Some aspects of the life history of *Cobitis avicennae* (Actinopterygii: Cypriniformes: Cobitidae) from Western Iran

Hadi Jamali, Rahim Patimar, Vahid Daraei, Nafiseh Paricheh, Mohammad Farhadi, Sareh Nazerian

*Department of Fisheries, Faculty of Natural Resources, Urmia University, Urmia 46414-356, Iran*

*Department of Fisheries, Persian Gulf University, Boosheh, Iran*

*Department of Fisheries, Gonbad Kavous University, Gonbad Kavous, Iran*

*Department of Fisheries, Faculty of Natural Resources, Urmia University, Urmia 46414-356, Iran*

*Corresponding author: Hadi Jamali, Department of Fisheries, Faculty of Natural Resources, Urmia University, Urmia 46414-356, Iran. Tel: +98 917 336 8496*  

**ARTICLE INFO**

**Article history:**  
Received 4 Jan 2016  
Received in revised form 8 Feb 2016  
Accepted 10 Apr 2016  
Available online 1 Jun 2016

**Keywords:** *Cobitis avicennae*  
Growth  
Reproduction  
Gamasiab River

**ABSTRACT**

**Objective:** To describe the age structure, growth, reproductive characteristics and length-weight relationship of *Cobitis avicennae* (*C. avicennae*) population inhabiting the Gamasiab River, Western Iran.

**Methods:** *C. avicennae* was collected throughout the spawning season (February to July, 2015) in Gamasiab River and its age, growth, and reproductive traits were investigated. Total length was measured to the nearest 1 mm, and total weight and gonad weight to the nearest 0.001 g. The age was determined using operculum. Sex was determined by examination of the gonad tissue. The number of eggs was estimated by gravimetric method. Average egg diameter was examined by measuring 30 eggs for each female with an ocular micrometer microscope. The growth model was isometric for males and sexes combined and negatively allometric for females. The absolute fecundity ranged between 132 and 900 eggs with a mean of 490.55 eggs.

**Results:** The maximum age was 3 years. The specimens size ranged from 32.63 to 100.00 mm in total length, weighing from 0.22 to 5.17 g in total weight. Length-weight relationship was estimated as $W = 1E-05TL^{2.94}$ for males and $W = 7E-06TL^{2.94}$ for females. The growth model was isometric for males and sexes combined and negatively allometric for females. The absolute fecundity ranged between 132 and 900 eggs with a mean of 490.55 eggs.

**Conclusions:** The life history traits described for *C. avicennae* from the Western Iran basin indicated a moderate life span, a moderate body weight, a short duration of spawning season, relatively high heterogeneity in egg size and low egg number. Some life history traits of *C. avicennae* demonstrated obvious differences compared with its closely related species, indicating that latitude and local environment conditions are important selective forces for this species.

1. Introduction

The *Cobitis* genus fishes are represented in Iran by three valid species. These species are *Cobitis linea* (*C. linea*) and *Cobitis keyvani* (*C. keyvani*)[2]. *Cobitis faridpaki* and *C. keyvani* are found in the Southern Caspian Sea basin. However, some researchers reported that the spined loach *Cobitis taenia* Linnaeus, 1758 (*C. taenia*) was also found in the basin[3]. While some others believe that the fish cannot be *C. taenia; C. taenia* is rather a Northern European species and its occurrence in the Southern Caspian Sea basin is unlikely[4]. *Cobitis linea* was found in the Kor River basin and the upper Kul River drainage of the Hormozgan basin[5,6]. Species of this family are small benthic freshwater fishes with a wide distribution area covering large parts of Eurasia and Africa[7]. Spined loach during the day remains buried in sand, mud or dense weed growths, being active at night, and is mostly solitary[8]. The loaches achieve sexual maturity in the first (males) or second (females) year of their life[9,10].

Mousavi-Sabet et al.[11] recently described *Cobitis avicennae* (*C. avicennae*) as a new Cobitidae species from Western Iran. *C. avicennae* is known from the Tigris River drainages. This river drains from the Zagros M mountains. Detailed description of its life history has not been given in the literature. In this context, examination of the basic biological parameters for each species is fundamental for understanding species life history patterns and important with respect to implementing effective management and...
The comparison of GSI values during the reproductive period and its nearest 0.05 mm with an ocular micrometer microscope. The specimens were caught during the sampling period. The total length and weight of males ranged from 33.5 to 79.9 mm and 0.22 to 3.08 g, while for females it ranged from 32.63 to 100.00 mm and 0.17 to 5.17 g, respectively. Opercula examination revealed that the majority of specimens were in the age group of 2 years, with 3 years being the oldest age recorded for both sexes. Observed length-at-age in the population was different between sexes, females being longer and heavier than males (Table 1). Length frequency distribution of the fish (Figure 1) indicated that the most males and females were in the size range of 39.3–52.9 mm. Males with length over 73.3–80.1 mm were rare.

Table 1

| Age (years) | Total length | Total weight | Male 1 | Male 2 | Female 1 | Female 2 |
|-------------|--------------|--------------|--------|--------|----------|----------|
|             | Min–Max      |              | 36.55 ± 6.25 | 36.12 ± 6.38 | 55.08 ± 17.24 | 76.89 ± 17.23 |
| 1           | 33.5–39.7     | 0.26 ± 0.08  | 0.22–0.33  | 2.51     |
| 2           | 52.91 ± 12.5  | 0.80 ± 0.19  | 0.39–1.54  | 1.41–3.08 |
| 3           | 76.89 ± 17.23 | 2.45 ± 0.57  | 1.41–3.08  | 1.41–3.08 |
| Female 1    | 41.25 ± 9.65  | 0.41 ± 0.15  | 0.17–0.60  | |
| 2           | 55.08 ± 17.24 | 0.95 ± 0.26  | 0.62–1.28  | |
| 3           | 81.37 ± 22.14 | 2.79 ± 0.62  | 1.24–5.17  | |

The growth model was isometric for males and sexes combined (Figure 2). The growth model was negatively allometric for females (Pauly’s t-test, tfemale = 2.51, tpoint = 1.96, P < 0.05) while growth model was negatively allometric for males (Pauly’s t-test, tmale = 1.59, tpoint = 1.96, P > 0.05) because the b value was not significantly different from 3 (Pauly’s t-test, tpoint = 1.96, P = 0.05) while growth model was negatively allometric for females (Pauly’s t-test, tfemale = 2.51, tpoint = 1.96, P < 0.05). The overall ratio of males to females was 1:1.05 and Chi-square analysis indicated a significant difference from an expected ratio of 1:1 (χ² = 18.70, P < 0.05). An unequal sex ratio was observed among length classes (Figure 1).

The total length-weight relationships were evaluated for males, females and sexes combined. A significant relationship with the high regression coefficient (r > 0.96) was found between the length and weight of the loach. Length-weight relationships were found as W = 1E – 05TL^{2.83} for males, W = 1E – 05TL^{2.85} for females, and W = 7E – 06TL^{0.94} for sexes combined (Figure 2).

The GSI values of males were significantly lower than those of females.
females. The maximum recorded values of GSI were 3.89 ± 0.96 and 14.33 ± 2.30 in April for males and females, respectively. The GSI of both sexes followed almost the same pattern (Figure 3). The reproductive period for this species in the river was thus March and April when GSI was considerably higher. It thereafter decreased in May showing start of the resting period.

The minimum and maximum of absolute fecundity was 132 and 900 eggs from a 2-year old and 3-year old female, respectively. The mean value of absolute fecundity was (490.55 ± 209.71) eggs/female. The linear function was adequate for expressing fecundity-total weight and fecundity-total length relationships (Figure 4). All correlation coefficients calculated between fecundity and each of the independent variables, while moderate, were statistically significant ($P < 0.05$). Fecundity relative to total weight fluctuated from 40 to 209 eggs/g, with a mean value of (146.70 ± 43.62) eggs/g. The relationship of relative fecundity (fecundity per gram) with total weight was not found to be statistically significant ($P > 0.05$), while the relative fecundity-total length relationship was significant though with a low correlation coefficient (Figure 5). The ovaries of mature females contained large yolk-filled eggs that ranged in size from 0.3 to 2.0 mm [mean: (1.10 ± 0.21) mm]. The majority of oocytes ranged from 1.18 to 1.40 mm in diameter (Figure 6).
showed that longevity was the same for both sexes, however, the sex ratio that does not differ significantly from unity (1:1). For C. avicennae, the highly female dominated sex ratio could be due to a higher survival rate or a longer life span in females. Our data from the Western Iran basin indicated a moderate life span (3 years for both sexes), a moderate body weight (weight-length relationship: $b > 3$), a short duration of spawning season, and isometric for male and both sexes combined. Different values for male or female C. avicennae and also for other loaches [18-20] reflect slight changes in body form with sex and species and could be attributable to different environmental habitat conditions and species characteristics.

The spawning period for C. avicennae in the Western Iran basin (from February to April) is similar to that described for Cobitis elongatoides and Cobitis trichonica from Europe. Other European Cobitis species have different spawning periods, e.g. Cobitis bilineata and Cobitis narentana in April–August, Cobitis paludica (C. paludica) and C. taenia in April–July, and Cobitis tanaica in May. The single peak in GSI during the spawning season indicated that C. avicennae is not a multiple-spawner in the Western Iran basin. The production of multiple batches of eggs provides certain advantages[22], especially for those species living in fluctuating environments[23], and has been suggested for C. taenia, Cobitis bilineata and C. paludica[10,24-26], but could not be confirmed for C. avicennae in the study area.

In the present study, absolute fecundity was positively correlated with fish size (length and weight). Biologically, it might be deduced that total energetic investment in reproduction tends to increase with fish size, while the relationship between relative fecundity and fish weight is not significant. This implies that proportional energetic investment in reproduction, as energy allocation per unit of fish size, is variable and not significant for this species. It was revealed from the study that absolute fecundity and egg size in C. avicennae increase linearly with an increase in fish size. The positive relationships observed in the present study correspond well with earlier reports on C. paludica[26].

The maximum absolute fecundity of 900 eggs from a 3 years old C. avicennae female was lower than the 1 400 eggs[27], 1 235 eggs[17] and 1 986 eggs[26] observed for C. paludica, and the 4282 eggs for C. taenia[28]. The variation in Cobitis fecundity is believed to be not only due to species characteristics but also due to nutrition, food availability and supply, and ecological conditions in the water bodies[29].

To summarise, the life history traits described for C. avicennae from the Western Iran basin indicated a moderate life span (3 years for both sexes), a moderate body weight (weight-length relationship: $b > 3$), a short duration of spawning season,
relatively high heterogeneity in egg size (0.30 to 2.00 mm), and low egg number (ranging from 132 to 900). These findings provided important new data with respect to the life history of this endemic species. In following the future status of C. avicennae, scientists should endeavor to expand the database on growth and reproduction and to assess the potential impacts of habitat degradation on populations of this species.

Conflict of interest statement

We declare that we have no conflict of interest.

References

[1] Mousavi-Sabet H, Vasil’eva ED, Vatandoust S, Vasil’ev VP. Cobitis faridpaki sp. nova-a new spined loach species (Cobitidae) from the Southern Caspian Sea basin (Iran). J Ichthyol 2011; 51: 925-31.

[2] Mousavi-Sabet H, Yerli SV, Vatandoust S, Ozeren SC, Moradkhani Z. Cobitis keyvani sp. nova-a new species of spined-loach from south of the Caspian Sea basin (Teleostei: Cobitidae). Turk J Fish Aquat Sci 2012; 12: 7-13.

[3] Abdoli A, Naderi M. The biodiversity of fishes of the southern basin of the Caspian Sea. Tehran: Abzian Scientific Publication; 2009. Persian.

[4] Kottelat M, Freyhof J. Handbook of European freshwater fishes. Cornwall: Publications Kottelat; 2007.

[5] Bânărescu P, Nalbant TT. The 3rd Danish expedition to Central Asia. Zoological results 34. Cobitidae (Pisces) from Afghanistan and Iran. Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København 1966; 129: 149-86.

[6] Bianco PG, Nalbant TT. Redescription of Cobitis lineata, with some remarks on the subgenus Bicanestria (Cypriniformes: Cobitidae). Copeia 1980; 4: 903-6.

[7] Perdices A, Doadrio I. Phylogenetic relationships and classification of the genera Cobitis and Sabanejewia (Cobitidae) based on allozyme data. In: Ninth International Congress of European Ichthyologists (CEI9) “Fish Biodiversity”; 1997; Napoli-Trieste, Italy.

[8] Coad BW. Freshwater fishes of Iran. Ottawa: Brian W. Coad’s Personal Website; 2012. [Online] Available from: http://www.briancoad.com.Species%20A ccounts/Cobitidae%20Cyprinodontidae.htm#Cobitis [Accessed on 10th April, 2012]

[9] Boron A, Pimpick E. Fecundity of spined loach, Cobitis taenia from the Zegrzyński Reservoir, Poland (Osteichthyes, Cobitidae). Folia Zool 2000; 49: 135-40.

[10] Marconato A, Rasotto MB. The biology of a population of spined loach Cobitis taenia L. Bull Zool 1989; 56: 73-80.

[11] Mousavi-Sabet H, Vatandoust S, Esmaeili HR, Geiger MF, Freyhof J. Cobitis avicennae, a new species of spined loach from the Tigris River drainage (Teleostei: Cobitidae). Zootaxa 2015; 3914: 558-68.

[12] Afshin I. [Rivers of Iran]. Tehran: Ministry of Energy of Iran Publications; 1994. Persian.

[13] Pauly D. Fish population dynamics in tropical waters: a manual for use with programmable calculators. Manila: International Center for Living Aquatic Resources Management; 1984.

[14] Ricker WE, editor. Methods for assessment of fish production in fresh waters, Oxford: Blackwell Scientific Publ.; 1978.

[15] Zar JH. Biostatistical analysis. Englewoods Cliffs: Prentice Hall; 1984.

[16] Mousavi-Sabet H, Kamali A, Soltani M, Bani A, Esmaeili HR, Rostami H, et al. Age, reproduction, and fecundity of a population of Cobitis sp. (Actinopterygii: Cypriniformes: Cobitidae) from the Babolrud River in the Southern Caspian Sea basin. Acta Ichthyol Piscat 2011; 41: 117-22.

[17] Mousavi-Sabet H, Kamali A, Soltani M, Bani A, Esmaeili HR, Koshbavar Rostami H, et al. Reproductive biology of Cobitis keyvani (Cobitidae) from the Talar River in the Southern Caspian Sea basin. Iran J Fish Sci 2012; 11: 383-93.

[18] Slavik O, Rab P. Life history of spined loach, Cobitis taenia, in an isolated site (Psovka Creek, Bohemia). Folia Zool 1996; 45: 247-52.

[19] Soriguer MC, Vallespin C, Gomez-Cama C, Hernandez JA. Age, diet, growth and reproduction of a population of Cobitis paludica (de Buen, 1930) in the Palarncar Stream (southwest of Europe, Spain) (Pisces: Cobitidae). Hydrobiologia 2000; 436: 51-8.

[20] Przybylski M, Valladolid M. Age and growth of the Iberian loach, Cobitis paludica in the Lozoya River (Madrid, Central Spain), an intermittent stream. Folia Zool 2000; 49: 163-9.

[21] Bohlen J, Ritterbusch D. Which factors affect sex ratio of spined loach (genus Cobitis) in Lake Muggelsee? Environ Biol Fish 2000; 59: 374-52.

[22] Burt A, Kramer DL, Nakatsu K, Spry C. The tempo of reproduction in Hypessobrycon pulchripinnis (Characidae) with a discussion on the biology of ‘multiple spawning’ in fishes. Environ Biol Fish 1988; 22: 15.

[23] Nikolaev GV. The ecology of fishes. London: Aademic Press; 1963.

[24] Bohlen J. Similarities and differences in the reproductive biology of loaches (Cobitis and Sabanejewia) under laboratory conditions. Folia Zool 2000; 49(Suppl 1): 179-86.

[25] Bohlen J. Behaviour and microhabitat of early life stages of Cobitis taenia. Folia Zool 2000; 49(Suppl 1): 173-8.

[26] Oliva-Paterna FJ, Torralva MM, Fernandez-Delgado C. Age, growth and reproduction of Cobitis paludica in a seasonal stream. J Fish Biol 2002; 60: 389-404.

[27] Lobon-Cervia J, Zabala A. Observation on the reproduction of Cobitis paludica De Buen, 1930 in the Jarma River. Cybium 1984; 8: 63-8.

[28] Bohlen J. Reproduction of spined loach, Cobitis taenia, (Cypriniformes; Cobitidae) under laboratory conditions. J Appl Ichthyol 1999; 15: 49-53.

[29] Patimar R, A moueI M, Mir-Ashrafi Langroudi SM. New data on the biology of Cobitis C. satunini from the southern Caspian basin (Northern Iran). Folia Zool 2011; 60: 308-14.