A model-based evaluation of reefs connectivity and habitat degradation scenarios - Implications for future marine spatial planning and marine conservation policies in the Western Indian Ocean

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Abstract

Coastal and marine ecosystems are under increasing pressure from a wide variety of threats such as habitat degradation, overfishing, offshore energy development, and climate change. As marine ecosystems degrade, so do the well-being and livelihoods of populations that depend directly on the ecosystem goods and services they provide. Marine protected areas have been proposed to protect biodiversity, restore damaged ecosystems, sustain fisheries, and rebuild overexploited stocks. The effectiveness of MPAs depends in part on their effectiveness as connected networks, linked over large areas by ecological processes such as larval dispersal. The CBD AICHI Target 11 calls for 10% of coastal and marine areas to be conserved by 2020 through effectively managed, ecologically representative and well connected systems of protected areas, and integrated into the wider landscapes and seascapes. According to the Regional State of the Coast Report (UNEP-Nairobi Convention and WIOMSA, 2015), "there is need for immediate and substantive actions to increase the adaptive capacity of coastal marine ecosystems and the people that depend on them, especially in relation to MPAs". In order to better assess the situation in the Western Indian Ocean, we applied a biophysical model driven by ocean currents to evaluate connectivity between reefs. We applied graph-theoretic analysis, including clustering and a betweenness centrality metric. Our results show high interconnectivity within several sub-regions and lower connectivity across the WIO region. We compared the results with the current MPA network, and proposed sites/reefs that should be considered priority sites for MPA implementation: Pebane, Cosmoledo, Majunga, Masoarivo, Platte Island, Farquhar, Agalega and Geyser bank. The next

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step of this work is the generation of scenarios to study habitat degradation consequences on coral reef ecosystems connectivity patterns in order to better support decision-making. Results are discussed in terms of implications for transboundary marine policies and regional cooperation in the WIO. This work was conducted within the framework of the SIREME (IRD) and MASPAWIO (IUCN) projects.