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DATE : December 14, 2022

FOR : **DIR. JOE AMIL M. SALINO**
Regional Director
ENVIRONMENTAL MANAGEMENT BUREAU
MIMAROPA Region
6th Floor, DENR By the Bay Bldg.,
Roxas Blvd., Ermita, Manila

FROM : **BENJAMIN ARMAND A. TANSINGCO**
VP-Environmental Management

SUBJECT : **Coastal Resources Assessment Report for the Year 2022**

Dear Dir. Salino:

We are herewith submitting to your office a copy of the '**Aquatic Biota-Marine Biology Assessment**." of Coral Bay Nickel Corporation for the year 2022. This is in compliance to the EMoP of the December 2018 Environmental Performance Report and Management Plan (EPRMP) of Coral Bay Nickel Corporation. The assessment was conducted last May 23-27, 2022 in Coral Bay, Rio Tuba, Bataraza, Palawan by Three Sevens Management Consultancy.

We shall take note of the recommendations made by the assessment team in the monitoring report and will make our best effort to implement those that are ponsible for our company to undertake.

Thank you very much.

Very truly yours,

BENJAMIN ARMAND A. TANSINGCO
VP- Environmental Management

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AQUATIC BIOTA-MARINE BIOLOGY ASSESSMENT

CORAL BAY NICKEL CORPORATION
Rio Tuba, Bataraza, Palawan

May 2022

AQUATIC BIOTA-MARINE BIOLOGY ASSESSMENT

23 – 27 May 2022

CORAL BAY NICKEL CORPORATION

BATARAZA, PALAWAN

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REVISION HISTORY:

REVISION	DATE OF ISSUE	DESCRIPTION	AUTHORITY	
			NAME	**SIGNATURE**
0	5 August 2022	For CBNC's Review	**Raffy R. Perez** Chief Operating Officer	
1	6 September 2022	Final Report	**Raffy R. Perez** Chief Operating Officer	
2		For submission	**Raffy R. Perez** Chief Operating Officer	

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ABBREVIATIONS

ACB	*Acropora* branching
ACT	*Acropora* tabular
ACS	*Acropora* submassive
BMB	Biodiversity Management Bureau
Bgy	Barangay
CBNC	Coral Bay Nickel Corporation
CB	Non-*Acropora* branching
CE	Non-*Acropora* encrusting
CF	Non-*Acropora* foliose
CHL	*Heliopora*
CM	Mushroom coral
CME	*Mellipora*
CMR	Mushroom coral
CPCe	Coral Point Count with Excel extensions
CPUE	Catch-per-unit effort
CRA	Coastal Resource Assessment
CS	Non-*Acropora* submassive
D	Dominance Index
DC	Dead coral
DENR	Department of Environment and Natural Resources
EPEP	Environment Protection and Enhancement Program
EMP	Environmental Monitoring Plan
FVC	Fish visual census
GIS	Geographic information system
GPS	Global positioning system
HC	Hard coral
HCC	Hard coral cover
H	Shannon Index
IV	Importance Value
Is.	Island
LIT	Line intercept transect
MA	Macroalgae
MPA	Marine protected area
OT	Others
PCSD	Palawan Council for Sustainable Development
Pt .	Point
PVC	Polyvinyl chloride

RB	Rubble
SC	Soft corals
SD	Sand
SI	Silt
SP	Sponge
TAU	Taxonomic amalgamation unit
1-D	Simpson Index

Units of Measurement

cm	centimeter
g	gram
m	meter
km	kilometer
m^2	square meter
ha	hectare
km^2	square kilometer
MT	metric ton
cells/m^3	cells per cubic meter
m^2/ha	square meter per hectare
ind/ha	individual per hectare
ind/m^2	individual per square meter cells/L
	cells per liter

EXECUTIVE SUMMARY

The aquatic biota-marine biology assessment was conducted on 23 – 27 May 2022. The assessment was conducted to monitor any changes and determine the latest condition of the seagrass, plankton, mangroves, coral reefs, and reef and freshwater fish communities in established monitoring sites; identify the areas covered and map the coral reefs and seagrass in Coral Bay; determine the fisheries of Bgy. Rio Tuba; establish monitoring sites and baseline data on coastal integrity; and install monitoring blocks as permanent monitoring stations for coral habitat assessment.

Seagrass

The total number of observed seagrasses species is five, all belonging to Division Antophyta (Angiosperms), Class Monocotyledoneae under Families of Hydrocharitaceae and Cymodoceaceae. Identified and recorded species of seagrasses include *Enhalus acoroides, Halophila ovalis, Halodule pinifolia, Halodule uninervis,* and *Thalassia hemprichii*. Among the recorded species, *T. hemprichii and H. pinifolia* appeared in three out of the four stations.

Based on the recent seagrass assessment conducted in the monitoring stations, no seagrass was observed in Ursula island, while only one species was observed in Ocayan river compared to two species observed in the previous years. A lower number of seagrass species was observed in Tagdalungon, small sandbar and Big sandbar.

Plankton

A total of 23 species comprising 19 phytoplankton and four zooplankton were recorded. This number is lower compared to the number of species recorded during the 2020 and 2021 surveys with 31 and 52 species, respectively.

Mangroves

Four mangrove species were documented in Tagdalungon, Bgy. Bataraza to include *Rhizophora apiculata, Rhizophora mucronata, Sonneratia alba,* and *Ceriops tagal*, which implies that the mangrove forest is a mixture of primary and secondary growth form. Species Importance Value (IV), however, revealed that

S alba was the most dominant mangroves in the area with 130%, followed by *R. mucronata* (81%), *R. apiculata* 62%, and *C. tagal* (26%).

Corals reefs

The reefs at Coral Bay and Ursula Island are mostly in "poor" to "fair" conditions like most sites in the Philippines despite their remote locations in southern Palawan. Among the eight stations monitored, only Maranto Pt. is in good condition (40%) and recorded one of the most numbers of coral genera (23).

The trend of the four substrates encountered in monitoring stations varied yearly. The HC cover increased from 33.3% (2020-1) to 40.1% (2020-2), but declined during the 2021 and 2022 monitoring, although no significant difference decrease was noted. The annual HC cover monitoring in Causeway and Mooring Dolphin from 2019-2022, and 2020-2022 for Small sandbar generally showed no significant change.

During the 2021 and 2022 monitoring, the more accurate and image-based method (viz., photo-quadrat method) was used which enable the research divers to re-analyze and validate the substrate encountered. This method also can also be used to note coral genera encountered within the photo-quadrat, and other associated macroinvertebrates. The continuous use of this photo-quadrat method could result to more accurate substrate cover reading. Compared to the 2021, signs of recovery were observed during the 2022 monitoring.

Reef fishes

A total of 209 reef fish species belonging to 38 families were identified in the nine monitoring stations. Among the stations surveyed, the highest number of fish species encountered was recorded in Ursula Is. 2 with 89 species and Ursula Is. 1 (79 species), followed by Big sandbar (69 species), Small sandbar (67 species), Maranto Pt. (54 species), Ameril Is. (50 species), Causeway (47 species), Mooring Dolphin (42), and Discharge Point (31).

Among the monitoring stations, the Discharge Pt. recorded the highest fish mean density at 4,672 ind/1,000m^2, followed by Ursula Is. 2 with 2,906 ind /1,000 m^2 and Ursula Is. 1 with 2,712 ind /1,000 m^2, all classified under "high" category. All other reefs surveyed fall under "low" to "moderate" to categories

Freshwater fishes

The freshwater and brackishwater fish species caught in Lower Kinurong Siltation Pond are Nile tilapia *Oreochromis niloticus* which still dominates fish catch in terms of number and weight, followed by *Megalops cyprinoides* (Bulan-Bulan), *Lutjanus argentimaculatus,* and milkfish *Chanos chanos*.

Beach Profiling

All of the stations in Tagdalungon and Nagoya have sandy-coral rubble, while the stations surrounding Ursula Is. have a sandy substrate. This means that there were coral reefs nearby that were subjected to waves and currents that resulted in coral rubble on the beaches of Tagdalungon and Nagoya areas.

Fisheries surveys

The extensive fishing grounds nearby Bgy. Rio Tuba having patch reefs separated by channels or deep water requires the use of motorized banca in fishing. A survey showed that majority of the fishers (73%) have motorized boats which indicate that fishers are exploiting far and wider fishing grounds.

In terms of productivity, *kawil* (hook-and-line) reported an average catch-per-unit effort (CPUE) of 2.5 kg/fisher/hour, while *lambat* (bottom set-gillnet) has an average CPUE of 4 kg/fisher/hour. Overall, higher catch rates were reported by gill netters targeting a variety of *isdang bato* (coral reefs fishes), *talakitok* (jacks), and *galunggong* (round scads).

Nearly all respondents (98%) said that the fishery has been deteriorating as they venture in farther fishing ground sin search for a good haul, while only 2% informed that their catch rates improved compared to its previous state. Decrease in volume of fish catch is largely attributed to the increasing number of fishers competing for the remaining fishery resources, competition with commercial fishers, and destructive fishing activity such as blast and poison fishing.

Recommendations

For Coral Bay Nickel Corporation:

1. All established beach profiling stations should be profiled periodically (e.g. quarter or semestral) to monitor possible changes.
2. Frequent monitoring of planktons to determine the seasonality variations between plankton community, water quality and environmental factors (e.g., climate related variables). Moreover, the absence of phytoplankton in the estuary region of Lower Kinurong needs further monitoring.
3. Seasonal monitoring (i.e., northeast, and southwest monsoons) of the reefs identified as permanent stations where concrete blocks were installed be conducted, even only in two stations for temporal and spatial comparison.
4. More frequent monitoring of seagrass cover in Ursula Island to monitor the possible occurrence and/or shifting of sand, thus, covering the seagrass beds.

For CBNC together with local community, LGU and all stakeholders:

5. Continuous scientific-based reforestation of mangrove areas is encouraged and appropriate alternative livelihood should be given to coastal communities to alter the exploitation of mangrove resources and ease the pressure on the seagrass and seaweed resources.
6. Information education campaign (IEC) on the role of seagrass on the marine ecosystem and their significant contribution to fishery production and ecological functions, and on the importance of beaches as protection for the coastal communities against strong typhoons and tsunamis.
7. Strict protection, monitoring, and inclusion of the seagrass beds in Small sandbar, Big sandbar and Tagdalungon as part of marine protected areas.
8. Protection and conservation of shallow reef habitats that mostly harbor small-sized reef fish and serves as nursery ground.
9. Longer monitoring of the fish catch in Bgy. Rio Tuba to provide an overview if the fishery resources in the area have change over the years.

1. INTRODUCTION

The province of Palawan has been capitalizing on the abundance of natural resources to spur economic growth and improve the quality of life of the local communities. Being the Philippines' last environmental frontier, Palawan has been at the forefront on highlighting responsible resource extraction and other environmentally-critical projects by implementing stringent regulations to mitigate impacts on the environment and people.

Protected by layers of conditionalities issued by concerned government agencies upon issuance of permits to operate, the Coral Bay Nickel Corporation (CBNC) as the first nickel processing plant in the Philippines, commits to comply and sustainably protect the immediate environment and the community. The operation of CBNC commenced in 2005 in Bgy. Rio Tuba, Bataraza, Palawan, and utilize the technology of High-Pressure Acid Leaching to convert the low-grade nickel ore having 1.26% nickel (Ni) and 0.15% Cobalt (Co) to high value, highly concentrated sulfides of nickel and cobalt (NiS and CoS) with 56% Ni and 4.5% Co. The leached slurry is neutralized and the impurities or solids are allowed to settle in the tailings dam, while the effluent or treated wastewater is discharged through a pipeline in the causeway located in Coral Bay.

The CBNC is mandated to implement responsible mineral processing through the approved Environmental Protection and Enhancement Plan (EPEP), Social Development and Management Plan (SDMP), and the Final Mine Rehabilitation and Development Program (FMR/DP). The regular assessment of flora and fauna, together with the coastal resources, are measures embodied in the EPEP to ensure continuous protection of the impact areas.

The annual assessment of coastal resources is focused on marine and freshwaters that drain in Coral Bay in Bgy. Rio Tuba, Bataraza. The CBNC also maintains the Lower Kinurong Siltation Pond that drains into Ocayan River. Aside from two major rivers (i.e., Ocayan and Rio Tuba rivers), Coral Bay area also features several portions of sand bars, coral reefs, coralline-sandy beaches of Small and Big Sandbar, and Ameril Island.

Objectives of the Study

The aquatic biota-marine biology assessment was conducted on 23 –27 May 2022. The main objective of the assessment was to monitor the changes and determine the latest conditions of the plankton, mangroves, seagrass, coral reefs, reef fish communities, and freshwater fishes in established monitoring sites. It also aimed the following:

1. identify the areas covered and map the coral reefs and seagrass in Coral Bay;
2. determine the fisheries profile of Bgy. Rio Tuba;
3. establish monitoring sites and baseline data on coastal integrity; and
4. install monitoring blocks as permanent monitoring stations for coral habitat assessment.

This report is divided into four sections following this introduction. The methods employed to assess each component (i.e., beach profiling, mapping of coral reefs and seagrass, and fisheries profile) are shown in Section 2. Section 3 presents the results and data collected from these assessments, while Section 4 presents the trends and the prevailing quality of parameters on each component monitored in the primary impact areas of the operations of CBNC. Conclusion and recommendations based on the current observations are presented in Section 5.

2. METHODOLOGY

This section presents the methodology for regular assessment of plankton, mangroves, seagrass, coral reefs, reef fish communities, and freshwater fishes; mapping of coral reefs and seagrass in Coral Bay; determination of fisheries profile in Bgy. Rio Tuba; establishment of baseline data on coastal integrity; and installation of blocks to establish permanent monitoring stations for coral habitat assessment.

Table 1 presents the components assessed in monitoring sites for aquatic biota within the CBNC's inland water and coastal operations, while Figure 1 shows the geographical location of these stations in Bgy. Rio Tuba, Bataraza, Palawan. The GPS coordinates of all established monitoring points per component are presented in Appendix 1.

Table 1. Monitored components and their locations for aquatic biota and marine biology assessment in Coral Bay Nickel Corporation, Bgy. Rio Tuba, Bataraza, Palawan.

Monitoring Sites	Seagrass	Mangroves	Plankton	Coral Reefs	Reef Fishes	Beach Profie
Primary Impact Areas						
Discharge Point			✓	✓	✓	
Causeway			✓		✓	
Mooring Dolphin			✓	✓	✓	
Tagdalungon	✓	✓				✓
Lower Kinurong Siltation Pond			✓		✓	
Secondary Impact Area						
Ocayan River	✓		✓			
Other Monitoring Areas						
Small Sandbar	✓			✓	✓	
Big Sandbar	✓			✓	✓	
Maranto Pt.				✓	✓	
Ameril Island				✓	✓	
Ursula Island				✓	✓	✓
Total	**4**	**1**	**5**	**7**	**8**	**2**

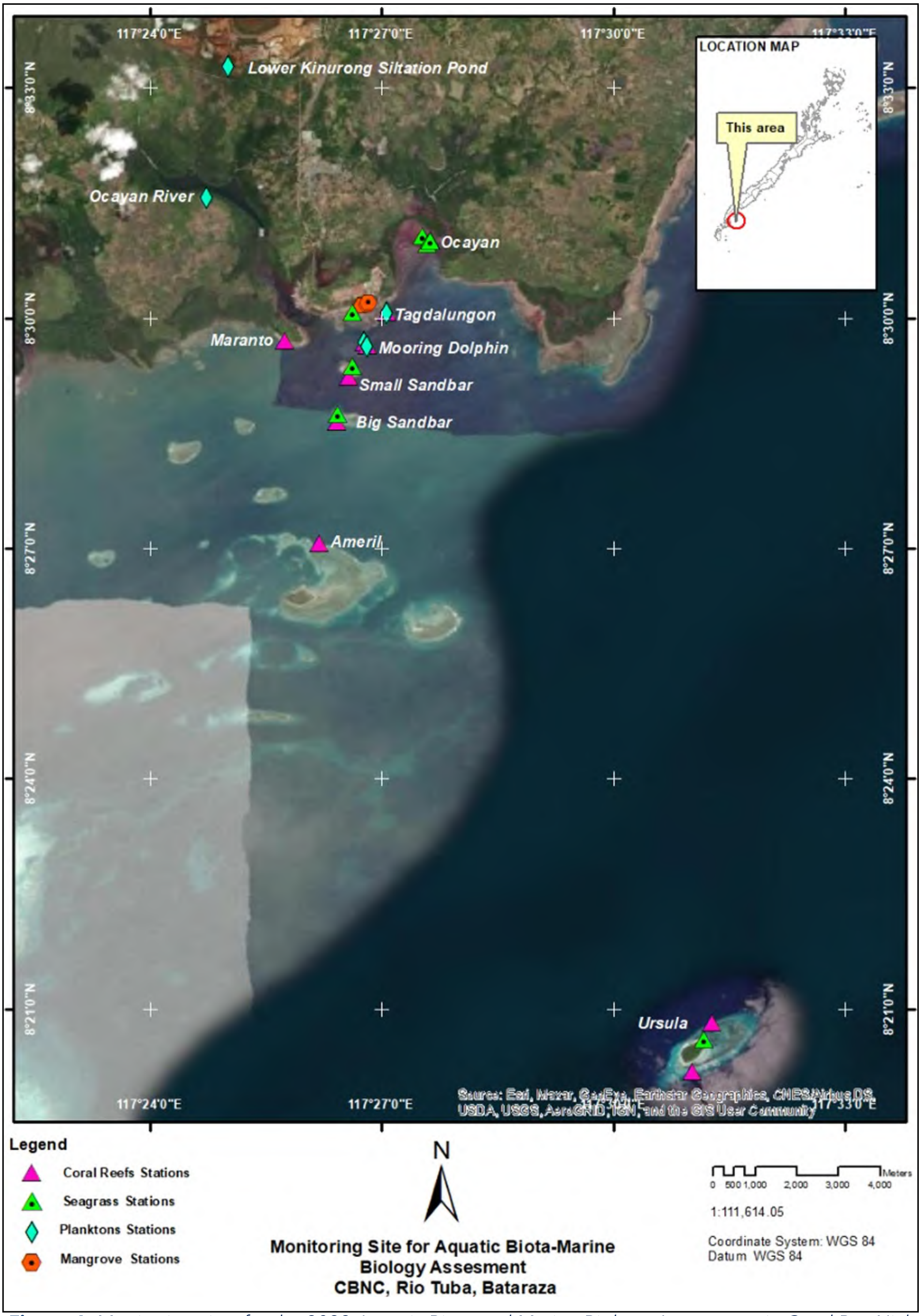


Figure 1. *Monitoring sites for the 2022 Aquatic Biota and Marine Biology Assessment in Coral Bay Nickel Corporation, Bgy. Rio Tuba, Bataraza, Palawan.*

2.1 Seagrass

The revised transect-quadrat sampling method was based on the DENR Administrative Order No. 2016-26 (Guidelines on the assessment of coastal and marine resources). This method was used in assessing the seagrass beds in Bgy. Rio Tuba, Bataraza, Palawan last May 24-26, 2022. A 50-m transect line was laid perpendicular to the shoreline starting at the shallowest point where the seagrass first appears going seaward. A 0.5 m by 0.5 m PVC pipe quadrat was placed on the right side of the transect line every 5 m interval. Reading and recording of parameters were done for the three replicated transects per station.

Parameters taken to describe the whole seagrass meadow includes substrate type, seagrass species, percent cover and canopy height, and was conducted along with percent cover of algae and epiphytic algae found on seagrass and on its blades. Photos were taken every 5 m, 25 m and 45 m of the transect line. However, availability of the images was based on the water visibility in the area and the sea level during sampling.

The seagrass shoot density was also determined by counting the number of shoots per species within the quadrat multiplied by 4 to obtain the per m^{-2} unit. Seagrass cover was estimated based on the method of Saito and Atobe (1970) as thoroughly discussed by Ganzon-Fortes (2011), using the formula:

$$\% \text{ cover} = \frac{\sum(Mi \times fi)}{\sum f}$$

where:

Mi is the midpoint percentage of each species;

fi is the number of sectors with the same class of dominance;

∑f is the total number of grids in the quadrat, which is 25.

Status or condition of the assessed seagrass beds was obtained following the criteria as stated by PCSD (2013):

Condition	**%**
Excellent	76–95
Good	51–75
Fair	26–50
Poor	1–25

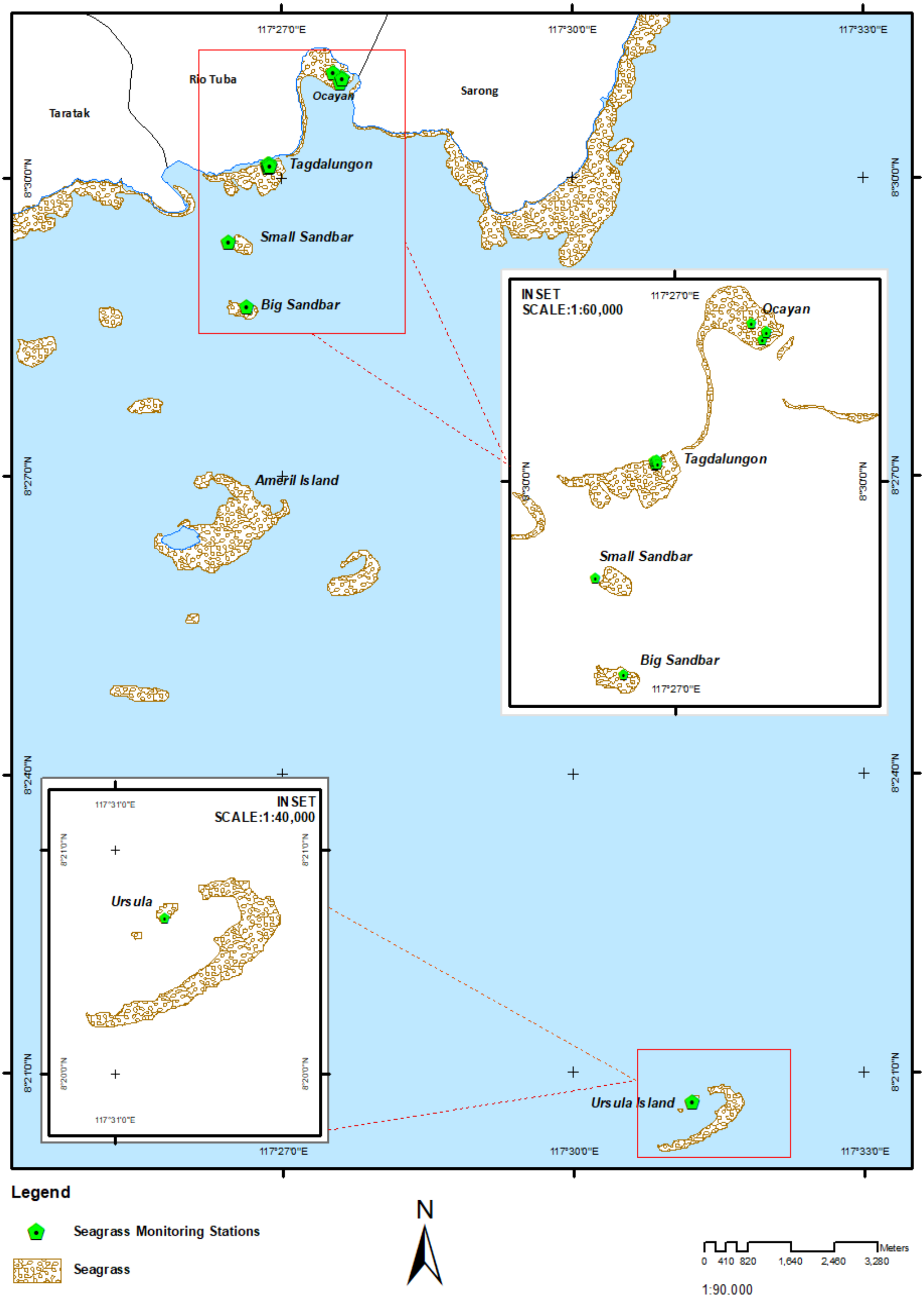


Figure 2. Seagrass monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan.

2.2 Plankton

There were four monitoring stations for plankton comprised of Ocayan River, Causeway, Discharge Point and Mooring Dolphin for marine plankton, and Lower Kinurong Siltation Pond for freshwater plankton (Figures 3 and 4). Collections of samples were done using a plankton net with 20 µm mesh size, and stored in sampling bottles with 1% diluted formalin (Figure 3). The collection of water samples for plankton analysis was conducted following the vertical tow method. After towing, at least 100 ml of water samples with three replicates per sampling station were collected from the net bucket.

Figure 3. Collection (left) and preservation (right) of freshwater plankton in Lower Kinurong, Bgy. Rio Tuba, Bataraza, Palawan (May 2022)

The water samples were then preserved using a 5% formalin solution. In the laboratory, three 1 ml aliquot subsamples per sampling bottle (three sampling bottles per station) were placed in the Sedgewick Rafter for plankton examination. An inverted, Euromex "Oxion" series microscope was used for such purpose, while the books of Conway (2012), Omura et al. (2012), Al-Yamani et al. (2011), and Perry (2003) served as the references for plankton identification. Measurements of water depth and readings (initial and final) from the flow meter were recorded to determine the volume of the sampled water.

Plankton density was computed using Segdewick/Segdewick R after formula:

$$\# \, of \, \frac{cells}{L} = \left(\frac{\# \, of \, cells \, counted}{Slide \, volume}\right) * \left(\frac{1}{CF}\right) * \left(\frac{1000ml}{L}\right) \quad \text{where} \quad CF = \frac{Original \, Volume}{Sampl \, Volume}$$

Figure 4. Plankton monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

2.3 Mangroves

The mangrove area in Tagdalungon, Bataraza, Palawan is one of the primary impact areas of CBNC. In this monitoring, four plots were established (Figure 5).

Figure 5. Mangrove monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

The relative measurements used for this assessment include density, basal area (dominance), and the probability of occurrence throughout the plot (frequency). These relative measurements are often combined to give an importance value (Curtis 1959) and should only be used as a supplement to absolute values.

The mangrove vegetation was assessed following the standard protocol described by English et al. (1997), wherein the transects were laid perpendicular to the shoreline. At the chosen sampling sites for a mangrove area a 100 m transect line was laid from the shoreline extending to the landward zone of the mangrove stand/forests. Three plots measuring 10 m x 10 m was established along the transect line at 35 m interval. The number of plots per transect were determine depending on the extent of the mangrove stand. All trees (growing with heights > 3m) enclosed within the 10 m x 10 m plot were identified and counted. Then, within each 10 m x 10 m plot, a smaller 5 m x 5 m quadrat was made and all saplings (heights between 2 and 3 m) inside this quadrat were identified and counted. Moreover, a smaller 1 m x 1 m quadrat was made and all seedlings (heights < 1m) inside this smaller quadrat were identified and counted.

2.4 Coral Reefs

Eight coral reef stations were monitored with six within the vicinity of Coral Bay, and two in Ursula Island (Figure 6). Among these stations, two were near the primary impact sites (i.e., Causeway and Mooring Dolphin), while the rest were designated as other monitoring stations. The depths of monitoring stations ranged between 3 and 10 m. Geographical coordinates and other station information are listed in Appendix 1.

The substrate/coral cover of monitoring stations were assessed using the modified photo-quadrat method (Luzon et al. 2019) using scuba. In each station, two 50-m transect lines were laid parallel to the shoreline at 5-10 m depth, and a 10 m interval separated the two transects. The assessments started by taking photographs of the shallower side of the transect line using a GoPro camera (ver. 9.0) placed in a monopod starting at 0 m with 1 m interval. Colony shots of other corals and benthic life forms were also taken within the vicinity, especially those that were not intercepted within the transect (Figure 7). All the monitoring activities were conducted between 8:00 AM and 4:00 PM coinciding with the good weather.

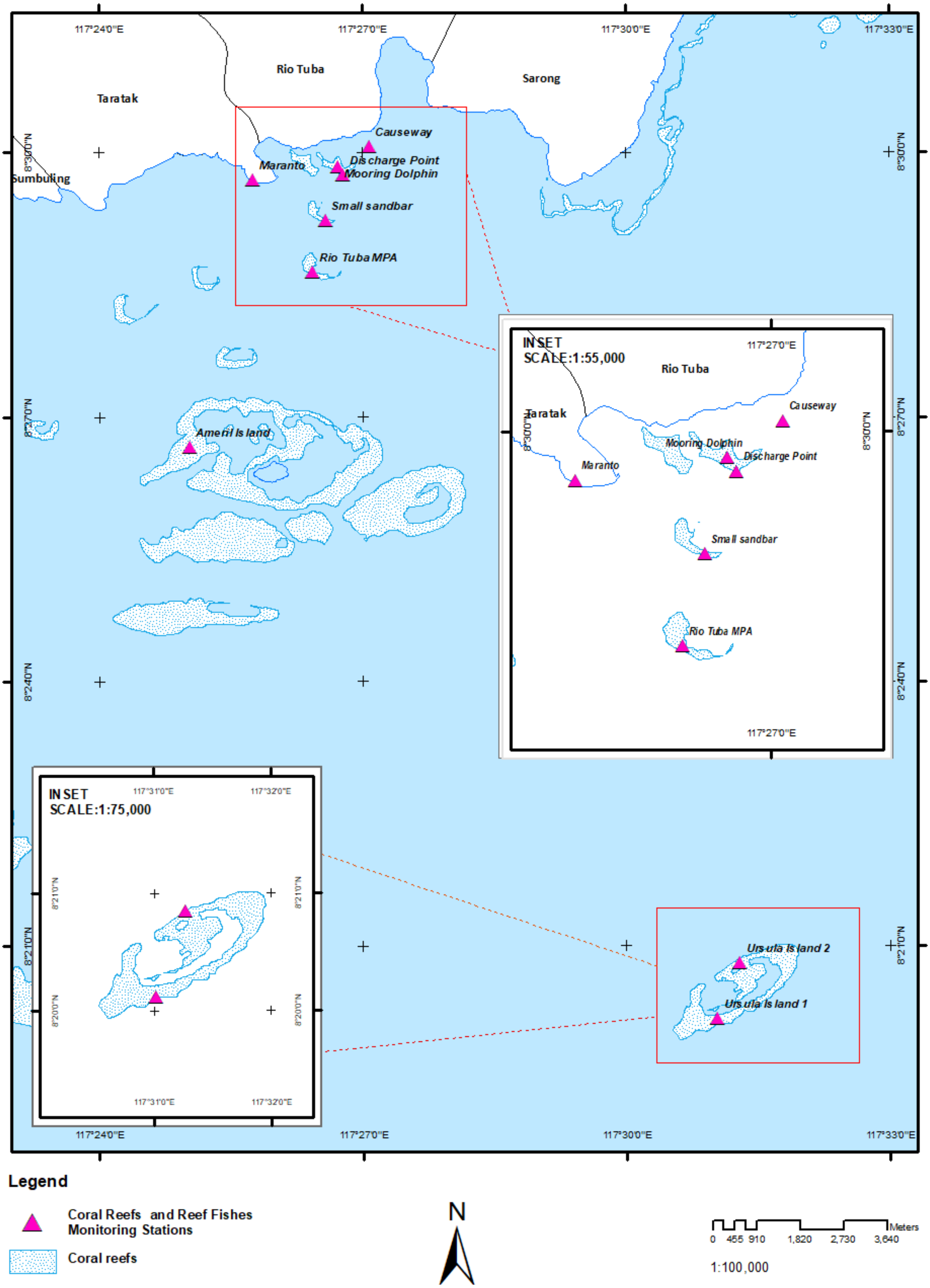


Figure 6. *Coral reefs and reef fish communities monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan.*

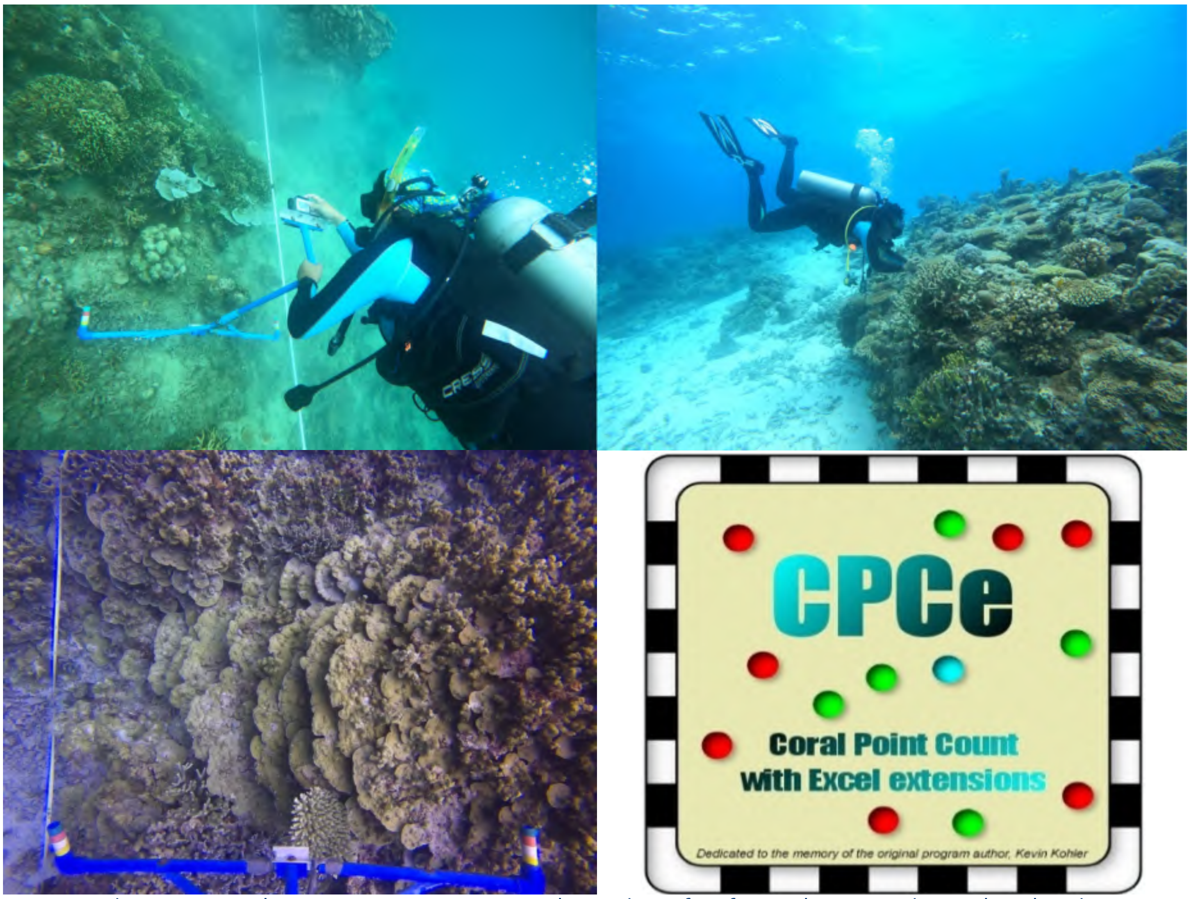


Figure 7. Substrate/coral cover monitoring in selected reefs of Coral Bay and Ursula Island, Rio Tuba, Bataraza, Palawan: actual monitoring using the photo-quadrat method (upper left), photo-documentation of coral genera within the vicinity in one of the stations (upper right), an example of a frame collected using the photo-quadrat method (lower left), and the Coral Point Count with Excel extensions (CPCe) program used to analyze the collected substrate photos (lower right).

After each dive-day, collected photos were stored in a laptop computer and/or external hard drive for further data processing. Photos were analyzed and scored using the program Coral Point Count with Excel extension (CPCe) (Kohler and Gill, 2006) installed in a laptop computer. In scoring photos, a 10-point scheme was used to aid in identifying the substrate. The benthic life form categories by English et al. (1997) were used: hard coral (HC), dead coral (DC), macroalgae (MA), other soft corals (SC), sponges (SP), organisms (OT), rubbles (RB), sand (SD), and silt (SI). The HC were also subcategories into branching *Acropora* (ACB), digitated *Acropora* (ACD), tabulated *Acropora* (ACT), other branching corals (CB), other encrusting corals (CE), other foliose corals (CF), other massive corals (CM), mushroom corals (CMR), other submassive corals (CS), and *Heliopora* (CHL). The mean HC cover of all transects was computed and interpreted following the HC cover and diversity categories of Licuanan et al. (2017) and Licuanan (2020) (Table 2).

Table 2. Scales and categories used for assessing hard coral (HC) cover and HC diversity (as taxonomic amalgamation units, TAUs) of the monitoring stations in Coral Bay and Ursula Island, Rio Tuba, Bataraza, Palawan following Licuanan et al. (2017)[1] and Licuanan (2020)[2].

Hard coral cover (HCC)[1]		Hard coral diversity[2]	
Excellent	>44%	Diversity Category A	>26 TAUs
Good	33%-44%	Diversity Category B	22-26 TAUs
Fair	22%-33%	Diversity Category C	18-22 TAUs
Poor	<22%	Diversity Category D	<18 TAUs

Each coral colony encountered was also identified down to generic level by examining the morphological features of the photos collected using Veron et al. (2021). The valid generic names of identified corals were verified using the World Register of Marine Species (https://www.marinespecies.org) website.

2.5 Reef Fish Communities

The same method from the previous monitoring was employed using two 50-m replicate transects per station (refer to Figure 6). Transects were spaced approximately 10 m apart and laid parallel to the shoreline maintaining 5-10 m depth. A belt transect was established wherein a 50 m long transect with a 10-meter arbitrary corridor was used to enclose an approximate area of 500 m^2.

To determine the density and biomass of reef fish communities in each station, the daytime fish visual census (FVC) technique was utilized (English et al. 1997, Uychiaoco et al. 2010). In each transect, the count, and length estimates of diurnally-active and non-cryptic reef fishes with a minimum length of 1 cm were recorded. Underwater photographs were also taken during the surveys to verify the identification of some reef fishes. The works of Allen et al.

(2003) and Kuiter and Tonozuka (2004) served as references in species identification based on morphological features. Fish biomass was estimated using the formula:

$$\mathbf{W = aL^b}$$

where:

W : weight of fish in grams,

L : estimated total length of fish (in cm)

a, **b** : regression parameters obtained from Fish Base, Kulbicki et al. (1993), and Palla et al. (2018).

Fishes encountered were categorized as target, indicator, and major groups. "Target" fishes are species of interest in reef fisheries due to their high market value; a decrease in the density and biomass of these fish species is a good measure of fishing exploitation in the concerned reef areas. Target fish species include surgeonfishes (Acanthuridae, except genus *Zebrasoma*), fusiliers (Caesionidae), jacks/pompano (Carangidae), sweetlips (Haemulidae), wrasses (Labridae, subfamily Cheilininae only), snappers (Lutjanidae), goatfishes (Mullidae), threadfin bream (Nemipteridae), parrotfishes (Scaridae), groupers (Serranidae, subfamily Epinephelinae only), and rabbitfishes (Siganidae). "Indicator" fishes mostly feed on coral polyps (good indicators of live coral cover) and are highly territorial species. On the other hand, "major" fishes are neither categorized as target nor indicator groups.

In addition, reef fish species were further classified according to their trophic structure or food habit. They were categorized as benthic invertivore, corallivore, detritivore, herbivore, omnivore, piscivore and planktivore. These are based on information per species available in Fish Base database (*www.fishbase.org*).

2.6 Freshwater Fishes

To remove bias in the survey, the same technique was utilized for the assessment of freshwater fishes in Lower Kinurong Siltation Pond. Experimental fishing was carried out using a bottom set gillnet (*lambat palubog*) positioned at the deepest portion of the pond for two hours before hauling. Fish catches were measured and identified down to the lowest possible taxon, while photographs of the fish samples were also taken *in situ* for proper identification. The fishing activity was done both during low and high tides to capture variation in the species composition and volume of fish at different tidal levels in accordance with the report from the local fishers.

2.7 Fisheries Profile

The study was conducted in three fishing communities of Rio Tuba, Bataraza, namely sitios Tagdalungon, Marabahay and Bukid-Bukid. Fisheries assessments were conducted through semi-structured interviews, landing and market surveys.

A total of 50 respondents in three fishing community were interviewed, fisher respondents were chosen following a snowball sampling where an enumerator interview the first fisher encounters in the community and proceed with the next fishers and so on. Interviews were carried-out by trained enumerators who were briefed well about the flow of the questionnaires prior to the survey in order to standardized data collection. The survey questionnaires are divided into three sections including Personal Information, Fisheries Information and Perceived changes in fishing. For the fish landing survey, enumerators are stationed in beach front of three sitios or in an established buying stations where fishers landed to sell their fish catch. Total volume of fish catch is measured and identified to lowest possible taxon, meanwhile, market survey was carried-out in Marabahay wet market and established *talipapa* in three sitios.

For the computation of Catch per Unit Effort (CPUE) of fishing gear the following formula were used:

Bottom set-gillnet

CPUE (kg) = Total catch (kg)/Fishing time/Number of Crew/Length in meters

Hook and Line

CPUE (kg) = Total catch (kg)/Fishing time/Number of Crew/Length in meter

Spear gun

CPUE (kg) = number of crew/diving hours

Jig

CPUE = Total catch (kg)/jigging time/num. of crew

Ethical Considerations

The respondents are brief regarding scope of the project prior to the conducts of the survey to ensure that he/she fully understand the purpose of the interview and participated voluntarily. Resulting data will be treated with confidentiality, processed and analyze following the ethical standards set by the ethical review committee.

2.8 Beach Profiling

The Emery method for conducting beach profiling based on the "Coastal and Marine Biodiversity Assessment and Monitoring: How-to Guideline" developed by BMB-DENR together with its funding partners, was used in this assessment.

A 50 m transect line was laid starting from land heading to the sea. The back (landward) rod was placed on or near the fixed point and the other rod several meters seaward. The location of the front (seaward) rod was dictated by fixed distances where elevation readings are to be measured. Reading started at Point 1 which corresponds to the position of the back (landward) rod. It can be the fixed point, or a certain distance away from the fixed point if adjustments were made. At Point 1, X and dz should be 0. 6. At Point 2, note the distance (X) between two rods. The difference in elevation, dz, between Point 1 and Point 2 was acquired by sighting the lower of the two rods to the horizon and projecting the intersection of the lower rod and the horizon onto the higher rod. Reading and recording of substrate types and vegetation was done for each station (Figure 8).

Parameters used to describe the beach profile includes substrate type elevation and beach width. Photos were also taken for each station (Appendix 11)

Figure 8. Established stations for beach profiling in Tagdalungon and Ursula island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

2.9 Mapping of Seagrass and Coral Reefs

The study area is situated between 8.353 to 8.545 North latitude and 117.407 to 1170531 East longitude within the jurisdiction of Bgys. Rio Tuba and Ocayan, Bataraza, Palawan. There were five different components reflected in the location map, such seagrass, mangroves, plankton, sandbar, and coral reefs (see Figure 1). However, this study focused mainly on the seagrass and coral reefs also reflecting the extent of the study area. The primary objective was to map and determine the extent of coral reefs and sea grass along the coastline and shallow areas as reflected in the map of study area, including the Ursula Island.

The Sentinel 2 satellite images with 10 m resolution were utilized to map and determine the extent of coral and seagrass cover downloaded from the Copernicus website. Images with cloud cover of less than 10% were given the highest consideration. Bands 2, 3, and 4 with 10 m resolution were utilized to generate classified images using SNAP free software exclusively created for Sentinel satellite imagery. Supervised classification was utilized for image interpretation supplemented with data obtained from ground field validation, Google Earth, and photo and video documentation to ensure that the actual biophysical features have similar cover types represented in the classified image. Figure 9 shows the methodological flowchart applied for this study.

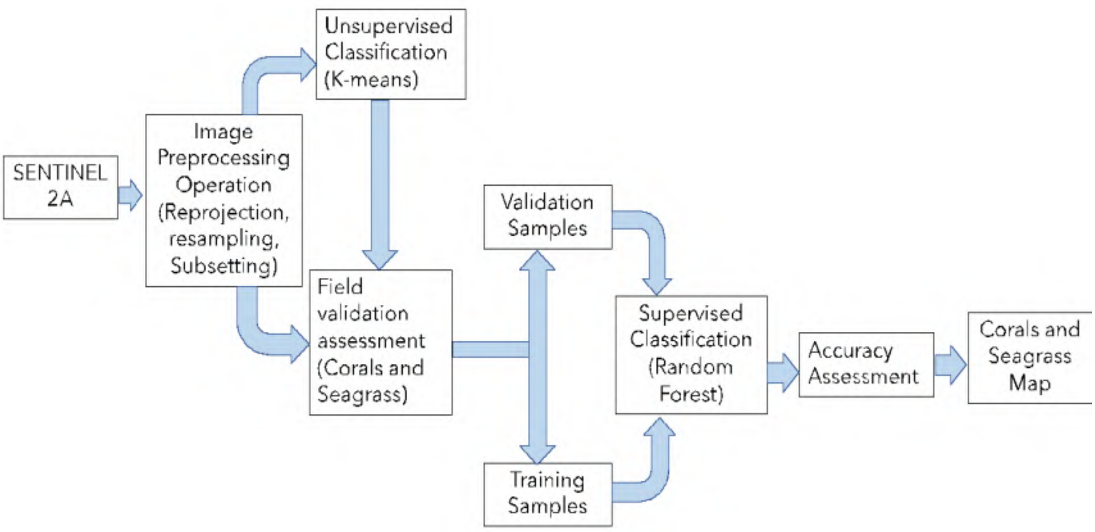


Figure 9. Research methodological flowchart on mapping of coral reefs and seagrass in Coral Bay, Bgy. Rio Tuba, Bataraza.

2.10 Installation of concrete blocks for coral reef monitoring

To continually monitor the same reef spot and detect future changes in the coral reefs, concrete blocks (30 cm x 30 cm x 8 cm) were installed every 5 m along the 100 m monitoring site (Figure 10). Future monitoring will use these concrete blocks as the basis of laying transect lines for coral/substrate cover and reef fish communities. Without monitoring blocks, any fine scale changes in the reef areas will not easily be detected, thus, its importance.

Monitoring blocks were installed in four (4) out of seven (7) coral reefs monitoring stations, namely: Mooring Dolphin, Big sandbar, Maranto Point and Ameril Island.

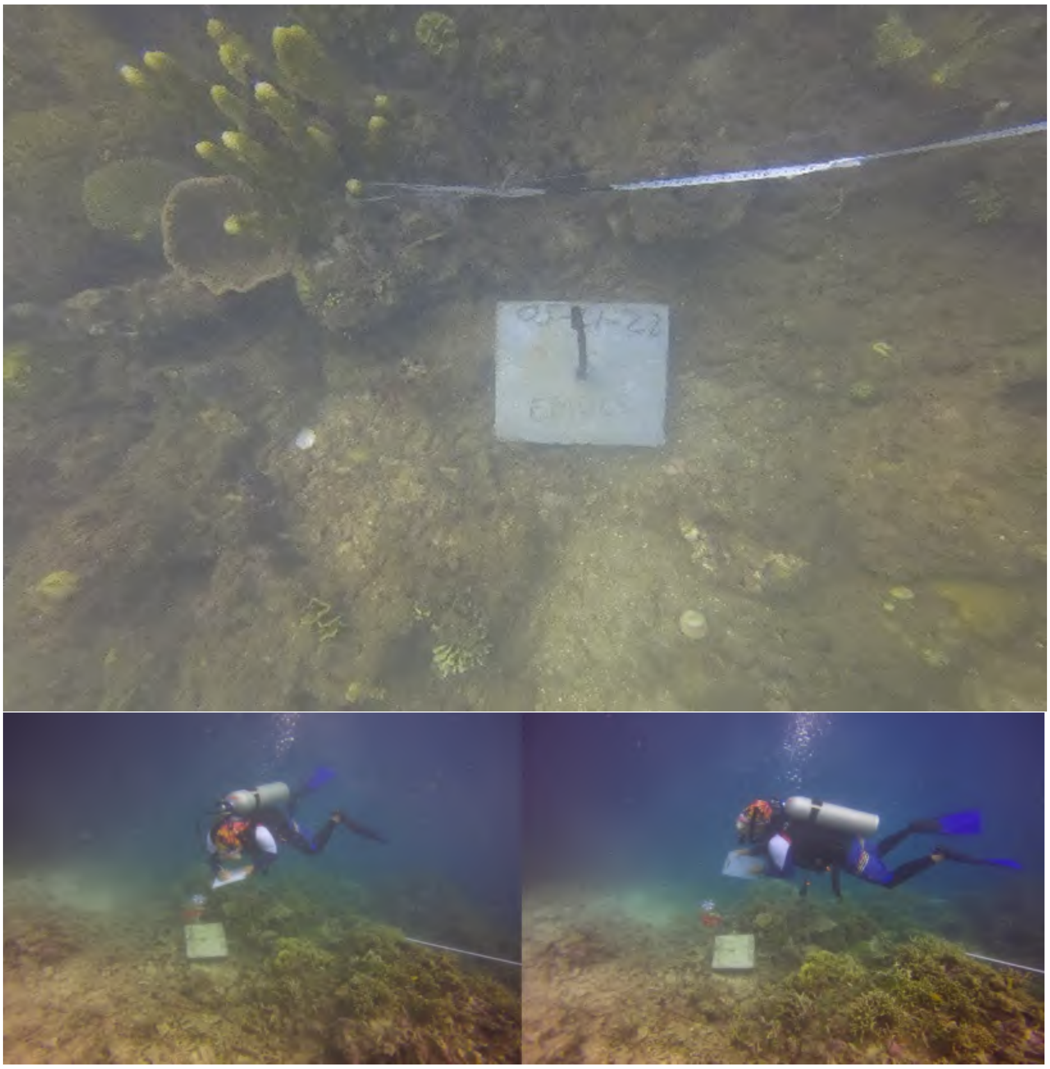


Figure 10. Concrete block installed in coral reefs monitoring stations in Bgy. Rio Tuba, Bataraza, Palawan.

3. RESULTS AND DISCUSSION

3.1 Seagrass

3.1.1 Species Composition

A total of five seagrasses species were observed, all belonging to the Division Antophyta (Angiosperms), Class Monocotyledoneae, and under families Hydrocharitaceae and Cymodoceaceae (Table 3). Identified and recorded species include *Enhalus acoroides, Halophila ovalis, Halodule pinifolia, Halodule uninervis,* and *Thalassia hemprichii*. Among the recorded species, *T. hemprichii and H. pinifolia* appeared in 3 out of the 4 stations. The least recorded species was *E. acoroides*, only appearing in Ocayan River. The muddy substrate of Ocayan River is the preferred habitat of *E. acoiroides* (Komatsu et al., 2004).

Table 3. Species composition of seagrasses encountered in monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

	Species	Small sandbar	Big Sandbar	Tagdalungon	Ocayan river
Hydrocharitaceae					
1	*Enhalus acoroides*			✓	✓
2	*Thalassia hemprichii*	✓	✓	✓	
3	*Halophila ovalis*	✓	✓		
Cymodoceaceae					
4	*Halodule uninervis*	✓			
5	*Halodule pinifolia*	✓	✓	✓	
	TOTAL	4	3	3	1

The number of recorded seagrass species in Coral Bay in this monitoring period is low compared to 2021 wherein nine species were recorded. There are 18 species found within the country, and 11 of them are found in Palawan (Fortes, 2013; PCSDS, 2015).

3.1.2 Species relative importance value

Five seagrass species (*E. acoroides, H. pinifolia, H. uninervi, H. ovalis;* and *T. hemprichii*) were recorded in monitoring stations, four of which were recorded in Small sandbar (Table 4). Tagdalungon area has three species of seagrass, while the Ocayan River had the lowest number of species with only one, the *E. acoroides*. Table 4 shows the comparison of seagrass importance value, diversity and evenness indices while Figure 11 presents the comparison of relative importance value (%) of seagrass species.

Table 4. Comparison of seagrass importance value, diversity, and evenness indices in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (June 2021 and May 2022)

Family/Species	Species relative "Importance value" %								
	2021	2022	2021	2022	2021	2022	2021	2022	2021
	Ocayan river		Tagdalungon		Small sandbar		Big sandbar		Ursula
Hydrocharitaceae									
Enhalus acoroides	82.8	100	18.6	12.3	1.5	--	0.2	--	0.1
Halophila minor	--	--	--	--	2.4	--	1.2	--	--
Halophila ovalis	--	--	--	--	12.0	23.2	--	16.4	60.7
Thalassia hemprichii	--	--	7.4	12.5	15.8	26.3	2.9	26.3	--
Potamogetonaceae									
Cymodocea	--	--	--	--	41.8	--	--	--	--
rotundata	17.2	--	6.4	--	8.5	--	72.9	--	15.6
Cymodocea	--	--	30.5	65.2	4.3	20.3	17.8	57.3	23.6
serrulata	--	--	37.1	--	1.2	30.2	4.5	--	--
Halodule pinifolia	--	--	--	--	12.5	--	0.5	--	--
Halodule uninervis									
Syringodium									
isoetefolium									
Species richness 2	1	5		3	9	4	7	3	4
Evenness index (Shannon J')	0.54	0.48	0.93	0.66	0.83	0.75	0.45	0.40	0.95
Diversity index 0.16	0	0.64	0.25	0.79		0.45	0.35	0.30	0.45

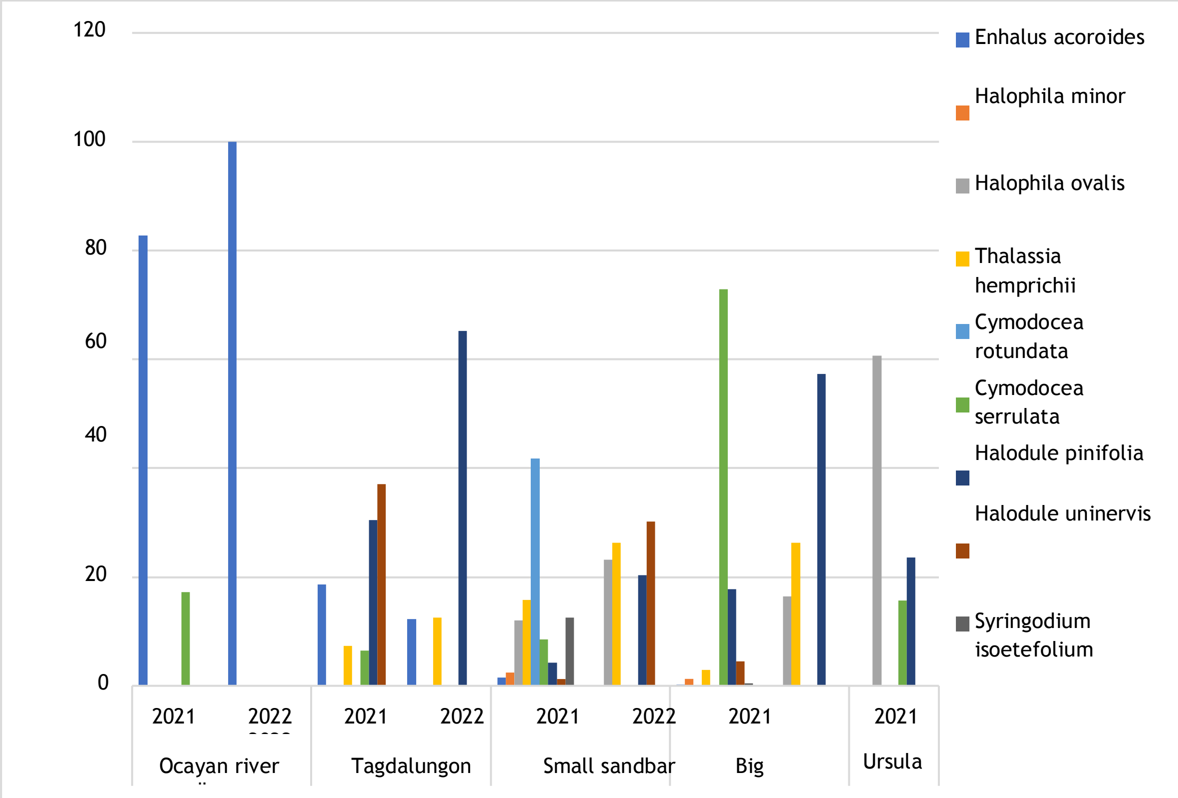


Figure 11. Comparison of relative importance value (%) of seagrass species recorded in monitoring stations in Bgy. Rio Tuba, Bataraza, Palawan. (May 2022).

Based on the recent seagrass monitoring activity, no seagrass was observed in Ursula Island, while only one species was observed in Ocayan river compared to two species observed in the previous years. Lower number of seagrass species was also observed in Tagdalungon, Small sandbar and Big sandbar. This may all be caused by stronger wave action and current due to stronger typhoons experienced by the province of Palawan in the previous months prior to this survey. Due to the impacts of stronger typhoons, the sand nearby the seagrass meadows tend to cover small shoots and cannot be easily seen. Lower values can be seen in the evenness index and diversity index.

3.1.3 Seagrass Cover

The seagrass cover in Coral Bay and Ursula Island is predominantly composed of *E. acoroides* with a total percent cover of 14%, followed by *H. pinifolia* with 11% cover. Lowest seagrass cover was seen in *H. ovalis* with 4%, followed by *T. hemprichii* (8%).

Table 5. Seagrass cover (%) per species of monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Family/Species	**Seagrass cover (%)**								
	2021	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**
	Ocayan river		Tagdalungon		Small sandbar		Big sandbar		Ursula
Hydrocharitaceae									
Enhalus acoroides	12	8	6	6	1	--	1	--	--
Halophila minor	--	--	--	--	1	--	--	--	--
Halophila ovalis	--	--	--	--	2	1	4	3	2
Thalassia hemprichii	--	--	2	2	1	2	1	4	--
Potamogetonaceae									
Cymodocea	--	--	--	--	5	--	2	--	--
rotundata	2	--	2	--	11	--	--	--	1
Cymodocea serrulata	--	--	7	5	4	3	4	3	1
Halodule pinifolia	--	--	7	--	13	9	26	--	--
Halodule uninervis	--	--	--	--	4	--	--	--	--
Syringodium									
isoetefolium									
Sediment 86			76		58		64	10	96
Total seagrass cover	14	8	24	13	42	15	38	10	4

Seagrass cover was highest in the Small sandbar at 15%, followed by Tagdalungon at 13%. Lowest percent cover was observed in Ocayan at 8% having only *E. acoroides* as the only seagrass species present in the area, followed by Big sandbar with 10% cover. Generally, all of the stations monitored this 2022 have lower percent cover compared to the monitoring made in 2021 (Figure 12). This further proves the possibility of the negative impacts of strong winds and wave action due typhoons on the seagrass beds of Coral Bay and Ursula Island, Rio Tuba, Bataraza, Palawan.

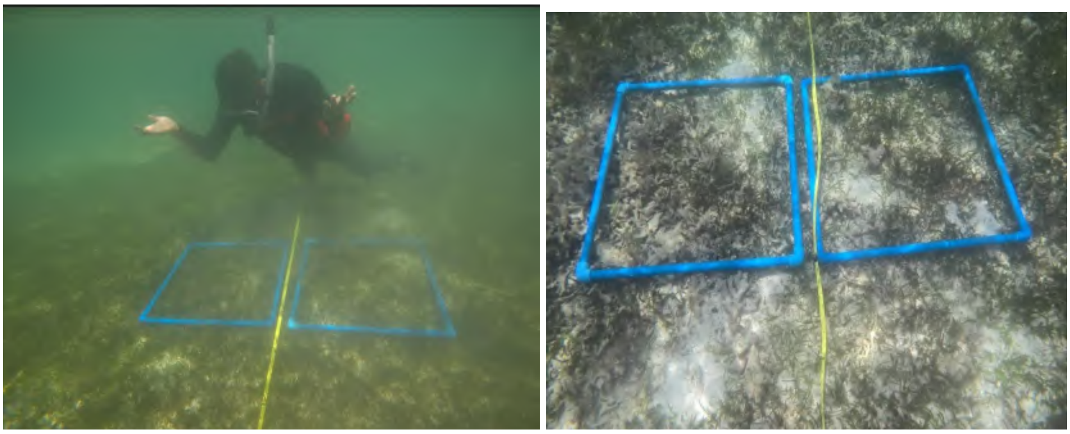


Figure 12. Seagrass assessment in Tagdalungon, Coral Bay Rio Tuba Bataraza, Palawan (May 2022).

The highest seagrass cover was observed in the Small sandbar station followed by Tagdalungon, both of which are poor in condition. The lowest seagrass cover was found in Ocayan which was also in poor condition followed by Big sandbar (Table 6). High seagrass cover provides sanctuary for clam species as seagrasses serve as a refuge for other invertebrate predation (Peterson 1982). High seagrass cover and canopy height also reduces the impact of currents within the bed which contributes to higher particulate food concentrations that can cause higher growth rates in some species of clams (Peterson 1982).

Table 6. Seagrass cover and condition of monitoring stations in Coral Bay and Ursula Island, Rio Tuba, Bataraza, Palawan (2021 and 2022).

Monitoring Site	Seagrass cover (%) (2021)	Condition	Seagrass cover (%) (2022)	Condition
Ocayan	14	Poor	8	Poor
Tagdalungon	18	Poor	13	Poor
Small sandbar	42	Fair	15	Poor
Big sandbar	34	Fair	10	Poor
Ursula Island	4	Poor	-	-

The substrate of the seagrass beds in Rio Tuba are generally sandy to coral rubble, except for Ocayan River having a muddy substrate (Table 7).

Algal and epiphyte cover is quite low to almost none for all of the stations, except for Ocayan River which may be due to low water movement in the area. The presence of few invertebrates was also observed in Small Sandbar, Big Sandbar and Tagdalungon.

Table 7. Substrate type and other related macrobenthic invertebrates in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Monitoring Site	Substrate	Algal cover	Epiphyte cover	Macroinvertebrate type
Small Sandbar	Sandy	Very few	None	Starfish and bivalves
Big Sandbar	Sandy-coral rubble	Very few	Few	Sea urchins
Tagdalungon	Sandy	Very few	Very few	Sea cucumber
Ocayan	Muddy	Very few	Few	None

3.1.4 Seagrass-associated seaweeds

There were six seagrass-associated seaweed species recorded in the monitoring stations. Three of the species are chlorophytes (green seaweeds), two phaeophytes/ochrophytes (brown seaweeds), and one rhodophyte (red seaweeds). Among the stations surveyed, Ursula Island had the highest number of seaweed species with four, followed by Tagdalungon and Small Sandbar with three species each, while Big Sandbar have two species. Lowest number of seagrass species was in Ocayan River with one species.

Percent cover of these seaweeds in the area was relatively "low" (Table 8). There were 15 species recorded in 2021 compared to the six species during this survey. Lower percent cover was recorded from 44.56% in 2021 to 15% in 2022. Similar to the trend with the decrease in seagrass cover, seaweed cover followed the same trend. Instead of seeing a transition from seagrass bed to algal bed, the situation may be due to the impacts of unforeseen natural phenomenon, such as strong waves and typhoons. However, these observations need to be confirmed with seasonal monitoring (e.g., monitoring during *habagat* and *amihan* monsoon seasons).

Table 8. Species composition and cover of seagrass-associated seaweeds in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Division/ Seaweed species	Sampling Station					Total cover per species
	Ocayan river	Tagdalungon	Small sandbar	Big Sandbar	Ursula island	
Chlorophyta						
Caulerpa sertularioides	--	0.12				0.12
Halimeda cylindracea	0.22		0.60			0.82
Halimeda macroloba	--	2.22	1.88	1.80	2.4	8.3
Phaophyta						
Padina sp.	--	0.28		1.26	1.44	2.98
Sargassum sp.	--		0.76		.80	1.56
Rhodophyta						
Galaxaura sp.	--				1.22	1.22
Total seaweed cover (%)	0.22	2.62	3.24	3.06	3.06	

3.1.5 Seagrass associated macro-invertebrates

There were four macroinvertebrate species noted in the seagrass beds of the monitoring stations. These included three species of Echinodermata (one species from Class Asteroidea; and two species from Class Echinodea;) and one species of Mollusca (Class Gastropoda) (Table 9). The number of macroinvertebrate species in this year's monitoring is lower than the recorded species in 2021. There were 12 macro-invertebrates in 2021 compared to four in 2022. Lower vegetation and cover either from seagrass or algae may have caused reduced number in macro-invertebrates throughout all the stations in Coral Bay and Ursula Island, Rio Tuba, Bataraza.

Table 9. Species composition and frequency of occurrence of seagrass- associated macroinvertebrates in the monitoring stations of Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Macro-invertebrate species	Frequency of occurrence (No. of individual)					Total
	Ocayan river	Tagdalungon	Small sandbar	Big Sandbar	Ursula island	
Phylum: Echinodermata						
Class: Asteroidea *Protoreaster nodosus*	2	4	1	2	3	12
Class: *Echinoidea* *Archaster sp.* *Diadema sp.*	2 --	-- 1	1 --	3 2	-- 2	6 5
Phylum: Mollusca						
Class: Gastropoda *Conus leopardus*	--	--	--	1	2	3
Total frequency	4	5	2	8	7	

3.2 Plankton

A total of 23 species comprising of 19 phytoplankton and four zooplankton were recorded (Table 10). This number is lower compared to the number of species recorded during the 2020 and 2021 monitoring (31 and 52 species, respectively) (Table 11). The density is estimated to range from 889 to 324,555 cells per cubic liter depending on the species. The estimated density is similar to the 2021 monitoring, but is comparatively lower than in 2020. The variability in abundance, density and species may indicate seasonality and changes of physico-chemical properties of the water. Depth of sampling may also affect the species variability, although these were not recorded from this monitoring as well as in the recent ones.

Table 10. Plankton species encountered and their corresponding number of cells recorded from the pooled sampled specimens in sampling stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

Class/group	Genera/species	Cells/L	Cells/L^3
Phytoplankton	*Rhizosolenia setigera*	324.55	324554.95
	Thalassionema sp.	182.45	182450.46
	Chaetoceros sp.	180.58	180578.07
	Thalassionema nitzschioides	131.42	131421.80
	Pseudo-nitzschia sp.	43.17	43168.86
	Ceratium trichoceros	40.85	40851.77
	Thalassionema frauenfeldii	35.41	35407.70
	Protoperidinium oceanicum	23.74	23738.22
	Chaetoceros peruvianus	14.76	14759.82
	Ditylum brightwellii	14.26	14263.88
	Odontella mobiliensis	10.80	10802.76
	Ceratium dens	10.78	10783.34
	Ceratium tripos	10.76	10761.72
	Coscinodiscus granii	9.70	9697.86
	Odontella sinensis	4.82	4823.53
	Chaetoceros affinis	4.01	4008.27
	Dinophysis caudata	3.16	3164.02
	Chaetoceros simplex	1.33	1333.33
	Rhizosolenia crassispina	0.89	888.89
Zooplankton	*Acanthocyclops* sp.	195.00	194996.79
	Cyclops spp.	153.52	153522.34
	Mesocyclops sp.	105.78	105777.78
	Acartia sp.	9.33	9329.87

Table 11. List of plankton species recorded from 2020 to 2022 in the monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

2020	2021	2022
	Phytoplankters	
Bacillaria paradoxa	*Ceratium dens*	*Rhizosolenia setigera*
Bacillaria sp	*Ceratium furca*	*Thalassionema* sp.
Bacteria strumhyalinum	*Ceratium humile*	*Chaetoceros* sp.
Biddulphiaceae B. Sinensis	*Ceratium trichoceros*	*Thalassionema nitzschioides*
Calanoides cf. *carinatus*	*Ceratium tripos*	*Pseudo-nitzschia* sp.
Ceratium dens	*Chaetoceros affinis*	*Ceratium trichoceros*
Chaetoceros affinis	*Chaetoceros danicus*	*Thalassionema frauenfeldii*
Chaetocerotaceae C. Didymus	*Chaetoceros decipiens*	*Protoperidinium oceanicum*
Chaetocerotaceae C. Socialis	*Chaetoceros peruvianus*	*Chaetoceros peruvianus*
Closterium sp.	*Chaetoceros simplex*	*Ditylum brightwellii*

2020	2021	2022
Corethron sp.	*Chaetoceros* sp.	*Odontella mobiliensis*
Cytotella eccentricus	*Coscinodiscus granii*	*Ceratium dens*
Ditylum brightwelli	*Dinophysis caudata*	*Ceratium tripos*
Epithemiaventricosan	*Ditylum brightwellii*	*Coscinodiscus granii*
Eucampia zodiacus	*Euterpina* sp.	*Odontella sinensis*
Guinardia sp.	*Guinardia* sp.	*Chaetoceros affinis*
Lauderiaceae L. Annulata	*Lauderia annulata*	*Dinophysis caudata*
Leptocylindraceae L. Danicus	*Leptocylindricus sp.*	*Chaetoceros simplex*
Melosira sp.	*Odontella mobiliensis*	*Rhizosolenia crassispina*
Microspora Naviculaceae	*Odontella sinensis*	
Microspora sp.	*Protoperidinium oceanicum*	
N. Sigma	*Pseudo-nitzschia* sp.	
Naviculaceae N. Longa	*Rhizosolenia crassispina*	
Naviculasp	*Rhizosolenia setigera*	
Odentella sinensis	*Thalassionema frauenfeldii*	
oscinodiscaceae C. Granii	*Thalassionema nitzschioides*	
Prorocentumsp	*Thalassionema* sp.	
Protoperidinium sp.		
Protoperidinium sp.		
Pseudo-nitzchia australis		
Pseudo-nitzchia sp.		
R. delicatula		
Rhizosoleniaceae probosciaalata		
T. nitzchioides		
Tabellaria sp.		

2020	2021	2022
	Zooplankters	
Brachionidae Keratellatropica (	*Acanthocyclops* sp.	*Acanthocyclops* sp.
Calanoides sp.	*Acartia* sp.	*Cyclops* spp.
Calanus sp.	*Cyclops* spp.	*Mesocyclops* sp.
Calocalanus pavo	*Mesocyclops* sp.	*Acartia* sp.
Centropages brachiatus	*Tropocyclops* sp.	
Centropages sp.		
Daphnia sp.		
Euterpinaacutifrons		
Fritillaris sp.		
Oithonidae Dioithonarigida		
Paracalanus parvus		
Undinula vulgaris		

The plankton in the monitoring stations within the Coral Bay seems to be dominated by a few certain species as shown in Figure 13. Major dominant phytoplankon include *Rhisolenia setigera*, *Thalassionema* sp., *Chaetoceros* sp. and *Thalasionema nitzschiodea*. Zooplankton on the other hand, are almost in balance, except for *Acartia* sp. which was comparably observed in lower density. Similar to the observation in 2021, no phytoplankton was recorded in the estuary region (Lower Kinurong).

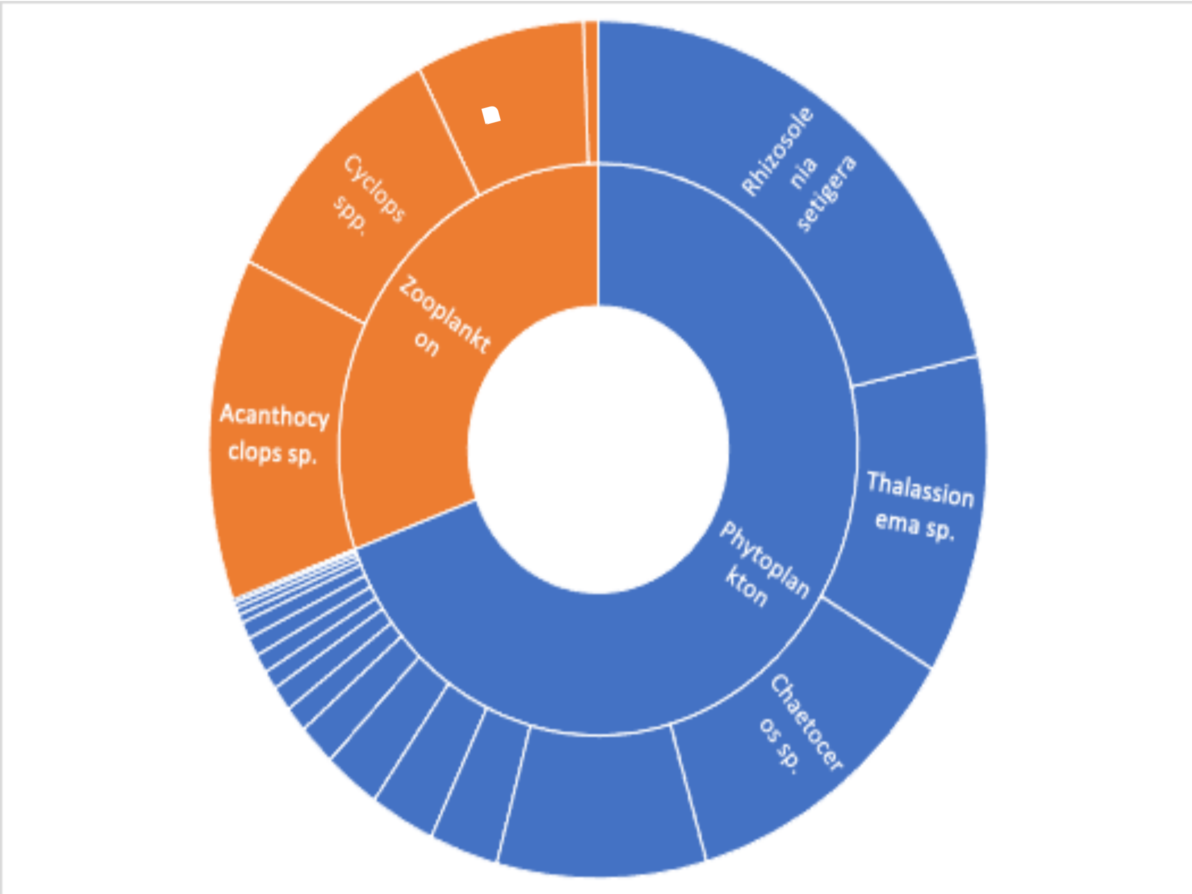


Figure 13. Composition of phytoplankton (blue) and zooplankton (orange) recorded from six monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

Diversity and evenness suggested that there is high diversity, except for Lower Kinurong, and yet dominant species is supported as shown in Table 12. Finally, significant differences in the abundance and density of plankton recorded in five monitoring stations (H = 16.84; p = 0.05) were observed, especially for Lower Kinurong which have very low number of species, abundance and density compared to the other five stations.

Table 12. Comparison on the diversity indices of plankton in six monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

Sampling sites	Taxa	Total Cells/L	Mean cell/L	Dominance D	Shannon H	Evenness e^H/S
Causeway	15.00	502.88	21.86	0.16	2.08	0.53
Mooring Dolphin	14.00	336.60	14.63	0.13	2.22	0.66
Ocayan River	16.00	213.89	9.30	0.19	1.95	0.44
Discharge Point	17.00	157.69	6.86	0.17	2.09	0.48
Tagdalungon	14.00	150.68	6.55	0.15	2.09	0.58
Lower Kinurong	2.00	149.33	6.49	0.56	0.63	0.94

Such patterns of species and abundance differences had long been observed in Philippine seas. Taniguchi (1972) noted that large-size phytoplankton (e.g., diatoms) may dominate surface areas of water as they cannot be ingested by microzooplankton, while in the Philippine seas, the subsurface chlorophyll *a* maximum layer was formed and are most likely dominated by small phytoplankton. Moreover, Calumpong et al. (2013) also described patterns of species and dominance shifts from blue-green algae in wet and diatoms in dry seasons in the Ticao Pass, Masbate, Philippines.

Moreover, abundance of all the species identified are high similar to the most recent records in 2021. The high abundance of phytoplankton suggests a most frequent sampling of changes in plankton's abundance, physico-chemical properties of water (e.g., water salinity, nutrients and temperature chlorophyl a, among others) to monitor for possibility of early detection of algal blooms that may cause red tide in the area as well as potential climate change effects specifically on plankton community.

3.3 Mangroves

Four mangrove species were documented in this year's monitoring, which include *Rhizophora apiculata, Rhizophora mucronata, Sonneratia alba,* and *Ceriops tagal in* Tagdalungon, Bgy. Rio Tuba, Bataraza, Palawan (Table 13). Due to small number of species, forest diversity and evenness were not calculated.

Table 13. Mangrove species composition and community structure in Tagdalungon, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Species	*R.apiculata*	*R.mucronata*	*S. alba*	*C. tagal*	TOTAL
Number of individuals	31	49	33	5	**118**
Mean	20.51	17.5	40.71	23.12	
Frequency	635.8	857.6	1343.5	115.6	**2952.5**
Percentage	26.27	41.53	27.97	4.24	**100**
Basal area	330.38	240.58	1301.78	419.82	**2292.57**
Stem/ha	8.66	13.99	9.32	1.33	**33.3**
Relative Density	26.27	41.53	27.97	4.24	**100**
Relative Frequency	22	29	45	4	**100**
Relative Dominance	14.41	10.49	56.78	18.31	**100**
Importance Value	62.22	80.68	129.64	26.41	

A total of 118 mangrove individuals were accounted within the plots made with an estimated 33.3 stem ha^{-1} and basal area of 2,293 stands/ha. Among these species, *S. alba* dominated the area with 1,302, followed by *C. tagal* (420), *R. apiculate* (330), and *R. mucronata* (241). This result implies that the mangrove forest is a mixture of primary and secondary growth forms. Species Importance Value (IV), however, revealed that *S. alba* was the most dominant mangrove species in the area with 130%, followed by *R. mucronata* (81%), *R. apiculata* 62%, and *C. tagal* (26%). The average densities of mangrove seedlings and saplings were calculated at 1267 ha^{-1} (178 seedlings and 1,089 saplings).

3.4 Coral Reefs

3.4.1 Coral genera composition/categories

There were 40 coral genera belonging to 14 families recorded within the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan. Among these families, only Acroporidae, Fungiidae, Merulinidae, and

Poritidae were noted across all stations. Among the stations, Ursula Is. 1 and Maranto Pt. had the highest number of recorded coral families with 12 each, followed by Big sandbar (11), Mooring Dolphin (11), Causeway (10), Small sandbar (10), Ursula Is. 2 (9), and Ameril Is. (8) (Figure 14).

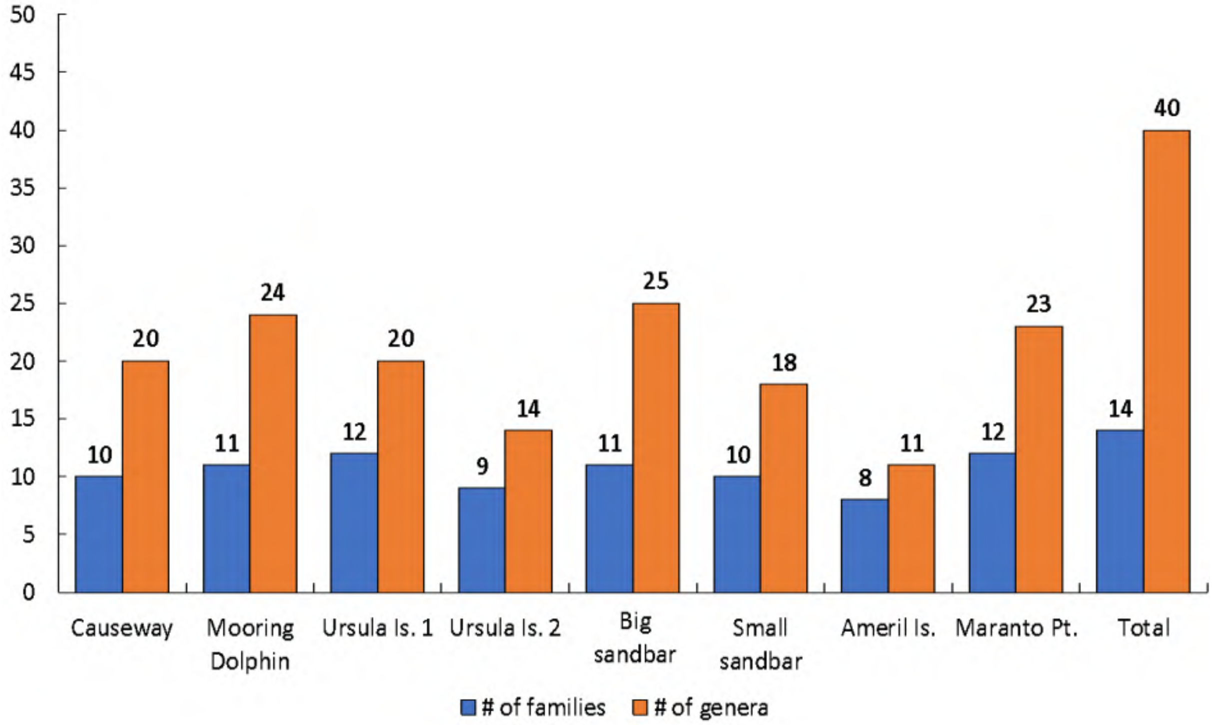


Figure 14. Number of coral families and genera recorded in the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

In terms of genera, only *Acropora*, *Favites, Fungia, Montipora*, and *Porites* were noted across all stations, while *Stylophora* was noted in 7 of 8 stations, and *Montastrea* and *Seriatopora* were observed in six stations. On the other hand, *Herpolitha, Lithophylion, Pavona, Platygyra,* and *Sandolitha* were encountered in one station only. The complete list of coral families and genera encountered in each monitoring station can be seen in Appendix 5. Some of the coral genera recorded are also shown in Figures 15 and 16.

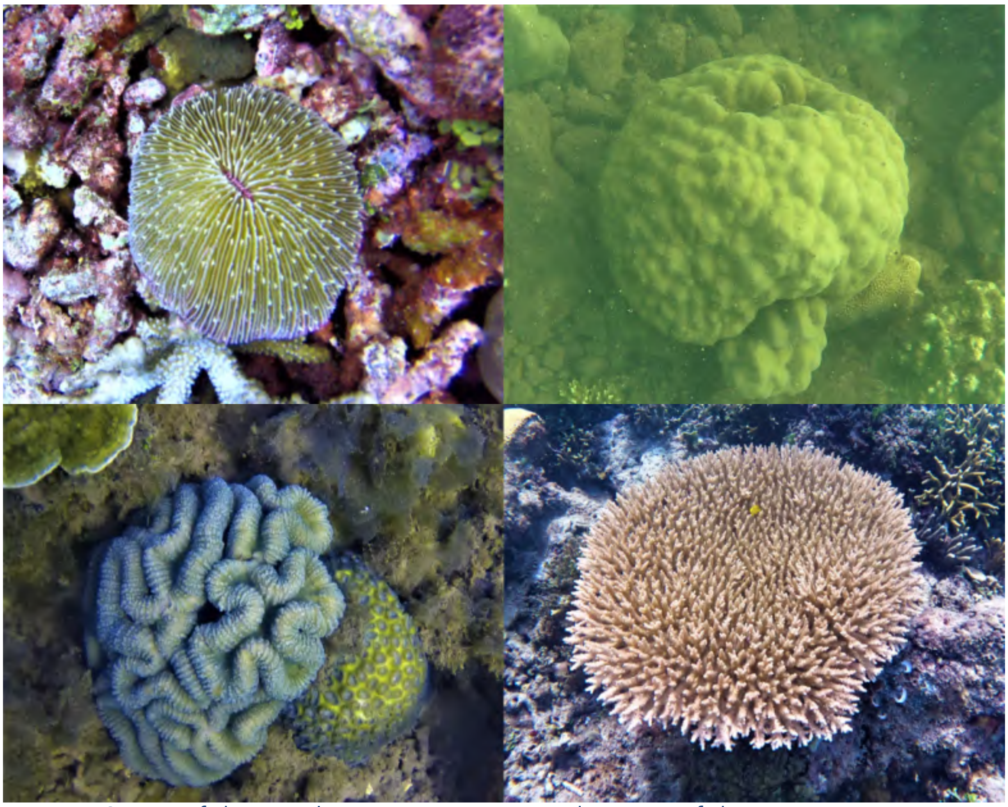


Figure 15. Some of the coral genera encountered in one of the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022): Fungia (upper left), Porites (upper right), Symphillia (lower left), and Acropora (lower right).

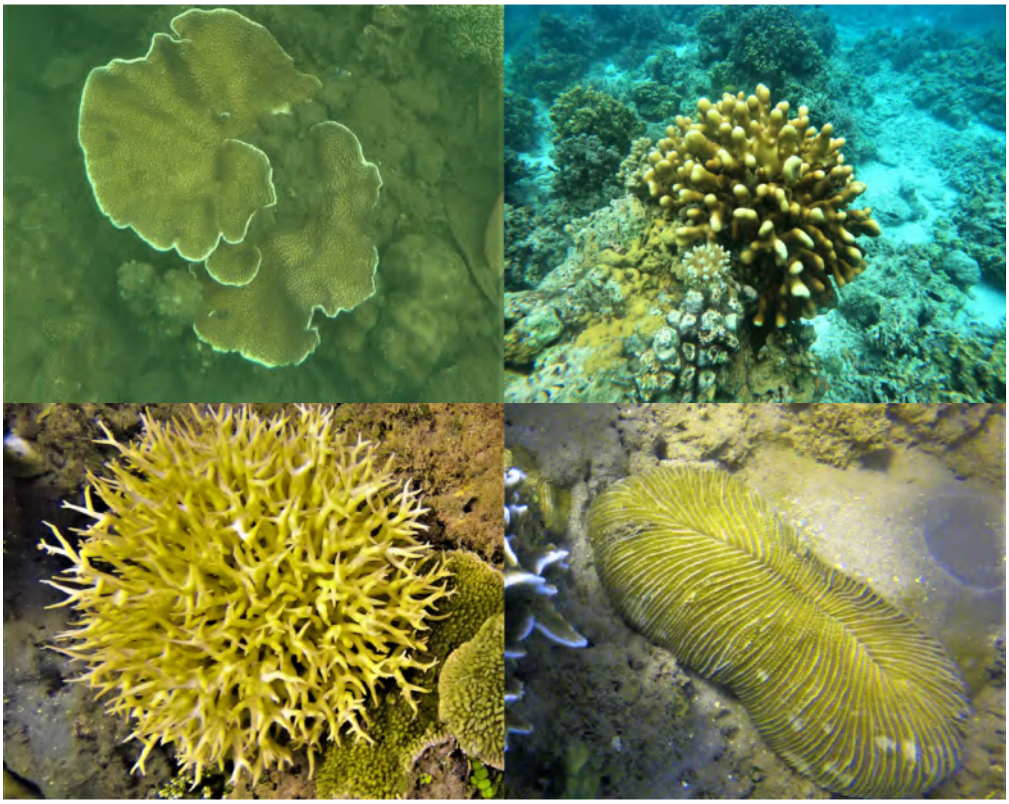


Figure 16. Some of the coral genera encountered in one of the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022): Turbinaria (upper left), Stylopora (upper right), Seriatopora (lower left), and Ctenactis (lower right).

The mean HC Diversity Category of the monitored stations was computed at 21.7 TAUs, categorized as "Diversity Category C". Among these stations, the number of coral genera in Big sandbar (25), Mooring Dolphin (24), and Maranto Pt. (23) were categorized in Diversity Category B, while Causeway (20) and Ursula Is. 1 (20) had Diversity Category C. On the other hand, Small sandbar (18), Ursula Is. 2 (14), and Ameril I.s (11) had Diversity Category D (Table 14).

Table 14. Diversity categories of the coral genera encountered in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan, Philippines (May 2022).

Monitoring stations	**Hard coral diversity**		
	# of families	**# of TAUs/genera**	**Category**
Causeway	10	20	Diversity Category C
Mooring Dolphin	11	24	Diversity Category B
Ursula Is. 1	12	20	Diversity Category C
Ursula Is. 2	9	14	Diversity Category D
Ameril Is.	11	25	Diversity Category B
Big sandbar	10	18	Diversity Category D
Small sandbar	8	11	Diversity Category D
Maranto Pt.	12	23	Diversity Category B
Total	**14**	**40**	
Mean	**10.8**	**21.7**	**Diversity Category C**

Generally, the number of coral genera recorded in 2022 increased compared to 2021. The number of coral genera in Causeway, Mooring Dolphin, Ursula Is. 2, Rio Tuba MPA, Small sandbar, and Maranto Pt. increased, while a decreasing trend was noted in Ursula Is. 2 and Ameril Is. (Figure 17).

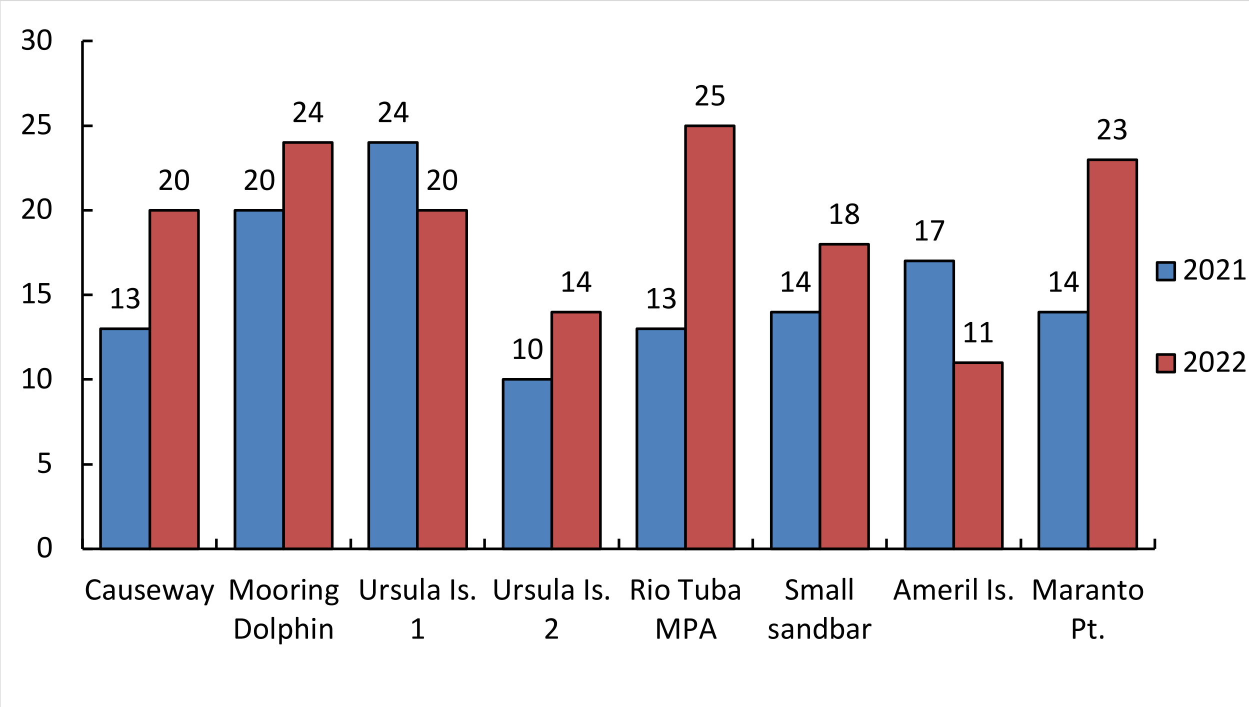


Figure 17. Comparison on the number of coral genera recorded in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan during the 2021 and 2022 monitoring.

The number of coral genera encountered increased in 2022 compared to the 2021 monitoring, except in Ameril Is. However, many coral recruits have been observed on this island, and when protected, could help in the enhancement of HC cover in some parts of the reef.

Most of the coral genera encountered were massive and submassive. Generally, these coral types are more resilient to environmental stressors, such as wave action, eutrophication, sedimentation, and increased sea surface temperature compared to their branching corals counterpart (Schloder and D'Croz 2004, Baldock et al., 2015, Ferreira et al. 2021). It is important to regularly monitor the presence and number of coral genera in the monitoring stations to help us protect these coral genera, especially those that are vulnerable to climate and anthropogenic stressors. A complex and healthy coral reef can harbor higher fish populations and provide a wider range of ecosystem goods and services (Moberg and Folke 1999, Woodhead et al. 2019).

3.4.2 Overall substrate cover/benthic life forms

The substrates in the monitored stations are categorized into biotic (living) and abiotic (non-living) components. The main biotic components include HC, SC, MA, SP and OT, and the abiotic components are DC, RB, SD, and SI. The mean cover of biotic components in reef stations was calculated at 43.6%, while the abiotic component at 56.4%.

The highest mean substrate cover of biotic components was that of HC (29.5%), followed by MA (11.7%), OT (1.0%), SP (0.9%) ,and SC (0.5%). In terms of abiotic components, these were dominated by DC (32.0%) and SI (12.3%), while SD and RB contributed 7.4% and 4.7%, respectively. Among the substrate categories, HC, DC, SI, and MA contributed to 85.5% of the substrate cover of the monitoring stations as shown in Figure 18.

The HC cover among the stations ranged between 10.1% and 40.6% (mean = 29.5%). The highest HC cover was recorded in Maranto Pt. (40.6%), followed by Small sandbar (32.7%), Causeway (31.7%), Ameril Is. (31.4%), Big sandbar (31.1%), Ursula Is. 1 (30.3%), and Ursula Is. 2 (28.0%). The lowest HC cover was observed in Mooring Dolphin (10.1%) (Figure 18).

The DC cover ranged from 12.3% to 61.9% (mean = 32.0%), with the two highest DC cover observed both in Ursula Island (61.9% in Ursula Is. 1, 43.1% in Ursula Is. 2). The DC cover in other stations include 41.6% in Small sandbar, 35.1% in Rio Tuba MPA, 32.0% in Ameril Island, and 18.2% in Maranto Pt. The two lowest DC cover were recorded in Mooring Dolphin and Causeway at 12.6% and 12.3%, respectively (Figure 18).

Meanwhile, SI in the monitoring stations ranged between 0.0% and 53.7% (mean = 12.3%). Silts were observed in all stations, except in the island stations (i.e., Ursula Is. 1 and 2, Ameril Is.) which are less influenced by siltation from the mainland. Causeway had the highest SI cover at 53.7%, followed by Mooring Dolphin (22.6%), Maranto Pt. (7.7%), Small sandbar (7.3%), and Big Sandbar (6.0%) (Figure 18).

On the other hand, MA cover ranged from 0.6% to 42.6% (mean = 11.7%). The MA covers in Mooring Dolphin (42.6%) and Maranto Pt. (31.3%) were higher compared with the rest of the stations: Ameril Is. (10.7%), Small sandbar (3.3%), Big sandbar (2.7%), Ursula Is. 2 (1.9%), Causeway (1.4%), and Ursula Is. 1 (0.6%) (Figure 18).

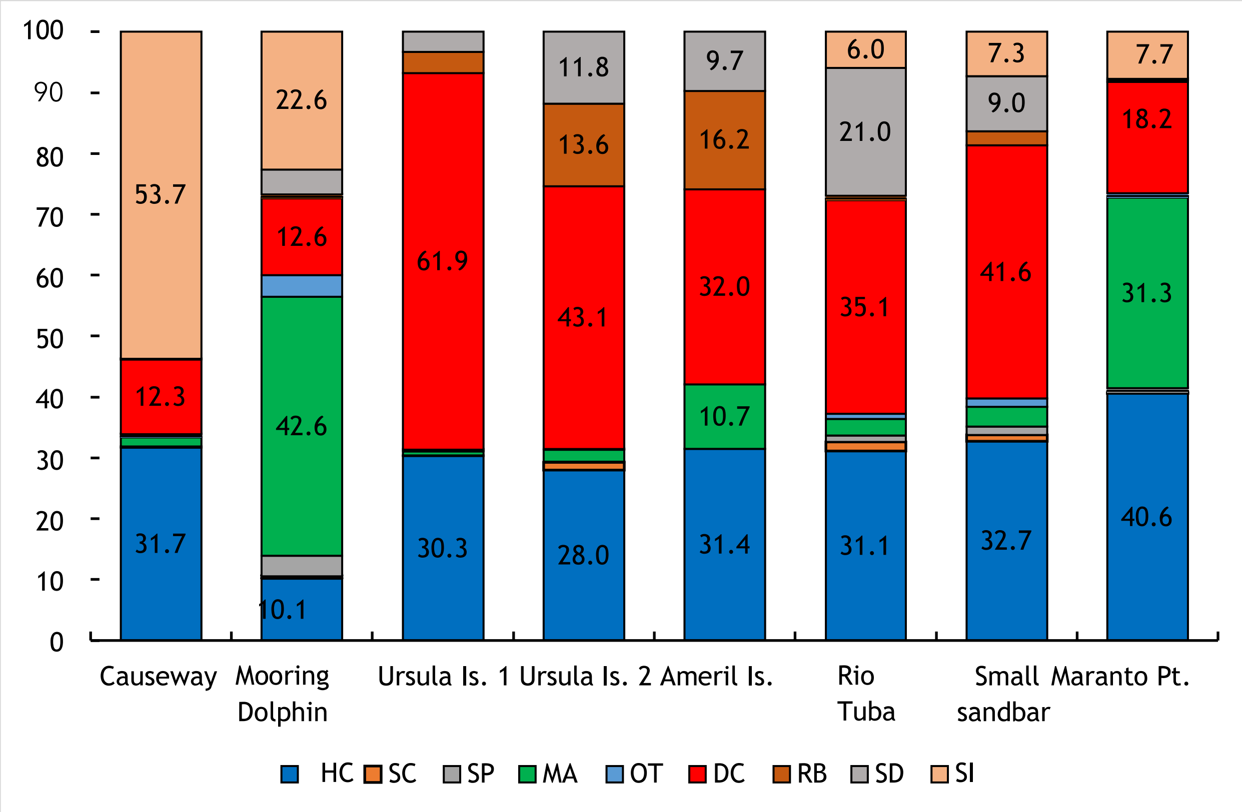


Figure 18. Mean substrate cover of monitoring stations in Coral Bay and Ursula Island Bgy. Rio Tuba, Bataraza, Palawan (May 2022). *Abbreviations used: HC-hard coral, SC-soft corals, SP-sponge, MA-macroalgae, OT- others, DC-dead coral, RB-rubble, SD-sand, and SI- silt. Values lower than 5% are not shown in the graph.*

The SC in the surveyed stations ranged between 0.0% (Causeway, Ursula Is. 1, Ameril Is.) and 1.5% (Big sandbar). The SP ranged between 0.0% (Ameril Is) and 3.4% (Mooring Dolphin), and OT ranged from 0.0% (Ameril Is.) to 3.5% (Mooring Dolphin). On the other hand, the RB ranged between 0.0% (Causeway) and 16.2% (Ameril Is.), while SD ranged from 0.1% (Causeway) to Big sandbar (21.0%) (Figure 18). The complete list of substrate cover in each monitoring station is listed in Appendix 6.

The reefs at Coral Bay and Ursula Island in Rio Tuba, Bataraza, Palawan, Philippines, are mostly in poor to fair conditions like most sites in the Philippines despite their remote locations in southern Palawan. Among the eight stations monitored, only Maranto Pt. has good condition (40%) of coral reefs and one of the most recorded numbers of coral genera (23). Although the station is near to a community, one of the possible reasons for this relatively high HC cover and number of coral genera is due to the presence of crocodiles within the vicinity according to the locals. The presence of crocodilian population in a locality is thought to enhance the local fisheries productivity (the so-called "Fittkau's hypothesis") since local fishermen are discouraged to engage in regular fishing activities in a known crocodile habitat, which cause less anthropogenic impacts on coral reefs. In fact, a few cases of crocodile attacks in humans have been reported in local communities and this has prompted some local fishermen to refrain from fishing near Maranto Pt., resulting in reduced fishing pressure and enhanced recovery of local fish populations (Bucol et al. 2020).

3.4.3 Hard coral (HC) cover in each monitoring station

The HC cover of monitoring stations ranged between 10.1% and 40.6% with a mean of 29.5%, categorized in "fair" condition (Licuanan et al. 2017). Only one station (Maranto Pt.) has "good" condition (40.6%), while the Mooring Dolphin station has "poor" (10.1%) HC condition. The rest of the monitoring stations have "fair" conditions (28.0% - 32.7%) (Table 15).

Table 15. Hard coral (HC) cover and conditions of monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan based on Licuanan et al. (2017) (May 2022).

Monitoring station	Hard coral cover (HCC)	
	%	Category
Causeway	31.7	Fair
Mooring Dolphin	10.1	Poor
Ursula Is. 1	30.3	Fair
Ursula Is. 2	28.0	Fair
Ameril Is.	31.4	Fair
Big sandbar	31.1	Fair
Small sandbar	32.7	Fair
Maranto Pt.	40.6	Good
Mean	**29.5**	**Fair**

Among the HC subcategories, other branching corals (CB) dominated with a cover of 8.4%, followed by other massive corals (CM) (6.4%), encrusting corals (CE), branching *Acropora* (ACB) (4.4%), and foliose corals (CF) (1.7%). The rest of HC subcategories were composed of other submassive corals (CS) (0.8%), mushroom corals (CMR) (0.8%), tabulated *Acropora* (ACT) (0.7%), and digitated *Acropora* (ACD) and *Heliopora* (CHL) with 0.1% each. The CB dominated as the major HC subcategory in Small sandbar (23.5%), Ameril Is.

(15.4%), and Big sandbar (13.8%), while CM dominated in Causeway (25.6%) and Mooring Dolphin (4.9%). On the other hand, CE co- dominated in Ameril Is. (15.2%), and also in Ursula Is. 2, while it was ACB (23.6%) in Ursula Is. 2, and CF (11.3%) in Maranto Pt. (Figure 19). The full list of HC subcategories per monitoring station is listed in Appendix 7.

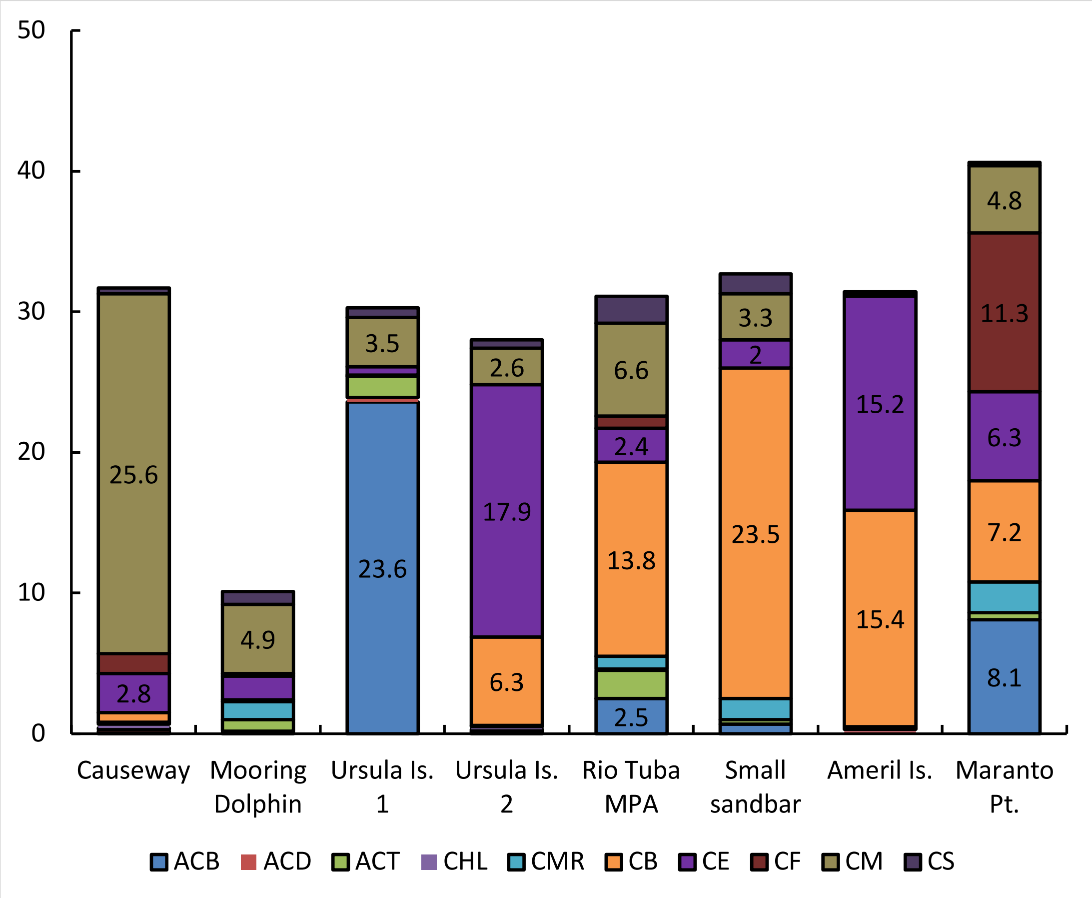


Figure 19. Subcategories of hard coral (HC) cover in the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022). Abbreviations used: ACB-branching Acropora, ACD-digitated Acropora, ACT- tabulated Acropora, CHL-Heliopora, CMR-mushroom corals, CB-other branching corals, CE- other encrusting corals, CF-foliose corals, CM-other massive corals, and CS-other submassive corals. Values lower than 2% are not shown in the graph.

3.4.4 Substrate cover per station

The substrate cover varied per station. In Causeway, SI dominated the substrate with a mean cover of 53.7%, followed by HC (31.7%), and DC (12.3%). The remaining substrates are composed of MA (1.4%), SP (0.2%), and SD (0.1) . No SC and RB recorded in this station. In Mooring Dolphin, MA dominated the substrate with a mean cover of 42.5%, followed by SI (22.6%), DC (12.6%) and HC (10.1%), while SD (4.2%), OT (3.5%), SP (3.4%), RB (0.6%), and SC (0.4%) completed the list of substrate cover in this station (Figure 20).

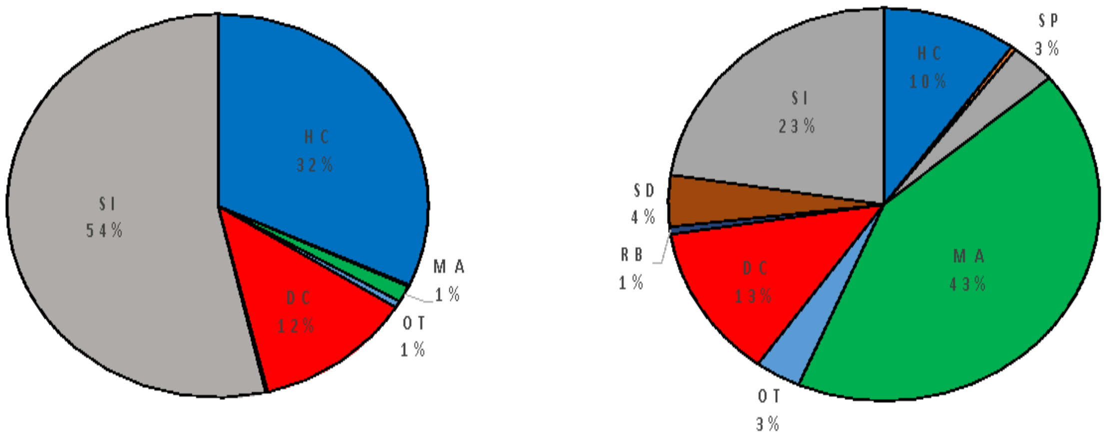


Figure 20. Substrate cover of monitoring station in Causeway (left) and Mooring Dolphin (right), Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan, Philippines. Abbreviations used: HC-hard coral, SC-soft corals, SP-sponge, MA- macroalgae, OT-others, DC-dead coral, RB-rubble, SD-sand, and SI-silt. Values lower than 1% are not shown in the graph.

Both DC and HC dominated the substrate covers of the Big sandbar and the Small sandbar. Big sandbar had a DC cover of 35.1%, an HC cover of 31.1%, and a SD cover of 21.0%. Other substrates include SI (6.0%), MA (2.7%), SC (1.5%), SP (1.1%), OT (0.8%), and RB (0.7%) (Figure 20). On the other hand, about three-fourths of the substrates were composed of DC (41.6%) and HC (32.7%) in Small sandbar, while SD (9.0%) and SI (7.3%) were also noted. The rest of the substrates were comprised of MA (3.3.%), RB (2.4%), SP and OT with 1.1% each, and SC (1.1%) (Figure 21).

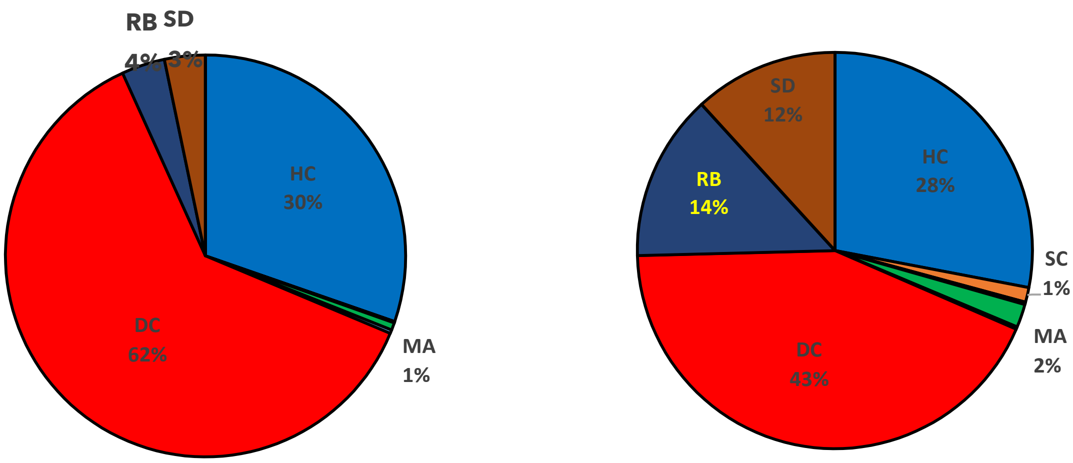


Figure 21. Substrate cover of monitoring stations in Big sandbar (left) and Small sandbar (right), Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan (May 2022). Abbreviations used: HC-hard coral, SC-soft corals, SP-sponge, MA-macroalgae, OT- others, DC-dead coral, RB-rubble, SD-sand, and SI-silt. Values lower than 1% are not shown in the graph.

In Ursula Is. 1, the substrate cover was dominated by DC (61.9%) and HC (30.3%). Other substrates include RB (3.5%), SD (3.3.%), MA (0.6%), OT (0.3%), and SP (0.1%). No SC and SI were recorded in this station. On the other side of the island (Ursula Is. 2), DC (43.1%) and HC (28.0%) also dominated the substrate cover, followed by RB (13.6%) and SD (11.8%). The mean cover of other substrates includes 1.9% for MA, 1.2% for SC, and 0.2% each for SP and OT. No SI were also recorded in this station (Figure 22).

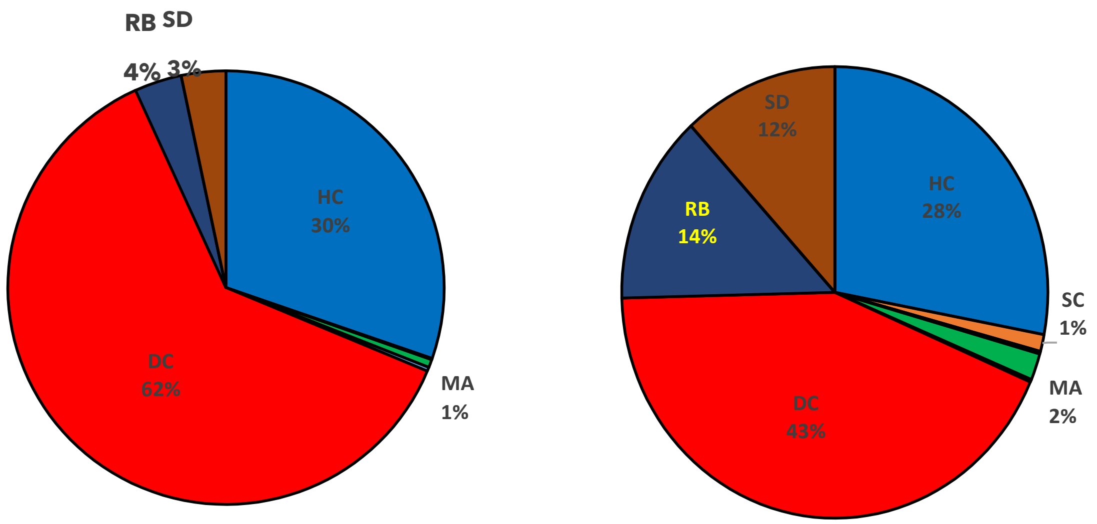
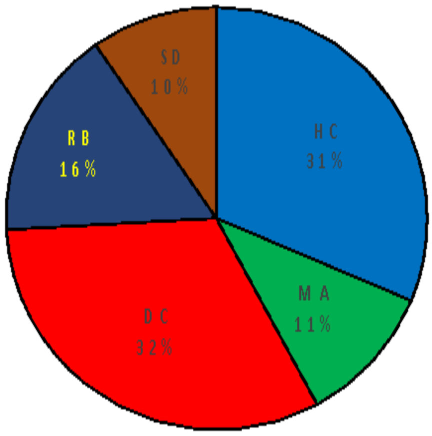


Figure 22. Substrate cover of monitoring stations in Ursula Is. 1 (left) and Ursula Is. 2 (right), Bataraza, Palawan (May 2022). Abbreviations used: HC-hard coral, SC-soft corals, SP-sponge, MA-macroalgae, OT- others, DC-dead coral, RB-rubble, SD-sand, and SI-silt. Values lower than 1% are not shown in the graph.

The DC (32.0%) and HC (31.4%) covers in Ameril Is. accounted for 63% of the total substrate cover. Other substrates include RB (16.2%), MA (10.7%), and SD (9.7%). No SC, SP, and OT were recorded in this station (Figure 24). On the other hand, HC (40.6%) and MA (31.3%) dominated in Maranto Pt., while DC contributed 18.2% of the substrates. The rest of the substrate were composed of SI (7.7%), OT (0.8%), SP (0.7%) and SD (0.4%). The RB and SC have substrate cover of 0.2 % and 0.1%, respectively (Figure 23).



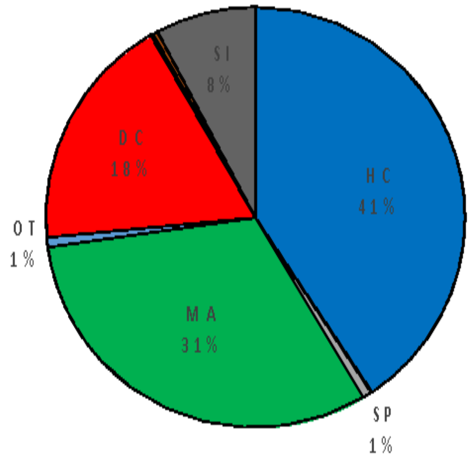


Figure 23. Substrate cover of monitoring stations in Ameril Is. 1 (left) and Maranto Pt. (right), Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan (May 2022). Abbreviations used: HC – hard coral, SC – soft coral, SP sponges, MA – macroalgae, OT – other organisms, DC – dead coral, RB – rubble, SD – sand, and SI – silt. Values lower than 1% are not shown in the graph.

The station with the second highest HC cover is Small sandbar, a few kilometers away from the impact sites. Meanwhile, the lowest HC cover was observed in Mooring Dolphin, a station with one of the lowest visibilities among the monitoring stations, and within the impact sites of the CBNC operation.

On the other hand, Ursula Island has the highest DC cover among the monitoring stations with only a fair HC cover. Ironically, this station had one of the lowest HC covers despite having the farthest location from mainland Bataraza. The high HC coral can be attributed to the rampant illegal fishing activities, particularly blast fishing which was confirmed by the research divers. Although Ursula Island is a bird sanctuary, only the terrestrial component has been strictly protected and the surrounding reef was not included in the law enforcement. A similar situation was also observed in Ameril Island, an island monitoring station that also have high DC cover despite its far location.

3.4.5 Temporal monitoring of substrate cover (2019-2022)

3.4.5.1 Overall monitoring of selected substrates (2020-2022)

The trend of the four substrates encountered in monitoring stations varied yearly. The HC cover increased from 33.3% (2020-1) to 40.1% (2020-2), but declined during the 2021 and 2022 monitoring, although no significant difference decrease was noted (P>0.05). The DC cover remains the same during the last four monitoring activities, except during the 2021 monitoring when the DC cover decreased to only 2.7%. For MA cover, a significant difference (P<0.05) was observed in the different monitoring periods. It increased dramatically from 2.9% (2020-2) to 49.3% (2021), and decreased significantly to 11.7% in 2022 (P<0.05). On the other hand, SI increased from 4.9% (2020-1) to 12.3% (2022), although no significant differences were seen across the monitoring periods (P>0.05) (Figure 24).

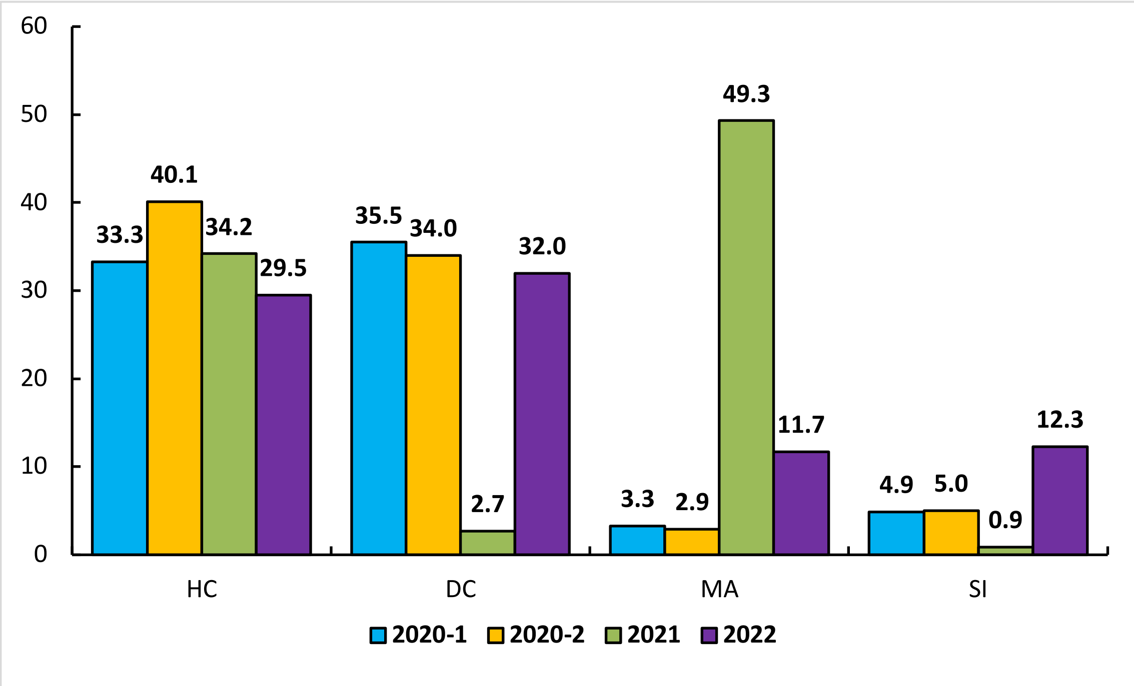


Figure 24. Comparison of the mean substrate cover of hard coral (HC), dead coral (DC), macroalgae (MA), and silt (SI) from monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan from 2020 to 2022

The dominant MA in the monitoring stations are the filamentous algae, while *Halimeda, Sargassum* and *Padina* were also noted in some stations. The dominance of macroalgae and high silt/sedimentation load can be attributed to the high nutrient loading in both Causeway and Mooring Dolphin (impact sites) which can deteriorate water quality and increase algal blooms due to water eutrophication. The increase of MA cover from 2020 to 2021 could be attributed to either the new method employed or increased nutrient loading. In this year's monitoring, a dramatic decrease in MA cover was observed and the second possible explanation could be ruled out. However, regular monitoring of water quality (e.g., nutrient loading, ammonia, etc.) especially in the stations near the impact sites may help in confirming this.

3.4.5.2 Hard coral cover monitoring (2019-2022)

Overall, no significant decrease was observed in the HC cover of Causeway, Mooring Dolphin, and Small sandbar stations from 2019 to 2022. The HC cover in Causeway did not significantly change throughout the monitoring periods. No significant change was observed in the HC cover of Mooring Dolphin from 2019 to 2020-2 but decreased dramatically in 2021, while slight recovery were noted during the 2022 monitoring. A decreasing similar trend was also observed in Small sandbar, of which the 2020-2 data recorded 55.3% HC cover and dropped to 42.3% in 2021, and 32.7% in 2022 (Figure 25).

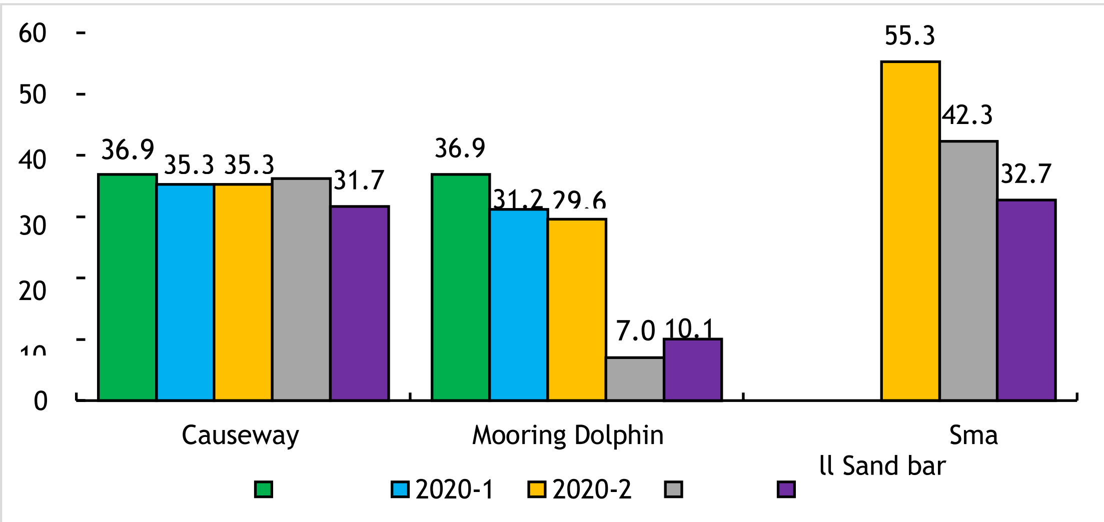


Figure 25. Comparison of the mean hard coral (HC) cover of Causeway, Mooring Dolphin, and Small sandbar in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan from 2019 to 2022.

The HC cover in Big Sandbar did not change significantly during the 2021 and 2022 monitoring. However, the number of coral genera increased by almost two-folds from 2021 to 2022. Based on Licuanan's (2020) diversity category, there is a jump from category D to category B, showing signs of management effectiveness in the Big Sandbar. Enhancement of management strategies should be focused on this site to increase coral cover as well, including fish populations.

The annual HC cover monitoring in both the Causeway and Mooring Dolphin from 2019-2022, and 2020-2022 for Small sandbar generally showed no significant decrease. However, a dramatic decline was observed for Mooring Dolphin in 2021 due to the change in the method used. Prior to the 2021 monitoring, the line-intercept-transect (LIT) method was previously used which only recorded the substrate intercepted by the transect line. Any deviation from this line of monitoring (e.g., movement of transect underwater, revisiting not the exact location) may impact the substrate cover result. During the 2021 and 2022 monitoring, the more accurate and image-based method (viz., photo-quadrat method) was used which enable the research divers to re-analyze and validate the substrate encountered. This method also can also be used to note coral genera encountered within the photo-quadrat and other associated macroinvertebrates. The continuous use of this photo-quadrat method could result to a more accurate substrate cover reading. Compared to the 2021, signs of recovery were observed during the 2022 monitoring.

3.5 Reef Fishes Communities

3.5.1 Species diversity

A total of 209 fish species belonging to 38 families were identified in nine monitoring stations. For this year's monitoring, the mean species diversity of reef fishes was estimated at 58 species/1,000 m^2, which falls under the "moderate" category based on categories for species richness established by Hilomen et al. (2000).

Among the stations, the highest number of fish species encountered was recorded in Ursula Is. 2 (89 species) and Ursula Is. 1 (79 species), followed by Big sandbar (69 species), Small sandbar (67 species), Maranto Pt. (54 species), Ameril Is. (50 species), and Causeway (47 species). Meanwhile, a low number of fish species was recorded in Mooring Dolphin and Discharge Pt. with 42 species and 31 species, respectively.

The highest number of targeted fish species was encountered in Ursula Is. 2 with 37 species, followed by Ursula Is. 1 (31 species), Small sandbar (23 species), Discharge Point (20 species), and Mooring Dolphin (20 species). Causeway Reef, Ameril Is., Maranto, and Big sandbar were observed to have a low targeted fish species with 17 species each.

For this year's monitoring, a large proportion of the reef fish encountered in monitoring station belong to the Major group with 111 fish species, followed by the fish species belong to the Target group with 87 species recorded and Indicator group with 11 species (Table 16).

Table 16. Summary of the species composition and categories of reef fishes encountered in the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Monitoring Site	Num. of Fish Families	Num. of Species	Target Species	Indicator Species	Major Species
Ameril Is.	17	50	17	1	32
Big sandbar	22	69	17	6	46
Causeway Reef	17	47	17	3	27
Discharge Pt.	18	31	20	-	11
Maranto Pt.	19	54	17	3	34
Mooring Dolphin	17	42	20	1	21
Small sandbar	16	67	23	6	38
Ursula Is. 1	19	79	31	4	44
Ursula Is. 2	20	89	37	3	49
TOTAL	**38**	**209**	**87**	**11**	**111**

Result of this year's monitoring recorded a relatively higher number of fish families and species compared to reef areas monitored from 2018 to 2021. The observed increase in the number of fish families and species recorded is apparent in the Big Sandbar, Ursula Island and Discharge Pt. stations. The same pattern was also observed in the number of the Target, Major and Indicator species which recorded a relatively higher number of fish species observed in this year's monitoring (Figures 26-27, Table 17).

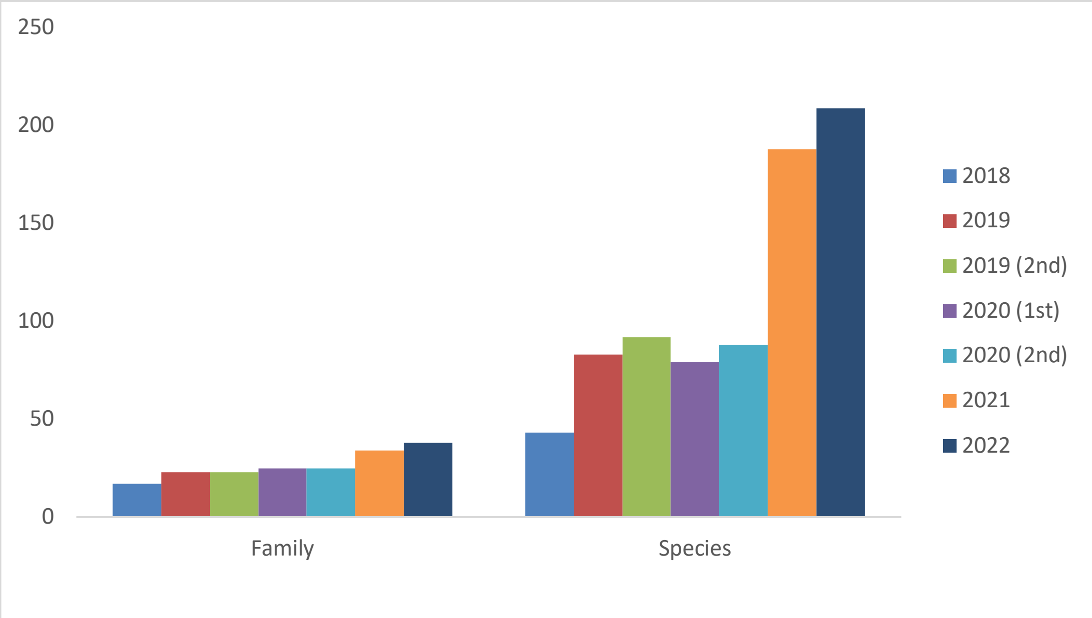


Figure 26. Total number of fish families and species in the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Philippines from 2018 to 2022.

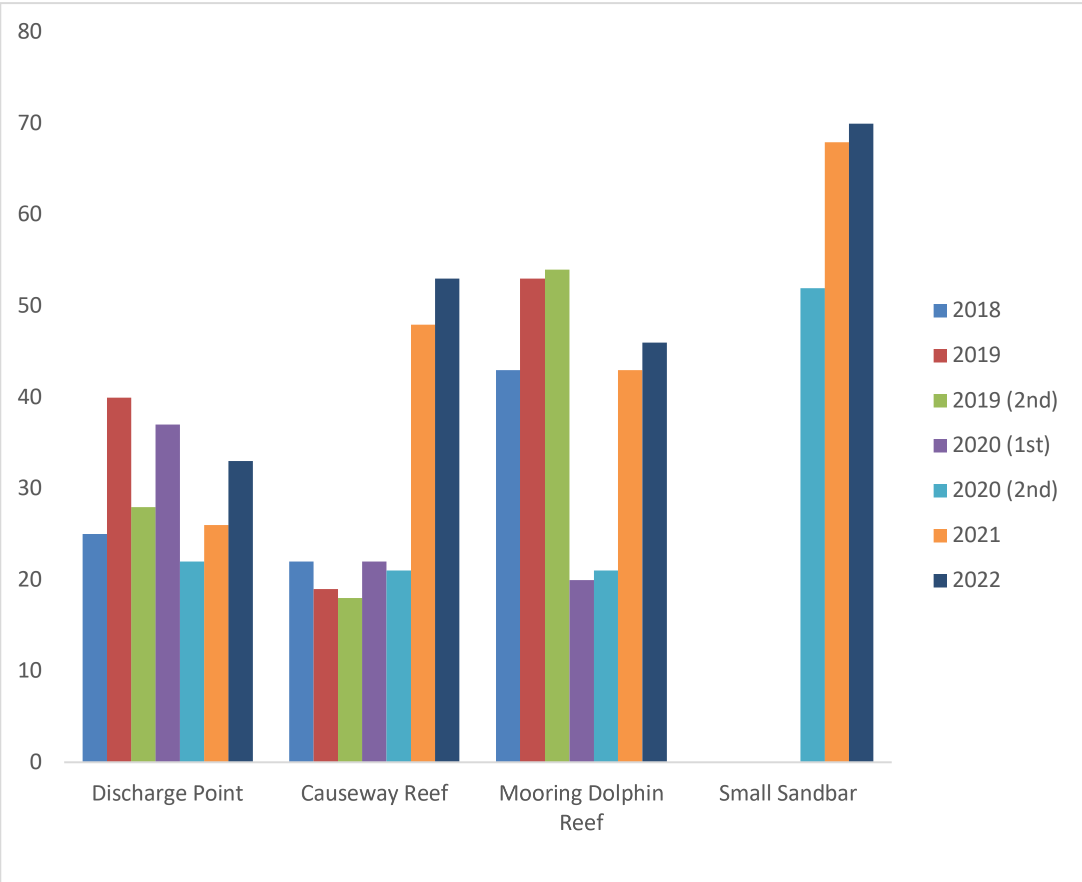


Figure 27. Total number of fish species per monitoring station in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan from 2018 to 2021.

Table 17. Summary of the species composition and categories of reef fishes encountered from 2018 to 2021 in selected monitoring stations in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

Year	Stations	Fish families	Species	Target species	Indicator species	Major species	Data Source
Dec. 2018	Mooring Dolphin Causeway Discharge Pt.	17	43	18	2	28	2018 Report*
June 2019	Mooring Dolphin Causeway Discharge Pt.	23	43	51	1	43	2019 Report*
Dec. 2019	Mooring Dolphin Causeway Discharge Pt.	23	92	39	1	51	2019 Report*
June 2020	Mooring Dolphin Causeway Discharge Pt.	25	79	39	3	37	2020 Report*
Dec. 2020	Mooring Dolphin Causeway Discharge Pt.	25	88	31	2	55	2020 Report*
June 2021	Several reefs	34	185	77	13	95	2021 Report
June 2022	**Several reefs**	**38**	**209**	**87**	**11**	**111**	**This Survey**

* Biodiversity Assessment Report conducted twice a year.

3.5.2 Population Density

The overall mean population density of fish communities observed in monitoring stations was computed at 2,131 indiv/1,000 m^2 which falls under the "moderate" category (Naῃola et al. 2004). Small-sized reef fishes belonging to the family Pomacentridae (damselfishes) were the most abundant, followed by fish belonging to the families Labridae (wrasses), Carangidae (jacks and pompano), Apogonidae (cardinalfishes), Caesionidae (fusiliers).

Among the monitoring stations, the Discharge Pt. recorded the highest fish mean density at 4,672 indiv/1,000m^2, followed by Ursula Is. 2 with 2,906 indiv/1,000 m^2 and Ursula Is. 1 with 2,712 indiv/1,000 m^2, all classified under "high" category. All other reefs surveyed in Coral Bay fall under "moderate" to "low" category (Table 18).

Table 18. Fish densities and biomass of reef fishes encountered in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Stations	Individuals per 1000 m^{-2}	Category (Naῆola et al. 2004)
Ameril Is.	1,762	Moderate
Big Sandbar	2,114	Moderate
CBNC Causeway	1,988	Moderate
Discharge Pt.	4,672	High
Maranto Pt.	1,266	Moderate
Mooring Dolphin	608	Low
Small Sandbar	846	Low
Ursula Is. 2	2,548	High
Ursula Is. 1	3,376	High
TOTAL	**19,180**	
Mean	**2,131**	**Moderate**

The mean reef fish density recorded in this year's monitoring is higher compared to the previous monitoring activities (2018-2021) in Coral Bay (Figure 28). The increase in mean density in Causeway is attributed to the occurrence cryptic and diurnally active reef fish belonging to the family Apogonidae (cardinalfishes), and the herbivorous reef fish belonging to the family Pomacentridae (damselfishes) that settle in reef areas and fiercely defend defined areas of reef substratum. Furthermore, some schools of juvenile snappers (Lutjanidae) and threadfin breams (Nemipteridae) frequently visit the area in search for food and protection from predators. The Mooring Dolphin, on the other hand, recorded a slight decrease in fish density when compared with the previous monitoring activities. Sediment accumulation and elevated levels of suspended elements in the water column from nearby rivers might have influence the declining coral cover consequently impacting the fish population in the area.

Meanwhile, the increase in the cover of soft corals and other marine lifeforms attached to the underwater structures in Discharge Pt. provides shelter and food sources for the migrating fish in the area. The recorded increase in the density of fish species is largely attributed to the influx of fish species that thrive in brackish water conditions. The minimal presence of human activity, fishing restrictions, and abundance of food sources greatly influence the continuously increased of fish species residing in Discharge Pt.

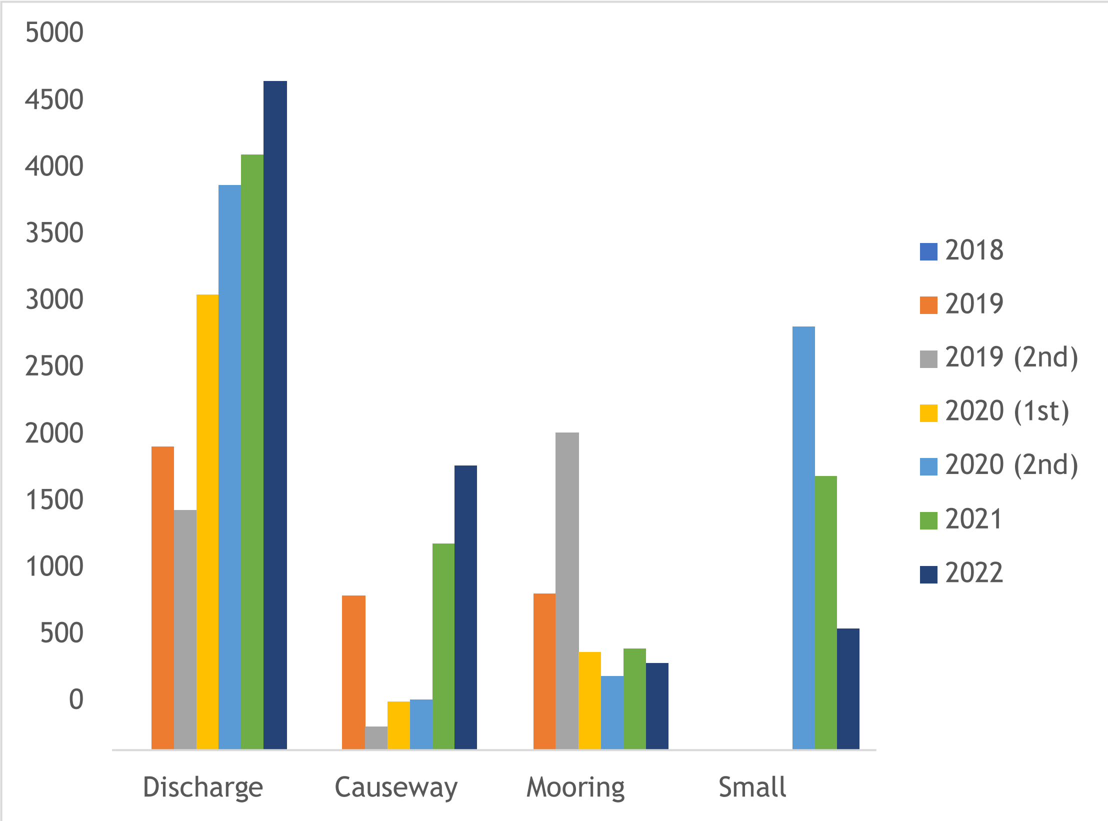


Figure 28. Densities of reef fishes encountered from 2018 to 2021 in the monitoring stations Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan, Philippines (May 2022).

3.5.3 Fish biomass

Results of the reef fish communities monitoring revealed that the mean biomass in the monitoring stations was estimated at 28.6 MT/km^2 as potential harvestable fish biomass. The estimated mean biomass of reef fishes falls under the "high" category (21-40 MT/km^2) based on categories for ecological health conditions of reef fish suggested by Naῆola et al. (2004).

Among these stations, reef fishes encountered in Discharge Pt. station fall under the "very high" category, followed by Ursula Island stations and Big sandbar with "high" category (> 10.0 MT/km^2). The other monitoring stations fall under the very low and very low categories (Table 19).

Table 19. Fish biomass (MT/km^2) in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Sites	Biomass (mt/km^2)	Category
Ameril Is.	5.1	Low
Big Sandbar	10.3	High
CBNC Causeway	6.2	Low
Discharge Point	191.2	Very High
Maranto Point	4.6	Low
Mooring Dolphin	5.8	Low
Small Sandbar	9.6	Low
Ursula Island 2	13.9	High
Ursula Island 1	10.9	High
TOTAL	**257.5**	
Mean	***28.6***	**Very high**

Potential harvestable fish biomass is composed primarily of Target fish species, particularly those belonging to the families Labridae (subfamily Scarinae, parrotfishes), Caesionidae (fusiliers), Lutjanidae (snappers), Nemipteridae (threadfin breams), and Acanthuridae (surgeonfishes). Relatively high estimates of the mean biomass of targeted fish species observed in Discharge Pt. station are represented by the schools of large-bodied parrotfishes, fusiliers, scads, snappers, and breams. The reef areas in Ursula Island came in second in terms of mean biomass, with abundant of groupers (Serranidae, subfamily Epinephilinae) comprising a large portion of the biomass. Meanwhile, the Indicator group which is largely represented by the butterflyfishes (Chaetodontidae) and some wrasses (Labridae) were observed in reef areas of Big Sandbar, Small Sandbar, Causeway Reef, and Mooring Dolphin Reef (Figure 29, Table 20). These groups of reef fishes have been used as indicators of reef health since they are highly associated with coral reefs; a low abundance of these fish groups may presume that these reef areas are in poor conditions.

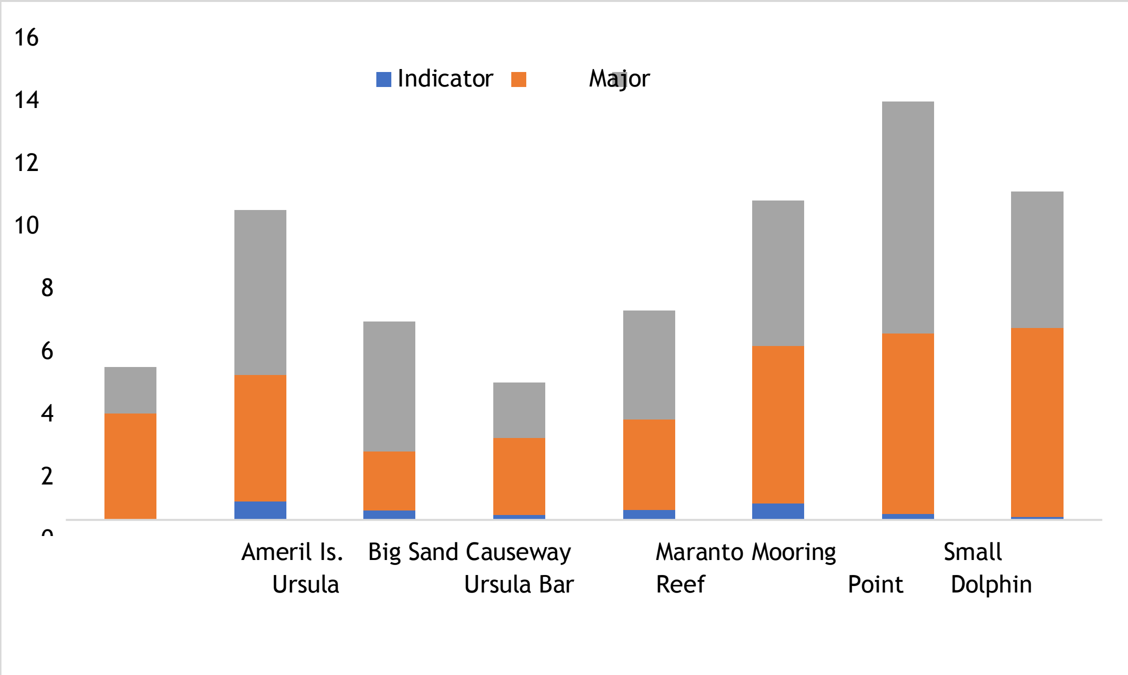


Figure 29. Biomasses of target, major, and indicator fish groups in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Table 20. Biomasses of target, major, and indicator fish groups in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Stations	Indicator	Major	Target	Total Biomass
Ameril Is.	0.0	3.5	1.5	5.1
Big Sand Bar	0.6	4.2	5.5	10.3
CBNC Causeway	0.3	2.0	4.3	6.6
Discharge Pt.		5.4	185.8	191.2
Maranto Pt.	0.2	2.6	1.8	4.6
Mooring Dolphin	0.3	3.0	3.6	6.9
Small Sandbar	0.6	5.2	4.8	10.6
Ursula Is. 2	0.2	6.0	7.7	13.9
Ursula Is. 1	0.1	6.3	4.5	10.9
Total	**2.3**	**38.1**	**219.6**	**260.0**

The mean biomass of the target, major, and indicator fish groups recorded in this year's monitoring was relatively higher compared to the previous monitoring activities conducted in CBNC primary impact areas, except in Mooring Dolphin where a significant decline in fish biomass was recorded (Haribon Environmental Services and the Palawan Community-Based Fisherfolk Alliance 2020a, 2020b). The increase in fish biomass in most of the stations is largely attributed to the minimal fishing activity in the area, allowing the fish to recover quickly and grow to their optimal sizes to reproduce. Furthermore, Big Sandbar and Discharge Pt. stations function as *de-facto* MPAs, wherein restricted access to fishery resources contributed to the burgeoning of fish biomass in these areas.

It is also worth mentioning that during the survey in Small Sandbar and Mooring Dolphin, corpses of dead fishes with manifestations of injuries from blast fishing incidents were found scattered underwater. Illegal activities such as this indiscriminately kill marine life within the blast site. Moreover, the expansion of coastal dwellers in Maranto Pt. and the anchoring of commercial fishing vessels in some parts of the reefs may also affect the dwindling fish biomass in the area.

3.5.4 Trophic Group

This year's monitoring exhibits almost similar pattern in the trophic structure of reef fishes based on population densities which are largely represented by herbivores (34%) and benthic invertivores (32%) (Figure 30). Herbivorous reef fishes show a wide range of feeding habits and ingest a variety of plant materials (e.g., macroalgae, epilithic algal turf, detrital materials, and algal mats). Herbivores have various functional groups such as scrapers, excavators, grazers, and browsers that promote the resiliency of the coral reef habitat (Green and Bellwood, 2009). Planktivores, however, usually appear in large groups feeding on plankton in the midwater and this was largely represented by the reef fishes belong to families Pomacentridae, Caesionidae, and Labridae. Benthic invertivores feeds primarily on invertebrates thriving in the bottom or hiding under coral rubbles and sandy substrates. This was largely represented by the reef fishes belonging to the families Labridae, Nemipteridae, Mullidae (goatfishes), and Chaetodontidae.

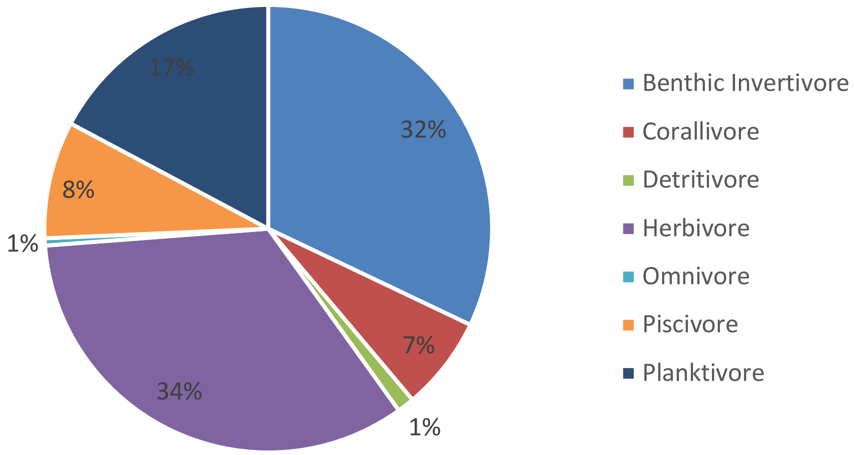


Figure 30. Trophic structure of reef fishes (based on population density) in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

The trophic structure of the reef fish communities in terms of biomass is largely represented by planktivores, followed by piscivores and herbivores (Figure 31). The shift in dominance in favor of the planktivore fishes is largely attributed to the abundance of schools of fishes from the family Caesionidae (fusiliers) and Pomacentridae (damselfishes). Piscivores also recorded a significant increase in terms of biomass, and the presence of large-bodied fish from the family Carangidae particularly in Discharge Pt. positively influence this trophic group. Herbivores are still present in considerable numbers, and maintenance of herbivore species appears to be critical for preserving coral reefs, because complementary feeding by diverse herbivores produces positive, but indirect, effects on corals, the foundation of species of these whole ecosystems.

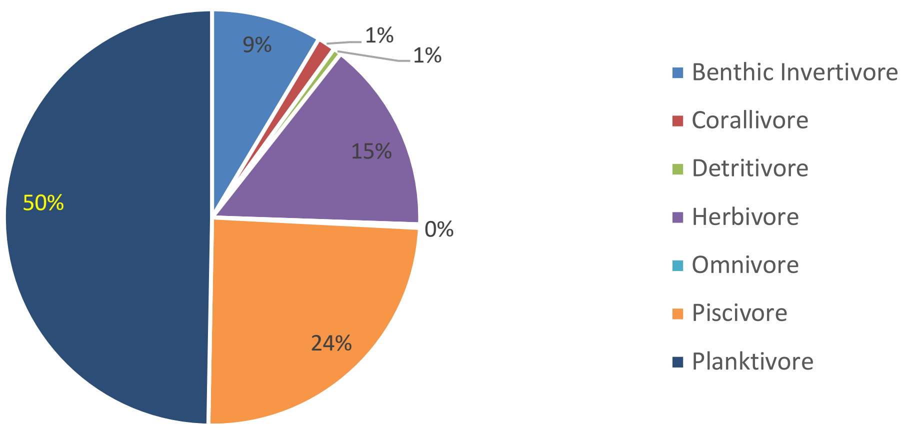


Figure 31. Trophic structure of reef fishes (based on biomass) in monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

3.6 Freshwater Fishes

Experimental fishing in these years' monitoring caught a variety of freshwater and brackishwater fish species. The Nile tilapia (*Oreochromis niloticus*) still dominated the fish catch in terms of number and weight, followed by *Megalops cyprinoides* (Bulan-Bulan), *Lutjanus argentimaculatus,* and milkfish *Chanos chanos*. During this year's monitoring, the number of tilapia individuals caught using gill net is lower than the previous monitoring period, however, there is an increase in the fish species diversity (Table 21).

Table 21. List of fish species caught in Lower Kinurong Siltation Pond, CBNC, Bgy. Rio Tuba, Bataraza, Palawan (2020-2021).

Year of sampling	Scientific Name	Local Name	Number of Sample	Weight (kg)
2020 (1st half)	*Oreochromis niloticus*	Tilapia	10 pcs	--
2020 (2nd half)	*O. niloticus*	Tilapia	7 pcs	--
	Megalops cyprinoides	Bulan Bulan	1 pc	--
	Opicephalus striatus	Dalag	2 pcs	--
2021 report	*O. niloticus*	Tilapia	15 pcs	5.0
2022 (This Study)	*Orechromis niloticus*	Tilapia	11 pcs	3 kg
	Megalops cyprinoides	Bulan-Bulan	5	0.67 kg
	Chanos chanos	Bangus	1	0.30 kg
	Lutjanus argentimaculatus		3	0.50 kg

The proximity of Lower Kinurong Siltation Pond to the brackish water environment influences the distribution of fish species in these areas. Experimental fishing in both during the high and low tides may be attributed to the increase in the variety of fish species collected. Changes in the tidal level affect the movements of the fish as increasing tidal level brings food and broader space for the fish to roam around and hunt. Interview with the local fishers reported the presence of juvenile fish is noticeable in the area, however, the larger mesh size of the gill net allows the fish to escape from entanglement. This could be true since mangrove areas and brackish water environments had been known as nursery grounds for a wide array of fish species.

3.7 Beach Profiling

The substrate of the selected beaches in Tagdalungon and Ursula Island in Bgy. Rio Tuba, Bataraza can generally be categorized either sandy with coral rubble or sandy. All stations in Tagdalungon and Nagoya have sandy-coral rubble substrate (Figure 32) while the stations surrounding Ursula Island have a sandy substrate (Figure 33).

Figure 32. Beach profile monitoring stations were established in a) Tagdalungon 1, b) Tagdalungon 2, c) Nagoya 1, and d) Nagoya 2 in Bgy. Rio Tuba, Bataraza, Palawan (May 2022*)*

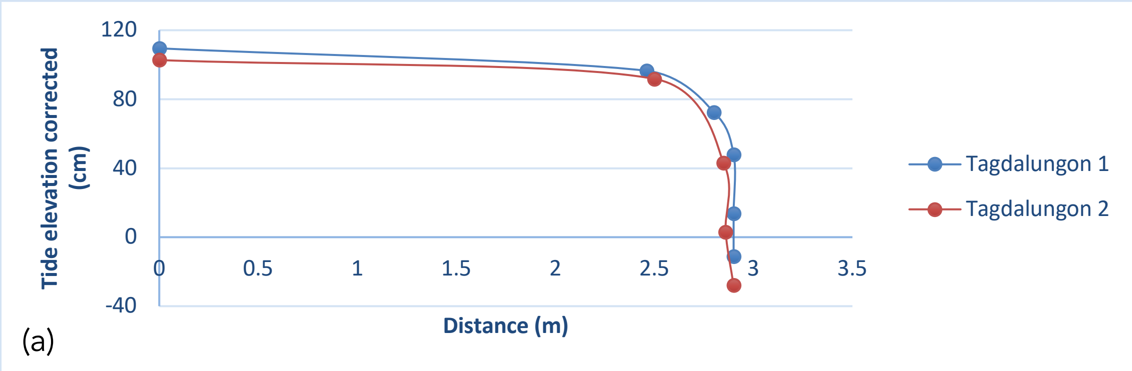
This suggests that there were coral reefs nearby that were subjected to waves and currents that resulted to coral rubble in the beaches of Tagdalungon and Nagoya area.

Figure 33. Beach profile monitoring stations were established in four (4) stations in Ursula Island, Rio Tuba, Bataraza, Palawan (May 2022).

Table 22. Substrate type and other related organisms in Bgy. Rio Tuba, Bataraza, Palawan.

Site	***Substrate type***
Tagdalungon 1	Sandy-coralline-rubble
Tagdalungon 2	Sandy-coralline-rubble
Nagoya 1	Sandy-coralline-rubble
Nagoya 2	Sandy-coralline-rubble
Ursula 3	Sandy
Ursula 4	Sandy
Ursula 6	Sandy
Ursula 9	Sandy

Both stations in Tagdalungon have long stretch of beach area and the same steep edge as shown in Figure 34. Based on the satellite imagery, the end of both stations are mangroves. In terms of elevation, Tagdalungon station 1 is higher than Tagdalungon 2 with a difference of 0.68 m between stations.



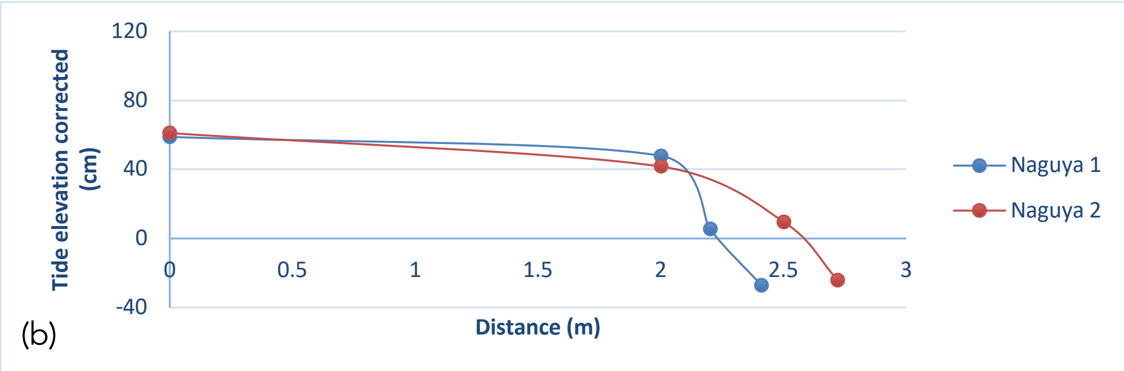
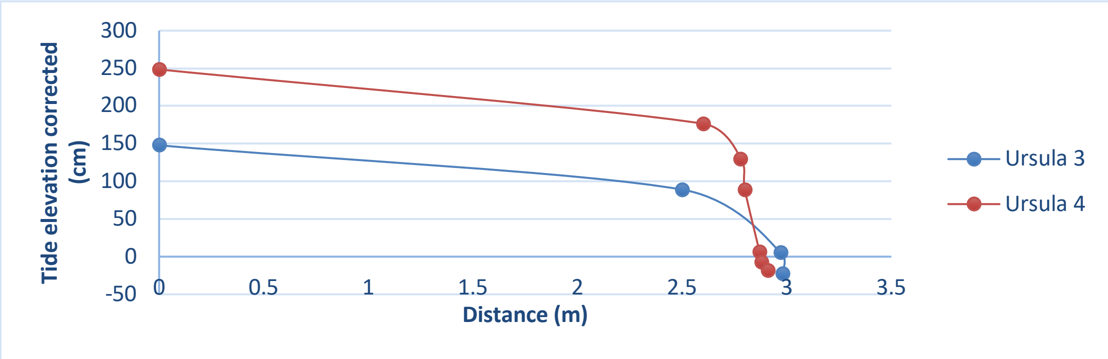


Figure 34. Comparison of tide corrected results for the two stations in (a) Tagdalungon and (b) Nagoya, Bgy. Rio Tuba, Bataraza, Palawan (May 2022)

On the other hand, both stations have a short beach area, but Nagoya 2 station is steeper than Nagoya 1 (Figure 35). This is possibly due to the different impacts of wave action on both stations. Based on the satellite imagery, the end of both stations are also mangroves. Nagoya station 2 is higher than Nagoya 1 in terms of elevation and the difference between stations is 0.22 m.

Figure 35 shows the results of stations 3 and 4 in Ursula Island. Since this is an island, there are more factors to be considered, such as the water current and wind direction that may cause a difference in sediment structure and tide level between the two stations. Ursula Station 3 has a lower elevation compared to Ursula Station 4 with a difference of 1.007 m. Both stations have a long beach area but have a steep edge which might be due to being an island or this is where the splash of wave occurs



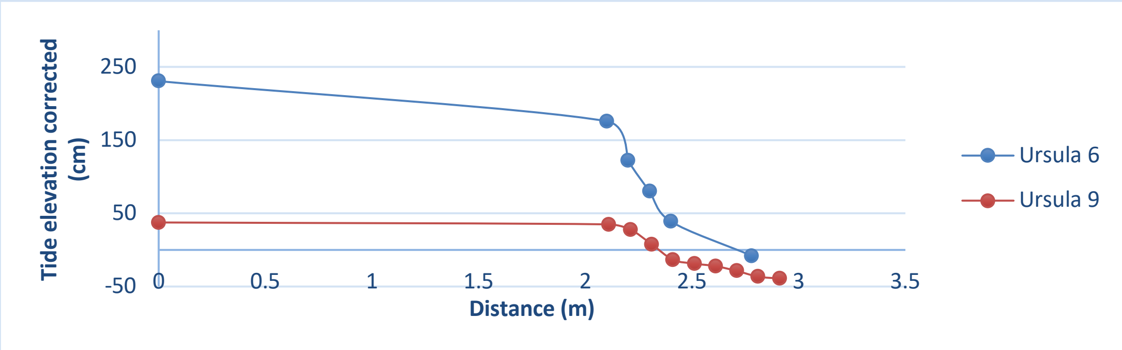


Figure 35. Comparison of tide corrected results for 4 stations in Ursula Island, Bataraza, Palawan: (a) Ursula 3 and 4 and (b) Ursula 6 and 9.

Based on Figure 35, Ursula Station 6 has higher elevation compared to Ursula Station 9 with a 1.93m difference between stations. Both stations have a long beach area, but has a steep edge which is a characteristic of beach profiles from an island. Ursula Station 9 also has a flat formation of sediment compared to the other stations on Ursula island.

3.8 Mapping of Coral Reefs and Seagrass

Mapping and monitoring seagrass and coral reefs require spatial information. Mapping these habitats in the shallow areas utilizes the capability of remote sensing and geographic information system (GIS). This was carried out in the coastal areas of Bgy. Rio Tuba, Bataraza, Palawan containing a range of seagrass beds, corals reef and sandy areas located in Ameril Island.

The classified image in Figure 36 shows that for shallow areas, seagrass and sandbar has a visible spectral reflectance compared to corals located in the deep sea. Mapping of seagrass and coral reefs was supplemented by ground field validation to determine its spatial extent and eventually used as benchmark data for subsequent monitoring.

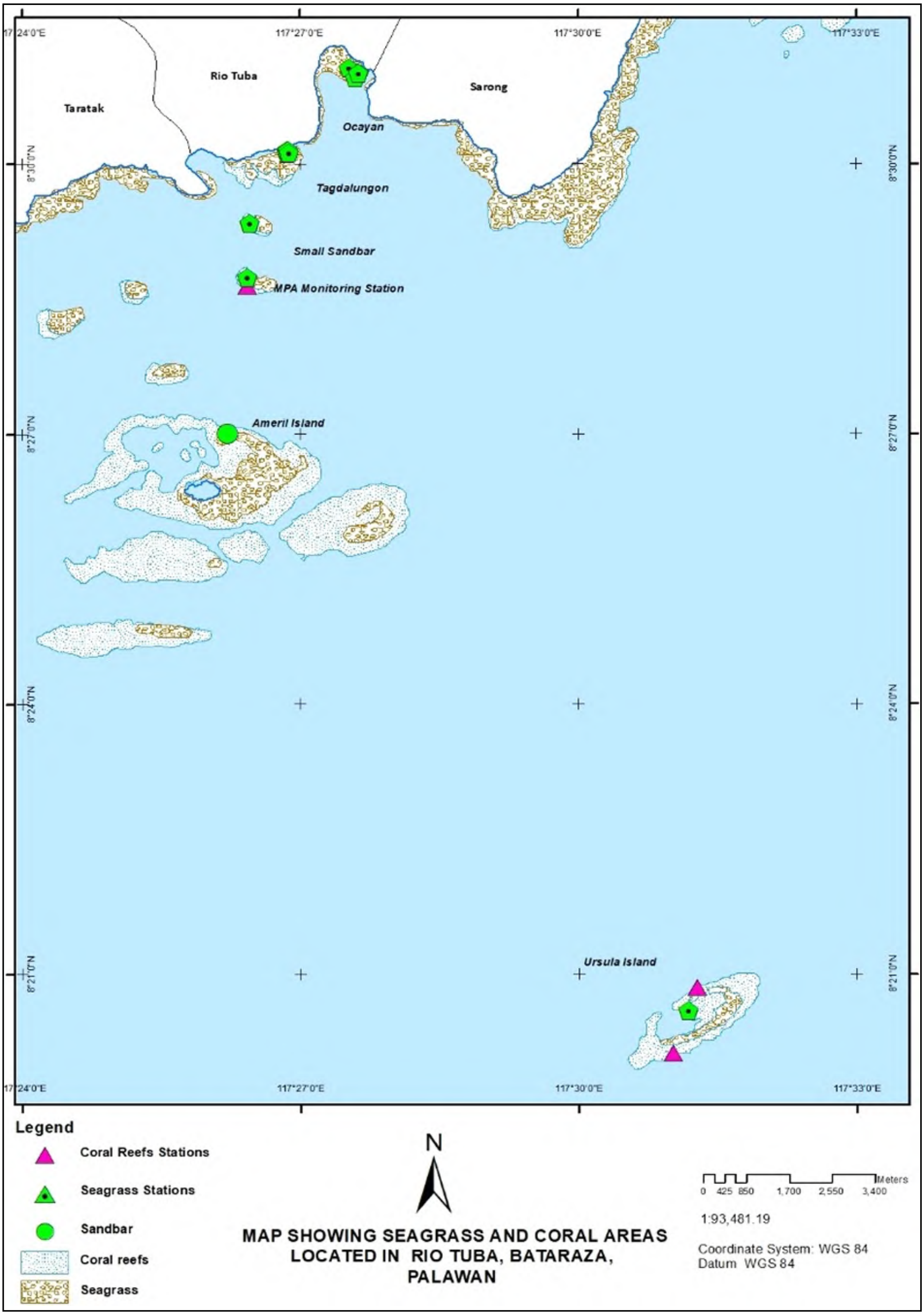


Figure 36. Classified image of segrass and coral reef extent in selected areas in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan (Based on Sentinel 2021 and ESRI Basemap).

Based on Figure 36, the quantitative distribution of seagrass and coral reefs across selected areas was calculated. The total seagrass area in selected areas is 302.7 ha, while the coral reefs have total area of 568.5 ha. A large scale part of Ameril Is. is surrounded by 394 ha of corals and 182 ha of seagrass, while the Ursula Is. is surrounded by 155 ha coral reefs. No coral reefs where observed in Ocayan and Tagdalungon.

Table 23. Extent (in ha) of seagrass and coral reefs in selected areas in Coral Bay, Bgy. Rio Tuba, Bataraza, Palawan.

Location	Seagrass area (ha)	Coral reef area (ha)
Ocayan	49.0	-
Tagdalungon	50.0	-
Small sandbar	9.7	7.5
Big sandbar	12.0	12.0
Ameril Is.	182.0	394.0
Ursula Is.	-	155.0
Total	**302.7**	**568.5**

The area only shows the presence of coral reefs and seagrass in Coral Bay and Ursula Island. Some of these patches of seagrass and coral reefs were assessed and monitored annually. Based on the recent assessment, seagrass cover in monitoring stations in Ocayan, Tagdalungon, Small sandbar and Big Sandbar ranged from 8-15%, which are characterized as "Poor" condition. While the recorded 4% seagrass cover in 2021 was not observed in 2022 in Ursula Island, which could be attributed to the possible shifting of sand due to strong wind and wave action.

In terms coral reefs, 2022 assessment showed that Small sandbar have the highest percentage of hard coral cover with 32.7%; Ameril Island with 31.4%; Big sandbar with 31.1%, and Ursula Island with average of 29% (28% in Ursula 1 and 30% in Ursula 2). These stations are categorized as "Fair".

3.9 Fisheries Profile

Most of the respondents were middle-aged (30 to 45 years old), though ages of respondents ranged from 21 to 72 years old (Table 24). The wide age range provides a good representation of the responses from different age classes and contributes relevant insights on the status of the municipal fisheries in Bgy. Rio Tuba, Bataraza, Palawan. Majority of the respondents were married (82%) and had an average of 5 children per household.

Table 24. Demographic characteristics of the respondents for fish catch survey conducted in Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Sitio	Number of respondents	Age (Range)	No. of Years in fishery
Marabahay	19	43 (24-62)	24 (1-61)
Tagdalungon	18	41 (21-72)	26 (2-63)
Bukid-Bukid	14	40 (30-54)	24 (1-62)

Most respondents were able to receive a formal education. Twenty nine percent (44%) were able to attend elementary level and graduate, 13% were able to reach and finish high school, 4% were able to reach college level. Twenty-seven (27%) did not receive any formal education and the remaining twelve percent (12%) opted not to provide direct answer the question.

Majority (70%) of the fishers interviewed has been in the fisheries sector for more than 20 years, while 20% have been fishing for 11 to 20 years, five percent (5%) is fishing for 5 to 10 years, and remaining 5% for less than 5 years. In general, the fishers utilize their fish catch both for consumption and livelihood (52%). They usually sell their catch to fish vendors at the local market, to a station buyer, or peddle them around their neighborhood. Fishers engage in fishing solely to generate income usually serve as crew on a commercial fishing vessel or enter into an agreement with the buyer to target specific kinds of fish (octopus, suno (grouper), lobster etc..) as shown in Figure 37. While fishers who have access to other source of livelihoods or with regular earnings only engage in fishing for their own consumption.

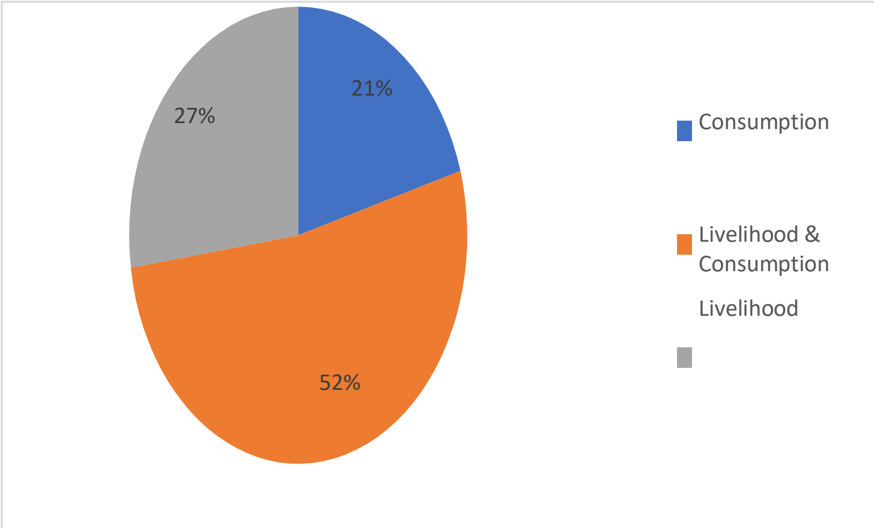


Figure 37. Purpose of fishing of local residents of Bgy Rio Tuba, Bataraza, Palawan (May 2022).

3.9.1 Boat ownership

The majority of the fishers (73%) owned a motorized fishing boat, allowing them to explore farther fishing grounds. Fishers in Rio Tuba explore an extensive fishing ground with patch reefs/shoals separated by channels or deep water therefore moving from one fishing ground to another is quicker using a motorized fishing boat. Twenty three percent (23%) of the fisher respondents who do not own a fishing boat join other fishermen as crew to earn a share in portion of the total catch or paid in cash in a bi-monthly basis for the fishers employed in a commercial fishing vessel. Fishers who use a non- motorized fishing boats (4%) uses a small canoe or fabricated makeshift bamboo rafts or styrofoam that move through paddling while fishing in shallow reefs nearshore (Figure 38). Fishers who do not have a boat is recorded in Sitio Marabahay and Bukid-Bukid, while in Sitio Tagdalungon two (2) of the respondents use a non-motorized fishing vessel.

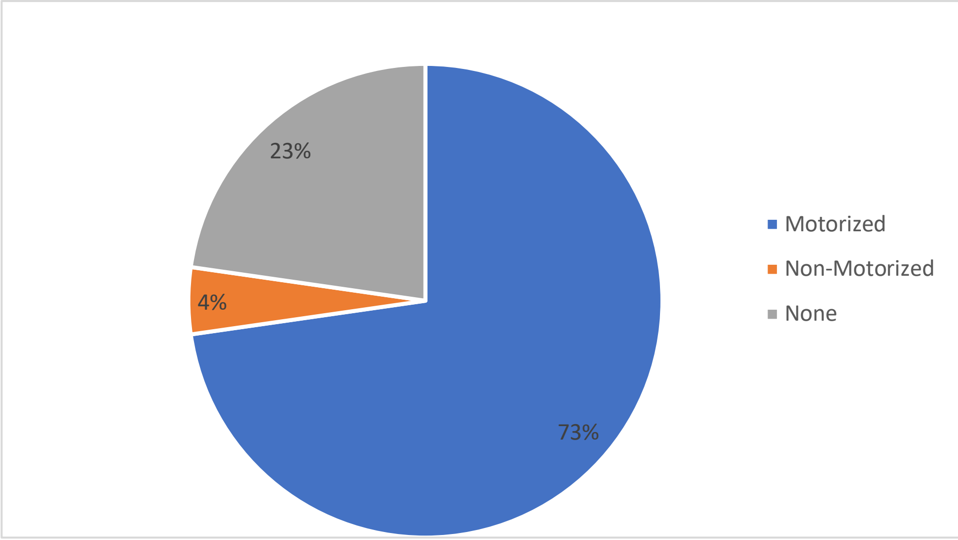


Figure 38. Types of fishing boats in Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

3.9.2 Fishing gears and catch composition

Majority of the fisher respondents prefers the used of Hook and Line (Kawil), followed by the Nets (Bottom set gillnet) Squid/octopus jigs and Spears (Figure 39). The *kawil* or handline is the simplest, wherein a single weighted vertical line with one to two baited hooks is dropped into the water.

The reel is usually a homemade bamboo spool or wooden cylinder. This gear is baited with smaller or chopped fish and used to catch carnivorous fishes like the groupers, emperors, snappers, and some species of breams. Due to its simplicity, the handline can be deployed even in complex coral reefs without getting entangled. Other types of hook and line use in Rio Tuba is the bottom- set long line usually has at least 100-1800 hooks suspended along the length of a main line to target demersal fishes in coral reef areas. The gear can be set at the bottom of both deep and shallow areas and hooks varies from small to large, depending on the available species and depth of the fishing ground.

The bottom-set gill net is the second-most used fishing gear. The net has floaters along the top to keep it suspended upright and weights at the bottom so that the net sinks close to the bottom. It is designed to catch demersal or bottom-dwelling fish species. Bottom set-gillnet are set at the edge of the reefs while avoiding touching the reefs to prevent entanglement. Length of net range from 100m to 2000m with mesh size ranges from 4cm to 10cm based on the target species.

The spear gun used was mechanically operated, with a wooden handle and a spear with floppers. Spear fishers primarily target coral reef fishes. Based on the individual interview majority of the spear gun users hunt for fish manually and rely on their freediving and breath-holding skills, while there are few who admit that they use an air compressor to be able to stay underwater for a longer period of time.

Squid jigs (Kawil pamusit), is a multiple hooked device imitating the form of a fish, shrimp or octopus which are worked by jerking up and down under bright light making lure attractive to squids this is usually operates during full moon.

Fishers also mentioned that simple handline with two to three barbed hooks is usually use as supplemental fishing gear, they tend to drop their fishing line in the water hoping to land bigger fish while waiting for the perfect timing to haul their fishing gear (Bottom set-gill net).

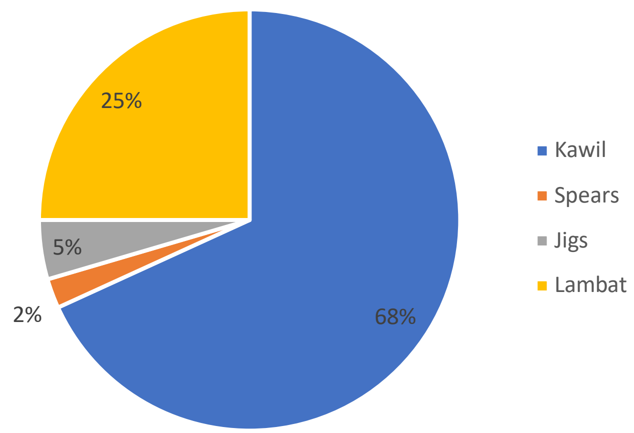


Figure 39. Types of fishing gears used by fishermen in Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

3.9.3 Catch composition

Nature of fisheries in Brgy. Rio Tuba is characterized by non – selective types of fishing methods that uses different type of fishing gear and target wide variety of fish species. Interestingly, observed similarity in catch composition of different fishing gear is noticeable since most of the fishers prefer to fish at the edge of the reef (Figure 40). However, small pelagic like galunggong (scad), salay ginto is only listed in fishers using gillnet while fish catch from the handline users is limits to coral reef fish strictly. The emperor (Lethrinidae locally knows as *kanuping, dugso*), are the most commonly fish caught in Brgy. Rio Tuba, followed in importance by grouper (Seranidae locally known as *Suno, Lapu lapu*). These fish are usually sold to buyer (Comprador) and ended-up in local wet market due to their high market value, impressive size, and good quality of meat while smaller fish and with low quality is kept for the household consumption.

Other fishes comprise fish caught in Brgy. Rio Tuba are Maya-maya (Lutjanidae), Pusit (Loliginidae), Balo (Belionidae), Talakitok (Carangidae), Bisugo (Nemipteridae) and Tulingan (Scombridae). The same species that fishers enumerated comprising their fish catch were also observed in local fish market at sitio Marabahay and fish peddlers in the neighborhood.

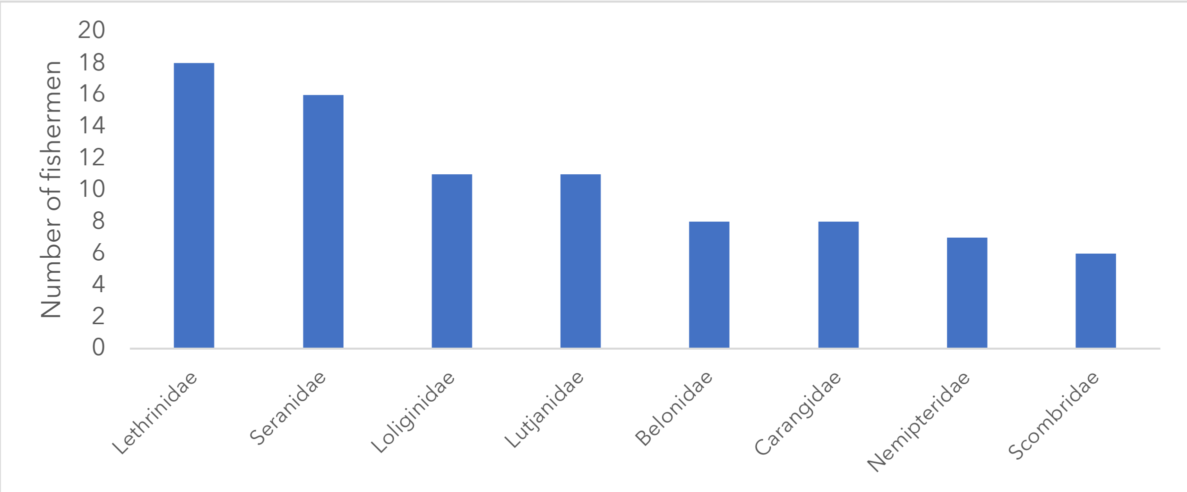


Figure 40. Catch composition in the artisanal fisheries in Bgy. Rio Tuba, Bataraza, Palawan.

3.9.4 Catch rates and income

The Catch Per Unit Effort (CPUE) is calculated from two different sources; one on one interview and fish landing survey. Kawil (Hook and Line) reported an average CPUE of 2.014 kg/fisher/hour while Lambat (Bottom set-gillnet) has an average CPUE of 3.0 kg/fisher/hour. Overall higher catch rates were reported by gill netters targeting wide variety of *isdang bato* (coral reefs fish), Talakitok (Jacks) and Galunggong (Scads). During high season, normal catch rates are doubled and tripled with some fishers saying that catches could reach more than 20 kg up to 60 kilos per trip especially for gill netters during high season in months from March to November. During low season, the majority of fishers reported catches of less than 3 kg with some saying that their catches are not even enough to breakeven for the day's fishing costs. On the other hand, recorded Catch per Unit Effort (CPUE) in Rio Tuba is relatively high compare to the fishers in Bgy. of Bono Bono and Malihud (1.014 kg/fishing trip) that mostly explore fishing grounds in San Antonio Bay (NFRDI 2018, NFRDI 2019).

Most fishers reported that their income from fishing is enough only to cover their daily household needs (76%), while twenty two percent (22%) even stated that their income from fishing alone is insufficient to provide their daily household needs. Meanwhile, a very small proportion (2%) of the respondents reported that their income from fishing is high enough to support the education of their children even at college.

Most of the fishers go out fishing at least three to six times a week, dependent on whenever weather conditions are good, or for some, are at least tolerable. Some fishers' fish twice a day: once in the morning and once at night, except during nights when there is a full moon. Sundays are usually for resting and for attending other personal matters (Figure 41).

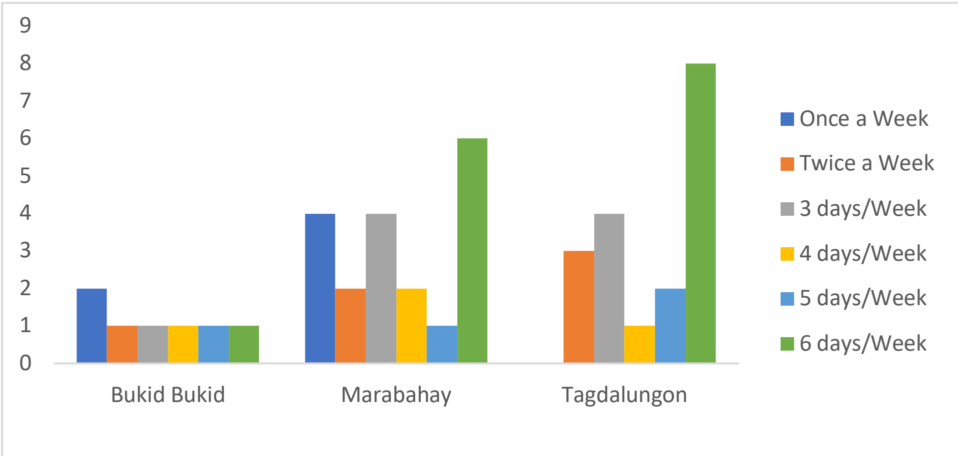


Figure 41. Number of fishing days per week of fishers from Bgy. Rio Tuba, Bataraza, Palawan.

3.9.5 Catch trends and perceived causes of change

Generally, ninety eight percent (98%) (49 out of 50) of the interviewed fishers said that the fishery has been deteriorating as they venture in farther fishing ground in search for good haul, while 2% said that it improved compared to its previous state. The differences in the observation could be due to the varying ages of the respondents with some being new while others have been in fishing for over 20 years already. Obviously, worse decline was reported by older fishers who already fished as early as 1980s or earlier when the condition of the fishery was much better. Fisher in all three Sitios mentioned that observed decline in volume of fish catch maybe attributed to the following; i. Increasing number of fishers competing for the remaining fishery resources ii. Competition with commercial fishers and, iii. Destructive fishing activity (Blast and Poison fishing) as shown in Figure 42.

Anecdotal reports and personal interview with Municipal Agriculturist revealed that fishing pressure in and around the municipal waters of Bataraza has increased over the years, with large numbers of poachers from the neighboring municipalities and provinces (mainly from Mindoro and Visayas) converging in the surrounding waters of Bataraza. This abrupt increase in the number of fishers, compounded with the broad expanse of municipal waters and insufficient resources of the local government to enforce policies, have led to the rampant use of destructive fishing practices and commercial-scale fishing within municipal waters. This resulted to the continuous decline in production of fishery resources around the municipality.

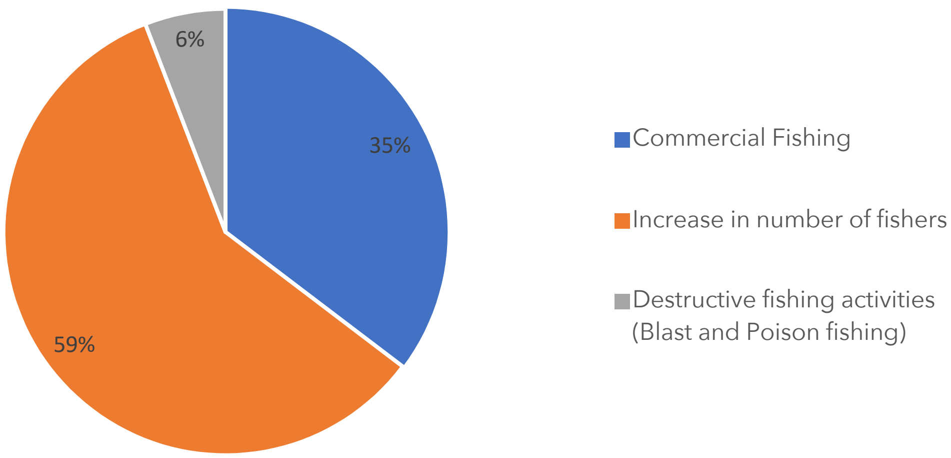


Figure 42. Observed causes of decline in fisheries production in Bgy. Rio Tuba Bataraza, Palawan.

Fishing pressure in and around the municipal waters of Bgy. Rio Tuba and Bataraza in general has increased through the years, with large numbers of poachers from neighboring municipalities and provinces (mainly from Mindoro and Visayas) converging in the surrounding waters of Bataraza, Palawan. The increase in the number of fishers, compounded with the broad expanse of municipal waters and insufficient resources of the local government to enforce policies, have led to the rampant use of destructive fishing practices and commercial-scale fishing within municipal waters. This resulted to the continuous decline in production of fishery resources.

4. DISCUSSION

4.1 Primary Impact Areas

Out of eleven (11) monitored areas, five (5) are identified as primary impact areas of the CBNC's operations, namely: Tagdalungon, Lower Kinurong Siltation Pond, Causeway, Discharge Point area, and Mooring Dolphin.

Components of seagrass and mangroves are monitored in Tagdalungon; planktons in discharge point, causeway, mooring dolphin, and lower Kinurong; coral reefs in discharge point area and mooring dolphin; and reef fishes in discharge point area, causeway, mooring dolphin and lower Kinurong siltation pond (for freshwater fishes).

4.1.1 Tagdalungon

This monitoring site is located along the coastal areas of Coral Bay with local communities active in fishing and also serves as communal gleaning area. Lower seagrass species from 5 in 2021 to 3 in 2022 was observed in Tagdalungon area (Figure 43), and a decrease in seagrass cover from 18% in 2021 to 13% in 2022. Aside from anthropogenic factors, the stronger wave action and current due to stronger typhoons experienced by the province of Palawan from the previous months prior to this survey. Due to the impacts of stronger typhoons, lower values can be seen in the evenness index and diversity index.

Tagdalungon holds some of the old growth mangrove forest among other monitoring sites of CBNC. Similarly, the lower number of seedlings and sapling, and the higher average girth size of the mangroves justify this assumption. Compared to previous report, importance value of mangroves in Tagdalungon is more than 100% (especially *S. alba*) and as low as 26% which is higher than 9% computed in 2021. Mangrove forest of Tagdalungon is less diverse in terms of number of species as compared to other areas in Palawan but composed of some old and secondary growth trees which is important to be protected.

4.1.2 Lower Kinurong Siltation Pond

While there is no wastewater from CBNC, the Lower Kinurong

Siltation Pond located close to the CBNC Hydrometallurgical Processing Plant.

Similar to the observation in 2021, no phytoplankton was recorded in the Lower Kinurong Siltation Pond. There is very low number of species (2 species of zooplankton) with total of 149.33 cells/L, low abundance and density as compared to other sites in primary impact areas.

Fresh and brackish fishes caught during this year's survey increased in species diversity. Collected fishes are Nile tilapia (*Oreochromis niloticus*) which dominated fish catch in terms of quantity and weight, *Megalops cyprinoides* (Bulan-Bulan), *Lutjanus argentimaculatus,* and milkfish *Chanos chanos*.

4.1.3 Mooring Dolphin

There is high abundance of phyto-zooplankter species (14 species) with total of 336.60 cells/L and is considered to be highly diverse as suggested by diversity and evenness index.

The substrate cover of Mooring Dolphin falls under Hard Coral diversity category C with 11 coral families and 24 TAU/genera, which increased from 20 coral genera in 2021. The mean substrate cover in Mooring Dolphin is dominated by biotic component composed of macroalgae (42.6%), hard corals (10.1%), sponge (3.4%) and others (3.5%). Abiotic components are composed of dead coral (12.6%), sand (4.2%) and silt (22.6%). Hard coral cover in Mooring Dolphin is categorized as "poor".

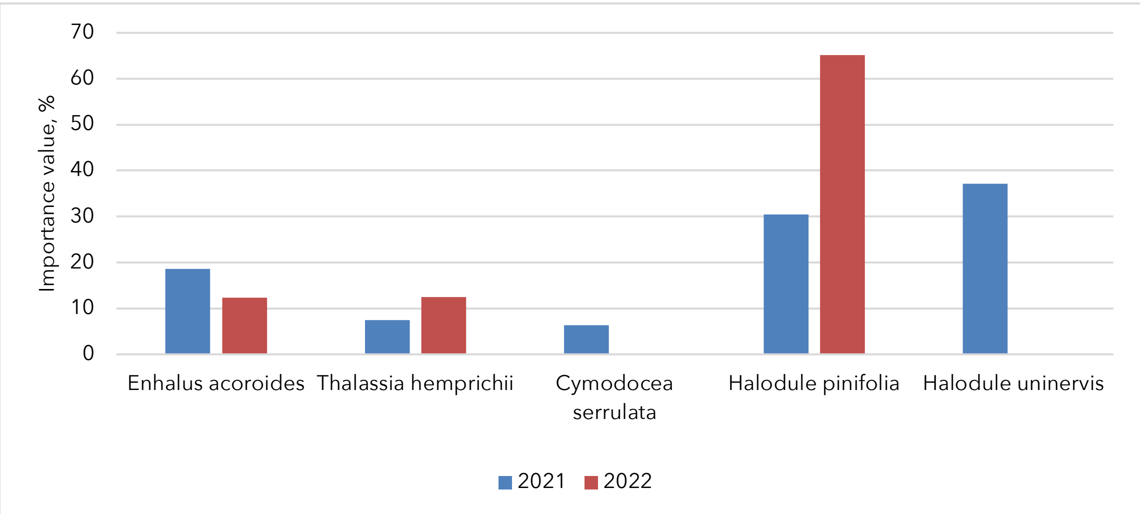


Figure 43. Seagrass species in Tagdalungon, Bgy. Rio Tuba, Bataraza, Palawan (May 2022).

Increase of MA (microalgae) are the filamentous algae, while Halimeda, Sargassum and Padina were noted in Mooring Dolphin. The increase of MA cover from 2020 to 2021 could be attributed to either the new method employed or increased nutrient loading.

The mean biomass for the target, major, and indicator fish groups recorded in this study is relatively higher compared to the previous monitoring activities conducted in CBNC primary impact areas, except in Mooring Dolphin where a significant decline in fish biomass is recorded. A decline in fish biomass and density was observed in this year's survey in the nearby reef areas of the impacted areas in Mooring Dolphin. A noticeable increase in sediment accumulation and increasing levels of suspended particles in the water column from the nearby rivers are among the factors considered to contribute to this phenomenon.

4.1.4 Causeway Station

Phyto-zooplankter is highly diverse with 15 species recorded and total of 502.88 cells/L as suggested by diversity and evenness index.

The substrate cover of Causeway falls under Hard coral diversity category C with 10 coral families and 20 TAU/genera, which increased from 13 coral genera in 2021. The mean substrate cover in Causeway is dominated by abiotic component (silt – 53.7%, dead corals – 12.3%). Biotic component is composed of hard corals (31.7%), macroalgae (1.4%), and others (0.6 %). Hard coral cover in Causeway is categorized as "fair". The macroalgae (MA) was observed to increase from 2020 to 2021, which could be attributed to either the new method employed or increased nutrient loading.

The fish density observed in causeway was considered to be moderate at 1,988 individuals per 1000m^{-2}, higher than previous monitoring (2018- 2021). The increase in mean density in Causeway is attributed to the cryptic and diurnally active reef fish belonging to the family Apogonidae (cardinalfishes), and the herbivorous reef fish belonging to the family Pomacentridae (damselfishes) that settle in reef areas and fiercely defend defined areas of reef substratum. Furthermore, some schools of juvenile fishes from the family Lutjanidae (Snapper) and Nemipteridae (threadfin breams) frequently visit the area in search of food and protection from predators.

4.1.5 Discharge Point

Discharge Point and nearby reef areas are considered as the primary impact areas of CBNC operations since this is where the effluent discharge from the Tailings Storage Facility No. 2. is released. Thus, it is crucial to regularly conduct monitoring activities of fish populations and other marine organisms in the area as they can be a good indicator of the impact and overall conditions of the marine environment.

Result of this year's assessment recorded relatively higher number of fish species and families encountered compared to reef areas monitored from 2018 to 2021. Observed increase in number of fish family and species recorded is apparent in Discharge Point Station where the highest mean density at 4,672 individuals/1,000m^2, equivalent to a 'high' category (Nanola et. Al 2004), and was higher that the recorded fish density in Ursula Island.

The fish biomass in Discharge Point (191.2 MT/km^2) fall under the "very high" category. Relatively high estimates of the mean biomass of targeted fish species observed in Discharge Point station are represented by the schools of large-bodied parrotfishes, fusiliers, scads, snappers, and breams. The reef areas in Ursula Island came in second in terms of mean biomass, with abundance of Serranidae from the sub-family Epinephilinae comprising a large portion of the biomass.

The increase in the cover of soft corals and other marine lifeforms attached to the underwater structures in Discharge Point provides shelter and food sources for the migrating fish in the area. The recorded increase in the density of fish species is largely attributed to the influx of fish species that thrive in brackish water conditions. The minimal presence of human activity, fishing restrictions, and abundance of food sources greatly influence the continuously increased of fish species residing in Discharge Point.

5. CONCLUSION AND RECOMMENDATIONS

Mangroves

Mangrove forest of Tagdalungon is less diverse compared to other areas in Palawan but composed of some old and secondary growth trees which is important to be protected. Activities such as coastal clean-up, additional law enforcement body, and information and education campaigns should be harmonized in the coastal communities to reduce wastes and raise awareness on the importance of mangrove forest as well as local policies that are being implemented in the area. Human settlements and land use change expansions should likewise be monitored to minimize invasion in mangrove areas. Continuous scientific-based reforestation of mangrove areas is encouraged. Finally, appropriate alternative livelihood should be given to coastal communities to alter the exploitation of mangrove resources.

Plankton

The monitoring stations still holds diverse plankton, yet are currently dominated by certain species group. There are few differences in the species records from recent reports in which the number of species observed is declining. Several species reported in previous years was not recorded in this year's monitoring and vice versa, suggesting further monitoring to identify seasonality variations between plankton community, water quality and environmental factors (e.g., climate related variables). This is to evaluate the potential effects of pollution and climate change to plankton community and productivity which would be one of the major factors to be monitored regularly. Moreover, the absence of phytoplankton in the estuary region of Lower Kinurong needs further monitoring.

Seagrass

The seagrass beds in selected areas of Coral Bay, Bgy. Rio Tuba, Bataraza are undergoing a tremendous pressure from natural phenomena and human activities. Seagrass loss can be attributed to natural wave action, sea level rise, sediment loading and possible increase in water temperature from the climate change. As a consequence, percent cover and abundance has been recorded to decline in most areas of Palawan (PCSDS 2015). To avoid greater loss and further destruction, it is recommended that the following activities are performed to preserve the remaining seagrass beds in the area which is an important part of the marine ecosystem:

1. Intensive information education (IEC) on the role of seagrass on the marine ecosystem and their significant contribution to fishery production and ecological functions;
2. Introduction of alternative livelihood projects and other income generating projects to ease the pressure on the seagrass and seaweed resources; and
3. Strict protection, monitoring, and inclusion of the seagrass beds in Small sandbar, Big sandbar and Tagdalungon as part of marine protected areas.
4. More frequent monitoring of seagrass cover in Ursula Island to monitor the occurrence and/or shifting of sand, thus, covering the seagrass beds.

Coral Reefs

The number of coral genera in the monitoring stations increased in this year's monitoring compared to the previous monitoring periods. Some coral recruits were also observed in most stations which could help enhance the HC cover in the area if properly protected from both natural and man-made disturbances. Most of the corals encountered belong to massive and submassive categories which show greater resiliency to climate stressors but are similarly threatened by man-made activities, such as indiscriminate anchoring, pollution, blast, and poison fishing. This is evident in the "poor" to "fair" coral cover in most of the monitoring stations, with Maranto Pt. as the only station in "good" condition in which crocodile sightings are reported. Similarly, some stations have a relatively high SI cover which could affect the survival of other coral species.

Overall, no significant change was observed in the HC cover in the monitoring stations, including the Causeway. This means that the CBNC operation does not affect the coral cover within this station, however, a longer monitoring and deeper study are needed. The reduced HC cover in Mooring Dolphin could be due to the monitoring method used before, and an apparent recovery has been observed, although further monitoring is needed to confirm such recovery. The occurrence of MA in the stations could indicate high nutrient inputs from the nearby rivers which might have increased their growth. The situation also worsened when the number of herbivorous marine organisms (e.g., fish, echinoderms, mammals) was reduced.

It is recommended to use the concrete blocks in subsequent monitoring to determine any fine-scale changes in the coral reefs, particularly those near the impact areas and areas where coral recruits were observed. It is also recommended that if funding and time permit, seasonal monitoring of these reefs (i.e., northeast, and southwest monsoons) be conducted, even only in two stations for temporal and spatial comparison.

Reef Fishes

This study shows that fish species observed within the Coral Bay are composed mainly of small sized fish population, and frequency of large-sized fish are "low". It should be noted, however, that the locations of the monitoring stations are within the shallow reefs' habitats and extensive back reef lagoon area, wherein small-sized fish species use as refuge/feeding site to maximize growth while minimizing the risk of predation, and as part of ontogenetic habitat shift as a function of food choices, size, and development. These shallow reef habitats that mostly harbor small-sized reef fish, played crucial role in life stages of the fish as nursery ground and must be prioritized as areas for protection and conservation.

Freshwater Fishes

Freshwater and brackish water fish species such as Nile tilapia (*Oreochromis niloticus*) , *Megalops cyprinoides* (Bulan-Bulan), *Lutjanus argentimaculatus,* and milkfish *Chanos chanos* were caught in Lower Kinurong Siltation Pond. This year's monitoring showed increase in fish species diversity compared to previous years.

Fish Catch

The extensive fishing ground of Bgy. Rio Tuba having patch reefs separated by channels or deep water requires the use of motorized banca in fishing. Survey showed that majority of the fishers (73%) have motorized boats which indicate that fishers are exploiting far and wide fishing grounds.

In terms of productivity, *kawil* (hook and Line) reported an average CPUE of 2.5 kg/fisher/hour, while lambat (bottom set-gillnet) has an average CPUE of 4 kg/fisher/hour. Overall, higher catch rates were reported by gill netters targeting a variety of *isdang bato* (coral reefs fish), talakitok (jacks), and galunggong (roundscads). Almost all respondents (98%) of the fishers said that the fishery has been deteriorating as they venture in farther fishing ground in search for good haul, while 2% said that it improved compared to its previous state. Decrease in volume of fish catch is largely attributed to the increasing number of fishers competing for the remaining fishery resources, competition with commercial fishers, and destructive fishing activity such as blast and poison fishing.

To determine the fish catch composition in the fishing grounds nearby Bgy. Rio Tuba, it is recommended that experimental fishing be conducted using both the handline and gill net to fully confirm the species caught and CPUE. Longer monitoring of this resource will give as an overview if the fishery resources in the area have change over the years.

Beach Profile

The beaches of the selected stations of Coral Bay, Bgy. Rio Tuba, Bataraza are undergoing a tremendous pressure from natural phenomena and human activities as can be seen in the photos such as human settlement. Beach erosion can be attributed to natural wave action, sea level rise through climate change, and infrastructures being built on the beach.

To avoid greater loss, it is important that the following activities are performed to retain the beaches in Bgy. Rio Tuba:

1. All stations should be profiled periodically (e.g. quarter or semestral) to monitor possible changes;
2. Intensive information education campaign (IEC) on the importance of beaches as protection for the coastal communities against strong typhoons and tsunamis;
3. Provide areas for resettlement away from the beach for coastal communities to prevent harmful impacts from strong typhoons;
4. Strict protection and monitoring of Tagdalungon, Nagoya, and Ursula to prevent additional human settlement.

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7. APPENDICES

Appendix 1. Coordinates of monitoring stations per component of Coral Bay Nickel Corporation, Bgy. Rio Tuba, Bataraza, Palawan, Philippines (May 2022).

a. Corals Reefs, Reef Fishes and Freshwater Fishes

Station	Latitude (north)	Longitude (east)	Depth range (m)	Visibility (m)	Notes
Causeway	08.50117	117.45119	3-5	5	Along CBNC Trestle
Mooring Dolphin	08.49454	117.44635	6-7	5	Near CBNC Trestle
Ursula Is. 1	08.33554	117.51715	10	20	
Ursula Is. 2	08.34646	117.52048	10	20	
Big Sandbar	08.47737	117.44054	7	8	
Small sandbar	08.48710	117.44297	5	7	
Ameril Is.	08.45089	117.43657	10	10	
Maranto Pt.	08.49409	117.42923	3	7	Near community
Lower Kinurong siltation pond	08.55460	117.41705			Freshwater fish

b. Seagrass Monitoring Stations

Station	Latitude (north)	Longitude (east)
Big Sandbar	8.47895	117.44061
Small Sandbar	8.48951	117.44106
Tagdalungon	8.50116	117.44394
Ocayan River	8.51807	11746027
Ursula Island	8.34320	117.51969

c. Plankton

Station	Latitude (north)	Longitude (east)
Ocayan River	8.52618	117.46124
Causeway	8.50114	117.45120
Mooring Dolphin	8.49472	117.44648
Lower Kinurong siltation pond	08.55460	117.41705
Discharge Point	08.49382	117.44706

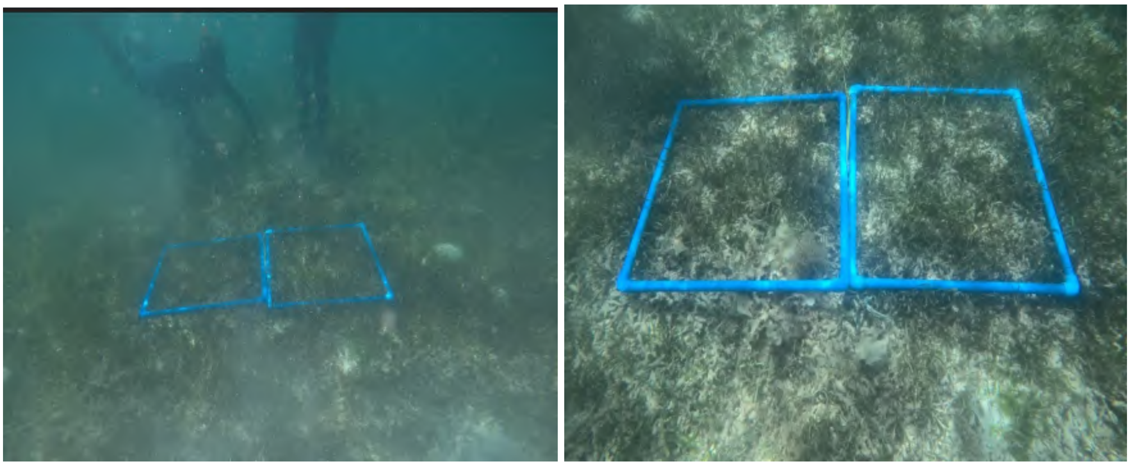
d. Mangroves

Plots in Tagdalungon Area	North (Lat)	East (Long)
Plot 1	8.50280	117.44596
Plot 2	8.50264	117.44599
Plot 3	8.50272	117.44699
Plot 4	8.50329	117.44719

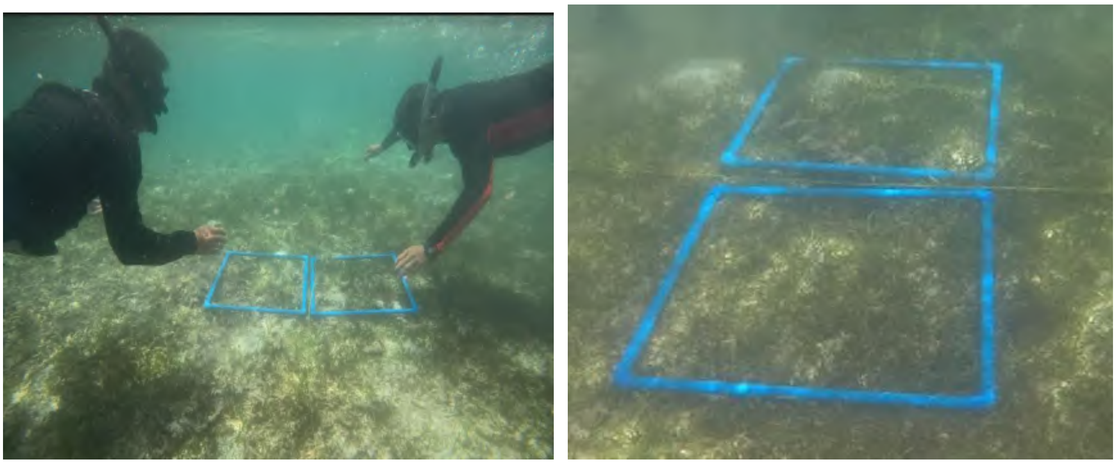
e. Beach Profiling

Station Name	Latitude	Longitude
1. Tagdalungon 1	N 08°30' 10.6 ''	E 117°26'42.6''
2. Tagdalungon 2	N 08° 30'13.0"	E 117°26'51.1''
3. Naguya 1	N 08° 30'14.3	E 117°26'59.5''
4. Naguya 2	N 08° 30'14.6	E 117°27'00.5''
5. Ursula 3	N 08° 20'27.4"	E 117°30'53.7''
6. Ursula 4	N 08° 20'31.1"	E 117°30'59.1''
7. Ursula 6	N 08°20' 24.6 ''	E 117°31'07.9"
8. Ursula 9	N 08° 20'22.4"	E117°30'53.6''

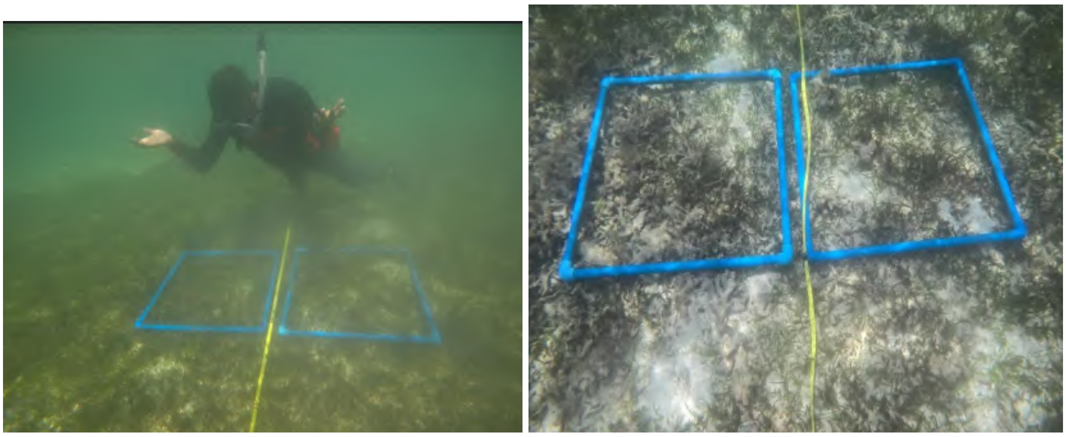
Appendix 2 Seagrass Assessment in Small sandbar, Big Sandbar, Tagdalungon and Ocayan River



a. Small sandbar, Coral bay, Bgy. Rio Tuba, Bataraza, Palawan



b. Big sandbar, Coral bay, Bgy. Rio Tuba, Bataraza, Palawan



c. Tagdalungon, Coral bay, Bgy. Rio Tuba, Bataraza, Palawan

d. Ocayan River, Coral bay, Bgy. Rio Tuba, Bataraza, Palawan

Appendix 3. Mangrove monitoring station in Tagdalungon, Bgy. Rio Tuba, Bataraza, Palawan.

Appendix 4. Comparison of cell abundance and density of phyto-zooplanters in each monitoring stations. ANOVA (H = 16.84; p = 0.05).

Mann-Whitney pairwise comparison (*p* value)					
	Lower Kinurong	Ocayan River	Causeway	Mooring Dolphin	Discharge Point
Ocayan River	0.00				
Causeway	0.01	1.00			
Mooring Dolphin	0.02	1.00	1.00		
Discharge Point	0.00	1.00	1.00	1.00	
Tagdalungon	0.02	1.00	1.00	1.00	1.00

Appendix 5. Occurrence of coral genera encountered in monitored reefs in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan. A positive (+) sign denotes the presence of such genera.

Family	Genus	Causeway	Mooring Dolphin	Ursula Is. 1	Ursula Is. 2	Big Sandbar	Small sandbar	Ameril Is.	Maranto Pt.
Acroporidae	*Acropora*	+	+	+	+	+	+	+	+
	Astreopora	+	+	+		+			+
	Isopora	+			+	+	+	+	
	Montipora	+	+	+	+	+	+	+	+
Agariciidae	*Coeloseris*					+	+		+
	Gardineroseris								+
	Leptoseris			+	+				
	Pavona			+					
Dendrophylliidae	*Turbinaria*	+		+			+		+
Diploastraeidae	*Diploastrea*		+	+		+	+		+
Euphylliidae	*Euphyllia*		+			+			+
	Galaxea		+	+		+	+	+	
Faviidae	*Favia*	+	+	+	+				
Fungiidae	*Ctenactis*		+		+	+	+		+
	Fungia	+	+	+	+	+	+	+	+
	Herpolitha					+			
	Lithophyllon			+					
	Sandalolitha								+
Helioporidae	*Heliopora*	+			+	+		+	
Lobophylliidae	*Echinophyllia*	+					+		+
	Lobophyllia		+				+		
	Oxypora		+					+	
	Symphyllia	+	+						+
Merulinidae	*Caulastrea*		+			+			
	Echinipora	+				+	+		

Family	Genus	Causeway	Mooring Dolphin	Ursula Is. 1	Ursula Is. 2	Big Sandbar	Small sandbar	Ameril Is.	Maranto Pt.
	Favites	+	+	+	+	+	+	+	+
	Goniastrea	+		+	+	+		+	
	Hydnophora		+			+			
	Leptoria			+		+			
	Merulina		+						+
	Mycedium	+				+			+
	Pectinia	+	+						+
	Platygyra		+						
Montastraeidae	*Montastrea*	+	+	+		+		+	+
Pocilloporidae	*Pocillopora*	+	+	+		+			
	Seriatopora	+		+	+	+	+		+
	Stylopora	+	+	+	+	+	+		+
Poritidae	*Goniopora*		+				+		+
	Porites	+	+	+	+	+	+	+	+
Scleractinia *incertae sedis*	*Pachyseris*		+	+	+	+	+		+
Total		**20**	**24**	**20**	**14**	**25**	**18**	**11**	**23**

Appendix 6. Percentage (%) of substrate cover in monitoring stations in Coral Bay and Ursula Island, Rio Tuba, Bataraza, Palawan, Philippines (May 2022).

Stations	Hard coral (HC)	Soft coral (SC)	Sponge (SP)	Macro-algae (MA)	Others (OT)	Dead coral (DC)	Rubble (RB)	Sand (SD)	Silt (SI)
Causeway	31.7	-	0.2	1.4	0.6	12.3	-	0.1	53.7
Mooring Dolphin	10.1	0.4	3.4	42.6	3.5	12.6	0.6	4.2	22.6
Ursula Is. 1	30.3	-	0.1	0.6	0.3	61.9	3.5	3.3	-
Ursula Is. 2	28.0	1.2	0.2	1.9	0.2	43.1	13.6	11.8	-
Rio Tuba MPA	31.1	1.5	1.1	2.7	0.8	35.1	0.7	21.0	6.0
Small sandbar	32.7	1.1	1.3	3.3	1.3	41.6	2.4	9.0	7.3
Ameril Is.	31.4	-	-	10.7	-	32	16.2	9.7	-
Maranto Pt.	40.6	0.1	0.7	31.3	0.8	18.2	0.2	0.4	7.7
Mean	**29.5**	**0.9**	**0.9**	**11.8**	**0.9**	**32.1**	**4.7**	**7.4**	**12.2**

Appendix 7. Percentage (%) of hard coral (HC) subcategories in monitoring stations in Coral Bay and Ursula Island, Rio Tuba, Bataraza, Palawan, Philippines (May 2022).

Stations	ACB	ACD	ACT	CHL	CMR	CB	CE	CF	CM	CS	Total
Causeway	0.2	0.1	0.1	0.3	0.1	0.7	2.8	1.4	25.6	0.4	**31.7**
Mooring Dolphin	0.1	0.1	0.8	-	1.3	0.1	1.7	0.2	4.9	0.9	**10.1**
Ursula Is. 1	23.6	0.3	1.5	-	-	0.1	0.6	-	3.5	0.7	**30.3**
Ursula Is. 2	0.2	-	0.1	0.2	0.1	6.3	17.9	-	2.6	0.6	**28.0**
Rio Tuba MPA	2.5	-	2.0	0.1	0.9	13.8	2.4	0.9	6.6	1.9	**31.1**
Small sandbar	0.7	-	0.3	-	1.5	23.5	2.0	-	3.3	1.4	**32.7**
Ameril Is.	-	0.2	-	0.1	0.2	15.4	15.2	-	0.1	0.2	**31.4**
Maranto Pt.	8.1	-	0.5	-	2.2	7.2	6.3	11.3	4.8	0.2	**40.6**
Mean	**4.4**	**0.1**	**0.7**	**0.1**	**0.8**	**8.4**	**6.1**	**1.7**	**6.4**	**0.8**	**29.5**

Appendix 8. Occurrence of reef fish species encountered in the monitoring stations in Coral Bay and Ursula Island, Bgy. Rio Tuba, Bataraza, Palawan, Philippines. A positive (+) sign denotes the presence of such genera. Abbreviations used: AME-Ameril Island, BSB-Big sandbar, CAW-Causeway, DIP-Discharge Pt., MAR-Maranto Pt., MOD-Mooring Dolphin, SSB-Small sandbar, UR1-Ursula Is. 1, UR2-Ursula Is. 2.

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Acanthuridae	*Acanthurus pyroferus*	Herbivore	Target									+
Acanthuridae	*Acanthurus thompsoni*	Planktivore	Target				+	+	+			
Acanthuridae	*Ctenochaetus binotatus*	Detritivore	Target		+	+					+	+
Acanthuridae	*Ctenochaetus striatus*	Detritivore	Target								+	+
Acanthuridae	*Naso caeruleacauda*	Herbivore	Target								+	
Acanthuridae	*Naso* sp.	Herbivore	Target	+			+	+	+	+		
Acanthuridae	*Zebrasoma scopas*	Herbivore	Major		+			+			+	
Anthiadidae	*Mirolabrichthys tuka*	Planktivore	Major									+
Anthiadidae	*Pseudanthias huchtii*	Planktivore	Major									+
Apogonidae	*Apogon* sp.	Benthic Invertivore	Major	+	+			+			+	
Apogonidae	*Cheilodipterus macrodon*	Piscivore	Major			+						
Apogonidae	*Cheilodipterus quinquelineatus*	Benthic Invertivore	Major	+	+	+		+		+		+
Apogonidae	*Nectamia bandanensis*	Benthic Invertivore	Major					+				
Apogonidae	*Ostorhinchus chrysopomus*	Benthic Invertivore	Major			+		+				
Apogonidae	*Ostorhinchus compressus*	Benthic Invertivore	Major	+				+		+		
Apogonidae	*Ostorhinchus sealei*	Benthic Invertivore	Major		+	+		+		+		
Apogonidae	*Pristicon trimaculatus*	Benthic Invertivore	Major							+		
Apogonidae	*Taeniamia zosterophora*	Benthic Invertivore	Major		+					+		
Aulostomidae	*Aulostomus chinensis*	Benthic Invertivore	Major		+							+
Balistidae	*Balistapus undulatus*	Omnivore	Target		+						+	+
Balistidae	*Odonus niger*	Benthic Invertivore	Major				+					

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Balistidae	*Sufflamen chrysopterum*	Benthic Invertivore	Major								+	
Blenniidae	*Aspidontus taeniatus*	Benthic Invertivore	Major					+			+	+
Blenniidae	*Blenniella* sp.	Benthic Invertivore	Major									+
Blenniidae	*Ecsenius bicolor*	Herbivore	Major	+								
Blenniidae	*Meiacanthus grammistes*	Benthic Invertivore	Major								+	
Carangidae	*Atule mate*	Planktivore	Target				+					
Carangidae	*Caranx melampygus*	Piscivore	Target				+					
Carangidae	*Caranx* sp.	Piscivore	Target			+						
Carangidae	*Selar crumenophthalmus*	Piscivore	Target				+					
Centriscidae	*Aeoliscus strigatus*	Planktivore	Major	+				+		+		
Chaetodontidae	*Chaetodon adiergastos*	Benthic Invertivore	Major			+		+				
Chaetodontidae	*Chaetodon auriga*	Benthic Invertivore	Major							+	+	
Chaetodontidae	*Chaetodon baronessa*	Corallivore	Indicator							+	+	+
Chaetodontidae	*Chaetodon decussatus*	Omnivore	Major									+
Chaetodontidae	*Chaetodon kleinii*	Corallivore	Indicator		+						+	+
Chaetodontidae	*Chaetodon lunulatus*	Corallivore	Indicator	+	+						+	+
Chaetodontidae	*Chaetodon melannotus*	Corallivore	Indicator		+					+		
Chaetodontidae	*Chaetodon octofasciatus*	Corallivore	Indicator	+	+	+		+	+	+		
Chaetodontidae	*Chaetodon* sp.	Benthic Invertivore	Major			+						
Chaetodontidae	*Chaetodon vagabundus*	Corallivore	Indicator							+		
Chaetodontidae	*Chelmon rostratus*	Benthic Invertivore	Major			+		+	+	+		
Chaetodontidae	*Heniochus pleurotaenia*	Corallivore	Indicator		+					+		
Chaetodontidae	*Heniochus singularis*	Benthic Invertivore	Major			+						
Chaetodontidae	*Heniochus varius*	Corallivore	Indicator		+			+				

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Ephippidae	*Platax teira*	Herbivore	Target				+		+			
Epinephelidae	*Cephalopholis argus*	Piscivore	Target									+
Epinephelidae	*Cephalopholis boenak*	Piscivore	Target				+					
Epinephelidae	*Cephalopholis microprion*	Piscivore	Target	+	+	+	+		+	+	+	+
Epinephelidae	*Epinephelus hexagonatus*	Piscivore	Target									+
Epinephelidae	*Epinephelus merra*	Piscivore	Target									+
Epinephelidae	*Epinephelus ongus*	Piscivore	Target								+	+
Epinephelidae	*Epinephelus quoyanus*	Piscivore	Target	+							+	+
Epinephelidae	*Epinephelus sexfasciatus*	Benthic Invertivore	Target			+						
Epinephelidae	*Epinephelus* sp.	Piscivore	Target								+	+
Epinephelidae	*Epinephelus spilotoceps*	Piscivore	Target								+	
Epinephelidae	*Plectropomus leopardus*	Piscivore	Target	+								
Epinephelidae	*Plectropomus oligacanthus*	Piscivore	Target			+						
Fistulariidae	*Fistularia commersonii*	Piscivore	Target					+				
Gerreidae	*Gerres oyena*	Benthic Invertivore	Major			+						
Gobiidae	*Amblygobius hectori*	Herbivore	Major					+	+			
Haemulidae	*Diagramma melanacrum*	Benthic Invertivore	Target		+				+			+
Haemulidae	*Diagramma pictum*	Benthic Invertivore	Target				+		+			
Haemulidae	*Plectorhinchus chaetodonoides*	Benthic Invertivore	Target	+		+	+			+		
Haemulidae	*Plectorhinchus lessonii*	Benthic Invertivore	Target							+		
Haemulidae	*Plectorhinchus lineatus*	Benthic Invertivore	Target									+
Holocentridae	*Myripristis kuntee*	Benthic Invertivore	Target									+
Holocentridae	*Myripristis murdjan*	Benthic Invertivore	Target		+			+				
Holocentridae	*Myripristis* sp.	Planktivore	Target			+						

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Holocentridae	*Neoniphon argenteus*	Benthic Invertivore	Target								+	
Holocentridae	*Neoniphon sammara*	Benthic Invertivore	Target									+
Holocentridae	*Sargocentron rubrum*	Benthic Invertivore	Target		+							
Holocentridae	*Sargocentron* sp.	Benthic Invertivore	Target			+			+			
Kyphosidae	*Kyphosus cinerascens*	Herbivore	Target						+			
Labridae	*Anampses* sp.	Benthic Invertivore	Major								+	
Labridae	*Bodianus mesothorax*	Benthic Invertivore	Major		+							
Labridae	*Cheilinus chlorourus*	Benthic Invertivore	Target	+		+		+	+	+	+	
Labridae	*Cheilinus fasciatus*	Benthic Invertivore	Target	+	+			+	+	+		+
Labridae	*Cheilinus* sp.	Benthic Invertivore	Target			+						
Labridae	*Choerodon anchorago*	Benthic Invertivore	Target			+		+		+		
Labridae	*Cirrhilabrus cyanopleura*	Planktivore	Major	+						+	+	+
Labridae	*Coris batuensis*	Benthic Invertivore	Major								+	+
Labridae	*Coris gaimard*	Benthic Invertivore	Major								+	
Labridae	*Diproctacanthus xanthurus*	Corallivore	Indicator		+	+		+		+	+	
Labridae	*Epibulus brevis*	Piscivore	Target	+				+	+	+		+
Labridae	*Epibulus insidiator*	Piscivore	Target							+		
Labridae	*Gomphosus varius*	Benthic Invertivore	Major								+	
Labridae	*Halichoeres chloropterus*	Benthic Invertivore	Major		+			+		+		
Labridae	*Halichoeres chrysus*	Benthic Invertivore	Major									+
Labridae	*Halichoeres hartzfeldii*	Benthic Invertivore	Major			+						
Labridae	*Halichoeres hortulanus*	Benthic Invertivore	Major								+	+
Labridae	*Halichoeres leucurus*	Benthic Invertivore	Major	+	+			+	+	+		
Labridae	*Halichoeres melanochir*	Benthic Invertivore	Major									+

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Labridae	*Halichoeres melanurus*	Benthic Invertivore	Major	+	+			+	+	+	+	+
Labridae	*Halichoeres richmondi*	Benthic Invertivore	Major		+							
Labridae	*Halichoeres* sp.	Benthic Invertivore	Major							+		
Labridae	*Hemigymnus melapterus*	Benthic Invertivore	Target	+				+		+		+
Labridae	*Labrichthys* sp.	Benthic Invertivore	Major					+			+	
Labridae	*Labrichthys unilineatus*	Corallivore	Indicator								+	
Labridae	*Labroides bicolor*	Benthic Invertivore	Major								+	+
Labridae	*Labroides dimidiatus*	Benthic Invertivore	Major	+	+	+	+	+	+	+	+	+
Labridae	*Labropsis manabei*	Corallivore	Indicator			+						
Labridae	*Macropharyngodon meleagris*	Benthic Invertivore	Major								+	+
Labridae	*Novaculichthys taeniourus*	Benthic Invertivore	Major								+	+
Labridae	*Oxycheilinus digramma*	Benthic Invertivore	Target		+			+	+	+	+	
Labridae	*Oxycheilinus* sp.	Benthic Invertivore	Target					+				
Labridae	*Oxycheilinus unifasciatus*	Piscivore	Target			+				+		
Labridae	*Pseudocheilinus hexataenia*	Benthic Invertivore	Major								+	+
Labridae	*Pteragogus cryptus*	Benthic Invertivore	Major	+				+				
Labridae	*Stethojulis bandanensis*	Benthic Invertivore	Major			+		+	+	+		+
Labridae	*Thalassoma hardwicke*	Benthic Invertivore	Major								+	+
Labridae	*Thalassoma jansenii*	Benthic Invertivore	Major								+	
Labridae	*Thalassoma lunare*	Benthic Invertivore	Major	+	+	+	+	+	+	+	+	+
Labridae	*Wetmorella albofasciata*	Benthic Invertivore	Major		+							
Lethrinidae	*Lethrinus obsoletus*	Benthic Invertivore	Target	+								
Lethrinidae	*Monotaxis grandoculis*	Benthic Invertivore	Target								+	+
Lutjanidae	*Caesio caerulaurea*	Planktivore	Target				+					+

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Lutjanidae	*Caesio teres*	Planktivore	Target			+	+			+		+
Lutjanidae	*Lutjanus argentimaculatus*	Piscivore	Target			+	+		+			
Lutjanidae	*Lutjanus biguttatus*	Piscivore	Target	+		+		+				
Lutjanidae	*Lutjanus carponotatus*	Piscivore	Target		+				+			
Lutjanidae	*Lutjanus decussatus*	Piscivore	Target				+		+	+	+	+
Lutjanidae	*Lutjanus ehrenbergii*	Piscivore	Target			+						
Lutjanidae	*Lutjanus lutjanus*	Piscivore	Target				+					
Lutjanidae	*Lutjanus quinquelineatus*	Piscivore	Target						+			
Lutjanidae	*Pterocaesio chrysozona*	Planktivore	Target								+	
Lutjanidae	*Pterocaesio digramma*	Planktivore	Target		+							
Lutjanidae	*Pterocaesio randalli*	Planktivore	Target									+
Lutjanidae	*Pterocaesio tile*	Planktivore	Target									+
Microsdesmidae	*Ptereleotris evides*	Planktivore	Major								+	
Monacanthidae	*Pervagor janthinosoma*	Benthic Invertivore	Major		+							
Monodactylidae	*Monodactylus argenteus*	Omnivore	Major			+	+					
Mullidae	*Parupeneus barberinus*	Benthic Invertivore	Target					+	+		+	+
Mullidae	*Parupeneus cyclostomus*	Benthic Invertivore	Target		+						+	
Mullidae	*Parupeneus multifasciatus*	Benthic Invertivore	Target		+					+	+	+
Mullidae	*Parupeneus trifasciatus*	Benthic Invertivore	Target							+	+	+
Mullidae	*Upeneus tragula*	Benthic Invertivore	Target			+						
Nemipteridae	*Pentapodus bifasciatus*	Benthic Invertivore	Target		+				+		+	
Nemipteridae	*Pentapodus caninus*	Benthic Invertivore	Target						+			
Nemipteridae	*Scolopsis bilineata*	Benthic Invertivore	Target								+	
Nemipteridae	*Scolopsis ciliata*	Benthic Invertivore	Target			+	+	+	+			

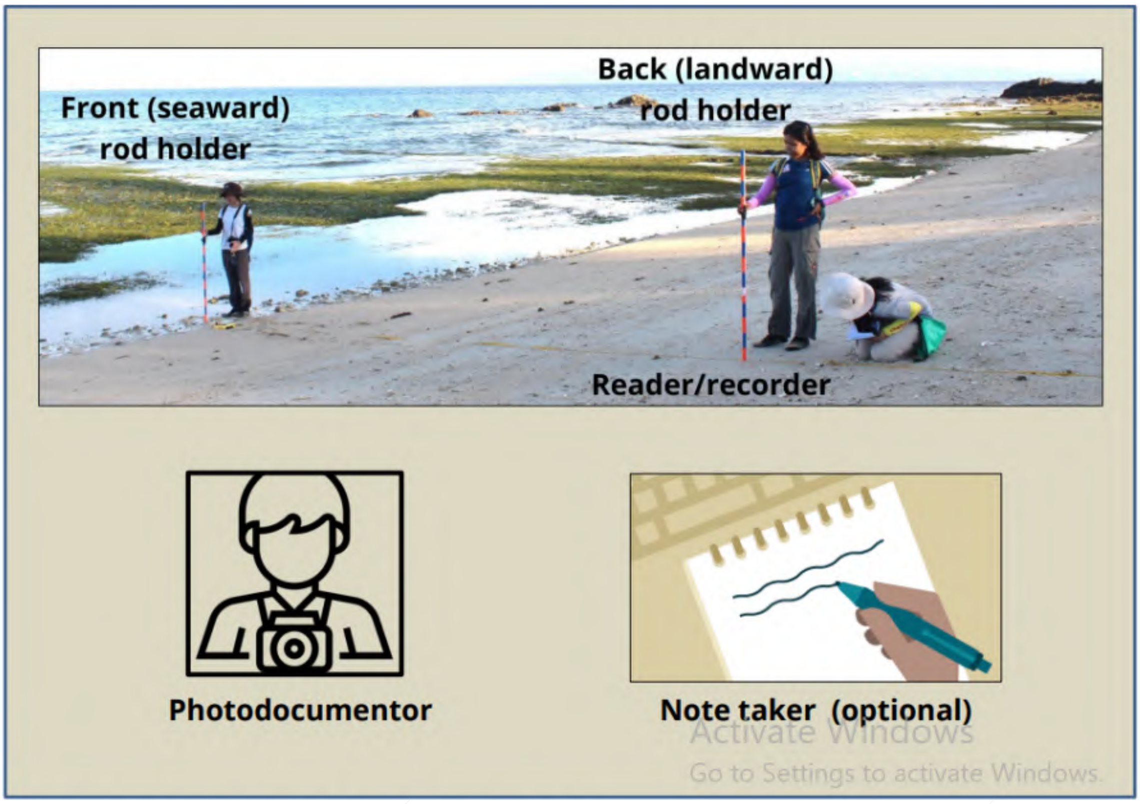
Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Nemipteridae	*Scolopsis margaritifera*	Benthic Invertivore	Target	+	+	+		+	+	+	+	+
Pempheridae	*Pempheris vanicolensis*	Benthic Invertivore	Major		+							
Plotosidae	*Plotosus lineatus*	Benthic Invertivore	Major					+	+			
Pomacanthidae	*Centropyge vrolikii*	Herbivore	Major								+	+
Pomacanthidae	*Chaetodontoplus mesoleucus*	Corallivore	Major	+	+				+	+	+	+
Pomacanthidae	*Pomacanthus sexstriatus*	Omnivore	Major				+					
Pomacentridae	*Abudefduf bengalensis*	Planktivore	Major			+						
Pomacentridae	*Abudefduf sexfasciatus*	Herbivore	Major			+						
Pomacentridae	*Abudefduf sordidus*	Herbivore	Major			+						
Pomacentridae	*Abudefduf vaigiensis*	Herbivore	Major				+					
Pomacentridae	*Acanthochromis polyacanthus*	Planktivore	Major	+	+		+	+	+	+	+	+
Pomacentridae	*Amblyglyphidodon curacao*	Planktivore	Major		+			+	+	+	+	+
Pomacentridae	*Amblyglyphidodon leucogaster*	Planktivore	Major	+	+							+
Pomacentridae	*Amphiprion clarkii*	Planktivore	Major									+
Pomacentridae	*Amphiprion frenatus*	Herbivore	Major									+
Pomacentridae	*Chromis analis*	Planktivore	Major									+
Pomacentridae	*Chromis atripectoralis*	Planktivore	Major	+							+	
Pomacentridae	*Chromis atripes*	Planktivore	Major	+							+	+
Pomacentridae	*Chromis margaritifer*	Planktivore	Major									+
Pomacentridae	*Chromis* sp.	Herbivore	Major		+			+	+			
Pomacentridae	*Chromis ternatensis*	Planktivore	Major	+	+		+	+		+	+	+
Pomacentridae	*Chromis viridis*	Planktivore	Major		+					+	+	
Pomacentridae	*Chrysiptera hemicyanea*	Herbivore	Major	+		+				+		+
Pomacentridae	*Chrysiptera oxycephala*	Herbivore	Major	+	+			+				

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Pomacentridae	*Chrysiptera parasema*	Herbivore	Major	+	+			+		+		
Pomacentridae	*Chrysiptera rex*	Herbivore	Major			+			+			
Pomacentridae	*Chrysiptera rollandi*	Herbivore	Major	+						+		+
Pomacentridae	*Chrysiptera springeri*	Herbivore	Major	+						+		
Pomacentridae	*Chrysiptera talboti*	Herbivore	Major									+
Pomacentridae	*Dascyllus aruanus*	Herbivore	Major		+						+	+
Pomacentridae	*Dascyllus melanurus*	Herbivore	Major		+						+	
Pomacentridae	*Dascyllus reticulatus*	Herbivore	Major		+						+	
Pomacentridae	*Dascyllus trimaculatus*	Herbivore	Major									+
Pomacentridae	*Dischistodus melanotus*	Herbivore	Major		+	+			+	+		
Pomacentridae	*Dischistodus perspicillatus*	Herbivore	Major		+			+				
Pomacentridae	*Dischistodus prosopotaenia*	Herbivore	Major		+			+	+	+		+
Pomacentridae	*Neoglyphidodon bonang*	Herbivore	Major		+			+				
Pomacentridae	*Neoglyphidodon melas*	Herbivore	Major							+	+	
Pomacentridae	*Neoglyphidodon nigroris*	Herbivore	Major	+	+	+		+	+	+	+	+
Pomacentridae	*Neoglyphidodon oxyodon*	Herbivore	Major			+			+			
Pomacentridae	*Neopomacentrus nemurus*	Planktivore	Major				+					
Pomacentridae	*Neopomacentrus taeniurus*	Planktivore	Major			+						
Pomacentridae	*Pomacentrus adelus*	Planktivore	Major	+		+		+	+	+	+	
Pomacentridae	*Pomacentrus alexanderae*	Planktivore	Major	+	+		+		+	+		+
Pomacentridae	*Pomacentrus amboinensis*	Herbivore	Major	+	+						+	+
Pomacentridae	*Pomacentrus auriventris*	Planktivore	Major								+	
Pomacentridae	*Pomacentrus brachialis*	Herbivore	Major		+					+	+	+
Pomacentridae	*Pomacentrus burroughi*	Herbivore	Major	+	+	+			+	+		+

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Pomacentridae	*Pomacentrus chrysurus*	Herbivore	Major	+	+	+		+			+	
Pomacentridae	*Pomacentrus lepidogenys*	Planktivore	Major					+		+	+	+
Pomacentridae	*Pomacentrus moluccensis*	Herbivore	Major	+	+			+		+	+	+
Pomacentridae	*Pomacentrus philippinus*	Herbivore	Major	+						+	+	+
Pomacentridae	*Pomacentrus* sp.	Herbivore	Major						+			
Pomacentridae	*Pomacentrus stigma*	Herbivore	Major	+	+		+			+		
Pomacentridae	*Pomacentrus tripunctatus*	Herbivore	Major			+						
Pomacentridae	*Pomacentrus vaiuli*	Herbivore	Major			+			+			+
Pomacentridae	*Stegastes lacrymatus*	Herbivore	Major							+	+	+
Pseudochromidae	*Labracinus cyclophthalmus*	Piscivore	Major		+							
Scaridae	*Cetoscarus ocellatus*	Herbivore	Target	+						+		
Scaridae	*Chlorurus bleekeri*	Herbivore	Target	+						+	+	+
Scaridae	*Chlorurus bowersi*	Herbivore	Target								+	
Scaridae	*Chlorurus microrhinos*	Herbivore	Target							+	+	+
Scaridae	*Chlorurus spilurus*	Herbivore	Target	+				+		+	+	+
Scaridae	*Scarus dimidiatus*	Herbivore	Target							+		+
Scaridae	*Scarus flavipectoralis*	Herbivore	Target			+					+	
Scaridae	*Scarus ghobban*	Herbivore	Target				+		+			
Scaridae	*Scarus hypselopterus*	Herbivore	Target		+					+	+	
Scaridae	*Scarus niger*	Herbivore	Target									+
Scaridae	*Scarus quoyi*	Herbivore	Target	+	+			+			+	+
Scaridae	*Scarus rivulatus*	Herbivore	Target									+
Scaridae	*Scarus* sp.	Herbivore	Target	+		+		+		+		+
Scaridae	*Scarus tricolor*	Herbivore	Target								+	

Family	Sci.Name	Trophic Group	Group	AME	BSB	CAW	DIP	MAR	MOD	SSB	UR1	UR2
Siganidae	*Siganus canaliculatus*	Herbivore	Target				+					
Siganidae	*Siganus vermiculatus*	Herbivore	Target				+					
Siganidae	*Siganus virgatus*	Herbivore	Target								+	+
Siganidae	*Siganus vulpinus*	Herbivore	Target	+							+	+
Sphyraenidae	*Sphyraena barracuda*	Piscivore	Target				+					
Sphyraenidae	*Sphyraena flavicauda*	Piscivore	Target		+			+				
Synodontidae	*Saurida gracilis*	Piscivore	Target	+				+		+		+
Tetraodontidae	*Arothron nigropunctatus*	Benthic Invertivore	Major					+				
Tetraodontidae	*Canthigaster papua*	Benthic Invertivore	Major		+	+						+
Tetraodontidae	*Canthigaster valentini*	Corallivore	Major		+							
Zanclidae	*Zanclus cornutus*	Benthic Invertivore	Major	+	+		+	+	+	+	+	+
Total				**53**	**68**	**53**	**32**	**60**	**46**	**70**	**83**	**92**

Appendix 9. Composition of the beach profiling team.



Source: BEAM Basic Training: Field techniques for Citizen Science, 2-4 June 2021 @ University of the Philippines

Appendix 10. Survey questionnaire used for obtaining fisheries profile including fish catch and gear composition in three fishing communities of Bgy. Rio Tuba, Bataraza, Palawan.

CATCH FISHERIES PRODUCTION IN BGY. RIO TUBA, BATARAZA

Questionnaire

Interviewer: ______________________________ Oras nagsimula: _________ Oras natapos: __________

Petsa: __________________ Barangay: ____________________ Municipality:______________________

I. PERSONAL INFORMATION

1. Pangalan ng mangingisda (optional): ___________________________
   a. Full o Part-time na mangingisda? ___ *Full-time* ___ *Part-time*
2. Kasarian:______________ Edad: _______________
3. Marital status (**Check only 1**): ___ *Single* ___ *Married* ___ *Separated/Widow*
4. Ilan ang anak? _______________
5. Edukasyon (**Check only 1**):
   __ *none* ___ *under high school* ___ *high school graduate* ___ *vocational* _____ *college level* ____ *college graduate*
6. May iba ka pa bang trabaho/pinagkakakitaan maliban sa pangingisda? ___ Wala ___ Meron
   Kung meron, ano? ___________________

II. FISHERIES INFORMATION

7. Paano nakatutulong ang mga **isda** sa inyong pamumuhay:
   __ pagkain para sa pamilya
   __ pangkabuhayan:
   ___ a) binebenta sa palengke/buyer ___ b) aquarium ___ c) binibenta ng buhay (live fish trade)
   ___ d) tourism ___ e) iba pa (isulat kung anong klase): _____________
8. May sariling bangka (**Check only 1**)? ___*Motorized* ___*Non-motorized* ____ *Both* ___ *Wala*
9. Detalye ng mga fishing gear:
   a. *kung lambat: 1)* ___ *single* ___ *2ply/3ply* ____ *fine meshed (e.g. nakakahuli ng dilis)*
   *2)*___________ *mesh size (mata)*
   *3)*___________ *haba/length (metro? dipa? banata?)*
   4) ___________ *taas/height (ilang mata?)*
   b. kung kawil: 1) ___________ *ilang hooks/kawil/taga/bingwit?*
   c. kung bubo: 1) size (metro o dangkal): _____ *width* _____ *length*
   2) gawa sa anong materyal (e.g. kawayan, plastic, etc.)? ___________________________
   2) ilang piraso (units) meron kayo? ______
   d. kung pana 1) mano-mano compressor

1 of 3

Commissioned by Terraserens Management Consultancy Services for
Coral Bay Nickel Corporation
Bgy. Rio Tuba, Bataraza

10. Gamit ang 3 gear na napili sa #11, ilang kilo ang karaniwang nahuhuli ninyo tuwing mangingisda (normal season), pag mataas ang huli (high season) at pag mababa ang huli (low season)? **Isulat sa Table 1.**

<u>Table 1</u> (For #11, 13-14)

Fishing Gear (Gamit sa pangingisda)	Uri ng mga isda na nahuhuli	Karaniwang Huli (kg)		
		Low Season	Normal	High Season
1.	1. 2. 3. 4. 5.			
2.	1. 2. 3. 4. 5.			
3.	1. 2. 3. 4. 5.			

11. Gaano kayo kadalas nangingisda? _____*Araw-araw* ______ *Beses bawat linggo (mula 1 – 6 beses)*
12. Ilan kayo sa bangka kapag lumalaot/nangingisda (no. of fishers per boat per trip)? ______________
13. Ilang oras kayo nangingisda? __________________________
14. Saan kayo madalas nangingisda? **Tingnan ang mapa at isulat ang grid number (ex: A5, D12).** _________________
15. Ito ba ay: _____ putikan ______seagrass _____ buhanginan _____ corals/bahura _____ laot) _____ iba pa (isulat kung anong klase ___________________)?

<u>Table 2</u> **(For #22-24)**

23. Anong DEKADA HULING NAKAHULI NG MARAMI **(e.g. 1950's, 1960's) ; Gaano kabigat?**		**24.** Anong DEKADA tuluyan nang NAWALA? (*zero catch*) **(e.g. 1950's, 1960's)**
Year	Volume	

25. Kamusta ang kinikita niyo mula sa pangingisda ngayon **(check only 1)**?

___ Maganda pa (nakakapagpaaral pa ng college)

___ Tamang-tama lang sa pang-araw araw na gastusin ng pamilya

___ Hindi sapat sa pang-araw-araw na gastusin ng pamilya (kailangan pa ng ibang mapagkakakitaan)

26. May pagbabago ba sa kalagayan ng pangingisda mula noong una kayong nangisda? ____ Meron ____ Wala

27. Kung MERON, ano ang pagbabago?

DAMI ng nahuhuling isda (amount): ____ bumaba ____ tumaas

URI/KLASE ng nahuhuling isda (kinds): ____ kumonti ____ dumami

Lugar na pangisdaan: __________ Lumayo, ________ Lumapit

28. Ano sa tingin ninyo ang mga dahilan ng mga pagbabago?

_____ Mahigpit na kumpetisyon dulot ng commercial fishing boats (malalaking bangka)

_____ Iligal na pagpasok ng dayong mangingisda sa loob ng munisipyo

_____ Inepektibong pagpapatupad ng mga batas o ordinansang ukol sa pangingisda

_____ Labis na pagdami ng nangingisda

_____Iba pa, ____

29. Ano sa tingin niyo ang solusyon upang mapanatili o maparami ang dami ng nahuhuling isda?

____

Maraming salamat po!

Appendix 11. Beach Profile in Tagdalungon and Ursula Island, Bgy. Rio Tuba Bataraza, Palawan

a. Beach Profile Station 1 in Tagdalungon, Bgy. Rio Tuba, Bataraza, Palawan

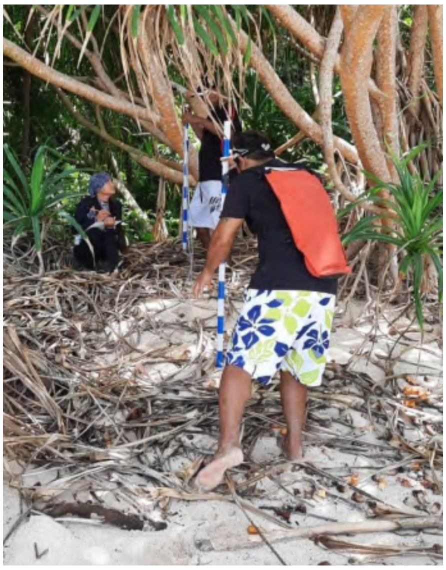
b. Beach Profile Station 2 in Tagdalungon, Bgy. Rio Tuba, Bataraza, Palawan

c. Beach Profile Station 1 in Nagoya area, Bgy. Rio Tuba, Bataraza, Palawan

d. Beach Profile Station 2 in Nagoya area, Bgy. Rio Tuba, Bataraza, Palawan

e. Beach Profile Station 1 in Ursula Island (Ursula 3), Bgy. Rio Tuba, Bataraza

f. Beach Profile Station 2 in Ursula Island (Ursula 4), Bgy. Rio Tuba, Bataraza

g. Beach Profile Station 3 in Ursula Island (Ursula 6), Bgy. Rio Tuba, Bataraza


h. Beach Profile Station 4 in Ursula Island (Ursula 9), Bgy. Rio Tuba, Bataraza

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