World Journal of Fish and Marine Sciences 5 (6): 674-679, 2013
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2013.05.06.74124

Interrelationship Between Morphometric Variables And Body Weight *Capoeta trutta* (Heckel, 1843) Evaluated by Path Analysis in Gamasiab River of Kermanshah Province, West of Iran

[1]Mojtaba Poria, [2]Fathali Nouri, [1]Keyvan Ghanbary and [3]Poria Heshmatzad

[1]Fisheries Office of Kermanshah Province, Iran
[2]Research Center of Agriculture and Natural Resources, Kermanshah Province, Iran
[3]Young Research Club Kermanshah Azad University, Iran

Abstract: The objective of this study was to verify which morphometric measures are more directly associated with the Body weight of black fish (*Capoeta trutta*). A 252 samples of black fish(167 maleand 85 female) from Gamasiab River with average body weight 104.19±2.98g(Male 93.20±1.73g and Female 125.78±7.65g) were caught, weighed and measured morphometric characteristics. The morphometric measures taken were: body weight (BW g), body length (TL mm), standard length (SL mm), fork length (FL mm), body height (BH mm), body width (BD mm), head length (HL mm) and snout length (SNL mm).the phenotypic correlationsanalysis between body weight and morphometric measurements showed that body weight was significant (P<0.01) positively correlated with other morphometric measurements in the male, female and total (male and female).These correlations were later deployed in direct and indirect effects through path analysis and the direct and indirect contributions of each variable were measured in percentage terms. The standard length, head length, body height and snout length measurements were important for determining the body weight of male fish (*Capoeta trutta*) also the total length and fork length had indirect effect in body weight by snout length. The total length, body height and head length measurements were important for determining the body weight of female fish (*Capoeta trutta*) also the fork length, snout length, body height and standard length had indirect effect in body weight by total length. The total length, snout length, standard length, head length and body height measurements were important for determining the body weight of total (male and female) fish (*Capoeta trutta*) also the body weight and fork length had indirect effect in body weight by total length.

Key words: Morphometric · *Capoeta trutta* · Direct effect · Indirect effect · Gamasiab

INTRODUCTION

The family *Cyprinidae* is the largest fresh water fish family that contains a number of large genera. The genus *Capoeta* belonging to the family *cyprinidae* is characterized bya fusi form body, one-two pairs or no barbles in some species, a 3-row pharyngeal teeth and small to medium sized scales. Most *Capoeta* species prefer stagnant waters and fed on algae and aquatic insects. The genus *Capoeta* with about 20 species distributed in south China, North India, Turkmenistan, Aral Sea, Middle East and Anatolia [1], has 7 species and 3 subspecies in Iran. In Kermanshah Province, *Capoeta trutta* along with the *Luciobarbusesocinus*, Tor *grypus* and *Luciobarbusbarbulus* is of importance as a commercial and sport fish and can be found in local fish market places. Gamasiab River of Kermanshah Province one of the important rivers of the Tigris basin in Iran and are inhabited by *C. trutta*. Over 30 native fish species which mostly belong to the family *Cyprinidae*, can be found in water resources of Kermanshah Province. After the large *Luciobarbus* and tor species, *C. trutta* is the most important edible fish, especially for the local people living at the vicinity of the Alvand Rivers. Breeding programs that are aimed at body yield increase present difficulties, since the direct measurement results in sacrifice of the animal and hence in the loss of a potential breeder within the group [2]. Correlation of body

Corresponding Author: Keyvan Ghanbary, Kermanshah Province, Iran, P.O. Box: 6714635181.
Tel: +09188576152.

yields with morphometric measurements has been the subject of several studies for some fish species [3, 4, 5]. However, this simple correlation only makes it possible to evaluate the direction and magnitude of the association between two characters, without providing necessary information concerning the direct and indirect effects of a group of characters in relation to a dependent variable of major importance [6]. "Path analysis" is a device that a breeding researcher can use to break the correlation of direct and indirect effects [6, 7] through basic variables such as body yields and explanatory variables such as morphometric ratios and measures, providing a better understanding of the reasons for the associations between these traits [8]. The interpretation of results was based on the following criteria: if an independent variable (x) does not present a significant correlation coefficient with the dependent variable (y), this indicates that it is not determining the variation in y, regardless of any presence or absence of any high direct effect on y; if an independent variable (x) has a significant correlation and high direct effect on the dependent variable (y), this indicates that it is determining the variation of y; and, if the independent variable (x) show a significant correlation but low direct effect on the dependent variable (y), this indicates that it should not be used alone as a determining factor for y [9]. This study used path analysis of the phenotypic correlations to verify which morphometric measures would be more directly associated with body weight of (*Capoeta trutta*). This study used path analysis of the phenotypic correlations to verify which morphometric measures would be more directly associated with body weight of (*Capoeta trutta*). Length-Weight Relationships and Morphometry for eleven Fish Species from Ogudu Creek, Lagos, Nigeria were studied by Lawson *et al.* [10]. Comparative Survey of Morphometric-meristic Male and Female Anjak (*Schizocyprisbrucei*) Fish, Annandale and Hora, 1920) of Hamoun Wetland in South East Iran were studied Abbaspour *et al.* [11]. Length-Weight Relationship and Condition Factor of *Schizopyge curvifrons* (Heckel, 1838) from River Jhelum, Kashmir, India were also studied by Iqbal Mir *et al.* [12].

MATERIALS AND METHODS

Gamasiab River is located in west of Kermanshah province. Themain reasons for the selection of *C. trutta* for this study were the abundance of the species and the lack of knowledge on its morphologic features and its sport and commercial value. For this study at least one kilometer reach of each river was selected and sampled on a monthly basis. The sampling station in Gamasiab River was located at the Geographical coordinate: 34° 25' 39" N and 47° 31' 02" E, altitude: 1400 meters above sea. The sampling was done during August 2008 – July 2009 on a monthly basis. Fishing was done using gill and cast nets of 1-4 cm mesh sizes. After death due to over-anaesthetization, the fish were preserved in 10 percent Formalin solution. Eight morphometric variables including body weight, body length, fork length, standard length, head length, snout length, body width and body depth were recorded. Body weight was measured with the nearest 0.1 g. The phenotypic correlation coefficients were computed and the path coefficient analysis was performed using phenotypic correlations to assess direct and indirect effect of morphometric traits on body weight by used of SAS9.2, Path 2 and SPSS20 software's.

RESULTS AND DISCUISSION

The Spearman's rank correlation coefficient between body weight and morphometric measurements were calculated (Table 1). The results indicated that the male TL(0.986**) SL (0.987**), FL (0.985**), BH (0.995**), BD (0.967**), SNL (0.916**) and HL (0.967**), female TL(0.895**) SL (0.894**), FL (0.889**), BH (0.896**), BD (0.877**), SNL (0.619**) and HL (0.881**) and total (male and female) TL(0.992**) SL (0.991**), FL (0.989**), BH (0.984**), BD (0.992**), SNL (0.979**) and HL (0.965**) had a significant ($P<0.01$) positive correlation with body weight (Table 1). Correlation of body yields with morphometric measurements has been the subject of several studies for some fish species and this result reported by other authors: Rafael *et al*. found significant phenotypic correlations between body height with a value of 0.83, head length with a value of 0.48, BD/HL with a value of -0.26 and BD/SL with a value of -0.16 by body weight in round fish (*pacu Piaractusmesopotamicus*, *tambaqui Colossoma macropomum* and their hybrids) [4], Nasri-tajan and Taati [13] found correlation coefficient with a value of 0.74 between body weight and body length in (*Cynoglossus arel*), Johari *et al.* [14] found correlation coefficient with a value of 0.967 between body weight and body length in female black fish (*Capoeta trutta*), Sang *et al.* [5] also reported that body measurements were effective in the estimation of weight and body yield in catfish *Pangasianodon hypophthalmus*, Barbosa *et al.* [15] found standard length as the measure most correlated with a value of 0.93 with live weight, in tilapia, Charo-Karisa *et al.* [16] found significant phenotypic correlations ranging 0.64 and

0.89 between

Table 1: Correlation coefficients direct and sums of the indirect effects and percentages of direct and indirect effects of morphometric measurements with body weight *Capoeta trutta* in Gamasiab River

Variables	Correlation coefficient	P value	Direct effects	Sums of indirect effects	% direct effects	% indirect effects
Male						
TL	0.827	0.000	-0.788	1.615	32.79	67.21
SL	0.861	0.000	0.448	0.412	52.07	47.93
FL	0.926	0.000	-0.465	1.392	25.04	74.96
BH	0.929	0.000	0.433	0.495	46.64	53.36
SNL	0.955	0.000	0.78	0.18	81.26	18.74
HL	0.851	0.000	0.650	0.201	76.38	23.62
Female						
TL	0.9895	0.000	1.766	-0.776	69.46	30.54
SL	0.9891	0.000	-0.033	1.022	3.15	96.85
FL	0.9894	0.000	-1.781	2.771	39.13	60.87
BD	0.9807	0.000	-0.123	1.104	10.03	89.97
BH	0.9946	0.000	1.086	-0.091	92.24	7.76
SNL	0.9440	0.000	-0.43	1.37	23.83	76.17
HL	0.9722	0.000	0.500	0.472	51.43	48.57
Male & Female						
TL	0.912	0.000	2.29	-1.38	62.45	37.55
SL	0.898	0.000	3.75	-2.85	56.80	43.20
FL	0.906	0.000	-4.97	5.87	45.83	54.17
BD	0.906	0.000	-7.88	8.78	47.28	52.72
BH	0.904	0.000	9.00	-8.10	52.64	47.36
SNL	0.896	0.000	0.84	0.06	93.76	6.24
HL	0.874	0.000	-2.14	3.01	41.53	58.47

Morphometric measurements: body length (TL), standard length (SL), fork length (FL), body height (BH), body width (BD), head length (HL), snout length (SNL) and head length (HL).

Table 2: Estimation of direct and indirect effects, obtained by path analysis, between the morphometric measurements and ratios and body weight *Capoeta trutta* in Gamasiab River

Effects	TL	SL	FL	BD	BH	SNL	HL
Male							
Direct	-0.788	0.448	-0.465	0.433	0.776	0.650	-0.788
In direct by TL		0.447	-0.454	0.243	0.734	0.645	
In direct by SL	-0.785		-0.460	0.266	0.744	0.648	-0.785
In direct by FL	-0.768	0.443		0.314	0.762	0.641	-0.768
In direct by BH	-0.442	0.275	-0.338		0.606	0.394	-0.442
In direct by SNL	-0.745	0.430	-0.457	0.339		0.613	-0.745
In direct by HL	-0.781	0.447	-0.459	0.263	0.731		-0.781
Female							
Direct	1.766	-0.033	-1.781	-0.123	1.086	-0.430	0.500
In direct by TL		-0.0332	-1.7812	-0.1221	1.0806	-0.4166	0.4963
In direct by SL	1.7654		-1.7808	-0.1223	1.0810	-0.4179	0.4969
In direct by FL	1.7656	-0.0332		-0.1220	1.0802	-0.4159	0.4960
In direct by BD	1.7521	-0.0330	-1.7661		1.0770	-0.4230	0.4967
In direct by BH	1.7570	-0.0331	-1.7718	-0.1220		-0.4130	0.4916
In direct by SNL	1.7119	-0.0323	-1.7241	-0.1211	1.0438		0.4956
In direct by HL	1.7526	-0.0330	-1.7669	-0.1222	1.0677	-0.4259	
Male & Female							
Direct	3.715	-4.942	-7.841	8.946	0.833	-2.087	-2.08671
In direct by TL		3.715	-4.942	-7.841	8.946	0.833	-2.087
In direct by SL	2.268		-4.959	-7.859	8.985	0.838	-2.124
In direct by FL	2.277	3.743		-7.874	9.000	0.836	-2.106
In direct by BD	2.279	3.743	-4.968		8.999	0.837	-2.107
In direct by BH	2.275	3.744	-4.969	-7.874		0.837	-2.109
In direct by SNL	2.270	3.740	-4.948	-7.844	8.966		-2.128

In direct by HL	2.231	3.721	-4.890	-7.751	8.867	0.835

Morphometric measurements: body length (TL), standard length (SL), fork length (FL), body height (BH), body width (BD), head length (HL), snout length (SNL) and head length (HL).

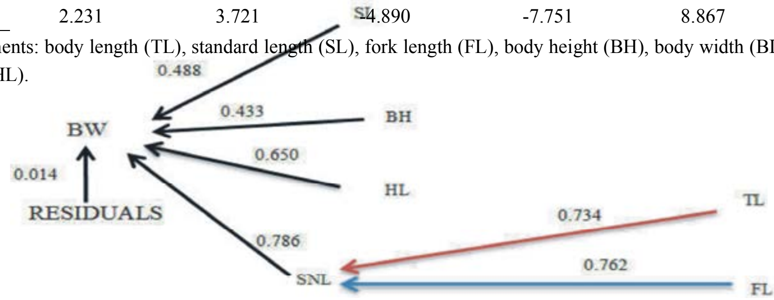

Fig. 1: Path Diagram Morphometric with Body Wight for Meal Fish of *Capoeta trutta*.

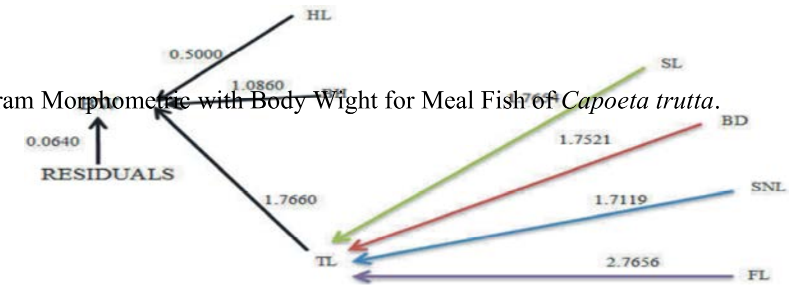

Fig. 2: Path Diagram Morphometric with Body Wight for Female Fish of *Capoeta trutta*.

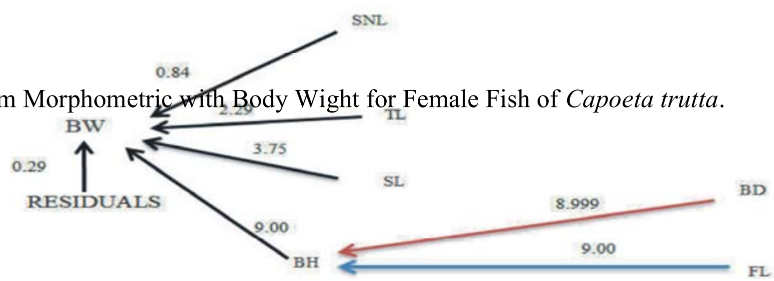

Fig. 3: Path Diagram Morphometric with Body Wight for total (male and female) Fish of *Capoeta trutta.*

body measurements and weight of tilapia, Freato *et al.* [3] found correlation coefficient in order with a value of 0.89, 0.89 and 0.92 between standard length, height and body circumference weight of species *piracanjuba Bryconorbignyanus* and Rutten *et al.* [17] found correlation coefficient in order with a value of 0.76 and 0.91 between height and width with body weight, also in tilapia.

The stepwise procedure resulted in the inclusion of the following morphometric measures: Body weight = TL, SL, FL, BD, BH, SNL and HL. Rafael *et al.* [4] reported the equation of in round fish (*pacu Piaractusmesopotamicus*, *tambaqui Colossoma macropomum* and their hybrids) WEIGHT = HL, BH, BD, BH/SL, BD/SL, BD/HL; carcass yield = HH, BH, BD, HH/SL, HL/BH, BD/BH; RCOST = HH/SL, BH/SL, BD/SL, HH/BH, BD/HL; filet with rib yield = HH, BD/SL, HL/HH, BD/HL; filet yield = HH, HL/HH, BD/HL. Johari *et al.* [14] reported The equation of body weight in female black fish (*Capoeta trutta*), total weight = -11.78+3.107 total length and Nasri-tajan and Taati [13] reported The equation of body weight in female (*Cynoglossus arel*), total weight= 0.494×total lenght 1.598.

The positive highest direct effect value for body weight in male black fish (*Capoeta trutta*), were SNL (0.780), HL (0.650), SL (0.448) and BH (0.443) and The highest negative direct effect value for body weight were TL (-0.788) and FL (-0.465).The positive highest indirect Sums of effect value for body weight were TL (1.615), FL (1.392), BH (0.495) and SL (0.412) (Table 2). The positive highest direct effect value for body weight in female black fish (*Capoeta trutta*) were TL (1.766), BH (1.086) and HL (0.500) and The highest negative direct effect value for body weight were FL (-1.781) and SNL (-0.430). The positive highest indirect Sums of effect value for body weight were FL (2.771), SNL (1.730), BD (1.104) and SL (1.022) and The highest negative indirect effect value for body weight were TL (-0.776) and BH (-0.091) (Table 2). The positive highest direct effect value for body weight in total (male and female) black fish (*Capoeta trutta*), were BH (9.00), SL (3.750), TL (2.290) and SNL (0.840) and The highest negative direct effect value for body weight were BD (-7.880), FL (-4.970) and HL (-2.140). The positive highest indirect Sums of effect value for body weight were BD (8.780), FL (5.870), HL (3.010) and SNL (0.06) and The highest negative indirect effect value for body weight were BH (-8.100), SL (-2.850) and TL (-1.380) (Table 2). The highest direct percentage value for body weight in male black fish (*Capoeta trutta*), were BH (92.24%) HL (51.43%) and FL (39.13%). The highest indirect percentage value for body weight were SL (96.85%), BD (89.97%), SNL (76.17%) and FL (60.87%) (Table 2), The highest direct percentage value for body weight in female black fish (*Capoeta trutta*), were BH (92.24%), TL (69.64%) and HL (51.43%).The highest indirect percentage value for body weight were SL (96.85%), BD (89.97%) and FL (60.87%) (Table 2) and The highest direct percentage value for body weight in total (male and female) black fish (*Capoeta trutta*), were SNL (93.76%), TL (62.45%) and SL (56.80%).The highest indirect percentage value for body weight were HL (58.47%), FL (54.17%) and BD (52.72%) (Table 2) indicating that standard length, head length and body width is important in determining body weight in male black fish (*Capoeta trutta*), (Fig. 1), the total length, body width and body height is important in determining body weight in female black fish (*Capoeta trutta*), (Fig. 2) and the total length, SNL length head length, body width and had length is important in determining body weight in total (male and female) black fish (*Capoeta trutta*), (Fig. 3). Path analysis of body yields with morphometric measurements has been the subject of several studies for some fish species. Rafael *et al*. [4] reported that body measurements were effective in the estimation of weight and body yield in round fish (*pacu Piaractusmesopotamicus*, *tambaqui Colossoma macropomum* and their hybrids) there found a direct effect of HL with a value of (1.232 and 62.09%), BH with a value of (0.353 and 42.53%) and BD with a value of (0.875 and 57.72%), Serafini [18], evaluating the performance, along with morphometric and carcass traits, of *tambaqui*, *pacu* and their hybrids, observed for the final weight of *tambaqui* and the hybrid *tambacu* in comparison with *pacu*. Serafini [18] and also observedthat fish with a higher carcass percentage (*tambaqui* and *tambacu*) also have the largest head measures, reinforcing the path analysis results, i.e., fish with larger head size, or with heads longer than the body height are those with highest carcass yield and Sang *et al.* [5] also reported that body measurements were effective in the estimation of weight and body yield in catfish (*Pangasianodon hypophthalmus*).

CONCLUSION

The standard length, head length and body width measurements by the direct effect and body length, fork length and snout length measures by the indirect effect are important for determining the body weight of male black fish (*Capoeta trutta*), The total length, body width, body height and standard length measurements by the direct effect and head length, fork length and snout length measures by the indirect effect are important for determining the body weight of female (*Capoeta trutta*) and The total length, body width, head length, snout length and body height measurements by the direct effect and standard length and fork length measures by the indirect effect are important for determining the body weight of total (*Capoeta trutta*). This morphometric could be used in breeding programs as a measure of direct selection for fish with better body weight traits, but first, it is necessary to conduct a genetic study to provide information about the heritability and genetic correlation of this variable with the body weight.

REFERENCES

1. Alp, A., C. Kara, F. Üçkardeş, J. Carol and E. García-Berthou, 2005. Age, Growth and Condition of *Capoeta trutta* angorae Hanko 1924 from the Upper Water Systems of the River Ceyhan, Turkey. Turk J. Vet. Animal Sci., 29: 665-676.
2.` Crepaldi, D.V., E.A. Teixeira and P.M.C. Faria, 2008. Carcass yield in catfish (*Pseudoplatystoma* spp.) Assessed by ultrasound. Brazilian Journal of Health and Production Animal, 9(4): 813-824.
3. Freato, T.A., R.T.F. Freiatas and V.B. Santos, 2005. Effect of slaughter weight in yield processing of piracanjuba (*Bryconorbignyanus,* Valenciennes, 1849). Science and Agro Technology, 29(3): 676-682.
4. Rafael, V.R.N., T.F. Rilke, A.S. Moacyr, C.C. Adriano,

A.F. Thiago, V.R. Priscila and B.A. Ivan, 2012. Interrelationships between morphometric variables and rounded fish body yields evaluated by path analysis. Brazilian Journal of Animal Science, 41(7): 1576-1582.

5. Sang, N.V., A. Thomassenm and G. Klemetsdal, 2009. Prediction of fillet weight, fillet yield and fillet fat for live river catfish (*Pangasianodon hypophthalmus*). Aquaculture, 288: 166-171.
6. Cruz, C.D., 2001. Genes program, release windows: computer application in genetics and statistics. Viçosa, MG: Universidade Federal De Viçosa, 648.
7. Cruz, C.D. and P.C.S. Carneiro, 2003. Biometric models applied to genetic improvement. Viçosa, MG: Federal University of Viçosa, pp: 585.
8. Costa, A.C., 2011. Morphometric measurements in the evaluation of body weight and yield of *pacu Piaractusmesopotamicus* and *tambaqui Colossoma macropomum*. Dissertation (Master of Animal Science) - University of Lavras, Lavras, pp: 64.
9. Loures, B.T.R.R., R.P. Ribeiro and L. Vargas, 2001. Dietary management of Nile tilapia, *Oreochromis niloticus*, associated with physical, chemical and biological environment. Acta Scientiarum, 23(4): 877-883.
10. Lawson, E.O., S.L. Akintola and F.A. Awe, 2010. Length-Weight Relationships and Morphometry for Eleven (11) Fish Species from Ogudu Creek, Lagos, Nigeria. 2013ISSN 1992-0067© IDOSI Publications, Advances in Biological Research, 7(4): 122-128.
11. Abbaspour, R., M. Rahbar and J. Mesgaran Karimi, 2011. Comparative Survey of Morphometric-meristic Male and Female Anjak Fish (*Schizocyprisbrucei*, Annandale and Hora, 1920) of Hamoun Wetland in South East Iran.© IDOSI Publications,Middle-East Journal of Scientific Research, 14(5): 620-623.
12. Iqbal Mir, J., R. Shabir and F. Ahmad Mir, 2011. Length-Weight Relationship and Condition Factor of *Schizopyge curvifrons* (Heckel, 1838) from River Jhelum, Kashmir, India.© IDOSI Publications,World Journal of Fish and Marine Sciences, 4(3): 325-329.
13. Nasri-tajan, M. and R. Taati, 2010. Relationship length-weight of sole (*Cynoglossus arel*) in north coast of Persian Gulf. Science-Research Journal of Marine Biology, 6: 87-91.
14. Johari, N., M. Kazmian, M. Shapori and S. Vatandost, 2010. Compressionof morphometric and meristic characteristic of *Capoetacapoeta* in Talar River of Mazandaran province. Science-Research Journal of Marine Biology, 6: 53-64.
15. Barbosa, I.C.B., P.L.S. Carneiro and C.H.M. Malhado, 2008. Performance and sensory evaluation of two strains of Nile tilapia. Scientific Journal of Animal Production, 10(1): 50-59.
16. Charo-karisa, H., H. Bovenhuis and M.A. Rezk, 2007. Phenotypic and genetic parameters for body measurements, reproductive traits and gut length of Nile tilapia (*Oreochromis niloticus*) selected for growth in low-input earthen ponds. Aquaculture, 273: 15-23.
17. Rutten, M.J.M., H. Komen and H. Bovenhuis, 2005. Longitudinal genetic analysis of Nile tilapia (*Oreochromis niloticus L.*) body weight using a random regression model. Aquaculture, 246: 101-113.
18. Serafini, M.A., 2010. Interspecific diallel cross between *pacu Piaractusmesopotamicus* and *tambaqui Colossoma macropomum* Tese (Ph.D. in Animal Science) - University of Lavras, Lavras.