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MORPHOMETRIC COMPARISONS OF THE MOSQUITOFISH POPULATIONS (GAMBUSIA HOLBROOKI) FROM KASHMAR REGION, KHORASAN RAZAVI PROVINCE, NORTHEASTERN IRAN

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ABSTRACT: The present study was conducted to investigate the morphometric characteristics of Mosquitofish populations (*Gambusia holbrooki*) in the Kashmar Region. For this purpose, 60 specimens of Mosquitofish (30 males and 30 females) were caught from Kashmar Region, Khorasan Razavi province (northeastern Iran) using Electrofishing. Twenty-nine morphometric characters were used for biometry in both sexes. Univariate analysis of variance (ANOVA) and Principal Component Analysis (PCA) was used for each morphometric character to evaluate the significant difference between the male and female populations. ANOVA revealed significant differences in 18 morphometric characters among studied populations. The results of this study could be taken to consider the male and female populations of *G. holbrooki* as stocks in Iran.

KEYWORDS: Morphometric, *G. holbrooki*, male and female, Kashmar Basin, Iran

INTRODUCTION

Morphometric measurements and meristic counts are considered as easiest and authentic methods for the identification of specimen which is termed as morphological systematics[1]. Morphological characteristics and color patterns continue to be used extensively for taxonomic descriptions[13]. The study of morphological characters such as morphometric, meristic has a long tradition in ichthyology[15]. Various studies in morphology such as meristic and morphometric characters had proven to be effective parameters to elucidate stock assessments[4]. Morphometric differentiation among fish populations would be attributed either to distinct genetic structure or to environmental conditions in each area[11]. *Gambusia holbrooki*, commonly called as mosquitofish, is an exotic, originating in eastern and southern North America and introduced to Iran from stocks introduced to Italy and from Baku in Azerbaijan. This species was first introduced to the Ghazian marshes of the Caspian littoral of Iran[7,12]. This species inhabits slowly moving or stagnant waters with preference of areas densely covered with plants[6]. It is carnivorous, feeding on mosquito and mosquitofish (canibalism), small crustacean, zooplankton (copepod, cladocer) and insects[2]. *G. holbrooki* has ability to rapidly reproduce, disperse widely and occupy diverse habitats, to the detriment of native species[12]. There is a little information on fish population biology in Iran[10]. The effects of *G. holbrooki* in competition with native

fishes and biology of this species in Iran requires study. Therefore, the objective of this study is to compare the morphological variation between the two populations of *G. holbrooki* (male and female populations) from Kashmar Region in Iran. Comparisons between morphological results between the male and female Populations of *G. holbrooki* enabled us to assess the fish stock in Iran.

MATERIALS AND METHODS

A total of 60 specimens (30 males and 30 females) of *G. holbrooki* were collected from Kashmar Region (35°14' N; 58°28' E), Khorasan Razavi Province, using Electrofishing in September 2014 (Figure-1).

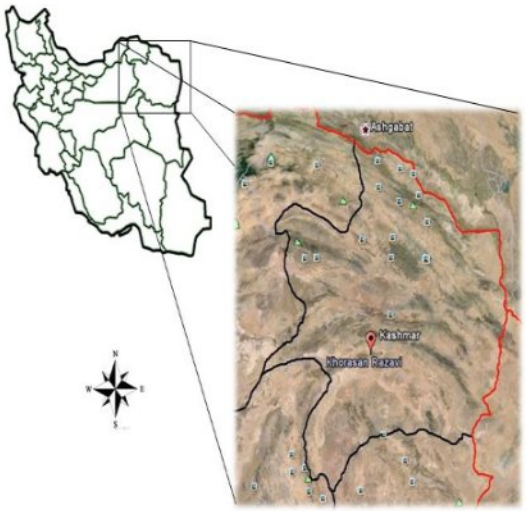

Figure 1. Collecting location for *G.* ***holbrooki*** in the Kashmar Region,Khorasan Razavi province, Iran.

The collected specimens were fixed in in 10% formalin and transported to the laboratory. Twenty-nine morphometric factors were used for biometry in both sexes. All lengths were measured to the nearest mm. To remove the size component from the shape measurements[14], all individual morphometric measurements were standardized by PAST software. Univariate analysis of variance (ANOVA) and Principal Component Analysis (PCA) were used for each morphometric character to evaluate the significant difference between the two populations. This study was carried out using Excel 2010, Spss 17 and PAST Software.

RESULTS AND DISCUSSION

All data of morphometric factors of fishes (min-max, mean, standard deviation) are listed in Table 1.

In this study, ANOVA revealed significant differences in 18 morphometric characters (Table 2). There are significant differences between head width, head depth, body depth, body, width, distance between eyes, postorbital length, mouth width, caudal peduncle depth, dorsal fin height, anal fin height, pectoral fin base length, ventral fin base length, ventral fin height, predorsal length, postdorsal length, preanal length,

Table 1. Morphometric characteristics for *G. holbrooki* populations from Kashmar Region in Iran

		Male population (30 samples)		Female population (30 samples)	
	Characters (mm)	**Min-Max**	**Mean±SD**	**Min-Max**	**Mean±SD**
1	Total length	25.71-34.00	31.18±2.13	27.50-55.30	40.91±9.08
2	Standard length	20.90-27.65	24.85±1.76	21.50-45.01	33.19±7.66
3	Head length	5.60-7.60	6.64±0.55	6.10-11.21	8.70±1.80
4	Head width	3.15-4.20	3.74±0.27	3.45-8.40	5.64±1.48
5	Head depth	3.50-4.50	4.05±0.33	4.00-8.33	6.10±1.44
6	Head depth in eye section	2.65-3.77	3.12±0.28	2.79-6.10	4.49±1.14
7	Body depth	4.20-6.20	5.40±0.53	5.00-12.40	8.99±2.64
8	Body width	3.10-4.00	3.47±0.24	3.43-9.20	6.65±2.06
9	Distance between eyes	3.00-3.90	3.45±0.25	3.60-6.90	5.43±1.28
10	Postorbital length	2.15-3.15	2.51±0.22	2.42-4.70	3.55±0.73
11	Mouth width	1.70-2.50	2.16±0.20	2.10-4.05	3.11±0.62
12	Snout length	1.60-2.27	1.95±0.17	1.75-3.25	2.54±0.52
13	Eye diameter	2.00-2.73	2.21±0.16	1.90-3.90	2.65±0.47
14	Caudal peduncle length	4.00-5.40	4.66±0.39	3.50-6.35	5.17±0.86
15	Caudal peduncle depth	2.90-4.55	3.61±0.34	3.00-6.11	4.53±1.07
16	Dorsal fin base length	2.80-4.00	3.26±0.29	2.70-5.10	4.00±0.76
17	Dorsal fin height	4.68-7.15	6.14±0.59	5.20-9.60	7.30±1.49
18	Anal fin base length	2.90-3.61	3.24±0.19	2.85-4.15	3.52±0.40
19	Anal fin height	6.50-10.50	9.15±0.79	5.50-9.50	7.43±1.26
20	Pectoral fin base length	1.50-1.92	1.73±0.13	1.69-3.30	2.36±0.45
21	Pectoral fin height	4.20-6.62	5.64±0.62	4.35-8.70	6.79±1.43
22	Ventral fin base length	0.87-1.11	0.94±0.06	0.93-1.96	1.26±0.26
23	Ventral fin height	1.80-2.80	2.35±0.27	2.50-5.10	3.81±0.99
24	Prepelvic length	6.50-8.70	7.57±0.51	6.90-13.30	9.98±2.14
25	Predorsal length	12.05-16.50	14.91±1.32	14.12-29.50	21.99±5.25
26	Postdorsal length	11.00-14.70	13.33±0.93	11.00-21.70	16.34±3.44
27	Preanal length	9.48-12.20	10.64±0.63	11.30-26.20	18.86±5.11
28	Postanal length	14.00-19.20	17.51±1.28	12.97-24.50	19.01±3.88

Table 2: The Results of ANOVA of morphometric characteristics for *G. holbrooki* populations from Kashmar Region in, Iran

	Morphometric character	***F* value**	***P* value**
1	Total length	0.000	1.000
2	Standard length	0.600	0.443
3	Head length	1.102	0.300
4	Head width	16.193	0.000
5	Head depth	22.678	0.000
6	Head depth in eye section	2.421	0.127
7	Body depth	22.377	0.000
8	Body width	32.893	0.000
9	Distance between eyes	25.914	0.000
10	Postorbital length	15.609	0.000
11	Mouth width	14.647	0.000
12	Snout length	1.763	0.192
13	Eye diameter	.105	0.748
14	Caudal peduncle length	1.025	0.317
15	Caudal peduncle depth	8.074	0.007
16	Dorsal fin base length	.190	0.665
17	Dorsal fin height	9.052	0.004
18	Anal fin base length	.994	0.324
19	Anal fin height	73.650	0.000
20	Pectoral fin base length	10.475	0.002
21	Pectoral fin height	3.814	0.058
22	Ventral fin base length	5.932	0.019
23	Ventral fin height	10.583	0.002
24	Prepelvic length	1.616	0.211
25	Predorsal length	18.292	0.000
26	Postdorsal length	11.476	0.002
27	Preanal length	43.722	0.000
28	Postanal length	54.484	0.000
29	Dorsal-anal length	11.756	0.001

postanal length and dorsal-anal length of the studied populations (P<0.05, Table 2). Principal Component Analysis of morphometric characters extracted 2 factors with Eigen values >1, explaining 76.81% of the variance (Figure 2). The first principal component (PC1) accounted for 70.91% of the variation and the second principal component (PC2) for 5.90% (Table 2), and the most significant loadings on PC1 were head width, head depth, body depth, body width, distance between eyes, anal fin height, ventral fin height, predorsal length, postdorsal length, preanal length, postanal length, dorsal-anal length and on PC2 were standard length, head length, head depth, head depth in eye section, body depth, body width, snout length, eye diameter, caudal peduncle length, caudal peduncle depth, dorsal fin base length, prepelvic length, predorsal length, postanal length, dorsal-Anal length.

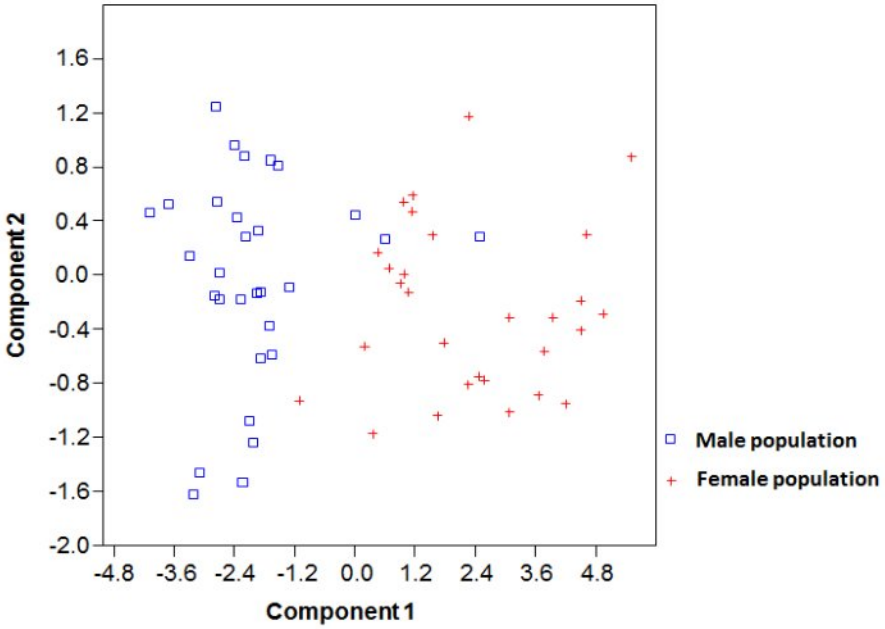

Figure 2. Principal component analysis of morphometric data taken from *G. holbrooki* populations from Kashmar Region in Iran.

Table 3. Results of principal component analysis (PCA) of morphometric measurements for *G. holbrooki* populations in Kashmar Region

PC	Eigen value	Variance (%)	Cumulative (%)
1	7.242	70.91	70.91
2	1.263	5.90	76.81

Morphological (meristic and morph - ometric characteristics) differentiation between fish stocks can provide a basis for stock structure and may be applicable for fisheries management[3]. Morphological measurements of fish populations are the powerful tool for characterizing of the same populations[13]. Many studies have been conducted about morphological differentiation between male and female populations of fish. For example, Gogoi and C.Goswami[8] reported morphometric and meristic measurements of *Amblypharyngodon mola* from different habitats of Assam. In this study, there was significant difference ($P<0.05$) between morphometric characters of mature male and female *A. mola*.

In our study, segregation was partly confirmed by PCA. The results showed significant differences between morphometric measurements of the male and female populations. The studied populations were different in morphometric characters that include standard length, head length, head depth, head width, head depth in eye section, body depth, body width, snout length, eye diameter, distance between eyes, caudal peduncle length, caudal peduncle depth, dorsal fin base length, anal fin height, ventral fin height, prepelvic length, predorsal length, preanal length, postanal length and dorsal-anal length.

It seems that the differentiation in morphometric characters may be affected by genetic, environmental factors and the interaction between them[9,16]. This subject has been discussed in many studies e. g. Abbaspour *et al*[1] and Vatandoust *et al*[17]. Vatandoust *et al*[17] compared the morphometric and meristic characters in male and female populations of *Schizocypris brucei* in Hamoun wetland of Iran. The results showed that male and female populations were different in 2 meristic factors and 20 morphometric factors. According to the obtained results, mean fork length and total weight were 18.5±1.99 (±SD) cm and 55.5±14.45 (±SD) g respectively. Also, mean standard length was 15.4±1.70 (±SD) cm and mean fork length was 16.9±1.73 cm. Vatandoust *et al*[17] also determined morphometric characteristics of five populations of *Salmo trutta fario* along the southern Caspian Sea basin in Iran. In this research, the PCA of morphometric characters separated the populations from each other and grouped into 5 areas in morphometric. They stated that morphometric characters can demonstrate variation in response to differences in environmental parameters. The many studies showed that morphometric measurements are

beneficial for separation of populations of fish, whereas the meristic measurements could not separate the fish populations. It seems that morphological characters of two populations of *G. holbrooki* are affected by factors such as temperature, feeding, behavior, foraging efficiency, reproduction and etc. The present study could provide the information for future studies on morphological differences of the *G. holbrooki* populations from different environments. Also, the results of this study could be taken to consider the male and female populations of *G. holbrooki* as stocks in Iran.

REFERENCES

1. Abbaspour, R., M. Rahbar & J. Mesgaran Karimi, 2013. Comparative survey of morphometric-meristic male and female Anjak fish (*Schizocypris brucei*, Annandale and Hora, 1920) of Hamoun Wetland in South East Iran. *Middle-East Journal of Scientific Research*, 14 (5): 620-623.

2. Allen, G.R., S.H. Midgley & M. Allen, 2002. Field guide to the freshwater fishes of Australia. *Western Australian Museum*, Perth, Western Australia, pp.394..

3. Begg, G.A., K.D. Friedland & J.B. Pearce, 1999. Stock identification and its role in stock assessment and fisheries management: an overview. *Fisheries Research*, 43: 1-8.

4. Bektas, Y. & A.O. Belduz, 2009. Morphological variation among Atlantic horse mackerel, *Trachurus trachurus* populations from Turkish coastal waters. *Journal of Animal and Veterinary Advances*, 8 (3): 511-517.

5. Cavalcanti, M.J., L.R. Monteiro & P.R.D. Lopes, 1999. Landmark based morphometric analysis in selected species of Serranid fishes (Perciformes: Teleostei). *Zool. Stud*., 38(3), 287-294.

6. Cech, J.J.J., M.J. Massingill, B. Vondracek & A.L. Linden, 1985. Respiratory metabolism of mosquitofish, *Gambusia affinis*: effects of temperature, dissolved oxygen, and sex difference. *Environmental Biology of Fishes*, 13: 297-307.

7. Coad, B.W., 2016. Freshwater fishes of Iran. Available at: http: // www.briancoad.com. 30 April.

8. Gogoi, R. & U. C.Goswami, 2015. Morphometric and meristic study of *Amblypharyngodon mola* (Ham- Buch) from different habitats of Assam. *Annals of Biological Research*, 6 (2):10-14.

9. Heidari, A., H. Mousavi-Sabet, M. Khoshkholgh, H.R. Esmaeili & S. Eagderi, 2013. The impact of Manjil and Tarik dams (Sefidroud River, southern Caspian Sea basin) on morphological traits of Siah Mahi *Capoeta gracilis* (Pisces: Cyprinidae). *International Journal of Aquatic Biology*, 1(4): 195-201.

10. Heydarnejad, M.S., 2009. Length-weight relationship for six freshwater fish species. *Chinese Journal of Oceanology and Limnology*, 27: 61-62.

11. Kinsey, S.T., T. Orsoy, T.M. Bert & B. Mahmoudi, 1994. Population structure of the Spanish sardine *Sardinella aurita*: natural morphological variation in a genetically homogenous population. *Marine Biology*, 118: 309-317.

12. Sedaghat, S. & A. Hoseini, 2012. Length-Weight and Length-Length Relationships of Gambusia (*Gambusia holbrooki*) in the Dinor River Khorasan Razavi, Iran. *World Journal of Fish and Marine Sciences*, 4 (5): 530-532.

13. Strauss, R.E. & C.E. Bond, 1990. Taxonomic methods: Morphology. In: Schreck, C.B. and Moyle (Eds.), Methods for fish biology. *American Fisheries Society*, Betesda, Maryland, 109-140.

14. Thorpe, R.S., 1976. Biometric analysis of geographic variation and racial affinities. *Biological Revue*, 51: 407-452. Tudela, S., 1999. Morphological variability in a Mediterranean, genetically homogeneous population of the European anchovy, *Engraulis encrasicolus*. *Fisheries Research*, 42: 229-243.

15. Murta, A.G., 2000. Morphological variation of horse mackerel (*Trachurus trachurus*) in the Iberian and North Africa Atlantic: implications for stock identification. *ICES J. Mar. Sci*., 57: 1240-1248.

16. Vatandoust, S., A. Abdoli, H. Anvarifar & H. Mousavi-Sabet, 2014. Morphometric and meristic characteristics and morphological differentiation among five populations of Brown Trout *Salmo trutta fario* (Pisces: Salmonidae) along the southern Caspian Sea basin. *European Journal of Zoological Research*, 3 (2):56-65.