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Understanding Patterns of Hard Coral Demographics in Kenyan Reefs to Inform Restoration

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Abstract : Background: Coral reefs are becoming increasingly vulnerable due to several threats ranging from climate change to overfishing. This has resulted in increased management and conservation efforts to protect reefs from degradation and facilitate recovery. Recruitmentof new individuals are isimportant in the recovery process and critical for the persistence of coral reef ecosystems. Local coral community structure can be influenced by successful recruit settlement, survival, and growth Understanding coral recruitment patterns can help quantify reef resilience and connectivity, establish baselines and track changes and evaluate the effectiveness of reef restoration and conservation efforts. This study will examine the abundance and spatial pattern of coral recruits and how this relates to adult community structure, including the distribution of thermal resistance and sensitive genera and their distribution in different management regimes. Methods: Coral recruit and demography surveys were conducted from 2020 to 2022, covering 35 sites in 19coral reef locations along the Kenyan coast. These included marine parks, reserves, community conservation areas (CMAs), and open access areas from the north (Marereni) to the south (Kisite) coast of Kenya and across different reef habitats. The data was collected through the underwater visual census (UVC) technique. We counted adult corals (>10 cm diameter)of23 selected genera using belt transects (25 by 1 m) and sampling of 1 m2 quadrat (at an interval of 5m) for all coloniesless than 10 cm diameter. The benthic cover was collected using photo quadrats. The surveys were only done during the northeast monsoon season. The data wereanalyzed using the R program to see the distribution patterns and the Kruskal Wallis test to see whether there was a significant difference. Spearman correlation was also applied to assess the relationship between the distribution of coral genera in recruits and adults. Results: A total of 44 different coral genera were recorded for recruits, ranging from 3at Marereni to 30at Watamu Marine Reserve. Recruit densities ranged from 1.2±1.5recruit m-2 (mean±SD) at Likoni to 10.3± 8.4 recruit m-2 at Kisite Marine Park. The overall densityof recruitssignificantly differed between reef locations, with Kisite Marine Park and Reserve and Likonihaving significantly large differences from all the other locations, while Vuma, Watamu, Malindi, and Kilifi had significantly lower differences from all the other locations. The recruit generadensity along the Kenya coastwas divided into two clusters, one of which only included sites inKisite Marine Park. Adult colonies were dominated by Porites massive, Acropora, Platygyra, and Favites, whereas recruits were dominated by Porites branching, Porites massive, Galaxea, and Acropora. However, correlation analysis revealed a statistically significant positive correlation ($r=0.81$, $p<0.05$) between recruit and adult coral densities across the 23 coral genera. Marereni, which had the lowest densityof recruits, has only thermallyresistant coral genera, while Kisite Marine Park, with the highest recruit densities, has over 90% thermal sensitive coral genera. A weak positive correlation was found between recruit density and coralline algae, dead standing corals, and turf algae, whereas a weak negative correlation was found between recruit density and bare substrate and macroalgae. Between management regimes, marine reserves were found to have more recruits than no-take zones (marine parks and CMAs) and open access areas, although the difference was not significant. Conclusion: There was a statistically significant difference in the density of recruits between different reef locations along the Kenyan coast. Although the dominating genera of adults and recruits were different, there was a strong positive correlation between their coral communities, which could indicate self-recruitment processes or consistent distance seedings (of the same recruit genera). Sites such as Kisite Marine Park, with high recruit densities but dominated by thermally sensitive genera, will, on the other hand, be adversely affected by future thermal stress. This could imply that reducing the threats to coral reefs such as overfishingcould allow for their natural regeneration and recovery.

Keywords : coral recruits, coral adult size-class, cora demography, resilience
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