



# Assessing the influence of four years of Marine Protected Area status in the Koh Rong Marine National Park



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In 2016, the Fisheries Administration (FiA), Royal Government of Cambodia, supported by Fauna & Flora International (FFI) and local community and NGO partners, proclaimed the first large-scale Marine Protected Area (MPA) in Cambodia. Encompassing the islands of the Koh Rong Archipelago, this MPA signalled a significant breakthrough in marine conservation for the nation.

The Koh Rong MPA aimed to reduce the influence of anthropogenic stressors including overexploitation, Illegal, Unreported and Unregulated (IUU) fishing and unsustainable development while promoting the recovery of marine ecosystems, in turn attracting increasing numbers of tourists to the area.

Since the proclamation of this MPA four years ago, a community-led approach to compliance and enforcement has driven the management strategy. This has been led by community patrols operating under the Community Fisheries (CFI) framework, widely implemented throughout Cambodia in both marine and freshwater environments. **Monitoring of marine habitats is a crucial guide to determining the influence of MPA effectiveness.**

In April 2019, FFI led a research expedition in collaboration with project partners, specifically Song Saa Foundation and Kuda Divers. The objective of this expedition was to conduct a thorough assessment of coral reef habitat within the MPA.

In total, 20 permanent monitoring sites in the Koh Rong Archipelago were surveyed, in addition to five sites at the remote outer islands of Koh Prins and Koh Tang. All surveyors who participated in this expedition were either coral reef monitoring trainers or surveyors who had undergone a rigorous training programme prior to joining the trip.

Monitoring of sites within the MPA and at unprotected outer islands enabled comparative inferences on the efficacy of spatial protection in Cambodia. Surveys utilised a methodology agreed by the Cambodian Coral Reef Monitoring Network (Thorne and Longhurst, 2013). **Data were collected on fish abundance and biomass, benthic stratum composition, invertebrate abundance and structural complexity.**

## FISH ABUNDANCE AND BIOMASS

Reef fish biomass is often used by MPA managers as a metric to assess the impact of anthropogenic influence and to understand the efficacy of marine management (Campbell *et al.*, 2012; Woodhead *et al.*, 2019). The Koh Rong reef monitoring programme has collected data on two families of reef fish, specifically *Serranidae spp.* (grouper) and *Scaridae spp.* (parrotfish) since its inception. The former are top predators in Cambodian reef ecosystems, while the latter are key trophic level herbivores in a functional coral reef system. Biomass for both families was calculated at very low densities in 2019, perhaps indicative of an ecosystem which has been influenced by intensive fishing pressure and environmental degradation (McClanahan *et al.*, 2015). However, the biomass of both families has been on a gradual positive temporal trend since the establishment of surveys in 2010, albeit from a low baseline.

**Surveys at the outer islands revealed lower reef fish biomass than sites within Koh Rong MPA, indicating that locally-led management strategies may offer improved protection to fish populations.**

Reef fish abundance was assessed by creating two sub-groups; one with commercial fish and parrotfish, and one of all other fish species amalgamated. The category 'commercial fish' exhibited a general stability from 2014 – 2019, with *Lutjanidae spp.* (snapper) the most frequently encountered fish within this group at a mean of 12.65 individuals per 500m<sup>3</sup> across all sites. Despite the importance of *Haemulidae spp.* (sweetlips) as a commercial fishery throughout Southeast Asia (Muallil *et al.*, 2019), this family was nearly absent throughout the entire archipelago and outer island sites.

**Overall, sites situated on the western side of Koh Rong frequently showed the highest abundance of all reef fish combined**, with mean abundance at 180.81 individuals per m<sup>3</sup>. Interestingly, the Song Saa Private Island no-take reserve, which sits within Koh Rong MPA, had the lowest abundance recorded for any site. Abundance of reef fish was significantly higher at the outer islands compared to Koh Rong with 267.15 individuals per 500m<sup>3</sup>. Outer island fish communities were boosted in number primarily by reef fish species which aggregate in large shoals such as *Caesionidae spp.* (fusiliers).



## INVERTEBRATES

The invertebrate community was dominated by *Diadaema spp.* (longspine sea urchin) throughout the archipelago. Mean abundance of *Diadaema spp.* was calculated at 81.2 per 100m<sup>2</sup> across all sites. It is plausible that *Diadaema spp.* now occur at such high densities due to transitioning to the

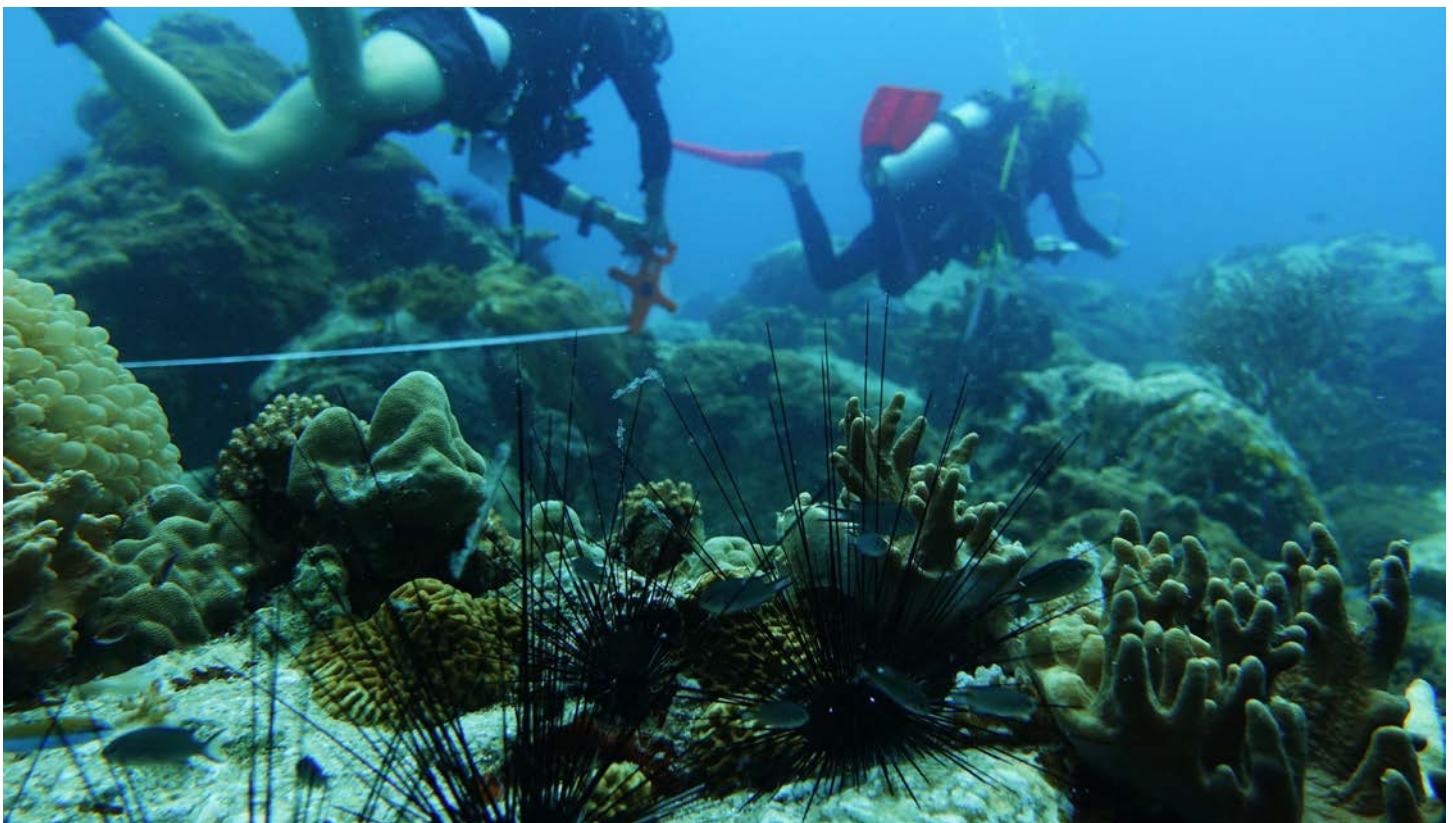
key trophic level herbivore role, left vacant by low abundance of *Scaridae spp.* as observed throughout the Koh Rong MPA. *Diadaema spp.* may be occupying the trophic niche left by *Scaridae spp.* resulting in exponential population growth.

Diversity of both fish and invertebrate assemblages was calculated using the Simpson's Index. The diversity of the reef fish community increased from 2016 surveys, calculated at 0.96 of a maximum of 1 on the species index. This is the highest fish diversity score ever calculated in the archipelago. In contrast, diversity of invertebrates remained relatively stable throughout all years of coral reef monitoring. An increase in fish diversity and stability among invertebrate communities can be considered a positive indicator for the current management strategies of the MPA.

## BENTHIC HABITAT

Structural complexity is a crucial factor driving abundance and diversity of fish and invertebrate communities through provision of refuge spaces. **Sites situated on the western side of the archipelago were the most topographically complex, and this observation overlapped with sites showing greater abundance of reef fish.**

Live coral cover was calculated at a mean of 29.80% across the Koh Rong MPA, and a comparison of these nearshore reefs to the outer islands revealed no difference in hard coral cover, despite significantly lower turbidity at the outer islands. Hard coral communities were dominated by bouldering and encrusting coral families, primarily *Porites spp.* (35.56%) and *Diploastrea spp.* (14.08%), with bouldering and encrusting growth forms also encompassing 85.44% of all coral recorded by surveyors. These morphologies offer little in the way of topographic complexity or refuges, therefore limiting diversity and abundance of reef fish and invertebrates.



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## CONCLUSIONS

Four years since its proclamation, the Koh Rong MPA has yet to positively influence many metrics typically used to assess coral reef ecosystem health. However, further degradation has been prevented by current management strategies. **Results from this research demonstrate a reef system displaying stability under sustained anthropogenic pressure.**

Despite slight temporal variation, a general upward trend in abundance of *Scaridae spp.* and *Serranidae spp.* continues to occur. Hard coral cover continues to increase steadily within the MPA, and diversity of fish and invertebrate communities has increased or remained stable. The lack of further decline in these crucial indicators is a positive sign for the current marine management initiatives deployed throughout the archipelago. Yet, biomass of both *Serranidae spp.* and *Scaridae spp.* remains low, indicative of a heavily fished ecosystem and influencing reef fish communities (McClanahan *et al.*, 2015; Graham *et al.*, 2019).

## RECOMMENDATIONS

For coral reef ecosystem health to significantly improve, it is imperative for the Royal Government of Cambodia to enact more stringent enforcement and management strategies within the Koh Rong MNP. It is clear that many of the threats originally described by researchers nearly two decades ago remain prevalent. **Promoting recovery of coral reef habitat in Koh Rong will require an improvement in MPA compliance, site level Monitoring, Control & Surveillance, and fisheries regulation.**

In order to detect and deter IUU fishing, patrol officers must have access to more advanced training and equipment, complimented by power to enforce the law with support from government. Compliance among private sector stakeholders can be improved through more inclusion of this group in MPA development activities. Lastly, a triangulation of biophysical data, known fishing vessel activity and patrol vessel tracks revealed a disconnection between current enforcement effort and those sites which could be considered as having the highest biodiversity value. These sites are primarily located on the western side of the MPA, where patrolling is essentially non-existent and there are no local resource management groups. Therefore, to improve compliance it is recommended to implement more effective and comprehensive patrols, especially with navy & Ministry of Environment participation, and to improve the capacity and willingness of local resource management groups to cover these areas.

## REFERENCES

Campbell, S. J. *et al.* (2012) 'Avoiding conflicts and protecting coral reefs: customary management benefits marine habitats and fish biomass', *Oryx*. Cambridge University Press, **46(4)**, pp. 486–494.

Graham, N. *et al.* (2019) 'Global baselines and benchmarks for fish biomass: comparing remote reefs and fisheries closure'. Inter-Research.

McClanahan, T. R. *et al.* (2015) 'Biomass-based targets and the management of multispecies coral reef fisheries', *Conservation Biology*. Wiley Online Library, **29(2)**, pp. 409–417.

Muallil, R. N. *et al.* (2019) 'Effectiveness of small locally-managed marine protected areas for coral reef fisheries management in the Philippines', *Ocean & Coastal Management*. Elsevier, **179**, p. 104831.

Thorne, B. and Longhurst, K. (2013) 'Development of a standardised national methodology for coral reef surveys', *Cambodian Journal of Natural History*, **2**, p. 80.

Woodhead, A. J. *et al.* (2019) 'Coral reef ecosystem services in the Anthropocene', *Functional Ecology*. Wiley Online Library

**A full technical report is available upon request: Glue, M. and Teoh, M. (2020) Koh Rong Marine National Park: Coral Reef Status Report. Phnom Penh, Cambodia: Fauna & Flora International**



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