Density and White Shrimp Growth Pattern (*Penaeus merguiensis*) in Kampung Nipah Waters of Perbaungan North Sumatera

Sri Natalia Silaen[1*], and Miswar Budi Mulya[l]
[1]Department of Biology FMIPA University North Sumatera Jl. Dr. T. Mansyur No. 9, Padang Bulan Campus, Medan, 20155, North Sumatra

*Email: sri_silaen@yahoo.co.id

Abstract. The purpose of the study was to determine the density and pattern of growth of white shrimp (*Penaeus merguiensis)*of the village Nipah waters. The data collection was conducted by sampling using nets and fishing gear "Langge" (a tool) to determine the density of the three observation stations. The result showed that the distribution of white shrimp in the waters of the estuary and surrounding degraded over the past ten years. The highest density at station II is 0.56 and 5/m^2 and at least at the third station as much as 0.42 and 6/m^2. The correlation between the density of shrimp with depth as well as the fraction of the base substrate showed that only the depth of the waters who has any significant correlation with the density of shrimp, although the closeness of the relationship is small.

Keywords: aquatic estuary, density, white shrimp

1. Introduction

Indonesia is a country that has the potential of a most biggest source of sea shrimp. Shrimp is Indonesia's leading fishery commodity because of the high value or price of shrimp and the increasing demand for shrimp both in the domestic market and in International market. Shrimp has the largest export value of about 21% of world trade. For Indonesia alone shrimp are a mainstay export commodity and source of foreign exchange earnings considering about 50% of the total export of fishery products was sourced from this business. Shrimp exports to Indonesia over the last 25 years have an average growth rate of 27.8% [1].

Based on data from the Ministry of Marine Affairs and Fisheries (2011) for 5 years period from 2007 to 2011, the production of shrimp catch fisheries continues to fluctuate, in 2007 the production reached 258.976 tons, the year 2008 reached 236.922 tons, the year 2009 reached 236.870 tons, in 2010 as much as 227.326 tons [2]. In 2011 as many as 228.870 tons. The development of production for five years including decreased average -2.97%.

Indonesia currently ranks fourth in the world after China, Thailand, and Vietnam as the largest country regarding shrimp trade commodities. Based on the target of shrimp production in 2010, Indonesia has eight provinces that become largest shrimp producer, namely East Java, Central Java, DKI Jakarta, Lampung, Bali, North Sumatra, Southeast Sulawesi, and Sulawesi [3].

There are 11 types of penaeid shrimp that can categorized as having important commercial values in Indonesian water, consisting of two genera Penaeus and Metapenaeus [4]. In commercial terms, preferred are *Penaeus monodon* and *Penaeus merguiensis* (white shrimp), as both of these species can reach large sizes and good market for export.White shrimp (*Penaeus merguiensis*) was found in almost all Indonesian waters, ranging from estuaries of mangroves, coastal waters around mangroves such as estuaries, lagoons, and bays, to open waters [5].

According to North Sumatra Head of Fishery and Marine Affairs, Zonny Waldy said that the value of North Sumatera fish and shrimp exports moved up in early 2016 or to 38.975 million US dollars, the impact of fisherman catch and more selling price of up 0.85%. Head of the Central Bureau of Statistics (BPS) of North Sumatra, Wien Kusdiatmono said in January-February 2015, the export value of shrimp and shrimp was 37.753 million US dollars while in the same period 2016 was 38.975 million US dollars.

According to the fishermen in the area of white prawns sold at a price of about Rp 65.000,00 to Rp 75,000.00 per kg marketed in the area in Indonesia to Malaysia and also beneficial in the economy of white shrimp is also both consumed and good for the body. The increase in export value was driven by increasing exports and higher prices. Provincial Government of North Sumatra (2016) is continuously trying to improve the catch of fisherman ranging from helping fishing gear, environmental improvement around the sea to the provision of fishermen's insurance.

From some information above, data on white shrimp fluctuate every year and in Kampung Nipah itself is not known data related to the decrease and increase of white shrimp. Aquatic estuary in the village of Nipah, District Sei Nagalawan Perbaungan much overgrown with mangrove vegetation is very potential in supporting the life of white shrimp. To date, the abundance and growing data of the white shrimp population of *Penaeus merguiensis* in Nipah village estuary waters have not been obtained for that; it is necessary to conduct research.

2. Methods

2.1. Time and Place of Study

This research was conducted since August – September 2016 in Kampung Nipah Waters of Sei Nagalawan Subdistrict, Perbaungan Subdistrict, Serdang Bedagai Regency, North Sumatera. Geographically the estuary waters of Nipah village are at 03°35'32 "- 3°35'39.66"LUK and 99°5'33.00" - 99°6'18.06"BT.

2.2. Tools and materials

The tools used in the study are boat, buoy, fishing nets, nets, compass, refractometer, Hg thermometer, pH meter, sechidisk, analytical scale, strap rope, cool box, slider, roll meter, sample container, stationery, GPS, Meter cloth, net, digital camera, plastic, knife, paper label, wooden pillar, rubber band, raffia rope.The material used are white shrimp samples, water samples, and substrate.

2.3. Determination of Research Station

The research was conducted in 3 stations using purposive sampling. Station I is in coastal waters (3°35'32 "LU - 99°5'33.00" BT), station II is in the high seas (3°35'48,91"LU - 99°5'41.62 " BT) and station III is in the mouth of the estuary (3° 35'39.66"LU 99°6'18.06"BT).

2.4. Shrimp Sampling.

Shrimp sampling is done using a net with an area of 112.35 m^2 and “langge” at low tide in the morning noon. The net was spread to the surface of the water, then silenced for an hour at the bottom of the water and positioned in the direction of the fisherman's boat, after one hour the net was pulled and the shrimp snagged in the net catching of shrimp using “langge”, done at night (18.00-20.00 WIB) only with 10.5 m^2 “langge”. “Langge” was opened and inserted into the waters then left for 15 minutes and then lifted and taken the caught shrimp Measurement of Physical-Chemical Water and Substrate.

2.5. Parameters

Measurements of physical-chemical factors of water and substrate were carried out at each station by repeating the shrimp sampling period. Measurements of physical chemical parameters include water temperature, water crosses, water brightness, DO and BOD_5, pH, flow velocity, water depth, and substrate fraction.

2.6. Data analysis

The analysis of white shrimp data included abundance using the formula according to Brower et al. [6], growth pattern according to Sparre &Venema [7], white shrimp sex ratio using Campbell formula [8], and Pearson correlation analysis using Sugiyono formula [9].

3. Results and Discussion

The value of density obtained at station I is 0.52 ind/m^2, station II is 0.56 ind/ m^2 and station III is 0.42 ind/ m2 (Table 1). From the research that has been did shows that the most density value, found in station II followed the station I and the lowest at the station III.

Station II is an area of shrimp catching and at the station is also found a lot of white shrimp ripe gonad Station III was located at the base of the river estuary that has a lower salinity (28°/8) due to the flow of water entering the river into the waters, so that the white shrimp are also getting less.

Table 1. Density, and Sex Ratio of White Shrimp on each Station

No	Station	K (ind/m^2)	Male(tail)	Female(tail)	Sex Ratio
1	Station I	0.52	23	94	1:4 (4.086)
2	Station II	0.56	16	111	1:7 (6.93)
3	Station III	0.42	32	64	1:2 (2)

Based on the results from Table 1 it can also be seen that the ratio of white shrimp sex of *Penaeus merguiensis* at each station was dominated by female shrimp.

The results of this study indicated at the time of the study allegedly female shrimps spawning on the high seas. This was evidenced by a large number of female shrimps and has a maturity level 3 gonad (TKG 3). White shrimps obtained were at maximum size 51 g and length 19.6 cm and generally found in station II.

3.1. Physical Chemical Chemical Factor

Data on the measurement of physical, chemical factors of the waters during the research station can wa seen in Table 2 and Table 3.

Table 2. Physical Characterization of Aquatic Chemistry

Parameter	Unit	Station I	Station II	Station III
Temperature	°C	29.7	26.5	27.5
Salinity	°/∞	28	26	20
pH	-	5.6	7.8	7.2
DO	mg/L	6.36	7.04	792
BOD5	mg/L	1.3	0.7	0.7
Current velocity	m/s	0.9	2.8	0.7
Light intensity	Candela	1116	1034	1228
Penetration of light Meter	Meter	1	0.9	0.5

Table 3. Value of substrate from each station seeing

Station / Fraction	I	II	III
Liat (%)	10	85	60
Sand (%)	70	10	25
Dust (%)	20	5	15

A. Temperature

From Table 2 it can be seen that the temperature values of the three stations ranged from 26.5°C to 29.7°C. The highest temperature at station I while the lowest temperature obtained at the station 8A II while for salinity at the station 3. The value of temperature and salinity obtained can still support the life of white shrimp. Mintarjo et al. (1984) state that temperatures affect shrimp growth and life where the rate of growth increases with the rise in temperature. [10] The range of aquatic environmental parameters is a factor that causes the distribution of white shrimp to spread evenly at different substrater depth and time intervals at 26°C-27°C. Barnes (1988) state that the criteria of a reasonable salinity range for aquatic organisms are °/8 - 30 °/8 [11]. Temperature and salinity were the most influential factors to shrimp abundance and survival [12]. Meanwhile, temperature is the most influential factor on survival and shrimp growth [13]. Temperature also has an important the population density and long relationship of shrimp weight. The increase in temperature increases the metabolism rate in the shrimp body to some extent and after that the temperature rise decreases [6].

B. pH

Based on the value of Table 2, the pH values ranged from 5.6 to 7.8 where the highest pH was at station II while the lowest was at the station I. The values obtained from the three observation stations supported the life of white shrimp. Life in water can still survive when the waters have a pH range of 5-9. [14] The differences in pH value in the water is due to the addition or loss of CO_2 through the process of photosynthesis that will cause changes in the pH in the water [5]

C. DO

The DO values in Table 2 obtained in the study ranged from 6.36-7.92 mg / L. DO is highest at station III whereas the lowest DO at station I. Optimum dissolved oxygen for aquatic biota life including white prawns ranging from 4.10 mg / L - 6.60 mg / L with a minimum tolerance limit is 4.00 mg / L. white shrimp can still live in waters that have a minimum oxygen content of 3.00 mg / L [16]. The high dissolved oxygen content in the waters was influenced by the temperature, pressure, and concentration of various dissolved ions in the waters. [15]

D. BOD_5

From Table 2, the BOD_5 value at each station ranged from 0.7-1.3 mg / L that the highest BOD_5 was at the station I and the lowest value was in station II and III. The BOD5 value is the amount of oxygen required by aerobic microorganisms in the process of decomposition of organic compounds, measured at certain temperature [2]. The difference of BOD_5 value at each station was caused by the number of different organic bodies at each research station. The high value of BOD is user as bioindicator about the number of organic material compounds that enter in water. The greater the BOD_5 value of water, the lower the dissolved oxygen content [17].

E. Current Speer

The current velocity at the observation station performed during the study ranged from 0.7 to 2.8 m/s, and the highest current velocity was in station II while the lowest current velocity had found at station III. Current velocity in estuary waters is affected by tidal water. The high concentrations of organic materials was caused by fresh water flow and water mixing due to tides [18]. Of these factors produce high productivity and make the white shrimp was found. The value of current velocity

obtained at the three observation stations in Kampung Nipah Serdang Bedagai estuary still in the category of safe and normal and good in supporting the life of white shrimp.

F. Light intensity

Based on the observations in the field, in Table 2 above the results of the light intensity of each station ranges from 1.034-1228 Candelas where the highest light intensity is at the station III and the lowest at station II. The intensity of sunlight was reduced then the process of photosynthesis will be inhibited so that oxygen in water will also be reducer, where oxygen is needed aquatic organisms for metabolism. The results obtained from this research that a station the light intensity factor obtained is still in normal condition in the life of white shrimp in estuary waters of Kampung Nipah. [19]

G. Penetration of light

The value of light penetration was influenced by suspended particles dissolved in water thereby reducing the rate of photosynthesis [20]. The brightness of water is associated with suspended solids, the color of water and the light entering the water [21].

The results showed that the penetration value of light at each station ranged from 0.5-1 m, where the highest light penetration is at the station I and the lowest at station III, this was influenced by sunlight, suspended solids, measurement time and water color. A good brightness level ranges from 30-65 cm to support the productivity of aquatic organisms merguiensis de Man) in Mangrove Ecosystem Sei Tuan Sumatera Utara. The average value of light penetration in Nipah's estuary waters is still good for the survival of white shrimp (*Penaeus merguiensis*) and other organisms. [22]

H. Substrate Fraction

The station I sand fraction has the highest value of 70%. While at station 2 and station three clay fraction more Overall substrate fraction in Kampung Nipah Serdang Bedagai waters is general and the sandy fraction. The sandy clay substrate was favored by white. Water favored by white shrimp *Penaeus merguiensis* are water with sandy clay substrates [5]. Likewise, they prefer turbid water with clay substrates mixed with sand. [10]

3.2. White Shrimp Growth Pattern

Growth pattern is used to find out the relationship of a long weight of white shrimp at each station. The long-weight relationship of shrimp can be seen in Table 4.

Table 4. Connect below long-weight shrimp

No	Station	Average value b	Pattern of growth
1	I	1.924	Allometrik negative
2	II	3.578	Allometrik positive
3	III	2.355	Allometrik negative

From Table 4.1.3 it shows the growth pattern of white shrimp (*Penaeus merguiensis*) at station II is allometric positive where the growth of shrimp weight is more dominant compared with length, where as in station II and III allometric negative which indicates the addition of length is more dominant or Faster than weight. This is due to the white shrimp growth was influenced by physical-chemical factors of water and the availability of food. Growth are influenced by two factors: intrinsic factor (inside) and extrinsic factor (outside). Intrinsic factor is a factor that comes from within the white prawns are genetic, age, size of ability to use food and resistance of attack to disease [6].

3.3. Pearson Correlation Analysic

Pearson correlation analysis can was obtained by analyzing the relationship of white shrimp density with the physical-chemical factor in Nipah kampong estuary waters by using Pearson correlation analysis. The correlation (r) can was seen in Table 4.1.4 below this.

Table 5. Value of correlation result of white shrimp density with physical chemical factor of water

Parameters	**Correlation Value**
pH	0.996
Temperature	-0.859
Salinity	0.468
Penetration of light	-0.508
DO	0.531
BOD_5	-0.984
Current speed	0.580
Light intensity	-0.092

Table 5 showed that pH,temperature and BOD_5 played a very significant effect on the density of white shrimps. pH has a very positive effect on the density of white shrimp, which means that the density of white shrimps will be higher with increasing pH value. Temperature and BOD_5 have a very significant negative effect which means the density of white shrimp will be higher with the decrease in temperature value and BOD_5.

4. Conclusions

The value of white shrimp density of *P. merguiensis in* Nipah village waters ranged from 0.42-0.56 ind/m. Comparison of male and female shrimp in the three observation stations was more dominated by female shrimp. The pattern of white shrimp growth at stations I and III including allometric negative, while at station II is allometric positive. pH of water has a very positive effect on the density of white shrimp, while the temperature and BOD5 have a very significant negative effect on the density of white shrimp.

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