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Meristic and Morphometric Studies on Indus Mahseer *Tor macrolepis* (Teleostei: Cyprinidae) from District Attock, Pakistan

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ABSTRACT

Among Mahseers, Indus Mahseer *Tor macrolepis* is the important game and food fish of Pakistan. The meristic and morphometric data of this fish is lacking for the species present in the Pakistan. For the study, one year fish sampling was conducted at various sites of Attock district and adjoining areas from 2008 to 2009. For the purpose, Haro River was divided into four sampling zones: each at a distance of 10 km, from July 2008 to June 2009 in Attock region, Pakistan. Fifth sampling zone was selected in the Hasan Abdaal, Pakistan. A total of 118 specimens were collected from these five sampling zones and more than forty important morphometric and meristic parameters were selected for the study. Collected samples ranged from 12.32- 15.86 in total length (TL), 11.05-14.21 in fork length (FL) and 9.68-12.4 in standard length (SL). In the fish, gill rakers were counted as 2-3/11-13, rostral barbel length (RBL) was found slightly shorter than maxillary barbel length (MBL), no distinct stripes or spots present on body, eyes were present in ventral view of head and terminal mouth was observed. High level of significant relationships were observed with total length (TL) and head length (HL) when compared to all other morphometric parameters studied. Present study will help the taxonomists and fisheries scientists to distinguish *T. macrolepis* from other *Tor* species. © 2011 Friends Science Publishers

Key Words: *Tor macrolepis*; Morphometry; Meristic count

INTRODUCTION

The freshwater fishes of the genus *Tor* commonly known as Mahseer with wide distribution in Southern Asia from Afghanistan in the West to Thailand and Malaysia in the East and also present in China, are medium to large sized barbs occurring in Pakistan, Indonesia, South and Southeast Asia including the Indian peninsula (Heckel, 1838; Serene, 1951; Menon, 1992; Naeem *et al*., 2011). *Tor* genus includes *Tor macrolepis* and more than 20 other species but their taxonomy is yet to be established scientifically (Hora, 1939; Mirza & Javed, 1986; Menon, 1992; Roberts, 1993; Kottelat, 2000; Chen & Yang, 2004).

Hamilton (1822) first classified mahseers and placed *Tor* species under the genus *Cyprinus*. He recognized three species of mahseers; *Cyprinus tor*, *C. putitora* and *C. mosal*. Later, Gray (1833) created genus *Tor* to accommodate these. Heckel (1838) described a mahseer species *Labeobarbus macrolepis* from Kasmir locality. Later it was accepted as *Barbus macrolepis* (Heckel) by Valenceinnes (1841; 1842) and Gunther (1868). Day (1871) named it as *Barbus tor*. Day (1878; 1889) grouped Hamilton's *Cyprinus putitora*, *C. tor* and *C. mosal* together under a single species *Barbus tor* but Hora and Mukerji (1936) and Hora (1939; 1943) were of the opinion that *C. putitora* is clearly distinct from *C. tor* but may be conspecific with *C. mosal*. Silas (1960) merged the species *Labeobarbus macrolepis* with *T. putitora*.

Ahmed (1943) recorded a species of Mahseer i.e., *T. putitora* (Hamilton) even from River Ravi at Lahore. In 1963, he listed only two species of Mahseers from West Pakistan i.e., *T. tor* and *T. putitora* (Hamilton). Mirza (1967) described a new species *N. zhobensis* from River Zhob in North East Baluchistan. Mirza and Omer (1974) recorded *T. mosal* (Hamilton) from River Haro in Northern Punjab. Subsequently most of the authors listed four species of mahseers from Pakistan (Mirza, 1975 & 1981); *T. putitora* (Hamilton), *T. tor* (Hamilton), *T. mosal* (Hamilton) and *N. zhobensis* (Mirza).

A study to clear the systematic position of various species of *Tor* found in Pakistan and Azad Kashmir was conducted by Mirza and Javed, (1985). This study

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concluded that record of *T. mosal* was based on specimens of *T. tor* approaching *T. mosal* in head length/body depth ratio consequently only 3 Mahseer species i.e., *T. putitora*, *T. tor* and *N. zhobensis* were described.

Among these three species *T. zhobensis* is different from the remaining species in having a more or less well developed groove in front of nostrils, breadth of head greater than its height, Lateral line scales more than 32, smaller size of scales, small size of eyes and wide mouth. Hence a new subgenus named as *Naziritor*, which was subsequently elevated to genus after the name of Dr. Nazir (Ex Director of Fisheries) has been erected to accommodate this species (Mirza & Javed, 1985).

Mahseer present in the Indus water system was considered as *T. putitora*. According to Mirza *et al.* (2004), Mahseer is present in both Indus water basin and Ganga-Brahamputra water basin system. Mahseer present in Ganga-Brahamputra system belongs to *T. putitora*, where as of Indus basin is *T. macrolepis* (Heckel). In Pakistan, Mahseer *T. macrolepis* is present in the four out of five Ichthyogeographic provinces except Hindukush Karakoram province. In 2004, International Fish Base accepted *T. macrolepis* (Heckel, 1838) as senior synonym in place of *Labeobarbus macrolepis* (Heckel, 1838) vide reference No. 41236 (Froese & Pauly, 2011).

The present study was aimed to describe the morphometric ratios and meristic counts of *T. macrolepis* as there is almost no scientific data on this important mahseer fish species available in literature. In the present paper, important meristic and morphometric proportions have been discussed to clarify the taxonomic ambiguities in this regard.

MATERIALS AND METHODS

Mahseer sampling was conducted from July 2008 to June 2009 in Attock region for the study of PhD thesis. During this period, sampling was made from different sites of Attock district and adjoining areas. For this purpose, the Haro River was divided into four sampling zones. Each part consisting of about ten kilometer area starting from upstream of the Haro River Toll Plaza at G.T. road and ending at Garyala junction with the Indus River. Fifth batch of fish samples was collected from Hasan Abdaal area around Nalah Kala and adjoining water streams. A total of 118 specimens of Mahseer (9.4 to 26 cm total length) were collected from different sites of the Haro River and adjoining areas.

Many different methods were used to collect the fishes depending upon the circumstances like angling, hook & line, pond net, cast net, scoop net, gill net drag net and cover pot etc. Specimens in field were fixed in 10% formalin. Larger specimens were also given intra-peritoneal injection of formalin. The samples were packed in soaked cotton with pure formalin and were transported to laboratory and shifted in 70% ethanol for further investigation. Each specimen was numbered and tagged in the dorsal fin. The meristic and morphometric measurements were done with the help of magnifying glass model 50 m.m. dia (China), stage microscope, electric balance, scales, divider and vernier caliper etc.

All counts and measurements are taken following Jayaram (1981) and classification was followed after Mirza (2004). Abbreviations of meristic and morphometric characters are given in Table I.

RESULTS

Mean values of thirty morphometric measurements of *T. macrolepis* are given in Table II. Comparison of ranges of morphometric ratios among five sampling groups of *T. macrolepis* and their mean values are given in Table III and IV, respectively. Body profile gently arched on both sides, laterally compressed and compression more towards tail; elongate and muscular and streamlined body; mouth sub-terminal and of intermediate size; head oval shaped slightly pointed; HL 20.55 to 26.8% (m; 22.60) of TL and 26.34-35.61% (m; 28.93) of SL; HH contains 53.57-69.23% (m; 60.63) of HL and its HB contained 43.63 to 56.6% (m;50.00) of HL; SNL contained 5.93-8.36% (m; 7.06) in TL; it contains 7.69-11.64% (m; 9.04) of SL and 24.52-36.92% (m; 31.27) of HL; eyes large and dorsolateral in position; ED contained 3.95-6.91% (m; 5.32) of TL; 5.03-8.90 (m; 6.83) of SL; 18.91 to 29.41% (m; 23.59) of HL. MBL longer than the diameter of the eye and usually reaching beyond posterior margin of the eye; RBL equal to or slightly shorter than MB; not reaching anterior margin of the eye. RBL contained 14.51-28% (m; 20.84) of HL and 66.66-122.22% (m; 88.64) of ED; MBL contained 16.12-34.00% (m; 24.05) of HL and 62.50-141.28% (m; 102.74) of ED. Thick fleshy lips; LUJ contained 4.79-8.51% (m; 6.30) of TL; 6.30-10.27% (m; 8.06) of SL; 21.27-35.59% (m; 27.94) of HL.

BH greater than BB; it contained 16.19-24.25% (m; 20.38) of TL; 12.62-31.74% (m; 26.07) of SL and 66.07-109.09% (m; 90.82) of HL. BB contained 10.4-13.83% (m; 12) of TL; 10.57-17.81% (m; 15.32) of SL; 41.07-64.06% (m; 53.36) of HL. Dorsal fin almost in middle of the body with upper margin concave; last simple dorsal ray forming strong and bony spine; three rudimentary spine also present. It contained 16.45-23.40% (m; 20.34) of TL; it contains 17.79-29.86% (m; 26.01) of SL and 69.64-102.38% (m; 90.82) of HL. PRDL contained 36.59-42.18% (m; 39.19) of TL; it contains 47.54-67.66% (m; 50.27) of SL. PODL contained 36.24-41.86% (m; 38.99) of TL; it contains 47.96-55.55% (m; 49.92) of SL.

Pelvic fin horizontal, almost in the midway between head to caudal base, origin of pelvic fins slightly behind or just underneath dorsal fin origin; pectoral fin not reaching pelvic fin and pelvic fin are separated from anal; distance between pectoral and pelvic almost equal to the distance between pelvic and anal fin base; first ray of each paired fin

Table I: List of Abbreviations of meristic and morphometric characters

TL	Total length
SL	Standard length
HL	Head length
HH	Head height
HB	Head breadth
ED	Eye diameter
BB	Body breadth
BH	Body height/depth
AS	Axial Scale
DF	Dorsal fin
PF	Pectoral fin
VF	Ventral fin
CF	Caudal fin
PRDL	Pre dorsal length
PODL	Post dorsal length
RBL	Rostral barbel length
MBL	Maxillary barbel length
LD	Least Depth of caudal peduncle
CPL	Caudal peduncle Length
LBAF	Length of base of anal fin
LBCF	Length of base of caudal fin
LBDF	Length of base of dorsal fin
LBPF	Length of base of pectoral fin
LBVF	Length of base of ventral fin
POL	Postorbital length
PRDS	Predorsal scale
FL	Fork length
LLS	Lateral-line scale
D-LLS	Above
V-LLS	Below
FR	Fin Rays
DFR	Dorsal fin ray
AFR	Anal fin ray
PFR	Pectoral fin ray
VFR	Ventral fin ray
CFR	Caudal fin ray
CPS	Circumpeduncle scale
GR	Gill rakers
LUJ	Length of upper jaw
PPL	Pre-pelvic Length
IOW	Interorbital width
SNL	snout length
LDF	length of dorsal fin
LDF	length of dorsal fin
LPF	length of pectoral fin
LPELF	length of pelvic fin
LAF	length of anal fin
LCF	length of caudal fin
LBPELF	length of base of pelvic fin
LCP	length of caudal peduncle
WWPS	Wet Weight of preserved specimen

simple (unbranched); a scaly appendage of 2 or 3 scales (Axial scale) present at the base of pelvic fins. PPL contained 38.13-43.61 % (m; 40.84) of TL; 47.36-57.53% (m; 52.28) of SL; 42.30-50.52% (m; 45.65) of FL; 154.14-201.51% (m; 181.12) of HL.

Anal fin equal or slightly smaller than pectoral fin; not reaching the base of caudal fin. It contained 12.30-17.64% (m; 14.78) of TL; 15.49-22.22% (m; 18.92) of SL; 52.17-77.27% (m; 65.68) of HL. Caudal fin deeply forked, its length contained 17.25-28.96% (m; 23.7) of TL; it contained 21.87-32.80% (m; 27.92) of SL and 70.17-111.11% (m; 96.20) of HL. LCP long narrow tapering; its

Table II: Morphometric measurements (mean values) in five sampling groups of *Tor macrolepis*

Measurement (cm)	Group -I	Group -II	Group -III	Group -IV	Group -V	MM	SD
TL	12.49	15.86	13.13	13.65	12.32	13.49	1.43
SL	9.78	12.4	10.37	10.69	9.68	10.58	1.10
FL	11.33	14.21	11.76	12.25	11.05	12.12	1.25
PPL	5.18	6.45	5.34	5.55	5.13	5.53	0.54
PRDL	4.95	6.12	5.13	5.39	4.88	5.29	0.50
PODL	4.82	6.27	5.24	5.3	4.8	5.29	0.60
HL	2.97	3.71	2.86	2.99	2.73	3.05	0.38
HH	1.78	2.13	1.8	1.83	1.71	1.85	0.16
HB	1.33	1.74	1.47	1.55	1.38	1.49	0.16
SN	0.94	1.13	0.92	0.94	0.85	0.96	0.10
POL	1.44	1.7	1.6	1.45	1.22	1.48	0.18
DE	0.74	0.83	0.68	0.67	0.63	0.71	0.08
BH	2.34	2.8	2.77	3	2.74	2.73	0.24
BB	1.48	1.81	1.67	1.73	1.47	1.63	0.15
LDF	2.47	3.11	2.7	2.8	2.57	2.73	0.25
LPF	2.02	2.48	1.96	2.02	1.87	2.07	0.24
LVFR	1.72	2.05	1.85	1.84	1.71	1.83	0.14
LAF	1.8	2.25	2.01	2.02	1.86	1.99	0.17
LCF	2.82	3.35	2.92	2.79	2.77	2.93	0.24
RBL	0.68	0.77	0.57	0.56	0.55	0.63	0.10
MBL	0.8	0.86	0.67	0.64	0.62	0.72	0.11
LUJ	0.78	1.01	0.82	0.82	0.8	0.85	0.09
LBAF	0.67	0.79	0.73	0.78	0.65	0.72	0.06
LBDF	1.33	1.63	1.33	1.42	1.29	1.40	0.14
LBPF	0.5	0.58	0.47	0.49	0.47	0.50	0.05
LBVF	0.45	0.68	0.49	0.51	0.5	0.53	0.09
LBCF	1.14	1.38	1.12	1.22	1.03	1.18	0.13
LCP	1.56	2.18	1.62	1.67	1.48	1.70	0.28
WWPS (gm)	15.63	34.25	24.44	29.29	20.49	24.82	7.28
LD (cm)	1.09	1.31	1.19	1.24	1.13	1.19	0.09

M= mean of mean; SD=standard deviation

LD contained 7.53-13.19% (m; 8.95) of total length; it contains 9.76-13.22% (m; 11.44) of SL and LCP contained 12.94-19.53% (m; 15.98) of SL (Table III & IV).

Gill rakers of moderate size and conical in shape. Upper arm contains 2-3 while lower arm contains 11-13. No branched gill rakers noticed. Different meristic counts of Indus Mahseer *T. macrolepis* are given in Table V.

Color: Main body color greyish with yellowish tinge on the dorsal side, becoming scarlet or sometimes silvery orange on the lateral sides; ventral side cream colored; paired fins and anal fin pale with yellowish tinge; dorsal fin and caudal fin greyish.

Significant correlation found in total length (Table VI) and head length (Table VII) with various body parts in all sampling groups of *T. macrolepis.*

DISCUSSION

Smith (1945) and Jayaram (1981) diagnosed *Tor* by fleshy lips, continuous at angles of mouth; lower lip with or without a median lobe and the post labial groove uninterrupted; and dorsal fin with a scaly sheath at its base. Kottelat and Whittten (1993) diagnosed *Tor* by following character: lower lip developed in to fleshy lobe or at least with two notches delimiting the usual position of the lobe; post labial groove uninterrupted; no horny sheath on the lower jaw; and a few (7-17) gill rakers on the lower arm.

Table III: Comparison of ranges of morphometric ratios among five sampling groups of *Tor macrolepis*

% ratio	Group-I		Group-II		Group-III		Group-IV		Group-V	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
HL/TL	21.04	25.00	21.34	26.80	20.55	23.04	21.37	23.26	21.37	23.46
HL/SL	26.79	32.74	26.87	35.61	26.34	28.92	26.57	29.33	26.74	30.15
HH/HL	53.57	64.81	53.65	69.23	57.62	66.15	55.31	66.66	54.83	64.28
HB/HL	43.63	56.60	45.09	52.00	47.45	55.55	48.93	55.71	48.14	56.14
ED/TL	3.95	6.75	4.03	6.91	4.36	6.06	4.26	5.78	4.60	5.78
ED/SL	5.03	8.48	5.08	8.90	5.64	7.69	5.55	7.63	5.36	7.63
ED/HL	18.81	29.41	18.91	27.45	20	27.27	19.71	25.53	20.96	26.19
BB/TL	12.83	10.57	10.40	12.84	11.47	13.48	10.45	13.83	10.81	13.81
BB/SL	14.11	16.57	13.29	16.47	10.57	17.67	14.53	17.81	13.55	17.46
BB/HL	43.63	57.42	41.07	56.75	52	64.06	47.91	63.76	47.91	62.68
BH/TL	17.10	19.91	16.19	20.18	20.18	23.21	20.73	24.25	21.37	24.01
BH/SL	22.94	26.01	12.62	25.88	25.23	29.78	26.12	30.32	26.76	31.74
BH/HL	69.64	91.08	66.07	88.00	91.37	109.09	93.54	108.82	93.54	105.26
BB/BH	60.00	66.62	59.52	68.42	50	70	46.00	65.67	45.83	59.45
DF/TL	16.45	22.07	17.22	23.40	19.01	22.22	19.36	22.91	19.09	22.95
DF/SL	17.79	22.07	21.35	28.57	24.4	28.57	24.55	29.86	24.59	29.86
DF/HL	71.01	94.23	69.64	96.00	87.5	102.08	88.57	102.38	87.50	102.38
PF/TL	13.40	18.91	13.75	19.26	13.49	16.82	13.73	16.81	13.63	16.66
PF/SL	17.53	24.13	17.40	24.70	17.39	21.42	17.11	22.02	16.90	21.69
PF/HL	59.67	88.91	58.69	82.35	62	77.08	61.70	77.08	59.67	75.51
VF/TL	11.59	15.72	12.30	15.42	12.9	15	12.58	15.00	12.87	15.23
VF/SL	15.15	20.65	15.49	19.64	16.52	18.88	16.20	19.64	15.96	19.27
VF/HL	47.16	65.71	42.85	67.64	57.14	69.38	56.45	68.75	56.45	67.92
AF/TL	12.70	17.64	12.30	15.42	14.14	17.17	14.05	16.66	14.01	16.84
AF/SL	16.18	19.90	15.49	19.86	17.7	22.07	17.56	22.22	17.21	22.20
AF/HL	52.17	68.62	53.57	64.51	65.51	77.27	63.23	76.19	61.29	76.19
CF/TL	20.58	24.67	19.50	28.96	20.85	23.73	17.25	22.75	20.83	25.00
CF/SL	26.47	32.02	24.37	32.19	25.35	31.03	21.87	29.16	26.82	32.80
CF/HL	82.35	105.55	83.33	97.36	71.42	106.81	79.03	104.54	70.17	111.11
PRDL/TL	37.94	40.54	36.59	39.77	37.5	42.18	38.42	41.02	36.82	41.83
PRDL/SL	49.33	67.66	48.43	50.00	47.54	50.61	49.47	52.03	50.24	51.16
PODL/TL	36.24	40.09	38.85	41.59	37.7	41.86	37.36	40.67	36.43	40.47
PODL/SL	47.97	50.66	50.00	51.56	49.38	55.55	47.96	50.52	48.75	49.80
RBL/ED	66.66	107.69	78.94	122.22	76.92	121.42	75.00	93.33	71.42	100.00
MBL/ED	92.30	128.57	86.36	141.28	62.5	89.82	76.92	121.42	78.57	118.18
LD/LCP	69.23	85.18	50.00	81.48	62.16	86.95	8.45	9.74	71.42	84.61
LD/TL	7.71	10.36	7.53	9.32	8.7	9.82	10.22	13.19	8.55	10.00
LD/SL	10.25	13.21	9.76	12.94	10.95	12.29	10.22	13.19	10.73	13.22
LBAF/TL	4.10	7.22	4.03	5.40	4.96	6.33	5.08	6.33	4.95	5.92
LBDF/TL	9.62	11.88	9.09	12.76	9.84	11.61	9.71	11.97	9.62	11.73
LBPF/TL	3.53	4.38	2.95	4.83	3.2	4.04	3.20	4.23	3.19	4.34
LBVF/TL	2.89	4.28	2.63	4.78	3.6	4.31	3.20	4.23	3.28	4.95
LBCF/TL	8.00	10.18	8.00	11.17	7.08	9.85	7.62	9.85	7.43	9.62
LUJ/HL	22.77	30.18	22.78	33.01	22.72	35.59	21.27	29.57	27.08	33.33
PPL/TL	39.82	43.33	39.56	43.29	38.5	42.4	38.13	42.07	39.56	43.61
PPL/SL	50.92	55.15	49.87	57.53	48.78	53.24	47.36	56.94	50.28	55.02
PPL/FL	43.04	48.96	43.64	50.52	42.3	47.36	43.88	47.42	44.03	49.48
PPL/HL	159.42	184.31	154.14	188.23	172	201.51	173.07	195.23	177.08	195.65
SNL/TL	6.19	8.36	6.15	8.25	6.60	8.2	6.20	7.42	5.93	7.36
SNL/SL	7.87	10.74	7.74	11.64	8.04	10.00	7.78	9.71	7.69	10.05
SNL/HL	24.52	36.11	27.47	36.00	28	36.92	27.94	34.04	25.00	33.33
LUJ/TL	4.79	7.61	5.11	8.51	5.00	7.55	5.03	6.84	6.25	6.73
LUJ/SL	7.37	9.69	7.03	10.27	6.32	9.09	6.30	9.02	7.83	9.52
POL/TL	10.66	12.61	9.75	12.84	9.68	11.6	9.93	11.46	8.71	11.22
POL/SL	13.52	16.09	12.58	16.47	10.68	14.77	12.63	14.53	11.98	13.75
POL/HL	42.02	54.90	41.11	56.00	44.06	52	45.16	53.19	41.17	47.82
LCP/SL	13.66	19.09	12.94	19.53	13.21	18.45	13.88	16.66	13.52	17.5
RBL/HL	18.81	27.45	16.21	28	17.18	25	14.51	23.72	16.12	22.64
MBL/HL	21.78	33.33	17.92	34.00	19.69	27.08	16.12	27.11	17.74	25.49

Min= minimum; Max= maximum

Rainboth (1996) diagnosed *Tor* by the following characters: medium to large sized fishes with large scales, fewer than 30 scales in lateral line; a non-serrated spine in dorsal fin; medial lobe in lower lip at mandibular symphysis. Wu (1977), Chen and Chu (1985), Chu and Chen (1989) and Shan *et al.* (2000) diagnosed *Tor* lower lip with a median lobe and post labial groove continuous. According to the specialized extent of other characters,

Table IV: Comparison of mean of morphometric ratios among five sampling groups of *Tor macrolepis* with the mean of the mean values

% Ratio	Group -I	Group - II	Group -III	Group -IV	Group -V	M.M.	SD
HL/TL	23.51	23.55	21.84	21.94	22.14	22.60	0.86
HL/SL	30.6	30.23	27.64	28	28.19	28.93	1.37
HH/HL	60.1	58.24	62.25	61.34	61.22	60.63	1.54
HB/HL	48.41	47.46	51.68	51.86	50.59	50.00	1.98
ED/TL	5.96	5.38	5.21	5	5.07	5.32	0.38
ED/SL	7.8	6.9	6.61	6.38	6.46	6.83	0.58
ED/HL	25.35	23.01	23.91	22.73	22.93	23.59	1.09
BB/TL	11.57	11.42	12.63	12.48	11.91	12.00	0.54
BB/SL	15.09	14.62	15.8	15.93	15.17	15.32	0.54
BB/HL	49.39	48.76	57.88	56.96	53.81	53.36	4.20
BH/TL	18.28	17.89	21.41	22.05	22.28	20.38	2.13
BH/SL	23.93	22.13	27.11	28.14	28.37	25.94	2.77
BH/HL	78.37	76.42	98.1	100.52	100.68	90.82	12.32
BB/BH	63.03	63.88	59.12	56.72	53.6	59.27	4.30
DF/TL	19.76	19.76	20.46	20.73	20.97	20.34	0.56
DF/SL	25.62	25.35	25.93	26.46	26.7	26.01	0.56
DF/HL	83.89	83.88	93.8	94.48	94.72	90.15	5.73
PF/TL	16.04	15.84	15	14.87	15.24	15.40	0.52
PF/SL	20.87	20.29	18.98	18.98	19.41	19.71	0.84
PF/HL	69.09	67.55	68.59	67.82	68.89	68.39	0.67
VF/TL	13.53	12.9	14	13.54	13.9	13.57	0.43
VF/SL	17.61	16.55	17.71	17.28	17.68	17.37	0.49
VF/HL	57.68	55.26	64.13	61.73	62.79	60.32	3.71
AF/TL	14.25	14.22	15.4	14.88	15.14	14.78	0.53
AF/SL	18.58	18.24	19.49	19.01	19.3	18.92	0.51
AF/HL	60.79	60.7	70.54	67.91	68.47	65.68	4.61
CF/TL	22.15	21.56	22.3	20.97	22.44	21.88	0.61
CF/SL	28.84	27.17	28.23	26.77	28.58	27.92	0.90
CF/HL	94.38	90.49	100.9	95.58	99.66	96.20	4.19
PRDL/TL	39.01	38.57	39.15	39.53	39.67	39.19	0.44
PRDL/SL	51.39	49.46	49.52	50.49	50.47	50.27	0.80
PODL/TL	37.98	39.33	39.89	38.85	38.91	38.99	0.70
PODL/SL	49.31	50.57	50.65	49.56	49.52	49.92	0.64
RBL/ED	90.44	91.98	85.58	85.67	89.54	88.64	2.89
MBL/ED	107.81	105.68	99.87	98.83	101.53	102.74	3.85
LD/LCP	71.64	63.94	74.73	74.99	75.83	72.23	4.90
LD/TL	8.76	8.53	9.19	9.08	9.17	8.95	0.29
LD/SL	11.35	10.94	11.63	11.58	11.69	11.44	0.31
LBAF/TL	5.3	4.99	5.56	5.65	5.3	5.36	0.26
LBDF/TL	10.54	10.44	10.49	10.46	10.52	10.49	0.04
LBPF/TL	3.98	3.75	3.58	3.62	3.86	3.76	0.17
LBVF/TL	3.53	3.38	3.78	3.76	4.14	3.72	0.29
LBCF/TL	9.08	8.83	8.48	8.85	8.33	8.71	0.30
LUJ/HL	26.48	27.48	28.52	27.66	29.57	27.94	1.16
PPL/TL	40.86	40.82	40.46	40.65	41.42	40.84	0.36
PPL/SL	53.18	52.41	51.19	51.89	52.71	52.28	0.77
PPL/FL	45.79	45.68	45.19	45.35	46.22	45.65	0.40
PPL/HL	174.07	173.71	185.32	185.39	187.11	181.12	6.64
SNL/TL	7.36	7.32	6.94	6.85	6.83	7.06	0.26
SNL/SL	9.58	9.4	8.79	8.74	8.7	9.04	0.42
SNL/HL	31.25	31.16	31.82	31.24	30.87	31.27	0.34
LUJ/TL	6.2	6.48	6.24	6.06	6.51	6.30	0.19
LUJ/SL	8.07	8.31	7.89	7.74	8.29	8.06	0.25
POL/TL	11.43	11.12	10.5	10.61	9.97	10.73	0.57
POL/SL	14.88	14.28	13.16	13.54	12.68	13.71	0.88
POL/HL	48.74	47.34	47.91	48.38	45.02	47.48	1.47
LCP/SL	15.94	17.35	15.62	15.55	15.47	15.99	0.78
RBL/HL	22.89	21.06	20.27	19.48	20.5	20.84	1.28
MBL/HL	27.25	24.04	23.57	22.39	22.98	24.05	1.90

M.M.=Mean of the Mean values

Wu (1977), Chen and Chu (1985), Chu and Chen (1989) and Shan *et al*. (2000) further subdivided the Chinese *Tor* species in to three subgenera: *Tor (Tor)*, *Tor (Folifer)* and *Tor (Parator*). Nowadays more and more Ichthyologists (Rainboth, 1991; Zhou & Cui, 1996; Kottelat, 2001) tend to treat all the previous subgenera as separate genera. Chen and Yang (2004) described *Tor* genus with following characters: lower lip developed into fleshy lobe, or at least with two notches delimiting the usual position of the lobe; post labial groove uninterrupted; last simple dorsal fin ray osseous and non-serrated; no forward directed pre dorsal procumbent spine; no groove in front of nostrils.

Indus Mahseer *T. macrolepis* in Indus river basin has long been misidentified as *Tor putitora* (Hamilton, 1822), which occurs in Ganges and Brahamputra River system by

Table V: Meristic Counts in five sampling groups of *Tor macrolepis*

Meristic Feature	Meristic Counts				
	Group - I	Group - II	Group - III	Group – IV	Group - V
Dorsal Fin Ray	IV, 8-9	IV, 8-9	IV, 7-9	IV, 7-9	IV, 8
Anal	II, 5-6	II, 5-6	II, 5	II, 5	II, 5
Pectoral	16, 18	16, 18	17, 18	16-18	15-17
Ventral	I, 7	I, 7-9	I, 7-8	I, 7	I, 7
Caudal	19	19	19	19	19
Lateral line Scale	24-25	24-27	26-28	26-28	25-28
D-LLS	3.5	3.5	3.5	3.5	3.5
V-LLS	2.5	2.5	2.5	2.5	2.5
Circumpeduncle Scale	12	12	12	12	12
Gill Rakers	II/11, 13	II-III/11-13	II-III/13	III/13	II-III/13

Branched Rays are indicated by Arabic numerals and Unbranched Rays are indicated by Roman numerals

Table VI: Correlation Analysis of Various Body Parts with Total Length in five sampling groups of *Tor macrolepis*

Parameters	Coefficient of Correlation (r-value)				
	Group-I	Group-II	Group-III	Group-IV	Group-V
PPL	0.996183	0.996473	0.980872	0.9904	0.9776
PRDL	0.996910	0.998892	0.962333	0.9935	0.9792
PODL	0.993987	0.997289	0.974753	0.9935	0.9852
HL	0.973618	0.985917	0.974796	0.9924	0.9872
HH	0.950280	0.971945	0.970044	0.9829	0.9711
HB	0.987042	0.903224	0.953089	0.9840	0.9498
SNL	0.916700	0.940714	0.94272	0.9554	0.9269
POL	0.980789	0.831014	0.961127	0.9623	0.9250
DE	0.871293	0.948762	0.68052	0.8944	0.9102
BH	0.979994	0.957471	0.857221	0.9708	0.9740
BB	0.976427	0.978437	0.846998	0.9728	0.9476
LDF	0.937852	0.958896	0.918337	0.9832	0.9793
LPF	0.945888	0.952091	0.925684	0.9611	0.9213
LPELF	0.935403	0.946687	0.917575	0.978	0.9415
LAF	0.975263	0.980195	0.951184	0.9793	0.9468
LCF	0.981337	0.984041	0.947252	0.8012	0.9600
RBL	0.741513	0.784225	0.838435	0.7626	0.8421
MBL	0.724763	0.799403	0.891450	0.919	0.8600
LUJ	0.911676	0.923955	0.903397	0.9708	0.9656
LBAF	0.809316	0.917923	0.941133	0.9721	0.9497
LBDF	0.936896	0.950484	0.967163	0.9627	0.9532
LBPF	0.975123	0.854982	0.923971	0.8821	0.5075
LBPELF	0.919101	0.799191	0.740528	0.9779	0.3584
LBCF	0.961122	0.958342	0.922848	0.9569	0.9199
LCP	0.959956	0.980477	0.850403	0.9762	0.8498
WWPS	0.960337	0.907453	0.971156	0.9597	0.9635
LD	0.944603	0.975703	0.955119	0.9957	0.9443

Table VII: Correlation Analysis of Various Body Parts with Head Length in five sampling groups of *Tor macrolepis*

Parameters	Coefficient of Correlation (r-value)				
	Group-I	Group-II	Group-III	Group-IV	Group-V
TL	0.9736	0.9859	0.9748	0.9924	0.9872
SL	0.9695	0.9859	0.9781	0.9891	0.9737
FL	0.9756	0.9865	0.9779	0.9860	0.9798
PPL	0.9793	0.9838	0.9697	0.9859	0.9756
PRDL	0.9727	0.9853	0.9651	0.9873	0.9715
PODL	0.9622	0.9834	0.9642	0.9866	0.9749
HH	0.9441	0.9698	0.9645	0.9815	0.9589
HB	0.9705	0.8879	0.9522	0.9794	0.9382
SNL	0.9253	0.9141	0.9489	0.9488	0.9289
POL	0.9447	0.8059	0.9623	0.9617	0.9261
DE	0.9004	0.9469	0.6830	0.8666	0.9156
BH	0.9637	0.9318	0.8511	0.9762	0.9599
BB	0.9638	0.9455	0.8175	0.9822	0.9466
LDF	0.8863	0.9572	0.8835	0.9780	0.9768
LPF	0.9159	0.9111	0.9241	0.9496	0.9010
LPELF	0.9127	0.9267	0.8930	0.9648	0.9206
LAF	0.9379	0.9821	0.9539	0.9623	0.9353
LCF	0.9597	0.9728	0.9505	0.8423	0.9569
RBL	0.7128	0.8019	0.8122	0.7870	0.7927
MBL	0.7024	0.7743	0.8908	0.7665	0.8191
LUJ	0.8938	0.9423	0.9011	0.9258	0.9631
LBAF	0.8649	0.8880	0.9017	0.9674	0.9380
LBDF	0.9619	0.9409	0.9520	0.9661	0.9236
LBPF	0.9696	0.8155	0.9113	0.9551	0.4878
LBPELF	0.9236	0.7609	0.6911	0.8573	0.3258
LBCF	0.9522	0.9364	0.8905	0.9736	0.9239
LCP	0.9108	0.9640	0.8327	0.9397	0.8355
WWPS	0.9166	0.8770	0.9466	0.9840	0.9668
LD	0.9243	0.9595	0.9266	0.9571	0.9412

various authors (Hamilton, 1822; Hora, 1939; Chen & Chu, 1985; Chu & Chen, 1989; Shan *et al*., 2000). According to many ichthyologists *T. putitora* and *T. tor* are distinct species (Hora, 1939; Sen & Jayaram, 1982; Mirza & Javed, 1986; Menon, 1992; Talwar & Jhingran, 1992) and that *T. putitora* can be distinguished from all other *Tor* species by that head length greater than body depth. *T. macrolepis* is different from *T. putitora* by the following counts and morphometric characters, having 3.5 (vs. 4.5) from dorsal fin to lateral line, shorter caudal peduncle length (15.98% vs. 17.2% of standard length); longer body depth (26.07% vs. 24.0% of standard length), this character is more obvious in the ratio between head length and body depth (90.82% vs.79.9% of head length); longer caudal peduncle depth (11.44% vs. 10.9% of standard length). median lobe of lower lip short, its posterior margin triangular, not extending to the vertical across the inner corners of the mouth; no longitudinal stripe present along side of the body and eyes visible in ventral view of head. *T. macrolepis* (Heckel) can be distinguished from other *Tor* species by the combination of the following features: 2-3/11-13 gill rakers on the out side of the first gill arch. RBL slightly shorter than the MBL but longer than diameter of the eye. No longitudinal stripe present along the body; eyes visible in ventral view of head. Mouth terminal; no distinct stripes or spots present on body. (Table VIII).

Of the morphometric characters examined, all exhibit a significantly positive correlation (P<0.001) with total length and head length, which indicates the isometric growth in all organs of *T. macrolepis* under natural condition.

From the present study, it can be inferred that Indus Mahseer *T. macrolepis* is actually a different/allopatric species having distinct features from the *T. putitora* occurring in the Ganges river system of India.

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REFERENCES

Ahmed, N., 1943. Fauna of Lahore. 5. Fishes of Lahore. *Bull. Dept. Zool. Pb. University Lahore*, 1: 253–374

Chen, Y.R. and X.L. Chu, 1985. Systematic study of the genus *Tor* (Pisces: Cyprinidae) with description of a new species. *Zool. Res*., 6: 79–86

Chen, Z. and J. Yang, 2004. A new species of genus *Tor* from Yunan China (Teleostei: Cyprinidae). *Environ. Biol. Fishes*, 70: 185–191

Chu, X.L. and Y.R. Chen, 1989. *The Fishes of Yunan*, p: 337. China, Part I. Cyprinidae, Science Press, Beijing, China

Day, F., 1871. Monograph of Indian Cyprinidate. Part-I. *J. Roy. Asiat. Soc. Bengal*, 40: 95–143

Day, F., 1878. *The Fishes of India*, p: 778. Being a Natural History of the fishes known to inhabit the seas and fresh waters of India, Burma and Ceylon, Bernard *Quaritch*, London

Day, F., 1889. *The Fauna of British India including Ceylon and Burma, Fishes.* p: 509. Taylor and Francis, London

DESAI, V.R., 2003. *Synopsis of Biological Data on the Mahseer Tor tor (Hamilton, 1822)*, pp: 1–38. FAO Synopsis No. 158 Rome

Froese, R. and D. Pauly, 2011. *FishbBase, World Wide Electronic Publication*. www.fishbase.org. version (02/2011)

Gray, J.E., 1830-1835. *Illustrations of Indian Zoology*, p: 405. Chiefly selected from the collection of Major general Hardwicke, Treuttel, Wurtz, treuttel, Jun and Richter, London

Gunther, A., 1868. *The Catalogue of Fishes in the British Museum*, Vol. **7**. London

Hamilton, F., 1822. *An Account of Fishes Found in the River Ganges and its Branches.* Edinburgh, UK

Heckel, J., 1838. *Fische aus Caschmir*, p: 60. Carl Freiherm V. Hugel, Wien, Germany

Hora, S.L. and D.D. Mukerji, 1936. Fish of the Eastern Doon, United Provinces. *Rec. Indian Mus.* 38: 133–146

Hora, S.L., 1939. The game fishes of India. VIIIth Mahseer or the large scaled barbells of India. *J. Bombay Nat. Hist. Soc*., 41: 272–285

Hora, S.L., 1943. Specific Identity of the mahseers. *J. Bombay Nat. Hist. Soc*., 44: 303–304

Jayaram, K.C., 1981. *The Freshwater Fishes of India, Pakistan, Bangladesh, Burma and Srilanka*, p: 475. Zoological Survey of India, Calcutta, India

Kottelat, M., 2000. Notes on the taxonomy, nomenclature and distribution of some fishes of Laos. *J. South Asian Nat. Hist*., 5: 83–99

Kottelat, M., 2001. *Fishes of Laos*, p: 198. WHT Publications (Pte) Ltd., Srilanka

Kottelat, M. and A.J. Whitten, 1993. *Fishes of Western Indonesia and Sulawesi*. P: 221. Periplus, Hong Kong

Menon, A.G.K., 1992. Taxonomy of the Mahseer fishes of Genus *Tor* Gray with description of new species from Deccan. *J. Bomb. Nat. Hist. Soc*., 89: 210–228

Mirza, M.R., 1967. *Tor zhobensis* sp. Nov. a new mahseer from the River Zhob, West Pakistan. *Pakistan J. Sci.*, 19: 54–57

Table VIII: Meristic counts and proportional measurements comparisons among *Tor macrolepis, T. putitora, T. tor, T. mosal* and *T. yingjiangensis* (Mean±SD)

	T. macrolepis	*T. putitora*	*T. tor*	*T. mosal*	*T. yingjiangensis*
Total length (mm)	94-425	78-1060	188-815	180-420	82-238.5
Standard Length (mm)	73-360	45-850 (190.4)		142-350	60-181(m: 112.8)
Dorsal Fin Rays	IV, 7-9	IV, 8	III, 9	IV, 8-9	IV, 9
Anal Fin Rays	II, 5-6	III, 5	II-III, 5	III, 5	III, 5
Pectoral Fin Rays	15-18	17-18	19	17	III, 15-16
Ventral Fin Rays	I, 7-8	I, 8	9	8-9	I, 8-9
Lateral Line Scales	24-28	25-28	22-27	23-26	24-26
D.LLS	3.5	4.5	4.5	3.5	4-4.5
V.LLS	2.5	2.5	2.5	3.5	3-3.5
Predorsal scales	9	9	9		10
Circum-Peduncle scales	12	12			12
Percentage of SL					
Body depth	22.13-28.37 (25.93 ±2.48)	17.6-27.5 (24 ±2.4)	25.3-29.4 (27.3)	25-30.3 (27.65)	25.5-27.3 (26.4 ±0.7)
Head length	26.94-30.60 (28.60 ±1.47)	27.9-33.3 (30 ±1.4)	25.2-26.8 (26)	25-28.57 (26.78)	28.7-33.9 (31.6 ±2.3)
Caudal peduncle length	14.57-17.35 (15.75 ±0.91)	16.3-18.2 (17.2 ±0.8)			11.3-14.8 (13 ±1.4)
Caudal peduncle depth	10.89-11.69 (11.35 ±0.35)	7.3-12.2 (10.9 ±1.1)		14.0-16.0 (15.0)	11.1-13.3 (12 ±0.9)
Percentage of HL					
Snout length	30.87-33.59 (31.66 ±1.0)	25.6-35.5 (30.8 ±3.01)	32-37.9 (35)	29.6	33.3-35.4 (33.8 ± 0.9)
Eye diameter	18.45-25.35 (22.73 ±2.31)	15.2-35.7 (25.3 ±5.2)	21.6-30 (25.8)	24.0	17.7-25.6 (22 ±3.8)
Interorbital width		22.6-30.5 (26.1 ±2.0)		32.0	25-28.8 (26.3 ±1.7)
Rostral barbel length	19.48-23.33 (21.26 ±1.53)	18.8-27.4 (23.1 ±2.3)		20.8	23.1-27.1 (25.7 ±1.6)
Maxillary barbel length	22.39-27.25 (24.26 ±1.77)	20-30.6 (25.7 ±3.1)		27.2	24-29.2 (26.3 ±1.9)
Percentage of caudal peduncle length					
Circum-Peduncle depth	63.94-75.83 (72.75 ±4.56)	41.2-73.0(63.7 ±7.8)		70.83	75-106.7 (93.1 ±13.1)
Percentage of TL					
Body depth	17.89-22.28 (20.40 ±1.9)	14.2-21.2 (18.6 ±1.7)		23.06	18.3-20.8 (19.6 ±1.0)
Head length	21.33-23.55 (22.39 ±0.93)	22.1-25.6 (23.4 ±0.9)		23.06	21.8-25.9(23.4 ±1.7)
Percentage of HL					
Body depth	76.42-100.68(91.69 ±11.22)	60.0-88.1(79.9 ±7.0)	97.1-113.3 (104.5)	100	77.1-90.2 (84 ±7.4)
References	Present Study	Hora (1939)	Desai *(2003)*	Hora (1936)	Chen and Yang (2004)

Range, values in parenthesis are means± SD

Mirza, M.R., 1975. Freshwater fishes and zoogeography of Pakistan. *Bijdr. Dierk*., 45: 143–180

Mirza, M.R., 1981. The systematics and zoogeography of the freshwater fishes of Pakistan and Azad Kashmir. *Proc. Pakistan Congr. Zool*., 1980: 1–41

Mirza, M.R., 2004. *Freshwater Fishes in Pakistan*, 2nd edition. Urdu Science Board, Lahore, Pakistan

Mirza, M.R., M. Ayub and S.S. Mir, 2004. *The Mahseers (Pisces: Cyprinidae) of Pakistan. Macchli Nama, Fish*. Department Govt. of the Punjab, Mahseer No.1-7

Mirza, M.R. and M.N. Javed, 1985. A note on the Mahseer of Pakistan with the description of *Naziritor* a new subgenus (Pisces: Cyprinidae) *Pakistan J. Zool*., 17: 225–227

Mirza, M.R. and M.N. Javed, 1986. A contribution to the fishes of the genus *Tor* Gray (Pisces: Cyprinidae) from Pakistan and Azad Kashmir. *Biologia*, 32: 71–82

Mirza, M.R. and T. Omer, 1974. A note on the fishes of the River Haro with record of *Tor mosal* (Hamilton) from Pakistan. *Pakistan J. Zool*., 6: 193–194

Naeem, M., A. Salam, S.S. Tahir and N. Rauf, 2011. The effect of fish size and condition on the contents of twelve essential and non essential elements in *Aristichthys nobilis* from Pakistan. *Pakistan Vet. J.*, 31: 109-112

Rainboth, W.J., 1991. Cyprinids of South East Asia. *In*: Winfield, I.J. and J.S. Nelson (eds.), *Cyprinid Fishes*, pp: 156–210. Chapman and Hall, London

Rainboth, W.J., 1996. *Fishes of the Cambodian Mekong*, p: 265. Food and Agriculture Organization of the United Nations, Rome, Italy

Roberts, T.R., 1993. The freshwater fishes of Java, as observed by Kuhl and Van Hasselt in 1820-23. *Zool. Verhand*., 285: 1–94

Sen, T.K. and K.C. Jayaram, 1982. *The Mahseers Fishes of India-A Review*, pp: 38–39. Rec. Zool. Surv. India Misc. Publication Occ., India

Serene, R., 1951. Sur la faune ichthologique du Laos. *Indo-Pacific Fisheries Council*, 49: 1–26

Shan, X.H., R.D. Lin, P.Q. Yue and X.L. Chu, 2000. Barbinae. *In*: Yue, P.Q. (ed.), *Fauna Sinica, Osteichthyes, Cypriniformes III*, pp: 3–170. Science press, Beijing, China

Silas, E.G., 1960. Fishes from Kashmir valley. *J. Bombay Nat. Hist. Soc*., 51: 66–77

Smith, H.M., 1945. The freshwater fishes of Siam or Thailand. *Bull. US Nat. Mus.*, 188: 1–622

Talwar, P.K. and A.G. Jhingran, 1992. *Inland Fishes of India and Adjacent Countries*, Vol. I, p: 541. A.A. Balkema, Rotterdam

Valenceinnes, A., 1841. *Historic Nanturelle Poissens*, Vol. 15. Paris

Valenceinnes, A., 1842. *Historic Nanturelle Poissens*, Vols. 16. Paris

Wu, X.W., 1977. *The Cyprinid Fishes of China*, Part 2, p: 369. Technology Printing House Shangai, China

Zhou, W. and G.H. Cui, 1996. A review of *Tor* species from the Lancangjiang River (upper Mekong River), China (Teleostei: Cyprinidae). *Ichthyol. Explor. Freshwat.*, 7: 131–142

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