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Possible effects of human impacts on epibenthic communities and coral rubble features in the marine Park of Bunaken (Indonesia)

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Abstract

Indo-Pacific coral reefs are considered among the most complex and biodiversified ecosystems in the world. Their existence is threatened by both natural and anthropogenic factors. Therefore, the assessment of anthropogenic disturbances is necessary to protect and manage these marine natural resources. In Bunaken Marine Park (North Sulawesi, Indonesia) epibenthic assemblages and coral rubble features at four impacted sites (each of them located close to villages and frequently exploited as recreational diving spots), and four well preserved sites (far from villages and scarcely frequented by divers), were investigated at 6, 12 and 18 m depth, in order to identify

possible reef modifications. The assemblages were sampled by way of photographs. Coral rubble cover was estimated both by way of photographs and along belt transects, while grain size and the living fraction of the coral rubble were assessed by direct samples. The data showed significant differences between the study sites and between depths with regard to human activity. The hard coral cover and the assemblage heterogeneity are higher in control sites than in the impacted site where, especially in shallow water, the mechanical damage can strongly affect the assemblage structure.

The mean percentage of coral rubble cover was significantly higher in the impacted sites, while its living portion was higher in the controls. The fine fraction (0.1–0.5 cm) of coral rubble was more abundant in the impacted sites, coarse fraction (4–8 cm) prevailed at the control sites while intermediate fractions did not show any differences. The three-dimensional structural complexity of the assemblages was reduced in the sites affected by physical disturbances. These results are strongly independent of depth. Human activities, which damage corals and increase coral rubble production, are mainly performed on the reef flat and reef edge but their effects are transferred along the reef wall in depth.



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Keywords

coral reefs; human impact; epibenthic assemblages; coral rubble; marine protected area; North Sulawesi

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