Length-weight relationship and condition factor of white shrimp *Penaeus merguiensis* captured in ecosystem mangrove of Bagan Asahan, Tanjungbalai, Asahan, North Sumatra, Indonesia

A Suryanti*1, N Riza2, and T S Raza’i3

1 Social Economic of Fisheries Departement, Marine science and Fisheries Faculty, Universitas Raja Ali Haji Maritim, Jl.Politeknik Senggarang, 29100 Tanjungpinang, Indonesia
2 Department of Aquatic Resource Management, Faculty of Agriculture, Universitas Sumatera Utara, Jl. A. Sofyan No.3 Medan, North Sumatera 20155, Indonesia

3 Aquaculture Departement, Marine science and Fisheries Faculty, Universitas Raja Ali Haji Maritim, Jl.Politeknik Senggarang, 29100 Tanjungpinang, Indonesia

*Email: yanti.ajb@gmail.com*

Abstract. White Shrimp *Penaeus merguiensis* was commonly found in Mangrove Ecosystem of Bagan Asahan Village. The purpose of this research are to determine length-weight relationship and condition factor of white shrimp *Penaeus merguiensis* around ecosystem mangrove waters in Bagan Asahan Village. This research was conducted for 3 month in Maret until Mei 2017 with determination of research station used purposive sampling method. The shrimp samples were taken by shrimp trawl. The result showed that 98 shrimp which consists of 58 males and 40 female. The carapace length of male shrimp between 6,05 – 22,125 mm and total weight ranged from 0,12 – 6,95 g. Male shrimp had carapace length between 7.125 – 18.25 mm and total weight ranged from 0.14 – 3.82 g. Female and male white shrimp had different growth pattern. Female shrimp had b = 2.984 included in negative allometric and male shrimp with b = 3.187 included in positive allometric. The value of correlation coefficients was more than 90% for both male and female showed very strong relation between length carapace and body weight. The value of shrimp condition factor ranged from 0.570 – 1.773 and included to flat (thin) body shrimp.

1. Introduction

Mangroves are defined by the presence of trees that mainly occur in the intertidal zone, between land and sea, in the (sub) tropics. The aeral roots of mangroves partly stabilise this environment and provide a substratum on which many species of plants and animals live [1]. Mangrove is an important spawning and nursery ground for shrimp, fish and crabs [2]. Mangroves also serve as fish nurseries and spawning grounds for finfish, crabs, shrimps, mollusks, and other sea life [3]. [4] have demonstrated that there’s positive correlations between mangrove extent and shrimp catch. Some types of commercial shrimp around of mangrove in Bagan Asahan village are white shrimp (*Penaeus* sp.) and giant prawns (*Macrobrachium* sp.).

White shrimp (*Penaeus merguiensis*) is a type of shrimp that lives on sand and mud, from coastline and river mouth to a depth of about 55 m, usually less than 20 m and likes cloudy water [5]. Many
authors have reported on the length-weight relationship of *Penaeus merguiensis* at some place in the world. Persian Gulf and Oman Sea, Iran [6], Mumbai, Indian [7], and the Sonmiani Bay Lagoon, Balochistan, Pakistan [8]. However, the study length-weight relationship and condition factors of white shrimp in ecosystem mangrove of Bagan Asahan Village, Tanjungbalai Sub-district, Asahan Regency, North Sumatera Province, Indonesia never published.

The purpose of this research is to determine the relationship of length and weight and condition factor of White Shrimp *Penaeus merguiensis* that catch in ecosystem mangrove waters, Bagan Asahan Village, Tanjungbalai District, Asahan Regency. This research is expected to provide information related to length-weight relationship and the condition factor of white shrimp *Penaeus merguiensis* in the study area for sustainable management of shrimp resources.

2. Material And Method

2.1. Study site

This research was conducted for 3 months in March - May 2017 in ecosystem mangrove of Bagan Asahan Village, Tanjung Balai Sub-district, Asahan Regency, North Sumatera Province. Determination of sampling point by used purposive sampling method and determined 3 station sampling. The measurement of samples were conducted in Laboratory of Aquatic Resources Management, Faculty of Agriculture, Universitas Sumatera Utara. The tools were 0.01 mm vernier caliper, digital scales with 0.01 g accuracy, shrimp trawl, digital camera, stationery and magnifying glass. The material were white shrimp *Penaeus merguiensis* and alcohol 96%.

2.2. Sampling of shrimp

The sampling of shrimps in each station used shrimp trawl. The shrimp trawl had length 12 m and width / height of 2 m with 200 mesh with mesh size 0.5 cm. Shrimp samples obtained and measured the length of its carapace that measured from the front of base carapace to the limits of shrimp carapace with the body. The weight of the shrimp body was measured used a digital scales. Determination of the sex of the shrimp visually visible with using magnifying glass.

2.3. Problem formulation

The length-weight relationship was calculated by the formula [9]:

\[ W = aL^b \]  \hspace{1cm} (1)

Information :

- \( W \) = weight (g)
- \( L \) = length of carapace (mm)
- \( a \) = the intercept on the Y-axis
- \( b \) = exponent/ slope

Condition factor was calculated by the formula [9].

a. if isometric growth pattern \((b = 3)\) use formula:

\[ K = \frac{10^5}{L^3}W \]  \hspace{1cm} (2)

b. if allometrik growth pattern \((b \neq 3)\) use formula:

\[ K = \frac{W}{aL^b} \]  \hspace{1cm} (3)
Information:
$K =$ condition factor
$W =$ weight (g)
$L =$ length of carapace (mm)
a dan b = constanta

3. Results and Discussions
3.1. Length-weight relationship

The number of white shrimp samples captured during the study was 40 female shrimps and 58 male shrimps. The result of white-shrimp body length-weight relationship analysis was presented in Table 1.

Table 1. The Result of analysis of length-weight relationship of white shrimp *Penaeus merguiensis*

| Parameter                          | Female          | Male           |
|-----------------------------------|-----------------|----------------|
| Number of shrimp sample           | 40              | 58             |
| Range of carapace length (mm)     | 6.05 – 22.125   | 7.125 – 18.25  |
| Range of weight (a)               | 0.12 – 6.95     | 0.14 – 3.82    |
| b value                           | 2.984           | 3.187          |
| Coefficient correlation (r)       | 0.967           | 0.959          |
| Regression equation               | $0.0006x^{2.984}$ | $0.0004x^{3.187}$ |
| T-test                            | $T_{count} < T_{table}$ | $T_{count} > T_{table}$ |
| Type of growth pattern            | Isometric       | Allometric     |

The result of t test in Table 1 showed that female white shrimps has equal to 3 (b = 3) with $T_{count}$ smaller than $T_{table}$ ($t_{count} < t_{table}$). It was significant and included to isometric growth pattern with means the length increase equals the weight gain. Male white shrimp has bigger than 3 (b $>$ 3) with $T_{count}$ more than $T_{table}$ ($t_{count} > t_{table}$). It was not significant and included to allometric growth pattern that means the length increase was not same as the weight gain.

The value of b in Table 1 showed that growth pattern for female white shrimp with b = 2.984 belonging to negative allometric, while for male white shrimps with value of b = 3.187 belonging to positive allometric or weight gain faster than length increase. The value of b = 3 indicated that long growth was balanced with weight gain or isometric growth, whereas if the b value was greater or smaller it was called allometric growth [9]. The difference in growth pattern between male and female shrimp was similar to the research by [6] in Persian Gulf and Oman Sea with b value of 2.740 for male shrimp and b value of 2.843 for female shrimp, samea negative allometric growth. Different with the result by [7] in Sonmiani Bay Lagoon, Balochistan, Pakistan showed the growth patterns of both (male and female) shrimp included to allometric negative. The effect of length and body weight was very large on the value of b obtained, so the factors that influence the body size indirectly will be able to influence the variation pattern of the value b [9].

The coefficient of correlation (r) of long-weight relationship for female white shrimp was 0.967 and male white shrimp was 0.959. The correlation showed a very strong relationship between the increase of length carapace and the increase of body weight both male and female white shrimp.
Figure 1. The Length-weight relationship of female shrimp

Figure 2. The Length-weight relationship of male shrimp

3.2. Condition Factor

The result of Condition Factor of white shrimp *P. merguiensis* could be seen in Table 2.

**Table 2.** The value of condition factor of White Shrimp *P. merguiensis* in Ecosystem Mangrove Waters of Bagan Asahan Village

| Gender | Average L (mm) | Average W (gr) | Condition Factor Range (Kn) |
|--------|----------------|----------------|-----------------------------|
| Female | 14.858         | 2.326          | 0.588 – 1.676               |
| Malae  | 12.132         | 1.232          | 0.490 – 1.485               |

Table 2 shows that condition factor of female white shrimp was 0.588 - 1.676 and the value of white male shrimp condition factor was 0.490 - 1.485. It showed the female white shrimp was more plump compared with male white prawns. The mature adult stage white shrimp as thicker, with higher weight in proportion to length, than younger organisms in the growth stage so affect the growth pattern and shrimp condition factor [10]. The value of condition factor showed that female white shrimp had better condition factor for reproduction process than male white shrimp. Condition factor was useful in expressing the wellbeing or fatness of the shrimp, it varies with sex, stage of maturity,
and time of the year. The differences in the condition factor between males and females could be due to the presence of gravid females or due to higher weight of the females’s gonads [11].

The value of condition factor for female and male white shrimp included to flat (thin) body. This is same with statement [9], that the range of the condition factor between 3 – 4 included to fat and the range of condition factor between 1 – 2 include to thin shrimp.

4. Conclusions
The length-weight relationship of female white shrimp included in isometric growth pattern or the increase of weight faster than length of carapace and male white shrimp included allometric positive growth pattern or the increase of weight equal with length increase. White shrimp both male and female belonging to flat (thin) body shrimp.

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