White-edged lyretail (*Variola albimarginata*): A preliminary study on some biological aspects

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Abstract. The groupers are among the fishes that are threatened globally due to their high economic value. However, their biological information is limited, including the white-edged lyretail (*Variola albimarginata*). The fish is considered as the least concern (LC) based on the IUCN category. The objective of the present study was to study some biological aspects of the white-edged lyretail harvested in the northern coast of Aceh. The fishes were collected in several fish landing sites (TPI) and fish market located in Banda Aceh and Aceh Besar District from June to August 2020. A total of 30 fish samples were collected in this study. The total lengths (TL) and weights (W) ranged between 14.30-36.02 cm and 33.2-581.6 g, respectively. In addition, 25 of collected fishes were female with the gonad maturity phases varied from one (1) to four (4) with the gonad index (GSI) ranged between 0.1758-2.4038. The result of this study will be valuable in developing fisheries management and conservation of the species.

1. Introduction

Grouper fish is a type of predatory fish originating from the Serranidae family with more than 160 species [1] and 39 species are found in Indonesian waters [2]. Groupers usually live in reef waters [3], do not cluster and are sedentary [4]. Grouper is a fish that has important economic value due to high market demand, not only in Indonesia but also in the world market. The distribution area of grouper fish in Indonesian waters includes the waters of Kalimantan, Sulawesi, Nusa Tenggara, Seribu Islands, Karimunjawa Islands and along the northern coast of Sumatra Island [1, 5]. Grouper fish in Aceh waters are mostly caught by fishermen in northern waters of Aceh and Simeulue Island. One of the grouper genera which has high selling value in this area is *Variola*.

White-edged lyretail *Variola albimarginata* is one of two species of the genus *Variola* found in the northern waters of Aceh [6]. Information that has been published about this species in the northern waters of Aceh includes distribution and specific genetic markers [7, 8]. Information regarding the biological aspects of this species has never been published. It is important to do to analyze the performance of fisheries biology in relation to the level of exploitation of this species. Based on the IUCN Red List categories, *V. albimarginata* was considered Least Concern (LC) category [9].
This study aims to analyze the length-weight relationship, gonad maturity distribution and gonad-index of *V. albimarginata* in the northern waters of Aceh. The results of this study are expected to be the basis for sustainable fisheries management.

2. Materials and Method

2.1. Time and location
The research was conducted from June to August 2020 in several fish landing sites and fish market located in Banda Aceh and Aceh Besar District. The fishing grounds of the groupers in the northern coast of Aceh is shown in Figure 1.

![Figure 1. Map of the fishing grounds (dashed line) of groupers in the northern coast of Aceh.](image)

2.2. Data collection
Sampling of white-edged lyretail biology was based on simple random sampling. A total 30 fish samples were collected during the research. The fish samples were captured using handlines and gill nets that operated by local fishers in the northern coast of Aceh. The total length of each individual fish was measured using a ruler with an accuracy of 1 mm and the body weight and gonad weight measured using a digital balance (Ozone Digital Kitchen Scale OX-315) with accuracy of 1 gram.

2.3. Data analysis
The Linear Allometric Model (LAM) was performed to calculate the $a$ and $b$ parameters by log-transformed weight and length measurements as follows [10]:

\[ W = e^{0.56} (aL^b), \]

where $W$ is fish weight (g), $L$ is total length of fish (mm), $a$ is the regression intercept, $b$ is regression coefficient, $e$ is the variant of residual from LAM, and 0.56 is the correction factor of the dataset. The growth pattern is isometric if $b = 3$ and allometric if $b < 3$ (allometric negative, $b < 3$, and allometric positive, $b > 3$).

The sex and gonad maturity level were identified based on the gonad morphology [11]. The gonad-index (GI) was calculated as follows [12]:

\[ GI = \left( \frac{W_g}{W} \right) \times 100\%, \]

where $W_g$ is gonad weight (g) and $W$ is fish weight (g).
3. Results and Discussion

3.1. Length-weight relationship
A total of 30 *V. albimarginata* were calculated for length-weight relationships. The total lengths ranged from 14.18 to 36.02 cm (mean 22.93 ± 4.31 cm). Weights ranged from 34 to 594 g (mean 160.71 ± 104.12 g).

The *b* value of *V. albimarginata* was 2.96 with a determination coefficient (*r*²) of 92%. The exponent *b* value irrespective of size were lower than 3 (*b* < 3), thus *V. albimarginata* could be categorized as species displaying an allometric negative growth pattern. Generally, exponent *b* value lie between 2.5 and 3.5 [13]. Population *b* value are dependent on physiological growth condition such as gonad development or food availability [14], biological and environmental condition, geographical, temporal and sampling factor [15, 16].

4. Gonad Maturity Distribution and Gonad-Index
A total of 25 from 30 sampled fish were found to be female, the other five sampled fish were categorized as unidentified gonads (UI). This is because most of the serranids are protogynous hermaphrodites, where the fish gonads undergo a differentiation process from female to male phase [17]. Hermaphrodite fish exhibit age and degree of sexual inversion, which are characteristic of a particular geographic area. Collecting grouper stocks qualitatively-quantitatively is important to study growth in relation to geographic origin and reproduction [18]. Most serranids will change sex from female to male when they reach adult size, but not all are.

The reproductive characteristics of the other three hermaphrodite grouper species studied by Coleman *et al.* [19], and Sluka and Sullivan [4] suggest that these characteristics can affect the sustainability of aquatic stocks. Some stocks of protogynous hermaphrodite grouper are much more susceptible to capture than comparable fish stocks [19-21].

Many reef fish are known to congregate in large numbers at specific times and places to reproduce. Serranids stocks are usually the reef fish stocks most susceptible to increased fishing pressure [22, 23]. Spawning aggregation sites in a number of locations in the Atlantic and Pacific Oceans have been lost due to overfishing [24].
Figure 3. Monthly gonad maturity distribution of white-edged lyretail (*Variola albimarginata*).

Gonad maturity stage of *V. albimarginata* is divided into four phases, immature (never spawned), developing (ovaries beginning to develop, but not ready to spawn), spawning capable (fish are developmentally and physiologically able to spawn in this cycle), regressing (cessation of spawning), regenerating (sexually mature, reproductively inactive) [11]. The gonad maturity level in June 2020 was dominated by phase 1 and 2, where the female gonads were in immature and developing conditions. Female fish that are mature (spawning capable) in July 2020, where all female fish samples are in that phase. 60% of female fish were found to be in developing gonads in the following month (August 2020) and the rest were in mature condition.

The gonad development is part of fish reproduction before spawning occurs. During this time, most of the metabolic processes go to gonad development. Gonad maturity phases are needed to determine the ratio of fish that will reproduce. The resulting study will also obtain information about when the fish will spawn, spawning, or have finished spawning [25, 26].

| Month | n  | Gonad-Index | Standard Error |
|-------|----|-------------|----------------|
| June  | 16 | 0.29        | 0.11           |
| July  | 4  | 3.61        | 0.98           |
| August| 5  | 0.67        | 0.24           |

The gonad-index of *V. albimarginata* females ranged between 0.006-6.52 (mean 0.90 ± 1.46). The highest GI was found in July (mean 3.61 ± 0.98) between the three months of the study. This is consistent with the results of the gonad maturity distribution, where in that month many female fish with mature (spawning capable) gonad phase were found. July is thought to be one of the spawning months for *V. albimarginata* in the northern coast of Aceh.

5. Conclusion

The growth pattern of *V. albimarginata* is allometric negative with a length range of 14.18-36.02 cm TL (mean 22.93 ± 4.31 cm) and weights range of 34-594 g (mean 160.71 ± 104.12 g). A total of 25 from 30 sampled fish were found to be female, the other five sampled fish were categorized as unidentified gonads. The domination of female regarding the serranids are protogynous hermaphrodites. The spawning season of this species is predicted on July.
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