Research Journal of Fisheries and Hydrobiology, 3(2): 48-53, 2008

Length-weight Relationship and Condition Factor of *Pterygoplichthys pardalis* (Pisces: Loricariidae) in Malaysia Peninsula

[1]Samat, A., [1]Shukor, M. N., [1]Mazlan, A.G., [2]Arshad, A. and [2]Fatimah, M.Y.

[1]Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Malaysia.
[2]Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 Serdang, Malaysia.

Abstract: The *Pterygoplichthys pardalis* in the Langat River of Malaysia Peninsula was studied for its length-weight relationships and condition factor for the period of August 2003 to October 2004. It was revealed that *P. pardalis* has the allometric growth with b = 2.538 ± 0.039 and a = 0.040 ± 0.006 (n = 928). The condition factor (*K*) for *P. pardalis* ranged between 1.125 and 8.802. There was no clear pattern showed in both growth parameters for the period of the study, suggesting that there was no significant influence of dry and wet season on to the fish. The best fish condition was recorded for those individuals with length of between 30 and 40 cm (TL) that was coincided with the maturation stage of the fish.

Key words: Length-weight relationship, condition factor, *Pterygoplichthys pardalis*, Malaysia Peninsula

INTRODUCTION

Length and weight relationships are of great importance in fisheries research because they provide information on population parameters Krause et al.[12]. Øvredal and Totland,[19]. Ecoutin et al[7]. First, a change in length and weight tells the age and year-classes of fishes, which is important in fishery. Secondly, the data can be used to estimate the mortality rate, and thirdly they can be used to assess the sustaining power of the fishery stock. In addition, the data on length and weight can also provide important clues to climatic and environmental changes, and the change in human subsistence practices[20,17].

However, the size attained by the individual fish may also vary because of variations in food supply, and these in turn may reflect variations in climatic parameters and in the supply of nutrients or in the degree of competition for food. Thus, a change in size through a certain period of time may indicate a change in average age resulting from those factors. Environmental deterioration, for example, may reduce growth rates and will cause a decrease in the average age of the fish. In reality, the interactions between environmental changes and growth rates for instance are believed to be complex and difficult to explain.

Knowledge on the condition of introduced benthic fish species such as *P. pardalis* in the tropical freshwater environment is even scarcely documented. This study aimed to estimate the growth performance of young *P. pardalis* and to characterize the condition factor of the species in Malaysian waters, which in principle are different in terms of resources and habitat characteristics compared to its original ecosystem in South America.

MATERIALS AND METHODS

Length-Weight Relationship: The length-weight relationship (LWR) of *Pterygoplichthys pardalis* was determined from individuals collected from Langat River. They were collected using cast nets with mesh size of 10 mm from August 2003 to October 2004. Sampling effort was standardized and equalized by keeping time and the quantity of instruments (nets and man power) employed at each site constant. Total length (cm) of individual fish was taken from the tip of the snout to the extended tip of the caudal fin using a measuring board. Body weight was taken to the nearest gram using a top Mark Electronic Balance after blot-drying excess water from the body.

Length-weight relationship was expressed by the equation $W = aL^b$ (formula 1). The 'b' is an exponent with a value between 2.5 and 3.5 demonstrating normal growth dimensions or interpretation of relative well-being[4,11]. Linear transformation was made using natural logarithm at the observed lengths and weights proposed by Zar[25]. The expression of the relationship is represented by the following formula:

$$\text{Log } W = b \log L + \log a \text{ ----------- Formula 1}$$

Corresponding Author: Samat, A. Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi.
Fax: 03-89253357, E-mail: nature@ukm.my

Where: W = the weight of the fis in grams,
L = the total length of the fish in centimeters
a = exponent describing of the rate of change of weight weight with length
b = weight at unit length

Condition Factor: The degree of well-being or relative robustness of the fish is expressed by‘ coefficient of condition’ (also known as condition factor or length-weight factor). Variations in the fish’s coefficient of condition primarily reflect the state of sexual maturity and degree of nourishment. Condition factor values may also vary with fish age, and in some species, with sex. Gomiero and Braga[19]. described the condition factor as an indicator to fish welfare in their habitat. It is represented by the letter *K* (formula 2) when the fish is measured and weighed, as in the following equation [20]. This ‘*K*’ value can be basically and directly interpreted as ‘the higher the value, the better the condition of the fish’.

$$K = \frac{100\ W}{L^b} \text{ --------------- Formula 2}$$

Where:
W = the weight of the fish in grams
L = the total length of the fish in centimeters
b = the value obtained from the length-weight equation (Formula)

In this study, the exponent ‘b’ value that is equal to 3 in formula 2 was not used to calculate the ‘*K*’ value because Le Cren[13]. and Bolger and Connolly[5]. claimed that it is not a real representation of the length-weight relationship for the great majority of fish species. Instead, as suggested by Lima-Junior *et al*.,[15]. the exponent ‘b’ value used was obtained from the estimated length-weight relationship equation ($W = aL^b$) generated from the data of the sampled individuals.

Further, the monthly relative condition factor (*Kn*;formula 3) of the fish samples was calculated following Le Cren[13]. This *Kn* value can also be used to compare conditions between species, though in this study, it was used to compare the *P. pardalis* condition during dry and wet season, and within their size classes (< 10 cm, 10-20 cm, 20-30 cm, 30-40 cm and > 40 cm TL).

$$Kn = \frac{W}{W'} \text{ --------------- Formula 3}$$

Where:
W = the weight of the fish in grams
$W' = aL^b$
b = the value obtained from the formula 1

Relationship between the length and weight parameters and the water level (water volume) of the Langat River was also examined. The fishes caught were classified into two groups. First, individuals caught during high water (September 2003-January 2004) and second, individuals caught during low water (February-August 2004).

Data Analysis: Variations in the length-weight relationship (represented by ‘b’) and condition factor (represented by *K* and *Kn*) of the individual fish living in the natural habitat were described throughout the year and between high (reflecting the wet season) and low (reflecting dry season) water. Relationship between length and weight of the fish was examined by simple linear regression analysis[25]. The nonparametric Kruskal-Wallis test (One-way Analysis of Variance) was conducted to perform comparisons between groups of data with regard to dry and wet seasons (i.e. of the ‘b’ value), and t-test for the paired samples. The minimum significant level for the relevant test was set at $p < 0.05$.

RESULTS AND DISCUSSION

The Length-Weight Relationship: The length-weight relationship of 928 individuals *P. pardalis* that were randomly caught from Langat River is shown in Figure 1. The analysis revealed that *P. pardalis* in the open waters has the allometric growth with b = 2.538 ± 0.039 and a = 0.040 ± 0.006 ($p < 0.05$). Apparently, the exponent ‘b’ value obtained lies a little bit far from the ideal value; that is three[20]. Results from this pooled sample also exhibited a negative allometric growth, suggesting that they tend to become thinner as they grow larger.

Commonly seen in most fishes both of the tropical and temperate regions are their ‘b’ values ranging from 2.7 to 3.3[10,21]. Abdallah[1]. Morey *et al*.,[18]. In this study, the ‘b’ value estimated from length-weight relationship of *P. pardalis* was 2.538, slightly lower than the common range value. However, a similar range value was reported for many fish species especially of the same order (Siluriformes). For example, *Liposarcus multiradiatus* (order: Siluriformes, family: Loricariidae) only has its exponential power parameter (b) at just 2.5[14].

Another example of species from the same order is the *Heterobranchus longifinis* (family: Clariidae) which has negative allometric ‘b’ values ranging from 2.025 to 2.153[13]. that were lower compared with those of *P. pardalis* from Langat River. Some other Siluriformes fish however, have their ‘b’ close to the isometric value (three) such as those exhibited by *Chrysichthys nigrodigitatus* (family: Bagridae) with b=3.042 and *Clarias gariepinus* (family: Clariidae) with b = 2.880[8].

The study on length-weight relationships of the *P. pardalis* in Langat River found that the 'b' values during August 2003 and October 2004 ranged from 2.265 ± 0.202 and 2.879 ± 0.099 (Table 1). If b > 2.5 is considered the lower margin of normal weight growth of the fish, then *P. pardalis* grew relatively well during the months of August to September 2003, December 2003 to January 2004, April to July 2004 and finally in September and October 2004. For the rest of the months, the 'b' values were found just below the marginal value (b = 2.5). Although the variations occurred were significantly different ($p < 0.05$), in general this result showed no clear pattern in the weight growth of the fish for the period of 15 months of the study.

Although the exponent 'b' value of the *P. pardalis* found in this study was generally low, the values calculated for several months in the year of 2004 (2.746 in January, 2.729 in September and 2.879 in October) indicated that the ideal 'b' value (b = 3) or larger could possibly be reached. Report for other species of the same family (Loricariidae) such as *Hypostomus strigaticeps* showed that its 'b' value ranged from 2.515 to 3.040 throughout the year. Their 'b' values gradually decreased from 3.040 in autumn, 2.653 in winter, 2.596 in spring and 2.515 in summer[16].

A similar species (*H. strigaticeps*), which was examined at different times and locations in South American streams also exhibited a quite clear fluctuation in their 'b' values throughout the year with 3.19 in February, 2.50 in April, 2.89 in June, 2.83 in August, 2.96 and 3.10 in December[9]. These studies showed that 'b' values of the two loricariids were never consistent even for the same species (*H.strigaticeps*). Basically, for *H. strigaticeps* in particular, its growth pattern was most likely influenced by the local regular climatic variation. For *P. pardalis* in the Langat River, there was no clear relationship between the 'b' value calculated and the dry and wet seasons. However, it was observed that relatively higher 'b' values were obtained at the beginning of higher water level between September and October 2004, and right at the end of high water level in January 2004.

Furthermore, when the monthly 'b' values of *P. pardalis* were analyzed based on water level (representing wet and dry seasons), it was observed that the 'b' values for the wet months were relatively higher than for the dry season (Figure 2), but the differences were not significant. It is understood that the increase in weight of any individual was not due to a single factor but various factors[22,23]. The factors could be either intrinsic or extrinsic, or both and favoured the changes of the growth parameters (length and weight) of the fish[9,24,2]. Such phenomena are also believed to account for the *P. pardalis* growth in Langat River.

Condition Factor (K) and Relative Condition Factor (Kn): It is one of the standard practices in fishery ecology that the individual fish species conditions determined based on the analysis of length-weight data reflected that the heavier fish at a given length is in better condition[5]. indicating the conducive environmental condition. The condition factor (K) for *P. pardalis* of the Langat River ranged between 1.125±0.182 detected in October 2004 and 8.802±4.208 in February 2004 (Table 2). Generally, the K values showed no specific pattern throughout the year, suggesting that there was no relationship between K and the water level.

There was no significant difference between Kn values for months during the dry and wet seasons (Figure 3), indicating that seasonal variations did not affect the general condition of the fish. This result differed from with findings from other studies such as by Anibeze[3]. on a clariid fish (*Heterobranchus longifinis*). Anibeze[3]. and Gomiero and Braga[9]. reported that better condition during the wet season was due to the availability of food and enhancement during their gonad development. Relatively lower Kn values are usually due to the fact that a larger part of the energy is allocated for certain activities such as growth and emptying of ovaries[6].

Table 1: Monthly length-weight relationship parameters for *Pterygoplichthys pardalis* from Langat River.

Month	Parameters			
	N	a ± s.d.	b ± s.d.	r^2
Aug-03	86	0.028 ± 0.018	2.669 ± 0.182	0.902*
Sep-03	97	0.025 ± 0.010	2.677 ± 0.108	0.978*
Oct-03	55	0.053 ± 0.022	2.480 ± 0.111	0.976*
Nov-03	30	0.064 ± 0.068	2.442 ± 0.291	0.778
Dec-03	29	0.036 ± 0.019	2.582 ± 0.144	0.979*
Jan-04	49	0.018 ± 0.005	2.746 ± 0.085	0.971*
Feb-04	50	0.110 ± 0.083	2.265 ± 0.202	0.902*
Mar-04	87	0.046 ± 0.020	2.494 ± 0.115	0.970*
Apr-04	82	0.034 ± 0.010	2.563 ± 0.079	0.972*
May-04	49	0.034 ± 0.010	2.576 ± 0.082	0.981*
Jun-04	64	0.025 ± 0.017	2.678 ± 0.184	0.914*
Jul-04	58	0.053 ± 0.031	2.478 ± 0.166	0.891
Aug-04	56	0.059 ± 0.032	2.398 ± 0.150	0.884
Sep-04	71	0.021 ± 0.005	2.729 ± 0.059	0.980*
Oct-04	65	0.012 ± 0.004	2.879 ± 0.099	0.965*

*Significant at $p < 0.05$

On the other hand, Langat River never experienced significant adverse environmental conditions such as drought throughout the study. The water level during the dry season was never below than one meter at any site studied. Thus, there should be no shortage of food (i.e. detritus) available for the fish during the dry season and this fish growth was expected to be unaffected.

Table 2: Monthly *K* values of *Pterygoplichthys pardalis* from Langat River.

Month	$K \pm$ s.d.	Length (avg)	Weight (avg)
Aug-03	1.357 ± 0.906	73-411 (150)	0.8-551.9 (67.2)
Sep-03	1.721± 0.476	49-476 (117)	1.1-760.4 (68.4)
Oct-03	4.395 ± 1.348	64-478 (259)	2.3-807.1 (257.2)
Nov-03	6.304 ± 0.806	287-457 (392)	1190.6- 720.8 (500.7)
Dec-03	3.452 ± 0.652	132-450 (286)	18.1-685.4 (267.5)
Jan-04	1.544 ± 0.449	91-480 (265)	1.6-672.1(186.7)
Feb-04	8.802 ± 4.208	75-489 (297)	1.2-931 (301.5)
Mar-04	3.568 ± 1.069	63-436 (220)	2.5-626.9 (162.1)
Apr-04	3.205 ± 0.672	89-440 (240)	5.6-624.7 (167)
May-04	3.156 ± 0.567	122-456 (243)	14.5-664.5 (169.3)
Jun-04	2.165 ± 0.603	60-465 (263)	1.4-822.1 (220.3)
Jul-04	4.392 ± 1.542	80-427 (232)	4.6-532.8 (161.2)
Aug-04	5.028 ± 1.834	122-460 (247)	14.1-561.1 (150.5)
Sep-04	1.995 ± 0.523	59-480 (254)	1.3-758.4 (191.4)
Oct-04	1.125 ± 0.182	115-419 (248)	13.6-599.4 (163.8)

There are also suggestions that fish condition can be influenced by certain extrinsic factors such as changes in temperature and photoperiod[24]. For the *P. pardalis* in Langat River, the temperature and photoperiod elements might not be significant factors because Malaysia in general experiences no great difference on those parameters throughout the year compared with the temperate countries. The oxygen content, total suspended solid and macro nutrients of the water were among the physicochemical variables that appeared to be relatively high in Langat River. However, those physicochemical variables might cause only a minor effect or no effects on the *P. pardalis* because it was found to be a dominant species especially at the middle segments of the Langat River.

Kn values of the *P. pardalis* increased almost gradually as they grew from juvenile to adult stage (Figure 4). The *Kn* values then decreased for the individuals of *P. pardalis* that were larger than 40 cm (TL). This result suggested that in general, their growth from juvenile to adult stage was not influenced or affected by any sort of extrinsic factors. It was also assumed that their gonad developed gradually until the maturation stage, which was when their body lengths were between 20 and 30 cm. The best fish condition was recorded for those individuals with length (TL) of between 30 and 40 cm. It was the stage when the gonads of most of the individual fish were fully grown, thus contributing to the higher *Kn* values. Relatively smaller number of larger fish (> 40 cm) occurred with fully grown gonad, especially for female fish. It seems that this group (with size > 40 cm) of the individual fish was relatively less productive compared with the smaller or younger groups. Probably, this was one of the reasons why the group had relatively lower *Kn* value.

Sufficient space area and abundant food supply throughout the year were probably some of the main factors contributing to the steady increase in their weight and length (growth). Such consistent increase shown by this species does not necessarily occur in other species of the same family (Loricariidae). A study on several species of characid fishes that shared the same habitat in a South American stream by Lizama and Ambrosio[16]. found that each of them have their own growth pattern reflected by the existing living condition.

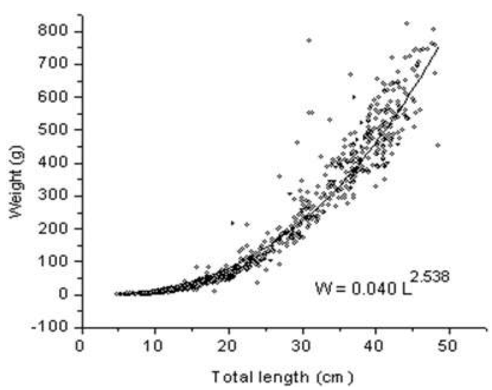
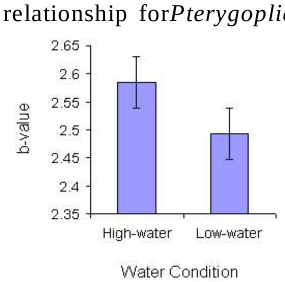


Figure 1: Length-weight relationship for*Pterygoplichthys pardalis* from Langat River.



Summary test result

Water condition	b-value	± s.d.
High-water	2.585	0.064
Low-water	2.493	0.067
t -test	*t* = 0.770	p = 0.484

Figure 2: The exponent 'b' values obtained from the length-weight relationship analysis for *Pterygoplichthys pardalis* from Langat River during high and low water levels.

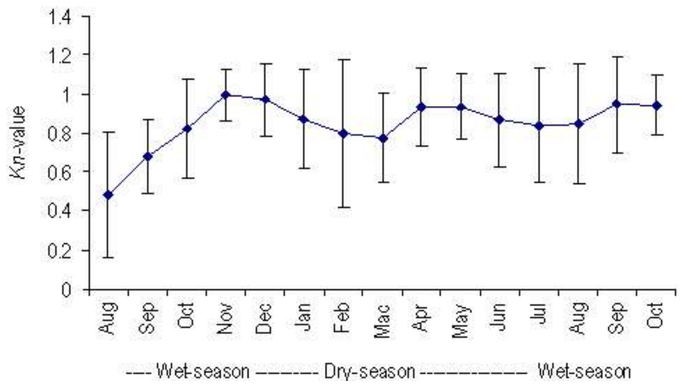


Figure 3: Monthly *Kn* values of *Pterygoplichthys pardalis* from Langat River between August 2003 and October 2004.

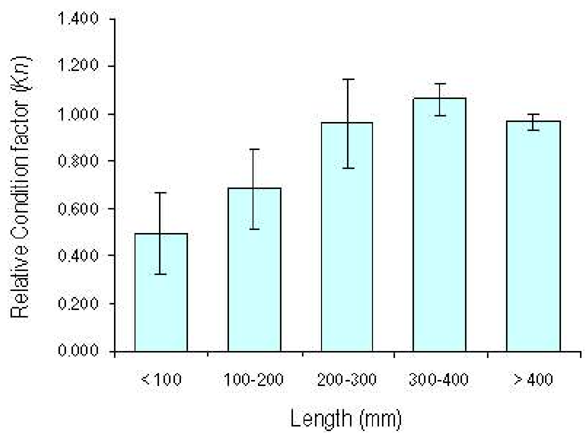


Figure 4: Average relative condition factor (*Kn*) for *Pterygoplichthys pardalis* per size class in Langat River from August 2003 to October 2004; *n* = number of individuals.

ACKNOWLEDGMENTS

The authors thank Mr. Azrindra and Mr. Husdy of Universiti Kebangsaan Malaysia who help us to collect the fish samples from the field. We thank Dr. Jonathan W. Armbruster of Auburn University for his kind to confirm the identity of the species studied. This research was funded in part by the IRPA Grant (09-02-02-0065-EA180) from the Ministry of Science and Tecnology and a Research Fellowship from Universiti Kebangsaan Malaysia (ST/16/2004).

REFERENCES

1. Abdallah, M., 2002. Length-weight relationship of fishes caught by trawl off Alexandria, Egyp. Naga, ICLARM Qtr, 25(1): 19-20.
2. Altinok, I. and J.M. Grizzle, 2001. Effects of brakish water on growth, feed conversion and absorption efficiency by juvenile euryhaline and freshwater stenohaline fishes. J. Fish Biol., 59: 1142-1152.
3. Anibeze, C.I.P., 2000. Length-weight relationship and relative condition of *Heterobranhus longifilis* (Valenciennes) from Idodo River, Nigeria. Naga, ICLARM Qtr, 23(2): 34-35.
4. Bargenal, T., 1978. Methods for assessment of fish production in freshwaters, 3rd. Ed. Oxford: Blackwell Scientific Pub.
5. Bolger, T. and P.L. Connolly, 1989. The suitable of suitable indices for the measurement analysis of fish condition. J. Fish Biol., 34(2): 171-182.
6. Da Costa, M.R and F.G. Araujo, 2003. Length-weight relationship and condition factor of *Microponias furnieri* (Desmarest) (Perciformes, Sciaenidae) in the Sepatiba Bay, Rio de Janerio State, Brazil. Rev. Bras. Zool. 20(4): 685-690.
7. Ecoutin, J.M., J.J. Albaret and S. Trape, 2005. Length-weight relationships for fish populations of a relatively undisturbed tropical estuary: the Gambia. Fish. Res., 72: 347-351.

8. Fafioye, O.O and O.A. Oluajo, 2005. Length-weight relationships of five fish species in Epe lagoon, Nigeria. African J. Biotech., 4(7): 749-751.
9. Gomiero, L.M and F.M.S. Braga, 2005. The condition factor of fishes from two river basins in Sao Paulo stae, Southeast of Brazil. Act. Sci. Maringa, 27(1): 73-78.
10. Gonzales, B.J., H.P. Palla and H. Mishina, 2000. Length-weight relationship of five serranids from Palawan Island, Philippines. Naga, ICLARM Qtr, 23(3): 26-28.
11. King, R.P., 1996. Length-weight relationships of Nigerian coastal water fishes. Naga, ICLARM Qtr., 53-58.
12. Krause, J., J. Jean-Guy and D. Brown, 1998. Body length variation within multi-species fish shoals: the effects of shoal size and number of species. Oceologia, 114: 67-72.
13. Le Cren, E.D., 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch *(Perca fiuviatilis).* J. Animal Ecol., 20: 201-219.
14. Liang, S.H., H.P. Wu and B.S. Shieh, 2005. Size structure, reproductive phenology, and sex ratio of an exotic armored catfish (*Liposarcus multiradiatus*) in the Kaoping River of Southern Taiwan. Zool. Stud., 44(2): 252-259.
15. Lima-Junior, S.E., I.B. Cardone and R. Goitein, 2002. Determination of a method for calculation of Allometric Condition Factor of fish. Act. Sci. Maringa, 24(2): 397-400.
16. Lizama, M.A.P and A.M. Ambrosio, 2002. Condition factor in nine species of the Characidae family in the upper Parana River floodplain, Brazil. Brazil. J. Biol., 62(1): 113-124.
17. Luff, R.M and G.N. Bailey, 2000. Analysis of size changes and incremental growth structures in African catfish *Synodontis schall* (schall) from Tell el-Amarna, Middle Eygpt. J. Arch. Sci., 27: 821-835.
18. Morey, G., J. Moranta., E. Massuti., A., Grau., M. Linde, F. Reira and B. Morales-Nin, 2003. Weight-length relationships of littoral to lower slope fishes from the western Mediterrenean. Fish. Res., 62: 89-96.
19. Øvredal, J.T and B. Totland, 2002. The scantrol fish meter for recording fish length, weight and biological data. Fish. Res., 55: 325-328.
20. Pauly, D., 1984. Fish population dynamic in tropical waters: a manual for use with programable calculators. Naga, ICLARM Qtr., 5-95.
21. Santos, M.N., M.B. Gaspar., P. Vasconcelos and C.C. Monteiro, 2002. Weight-length relationships for 50 selected fish species of the Algarve coast (southern Portugal). Fish. Res., 59: 289-295.
22. Silvia, H.L., P.F. Schwarmborn. and B.P. Ferreira, 2002. Age structure and growth of a dusky damselfish, *Stegates fuscus*, from Tamandare reefs, Pernambuco, Brazil. Env. Biol. Fish,. 63: 79-88.
23. Townsend, C.R., L.V.F. Silva and B. Baldisserotto. 2003. Growth and survival of *Rhamdia quelen* (Siluriformes, Pimelodidae) larvae exposed to different levels of water hardness. Aquaculture, 215: 103-108.
24. Youson, J.H., J.A. Holmes., J.A. Guchardi., J.G. Seelye, R.E. Beaver., J.E. Gersmehl., S.A. Sower and F.W.H. Beamish, 1993. Importance of condition factor and the influence of water temperature and photoperiod on metamorphosis of sea lamprey, *Petromyzon marinus*. Can. J. Fish. Aquat. Sci., 50: 2448-2456.
25. Zar, J.H., 1984. Biostatistical analysis. New Jersey. Prentice Hall.