

Case Study #5: The return of biodiversity and resilience to Chumbe Island

Jack Coupland, Conservation Manager, Chumbe Island Coral Park (CHICOP)

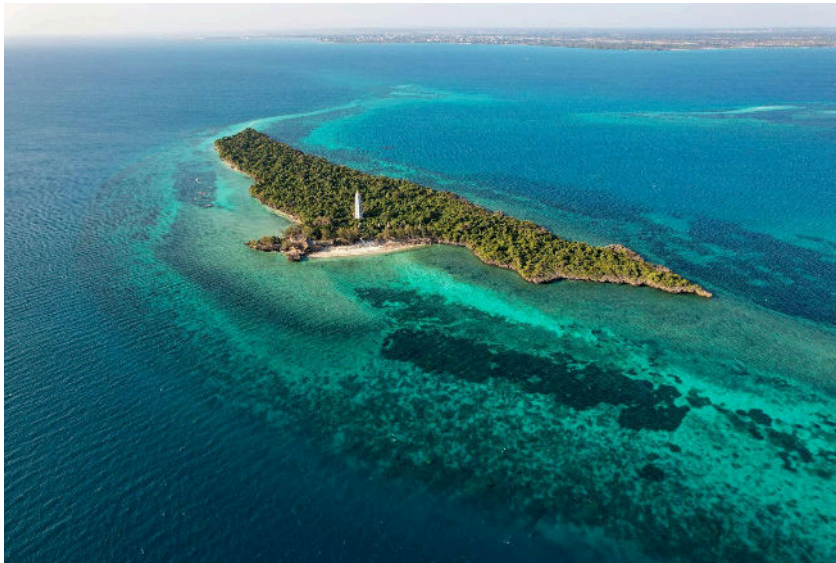


Figure 1: Chumbe Island and surrounding reef, situated 8 km from Unguja.

Introduction

The Zanzibar Archipelago is famed for its beautiful and abundant coral reefs, attracting hundreds of thousands of tourists each year. With a population increasingly dependent on its natural resources however, many of its reefs have been overexploited and damaged through unsustainable fishing practices. This has left many reefs with reduced resilience to combat the effects of climate change, further reducing coral reef health (Bravo *et al.*, 2021).

Sitting eight km off the southwest coast of Zanzibar, Chumbe Island is an internationally recognised biodiversity hotspot and boasts one of the healthiest coral reefs in the region. This marine protected area (MPA) was established through the advocacy of a private company, Chumbe Island Coral Park Ltd. (CHICOP), and gazetted in 1994 through a public-private partnership with the Revolutionary Government of Zanzibar. The company fully manages and finances the MPA, which includes a Coral Reef Sanctuary (CRS) and Closed Forest Reserve (CFR). Since its establishment, Chumbe has been recognized as a UNEP global laureate for ‘Outstanding Environmental Achievement’, is an accredited ‘Global Ocean Refuge’ (Blue Park), which is one of the highest accolades for marine protected area management effectiveness (PAME) and was recently ranked as the top MPA globally for marine protected area governance (MPAG) effectiveness.

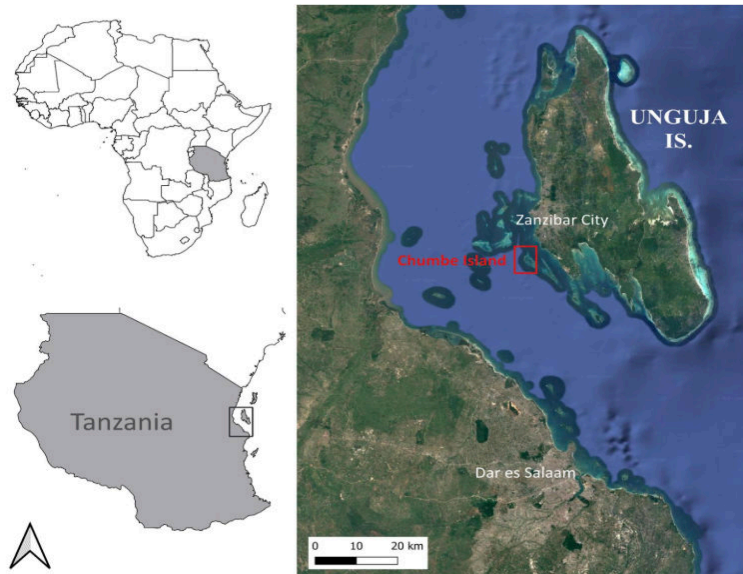


Figure 2: Chumbe Island location.

Management, enforcement and education

CHICOP operates through three key pillars: **conservation, education and ecotourism**. Since its inception, all costs associated with protected area management and environmental education services to schools, fishers and communities, are borne by CHICOP, funded through the revenue generated by the small ecolodge located on the island. Built using high-end award-winning eco-architecture and technology, the lodge has a strict carrying capacity (18 pax) and operates to ensure zero environmental impact. Through this model, Chumbe became the first privately managed and financially self-sustaining MPA in the world.

One of the primary tasks upon commencement was the eradication of rats from the island, an undertaking that took over two years of baiting and trapping. Post trapping resulted in an increase in terrestrial biodiversity, with the CFR now host to 80 species of bird, five reptiles and a healthy population of coconut crabs (*Birgus latro*), the world's largest terrestrial arthropod (Carter, 2017). Recent studies in the region have illustrated the large ecological benefits of removing rats from island ecosystems, with the impacts filtering down from terrestrial habitats into adjacent marine environments, boosting productivity through processes such as the marine subsidy (Graham *et al.*, 2018; Gunn, 2023).

The CRS is a fully protected no-take area, ensuring the conservation of vibrant coral reefs, seagrass beds, and diverse marine life. The enforcement of the no-take regulations is carried out by a team of CHICOP rangers, mostly former fishers themselves, who conduct daily patrols of the MPA in order to ensure compliance. When fisher incidents do occur in the CRS, enforcement is conducted through educating local fishers on the 'spill over' benefits of having a no-take area as a refuge. This is further supported through ongoing community outreach and engagement, with local community leaders and women's groups participating in Chumbe's Advisory Committee for collaborative governance and decision making. This enforcement approach has been incredibly successful, with reported poaching attempts decreasing from 170 in 1994 to only 10 in 2023 (Kloiber *et al.*, 2023).



Figure 3: The revenue generated from the ecolodge's 7 bungalows finances all the conservation and education activities

Key Outputs: Biodiversity returns

Through the effective management of the coral reef sanctuary, Chumbe is now host to the healthiest and most productive coral reef system in Zanzibar:

- **Increased biodiversity:** protected from destructive fishing practices, the reef has seen recoveries of up to 80 percent live hard coral cover and 59 genera of hard coral species recorded, providing habitat for 529 species of reef fish and 257 reef-based invertebrate species identified in the sanctuary (Carter, 2017; Kloiber *et al.*, 2023). Green turtles (*Chelonia mydas*) and critically endangered Hawksbill turtles (*Eretmochelys imbricata*) are supported with foraging grounds that include seven different seagrass species.
- **Black-tip reef shark recovery:** with the increase in biodiversity, there has also been a return of black-tip reef sharks (*Carcharhinus melanopterus*). These are vital predators that maintain optimal productivity of food webs in the ocean, maintaining healthy fish populations and transporting nutrients to the reef (Roff *et al.*, 2016). Sightings were rare when the park was first gazetted but have since become regular sightings in the 'Big 5' and 'SHARE' citizen science initiatives. This includes regular sightings of neonate sharks, a life stage in which they are particularly vulnerable to fishing pressure, highlighting the importance of the CRS as one of the few remaining breeding grounds in Zanzibar for this species listed as Vulnerable on the IUCN Red List.
- **Dramatic increase in commercially valuable fishery species biomass:** increasing from 194 kg/ha in the 1990s to a staggering 1,506 kg/ha by the 2020s (Kloiber *et al.*, 2023). This increased productivity of the MPA is vital for maintaining fishery livelihoods in Zanzibar. Commercially important fish can reach sufficient size to produce exponentially more offspring that are able to stay in the 'refuge' of the sanctuary until they reach optimal ages for dispersal and 'spillover' to areas accessible to local fishers. Tagged fish studies reveal effective spillover from Chumbe reaching many kilometres beyond the CRS (Tyler, 2005). As nearshore fisheries are facing a crisis across Zanzibar due to overexploitation, CHICOPs re-stocking services are increasingly essential for the livelihoods and food security of coastal communities.

- **Increased coral resilience:** whilst the CRS is healthy compared to control sites outside the MPA, it is still vulnerable to external anthropogenic pressures such as increased sea surface temperatures and declining water quality. Severe bleaching events have occurred at the CRS in 1998 and 2016, causing coral stress and mortality, leading to algal encroachment. With a high number of herbivorous reef species however, such as parrotfish, this macro algae can be kept in check, allowing hard corals time to recover, preventing a regime shift to an algal dominated reef common on unprotected reefs (Carter, 2017).



Figure 4: The CRS boasts up 80% coral cover, meeting the threshold requirements to be regarded as pristine

Conclusion

The management strategy of CHICOP has not only seen a boost in biodiversity within its CRS and CFR but has also run education courses that has reached nearly 13,000 stakeholders (school children and community members), and through carefully managed ecotourism has generated millions of dollars that has gone back into conservation management, job creation and community support (Kloiber *et al.*, 2023). Despite the relatively small size of Chumbe (~74ha), the impact of effective management on biodiversity recovery has been profound. Indeed, its scale has been an important factor in enabling highly effective management, ensuring the control of localized threats (such as crown-of-thorns) and exploring advanced coral restoration possibilities. If replicated to wider key sites of biodiversity importance, the network effect on regional biodiversity preservation has extraordinary potential, by not only protecting key habitat areas, but also creating linked refugia, migration corridors and supporting regional resilience against the impacts of climate change.



Figure 5: A boost in fish biodiversity with 529 species of reef fish identified

References

- Bravo, H., Cannicci, S., Huyghe, F., Leermakers, M., Sheikh, M.A., & Kochzius, M (2021) Ecological health of coral reefs in Zanzibar. *Regional Studies in Marine Science*, Vol 48, ISSN 2352-4855.
- Carter, E. (2017). Third Ten-Year Management Plan for Chumbe Island Coral Park Ltd. (2017-2027). CHICOP. Zanzibar: CHICOP.
- Gunn, R. L. (2023). Terrestrial invasive species alter marine vertebrate behaviour. *Nat Ecol Evol* 7, 82–91 (2023). <https://doi.org/10.1038/s41559-022-01931-8>
- Graham, Nicholas A. J.; Wilson, Shaun K.; Carr, Peter; Hoey, Andrew S.; Jennings, Simon; MacNeil, Aaron (2018). Seabirds enhance coral reef productivity and functioning in the absence of invasive rats. *Nature*, 250-253.
- Kloiber, U., Grünendieck, E., & Salim, S. A. (2023). 7th Conservation & Education Status Report 2022-23. Zanzibar: CHICOP.
- Roff, G., Doropoulos, C., Rogers, A., Bozec, Y.-M., Krueck, N. C., Aurellado, E., . . . Mumby, P. J. (2016). The Ecological Role of Sharks on Coral Reefs. *Trends in Ecology and Evolution*, 395-407.
- Tyler, E. H. (2005). The effect of fully and partially protected marine reserves on coral reef fish populations in Zanzibar, Tanzania. University of Oxford.



Figure 6: The CRS is a refuge for species such as the Critically Endangered hawksbill turtle



Figure 7: Black-tip reef sharks are commonly sighted in the CRS, providing essential ecological benefits and an important indicator of ecosystem health



Figure 8: The no-take zone allows commercially important reef fish a refuge to reach larger sizes, producing exponentially more offspring which can spillover to outside the MPA, providing fisheries benefits



Figure 9: Educating local fishers on the ‘spill over’ benefits of having a no-take area as a refuge



Figure 10: Visiting school children learning to snorkel as part of the CHICOP Environmental Education program