ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Length-Weight Relationships of Demersal Fishes from the South China Sea of Malaysia

Lubna Alam[1]*, Mazlan Abd Ghaffar[2], Mazlin Bin Mokhtar[1] and Md Azizul Bari[1]

[1]Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), Bangi, 43600, Selangor DE, Malaysia
[2]Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM), Bangi, 43600, Selangor DE, Malaysia

ABSTRACT

This study attempts to look into the length weight relationship of demersal fish species collected from the South China Sea of Malaysia. Demersal fish species from wild were captured, total length and weight of each fish were measured, and gonads were observed. Gonadosomatic index and length-weight relationship were calculated. Gonadosomatic index varies between 0.16 (*Plectohinchus pictus*) and 7.53 (*Sphyraena jello*). b values of length-weight relationship ranged from 2.423 (Compressiformes) to 3.285 (Fusiformes). This study shown that most of the fishes were not in good condition during their maturity.
Keywords: Demersal, GSI, Length, Weight

**Corresponding author*

INTRODUCTION

Fish are the most numerous of the vertebrates, with at least 20000 known species, and more than half (58%) are found in the marine environment. More than one billion people worldwide rely on fish as a major source of animal proteins. According to FAO report population growth, urbanization and rising per capita incomes have led the world fish consumption to more than triple over the period 1961-2001, increasing from 28 to 96.3 million tones. Global fisheries production reached 130.2 million tons in 2001, having doubled over the last thirty years. However, a significant part of the increase has come from aquaculture. While output from capture fisheries grew at annual average rate of 1.2 percent, output from aquaculture grew at a rate of percent reaching 39.8 million tons in 2002. This rate is also higher than for other animal food producing system such as terrestrial famed meat [7].

Beside this contribution in the world's food supply, aquaculture also plays an important role in improving our livelihood by reducing poverty, providing jobs and boosting foreign exchange earnings in the developing world. As a result aquaculture became one of the most important economic activities in developing countries. Aquaculture productions mostly depend on the growth of and thus the length-weight data are essential for understanding growth rate, age structure and other aspects of population dynamics [10]. Individual condition is an important component of performance, survivorship and reproductive success in fish [8]. The length weight relationship provides an opportunity to calculate an index commonly used by fisheries biologist to compare the condition factor of well being of a fish [17]. Condition can be defined in energetic terms as the amount of energy available to an individual which may be allocated to various life functions including reproduction, foraging and over-winter survival [15]. Considering the importance of studying condition factor according to their maturity, in this study the length-weight relationship was investigated.

MATERIALS AND METHODS

Study Area

The field work was carried out at the island "Pulau Perhantian" in Malaysia and samples were collected from the South Chaina Sea (Fig. 1). The name "Perhentian" means "point to stop" in Malay, referring to their longstanding role as a waypoint for traders between Bangkok and Malaysia. The Island lie approximately 10 nautical miles (19 km) offshore the coast of northeastern Malaysia in the state of Terengganu, approximately 40 miles (64 km) south of the Thai border. The island is fringed by white sand beach, and the reefs and crystalline water is host to a wide variety of coral, sea-turtles, jellyfish, small sharks and reef-fish. The islands' maximum elevation is approximately 100 m and they are uniformly covered in coastal tropical jungle, with few interior foot-trails and no roads. The islands' only permanent inhabitants are the owners and staff of the numerous cabin-style resorts that dot the islands. The islands were sparsely inhabited by fishermen for centuries, although tourism now accounts for most economic activity.

Sampling

This experiment required a large number of demersal fish species. Total of 23 demersal fish species were collected from different location of South China Sea by bottom water trawl net. The sampling was carried out on 2, 3 and 6 September, 2006. All the hauls were made during day times. The selections of trawl stations were chosen by the local experienced fishermen (Table1 and Figure 2). All the demersal fish caught were sorted into species group and preserved for further study.

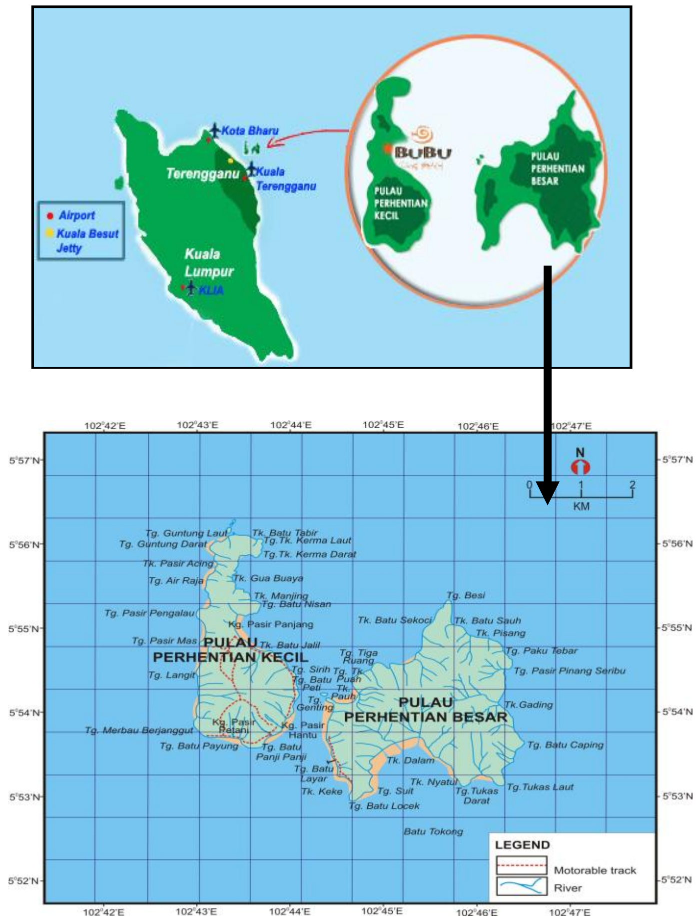

Fig. 1. Location map of Pulao Perhantian

Table 1. Date, location, duration, speed and range of sampling

	Location		Duration	Speed	Range
Day	Start	End	(hour)	(knot)	(km)
2/9/2006	6°00'N,102°47'E	6°05'N,102°39'E	3.45	3	19.17
3/9/2006(A)	5°58'N,102°44'E	6°01'N,102°38'E	2.4	2.8	12.45
3/9/2006(B)	6°01'N,102°38'E	6°02'N,102°42'E	2.05	2.2	8.35
6/9/2006	5°51'N,102°47'E	5°50'N,102°48'E	3.05	2.3	12.99

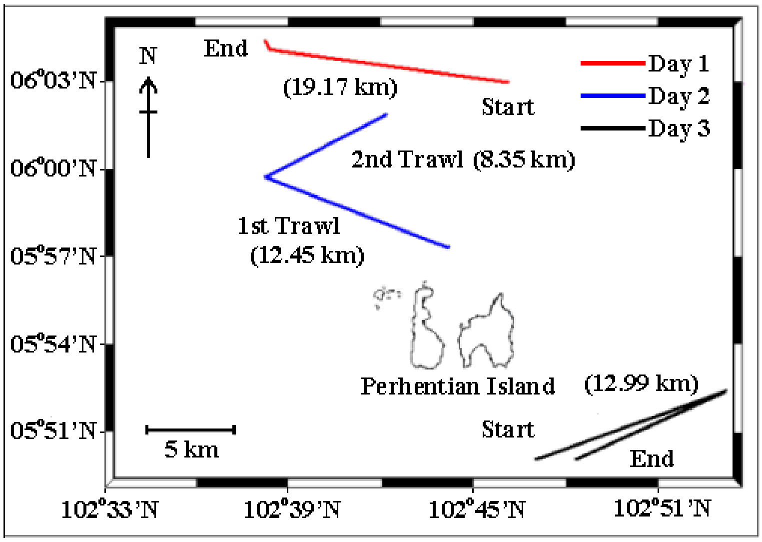

Fig. 2. Different location of sample collection

Analytical Method

Total length (cm) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board [6]. Weight of each individual of different species was measured in gram.

Each fish was dissected to take out the gonad. Gonads were separated and weighted. Then the different stages of maturity were identified based on microscopic observation of the gonads (i.e. color, shape, transparency and vascularisation of ovaries

Measurement of GSI

The gonadosomatic index was expressed as a percentage of body mass. It was calculated to assess maturity by using the following equation,

$$GSI = \frac{Gonadmass}{Bodymass - Gonadmass} \times 100$$

(Clean body weight)

Measurement of Length-Weight Relationship

The length-weight relationship in fish is demonstrated as an exponential relation. The LWR was estimated by using the equation $\mathbf{W = a\,L^b}$ [15]. The values of constant *a* and *b* were estimated from the log transformed values of length and weight i.e. *log* W = *log a* + *b log L,* via least square linear regression [18]. The condition factor was calculated by usual formula c.f. = $100W/L^3$ [1983]; where W= weight in grams; L= total length (cm). For measuring the length-

ISSN: 0975-8585

weight relationships the Software "Microcal Origin 6.0" was used. Linier regression analysis was used to examine the relationship between gonadal and somatic calorific value, water content and maturity stages of fish.

RESULTS

Gonadal development

Gonadosomatic index for each species varies according to the gonad maturity of different fish species and ranged between 0.16 (*Plectohinchus pictus*) and 7.53 (*Sphyraena jello*). The GSI values are high in mature fish (Table 2).

Table 2 Status of maturity of demersal fish species collected from South China Sea

Sp (N)	Species name	Total length (cm)	Weight of fish (cm)	Weight of gonad (g)		GSI
				Stage	Wet weight	
1	*Nemipterus peronii*	18±2.64	78.88±3.88	II	0.15±0.05	0.18±0.08
2	*Selar crumenophthalmus*	20.16±1.60	102.93±13.77	IV	1.86±0.76	1.89±0.01
3	*Sillago sihams*	17.33±0.28	37.99±1.52	III	0.79±0.01	2.12±0.29
4	*Pentapodus bifasciatus*	20±5.19	111.92±62.85	I	0.12±0.02	0.08±0.004
5	*Selaroides leptolepis*	15.16±1.89	49.40±2.01	III	2.3±0.12	4.88±1.00
6	*Saurida tumbil*	24.5±7.08	105.59±55.04	I	0.4±0.01	0.31±0.01
7	*Upeneus sulphureous*	17±1.32	62.6±8.66	II	0.16±0.04	0.27±0.05
8	*Carangoides orthogrammus*	15.5±0.5	56.75±2.97	I	0.35±0.24	0.62±0.02
9	*Halichoeres pictus*	18.5±0.82	60.68±12.38	I	0.35±0.11	0.54±0.06
10	*Inegocia harrissi*	10.23±0.87	7.48±1.18	I	0.26±0.09	3.44±0.89
11	*Alectes indicus*	9.5±0.5	12.14±2.35	I	0.07±0.01	0.79±0.06
12	*Trixiphichthys weberi*	15.66±0.28	40.60±0.78	III	0.18±0.01	0.44±0.01
13	*Sphyraena jello*	29.16±5.34	129.20±61.33	IV	13.83±0.23	7.53±1.05
14	*Plectohinchus pictus*	15.83±2.84	46.77±13.31	I	0.13±0.06	0.16±0.04
15	*Terapon theraps*	16.16±3.01	87.07±14.22	III	4.65±0.76	6.67±0.97
16	*Trichiurus lepturus*	39.09±2.63	55.14±5.14	II	0.16±0.11	0.29±0.02
17	*Priacanthus tayenus*	17.5±0.70	55.05±10.59	III	0.23±0.07	0.41±0.21
18	*Arius maculates*	28.16±1.75	288.91±19.20	ND	ND	ND
19	*Pseudorhombus arsius*	13.83±0.28	30.30±1.50	ND	ND	ND
20	*Lagocephalus wheeleri*	13.66±0.28	35.41±1.66	ND	ND	ND
21	*Istiogobius ornatus*	9.16±0.28	9.85±0.36	ND	ND	ND
22	*Epinephelus sexfasciatus*	7.56±1.45	11.54±1.82	ND	ND	ND
23	*Gerres filamentosus*	18.9±2.26	146,85±27.78	ND	ND	ND

Length-weight relationship

Demersal fish species collected in this study ranged in size from 7.56 cm (*Epinephelus sexfasciatus*) to 39.09 cm (*Trichiurus lepturus*) in mean total length and 7.48 g (*Inegocia harrissi*) to 288.91 g (*Arius maculates*) in mean total weight (Table 2). Most of the species were under 20 cm in length and under 100 g in weight.

The condition factor, parameter a and b and the gonadosomatic index of three groups of species according to their body forms are summarized in Table 3. b values rose from 2.423 (compressiformes) to 3.285 (fusiformes). The b value of Rounded fish species was also lower with a value of 2.734. The condition factor ranged from 1.15 (rounded) to 1.60 (fusiformes) species.

Table 3. Length-Weight relationships of three groups of fish species based on body form

Body form	GSI	r^2	a	b	CF
Compressiformes	2.463±2.1	0.9969	0.08094	2.423	1.43
Fusiformes	1.317±2.43	0.6086	0.00638	3.285	1.60
Rounded	2.762±3.06	0.6805	0.02038	2.734	1.15

DISCUSSION

Wild demersal fish species showed remarkable fluctuations in length-weight relationship. In this study the efficient sampling was carried out to include the widest variety of demersal fish species. The fish species collected in this study were from same ecological habitat. For this reason, it is considered that the biological activities of these species were closely resembled. Variation in fish size (ranging from 7.56 cm to 39.09 cm) indicates that the fish population ranged from immature to fully matured ones. This finding is similar to that of Fafioye and Oluajo (2005) [6]. This wide range also suggests differences in their growth [9].

Population growth condition of collected demersal fish species according to their body forms were estimated by analyzing the length-weight relationship ($W=aL^b$). In this case “a” is a factor and the exponent “b” is lies between 2.5 and 3.5, usually close to 3. When b=3, weight growth is called isometric, meaning that it proceeds in the same dimension as the cube of length. When $b \neq 3$, weight growth is allometric, meaning that it proceeds in a different dimension. Allometric growth can be either positive (b>3) or negative (b<3) (Pauly, 1984). In this study the values of b=2.423 and 2.734 for compressiformes and rounded species respectively show the negative allometric growth and the rate of increase in body length is not proportional to the rate of increase in body weight. Fafioye and Oluajo (2005) [6] also mention the similar findings. These negative allometric growths imply that the fish species tend to become thinner as they grow longer [16]. The value of b=3.285 for fusiformes species show positive allometric growth. Abdallah [1] recorded b values between 2.5 to 3.44 for the fishes studied in different marine bodies. The result indicated that the fusiformes group of fish displayed length and weight relationship with allometrically positive population growth pattern (b>3.0). Whereas as the other two groups of fish compresiformes and rounded displayed a different rate of change in length and weight with allometrically negative population growth pattern (b<3.0).

In this study the highest value of GSI observed in mature fish species. Similar GSI value has been found in female dentex [4]. This study also showed a trend of increasing GSI value with maturity stages which was similar to the findings of MEMÌS and GÜN [12].

In case of length-weight relationships, the "b" values also changes due to changes in physiological growth condition (condition factors) such as development of gonads or food availability for the reproductive population [11]. Most of the fish species studied in this study were sexually mature. As a result the condition factor of different body formed species was lower. It implies that the mature fishes are not in good condition because they spend more energy for their gonadal development. In case of fusiformes group, 90% fish species were sexually mature but their b value is high and condition factor was 1.60. Barnham & Baxter [3] described the condition of Brown trout. According to their finding, Brown trout having the condition factor 1.19 was in fair condition and 1.66 was in excellent condition. In both cases the fish were matured. In this study, though the fusiformes fishes were matured but their length and weight were well proportioned. As a result they represented the good condition. On the other hand, in the rounded group, among 6 species only 2 species were sexually mature but their b value is lower. There was also a strange value in case of compressiformes group. There were only three species in this group and among them 2 species were sexually mature, the "b" value was lower (1.43). The differences in weight for all the sampled batches may be due to the individual condition factor (c.f.) as it relates to the well-being and degree of fatness [13]. Diaz et al. (2000) found similar results in demersal fishes from the upper continental slope of Colombia. The condition factors of three groups of fishes are 1.43, 1.60 and 1.15. These values are lower than those values (2.9 and 4.8) documented by Bagenal and Tesch (1978) for mature fish fresh body weight. This suggested that the condition of demersal fish species collected in this study were extremely unfavorable. This finding has a great importance in future research.

CONCLUSION

This investigation revealed that most of the fishes collected from South China Sea were not in good condition because of their maturity. The low condition factor and the b values of length weight relationship in rounded and compressiformes body formed group of fishes also support this finding.

ACKNOWLEDGMENT

The authors wish to thank the Faculty of Science and Technology, University Kebangsaan malaysia for proving the support to carry out this research. This publication was supported by the research project "Dana Lonjakan Penerbitan" (Ref. No. UKM-DLP-2011-083).

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