

## **Enhanced fish diversity following active coral reef restoration efforts in Tun Sakaran Marine Park, Sabah, Malaysian coral triangle**

### **ABSTRACT**

Located in the heart of Malaysia's Coral Triangle – a region well-known for its outstanding marine biodiversity – are two Marine Protected Areas (MPAs), the Tun Sakaran Marine Park (TSMP) and Sipadan Island Park (SIP). The remote seascapes were both gazetted as an MPA in the same year, 2004, on widespread damaged coral reef ecosystems due mainly to the rampant use of prohibited fishing devices and unsustainable fishing practices targeting coral reef fishes. Our study was conducted in the TSMP, where active coral reef restoration and rehabilitation efforts using the coral frame method have been in place by the park management authority since 2011. The objectives of this study are 1) to determine the fish biodiversity and estimate the fish species abundance in TSMP, and 2) to determine the correlation between hard coral cover on coral frames and the diversity and abundance of reef fishes. Two coral reef restoration sites within TSMP were selected as the study stations. Underwater observations were made between July 2020 and January 2021, using Baited Remote Underwater Video Systems (BRUVS). Data on substrate type were obtained from photos taken by cameras placed adjacent to the deployed BRUVS, at the top of the coral frames. The photos were analysed to determine the types of substrate cover using the Coral Point Count with Excel Extension (CPCe) software. The results show a total of 3,208 individual fishes, identified into 146 species from 27 families. The three most abundant families, which make up just over half (52%) of the total abundance are Caesionidae, comprising 19.73% of the total composition, followed by Pomacentridae (16.05%) and Labridae (15.93%). Moon Wrasse, *Thalassoma lunare* is the most abundant species comprising 11.47% of the total abundance of fishes observed, while only four species of elasmobranchs, all batoids, were recorded. Notably, two of the four batoid species are listed as vulnerable in the IUCN Red List of threatened species. As for the type of substrate cover on the coral frame, a total of 2,750 points were categorized from 50 photos combined from both sites. Our results show that there are no significant differences ( $p > 0.05$ ) between hard coral cover on coral frames and the reef fish abundance, and between the percentage of hard coral cover on coral frames and the reef fish species at both sites. This is likely due to the low percentage of hard coral cover on the coral frames at both sites which is below 50%, with Site 2 exhibiting a slightly higher cover (37.96%) compared to Site 1 (27.70%). Despite the low percentage, it is noteworthy that the hard coral cover on the coral frames in both sites appears denser and structurally more complex than the adjacent depleted coral reefs. We conclude that active coral reef restoration and rehabilitation efforts are important in accelerating the re-colonization of damaged coral

reefs by coral reef inhabitants, particularly by juvenile coral reef fishes. Lessons learned from this study may help park managers in refining coral reef restoration techniques of the damaged reefs.