to accomplish specific goals when a marine reserve is designed, attention should be paid to the variability in dispersal patterns of marine organisms (Halpern, 2003; Halpern & Warner, 2002).

Protection effectiveness can be judged in terms of producing higher densities and diversity of organisms. Unfortunately, two difficulties often need to be faced: (1) quantitative investigations before reserve establishment are often lacking; (2) finding experimental controls to reserve areas is not always easy and sometimes impossible: reserve areas are often unique for geographical location and/or topographical features relative to areas nearby. In fact controls, should be chosen randomly from a set of similar locations having the same type of assemblages and similar habitat features to those protected but unaffected by protection (Chapman, Underwood, & Skilleter, 1995; Gell & Roberts, 2003; Underwood, 1992).

The biological impact of marine reserves has been reviewed by examining studies where data 'before' vs. 'after' creation of the reserve and 'inside' vs. 'outside' the reserve were available (Fraschetti, Terlizzi, Micheli, Benedetti-Cecchi, & Boero, 2002; Halpern, 2003). Results are encouraging and reserves of any size appear to support the predictions of many fisheries models thus producing higher densities, sizes and diversity of organisms. Also, subtidal and intertidal benthic species distribution can be affected, aside from the direct influence of protection, from a wide range of indirect effects, including trophic cascades (e.g., Castilla, 1998; Edgar & Barrett, 1999; Sala, Boudouresque, & Harmelin-Vivien, 1998; Shears & Babcock, 2003). Also, humans intrude upon intertidal and shallow subtidal habitats by chronic removal of predatory gastropods, grazers and algae to support commercial activities (Castilla, 1999; Lasiak, 1998, 1999), harvesting bait species by recreational fishermen (Kingsford, Underwood, & Kennelly, 1991), by collecting shells for aesthetic purposes (Underwood, 1993) and trampling (Brosnan & Crumrine, 1994; Keough & Quinn, 1998; Milazzo, Chemello, Badalamenti, & Riggio, 2002). Furthermore, there is evidence that top predators can promote major changes in patterns of distribution and dominance of organisms on the shore (Castilla, 1999).

Tavolara-Capo Coda Cavallo MPA was established in 1997. This is a multiple-use protected areas, like all Italian MPAs, which typically include 'A' protection locations (i.e., no-entry, no-take reserves), 'B' protection locations where limited human activities are permitted (entry, no-take) and 'C' protection locations having a lesser degree of protection. To assess protection effect on marine organisms at this MPA no comparison with data taken before the establishment can be done since no quantita-