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Age and growth study of Fresh water shark, *Wallago attu* (Bloch and Schneider) from Manchar Lake, District Jamshoro, Sindh, Pakistan

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Abstract: To study the age and growth of freshwater shark, *Wallago attu* (Bloch and Schneider) from Manchar lake district Jamshoro a total of 476 (367 and 109 male and female respectively) fish ranging in size from 15.0 to 65.0 cm and 159.3 to 1658.9 g in total length and weight respectively were collected from the catch of fishermen of the lake during March to August 2011. The relation between total length and weight of male, female and sexes combined were described by following equations.

Log W = -2.30 + 3.10 Log L (for males)

Log W = -2.14 + 2.90 Log L (for females)

Log W = - 1.76 + 2.95 Log L (for sexes combined)

It may be seen through regression equations that the values of (b) was practically identical in all cases and very close to ideal 3. The values in males were found better than females. The relative condition factor (Kn) values from this study Kn = 1.0, 0.99 and 1.0 for male, female and sexes combined respectively, represented fish in overall good condition. Males were found slightly better in condition than that of female from Manchar Lake District Jamshoro, Sindh, Pakistan. It was inferred from the length-frequency analysis that the model length 47.6 cm represents as 0^+ age group and the subsequent model lengths 53.3 and 57.9 cm designated as 1^+ and 2^+ age groups respectively. The morphometric study of fresh water shark, *Wallago attu* revealed that there is no significant (P>0.05) difference among male and female was noticed from quite a good number of fish samples in the present study. It was concluded that the single population of this fish is available in Manchar Lake district Jamshoro, Sindh, Pakistan.

Keywords: Growth Study of Fresh Water Shark, Manchar lake.

1. INTRODUCTION

The information on age and growth is *sine qua non* to the life cycle and behavior of any fish and its performance in capture and culture environment. The age determination in fish is generally based on the presence of growth rings, which appears on scales and other hard parts of the body. As the catfish do not possess scales, the age determination studies have been based on the length-frequency distribution, vertebrae and pectoral spines (Kohli and Goswami, 1989). Morphometrics is the quantitative analysis of organism, shape and integral component in evolutionary ecology and developmental studies in biology while taxonomist and sytematists use morphological information to describe and diagnose species, morphometricians are interested in understanding the pattern of shape variation within and among samples (life stages, populations and species) as well as informing and testing hypothesis regarding the origin of those pattern of variation in the growth pattern (Shearer, 1994). In all animal groups because of difference in relative rates of increase in body parts, organs or tissues, body proportions change during the course of growth that results in significant alternations of body form (Thompson and Arcy, 1917). Such relationships have been termed as allometric (Huxley, 1932). Measurement of growth as length quantifies as axial growth, measurement as weight quantifies as growth in bulk. These two categories of growth are highly correlated (Wootton, 1990). *Wallago attu*, is catfish on account of its fierce and voracious habits is popularly known as freshwater shark and locally known as Jhirko, Mullee and Poiky belongs to the family siluridae of order siluriformes. It is widely distributed through out Pakistan, Bangladesh, India, Sri Lanka and Myanmar (Mirza, 1982). It grows very rapidly and attains length about six feet and weight up to 60 kg. It occurs in lakes and slow moving water bodies and provides good sport to anglers and cheap nourishing food to millions of people (Khan, 1934). But in spite of its importance in more than one way, very little information is available on its biology and fishery from Pakistan and elsewhere. No published literature is available on the morphometry and age and growth of this commercially important fish from Pakistan. The present study has been design to investigate few aspects of its biology such as age and growth, morphometric and meristic characteristics and length-weight relationship of *Wallago attu* from Manchar Lake, district Jamshoro, Sindh, which would serve as base line data for future researchers.

2. MATERIALS AND METHODS

Age and growth studies

The samples of *Wallago attu* for the present study were obtained monthly from March to August 2011, from the catch of various fishermen of the

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Manchar Lake, District Jamshoro. A total of 476 (367 males and 109 females respectively) fish were collected ranging from 15.0 to 65.0 cm and 159.3 to 1685.9 (g) in total length and weight respectively. The total length of fish was recorded to the nearest cm and weight up to 0.1 by using sensitive portable battery operated field balance (Model No., CT, 1200-s, Made in USA) respectively. The measured fish were then sexed by dissecting the abdomen. The Length-weight relationship of the experimental fish was calculated from the logarithmic formula: log a + b Log L. Ponderal index (Kn) was calculated separately for males, females and sexes combined of different length groups for each 5cm interval as suggested by LeCren (1951).

Age determination

Total 476 specimens of *W. attu* ranging in size from 15.0 to 65.0 cm in total length were used for the age determination by using length-frequency method as given by Peterson (1896). The total sampled fish were then divided into 5cm length groups for the analysis.

Morphometric study

The ten various morphometric characters of the experimental fish were measured with the help of measuring tape and digital Vanier caliper.

Meristic counts

Five meristic counts were made such as dorsal fin, ventral fin, pectoral fin, pelvic fin and tail fin rays of the experimental fish with the help of hand lens.

3. RESULTS

1. Length-weight Relationship

The Length weight equations were computed, separately for males, females and sexes combined sampled during the period of March to August 2011. The sample was ranged between 15.0 to 65 cm and 159.3 to 1685.9 (g) in length and weight of Fresh water Shark, *Wallago attu* obtained from the various fishermen of the Manchar Lake, District Jamshoro and presented in **(Table 1)**. When empirical values of lengths were plotted against their respective weights on an arithmetic scale, smooth curves were obtained for male, female and combined sexes respectively. A plot of weight against length on double logarithmic paper, however, yielded a straight line as expected (Figs. 4, 5 and 6) respectively. The correlation coefficients for males, females and combined sexes were (0.95), (0.98) and (0.97) respectively. This indicated a close relationship between length and weights. The regressions, when calculated using the method of least squares for male and female of Fresh water Shark, *Wallago attu* in the size range of 15.0 to 65 cm, gave the formulae.

Log W = -2.3 +3.10 Log L (Male) (r = 0.97)
Log W = - 2.14 +2.90 Log L (Female) (r = 0.98)
Log W = - 1.79 + 2.95 Log L
(Combined sexes) (r = 0.97)

As noted from the above equation, the regression coefficient values for males, females and combined sexes were found to be practically identical and followed the cube law (b= 3). The agreement between the empirical weight and computed weight from regression can be termed as ideal growth (positive Allometry).

2. Relative Condition Factor

The relative condition factor (Kn) for all fish samples was determined from the average lengths and weights of 5.0 cm interval of total length groups **(Table 2).** The relative condition factor (Kn) was determined for either sex separately. The Kn values for males ranging from 0.8 to 1.10 mean1.0 ± 0.55, in case of female these values were ranging from 0.98 to 1.06

Table 1. Data on length and weight of fresh water shark, *Wallago attu* (Bloch and Schneider) from Manchar Lake District Jamshoro, Sindh, Pakistan

Length group (cm)	Male		Female		Combined Sexes	
	Ave. Length	Ave. Weight	Ave. Length	Ave. Weight	Ave. Length	Ave. Weight
15.1-20.0	18.0 ± 1.22	159.3 ± 2.25	Nil	Nil	18.0 ± 1.22	159.3 ± 2.25
20.1-25.0	23.3 ± 0.55	244.9 ± 1.33	Nil	Nil	23.3 ± 0.55	244.9 ± 1.33
25.1-30.0	27.8 ± 1.15	363.1± 3.33	Nil	Nil	27.8 ± 1.15	363.1 ± 3.33
30.1-35.0	33.5 ± 0.88	403.5 ± 5.25	Nil	Nil	33.5 ± 0.88	403.5 ± 5.25
35.1-40.0	37.6 ± 1.10	480.0 ± 4.55	Nil	Nil	37.6 ± 1.10	480.0 ± 4.55
40.1-45.0	43.8 ± 0.99	600.8 ± 4.24	42.4 ± 1.11	616.7 ± 3.33	43.1 ± 1.0	603.8 ± 3.55
45.1-50.0	48.0 ± 1.15	796.8 ± 4.44	47.2 ± 1.25	834.7 ± 5.25	47.6 ± 1.10	815.8 ± 5.55
50.1-55.0	53.3 ± 0.55	850.2 ± 3.75	53.2 ± 0.88	864.6 ± 4.88	53.3 ± 0.70	857.4 ± 4.80
55.1-60.0	58.0 ± 1.0	874.8 ± 5.20	57.8 ± 1.22	939.4 ± 5.60	57.9 ± 1.10	907.1 ± 5.30
60.1-65.0	62.8 ± 1.20	972.0 ± 4.44	62.9 ± 1.90	1040.2 ± 5.80	62.9 ± 1.25	1006.1 ± 5.22

Table 2. Data on Relative condition factor (Kn) of fresh water shark, *Wallago attu* (Bloch-Schneider) from Manchar Lake district Jamshoro, Sindh, Pakistan.

Length groups (cm)	Male			Female			Combined Sexes		
	Obs weight	Cacl weight	Kn	Obs weight	Cacl weight	Kn	Obs weight	Cacl weight	Kn
15.1-20.0	1.7	2.20	0.8	---	----	-----	1.7	2.20	0.8
20.1-25.0	2.10	2.40	0.9	----	-----	-----	2.10	2.40	0.9
25.1-30.0	2.30	2.50	0.9	-----	----	-----	2.30	2.50	0.9
30.1-35.0	2.60	2.60	1.0	-----	----	-----	2.60	2.60	1.0
35.1-40.0	2.70	2.70	1.0	-----	-----	-----	2.70	2.70	1.0
40.1-45.0	2.90	2.80	1.0	2.70	2.54	1.06	2.85	2.75	1.04
45.1-50.0	3.10	2.90	1.10	2.77	2.68	1.03	2.96	2.83	1.06
50.1-55.0	3.20	3.0	1.10	2.80	2.83	0.98	3.10	2.90	1.06
55.1-60.0	3.30	3.10	1.10	2.92	2.94	0.99	3.22	3.01	1.06
60.1-65.0	3.50	3.20	1.0	2.92	3.03	0.99	3.33	3.09	1.07
Mean	Kn	=	1.0			0.99			1.0

Obs weight = Observed weight, Cacl weight = Calculated weight Kn =Relative condition factor

with mean values of 0.99 ± 0.66, while for combined sexes Kn values were ranging from 0.80 to 1.07 with mean was 1.0 ± 0.5. The values of Kn showed fluctuation in all size groups of both males, females and combined sexes when t-test was applied on data of Kn for males, females and combined sexes was found that the values are statically non-significant ($p<0.05$). On average the males and combine sexes were in a slightly better conditions (mean Kn =1.0) than females (mean Kn = 0.99 respectively).

The length -weight relationship values indicated that growth of Fresh water Shark, *Wallago attu* from the Manchar Lake, District Jamshoro was found to be positive allometry and the regression co-efficient (b= 3) in all cases male, female and combined sexes showed ideal growth. The relative condition factor values indicated that the males were found to be slightly better condition than that of females.

Age Determination study

For the age determination study, length-frequency analysis was performed for *Wallago attu* (Bloch and Schneider) from Manchar Lake district Jamshoro, Sindh was determined from 476 specimens (367 male and 109 female) ranging in length between 15.0 to 65.0 cm in total length. The entire data were pooled, male, female and their combined length-frequencies as percentage are shown in **(Table 3)**. Three age groups were observed through length-frequency polygons (Fig. 1) at model length 47.6, 53.3 and 57.9 cm. It was inferred from the length-frequency analysis that the model length 47.6 cm represents as 0^+ age group and the subsequent model lengths 53.3 and 57.9 cm designated as 1^+ and 2^+ age groups respectively. Beyond two years, the peaks of frequency polygons were not found to be distinct **(Fig. 1).**

Table 3. Length-frequency data of fresh water shark, *Wallago attu* (Bloch-Schneider) from Manchar Lake district Jamshoro, Sindh, Pakistan

Length group (cm)	No. of male	No. of female	Total number of fish	Percentage frequency
15.1-20.0	05	Nil	05	1.1
20.1-25.0	08	Nil	08	1.7
25.1-30.0	14	Nil	14	2.9
30.1-35.0	16	Nil	18	3.8
35.1-40.0	18	Nil	20	4.2
40.1-45.0	50	15	65	13.7
45.1-50.0	60	20	80	16.8 0^+
50.1-55.0	66	30	96	20.2 1^+
55.1-60.0	70	36	106	22.3 2^+
60.1-65.0	60	08	68	14.3
Total	367	109	476	

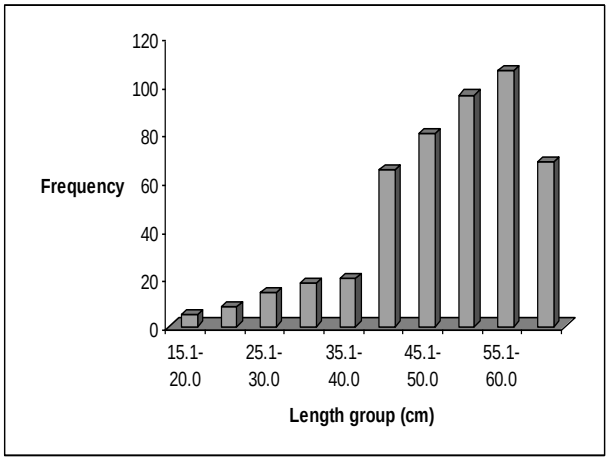

Fig. 1. Length-frequency polygons of freshwater shark, *Wallago attu* (Bloch) from Manchar Lake district Jamshoro, Sindh, Pakistan

Morphometric Study

a) Morphometric measurements

The statistical calculation of 10 morphometric variables of male and female *Wallago attu* from Manchar Lake district Jamshoro has been described. The values of regression equations (b) and coefficient of correlation (r.) of all variables in relation to total length for male and female are shown in Table 4 and 5 respectively. It was inferred from the tables of various body parts that the values of dorsal fin length (DFL), tail fin length (TFL) and ventral fin length (VFL) showed ideal relationship (r = 0.99, 0.99 and 0.98 respectively) with total length in male **(Table 4).** While in case of female the values of tail fin length (TFL), ventral fin length (VFL) and girth showed ideal relationship (r = 0.99, 0.99, and 0.98 respectively) **(Table 5).** It is therefore concluded that there is no significant (P>0.05) difference was noticed between male and female of fresh water shark, *Wallago attu* from Manchar lake district Jamshoro.

Table 4. Regression equation and coefficient of correlation of different morphometric characters in relation to total length in male, *Wallago attu* (Bloch) from Manchar Lake district Jamshoro, Sindh, Pakistan

Morphometric Character	Coefficient of Correlation (r.)	Regression Equation
Standard Length	0.92	TL = - 4.02 + 4.54 SL
Head Length	0.90	TL = - 0.54 + 1.57 HL
Eye Diameter/HL	0.96	HL = - 0.06 + 0.50 ED
Dorsal Fin Length	0.99	TL = - 0.20 + 0.16 DFL
Ventral Fin Length	0.98	TL = - 0.69 + 1.39 VFL
Pectoral Fin Length	0.94	TL = - 0.41 + 0.42 Pec. FL
Pelvic Fin Length	0.90	TL = - 0.66 + 0.53 Pel. FL
Tail Fin Length	0.99	TL = - 0.36 + 0.42 TFL
Girth	0.94	TL = - 0.62 + 1.20 Girth

Table 5. Regression equation and coefficient of correlation of different morphometric characters in relation to total length in female, *Wallago attu* (Bloch) from Manchar Lake district Jamshoro, Sindh, Pakistan

Morphometric Character	Coefficient of Correlation (r.)	Regression Equation
Standard Length	0.96	TL = - 0.14 + 0.14 SL
Head Length	0.92	TL = - 2.28 + 2.48 HL
Eye Diameter/HL	0.94	HL = - 1.46 + 1.21 ED
Dorsal Fin Length	0.96	TL = - 0.71 + 0.46 DFL
Ventral Fin Length	0.98	TL = - 1.0 + 1.40 VFL
Pectoral Fin Length	0.92	TL = - 0.14 + 0.25 Pec. FL
Pelvic Fin Length	0.90	TL = - 0.15 + 0.25 Pel. FL
Tail Fin Length	0.99	TL = - 0.85 + 0.81 TFL
Girth	0.99	TL = - 0.85 + 1.30 Girth

b) Meristic counts

Meristic counts of five different parameter such as dorsal fin ray, ventral fin ray, pectoral fin ray, pelvic fin ray and tail fin ray of male and female of fresh water shark, *Wallago attu* (Bloch) from Manchar Lake district Jamshoro were counted and their rages and mean values are presented in **Table 6.** The t test was applied on the rage and mean values of the meristic counts and was observed that no significant (P>0.05) difference was found between the counts in male and female of *Wallago attu* (Bloch) from Manchar Lake district Jamshoro, Sindh, Pakistan.

Table. 6. Mean and range values of meristic counts of fresh water shark, *Wallago attu* (Bloch) from Manchar Lake district Jamshoro, Sindh, Pakistan

Meristic Character	Male Range	Mean	Female Range	Mean
Dorsal fin ray	**4-6**	**4**	**4-6**	**4**
Ventral fin ray	**86-90**	**87**	**86-90**	**87**
Pectoral fin ray	**14-16**	**15**	**14-16**	**15**
Pelvic fin ray	**10-11**	**09**	**10-11**	**09**
Tail fin ray	**17-20**	**18**	**17-20**	**18**

4. DISCUSSIONS

The present investigations on the age and growth study of fresh water shark, *Wallago attu* (Bloch) from Manchar Lake district Jamshoro, Sindh was consists of length-weight relationship, relative condition factor, length-frequency analysis, morphometric measurements and meristic counts. The length-weight relationship study showed that the values of regression analysis (b) in all cases were found to be practically identical and close to the ideal (b = 3) male (b = 3.10), female (b = 2.90) and combined sexes (b = 2.95) in the present study. Various researchers have reported values of regression coefficient (b> 3) or near 3 in different fish species like Narejo *et al*., 1999; Jafri *et al*., 1999; in *Tenualosa ilisha*, Narejo *et al*., 2000; in *Gudusia chapra*, Narejo *et al*., 2002; in *Monopterus cuchia*, Narejo 2006; in *Cirrhinus reba*, Laghari *et al*., 2009; in *Rita rita*, Dars *et al*., 2010; in *Labeo gonius*, Laghari *et al*., 2011; in *Tilapia nilotica*. The above findings accords with the present study. The relative condition factor values showed variations at all length groups of male and female. The values of relative condition factor (Kn) in male ranges from 0.8 to 1.10 with mean 1.0, incase of female these values were ranges from 0.98 to 1.06 with mean values of 0.99 and in case of sexes combined the (Kn) values ranges from 0.80 to 1.07 with mean values of 1.0. It indicated that the males of freshwater shark were found to be slightly in better condition than that of females. Similar observations

were reported by various workers in different fish species (Shafi *et al*., 1974; Narejo *et al*., 1999 in *Tenualosa ilisha*, Narejo *et al*., 2000 in *Gudusia chapra*, Narejo *et al*., 2001 in *Pisodonophis boro*, Narejo *et al*., 2003 in *Mastacembelus armatus*, Mastoi *et al.*, 2005 in *Labeo calbasu*, Laghari *et al*., 2009; in *Rita rita*, Dars *et al*., 2010; in *Labeo gonius*, Laghari *et al*., 2011; in *Tilapia nilotica*. For age determination of fresh water shark, *Wallago attu* length-frequency analysis was performed. Three age groups were discernable through length-frequency polygons at model length 47.6, 53.3 and 57.9 cm represents as 0^+ age group and the subsequent model lengths 53.3 and 57.9 cm designated as 1^+ and 2^+ age groups respectively. Beyond two years, the peaks of frequency polygons were not found to be significantly distinct in the present study. Jayaram (1977) calculated the age of *Wallago attu* from Indian water and concluded that the fish at model length of 58 and 65 cm designated as 1^{st} and second year of age respectively. Goswami and Devaraj (1992) studied age and growth of freshwater shark, *Wallago attu* by using length-frequency method from Dhir Beel, Brahmaputra Basin, Assam, India. They commented that the fish attains 55 cm and 60 cm length at their 1^{st} year and 2^{nd} of life. The above observation of Goswami and Devaraj (1992) are very close and supports the findings of the present study. The present investigation on morphometric and meristic characters of fresh water shark, *Wallago attu* was based upon 476 specimens (367 and 109 male and female respectively). In the present study it was inferred that the values of dorsal fin length (DFL), tail fin length (TFL) and ventral fin length (VFL) showed ideal relationship (r = 0.99, 0.99 and 0.98 respectively) with total length in male. While in case of female the values of tail fin length (TFL), ventral fin length (VFL) and girth showed ideal relationship (r = 0.99, 0.99, and 0.98 respectively). The meristic counts in the present study did not show any significant difference between male and female. The higher values of co-efficient of variation and significant values of regression co-efficient for morphometric variables as compared with meristic variables suggested that meristic variables have higher taxonomic value in species identification, while morphometric variables are more under the control of age, environment related variables and population genome, hence having lower values in species identification but can be predictive of inter-stock variation and environmental conditions, like, food, temperature, rearing conditions and season (Jakupsstovu and Haug, 1988; Bromley, 1989). The above statement supports the findings of the present study. In the present study it was concluded that there is no significant (P>0.05) difference in morphometric and meristic characters was noticed between male and female of fresh water shark, *Wallago attu* from Manchar lake district Jamshoro. Similar results no morphological difference between male and female have been published by number of authors in various fish species from different countries like (Prakash and Verma 1982 in *Monopterus albus*; Hoque and Rehman 1985 in *Gudusia chapra*; Salam and Janjua (1991 *in Labeo rohita*; Kohinoor *et al*., 1995 in *Tilapia nilotica*; Azadi and Naseer 1996b in *Labeo bata*; Narejo *et al*., 1999 in *Gudusia variegata*; Lashari *et al*., 2004 in *Cirrhinus reba*; Narejo *et al*., 2008 in *Tenualosa ilisha*; Narejo, 2010 in *Gudusia chapra*).

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