Investigating Fish Communities on Coral Reefs with Different Levels of Management in Grenada

Investigación de comunidades de peces en arrecifes de coral con diferentes niveles de gestión en Granada

Enquête sur les communautés de poissons sur les récifs coralliens avec différents niveaux de gestion à la Grenade

ADARA JAGGERNAUTH[1], STEPHEN NIMROD[2], DEIRDRE BROPHY[1]
[1]*Marine And Freshwater Research Centre, Atlantic Technological University, Atu Galway Campus, Dublin Road, Galway, Ireland*
Abjaggernauth@Gmail.Com Deirdre.Brophy@Atu.Ie
[2]*St. George's University, University Centre, West Indies, Grenada*
Snimrod@Sgu.Edu

EXTENDED ABSTRACT

Coral reefs, often called the "rainforests of the sea," are critical ecosystems providing essential services such as coastal protection, fisheries, and tourism, particularly for Small Island Developing States (SIDS) like Grenada (UNDP, 2021). Despite covering less than 1% of the ocean floor, coral reefs support approximately 25% of all marine species, making them among the most biodiverse ecosystems on Earth (UNDP, 2021). However, these ecosystems face increasing threats from overfishing, habitat destruction, pollution, and climate change. Marine Protected Areas (MPAs) are vital tools for mitigating these impacts by regulating human activities and fostering ecosystem resilience (Hoegh-Guldberg et al., 2007). This study examines how varying levels of MPA management influence fish communities in Grenada, focusing on three MPAs: Sandy Island/Oyster Bed MPA (SIOBMPA), Moliniere Beausejour MPA (MBMPA), and Grand Anse MPA (GAMPA). These MPAs represent a spectrum of management effectiveness, ranging from active enforcement at SIOBMPA to limited and no management at MBMPA and GAMPA respectively.

Fieldwork was conducted in May 2024, employing the Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol. Nine sites across the three MPAs were surveyed using underwater visual census techniques along 30-meter transects. Fish were categorized by size using a 1-meter-wide T-bar, and biomass estimates were calculated based on species-specific length-weight relationships. The study also calculated ecological metrics including the Shannon diversity index, fish abundance, and mean trophic levels (MTL) to assess differences in fish community structure among MPAs. Fish species were categorized into carnivores, herbivores, and omnivores to examine diet-related patterns in biomass and abundance.

The study revealed significant spatial variation in fish biomass, abundance, diversity, and trophic levels across the MPAs. SIOBMPA, with active management and enforcement, exhibited the highest biomass and diversity, particularly among carnivorous and omnivorous species. In contrast, GAMPA, with no management, had lower biomass and species diversity. MBMPA, where management is limited, showed intermediate values. Specifically, the mean trophic level was highest in SIOBMPA and MBMPA, which could mean better ecosystem health in these areas. Pairwise comparisons showed that SIOBMPA supported significantly higher biomass of carnivores and omnivores compared to GAMPA. The differences between MBMPA and GAMPA were not statistically significant, though biomass levels were higher in MBMPA for both diet groups. These results suggest that active management and enforcement may be crucial for maintaining healthy fish communities.

This study highlights how varying levels of management may influence fish communities across three MPAs in Grenada, providing a baseline assessment of fish communities. Metrics such as biomass, abundance, diversity, and mean trophic levels were highest at the actively managed Sandy Island/Oyster Bed MPA (SIOBMPA), while lower values were observed at Moliniere Beausejour and Grand Anse MPAs. These findings align with global evidence that active management supports healthier ecosystems (Edgar et al., 2014). However, persistent challenges, such as illegal fishing, remain a significant concern, even in managed MPAs, highlighting the need for stronger enforcement and community engagement (Grenada Coral Reef Foundation, 2024).

The study's short temporal scope and the lack of habitat complexity analysis are noted limitations, emphasizing the need for long-term monitoring to better assess trends. Regular assessments of fish populations, including metrics like Mean Trophic Level and biomass, are essential for evaluating the effectiveness of MPAs. Enhanced enforcement, the establishment of no-take zones, and active stakeholder engagement are critical next steps to support adaptive management and ensure sustainable use of marine resources in Grenada (Grenada Coral Reef Foundation, 2024).

LITERATURE CITED

Edgar, G. J., Stuart-Smith, R. D., Willis, T. J., Kininmonth, S., Baker, S. C., Banks, S., & Thomson, R. J. (2014). Global conservation outcomes depend on marine protected areas with five key features. *Nature, 506*(7487), 216-220.

Graham, N. A. J., Dulvy, N. K., Jennings, S., & Polunin, N. V. C. (2005). Size-spectra as indicators of the effects of fishing on coral reef fish assemblages. *Coral Reefs, 24*(1), 118-124.

Grenada Coral Reef Foundation (GCRF). (2024). *Grenada Marine Protected Areas Coral Reefs Status Report Draft*. Submitted to Grenada Sustainable Development Trust Fund (GSDTF), Kirani James Athletic Stadium, Queens Park, St. George's, Grenada.

Hoegh-Guldberg, O., Poloczanska, E. S., Skirving, W., & Dove, S. (2017). Coral reef ecosystems under climate change and ocean acidification. *Frontiers in Marine Science, 4*, Article 158. https://doi.org/10.3389/fmars.2017.00158

United Nations Development Programme. (2021). *Small Island Developing States are on the frontlines of climate change*. UNDP. Retrieved December 20, 2024, from https://climatepromise.undp.org/news-and-stories/small-island-developing-states-are-frontlines-climate-change-heres-why

KEYWORDS: Fish Communities, Marine Protected Areas, Coral Reefs, Adaptive Management, Biodiversity Assessment.