Pakistan J. Zool., vol. 45(4), pp. 903-907, 2013

Morphometric Parameters Based Study of the Hatchery Raised and Natural Populations of *Labeo rohita*

Fayyaz Rasool,[1] Naureen Aziz Qureshi,[2*] Shakeela Parveen,[3] Muhammad Siddique,[2] Amjad Hameed,[4] Noor Khan[1] and Khalid Javed Iqbal[1]

[1]*Department of Fisheries and Aquaculture, University of Veterinary and Animal Sciences, Lahore*
[2]*Government College University, Faisalabad*
[3]*Department of Zoology and Fisheries, University of Agriculture, Faisalabad*
[4]*Nuclear Institute of Agriculture and Biology, Faisalabad*

Abstract.- The variation amongst the different populations of *Labeo rohita* on the basis of morphometric parameters was studied. Samples were collected from different geographical locations and representatives of the farmed and natural populations pertaining to four riverine sites and compared with one hatchery population. Data regarding the morphogenetic parameters *viz*., body weight, fork length, total length and lengths of dorsal, caudal, anal, pectoral and pelvic fins of each individual were measured. Analysis of variance (ANOVA) for the different morphometric parameters of study was done using Minitab 16.0. The Pearson correlation analysis of the morphometric parameters was done by XLSTAT 2012 version 1.02. The results indicated that the body weight, total length and average length of paired pectoral fins of *L. rohita* were non-significantly different (P> 0.05), anal fin length was significantly different (P<0.05), and all the remaining parameters were highly significantly different (P<0.01) among the sites. The correlation of fish body weight and fork length was highly significant (p<0.001) and positive with all the parameters except with the caudal fin which was positively but non-significant in correlation with fork length (p = 161). The observations on the morphometric parameters and the condition factor for *Labeo rohita*, showed that population of the target species collected from Qadirabd Barrage on the Chenab River was the best.

Key words: *Labeo rohita*, farmed fish, condition factor, morphometric parameters.

INTRODUCTION

Labeo rohita commonly known as Rohu or Dumbra is a fish of the carp family Cyprinidae found commonly in rivers and freshwater lakes in and around South Asia and South-East Asia. This is occasionally omnivorous in nature (Keralaagriculture, 2012) and treated as a delicacy in Pakistan, Bangladesh, India, Nepal and other Asian countries. It does not breed in the lentic environments and the major method for its breeding is the induced breeding under controlled conditions (Froese *et al.*, 2006). *Labeo rohita* can attain maximum length up to 200 cm, the maximum weight of 45 kg (Frimodt, 1995) and the maximum reported age of 10 years (Khan and Jhingran, 1975). It is characterized by dorsal fin with 12-14½ branched rays; lower profile of head conspicuously arched; short dorsal fin with anterior branched rays shorter than head; 12-16 predorsal scales; snout without lateral lobe (Kottelat, 2001). Adults inhabit rivers (Talwar and Jhingran, 1991), it is diurnal species and usually solitary.

Many natural populations of fish species have decreased drastically in number, mainly because of the effects of over-exploitation, habitat alterations, including physiography, abiotic, and biotic features, the release and introduction of exotic fish species, etc. Over harvesting or fishing, especially when directed against a specific size or class age, can reduce the size of the population to a level where inbreeding and loss of genetic diversity may be a serious problem or may lead to extinction of local populations or segments of the population (Ryman *et al.*, 1995). The studies have been conducted for the comparison of morphometric parameters along with genetic disturbances for the conservation of this endemic species in the sub-continent (Faith *et al.*, 2004). Therefore, on the basis of different studies it can be described that the occurrence of different morphological characteristics within the populations of the same species are confirmed evidences to some extent for the presence of the

* Corresponding author: naureenaziz.qureshi@gmail.com
0030-9923/2013/0004-0903 $ 8.00/0

different kinds of the Indian major carps within the same species. These studies were confirmed by the stocks of *Labeo rohita* from the moats as the representatives of the standing water bodies compared with the stock captured from the Ganga and Yamuna rivers of India (Khan and Jingran, 1975).

The condition factor is used as the growth index for the fish and hence is necessary measurement to make a comparison amongst the different populations of the same species (Abowei *et al.*, 2009; Isa *et al.*, 2010).

The present work investigates the link between the hatchery raised and natural populations of the riverine system of Punjab on the basis of morphometric parameters of *Labeo rohita* collected from different geographical locations. The study will be helpful in the selection of suitable candidates which have better morphological features and growth potential for quality aquaculture production.

MATERIALS AND METHODS

Labeo rohita, were collected from different natural and manmade reservoirs to evaluate differences between them on the basis of morphometric parameters. The 100 samples from each site were collected *i.e.* were the representatives of hatchery raised and natural populations of the Riverine systems of Punjab *viz.*, UVAS-Fish Hatchery, C-block Ravi campus Pattoki District Kasur, Trimu Barrage at the junction of River Chenab and Jhelum near district Jhang, Taunsa Barrage at River Indus near Tehsil Kot Adu District Muzaffar Garh, Qadirabad Barrage at River Chenab near District Mandi Bahuddin and Baloki Barrage at River Ravi near Tehsil Bhai Phero District Kasur. Data regarding the morphogenetic parameters *viz.*, body weight, fork length, total length and lengths of dorsal, caudal, anal, pectoral and pelvic fins of each individual were recorded. The condition factor and the length weight relationship were also estimated by regression analysis. Analysis of variance (ANOVA) for the difference in morphometric parameters between sites was done by Minitab 16.0 using General Linear Model Theory (Steel and Torrie, 1998). The XLSTAT 2012 version 1.02 of the computer software was used for the Pearson correlation of the morphometric parameters. The Fulton condition factor (K) was determined by the following formula (Froese, 2006):

$$K = \frac{W \times 10^5}{L^3}$$

RESULTS AND DISCUSSION

The samples of the *L. rohita* having almost same age were captured in January-February, 2011 from the Pattoki fish hatchery, Trimu barrage at the junction of Chenab and Jhelum Rivers, Taunsa barrage at Indus River, Qadirabad barrage at Chenab River and Baloki barrage at Ravi River. The average weights, total lengths and averages of other morphological parameters are given Table I. The results obtained by statistical analysis showed that the wet body weight and anal fin lengths of *L. rohita* were significantly different; the fork length, dorsal, caudal and pelvic fin lengths were highly significantly different; while in case of total length and pectoral fin length there was non significant difference among the sites (Table I).

The results of this study indicated that the wet body weight and total length of the *L. rohita* populations from the different sites was not significantly different, while the fork length of the populations amongst sites was highly significantly different. Same results were postulated by Khan *et al.* (2003) while working with the farmed *Labeo rohita* and also these results are in accordance with the findings of Tahir *et al.* (2008) working with the farmed Indian major carps. In case of other morphometric parameters; the length of the paired pectoral fins was non significantly different ($P>0.05$) and anal fin length was significantly different ($P<0.05$), while the differences for all the remaining fin types included in the present study were highly significant ($P<0.01$) among the sites. From these results it is clear that the populations of the same species collected from different geographical locations have differences in their body characteristics. Same results were postulated by Faith *et al.* (2004) while working on the morphometric parameters and genetic studies of the endemism of the fish populations in the sub-continent. These findings are also according to the

Table I.- Average morphometric parameters of *Labeo rohita* collected from different water bodies of Punjab, Pakistan.

Sites	Wt. (g)	FL (cm)	T L(cm)	DF(cm)	CF(cm)	AF(cm)	PeF(cm)	PlF(cm)	K
Hatchery	228.30±27.78	23.25±1.23	26.45±1.29	6.49±0.61	5.65±0.33	4.43±0.65	4.37±0.41	4.08±0.34	1.23
Trimu Barrage	253.60±27.19	23.92±1.34	27.08±1.43	6.57±0.57	5.73±0.36	4.49±0.60	4.65±0.50	4.33±0.54	1.28
Taunsa Barrage	249.75±30.43	24.33±0.96	27.16±1.05	6.56±0.40	5.69±0.42	4.57±0.48	4.58±0.46	4.33±0.48	1.25
Qadirabad Barrage	248.80±11.67	24.51±0.56	27.43±0.46	6.64±0.32	5.56±0.18	4.52±0.30	4.57±0.32	4.33±0.36	1.23
Baloki Barrage	253.80±23.47	24.54±1.54	26.66±1.52	5.49±0.41	4.74±0.79	4.07±0.66	4.23±0.73	3.96±0.73	1.34
P-Values	0.052^{NS}	0.004**	0.800^{NS}	0.000**	0.000**	0.037*	0.055^{NS}	0.003**	-

*K, Condition factor; NS, Non Significant; **, Highly Significant; *, Significant.
FL, fork length; TL, total length; DF, dorsal fin length; CF, caudal fin length; AF, anal fin length; PeF, average length of paired pectoral fins; PlF, average length of paired pelvic fins.

Table II.- Length-weight relationship of *Labeo rohita* collected from different water bodies of Punjab, Lahore.

Sites	Log_{10} Transformed Regression Equation		r	R^2	Probability
Hatchery	Y = 0.199 + 1.73 (X)	SE = 0.071	0.990	0.981	0.000
Trimu Barrage	Y = 0.460 + 1.57 (X)	SE = 0.091	0.981	0.967	0.000
Taunsa Barrage	Y = 0.319 + 1.60 (X)	SE = 0.081	0.986	0.977	0.000
Qadirabad Barrage	Y = 0.233 + 1.78 (X)	SE = 0.061	0.993	0.990	0.000
Baloki Barrage	Y = 0.460 + 1.57 (X)	SE = 0.091	0.981	0.970	0.000

*SE, Standard error; r, Correlation coefficient; R^2, Coefficient of determination; X, Fork length (cm); Y, Fish body weight (g)

results of Khan and Jingran (1975) where they concluded that the populations of *Labeo rohita* collected from the flowing water bodies and standing water bodies represents significant differences on the basis of morphological data.

The condition factor (K) values for the *L. rohita* populations from hatchery, Trimu, Taunsa, Qadirabad and Baloki are shown in Table I. The correlation co-efficient for *L. rohita* was calculated as 0.990, 0.981, 0.986, 0.993 and 0.981 for the Hatchery, Trimu, Taunsa, Qadirabad and Baloki populations, respectively. As the data showed a positive correlation between total length and body weight of fish species is indicated by "r" and high value of "r" (nearly one) for each regression equation showed the high accuracy of these regression model. Maximum linear increment r=0.993 for *L. rohita* in Qadirabad population, nearest equal to 1 that depicted significant and direct relationship among the total length and body weight (Table II). The correlation amongst the different Morphometric parameters is shown in correlation map (Table III).

For population of *L. rohita* with a highest value in Qadirabad of r =0.993 nearly equal to 1 showed the significant and direct relationship with respect to average total length and body weight of this species and showed the good condition of fish because if the value is equal to one it shows the good condition in relation to previous stocks of this fish. These results are same as the results concluded by Narejo (2006) while studying the length-weight relationship and relative condition factor of a carp, *Cirrhinus reba* (Hamilton) from Manchar Lake, Distt. Dadu, Sindh, Pakistan. These results are in accordance with the findings of Abowei *et al.* (2009) who found that the condition factor values were from 0.917 for *I. africana* and 0.985 for *C. senegalensis* and found that all species in study showed iso-metric growth except *S. maderensis* and *C. senegalensis* which showed positive allometric trend from their findings while working with five fish species of the Nkoro River in Niger delta region of the Nigeria. These results are also on the same lines with the results of Isa *et al.* (2010) who calculated condition factor values 0.9105±0.1986, while working with twelve freshwater species in the basin of the Kerian River in Perak and Lake Peduat

Table III.- Correlation matrix.

Var.	Weight	FL	TL	DF	CF	AF	PeF
FL	0.639	1					
	<0.001						
	0.408						
TL	0.705	0.879	1				
	<0.001	<0.001					
	0.497	0.772					
DF	0.422	0.422	0.633	1			
	<0.001	<0.001	< 0.0001				
	0.178	0.178	0.401				
CF	0.391	0.141	0.376	0.614	1		
	<0.001	0.161	0.000	< 0.0001			
	0.153	0.020	0.141	0.377			
AF	0.733	0.429	0.614	0.643	0.727	1	
	<0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
	0.537	0.184	0.377	0.413	0.529		
PeF	0.692	0.337	0.491	0.447	0.649	0.741	1
	<0.001	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
	0.479	0.113	0.241	0.200	0.422	0.550	
PlF	0.764	0.420	0.558	0.537	0.675	0.804	0.876
	<0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	0.583	0.176	0.311	0.289	0.456	0.646	0.767

Var., variables; Wt., body weight.
For Abbreviations see footnote of Table I and II.

Kedah. These findings are in coherence with the results ranges near to one 0.925-0.999 by Mahboob and Sheri (1999) for farmed major carps. These results also indicated that the growth tends to be isometric in nature which is in relation to the findings of Naeem *et al.* (2010) who proved that a tendency for regression coefficient (b) in the relation $W = aL^b$ to be close to or greater than similar figure for hybrid, *Catla catla*♂ X *Labeo rohita*♀, which gives the idea that growth in many cases tends to be isometric and also by Tahir *et al.* (2008) for farmed major carps. The correlation among the morphometric parameters was also studies and results showed that all the morphometric parameters *viz.*, fish body weight, fork length, total length, dorsal fin length, caudal fin length, anal fin length, average length of the paired pectoral fins and average length of the paired pelvic fins showed highly significant (P<0.001) and positive correlation with each other. As for the length-weight relationship it is clear that length and weight are significantly correlated but in case of fins correlation there is difference among the populations of the same species and results are in accordance with the results of Faith *et al.* (2004) while working on the morphometric parameters and genetic studies of the endemism of the fish populations in the sub-continent.

CONCLUSIONS

On the basis of the result of this study which were drawn by the observations on the morphometric parameters and the condition factor for *Labeo rohita*, it was concluded that population of the target species collected from Qadirabd Barrage on the Chenab River was the best followed by the Taunsa and Trimu Barrages populations on the River Indus and at the junction of River Chenab and Jhelum, respectively.

REFERENCES

ABOWEI, J.F.N., DAVIES, O.A. AND ELI, A.A., 2009. Study of the length–weight relationship and condition factor of five fish species from Nkoro River, Niger Delta, Nigeria. *Curr. Res. J. biol. Sci.*, **1**: 94-98.

CARLANDER, D., 1970. *Handbook of freshwater fishery*

biology, Vol. 1. The Iowa State University press, Iowa, USA.

FOOD AND AGRICULTURE ORGANIZATION OF UNITED STATES, 2010. "*Cirrhinus mrigala*" Fisheries global information systemhttp://www.fao.org/fishery/culturedspecies

FAITH, D.P., REID, C.A.M. AND HUNTER, J., 2004. Integrating phylogenetic diversity, complementarily, and endemism for conservation assessment. *Conserv. Biol*., **18**: 255-261.

FRIMODT, C., 1995. *Multilingual illustrated guide to the world's commercial warm water fish*. Fishing News Books, Osney Mead, Oxford, England. 215 p.

FROESE, R., 2006. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. *J. appl. Ichthyol*., **22**: 241–253.

ISA, M.M., RAWI, C.S.M., ROSLA, R., SHAHAND, S.A.M. AND SHAH, A.S.R.M., 2010. Length – weight relationships of freshwater fish species in Kerian River Basin and Pedu Lake. *Res. J. Fish. Hydrobiol*., **5**: 1-8.

KHAN, H.A. AND JHINGRAN, V.G., 1975. *Synopsis of biological data on Rohu* Labeo rohita *(Ham., 1822)*. FAO Fisheries Synopsis No III. 100.

KOTTELAT, M., 2001. *Fishes of Laos*. WHT Publications Ltd., Colombo 5, Sri Lanka, pp. 198.

LECREN, E.D., 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J. Anim. Ecol*., **20**: 201-219.

MAHBOOB, S. AND SHERI, A.N., 1999. Length-weight relationship of carps under the influence of different fertilizers and feed supplementation in composite culture system. *Pakistan J. Zool.*, **31**: 11-15.

NAEEM, M., SALAM, A., ISHTIAQ, A. AND SHAFIQUE, S., 2010. Length- weight and condition factor relationship of farmed hybrid (*Catla catla*♂ X *Labeo rohita*♀) from Multan, Pakistan. *Sindh Univ. Res. J*., **42**: 35-38.

NAREJO, N.T., 2006. Length-weight relationship and relative condition factor of a carp, *Cirrhinus reba* (Hamilton) from Manchar Lake, Distt. Dadu, Sindh, Pakistan. *Pakistan J. Zool*., **38**: 11-21.

PETHIYAGODA, R., 1991. *Freshwater fishes of Sri Lanka.* The Wildlife Heritage Trust of Sri Lanka, Colombo, pp. 362.

RYMAN, N., UTTER, F. AND LAIKRE, L., 1995. Protection of intraspecific biodiversity of exploited fishes. *Rev. Fish. Biol. Fish*., **5**:417–446.

ROBERTS, T.R., 1997. Systematic revision of the tropical Asian labeon cyprinid fish genus *Cirrhinus*, with descriptions of new species and biological observations on *C. lobatus*. *Nat. Hist. Bull. Siam. Soc.*, **45**: 171-203.

STEEL, R.G. AND TORRIE, J.H., 1998. *Principles and procedures of statistic*, McGraw-Hill Book Co, New York, NY, 2nd Edt., pp. 633.

TAHIR, M.Z.I., AHMED, I., MATEEN, A., ASHRAF, M., NAQVI, Z.H. AND ALI, H., 2008. Studies on partial replacement of fish meal with oilseeds meal in the diet of major carps. *Int. J. Agric. Biol*., **10**: 455-458.

TALWAR, P.K. AND JHINGRAN, A.G., 1991. *Inland fishes of India and adjacent countries. vol 1*. A.A. Balkema, Rotterdam, 541 p

WELCOMME, R.L., 1988. *International introductions of inland aquatic species.* FAO Fish. Tech. Pap., pp. 294-318.

ZHANG, S. AND REDDY, P.V.G.K., 1991. On the comparative karyomorphology of three Indian major carps, *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhinus mrigala* (Hamilton). *Aquaculture*, **97**: 7–12.

(Received 9 August 2012, revised 27 April 2013)