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Species composition, length-weight relationship (LWR) and catch per unit effort (CPUE) of handline fishing in puerto princesa Bay, Palawan, Philippines

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Abstract
At present, no study had been conducted on the species composition, relative abundance, Catch Per Unit Effort and Length-Weight Relationship of the most common caught by handline in Puerto Princesa Bay as confirmed by the paucity of published literature. Hence this study was realized. About 16 species were identified in this study and *Scolopsis taeniopterus* was the most common species. This species has an isometric growth. The catch per unit effort varies daily, depending on the condition of the weather. It is recommended to conduct the same study on the other part of the bay using different fishing gears to collect more species from the bay. Also, a year round sample collection to provide a comprehensive data for the size structure of *S. taeniopterus*. On the other, hand gonadosomatic index, hepatosomatic index and fecundity of this species in Puerto Princesa Bay.

Keywords: Species composition, length-weight relationship, catch per unit effort, Puerto Princesa bay

Introduction
As an archipelagic country, fishing is one significant industry in the Philippines [4]. Over 1.6 million Filipinos in the coastal community rely their livelihood in the fishing industry. And last 2015, the annual harvest is around 2.3 million tons from capture fisheries with the estimated value of around 147.37 pesos [16]. Thus, fishing activity played a vital role in the economy of the country. Fishing activities not only have a direct impact on target species and by-catch, but also on the whole marine ecosystem. The loss of biological diversity is a massive worldwide phenomenon [15]. Human activities threatened productivity, diversity and survival of coastal resources leading to a growing need to understand and manage coastal zones [12]. Fishing activity affects population structure, habitats, biodiversity and productivity [11] especially when using inappropriate fishing gears, either passive or active gears and hand line is an example of a passive gear.

Handline fishing is one of the simplest fishing methods used by many artisanal fishermen and it requires simple gears and materials are economical for the fishermen involve [26]. The advantages of using handline in fishing are contributing much to the fishermen's income [25]. Handline fishing is the third fishing method use in catching pelagic or demersal species, based on the fishing profile handline fishing in the Philippines on 2016 [4]. And one of the most important applications and study for the most common fish species caught by handline is length weight relationship [8].

Length-weight relationship is important in fisheries research because they provide information on population parameters [20]. In addition, it can be used in evaluating and studying natural history of fishes and also important in fish biology, population in studying stock condition in estimating status of fish communities in the Philippines [2].

To estimate the abundance of the fish in a particular area, catch per unit effort (CPUE) can be applied. It is useful if the relation between CPUE is linear through the origin [22]. It can also use in commercial and recreational fisheries in the assessment of fish population CPUE and abundance is frequently assumed and recognized that CPUE may not accurately reflect changes in abundance [18]. In some reviewed study, CPUE with the used of data in fisheries and argued the importance of understanding with the spatial distribution of fish and allocation of fishing effort to interpret CPUE data [13]. Such tool can be used to determine the population of fish in Puerto Princesa Bay. Puerto Princesa Bay is rich marine resources and the potential

significance as fishing ground of this marine ecosystem to the local fishermen in this coastal community [9]. At present, only few studies had been conducted on the species composition, relative abundance, catch per unit effort (CPUE) and length-weight relationship of the most common caught by handline in Puerto Princesa Bay as confirmed by the paucity of published literature. Hence this study was realized.

Generally, this study aims to gather and establish data of fishes in Puerto Princesa Bay, Philippines. Hence, the objectives of this study were to determine the species composition and relative abundance caught by handline fishing method in Puerto Princesa Bay, Philippines; to determine the Catch per Unit Effort of handline used in Puerto Princesa Bay, Philippines; and to calculate the length-weight relationship parameters of most common fish caught in Puerto Princesa Bay, Philippines.

Materials and Methods

Locale of the study

Puerto Princesa bay is one of the several bays in city of Puerto Princesa. It is located at the eastern part of the city, facing the Sulu Sea (Figure 1). It plays an important role in the economy of the city as gateway to the several shipping lines that brought in and out several the products in the in the province as well as in the other parts of the country. Since the bay is rich in marine resources, vast of dolphins are thriving the area and now it opens an opportunity to the tourism industry to cater dolphins watching. Aside from this, it also serves as important fishing ground to the local communities that settle in the coastal areas of the bay. Three fishing area were established with 8-12 m depth. It was characterized as sandy to muddy substrates.

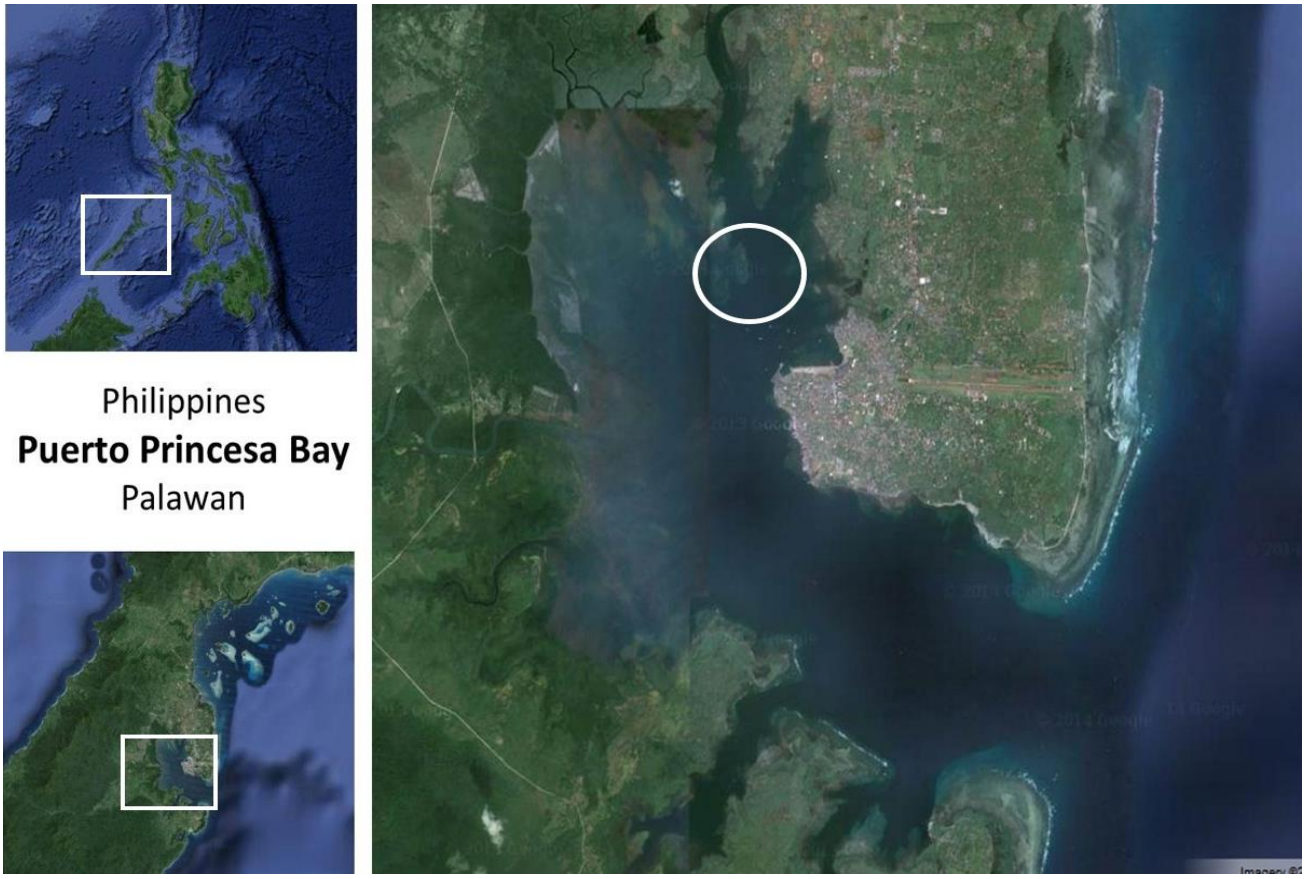

Fig 1: Satellite image of Puerto Princesa Bay, Palawan, Philippines

Sampling Procedure

The study was conducted in the whole month of February 2016 using hook in line fishing method. An expert fisherman in hook in line was hired to do the fishing every day. Fishing was conducted at early morning for one hour. All caught fish within one hour were collected and brought to Western Philippines University-Puerto Princesa Campus for biometrics measurement and analysis. Identification of the samples was done using Food Fishes of Palawan of Gonzales [10].

Data Analysis

All data were processed statistically using Microsoft excel 2010. A descriptive statistic was used in the correlation among various parameters such as CPUE. The Catch Per Unit Effort (CPUE) was determined by dividing the Total Catch (g) to the Total Time Spent for Fishing (h). For the length–weight relationships were calculated as $W = a\ L^b$. (Logarithmic form: $\log W = \log a + b^*\log L$) where, W is the total weight (g), L is the total length (cm), *a* is the intercept (initial growth coefficient or condition factor) and *b* is the slope (relative growth rate).

Results and Discussion

Species Composition

From 19.536 kg caught in Puerto Princesa Bay, Philippines for the whole month of February 2016, 16 species of fish under 10 families were identified (Table 1 and Figure 2).

Table 1: Checklist of fish species caught in Puerto Princesa Bay.

Family	Species	Common Name	Local Name
Carangidae	*Carangoides oblongus*	Coachwhip Trevally	Talakitok
Engraulidae	*Stolephorus heterolobus*	Anchovy	Dilis Bahura
Gerridae	*Pentaprion longimanus*	Longfin mojarra	Latab
Leiognathidae	*Leignathus leuciscus*	Whipfin Ponufish	Sapsap
Lethrinidae	*Lethrinus letjan*	Pinkear Emperor	Kanuping
	Lethrinus ornatus	Ornate Emperor	Amadas
	Monotaxis grandoculis	Bream	Lagao
Lutjaniade	*Lutjanus malabaricus*	Malabar Blood Snapper	Maya-maya
Mullidae	*Upeneus vittatus*	Yellow Striped Goatfish	Saramulyete
	Parupeneus ciliatus	White Saddle Goatfish	Saramulyete
Nemipteridae	*Scolopsis taenoptera*	Monicle Thread Bream	Bisugo
Serranidae	*Cephalopholis boenak*	Brown-barred Grouper	Lapu-lapu
	Cephalopholis sexmaculata	Six-blotch Hind Grouper	Lapu-lapu
	Epinephelus macrospilos	Spoted Grouper	Lapu-lapu
	Epinephelus ongus	White Streaked Grouper	Lapu-lapu
Synodontidae	*Saurida tumbil*	Greater Lizardfish	Kalaso

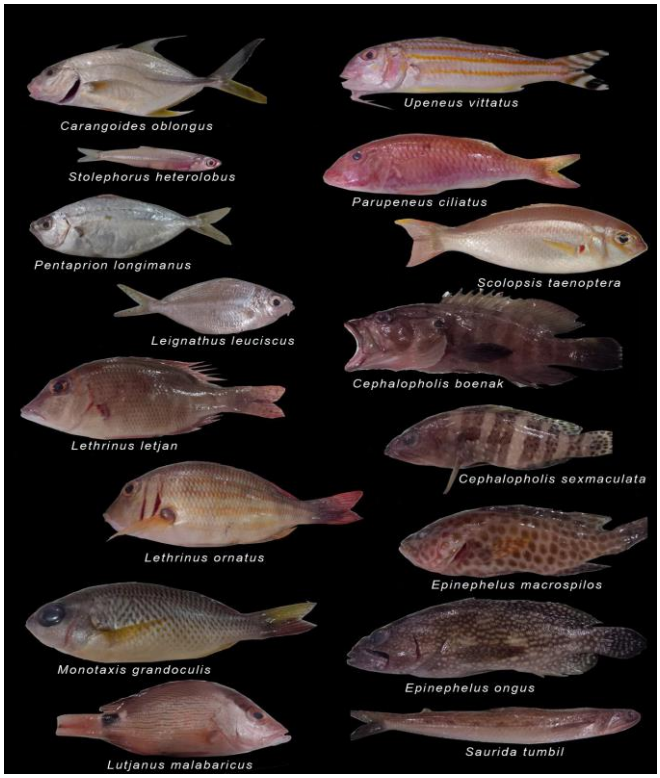

Fig 2: Photos of the 16 species caught in Puerto Princesa Bay, Palawan, Philippines.

This result is quite higher compared to the study conducted in Ulugan Bay with only had 4 species under 2 families [14] however it is quite lower compared to the study in Honda Bay with 30 species under 13 families [1]. The gear (stationary liftnet) used in the study of Abilito [1] was the reason of having more species caught in Honda Bay. The Stationary Liftnet is one of the most effective gear used by both municipal and commercial fishing sectors in the country [24]. Meanwhile this study and the study of Malacad [14] in Ulugan Bay used handline to catch fish. The efficiency of this gear is depending on the target species [23].

Relative abundance

Among 16 species were identified, *S. taenoptera* under family Nemipteridae was the most dominant. It comprises the 59% (11,617g) of the total samples caught in the entire sampling. It was followed by *M. gradoculis* with 14% (2,737g), Others (comprises 12 different species with minimal counts) with 8% (1,481g), *U. vittatus* with 7% (1,456g) while *L. ornatus*, (679g) *L. letjan* (740g) and *L. malabaricus* (826g) had equal 4% (Figure 3).

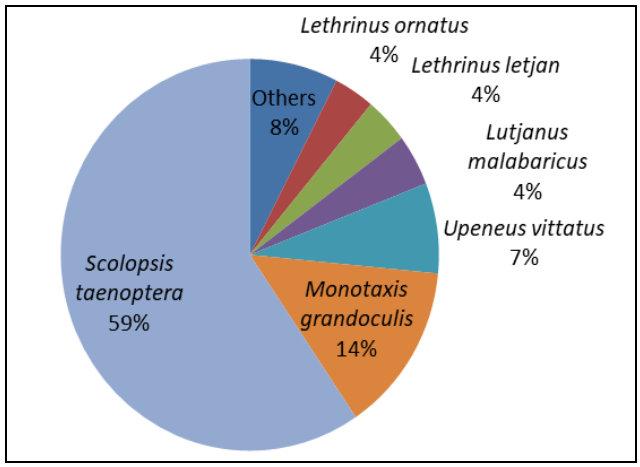

Fig 3: Relative abundance of fish caught in Puerto Princesa Bay, Philippines

Scolopsis taeniopterus under family Nemipteridae was the most abundant species caught by handline in Puerto Princesa Bay. This result was relatively similar to the study of Malacad in Ulugan Bay [14] and Balisco and Babaran in Guimaras Island [3] that species belonging to Nemipteridae were common caught by handline. On the other hand, nemipterids species was also common catch of trawl in San Pedro Bay, Philippines [6]. It is also belonging to the abundant demersal fish in Gulf of Thailand caught by trawls during 1966-1976 [5]. Substrate, food and depth of the sampling sites might be the reason of the abundance of *S. taeniopterus*. The fishermen in the area claimed that this species is only abundant in the area were the bottom is sandy to muddy with 8 to 12 m depth and where the shrimp is abundant. These statements of the locals are also supported by Russell [19] that the family of this species is abundantly distributed in coastal waters, and occur mainly on muddy or sandy ground between 5 to 80 m depths usually in schools. They are carnivorous that feeds on small fish, crustaceans, molluscs (mainly cephalopods), polychaetes and echinoderms [19].

Catch per unit effort (CPUE)

There were 24 handline sampling were conducted in the whole month of February 2016. The average Catch per Unit

Effort (CPUE) was 814 g.hr^{-1} for the entire sampling. Day 8 had the highest CPUE with 1,442 g.hr^{-1} followed by day 16 with 1,208 g.hr^{-1}, day 9 with 1,175 g.hr^{-1}, day 17 with 1,076 g.hr^{-1}, day 10 with 1,055 g.hr^{-1}, day 1 with 999 g.hr^{-1}, day 14 with 963 g.hr^{-1}, day 7 with 927 g.hr^{-1}, day 12 with 913 g.hr^{-1}, day 2 with 857 g.hr^{-1}, day 5 with 846 g.hr^{-1}, day 11 with 832 g.hr^{-1}, day 6 with 830 g.hr^{-1}, day 19 with 798 g.hr^{-1}, day 15 with 791 g.hr^{-1}, day 3 with 733 g.hr^{-1}, day 18 with 672 g.hr^{-1}, day 24 with 650 g.hr^{-1}, day 4 with 640 g.hr^{-1}, day 13 with 610 g.hr^{-1}, day 22 with 480 g.hr^{-1}, day 20 with 420 g.hr^{-1}, day 21 with 350 g.hr^{-1}, and day 23 with 277 g.hr^{-1} respectively (Figure 4).

In terms of CPUE, day 8 to 9 and day 16-17 were the days had the highest CPUE while the day 20 to 23 were the days had the lowest CPUE. According to locals, the month of February is affected by the early blows of northeast monsoon. However, the fisherman observed that during day 8 to 9 and day 16-17 where the highest CPUE observed was the days the weather was calm while the last 4 days of the sampling conducted, the wind was strong which resulted to the low catch of the fisherman. The handline fishing is difficult with this kind of weather situation [17]. It was observed during low tide, the nemipterids were caught in the deeper (10m) part of the bay and having muddy substrates.

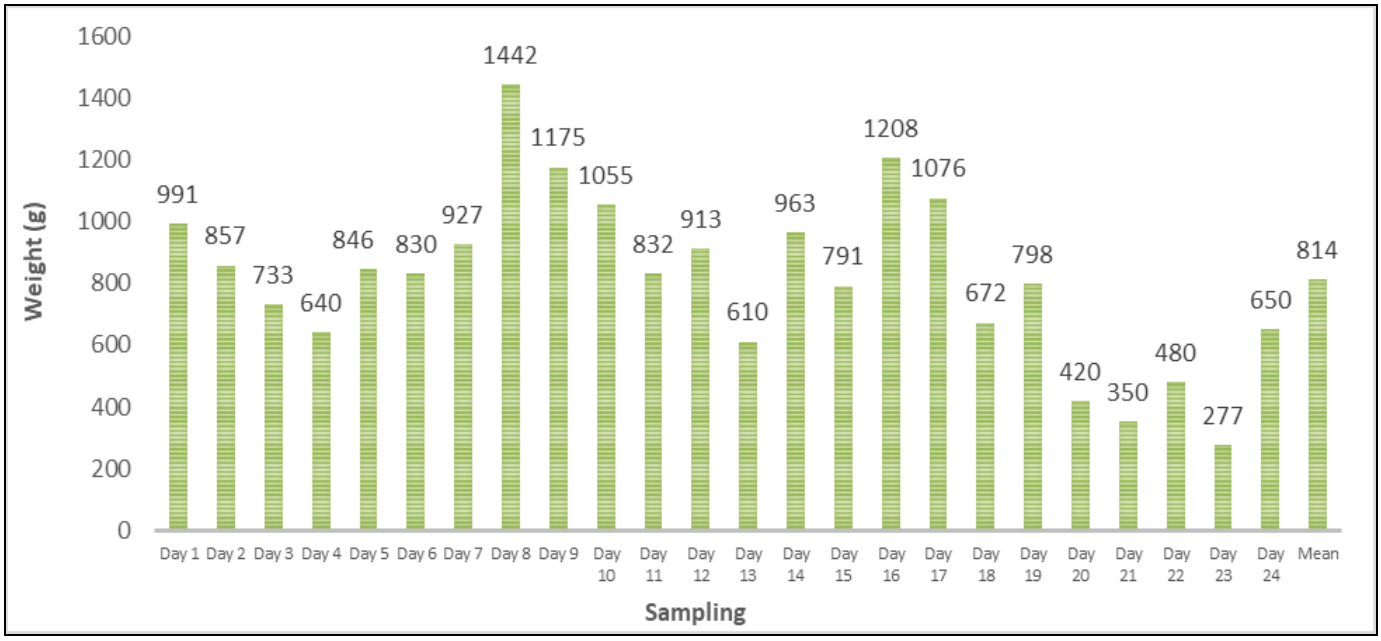

Fig 4: CPUE in Puerto Princesa Bay, Philippines in the month of February 2016.

Length-weight Relationship of *Scolopsis taenoptera*

A total of 316 individuals of Monicle Thread Bream (*S. teanoptera*) under family Nemipteridae were collected and measured from Puerto Princesa Bay using hand line gear. The mean weight of *S. taenoptera* was 36.39 g and it ranged from 7 g to 208 g while the mean length was 11.03 cm and it ranged from 7.8 cm to 20.5 cm. The b value of *S. taenoptera* was 2.38 and the correlation coefficient r value was 0.673. The Length-Weight Relationship (LWR) of *S. taenoptera* was found to be W= 2.203x - 1.820 (Figure 5). Thus, the growth of *S. taenoptera* is said to be isometric (b≈3)

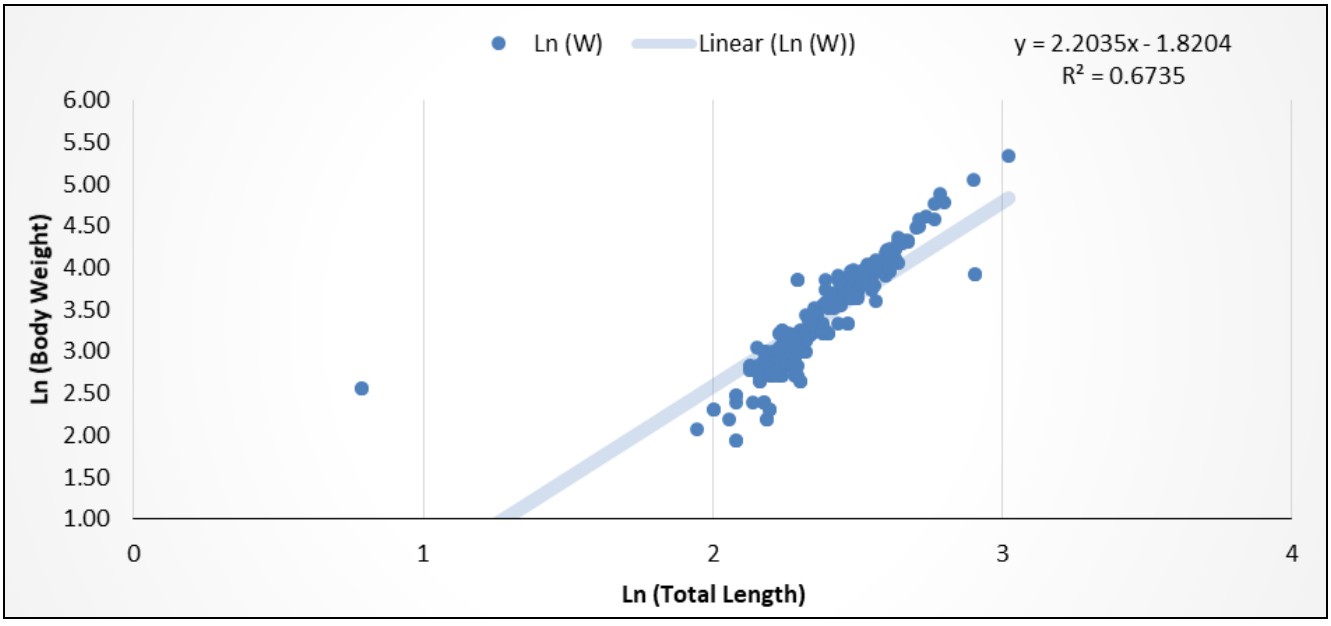

Fig 5: Length-weight relationship of *S. taenoptera* in Puerto Princesa Bay, Philippines.

A similar study was conducted on the LWR of nemipterids conducted in Honda Bay using 40 samples [21] and Ulugan Bay using 258 samples [27]. The LRW of nemipterids in Honda Bay was found to be $W=0.433L^{2.78000}$ and the r value was 0.936. The growth observed on samples were considered negative allometric since b<3 [21] while the LWR of nemipterids in Ulugan Bay was found to be $0012L^{2.984}$ and the r value was 0.976. The growth observed on samples were said to be isometric since b≈3 [27]. In this study, the LWR of *S. taenoptera* were observed in Puerto Princesa Bay. The b-value and correlation coefficient of this nemipterids differed between three sites, species and the number of samples may also contribute to the difference on above values. The LWR in Honda Bay used 40 samples and Ulugan Bay used 254 samples wherein the number of samples in this study was 316 samples and the species used in Honda Bay and Ulugan Bay was *N. hexodon* while *S. taenoptera* was used in this study since they were the most common species caught in handline. The for *S. taenoptera* in the graph (Figure 5) represent a and b parameters by power regression analysis. There are two samples present in the graph (Figure 5) which differs in the body shape from the other samples. The possible reason for these outliers was due to the light weight of the juveniles in the fish samples. Length-weight relationship is a very important parameter to understand the growth dynamics of fish population. Parameter b value means the growth of the fish species; negative allometric, isometric and positive allometric growth [7].

Conclusion

Handline fishing in Puerto Princesa Bay, Philippines can catch up to 16 species of fish. *Scolopsis taeniopterus* was the most common species occurred in the sandy to muddy substrate in the bay. This species has an isometric growth (b=3) and implied that this species did not increase in weight faster than the cube of their total length. A high positive correlation on the length and weight of *S. taenoptera* was observed. The length of fish increases with the weight of fish increases. The catch per unit effort varies daily, depending on the condition of the weather.

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