A preliminary study on biological aspects of the orange-spotted grouper (Epinephelus coioides) harvested in the northern coast of Aceh, Indonesia

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Abstract. Considered as the least concern (LC) based on the IUCN category, the biological information of Epinephelus coioides is limited. The present study's objective was to study some biological aspects of the orange-spotted grouper harvested in the northern coast of Aceh. The fishes were collected from June - August 2020 in several fish landing sites (TPI) and fish market located in Banda Aceh and Aceh Besar district. In total, 30 fish specimens were collected in this study. The total length (TL) of the fishes ranged from 194.1-237.6 mm. Also, the weight of the fishes ranged from 100.7-176.7 g. All the collected fishes were female with the gonad maturity levels in level one (1), with the average gonad weight of 0.01 g. This study provides a reference point of some biological aspects of the orange-spotted grouper that will help develop a practical fisheries management of the species.

1. Introduction

Aceh is a province located in Indonesia's westernmost part. Aceh region is rich in marine biodiversity, e.g., coral reefs [1-4], reef fishes [5-10], macroinvertebrates [11], etc. Like other coastal regions, Aceh depends on the fisheries sector. Capture fisheries play an essential role in Aceh's fisheries, with steadily increasing production numbers every year, including grouper fisheries. The groupers are one of the highest-priced marketed reef fishes in the world due to their delicate, desirable taste and flavor [12-14]. As a result, the groupers are regarded as one of the first fish groups to be overexploited worldwide [13]. Based on the IUCN categories, out of 160 recognized grouper species globally, 60% were considered Data Deficient and Least Concern (LC) [13].

Epinephelus coioides is one of the grouper species considered as the LC category with a decreasing population [15]. The fish is widespread in the Indo-West Pacific from the Red Sea and eastward to Palau and Fiji, north to Ryukyus Islands, the Arafura Sea, and Australia [16]. Like other groupers, E. coioides had high economic value and market demand in Indonesia, including Aceh. Nevertheless, even though they are commercially important in Aceh, there is still limited information on the biological features of E. coioides, including its bio-reproduction characteristics. The absence of the initial biological information will lead their management practices to be more problematic.
There have been very few comprehensive studies of groupers in the Aceh region and its adjacent waters. Most of the studies in this region focused on the taxonomy (mostly inventory studies of the groupers). For example, [17], utilizing molecular techniques, recorded at least 18 commercially important groupers species landed in Weh Island with *Epinephelus*, was the dominant genus found. [18] also used the molecular marker to identify grouper species in Peukan Bada, Aceh Besar, and successfully authenticated eight grouper species. In addition, [19] recognized 21 grouper species landed in Peukan Bada, Aceh Besar. Another study by [20] focused on the grouper fisheries in Weh Island, and they recorded six types of fishing gear: gillnets, encircling gillnets, hand lines, purse seines, spearguns, and troll lines used to caught grouper in this region. Limited studies documented the biological aspect of groupers in Aceh, among others, the study by [21]. Hence, the present study's objective was to study some biological aspects of the orange-spotted grouper (*E. coioides*) harvested on Aceh's northern coast.

2. Materials and Method
The fishes were collected from June - August 2020 in several fish landing sites (TPI) and fish market located in Banda Aceh and Aceh Besar district (Figure 1) and identified based on [22, 23]. Some biological parameters, i.e., total length (TL), total weight (W), sex, maturity level, fecundity, etc. were obtained at Genetics and biodiversity Laboratory in the Faculty of Marine and Fisheries, Universitas Syiah Kuala. In addition, the length-Weight relationship was analyzed used the linear allometric model (LAM) following [24] and [25]. Additionally, Fulton's condition (K) and Relative weight (Wr) were calculated based on [26]. The data were presented as tables and figures.

![Figure 1](image_url). Map of the grouper fishing ground (dashed line) on the northern coast of the Aceh region.

3. Results and Discussion
In total, 30 fish specimens were collected in this study. All samples found in this study were small and young (between 194.1-237.6 mm TL and 100.7-176.7 g). Fulton's condition (K) ranged from 2.28-3.02, and relative weight ranged from 91.87-114.30 (Table 1). All the collected fishes were female with the gonad maturity levels in stage one.
Table 1. Some biological parameters of *E. coioides* harvested in Aceh's northern coast.

| Parameters                   | Min   | Max   | Average       |
|------------------------------|-------|-------|---------------|
| Total Length (mm)            | 194.1 | 237.6 | 221.6 ± 1.3   |
| Weight (g)                   | 100.7 | 176.7 | 147.5 ± 23.3  |
| Fulton’s condition (K)       | 2.28  | 3.02  | 2.52 ± 0.21   |
| Relative weight (Wr)         | 91.87 | 114.30| 100.08 ± 4.20 |

The LWRs analysis results showed that fish had a *b* value of 2.76 with a correlation coefficient of 0.94 (Figure 2a). This result indicated *E. coioides* had a negative allometric growth pattern and a strong correlation between body weight and total length. In addition, the regression models showed similar growth patterns between the observed and predicted (Figure 2b).

Figure 2. The length-weight relationships (a) and comparison of observed and predicted growth of *E. coioides* (b) harvested in Aceh's northern coast.

In general, the growth pattern resulted in this study is comparable with previous studies of several grouper species: Spotted coral grouper, *Plectropomus maculatus* (*b*= 2.9694) and Yellow-edged lyretail, *Variola Louti* (*b*= 2.4881) harvested in Berau waters, East Kalimantan [27]; *Cephalopholis boenak* (*b*=2.89), *C. sonnerati* (*b*=2.98), *C. urodeta* (*b*=2.94), *Epinephelus caeruleopunctatus* (*b*=2.92) from Inshore Waters of Kenya [28]; Leopard coral grouper, *P. leopar dus* (*b*=2.6264), Blacksaddled coral grouper, *P. laevis* (*b*=2.872), Brown-marbled grouper, *E. fuscoguttatus* (*b*=2.847) and Duskytail grouper, *E. bleekeri* (*b*=2.847) fished in northern Aceh [21]; whitespotted grouper, *E. coeruleopunctatus* (*b*=2.84 for male and *b*=2.86 for female) harvested in the coastal waters of Padang City, Indonesia [29]; and several other marine fishes: Largescale mullet, *Liza macrolepis* (*b*= 2.49) from Lambada Lhok waters in Aceh Besar, Indonesia [30]. Several factors, such as environmental conditions, seasons, fish behavior, etc., could be associated with the growth pattern [25, 30].

In addition, the average Fulton's condition factor was higher than 1 (2.79 ± 1.10) and similar to earlier grouper studies [21, 29]. Additionally, the K value found in this study is higher than the White grouper, *E. aeneus* from the south-west coast of Senegal, West Africa (1.212-1.361) [31]; and other marine species: Largescale mullet, *Liza macrolepis* (1.16-1.22) and *M. engeli* (1.03 to 1.09) from Lambada Lhok waters in Aceh Besar, Indonesia [30]; and Skipjack tuna (*Katsuwonus pelamis*) fished in the western and central Pacific Ocean (1.3-1.84)[32]. Furthermore, the average relative weight was above 100 (100.08± 4.20). These results indicated that the grouper harvested in Aceh's northern coast were in excellent health [26]. Also, the region is still providing enough food for the orange-spotted grouper.
Aceh's northern coast is endowed by a healthy coral reefs ecosystem [2, 3]. Most groupers are reef-associated fishes [22, 23]. Like other reef-associated fishes, their lives also depend on the coral reefs condition. A healthy reef ecosystem provides food, protected, and spawning areas for fish and various other marine organisms [33]. In a study in Negros Oriental, central Philippines, [34], the fish biomass in the healthy reef sites was five-fold higher than poor condition reef sites.

Finally, the current study's data will be useful in developing a practical fisheries management of the orange-spotted grouper (E. coioides) in on Aceh's northern coast and can be used for reference information for future studies.

4. Conclusions
This study is providing baseline data of some biological aspects of the orange-spotted grouper (E. coioides). The results of this study showed that E. coioides had a negative allometric growth pattern. The average Fulton's condition and the average relative weight showed that the E. coioides were in good condition, indicating that Aceh's northern coast is a suitable habitat for the fish.

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