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Short Communication

Some biological characteristics of *Carassius gibelio* (Bloch, 1782) (Teleostei: Cyprinidae) in the Azad dam Lake in Western Iran

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Abstract: The freshwater Prussian carp, *Carassius gibelio* (Bloch, 1782) is a cyprinid, known as a hazardous species for native fish communities. In the present study, some population parameters, including length-weight relationship (*LWR*), condition factor (*KF*), relation condition factor (K_n), age and growth of *C. gibelio* in the Azad dam, Kordestan Province, Iran were estimated. The *LWR* indicating a positive allometric growth pattern. The von Bertalanffy growth parameters were estimated as L_∞=337mm, K=0.255 yr^{-1}, t_0=-0.21 yr. There was a significantly positive correlation between *TL* and *KF* (r^2=0.89). The average of K_n was lower than 1 which suggested that the well-being of the fish was not good in the Azad dam region.

Keywords: Growth parameters, LWR, Condition factor, Gold fish, Invasive species.

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Introduction

Two species of *Carassius* including *C. aur*atus and *C. gibelio* have been confirmed from Iran. The freshwater goldfish, *C. auratus* (Linnaeus, 1758) is a cyprinid native to Eastern Asia (Lelek 1987), inhabits lakes, ponds, and slow-moving rivers, as a consequence of human introduction. It has been widely distributed in the fresh and brackish waters of the Caspian Sea basin (Patimar 2009; Esmaeili et al. 2017). Another species, *C. gibelio* is also found in Iran. However, its taxonomic position is still under debate. Kottelat & Freyhof (2007) and Esmaeili et al. (2014, 2017) considered it as distinct species. *Carassius gibelio* is distributed in Eastern Europe, Russia to northeastern China and has been introduced elsewhere. There are well-documented articles on the effects of introduced exotic fish species (see e.g., Crivelli 1995; Esmaeili et al. 2014) and, because of significant losses of biodiversity and changing the functioning of ecosystems, the biological invasions have received increasing attention (Mack et al. 2000; Esmaeili et al. 2014).

Being an exotic fish, the *Carassius* is known as a hazardous species for native fish communities (Crivelli 1995). Its bottom sucking feeding methods can increase turbidity (Crivelli 1995), and it can contribute to phytoplankton blooms. Furthermore, it seems that the growth of cyanobacteria is stimulated when they pass through goldfish intestines (Kolmakov & Gladyshev 2003). It is an omnivorous species, feed on planktonic crustaceans, phytoplankton, insect larvae, fish eggs and fry, benthic vegetation, and detritus (Nico & Schofield 2006) and thus can have severe effects on other fishes. Hence, increasing knowledge on different aspects of this fish will be an important issue in

conservation biology and ecosystem management.

Despite the wide distribution of *C. gibelio* in Iran, knowledge on the life history parameters of the fish is limited. Previous studies on the life history parameters of the genus *Carassius* in Iranian inland waters were limited to the length-weight, age, growth and reproduction (Bagheri et al. 2010; Patimar 2009) in the northern part of Iran. Therefore, the aim of the present study was to estimate the LWR, condition factor, relation condition factor, age and growth of *C. gibelio* in the Azad dam from Kurdistan province, Iran, which was constructed and impounded water in 2011.

Materials and Methods

The Azad dam is located on the Komasi River, 75km west of Sanandaj, at an altitude of about 1400m above sea level. It is an earthen dam with a clay core. The crest length and maximum height of the dam are 595 and 117m, respectively. The total capacity of the dam is 300 million m^3.

This investigation was carried out in August-November 2015 and February-May 2016. Three sampling sites were selected along the dam using multi-mesh gill net (20m length and 4m height, with 14, 18, 22, 26, 30, 33 and 40mm mesh sizes). A total of 66 specimens of *C. gibelio* were collected. The fork length (*FL*), standard length (*SL*) and total length (*TL*) was measured to the nearest 1mm and total weight to the nearest 1g (for overall individuals).

Scales were collected from the middle of the body behind the pectoral fins above the hypothetical lateral line and preserved in the envelopes for future treatment in the laboratory. The scales were washed, placed in small covered Petri dishes with tap water. Then, the organic layers were removed by rubbing and washing the scales between the fingers in tap water. The length-weight relationship was derived by applying an exponential regression as the following equation:

$$W = aTL^b$$

Where W is the total weight (g). TL, the total length (mm), and a and b are parameters to be estimated. Parameters estimation was conducted by least squares linear regression on log-log transformed data:

$$ln(W) = ln(a) + b \times ln(TL).$$

Pauly's t-test was performed to compare the difference of slope value from b=3 (isometric growth) (Pauly 1984). The condition factor (KF) was calculated as the following equation (Froese 2006):

$$KF = \frac{W}{TL^3} \times 100$$

The relative condition factor (K_n) compensates for changes in form or condition with an increase in length and was calculated using the following equation (Froese 2006):

$$K_n = \frac{W}{aTL^b}$$

Where W is weight (g), TL is total length (mm), a and b are the exponential form of the intercept and slope, respectively, of the logarithmic length–weight equation. The Pearson correlation coefficient was calculated to investigate the relationship of K_n, KF and TL.

The von Bertalanffy growth curve (von Bertalanffy 1938) was fitted to the observed lengths at the age for the resulting age-length key using a non-linear estimation method as the following:

$$L_t = L_\infty(1-e^{-K(t-t_0)})$$

Where L_t is the total length at age t, L_∞ is the theoretical maximum length, K is a growth coefficient and t_0 is the hypothetical age for $L_t = 0$. The TropfishR package in R software was used to estimate L_∞, K, and t_0 of the Von Bertalanffy equation (Mildenberger et al. 2017). The parameter ($Ø'$), the growth performance index, was calculated according to Pauly (1983):

$$Ø' = logK + 2logL_\infty$$

Results

The mean (±SD) total length and weight of the collected individuals were 191.8 (±48.0) mm and 143.8 (±107.9) g, respectively (Table 1). The total length group of 190-209mm was prevailing and

Table 1. Descriptive statistics of weight (W), total length (TL), condition factor (KF) and relative condition factor (Kn) of *Carassius gibelio* in the Azad dam.

Parameter	N	Mean	SD	Min-Max
W (g)	66	143.8	107.9	3.8-404.0
TL (mm)	66	191.8	48.0	70-271
KF	66	1.68	0.23	1.11-1.68
K_n	66	0.88	0.09	0.74-1.32

Table 2. Length-length relationships of *Carassius gibelio* in the Azad dam.

Equation	*N*	*a*	*b*	r^2
FL=a+b×TL	66	-4.51	0.922	0.99
FL=a+b×SL	66	7.29	1.094	0.99
SL=a+b×TL	66	-8.96	0.833	0.99

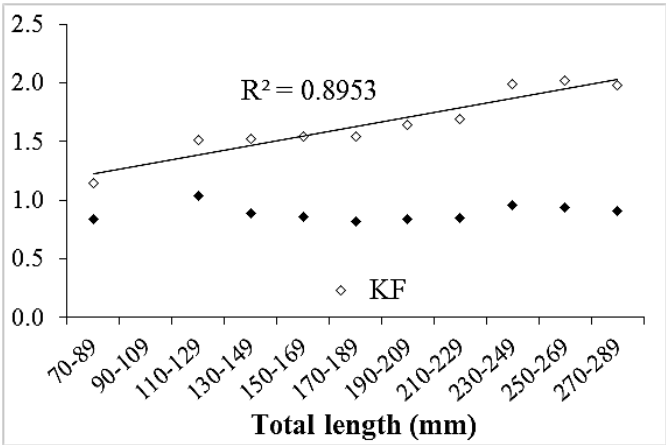

Fig.1. Variation of mean condition factor (KF) and relative condition factor (Kn) of *Carassius gibelio* in different size classes in the Azad dam.

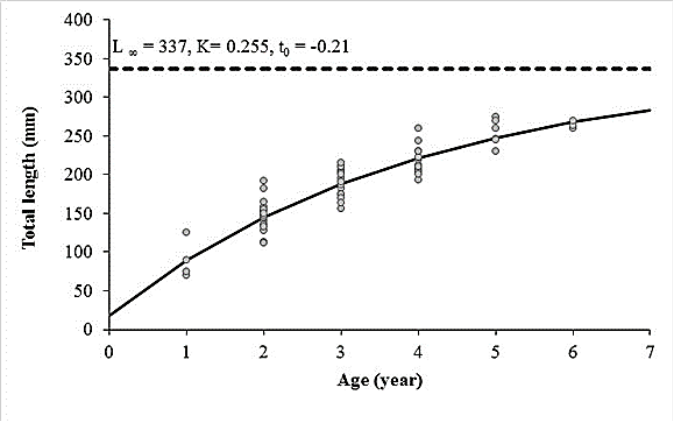

Fig.2. Theoretical growth curve calculated for fork length of *Carassius gibelio* in the Azad dam.

formed 25.3%, followed by the length group of 105-110, comprising 21.1% of the total catch.

Length-length relationships (LLRs) and the coefficient of determination r^2 are given in Table 2 which were found to be highly correlated (in all cases: r^2=0.99, P<0.001). The *TL* and *W* regression from all of the whole samples were: $W=0.000003\times TL^{3.3537}$ (r^2=0.99, n=66). The estimation of *b* was 3.3537, significantly different from 3.0 (t-test, P<0.001), indicating a positive allometric growth.

The average *KF* value was 1.68±0.23. The correlation between *TL* and *KF* was statistically significant with a positive correlation (r^2=0.89; Fig. 1). The average of K_n values were 0.88±0.13. There was no a correlation between *TL* and K_n (Fig. 1). A perusal of the data on the K_n values showed that the parameter was lower than 1 in all size classes except 110-129mm. In the size, 90-100mm K_n was the highest (1.03).

The age of *C. gibelio* ranged 1–6 years. In the age compositions, age 2 was the most dominant age group, representing 30.3% of individuals (Fig. 2). The von Bertalanffy growth equation was estimated as shown in Figure 2 as:

$$L_t = 337(1 - e^{-0.255(t-(-0.21))})$$

The growth performance index (*Ø'*) of *C. gibelio* was computed as 2.47.

Discussion

The study on the life history of genus *Carassius gibelio* is scarce. Therefore, in the present study, the growth parameters of *C. gibelio* were compared with *C. auratus*. The *b* value of the length-weight relationship usually ranges from 2.50 to 3.50 (Froese

Table 3. The von Bertalanffy growth parameters of *Carassius auratus* from different locations and *C. gibelio* in the present study.

Study area	Sex	Age (yr)	L_∞ (cm)	K (yr^{-1})	t_0 (yr)	Ø'	Author (s)
Alma-Gol wetland, Iran	M	0^+-6^+	18.3	0.31	-1.05	2.02	Patimar 2009
	F	0^+-8^+	24.9	0.19	-1.21	2.07	
Ala-Gol wetland, Iran	M	0^+-8^+	22.5	0.24	-0.83	2.09	Patimar 2009
	F	0^+-8^+	24.3	0.23	-0.80	2.13	
Lake Trasimeno, Italy	M+F	1-5	43.0	0.27	-0.16	2.70	Lorenzoni et al. 2010
East Hammar marsh, Iraq	M+F	1-7	32.6	0.24	-	2.41	Al-Noor 2010
Azad Dam, Iran	M+F	1-6	33.7	0.28	-0.20	2.47	Present study

2006). In the present study, the exponent *b* was 3.3538 remained within the expected range for all species. In contrast, Patimar (2009), Bagheri et al. (2010), Lorenzoni et al. (2010), Al-Noor (2010), and Sungur Birecikligil et al. (2016) reported a lower *b*-value (between 2.64 and 3.18) in different locations of the world. The sampling gear might influence the size range covered and cause deviations from existing values *LWR* parameters. In addition, geographical location and associated environmental conditions such as water temperature, which is the determining factor of feeding capacity, seasonality, stomach fullness, disease and parasite loads can affect the value of *b* (Bagenal & Tesh 1978; Froese 2006).

According to Kumolu & Ndimele (2010), the condition factor reflects information on physiological states of fish in relation to welfare. Also, high condition factor values indicate favorable environmental conditions (Blackwell et al. 2000). In the present study, *C. gibelio* was observed to be in suitable condition, as the value of "*KF*" was >1. As shown in Fig. 1, there was a significantly positive correlation between size classes and *KF*, and *KF* was >1 for all length classes.

K_n has been used as it indicates the suitability of the environment for fish growth. According to George et al. (1985), K_n indicates the general well-being of the fish. If the values of K_n>1 indicates that the well-being of the fish is good whereas, its value <1 reflects that the well-being of the fish is not in a good condition and poor feeding activity. In the present study, the K_n of *C. gibelio* were lower than to 1. These results suggested that the well-being of the fish was not good in the Azad dam region.

Knowledge of fish age and growth is necessary for stock assessment, develop management or conservation plans (Helfman et al. 1997). There are no previous estimates on growth rates of *C. gibelio* in the Iranian inland waters, except Patimar (2009). The results showed that the rapid growth of *C. gibelio* was found during the two first years of life, followed by a period of slow growth rate in the rest of life. The age of *C. gibelio* varied from 1 to 6 yr. Similar results were reported by Al-Noor (2010) and Lorenzoni et al. (2010) for *C. auratus*. In contrast, Patimar (2009) found that the age *of C. auratus* ranged between 0^+ and 8^+ (Table 3). According to Holmgren and Appelberg (2001) and Bautista et al. (2012), the range of age distribution in a population is closely related to the nutritional status of the environment.

The asymptotic length (L_∞) of *C. gibelio* was 33.7cm is similar to that reported by Al-Noor (2010) for *C. auratus*. In contrast, Patimar (2009) reported a lower and Lorenzoni et al. (2010) a higher, different L_∞ (ranged between 18.3-24.9cm and 43.0, respectively) for *C. auratus*. The growth performance index (Ø') of *C. gibelio* (2.47) is similar to that found Al-Noor (2010) for *C. auratus*. The index was estimated a lower in the Caspian basin and Lorenzoni et al. (2010) a higher value (Table 3). Holmgren & Appelberg (2001) and Bautista et al. (2012) reported that the growth characteristics of the local populations in the same species change due to habitat variations, water quality, and nutrients.

In conclusion, *C. gibelio* has a positive allometric growth. The rapid growth was occurred during the two first years of life. K_n of *C. gibelio* was lower than

to 1 which suggested that the well-being of the fish was not good in the Azad dam region.

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References

Al-Noor, S. 2010. Population Status of Gold Fish *Carassius auratus* in Restored East Hammar Marsh, Southern Iraq. JKAU: Marine Science 21(1): 65-83.

Bagenal, T. B. & Tesch, F.W. 1978. Age and growth. In: Methods for assessment of fish production in freshwaters. 3rd edn. T. Bagenal (Ed.). IBP Handbook No. 3. Blackwell Scientific Publications, Oxford, UK. pp. 101-136.

Bagheri, T.; Abdoli, A. & Hedayati, S.A.A. 2010. Study of age and growth of crucian carp (*Carassius auratus*) in Gorganroud estuarine. Iranian Journal of Biology 23 (6): 843-849. (In Farsi)

Bautista, J.J.; Romero, S.S.; Gonzalez-Pelaez, L.; Campos-Davila, D.B. & Lluch-Cota, J. 2012. Length–weight relationships of wild fish captured at the mouth of Rio Verde, Oaxaca, Mexico and connected lagoons (Miniyua, El Espejo, Chacahua and Pastoria). Journal of Applied Ichthyology 28: 269–271.

Sungur Birecikligil, S.; Cicek, E.; Ozturk, S.; Secer, B. & Celepoglu, Y. 2016. Length-length, length-weight relationship and condition factor of fishes in Nevşehir Province, Kızılırmak River Basin (Turkey). Acta Biological Turcica 29(3): 72-77.

Blackwell, B.G.; Brown, M.L. & Willis, D.W. 2000. Relative Weight (W*r*) Status and Current Use in Fisheries Assessment and Management. Review Fisheries Science 8: 1-44.

Crivelli A.J. 1995. Are fish introductions a threat to endemic freshwater fishes in the northern Mediterranean Region. Biological Conservation 72: 311-319.

Esmaeili, H.R.; Mehraban, H.; Abbasi, K.; Keivany, Y. & Coad, B. 2017. Review and updated checklist of freshwater fishes of Iran: Taxonomy, distribution and conservation status. Iranian Journal of Ichthyology 4 (Suppl. 1): 1-114.

Esmaeili, H.R.; Teimory, A.; Owfi, F.; Abbasi, K. & Coad B.W. 2014. Alien and invasive freshwater fish species in Iran: Diversity, environmental impacts and management. Iranian Journal of Ichthyology 1(2): 62-72.

Froese, R. 2006. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. Journal of Applied Ichthyology 22: 241-253.

George, J.P.; Sharma, A.K.; Venkateshvaran, K.; Sinha, P.S.R.K.; Venugopal, G. & Biradar, R.S. 1985. Length- weight relationship and relative condition factor in *Cirrhinus mrigala* and *Labeo rohita* from a sewage fed tank. The Annals of Zoology 23: 70-90.

Helfman, G.S.; Collette, B.B. & Facey, D.E. 1997. *The Diversity of Fishes*. Blackwell Science.

Holmgren, K. & Appelberg, M. 2001. Effects of environmental factors on size-related growth efficiency of perch, *Perca fluviatilis*. Ecology of Freshwater Fish 10: 247-256.

Kolmakov V.I. & Gladyshev M.I. 2003. Growth and potential photosynthesis of cyanobacteria are stimulated by viable gut passage in crucian carp. Aquatic Ecology 37: 237-242.

Kottelat, M. & Freyhof, J. 2007. *Handbook of European Freshwater Fishes*. Kottelat, Cornol, Switzerland and Freyhof. Berlin. Germany.

Lelek, A. 1987. The freshwater fishes of Europe. Threatened fishes of Europe. AULA-Verlag, Wiesbaden.

Lorenzoni, M.; Ghetti, L.; Pedichillo, G. & Carosi, A. 2010. Analysis of the biological features of the goldfish *Carassius auratus auratus* in Lake Trasimeno (Umbria, Italy) with a view to drawing up plans for population control. Folia Zoologica-Praha 59(2): 142-156.

Mack R.N.; Simberloff D.; Lonsdale W.M.; Evans H.; Clout M. & Bazzaz F.A. 2000. Biotic invasions: causes, epidemiology, global consequences, and control. Ecological Applications 10: 689-710.

Mildenberger, T.K.; Taylor, M.H. & Wolff, M. 2017. TropFishR: Tropical Fisheries Analysis with R_. R package version 1.2, <URL: https://CRAN.R-project.org/package=TropFishR>.

Nico, L. & P. J. Schofield. 2006. *Carassius auratus*. USGS Non-indigenous Aquatic Species Database, Gainesville, FL.

Patimar, R. 2009. Some biological parameters of Silver Crucian carp, *Carassius auratus,* in the international wetlands of Alma-Gol and Ala-Gol (Golestan Province, Iran). Iranian Journal of Fisheries Sciences 8(2): 163-174.

Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Technical Paper. 234 p.

Pauly, D. 1984. Fish population dynamics in tropical waters: A manual for use with programmable calculators. ICLARM, Manila.

Von Bertalanffy, L. 1938. A quantitative theory of organic growth. Human Biology 10: 181-243.

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یافته علمی کوتاه

برخی از خصوصیات زیستی ماهی *Carassius gibelio* (Bloch, 1782) در دریاچه سد آزاد کردستان، ایران

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چکیده: ماهی آب‌شیرین کاراس *Carassius gibelio* (Bloch, 1782) از خانواده کپور ماهیان، یک گونه مضر برای ماهیان بومی محسوب می‌شود. در این مطالعه برخی از پارامترهای جمعیت شامل رابطه بین طول-وزن (*LWR*)، ضریب چاقی (*KF*)، ضریب چاقی نسبی (K_n)، سن و رشد ماهی کاراس در سد آزاد استان کردستان برآورد شد. رابطه بین طول-وزن نشان داد که این ماهی دارای رشد آلومتریک مثبت است. پارامترهای رشد برتلانفی شامل L_∞=337 mm, K=0.255 yr^{-1}, t_0=-0.21 yr محاسبه شد. رابطه معنی‌دار مثبتی بین طول کل و ضریب چاقی وجود دارد (r^2=0.89). میانگین ضریب چاقی نسبی کمتر از ۱ بود که نشانگر وضعیت نامطلوب سلامت ماهی کاراس در دریاچه سد آزاد است.

کلمات کلیدی: پارامترهای رشد، رابطه طول-وزن، ضریب چاقی، ماهی کاراس، گونه مهاجم.