Biological Surveys of Three MPAs and their Reference Sites in Majuro Atoll, Republic of the Marshall Islands

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INTRODUCTION

In recent years, there has been a move by coastal communities around the world to designate areas for conservation or protection. In Micronesia, there have been similar efforts made by the islands to protect nearshore marine resources from overharvesting and other local threats. Because most protected areas in Micronesia have been designed to preserve or recover locally important species, site managers often need information to help them to make informed decisions towards achieving specific management objectives. Some of this information can be extracted from data collected through monitoring activities by local resource agencies, NGOs and local communities. At the regional level, monitoring data can provide larger trends that may exist across Micronesia and inform regional conservation initiatives.

In 2006, the 5 jurisdictions within Micronesia region launched the Micronesia Challenge, a commitment to "effectively conserve 30% of nearshore marine and 20% of the forest resources across Micronesia by 2020". Today, there are over 150 Marine Protected Areas in the region, from small community-based sites to areas that encompass entire islands and surrounding reefs. Some protected areas were established and are enforced through traditional means, while others have been created through legislation and are policed by trained officers on salary. Although there is a recognized need for accurate information on the state of these MPAs, very few of these sites have implemented long-term monitoring programs to provide managers with useful information. Because such programs require specialized skills, particularly survey methods and data analysis, and long-term commitment of resources, most data available for these MPAs have been the results of ad hoc research projects that were not necessarily designed to meet management needs.

Since the declaration of the Micronesia Challenge, there have been efforts to document each of the jurisdiction's progress towards achieving the MC goals. One of such efforts was the formation of an MC Marine Measures Group comprised of individuals, agencies and organizations who are directly implementing monitoring activities. This group was tasked to identify a minimum set of indicators and standardize methods that will consistently be applied across MPAs in Micronesia. During the 2nd MC Measures Workshop, these set of indicators and methods were agreed to by all the jurisdictions.

Palau International Coral Reef Center (PICRC), through the Capacity Enhancement for Coral Reef Monitoring project supported by Japan International Cooperation Agency (JICA), set out to test these methods across MPAs across Micronesia. The selection of the MPA sites was based on ease of access and recommendations from PICRC partners in each of the islands. A total of 14 MPAs were surveyed along with their reference sites. Four of the sites were in Palau, one site in Yap, and 3 sites were selected in each of the islands of Chuuk, Pohnpei, and RMI. Although the team also aimed to identify issues and challenges in consistently applying the methods, this report only covers the survey data collected in RMI. All the MPAs surveyed were restricted only to the main Majuro Atoll.

METHODS

Study Sites

Survey was conducted between October 7 and 18 in Majuro Atoll (Fig.1).

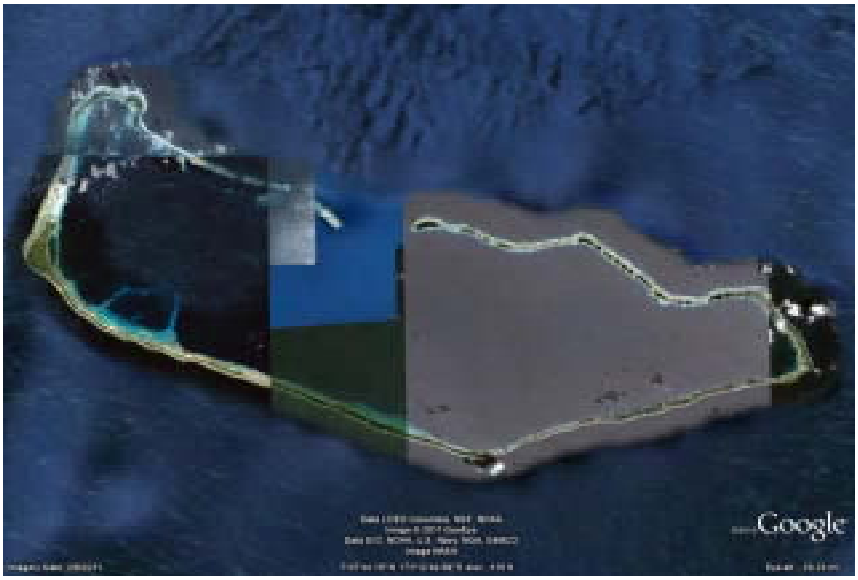


Figure 1 Majuro Atoll. Image taken from Google Earth.

The surveys focused on 3 MPAs, Bikirin, Denmeo, and Woja, and adjacent reference sites. Both Bikirin and Denmeo are islands on the northwest rim of the Majuro Atoll. Woja is another small island on the southwest portion of the atoll. The marine protected areas are composed of the reefs surrounding the islands, including reefs within the lagoon and on the ocean side of the islands. The formal designation of these MPAs prohibits all forms of fishing and other extractive activities but there is no established long-term monitoring program within these MPAs.

Figure 2 Image showing survey station in Woja MPA. Yellow tacks indicate stations within the MPA and the blue tacks are reference stations. Image taken from Google Earth.

Figure 3 Image showing survey station in Denmeo MPA. Yellow tacks indicate stations within the MPA and the blue tacks are reference stations. Image taken from Google Earth.

Figure 4 Image showing survey station in Bikirin MPA. Yellow tacks indicate stations within the MPA and the blue tacks are reference stations. Image taken from Google Earth.

Benthic and Fish Surveys

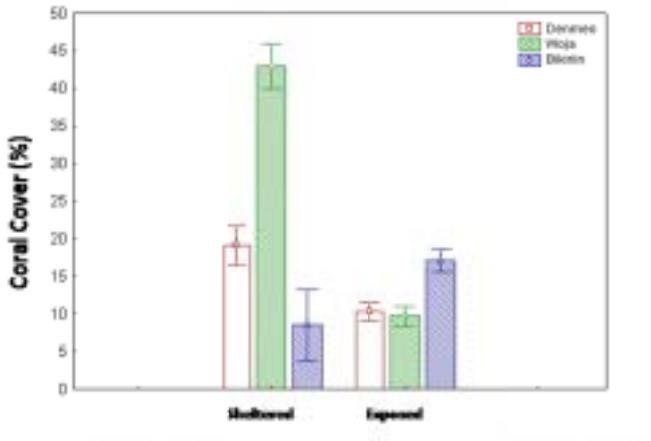
Stations were established within the survey sites and stratified by status (MPA or reference) and exposure (exposed or sheltered). A total of four stations were established in each of Denmeo and Woja, 2 stations in the sheltered side of the islands and two on exposed sides. Stations were similarly established in corresponding reference sites. For the smaller Bikirin MPA and its reference site, only 2 stations were established, 1 each on both the sheltered and exposed sides of the islands.

In each station, 5-50 x 5 m belt transects were surveyed at the depth of 10m for size and density of commercially targeted fish species. Commercially targeted macro-invertebrates were also surveyed along the five transects, using a reduced belt width of 2 m. Benthic cover and richness was estimated by photographing 50, 0.25m^2 quadrats on every meter of the transect tape. The photographs were analysed using CPCe by categorizing the benthic cover or substrate of 5 random points in each quadrat. The diameter and genus of all juvenile corals between 0.5 - 5 cm were also recorded using visual surveys along 0.3 m on either side of the first 10 m of each transect.

RESULTS

Benthic Assemblages

Among all the MPAs, there was a significant difference in mean coral cover in the exposed versus sheltered stations. The sheltered stations within all of 3 MPAs, Woja had the highest coral cover of 42.9%, followed by Denmeo with 19.1% and Bikirin with 8.5%. For exposed stations, Bikirin had the highest mean coral cover at 17.1% followed by Denmeo (10.2%) and Woja (9.7%).



Mean coral cover at the sheltered reefs of Bikirin MPA was 8.5% compared with the sheltered reference site, which had a coral cover of 8.9% (Fig.5a). On the exposed reefs, coral cover was 17.1% inside the MPA and 18.8% in the reference site. Coral coverage was not significantly different in the MPA and the reference site in both sheltered and exposed reefs. At Denmeo, the sheltered reefs had a mean coral cover of 19.1% inside the MPA and 21.6% at the reference site (Fig.5b). In the exposed reefs, the reference site had significantly higher coral cover (22.4%) than the MPA (10.3%). Exposed reefs in Woja had a coral cover of 9.7% in the MPA and 13.4% in the reference site (Fig.5c). Sheltered reefs had higher coral cover at 42.9% in the MPA and 39.1% in the reference site; however, this difference is not significant.

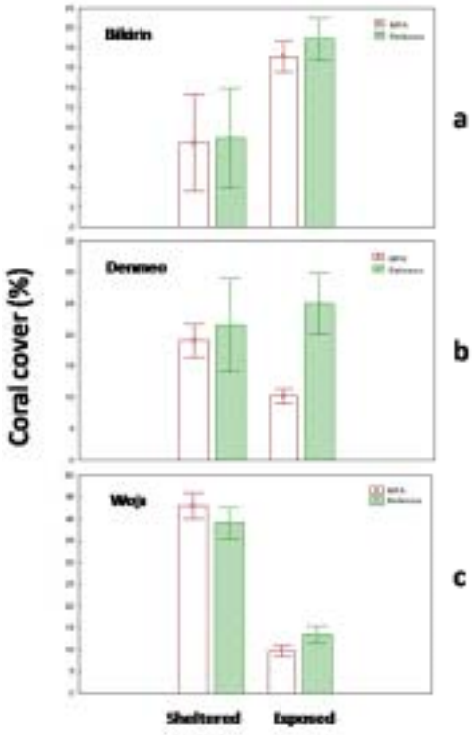


Figure 5 Coral cover in percent in (a) Bikirin, (b) Denmeo, and (c) Woja compared to their corresponding reference sites. Error bars indicate standard error.

Coral richness, measured as the number of coral genera, was not significantly different in the sheltered reefs in Bikirin (1.8) and its reference site (2.0) (Fig.6a). This was also the case for the outer reefs in the MPA (9.6) and reference (8.8). However, coral richness was significantly higher in the outer, exposed reefs than the sheltered reefs both in the MPA and reference site. In the sheltered reefs in Denmeo, coral richness was significantly higher in the MPA (3.9) than the reference (2.4). On the outer reefs in Denmeo, coral richness was 7.3 in the MPA and 5.3 in the reference. In Woja, coral richness for the MPA was 5.4 for the exposed reefs and 3.9 for the sheltered reefs. Coral richness for the corresponding reference site was 5.4 for the outer reef and 3.1 for the inner reef. These differences between coral richness at Woja and its reference site were not significant.

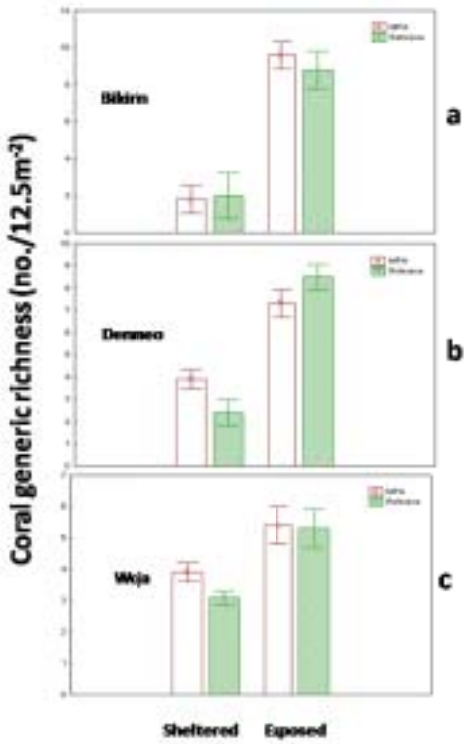


Figure 6 Coral generic richness in (a) Bikirin, (b) Denmeo, and (c)Woja compared to their corresponding reference sites. Error bars indicate standard error.

Recruit density, or the number of juvenile corals in a given area, for Bikirin MPA was 0.8 in the sheltered reefs and 20.6 in the outer reefs. Its reference site also had significantly higher recruit density in the outer reefs (21.2) than the inner reefs (0.8). This comparably lower recruitment density in the inner reefs was also observed in the other two MPAs. Recruit density in the outer reefs of Denmeo was 17.1 and 14.5 for the reference site. The inner reefs had recruit densities of 4.6 in the MPA and 2.4 for the reference. Woja had recruit densities of 7.1(MPA) and 4.5 (reference) in the inner reefs and 21.6(MPA) and 37.1(reference) for the outer reefs. A significant difference in recruit density between an MPA and reference only occurred on the outer reefs of Woja.

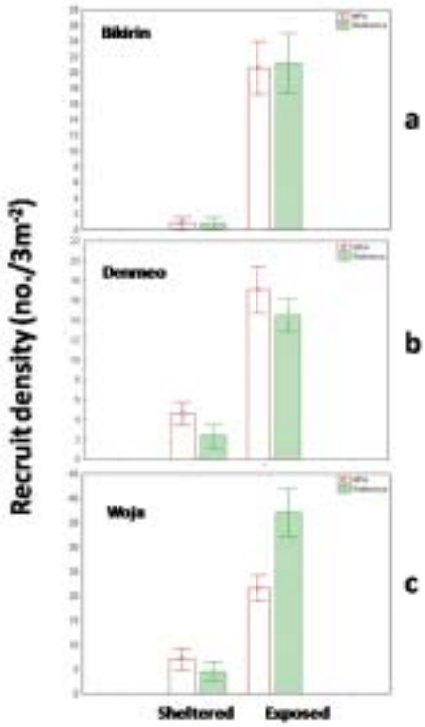


Figure 7 Recruit density in (a) Bikirin, (b) Denmeo, and (c) Woja. Error bars indicate standard error.

Recruit richness for Bikirin in the inner reefs was 0.2 in the MPA and 0.6 in the reference. On the outer reefs recruit richness was 7.8 in the MPA and 8.0 in the reference. In Denmeo, recruit generic richness was higher in the outer reefs in both the MPA (6.7) and reference (6.4). Richness was significantly lower in the inner reefs—MPA (2.1) and reference site (1.0). The outer reefs of Woja and its reference site also had significantly higher richness than the inner reefs. The outer reefs in the MPA had a recruit richness of 6.5 and the outer reefs of the reference site had a recruit richness of 7.7. The inner reefs had lower recruit richness of 2.1 in the MPA and 0.8 in the reference site.

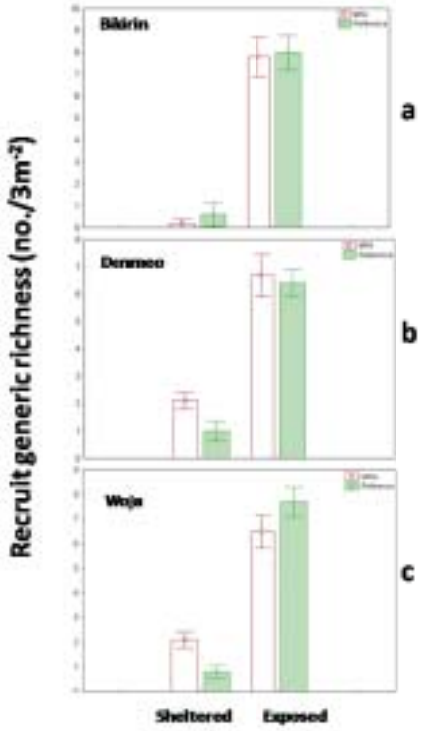


Figure 8 Recruit generic richness in (a) Bikirin, (b) Denmeo, and (c) Woja. Error bars indicate standard error.

Macro-invertabrates

The densities of invertebrates in all the sites surveyed were very low (1.5/transect) and the data collected were not further analyzed.

Fish Assemblages

Fish density in the sheltered reefs of Bikirin was 7.2 compared to 12.8 in the reference site (Fig.9a). Fish biomass was also greater in the reference site. However, these differences in density and biomass were not significant (Fig.10a). Differences in fish density and biomass in the outer reefs in the MPA and reference site were also not significant. Denmeo and Woja compared to their reference sits also showed no significant difference in fish density and biomass in the sheltered and exposed reefs (Fig.9b,c and Fig10b,c).

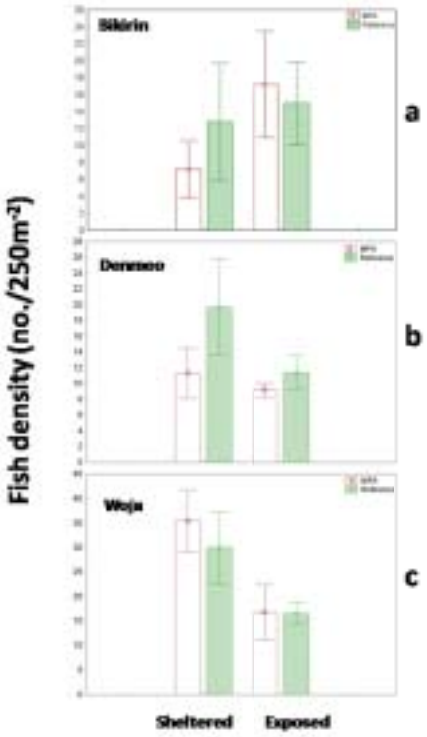


Figure 9 Fish density in (a) Bikirin, (b) Denmeo, and (c) Woja. Error bars indicate standard error.

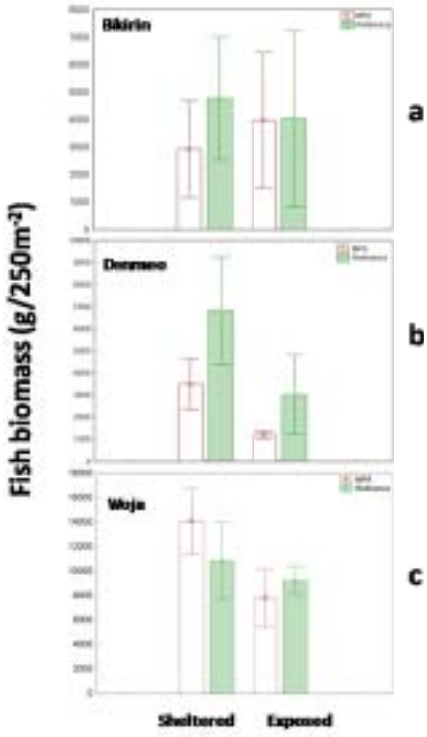


Figure 10 Fish biomass in grams in (a) Bikirin, (b) Denmeo, and (c) Woja. Error bars indicate standard error.

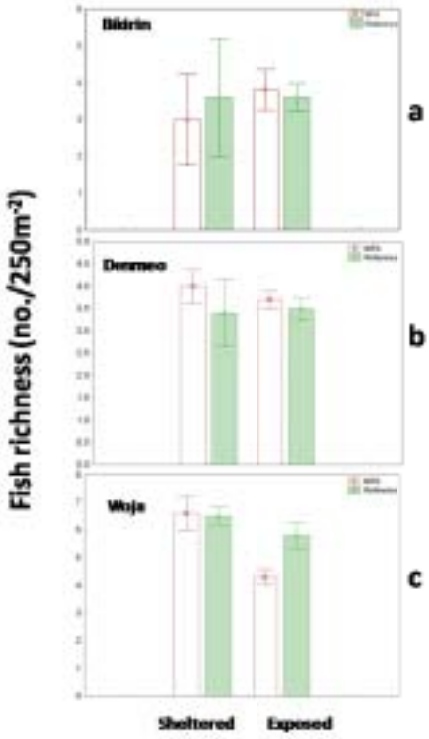


Figure 11 Fish richness in (a) Bikirin, (b) Denmeo, and (c) Woja. Error bars indicate standard error.

DISCUSSION:

The results of the surveys presented in this report are snapshots in time. Long-term monitoring is necessary to evaluate trends over time and to determine how the MPAs are working. It is important for monitoring over time to have consistency in methods. Therefore, we recommend that a targeted fish and invertebrates species list be created so that different people will count the same fish and invertebrates. We also recommend that people who do surveys be trained so that data between different observers can be compared. Serious considerations should also be given to how survey data are managed and stored.

While efforts on MPAs should continue, consideration should also be given to water quality. Effective conservation of Majuro's marine resources needs to address water quality issues particularly in the sheltered reefs in the lagoon where water circulation may be limited and coral recruitment is generally low. Coral populations and coral recruitment cannot persists if water quality continues to deteriorate. So to achieve effective MPAs, other efforts focused on issues outside of the MPAs are necessary.

Acknowlegements:
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