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Cover Photo

Haliotis asinina, the largest and highly prized species of abalone in the Philippines has been excessively harvested for export, severely affecting its wild population. To help restore its population and support the needs of the growing abalone aquaculture industry, the WPU and its partners engage in the mass production of *H. asinina* for cage culture and eventual restocking in the wild (Photo by R. Dolorosa).

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Editorial

Endowed with relatively intact forests and spectacular reef formations teeming with astounding biodiversity, the island of Palawan has been dubbed as the Philippines 'Last Ecological Frontier' and declared by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as 'Man and Biosphere Reserve'. While the significance of its resources gained global support and recognition, the danger that Palawan faces against the forces of both human and nature remains a major challenge among the academe, local and national government units, non-government organizations and to all concerned individuals whose life depends on what bounty the land and sea could offer.

With its vision to become the leading centre for sustainable development in the west Philippines and beyond, the Western Philippines University through collaborative works and funding support from various institutions here and abroad, has worked on varied sustainable biodiversity utilizations. With our desire to reach a wider audience and encourage more people to join us in this vital quest, the university publishes original research articles in aquatic sciences in this issue, the first externally referred.

The Palawan Scientist is a peer-reviewed multi-disciplinary journal that welcomes original research articles in various fields of social and natural sciences. It is hoped that through this journal, a culture of information sharing is strengthened within Palawan and expanded through time; and may this guide us all in making a difference in the world we are in today.

Thank you for all your contributions!

Roger G. Dolorosa, PhD
Editor-in-Chief

Fecundity and condition factor of abalone *Haliotis asinina* broodstock conditioned in banana leaf and "buho" slat substrates

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ABSTRACT

This study was conducted to document the spawning behaviour and determine the fecundity and condition factor of the female abalone *Haliotis asinina* broodstock conditioned using two indigenous substrates, the banana (*Musa* spp.) leaf and "buho" (*Schizostachyum lumampao*) slat, for three months at Western Philippines University-Binduyan Marine Research Station (WPU-BMRS). Those abalone conditioned with no substrate served as control. Forty-five female broodstocks with 5-7cm shell length were used in the study. The spawning episode of the three treatments did not correlate with the lunar cycle. They spawned either later or earlier than the full moon and new moon. Spawning happened 3-5 nights in a row with an interval of 8-10 days. There was no significant difference (P>0.05) among the three treatments on the number of individuals that spawned within the four spawning episodes. Abalone conditioned in banana leaf substrate had an average fecundity of 259,353.21±39,307.63 eggs. However, there was no significant difference among treatments (P>0.05). The initial and final condition factors of each treatment were significantly different (P<0.01) but there were no significant differences on the condition factor among treatments. The indigenous substrates, banana leaf and buho slat are potential alternative substrates for broodstock conditioning. However, spawning performance and fecundity of abalone broodstock were not influenced by the substrates. Similar long-term studies are recommended.

Keywords: abalone, broodstock, condition factor, fecundity, *Haliotis asinina*, substrates

INTRODUCTION

Throughout many parts of Asia, abalones are highly prized seafood (Butterworth 2010). They have been collected more than 7,000 years ago along the Pacific coast for food and for the manufacture of shell implements and mother-of-pearl decorations (Olin 1994). Among the five species of tropical abalone in Philippine marine waters, *Haliotis asinina* is the biggest which is being cultured in the country (SEAFDEC 2000, 2008).

The abalone *H. asinina* achieves sexual maturity within 6-8 months of culture at shell size range of 35-40mm (SEAFDEC 2000). The smallest individual with a mature gonad from the wild is about 40mm shell length while hatchery reared abalone is about 35mm (Capinpin et al. 1998). Tank-reared broodstock can spawn year-round (SEAFDEC 2000). There is no need for induction for *H. asinina* broodstock for they are able to spawn in the hatchery. Moreover, gonadal maturity and readiness to spawn can be assessed visually. Mature abalone which are ready to release gametes are generally creeping near the water surface. They are active but relaxed and their feet felt soft and flabby (Setyono 2006).

Various studies have used artificial substrate in rearing *H. asinina* such as plastic cages and polyvinyl chloride (PVC) pipes, both offshore and in indoor tanks (Capinpin et al. 1999, Setyono 2007, Minh et al. 2010). There are also unpublished studies that used indigenous materials as culture substrate such as bamboo (Villapa 2009), wood (Valdestamon 2009) and coconut stalk (Lota 2009). However, indigenous substrates have not been tried as conditioning substrate for abalone broodstock. In this study, two indigenous materials, banana leaf and “buho” slat were used to determine the spawning pattern, fecundity and condition factor of abalone broodstock.

MATERIALS AND METHODS

Experimental Area and Duration of Study

This study was conducted at the Western Philippines University – Binduyan Marine Research Station (WPU–BMRS) in Bgy. Binduyan, Puerto Princesa City from July to September 2012. The site is 79km away from the city proper of Puerto Princesa. Nine tank compartments were used in this study. Each compartment was placed with one conditioning basket (Figure 1). The abalone broodstocks were conditioned at 25-29^{o}C temperature and 30-37ppt salinity in wooden tanks. Four spawning episodes occured during the study period.

Figure 1. Photograph of the wooden tank compartments (left) and conditioning basket with *Gracilaria* sp. as abalone food (right).

Experimental Design

This study used indigenous materials as test substrates, the banana (*Musa* spp.) leaf and “buho” (*S. lumampao*) slats. Those with no substrates served as control. Each treatment had three replicates. The treatments and replicates were distributed using Completely Randomized Design (CRD). Test substrates were placed inside the conditioning baskets.

Test Abalone Management

The female abalone broodstocks were procured from Bgy. Tagburos, Puerto Princesa City. They were kept in a fiberglass tank filled with sea water and provided with aeration while in transit from Tagburos to Binduyan. At BMRS, the abalone broodstock were conditioned in concrete tank for two weeks before the experiment. Conditioning gave the abalone time to acclimate to a contained environment and to prepare its body for spawning. Forty-five individuals were used in this study with shell length ranging from 5-7cm. Each replicate had five individuals of female abalone broodstock. Each female abalone broodstock was tagged (e.g. 1A1, 1B1, 1C1…) using a dymo plastic tag attached with epoxy on abalone shell to monitor each individual’s performance.

Tank and Substrate Preparation and Management

Nine wooden tank compartments (97cm × 80cm × 60cm) were used for all replicates. Each compartment was cleaned before filling it up with sea water. Nine conditioning baskets (60cm diameter × 55cm high) were used. They were made of cut PVC pipes as frame and plastic (Amazon®) net as enclosure which were tied with polyamide nylon.

Slats of “buho” were tied with polyamide nylon while banana leaves were sewed with monofilament nylon “kuralon”. Fabricated substrates were placed in tanks and soaked in sea water for 10-15 days to condition the indigenous materials. Each substrate had a dimension of 40cm × 25cm. Five pieces were stacked together to form a holder which was placed inside the conditioning basket. Change of water was done every other day in the holding tanks.

Broodstock Management

Female abalone broodstocks were placed in wooden compartments after they had been conditioned in concrete tank. Before stocking, the shell length (mm) was measured using Vernier caliper and the total weight (g) by digital weighing scale. The broodstocks were fed *ad libitum* with seaweeds (*Gracilaria* spp.). Monitoring was done every morning and afternoon for water quality parameters such as temperature (thermometer), salinity (refractometer) and checking of aeration. Siphoning of dirt was done every morning for the maintenance of good water quality. At least 60% of the water was replaced every other day.

Broodstock Selection and Spawning

Materials such as glass and plastic containers, beakers, plastic cups, pipettes, stirring rods, portable aerators and spatula were prepared before the time of spawning. Spawning was checked and monitored from 10:00pm to 3:00am. The abalone was separated when it was creeping toward the water surface and ready for spawning (Setyono 2006). Its gonad development was assessed before placing it in the glass container for spawning observation (Table 1). Upon inspection, the abalone with gonad stages 2 -3 was selected to be placed in the glass container.

Table 1. Stage of gonadal development of *H. asinina* (after Singhagraiwan and Doi 1992).

Stages	Criteria used for observation by the naked eye
0	No gonad development
1	Pre-matured gonad covering a little portion of hepatopancreas
2	Partially matured gonad covering about 25% of hepatopancreas
3	Fully matured gonad covering about 50% of hepatopancreas

The glass container that contained 5L of seawater had an aeration from a portable aerator. One glass container was used for each abalone. The individual female abalone that crept towards the top of the container and about to spawn was monitored closely to avoid spilling of eggs outside the container. Sometimes, the glass container was covered with basin to capture spawned eggs. After spawning was completed, each broodstock was lifted out of the container and put back in the conditioning basket. The water inside the spawning container was stirred gently to distribute the eggs well in the water column. A 250ml beaker or plastic cup was used to scoop egg samples, from which 1ml aliquot sample was extracted using a glass pipette. The aliquot was placed in the Sedgewick chamber and viewed under the microscope with high power objective (HPO) (40x) magnification.

The eggs present were counted and sampling was repeated for five times. Fecundity (F) was computed using the formula:

$$F = \frac{\text{total number of eggs counted}}{\text{volume of sample}} \times \text{total volume of container}$$

Spawning Performance

Each spawner was checked if it had fully spawned or partially spawned every spawning night. All female abalones with stage 3 gonads were spawners while some of those with stage 2 gonads were partial spawners. Handling from experimental basket to glass container did not interrupt the spawning. The abalones that spawned and did not spawn were recorded as well as their fecundity.

The spawning performance (SP) was computed following the formula:

$$SP = \frac{\text{number of individuals that spawned}}{\text{total number of individuals}} \times 100$$

Condition Factor

The condition factor of each individual was computed by using the formula:

Condition Factor or $K = (W/L^{2.99}) \times 5575$ (see Dlaza 2006).

where: W – body weight (g), L – shell length (mm)

Data Analyses

The data were encoded in the Microsoft Excel program and analysed using ANOVA or T-test and descriptive statistics. The computer program included a sort routine which automatically generated the stand tables and corresponding charts which were presented in means ± standard error.

RESULTS AND DISCUSSION

Spawning Performance

Spawning performance during each spawning episode refer to the number of individuals that spawned per treatment. All female abalones that spawned during the duration of the study have contributed to the overall spawning performance. Within four spawning episodes, the abalone conditioned in no substrate had 93.3% (14 of 15) spawning performance, in banana leaf substrates was 86.6 % (13 of 15) and in buho slat substrates was 73.3 % (11 of 15) (Table 2).

Table 2. Spawning performance of abalone in three treatments (T) during the first, second, third, fourth episodes and the overall spawning data.

T	First spawning		Second spawning		Third spawning		Fourth spawning		Overall	
	No.	%	No.	%	No.	%	No.	%	No.	%
1 (BLS)	7	46.7	9	60.0	10	66.7	9	60.0	13	86.6
2 (BS)	8	53.3	11	73.3	10	66.7	4	26.7	11	73.3
3 (NS)	12	80.0	11	73.3	12	80.0	3	20.0	14	93.3

Within the four spawning episodes, abalone conditioned in buho substrates and no substrate showed high performance on the 1st to the 3rd spawning episodes but low on the 4th spawning. On the other hand, abalone conditioned in banana leaf substrates showed a maintained performance within the four spawning episodes. There was no significant difference (P>0.05) among the three treatments on the number of individuals that spawned during the four spawning episodes. The first and second spawning episodes happened within 1-3 nights after the new and full moon, respectively. The third spawning episode was within the lunar cycle but the 4th episode was earlier than the lunar cycle compared to the three spawning episodes (Figure 2).

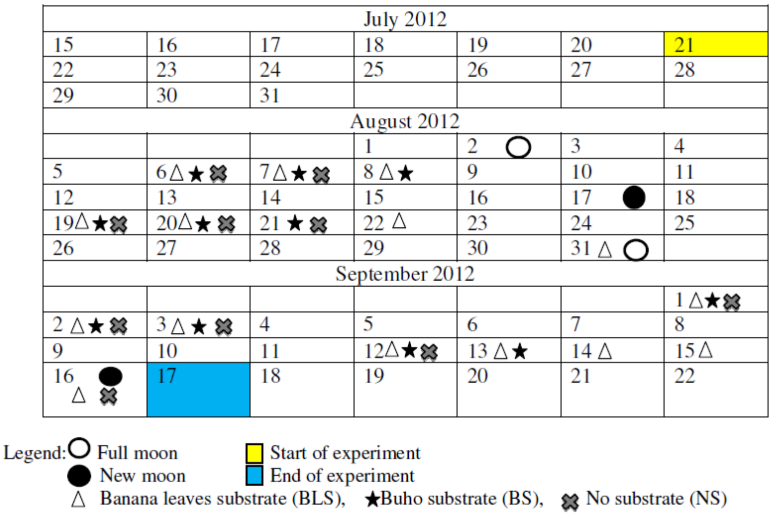

Figure 2. Spawning calendar of abalone broodstock during the four spawning episodes.

The spawning performance showed that abalone conditioned in each treatment did not always follow the lunar cycle, hence not predictable. However, Capinpin & Hosoya (1995) observed that spawning coincided with new and full moon for recently captured *H. asinina* held in tanks. This lunar periodicity lasted for two months after which spawning continued every two weeks but no longer coinciding with the lunar cycle. In other words, spawning cycle is entrained with the new and full moon periods. In another study, the time interval between successive spawning of hatchery-reared abalone provided with optimal rearing conditions and adequate algal food was 13-15 days (Capinpin et al. 1998). Abalone spawn at night during 11:00 PM to 3:00 AM. Males usually spawn first then followed by the females. According to Capinpin (pers comm.), abalone kept too long before being used in the experiment may lose spawning synchronicity with the lunar cycle as cues and being associated with new and full moon can no longer be experienced by the abalone.

On the other hand, spawning of *H. asinina* in Heron Reef, Australia did not correlate precisely with the lunar cycle but much relate to the tidal cycle (Counihan et al. 2001). Abalone in this study shows an asynchrounous spawning pattern which is similar to the report of Capinpin et al. (1998). There are instances that an individual may spawn partially during the spawning episode but does not spawn its eggs in one release. In Heron Reef, Australia, *H. asinina* are considered as extremely synchronous spawners (Counihan et al. 2001).

In this study, spawning episode happened within 3 - 5 nights. This was longer than those in Heron Reef, Australia with spawning episode of 1 to 3 nights (Counihan et al. 2001). The spawning interval between two successful spawning episodes varied from 8 - 10 nights. This was however, shorter than in Heron Reef, Australia which was 12 to 15 days (Counihan et al. 2001) and hatchery-reared abalone which was 13 to 15 days (Capinpin et al. 1998). As observed during the study, abalones conditioned in banana leaf substrates have longer and earlier spawning episodes. The other treatments (buho & no substrate) have shorter spawning night and sometimes behind scheduled date (Figure 2). During spawning events, the abalone would creep near the water surface and move its muscular foot above the water level (Setyono 2006). On spawning nights at 10pm – 3am, the abalones were actively crawling and creeping up and down the water column. Some would even creep and show a cue of spawning even they did not possess mature gonad.

Fecundity

Abalone on banana leaf substrates had high average fecundity during the first spawning episode with 417,457.14±110,01554 eggs. Those in no substrate had high average fecundity of 664,666.7±197,333.3 eggs on the fourth spawning episode. Those in buho substrates had generally low average fecundity and the lowest at 74,000±28,011.9 eggs during the fourth spawning episode (Figure 3). However, there was no significant difference (P> 0.05) among the three treatments within the four spawning episodes.

Most abalone from different treatments spawned during the four spawning episodes (Figure 3). There were a few that did not spawn throughout the four spawning episodes. Individual abalone spawned differently during each spawning episode. Those that spawned partially had either decreased or increased its fecundity in the succeeding spawning event. Similarly, Counihan et al. (2001) reported that each individual abalone spawned within one or two nights, or not at all, and 78.1% spawned on at least one night during the spawning event.

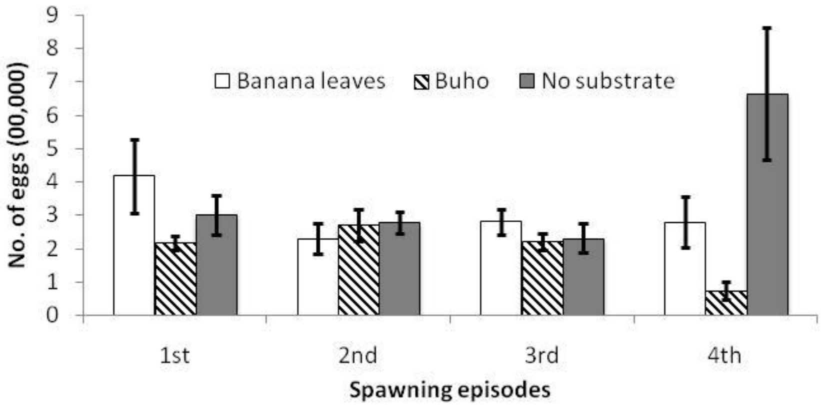

Figure 3. Average (±SE) fecundity of abalone broodstock conditioned in three treatments during the four spawning episodes.

Abalone conditioned in banana leaf substrates had an average fecundity of 259,353.21±39,307.63 eggs during the four spawning events. Those in no substrate had 237,265.5±32,161.21 eggs and those in buho substrates had 214,830.303±28,603.29 eggs (Figure 4). However, fecundities were not significantly different ($P>0.05$) among the three treatments.

The highest fecundity of abalone conditioned in banana leaf substrate with 2,431,000 eggs was obtained by an individual with a shell length of 73mm. Generally, abalone with shell length of 57-73mm had high fecundity (Figure 5).

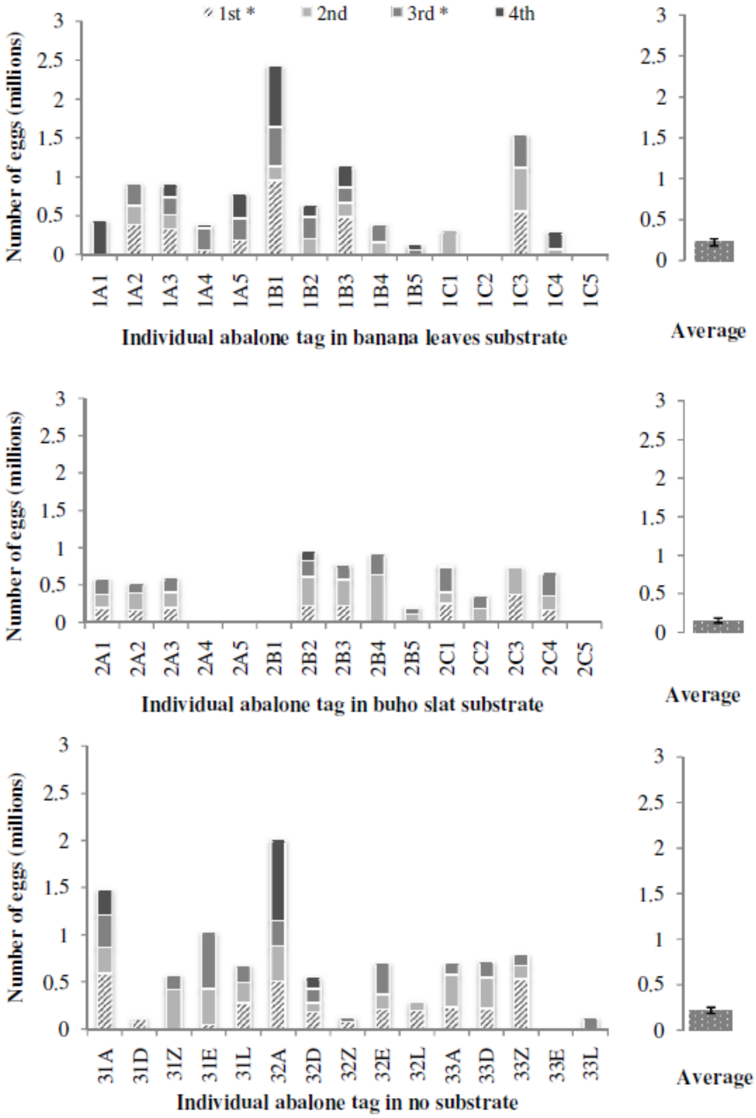

Figure 4. Average fecundity of individual abalone in three treatments during four spawning episodes.

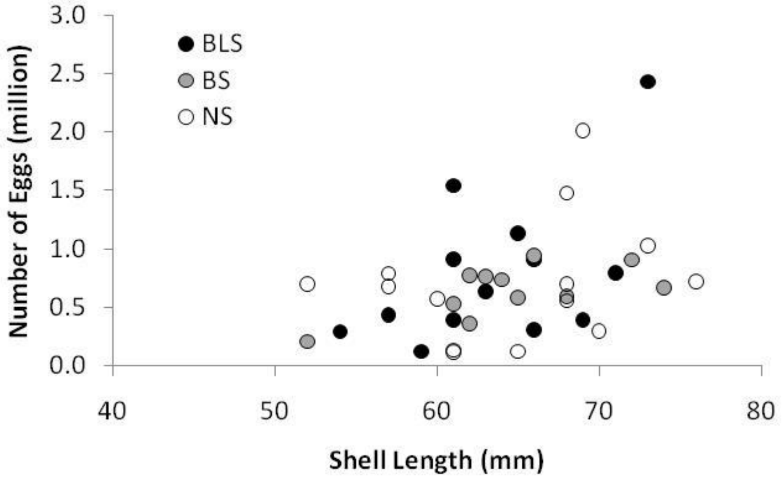

Figure 5. Distribution of abalone fecundity in relation to shell length during the four spawning episodes.

Condition Factor

After four spawning episodes, the abalone in all three treatments increased in condition factor (K). Those in no substrates had increased in *K* from 1.17±0.02 to 1.31±0.04g mm^{-1}, in banana leaf substrates from 1.12±0.03 to 1.24±0.04g mm^{-1} and in buho substrates from 1.14±0.03 to 1.19±0.09g mm^{-1} (Table 3). Moreover, the condition factors of the three treatments between initial and final measurements were significantly different (P<0.01). On the 4^{th} spawning episode, mortality of abalone was observed in buho substrate where a part of the flesh was accidentally cut during the removal of broodstock in one spawning event.

Table 3. Average shell length, total weight, condition factor and number of individual survived during the four spawning episodes of abalone conditioned in banana leaves substrate, buho slat substrate and no substrate.

Treatment	Initial			Final			No. survived
	Shell length (mm)	Total weight (g)	Condition factor (K) (g mm^{-1})	Shell length (mm)	Weight (g)	Condition factor(K) (g mm^{-1})	
BLS	64.27±1.44	52.43±4.03	1.12±0.03	67.00±1.40*	64.92±4.36*	1.24±0.04*	15
BS	63.80±1.58	51.51±3.32	1.14±0.03	67.07±1.54*	67.46±4.79*	1.19±0.09*	14
NS	64.53±1.70	55.45±3.91	1.17±0.02	65.27±1.47	63.11±3.52*	1.31±0.04*	15

*-values are significantly different (P<0.05) from initial sampling.

Majority of the abalone conditioned in three treatments had increased their *K* within the conditioning period (Figure 6). Only a few individuals have a decreased K after four spawning episodes. One factor that could have affected their *K* is the absence of mature gonads which contributed to the weight of the abalone. Mature gonads are sometimes more than 75% of the entire digestive gland which becomes bulky and can often be seen without lifting the animal's body (Setyono 2004b). This condition was not observed after the fourth spawning episode which indicates that the gonads are spent and need to re-mature for the next spawning episode.

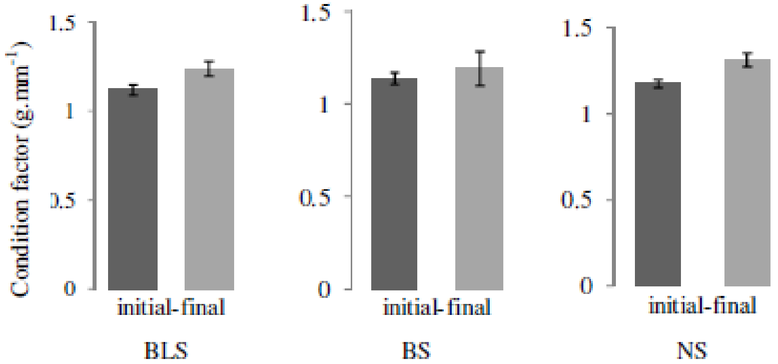

Figure 6. Mean (±SE) initial and final condition factor of broodstock abalone conditioned in banana leaves substrate (BLS), buho substrate (BS) and no substrtae (NS).

The increased *K* after four spawning episodes shows that conditioning is favorable to abalone broodstock. However, there was no significant difference (P>0.05) among the treatments on final *K*. This result is similar to the report of Setyono (2004a), where abalone conditioned within 14 weeks had a significantly different *K* between initial and final *K*. In addition, abalones conditioned in no substrate were observed to have grouped together in one part of the conditioning basket. Due to lack of substrate inside the baskets, the shell of other abalone served as their substrate for attachment. It is important to condition the abalone spawners to increase its condition factor.

CONCLUSION AND RECOMMENDATIONS

In abalone hatchery, broodstock conditioning is important to increase its condition factor. Spawning performance and fecundity of abalone broodstock are not influenced by the substrates. Both banana leaves and buho slat substrates are potential alternative substrates for the conditioning of abalone broodstock.

Similar studies should be done for a longer period to know the advantages and disadvantages of conditioning with and without substrates.

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Effects of poaching on Topshell *Tectus niloticus* population of Tubbataha Reefs Natural Park, Palawan, Philippines

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ABSTRACT

Poaching a significant volume of the reef gastropod topshell *Tectus niloticus* in Tubbataha Reefs Natural Park (TRNP) in 2006 to 2007 has prompted the management to seek detailed information on the impact of such illegal activities. To determine the present status and trends of topshell population in TRNP and to gather background information about poaching and trade, a follow up assessment in 2008 was conducted. Data on trading and poaching were derived from interviews and other secondary data. Abundance of topshells varied according to three surveyed depths; the highest was in the middle sites (~1.5m), followed by intertidal (1m); and the lowest abundance occurred at 5m deep sites. The abundance in 2008 was 75% lesser than in 2006. Since 2004, there were 33 cases of poaching apprehensions in the park, of which, 15 were topshell related, involving 26 boats and 190 fishermen. The promising economic benefit and the demand in black markets, plus the assurance to collect much volume, appeared to be the driving forces for topshell collection in TRNP. To prevent further decline on topshell populations, there is a need to sustain law enforcement and patrolling in the park.

Keywords: density, poaching, *Tectus niloticus*, Tubbataha Reefs

INTRODUCTION

The Topshell *Tectus niloticus* locally known as *samong* is one the most abundant gastropods in shallow rocky waters of Tubbataha Reefs Natural Park (TRNP) (Dolorosa & Schoppe 2005) – the only pure marine park in the country inscribed as World Heritage Site in 1993 by the United Nations Educational Scientific and Cultural Organization (UNESCO) (Songco & Jack 2009). The shell of this large reef gastropod is a valuable raw material in making jewelry, buttons, accessories and various cosmetic products (Hoang et al. 2007; Nash 1993). Because of overharvesting, Fisheries Administrative Order (FAO) 208 series of 2001 classified topshell as threatened species and section 97 of Philippine Fisheries Code of 1998 (RA 8550) prohibits its collection and trade (Department of Agriculture 1998, 2001). Despite of these prohibitions, topshells are still collected mainly for economic gain.

The TRNP holds large population of topshells (Dolorosa et al. 2010) much higher than those reported in other studies (Chambers 2007). The TRNP is a no take zone park, yet, illegal collectors persistently enter the park to harvest topshell (TMO unpublished data, Dolorosa et al. 2010).

Topshells of TRNP has been surveyed in 2006 (Dolorosa et al. 2010), but monitoring was not sustained the following year due to limited resources. If illegal collection is persistently taking place, topshell's populations in the Park could have been reduced at an undetermined degree. Thus, the general objective of this study was to investigate the impact of poaching on the population of topshell in TRNP and to provide recommendations for future management. Specifically, it sought to determine the density, depth distribution and size composition of topshells in Tubbataha Reefs in 2008; and to provide background information on the gathering and trade of topshell in Palawan relative to its poaching in TRNP.

MATERIALS AND METHODS

The Study Site

Tubbataha Reefs Natural Park (TRNP) is located in the Middle of the Sulu Sea within 8°43'-8°57' N latitude and 119°48'-120°3' E longitude (Figure 1). It lies 150km southeast of Puerto Princesa City, Palawan and 130km south of Cagayancillo, the nearest land mass and the municipality with political jurisdiction over Tubbataha.

The park was inscribed in the United Nations Educational Scientific and Cultural Organization (UNESCO) World Heritage Site in 1993 and was included in the List of Wetlands of International Importance or the Ramsar List in 1999. By virtue of Presidential Proclamation 1126 dated August 23, 2006, the park was renamed from Tubbataha Reef National Marine Park (TRNMP) to Tubbataha Reefs Natural Park (TRNP). The same proclamation expanded the TRNP's area from 33,200ha to 96,828ha to include the Jessie Beazley Reef (TRNP Management Plan, unpublished data). In 2009, TRNP Act of 2009 (R.A 10067) established TRNP as a protected area under the NIPAS Act (R.A. 7586) and the Strategic Environmental Plan (SEP) for Palawan Act (R.A. 7611) (Congress of the Philippines 2009).

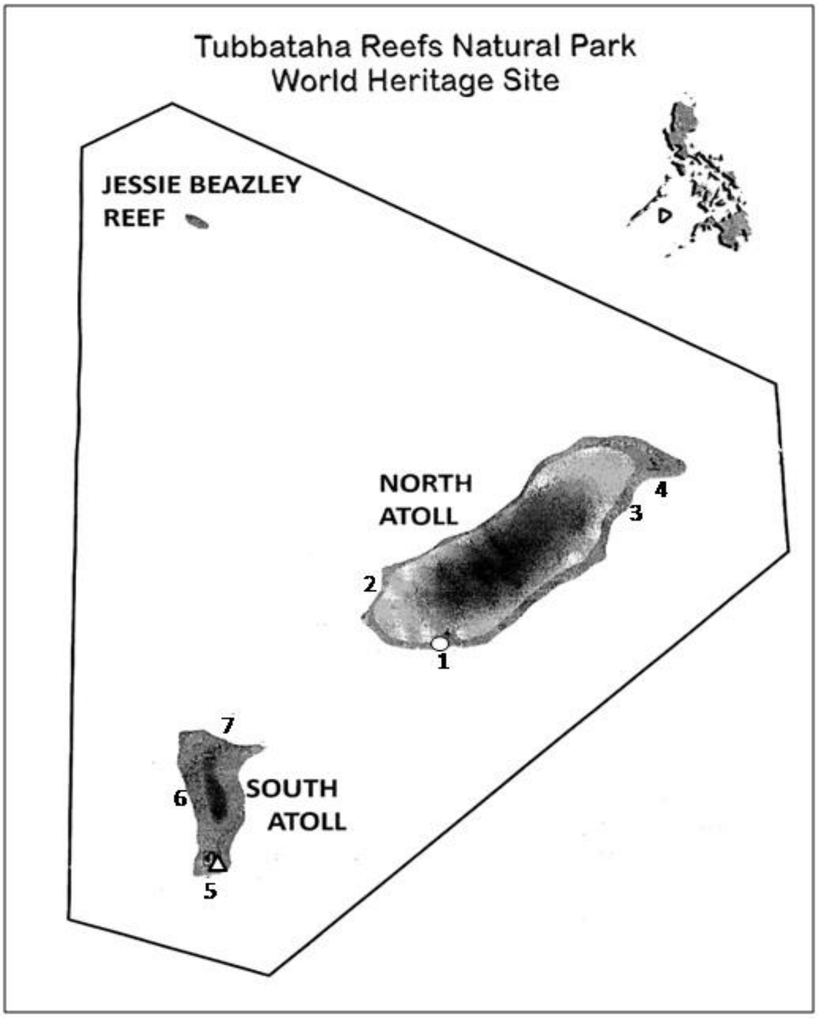

Figure 1. Map of TRNP indicating the seven permanent monitoring sites (Modified after Songco & Jack 2009).

Data Gathering Procedure

A topshell density assessment was conducted between May 27 and June 3 in 2008. Seven permanent sites at 1.5m water depth established in 2006 were revisited. At each site, 100m x 2m permanent transect was augmented with replicates in the intertidal zone (1m) and a deeper zone (5m) in 2008. All depths were surveyed during day high tide with the aid of scuba gears. In total, 21 transects were surveyed covering an area of 4,200m^2. The basal diameter of each topshell found along 1m both sides of the transect line was measured with a ruler glued to the slateboard (Dolorosa et al. 2010). To obtain background information on trade and poaching in TRNP, 17 fishermen were interviewed on

November 11, 2008 in Barangay I and IV of Roxas, Palawan (known residence of apprehended poachers) and matrix of cases in TRNP was obtained from Tubbtaha Management Office (TMO).

Data Analysis

Abundance of topshells at each transect (individuals per $200m^2$) was converted into individuals per hectare. For size structure, individuals with shell diameter measuring <50mm were considered juveniles, while those measuring >50mm are classified as adults or sexually mature (Ponia et al. 1997). Data obtained from fishers were linked with the poaching incidences in TRNP. Similarly, information on poaching incidences from TMO was used to support the findings on present population of topshells as impacted by poaching.

RESULTS AND DISCUSSION

Density and Distribution

The mean density of topshells in permanent monitoring sites (1.5m depth zone) was abruptly reduced from nearly $6{,}000ind.ha^{-1}$ in 2006 to only about $2{,}000ind.ha^{-1}$in 2008. All sites displayed reduced densities with Site 7 as the most affected. In 2006, the mean density (>$11{,}000ind.ha^{-1}$) in Site 7 dropped to $1{,}000ind.ha^{-1}$ in 2008. Only Sites (1 and 2) close to the Ranger Station remained to have relatively high density (Figure 2). Replicate sites in the intertidal (1m) and deeper (5m) zones had much lower average density of topshells at $129ind.ha^{-1}$ and $50ind.ha^{-1}$, respectively (Figures 3 & 4). Most of the monitoring sites in both areas which have no topshells as substrates are either sandy in intertidal areas, or packed with live corals as in case of the deep sites. Such types of substrates do not favor the occurrence of topshells (Colquhoun 2001) due to less amount or absence of algae to which topshells primarily feed on. In intertidal areas though, it is possible also that the topshells were heavily exploited. Note that sites 1 and 2 in intertidal sites have considerable number of topshells but the rest of the sites that are away from the ranger station did not have any topshells at all.

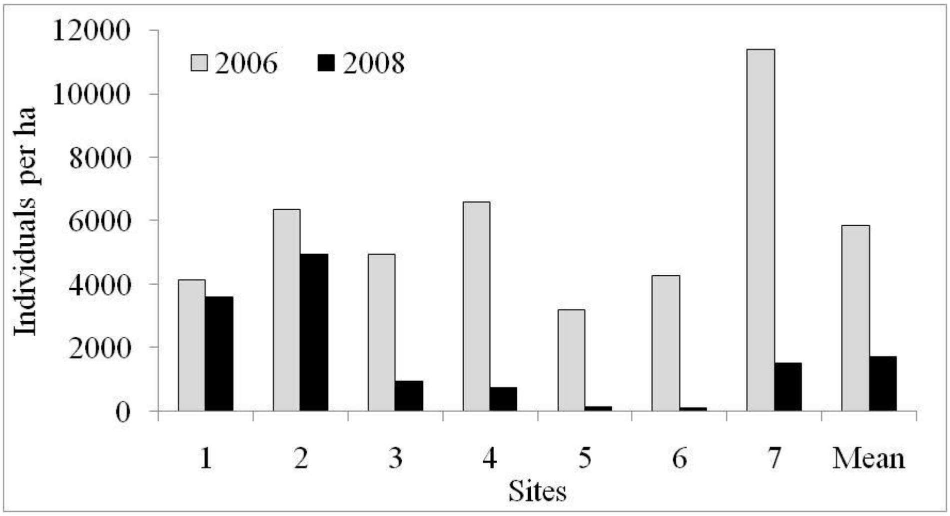

Figure 2. Topshell density (ind.ha^{-1}) in 2006 and 2008 recorded in seven permanent monitoring sites (middle sites) of TRNP.

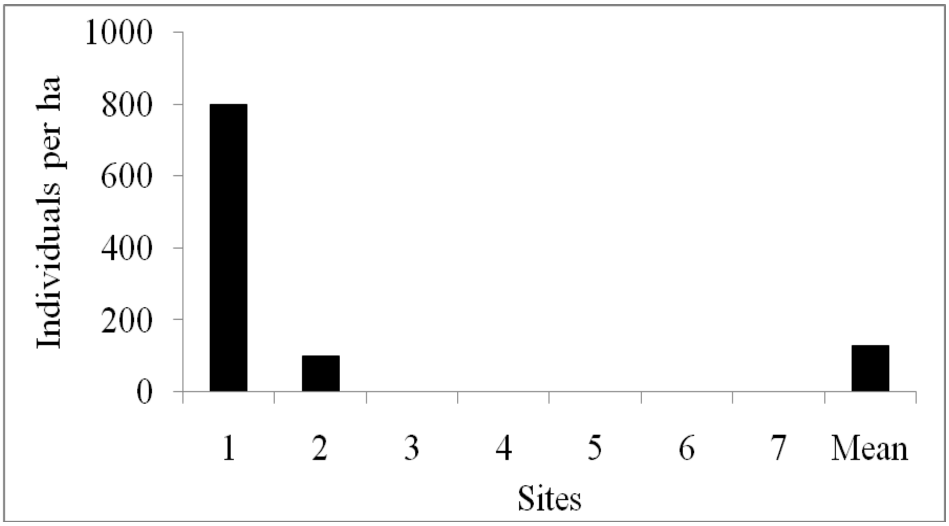

Figure 3. Topshell density (ind.ha^{-1}) recorded in intertidal sites (1m) of TRNP in 2008.

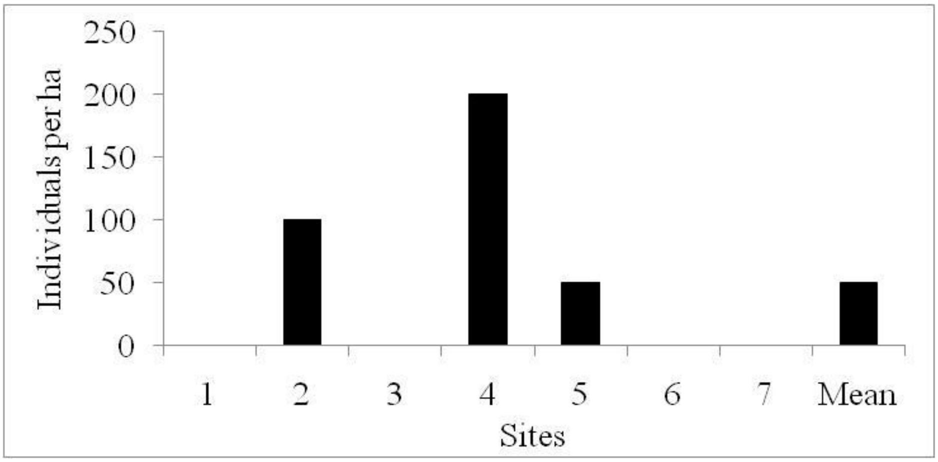

Figure 4. Topshell density (ind.ha^{-1}) recorded in the deep sites (5m) of TRNP in 2008.

Size Structure

The size of topshells ranged between 30mm and 160mm. In 2006, size range was at 17mm to 130mm (Dolorosa et al. 2010). However, the overall number of young topshells (n=3) noted this time is much lower than in 2006 (n=236). In Jessie Beazley, no live topshell was recorded though empty shells were found. The mean basal diameter (MDB) was larger in 2008 (82.1mm) compared to 2006 (67mm, Dolorosa et al. 2010) as a possible result of the underrepresentation of juveniles. Such could indicate that recruitment has been affected by the removal of large individuals during poaching.

Poaching has greatly reduced the topshell density in seven permanent monitoring stations by around 75% in the span of two years. But even then, the recorded density remained exceptionally high compared to other sites in the country and elsewhere in its geographic range. For instance, Sabang Reef of Binduyan and its adjacent unprotected reefs in Puerto Princesa only had densities of 190ind.ha^{-1} and 27ind.ha^{-1}, respectively (Gonzales 2005). In the Great Barrier Reef and the Cartier Reef in Australia, topshells were estimated at 500 ind.ha^{-1} (Castell 1997) and 3ind.ha^{-1} (Smith et al. 2002) respectively. Omaka Village and Tongareva Marine Research Center in Cook Islands had a density only of 750ind.ha^{-1} and 650ind.ha^{-1}, respectively (Chambers 2007). Much lower densities were recorded in regions of Chuuk State Micronesia at 37ind.ha^{-1} (Gawel 1997), and Okinawa, Japan with 80ind.ha^{-1} (Isa et al. 1997).

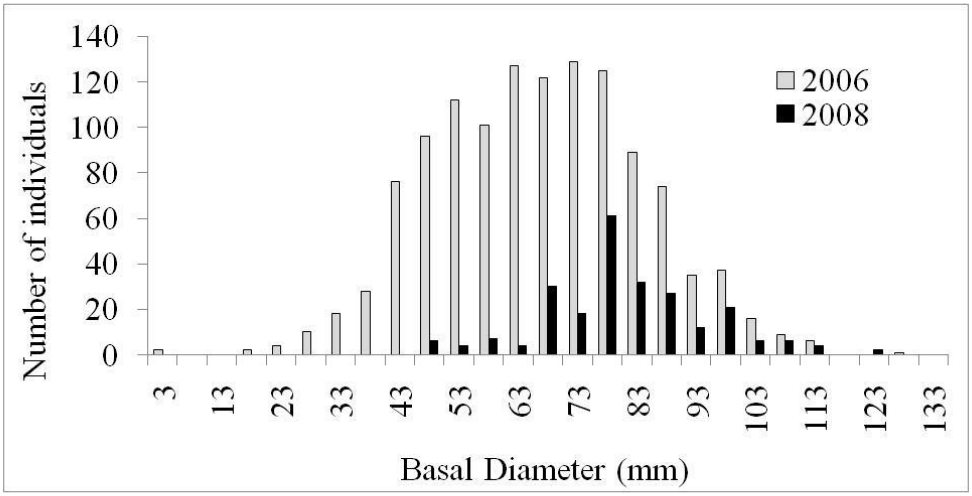

Figure 5. Number and size composition of topshells in the middle sites in years 2006 and 2008.

Topshells occur in coral reef flats from intertidal to sub-tidal zones that are moderately exposed to wave actions (Castell 1997, Nash 1993, Lemouellic & Chauvet 2008). Individuals are distributed according to age with juveniles found in rubble on the reef flat while adults display an increasing density towards the shallow reef slope down to the reef crest (Chambers 2007).

The same was also observed in Tubbataha but no distinct age distribution was established. Instead, mixtures of young and mature individuals were observed across three varying depths with much of the population (98%) concentrating in the sites with depth of 1.5m. At such depth, the area is characterized by presence of rocks (smoothered dead corals corals) and dead corals covered with filamentous algae that topshell primarily feed on. On the other hand, intertidal areas were covered mainly with sand and rubble having patches of live corals. Deep sites were dominated by live corals having some patches of sand and rubble. Both the intertidal and deep sites appeared to be less preferred by large topshells. Such may be due to the limited supply of food and the nature of substrates having lesser crevices to which topshells seek refuge especially at daytime when they are less active.

Trading and Poaching

The collection of topshell for commercial trading purposes in Roxas, Palawan started in 2002. The buying price of topshell then was only PhP25.00kg^{-1} but due to the demand and topshells becoming scarce in nearby areas, the price gradually went up until 2008. Poaching of topshells in TRNP was first documented in 2006. Its trend and other events related to it are shown in Table 1.

An increasing trend on topshells' price was observed over the years (2002 to 2008) (Figure 6). In 2006, traders instituted size classification with large individuals getting the highest price as much as PhP 180kg^{-1} (fishers' selling price) to 350.00kg^{-1} (traders' selling price). The increasing price might have been brought by the limited supply of topshell and the continuous demand for the same in the world market. Floren in 2003 reported that around 10,000-20,000 of topshells from Palawan are shipped to Cebu and exported to Korea and Taiwan. If each shell weighs 200g and sold at PhP 50kg^{-1}, income generated would be from PhP 100,000.00 to PhP 200,000.00. In TRNP, the difference between 2006 and 2008 mean density at 4120 individuals weighing around 824kg could amount to PhP 247,170.00 if a kilogram is sold at PhP 300.00. The amount could be much higher if many sites aside from TRNP have been exploited for topshell. These increasing prices of topshell could drive more fishermen to venture in the illegal harvesting of the species, further harming the remaining breeding populations in the wild.

Since 2006 until 2008, a total of 15 apprehensions were recorded involving 26 boats and 190 fishermen. A matrix of cases of Tubbataha Management Office (TMO) (TMO unpublished data) shows that earlier apprehensions involved mainly fishermen from Roxas, Palawan, comprising around 45% of the total apprehended persons. In early 2008, however, fishermen from various barangays of Puerto Princesa City and other parts of the province like Aborlan and Brooke's Point have replaced fishers from Roxas in gathering of topshells in the Park. The latest apprehension in 2008 involved 45 fishermen coming from as far as Cebu (TMO unpublished data).

Table 1. Highlights of events related to poaching and trade of topshell based on interview with topshell gatherers in Roxas, Palawan (TMO unpublished data).

Year	Chronological Event
2002	A Chinese businessman from Cebu came to Roxas, Palawan and started buying topshells at PhP25.00kg^{-1}. Fishermen started collecting topshells near shore not just for consumption but for selling purposes as well.
2003	Demand for topshell increased and so its price increase to PhP 50.00kg^{-1}. Topshell collection intensified further resulting to massive decline of its population in near shore areas. Fishermen started venturing farther even in TRNP despite of being aware that the latter is a protected area. Fishermen kept among themselves their operation to avoid competitors. There were also fishermen from Sitio Anilawan, Bgy. Babuyan venturing to TRNP. Elders from Cagayancillo revealed to some fishermen that topshells are abundant in “gusong”, their term for TRNP
2004	Price of topshell further increased to PhP 70.00kg^{-1} as a result of reduced supply. Traders and middlemen started to finance operation. A minimum of PhP 20,000.00 is staked for a 3-day period of operation in TRNP.
2005	Topshell reached a price of PhP 100.00kg^{-1}. It has replaced fishing as the main source of livelihood of fishers engaged in topshell collection, which has indeed become a lucrative business. Large scale illegal operations came into picture. Fishermen went in fleets to TRNP on bigger boats with high powered engines.
2006	April 18, 2006 marked the first apprehension on illegal collection of topshell in TRNP. A total of three boats and 25 fishermen from Roxas were arrested. Prices of topshell increased and price based on sizes; small-Php 110.00kg^{-1}, medium- PhP 150.00kg^{-1}, large-PhP 180.00kg^{-1}. In May 2006, the baseline data of topshell in TRNP were gathered by the park rangers.
2007	A total of eight cases involving 79 fishermen loaded 18 boats were recorded (TMO unpublished data). Majority of arrested fishermen still come from Roxas, Palawan. In June 2007, a total of 20 sacks topshells being shipped from Roxas to Puerto Princesa were sequestered.
2008	Illegal collection of topshell continued despite of the rigorous effort of the management to curb it. Six more apprehensions were made involving 86 fishermen (45 were from Cebu) on board of five boats. On December 22 and 23, 2008, the first arrest on reported buyers of topshell in Puerto Princesa was made in collaboration with the National Bureau of Investigation (TMO unpublished data.

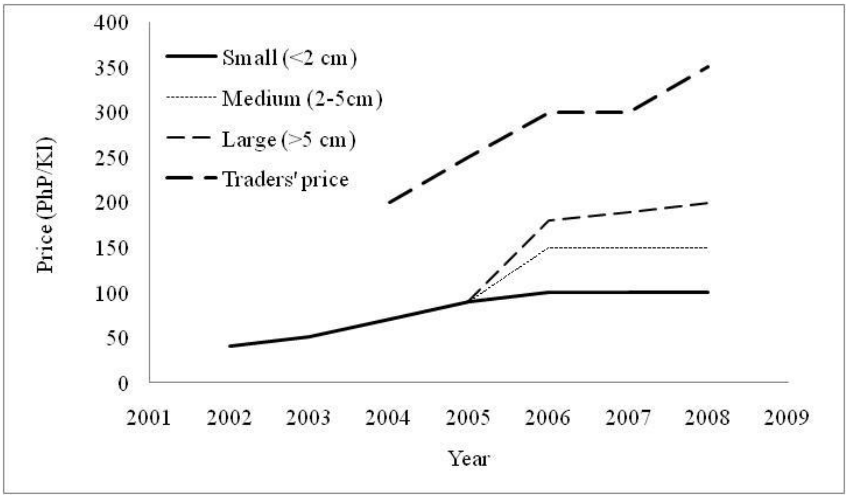

Figure 6. Buying price of topshell and their size classification set by traders in Palawan (2002-2008). (Note: price and size estimates were given by fishers/respondents. No interview was made with the traders).

Since topshells are sedentary and mostly abound in shallow sites, they are very vulnerable to poaching. Fishermen in Roxas, Palawan, revealed that they started collecting from Tubbataha in 2004. They added that they went in batches of two to three boats, each having four to eight men depending on the boat's capacity. Such is necessary for them to be able to collect topshells as much as they can in the shortest possible time. Operations are normally done at night using an improvised underwater flashlight. It took them only two to three hours to collect five sacks of topshell in TRNP.

In April 2006, five sacks and 119 individuals of topshells were confiscated while in 2007, 81 sacks and 761 individuals were sequestered in Roxas (Dolorosa et al. 2010), all approximately weighed more than 3 metric tons. Based on the measurements of seized topshells, poachers collected bigger shells and this might have significantly reduced the spawning stocks that resulted to low population of juveniles noted in this survey. It has to be noted though that juveniles are also hard to find since they tend to camouflage and hide thus, even in their known habitat in rubble of reef flat (Castell 1997), they were barely noted.

It is reported that selling price was at PhP 300.00kg^{-1} in 2006, but fishermen only get PhP 110.00-280.00kg^{-1}, depending on shell size, from buyers or traders who usually fund their operations through provision of fuel and food in advance. A minimum of PhP 20,000.00 is put at stake by buyers in return of buying the topshells which are then shipped either to Cebu or Manila. Due to high demand, illegal collection continued reaching its peak in

2007 with nine apprehensions made involving 93 persons. In 2008, cases reduced to 5 involving 78 people. This could be directly attributed to the intensified patrolling and surveillance in the park and also to the continued filing and prosecution of cases coupled with consistent information and education campaign (IEC) activity in hot spots coastal areas.

CONCLUSION AND RECOMMENDATIONS

Most of the topshells were found in the 1.5m depth zone, which could be the preferred and suitable habitats in TRNP. Poaching has significantly reduced the population of topshells in the park. The removal of large individuals could have affected the recruitment as shown by extremely low number of juveniles ecountered in this study than what has been recorded in 2006. Yet compared to other local sites, the remaining overall abundance is still higher suggesting the importance of TRNP as the last stronghold of topshell populations in the country.

Strategies like strengthened law enforcement and (IEC) must be sustained to halt poaching incidences in TRNP. Stock restoration through translocation of wild populations, and breeding and culture of topshell for stock enhancement may help restore the depleted areas in the country (Dolorosa et al. 2013a, 2013b). Regular topshell assessment in TRNP should be pursued and could become one of the indicators for evaluating the effectiveness of park management.

ACKNOWLEDGMENTS

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Trends in milkfish fry production in Sofronio Española, Palawan, Philippines with notes on 12-year province-wide production

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ABSTRACT

The gathering of wild milkfish fry in the Philippines remains an important livelihood activity among the coastal inhabitants as the milkfish growers continue to prefer the fry harvested from the wild over those produced from hatchery. However, up to date statistics on fry production from the wild is lacking. Given such shortage of information, the volume of fry and catch per unit effort (CPUE) from the two coastal villages in the municipality of Sofronio Española, Palawan were determined; and the 12-year data on volume of fry harvested within the province of Palawan were obtained from two major fry buyers in Puerto Princesa City. In Sofronio Española, the catch in 2011 was about 50% lower than in 2009; while the CPUEs in 2011 largely varied between the two villages. The dwindling volume of fry between 2000 and 2012 calls for further study to determine the causes of this decline which could be used as basis in proposing a management plan to sustain both fry and milkfish industry.

Keywords: milkfish fry, Palawan, Philippines

INTRODUCTION

Milkfish *Chanos chanos* (Chanidae), locally called 'bangus' is widely distributed in the tropical and warm temperate regions of the Indo-Pacific Ocean; it is an important aquaculture commodity in Southeast Asia with fry source mostly coming from the wild. Mother milkfish can reach a maximum total length of 150cm and a life span ranging from 5 to 20 years (Bagarinao 1999). The number of mature eggs a female milkfish can spawn varies between 1 - 9 million (JICA 1987, Yap et al. 2007). Because of the importance of wild milkfish fry in aquaculture, both the mother and the fry are protected in the Philippines under Republic Act 8550 for which sections 98-99 prohibit the capture of mother milkfish and exportation of both breeders and fry (DA 1998).

Fry collection with its peak season in the Philippines between April and June (Bagarinao 1999) is usually carried out traditionally with the use of locally made stationary (eg. tidal set net) or mobile gears (e.g. fry sweeper; fry bull dozer) (Villaluz 1984, Bagarinao 1999). The Philippines requires about 1.726 billion of milkfish fry per year. However, fry production from all regions in the Philippines was only about 161 million in 1995, thus having a deficit of 1.565 billion fry (Ahmed et al. 2001). Such deficit might be the result of inadequate statistics on the volume of collected milkfish fry (Bagarinao 1999, Ahmed et al. 2001, Avillanosa et al. 2005). Palawan is one of the largest milkfish fry producers in the country, however, available information on the volume of collected fry were only for the year 1963 and 1973 at 32 and 10 million fry, respectively (Ahmed et al. 2001).

In spite of its importance as a form of livelihood among the gatherers and in the milkfish culture industry, efforts to assess the present condition of fry grounds in the province of Palawan are virtually non-existent (Avillanosa et al. 2005). With the uncertainties on volume of fry harvested from the wild, this study aimed to determine the catch per unit effort in Sofronio Española; and trends in milkfish fry production in Palawan.

MATERIALS AND METHODS

The study was conducted in the only two known milkfish fry producing villages of Sofronio Española: Pulot Shore (8^{o}56’50.58”N 118^{o}02’01.76”E) and Punang (9^{o}03’10.08”N 118^{o}05’14.65”E) some 140 km south of Puerto Princesa, the capital city of the province of Palawan. The fry ground in Pulot Shore was relatively narrow with a gently sloping shoreline which allows fry gathering during high and low tides. In Punang, the fry ground was characterized by a wide sandy beach with fringing mangrove forests which makes fry gathering difficult during high tide (Figure 1). The number of fry collectors in Pulot Shore (43 persons) was three times higher than in Punang (14 persons).

The number of fry harvested from the two coastal villages was obtained by having a concession of milkfish fry in Sofronio Española during the years 2009 and 2011. Total number of fry harvested from the two villages in 2009 and 2011 was compared with Chi Square using the statistical software SPSS version 16 (Field 2009). The CPUE of fry gatherers from both villages in 2011 was determined by dividing the number of collected fry with the time spent in harvesting. The earnings of fry gatherer were also noted for each day of operation. To have a wider picture of trends in milkfish fry industry in Palawan, the data on the volume of harvested fry from other municipalities for 12 years were obtained from two major fry buyers stationed in the City of Puerto Princesa.

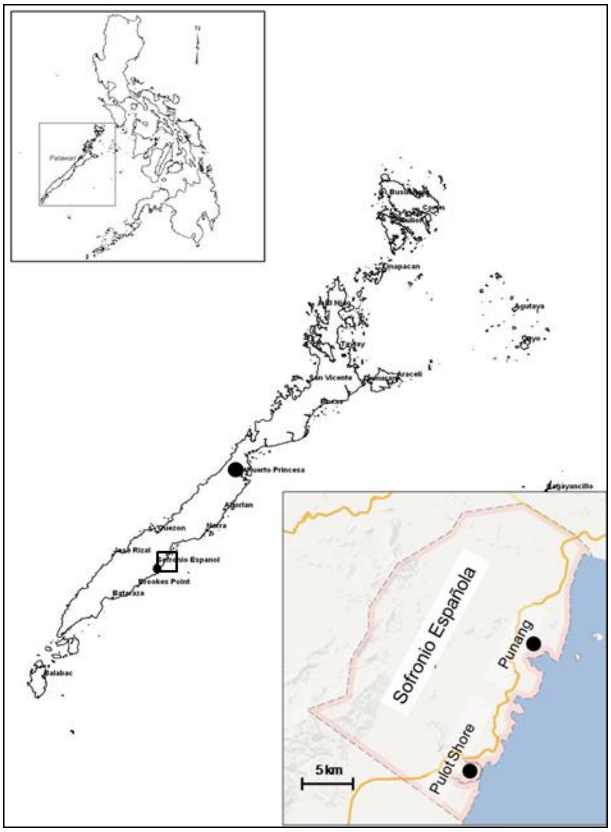

Figure 1. Location of Pulot Shore and Punang in Sofroñio Española, Palawan, Philippines.

RESULTS

The general trends in monthly volume of milkfish fry harvested from the two villages of Sofronio Española, Palawan were high during summer (March) and declined towards the early rainy season (June). In Pulot Shore, harvesting appeared in two seasons: March - June and September – December 2012. The highest number of harvested fry recorded in March (334,259 fry) comprised about 41% of all harvested fry (812,121 fry) in that village. In Punang, fry harvesting only occurred in summer until early rainy season (March – June). Hence, the volume of harvested fry (134,312 fry) captured during that period was much lower than in Pulot Shore (625,500 fry). Overall, the number of milkfish fry harvested in Punang only comprised 14% of all harvested fry (946,433 fry) from both villages (Figure 2).

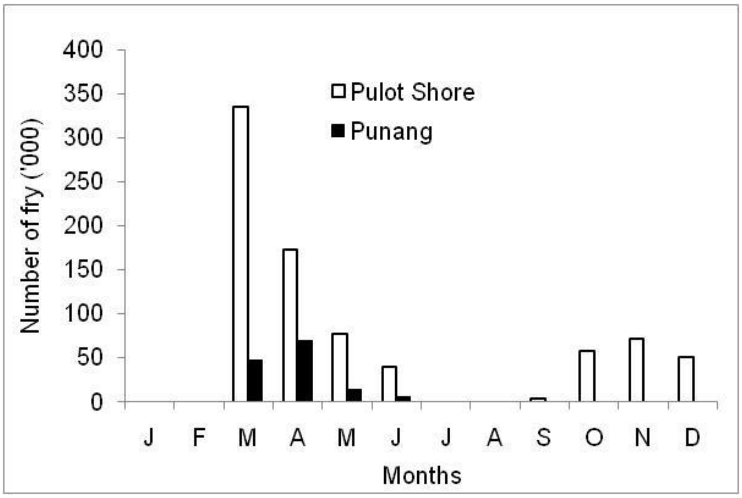

Figure 2. Monthly volume of wild fry harvested from Pulot Shore and Punang in 2011.

Volumes of fry in 2009 and 2011 have shown remarkable difference and decline for both villages (Figure 3). In 2009, the volume of harvested fry in Pulot Shore (1,461,321 fry) was 77% higher than in Punang. Such percent difference was elevated to 86% in 2011, with Pulot Shore having 812,121 fry compared to 134,321 fry from Punang. A significant decline on volume of harvested fry between 2009 and 2011 was noted for both Punang (χ^2 =16,7942 > 3.84) and Pulot Shore (χ^2 = 185,384 > 3.84). The combined volume of harvested fry from the two villages in 2011 (946,433 fry) was 50% lesser than in 2009 (1,907,999 fry).

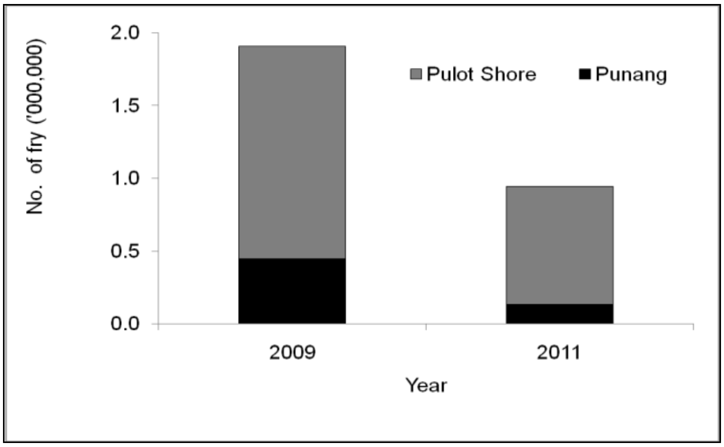

Figure 3. Total annual volume of harvested milkfish fry from the two villages of Sofronio Española, Palawan for the year 2009 and 2011.

Catch per Unit Effort and Earnings of Fry Gatherers

The CPUE in Pulot Shore was much higher in March, reaching about 443 fry.h^{-1} compared to about 200 fry.h^{-1} in other months of the year (Figure 4). In that month, the average income of PhP 190h^{-1} and an average of 5 h operation could make fry gatherers in Pulot Shore earn as much as PhP 950 per operation. However, the average CPUE (222 fry.h^{-1}), income (PhP 85 h^{-1}), and duration of operation (3.75 h) can only make the fry gatherers earn an average income of PhP 340 per operation (95% CI= PhP 520-160 per operation).

In Punang, the average CPUE in March (292 fry.h^{-1}) was twice higher than in other months of the year. The average income in March (PhP 80 h^{-1}) was twice higher than the average income (PhP 43 h^{-1}; Figure 5) from March to June, but much lower than in Pulot Shore. Monthly average time (2.2-3.1 h) spent in collecting fry was nearly twice lower than in Pulot Shore.

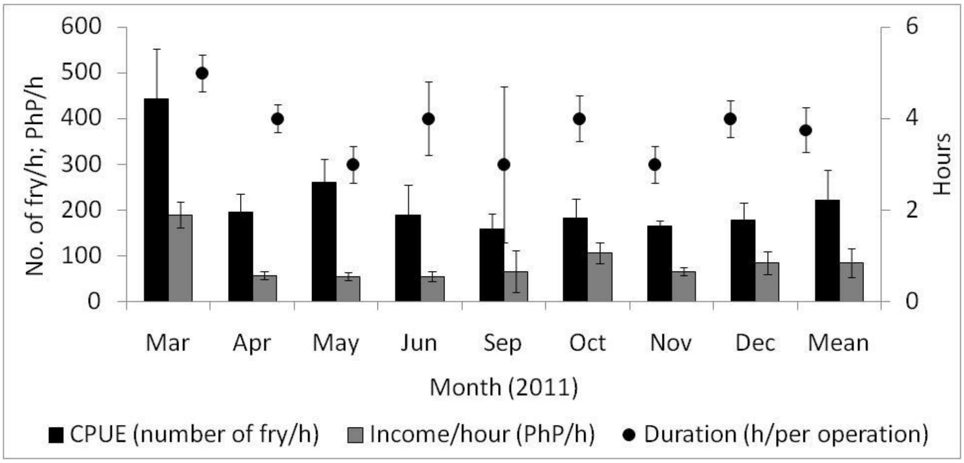

Figure 4. Catch per unit effort, average income/hour and duration of fry collection in Pulot Shore in 2011.

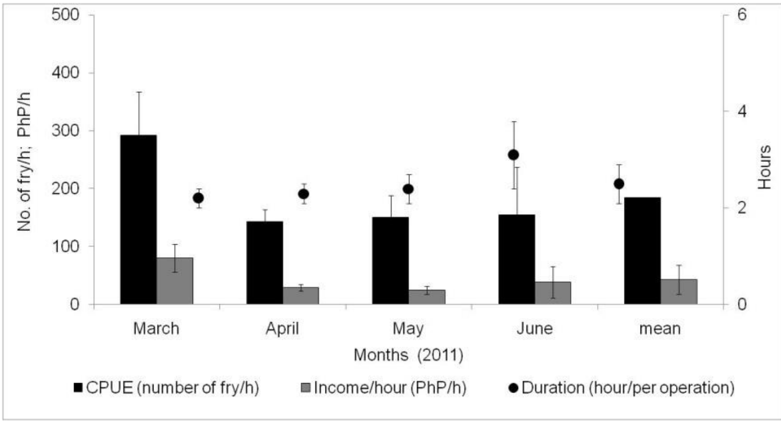

Figure 5. Catch per unit effort, average income/hour and duration of fry collection in Punang in 2011.

Volume of Harvested Fry in Palawan

The sources of fry as per record of the only two fry buyers in the City of Puerto Princesa were only 12 of the 23 municipalities in Palawan (Figure 6). In Buyer A, the highest number (>20 million) of harvested milkfish fry in 2001 was followed by a sharp decline in 2002 and was gently sustained towards 2005 (5,000,000 fry). There was a gradual recovery of supplies towards 2009 but not as high as in 2001. The volume of fry in Buyer B was relatively stable from 2006-2009. In 2011, the yearly volume of fry dropped by 60%.

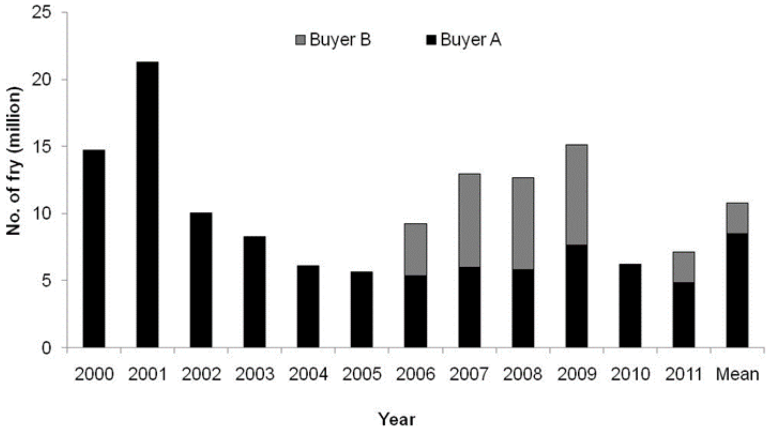

Figure 6. Yearly (2000-2011) number of milkfish fry harvested from Palawan water based on the records of two milkfish fry buyers in Puerto Princesa city. Data for 2012 only cover the first half of the year.

DISCUSSION

The variations in the volume of harvested milkfish fry could have been the effects of the monsoons, mangrove vegetations, topography, habitat degradation, and reduction in the number of breeding milkfish in the wild. The northeast monsoon which generally occurs during the months of September to February brings milkfish fry to the east coast of Palawan including the municipality of Espanola. By contrast, the southwest monsoon could have driven the current towards the centre of the Sulu Sea, limiting the fry that settles on the studied sites. The peak of fry season in this study coincided with the observed peak in the northern parts of Palawan which occurred for three to four months in a year, with a peak in May and the lean month is June (Avillanosa et al. 2005). In some provinces, the fry collection is observed year round with different peak and lean seasons. For example, in Glan, Cotabato the peaks in volume of wild milkfish fry occurred between April and October. In Hamtik, Antique the fry gathering occurred between March to November with peaks in May and October. In Santa Ana, Ilocos Norte the fry production is from April until October with peak in June (Bagarinao 1999).

Fry collection in Punang was only possible during low tide in areas not covered with mangroves. When high tide comes, these areas were too deep for the fry collectors to operate their gears. By contrast, the absence of mangrove trees in the shoreline of Pulot Shore allowed fry gatherers to operate both during high and low tides. In addition, Pulot Shore has sandy and gently sloping area, a characteristic of most milkfish fry grounds (Bagarinao 1999) and could be another reason for having a higher number of collected milkfish fry than in Punang where shoreline was relatively wide and flat.

The port serving as loading area of mined nickel in Punang since 2009 could have added to the reduced abundance of milkfish fry or difficulty in catching them. Heavy siltation clogged on the net collection devices, making the fry gathering difficult or such siltation and other pollutants could have affected the number of fry. Between 1998 and 2002, second cropping (September – December) was still observed in Punang (pers. obs.) so there is a possibility that fry abundance was affected with heavy siltation. Interviewed fry gatherers of Ahmed et al. (2001) believed that domestic pollution, siltation and turbidity have brought tremendous changes on fry catching grounds.

There might be some underestimation of volume of fry shipped out of Palawan. One of the buyers provided a summarized volume of milkfish fry instead of allowing the record book to be personally checked. Milkfish fry dealers may have the tendency to reduce the number of shipped fry to reduce air transport charges. The records of the Provincial Fishery Office depend on the report of fry buyers and such may not represent the real volume of fry shipped out of Palawan if the buyers do not declare the correct volume of fry.

The dwindling volume of harvested milkfish fry in Pulot Shore even with the absence of siltation from nickel mining port suggests that there are other factors affecting such decline. Accidental catching of mother milkfish (Sabalo) by drift net operators and unsustainable fishing operations specifically the use of illegal means of operations cause low catch of milkfish fry in Roxas, Palawan (Avillanosa et al. 2005). There are pressures and conflicts among habitat, human settlements, fisheries and tourism in many fry grounds (Bagarinao 1999). The volume of harvested wild milkfish fry is greatly affected by seasonal conditions, overexploitation, environmental pollution, illegal fishing, open access to fishing, conflicts in the use of rights and appearance of large number of fish predators (Ahmed 2001).

The similarities between the reported 10 million fry production in Palawan in 1973 (Bagarinao 1999) and the average volume of fry (10.66 million) from 2000 to 2011 indicated a stable supply of fry in the Province for the last 40 years. Such however was much lower compared to 32 million fry obtained in 1963 (see Bagarinao 1999).

Sources of data in this study did not include all the municipalities and fry buyers in Palawan so there is a possibility that the real volume of harvested fry from Palawan is much higher than the number indicated in this report. However, the sheer drop in the supply of fry in the two villages of Sofronio Española is quite alarming and could be happening in other parts of the province. Mother milkfish aggregate in estuarine areas to spawn (JICA 1987) are vulnerable to exploitation during their spawning period. Reef fishes that aggregate during spawning are so vulnerable to fishing (Johannes et al. 1999, Russell 2001, Sadovy, 2007). A declining trend in the volume of harvested marine fishes (Barut et al. 1997) and species richness (Nañola et al. 2011) has been reported in the Philippines.

Knowing where the milkfish aggregate to spawn and declaring such as protected areas can help ensure a steady supply of milkfish fry from the wild. Identification and protection of areas where other fish species aggregate to spawn are important in conserving marine biodiversity.

Continuous monitoring of milkfish fry production from the wild is needed to detect yearly changes in abundance. Understanding the factors that affect these changes is important to effectively manage the milkfish fry resources in Palawan. A nationwide monitoring is also needed for the government to evaluate the current condition of milkfish fry industry in other parts of the country.

The average income derived by fry collectors during the peak season (PhP 2,709), is much higher than in lean months (PhP 384). This is similar with the observation of Ahmed et al. (2001) in Puerto Princesa City where there is a large difference on the monthly average income during the peak (PhP 3,064) and lean (PhP 31) seasons. With health problems affecting some hatchery reared fry (Hilomen-Garcia 1997, Marte 2003, Cruz-Lacierda et al. 2004) and the high cost of its production in the Philippines (Lee et al. 1997), the demand for wild fry will continue to persist, making the supply in the wild critical for the development of milkfish farming industry.

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Notes on Mangrove Snake *Boiga dendrophila multicincta* (Boulenger, 1896) in Iwahig River, Puerto Princesa City

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Date observed: April 13, 2013; around 10:00 AM

Notes:

The genus *Boiga* is composed of about 20-30 species (Rodda et al. 1999) and widespread throughout low elevation and coastal habitats of the Philippines and other Asian countries. A sub-species, *Boiga dendrophila divergens* had been reported from the northeastern Luzon including the Babuyan Islands (see Brown et al. 2013). A Palawan endemic sub-species *Boiga dendrophila multicincta* is locally called 'binturan' (Leviton 1970). The species is commonly encountered in a semi-disturbed river in Iwahig, Puerto Princesa City, Palawan, Philippines. The one shown in the photo (~2m long) was spotted resting on branches of the mangrove tree *Scyphiphora hydrophyllacea* along the bank of Iwahig River, Puerto Princesa City (Figure 1). Two of the nine transect lines (intended for molluscs) had one mangrove snake at the start; several individuals were subsequently noted resting on branches of mangrove trees along the river banks, suggesting an unusually high population density. The same species is abundant in a semi-disturbed mangrove forest in Sitio Bunuangin, Port Barton, San Vicente (MPG Soniega, pers. comm.) and in a pristine mangrove forest in Puerto Princesa Underground River – one of the New Seven Wonders of Nature. The snake is feared for its tendency to chase intruders (people) once hurt. At night, it feeds on a variety of small vertebrates including birds, frogs, snakes and fishes (Minton & Dunson 1978; Savidge 1988). *Boiga* spp. are both important in the pharmaceutical industry (e.g. Lumsden et al. 2005; Mackessy et al. 2006) and pet trade (Shepherd et al. 2004; Mendizabal 2011). The mangrove snake is one of the many reptilian fauna in Palawan - the so-called "Philippines' Last Frontier". However, mangrove snake and other reptiles are illegally traded from Palawan. In 2011, 25 snakes, including 15 mangrove snakes, 9 vipers and a spitting cobra were seized by officials of the Palawan Conservation for Sustainable Development (PCSD) in El Nido, Palawan (Mendizabal 2011). While record of confiscation is limited, the magnitude of trade could be far higher than this. In addition, the seemingly unabated widespread habitat degradation in Palawan (Ramirez 2012; Tesorio 2013) could also threaten the existence of these species. Population survey and trade along with education and information campaign, and habitat protection and restoration could help conserve the populations of these mangrove snakes.

Figure 1. *Boiga dendrophila multicincta* resting on branches of *Scyphiphora hydrophyllacea* by the bank of Iwahig River.

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Protected versus unprotected area with reference to fishes, corals, macro invertebrates, and CPUE in Honda Bay, Palawan

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ABSTRACT

The impact of Sabang Reef Fish Sanctuary in Honda Bay, Palawan was evaluated using fish, coral cover, macro-invertebrates and CPUE as measures for success. Visual census and LIT methods were used for fish, macro-invertebrate and coral cover surveys, while administered interview was used to gather information on CPUE. The protection of fish sanctuary has shown its impact to the coral reef fisheries by the improvement in quantity of the resources. Fishes, macro-invertebrates, and hard coral cover inside the Sabang Reef Fish Sanctuary (Binduyan) showed increased in abundance, diversity, and number of commercial species compared to those outside of the sanctuary. This reflects the positive impact that a protected area gained over four years. Results indicated high exploitation rates of resources in the fished areas just outside the sanctuary. Furthermore, as a consequence of improved reef fisheries, more fishermen fishing in areas closest to the sanctuary have increased their catch.

Keywords: Protected, unprotected area, fishes, corals, macro invertebrates and CPUE

INTRODUCTION

Marine protected area or fish sanctuary is a popular strategy for the conservation and protection of coral reefs and the resources therein. It is well accepted as an initiative for coastal management. Alcala (1981) and other workers made studies on impacts of marine protected areas in some islands of Negros Oriental, Philippines. The gains that coral reefs have afforded to their stakeholders were accounted by White and Trinidad (1998). However, stakeholders could relish the benefits and gains of fish sanctuaries only if they are effectively and successfully managed. The scenario could be worse when the coastal dwellers are still in doubt of the benefits that they can gain from the sanctuary. Thus, it has become necessary not only to gather baseline information, but also monitor and evaluate the effects and impacts of fish sanctuaries. It is equally important that this information must reach the local resource users.

There are many indicators to measure successful fish sanctuaries. Among others, community managed fish sanctuary must have an improvement in the resource, increase in the quality and quantity of flora and fauna (Pollnac & Crawford 2000), increased catch, legal framework and full enforcement of laws inherent to the management of sanctuaries. Similarly, Crawford et al. (2000) mentioned increased fish abundance and diversity, improved coral cover, and increased fish catch by local fishermen as some of the success measures for community based marine sanctuary. On the other hand, time series data on resources and catch rates were used by Alcala et al. (2004) as evidences for local fisheries enhancement by marine reserves.

In its effort to efficiently manage the fisheries of Honda Bay, the Puerto Princesa City Government established three fish sanctuaries between year 2000 and 2004, namely: Manalo, Sabang Reef and Puntod Ilis fish sanctuaries. However, although Gonzales (2004) initially reported an increase in fish catch in the vicinity of fish sanctuary in Sabang Reef, Honda Bay, information on virtual gains and benefits by these sanctuaries to the local reef ecosystem and fishermen must also be known. The management of Sabang reef is done by patrolling along the sanctuary. This is being carried out by the people's organization (PO) members with the assistance of the Sangguniang Barangay. In addition to this, guard house was also situated near the sanctuary for monitoring purposes.

On the other hand, resource assessment of proposed fish sanctuaries in Honda Bay was conducted by DA-BFAR, Fisheries Resource Management Division in 1999. The DA-BFAR Fisheries Resource Management Project also provided baseline data on coastal resources of Honda Bay in year 2000 (FRMP 2001).

The general aim of this study was to evaluate the impact of Sabang Reef Fish Sanctuary to reef resources and fish catch. The specific objectives were: 1) to determine fish catch close to Sabang Reef Fish Sanctuary to other fishing areas distant from the sanctuary but within Honda Bay; and 2) to assess the conditions of coral cover, reef fishes, and macro-invertebrates inside and outside the fish sanctuary.

MATERIALS AND METHODS

Coral Cover and Fishes

Survey of coral cover was done in three sites in Honda Bay: Sabang Reef Fish Sanctuary, Bush Island, and Meara Island on May 24-28, July 26-30, August 9-13, and September 16-21, 2004 (Figure 1). Meara and Bush Island Stations were included in this study in order to elicit more inferences for the comparison of protected and unprotected areas. Line transect method (LIT) of English et al. (1997) and SCUBA were used during all survey periods. This study used the same methods employed by FRMP (2001) and Becira (2003) in the same sites.

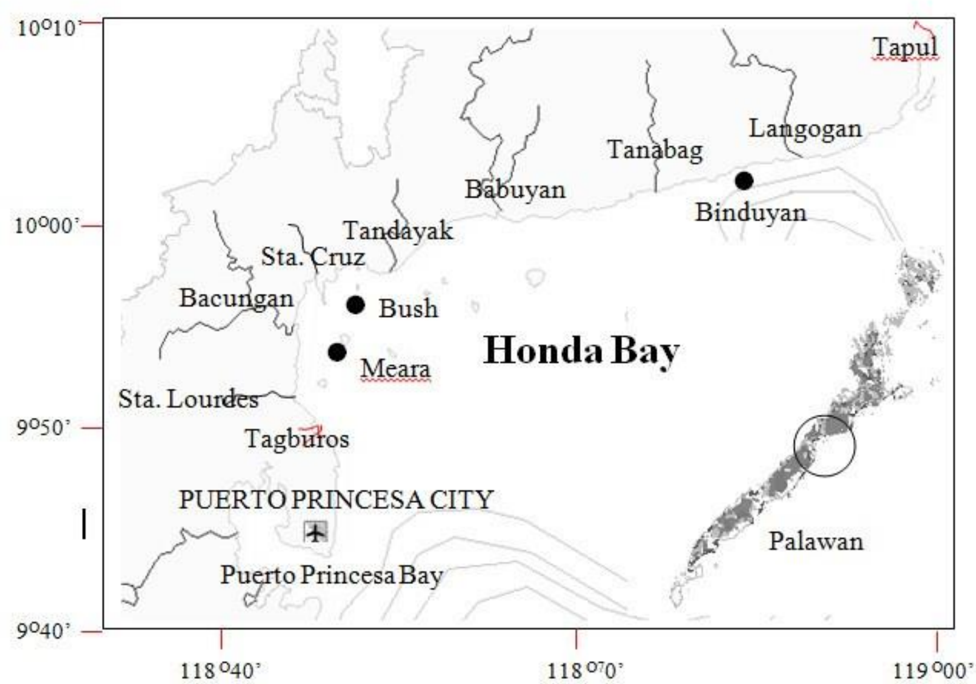

Figure 1. Map showing Palawan (lower right) and the location of sampling sites (+) in Honda Bay, Puerto Princesa City.

In Sabang Reef Fish Sanctuary, concrete block markers with 100-meter transect lines were established (Figure 2). Polyethylene ropes were used to connect concrete blocks, which could serve as permanent transect lines for future monitoring. Positions of fish transect inside (FTI-1 to 3) and outside (FTO-1 to 2) are shown in Figure 2. The data of one of the transect lines (FTI-2) inside the sanctuary were not included due to its difference in depth with other sites.

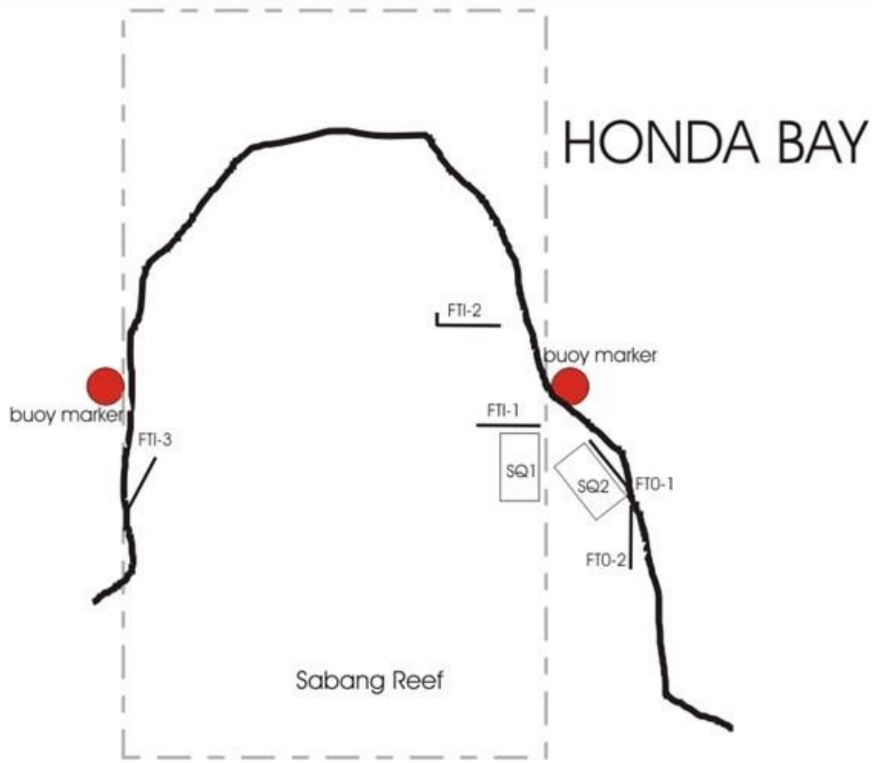

Figure 2. Sketch map of Sabang Reef Fish Sanctuary, showing the locations of permanent transect lines and quadrats used in this study. Fish Sanctuary area is enclosed by dotted lines.

Table 1. Geographical positions of the different sites in Sabang Reef Fish Sanctuary.

Sites	Longitude	Latitude
FTI-1	N10°00.474'	E119°04.217'
FTI-2	N10°00.406'	E119°04.262'
FTI-3	N10°00.570'	E119°04.360'
FTO-1	N10°00.494'	E119°04.164'
FTO-2	N10°00.502'	E119°04.184'

FTI = Fish sanctuary inside; FTO = Fish sanctuary outside

Macro-invertebrate Survey (Exclusive of Corals)

Data collection of the macro-invertebrates on the surveyed sites was conducted in conjunction with the transect surveys for coral reef and fish visual census. Visual census was conducted along imaginary 2m wide transect belt, using the transect lines for fish visual census and coral cover surveys. In Sabang Reef Fish Sanctuary, two permanent quadrats measuring 5m x 20m were used for the survey, one inside the fish sanctuary (SQ1) and another just outside of the sanctuary (SQ2) (Figure 2). Common species were identified to the lowest taxa possible. The organisms were classified according to phyla, while a taxonomic listing was generated.

CPUE and Impact to Fishermen

An administered interview was conducted, using interview forms designed to elicit the catch per unit effort of gears used by fishermen in Honda Bay. Interview forms included a map where the respondent can easily locate and mark his fishing grounds and information on catch per unit effort (CPUE), diversity of fish caught, size of fish caught, and other questions pertinent to the awareness and behavior of respondents towards the fish sanctuary.

Selection of barangays for interview was based on main fish landing areas and number of fishermen as recorded in the City Agriculture Office. Interviews were conducted to fishermen fishing in non-protected areas (Meara, Bush Islands, around Aracille Island, Pandan and Snake Island) and around protected area (Sabang Reef Fish Sanctuary) (Figure1). Interviews were conducted in Barangays Binduyan, Tagburos, Manalo, Lucbuan, Babuyan, San Rafael, and Concepcion. A total of 397 Honda Bay fishermen were interviewed comprising 77% of local fishermen fishing around the sanctuary.

Results were categorized according to major fishing gear used. Since the common major gear used by fishermen fishing near the Sabang Reef fish sanctuary and those fishing far from the sanctuary is handline, handline CPUE values were used to directly compare CPUEs between fishermen fishing near and far from Sabang Reef Fish Sanctuary. In this study, handline refers to simple handline as well as the multiple handline. Estimated distances of fishing area from the sanctuary were obtained from a navigational map and through informal interviews.

RESULTS AND DISCUSSION

Fishes

The result for the diversity, density, and biomass of reef fishes in four stations are shown in Table 2. Transects inside Sabang Reef Fish Sanctuary showed most number of fish families, number of species, number of commercial species, and highest density, except for biomass, which is lower than that of Meara Island station. This result is an indication that fish sanctuary in Binduyan has numerous fish species but small in size. This also suggests that the reef fish biomass in the sanctuary is still in the process of recuperation. Thus, continuous protection of the area will allow subsequent growth of fish populations therein.

The fish visual census conducted just outside the perimeter of the sanctuary revealed lowest values in species diversity, density, biomass, and number of commercial species. This result implies that the areas just around the fish sanctuary are most vulnerable to fishers, because fishers probably think that it is advantageous to catch spilled over fishes from the fish sanctuary.

On the other hand, the richness of the areas near the sanctuaries is manifested by the diversity of the fish families still found in the area. This implies that given a chance to regenerate, this area may also increase its fish production just like those inside the fish sanctuary. Similarly, if the area inside the fish sanctuary is not protected, most likely it will have the same condition with those in the outside area.

Table 2. Number of families and commercial fishes, diversity, density and biomass of coral reef associated fishes and their categories in four stations of Honda Bay, Palawan. Categories were after Hilomen et al. (2000).

Indicator/ Stations	Inside Sabang Reef Sanctuary (Ave.)	Category	Outside Sabang Reef Sanctuary (Ave.)	Category	Reef in Bush Island	Category	Reef in Meara Island	Category
No. of families	14.5		13.5		9		11	
*Species Diversity	106	Very High	36.5	Poor	52	Moderate	72	Moderate
**Density	1,052	Moderate	515	Poor	726	Moderate	580	Poor
***Biomass	4.7	Very Low	2.4	Very Low	4.5	Very Low	7.2	Low
No. of commercial species	9.5		3.5		6		3	

*Number of species per 1000m^2 144
**Number of individuals per 1000m^{2}145
***Estimated weight in mt per km^2

This study has provided information on the trend of diversity, density and biomass of reef fish surveys in Honda Bay (Table 3). The number of species within was nearly three times higher than outside the fish sanctuary. For Bush and Meara, the species richness and volume of catch were nearly three times lower than the previous studies. Survey sites in this table are with permanent transect lines, 149 thus could be useful for future studies.

Table 3. Trend in volume of catch and biomass of reef associated fishes in Meara, Bush and Sabang Reef Sanctuary.

Year/ Station	Inside of sanctuary			Outside of sanctuary			Bush			Meara			Source
	spp	indv.	kg	spp	indv.	kg	spp	indv.	kg	spp	indv.	kg	
2000							66	400	12	79.3	833.3	21.4	Nañola and Rodriguez (2001)
2004	106	1,052	4.7	36.5	515	2.4	52	726	4.5	72	580	7.2	This study

Coral Cover

The results of coral cover survey are presented in Tables 4 and 5. Outside Sanctuary has the highest benthic cover (55.36%), followed by Bush Island (53.40%). In terms of hard coral cover, Bush Island was the highest, followed by the Inside Sanctuary. Hard coral cover in the Inside Sanctuary (38.00%) was higher than the Outside Sanctuary (34.48%). There was higher soft coral cover outside the sanctuary than in the Inside Sanctuary.

The three sites were dominated by the presence of massive and branching corals. The genus *Acropora* was observed only in Bush Island and Binduyan fringing reefs. Presence and growth of coral recruits were observed in 4-year old permanent transect blocks.

Table 4. Benthic coverage (%) of the three areas in Honda Bay in May 24 – 28, 2004.

Category/Station	Inside Sanctuary	Outside Sanctuary	Bush	Meara
Biotic	51.47	55.36	53.40	31.90
HC	38.00	34.48	51.40	26.84
SC	10.41	19.73	0.00	0.70
SP	0.76	0.00	0.40	3.91
OT	2.30	1.15	1.60	0.45
Abiotic	30.59	44.65	46.60	68.10
DCA	27.79	22.62	18.95	29.97
R	3.73	4.10	12.85	0.00
RCK	9.71	3.35	0.00	18.59
S	7.30	12.38	2.40	0.00
Si	0.00	0.60	6.00	4.80
WA	0.00	1.60	6.40	14.74

Table 5. Trend in hard coral cover (%) in Meara, Bush Islands and Sanctuary.

Year/Station	Inside Sanctuary	Outside Sanctuary	Bush	Meara	Source
1999 (3-9m)	33.18				Tan et al. (1999)
FRMP-RSA 2000			39.32	22.24	Aliño et al. (2001)
July-Aug 2003 (1-3m)	40.50				Batin et al. (2003)
2003			45.83	43.20	Becira (2004)
2004 (3-9m)	38.00	34.48	51.40	26.84	This Study

Hard coral cover in 3-9m depth of Inside Sabang Reef Fish Sanctuary Station has increased from 33.18% in 1999 to 38.0% in 2004 (Table 5). On the other hand, consistent increased in coral cover was observed from 39.32% in 1999 to 51.4% in 2004 in an unprotected area (Bush Island), although far from conclusive, this suggests that coral cover can improve either the area is protected or not protected or more likely, destructive fishers have not yet visited the Bush Island Station between 2000 and 2004.

In Meara Island, hard coral cover has increased from 22.24% in 2000 to 43.20% in 2003. However, it showed a rapid decrease in 2004 with 26.84%. The four-year period data of coral cover in Meara Station exhibits an interesting trend, suggesting further indebt study in order to determine the factors influencing the abrupt changes in coral cover.

Comparing the results across country survey sites, current live coral cover in Honda Bay (31.90-55.36%) was higher compared to Romblon (17.2%) and Mindoro (19.94%) (SPCP-ASTI 1999) and similar to those of in Panglao Island (45.18%) and Bais Bay (50.26%), (Becira 2004).

This result also showed improvement (31.90-55.36%) compared to earlier assessment of Honda Bay live coral cover, which ranged from 19.3 to 50.63%, (SPCP-ASTI 1999; Becira 2004), and to the Philippine average live coral cover of 25 to 49.9% (White & Trinidad, 1998).

Macro-invertebrates

In Meara Island, a total of six species belonging to four families were noted in the survey area. Giant clams (Family Cardiidae) were the most dominant, having three species observed (Table 2). In terms of density count, *Tridacna squamosa* was most abundant with a density of 550 individuals per hectare. *Tridacna squamosa* was followed by the sea anemone (Class Anthozoa) having a density count of 500 individuals per hectare, *Tridacna derasa* with 250 individuals per hectare, and *Tridacna gigas* with 150 individuals per hectare (Table 6).

Inside the Sabang Reef Fish Sanctuary, a total of seven species were recorded (Table 6). Representative organisms of the Phylum Echinodermata were the dominant group. In terms of density count, *Euapta godeffroyi* (Family Synaptidae) was the most abundant having a density of 200 organisms per hectare, the rest have a density of 100 organisms per hectare.

There were six commercial species of macro-invertebrates found inside the Sabang Reef Fish sanctuary (Table 6): *Holothuria whitmaei*, *H. rigida*, *Lambis lambis*, *Tectus niloticus*, *Tridacna derasa*, and *T. squamosa*, while only one commercial species (*Holothuria rigida*) was recorded outside the sanctuary. On the other hand, there were three very important species observed in Meara station, namely: *Tridacna derasa*, *T. gigas*, and *T. squamosa*.

The Inside Sanctuary Station revealed the more diverse species, more number of commercial species, and highest total density of macro-invertebrate compared to those of the Outside Sanctuary and Meara Stations (Table 7). The number of commercial species and total density of macro-invertebrates immediately Outside Sanctuary Station were lower than that of Meara Station.

Table 6. Density (indv./ha) of macro invertebrates found in three stations in Honda Bay, Puerto Princesa City

Species	**Sabang Reef Fish Sanctuary**		**Meara Island**
	Inside (n=4)	**Outside** (n=3)	
ECHINODERMATA *Lamprometra* sp.		100	
Archaster typicus	100		
Echinaster luzonicus	100		
Echinaster callosus	50	50	
Linkia laevigata	350	150	50
Ophiarthrum pictum		100	
Ophiothrix nereidina	217		
Echinothrix diadema	50		50
Holothuria whitmaei	100		
Euapta godeffroyi		200	
Holothuria rigida		100	
MOLLUSCA *Rhinoclavis fasciata*	100		
Melanella candida		100	
Cypraea moneta	100		
Cypraea annulus	50		
Lambis lambis	250		
Tectus niloticus	150		
Tridacna derasa	100		250
Tridacna gigas			150
Tridacna squamosa	150		550
TOTAL	**1867**	**800**	**1050**

Table 7. Density and diversity of macro-invertebrates observed inside and outside of Sabang Reef Fish Sanctuary and Meara Stations.

Indicator\Station	Inside Sabang Reef Fish Sanctuary	Outside Sabang Reef Fish Sanctuary	Meara
Species diversity	14	8	5
No. of commercial species	6	1	3
Total density (no. of indv./ha)	1867	800	1050

Catch per Unit Effort

While going through with the completed CPUE forms, it was observed that the fishing ground in Honda Bay could be divided into three areas. These fishing grounds can further be classified into: A) most distant to sanctuary, B) distant to sanctuary, and C) close to sanctuary(Table 8). The CPUEs in these fishing areas, including those before and after the establishment of fish sanctuary are presented in the same table. The trends of catch per unit effort of handline in fishing grounds A (most distant from sanctuary), B, and C (close to Sanctuary) are compared in Figure 3 and Table 8.

The CPUE of all surveyed municipal fishing gears in fishing ground most distant to sanctuary showed a decreasing trend from 1998 to 2004. The CPUE of the two common gears in Honda Bay, which are spear gun and handline have decreased from 3.91 kg/person/hr and 4.66 kg/person/hr to 1.29 kg/person/hr and 1.57 kg/person/hr, respectively. The handline has been reducing its catch at the rate of 0.52 kg/person/hr per year (Table 8), while the spear gun at 0.44 kg/person/hr per year.

On the other hand, catch of gillnet has also declined from 10.7 kg/person/hr in 1998 to 2.15 kg/person/hr in 2004, having the highest rate of decrease at 1.43 kg/person/hr per year.

Table 8. Catch per unit efforts of fishermen fishing in three fishing Grounds (A, B, and C) in Honda Bay.

Fishing ground / CPUE	CPUE (kg/person/hr) from 1998 to 2004 Handline	Annual rate of decrease in CPUE Handline	% of respondents with increased CPUE in 2004	CPUE (kg/person/hr) Handline Before establishment of sanctuary 2002	CPUE (kg/person/hr) Handline After establishment of sanctuary 2004
A. Fishing areas extending from Bat Island to Bush Island (most distant to sanctuary, 30-40 km.)	4.66 to1.57	0.52	0	4.52	1.57
B. Fishing areas off the waters from barangays Manalo to Concepcion (Snake, Barlas, Arraceffi, Fundeado Islands) (distant to sanctuary, 11-30 km)	4.64 to1.64	0.5	4.3	4.19	1.64
C. Fishing grounds around Sabang Reef Fish Sanctuary (close to sanctuary, 0-11 km.)	2.60 to1.64	0.16	27	2.58	1.64

The rate of decrease in handline catch near a protected area (Sabang Reef Fish Sanctuary) was slower than the rate of decrease in handline catch in unprotected area (Figure 3). The CPUEs of the three fishing grounds before and after the introduction of management regimes are shown in Table 8. Annual rate of CPUE decrease was least in fishing ground C (160g), near sanctuary, compared to fishing grounds A and B (approximately 500g) (Table 8). This may be due to the impact of the sanctuary, which mitigated the abrupt decrease in fish catch in areas near Sabang Reef Fish Sanctuary, though detailed studies on the spillover effect and recruitment of target fishes should be conducted.

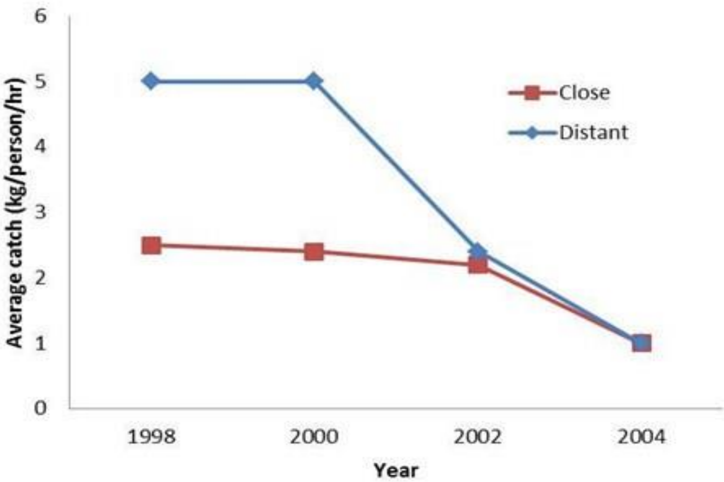

Figure 3. Catch trend in handline fishing from 1998 to 2004 in areas distant and close to fish sanctuary in Honda Bay, Palawan, Philippines.

The percentage of respondents with increased catch was highest (27%) in fishing ground closest to the sanctuary, of which gradually decreases in fishing grounds B (4.3%) and A (0%), which were far from the sanctuary (Figure 1, Table 8). This implies that the greater distance from the sanctuary the lesser is the chance for increased catch and vice versa. This observation is supported by the study in Apo Marine Reserve, where the density of large predatory fishes is highest in fished areas closest to the reserve (Alcala et al. 2004).

Empirical computation may generalize that having 27% of local fishermen who had increased their fish catches in a 2.5-year old sanctuary, suggests that approximately 10% of the local fishing population has increased catch per year. Assuming that the process and conditions will continue, all local fishermen of Sabang Reef Sanctuary shall increase their catch within 10 years after the establishment of the sanctuary. However, interviews revealed that the sanctuary ordinance was not fully enforced. Thus, if the sanctuary ordinance is fully enforced, it would take less than 10 years before 100% of local fishermen fishing near the sanctuary will increase their catch.

General Discussion

Comparing the results among the Outside Sanctuary Station and Meara and Bush Stations, there is a general observation for higher resource exploitation outside the perimeter of sanctuary area than those in the same unprotected area away from the sanctuary. This was observed in fish visual census and macro-invertebrates survey outside perimeter of sanctuary, wherein results revealed a decrease in species diversity, density, biomass, and number of commercial species (Tables 2 and 7). On the other hand, results of CPUE survey indicated high catch rate at the perimeter of the fish sanctuary.

The above result showed that the areas just around the fish sanctuary are most vulnerable to fishers, because they probably think that it was advantageous to competitively catch the spilled over resources coming from the fish sanctuary. Since Sabang Reef Fish Sanctuary was still young (2.5 years old), the sanctuary was in its recuperating stage in which, it cannot yet readily supply the existing resource requirements of the fishery outside its boundaries.

The CPUE that was reported to have increased to 5kg per trip in areas near Sabang Reef in 2003 (Gonzales 2004) represented the average catch of different kinds of gears in the area. This should not be confused with the result of this study, having a CPUE of 1.64kg for the catch/person/hr of hand lines in the area in 2004.

The protection of fish sanctuary has showed its impact to the coral reef fisheries by the improvement in quality and quantity of the resources. Fishes, macro-invertebrates, and hard corals inside the Sabang Reef Fish Sanctuary showed increase in abundance, diversity, and number of commercial species compared to those outside of the sanctuary. This reflected the positive impact that a protected area has gained overtime.

Further studies to infer on movement and direction of target fishes across the boundaries of MPAs should be promoted (Polunin 2002). Sightings of sharks, including whale sharks, turtles, and dolphins in pursuit of the schools of small pelagic fishes inside and along the perimeters of the sanctuary are also manifestations of improved coastal habitats and resources. It is also worthy to note that as a consequence of improved reef fisheries, more fishermen fishing in areas closest to the sanctuary had increased their catch.

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Notes on the occurrence of a rare Cardinal Fish at Coral Bay, Southern Palawan, Philippines

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A team of researchers led by Haribon Palawan and the author with staff from DENR-PENRO, assisted by Coral Bay Nickel Corporation (CBNC) staff conducted coastal habitat monitoring in several areas of Coral Bay, southern Palawan in March 2008 and 2014, under the auspices of CBNC.

While diving in one of the survey stations (Maranto Point), the author observed an unusual solitary fish, of which he has seen for the first time in his three-decade work in marine fishes of Palawan. The author took photographs of the fish under water to document fish occurence (Figure 1).

The fish was found in a shallow (2-3 meters deep) reef patch off the Maranto Point, located west of the mouth of Rio Tuba River in Coral Bay, Southern Palawan. The exact location of the site was: Latitude, 8.50400^{o}; Longitude, 117.28290^{o}. Although *A. griffini* might have been previously recorded in Palawan waters, it has not appeared in the pictorial guides of Palawan fishes (Schroeder 1980; Gonzales 2013) Seale also described this species from Bantayan Island, Philippines in 1910.

Figure 1. A 4cm TL *O. griffin* in Maranto Reef, Coral Bay, southern Philippines (March 2008).

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In January 2009, the fish photograph was sent to Dr. Kent Carpenter of the Department of Biological Science of the Old Dominion University, Virginia, USA for identification. After about a month, Dr. Carpenter identified the fish as *Apogon griffini* (Seale, 1910), a rarely seen kind of cardinal fish called northern spiny dogfish. Seale described this species from Bantayan Island, Philippines in 1910. The genus of this species was renamed to *Ostorhinchus* (Fishbase 2014).

This cardinal fish is found only from the Philippines to Northern Borneo (Malaysia, Indonesia and Brunei), which is a relatively limited range of distribution for a marine fish.

Ostorhinchus griffini is a fish native to Philippines. One alarming issue is that during the period of five-year underwater survey in Coral Bay, only one living individual of this fish species was recorded, found in a very restricted area of Coral Bay, indicating that the population of this fish species is at high risk in the area. The author again went with the same monitoring team to Coral Bay on March 23-28, 2014 and observed most probably the same solitary fish in the very same area at Maranto reef. Through fish visual estimate, the fish has grown three times its original length in 2008.

Although the CITES status of this fish has not yet been evaluated (FishBase 2014), this fish needs some degree of protection, especially in its local population. Its habitat is further threatened being only about 50 m distance from the shore, fronting a fishing village, open to human activities. Possible flush flood from Rio Tuba River and rampant dynamite fishing in the bay are other threats to the existence of this fish species.

Basing from its population status, area occupied, the extent where it occurs, and the threats it is facing, it is apparent that this species needs immediate protection in order to ensure its survival and prevent its loss in Coral Bay. Something has to be done to save this population, like protection of the Maranto Point coral reefs.

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