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NOTES ON FOOD, GROWTH AND REPRODUCTION OF *HOMALOPTERA AMPHISQUAMATA* (WEBER and DE BEAUFORT), (BALITORIDAE) FROM ALAS RIVER, ACEH, SUMATRA ISLAND

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Abstract

Approximately 253 specimens of freshwater fish Homaloptera amphisquamata *(Weber and de Beaufort) were collected during dry and rainy seasons from the upper reached of Alas river, Sumatra island in 1981-1983. Their food, growth and reproduction were studied. Phytoplanktonic algae, especially Bacillariophyceae and small aquatic insects are their food preference. The growth pattern was different between sex, that is allometric for the male and isometric for the female.*

Relatively, there is no difference of condition factor between sex (0.850 for the male and 0.848 for the female). However, the values were different between seasons. The mixed value in average was around 0.934 in rainy season and around 0.775 in dry season. Total fecundity highly varied from 63 up to 470 or 93 in average. The bigger size of the fish tended to show higher fecundity value. The percentage number of matured gonads during the rainy season was 8.89-22.55 % and in dry season was 8.21-18.33%. The diameter of matured eggs was around 2.01 mm in average.

Introduction

Homaloptera amphisquamata (Weber and de Beaufort), which is regarded as synonym of *H. gymnogaster* by Kottelat *et al.* (1993) is a small fish species which is found living in Sumatra island, especially at the shallow part of the upper reaches of several rivers, where the current is swifty or torrential and the bottom is gravelly, stony and sandy and the water temperature is a little bit cold. Local name is 'ikan ili'. During our study of fish fauna of Alas river and its tributaries at the surrounding of Ketambe Research Station, Gunung Leuser National Park, Sumatra island in 1981-1983, 253 specimens were collected for inventory purpose and for ecological as well as biological studies. Although the species has been scientifically known since the second decade of this century, their biological aspects have never been reported. This report provides some results of studies on its biological aspects, especially their food, growth and reproduction in their natural habitat.

Materials and Methods

The specimens were collected during the rainy and dry seasons by a dipnet and special designed V-trap of small size mesh (0.3 cm in diameter). Their total length was measured in mm and their weight in gram by using Triple Beam Balance of 0.01 g smallest scale. The specimens were then dissected, their gonad maturity stages were identified following Nikolsky (1963), each weight of gonad was measured in gram and each matured female gonads was collected to be preserved in Gilson solution. Each gut was tied up at both its inlet and outlet to be cut and preserved in 4 % formaldehyde solution.

Further analysis on morphological characters were done at the laboratory. The egg diameters were measured in mm under Camera Lucida, type 256575 Wild M3 of 10x16 magnification.The diameter was easily measured from its magnification which has been drawn on a piece of paper. The volume of the mixed food items was measured by water replacement principle, following Wirjoatmodjo (1980), by applying a plastic injection syringe and a pipette of 0.01 cc which were connected to a U-shape elastic plastic tube.

The volume of each food item was estimated under monocular Olympus stereo microscope of 10x10 magnification. The gut contents were diluted in water up to 10x and homogenized. About 0.05 cc was taken three times and observed on an object glass under the microscope. Observations were done at 5 objective fields. The estimated volume of food item was based on the ratio between the total size of each food item and the size of all total food items seen at the objective field, with assumption that the thickness of all food items on the object glass was similar.

Identification of food items was based on Smith (1950), Davis (1955), Edmonson (1959), Vashishta (1981), Fritsch (1961), Needham and Needham (1963) and Pennak (1971). Food preference identification was made by using Index of Preponderance of Natarajan and Jhingran (1961) by combining the procentage values of volume and frequency of occurrence in the following formula:

$$IP_i = \frac{V_i \times Occ_i}{\sum_{i=1}^{i=n} V_i \times Occ_i} \times 100\%$$

Where V_i is % volume of each food organism from sample unit (gut content); Occ_i is % frequency of occurrence from sample unit; $\sum V_i\ Occ_i$ is total $V_i \times Occ_i$ of all food organism found in the sample unit.

The values of IP were classified as 'main food', 'substitution food' and 'additional food' (Nikolsky, 1969). The fatness or well being was expressed as 'Condition Factor' and estimated by applying Hile's formula (Weatherly, 1972) as written below:

$$K = \frac{W}{L^3} \times 10^5$$

Where: K is condition factor; W is the weight of fish ; L is the length of fish

Test for the difference of values was based on Steel and Torrie (1960). The length weight relationship was determined by log-log regression which usually gave good fit to the data (see Ricker, 1975 and Bagenal, 1978). The formula is:

$$\text{Log } W = \log a + b \log L$$

Where log *a* is intercept and *b* is regression Coefficient.

Significant test was based on Steel and Torrie (1960) or Parker (1973). Gonad maturity was estimated by GonadoSomatic Index or GSI following Htun Han (1978) in Wirjoatmodjo (1980). The formula is :

$$GSI = \frac{W_g}{W_f} \times 100\%$$

Where W_g is the weight of gonad and W_f is the weight of the fish.

General description and habitat

H. amphisquamata is a small size fish. The adult is about 110 cm total length 12 g in weight. Based on Weber and de Beaufort (1916) the head length is 5.5-5.6 in total length, the head width is 4-5 in total length. The fin formula is D 3.7, A 3.5, P 6.9, V 3.6. The dorsal profile of head and body is rounded, abdominal side is flat, a pair of maxillary barble on the corner of mouth and other two pairs on snout and lateral line scales 70-73. Eight or more dark grey blotches, along the dorsal side of head and body.

The species is living in relatively clean, moderate to fast current and a bit cold water (19°-21° C), where the river bottom is stony and gravelly. Some chemical character of water during the dry and rainy seasons were: dissolved O_2 9.9-10.8 mg/1iter, PO_4 1.86-2.15 mg/liter, Ca as $CaCO_3$ 41.6-52.6 mg/liter and pH 6.0-6.2 (Wirjoatmodjo, 1987).

Thirty two species of aquatic insects have been recorded living in this river system and its surrounding small tributaries, covering:18 families: *Tabanidae, Baetidae, Chironomidae, Hydropsichidae, Naucoridae, Blattidae, Rhagionidae, Scoliidae, Psephenidae, Corydalidae, Libellulidae, Gyrinidae, Elmidae, Ephemeridae, Agrionidae, Perlidae, Veliidae* and *Elatridae (*Wirjoatmodjo and Hanna-Atmowidjojo, 1985*). In* addition there were about 33 plankton species (Algae) dominated by *Cymbellla, Navicula, Amphora, Nitzchia, Pinularia, Fragillaria, Melosira, Diatoma, Cladophora, Spirulina, Cyclotela, Diploneis, Oscillatoria, Nostoc,* and *Eunotia* (Wirjoatmodjo, 1987).

Results and Discussion

a. Natural food

The food items were analysed from 34 guts of fish in which 50% were female. The size of fish specimens was variable (27.9-70 mm total length and 0.3-3.5 g weight). Identification of food items from the gut content gave results several species of phytoplankton which belong to the family Bacillariophyceae and Chlorophyceae and also several species of aquatic insects which belong to the ordo Ephemeroptera, Trichoptera and Diptera. The remaining consisted of fragments of Unidentified aquatic insects, annellids and plants, as well as sands and detritus.

Table 1 shows the kinds of food items which were consist of phytoplankton and aquatic insect and their corresponding values of Preponderance Index. (IP). The values of IP were classified roughly into three groups:

- main food : if the IP value is 25% or more
- substitution food : if the IP value is 5-24%
- accidental food : if the IP value less than 5%

Table 1. Food items in *H. amphisquamata's* gut content and its corresponding value of IP.

Group of food items	Index of preponderance value (%)		
Phytoplankton	42.98		
-Bacillariophyceae		41.62	
Amphora			0.08
Navicula			4.05
Nitzchia			6.25
Sinedra			2.86
Cocconeis			15.14
Cymbella			0.06
Fragillaria			7.21
Bacillaria			3.85
Stauroneis			0.38
Diploneis			0.32
Diatonia			0.08
Denticula			0.23
-Chlorophyceae		1.96	
Cladophora			1.85
Stigeoclonium			0.11
Aquatic insect :	27.67		
-Chironomidae		17.51	
-Hydropsychidae		9.11	
-Ephemeropteridae		1.05	
Nematode	0.35		
Unidentified materials:			
-insect/animal fragment	16.24		
-plant fragment	0.97		
-detritus	11.43		
Sand/soil	0.26		

At species or genera level, none of the food item can be classified as main food. But at family level, Bacillariophyceae was the main food item (41.6%), followed by aquatic insect Chironomidae (17.5%) and Hydropsychidae (9.1%) as substitution food. However, the relatively high value for unidentified insect fragments (16.2%) and the identified ones at family level as a whole may be also indicating possibility of certain insect family as main food. Detritus (11.4%) was likely another secondary or substitution food, because there were also many detritus at the river bottom. Inger and Chin (1962) found larva of aquatic insect in the gut of Homalopterid species.

Table 2 shows the IP values based on different sex. A small difference of IP values between the male and the female can be seen. However, groups of food item preference in general is similar The male tended to eat phytoplankton and aquatic insect lesser than the female. If this is true, the possible reason may be due to the females need more energy to grow and gonad maturation. As to Bacillariophyceae, Synedra was the most important food for both sexes (13.7% for the male, 14.6% for the female), followed respectively by *Cymbella, Amphora* and *Navicula* for the male (10.1%, 6.1%, 4.0%) and *Navicula, Flagillaria, Cymbella* and *Nitzchia* for the female (7.6%, 5.4%, 4.9% and 4.3%).

Table 2. IP values for different sexes of *H. amphisquamata*

Groups of food items	IP Values (%)	
	Male	Female
Bacillariophyceae	38.64	42.16
Chlorophyceae	0.54	3.23
Identified family level of insect	26.26	29.67
Nematode	0.77	-
Unidentified fragment of aquatic insect	10.89	22.99
Unidentified fragment of aquatic plant	1.70	-
Detritus	9.11	13.56
Soil and sand particles	-	0.50

Table 3 shows the IP values based on the gonad maturity stages. The values show clearly no corellation between food preference and gonad maturation stages. The relatively high values of IP of the identified and non identified aquatic insects as food items at all level of gonad maturation which was also shown by Bacillariophyceae indicating that these group of organisms are very important for the survival of the fish species under studied. At all stages of gonad maturity, Bacillariophyceae was dominating as the main food item followed by aquatic insect and detritus. As to Chlorophyceae, Nematode, fragment of aquatic plant and soil or sand particles were eaten accidently. However, further study is needed to find out the real food preference, whether or not the fish selects food organisms. To understand this matter, population study of the existing phytoplanktons/ algae and aquatic insects should be done in order to compare the results with the existing food item in the gut.

Sahlan (1982) stated that the existing large number of organic waste (detritus) in river system may cause the increase of population of Bacillariophyceae species. Detritus is also food recource of many aquatic insects and other species of fish in the study area, e.g. *Glyptothorax major, Rasbora lateristriata* and others.

Table 3. The values of IP for different of gonad maturity of *H. amphisquamata*

Groups of food items	IP values at level of gonad maturity				
	I	II	III	IV	V
Bacillariophyceae	30.37	42.86	42.58	38.74	41.95
Chlorophyceae	-	0.75	4.77	0.46	0.40
Identified aquatic insect	32.40	22.65	25.98	34.87	27.98
Nematode	-	1.09	-	-	-
Unidentified fragment of aquatic insect	16.07	23.05	6.69	13.61	26.63
Unidentified fragment of aquatic plant	-	0.83	1.56	-	-
Detritus	15.16	8.77	14.59	12.18	3.05
Soil and sand particles	-	-	0.81	-	-

b. The Growth

b.1. Length-weight relationship

The regression analysis of different sex gave the following results:

The male, Log W= - 3.739 + 2.202 log L Correlation value (r) is 0.78
The female, Log W= - 5.521 + 3.124 Log L Correlation value (r) is 0.88

Both the correlation and regression values (r and b) for the male are lower than those of the female. Nevertheless the value for the male is still showing good length-weight relationship in log form. The significance of the regression equation was tested by regression ANOVA analysis (Campbell, 1975). The result for the male was very significant (F= 264, $F_{1/159}$ = 6.63), and for the female was also very significant (F= 303.3967, $F_{1/90}$= 7.08). Covariance analysis for the two regression equations gave result that the two equations are significantly different in term of regression coefficient (b), (F=16.52 versus $F_{0.05}$=3.84). That is meant for the same length of the male and the female fish, their weight are different. The lower value of slope or b for the male is meant that for a given length of the fish, its weight is lower than that in the female. The t-test of b value for the difference from three gave result of significantly different for the male (t = 5.8945; $t_{0.95:160}$=1.96). This means that the male shows allometrical type of growth. However the b value for the female is not significantly different from 3, that means showing isometrical type of growth (t= 0.689; $t_{0.05:91}$= 1.98), or the growth in length is in balance to the growth in weight. The scattered diagram of these both male and female length-weight regression equations are shown on figure 1. Hickling (1971) stated that the growth in weight of the fish is influenced by the quality and abundance of the food items, and Ricker (1975) also stated that it is also influenced by the time of the year and gonad maturity stage. It is therefore, the regression equation could also slightly change with the time of sampling because the abundance of algae (phytoplankton) and aquatic insect was usually found in certain months of the year, which is usually also due to the change of water quality.

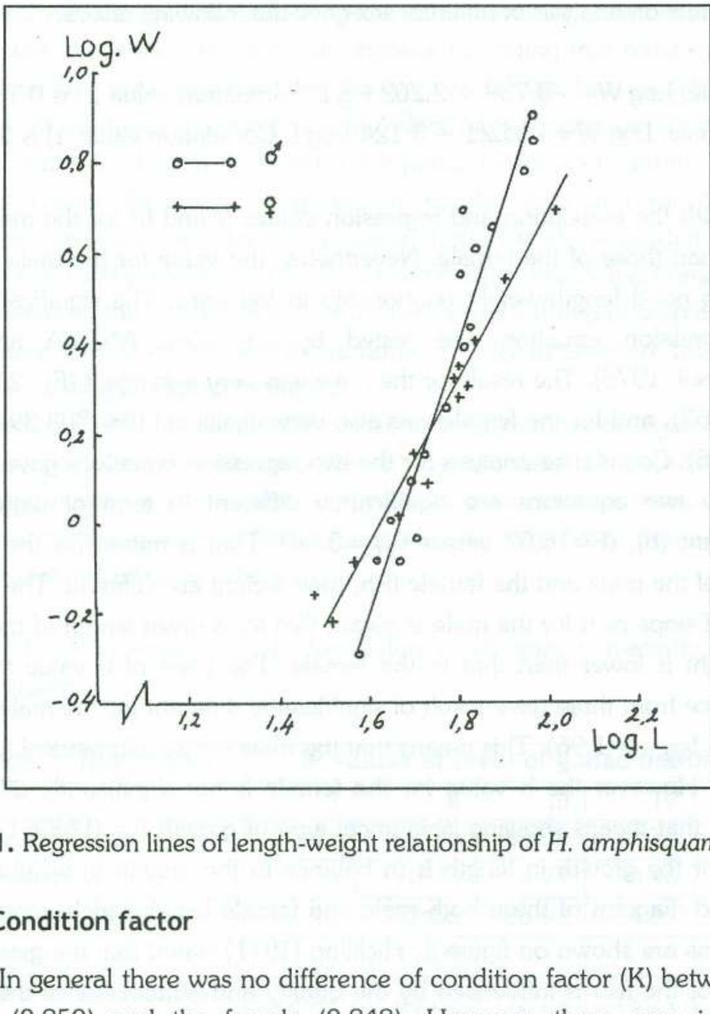

Fig. 1. Regression lines of length-weight relationship of *H. amphisquamata:*

b.2.Condition factor

In general there was no difference of condition factor (K) between the male (0.850) and the female (0.848). However, there was significant different of K between seasons. The average value of K for the mixed male and female specimens was 0.924 in rainy season and 0.775 in dry season, or thinner during the dry season and fatter during the rainy season. This is likely due to more specimens with matured gonad during the rainy season, as we can see in later chapter. Significant test for the difference of K between sexes and between seasons gave results $F_{(between\ sexes)} = 0.3773$ (not significant) and $F_{(between\ seaons)} = 21.9773$ (significant at P 99%; $F_{0.01} = 6.63$). Condition factor can be influenced by the abundance of the food items, gonad maturity stage and physical or chemical change of environmental quality. The K values usually decline after spawning time.

c. Reproduction

c.1. Gonad maturity

Mature gonads were found both during the dry and the rainy seasons, Chi-square test for the difference of the existing gonad maturation between seasons gave no significant result ($X^2 = 1.96$; $X^2_{table:\ 0.05} = 5.99$). Based on 120 specimens from 3 sample units in the dry season and 55.2% specimens in the rainy season were already matured condition at stage III-V. From the female gonads of these stages of maturity, the values of Gonado Somatic Index (GSI) in the dry season varied from 8.21% up to 18.33% and the GSI values in the rainy season were slightly higher, 8.89 - 22.5%(the male gonads were not collected and not analysed). The existing difference of GSI values between seasons was an indication that although no strict or special period of breeding season, the percentage number of females with matured gonads was higher during the rainy season. In the beginning of rainy season is the breeding and spawning time of many tropical fish species in Indonesia. The matured gonads of stage III were started to be found at specimens of about 45 mm total length.

c.2. Fecundity

Fecundity analysis was done upon female specimens of 49-91 mm total length . The results show that the fecundity (F) varied from 63 up to 470 eggs, or 193.4 in average. There was a tendency of the increasing F value with the increasing length of the fish. Log to log regression analysis of total length against fecundity gave the following result:

Log F = - 2.428 + 2.657 log L   r is 0.609 or low correlation.

Its regression line is shown on Figure 2.

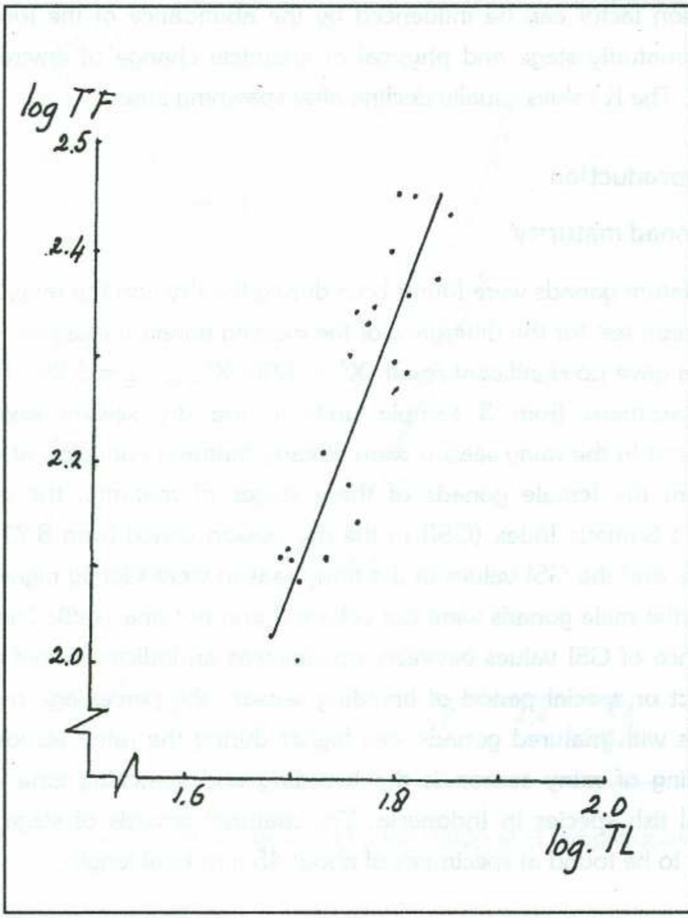

Fig 2. The regression line of the relation between the length of fish and its fecundity

However, Nikolskii (1969) stated that fecundity in general could increase up to a certain age and then declines. He also stated that fecundity can be influenced by the change of environmental condition, food supply and the difference of latitude. Within the limit of tolerance the fecundity may increase with the declining of latitude. Bagenal (1978) also stated that fecundity can also be influenced by population density, the age or the length and the weight of the fish and the time of the year.

Egg diameters in matured gonads varied from 0.09 mm up to 2.01 mm. Diagrams of frequency distribution of egg diameters at each stage of maturity (stage III-V) during the dry and the rainy seasons are shown on Figures 3 a and b.

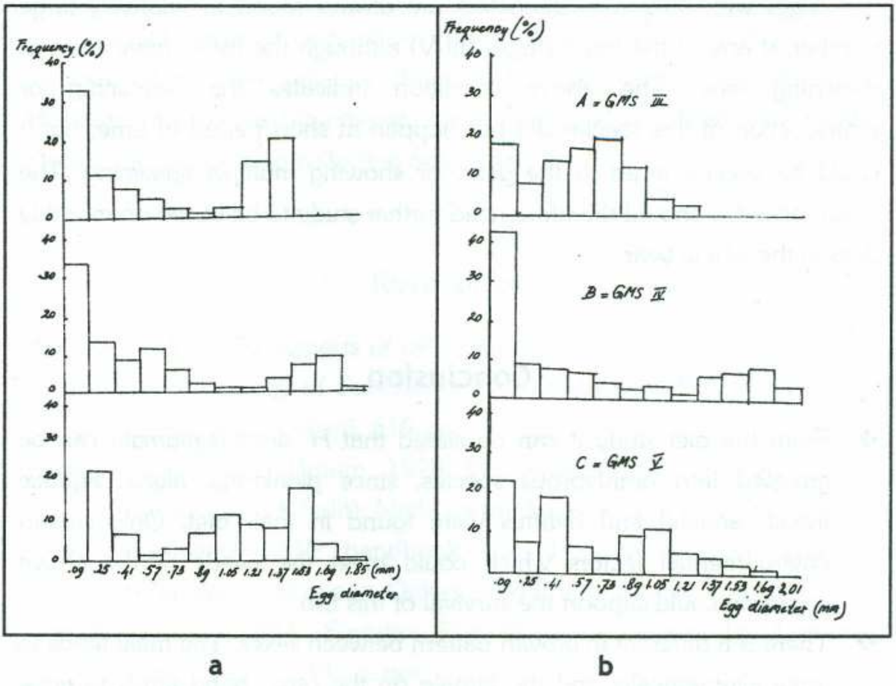

Fig. 3. Frequency distribution of egg diameters of *H. amphisquamata*, {a} dry season (A at GSI 166%; B at GSI 18.3%; C at GSI 8.2%), {b} rainy season (A at GSI 8.9%; B at GSI 22.2%; C at GSI 9.1 %)

During the dry season (Fig. 3 a) the egg diameters of stage III gonad (GSI=16.67%) varied between 0.09 and 1.85 mm. At stage IV (GSI=18.33%) the egg diameters were 0.09-2.09 mm and at stage V (GSI=8.21%) the diameters were 0.09-1.85 mm. The undulated pattern of distribution from the left to the right at the three stages shows the growth of young eggs to matured stage until ready to spawn at stage IV. Spawning can be seen by the decline of frequency or the lost of eggs of 1.85 mm and 2.09 mm at stage V. Similar pattern can also be seen on Fig. 3 b. The egg diameters at stage III (GSI=8.89%) were 0.09-1.37 mm and those of stage IV (GSI=22.55%) were 0.09-2.01 mm, where as those of stage V (GSI=9.09%) the egg diameters were 0.09-1.85 mm.

Eggs with 0.09 mm diameters are always found in relatively large number at any of the three stages (III-V) although the fishes have been at spawning time. The above condition indicates that spawning or reproduction of this species did not happen at short period of time, but it could be several times in the year, or showing multiple spawning. The exact fecundity should therefore need further study to be based on monthly data in the whole year.

Conclusion

- From the diet study it can be stated that *H. amphisquamata* can be grouped into omnivorous species, since planktonic algae, aquatic insect, annelid and detritus were found in their diet. Only certain environmentall factors which could meet the needs of the above organism could support the survival of this fish.
- There is a different in growth pattern between sexes. The male tends to grow allometrically and the female on the other hand tends to grow isometrically. So there is sexual dimorphism. In this case the male is slightly slender than the female. The similarity of condition factor (K) between sexes was therefore likely due to the composition of samples to be analysed, e.g. most of the males were relatively fatter than the females.
- Reproductive activity at population level occurs continuously in the year round, no special period of breeding season, and each female likely has its own spawning time and shows tendency of multiple

spawning. Fecundity is relatively low. It is therefore habitat destruction or poisoning of their habitat for quick fishing of bigger species (*Tor* spp) could also seriously reduce the population of this species in the wild.

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