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FREQUENCY DISTRIBUTION PATTERN, LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF FOUR GOBIID SPECIES OF FAMILY GOBIIDAE (ORDER PERCIFORMES) COLLECTED FROM KORANGI FISH HARBOR, KARACHI, PAKISTAN

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ABSTRACT

A study was conducted on the length-weight relationship, condition factor and frequency distribution pattern of 120 fishes representing two genera and four species of family Gobiidae. Fish samples were collected monthly during November 2009 to October 2010 from the landing specimens at Korangi fish harbour of Karachi Coast. In years 2009-2010, the total catch samples (N=120) contained 8.3% *Gobius occelatus*, 40.8 % of *G. biocellatus*, 25.0% of *G.viridipunctatus* and 25.0% of *Glossogobius giuris.* In the month of December 2009, total catch samples of four species constituted 60.0% and the total catch samples, in the month of April (2010) they constituted 22.86% dominating all other samples collected during other months of these two years. *Glossogobius giuris* 66.6% was abundant in total catch of year 2009. While *Gobius biocellatus* constituted 40.8% total catch, was dominant in catch of both years and *Gobius occelatus* constituted 8.3% of total catch was very rare. The regression coefficient (b) value of 3.45 and 3.18 for *G. biocellatus* and *Glossogobius giuris* slightly higher than 3 revealed that growth is positive allometric. The (b) value of 2.9 for *G. viridipunctatus* being not much less than ideal value 3.0, showed the isometric pattern of growth. The very high values of r^2 were obtained between total length and standard length. The values of condition factor (K) for four species were also determined.

Key words: Gobiidae**,** Frequency distribution pattern, Length-weight relationship, condition factor (K).

INTRODUCTION

The gobiid form the family Gobiidae comprises the most diverse group among teleost (Chen and Kottelate, 2005). Common names of these fishes are "Gobies" and "Mudskippers". According to Nelson (1994) this is one of the largest families of fish containing 212 genera and more than 2000 species. Gobies include some smallest fishes and also vertebrates in the world belonging to its two genera e.g. *Trimmaton* and *Pandaka* (1cm long). Most are small (>10cm in length), catadromous, demersal, found worldwide in tropical and subtropical environment. Mostly found in shallow marine water and estuaries include mangroves swamps and salt marshes (Talwar and Jhingran, 1991). A small number of gobies are fully adapted to fresh water environment e.g. Asian river gobies (*Rhinogobius sp.*). Cycloid or ctenoid scales present. Lateral line and swim bladder are absent. Head blunt with two large bulging eyes (Moyle, 1993). Two dorsal fins present (1st fin contain 2-8 spines). Pelvic fins united to form a sucker. Most are cryptic bottom dwelling carnivores of small benthic invertebrates; others are planktivores. Some species have symbiotic relationships with invertebrates (e.g. shrimps) and others remove ecto-parasites from skin, gills and fins of various large fishes (Shibukawa and Suzuki, 2004). Bumblebee goby (*Brachygobius aggregatus*) is a popular aquarium fish. Gobies are very tasty and have high nutritional value. The following subfamilies are recognized: Oxudercinae, Amblyopinae, Sicydiinae, Gobionellinae and Gobiinae. Mudskippers are highly specialized tropical member of this family included in subfamily Oxudercinae. They live in mangroves and mudflats, can breathe in air through skin and walk through their pectoral fins.

In Pakistan, local name of goby fishes are "Gullo". Zugmayer (1913) was the first who recorded three species of family Gobiidae included *Boleophthalmus dussumieri, B. boddavti, Glossogobius giuris* from 190 km upstream from sea in Porali river of Balochistan. Nazneen *et al.*, (1989) and Ramzan *et al.*, (2002) also listed these 3 species from Porali river of Balochistan. Qureshi (1955 & 1965) reported 3 genera and 8 species of this family from Sindh and Makran Coast of Pakistan, included; *Gobius brevirostris, G. viridipunctatus, G. ocellatus, G.biocellatus, Periophthalmus koelreuteri, Boleophthalmus tenius, B. dussumieri, B. dentatus* and only one species *Glossogobius giuris* from fresh water fishes of Pakistan. Froese and Pauly (2000) described 14 species of family Gobiidae from Sindh and Makran coast.

MATERIALS AND METHODS

The present study is based on the goby fishes obtained from fish landing at Korangi fish harbour. Between November 2009 to October 2010, a total of 120 gobiid fish were capture monthly. Fish samples were preserved in 10% formaldehyde. Field guide by Lin, C-c (2007) was used for the identification of species. Total length (TL) of all specimens was measured from tip of snout to longest axis of caudal fin. Wet weight (W) in grams was measured by using electronic balance.

Le Cren (1951) the length-weight relationship (LWR) was estimated by using cubic law:

$W= a.L^b$ …… (1)

Where as: W= Wet Weight in grams. a = was a scaly constant. b = exponent and L = Total length in centimeters.

As a general rule it is better to use the log transformation data than regression equation obtained from model 1. So, model 1 logarithmically transformed into model 2:

Log W = log a + log b L ---------- (2)

Where **a** and **b** are estimated by linear regression models. For each species, a regression was used to estimate the intercept (log a) and co-efficient or exponent (b) by using Microsoft Excel (Soft ware). The relationship between total length and standard length was also calculated by using the model 1.

According to Benedict et al., (2009) the condition factor (K) can be determined from by using following formula as follows:

The condition factor (K) $=Wx100 / TL^3$ ---------- (3)

Where as W=total weight and TL=total length of fish.

Linear regression equation was used for calculating the relationship between total length (TL) and standard length (SL) of fishes as follows;

Y= a+bX …….. (4)

RESULT AND DISCUSSION

A total of 120 specimens belonging to 2 genera and 4 species of family Gobiidae were collected monthly from the landing specimens at Korangi fish harbour during the period of November 2009 to October 2010. In the months of June, July & August, it was not possible to take samples because of flood and monsoon season. Four gobiid species included *Gobius biocellatus* (N= 49), *Gobius occelatus* (N=10), *Gobius viridipunctatus* (N=30) and *Glossogobius giuris* (N=31) were examined for estimating the parameters of length-weight relationship (a and b values), total length (TL) and standard length (SL) relationship, Coefficient of correlation (r^2), frequency distribution pattern and condition factor (K). These parameters are summarized in the Tables 1-5.

Frequency distribution pattern

120 samples of the four species of family Gobiidae were collected from Korangi fish harbour. In year 2009, the total catch samples (N=15) contained 13.3% individuals of *Gobius occelatus* and 6.6 % of *G. biocellatus*, 13.3% of *G.viridipunctatus* and 66.6% of *Glossogobius giuris*, constituted 60.0% of total catch samples, in the month of December. This sample was dominated then other sample collected in month of Nov. 2009. The body length of *Glossogobius* giuris (N=10) was ranged from 11.5-14.5 cm, the mean and standard deviation (S.D) of total length were also calculated as 12.9$\pm$ 1.17 and constituted 66.6% of its total catch in year 2009 (Table 1&2). It is predominated then all other species of that year. The total catch samples in year 2010 contained 7.6% individuals of *Gobius occelatus* and 45.7 % of *G. biocellatus*, 26.7% of *G.viridipunctatus* and 20.0% of *Glossogobius giuris*, constituted 22.86% of total catch samples, in the month of April. This sample was dominated then all other samples collected during other months of that year. The body length of *Gobius biocellatus* (N=48) ranged from 9.0-14.5 cm, the mean and Standard deviation (S.D) of total length were also calculated as 11.98$\pm$ 1.85 cm and constituted 45.7% of its total catch, which was dominated over samples of all other species of that year. While in year 2009, this species was very rare in total catch. The fishes belonging to the species *Gobius occelatus* (N=8) reached to body length ranged from 7.0-17.0 cm constituted 7.6% of the total catch in year 2010. This species was very rare in total catch of that year. The overall result showed that *Gobius biocellatus* constituted 40.8% total catch was dominated during survey in years 2009 and 2010. While *Gobius occelatus* constituted 8.3% of total catch was very rare (Masatosi and Sumonta, 1978; Ingles and Pauly, 1984; Zubia and Rehana, 2010).

Table 1. Frequency distribution of four species of family Gobiidae collected from Korangi fish harbour (November 2009 to October 2010)

Species name	Size range	Median	Sampling in 2009		Total catch	% Frequency	Rank
	cm.	cm.	Nov.	Dec.	(N)		
G. ocellatus	7.0-17.0	15.5	1	1	2	13.3	2
Gobius biocellatus	9.0-14.5	16.25	0	1	1	6.6	3
G. viridipunctatus	11.2-12.3	17.35	0	2	2	13.3	2
Glossogobius giuris	11.5-14.5	26	5	5	10	66.6	1
Total catch/month			6	9	SUM= 15		
% frequency/month			40	60			

Table 2. Counts and Measurements of the four species of family Gobiidae.

Species name	Sample size	Total length (TL)		Standard length (SL)		Weight (Wt)	
	(n)	range (cm)	Mean $\pm$ S.D	range (cm)	Mean $\pm$ S.D	range (g)	Mean $\pm$ S.D
Gobius ocellatus	6	7.0-17.0	12.1$\pm$ 3.27	7.0-17.0	10.1$\pm$ 2.33	22.0-42.0	29.7$\pm$ 6.65
Gobius biocellatus	16	9.0-14.5	11.98$\pm$ 1.85	8.0-11.5	9.85$\pm$ 1.24	10.0-40.0	20.13$\pm$ 11.7
Gobius viridipunctatus	14	11.2-12.3	11.7$\pm$ 0.36	8.0-9.0	8.57$\pm$ 0.39	6.0-12.0	8.86$\pm$ 1.87
Glossogobius giuris	10	11.5-14.5	12.9$\pm$ 1.17	11.5-14.7	10.3$\pm$ 0.93	14.0-28.0	22$\pm$ 6.19

S.D= Standard Deviation

Table 3. Condition factor (K) values of the four species of family Gobiidae

Species name	Sample size	Total length (TL)	Weight (Wt)	Condition factor (K)	Mean of K values
	(n)	range (cm)	range (g)	range	
Gobius ocellatus	6	7.0-17.0	22.0-42.0	6.41-0.85	2.3
Glossogobius giuris	10	11.5-14.5	14.0-28.0	1.14-0.92	1.01
Gobius bioceflatus	16	9.0-14.5	10.0-40.0	1.37-0.75	1.06
Gobius viridipunctatus	14	11.2-12.3	6.0-12.0	0.69-0.35	0.56

Table 4. Regression parameters of length-weight relationship of the four species of family Gobiidae.

Species	Length range (cm)	Weigth range (g)	N	log a	log b	r^2
Gobius ocellatus	7.0-17.0	22.0-42.0	6	0.71	***0.71	0.89
Gobius biocellatus	9.0-14.5	10.0-40.0	16	2.46	*3.45	0.91
Gobius viridipunctatus	11.2-12.3	6.0-12.0	14	2.22	**2.9	0.17
Glossogobius giuris	11.5-14.5	14.0-28.0	10	2.19	*3.18	0.93

*N= sample size. * on (b) value = shows positive allometric growth. ** shows Isometric pattern of Growth

r^2= coefficient of correlation *** shows growth is negative allometric

Table 5. Regression parameters of total length (TL) versus standard length (SL) relationship of the four species of family Gobiidae.

Species	(TL) range (cm)	(SL) range (cm)	N	a	b	r^2
Gobius ocellatus	7.0-17.0	7.0-17.0	6	1.59	0.7	0.97
Gobius biocellatus	9.0-14.5	8.0-11.5	16	1.95	0.66	0.96
Gobius viridipunctatus	11.2-12.3	8.0-9.0	14	0.87	0.81	0.54
Glossogobius giuris	11.5-14.5	11.5-14.7	10	0.6	0.75	0.9

*N= sample size. * on r^2 shows a high corelations between Tl vs SL

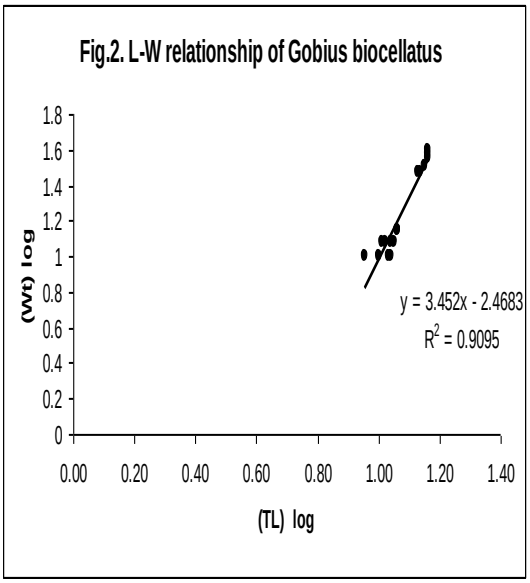

Fig.2. L-W relationship of *Gobius biocellatus*.

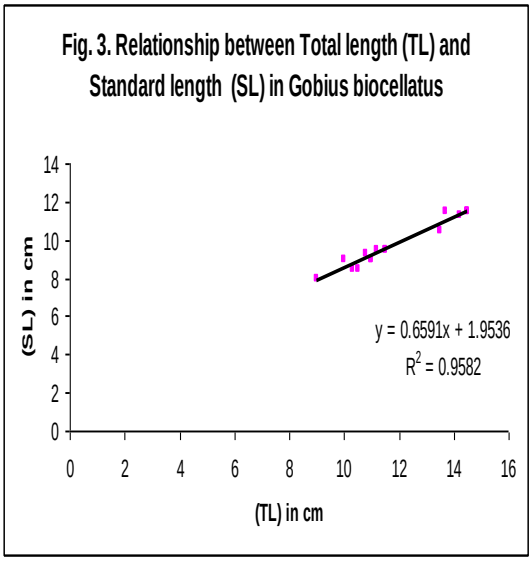

Fig.3. Relationship between total length (TL) and standard length (SL) in *Gobius biocellatus*.

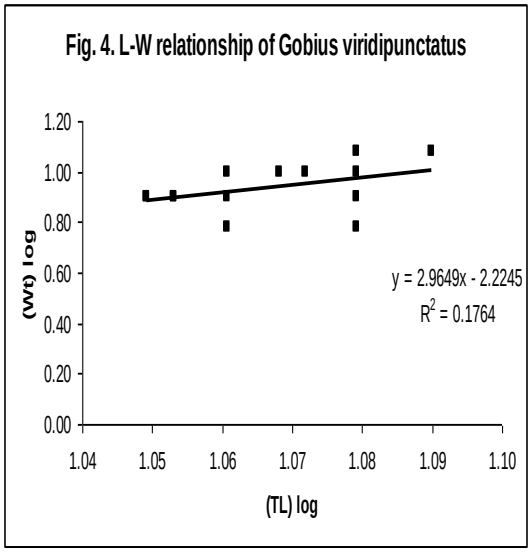

Fig.4. L-W relationship of *Gobius viridpunctatus*.

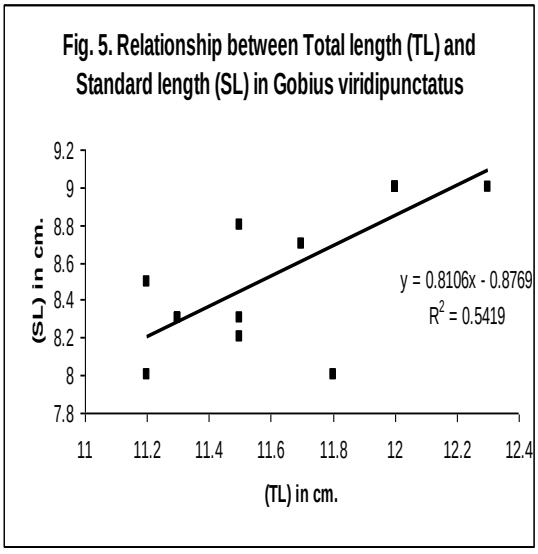

Fig.5. Relationship between total length (TL) and standard length (SL) in *Gobius viridpunctatus*.

Length-Weight relationship (LWR)

The total length (TL) and weight (Wt) values of 120 Gobiid specimens examined were used to adjust the length weight curve. The L-W relationship was calculated only for the combined sexes. The values of **a** (intercept) and **b** (exponent) of the regression equation were then used to calculate the values of condition factor (K). Length-weight relationship (LWR) was analyzed by cube law. The regression parameters of length-weight relationship were given in table 4. Highly significant positive correlations values 'r^2' ($r^2 > 0.9$) for the *Gobius occelatus* ($r^2 = 0.89$), *G. biocellatus* ($r^2 = 0.91$) and *Glossogobius giuris* ($r^2 = 0.93$) indicating that length and weight were highly correlated. The scatter diagram showed a parabolic relation between length and weight indicating the applicability of general cube law to these four Gobiid species. A straight line was obtained when logarithmic values of length and weight were plotted (Figures 2,4,6 & 8). LWR (logarithmic) were calculated separately for each species used to check whether the growth is positive or negative allometric. The data collected from 120 specimens of 2 genera and 4 species of family Gobiidae for analyzing LWR (logarithmic) examined by using model 2 (see Table 4 & Figures

2,4,6 & 8). Martin (1949) observed that the value of exponent (b) usually lies between 2.5-4.0 and the value of (b) remain constant at 3.0 for an ideal fish. If (b) value is greater or less than 3.0, than growth is allometric. If (b) value is less than 3.0 than it is negative allometric pattern of growth and if (b) value is greater than 3.0 than growth is positive allometric for their specific length. This deviation in value of exponent (b) from ideal value 3.0 revealed that L-W relationships of the species followed the cube law and might be affected by their surrounding condition of environment. In the present study, the regression coefficient value (b) of 3.45 and 3.18 for *G. biocellatus* and *Glossogobius giuris* is slightly higher than 3.0 revealed that L-W relationship of these two species follow the cubic law and might be affected by conditions of environment or condition of fishes. The (b) value of 2.9 for *G. viridipunctatus* is not very less than ideal value 3.0. So, this species showed the isometric pattern of growth. The very less (b) value of 0.17 for *G. occelatus* indicating that LWR not follow the cubic law (Esmaeili and Ebrahimi, 2006).

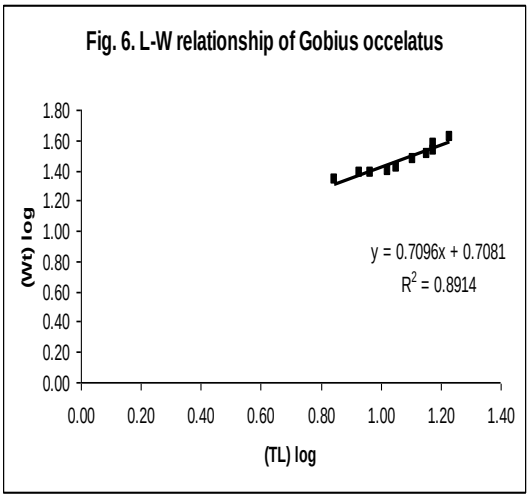

Fig.6. L-W relationship of *Gobius occelatus*.

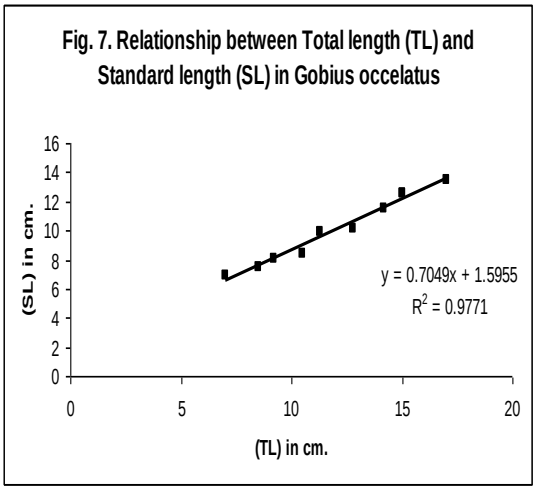

Fig.7. Relationship between total length (TL) and standard length (SL) in *Gobius occelatus.*

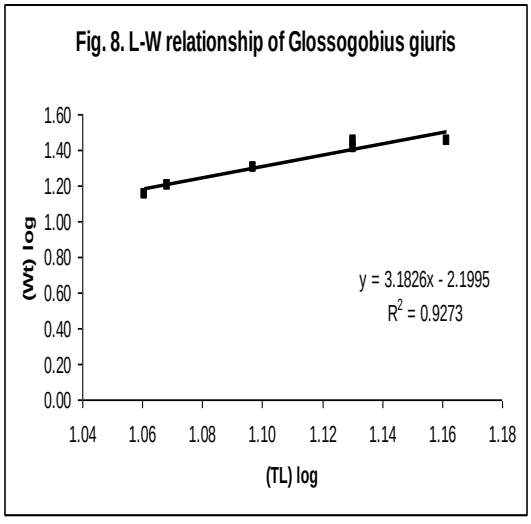

Fig.8. L-W relationship of *Glassogobius giuris.*

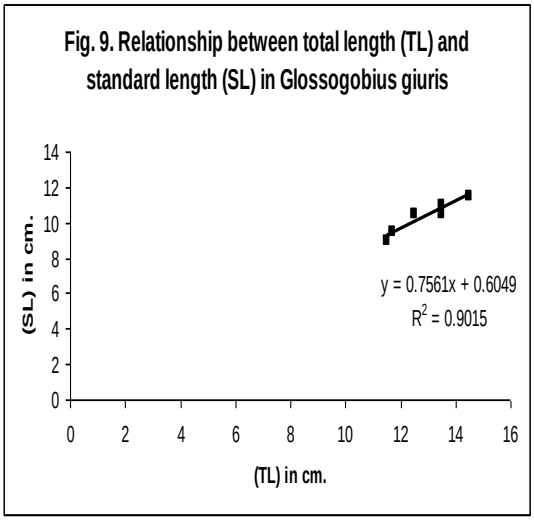

Fig.9. Relationship between total length (TL) and standard length (SL) in *Glassogobius giuris.*

Total length (TL) versus standard length (SL) relationship

The linear regression equation (model 4) was used to calculate the relationship between total length (TL) and standard length (SL) of the four species of the family Gobiidae (Anderson and Springer, 2005). For total length and standard length relationship, very high values of r^2 (0.96, 0.97 & 0.90) for *G. biocellatus, G. occelatus* and *Glossogobius giuris* and the straight line of the slope (b) revealed that total length and standard length are highly

correlated and interdependent of each other (Table 5; Figures 3,5,7 &9). While r^2 value of 0.54 for *G. viridipunctatus* showed moderate type of relationship between these two variables.

Condition factor (K)

For observed values in case of *Gobius ocellatus*, condition factor (K) values were ranged from 6.41 to 0.85 with a mean average value of 2.3. In *Glossogobius giuris*, it was ranged from 1.14-0.92 with a mean average value of 1.01. The mean calculated condition factor (K) was 1.06 with a range of 9.0 to 14.5 for *G. biocellatus*. The minimum value of (K) was observed for *G. viridipunctatus* ranged from 0.69 to 0.35 with a mean average value of 0.56 (Table 3). The maximum value of (K) coincides with beginning of spawning period. The condition factor (K) is totally dependent on both length and weight of the fish. Therefore when (b) = 3.0, then K remain constant. If weight increases more rapidly then cube of its length then K is increases with increase in length. When weight increases less than cube of its length then K tend to decrease with increase in size of fish (Benedict *et al.*, 2009).

REFERENCES

Anderson, W.D., JR. and V. G. Springer (2005). Review of the perciform fish genus *Symphysanodon* Bleeker (Symphysanodontidae), with descriptions of three new species, *S. mona, S.parini and S. rhax. Zootaxa*, 996:1-44.

Benedict, O. O., Y. A. Samsons and I. T. Omoniyi (2009). Length-Weight Relationship, Condition factor and Sex ratio of forty Fix Important fishes in a tropical flood river. *Research Journal of fisheries and Hydrobiology*, 4(2): 65-72.

Chen, I-S. and M. Kottelat (2005). Four new freshwater gobies of the genus *Rhinogobius* (Teleostei: Gobiidae) from Norther Vietnam, *Journal of natural history*, 39:1047-1429.

Esmaeili, H. R. and M. Ebrahimi (2006). Length–weight relationship in some freshwater fishes of Iran. *J. Appl. Ichthyol*., 22:328–329.

Froese, R. and D. Pauly (2000): FishBase 2000: *Concepts, design and data sources*, ICLARM, Los Baflos, and Laguna, Philippines. 344pp.

Ingles, J. and D. Pauly (1984). An atlas of the growth, mortality and recruitment of Philippines fishes. *ICLARM Tech. Rep*. 13. 127p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Le Cren, C.D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in perch, *Perca fluviatilis. Journal of Animal ecology*. 20: 201-209.

Lin, C.C. (2007). A field guide to fresh water fish and shrimps in Taiwan (Vol. 2). Common wealth publishing Co. Ltd., Taiwan.

Martin W.R. (1949). The mechanics of the environmental control of the body form of fishes. University of Toronto studies in Biological series 58, Published by the Ontario Fisheries Research Laboratory. 70: 1-72.

Masatosi, S. and I. Sumonta (1978). Size Frequency distribution of lizard fish, *Saurida undosquamis*, in the Inner Gulf of Thailand. *Bulletin of the Japanese Society of Scientific Fisheries*, 44(1):1-6.

Moyle, P. B. (1993). Fish: An Enthusiast´s Guide, Univ. of California Press.

Nazneen, S., M.S.A. Khan and M.A. Iqbal (1989). A note on fishes of Porali river (Balochistan) Pakistan. *Sci. Int.* (Lahore) 1 (5): 325-326.

Nelson, J. S. (1994). *Fishes of the world*. John Wiley and Sons, Inc. New York. 3rd edition. 600 pp.

Qureshi, M.R. (1955). Marine fishes of Karachi and Coasts of Sindh and Makran (Government Printing Press). 354pp.

Qureshi, M.R. (1965). Common fresh water fishes of Pakistan (Government Printing Press). 52pp.

Ramzan, M. M., K. Asmatulah and J.K. Kakar (2002). A note on the freshwater fishes of the river Porali, Balochistan. *Rec. Zool. Surv. Pakistan*, 14: 27-29

Shibukawa, K and T. Suzuki (2004). *Vanderhorstia papilio* a new shrimp-associated goby from the Ryukyu Islands, Japan (Perciformes: Gobiidae: Gobiinae), with comments on the limits of the genus. *Ichthyol. Res.* 51:113-119.

Talwar, P.K. and A.G. Jhingran (1991). Inland fishes of India and adjacent countries. Vol. 2.A.A. Balkema, Rotterdam.

Zubia, M. and Y. F. Rehana (2010). Size distribution pattern of two fishes of the genus *Leiognathus* (Leiognathidae: Perciformes) collected from Korangi Creek, Karachi Coast, Pakistan. *International Journal of Biology and Biotechnology*, 7(1-2): 144-144.

Zugmayer, E. (1913). Die Fische von Balochistan. Abh. K. Bayerischen Ak. Wiss, 26: 1-35,

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