

Analyzing the Catch Rate and Species Diversity Index of Deep-water Shrimps for Sustainable Fisheries Development and Management: Philippine Perspective

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During the collaborative deep-sea survey activities conducted by BFAR and foreign researchers in 2008 onboard the M.V. DA-BFAR to census the status of marine life in the Philippines, deep-water shrimps belonging to Family Pandalidae was found to flourish in the continental slopes of Western Luzon in the Philippines, and thus, was considered potential deep-sea resource that could be sustainably utilized. Considering the abundant catch of the shrimps using traps, exploratory fishing surveys were pursued to assess their potential for fisheries development. Belonging to Infraorder Caridea, Pandalidae is characterized by having five (5) pairs of well-developed legs with the third pair bearing with or without pincers, with an expanded pear-shaped abdominal pleuron overlapping the posterior part of the first and the anterior of third pleura. Both sexes lacks large copulatory organ on the first pair of pleopods and females usually carry eggs on the abdomen until hatching (FAO, 1998). In other countries in the Pacific, these shrimps are exploited commercially, particularly the genus *Heterocarpus*, using baited traps and trawls (King, undated). In the Philippines this resource is undeveloped primarily because local fisherfolk do not have the capacity of to explore the offshore areas while very little is known about the economic importance of these deep-water shrimps.

Based on the initial findings of the deep-sea survey activities using the M.V. DA-BFAR on the abundance of deep-water shrimps in Philippine waters, BFAR conducted a study to determine the factors that affect the catch rate of deep-water shrimps in West Philippine Sea using traps. The study was also aimed at understanding the zonation of these shrimp species based on abundance, distribution and diversity index at different fishing zones and water columns. Results of the analysis could be used as basis for the development of management framework for the sustainable utilization of the resource. Moreover, the study also aimed to determine the probable influence of soaking period of the traps in the catch rate of the shrimps. For the study, 25 trap fishing stations were established in West Philippine Sea (Fig. 1). Specifically, the study sites included the sea waters in Verde Island in Batangas and Mindoro up to northern Ilocos Region. The traps used were cylindrical in shape and made of polyethylene screen with flat bars used as the frame. Each trap measures 65 cm in length and 30 cm in diameter, and comes in three variations,

namely: fully-covered, partially covered, and uncovered (Fig. 2). About 30-46 traps were deployed for every fishing operation, immersed for 5-19 hours. Chopped sardines (*Sardinella* spp.), scads (*Decapterus* spp.) and lizard fish (*Saurida* spp.) were used as baits.

As shown in Fig. 1, the study area was divided into six (6) zones, namely: Ilocos waters, Pangasinan/La Union waters, Zambales waters, Bataan waters, Approaches of Manila Bay, and Mindoro/Batangas waters. Comparative analyses of the catch rate (CPUE) and species diversity index (SDI) of the shrimps in terms of fishing zone and

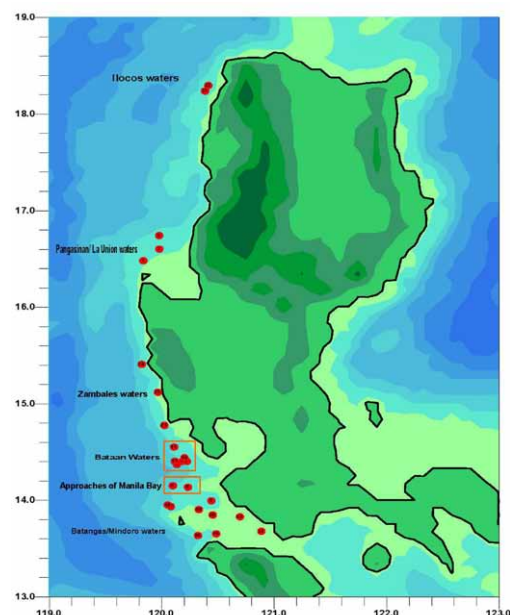


Fig. 1. Northern part of the Philippines showing the trap fishing stations



Fig. 2. Three variations of traps used in the fishing operations for deep-water shrimps

sampling column were carried out to determine the effect of zonation on the shrimp catch. The relevance of soaking time on the catch rate was also compiled and analyzed for its effect. The catch rate was computed using the formula:

$$CPUE_{(100 \text{ traps})} = \frac{\text{Total Shrimps Caught (Kg)}}{\text{Total No. of Traps Deployed}} \times 100$$

Meanwhile the species diversity index was determined using the Simpson's Diversity Index (D), where

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

n = total number of particular species observed

N = total number of all species observed

Discussions

A total of more than 7,500 Pandalid shrimps were recorded from the trap fishing operations, yielding a total catch of 72.0 kg with mean CPUE of 6.7 kg/100 traps. Abundant catch was recorded in Zambales waters with mean catch rate of 16.2 kg/100 traps while the lowest was in

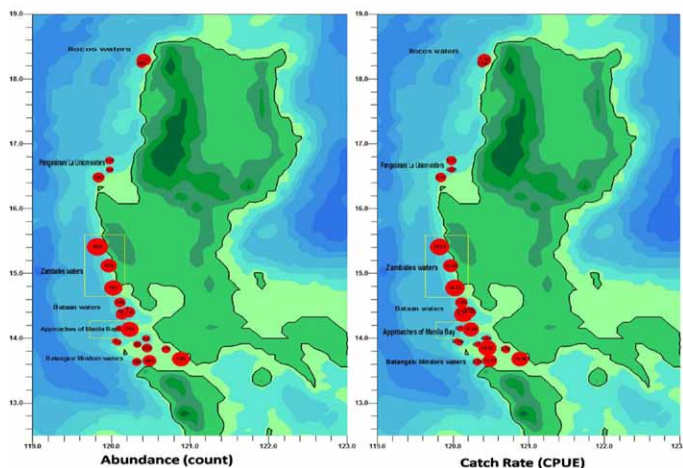


Fig. 3. Abundance and catch rate of Pandalid shrimps in different sampling stations in West Philippine Sea

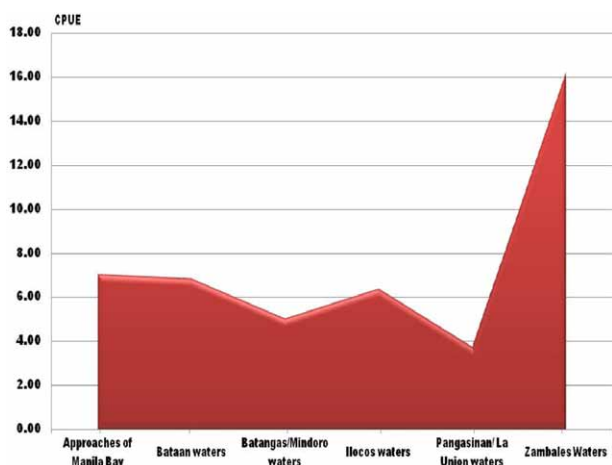


Fig. 4. Catch rate of Pandalid shrimps from various fishing zones in West Philippine Sea

Pangasinan/La Union waters with mean catch of 3.7 kg/100 traps (Fig. 3 and Fig. 4).

Moreover, abundant catch was recorded in depths of 400-500 m but slid down at 700-800 m, while low catch was recorded at depths of <100 m (Fig. 5). Analysis of the relevance of shrimp counts with respect to CPUE brings about very high relationship as shown in Fig. 6, implying that the catch rate was dependent on the abundance of the shrimps.

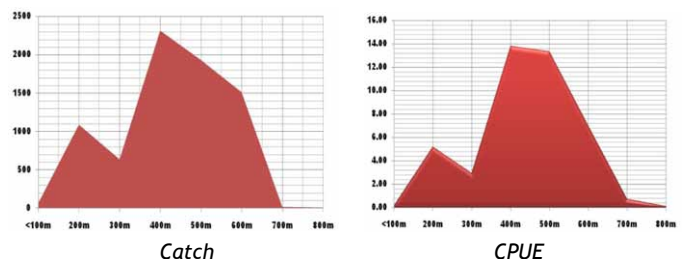


Fig. 5. Distribution of catch from various sampling depths

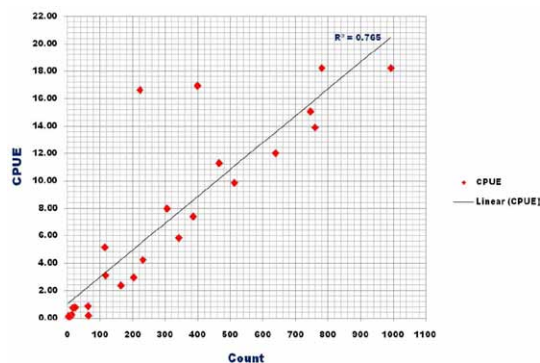


Fig. 6. Relationship between abundance and catch rate

Meanwhile, the analysis of the soaking period and catch rate correlation showed a negligible value of $R^2 = 0.15$ (Fig. 7). In terms of species composition, the total catch was classified into two (2) genus, *i.e.* *Heterocarpus* and *Plesionika*, and 10 possible species, namely: *Heterocarpus dorsalis* (Bate, 1888), *H. gibbosus* (Bate, 1888), *H. hayashii* (Crosnier 1988), *H. laevigatus* (Bate, 1888), *H. parvispina* (Crosnier 1988), *H. sibogae* (De Man, 1917), *H. woodmasoni* (Alcock, 1901), *Heterocarpus* spp., *Plesionika edwardsii* (Brant 1851), and *Plesionika* spp., although only three species were found to be well-distributed in the study

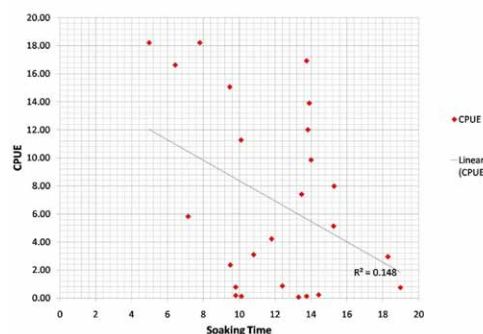


Fig. 7. Relationship between catch rate and soaking period (hours)

area. These are: *Heterocarpus hayashii*, *H. dorsalis* and *H. laevigatus*.

The computed SDI value reflects moderately high diversity with moderately low evenness, suggesting further about four (4) dominant species in the overall catch (Fig. 8). Relative to their abundance in the total samples (Fig. 9), the four dominant species were *Heterocarpus hayashii* (37.3%), *H. dorsalis* (27.6%), *H. gibbosus* (14.8%), and *Plesionika* spp. (10.7%).

The species composition and abundance at different fishing zones and columns are shown in Fig. 10. Specifically,

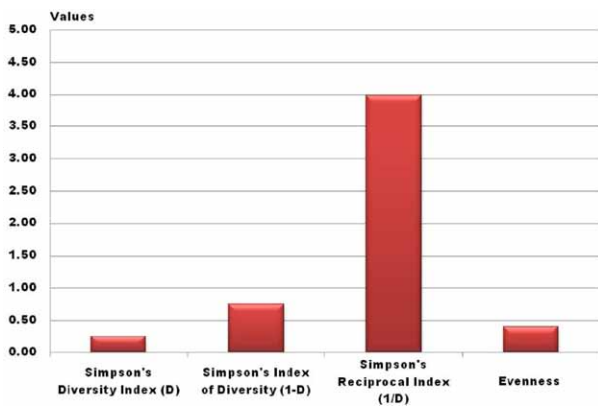


Fig. 8. SDI of Pandalidae species in West Philippine Sea

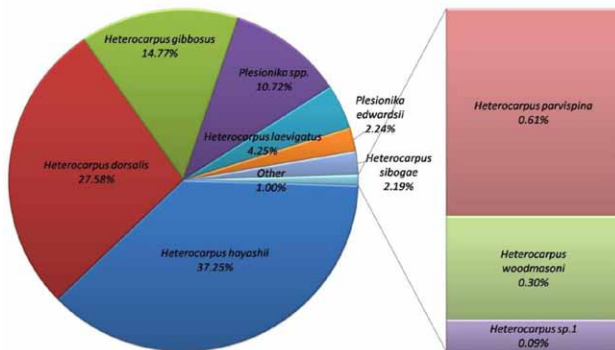


Fig. 9. Relative composition (%) of Pandalidae species catch

Plesionika spp. was the major species found in Batangas/Mindoro waters, *Heterocarpus dorsalis* at the Approaches of Manila Bay and Bataan, and *H. hayashii* in Zambales, Pangasinan/La Union and Ilocos waters. With regards to species distribution by depth, *Plesionika* spp. dominates in waters <100 to 200 m, *H. hayashii* from 300 to 500 m, and *H. dorsalis* at 600-800 m. It was also noted that *H. parvispina* and *H. woodmasoni* peak at 200 m, *Plesionika edwardsii* at 300 m, *H. laevigatus* at 400 m, *H. gibbosus* at 400-500 m and *H. sibogae* at 600 m.

The species diversity index analysis at different fishing zones revealed high in Batangas/Mindoro waters with about four (4) dominant species (*Plesionika* spp., *Heterocarpus dorsalis*, *H. hayashii*, and *H. laevigatus*) but lowest in Pangasinan/La Union waters with at least two (2) dominant species (*H. hayashii* and *H. dorsalis*). In terms of water depth, highest diversity was observed at 400-500 m with about three (3) dominant species (*H. hayashii*, *H. gibbosus* and *H. dorsalis*) and lowest at <100 m and 600 m with only one (1) species (*Plesionika* spp. and *H. dorsalis*) dominating, respectively (Fig. 11).

A possible reason for the higher species diversity in Batangas/Mindoro waters could be the wider depth range of the area as indicated in Fig. 12. The particular dominant species in certain fishing area could have also been contributed by the incidence of sampling and the depth deployment (zonation).

Conclusion

Based on the results of the study, the recorded catch rate of deep-water shrimps in West Philippine Sea was influenced by the zonation of the species. The observed high catch rate in Zambales waters was brought about by the depth deployment of traps along this area (400-500 m) which was at the column observed with the highest

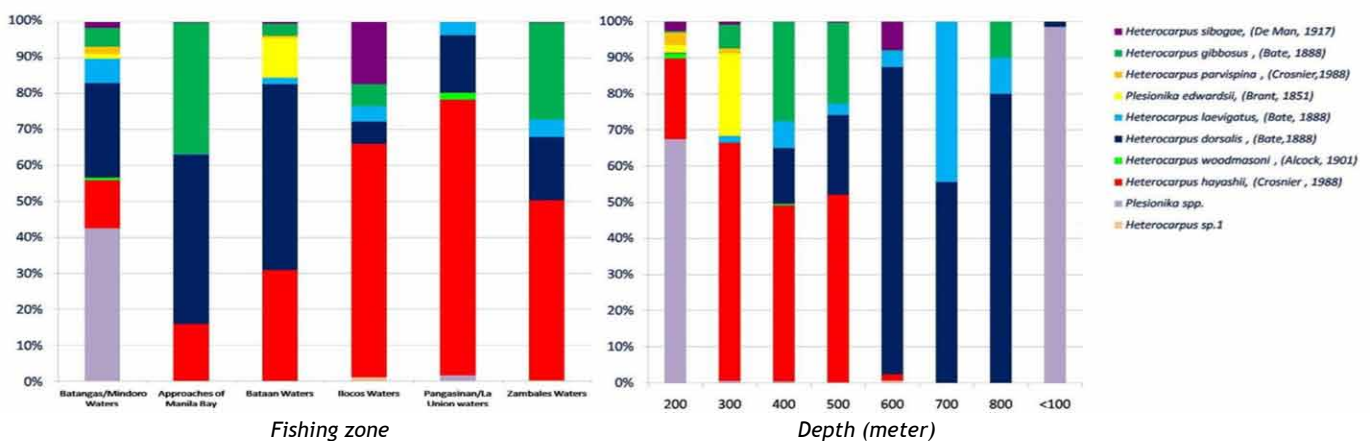


Fig. 10. Composition, percentage abundance, and distribution of Pandalid shrimps at various fishing zones and depths

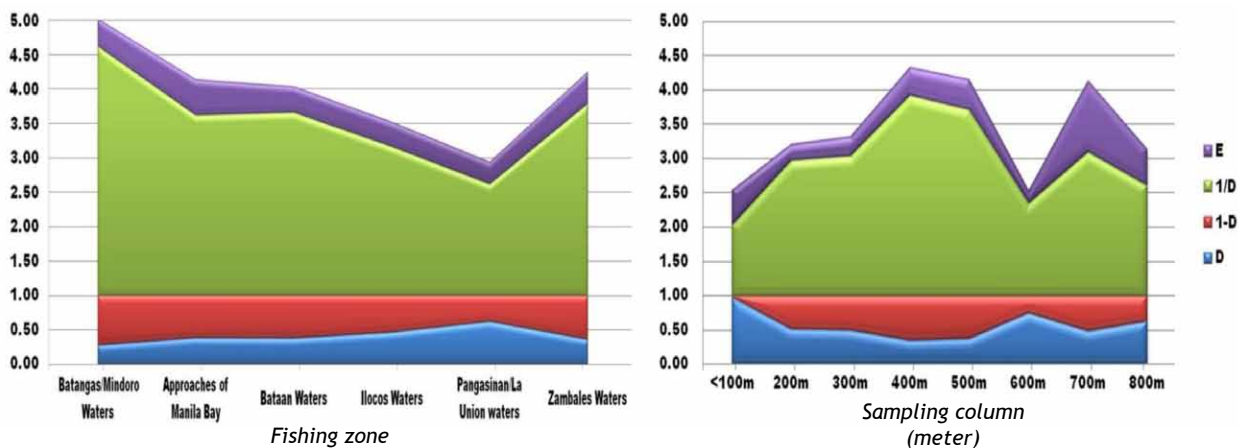


Fig. 11. Species diversity indices of Pandalid shrimp species at fishing zones and sampling columns

species diversity index. The species observed to abound at these layers were also larger compared to those recorded at shallower depths (<100-300 m). Nevertheless, in spite of the observed decreasing trend of catch rate when immersion time was prolonged, the resulting correlation value indicated negligible relationship. Therefore, catch rate was largely influenced by the abundance of the shrimps according to their zonation. Thus, given the appropriate depth deployment, good catch could be achieved.

Way Forward

Deep-water shrimp (Pandalidae) has a great potential for fisheries development in West Philippine Sea. Nonetheless, an appropriate and concrete framework should be designed to sustainably manage this resource. It should be noted that these shrimps are deep-water species with different biology from the cultured species such as the *Penaeus* spp., so that exploitation that goes beyond their capacity to reproduce could lead to extinction. Furthermore, prior to possible introduction of deep-water shrimps to the market, the biochemical composition (e.g. nutritive value and possible allergen content) of the species should be assessed while

techniques for post-harvest handling should be developed to prolong the shelf life of this species of shrimps.

References

A Menagerie of Diversity Indices. Retrieved July 22, 2011 from <http://www.malaysia.org.com>, 2007

Carpenter, K. E. and V. H. Niem. 1998. The Living Marine Resources of the Western Central Pacific. FAO Species Identification Guide for Fishery Purposes. Volume 2. Cephalopods, crustaceans, holothurians and sharks. Food and Agriculture Organization of the United Nations, Rome, 1998

Heterocarpus. Retrieved September 03, 2012 from http://en.wikipedia.org/wiki/Type_species

Michael G. King, undated. Deepwater Shrimp. Chapter 16 M/V DA-BFAR DY09 Cruise Report. 2008. Deep Sea Fisheries Resources Survey on the Continental Slopes and Approaches of Lingayen Gulf

Nepomuceno, L. T., J.G.Viron and R.V. Ramiscal. 2011. Marine Biodiversity Assessment Along the Waters of Bataan, Batangas, and Approaches of Manila Bay Using the Beam Trawl and Traps. M/V DA-BFAR Unpublished Report, 2011

Nepomuceno, L.T., R. V. Ramiscal, and R. P. Asuncion. 2012. Biodiversity Index of the Catch of Deep-sea Traps in West Philippine Sea. M/V DA-BFAR Unpublished Report, 2012

Simpson's Diversity Index. Retrieved July 22, 2011 from http://www.countrysideinfo.co.uk/biol_sampl_cont.htm, 2011

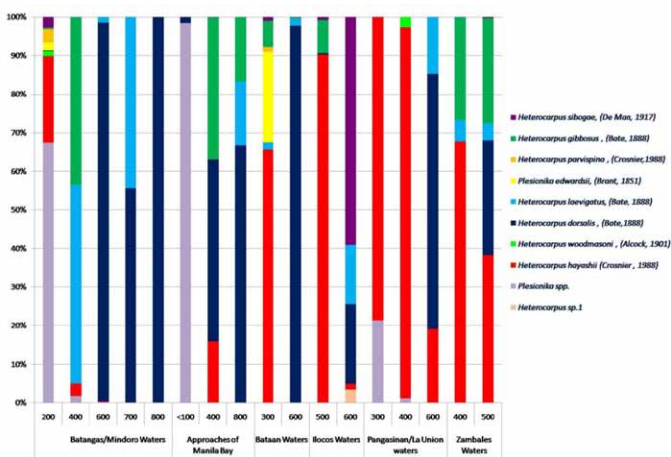


Fig. 12. Relative abundance (%) of the species monitored from sampling depths in the different fishing zones

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