

Variation in the status of *Acropora palmata* coral in relation to environmental factors along the west coast of Barbados

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Acropora palmata is a critically endangered Caribbean coral whose decline threatens both coastal ecosystems and shoreline protection. Barbados once supported extensive *A. palmata* colonies along its west coast, yet the environmental drivers shaping current patterns of colony health and distribution remain unclear. We re-surveyed twelve sites in 2025, five of which were also assessed in 2024 and all originally mapped in 2015, to evaluate temporal changes in colony abundance, size, and condition, and to test how spatial and environmental gradients influence *A. palmata* health. Average colony height increased from 2015 to 2024, but declined sharply in 2025, consistent with fragmentation following heavy wave action and Hurricane Beryl in 2024. Despite this size reduction, health index scores improved significantly from 2024 to 2025, indicating rapid recovery in live tissue and pigmentation since the 2024 bleaching and hurricane events. Lack of pattern in count across study years suggests that varying environmental conditions across sites had different impacts on abundance. Our PCA results revealed four distinct habitat groupings across the coastline, with strong environmental gradients associated with latitude, distance to breakwaters and runoff outputs, depth, and distance from shore. Percent dead tissue was significantly related to a depth/distance to shoreline gradient, colony abundance was strongly structured by latitude, and total colony area increased significantly along the same gradient. Distances to individual anthropogenic structures were not associated with colony condition once broader spatial gradients were considered. Collectively, these results indicate that *A. palmata* conditions along Barbados's west coast are shaped primarily by latitudinal environmental variation rather than direct proximity to runoff outputs or breakwaters. These findings provide an updated baseline for restoration planning and highlight the importance of spatial context in the management of recovering *A. palmata* populations.

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