

Length-weight relationship and condition factor of Mosquitofish (*Gambusia holbrooki*) in three inland basins of Iran

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Abstract. In this study, length-weight and condition factor of three populations of Mosquitofish (*Gambusia holbrooki*) from Gamasiab River, Sirzar River and Kashmar region (from three basins of the Iranian inland water) were studied. The maximum total length and weight of studied population were 55.30 mm and 2.67 g, respectively. The results revealed that there was a significant relationship between length and weight for fishes in each population. The *b*-value of studied populations ranged from 2.986 to 3.763 with a mean of 3.231. The growth pattern was isometric for Sirzar and Gamasiab populations, while that of Kashmar population indicated positive allometric growth pattern. The minimum and maximum of condition factors was 0.78 and 1.13 for Kashmar and Sirzar populations, respectively. This study provides useful information for biologists to a better understanding of the biology of this specie, particularly regarding its phenotypic plasticity in different inland water basins of Iran.

Key Words: length-weight relationship, morphometrics, phenotypic plasticity, inland water.

Introduction. Informations on length-weight relationship (LWR) of fishes are a useful tool for biologist in fisheries for their assessment and proper management due to providing the estimation of biomass from length observation (Rieker 1975; Nyaku et al 2008; Zamani Faradonbeh et al 2014, 2015). In addition, LWR is used in predicting growth and assessing nutritional status as defined by condition of fishes (Froese 2006). It also allows study of the ontogenetic allometric changes in fish growth (Teixeira-de Mello et al 2006; Teixeira-de Mello & Eguren 2008; Moutopoulos & Stergiou 2002).

The condition factor (K) is an important biological parameter, which shows the degree of well-being of fish in their habitat (Khallaf et al 2003). It shows the population's welfare during various stages of life cycle (Ahmad et al 2012). The condition factor is also a useful index for monitoring of environmental factors, feeding intensity, and growth in populations of fish species (Olusegun 1989; Zamani Faradonbeh et al 2015). This factor varies according to influences of physiological factors, and fluctuates according to different stages of the development (Ahmed et al 2011).

Mosquitofish, *Gambusia holbrooki*, which belongs to the family Poeciliidae, is a small, viviparous fish (Coad 2015). This species is one of the most widely distributed species of freshwater ecosystems (Botsford et al 1987; Cabral et al 1998) and found in brackish water, standing to slow-flowing water, vegetated ponds and lakes (Page & Burr 1991). Mosquitofish is well-known for its consumption of insect larvae, zooplankton and other invertebrates (Blaustein 1992). It is commonly used as a biological control for mosquitoes (Castleberry & Cech 1990).

The present study aimed to study the length-weight relationship (LWR) and condition factor (K) of *G. holbrooki* inhabiting the Gamasiab River (Tigris basin), Sirzar River (Haririver basin), and a pond in the Kashmar (Khorana Province, eastern Iran) (Dasht-e Kavir basin) belonging to three inland basins of Iran. *G. holbrooki* has a larger distribution in the inland water of Iran. Therefore, information emanating from this study will contribute to a better understanding of the biology of this specie, particularly its phenotypic plasticity in different inland water basins of Iran.

Material and Method. A total of 118 specimens of *G. holbrooki* were collected from Gamasiab River, Sirzar River and Kashmar region using electrofishing device on September and October 2013. The collected specimens were anesthetized in 1% clove oil solution at the field and then weighted by a digital balance to the nearest 0.010 g and their total length (TL) were measured to the nearest 0.01 mm using a digital caliper. Then, they were fixed in 10% formalin and transported to the laboratory. The length-weight relationship was estimated using the equation of $W = aL^b$ (Ricker 1975), where W is the total body weight (g), L is the total length (mm), b is the regression coefficient (slope) and a is the intercept of the regression. The growth pattern is isometric when the value of $b = 3$ and allometric when significantly different from 3 (Zamani Faradonbeh et al 2015). The significance of the regression of LWR has been assessed by ANOVA. In order to check if the obtained value of b is significantly different from the expected or theoretical value of 3 (isometric value), student's t-test was used.

The condition factor (K) was calculated according to Fulton (1904) and Froese (2006) using $K = 100W/L^b$, where W = weight of fish (g), L = total length of fish (cm), K = condition factor and 100 is a factor to bring the value of K near unity (Biswass 1999).

Results and Discussion. Descriptive statistics, including the sample size, ranges of the length and weight parameters, estimated LWR parameters i.e. a and b and coefficient of correlation (r^2) of studied populations are presented in Table 1. The recorded maximum total length and weight of *G. holbrooki* were 55.30 mm and 2.67 g, respectively.

All length-weight relationships were highly significant ($P < 0.05$), with r^2 values being greater than 0.96. The b -values of the length-weight relationships ranged from 2.986 for Sirzar population to 3.763 for Kashmar population. The growth patterns of Sirzar and Gamasiab populations were almost isometric, whereas that of Kashmar population indicated a highly positive allometric growth pattern.

Based on the results, the estimates of the parameter b , varying between 2.986 and 3.763 remain almost within the expected range (2.5–3.5) (Tesch 1971) with a mean b -value of 3.231 for all the populations. The different b -value of three studied populations of *G. holbrooki* showed that they have significantly different growth patterns. Differences in b -values can be attributed to the combination of one or more parameters, such as sexes, gonad maturity, health, season effect, degree of stomach fullness, differences in the length of samples caught, and environmental factors (Tesch 1971; Wootton 1992, 1998; Tesch 1971) that none of them considered in this study.

Sedaghat & Hoseini (2012) studied length-weight relationship of *G. holbrooki* in the Dinor River (Kermanshah Province, Iran). They determine a positive allometric pattern for females as: $W = 0.06L^{3.49}$ ($r^2 = 0.99$) and an isometric one as: $W = 0.05L^{2.87}$ ($r^2 = 0.84$) for males. Esmaili & Ebrahimi (2006) also reported a total length range of 23.8-40.5 mm for *G. holbrooki* with a mean b -value of 3.04 in freshwater of Iran. Lhan & Sari (2015) reported an almost allometric pattern ($b = 2.94$) for *G. affinis* in Marmara Lake of Turkey. Also, Andreu-Soler et al (2006) reported the length range of 20-57 mm with a b -value of 3.59 for *G. holbrooki* in the Segura River basin (SE Iberian Peninsula). All available LWRs data were in the range of the results of this study and the observed differences in the b -values can be related to their adaptation to different environmental conditions of their habitats.

In the present study, condition factors (K) was 0.99, 1.13, and 0.78 for Gamasiab, Sirzar and Kashmar populations, respectively. Condition factor is based on the hypothesis that heavier fishes of a given length are in better condition. Condition factors of ≥ 1 indicate a good level of feeding and proper environmental condition (Ujjania et al 2012) i.e. when condition factor value is lower, it means that the fish has attained an adverse condition (Le Cren 1951). In addition, the condition factors can be applied for comparing the condition, fatness, or well-being of fish (Froese 2006). The K -values of the Gamasiab and Sirzar populations were ≥ 1 showing their proper environmental conditions of habitats, whereas those of the Kashmar i.e. a small pond, was not proper (Froese 2006; Ujjania et al 2012). Condition of an individual fish of a given species at a given length can vary with feeding success, health, season, and location (Le Cren 1951; Ahmed et al 2011) that none of them above mentioned factors were considered in this study.

Table 1

Descriptive statistics and estimated parameters of length-weight relationships for three studied populations of *G. holbrooki* from inland waters of Iran

<i>Population</i>	<i>N</i>	<i>Total length (mm)</i>		<i>Total weight (g)</i>		<i>Relationship parameters</i>		
		<i>Min-max</i>	<i>Mean±SD</i>	<i>Min-max</i>	<i>Mean±SD</i>	<i>a</i>	<i>b</i>	<i>r²</i>
Gamasiab River	50	22.50-36.61	28.13±1.98	0.12-0.53	0.24±0.09	0.000008	3.086	0.96
Sirzar River	25	15.60-30.65	22.61±1.84	0.04-0.31	0.13±0.07	0.00001	2.986	0.98
Kashmar	43	25.71-55.30	35.94±2.12	0.18-2.67	0.72±0.03	0.000007	3.763	0.96

N = individuals; SD = Standard Deviation; a = intercept; b = slope; r² = coefficient of correlation.

Conclusions. Poecilids are able to inhabit a wide diversity of environments and tolerate high levels of habitat disturbances, being able to survive in environments that many other species are unable to endure (Araújo et al 2003). In agreement, the results of the present study showed that *G. holbrooki* can be adapted to different environmental condition by regulating its growth pattern. In addition, this study presented a basic information about the length-weight relationship and condition factor for three populations of *G. holbrooki* in Iran that would be useful for biologists to better understanding of its phenotypic plasticity in different water bodies.

References

- Ahmad D., Najar S., Balkhi A. M., Rather M. H., Sharma R., 2012 Length weight relationship and relative condition factor of *Schizopyge esocinus* (Heckel, 1838) from Jhelum River, Kashmir. *International Journal of Aquatic Science* 3(1):29-36.
- Ahmed O. E., Mohammed E. A., Afra A. A., 2011 Length-weight relationship and condition factors of six fish species in Atbara River and Khashm El-girba reservoir, Sudan. *International Journal of Agriculture Sciences* 3(1):65-70.
- Andreu-Soler A., Oliva-Paterna F. J., Torralva M., 2006 A review of length-weight relationships of fish from the Segura River basin (SE Iberian Peninsula). *Journal of Applied Ichthyology* 22:295–296.
- Araújo F. G., Fichberg I., Pinto B. C. T., Peixoto M. G., 2003 A preliminary index of biotic integrity for monitoring the condition of the rio Paraíba do Sul, Southeast Brazil. *Environmental Management* 32(4):516-526.
- Biswass S. P., 1999 *Manual of methods in fish biology*. South Asia. Publishers VT.TD, New Delhi, 195 pp.
- Blaustein L., 1992 Larvivorous fishes fail to control mosquitoes in experimental rice plots. *Hydrobiologia* 232:219-232.
- Botsford L. W., Vondracek B., Wainwright T. C., Linden A. L., Kope R. G., Reed D. E., Cech J. J., 1987 Population development of the mosquitofish, *Gambusia affinis*, in rice fields. *Environmental Biology of Fishes* 20:143-154.
- Cabral J. A., Mieiro C. L., Marques J. C., 1998 Environmental and biological factors influence the relationship between a predator fish, *Gambusia holbrooki*, and its main prey in rice fields of the Lower Mondego River Valley (Portugal). *Hydrobiologia* 382:41-51.
- Castleberry D. T., Cech J. J., 1990 Mosquito control in wastewater: a controlled and quantitative comparison of pupfish (*Cyprinodon nevadensis amargosae*), mosquitofish (*Gambusia affinis*) and guppies (*Poecilia reticulata*) in Sago pondweed marshes. *Journal of the American Mosquito Control Association* 6:223-228.
- Coad B. W., 2015 *Freshwater Fishes of Iran*. www.briancoad.com. Accessed: 10 October, 2015.
- Esmaeili H. R., Ebrahimi M., 2006 Length–weight relationships of some freshwater fishes of Iran. *Journal of Applied Ichthyology* 22:328–329
- Froese R., 2006 Cube law, condition factor and weight length relationships: history, metaanalysis and recommendations. *Journal of Applied Ichthyology* 22:241-253.
- Fulton T. W., 1904 The rate of growth of fishes. Twenty-second Annual Report, Part III. Fisheries Board of Scotland, Edinburgh, pp. 141–241.
- Khallaf E., Galal M., Athuman M., 2003 The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology* 12:405-416.
- Le Cren E. D., 1951 The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology* 20:201-219.
- Lhan A., Sari H. M., 2015 Length-weight relationships of fish species in Marmara Lake, West Anatolia, Turkey. *Croatian Journal of Fisheries* 73:30-32.
- Moutopoulos D. K., Stergiou K. I., 2002 Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). *Journal of Applied Ichthyology* 18(3):200-203.

- Nyaku R. E., Okayi R. G., Yemi I. Y., Abdulrahman M., 2008 Length-weight relationship and condition factor of three fish species in Benue river, Nigeria. *BEST J* 5:204-206.
- Olusegun A. S., 1989 Length-weight relationship and condition factor of *Synodontis robbianus* at Idah area of river Niger, Kogi state, Nigeria. *Pakistan Journal of Nutrition* 10(6):505-508.
- Page L. M., Burr B. M., 1991 A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Company, Boston, 432 p.
- Ricker W. E., 1975 Computation and interpretation of biological statistics of fish populations. *Bulletin of Fisheries Research, Board of Canada* 191:382 pp.
- Sedaghat S., Hoseini A., 2012 Length-weight and length-length relationships of *Gambusia (Gambusia holbrooki)* in the Dinor River Kermanshah, Iran. *World Journal of Fish and Marine Sciences* 4(5):530-532.
- Teixeira-de Mello F., Eguren G., 2008 Prevalence and intensity of black-spot disease in fish community from Canada del Drago´n stream (Montevideo, Uruguay). *Limnetica* 27:251-258.
- Teixeira-de Mello F., Iglesias C., Borthagaray A. I., Mazzeo N., Vilches J., 2006 Ontogenetic allometric coefficient changes. Implications of diet shift and morphometric attributes in *Hoplias malabaricus* (Bloch) (Characiforme, Erythrinidae). *Journal of Fish biology* 69:1770-1778.
- Tesch F. W., 1971 Age and growth. In: *Methods for assessment of fish production in fresh waters*. Ricker W. E. (ed), pp. 99–130, Blackwell Scientific Publications, Oxford.
- Ujjania N. C., Kohli M. P. S., Sharma L. L., 2012 Length-weight relationship and condition factors of Indian major carps (*C. catla*, *L. rohita* and *C. mrigala*) in Mahi Bajaj Sagar, India. *Research Journal of Biology* 2(1):30-36.
- Wootton J. T., 1992 Indirect effect, prey susceptibility, and habitat selection: impacts of birds on limpets and algae. *Ecology* 73(3):981-991.
- Wootton R. J., 1998 *Ecology of teleost fishes*. Kluwer Academic Publishers, Dordrecht, the Netherlands.
- Zamani Faradonbeh M., Eagderi S., 2014 Length-weight relationships and condition factor of three fish species from Taleghan River (Alborz Province, Iran). *Journal of advanced Botany and Zoology* 2(3):1-3.
- Zamani Faradonbeh M., Eagderi S., Ghoghji F., 2015 Length-weight relationship and condition factor of seven fish species of Totkabon River (southern Caspian Sea basin), Guilan, Iran. *International Journal of Aquatic Biology* 3(3):172-176.

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