

SIZE DISTRIBUTION AND MATURITY OF THE SLIMEHEADS (*Hoplostethus crassispinus*) IN THE DEEP SEA AROUND SIMEULEU ISLAND, WESTERN SUMATERA, EASTERN INDIAN OCEAN

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ABSTRACT

The slimeheads (*Hoplostethus* spp.) provide one of the likely economic important deep sea demersal fish resources in the near future. The fish was caught in western part of Sumatera, in the depth of more than 500 m deep, and was found in substantial amount in the deep waters around Simeuleu Island and the western off Banda Aceh. Data analysis was limited to the biological aspects, including length relationship, and maturity. Total length relationships with both standard length and weight as well as condition factor ($K=(W/L^3)*10^2$) were explored. Identification of length of first maturity (L_m) was also attempted. From the length distribution figure, it is likely that the slimeheads population consisted of one strong cohort. However, when it is separated, both the female, and male cohorts are likely consisted of two age groups. The female cohorts were represented by the length groups of approximately 31 and 39 cm, while the male cohorts by the length groups of 33 and 38 cm length. It is found that the length of first maturity was $L_m=31.9$ (32.0) cm. The total length (TL) and fork length (FL) relationship followed the equation of: $FL=0.821 TL-5.0706$ (FL and TL in mm). The LW relationship followed the equation: $W=0.0242 TL^{2.9065}$ (W in grs, TL in cm). Length and gonad weight (Wg) relationship followed the power equation: $Wg=0.000004 TL^{4.1278}$ (Wg in grs, TL in mm), while the condition factors of the individual fish during this period ranging from 1.2 to 1.9. Exploitation of the slimeheads resources should consider the L_m factor. It suggest that the size of fish caught should be bigger than the size of L_m , so that the fish stock could hopefully be exploited sustainably.

KEYWORDS: size distribution, first maturity, length relationship, slimeheads, Western Sumatera, Eastern Indian Ocean

INTRODUCTION

The slimeheads (*Hoplostethus* spp.) provide one of the likely economic important deep sea demersal fish resources in the near future. The fish were caught in western part of Sumatera, in the depth of more than 500 m deep, and found in substantial amount in the waters around Simeuleu and the western of Banda Aceh (Anonymous, 2006). In the southern part of the Australian waters, the so called orange roughy (*Hoplostethus atlanticus*) provide the similar deep sea fish resources that have been commercially exploited (Anonymous, 1989; 1992), but until recently, in the waters of western Sumatera there has been no fishing activity targetting on the slimeheads resources. One of the differences between these two species is in their individual size where the orange roughy reaching to about 4.5 kg, while the slimeheads during this survey was around 2.0 kg. It seems that the average size of slimeheads in the western Sumatera was smaller than the orange roughy found in Australian waters. While the Australian orange roughy fishery provide the deep sea trawl fisheries where fishing activities carried out at 800 to 1500 m deep, the slimeheads in the waters of western Sumatera would likely provide the shallower fishery, as

these resources were caught in substantial amount at the depth zone of 500 to 1,000 m.

In relation with the environmental aspects such as the very huge pressure and scarcity of food supply, it is likely that the deep sea fishes having a very high sustainment for survive. In this aspect, the chemical substances of their flesh, such as proteins, lipids, and other biochemical substances will need further pharmacological laboratory research, analysis, and application. Preliminary results of analyses shows that the slimeheads, *Hoplostethus crassispinus* containing 23.4% proteins, 4.1% fats, 0% carbohydrates, 2.1% ashes, and 70.4% water (Suseno *et al.*, 2007). It was also reported that 17 amino acids consisted of nine essential amino acids and eight non essential amino acids have been identified and high concentration of steroid components was found in the flesh of this species. It is likely that the slimeheads resources provide one of the unconventional fish resources that having prospect to be exploited in the near future. As it has been advised that exploitation of deep sea fish resources now days could hopefully be directed to get the benefit from the fish resources biodiversity and bioactive substances rather than catching fishes for direct human consumption (Badrudin *et al.*, 2006).

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This paper describes some biological aspects of the slimeheads (*Hoplostethus crassispinus*) including length distributions, maturity, and its relationships. Determination of length at first maturity provides one of the important aspects in fisheries management. Information obtained could hopefully provide additional aspects that should be considered for the exploitation and management of the resources in the framework of gaining a continuing flow of products and income for an indefinite period. It is mandatory that any fish resources exploitation apply a certain measure that each individual fish caught has reached a certain size at which the fish has spawned at least once during their reproductive cycles. With this measure it is expected that the parental stocks can be maintained at a sufficient level to support their reproductive capacity. The size of parental stock usually varies in its significance as a determinant of future stock size.

MATERIALS AND METHODS

Data of this species were parts of the results of the demersal fish resources exploratory trawling using the R/V Baruna Jaya IV, carried out in the framework of the Japan-Indonesia deep sea fisheries resources joint exploration marine research 2004, in the Western Sumatera of the Eastern Indian Ocean (Anonymous, 2006). Exploratory fishing covered the depth range of 250 to 1,000 m, while data analysis in this paper was limited only to the biological aspects of the slimeheads (*Hoplostethus crassispinus*). These include the relationship between total and standard length, length and weight, and sexual maturity. Total length relationships with both standard length and weight as well as condition factor ($K=(W/L^3)*10^2$) have been explored following the methods in biology of fish growth

(Iles, 1989; Weatherley & Gill, 1987). Maturity stage of female fish were grouped into five points, of which the stage III, IV, and V were considered as mature. The description of each point of maturity following Isa *et al.* (2002) and are described in Table 3 (Appendix 2). Length of first maturity (L_m) was calculated following the procedures explained by Udupa (1986) as presented in Table 4 (Appendix 2). The stomach content analysis was only limited to the method of the frequency of occurrence.

RESULTS AND DISCUSSION

The Species

Hoplostethus crassispinus belong to the family Trachichthyidae. According to Nakabo (2002), this family consisted of three genera; *Aulotrachichthys*, *Gephyroberix*, and *Hoplostethus*. The pictorial keys to the species are: Dorsal with six spines and 13 fins; Anal with three spines and 9 to 10 fins; pectoral with 16 to 17 fins; and linea lateralis with 27 to 29 scales (D VI, 13; A III, 9 to 10; P₁ 16 to 17; LL 27 to 29). Munro (1955), described the morphology of the family as follows: Body fairly deep, moderately compressed. Head large, with thin surface bones bearing bony ridges bordering mucous canals. Fins with few spines but body rough. Other recorded species within the genus *Hoplostethus* in both references are *H. crassispinus*, *H. rubellopterus*, *H. mediteranus*, *H. melanopus*, *H. Japonicus*, and *H. atlanticus*. The first four species have been found in the deep waters of the Indian Ocean, the fifth in the waters of Japan while the sixth species has found and commercially exploited in the deep waters of the southeast Australia, which is well known as *orange roughy*.

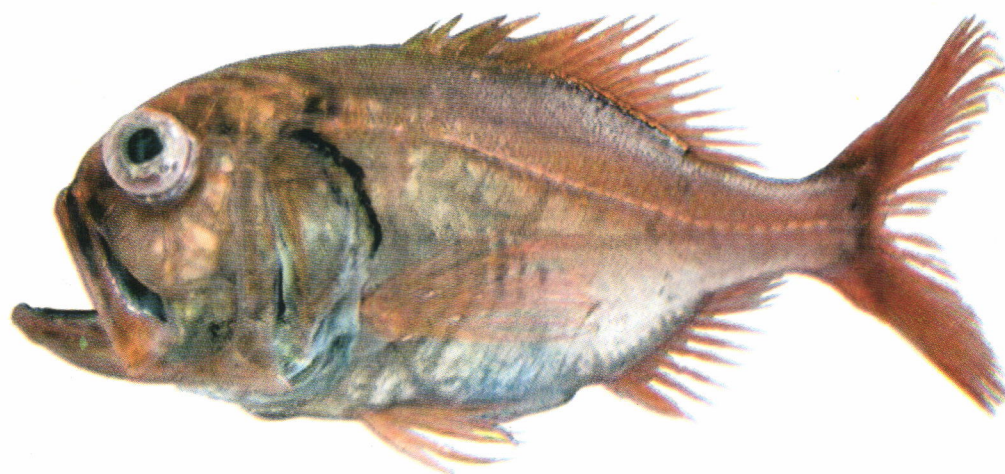


Figure 1. The slimeheads (*H. crassispinus*); (L=38 cm, W=690 g).

Length Distribution

From a total of 102 fish sampled consisted of 57 female and 45 male, ranging from 18 to 47 cm, it was found that the length distribution of total fish caught consisted of one strong mode (Figure 1, Table 1 and 2, Appendix 1). Differ with the shallow water demersal fish such as pony fish (*Leiognathus splendens*) reported by Badrudin (1987), silver biddy (*Pentaprion longimanus*)

(Badrudin & Sudradjat, 1978), and goat fish (*Upeneus sulphureus*) (Beck & Sudradjat, 1978) where the fish sampled consisted of several cohorts, it is likely that the deep sea fish of slimeheads sampled consisted of one strong cohort. However, when the length distribution is separated, both the female, and male cohorts are likely consisted of two age groups (Figure 2). The female cohorts were represented by the length groups of approximately 31 and 39 cm, while the male cohorts by the length group of 33 and 38 cm length.

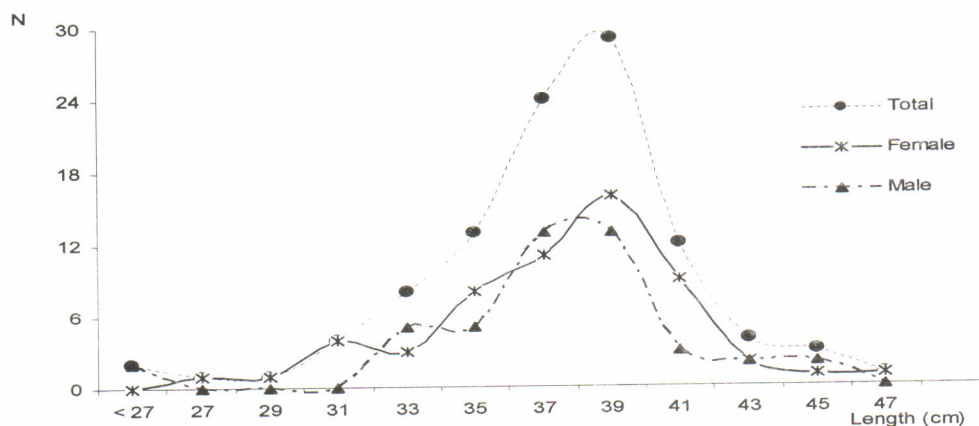


Figure 2. Length frequency distribution of the slimeheads (*H. crassispinus*) sampled in the waters around Simeuleu, Western Sumatera, Eastern Indian Ocean.

Length of First Maturity

Length of first maturity (Lm) is defined as length group or class at which 50% of the fish in that group already mature. Identification of length of first maturity was only based on female slimeheads. From a number of 57 female fish sampled, 12 individuals fish were immature and 45 were mature.

Based on the Lm calculations (Table 4, Appendix 2), it is found that the length of first maturity of the slimeheads in the waters around Simeuleu was Lm=31.9 (32.0) cm, with 95% confidence limits of 30.1 to 33.7 cm total length. In connection with fishery management, exploitation of the slimeheads resources, Lm factor should hopefully be considered in determining the fishing method and technique to be applied. It is suggested that the size of fish caught would be bigger than the size of Lm, so that to ensure the sustainability of the fish stock.

Length Relationships

Relationship between total length and fork length, total length and weight as well as total length and gonad weight of the slimeheads (*H. crassispinus*) sampled in the waters around Simeuleu have been explored. With this relationship one can estimates any parameter in relation with the total length or vice versa. The total length (TL-mm) and fork length (FL-mm) relationship of the slimeheads followed the equation of $FL=0.821 TL-5.0706$ ($R^2=0.954$). The relationship forming a linear regression with a very high correlation coefficient. Length (L) and weight (W) relationship of most fish followed the power equation of $W=a L^b$. The LW relationship of the slimeheads in the waters around Simeuleu followed the equation $W=0.0242 TL^{2.9065}$ ($R^2=0.893$), where W in g and TL in cm. It is likely that the growth pattern of this fish was almost isometric, where $b \approx 3$. As in the LW relationship, the length and gonad weight (Wg) relationship also followed the power equation $Wg=0.000004 TL^{4.1278}$ ($R^2=0.748$), where W in g and TL in mm.

Condition Factor

The condition factor (K) of the fish ranging from 1.2 to 1.9 (Tabel 5, Appendix 3). Condition is described as a morphometric interpretation of a fish's plumpness as compared to the population mean. Condition is a useful measure of assessing the physiological state of a fish. The mass of all major body constituent with the exception for the inorganic compounds, must decrease with a decline in condition. The equation of condition factor emphasizes the fact that the total condition factor of an individual fish can be affected by any independent changes that may occur in individual component. Conversely, any change in the total condition factor cannot be interpreted as a change in any single

component unless those in other component can also be accounted for.

According to Weatherley & Gill (1987), the procedure of K determination has been utilized effectively in three kind of population analysis. The first, in comparing two or more conspecific populations living either under similar, or different, conditions of food, density, climate etc. The second, in determining the timing and duration of gonad maturation, and the third in following the gradual build up or decline of feeding activity over an extended period, or of population changes possibly attributable to alterations in the food supply, condition change may be found to reflect fairly faithfully the change in body protein content and (especially) lipid content that occur.

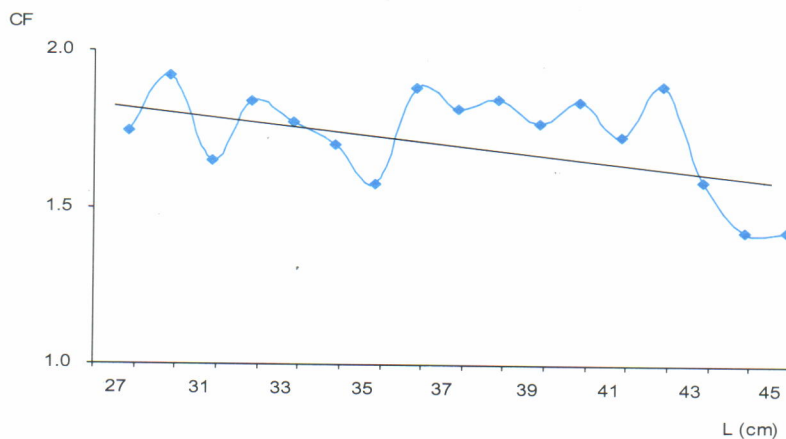


Figure 3. Plot of condition factor (CF) againsts total length (TL) of slimeheads (*H. crassispinus*) sampled in the waters around Simeuleu, Western Sumatera, Eastern Indian Ocean.

It is likely that the trend of condition factor (Figure 3) is decreasing toward the bigger size of the fish. This was consistent with Caulton (1982), that the mass of all major body constituent with the exception for the inorganic compounds, must decrease with a decline in condition. In connection with the $L_m=32$ cm, it is clear that this size is correspond to the second peak of the CF graph. With this situation, catching fish at this point (size>32 cm) will give opportunity for fish to spawn at least once or twice prior to be finally fished or caught.

Stomach Content

From a stomach content analysis it is possible to identify an inter ecological relationships between the fish itself and organisms found in their stomach. By using the frequency of occurrence it was found that the food habit of the slimeheads mainly consisted of other fish, shrimp, and worms. The percentage of these food items were paralepididae 12.2%, benthodesmus 2.7%, unidentified fish 27%, shrimp 20.3%, worms 35.1%, and

squids 2.7%. From these figure it is likely that the slimeheads provide a demersal predator fish.

CONCLUSION

The slimeheads (*Hoplostethus* spp.) provide one of the likely economic important deep sea fish resources found in substantial amount in the deep waters around Simeuleu Island to the western of Banda Aceh. Both the female and male cohorts of the slimeheads population consisted of two age groups. The female cohorts were represented by the length groups of approximately 31 and 39 cm, while the male cohorts by the length groups of 33 and 38 cm length. The condition factor of the fish ranging from 1.2 to 1.9. It was found that the length of first maturity was $L_m=31.9$ (32.0) cm. It is suggested that the size of fish caught should be bigger than the size of L_m , so that the fish stock could hopefully be exploited sustainably.

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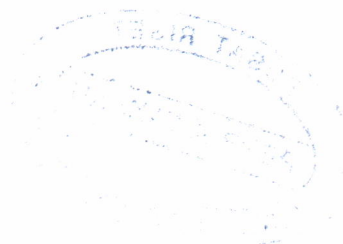
Appendix 1.

Table 1. Length frequency distribution of male and female of the slimeheads (*Hoplostethus crassispinus*)

Length group	Mid length	No.sample	Female	Male
<26	<27	2		2
26-28	27	1	1	-
28-30	29	1	1	-
30-32	31	4	4	-
32-34	33	8	3	5
34-36	35	13	8	5
36-38	37	24	11	13
38-40	39	29	16	13
40-42	41	12	9	3
42-44	43	4	2	2
44-46	45	3	1	2
46-48	47	1	1	
Total		102	57	45
%		100	56	44

Table 2. Number of mature and immature female slimeheads (*H. crassispinus*) sampled in the waters around Simeule, Western Sumatera, Eastern Indian Ocean

Length group	Mid Length	No.sample	Immature	Fully mature
26-28	27	1	1	-
28-30	29	1	1	-
30-32	31	4	3	1
32-34	33	3	2	1
34-36	35	8	5	3
36-38	37	11	-	11
38-40	39	16	-	16
40-42	41	9	-	9
42-44	43	2	-	2
44-46	45	1	-	1
46-48	47	1	-	1
Total		57	12	45
%		100	21	79



Appendix 2.

Table 3. Five point maturity scale for partial spawners (Isa et al., 2002)

Stage	State	Description
I	Immature	Ovary and testis about 1/3 length of body cavity. Ovaries pinkish, translucent; testis whitish. Ova not visible to naked eye.
II	Maturing	Ovary and testis about ½ length of body cavity. Ovary pinkish, translucent; testis whitish, more, or less symmetrical. Ova not visible to naked eye.
III	Ripening	Ovary and testis is about 2/3 length of body cavity. Ovary pinkish yellow colour with granular appearance, testis whitish to creamy. No transparent or translucent ova visible.
IV	Ripe	Ovary and testis from 2/3 to full length of body cavity. Ovary orange pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish creamy soft.
V	Spent	Ovary and testis shrunken to about ½ length of body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe ova, darkened, or translucent. Testis blood shot and flabby.

Table 4. Calculation procedures for the estimation of length at first maturity (Lm) of slimeheads, *Hoplostethus crassispinus* (Udupa, 1986)

Length group	Mid length	Log mid length	No. sample	Immature	Fully mature	% fully mature	Xi+1-Xi=X	qi=1-pi	pi.qi/ni-1
		(Xi)	(ni)			(ri)	(pi)		
26-28	27	1.4314	1	1					
28-30	29	1.4624	1	1			0.0310		
30-32	31	1.4914	4	3	1	0.250	0.0290	0.750	0.0625
32-34	33	1.5185	3	2	1	0.330	0.0272	0.670	0.0737
34-36	35	1.5441	8	5	3	0.375	0.0256	0.625	0.0335
36-38	37	1.5682 ¹⁾	11		11	1.000	0.0241		
38-40	39	1.5911	16		16				
40-42	41	1.6128	9		9				
42-44	43	1.6335	2		2				
44-46	45	1.6532	1		1				
46-48	47	1.6721	1		1				
			57	12	45	1.955	0.03		0.1697

Remarks: ¹⁾ Last log size at which 100% fully mature
 $m = 1.5682 + (0.03/2) - (0.03 * 1.955)$
 $m = 1.5034$
 Antilog (1.5034) = 31.87 cm → Lm = 31.9 cm
 95% Confidence limits
 Upper limit: Antilog (1.5034 + 1.96 * (0.03 * 0.1697)) = 33.7
 Lower limit: Antilog (1.5034 - 1.96 * (0.03 * 0.1697)) = 30.1



Appendix 3.

Table 5. Calculated condition factor for each length of individual fish and its mean

L (cm)	CF	L (cm)	CF	L (cm)	CF
18	1.715	36	1.758	39	1.575
18	1.742	36	1.747	39	1.829
Mean	1.73	36	1.507	39	1.758
		36	2.068	39	1.905
27	1.73	36	2.025	39	1.956
		36	1.865	39	1.618
30	1.581	36	1.960	39	1.694
30	2.438	36	2.139	39	1.585
30	1.685	36	1.629	39	1.875
Mean	1.901	Mean	1.86	39	1.585
				39	1.551
31	1.544	37	1.797	39	1.888
31	1.711	37	1.678	39	1.913
Mean	1.628	37	1.945	39	1.644
		37	1.589	Mean	1.74
32	1.801	37	1.885		
32	1.846	37	1.964	40	1.719
Mean	1.82	37	1.767	40	1.786
		37	1.912	40	1.737
33	1.763	37	1.873	40	1.961
33	1.864	37	1.826	40	1.786
33	1.686	37	1.885	40	1.634
33	1.664	37	1.441	40	1.883
33	1.795	37	1.895	40	2.001
Mean	1.75	37	1.579	40	1.881
		37	1.846	40	1.688
34	1.438	Mean	1.79	Mean	1.81
34	1.593				
34	1.845	38	2.123	41	1.763
34	1.641	38	2.114	41	1.553
34	1.908	38	1.859	41	1.821
Mean	1.68	38	1.659	41	1.654
		38	1.863	Mean	1.70
35	1.563	38	1.841		
35	1.563	38	1.658	42	1.667
35	1.749	38	1.904	42	1.795
35	1.726	38	1.658	42	2.119
35	1.294	38	1.813	Mean	1.86
35	1.889	38	1.555		
35	1.120	38	1.750	43	1.55
35	1.458	38	1.832		
Mean	1.55	38	1.857	44	0.998
		Mean	1.82	44	1.779
46	1.39			Mean	1.39