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Marine resource assessment for sustainable utilization of Snake Island, Palawan, Philippines

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Abstract. The marine resources of Snake Island were assessed from July 17 to August 9, 2008 using coastal habitat survey methods. The live benthic cover in the Island averaged 53.38% (good condition) and out of six stations, two stations have excellent reef condition. There were 171 fish species recorded the Island, with an average biomass of 37.17 mt/km^2. Snake Island has lower live coral cover and fish biomass, compared to neighbor islands due to insufficient protection and open access. However, Snake Island has its unique ecological role to marine biodiversity and characteristics of high potential tourist destination due to its wider white beach area, strategic location, and presence of excellent coral cover and attractive fishes in selected areas.

Key Words: marine biodiversity, sustainable tourism, coral reefs, reef fishes.

Introduction. In the Philippines, Puerto Princesa City has become a target recreational site both for domestic and foreign tourists, with tourist arrivals amounting to 176,347 guests in 2007 (Delos Santos 2008). Major attraction activities for tourists in Puerto Princesa are: visit to Underground River, island hopping in Honda Bay, mountain trek, city tour, SCUBA diving, snorkeling, among others. Hopping in the islands of Honda Bay attracts around 700 tourists per day, which has also become a consistent source of income to many coastal families.

However, although tourism can be a major source of income, it can have major effects on coastal environment unless the extent and type of activities are controlled and regulated. Hence, tourism should maintain sustainable use management, through biodiversity conservation practices, which ensure that renewable resources are not jeopardized, but remain available to us and the future generations (Gonzales et al 2006). Thus we have to measure tourism activities and resources in able to manage them.

The tremendous number of tourist visiting Honda Bay every day urgently calls for management of the kind, extent and locations of their activities, such that it will have very minimal impact to the environment of the islands in the bay. Negative effects of tourism could be minimized if priority is given to the identification and evaluation of resources and potential impacts, and a planning and control system is established (Clark 1996).

The more diverse and quantity of marine resources to see and enjoy, the more visitors will come, which will in turn generate income for the community and the society therein. Hence, many resort owners enhance their marine resources by means of improvement and protection in order to attract visitors (Gonzales & Bolen 2008).

Since the Island must be sustainably managed it will be important that the resources and potential impacts to the resources must be identified and assessed in order to consider it in the planning and control system of the plan. Hence, this study generally aims to conduct a marine resources assessment for planning the sustainable management of Snake Island in Honda Bay, Palawan. The specific objectives of which were to: conduct comprehensive baseline resource assessment in the marine environments of the Island, and provide recommendations for sustainable management and long term utilization of the resources of the Island. This paper presents the fish and coral components of the study undertaken by the Western Philippines University in the Island in 2008. Only few published studies are available for Palawan in terms of marine resource assessment, so that is why this study can be used as baseline data for future survey in the area.

Material and Method

The Snake Island. The Snake Island, named as *Kalungpang* Island in the National Mapping and Resource Information Authority (NAMRIA) - Philippines navigational map, is one of the 12 chartered islands of Honda Bay, situated east of the main land City of Puerto Princesa. The sand bar of Snake Island stretches out lengthily forming like a snake that the locals call it “Snake Island”. The Island is located at 9°54'12.12"N latitude and 118°49'28.38"E longitude and is situated on a 350 ha reef area, not including patches of small reefs fringing in the west of the island’s sand bar stretch. The Island can be reached by an outriggered boat within 40 min from Sta. Lourdes Pier, mainland, Palawan. Its location right at the center of Honda Bay is strategic to tourism since tourist going to neighbour islands might as well drop by this Island, because of its proximity. The total area of the Island exposed during low tide is about 27 ha, encompassing both mangrove and seagrass ecosystems, as well as sandy and coralline outcrops.

The north and northwest reef areas of the Island consist of a relatively narrow sandy beach and coral reef with depths ranging from 3.5 to 10 m. In the near west of the island, the boatmen’s association used to maintain a small area for fish feeding. This area has accumulated various species of fishes, which made it become a popular spot for visitors of Honda Bay. The south of the island is characterized by wide coral and rocky flats, the perimeter of which ends with either a gradual drop off in the east and abrupt drop-off in the south with depths ranging from 5 to 10 m. The eastern reefs slopes of the island are exposed to strong winds and water current during Northeast monsoon, facing the Sulu sea.

Survey methods. The survey was conducted July 17-19 and August 9, 2008. Dive surveys were done July 17-19, 2008. The eco-tourism team visited the Island again for ground trotting and to gather more information on fishes in the feeding area on August 9, 2008. The team used Self-Contained Underwater Breathing Apparatus (SCUBA) to survey corals and fishes. Survey stations were decided through consultation with the fishermen and Honda Bay boat operators, and by referring to a bathymetrical map of the area around the Island. Live coral cover and fishes were surveyed in stations found in Figure 1 and Table 1. Global positioning system (GPS) was used to get the coordinates of the location of stations for monitoring purposes.

Table 1

Geographical positions of the survey stations in Snake Island, Honda Bay, Palawan, Philippines, July 17 to 19, 2008

Station	*Latitude*	*Longitude*
1	9°54'24.54"N	118°49'25.98"E
2	9°54'38.94"N	118°49'50.52"E
3	9°54'35.04"N	118°51'10.86"E
4	9°53'45.00"N	118°50'31.26"E
5	9°53'40.56"N	118°49'12.18"E
6	9°53'33.33"N	118°49'27.36"E
Feeding area	9°54'12.12"N	118°49'28.38"E

Figure 1. Google earth map of Snake Island, showing the locations of coral, fish, and macro-invertebrate survey stations (Source: www.googlemap.com; accessed on June 7, 2008).

Coral cover. The survey followed the line-transect method of English et al (1997). Replicates were laid parallel to the shorelines along the drop-off belt of the island's fringing reefs. First replicates were laid along the reef drop-off belt at a depth between 10 and 60 ft (3.3-20 m). Second and third transects were laid consequently with an interval of approximately 10 meters towards the upper slopes or reef flats.

Percent benthic cover was determined by dividing the length of each of the benthic cover categories with the length of the transect line (30 m) and multiplied by 100. Mean of the three replicates represented the percent benthic cover in each of the 6 stations established. The average of the six stations represented the estimated live coral cover of the coral reefs in the Island.

For the coral reef cover survey: benthic cover were recorded by percentage cover of hard corals, soft corals, sponges, zoanthids, dead corals with algae, rubbles, rocks, sand, silt, etc.

Reef fishes. The surveys employed 30 m transect line in six stations with three replicates per station (Figure 1). All fishes encountered within 2.5 m on both sides, and 5 m above the transect line were identified and recorded on an underwater slate board. Fish abundance was determined by actual count. The total length of fish was estimated underwater which was later used to calculate the individual fish biomass. Parameters **a** and ***b*** were taken from Kulbicki et al 1993 and also from ***a*** and ***b*** values of fishes obtained locally by WPU.

References used for fish identification were: Gonzales (2005), Kuiter & Debelius (1994), Randall (1992), and Masuda et al (1984). Fishes were categorized as target (TGT), major families (MF), and as indicator (IND) (Appendix A). Target species are those commonly utilized in fisheries with varying commercial values. In this survey, examples of target fishes are groupers (Serranids), snappers (Lutjanids), parrotfishes (Scarids), and rabbitfishes (Siganids). Major families are those groups with less commercial value and are not commonly caught by fishermen. Indicator species are fish that are highly territorial such that their presence and abundance may indicate the condition of their habitat.

Sustainable tourism. Status of resources where conservation measures were based was taken from the result of the assessment. Habitats with relatively good conditions were given priorities as core zones of protected areas in the Island. Actual observations were noted and photographs were taken and used to augment documentation of the resources. Interview with boatmen regarding tourism activities were done before and after survey. Tour guides and boatmen were also interviewed regarding the protection being offered to island's resources.

Results and Discussion

Coral cover. Live benthic cover in the reefs of Snake Island ranged from 20.22% to 85.28% with an average value of 53.38%. Highest live benthic cover was found in station 2 (85.28%) followed by station 1 (79.89) and station 5 (65.89%) respectively. Lowest benthic cover was found in station 4 with the value of 20.22%. On the other hand, non-living benthic cover ranged from 14.72 to 79.78% with an average value of 46.62%. The highest non-living benthic cover was found in station 4 (79.78%) (Table 2).

Highest hard coral cover was observed in station 2 (84.11%). It was followed by station 1 and 5, respectively. Soft coral was only intercepted in stations 3, 4 and 6 of which the value ranges from 7.67 to 26.89%. The highest soft coral cover was observed in station 3 (26.89%) (Table 2).

Table 2

Average benthic cover (%) of the coral reefs in Snake Island, Honda Bay, Puerto Princesa City, Palawan, Philippines, July 17 to 19, 2008

Benthic category	*Station*						*Average*
	1	*2*	*3*	*4*	*5*	*6*	
Live benthic cover	*79.89*	*85.28*	*33.72*	*20.22*	*65.89*	*35.28*	*53.38*
Hard coral	77.50	84.11	4.94	6.11	65.33	20.72	43.12
Soft coral	0.00	0.00	26.89	12.78	0.00	7.67	7.89
Sponge	1.28	0.83	0.00	0.00	0.00	0.39	0.42
Others	1.11	0.33	1.89	1.33	0.56	6.50	1.95
Non-living benthic cover	*20.11*	*14.72*	*66.28*	*79.78*	*34.11*	*64.72*	*46.62*
Dead coral	18.89	6.89	46.94	37.17	24.67	41.50	29.34
Rock	0.00	0.00	9.44	5.72	0.00	6.39	3.59
Rubble	1.22	5.89	4.11	3.89	2.78	6.06	3.99
Sand	0.00	0.78	4.78	33.00	6.67	7.67	8.81
Silt	0.00	1.17	1.00	0.00	0.00	3.11	0.88

Total coral cover (sum of hard and soft coral cover) in six stations ranged from 18.89 to 84.11% with an average value of 51.01%. The highest total coral cover was found in station 2 (84.11%) followed by station 1 and 5 with 77.50 and 65.33%, respectively (Table 3). Among the stations established around Snake Island, two stations belong to excellent reef condition - stations 1 and 2. This adds to the number of excellent cover of coral reefs continuously discovered in Honda Bay (Gonzales 2003).

Average live benthic cover in Snake Island (53.38%) was lower compared to Pandan Island (55.31%) based on survey conducted by Becira et al (2012). However, two stations with excellent cover were recorded in Snake Island against one found in Pandan. The average live cover of Snake Island is however higher compared to Meara Island and similar with that of Bush Island (Figure 2) (Gonzales et al 2014). Live benthic cover was noted to be higher in the transect lines laid in the shallower parts, while dead corals were usually found in the drop-off belts.

The lower live coral cover in stations 3 and 4 could be attributed to the destruction of corals by the strong wave actions brought about by Northeast Monsoon (*Amihan*). The effect of collection of high valued shells like abalone and giant clams damaging the reef in the area was evident at station 6, that caused low live coral over in the areas.

Shifting from fishing to tourism activities may be one of the reasons why Snake Island still has high percentage of live benthic cover. The excellent coral cover in the west of Snake Island could be attributed to the protection given by the community (boat operators and tour guides). In addition, the presence of DENR office and "Samahan ng Mangingisda sa Honda Bay" (SAMAHOBA) have contributed to the protection and management of the area by alternately patrolling the area. The western part of the Snake Island also serves as navigational route for motor boats going to other islands in Honda Bay, where visible passenger boats would have deter illegal activities.

Table 3
Condition of reefs in Snake Island, Honda Bay, Puerto Princesa City, Palawan, Philippines, July, 2008

Station	*Total coral cover (%)*	*Reef condition**
1	77.50	Excellent
2	84.11	Excellent
3	31.83	Fair
4	18.89	Poor
5	65.33	Good
6	28.39	Fair
Average	51.01	Good

*Adjectival rating on coral reef condition was used to assess the health of coral community: < 25% - poor; > 25% but < 50% - fair; > 50% but < 75 – good, and > 75 – excellent (Gomez et al 1981).

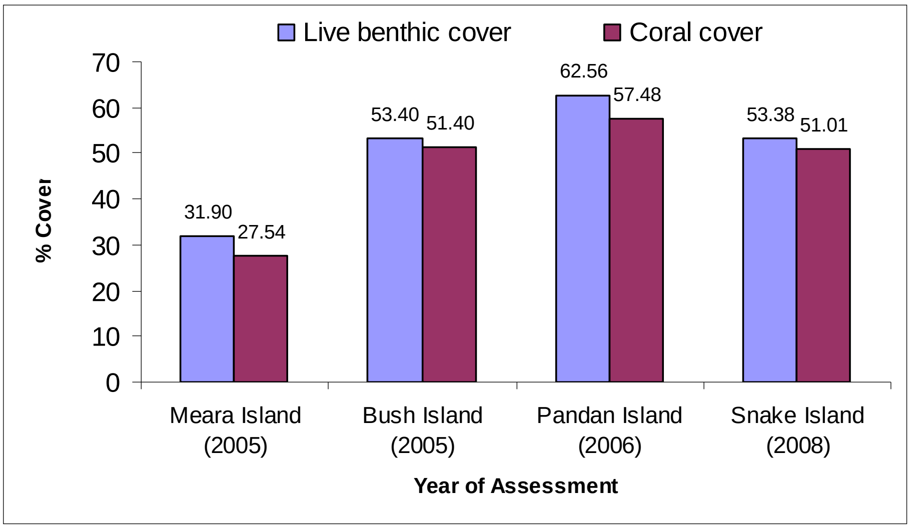

Figure 2. Live benthic and coral cover in the different assessed islands in Honda Bay, Palawan, Philippines.

Reef fishes. The total number of species observed in six stations was 165. Out of this, 162 were identified to species level and distributed to 27 families (Appendix A). The families with high number of species were Pomacentridae (39) Labridae (32), Chaetodontidae (17) Apogonidae (10), Nemipteridae (8), Seranidae (5) and Scaridae (5). These top families dominated the total fishes encountered during the survey around the island (represent 71.60%).

Some individuals of juvenile leopard coral grouper (*Plectropomus leopardus*) were observed in stations west and northwest of the Island, but no adult fish was noted. This implies that the population of this grouper is depleted.

Small schools of Caesionids were found in some stations: feeding area, stations 3 and 4, though smaller sized Caesionids were observed in stations 1 and 2 also. The results also showed that among the three categories (target, major families and indicator species), indicator species got the highest percentage (40%) composition followed by major families (38%), and target fish species (22%) (Appendix A). Although, the number of commercial species was high their sizes were considerably small, except in the feeding area where some large sizes of Siganids and Caranx were encountered.

The number of chaetodontids (Butterflyfishes) was considerably very low (10.49%). Butterflyfishes have been used as indicators for healthy coral reefs. In the case of Snake Island, some reefs that serve as refuge to butterflyfishes were observed to be in the process of regeneration.

Pomacentridae (Damselfishes) is known to comprise highly territorial reef fish. In this survey, this group had the highest individual count (2,151.00) with the relative abundance of 64.55%, followed by Caesionidae, 396 (10%) and Labridae, 271 (7%).

The average fish biomass was estimated at 37.17 mt/km^2. Station 4 has the highest fish biomass, 20,736.75 g/450 m^2 (46.08 mt/km^2) and most diverse (162 species/1000 m^2). Station 5 had the highest density (2,133 individual/1000 m^2). Based on the category of Hilomen et al (2000), the average fish biomass (37.17 mt/km^2) of Snake Island is considered high (Table 4).

The result showed that the fish biomass in the Island is higher than that of Pag-asa Island, with an average biomass of 23.3 mt/km^2 (Dantis et al 1999) is far lower than that of Pandan Island, 84.00 mt/km^2 (Gonzales et al 2006), which is only about 2 nautical miles south, but it is interesting to note that the fish diversity of the two nearby islands are very similar since they are adjacent (Table 4).

The fishes at stations 1, 2, 3 and 4 were obviously attracted to the movements of divers. This behaviour indicates that many of them are domesticated and used to presence of divers and accustomed to feeding.

The abundance of the fish was estimated at 1.4 individuals/m^2 with the average fish density of 1,444 individuals/1000 m^2 and is categorized as moderate. The high category ranged from 2,268 to 7,592 individuals/1000 m^2 density (Hilomen et al 2000).

The densities of fishes in the east side of the island were higher compared to those located in the west, though coral cover were low (Table 4). This might have something to do with the dynamics brought about by the Sulu Sea in the east side of the Island. Primary production study would greatly be useful to infer on the density and population status of fishes in the Sulu Sea side of Snake Island. This finding is similar to the finding in Pagasa Island (Gonzales & Bolen 2008) that coral reefs has low live cover while there was very high fish densities.

Table 4

Some ecological indicators of reef associated fish species in six fish sampling stations around Snake Island, Palawan

Station	*Depth (ft)*	*Families (species/ 1000 m^2)*		*Diversity (individual/ 1000 m^2)*		*Density (mt/ km^2)*	*Biomass*	*Remarks for biomass*
1	10-50	13	*(43)	96	*(584)	1,298	37.19	High
2	10-30	9	(36)	80	(537)	1,193	19.86	Medium
3	10-24	17	(64)	14	(520)	1,156	44.2	High
4	15-30	22	(79)	176	(746)	1,658	46.08	High
5	20-39	16	(64)	142	(960)	2,133	33.26	High
6	14-40	19	(67)	149	(552)	1,227	42.35	High
**Feeding area			(47)		(346)			

*Actual count per station (450 m^2); **Data in the feeding area was excluded in the total and average biomass; Total Fish Biomass = 223.09 mt/km^2; Average Biomass = 37.17 mt/km^2.

Conclusions and recommendations. Since Snake Island coral reef cover has better mean percentage live cover (more than 50%) compared to other coral reefs in Palawan and the Philippines, its integrity should be maintained and reefs must be protected to further improve its status. For the purpose of proper eco-tourism planning and management, Snake Island and its reefs should be classified into core zone and multipurpose zones (Figure 3). Area or zones for biodiversity conservation and multi-use, including eco-tourism must be distinct and clearly understood. In this way policies and regulations would be clear and would become legal basis for law enforcement.

Coral reef areas in the island should be managed through the establishment of marine protected area, where a fish sanctuary should be established as a core (no take) zone to serve as reservoir and generator of marine plants and animals in the area, and multipurpose zone to cater to the needs of fishers and other stakeholders for their respective interest (Figure 3). The reefs should be managed in a way that it would not only generate and enhance the reef ecosystem, but also extend aesthetic and educational values to visitors.

Damaged coral reefs if properly protected could recover within the span of five to ten years (Veron 1986). In addition, regular monitoring of the reefs shall be done in order to detect changes in reefs' conditions, so that managers could readily adjust management schemes parallel to the status and trends of the reefs, especially in relation to climate change.

Diver/swimmer capacity should also be considered in the area. Too many swimmers disturb the ecological processes operating in the system overtime. Excessive disturbance may cause animals to leave primary feeding or reproductive areas that may lead to decline in biodiversity, which is a primary feature that attracts tourists.

The portions of the northwest, west, and south sides of the Island are proposed for core zone, while the rest of the areas in the Island are for multi-use zone (Figure 3). However, multi-use zone has to have regulated activities in order to ensure the health of the resources and its habitats.

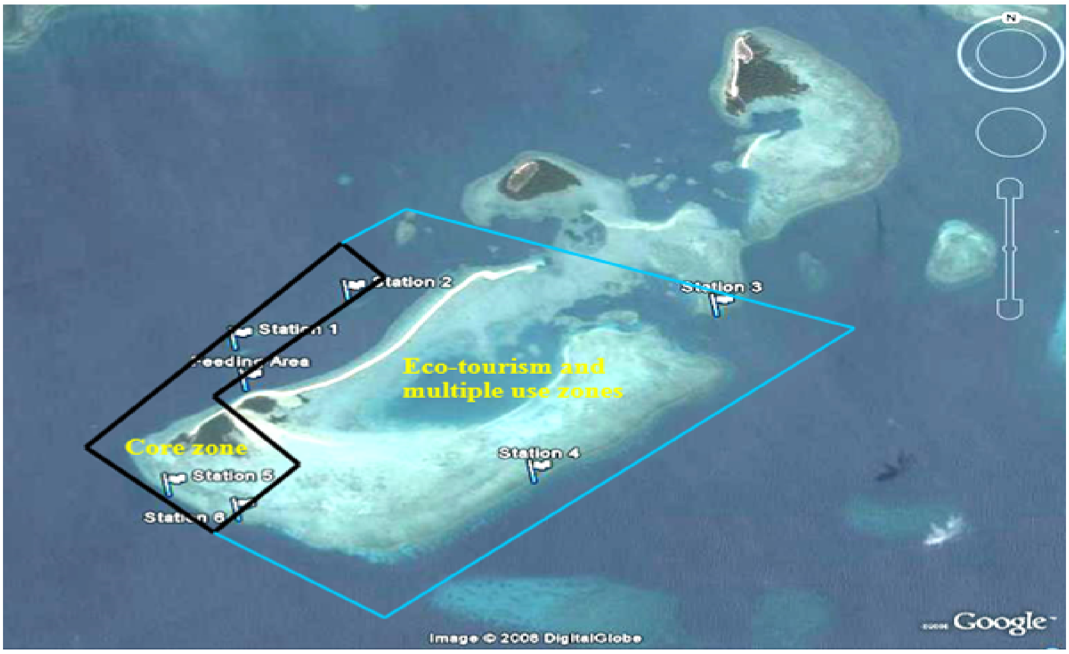

Figure 3. Map showing the proposed zoning of the protected area for Snake Island. Core zone in black, while multipurpose use zone in aqua blue.

Recommended swimming areas are practically located around the Island's long beach. However for safety purposes, the shallow waters at the northeast of the Island are most recommendable.

The east shore beach of the island is an alternative swimming area for guests and visitors, with similar beautiful waters and beach with the northwest shore. There are more beaches to swim in the Island, however, only selected portions are recommended in order to conserve and protect the life forms in the core zone (Figure 4).

There is only one ideal docking area identified for sea vessels, located in the west of the island (Figure 4). This area is suitable for docking because its location is at the leeward (covered from the wind) of the *Amihan*. Additionally, this area is very accessible to cottages and snorkeling/swimming areas. Small boats may dock on sandy beaches around the island, but only during high tide, and must observe environmentally safe engine operation and maintenance with regards to fuel and oil (e. g., bilge pump discharge of water contaminated with oil or fuel, changing engine oil). Presence of corals in shallow reefs must also be noted prior to docking. Recommended locations for cottages are the existing areas where cottages can be found. Infrastructures to be built in the Island should be regulated, for example, made of light materials, limited to table cottages, dressing rooms, information hut, comfort rooms, etc. Comfort rooms should be provided with environmentally sound facilities.

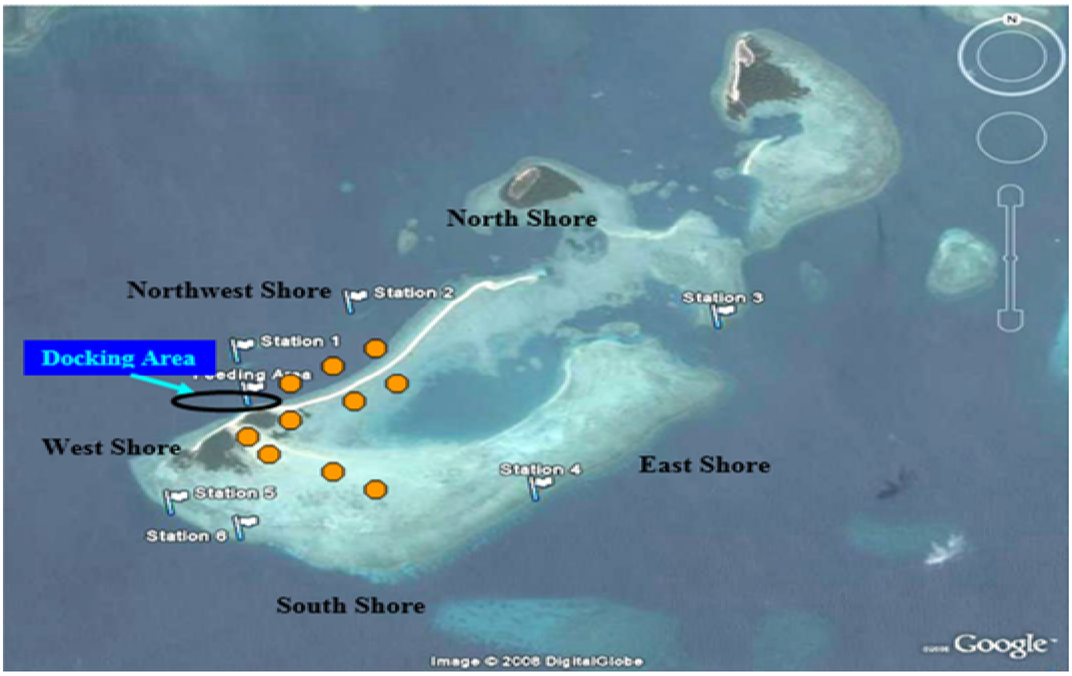

Figure 4. Map of Snake Island showing the north, northwest, south, east, and west shores, with recommended swimming areas (round orange), and the docking area (black ring).

Snorkeling sites are shown in Figure 5. Snorkeling areas must be characterized by a relatively shallow water depth, but deep enough to prevent divers to physically come in contact with the corals especially during low tide. The reef flat south of the Island is ideal for snorkeling to view clown fishes and sea urchins. It is characterized by boulders of massive reefs and patches of large seagrasses. One can observe digitate dominated coral communities towards the reef slope. Boats with transparent bottom may be used for underwater viewing by non-swimming and-diving guests. More areas for skin dive should be exploited to accommodate more divers in peak season.

Potential sites for SCUBA diving are located at drop offs of the Island (Figure 5). Divers seeking for giant clams and sea urchins must visit the southern drop off (stations 5 and 6). Coral reefs with excellent live cover and diverse types and shapes could be found in stations 1 and 2 (Figure 5).

Recommended fishing areas are found in drop offs around the island. Promising fishing sites are the Sulu Sea side of the Island and the body of water between Snake and Pandan Islands. In fishing, only handlines or pole and lines can be used. Fishing areas should be distinct from diving areas, because fishing hooks may disturb divers underwater. Visitors must not fish in areas designated as diving sites. Tour managers must be well informed of the spawning periods and size at maturity of fishes, so that fishing can be close during spawning periods. Practice of catch and return principle that allows the return of small fish that you caught into the sea, if it is still young, or if you do not have much interest in it will contribute to the sustainability of fish in the area.

Fish feeding is currently done in the northwest shore of the Island. Although this activity is very effective in attracting and entertaining tourists, it should not be encouraged, because it could entail a long term effect on the feeding capacity and behavior of fishes being feed. For example, fish that depends on feeds given by humans will lose its ability to find food by itself. Furthermore, fish will consume food that is alien to its natural food. This could have an effect on the biological process of the fish. As such, it is important to observe or conduct formal studies on this topic. It should be noted that feeding areas should not be in the same place with fishing areas. Feeding fishes could be disturbed by the fishing activities and fishes may stay away from the feeding area. Once the fishes are domesticated by feeding, feeding could be used by unscrupulous fishermen to gain more catch. Diving areas and feeding areas could be the same.

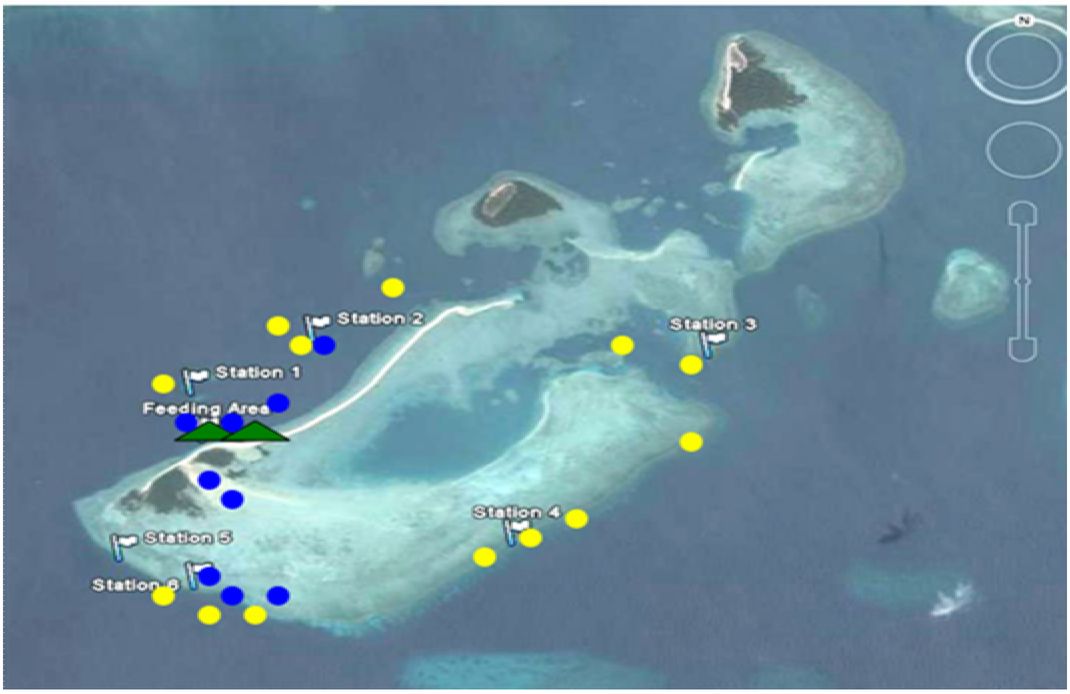

Figure 5. Map of Snake Island showing the recommended SCUBA dive sites (yellow circle), snorkeling sites (blue circle), and cottages (green triangle).

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Appendix A

Reef fish species composition Snake Island, Honda Bay, Palawan with its category: target (TGT), major families (MF), indicator species (IND) and distribution (percentage)

Family	*Species*	*TGT*	*MF*	*IND*
Apogonidae	*Apogon compressus*		X	
	Apogon polyacanthus		X	
	Apogon rhodopterus		X	
	Apogon trimaculatus		X	
	Cheilodipterus macrodon		X	
	Cheilodipterus quinquelineatus		X	
	Ostorhinchus novemfasciatus		X	
	Sphaeramia nematoptera		X	
	Sphaeramia orbicularis		X	
	Taeniamia fucata		X	
Acanthuridae	*Ctenochaetus binotatus*	X		
	Ctenochaetus striatus	X		
	Zebrasoma scopas	X		
Aulostomidae	*Aulostomus chinensis*		X	
Balistidae	*Balistapus undulatus*		X	
	Balistoides viridescens		X	
	Pseudobalistis flavimarginatus		X	
Caesionidae	*Caesio caerulaurea*	X		
	Caesio cuning	X		
Carangidae	*Caranx ignobilis*	X		
Centriscidae	*Aeoliscus strigatus*		X	
Chaetodontidae	*Chaetodon baronessa*			X
	Chaetodon bennetti			X
	Chaetodon ephippium			X
	Chaetodon mesoleucus			X
	Chaetodon multifasciatus			X
	Chaetodon octofasciatus			X
	Chaetodon ornatissimus			X
	Chaetodon oxycephalus			X
	Chaetodon speculum			X
	Chaetodon trifasciatus			X
	Chaetodon unimaculatus			X
	Chelmon rostratus			X
	Coradion chrysozonus			X
	Heniochus chrysostomus			X
	Heniochus diphreutes			X
	Heniochus singularius			X
	Heniochus varius			X
Ephippidae	*Platax orbicularis*			X
Fistulariidae	*Fistularia petimba*		X	
Haemulidae	*Plectorhinchus diagrammus*	X		
	Plectorhinchus chaetodontoides	X		
	Plectorhinchus lessonii	X		
	Plectorhinchus pictus	X		
Holocentridae	*Myripristis vittata*		X	
	Myripristis murdjan		X	
	Sargocentron cornutum		X	
Labridae	*Anampses meleagrides*		X	
	Bodianus bilunulatus		X	

	Bodianus mesothorax		X	
	Cheilinus celebicus		X	
	Cheilinus chlorurus		X	
	Cheilinus diagrammus		X	
	Cheilinus fasciatus		X	
	Cheilinus oxycephalus		X	
	Cheilinus trilobatus		X	
	Choerodon anchorage		X	
	Choerodon oligacanthus		X	
	Coris batuensis		X	
	Coris variegata		X	
	Epibulus insidiator		X	
	Halichoeres argus		X	
	Halichoeres chloropterus		X	
	Halichoeres hoeveni		X	
	Halichoeres marginatus		X	
	Halichoeres melanurus		X	
	Halichoeres ornatissimus		X	
	Halichoeres richmondi		X	
	Hologymnosus annulatus		X	
	Labrichthys unilineatus		X	
	Labroides dimidiatus		X	
	Macropharyngodon ornatus		X	
	Oxycheilinus unifasciatus		X	
	Pseudocheilinus evanidus		X	
	Pseudocheilinus octotaenia		X	
	Stegastes lividus		X	
	Stethojulis trilineatus		X	
	Thalassoma hardwicke		X	
	Thalassoma lunare		X	
Lutjanidae	*Lutjanus carponotatus*	X		
	Lutjanus decussatus	X		
	Lutjanus fulviflamma	X		
	Lutjanus guttatus	X		
Microcanthidae	*Microcanthus strigatus*		X	
Microdesmidae	*Ptereleotris evides*		X	
Mullidae	*Parupeneus barberinus*		X	
	Parupeneus indicus		X	
	Parupeneus multifasciatus		X	
	Upeneus tragula		X	
	Mulloidichthys flavolineatus		X	
Nemipteridae	*Pentapodus caninus*	X		
	Scolopsis cancellatus	X		
	Scolopsis ciliatus	X		
	Scolopsis lineatus	X		
	Scolopsis margaritifer	X		
	Scolopsis personatus	X		
	Scolopsis taenioptera	X		
	Scolopsis trilineata	X		
Ostraciidae	*Ostracion solorensis*		X	
Pomacanthidae	*Chaetodontoplus melanosoma*			X
	Chaetodontoplus mesoleucus			X
	Chaetodontoplus octofasciatus			X
	Paracentropyge multifasciata			X

Pomacentridae	*Abudefduf sexfasciatus*			X
	Abudefduf vaigiensis			X
	Acanthochromis polyacanthus			X
	Amblyglyphidodon aureus			X
	Amblyglyphidodon curacao			X
	Amblyglyphidodon leucogaster			X
	Amblyglyphidodon ternatensis			X
	Amphiprion akindynos			X
	Amphiprion chrysopterus			X
	Amphiprion clarkii			X
	Amphiprion melanopus			X
	Amphiprion ocellaris			X
	Amphiprion perideraion			X
	Chromis flavomaculata			X
	Chromis ternatensis			X
	Chrysiptera parasema			X
	Chrysiptera starki			X
	Chrysiptera caeruleolineata			X
	Dascyllus trimaculatus			X
	Dischistodus perspicillatus			X
	Neoglyphidodon melas			X
	Neoglyphidodon nigroris			X
	Neopomacentrus anabatoides			X
	Plectroglyphidodon johnstonianus			X
	Plectroglyphidodon lacrymatus			X
	Plectroglyphidodon phoenixensis			X
	Pomacentrus alexanderae			X
	Pomacentrus amboinensis			X
	Pomacentrus bankanensis			X
	Pomacentrus lepidogenys			X
	Pomacentrus molluccensis			X
	Pomacentrus nigromarginatus			X
	Pomacentrus sp. (binduyan)			X
	Pomacentrus sp. (gray)			X
	Pomacentrus sp. (palata)			X
	Pomacentrus vaiuli			X
	Pomacentrus sp.			X
	Pomachromis richardsoni			X
	Stegastes lividus			X
Pseudochromidae	*Labracinus cyclophthalmus*		X	
	Pseudochromis fuscus		X	
Scaridae	*Bolbometopon bicolor*	X		
	Scarus frenatus	X		
	Scarus sp. (brown)	X		
	Scarus sp. (brown)	X		
	Scarus sp. (green)	X		
Serranidae	*Cephalopholis boenak*	X		
	Cephalopholis cyanostigma	X		
	Diploprion bifasciatus	X		
	Ephiniphelus merra	X		
	Plectropomus leopardus	X		
Siganidae	*Siganus canaliculatus*	X		
	Siganus spinus	X		
	Siganus virgatus	X		

		Siganus vulpinus	X		
Tetraodontidae		*Arothron nigropunctatus*			X
		Canthigaster bennetti			X
		Canthigaster papua			X
Zanclidae		*Zanclus cornutus*			X
Total	27	162	36	61	65
Percent		100	22	38	40