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Assessment of coral reefs, butterflyfishes, and benthic macroinvertebrates in Lobo, Batangas using citizen science methods

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ABSTRACT

Coral reef assessments were conducted in Lobo, Batangas, using citizen science methods that implement a short training lecture and do not require the use of SCUBA. In the municipality of Malabrigo, the hard coral cover (HCC) was 30.9 ± 1.5% (Category C). Butterflyfish abundance was 7.2, while the species richness was 5.0 (Category D and B, respectively). The average feather star abundance was 10.8 (Category C), while the average abundance of Linckia was 1.5 (Category D). For Malabrigo, a comparison with past data showed a decrease in HCC and butterflyfish abundance. The abundance of giant clams also decreasedindicating the possibility of poaching in the area. The abundances of all other surveyed invertebrates (e.g. crown-of-thorns starfish, feather star, Linckia) remained the same. In the municipality of Soloc, the hard coral cover was 55.2 ± 5.2% (Category A). Butterflyfish abundance was 20.5 while species richness was 5.0 (Category C and B, respectively). The average feather star abundance was 1.0 (Category C), while the average abundance of Linckia was 0 (Category D). No COTS (Category A) nor giant clams (Category D) was observed. For Soloc, a comparison with past data showed an increase in HCC (although still at Category A). The abundance of butterflyfishes decreased, but the species richness increased. The abundances of all surveyed invertebrates (e.g. COTS, giant clams, feather stars, Linckia) remained the same. Both Malabrigo and Soloc possess wide HCC, resulting to the high abundance and diversity of butterflyfishes. The absence of biotic threats such as COTS indicates the resilience of there reefs. These two stations may supply coral recruits to nearby reefs, making these reefs potentially valuable in ecosystem services. Future directions should identify other reefs and establish more Marine Protected Areas (MPAs) to create a network of protected coral reefs in Lobo, Batangas.

***Keywords*:** coral reef assessment, citizen science methods, INSPIRE

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1. Introduction

Coral reefs in the Philippines are under threat from natural and anthropogenic impacts. Knowing which reefs are resilient to climate change and anthropogenic impacts is essential to protect these threatened reefs. In addition, these reefs provide ecosystem services, such as the provision of spawning, nursery, and feeding areas for economically valuable fishes and invertebrates [1]. This ensures food security for millions of Filipinos who live adjacent to the country's coastlines [2]. Coral reefs provide refuge and habitat for a variety of marine invertebrates (*e.g.* sponges, nudibranchs, and shell mollusks), and this contributes to the biodiversity associated with Philippine reefs [3-6]. Moreover, coral reefs shelter our coastlines from erosion, storm surges, and tsunamis, thereby providing coastal protection to communities, settlements, and towns adjacent to the sea [7-8].

The Investing in Sustainability and Partnerships for Inclusive Growth and Regenerative Ecosystems (INSPIRE) project aims to capacitate citizen scientists to assess and monitor coral reefs by training them on the Alwan methods [9], a set of simple reef assessment procedures that do not require SCUBA, but can measure hard coral cover (HCC), abundance of target marine macroinvertebrates, and butterflyfish abundance and species richness. Participants from Local Government Units (LGUs) in Lobo, Batangas were trained in the Alwan Methods and conducted surveys in two sampling stations in the municipality of Lobo: Malabrigo North and Soloc. The Malabrigo site is a Marine Protected Area (MPA), while the Soloc site is a proposed MPA. These two sites were surveyed by a scientific team in July 2021, and this study provides a picture of short-term changes in these reefs based on HCC, abundance, and diversity of target marine macroinvertebrates and butterflyfish. Such information can be useful in the evaluation of MPA effectiveness and/or justification for MPA establishment.

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2. Materials and methods

2.1. Study site

The surveys were conducted in October 2022 in the Barangays of Malabrigo and Soloc in Lobo, Batangas. Citizen scientists (*e.g., bantay dagat*, residents of the coastal communities) conducted the data collection under the supervision of trained scientists.

2.2. Data collection

The Alwan method [9] was used to determine biotic parameters in the two coral reefs. First, a section of the reef (henceforth termed 'the station') measuring 25 m × 75 m and a depth of 3-5 m was marked for the assessment activity with lines and floating buoys. Three types of surveys were conducted, namely the butterflyfish survey, target marine macroinvertebrates survey, and C30 coral survey.

2.3. Butterflyfish and total marine invertebrates survey

For each survey, six (6) citizen scientists spaced 4 m apart swam parallel to the shore twice from end-to-end of the station (25 × 75 m = 1,875 m^2) while counting the abundances of each type of butterflyfish (for the butterflyfish survey) or specific benthic invertebrates: chocolate-chip starfish (*Protoreaster* spp.), giant clams (*Tridacna* spp.), crown-of-thorns starfish (COTS), crinoids (*Crinoidea*), and pacific-blue starfish (*Linckia laevigata*) on a scorecard (for total marine invertebrates survey). The survey manual by Garcia D, *et al.* [9] was used.

The diversity and abundance of butterflyfishes can give a good indication of reef quality because they are dependent on corals for food and shelter [10]. Species abundance was computed by obtaining the average number of butterflyfish counted among the six (6) citizen scientists. Species richness was computed by obtaining the average number of butterflyfish species observed among the six (6) citizen scientists. The abundances of the invertebrates were used to determine the station's suitability for coral recruits, level of compliance (*e.g.* poaching), presence of biotic threats, water currents, and water quality.

2.4. C30 coral survey

Thirty 1 × 1 m photos were obtained using random numbers (*e.g.,* for direction and fin-kicks) throughout the station. Two citizen scientists (CS1 and CS2) adept at skin diving began at the center of the station (25 × 75 m = 1,875 m^2). The task of CS1 was to navigate to the random location (n = 1 to 30) and sink the marker to the bottom. If the random numbers led CS1 to the boundary of the station, CS1 swam back in the original direction until the remaining fin kicks were completed. The task of CS2 was to skin dive to the location where the marker sank and take a photo of the bottom substrate using a monopod, ensuring that the marker was situated to the right of the monopod, and the base of the monopod was facing the shore. The photos were scored using Coral Point Count with Excel (CPCe 4.1) [11]. Generally, in each photo, 10 random points were assigned for benthic category scoring: hard coral, white coral, seaweed, other living organisms, algal assemblage, abiotic, tape/water/block. Average percent cover values were computed for each benthic category by dividing the number of points for each benthic type by 500 points and averaging the component values across the five transects per site. Processing of 30 scored photos allowed for the measurement of the average hard coral cover in the station. Hard coral cover categories based on percent cover are shown in Figure 1 under 'Reef Quality'.

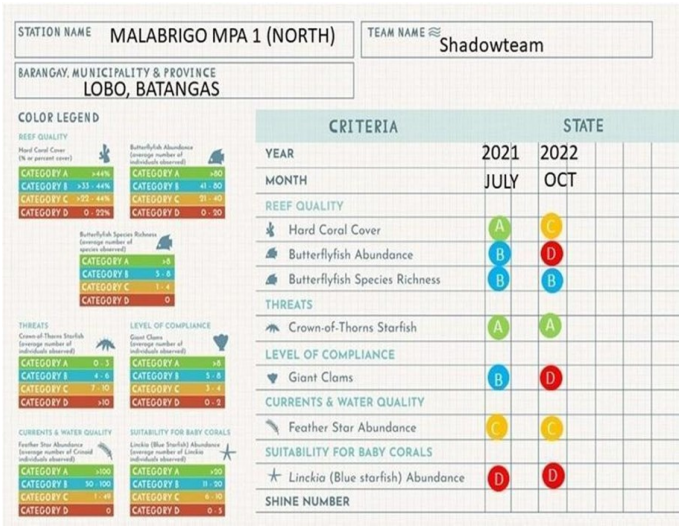

Figure 1. Comparison of biotic parameters for Malabrigo in October 2022 and July 2021. The left panel shows numerical equivalents of category grades (A, B, C, D).

3. Results and discussion

In Malabrigo, the hard coral cover (HCC) was 30.9 ± 1.5% (Category C). Butterflyfish abundance was 7.2, while the species richness was 5.0 (Category D and B, respectively). The average feather star abundance was 10.8 (Category C), while the average abundance of *Linckia* was 1.5 (Category D). For Malabrigo, a comparison with past data (Figure 1) showed a decrease in two category levels for HCC and butterflyfish abundance. In September 2021, Batangas was severely impacted by Severe Tropical Storm (STS) Jolina which resulted in strong waves that damaged abundant branching corals in Malabrigo. This reduced coral cover may also be the cause of the decrease in butterflyfish abundance since they rely on branching coral colonies for refuge and shelter. The abundance of giant clams also decreased by two category levels, which may indicate death as a consequence of strong waves from STS Jolina or illegal poaching. The abundances of all other surveyed invertebrates (*e.g.* COTS, feather star, *Linckia*) remained the same. In Soloc, hard coral cover was 55.2 ± 5.2% (Category A). Butterflyfish abundance was 20.5 and species richness was 5.0 (Category C and B, respectively). The average feather star abundance was 1.0 (Category C), while the average abundance of *Linckia* was 0 (Category D). No COTS (Category A) or giant clams (Category D) were observed. For Soloc, a comparison with past data (Figure 2) showed an increase in HCC (although still at Category A). The abundance of butterflyfish decreased by one category level, but the species richness increased by one category level. Since HCC remained at Category A, illegal collection for the aquarium trade could be a reason for the decrease in butterflyfish abundance. The abundances of all surveyed invertebrates (*e.g.* COTS, giant clam, feather star, *Linckia*) remained the same.

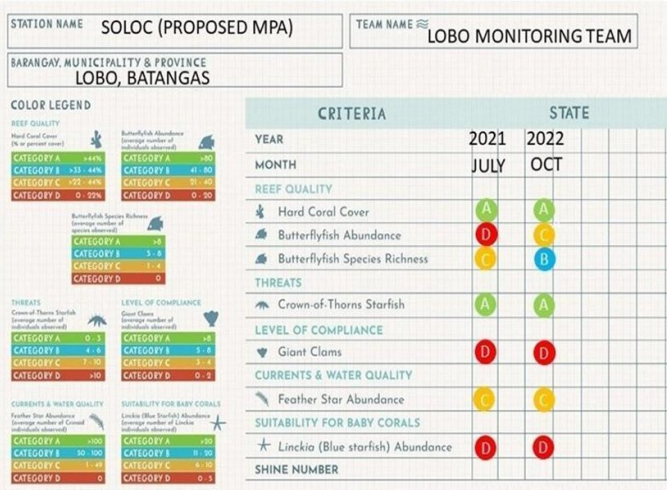

Figure 2. Comparison of biotic parameters for Soloc in October 2022 and July 2021. The left panel shows numerical equivalents of category grades (A, B, C, D).

The HCC for Malabrigo and Soloc was above the average HCC for the West Philippine Sea, about 26% [1], indicating that the two stations in Lobo have abundant corals. Increased patrolling activities and management of Malabrigo may address the decrease in HCC and butterflyfish abundance. Frequent monitoring and extraction of COTS in Malabrigo and Soloc should be conducted to avoid the rapid proliferation of COTS, if any are detected in the future. The low abundance of *Linckia* indicates a low abundance of coralline algae, which attracts the settlement of coral recruits [12-14]. Water currents in Malabrigo and Soloc typically become stronger from late morning to early afternoon, and it is possible that larvae/recruits in these two sites are transported to adjacent reefs through these currents. It is recommended to stock giant clams in these two stations, as they are MPAs/proposed MPAs. Aside from increasing the biodiversity of the reef, this could also attract tourists and divers to the stations and promote ecotourism.

4. Conclusions

The municipality of Lobo, Malabrigo and Soloc in Lobo, Batangas both possess abundant HCC, resulting in a high abundance and diversity of butterflyfish in the sea. The absence of biotic threats such as COTS indicates the absence of coral predators. These two stations may supply coral recruits to nearby reefs, making these reefs potentially valuable in terms of ecosystem services. Future directions should identify these other reefs and establish more MPAs to create a network of protected coral reefs in Lobo, Batangas.

The INSPIRE project has implemented the Alwan training workshop in other municipalities and provinces along the Verde Island Passage, such as Mabini (Batangas), Tingloy (Batangas), and Looc and San Agustin (Romblon). Baseline data for these sites have been collected and will be used as a reference for comparison during future Alwan assessments in these same sites over the next 3 years. By introducing and implementing the Alwan method in these municipalities along the VIP, the project was able to show that coral reef assessment can be done by supervised citizen scientists without the need for expensive SCUBA equipment. This will greatly enhance the number of coral reef assessments undertaken annually in the municipal waters of the VIP.

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