Fishery of the short-necked clam *Paphia undulata* in Southern Negros Occidental, Central Philippines*

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ABSTRACT

This study documents the fishery of the short-necked clam *Paphia undulata* in coastal waters of southern Negros Occidental. Catch and effort estimates were determined based on daily records of compressor divers gathered between February-July 2008 in Himamaylan City and July 2008-May 2009 in the town of Hinigaran. Fishing and marketing practices in both areas were also documented and population biology information noted.

Compared to earlier conditions, present fishing patterns show a worsened stage of overexploitation primarily characterized by collection of predominantly small and immature (mostly <45 mm shell lengths) sizes. Intensity/duration and location of fishing also varied due to both abundance and demand factors.

The difference in sizes of clams and the varying fishing durations in each area suggest a non-uniform pattern of settlement resulting most likely from differential larval recruitment, the likely factors causing the local *boom and bust fishery*. The larger and long term extent of the effect of these factors can only be further investigated by parallel 2-3 year fishery-dependent and -independent surveys.

Keywords: Paphia undulata, catch, catch rates, Central Philippines

INTRODUCTION

Like many finfish and invertebrates, shellfish are known to be good sources of protein for most of the coastal communities in the country. They also contribute to the total fisheries production in the country. However, these resources, including bivalves, are harvested at an increasing rate in most of our coastal areas, an obvious result of the swelling population in coastal areas as well as the constant demand of fishery resources in both the local and export markets. Consequently, bivalve aquaculture experiments are being attempted in various places to offset the exhaustion of natural beds by overexploitation (FAO, 1998). It is known that some bivalve species are popular delicacies served not only locally but in neighboring countries as well. The short-necked clam *Paphia undulata* (Figure 1), locally known as "nylon shell" in western Visayas is a commercially important invertebrate resource in the Philippines and is in fact one of the most sought after bivalve species in the region. It is usually sold live or chilled/frozen in the local markets while its meat is processed for the export trade. FAO (1988) reported that *Paphia undulata* constituted about 4.1% of the total world and Asian landings (excluding Japan) of the most important mollusk species in Asia for the year 1986 alone. However, there is a lack of parallel information for recent years thus the values can not updated.

In Negros Occidental, particularly in the towns of Hinigaran and Himamaylan, *P. undulata* is harvested from mudflats through compressor diving. Agasen et al. (1998) did an assessment of the species in the same

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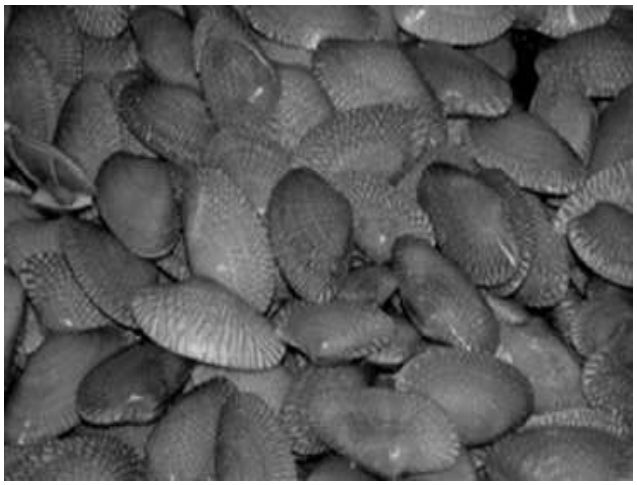

Figure 1. The short necked clam *Paphia undulata* (Born, 1778) (Mollusca, Pelecypoda: Veneridae), locally known in western Visayas as the "nylon shell".

area and concluded that it was overexploited. The fishery is still on-going in the area although there is a rather irregular seasonality in fishing due to dependence on stock abundance. A re-assessment of its status after more than a decade is needed considering that the importance of management interventions, on top of its over-exploitation, is still not properly recognized. Thus the objective of this paper was to examine the current status of the fishery by determining catch volume, catch rates, and their seasonality, as well as annual income, and to use these as bases for the assessment. A separate paper (Del Norte-Campos & Villarta, 2010) compares the status of the stocks 13 years ago (Agasen et al. 1998) and the present, using population biology information.

MATERIALS AND METHODS

The study was conducted in Himamaylan and Hinigaran, southern Negros Occidental, central West Visayas, Philippines (Fig. 2). Compressor diving operations for nylon shell are not continuous throughout the year, but shift from one locality to the other, depending on availability of marketable sized shells, without regular seasonality. Hence catch data were collected only during the months of operation in the respective localities, i.e. February to July 2008 in Himamaylan and July 2008 to May 2009 in Hinigaran. For both areas, estimates of the total volume of catch (kg) and the corresponding fishing effort (hours spent fishing) per fisher were determined based on daily records of compressor divers, while information on selling prices (Php), manpower and other fishing practices were obtained through informal interviews with the traders, vessel owners/operators and divers.

The catch per unit effort (kg hr^{-1}) was computed by dividing the catch (kg) with the fishing effort (h). Daily catches were averaged and then multiplied by the number of days fished per month to get estimates of the total monthly catch (kg) per diver. Total monthly catches were then multiplied by the actual number of months of diving operations to get the annual catch (kg) for each diver. This was then multiplied by the total number of divers to estimate the total annual catch of the fishery in both areas. To determine the annual value (Php) of the nylon shell catch for each area, the total annual catches were multiplied by the corresponding lower and upper limit of their price range during the time of survey in Himamaylan and Hinigaran, respectively. From this, the income per diver was also estimated by dividing the annual value by the number of divers in each area and dividing this further with the number of days fished for the year.

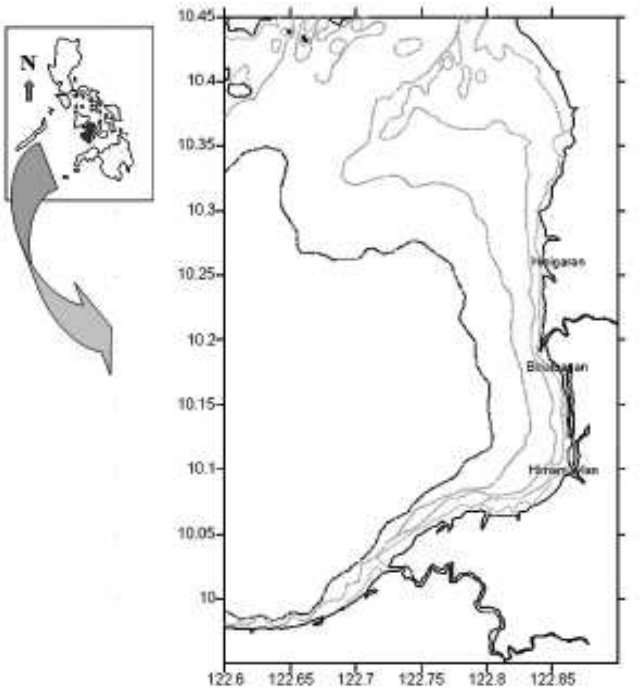

Figure 2. Location of the study area in southern Negros Occidental.

RESULTS AND DISCUSSION

Overview of the fishery

Nylon shell burrow deep into the muddy substrate and are harvested by compressor divers in depths ranging from 4 to 8 fathoms (7 to 14 meters) along the coast of Negros. Compressor diving, also known as *hookah*, is also used in other parts of the country for gathering *Paphia* spp, particularly in Leyte, Leyte (Cesar et al., 2003) and Bolinao, Pangasinan (Pastor and Juinio-Meñez, 2003). In southern Negros Occidental compressor diving for *P. undulata* is conducted during the daytime. Majority of the motorized boats leave around 0600H and return to land their catches around noon to early afternoon. Each boat usually has 3 divers and 1 compressor operator or lineman. The landing site in Himamaylan is located in Sitio Batang, Brgy Talaban. In Hinigaran, the 2 landing sites are located in the coastal barangays of Tagda and Gargato. Buyers typically finance the operations and dictate the selling price of the nylon shells from as low as Php 40 to as high as Php 80 per kilo in Himamaylan, and from Php 10 to 30 per kilo in Hinigaran. The disparity in selling price is discussed below.

Nylon shells bought from the divers are sorted mostly by women in the landing sites. Shells $\geq$ 2 inches (50mm) in length are packed live and shipped for export to Taiwan. A Taiwanese importer accepts up to 4 tons daily (except Sundays) of live nylon shells for export. The amount in excess of 4 tons, if any, is processed as meat along with the meat of shells < 2 inches in length for export to Japan.

The compressor diving fishery in Himamaylan started operations in February 2008 and lasted for only six months. The same group of divers and buyers then moved north to a neighboring town, Hinigaran, where diving operations started in July 2008 and ended in May 2009 (11 months).

Catch and Catch Rates

Himamaylan

Based on daily records of compressor divers from February to July 2008, mean daily catch ranged from 4.7 to 17.7 kg per diver, with an average of 4.3 diving hrs per day (Table 1).The highest computed catch rate (3 kg diver^{-1} hr^{-1}) was recorded in February while the lowest was observed in June (1.2 kg diver^{-1} hr^{-1}). On the average, compressor divers go out to harvest nylon shells 27 days in a month. From these, the computed mean monthly catch per diver (kg) was also highest in February (459.5) and lowest in June (116.5). Catch and catch rates decreased after February and continued to decline until June (Figure 5). The fishery stopped sometime in July although total catch for this month increased from the previous month (June). This rise in total catch may be attributed to the smaller number of boats (lower fishing effort) fishing in July (Figure 6), reducing competition for area covered by diving and increasing individual catch rates.

Table 1. Mean daily diving hours (per diver), number of diving days per month, mean daily catch (kg diver^{-1}), mean catch rate (kg diver^{-1}hr^{-1}) and mean monthly catch (kg diver^{-1}) in Himamaylan, Negros Occidental.

Months	Mean # of divers surveyed	Mean daily diving hours	Diving days	Mean daily catch (kg diver^{-1})	Mean CPUE (kg diver^{-1}hr^{-1})	Mean monthly catch (kg diver^{-1})
Feb '08	41.0	6.1	26	17.7	3.0	459.5
Mar	36.6	4.0	31	10.9	2.9	337.2
Apr	40.0	3.8	30	8.0	2.2	239.9
May	27.8	3.8	22	5.6	1.5	122.8
Jun	26.4	3.6	25	4.7	1.2	116.5
Jul	19.5	4.1	27	9.8	2.2	264.0
Overall Mean	**31.9**	**4.2**	**26.8**	**9.4**	**2.2**	**256.7**
Sd	**8.63**	**0.95**	**3.31**	**4.68**	**0.69**	**130.78**

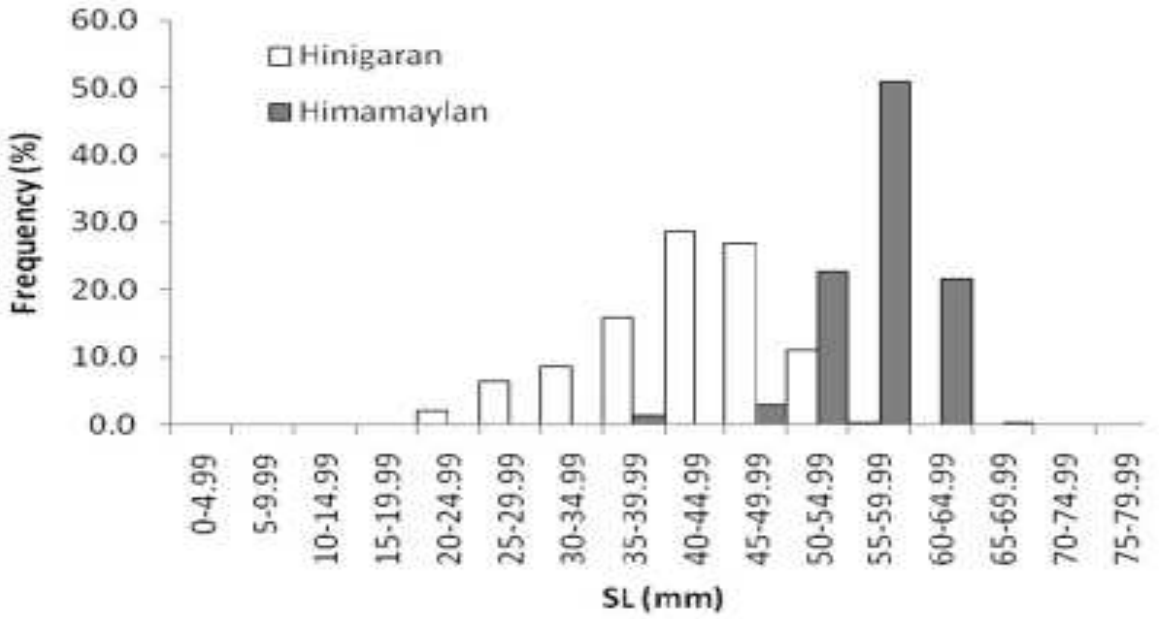

Figure 3. Size distribution of *Paphia undulata* from data collected during compressor diving surveys in Hinigaran and Himamaylan, southern Negros Occidental, April 2008 – March 2009.

Hinigaran

Computed catch and catch rates from July 2008 to May 2009 for Hinigaran are shown in Table 2. Mean daily catch and CPUE were highest in October-December 2008 and lowest in April to May 2009. Mean daily diving hours ranged from 4.0 to 5.4 with an overall mean of 4.9 hrs diving per day. Diving days per month varied throughout the duration of the fishery and this ranged from 12 to 30 with an average of 25 ± 6.2 days per month. Table 2 also shows the mean monthly catch per diver whereby highest values were also observed in the months of October, November and December 2008. Lowest mean monthly catch was observed in April and May 2009. A decline in the catch was observed after December which continued decreasing in the following months until all local fishing operations ceased after May 2009 (Figure 7). This period of operation indicates the absence of regular seasonality in the harvesting of nylon shell, and that effort is highest when other pressures, like demand for export, are present. This pattern was also observed in the study of Agasen et al. (1998) in the same area, wherein a decline in catch rates was observed from July 1996 to February 1997. In a similar study in Bolinao, Pangasinan (Pastor and Juinio-Meñez, 2003), a continued decline in the catch of the same species (locally called *kabloy*) was also observed during the survey period.

Catch and Value Estimates

Based on the mean monthly catch of 256.7 kg/diver (Table 1) and a total of six months of fishing operations in Himamaylan, the total "annual" catch of *P. undulata* per diver in the area was estimated to be 1.5 MT (Table 3). Information provided by local enumerators indicates that there were about 150 divers operating in Himamaylan during the months monitored. With this number of divers, the total annual catch for Himamaylan during the study was 231.0 tons. Using the lower and upper limits of the price range the total value of the catch per year would be between Php 9.2 – 18.5 M. This translates to a gross income of between Php 382.00 – 766.00 per diver per day. However, this would still be subject to at least 30% deduction for the boat operator's share.

Fishing operations in Hinigaran lasted for eleven months with a mean monthly catch of 572.1 kg/diver. This gave a total annual catch per diver of 6.3MT (Table 3). Information from enumerators provides a conservative

Table 2. Mean daily diving hours (per diver), number of diving days per month, mean daily catch (kg diver^{-1}), mean catch rate (kg diver^{-1}hr^{-1}) and mean monthly catch (kg diver^{-1}) in Hinigaran, Negros Occidental.

Months	Mean # of divers surveyed	Mean daily diving hours	Diving days	Mean daily catch (kg diver $^{-1}$)	Mean CPUE (kg diver^{-1} hr^{-1})	Mean monthly catch per diver(kg)
Jul '08	14	5.1	22.0	21.5	4.2	472.6
Aug '08	5	5.1	12.0	15.0	2.9	179.5
Sep '08	7	4.0	17.0	23.8	6.1	404.5
Oct '08	34	5.0	30.0	35.4	7.0	1062.4
Nov '08	39	5.4	29.0	33.7	6.2	977.6
Dec '08	34	5.4	30.0	33.4	6.2	1001.4
Jan '09	36	5.1	22.0	25.9	4.9	570.2
Feb '09	39	4.8	28.0	22.7	4.8	635.4
Mar '09	45	4.5	31.0	18.4	4.1	571.7
Apr '09	37	4.4	29.0	9.5	2.1	274.5
May '09	7	4.7	23.0	6.2	1.3	142.9
Overall Mean	**27.1**	**4.9**	**24.8**	**22.3**	**4.5**	**572.1**
Sd	15.41	0.44	6.18	9.66	1.84	325.27

(minimum) estimate of 120 divers. Total annual catch for Hinigaran during the study was about 755.2 tons, with a corresponding value ranging from Php 7.6 – 22.7 M. This would result to an estimated gross income per diver of Php 230 – 692 per day.

The current estimate of total annual catch for Hinigaran is 44.3% of the previous estimate (1356.3 MT) from Agasen et al.(1998). This decline suggests a more serious situation of stock depletion since the Negros stock was already considered overfished 13 years ago. This is further supported by estimates of exploitation rate (E=0.75) for recent years (Del Norte-Campos & Villarta, 2010). In addition, a comparison of the size distribution of shells clearly shows a shift to smaller sizes (mode ~ 45mm) in recent landings compared to those from 13 years ago (mode ~ 60mm) (Agasen et al. 1998) (Figure 4). This is especially significant since *P. undulata* attains sexual maturity at a size of about 45mm (Nabuab et al. this volume). Clearly, a substantial portion of landings from the current fishery consist of immature shells which have not been able to spawn yet. This is a condition that typically leads to reduced recruitment. Limiting catches only to shells larger than 45mm will allow most of the stock to spawn, maintaining natural recruitment levels. These results provide guidelines that are of critical importance in saving what is left of the nylon shell fishery in the study area.

The reason for the disparity in the price of nylon shell in the two localities is a result of the difference in sizes of the harvested shells in the two areas. Figure 3 shows that the modal size of nylon shells harvested from Himamaylan were from 55-60mm, while those from Hinigaran were much smaller with a modal size from 40-50mm. Hence the higher price commanded by larger shells in Himamaylan outweighed the 3-fold difference in estimated total landings in Hinigaran in terms of value (Table 3). Furthermore, an asymptotic length ($L\infty$) of 79 mm was estimated by del Norte-Campos and Villarta (2010) from the present data, which is lower than that (81.5 mm) estimated by Agasen et al. (1998). This reflects the scarcity of bigger sizes in recent catches (Figure 4) which again is consistent with worsening conditions in the fishery.

Apart from larger individuals in Himamaylan, monthly catches from a parallel fishery-independent dredge survey (Palla et al., in prep) showed that mean overall abundance of nylon shell was almost 12 times higher

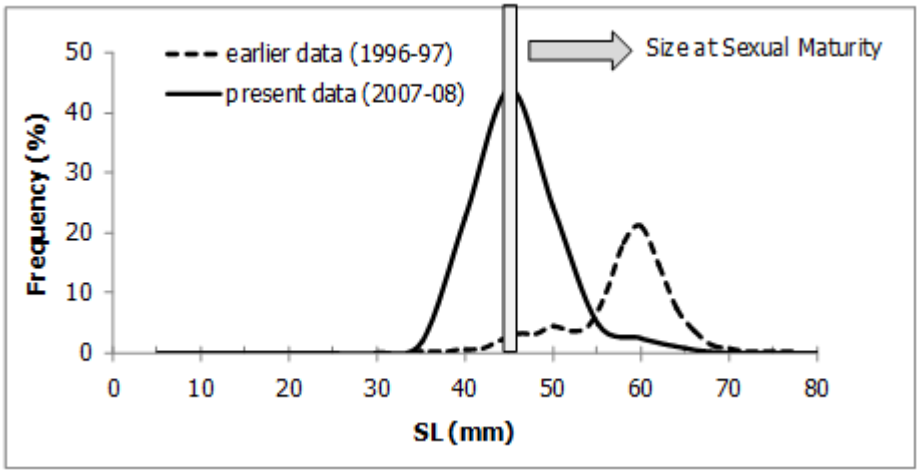

Figure 4. Shell length (mm) comparisons between Agasen et al., (1998) and present data, covering only the months wherein fishing occurred.

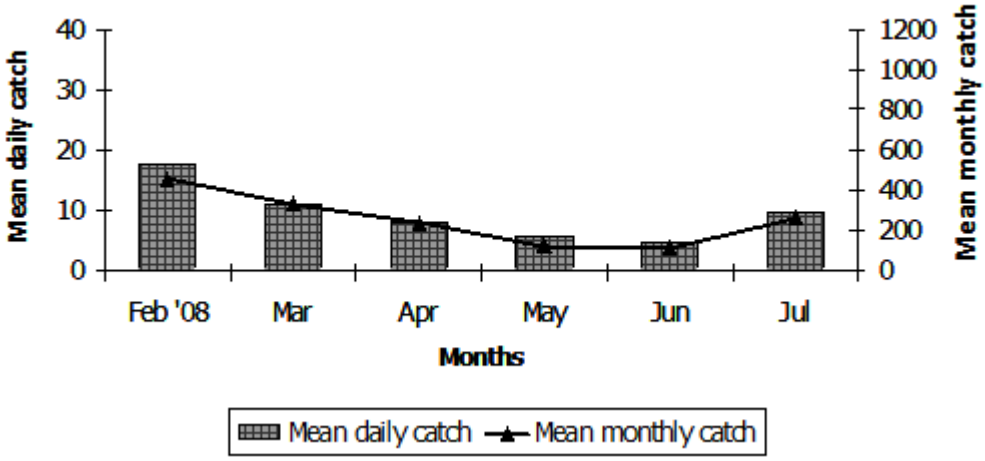

Figure 5. Mean daily catch (kg diver^{-1}) and mean monthly catch (kg diver^{-1}) in Himamaylan, Negros Occidental from February to July 2008.

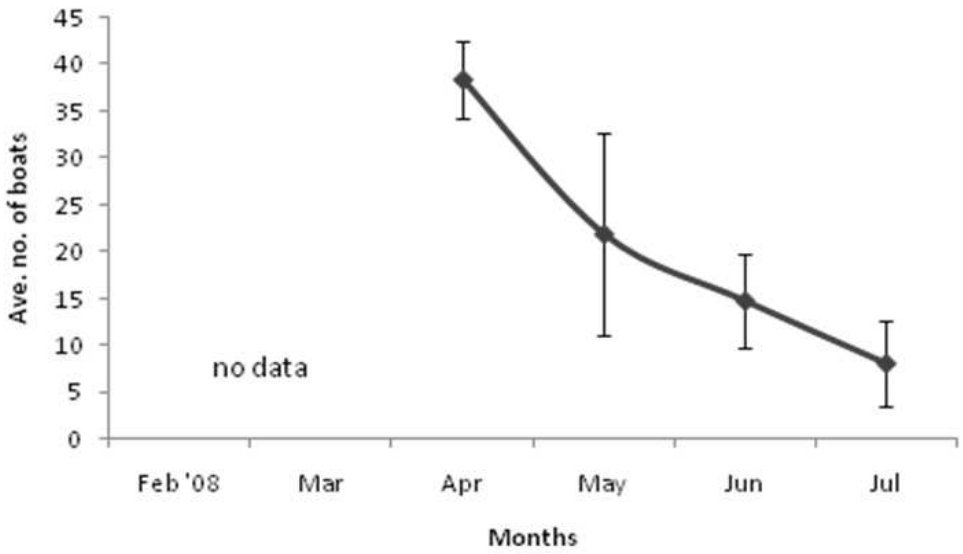

Figure 6. Average number of boats that operated in Himamaylan, Negros Occidental, from April to July 2008.

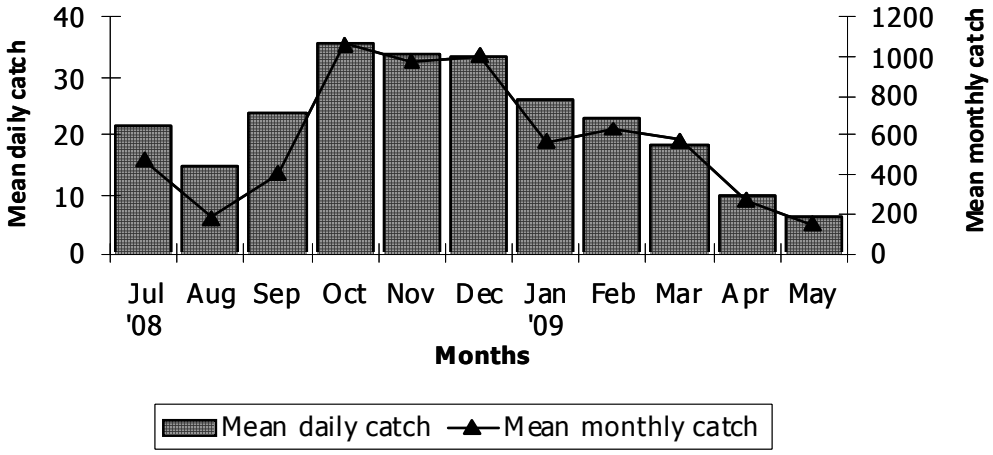

Figure 7. Mean daily catch (kg diver^{-1}) and mean monthly catch (kg diver^{-1}) in Hinigaran, Negros Occidental from July 2008 to May 2009.

Table 3. Catch and value estimates for the short-necked clam *Paphia undulata* in Himamaylan and Hinigaran, Negros Occidental.

Area	Mean monthly catch (kg/diver)	Months of operation	Total annual catch per diver (mt)	Total no. of divers	Total annual catch for the area (T)	Price (Php lower & upper limit)	Total value of catch (M Php)	Total no. of days fished	Income per diver per day (Php)
Himamaylan	256.66	6	1.54	150	231	40-80	9.24-18.48	161	382-766
Hinigaran	572.08	11	6.29	120	755	10-30	7.6-22.7	273	230-692

along the coast of Hinigaran (mean = 76.9 ind/100m^2) than in Himamaylan (mean = 6.5 ind/100m^2). This suggests that while *P. undulata* in the two localities belong to the same stock, recruitment is not spatially uniform and this eventually influences how the fishery operates in these localities.

The much higher abundance of smaller (= younger) individuals in Hinigaran indicates higher settlement (recruitment) in these waters. Once shells reach marketable size, their much higher abundance in Hinigaran attracts more fishing to the area, resulting in a shift of operations from Himamaylan, as was observed in July 2008. Heavy fishing may then exhaust this portion of the stock (in Hinigaran) if allowed to continue without regulation. Observations during the study period indicate that this is indeed what happens. When abundances in Hinigaran become too low and unprofitable, the return of operations to Himamaylan results in catching larger (=older) shells which had been allowed to grow the previous season. This explains the disparity in sizes and their corresponding prices as earlier discussed and also suggests that it is this portion of the stock that likely contributes to the bulk of spawning and recruitment the following year. Thus, the extent and duration of fishing in Hinigaran, may determine whether or not what is left in Himamaylan is able to maintain a fishable stock every year. When heavy fishing disrupts reproduction and recruitment in all portions of the stock, this leads to extreme interannual variability in abundance, resulting in "boom and bust" fisheries. In this context, the uneven impact of fishing on nylon shell along the coast of southern Negros Occidental results in the shifting of operations from one locality to another, which is more preferable to situations with extreme highs and lows. Because the above scenario implies a cycle of at least 2-3 years, there is a need for both fishery-dependent and –independent investigations covering such durations if we are to understand the dynamics of and to properly manage such targeted fisheries.

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