Is the Iloilo River still a Nursery Ground for Important Marine Fishery Resources during the Northeast Monsoon?

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ABSTRACT

Ichthyoplankton and decapod larvae taxonomic composition, density, relative abundance and frequency of occurrence were determined to assess if Iloilo River tidal inlet is still a nursery ground during the Northeast Monsoon. The sampling was conducted during the first quarter moon in the months of December 2016, January and February 2017 by towing a conical plankton net in 3 stations, namely upstream, upper midstream and lower midstream. A total of 7 taxonomic groups of ichthyoplankton and 7 decapod larvae taxa were recorded with densities ranging from 70.8 to 404.2 individuals/100m^3 and 112.7 to 1277.6 individuals/100m^3, respectively. Ichthyoplankton in all 3 zones were dominated by Gobiidae (>70%). Sesarmidae and Dotillidae dominated decapod larvae in all 3 zones (>65%). Ichthyoplankton and decapod larvae frequency of occurrence ranged from 0.44 to 0.49 and 0.65 to 0.84, respectively. Compared to other coastal nursery grounds, Iloilo River shows fewer taxa but similar densities. This implies that the river is a nursery ground, but is utilized by very few taxa during the Northeast Monsoon. Clupeids was the only economically important ichthyoplankton group recorded, although, it is unlikely this taxonomic group utilizes the river as a nursery ground. Portunidae, Penaeidae and Palaemonidae were the only economically important decapod larvae taxa utilizing the river as a nursery ground. Based on this information, further research exploring how to improve the ecological condition of the tidal inlet should be conducted to hopefully increase the number of economically important taxa.

KEYWORDS:

Ichthyoplankton, Decapod Larvae, Iloilo River Tidal Inlet, Nursery Ground, Mangroves

INTRODUCTION

Estuaries and tidal inlets have been reported by numerous publications as important spawning and nursery habitats for a variety of fishes (Beck et al., 2001). These areas are sources of recruits for a variety of fish stocks. However, there are very few specific areas in Southeast Asia that have been surveyed to identify if they are nursery grounds for different taxa. In recent years the importance of assessing individual mangrove habitats as nurseries has grown considerably because these areas have become degraded due to land reform and human encroachment. Understanding the possible ramifications of how choosing industrialization over food supply can create major food shortage issues as human developments expand is important. Knowledge on the productivity of degraded aquatic ecosystems, such as the Iloilo River, by studying ichthyoplankton and decapod larvae assemblages can be used to motivate the general public to improve the ecological condition of these water bodies.

Before and during Spanish colonization, Iloilo River was a rich fishing ground (Funtecha, 2003). Unfortunately, Iloilo River has become more polluted as Iloilo City has developed around it. The degradation of the river in recent years has caused the river to lose its ability to produce economically important fishery resources. To combat this problem, the Bureau of Fisheries and Aquatic Resources (BFAR) released Nile tilapia (*Orechromis niloticus*) and milkfish (*Chanos chanos*) fry into the Iloilo River (Pendon, 2015). A study conducted by del Norte-

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Campos and Campos (2010) found Iloilo River was a highly productive nursery ground with 10 times higher densities compared to that of the Visayan Sea. Considering this information, it is very important to assess how human development over the course of years has been affecting its productivity as a nursery ground.

There is also a new cause for concern that is being brought about by encroachment and development near the Iloilo River. Based on historical evidence and recent developments in the tidal inlet, there is a need to investigate as to whether the Iloilo River is still a nursing ground for a variety of fish and decapod species. The main objective of the study was to determine whether the Iloilo River tidal inlet is still a nursing ground for important marine fishery resources during the Northeast monsoon.

MATERIALS AND METHODS

Study Area

The Iloilo River is an intertidal tidal inlet that intersects Iloilo City (10°41’39” N to 10°41’33” N and 122°29’10.50” E to 122°35’4” E). The climate in Iloilo consists of a wet season that lasts from June to November and a dry season that lasts from December to May. The mean diurnal temperature ranges from 26.1 to 29.1°C. The population of Iloilo City as of 2010 was 425,000 people (NSO, 2010). The river has recently experienced several rehabilitation efforts to clean it up such as relocating informal residents and replanting of mangroves (IRDC, 2011).

The selection of the 3 sampling zones was dependently based on the motorized push net fishery, which target small fish and shrimps. The focus of this study was to sample along the mangroves within the area where the push net fishery operates. The separation of the 3 zones was based on land use pattern (Fig. 1). The boundary between the upstream and upper midstream was chosen because it is the border between the residential/fishpond zones and the commercial zones. The boundary between the upper midstream and lower midstream zones was chosen because it was the border between the commercial and residential areas.

The upstream zone (Fig. 1) is located in Mandurriao and Molo and starts at 10°41’32” N and 122°31’25” E and ends at 10°42’2” N and 122°32’23” E. The area surrounding the upstream part of the river consists mostly of farms, fishponds, fishing villages and residential areas. There are no commercial establishments such as hospitals and hotels located in this area. According to Andrada (2000), more fishing activities are observed in this area compared to the other parts of the river. The main gears observed during the study were surface gillnets and fyke nets.

The upper midstream zone (Fig. 1), located in Mandurriao, starts at 10°42’3” N and 122°32’27” E and ends at 10°42’18” N and 122°33’13” E. Most commercial establishments along the river are located in this area, including a total of 7 hospitals, which have been reported as large contributors of solid waste. The lower midstream zone (Fig. 1) starts at 10°42’18” N and 122°33’13” E and ends at 10°42’22” N and 122°34’3” W. This part of the river, located in La Paz and City Proper, is surrounded by a mixture of commercial, industrial and residential zones. Only 3 hospitals are located in this part of the river but according to the study performed by Tizon (2001) there were significantly higher levels of nitrogen and organic matter found in the sediment in the lower midstream zone.

Field Sampling

Samplings were conducted in the months of December 2016, January and February 2017 during the first quarter moon phase to coincide with the weaker tidal flow, which made maneuvering the boat easier and decreased the risk of damaging the plankton net. Altogether, a total of 9 tows were conducted during the entire study. Tows between sites were performed once sequentially and started in the upstream then upper midstream and lower midstream with a 30 min. delay in between samplings.

The plankton net (50-cm diameter ring with 200-mm mesh) was attached to a metal frame which was tied in the outriggers of the boat to ensure that the net fished a fixed 30 cm below the surface. The flow meter was then carefully assembled and reset before each tow. The net was towed in each zone along the northern shore for 10 minutes beside the mangroves to ensure a good representative of the ichthyoplankton and decapod larvae were collected. Once the 10 minutes had elapsed, the net was then hauled and taken out of the frame. The average speed of the boat was measured by an automated flow meter and was recorded then the flow meter was reset for the next tow. The collected plankton was then thoroughly washed using a portable 6-L sprayer, filled with filtered river water, into 500 ml plastic bottles. The river water was used to ensure that the

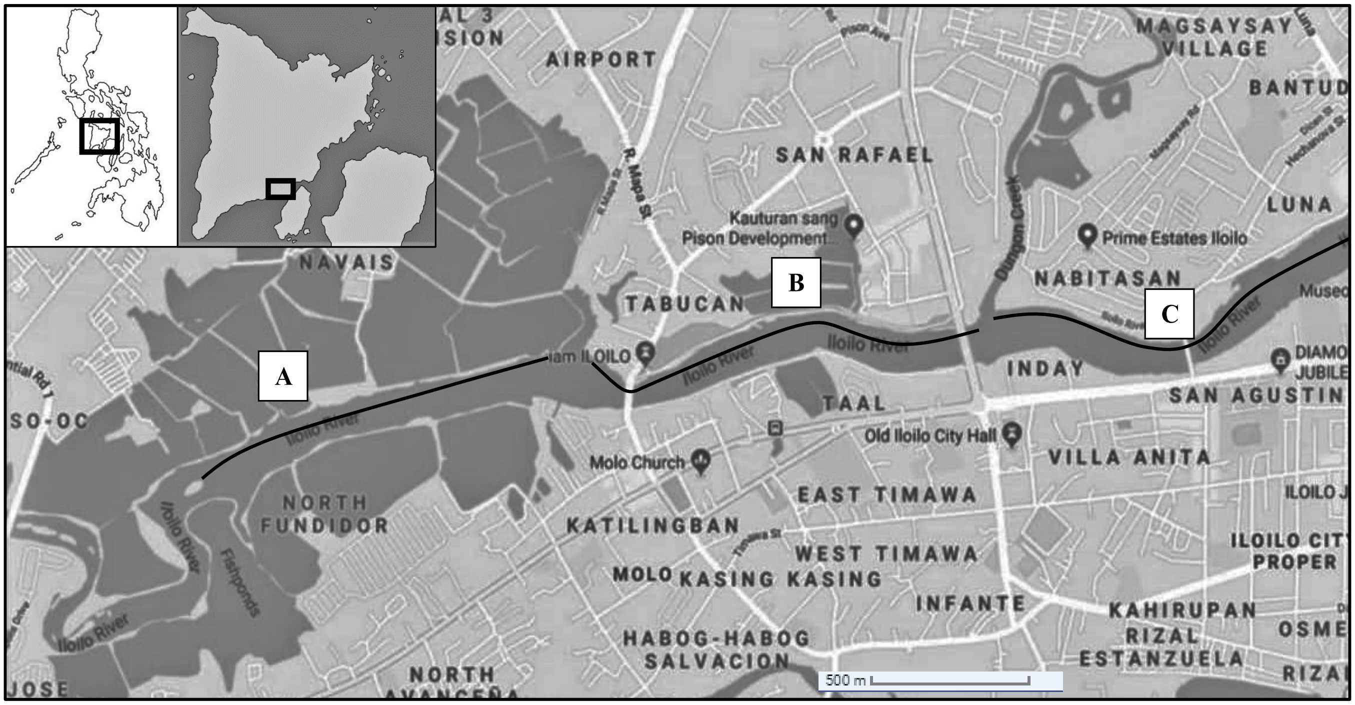

Figure 1. Map of the Philippines (top left), map of Panay Island (top middle), Map of Iloilo City with the three zones (A) upstream zone, (B) upper midstream zone, and (C) lower midstream zone (modified from Google Maps, 2017). Dark grey indicate areas covered with water

samples were not damaged by a hypotonic solution reaction. The jars were then immediately filled with 10% formalin to obtain a 5% formalin-river water mixture. The net was then quickly inspected for holes and was thoroughly rinsed again to ascertain the next tow was not contaminated from the previous hauling.

Once the sampling was finished, the plankton samples were temporarily stored in the city before they were transported to the Marine Pollution and Ecotoxicology (MPE) Laboratory at the University of the Philippines Visayas located in Miagao, Iloilo. The larvae samples were stored at room temperature and out of direct sunlight. The plankton net and flow meter were rinsed and cleaned with freshwater and then dried.

Sample Analysis

Ichthyoplankton and decapod larvae from entire samples were sorted and counted under a dissecting microscope with the use of a plankton counting container. Ichthyoplankton were identified using diagnostic characteristics such as pigmentation, number of vertebrae, and spines (Leis and Carson-Ewart, 2000). Decapod larvae were identified based on spines, rostrum and other identification characteristics cited by Bento (2018). Densities were calculated as follows (Omori and Ikeda, 1984):

$$\text{Density} = \frac{\text{Total number of planktonic organism}}{\text{volume of water filtered}}$$

Density of each taxon or species was compared to the total density using the relative abundance equation (Omori and Ikeda, 1984):

$$\text{Relative Abundance} = 100 \text{ x} \frac{\text{density of the taxa}}{\text{Total density}}$$

The number of occurrences of the plankton for each sampling period was compared to the total numbers of sampling periods at each zone using the frequency of occurrence equation (Omori and Ikeda, 1984):

$$\text{Frequency of Occurrence} = \frac{\text{\# of sampling periods observed}}{\text{Total \# of sampling periods}}$$

Data Analysis

One-way ANOVA was used to determine any significant differences on spatial variations in ichthyoplankton and decapod larvae parameters between the upstream, upper midstream and lower midstream zone. If the parameters were found to be significantly different then a Duncan Post Hoc Test was used to determine, which of the zones were significantly different. When densities were not normally distributed, a nonparametric Kruskal Wallis H Test was used followed by pairwise comparisons when appropriate.

RESULTS

Taxonomic Composition

Table 1 shows the total number of taxa found in the three zones. A total of 7 ichthyoplankton taxa and 7 decapod larvae taxa were identified. *Clupeidae* was the only economically important ichthyoplankton family recorded and only in the upstream and upper midstream zones. The Penaidae, Palaemonidae and Portunidae were the only economically important decapod larvae taxa recorded in all 3 zones. The average number of families recorded for decapod and ichthyoplankton larvae were not significantly different between the different zones (P>0.05).

Density

Figure 2 shows the mean ichthyoplankton and decapod larvae densities, which ranged from 70.8 to 404.2 ind./100m^3 and 112.7 to 1277.6 ind./100m^3, respectively No significant differences in both ichthyoplankton and decapod larvae densities between the 3 zones were found (P>0.05), but densities of both the ichthyoplankton and decapod larvae were much higher in the lower midstream zone than the other 2 zones. The lack of significant difference between the different sampling zones can be explained by the high variability of larvae densities between sampling periods. In addition, decapod larvae are approximately 51% of the overall total density (ichthyoplankton plus decapod larvae).

Relative Abundance

Figure 3A shows the relative abundance of ichthyoplankton with Gobiidae being the most relatively abundant fish family (79.4 - 87.0%). Eleotridae was also common with relative abundance

Table 1. Taxonomic composition of the upstream, upper midstream and lower midstream

Family	Upstream	Upper Midstream	Lower Midstream
Ichthyoplankton			
Eleotridae	14.89	36.79	229.91
Gobiidae	50.86	130.45	764.01
Clupeidae	0.40	0.57	0.00
Ambassidae	2.83	1.13	5.66
Blenniidae	0.00	0.00	26.88
Tetradontidae	0.00	0.00	0.71
Elopidae	0.00	0.57	0.00
Decapod Larvae			
Palaemonidae	6.67	27.59	153.51
Penaeidae	46.48	5.80	74.99
Dotillidae	33.75	19.10	879.32
Portunidae	1.35	8.63	16.98
Sesarmidae	1.21	2.55	11.32
Diogenidae	0.00	0.00	19.10
Paguridae	0.00	0.00	0.71

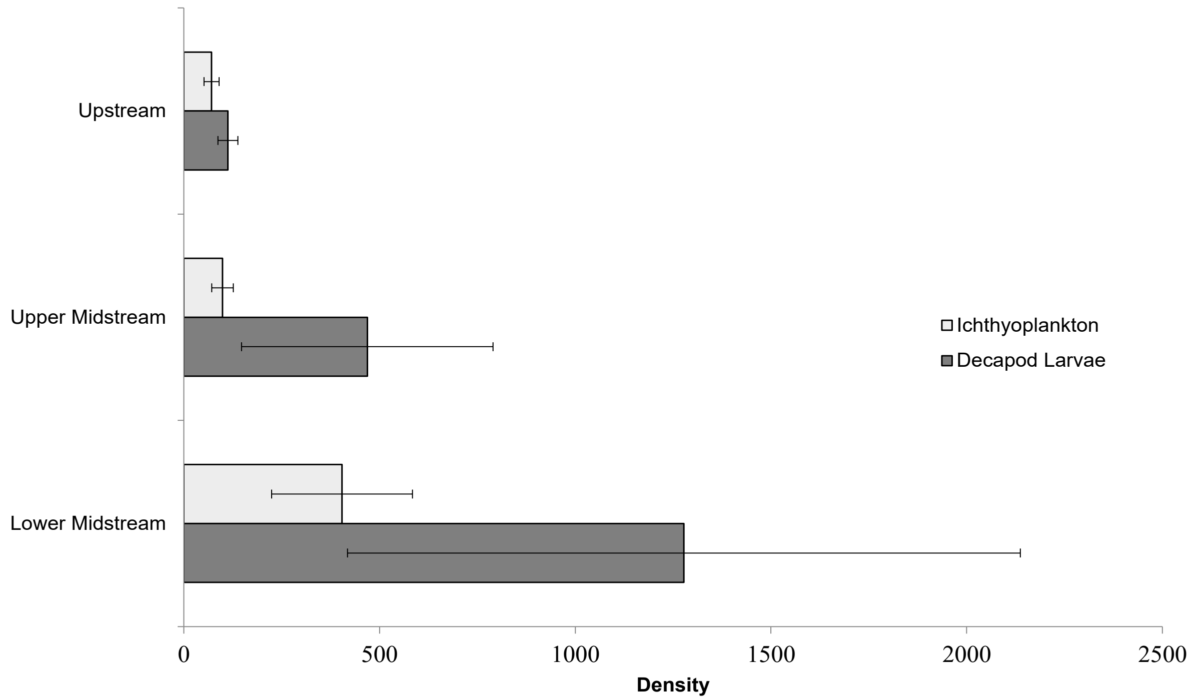

Figure 2. Densities of ichthyoplankton and decapod larvae sampled in the upstream, upper midstream and lower midstream zones (n=9; mean ± SD)

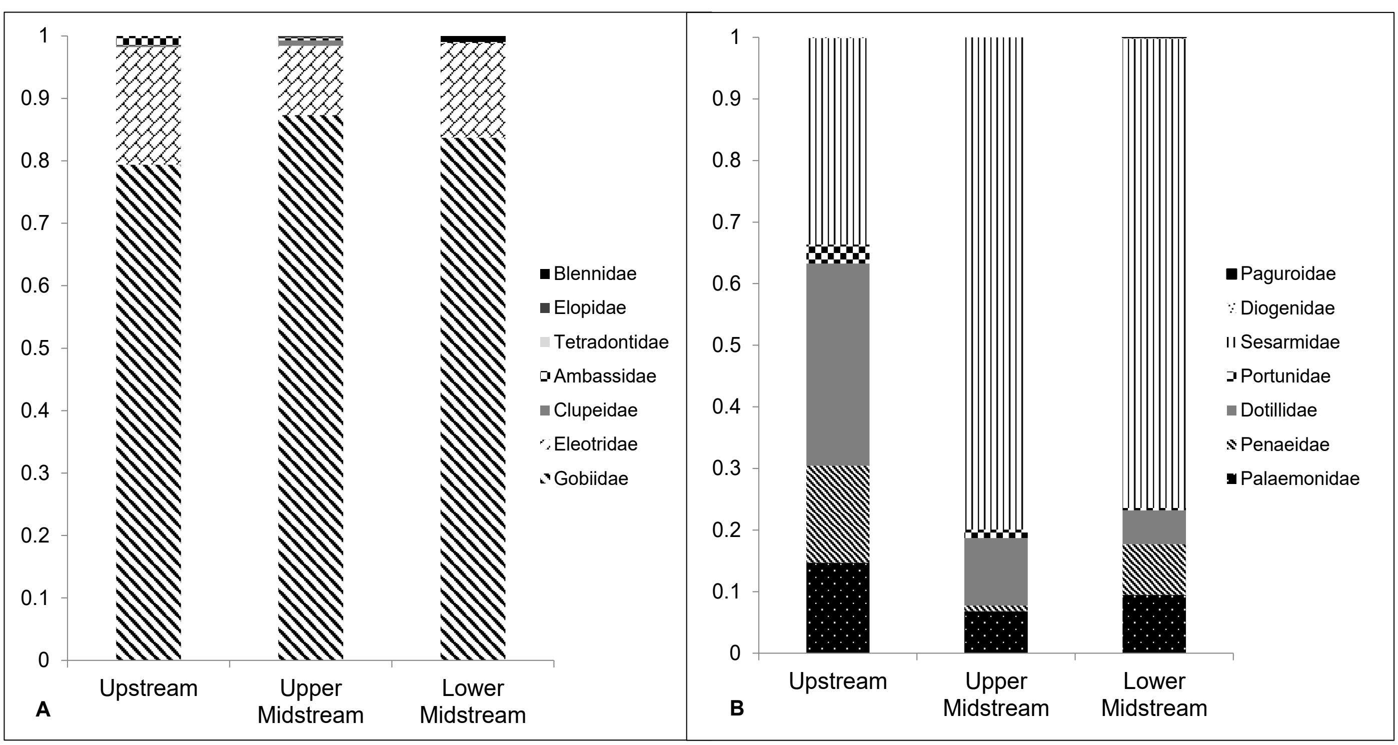

Figure 3. Relative abundance of (A) ichthyoplankton and (B) decapod families found in the three zones (n=9; mean ± SD)

of 11.1 - 18.9% of ichthyoplankton in the 3 zones. The next most common family was Ambassidae (0.1 - 1.5%), but was far less common than the 2 previously mentioned taxa. No significant difference in Gobiidae, Eleotridae, and Ambassidae relative abundance was measured between the 3 zones (P>0.05)

Figure 3B shows the decapod larvae relative abundance, which were dominated by the families Sesarmidae and Dotillidae (66.4 - 90.9%) in all the zones. Both families contain species with no commercial value and are mangrove dwelling crabs that are commonly seen in Iloilo River. Both Palaemonidae (6.8 - 14.7%) and Penaeidae (0.9 - 15.7%) are economically important shrimp taxa but were found only in moderate abundances. Portunidae was the only economically important crab taxa found in the river, but the relative abundance were quite low compared to the earlier mention taxa (0.4 - 3.1%). No significant difference in Palaemonidae, Portunidae and Penaeidae relative abundance between the 3 zones (P>0.05).

Frequency of Occurrence

Figure 4 shows ichthyoplankton and decapod larvae frequency of occurrences in all three zones, which ranged from 0.44 to 0.49 and 0.65 to 0.84, respectively. No significant difference of ichthyoplankton and decapod larvae frequency of occurrence between the three zones (P>0.05). Again, high variability was observed between sampling periods.

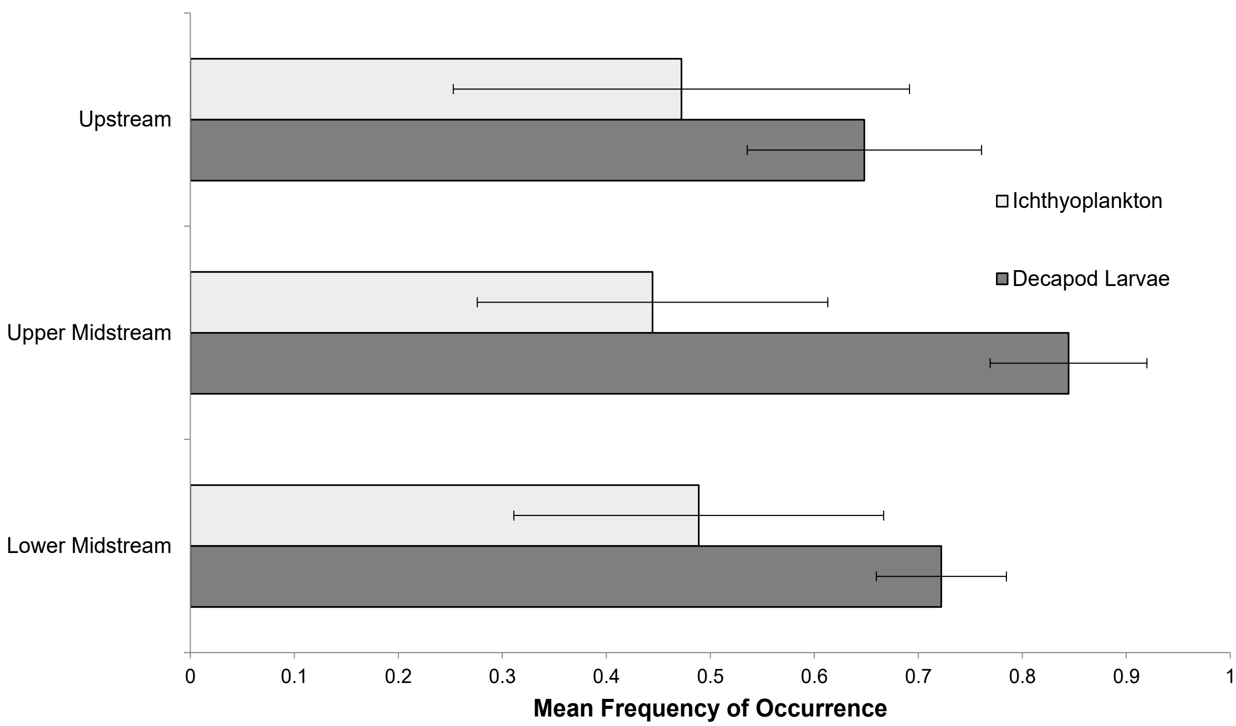

Figure 4. The ichthyoplankton and decapod larvae frequency of occurrence of in the upstream, upper midstream and lower midstream zone (n=9; mean ± SD)

DISCUSSION

Criteria for identifying nursery habitats were developed from Beck et al. (2001), which stated: 1) the nursery role of habitats must be compared on a unit-area basis and 2) a nursery ground habitat must have greater than average densities of larvae than other marine habitats. The densities of fish larvae and number of taxa found in this study were lower than del Norte-Campos and Campos (2010). Mean densities reported by the earlier mentioned study ranged from 175 to 3,034.1 individuals/100m^3. The lowest densities were found in March while the higher densities were found during the Southwest Monsoon. Indicating the Southwest Monsoon may be more productive than the Northeast Monsoon. In addition, higher densities of ichthyoplankton and decapod larvae were found in Iloilo River than the densities (55.6 to 168.5 ind./100m^3) recorded by Campos and Santillan (2006) along shallow coastal waters in southern Guimaras. The mean density recorded in the lower midstream zone (Fig. 2) was almost 3 times higher than the densities in the earlier mentioned study. Marine coastal areas similar to Taklong Island have been found to be productive recruitment areas in various studies (Nash et al., 2015). The densities recorded in this study were also comparable to the studies conducted in nursery grounds by Ooi and Chong (2011) and Razagholine et al. (2016). The densities recorded in the earlier mentioned studies were 212.67 to 472.11 ind./100m^3 and 94.29 to 143.43 ind./100m^3, respectively. This comparison somewhat implies that the Iloilo River is still a productive nursery ground during the Northeast Monsoon, but for fewer taxa.

The taxa Gobiidae and Eleotridae are utilizing Iloilo River as a nursery ground. These fishes are likely important prey items for economically important fishes and occupy important ecological niches. These two families are small demersal fish that live near rocks or mangrove roots. The dominance of these two families indicates that current environment of the river is best suited as a nursery ground for these taxa. Snappers (Lutjanidae), trevallies (Carangidae) and groupers (Serranidae) are known to often prey on gobies (Gobiidae), blennies (Blenniidae) and sleepers (Eleotridae) (Rimmer, 1998), which were found in sampled in this study. These smaller fishes provide nourishment to predators, which enter shallow inshore waters to feed on the relatively abundant food supply (Sheaves et al., 2014). While larvae from the families Centropomidae, Lutjanidae, Carangidae and Mugilidae were not caught in the present study, juveniles have been recorded within the river in previous studies (Andrada, 2000). On the other hand, Clupeidae was the only economically important ichthyoplankton taxa found in this study. Coastal and pelagic waters are usually the nursery grounds for Clupeidae larvae (Carpenter and Niem, 1999) but very few individuals were obtained during this study. With this information, it is unlikely that sardines utilize Iloilo River as a nursery ground. There is, however, a possibility that these fishes utilize Iloilo River as a nursery ground during the other months of the year.

Several economically important decapod larvae taxa were found in this study. Both Penaeidae and Palaemonidae were found to be abundant and are commonly sold in markets in the Philippines (Carpenter and Niem, 1999). These two families are also important prey to predatory fish that migrate into estuaries to feed (Sheaves et al., 2014) and it is likely that Iloilo River is important feeding ground for other economically important species. Portunidae larvae were found at lower densities than Penaeidae and Palaemonidae, but are also a commercially important. Portunidae crabs, including mud crabs (*Scylla serrata*), blue swimming crabs (*Portunus pelagicus*) and crenate swimming crab (*Thalamita crenata*), are commonly sold in markets throughout the Philippines (Carpenter and Niem, 1999).

The high variability of the ichthyoplankton and decapod larvae parameters between sampling periods can be explained because the samplings in each zone were conducted sequentially, not simultaneously. This sampling strategy was adopted due to financial limitations, which could not allow more than one vessel to operate at one time. Planktonic organisms in estuaries must be able to survive in a dynamic environment that can change rather quickly. Planktonic assemblage then varies accordingly in response to these changes particularly in relation to tidal movements. These changes are often reflected in studies that adopt this mode of sampling. Natural variability of mobile (vs attached) organisms is typically very high, but this is how nature is. For plankton, natural variability is more so, but the inability to sample simultaneously, hopefully, is not a major reason for variability in the data. To counteract this issue, other studies often conduct more samplings to attain a more evenly distributed dataset. The general remedy to reduce variability, under all circumstances, is to increase sample size even if it covers just one month or one season. Unfortunately, only nine samplings were conducted in this study due to budget and time constraints. This resulted in a data set that was not normally distributed.

CONCLUSION AND RECOMMENDATIONS

The information provided earlier implies Iloilo River is an important nursery ground for the families *Portunidae*, *Penaeidae* and *Palaemonidae*. Ichthyoplankton larvae samples were dominated by the families Gobiidae and Eleotridae in all zones, whereas the families Sesarmidae and Dotillidae dominated decapod larvae samples. The identification of Iloilo River as a nursery ground is important information and can provide motivation to the general public to improve the ecological restoration of Iloilo River.

The results of this study can be used provide Iloilo River motivation for future research to increase the effectiveness of the tidal inlet as a nursery ground. One major recommendation is a one year study should be performed on Iloilo River to assess whether Iloilo River is an important nursery ground and to identify other possible taxa that utilize the river as such. Understanding how both ichthyoplankton and decapod assemblages are affected by the continued development of Iloilo River is also imperative but requires periodic long term monitoring. Acute and chronic toxicity studies using water from different areas of estuary should be conducted with larvae and juveniles of various economically important species of fishes that both inhabit and previously inhabited in the estuary. Then, preliminary studies should be conducted to determine if Iloilo River could possibly be an area for a stock enhancement program for economically important and native fish species. Stock enhancement projects in Iloilo River will provide additional recruits to nearby fishing grounds and improve the livelihood of municipal fisherfolk by improving catches. Researchers should continue to employ local fishermen in future studies in the river. This will provide additional income to the fishfolk and improve relations between local fisherman in Iloilo and researchers from the University of the Philippines Visayas. This in turn will help build a cooperative relationship to rehabilitate the Iloilo River.

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REFERENCES

Andrada, K. A. 2000. A Survey of the Catch Composition of Fyke Nets in the Iloilo River. Undergraduate Thesis, University of the Philippines Visayas, Miagao, Iloilo. 1-27 p.

Beck, M. W., Heck Jr., K. L., Able, K. W., Childers, D. L., Eggleston, D. B., Gillanders, B. M., Weinstein, M. P. 2001. The Identification, Conservation, and Management of Estuarine and Marine Nurseries for Fish and Invertebrates: A better understanding of the habitats that serve as nurseries for marine species and the factors that create site-specific variability in nursery quality will improve conservation and management of these areas. Bio Sci, 51(8): 633-641.

Bento, M. 2018. Keys and bibliography for identification of larval stages of brachyuran crabs from western Indian Ocean. (Master's thesis). Retrieved from researchgate.net.

Campos, W. L. and Santillan, A. S. 2006. Diel patterns in abundance, distribution and composition of ichthyoplankton in shallow reef areas in Southern Guimaras, Central Philippines. Coastal Marine Science 30(1):1-6.

Carpenter, K. E., and Niem, V. H. 1999. FAO Species Identification Guide for Fishery Purposes the Living Marine Resources of the Western Central Pacific. Food and Agriculture Organization of the United Nations. Volumes I-IV.

del Norte-Campos, A. and W. L. Campos. 2011. Developing Indicators for the Biological Integrity of Iloilo River. Revised Terminal Report submitted to the Office of the Vice-Chancellor for Research and Extension of UP Visayas. 42p.

del Norte-Campos, A. and Manuel-Santos, M. 2014. On the occurrence of the Sulu Shrimp Metapenaeus suluensis Racek and Dall, 1965 (Crustacea: Decapoda: Penaeidae) in the Iloilo River, West Central Philippines. Phil Sci Let 7(2): 398-400.

Funtecha, H. F. 2003. The Iloilo River: Development History in a Changing Landscape, 1855-1937. The Journal of History 49 (1-4), 1-1.

Google Maps. 2017. Number of Hospitals located along Iloilo River. https://www.google.com.ph/maps/search/hospitals+Iloilo+City/@10.7283114,122.5576649,13z

IRDC. 2011. Iloilo Batiano Rivers Initiatives 5 (mpf resource 285-8). Retrieved from http://www.riverfoundation.org.au/admin/multipart_forms/mpf__resource_285_8___ILOILO%20BATIANO%20RIVERS%20INITIATIVES%205.docx

Leis, J. M. and Carson-Ewart, B. M (Eds). 2000. The Larvae of Indo-Pacific Coastal Fishes: An Identification Guide to Marine Fish Larvae. Sydney, Australia: Brill Academic Publisher.

Nash, R., Campos, J. and Freitas, V. 2015. Nursery Ground Ecology. Portugal: BioMarPT, 390 pp.

NSO. 2010. "Population and Annual Growth Rates for the Philippines and Its Regions, Provinces, and Highly Urbanized Cities". Census and Housing Population. Retrieved 15 March 2015.

Omori, M. and Ikeda, T. 1984. Methods in Marine Zooplankton Ecology, xiii. New York: Wiley, 332 pp.

Ooi, A. L. and Chong, V. C. 2011. Larval fish assemblages in a tropical mangrove estuary and adjacent coastal waters: Offshore-inshore flux of marine and estuarine species. Continental Shelf Research 31: 1599-1610.

Razagholine, S., Arshad, A., Nurul Amin, S. M. and Ara, R. 2016. Composition and diversity of larval fish in the mangrove estuarine are of Maruda Bay, Sabah, Malaysia. Journal of Environmental Biology 37:697-703.

Rimmer, M. 1998. Grouper and snapper aquaculture in Taiwan. Austasia Aquaculture 12(1): 3-7

Pendon, L. 2015 Jan 14. BFAR to seed Iloilo River with tilapia, bangus fry. Sun Star [accessed 2015 Feb 18. http://50.28.66.108/iloilo/local-news/2015/01/14/bfar-seed-iloilo-river-tilapia-bangus-fry-386622.

Sheaves, M., Baker, R., Nagelkerken, I., Connolly, R. M. 2014. True Value of Estuarine and Coastal Nurseries for Incorporating Complexity and Dynamics. Estuar Coast, 38(2):401-414.

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