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THE CHAMBERED NAUTILUS FISHERY OF PANAY ISLAND, WEST CENTRAL PHILIPPINES: FISHING PRACTICES AND YIELD

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ABSTRACT: The catch, catch rates, fishing and marketing practices of the chambered nautilus (*Nautilus pompilius* Linnaeus) fishery of Antique, northwestern Panay island, west central Philippines were studied between October 2001 and October 2002. Results showed a weather-related seasonality which dictates the availability of baits and thus, fishing effort. This seasonality is more apparent in the number of fishing days than the mean number and soaking time of traps. Mean daily catch for the study period was 1.75 kg fisherman^{-1} with a mean catch rate of 0.02 kg trap-hr^{-1}. Mean monthly harvest is equivalent to 16.5 kg fisherman^{-1} (= 30.5 inds. fisherman^{-1}), which would translate to a total annual harvest for the entire fishery of 6.6 MT yr^{-1}. The annual value of the harvest from the sale of the shells and the meat would amount to PhP 542.5T (~ US $ 10T), bringing an income of PhP 10.85T fisherman^{-1}yr^{-1}. The estimated annual catch is considered realistic, and would most likely exceed that of another existing, but even more seasonal, chambered nautilus fishery in Aklan, northern Panay. Since both fisheries have existed for decades, the catches may still be sustainable, as naturally imposed by the species' deep-water distribution and response to fluctuations in environmental conditions. Fishery-independent surveys would facilitate the estimation of the populations' stock size or biomass and the determination of their spatio-temporal distribution.

INTRODUCTION

The chambered nautilus, *Nautilus pompilius* Linnaeus, is one of the five accepted living species of externally shelled cephalopods (Saunders, 1987). This species is the most widespread *Nautilus* species, occurring throughout the Indo-Pacific. Despite its wide distribution, however, very little is known about it, due to its deep and geographically isolated habitats. In the Philippines, the ecology and behavior of *N. pompilius* were first scientifically studied by Haven (1972) and in 1977, she reported on some aspects of the reproductive biology, based on *N. pompilius* from the deep Tañon Strait, central Philippines. Females were reported to comprise only 8% of the entire annual catch, supporting much earlier findings (Willey 1895; Griffin 1902). Hayasaka *et al*. (1982) further reported aspects related to their habitat in Philippine waters. Variations in the morphology of individuals from the Philippines and Fiji Islands were presented by Tanabe *et al*. (1983). Zann (1984) studied the daily rhythmic activity and behavior of the species from Suva, Fiji, and reported that the species is crepuscular to nocturnal. Many aspects of *Nautilus pompilius*, as well as other species of *Nautilus* throughout its range, were reported by Saunders and Landman (1987). Kawamura and Bagarinao (1980) reported that lift nets are typically used to capture *N. pompilius* in Panay, but the account did not include other aspects regarding this fishery.

The species *Nautilus pompilius* (locally known as "lagang"), on the other hand, is the target not of lift nets, but of trap fisheries in Antique, northwestern and Aklan, northern Panay Island, west central Philippines (Fig. 1) (del Norte-Campos *et al*., 2000). It appears that the exploitation of the species in these areas has existed for decades, but until now, no catch and catch rate figures exist. The present paper thus provides information on the catch, fishing effort, catch rates, annual yield, and fishing/marketing practices of *N. pompilius*, particularly from northwestern Panay. These data contribute knowledge toward a better understanding

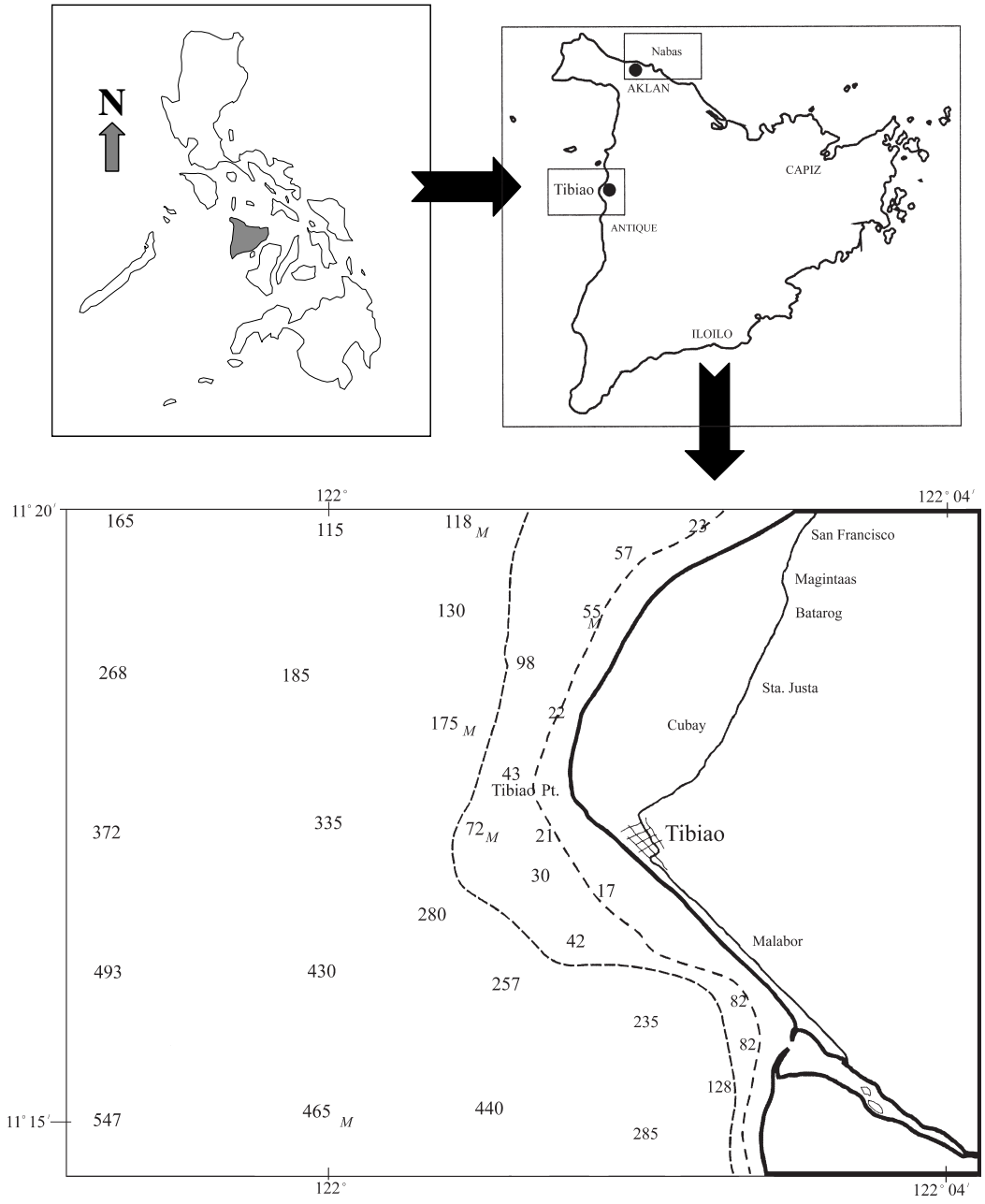

Figure 1. Location of chambered nautilus (*Nautilus pompilius*) trap fishing grounds in Panay Island, west central Philippines (numbers indicate depth in fathoms).

of the biology of the species and guide its rational exploitation not only in this area, but also in other locales where it is found.

MATERIALS AND METHODS

Data were collected mainly in Tibiao, Antique province, northwestern Panay Island, west central Philippines (11°16′ N, 122°02′E) (Fig. 1), between October 2001 and October 2002. The fishing grounds are located about 1 km off the coast of Tibiao, where the shelf is extremely narrow (~ 2 km). Fishermen report that the bottom substrate in these areas is sandy. No bottom temperature data are available, although the climate in this region of the Philippines is characterized as having two pronounced seasons: dry, from November to April and wet, from May to October (Encarnacion 1999). Fishermen in the area were requested to record their daily catches in pre-formatted notebooks. Information on the numbers caught, total weight (g) of the catch, number of hours and area of fishing was recorded. Shell diameters of the individuals caught were also measured by the fishermen to the nearest 0.5 mm using a ruler, and weighed to the nearest 20 g, using a kitchen weighing scale. Spot interviews were conducted to gather information on fishing and marketing practices, as well as to estimate the total number of fishermen who are involved in the fishery.

Daily catch (in kg and number of individuals caught) and fishing effort data were averaged per fisherman for each month. Fishing effort is expressed in terms of the number of traps per fisherman, multiplied by the number of hours spent fishing day^{-1}, or trap-hr fisherman^{-1}. Mean catch per unit effort, or CPUE in kg trap-hr^{-1} was derived from the mean daily catches (kg) divided by the fishing effort. Mean daily catches (kg) were multiplied by the mean monthly days fished, to derive estimates of mean monthly catches (kg). To estimate the total annual harvest of the fishery, the mean monthly catch was multiplied by the number of months when catches were reported (8 months), and the total number of fishermen in the area. It was not possible to determine the portion of the meat in each individual because samples brought to the laboratory had already been de-shelled by fishermen. Thus, the meat portion is estimated roughly to consist of about one-half of the total weight per individual. To obtain an estimate of the fishery's total annual income, the annual harvest (no. of individuals and meat weight in kg) was multiplied by the price of the shell and meat, respectively, and summed.

RESULTS

Fishing and Marketing Practices

Chambered nautili are harvested in Antique with the use of bamboo traps (locally called "bintol"), that measure 0.3 x 0.3 x 0.45 m (0.04 m^3) each. These traps are usually baited with toad meat, deployed to depths of 72 fathoms (~130 m) and retrieved by hand on monofilament lines. Fishermen usually work in pairs, travelling to the nearby fishing grounds aboard small outrigger boats (7 x 0.45 x 0.45 m), equipped with 5.8 HP engines.

Based on interviews, the catches are valued primarily for their shells, which are sold at an average price of PhP 35 pc^{-1} (US $ 1 » PhP 54) to shell craft dealers who visit from the island of Cebu, central Philippines. On the other hand, the less valuable meat is either sold only in local markets at PhP 35 kg^{-1}, or consumed dried or fresh in the households of the fishermen.

Fishing effort and Catch

The number of traps and hours spent fishing were relatively constant over the study period. The mean soaking duration for the traps was 11 hours daily, operated at night, that is, from 1800 to 0500 h (Tab. 1). The mean number of traps was ~ 7 ± 1.0 traps fisherman^{-1}, and this corresponds to a mean fishing effort of 75 ± 11.7 trap-hr fisherman^{-1}. The mean number of days with fishing effort was only 9 ± 5.8 days month^{-1}, with the highest observed in June (22 days) and the lowest in August (3 days) (Fig. 2). No fishing is conducted between February and May.

Mean daily catches for the nine-month fishing period ranged from 1.21–2.51 kg, with the mean corresponding to 1.75 ± 0.43 kg, equivalent to

Table 1. Fishing effort and catches of the chambered nautilus *Nautilus pompilius* fishery in Tibiao, Antique, north-western Panay, Philippines, October 2001-October 2002.

Month	Trap soaking time(hrs) man^{-1})	Mean no. of traps (fisher-	Mean fishing effort (trap -hr fisher-man^{-1})	Mean days fishing (month^{-1})	Mean daily catch		Mean monthly catch		Mean Length (mm)	Mean CPUE (kg trap-hr^{-1})
					(kg d^{-1})	(inds.)	(kg mo^{-1})	(inds.)		
Oct 2001	11	7.7	87.6	6.8	2.51	4.38	16.10	29.8	142.60	0.027
Nov	11	7.5	84.9	6.8	1.74	2.59	10.76	17.6	131.49	0.022
Dec	11	5.0	54.3	6.5	1.52	4.92	9.15	32.0	136.43	0.033
Jan 2002	11	7.0	72.6	5.0	1.31	3.00	6.55	15.0	137.16	0.018
Feb										
Mar										
Apr										
May										
Jun	11	7.5	82.5	22.0	2.12	3.93	46.25	86.5	136.98	0.023
Jul	11	7.5	82.5	11.0	2.15	3.91	25.12	43.0	122.87	0.027

3.28 ± 1.15 inds. (Tab. 1). The pattern in daily catches was different from that of monthly catches due to the erratic fishing effort in terms of number of days fishing. Mean monthly catches were highest in June (46.3 kg = 86.5 inds.) and July (25.1 kg = 43 inds.), declining to their lowest level in August at 3.5 kg (= 6 inds.) (Tab. 1; Fig. 2). Catches between September and October were observed to be relatively high also. The mean monthly size (shell diameter) of the individuals caught ranged from 122.87 to 142.6 mm (mean ± sd = 133.47 ± 5.78). In general, catch rates or CPUE of the traps were relatively constant, with values ranging from 0.02-0.03 kg trap-hr^{-1} (mean± sd = 0.023 ± 0.005) over the months (Tab.1).

Annual Harvest and Value

The mean monthly catch during the study period was equivalent to 16.5 kg, corresponding to 30.5 individuals. This would therefore translate to a total annual harvest of 6.6 metric tons (MT) yr^{-1} for the entire fishery, or 12,200 inds. yr^{-1} (Tab. 2). At an average price of PhP 35 shell^{-1}, the total value of the catch (shells only) would be equivalent to PhP 427T. The annual meat yield would be equivalent to 3.3 MT yr^{-1} valued at PhP 115,500. Thus, the total annual income of the entire fishery from the shells and meat would be equivalent to PhP 542.5T (» US$ 10T). On a per capita basis, this represents an annual income of PhP 10,850 fisherman^{-1} yr^{-1} (» US$ 200).

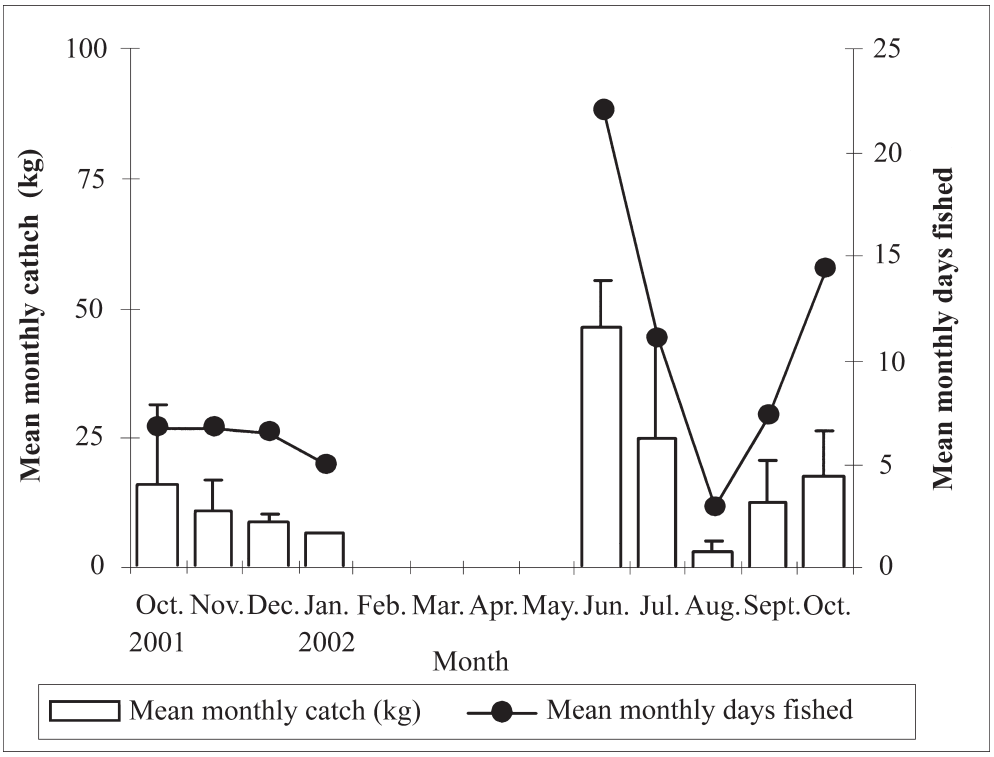

Figure 2. Mean monthly catch (kg) and no. of days fishing mo^{-1} for *Nautilus pompilius* caught using bamboo traps in Tibiao, northwestern Panay, Philippines, October 2001 – October 2002.

Table 2. Annual yield*, value** and income** derived from *Nautilus pompilius* shells and meat harvested in Tibiao, northwestern Panay Island, west central Philippines (PhP = Philippine peso).

Mean monthly catch		Estimated annual yield			Value of the Annual Catch (x 1000 PhP)			Annual Income (x 1000 PhP fisherman^{-1})		
(kg)	(inds.)	TOTAL (MT yr^{-1})	SHELLS (inds.yr^{-1})	MEAT (MT yr^{-1})	TOTAL	SHELLS	MEAT	TOTAL	SHELL	MEAT
16.5	30.5	6.6	12,200	3.3	542.5	427	115.5	10.85	8.54	2.3

*meat yield assumed to be at least ½ of total weight (kg).

**US$ 1 » PhP 54

DISCUSSION

The chambered nautilus fishery in northwestern Panay experiences a weather-related seasonality. Catches were not available from February to May (Fig. 2) because these months coincide with the dry period (summer) in the area, during which the bait (toads) used in the traps is scarce. The toads are usually just caught by the fishermen around the neighborhoods. In contrast, it was mentioned in Haven (1977), that nautili maintained in cages in Negros Oriental were fed with fish, pork and chicken meat. Fishermen in Panay Island however, do *not* use these more expensive foods. Fishermen who engage in this type of fishing are mostly poor and this fishery is, just like most municipal (artisanal) fishing activities, a low-investment source of income.

Although nautili were available all year-round in the Tañon Strait, seasonality was also apparent in the number of individuals that were caught (Haven 1977). But as in the present study, lesser numbers were likewise trapped during the summer months (esp. March and April) in Tañon. In the present study the number of fishing days per month reflected seasonality more in fishing effort, rather than soaking time and the number of traps in use. Thus, the lowest number of days fishing was observed in August, which coincides with the southwest monsoon, characterized by the occurrence of typhoons. Weather conditions therefore dictate fishing by influencing the availability of bait and fishing feasibility. This limitation in the study however, precludes any conclusions regarding the actual behavior of the species in these habitats.

For the lack of accessible references, the magnitude of the present catches cannot be compared with other chambered nautilus fisheries elsewhere. However, the Tibiao stock(s) and fishery must be bigger compared to that found in Nabas, Aklan, northern Panay (Fig. 1). Interviews and preliminary data collection in the latter area showed a greater degree of seasonality. Although more fishermen (~100) are involved in the fishery, it operates for at most 6 months (April/May-September) only every year. This period coincides with the southwest monsoon, characterized by calmer days in the area, compared to the more turbulent northeast monsoon period. Further comparisons also show that the Nabas fishery operates in deeper areas (170 fathoms). The materials used for the traps also differ slightly; instead of bamboo, traps in Nabas are made of steel and aluminum wire, thus costing more compared to those in Antique.

The present annual harvest estimate is considered conservative but most likely realistic, considering that the availability of catches all year round is unlikely. In addition, the number of fishermen involved in the fishery may also fluctuate, tending to be higher than the estimated 50 fishermen, used in the computation. Based on interviews, fishermen in the area can shift to other fishing operations (*e.g.* squid jigging) as an alternative occupation, during the lean months of the chambered nautilus fishery (*i.e.* when baits are less available).

In conclusion, independent fishery surveys may be helpful in obtaining independent estimates of biomass or stock size of the *Nautilus* populations, as well as to estimate or delimit the actual area or size of the fishing grounds. These are, however,

costly endeavors, not just in terms of logistics, but also in terms of causing additional mortality impacts on the population. From interviews, it was determined that the nautilus fisheries of Panay have existed for more than 30 years. Although the question of whether the catches are sustainable or not cannot yet be clearly answered at the present, it may perhaps be postulated that the chambered nautilus populations have a natural spatial and temporal refuge by way of their deep-water distribution and response (possibly migration) to environmental factors. These behavioral patterns may well serve to ensure the viability of these populations over a longer period of time.

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