Journal of Natural and Allied Sciences
Vol. II No.1, pp. 31-37, December 2018

Diel Patterns of Species in Balagan River, Binmaley, Pangasinan

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Abstract **–** This study was conducted to assess the diel pattern of species caught by surface gill net set at different time settings in Balagan River, Binmaley, Pangasinan. Setting of the gill net was done six times of the day, commencing at 9 to 10 AM, 2 to 3 PM, 5 to 6 PM, 9 to 10 PM, 2 to 3 AM and 5 to 6 AM. There were 13 species belonging to 12 families of finfishes and crustaceans present in the catch of surface gill net operated in Balagan River. Most of the species caught were present during the time of operations. The highest mean catch was observed during 2 to 3 AM operation with 465.00 g, followed by 2 to 3 PM with 343.75 g, 9 to 10 AM (298.50 g), 9 to 10 PM (223.00 g), 5 to 6 PM (160.50 g) and 5 to 6 AM (73.50 g). Despite the differences in catch, statistical analysis showed no significant difference (P>0.05) in terms of time operations. In terms of diel patterns of species caught, most of the species are either diurnal and nocturnal species. Three species namely, *Chanos chanos, Oreochromis mossambicus* and *Elops hawaiiensis* exhibited multi-activity patterns being present in all periods of the day.

Keywords **–** *Diel pattern, diurnal, nocturnal, crepuscular, gill net*

INTRODUCTION

The diel activity rhythm in most animals is a common behavioral adaptation. The activity patterns of animals over a 24-h period can usually be described as nocturnal, diurnal, or crepuscular. The animal's diel activity is dictated by its environment, food availability, predation risk, and reproduction constraints (Daan and Aschoff 1982). The diel rhythm also known as the circadian rhythm or biological clock has been studied in most finfishes (Hobson, 1965; Hobson et al. 1981; Bourke et al. 1996 and Felix-Hackradt et al. 2010). The activities of most fishes are dictated by their biological clock.

According to Aschoff (1984) there are four prototypes of such clocks that have evolved in adaptation to the four main periodicities in the environment: the tides, day and night, the lunar cycle, and the seasons. Each of these environmental cycles represents a temporal program that repeats itself in regular intervals and is hence predictable. The second factor (day and night) is a common observation to fishes where they are generally classified as diurnal and nocturnal. The third type is crepuscular fishes where they are active at the twilight period (Hobson, 1972). The studies made by Hobson of reef fishes in Hawaii and Californian nearshore waters revealed fishes active during the dusk period (sunrise and sunset).

This study aimed to look into the diel pattern and catch volume of some species of finfishes and crustaceans in Balagan river in Binmaley, Pangasinan.

MATERIALS AND METHODS

Location of the Study

The study was conducted in Balagan River located at Barangay Balagan, Binmaley, Pangasinan. The location was established in the river using a portable digital Global Positioning System (GPS) apparatus with geographical coordinates of 15° 58' 37.9" North and 120° 17' 34.6" East. The study area is located near the mangroves growing along the banks of the river.

Data- Gathering Instruments

A single surface gill net with 3-cm mesh size was utilized in this study. The monofilament knotted

ISSN 2599-4646 (Print) *www.psurj.org/jonas* ISSN 2599-4654 (Online)

netting of the fishing gear is made up of Polyamide (PA) material or commonly known as nylon. The net is 25 meters long with a depth of 3 meters. To facilitate sampling, three non-motorized boats were used for setting and hauling of the net. Standard weighing scale was used in determining the weight of the catch. A one-foot rule was also utilized in measuring the length of the species caught.

The gill net was used to gather data on species composition and volume of catch. Data obtained were further extracted to determine the length-weight relationship, diel activity patterns and catch per unit effort (CPUE).

To substantiate the study, a survey questionnaire was prepared to gather data on the profitability of the gill net operations in Balagan river.

Data Gathering Procedure

There was only one surface gill net used in this study. The net was set along the river parallel from the river banks. Setting of the gill net was done six times of the day, commencing at 9 to 10 AM, 2 to 3 PM, 5 to 6 PM, 9 to 10 PM, 2 to 3 AM and 5 to 6 AM. The soaking time is uniform at one hour each. After one hour the net was hauled from the starboard side of the boat. In the course of hauling the net, removal and separation of catch were done. After the catch was emptied on the plastic basin, they are immediately transferred in the net bags. Sampling was done every week. A bamboo stake was placed in the study area to serve as a marker.

The individual catch was measured using a 1 kg weighing scale. Identification of the species caught the net was undertaken in the field using the books of Conlu (1986) and Motoh and Kuronuma (1980). However, in case of difficulty of identification, the voucher specimens were brought to PSU-Binmaley Campus for further identification. The online information on fish identification from Fish Base (www.fishbase.org) was done.

Treatment of Data

The data gathered were treated using the available statistical program, the Microsoft Office Excel 2010. Analysis of variance (ANOVA) was employed to determine the differences in the volume of catch at different time of operations.

RESULTS AND DISCUSSION

Species Composition

Table 1 shows the species composition caught by gill net at different time of operations in Balagan river, Binmaley, Pangasinan. A total of 13 species belonging to 12 families of finfishes and crustaceans were present in the catch of surface gill net operated in Balagan River. Species of finfishes caught were *Chanos chanos, Oreochromis mossambicus, Elops hawaiiensis, Megalop scyprinoides, Liza vaigiensis, Gerres filamentosus, Ambassis gymnocephalus, Trichogaster pectoralis, Leiogtherapon plumbeus* and *Leiognathus bindus* while under Crustaceans were*, Metapenaeus ensis, Penaeus monodon and Macrobrachium lar.* Based on the results of the study, the presence of the 13 species varied by time. It was noted that during the 2 to 3 pm operation, there were 11 species present, followed by 2 to 3 am (10), 9 to 10 am and 9 to 10 pm (both with 8) and 5 to 6 am and 5 to 6 pm 9 (both with 3).

The species caught by surface gill nets were comparable with the studies of Piring et al. (2009) and Flores et al. (2011). Piring et al. (2009) identified 26 species of finfishes and crustaceans in the Manat river while Flores et al. (2011) noted 22 species in Lomboy river. The similarity of catch in terms of species may be attributed to the tributary connections of these riverine systems where species migration is inevitable.

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Table 1. Species caught by surface gillnet at different time of operations in Balagan River, Binmaley, Pangasinan.

Species Caught	Time					
	2-3 AM	5-6 AM	9-10AM	2-3 PM	5-6 PM	9-10 PM
FINFISHES						
Chanos chanos	+	+	+	+	+	+
Oreochromis mossambicus	+	+	+	+	+	+
Elops hawaiiensis	+	+	+	+	-	+
Megalops cyprinoides	+	-	-	+	-	+
Liza vaigiensis	-	-	+	+	+	-
Gerres filamentosus	+	-	-	+	-	-
Ambassis gymnocephalus	-	-	+	+	-	-
Trichogaster pectoralis	+	-	-	+	-	+
Leipotherapon plumbeus	+	-	+	+	-	-
Leiognathus bindus	+	-	-	+	-	-
Metapenaeus ensis	+	-	-	-	-	+
Penaeus monodon	+	-	+	+	-	+
Macrobrachium lar	-	-	+	-	-	+

Legend:
+ (present in the catch)
– (absent in the catch)

The presence of species in relation to time may be attributed to animal's adaptation. Keenleyside (1999) stressed that the basic purpose of animal's adaptation is survival and existence. Archer (2001) pointed out that animal's periodic migration will increase the chance of their survival. The periodic presence of such species may also be linked to food, spawning, migration and other behavioral adaptations.

The species variability in terms of time may likewise, related to organism's circadian rhythm. The internal biological clock which is a 24-hour cycle dictates organism's diel activities (Zhdanova and Reebs, 2006). Oliveira-Neto et al. (2008) disclosed that the trend of fish assemblages maybe linked to phylogeny, predation and net avoidance. In this study, the presence of fish and crustaceans are higher during the day (9-10 AM and 2-3 PM) and night time (9-10 PM and 2-3 AM) but absent or lower during dusk (5-6 PM) and dawn (5-6 AM) time. This suggests that fish activity is higher during day and night time and minimal during twilight time. Further discussion is presented in the diel activity patterns of the species caught by gill net.

Furthermore, the presence of species in the catch of gill net may also be attributed to species abundance in the area. The higher the population of the species thriving in the river may increase the probability of catch of the fishing gear whether it is passive or active type.

Volume of Catch

The volume of the catch of surface set gill nets at different time of operations is presented in Table 2. Results of the study revealed that the highest mean catch was observed during 2 to 3 AM operation with 465.00 g, followed by 2 to 3 PM with 343.75 g, 9 to 10 AM (298.50 g), 9 to 10 PM (223.00 g), 5 to 6 PM (160.50 g) and 5 to 6 AM (73.50 g). However, analysis of variance failed to show any significant differences (p>0.05) among the different time of operations.

The comparable catch of surface gill nets at different time of operations may be attributed to the

ISSN 2599-4646 (Print) www.psurj.org/jonas ISSN 2599-4654 (Online)

singular location of the sampling site. The gill net was set in a designated location based on GPS device. Levinton (1982) stressed that varied habitats are one of the factors that enhanced species diversity which eventually influences catch biomass. The comparability of catch biomass at different time of operations may be influenced by the monotonous habitat where the gear is set. A study made by Flores et al. (2011) disclosed similar findings on the comparability of catch biomass of gill nets operated at different lunar phases. The vicinity of the sampling sites from the mangrove areas was one of the factors noted.

SAMPLING	Time						Total volume (g)
	2-3 am	5-6 am	9-10 am	2-3 pm	5-6 pm	9-10 pm	
	Weight (g)						
First Sampling	157	53	179	248	159	0	**796**
Second Sampling	826	0	625	53	483	0	**1987**
Third Sampling	640	0	341	395	0	581	**1957**
Fourth Sampling	239	241	49	679	0	311	**1591**
Total Volume (g)	**1862**	**294**	**1194**	**1375**	**642**	**892**	
Mean Volume (g)	**465.50**	**73.50**	**298.50**	**343.75**	**160.50**	**223.00**	

Table 2. Volume of catch of surface gill nets at different time of operations in Balagan River

Diel patterns

The diel activity patterns of species of fish caught by gill net in Balagan river is presented in Table 3. The results showed that most of the 13 species of finfishes and crustaceans (*Chanos chanos, Oreochromis mossambicus, Elops hawaiensis, Megalop scyprinoides, Liza vaigiensis, Gerres filamentosus, Ambassis gymnocephalus, Trichogaster pectoralis, Leiogtherapon plumbeus*, *Leiognathus bindus, Metapenaeus ensis, Penaeus monodon and Macrobrachium lar)* caught by gill net are active during day and night time.

Chanos chanos, Oreochromis mossambicus and *Elops hawaiiensis* were active in all periods of the day. All the other species (*Megalop scyprinoides, Liza vaigiensis, Gerres filamentosus, Ambassis gymnocephalus, Trichogaster pectoralis, Leiogtherapon plumbeus*, *Leiognathus bindus, Metapenaeus ensis, Penaeus monodon and Macrobrachium lar)* were active only at day and night time except at twilight period.

ISSN 2599-4646 (Print) *www.psurj.org/jonas* ISSN 2599-4654 (Online)

Table 3. Diel patterns of species of fish caught by gill net in Balagan River

Species Caught	Diurnal	Nocturnal	Crepuscular
FINFISHES			
Family Chanidae *Chanos chanos*	+	+	+
Family Cichlidae *Oreochromis mossambicus*	+	+	+
Family Elopidae *Elops hawaiensis*	+	+	+
Family Megalopidae *Megalops cyprinoides*	+	+	-
Family Mugilidae *Liza vaigiensis*	+	-	+
Family Gerreidae *Gerres filamentosus*	+	+	-
Family Ambassidae *Ambassis gymnocephalus*	+	-	-
Family Osphronemidae *Trichogaster pectoralis*	+	+	-
Family Terapontidae *Leipotherapon plumbeus*	+	+	-
Family Leiognatidae *Leiognathus binchus*	+	+	-
CRUSTACEANS			
Family Penaeidae *Metapenaeus ensis*	-	+	-
Penaeus monodon	+	+	-
Family Palaemonidae *Macrobrachium lar*	+	+	-

Legend:
+ (present in the catch)
– (absent in the catch

CONCLUSION AND RECOMMENDATION

The diel patterns of organisms are dictated by several factors such as behavioral adaptations, environmental cues and their internal biological clock or popularly termed as circadian rhythm (Zhdanova and Reebs, 2005).

Hobson (1965) categorized fishes according to diel activity patterns as diurnal, nocturnal and crepuscular. Diurnal fishes are generally herbivores while the nocturnal are carnivores. Likewise, crepuscular fishes are piscivores hunting those disoriented group of fishes in the transition period (Cole and Lamson, undated).

Oliveira-Neto et al. (2008) on their study on the fish assemblages in the tidal creeks during day and night time, revealed that pelagic fishes are generally diurnal while deep water fishes are nocturnal. Felix-Hackradt et al. (2010) disclosed that fish assemblages were influenced by tidal fluctuations and net avoidance. Catches were high at night time in coincidence with receding tide. Conversely, lower catch biomass was noted during daytime where high tide occurred.

The presence of *Chanos chanos*, *Oreochromis mossambicus*, and *Elops hawaiiensis* may suggest that these species are active in all periods of the day. Bagarinao (1991) described adult *Chanos chanos* as diurnal fish based on the gut content. Kuhlmann et al. (2009) accounted for the diurnal feeding pattern of milkfish *Chanos chanos* fed with supplemental feeds in ponds. Philippart and Ruwet (1982) characterized *Oreochromis mossambicus* as mainly diurnal fish. Boschung and Mayden (2004) described *Oreochromis mossambicus* as opportunistic omnivore that can thrive from 0 ppt to 40 ppt salinity. The river of Balagan is a brackishwater which enables *Oreochromis mossambicus* to thrive. *Elops hawaiensis* is either diurnal or nocturnal feeder (Honebrink, 1990). The juvenile and adult groups of *Elops hawaiensis* can be found in the mangroves, swamps, tidal creeks or marshes. The presence of *Chanos chanos* and *Oreochromis mossambicus* during night and twilight periods despite being described as diurnal fishes may indicate the abundance of these species in the Balagan river. Their abundance may enhance the probability of catch by the sampling gear.

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