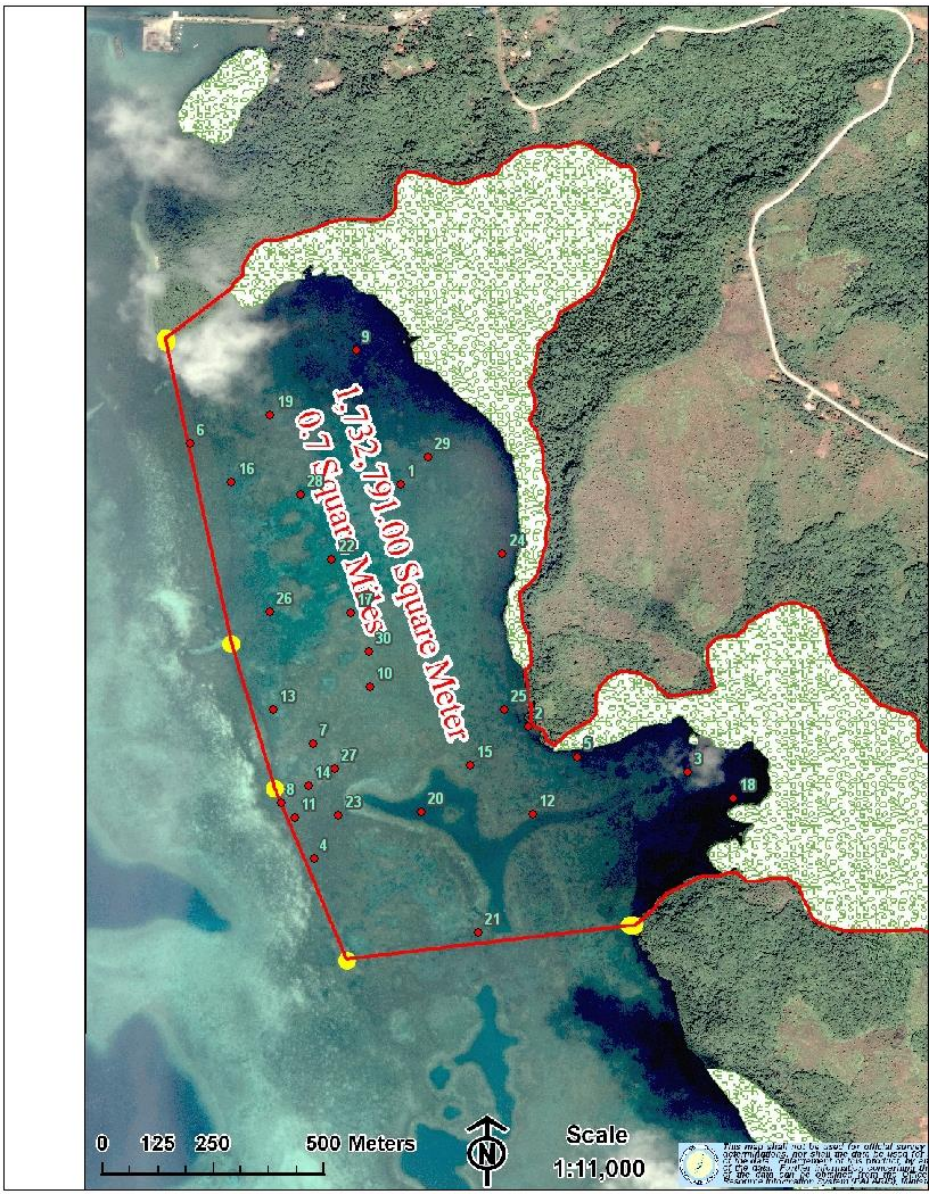
Baseline Report for the Proposed Chermang MPA



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INTRODUCTION

Legislation is currently in process to create a new Marine Protected Area (MPA), Chermang, in Ngarchelong state. The impetus for the proposed MPA came from Ngarchelong fishermen, who noticed the beneficial spillover effects on their fishing catch from Ngarchelong's first MPA, Ebiil, created by traditional *bul* in 2000 and made a legal MPA in 2004. Hoping to increase spillover benefits with an additional MPA, fishermen petitioned the Ngarchelong state government and worked with the Ebiil Society to advocate for the Chermang MPA. Chermang will be the second MPA in Ngarchelong and first in Palau to be initiated by local fishermen.

The proposed MPA will cover an area of 1,732,791m^2, which includes coral reef, seagrass, and mangrove habitats (Figure 1). The site was chosen because it has been long known to be a nursery site for economically important fish species, and to support high biodiversity of fish (including sharks), invertebrates, and turtles. It is also valued for its mangrove habitat, and has been a popular site for collecting mangrove crabs and gleaning mangrove clams. It was hoped that by protecting this site, fishers and gleaners could continue to benefit from its natural resources via spillover.

The Ngarchelong fishermen and Ebiil Society approached PICRC for technical assistance in performing baseline analysis and establishing methods that will be used by local fishermen for continuing monitoring efforts.

The objective of the study was to provide a baseline assessment of fish, invertebrate, and coral populations in Chermang. This information will provide the basis for future monitoring and allow evaluation of the proposed MPA's effectiveness.

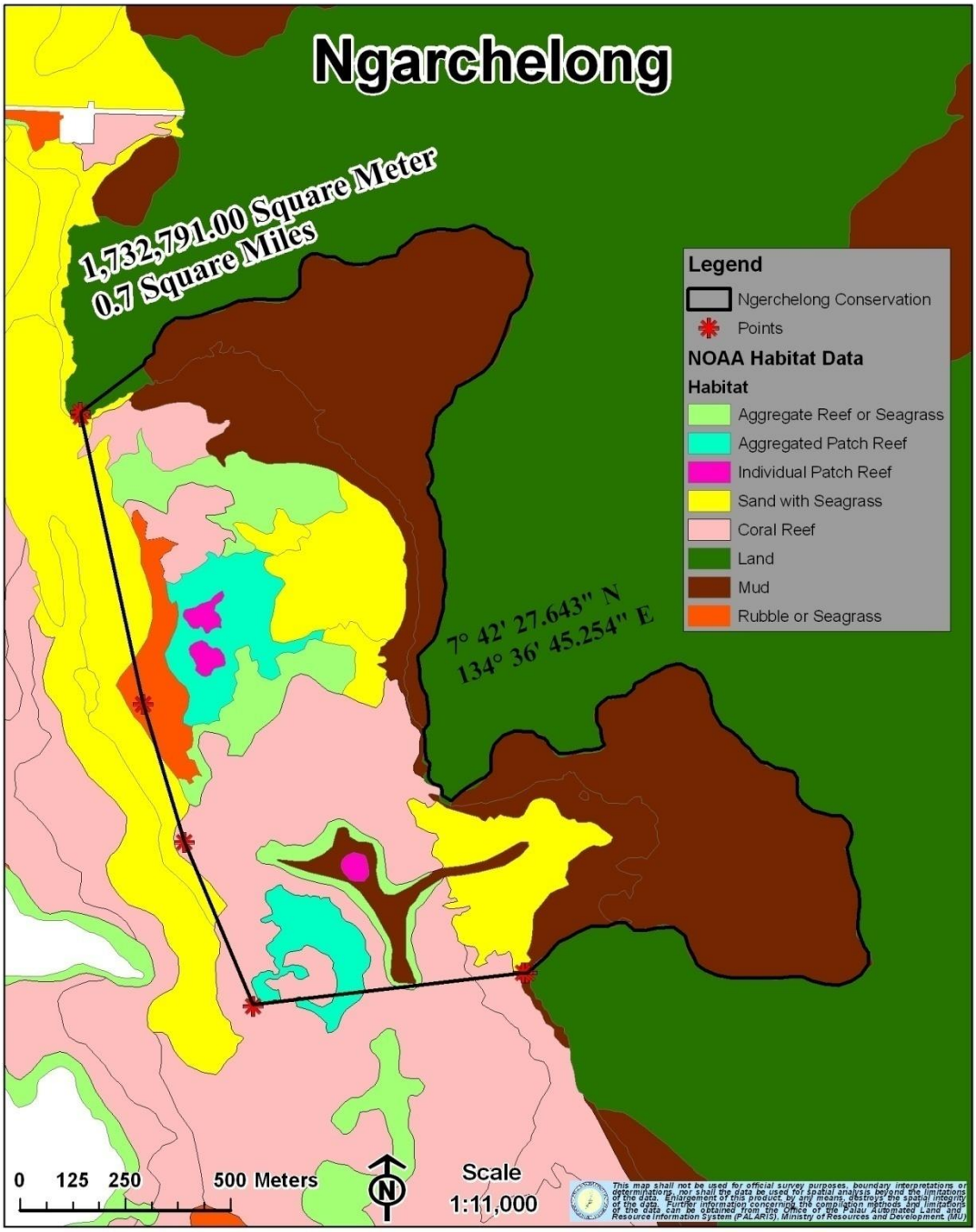

Figure 1: Habitat types in the proposed Chermang MPA

METHODS

Fish

Twelve research stations in the proposed MPA area were established, within each of which three transects (5m x25m) were surveyed. An observer recorded the species and sizes of commercially viable fishes within a 2.5m distance from the 25m transect line.Stations4, 6, 7, 9, 10, and 12 were completed on August 27th, 2013, and conducted at a depth of 1.5m. Stations 1, 2, 3, 4, 5, 8, and 11 were completed on August 28th, 2013, and conducted at a depth of 1.8m.Fish species richness was calculated as the number of different species of fish found in the proposed MPA and each station. Fish density was calculated as the average number of fish per the area of the transect (5mx25m, or 125m^2). Biomass was calculated using the length-weight relationship W=aL^b, where W is weight in grams, L is fish length in centimeters from the visual census, and a and b are constants found in Fish base.

Invertebrates

An observer moved along the same three transects as with the fish survey, recording the number and species of invertebrates that fell within 1m of either side of the 25m transect line (for a 2m x25m transect). Non-edible invertebrates were not counted in the surveys. Invertebrate species richness was calculated as the number of different species of invertebrates found in the proposed MPA. Invertebrate density was calculated as the number of individuals found per transect area (50m^2).

Benthos

Benthic cover was recorded with a photograph of a 0.5m^2 quadrat taken at every meter along the three 25m transects (25 total pictures per transect). Photographs were analyzed with CPCe (Coral Point Count with Microsoft Excel), using five random points in each quadrat.

Coral disease and size class

Three stations (1, 5, and 7) were evaluated for coral disease. The observer recorded all corals 1m from the transect (1x25m), and visually estimated a size class: Recruit (<1cm), A (1-10cm), B (11-30cm), C (31-60cm), D (61-100cm), or E(>100cm). If any corals showed signs of disease, the type of disease was recorded. The following diseases or afflictions were recorded: presence of Drupella, atramentous necrosis, black-band disease, bleaching, brown-band disease, crown of thorns scars, dark-spot syndrome, discoloration, growth anomalies (tumors), pigmentation response (pink), skeletal-eroding band, ulcerative white spots, white syndrome, and other.

RESULTS

Fish

Fish species richness

Mean fish species richness for the proposed MPA was 5 (standard error 0.9), with species richness per station ranging from 1 to 14. Species richness per station is summarized in Table 1. Total fish species richness for the proposed MPA was 25, with a total of 303 fish observed. The most commonly observed fish was *Siganuslineatus* (lined rabbitfish, or kelsebuul) with 89 individuals. The quantity of each species observed is summarized in Table 2. Since only commercially valuable fish species were recorded, these species richness values refer to diversity of commercially valuable fish only.

Table 1: Fish species richness per station

Station name	01	02	03	04	05	06	07	08	09	10	11	12
Fish species richness	6	3	3	6	14	3	5	4	6	3	4	1

Table 2: Total quantity of each fish species observed

Species	Quantity
Acanthurusnicrigauda	12
Acanthurusxanthopterus	16
Bolbometoponmuricatum	2
Cheilinusundulatus	5
Choerodonanchorago	23
Hipposcaruslongiceps	11
Kyphosusvaigiensis	5

Leptoscarusvaigiensis	13
Lethrinusharak	5
Lethrinusobsoletus	4
Lutjanusfulvus	44
Lutjanusgibbus	8
Lutjanusmonostigma	2
Nasounicornis	1
Parupeneusbarberinus	12
Plectorhinchusalbovittatus	2
Plectorhinchuschaetodonoides	1
Plectrorinchuslineatus	1
Sarcocentronspiniferum	2
Scarusgohbban	1
Siganusdoliatus	5
Siganusfuscescens	33
Siganusguttatus	5
Siganuslineatus	89
Siganuspunctatus	1

Fish density

Mean fish density for the proposed MPAwas 8.4fish/125m^2(standard error 2.8).Mean fish density per station ranged from 0.3 fish/125m^2 (standard error 0.3) to 29.3 fish/125m^2(standard error 15.9). Mean fish density by station is summarized in Table 3.

Table 3: Fish density per station

Station name	01	02	03	04	05	06	07	08	09	10	11	12
Mean fish density (#/125m^2)	7.0	5.3	9.3	4.7	29.3	1.3	27.3	2.3	5.3	1.0	7.7	0.3
Standard error	0.0	1.8	7.9	2.1	15.9	1.3	20.4	1.9	3.0	0.6	3.7	0.3

Fish biomass

Mean fish biomass for the proposed MPA was 3.6kg/125m^2 (standard error 2.1). Mean biomass per site is summarized in Table 4. Biomass values reflect only biomass of commercially valuable fish.

Table 4: Fish biomass per station

Station name	01	02	03	04	05	06	07	08	09	10	11	12
Mean biomass (kg/125m2)	1.1	0.72	1.4	0.60	24	0.30	13	0.33	0.55	0.094	0.95	0.04
Standard error	0.12	0.70	1.1	0.48	9.1	0.30	8.2	0.31	0.25	0.07	0.06	0.04

Invertebrates

Invertebrate species richness

Mean invertebrate species richness was 2.33(standard error 0.61) for the proposed MPA, with species richness per station ranging from 1 to 5.Invertebrate species richness by station is summarized in Table 5. Total invertebrate species richness for the proposed MPA was 8, and 527 total invertebrates were observed. The most common was *Stichopusvastus* (curryfish, or ngimes), with 332 individuals observed. Totals by species are summarized in Table 6. As with fish, these richness values reflect only commercially valuable species. Invertebrates were observed at only six sites: 2, 3, 4, 6, 7, and 9.

Table 5: Invertebrate species richness per station

Station name	01	02	03	04	05	06	07	08	09	10	11	12
Invertebrate species richness	0	5	3	2	0	1	2	0	1	0	0	0

Table 6: Total quantity of each invertebrate species observed

Species	Quantity
Actinopyga sp.	164
Bohadschiavitiensis	1
Hippopushippopus	20
Holothoria impatiens	4
Stichopushorrens	1
Stichopusvastus	332
Tridacnacrocea	3
Tridacnaderasa	2

Invertebrate density

Invertebrate density was 29.3 individuals/125m^2 (standard error 18.3). Mean invertebrate density per station ranged from 0.3individuals/125m^2 (standard error 0.3) to 91.3individuals/125m^2 (standard error 53.8). Mean invertebrate density by station is summarized in Table 7.

Table 7: Invertebrate density per station

Station name	01	02	03	04	05	06	07	08	09	10	11	12
Mean invertebrate density (#/125m^2)	0	91.3	71.7	8.0	0	2.7	1.7	0	0.3	0	0	0

Standard error	0	53.8	25.1	6.0	0	1.7	0.9	0	0.3	0	0	0

Benthos

Mean benthic cover for the proposed MPAwas 8.0% coral (standard error 2.4), 34.1% seagrass (standard error 7.4), 3.6%macroalgae (standard error 1.2), 31.6% sand (standard error 4.3), 2.4% rubble (standard error 0.7), 0.7% carbonate (standard error 0.2), 3.0% turf (standard error 1.0), 16.1% mud (standard error 4.8), and 0.02% other. The 34.1% seagrass is comprised of 30.5% *E. acroides* (standard error 4.1), 2.6% *T. hemprichii* (standard error 1.0), 0.04% *C. serrulatus* (standard error 0.04), and 0.8% assorted otherseagrass (standard error 0.4). Mean coral generic richness for the proposed MPA was 1.8 (standard error 0.4), with generic richness per site ranging from 0 to 9. Total coral generic richness for the proposed MPA was 15.

Coral disease and size class

Coral disease and size class weremeasured at stations 1, 5, and 7. No disease was observed. Coral size classes are summarized in Table 8.

Table 8: Coral size classes per station

Station name	Recruits (>1cm)	A (1-5cm)	B (11-30cm)	C (31-60cm)	D (61-100cm)	E (>100cm)
01	22	9	20	12	6	5
05	1	40	36	29	22	13
07	32	12	26	21	38	28
Mean	18.3	20.3	27.3	20.7	22.0	15.3
Standard error	9.1	9.9	4.7	4.9	9.2	6.7

DISCUSSION

The proposed Chermang MPA will protect commercially valuable fish and invertebrate species. The site currently exhibits fish and invertebrate density, biomass, and diversity comparable to other MPAs in Palau, suggesting that it is an important site for conservation. Primarily a seagrass habitat, the site also hosts healthy coral communities and coral recruits.The proposed MPA, however, faces continuing external threats, especially sedimentation from road development, farming, and piggeries, that suggest the need for additional land-based protection.

Continued future monitoring will be necessary to evaluate the effectiveness of the proposed MPA. To this end, reference sites outside the proposed MPAshould be established to provide a basis for comparison. Monitoring should occur at regular intervals, i.e. at least once per year, and MPA and reference sites compared to determine if fish richness, density, and biomass, invertebrate richness and density, benthic composition, and coral size class allocation and health are greater in the proposed MPA than in the reference sites. Studies of Ngarchelong fishing catches, catch per unit effort, and proportion of catch at the proposed MPA boundary could also inform the effectiveness of the proposed MPA at conferring economic benefit via spillover.