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MORPHOMETRIC, MERSITIC AND SOME BLOOD PARAMETERS OF *Barbus grypus* SHABOUT (Heckel 1843) IN SULAIMANI NATURAL WATER RESOURCES, IRAQ

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This study was taken to determine morphometric, meristic and hematological parameters of the *B. grypus* (H, 1843) in Sulaimani natural water resources of Sulaimani city, Iraq. 30 fish were used in this study and allocated to three groups that depend on fish length. Total lengths were 26.71 ± 0.85, 34.82 ± 0.82 and 43.78 ± 0.9, standard lengths were 26.27 ± 0.64, 29.43 ± 0.73 and 37.35 ± 0.91 for (20-30cm, 30-40 cm and 40-50 cm), respectively. Numbers of rays on dorsal fin were 7.5 ± 0.18, 7.8 ± 0.25 and 8.08 ± 0.05; numbers of scales were 5, 5 and 5 ± 17 for (20-30cm, 30-40 cm and 40-50 cm) lengths, respectively. The values of WBC were (1345.1 ± 314.22, 15133564 ± 2851414 and 19536900 ± 4594589 /mm^3), the values of RBC were recorded as 13885000 ± 2653096, 1317132.3 ± 91643.55 and 2077000 ± 139033/mm^3. The values of Hemoglobin (Hb) were 11 ± 0.95, 6.24±0.18 and 6.96 ± 0.25 g/dl. The values of PCV of were 45.4 ± 3.2, 25.6 ± 0.52 and 27.9 ± 0.97 % for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. According to the results in the present study suggest that mersitic characters were affected by many environmental factors such as light, temperature and dissolved oxygen, while hematological parameters were affected by age.

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INTRODUCTION

One of the newest and important aquaculture candidates is Barbus grypus (Heckel 1843). Shabout is a species that can be founded it in river also can be founded in estuaries, getting a maximum size of approximately two meters and more than 50 kg. The ecology of this species is euryhaline and eurytherme and nutritionally omnivorous and extensively spread in Iran, Turkey, Syria and Iraq (Nikpei, 1996).Spawning in this species generally occurs between May and mid June (Geldiay and Balik, 1988). Till now, in the literature has a few studies on its the biological characteristics (Al-Hakim et al., 1981; Khalaf et al., 1984; Epler et al., 2001; Sahinoz et al., 2007; Oymak et al., 2008; Khadjeh et al., 2010). Morphometric study of fish explains the fish shape o in the easiest probable fashion, removing information that is not relevant and so facilitating relationship between different fish species. Thus, morphometric is the study of variation in shape and its covariation with other variables of interests (Bookstein 1991; Dryden and Mardia 1998). Morphometricians use information of morphology to recognize the shape pattern variation within and among sample (life stages, populations, species etc.) as well as in framing and testing hypothesis concerning the variation origins of those in the pattern of growth. However, taxonomists and systematists use morphological information to illustrate and in diagnose of species. Analyses of enumerable body feature (meristic) have been broadly used for studying of fish stock structure. The majority enumerated features are external, involving fin spine number and fin rays, gill rakers and scales. Identification of fish stock has a long history throughout meristic analysis; nearly all fish species that take place as various stocks and that have been the subject of fishery management, also have received at least some analysis of meristic (Waldman, 2005). Another biomarker that has been used in diagnoses is the profile of hematology. For intensive fish rearing of with least losses, it is essential to be responsive of the fish health status. Variables in blood are helpful criteria to show physiological disturbances in intensively farmed fishes and can supply significant information for disease diagnosis and prognosis. Dawson (1979) noted that hematology a vital tool to study the rate and consequence of the toxins with-out losing the animals. The changes in blood of fish earlier to the onset of more outstanding morphological and physiological changes can be indicative of unfavorable aquatic medium (Eisler, 1967). For instance, variations in quality and quantity in hematological parameters as well as the red blood cell (RBC) and white blood cell (WBC) numbers, hematocrit (HCT, also recognized as packed cell volume (PCV)), the hemoglobin amount (Hb) are the most important findings as regards diagnosis (Şahan et al., 2007). Even though evaluation of spermatological and hematological characteristics of some fish species have been studied in few studies (Imanpoor and Farahi, 2011), there are no available data on *B. grypus* in Sulaimani natural water resources. The present study aimed to give a preliminary data about the morphometric, meristic description and some blood parameters of the *B. grypus*, with hope to increase the information about the *B. grypus* in Sulaimani freshwater fish.

MATERIALS AND METHODS

Sampling

Barbus grypus fish were caught by using gill net by fisherman in natural waters in Sulaimani city. Fish were selected in different sizes and allocated for three different groups by body length (20-30 cm, 30-40 cm and 40-50 cm). Thirteen specimens of wild *B. grypus* were sampled. After catching blood samples for hematological parameters were collected. These fish were brought to the laboratory of fish animal science department, college of agricultural science, university of Sulaimani, then all the morphometric parameters were measured individually.

Morphometric characters

Nearly thirteen external morphometric variables were measured on the head and body of each fish specimen using electronic digital balance, wooden measuring tray and other measuring scales to the nearest 0.1cm. All morphometric characters that were measured presented in Table 1.

Table 1. Morphometric traits of *Barbus grypus* for three different groups of length (20-30, 30-40 and 40-50 cm)

Morphometric Traits	Acronyms	Descriptions
Body weight	BW	Whole fish weight
Total length	TL	Distance from the tip of snout to the tip of upper lobe of the caudal fin
Standard length	SL	Distance between the tip of snout and the base of the caudal fin rays
Fork length	FL	Distance from the tip of snout to the centre of fork in the caudal fin
Head length	HL	Distance from the tip of snout to the posterior margin of Operculum
Body depth	BD	The vertical distance from the dorsal margin of the body to the ventral margin of the body measured at the base of the pectoral fin where it attaches to the body
Pre orbital length	POL	Distance from the tip of snout to the anterior margin of eye
Eye diameter	ED	Diameter of orbit along the body axis
Post orbital length	PoOL	Distance between the posterior margin of eye and the posterior margin of operculum
pre dorsal length	PDL-I	Distance from the tip of snout to the origin of first dorsal fin
dorsal fin base length	DFL-I	Distance between the origin and insertion points of first dorsal fin
Upper jaw length	UJL	The length from the anteriormost point of the premaxilla to the posterior edge of the maxilla
Pre pectoral length	PPcL	Distance from the tip of snout to the origin of left pectoral fin
Pectoral fin length	PcFL	Distance between the origin and posterior tip of left pectoral fin
Pre pelvic length	PPvL	Distance from the tip of snout to the origin of left pelvic fin
Pre anal length	PAL	Distance between the tip of snout and the origin of anal fin
Anal fin length	AFL	Distance between the origin and insertion points of anal fin
Caudal fin length	CFL	Distance between the origin and posterior tip of caudal fin
Caudal peduncle depth	CPD	Minimum vertical distance across the caudal peduncle

Meristic characters

For all fish were counted the numbers of spines and rays for all fins of the fish body. Also, for the pectoral fin were counted spines and rays from both left and right sides of fish body. All merstric characters that were measured presented in Table 2.

Table 2. Meristic characters of *Barbus grypus* used for the present study

No.	Acronym	Meristic character
1	DF	Number of fin rays on dorsal fin
2	DFS	Number of spines on dorsal fin
3	PcFR	Number of fin rays on pectoral fin
4	PcFS	Number of spines on pectoral fin
5	PvFR	Number of rays on pelvic fin
6	PvFS	Number of spines on pelvic fin
7	AFR	Number of rays on anal fin
8	AFS	Number of spines on anal fin
9	CFR	Number of rays on caudal fin
10	CFS	Number of spines on caudal fin
11	S	Number of scales on fish

Hematological Analysis

Blood samples were collected by using caudal vein, which insert a needle attached to a syringe for suctioning blood from the caudal vein. Whole blood samples were collected in small plastic vials containing heparin and stored under cooling condition prior to analysis by using the hematology analyzer BC-2800 is a compact, fully automatic hematology analyzer with 19 parameters, USA origin for complete blood count (CBC) test for determination of:

RBC (Red Blood Cell; mm)
WBC (White Blood Cell; mm)
PCV (Packed Cell Volume %)
MCH (Mean Corpuscular Hemoglobin)
MCHC (Mean Corpuscular Hemoglobin Concentration; g/l)
Hb (Hemoglobin; g/l)

Statistical analysis

Data collected for all parameters were analyzed by one way anova in a completely randomized design (CRD). Means with significant differences were compared by Duncan's multiple range tests, according to $p<0.05$ significance. Statistical analysis results are shown as mean values in tables. The statistical calculations of the results were completed using XLSTAT. Different letters were given to different treatments.

RESULT

Morphometric characters

Fish body weight for first group was 223.5±10.8 g, second group was 257.3±19.45g and 591.5±37.07 g for third group of fish, there was a significant difference between groups three with two other groups. The standard length (SL) for (20-30 cm) length was 26.27±0.64 cm, 29.43±0.73 for (30-40 cm) length and 37.35±0.91 for (40-50 cm) length, there were significant differences among them.

The head lengths were increased with increasing body length and it there were 6.22±0.09, 6.66±0.15 and 7.71±0.16 for (20-30 cm), (30-40 cm) and (40-50 cm), respectively. The head length in (20-30) and (40-50 cm) length were greater than body depths which were 5.75±0.15cm and 7.54±0.15. However, the head length in (30-40 cm) was smaller than body depth that was 7.2±0.23.

The length of eye diameter in (20-30 cm) length was 0.69±0.06 that significantly different with (30-40 cm) and (40-50 cm) lengths which were 0.82±0.04 and0.85±0.04. All the morphometric characters are summarized in Table (3).

Table 3. Descriptive statistics of morphometric traits for (20-30 cm), (30-40 cm) and (40-50cm) length fish groups

TRAITS (cm)	20-30 cm (N= 10)			30-40 cm (N= 10)			40-50 cm (N= 10)		
	Mini.	Maxi.	Mean ± SE	Mini.	Maxi.	Mean ± SE	Mini.	Maxi.	Mean ± SE
Body weight (g)	184	241	223.5±10.8 b	183	334	257.3±19.45b	474	755	591.5±37.07a
Total length	23.1	29.6	26.71±0.85b	31.5	37.5	34.84±0.82 b	41.5	48	43.87±0.9a
Standard length	24.5	29.4	26.27±0.64 c	26.8	32	29.43±0.73 b	33.8	41	37.35±0.91a
Fork length	24.3	31.3	27.9±0.72c	28	34.2	31.71±0.76 b	37	43.3	39.54±0.84a
Head length	6	6.7	6.22±0.09c	6	7.3	6.66±0.15b	7.2	8	7.71±0.16a
Body depth	5.5	6.5	5.75±0.15b	6.8	7	7.2±0.23a	7	8	7.54±0.15a
Eye diameter	0.5	1	0.69±0.06b	0.7	1	0.82±0.04a	0.7	1	0.85±0.04a
Post orbital length	24.1	32.33	2.25±0.88b	24.8	30.2	2.39±0.78b	34	37	2.68±0.63a
Pre orbital length	2	2.5	27.62±0.08b	2	2.5	27.69±0.06b	2.5	3	35.1±0.07a
Upper jaw length	1	2.5	1.85±0.16b	2.5	4.2	2.59±0.25a	2.5	3.5	2.95±0.14a
Lower jaw length	0.5	1.6	1.13±0.16c	1.3	2	1.55±0.07b	2.1	3	2.73±0.12a
pre dorsal length	12.2	13.6	12.78±0.23c	12	15.5	14.18±0.4b	14	18	16.7±0.63a
Post dorsal fin length	14.8	19.5	11.88±0.69b	11	13.5	16.81±0.47 a	13.5	19.4	16.98±0.81a
Pre pectoral length	6	6.5	6.25±0.06b	5.53	7	16.46±0.2b	8	9	8.45±0.16a
Pre pelvic fin length	12.1	14.2	13.41±0.30c	14	15.5	14.72±0.19b	17.3	19.5	18.37±0.29a
Pre anal fin length	18	22.3	19.79±0.59 c	19	32.5	22.96±1.40b	26.5	30	28.38±0.54a
Post anal fin length	10.5	12.6	11.19±0.27a	4.5	5.7	5.19±0.28b	6.3	8	7.08±0.28c
Caudal peduncle length	6.1	7.2	6.58±0.12b	5.8	8	6.63±0.25b	8	9.5	8.49±0.21a
Caudal peduncle depth	2.5	3	2.8±0.06c	2.5	4	3.72±0.21b	5	6	5.47±0.15a
Pectoral fin length	4.1	5.6	4.85±0.18c	4	5.2	4.19±0.22b	4.8	6.4	5.93±0.27a
Pre anus length	16.5	16.5	18.23±0.48c	19	23	20.95±0.55b	24.5	30	27.35±0.65a

N.B. : Mini minimum; Maxi. = Maximum

Mersitic characters

Numbers of rays on dorsal fin were 7.5± 0.18, 7.8±0.25 and 8.08±0.05 for (20-30 cm), (30-40) cm and (40-50 cm), respectively. There was a significant difference between (20-30 cm) and (40-50 cm) length. On the other hand, there was no significant difference among three groups of length for number of spines on dorsal fin which was 1 for each groups of length. Numbers of rays on caudal fin were 18.9±0.12, 19.2± 0.05 and 19.5±0.99 for (20-30 cm), (30-40) cm and (40-50 cm), respectively. There was no significant difference among groups. There were no spines on caudal fin for each group of fish length. Results for other traits were presented in Table 4.

Table 4. Meristic characters for three different lengths of *B. grypus*

Meristic characters	N	Length	Minimum	Maximum	Mean± S.E
Number of fin rays on dorsal fin	10	20-30	7	8	7.5± 0.18 b
	10	30-40	6	8	7.8±0.25 ab
	10	40-50	8	9	8.08±0.05 a
Number of spines on dorsal fin	10	20-30	1	1	1
	10	30-40	1	1	1
	10	40-50	1	1	1
Number of fin rays on pectoral fin	10	20-30	13	15	14 ±0.28 b
	10	30-40	13	16	14.2±0.31 b
	10	40-50	14	16	15.3±0.1 a
Number of spines on pectoral fin	10	20-30	0	0	0
	10	30-40	0	0	0
	10	40-50	0	0	0
Number of rays on pelvic fin	10	20-30	8	9	8.5±0.18 b
	10	30-40	8	9	8.8±0.16 ab
	10	40-50	9	9	9± 0 a
Number of spines on pelvic fin	10	20-30	0	0	0
	10	30-40	0	0	0
	10	40-50	0	0	0
Number of rays on anal fin	10	20-30	5	5	5±0 b
	10	30-40	5	7	5.6±0.18a
	10	40-50	5	6	5.9±0.07a
Number of spines on anal fin	10	20-30	1	2	1 .2±0.14a
	10	30-40	1	1	1±0a
	10	40-50	1	1	1 ±0a
Number of rays on caudal fin	10	20-30	18	19	18.9±0.12a
	10	30-40	19	20	19.2± 0.05a
	10	40-50	19	25	19.5±0.99a
Number of spines on caudal fin	10	20-30	0	0	0
	10	30-40	0	0	0
	10	40-50	0	0	0
Number of scales on fish	10	20-30	5	5	5±0 b
	10	30-40	5	5	5±0 b
	10	40-50	5	6	5.3±0.17 a

Hematological analysis

The hematological parameters of *B. grypus* 20-30 cm lengths were 1345.1±314.22/mm^3, 13885000±2653096/mm^3, 11±0.95 g/dl, 42.3±3.51 µm3, 69.46±5.61 pg, 45.4±13.68 % and 45.4±3.2 for WBC, RBC, Hb, MCV, MCH, MCHC and PCV, respectively. Also, blood parameters for 30-40 cm and 40-50 cm lengths were presented in Table 5.

Table 5. Hematological parameters for three different lengths *B. grypus*

Hematological parameters	No.	Length	Minimum	Maximum	Mean ± S.E
WBC	10	20-30	2246	4235	1345.1±314.22b
	10	30-40	6235648	28456710	15133564 ± 2851414 a
	10	40-50	89000	19400000	19536900 ± 4594589 a
RBC	10	20-30	850000	23200000	13885000 ± 2653096 a
	10	30-40	900000	1654000	1317132.3 ± 91643.55 b
	10	40-50	1370000	2680000	2077000 ± 139033b
HB	10	20-30	6.5	15.7	11 ± 0.95 a
	10	30-40	5.1	6.7	6.24 ± 0.18 b
	10	40-50	5.95	8	6.96 ± 0.25b
MCV	10	20-30	21.4	56.2	42.3 ± 3.51c
	10	30-40	100	123.8	113.08 ± 2.79b
	10	40-50	135.6	142.2	138.66 ± 0.73a
MCH	10	20-30	41.5	88	69.46 ± 5.61a
	10	30-40	15.7	35.1	28.17 ± 2.47 b
	10	40-50	22.5	47.9	35.36 ± 3.02 b
MCHC	10	20-30	148.2	264.8	45.4 ± 13.68 a
	10	30-40	18	25	25.6 ± 0.89 b
	10	40-50	21	33.1	27.9 ± 1.18 b
PCV	10	20-30	29	61	45.4 ± 3.2 a
	10	30-40	23	27	25.6 ± 0.52 b
	10	40-50	24	32	27.9 ± 0.97 b

DISCUSSION

Differences in meristic characters have been used as an essential tool in separating of populations in different fish species (Seymour, 1959; Anthony and Boyar, 1968). Variations in meristic between populations of fishes may be affected by genetic or environmental factors, or both (Bailey and Gosline, 1955). Many workers have recognized the variations in meristic characters to environmental factors such as light, temperature and dissolved oxygen through the period from fertilization to hatching (Taning, 1952; Wallace, 1973; Kwain, 1975). Total lengths were 26.71±0.85, 34.82±0.82 and 43.78±0.9 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. (Doğu et al., 2014), stated that total length for *b. grypus in* Ataturk dam was 66.85±1.5 cm. Standard lengths were 26.27±0.64, 29.43±0.73 and 37.35±0.91 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. Our finding was similar with (Borkenhagen, 2014), who stated that the standard length for *Arabibarbus grypus* was 19.7 cm.

Caudal peduncle lengths were 6.58±0.12, 6.63±0.25 and 8.49±0.219 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. The data from present study was similar with (Borkenhagen, 2014) that reported caudal peduncle length for *Arabibarbus grypus* was 15.3 cm (as percentage of standard length). Caudal peduncle depths were 2.8±0.06, 3.72±0.21 and 5.47±0.15 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. This finding was approximately close to (Borkenhagen, 2014), who noted that the caudal peduncle for *Arabibarbus grypus* was 9.8 mml.

Numbers of rays on dorsal fin were 7.5±0.18, 7.8±0.25 and 8.08±0.05 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. The data in this study was confirmed by (Borkenhagen, 2014), who stated that the number of rays on dorsal fin was between7 to 9 rays.

Numbers of scales were 5, 5 and 5±17 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. These data were very close to (Borkenhagen, 2014), they reported the number of scale for *Arabibarbus grypus* was 4 for 41 fish out 57 fish.

The values of WBC in this study (1345.1±314.22, 15133564 ±2851414 and 19536900± 4594589 /mm^3) for three different groups of fish length that were higher than stated values of (Doğu et al., 2014) in *B. grypus* (30.01 ±4.11 X103/mm^3), Ay-dın *et al.* (1998) in *S. glanis* (17.00 ±1.29 x103/mm^3), Yavuzcan et al. (1997) in *Oreo-chromis niloticus* (7.02 ±0.99 $x10^3/mm^3$).

The values of RBC were recorded as 13885000 ±2653096, 1317132.3±91643.55 and 2077000±139033/mm^3 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. (Doğu et al., 2014) noted that the RBC values for *B. grypus* in Ataturk dam was (2.05 ±0.07 $x10^6/mm^3$).On the other hand, Talal et al. (2011) stated that the values of RBC of *B. xan-thopterus* and *B. sharpeyi* as 3.45±0.77 and 3.55±0. 52 $x10^6/mm^3$, respectively.

The values of Hemoglobin (Hb) of *B. grypus* were 11±0.95, 6.24±0.18 and 6.96±0.25 g/dl for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. In the same way, Khadjeh et al. (2010) stated that the Hb in *B. grypus* as 6.50 ±0.10 g/dl. Talal *et al.* (2011) noted the Hb in *B. xanthopterus* and *B. sharpeyi* as 5.18 ±0.22 g/dl and 5.32 ±0.43 g/dl, respectively.

The values of MCV of *B. grypus* were caught in Sulaimani natural water resources were found as 42.3±3.51, 113.08±2.79 and 138.66±0.73 μm^3 for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. Our data was similar with (Doğu et al., 2014) (147.27 ±4.93 µm3) and *C. trutta* (149.71 ± 2.28 µm3). While, Khadjeh et al. (2010) found higher (261 ±4.87 µm3) MCV values in similar species.

The values of MCH of *B. grypus* were noted as 69.46±5.61, 28.17±2.47 and 35.36±3.02 pg in this experiment for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. Similar data were stated in *B. grypus* (45.70 ±0.88 pg), *C. trutta* (45.40 ±1.80 pg), *C. carpio* (49.10 pg), *C. au-ratus* (42.00 ±1.40 pg), *T. zilli* (46.48 ±2.49 pg) and *C. gariepinus* (51.39 ±0.04) (Khadjeh et al., 2010; Örün and ErdemLi, 2002; Grof and Zinki, 1999; Gbore et al., 2006).

The values of MCHC of *B. grypus* were reported as 45.4±13.68, 25.6±0.89 and 27.9±1.18 % for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. Our data were confirmed by (Doğu et al., 2014) that they reported The MCHC values in *B. grypus was* 26.47±0.84.*Cyprinidae* species like *C. trutta*, *S. glanis, C. lazera, O. niloticus* and *T. zillii* were stated as 30.32 ±0.80 %, 30.66 ±0.49 %, 31.20 ±0.85 %, 31.00 ±0.01 % and 33.14 ±1.88%, respectively (Örün and ErdemLi, 2002; Aydın et al., 1998; Yavuzcan et al., 1997; Gbore et al., 2006).

The values of PCV of *B. grypus* were 45.4±3.2, 25.6±0.52 and 27.9±0.97 % for (20-30cm, 30-40 cm and 40-50 cm) length, respectively. These data of *B. grypus* were similar with Khadjeh et al. (2010) (36.9 ±0.7).

CONCLUSION

In conclusion, this study is the first study on *B. grypus* in Sulaimani natural water resources that include investigations of morphometric, mersitic and hematological parameters. The results represent a precious baseline dataset and supply background information in this species that has large potential in aquaculture.

COMPETING INTEREST

We declare that they have no competing interests.

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