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Length-weight relationship and gut analysis of *Oreochromis mossambicus* (Peter, 1852) collected from local fish market of Quetta city, Baluchistan

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Abstract

Oreochromis mossambicus (Peters, 1852) is herbivorous exotic fish, mostly distributed worldwide and served as prominent food item. Our research is based on finding of length-weight relationships and stomach content analysis of *Oreochromis mossambicus* collected from fish market of Quetta city. A total of 250 fish samples including 138 male and 112 female were collected during the months of April 2016 to March 2017. The calculated length ranged from 9cm to 24.6cm (combined) and the weight ranged from 17.3g to 280g. The length weight relationship was calculated and represented as logarithmic form as Log W = -1.751+3.0071 × Log L , Log W= -1.7719+3.0212×Log L and Log W= -1.7272+2.9913×Log L were separately calculated for combined, male and female population respectively. The values of b for combined, male and female were 3.01, 3.02 and 2.99 respectively, which show isometric growth in *Oreochromis mossambicus*. Dissection of fish samples were made for food and feeding habits determination. Basic food of this fish mainly comprised of cynophyta (41.30%) and bacillariophyta (20.11%) followed by euglenophycea (16.11%), Chlorophyta (10.47%), Miscellaneous (10.74%), Copepod (0.72%), Plant matter (0.36%), rotifers (0.19%), algae (0.01%). In conclusion, the fish was found positive allometric in growth and omnivorous in nature.

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Introduction

Fishes are considered as a subject of over-expanding research; also inspires the imagination of students and the general public. Fishes are very important source of income and food source for humans throughout worldwide (Bard *et al.*, 1976). Tilapia belongs to the class osteichthyes; subclass is actinopterygii, order perciformes and family Cichlidae. Members of cichlidae family are bony in nature (Peter 1852). The family Cichlidae is wide spread across Africa, India and Sri Lanka (Balarin, 1979). Initially *Oreochromis mossambicus* was introduced in Pakistan from Thailand, Indonesia and Egypt in the year 1951 (Frose and Pauly, 2011).

Information of some numerical views such as length-weight relationships (LWRs) has vital importance in biology of fish. Length-weight connections can be utilized to determine weight from length (Pauly, 1993). In the fish biology and healthiness Length-weight relationship is another essential component. It is also essential standard in fisheries to obtain the information about different indirect factors including environmental changeability conditions that are best suitable to development of fishes (Pauly, 1983). The analysis of length-weight data is aimed at describing exactly the relationships between length and weight to allow adaptation of one to another. It also measures the changes from the predictable weight for length of separate fish (Dan-Kishiya, 2013).

Length-weight relationship can be utilized to make an expectation about the fish weight in order to the yield assessments of fish. In addition, Length–Weight relationship (LWR) also permit the estimation for the normal fish weight of a given length gather by building up a numerical connection between the two fishes (Beyer, 1987). This relationship has different applications in fish stock evaluation including assessing the standing stock biomass, and looking at the ontogeny of fish populace from various location (Patrakis and Stergiou, 1995).

Feeding is one amongst the most essential functions of a creature. The study of the feeding habits of different animals based upon examination of stomach content has turned into a standard practice (Hyslop, 1980).

The stomach content examination provides an essential knowledge into fish feeding habits and quantitative estimation of food is a vivacious part of fisheries. The habitat of this fish indeed is salty water and that is why it has been introduced in numerous countries (Mirza, 1990). Fish differ significantly in character of the food they consume. Our study fish is feed upon plants and therefore, falls in herbivorous mode of nutrition category. The main focus of this paper moves around Length-weight relationship and the feeding habits of *Oreochromis mossambicus* collected from fish market of Quetta city which was transported from Sindh River.

Material and methods

Fish Collection

A total of 250 fish samples were collected on monthly basis from April 2016 to March 2017 from local fish market of Quetta.

Length and Weight measurement

Measurement of Total Length (TL) was done with a measuring board nearest to 0.1cm. Fishes Total length was measured from the tip of the snout to tail fin with help of measuring tray. Body weight of fishes was measured nearest to 0.1g using with an electric balance.

Fish Preservation

Preservation of fish sample was placed in 5-10% ethanol and abdominal cavities were first opened to allow deep penetration of preservative chemicals for further investigation of gut contents.

Length-Weight Relationship

The length-weight relationship of all fishes was calculated by using the following illustration given by Achakzai *et al.*, 2013. $W= aL^b$ Where, W; weight (g), length; (cm), a; constant, b; exponent showed isometric growth equal to 3.0. The relationship of length and weight was calculated using linear regression method given as Log W= log a + b log L. Analysis of Gut contents: each fish was accurately cut, open and removed the stomach and immersed in 5-10% formalin.

The gut contents were carefully analyzed under binocular microscope (Nikon Eclipse E200) and identified by using the following keys (Wards and Whipple, 1959; Pennak, 1989; Sangpradub and Boonsoong, 2006).

Gut contents estimation

It was estimated though using point volumetric method (Pillay, 1952) and frequency of occurrence method (Hynes, 1950).

Point volumetric method

$$= \frac{\text{No of points allocated to component}}{\text{Total points allocated to sub-sample}} \text{ x } 100$$

Occurrence frequency was calculated using the formula: $P = \frac{b}{a} \times 100$

Where, a; total number of fish examined having food in their gut, b; number of fish have specific food item, P; percentage presence of each food item.

Gastro-Somatic index (GaSI)

It was calculated as per formula (Dadzie *et al*., 2000).

$$\text{GaSI} = 100\ \frac{SW}{BW}$$

Here, SW abbreviated for gut content and BW stands for body weights (g). Calculation was also made using the formula (Biswas, 1993).

$$\text{GaSI (\%)} = \frac{\text{Weight of gut (g)}}{\text{Weight of fish (g)}} \times 100$$

Gut fullness and its categories

It was calculated using gravimetric method (Hynes, 1950).

$$\text{Gravimetric method} = \frac{Total\ gut\ contents\ weight}{Total\ fish\ weight} \times 100$$

Guts were grouped into five different levels as; full, 3 quarter, ½ quarter and empty (100%, 75%, 50%, 25% and 0% respectively).

Index of preponderance

Natarajan and Jhingran, (1961) method was used to evaluate the relative importance of all food items; the index of preponderance was obtained using formula:

$$I = \frac{Vi\ Oi}{\sum Vi\ Oi} \times 100$$

Where I; Index of preponderance, Vi; percentage, Oi; Occurrence percentage, ∑; Summation

Results

Length-weight relationships (LWRs)

It was determined the length-weight relationships of *Oreochromis mossambicus* ranging from 9.0-24.6cm. Furthermore, determination of the regression coefficients was performed by least square method for combined; male and female using following equations:

Log W= -1.7905+ 3.036 Log L (Males species)

Log W= -1.7272+ 2.9913 Log L (Females species)

Log W= -1.751+ 3.0071 Log L (Combined species)

Food and feedings

About 250 of *Oreochromis mossambicus* fish samples were dissected to determine food and feeding habits. This fish showed great variations in gut contents. The phytoplankton was most abundant food recorded from this fish. Cynophyta was dominant phytoplankton comprised of 28.4% by volume and 26% by occurrence and volumetric method. The cynophyta included *Chroococcus,* Cynophacea, *Gomphosphaeria* and *Gloeocapsa* etc. Bacillariphyta was 16.8% by volume and 21.4% by occurrence and volumetric method. The dominant Bacillariphyta were *Cyclotella,* diatom and *Cymbella* etc. Euglenophyta were 16% by volume and 18% by occurrence and volumetric method. The most common Euglenophyta were *Euglena stellate* and *Paranema dufardin* etc. Chorophyta were 15.6% by volume and 12% by occurrence and volumetric method. The Chorophyta included *Comsmarium, Hydrodictyan,* and *Coelastrum*. The next dominant gut contents were Zooplankton. Among them copepods were most common. The copepods were 4% by volume and 3.2% by occurrence. The common copepods were *Herpecticoida* and *Cyclopoid*. Rotifea was second most common zooplankton found in the gut of this fish. The rotifer was 2.8% by volume and 1.2% by occurrence. Common rotifers were *Brachionus, Keratella,* and *Monostyla*. The Algae was 1.2% by volume and 0.2% in occurrence. The algae included *Spirogyra Chlorella* and *pyrenoidosa*. The plant matters were also recorded from the same fish. These were 3.2% by volume and 2% by occurrence. *Typha* was observed as most common plant matter.

Gut Fullness and Gastrosomatic Index (GaSI)

Current work has shown variation in values for Gut fullness and GaSI. It was noticed that during the months of August, May and June higher values of gut fullness were recorded and lower values were recorded in the month of October and July.

GaSI showed higher values in the months of August, March and May while, it was recorded while lower values of GaSI and gut fullness were recorded in July.

Index of Preponderance and stomach categories

This study also showed great variations in index of preponderance. It was observed that the basic food of *Oreochromis mossambicus* from Quetta Market primarily consist of Cynophyta (41.30%) and Bacillariophyta (20.11%) followed by euglenophycea (16.11%), Chlorophyta (10.47%).

Miscellaneous (10.74%), Copepod (0.72%), Plant matter (0.36%), rotifers (0.19%), algae (0.01%). Out of 250 guts; 50 (20%) were found empty, 80 (32%) were quarter, 30 (12%) were half, 60 (24%) were seen three quarter and 30 (12%) were full observed during entire study period.

Discussion

The Length-weight relationship is given in detail in Tables 1, 2 and 3. The gut content, monthly gut fullness and GaSI of *Oreochromis mossambicus* are also discussed in Table 5 and 6 respectively. The co-efficient of logarithmic LWRs of combined male and female of *Oreochromis mossambicus* are shown in Fig. 1, 2 and 3, the Gut content are shown in Fig. 4, 5, and 6. Fig. 7 and 8 show the mean Length and Mean weight of *O. mossambicus.*

In present study the value of a was -1.7905 and b was 3.036 for male population. Pervin and Mortuza (2008) reported that the value of b ranges 2.5 to 4 for many fishes.

They also suggested that if the value of b is equal to 3 the growth would be consider as isometric, below 3 negative allometric and above 3 would be considered as positive allometric (Bagenal and Tesch, 1978; King, 1996). The current study is strongly supported by aforementioned studies conducted by various researchers. Richer (1963) also suggested that the basic morphology of the fish remain unchanged during entire life (Wooten, 1990).

Table 1. Parameter estimation and descriptive statistics for length-weight relationships (LWRs) of male (M), female (F) and combined sexes (C).

Sex	N	Length range (cm)	Weight range (g)	*a*	*b*	r^2
M	138	9.2-24.6	17.5-280	1.7905	3.036	0.9769
F	112	9.0.-24.0	17.3-270	1.7272	2.9913	0.9774
C	250	9.0-24.6	17.3-280	1.751	3.0071	0.9768

Table 2. Data for length–weight relationship of *Oreochromis mossambicus* from fish market Quetta.

Length Groups (cm)	Males			Females			Combined		
	No. of Males	Length (cm) Mean± SD	Mean Weight (g)	No. of Females	Length (cm) Mean± SD	Mean Weight (g)	No. of combined Specimens	Length (cm) Mean± SD	Mean Weight (g)
9-11	9	10.0±0.56	20.5	10	9.9±0.67	20.1	19	9.9±0.61	20.3
11-13	21	12.1±0.55	28.6	10	11.9±0.50	27.4	31	12.0±0.53	28.2
13-15	25	13.9±0.60	52.1	24	14.0±0.67	52.8	49	13.9±0.63	52.4
15-17	23	15.9±0.66	69.1	23	15.9±0.56	70.3	46	15.9±0.61	69.7
17-19	26	17.8±0.59	94.7	19	17.5±0.45	89.9	45	17.7±0.55	92.7
19-21	13	20.0±0.62	159.2	9	19.8±0.59	163.4	22	19.9±0.61	160.9
21-23	12	22.1±0.46	204.0	10	21.7±0.47	195.3	22	21.9±0.50	200.0
23-25	9	23.9±0.63	257.1	7	23.4±0.40	249.9	16	23.7±0.57	253.9
Total	138			112			250		

Table 3. Mean Length and Weight of *Oreochromis mossambicus in groups.*

Length groups (cm)	Mean Length			Mean Weight		
	Combined	Male	Female	Combined	Male	Female
9-11	9.9	10.0	9.9	20.3	20.5	20.1
11-13	12.0	12.1	11.9	28.2	28.6	27.4
13-15	13.9	13.9	14.0	52.4	52.1	52.8
15-17	15.9	15.9	15.9	69.7	69.1	70.3
17-19	17.7	17.8	17.5	92.7	94.7	89.9
19-21	19.9	20.0	19.8	160.9	159.2	163.4
21-23	21.9	22.1	21.7	200.0	204.0	195.3
23-25	23.7	23.9	23.4	253.9	257.1	249.9

Table 4. Grading of various gut contents in *Oreochromis mossambicus* from Quetta Fish Market.

Food items	% composition of food items		ViOi	Index of Preponderance	Grade By Volume
	Volume (Vi)	Occurrence (Oi)			
Cynophyta	28.4	26	738.4	41.3	I
Bacillariophyta	16.8	21.8	359.52	20.11	II
Euglenophyta	16	18	288	16.11	III
Chlorophyta	15.6	12	187.2	10.47	IV
Miscellaneous	12	16	192	10.74	V
Copepod	4	3.2	12.8	0.72	VI
Plant matter	3.2	2	6.4	0.36	VII
Rotifera	2.8	1.2	3.36	0.19	VIII
Algae	1.2	0.2	0.24	0.01	IX
∑ViOi =1787.92					

Table 5. Monthly gut fullness and Gastrosomatic index (GaSI) of *Oreochromis mossambicus* from Quetta Fish Market.

Months	Gut fullness	GaSI
August	70	1.8
September	40	1.1
October	35	1
November	50	1.1
December	45	1.5
January	50	1.7
February	45	1.1
March	40	1.9
April	60	2
May	70	1.9
June	70	1.6
July	30	0.7
Average	50.42	1.45

Table 6. State gut fullness of *Oreochromis mossambicus.*

State	No of guts	Percentage
Empty 0%	50	20
Quarter 25%	80	32
Half 50%	30	12
Three Quarter 75%	60	24
Full 100%	30	12
Total	250	100

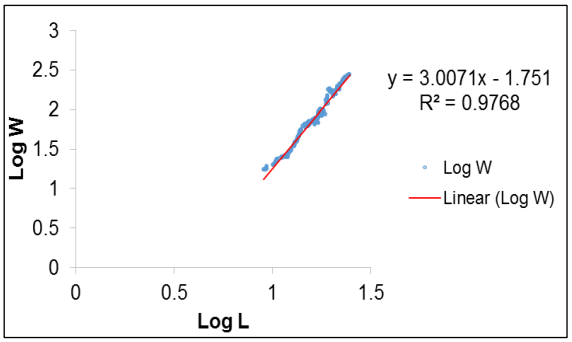

Fig 1. Co-efficient of logarithmic LWRs of combined *Oreochromis mossambicus*.

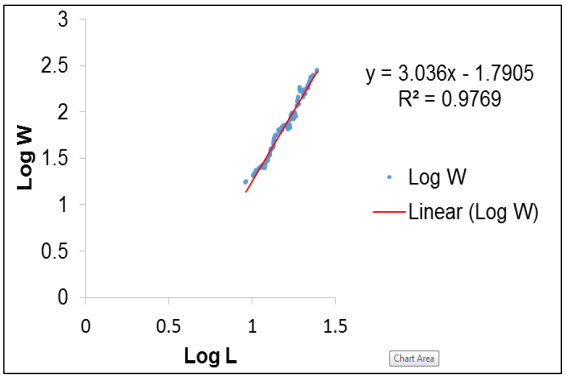

Fig 2. Co-efficient of logarithmic LWRs of male *Oreochromis mossambicus*.

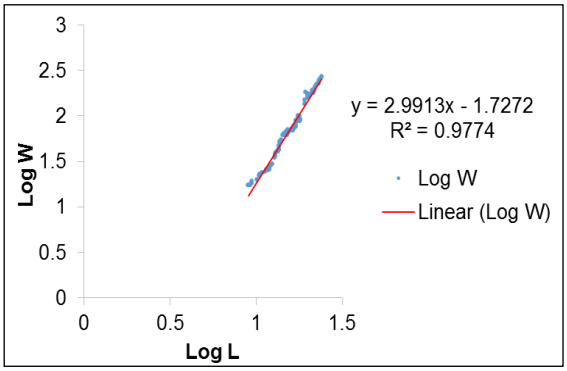

Fig 3. Co-efficient of logarithmic LWRs of female *Oreochromis mossambicus*.

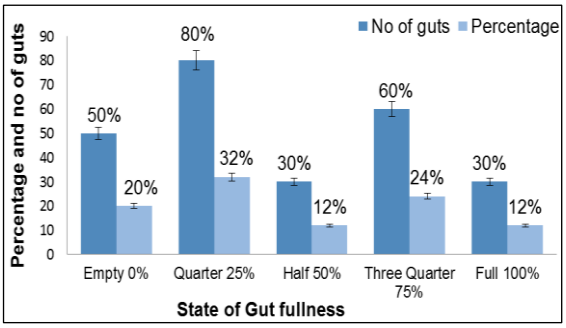

Fig 4. State gut fullness of *Oreochromis ossambicus*.

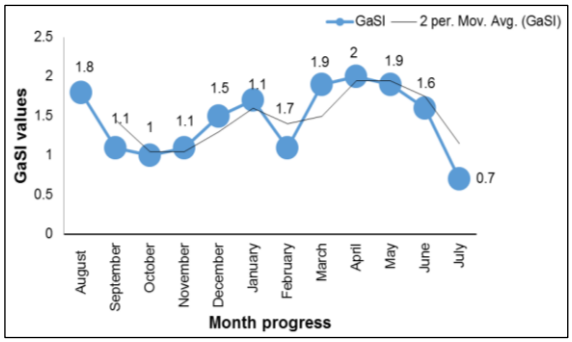

Fig 5. GaSI of *Oreochromis mossambicus* during the year.

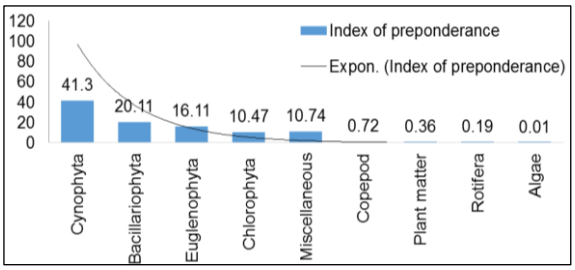

Fig 6. Index of preponderance of *Oreochromis mossambicus according to food items from fish market of Quetta.*

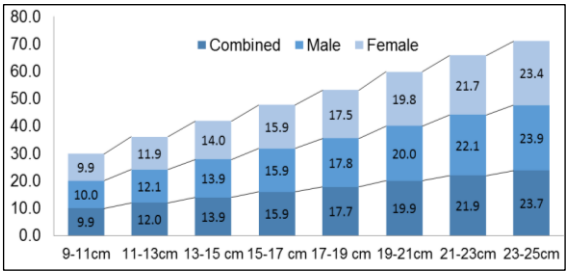

Fig 7. Mean Length Groups of Male, Female, and Combined *Oreochromis mossambicus*.

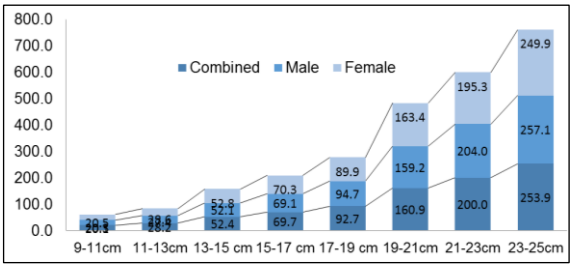

Fig 8. Mean weights of male, female and combined groups of *Oreochromis mossambicus*.

Achakzai *et al.*, (2013) also reported the value of b 3, which supports current study. Slightly different studies are conducted by Naeem *et al.*, (2010).

Similar findings were also recorded by Herath *et al*., (2014) in *Oreochromis mossambicus* from different water bodies of Sri Lanka. They reported isometric growth (*b*=3).

Our findings are in agreement with certain research conducted on *Oreochromis mossambicus* and *Salmo trutta* (Arslan *et al*., 2004 Naeem *et al*., 2011a; 2011b; Acakzai *et al*., 2013). We compared log a versus b to estimate for fish Base (Frose, 2006). Frose and Pauly, (2011) was also used similar comparison and found it to be very close to those values calculated for *O. mossambicus*.

Getabu, (1994) reported diatom (phytoplankton) abundantly isolated from the gut of *Oreochromis mossambicus* while, De moor, (1986) reported that phytoplankton is the most favored food for adult fish. These findings are strongly supported in current study. This study recorded phytoplankton as most abundant gut item from *O. mossambicus*. Bowen, (1976) reported that there is fast growing trend in *Oreochromis mossambicus* and fish mainly feed on detritus and diatom. Doup´e *et al.,* (2009) also suggested that the fish feed on phytoplankton. Yousaf *et al*., (1998) suggested that *Oreochromis mossambicus* is omnivorous and surface grazer in nature. Present study reported that *Oreochromis mossambicus* is omnivorous in feeding; these findings are strongly supported in a Tropical Reservoir, Nigeria on *O. niloticus* by Oso *et al*., (2006). Similar findings were also recorded in Egypt by Kariman and Khalifa (2009). Present findings on length-weight relationships and feeding habits of *Oreochromis mossambicus* would be the first findings form local fish market of Quetta city. These findings will be baseline for young researchers.

Conclusion

This would be the first attempt on length-weight relationships of *Oreochromis mossambicus* from local fish market of Quetta city. This study concluded that the fish is omnivorous in feedings and having positive allometric growth. This research will open the door in continuation to work on other fishes to estimate their length-weight relationships.

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