LWRs, condition factors and isopod parasites infection of the sumbo fish *Selar crumenophthalmus* (Pisces: Carangidae) in Lampulo fishing port, Banda Aceh, Aceh Province, Indonesia

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Abstract. In addition, the research on *S. crumenophthalmus* is very limited in Indonesia. The research that has been done is identification of fish species in Lampulo Fishing Port, Banda Aceh. But research on its stock assessment in wild has never been done. The aimed of this study is to analyze the length-weight relationship (LWRs), condition factors and Isopod parasites infection of the sumbo fish (*Selar crumenophthalmus*) in Lampulo Fisheries Port, Banda Aceh. The survey was conducted from February - April 2019. A total of 164 fish samples were collected. The results showed that the highest coefficient of b was recorded in March, where the b value of *S. crumenophthalmus* were 3.13 indicating an allometric positive growth pattern. The average Fulton’s condition factor (K) was 2.97 and the average Relative weight (Wr) condition factor was 100.26. The *Anilocra* sp. species of Isopod parasites were found in the gill layer of fish samples. The average prevalence and intensity value were 4.48 % and 0.04 ind/fish. The results of K and Wr analysis showed good conditions in the *S. crumenophthalmus* habitat were indicated that the aquatic environment is in a stable condition.

1. Introduction
Big-eyed scad fish (*Selar crumenophthalmus*) is one of the main catches of fishermen in Aceh Province, Indonesia. This is because of high economic value. In addition, these fish are pelagic species that are always present every year to be caught by fishermen [1]. Therefore, the existence of this species is very important and continuously exploited every year [2]. Furthermore, this species is the main fish resource of the Sulu-Celebes Sea (SCS) community, including Indonesia, Malaysia and the Philippines because people's lives in the region are highly dependent on these fish resources as food nutrition[3].

*S. crumenophthalmus* feeding habits were nekton, zooplankton, zoobenthos and detritus [4]. This species is distributed in East Africa, north to south Japan, the Hawaiian islands, Mexico, Peru, the Galapagos islands, Canada and Brazil [5].
In addition, the research on *S. crumenophthalmus* is very limited in Indonesia. The research that has been done is identification of fish species in Lampulo Fishing Port, Banda Aceh [6]. But research on its stock assessment in wild has never been done. Therefore, it is necessary to study the length weight relationship (LWRs) and the condition factor of *S. crumenophthalmus* to determine the condition of this fish in wild. In addition, the parasite inventory is also closely related to the condition of the fish, so it is also important to be studied in this study.

2. Materials and Methods

2.1 Location and time

Survey and sampling were conducted during February-April 2019. Data is collected on Lampulo Fisheries Port, Banda Aceh.

2.2 Data analysis

2.2.1 The LWRs. Analysis of LWRs was using Linear Allometric Model (LAM) refers to Muchlisin et al. [7]:

\[ W = a L^b \]  

Where: \( W \) is the body weight of fish (g), \( L \) is total length of fish (mm), \( a \) and \( b \) are equation constants.

2.2.2 The condition factor. The Fulton’s condition factor (\( K \)) and the relative weight of the condition factor (\( W_r \)) are used in this study. The Fulton condition factor was analyzed referring by Muchlisin et al. [7]:

\[ K = \frac{W L - 3}{100} \]  

Where: \( K \) is the Fulton’s condition factor, \( W \) is the body weight of fish (g), \( L \) is total length of fish (mm), \( -3 \) is a correction factor on the length coefficient which leads to number one.

The relative weight condition factor (\( W_r \)) referring by Froese [8]:

\[ W_r = \frac{W \times W_s}{100} \]  

Where: \( W_r \) is relative weight condition factor, \( W \) is the body weight of fish (g), \( W_s \) is the standard body weight of fish (g) estimated from the allometric Linear Model (LAM) who analyzed earlier.

2.2.3 The prevalence and intensity of parasite. Analysis of the prevalence and intensity of parasites carried out in this study refers to Muchlisin et al. [9]:

\[ \text{Prevalence} = \frac{\text{total infected fish}}{\text{total examined fish}} \times 100 \]

\[ \text{Intensity} = \frac{\text{total parasites}}{\text{total infected fish}} \]

3. Results and Discussions

A total of 164 fish samples were successfully analyzed in this study. The results of the analysis of LWRs were indicated that the value of \( b \) ranges from 2.47-3.13 with an average value of 2.79 (Table 1). Based on the average value of \( b \), *S. crumenophthalmus* was negative allometric growth patterns. These results were indicated that the condition of fish in wild poor of food, where growth of fish length is faster compared to body weight [10]. Furthermore, this condition can also occur because high competition between species in wild [11, 12].
Table 1. Value of $b$, determination (R), correlation (r), Fulton’s condition factor and Wr during the three months of the study

| Month   | Ind | Coefficient b | Determination R (%) | Correlation r (%) | Fulton K | Wr     |
|---------|-----|---------------|---------------------|------------------|----------|--------|
| February | 50  | 2.47          | 85.16               | 92.75            | 2.90     | 100.29 |
| March   | 63  | 3.13          | 89.49               | 93.78            | 3.01     | 100.26 |
| April   | 51  | 2.78          | 83.38               | 89.68            | 3.00     | 100.22 |
| Average | 54.67 | 2.79        | 86.01               | 92.07            | 2.97     | 100.26 |

The value of Fulton's condition factor in this study ranged from 2.90-3.01 with an average value of 2.97 (Table 1). These results was indicated that the presence of predators is still low so that the predation rate for *S. crumenophthalmus* is low in wild [13]. Furthermore, Fulton's condition factor values in this study was indicated that the condition of *S. crumenophthalmus* is still stable in wild [14, 15].

Figure 1. Linear regression LWRs of the *S. crumenophthalmus* in Lampulo Fisheries Port, Banda Aceh

The results of the analysis of relative weight condition factor (Wr) value between 100.22-100.29 with an average value reaching 100.26 (Table 1). According to Muchlisin et al. [7] that the condition of fish is said to be stable if the value of Wr> 100. This shows that fish inhabit aquatic environments where food sources are still available [16]. Thus the aquatic environment can still protect the lives of fish [17].
Figure 2. Growth pattern of *S. crumenophthalmus* in Lampulo Fisheries Port, Banda Aceh

The results of the ectoparasite inventory showed that *S. crumenophthalmus* was infected by *Anilocra* sp. from the Isopod order (Figure 3). The *Anilocra* sp. were found in the gill layer of fish samples. The average prevalence and intensity value were 4.48% and 0.04 parasite/fish (Table 2). Ectoparasites from the Isopod order (genus *Norileca*) were found to frequently infect *S. crumenophthalmus*, but the *Anilocra* genus was new in this study [18-20]. The other species of the Isopoda order which often infect fish were *Nerocila exocoeti*, *Nerocila madrasensis* and *Joryma tartoor* [21, 22]. According to Smit et al. [23] revealed that there were 95 families of the isopod order, of which 7 families were parasites such as: Gnathiidae, Tridentellidae, Bopyridae, Cryptoniscidae, Cymothoidae, Dajidae and Entoniscidae. The isopod parasites were found in the tail, gills, oral cavity, throat, the lower lip and upper head layer of fish [24].

Table 2. Prevalence and intensity of *Anilocra* sp. parasites. in *S. crumenophthalmus*

| Month     | ∑ Ind of species | ∑ Ind | Prevalence (%) | Intensity (ind/fish) |
|-----------|------------------|-------|----------------|---------------------|
| Februari  | 50               | 0     | 0              | 0                   |
| Maret     | 63               | 6     | 9.52           | 0.10                |
| April     | 51               | 2     | 3.92           | 0.04                |
| Average   | 54.67            | 2.67  | 4.48           | 0.04                |
Figure 3. *Anilocra* sp. ectoparasite, where (a) Dorsal view, (b) Ventral view and (c) Lateral view. Scala was 3 mm.

4. Conclusion

The results of the LWRs analysis show that *S. crumenophthalmus* has a negative allometric growth pattern (Average value of $b = 2.79$). The results of the Fulton’s condition factor and Wr condition factor showed that the *S. crumenophthalmus* environment was still stable. Ectoparasites that infect *S. crumenophthalmus* was *Anilocra* sp. from the order of Isopoda.

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