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Impact Assessment of Topshell *Trochus niloticus* Stock Enhancement in Honda Bay, Palawan

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ABSTRACT

The impact of the topshell *Trochus niloticus* stock enhancement in Honda Bay, Palawan was assessed using biological and sociological data. Results indicate that topshells in the protected area are significantly bigger in mean size compared to that in the unprotected area. The abundance in terms of number of individuals per hectare or the density of topshells in the protected area having 70.00 individuals per hectare is significantly higher compared to that in the unprotected area with only 27.50 individuals per hectare. It was found out that the density of topshells in the protected area increased significantly through time. Statistical analysis also showed that the sizes of the topshell in deep water station had significantly increased after more than two years of restocking. At the deep-water station, present study estimated the density of topshell in protected area at 190.00 individuals per hectare, all consisting of mature (≥6 cm) individuals.

Results of the present study further indicate that topshell as a resource is obviously heavily overexploited. The absence of mature topshells in the deeper waters of the unprotected area, including the area just outside of the sanctuary, indicates the magnitude of harvesting of the resource.

The data presented above validated the perceptions of the community that the restocking initiative in combination with protection,generally resulted into positive effects to their livelihood.

Keywords: Trochus, niloticus, topshells, stock enhancement

INTRODUCTION

The topshell, *Trochus niloticus* (Figure 1), is native to countries of the Western Pacific and has been introduced to many additional locations throughout the Pacific Islands. This shell is collected and exported for button making and other decorative uses while the meat is easily processed either salted or smoked, providing an important source of income for rural and fishing communities in the region.

In recent years, the market value of trochus shell has increased markedly. As a result, the level of exploitation has also increased in many Pacific Island countries. There are fears in some locations that present levels of harvesting will

not be sustainable and that serious resource depletion will occur if management regimes are not developed and instituted. In the Philippines, depletion of trochus shell in various areas due to unregulated harvest has been observed by fishermen.

In response to these concerns, the IUCN has placed *T. niloticus* to its list of commercially threatened invertebrates. In the Philippines, under the Fisheries Administrative Order (FAO) 168 and Fish Game Administrative Order No.11, trochus is classified as highly regulated shells. Recently, FAO 208 listed *T. niloticus* as threatened species thereby prohibiting gathering of the shell.

In an effort to revive trochus shell population in Honda Bay, Palawan, the local government units (both city and barangay), non-government organizations and the private sector have initiated a restocking program to re-seed the protected Sabang Reef in Binduyan, Puerto Princesa City (Figure 2). Marked laboratory reared juveniles produced in the nearby hatchery was released in the protected area in 2002 on several occasions.

The aim of this study is to evaluate the impact of the topshell stock enhancement project in Sabang Reef of Barangay Binduyan, Puerto Princesa City. The specific objectives of the study are: to determine the density of topshell in the area, to know the spatial distribution of top shell in the area, and to know the effect of stock enhancement in the area and size and number of shells collected by gleaners, gather information on the awareness and behavior of the community towards the topshell stock enhancement in the area.

Figure 1. The topshell, *Trochus niloticus* in various perspectives: left, as seen from the side; middle, as seen from the bottom; right, as seen from the top.

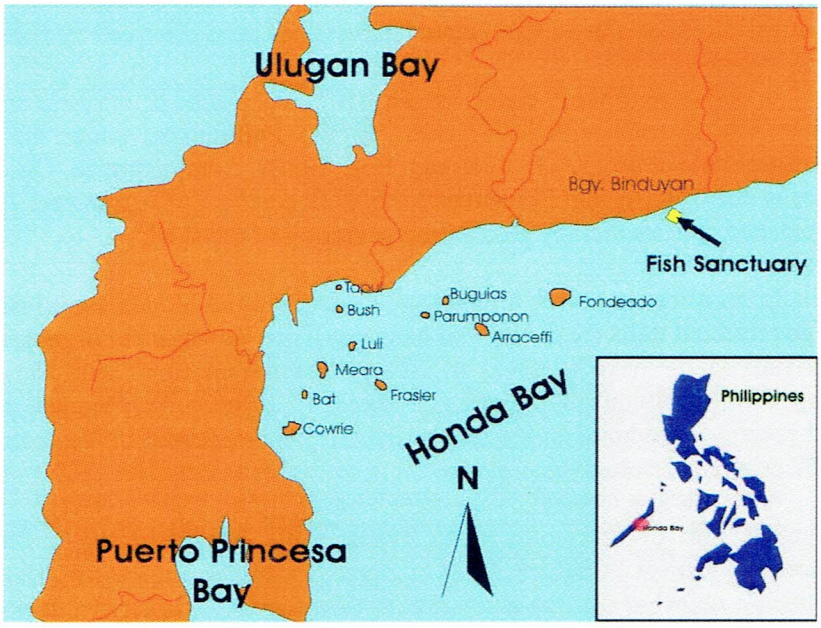

Figure 2. Map of Honda Bay showing the location of Sabang Reef in Barangay Binduyan, Puerto Princesa City.

METHODOLOGY

Biological Impact. Two methods were used to determine the abundance, distribution, and sizes of the topshells inside and outside of the marine protected area or fish sanctuary: the permanent quadrat and belt transect of English *et al.* with slight modifications.

At intertidal station, which is inundated with 1-2 m of seawater during high tide, two 20 x 200 m permanent quadrat was established parallel to the shoreline. Each 4000 m^2 sampling area was divided 10 survey path, each covering an area 400 m^2. For rapid assessment, 10 researchers including community volunteers walked along each survey path measuring 2 x 200 m. As individual researchers walked in their respective paths, the distribution of the topshells was noted and the abundance and individual sizes were measured.

In deep-water station, two 5 x 200 m belt transect was established perpendicular to the shoreline beginning at approximately 70 feet deep until 15 feet deep. Each 1000 m^2 sampling area was divided into two survey paths by a transect line, each covering an area of 500 m^2. A permanent transect line was fixed to the substrate using steel pegs to divide the belt transect and guide the divers their survey path. For rapid assessment, three SCUBA divers swam along each path. As

individual divers swam in their respective paths, the distribution of the topshells was noted and the abundance and individual sizes were measured.

Data from Iris Development Corporation was also used as baseline data for comparison.

Sociological Impact. An administered interview was conducted to assess the impact of the restocking initiative to the fishermen and/or gleaners. Data elicited in the interview forms are the following: changes in location and size of gleaning area; changes in abundance, distribution and sizes of gleaned topshell and other invertebrates; as well as other questions pertinent to the awareness and behavior of respondents towards the fish sanctuary and the restocking effort.

RESULTS AND DISCUSSION

Biological Impact. Data on the abundance and sizes of topshell in protected and unprotected areas are presented in Table 1. At the intertidal area, results revealed that topshells had a mean basal diameter of 4.58±1.43 cm for the protected area and 2.95±1.24 cm for the unprotected area. At the protected area, the maximum basal diameter of topshells was recorded at 6.70 cm. At the unprotected area, topshells had a maximum basal diameter of 4.90 cm. The minimum basal area of topshells was 2.00 cm in the protected area and 1.00 cm in unprotected area.

With regards to the abundance of topshells in the intertidal area as measured in terms of the number of individuals per hectare, the density was recorded at 70.00 individuals per hectare in the protected area and 27.50 individuals per hectare in the unprotected area.

Table 1. The abundance and sizes of topshells in the intertidal and deep stations.

	Intertidal (1-2 m)		Deep (4-21 m)	
	Protected	Unprotected	Protected	Unprotected
Mean Basal Diameter±SD (in cm)	4.58±1.43	2.95±1.24	10.63±0.57	0.00
Minimum Basal Diameter (in cm)	2.00	1.00	6.50	0.00
Maximum Basal Diameter (in cm)	6.70	4.90	16.50	0.00
Density (per ha)	70.00	27.50	190.00	0.00

In the deep water stations, this study revealed that the population of topshell in the unprotected area has been decimated. There were no topshells observed in the unprotected area during the survey. At the protected area, however, results showed that topshells had a mean basal diameter of 10.63±0.57 cm. The minimum basal diameter was measured at 6.50 cm while the maximum basal area has been observed at 16.50 cm. The density was observed at 190.00 individuals per hectare.

Data obtained from Iris Development Corporation, owner of the hatchery operating in the area, have indicated that in 2002 topshells in deepwater stations had a mean basal diameter of at 4.98±0.54 cm. The minimum basal diameter was measured at 4.60 cm while the maximum basal area has been observed at 7.40 cm. In 2003, the mean basal diameter was observed at 9.59±0.58 cm while the minimum basal diameter was measured at 8.30 cm and the maximum basal area at 11.20 cm.

Analysis of variance (ANOVA) revealed that the mean basal diameter of topshells in 2002 is significantly smaller (f=225.21, p=0.05, n=3) than the mean basal diameter in 2003 and 2004.

Sociological Impact. A total of 70 respondents were interviewed to evaluate the sociological impact of the restocking initiative in the protected area, such as the changes in their gleaning area and the length of time spent gleaning for topshells, abundance and size of gleaned shells, and their awareness and attitudes toward the restocking effort and protection.

Changes in gleaning area and length of time gleaning. When asked about the effect of the initiative to the size of their gleaning area, majority (71%) of the respondents believed that their gleaning area did not changed in size but rather remain the same, while 19% said that they now have a wider area to be gleaned than before. However, 9% of the respondents believed that the restocking effort and protection has had encroached to their gleaning area.

Table 2. Temporal changes in the population and sizes of topshell before and after restocking.

	Intertidal Station (1-2 m)	Deep Station (4–21 m)		
	Density (individual/per hectare)	Basal Diameter (cm)		
		mean	minimum	maximum
2002	40.00	4.98	4.60	7.40
2003		9.59	8.30	11.20
2004	70.00	10.63	6.50	16.50

When asked about the changes in the length of time spent for gleaning, 37% of the respondents said that they are spending less time gleaning for shells now than before. However, 31% believed that they are spending more time than before, while another 31% said that their gleaning time is still the same.

Changes in the abundance and size of gleaned topshells. When asked about the changes in abundance of topshells, majority (70%) of the respondents believed that the restocking effort has had a very obvious positive effect saying that they are gleaning more topshells now than before. However, 17% believed that the abundance of topshells did not change while 9% said that they are gleaning less topshells now than before.

When asked about the changes in size of the topshells, majority (61%) of the respondents believed that they are gleaning bigger topshells now than before. However, 19% believed that the size did not change saying that they caught the same size of topshells as before. Another 20% of the respondents did not answer the question.

Awareness and attitudes toward the restocking effort and protection. Assessing the respondents awareness to the initiative, almost all (96%) of the respondents said that they are aware of the restocking effort in their area saying that they knew that topshells are being released back to the protected area from time to time. Only 3% said that they are not aware of the initiative.

Although 96% of the respondents knew about the initiative, only 89% are aware about the prohibitions concerning the gathering of topshells, while 7% are not aware at all. Four per cent of the respondents did not answer the question.

When ask of their opinion regarding the prohibitions imposed by the government in gathering of topshells, almost all (94%) of the respondents said they are in favor of the prohibitions. However, 4% said they are not in favor.

In the intertidal area, results indicate that topshells in the protected area (4.58±1.43 cm) are significantly bigger ($t=2.03$, $p=0.05$, $n=39$) in mean size compared than that in the unprotected area (2.95±1.24 cm). The topshells at the protected area having a maximum basal diameter of 6.70 cm is also bigger compared with the topshells from the unprotected area with only 4.90 cm basal diameter. Likewise, the minimum basal area of topshells in the protected area is slightly bigger (2.00 cm in diameter) compared than in the unprotected area with only 1.00 cm.

The abundance in terms of the number of individuals per hectare or the density of topshells in the protected area having 70.00 individuals per hectare is significantly higher compared than in the unprotected area with only 27.50 individuals per hectare.

Comparing the present data with the results obtained by Gonzales (2002), it was found out that the density of topshells in the protected area increased significantly since the restocking initiative has been implemented. In May 2002, only 40.00 individuals per hectare were noted in the intertidal area of the sanctuary. In September 2004, 70.00 individuals per hectare were noted indicating an increase of 75% in abundance. The size of topshell in terms of its mean basal diameter, however, did not change.

Statistical analysis also showed that the sizes of the topshell in deep water station had significantly increased after the restocking initiative was implemented in 2002. In September 2002, the mean basal diameter was observed at 4.98±0.54 cm.

After the project was implemented, the mean basal diameter was recorded at 9.59±0.58 in 2003 and 10.63±0.57 in 2004.

The data presented above validated the perceptions of the community that the restocking initiative in combination with protection,generally resulted into positive effects to their livelihood. Majority of the community members are saying that they are gleaning more and bigger topshells now than before. Based on the results, it would seem that the establishment of the protected area did not effectively reduce the size of the gleaning area. It is also apparent that the length of time spent for gleaning did not change despite the increased abundance of topshells.

At the deep-water station, present study estimated the density of topshell in protected area at 190.00 individuals per hectare, all consisting of mature (≥6 cm) individuals. This result is slightly higher than the data obtained by the previous study conducted by Becira *et. al.* (2004) which estimated the density of topshells in the same protected area at 150.00 individuals per hectare.

Results of the present study indicate that topshell as a resource is obviously heavily overexploited. The absence of mature topshells in the deeper waters of the unprotected area, even in the survey area just outside of the sanctuary, indicates the magnitude of harvesting of the resource. This, despite almost all (94%) of the fishermen-respondents are aware of the government regulations prohibiting the gathering of the topshell, results of the study indicate that harvesting continued to be unabated. The present study also confirmed the findings of the previous study conducted by Becira *et. al.* (2004) in the same area that topshells were conspicuously missing outside of the protected area.

Comparing, however, the present data obtained in the protected area with the studies conducted in other countries, it was noted that the density of topshells in the protected area in Honda Bay is comparable or even higher to the density of topshells of other areas in the Pacific region. In Chuuk State, Micronesia for example, the densest population of topshell in a barrier reef was observed only at 37.00 individuals per hectare (Gawel, 1997). In Okinawa, Japan, mature topshells were recorded at a mean density of 80.00 individuals per hectare (Isa *et. al.,* 1997), and 45.00 individuals per hectare in Papua New Guinea (DFMR, 1997). In Marshall Islands, however, the mean density of topshell was recorded at 556.00 individuals per hectare in the inter-island channels and 962.00 individuals per hectare on reef flats (Kilma and Kobaia, 1997). These data, however, might represent a pristine environment.

CONCLUSIONS

Based on the data presented above, the following generalizations are hereby formulated:

1. At face value, the restocking initiative is successful. Data indicated that the population of topshell has increased significantly over time since the initiative has been implemented. Comparing the data obtained both study sites, the protected area has had higher topshell population than in the unprotected area. However, it could not be ascertained in this study whether the observed increase in population is only caused by the introduction of topshells in the protected area as expected or due to natural recruitment. Further study is necessary to detail the true cause of increase population.

2. Result of sociological survey showed positive impacts in aspects likes: changes in their gleaning area and the length of time spent gleaning for topshells, abundance and size of gleaned shells, and their awareness and attitudes towards the restocking effort and protection.

3. It is very obvious that harvesting of topshell continues despite of the prohibitions imposed by the government. Data indicate that population of mature topshell, which is commercially important, has been decimated even just outside of the protected area. Given a chance or if the enforcement of sanctuary regulations will fail, gleaners would still collect topshell even inside of the protected area.

4. Restocking initiative of commercially exploited species, e.g. topshell, would only be successful if implemented in combination with the establishment of a protected area. Data indicated that fishermen, if given a chance, would continue to exploit the introduced resource even if they are aware of the objectives of the restocking program and the prohibitions imposed by the government.

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