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TITLE: Distribution of macro-infaunal communities in phosphorite nodule deposits on Chatham Rise, Southwest Pacific: Implications for management of seabed mining

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ABSTRACT:

Protecting the structural and functional integrity of benthic communities is essential for the maintenance of ecosystem services by the deep sea. As large scale exploitation of minerals from the deep-sea floor becomes increasingly likely, there is a growing need for a better understanding of the spatial distribution of benthic communities and their relationships with environmental variables, so that effective management practices can be developed and implemented. Here, we present the results of a survey of the macro-infaunal community on the crest of Chatham Rise, Southwest Pacific, in an area rich in phosphorite nodule deposits that is proposed for future mining. Boxcore samples from the study area (~2500 km2) were used to describe macro-infaunal diversity and community structure relative to phosphorite nodule density and environmental variation, these data forming the basis for predictive models of the distribution of benthic communities. Analyses showed that variation in macro-infaunal community structure was similar at two spatial scales, within the survey areas (1?5 km) and among survey areas (5?50 km). Overall, macro-infaunal community structure was most strongly correlated with phosphorite nodule density, and was also correlated with longitude. Habitat suitability models were generated for three benthic communities using boosted regression trees. Models showed that each of these communities was associated with different seabed morphologies (i.e., uneven topography, slopes of depression features, or flat seabed), and produced contrasting predicted spatial distribution patterns among communities across the study area. One of these communities, dominated by lysianassid and phoxocephalid amphipods, was strongly associated with the presence of high-density phosphorite nodules and may represent a nodule-specific community. Macro-infaunal diversity (taxon richness) was significantly correlated with topographic variables, and was greatest in areas with uneven topography and inside depressions. Our findings show that two environmental variables that will be directly and permanently impacted by mining (nodule density and mesoscale topographic features) may be key drivers of benthic community structure and diversity. Mitigating impacts of phosphorite mining on Chatham Rise will require protecting areas of seabed spanning the entire range of phosphorite nodule densities, as well as including key topographic features that are associated with distinct macro-infaunal communities. Furthermore, these areas should be distributed along the east to west axis of the crest of the Rise in order to encompass the longitudinal range of environmental variability across the area for which a mining permit and a prospecting licence are held. The present study demonstrates how modelling of benthic communities can be an effective tool for spatial management of seabed mining.

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