Threatened fishes of the world: *Aphanius isfahanensis* Hrbek, Keivany & Coad, 2006 (Cyprinodontidae)

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Received: 12 February 2013 – Accepted: 26 March 2013

Abstract

The systematics, morphology, ecology and biology of an Isfahan endemic toothcarp, *Aphanius isfahanensis* Hrbek, Keivany & Coad, 2006 (Cyprinodontidae) are summarized. This fish is not listed in IUCN's Red Data Book, but it should be due to criteria such as restricted distribution, destruction of spawning grounds, dam construction, and environmental pollution. This vulnerable species has considerable ecological importance, but there are little data on its biology. The limited data on its distribution, ecology, reproduction and threats are summarized and discussed.

Zusammenfassung

Zu dem in Isfahan, Iran, endemischen Zahnkärpfling *Aphanius isfahanensis* Hrbek, Keivany & Coad, 2006 (Cyprinodontidae) werden Systematik, Morphologie, Ökologie und Biologie zusammengefasst. Die Fischart wird in der Roten Liste gefährdeter Arten der IUCN nicht aufgeführt, sie sollte aber hinzugefügt werden, wenn man die eingeschränkte Verbreitung, die Zerstörung der Laichgründe, den negativen Einfluss von Dammbauten und die Umweltverschmutzung zum Maßstab nimmt. Die anfällige Art ist von erheblicher ökologischer Bedeutung, doch gibt es nur spärliche Daten über ihre Biologie. Die wenigen vorhandenen Daten zu Verbreitung, Ökologie, Fortpflanzung und Gefährdung werden zusammengefasst und diskutiert.

Résumé

La systématique, la morphologie, l'écologie et la biologie d'un Cyprinodontidé endémique d'Isfahan, *Aphanius isfahanensis* Hrbek, Keivany & Coad, 2006 (Cyprinodontidae) sont résumées. Ce poisson ne figure pas dans le livre des listes rouges de l'IUCN, ce qui pourrait être dû à des critères comme la distribution réduite, la destruction de zones de reproduction, la construction de barrages et la pollution environnementale. Cette espèce vulnérable a une importance écologique considérable, mais il y a peu d'informations sur sa biologie. Les quelques données sur sa distribution, son écologie, sa reproduction et ses menaces sont résumées et discutées.

Sommario

La sistematica, la morfologia, l'ecologia e la biologia del nono *Aphanius isfahanensis* Hrbek, Keivany e Coad, 2006 (Cyprinodontidae), endemico dell'Esfahan, sono riassunte. Questo pesce non è elencato nel Libro Rosso dell'IUCN, ma dovrebbe esserlo a causa di criteri quali la distribuzione limitata, la distruzione delle zone di riproduzione, la costruzione di dighe e l'inquinamento ambientale. Questa specie vulnerabile ha una notevole importanza ecologica, ma ci sono pochi dati sulla sua biologia. Quelli disponibili sulla sua distribuzione, l'ecologia, la riproduzione e le minacce sono riassunte e discusse.

INTRODUCTION

The species of the pupfish genus *Aphanius* Nardo, 1827 (Cyprinodontiformes) are widely distributed along the late period Tethys Sea coastlines (Smith et al., 1995). The distribution includes coastal areas of the Mediterranean region to Red Sea and the Persian Gulf. Inland distribution is restricted primarily to the Mediterranean and the Near East orogenic belt, including Iran (Hrbek et al. 2002).

Distribution, taxonomy and biology of *Aphanius* in Iran have been subject of several works (Coad, 1996, 2000; Keivany and Soofiani 2004; Esmaeili et al. 2006; 2007; 2009; 2012; Bibak et al. 2012; Golmoradizadeh et al. 2012). However, only basic data on *A. isfahanensis* Hrbek, Keivany & Coad, 2006, exist (Hrbek et al. 2006, Esmaeili et al. 2008; Torabian et al. 2010; Alavi-Yeganeh et al. 2011).

Distribution: This species is restricted to Zayandehrud River in Isfahan Basin, central Iran. So far, it is known only from three localities, the type locality, Varzaneh Bridge, Zarrinshahr and Gavkhoni Wetland (Hrbek et al. 2006, Torabian et al. 2010) (Fig. 1).

Identification: *Aphanius isfahanensis* is distinguished at genetic level from all other species of

Aphanius with 82 molecular apomorphies, 19 transversion, 2 transver-sions/transitions and 61 transitions, which show fixed character states differences to homologous characters analyzed in other species from Iran (Hrbek et al. 2006).

Males of *A. isfahanensis* (Figs 2a, 3) can be distinguished from those of all other Iranian species by having a distinct black edge on the dorsal, anal and pelvic fins. The dorsal fin is covered with a high density of black blotches. Females of *A. isfahanensis* (Fig 2b) can be distinguished from females of *A. sophiae* and *A. vladykovi* by having flank-bars rather than spots. It can also be distinguished from *A. persicus* by less well-defined bars terminating at a mid-flank stripe and a relatively light grey stripe at the caudal fin base rather than a black spot or blotch. *Aphanius isfahanensis* can be distinguished unambiguously only from *A. vladykovi* by a lower lateral line scale count (Hrbek et al. 2006).

Counts of male flank bars are significantly fewer than in *A. sophiae*. The bars are broad with interspaces about equal or slightly narrower. The bars extend from behind the head to the tail. Anterior bars fade on the belly, whereas, posteriorly on the caudal peduncle, they encircle the body. The eye is bounded ventrally and postero-ventrally by a thin line of black pigment. The anal fin has a broad, blackish margin with the rest of the fin light cream-colored. The caudal fin rays and membranes are sparsely pigmented and the whole margin may be blackish, but in most fish pigment is restricted to the upper and lower margins.

Fig. 1. Distribution map of *Aphanius isfahanensis* in Zayandehrud River.

Habitat and ecology: The type locality is near the town of Varzaneh on the lower reaches of the Zayandehrud River, about 30 km up river from the terminal swamp, the Gavkhuni Wetland. Water temperature was 27°C, pH 6.7, brackish (EC 10.9 mS), dissolved solids 5450 ppm, dissolved oxygen 12.3 mg/L. Current was slow and there was no cover from riparian vegetation. This fish is now found in a park pool in Esfahan City (Fig. 5).

The typical habitat consists of slow-running waters with rich aquatic vegetation, where the fishes exhibit cryptic behavior, remaining among aquatic vegetation during most of the day and being rarely seen in the open areas. In most areas, this species occurs in sympatry with the introduced *Gambusia holbrooki* Girard, 1859. It feeds mainly on aquatic insect larvae and associated algae. Maximum age is less than 3 years and maximum recorded total length is 45 mm.

Spawning occurs mainly in April to July. The development of larvae and juveniles is known from both field observations and breeding in aquaria. Larvae hatch at about 7 mm total length and exhibit the general morphological characteristics of the genus. Adult morphology is acquired at about 15 mm total length. Maturity attained at about 30 mm total length (Keivany et al. 2013). The absolute fecundity ranges between 120-390 eggs with a diameter of up to 1.5 mm. The sex ratio is 0.8F:1M (Torabian et al. 2010).

Threats: The type locality, near the end of the Zayandehrud River in Varzaneh, and the Gavkhoni Wetland are experiencing drought for much of the year, especially in recent years, and Zarrinshahr locality, is subject to pollution. Most of the creeks which were the major habitat of this species have been totally destroyed or turned into concrete canals.

Fig. 2. Photos of *Aphanius isfahanensis* dead specimens. a) a male; b) a female. Photo by Y. Keivany.

Fig. 3. Photo of a male *Aphanius isfahanensis* in an aquarium. Photo by H. Bleher.

BRIEF DISCUSSION

The geological history of Iran has been shaped by geological events associated with the closing of the Tethys Sea. Sampling and analysis of central populations of *Aphanius* revealed at least nine deeply divergent species (Hrbek et al. 2002; Hrbek et al. 2006; Teimori et al. 2011; 2012). All lineages investigated are allopatrically distributed in separate hydrological basins.

A noticeable feature of the ichthyofauna of the Near East is the relative high degree of conservatism of external morphology in spite of substantial genetic divergence. In analysis of the Iranian members of the eastern clade of *Aphanius* (Hrbek & Meyer 2003) there are no fixed external morphological characters that would distinguish *A. isfahanensis* from its closest relatives. *Aphanius isfahanensis* can be distinguished by non-overlapping lateral line scale number only from *A. vladykovi*. Species of *Aphanius* also often differ in male color pattern since sexual selection is the major evolutionary force in this group of fishes. However, sexually selected color patterns are often convergent among species of *Aphanius*.

Fig. 4. Photo of a juvenile male *Aphanius isfahanensis* in an aquarium. Photo by H. Bleher.

Unfortunately, the published data on different aspects of *A. isfahanensis* is limited. Therefore, effort on the part of scientists and governments should be made in understanding the biology, ecology and behavior of this vulnerable species. One key objective in working with endangered species is to increase the number of individuals of the species concerned by artificially/controlled reproduction in captivity. Unfortunately, there is no policy for preserving this species in Zayandehrud River.

I recommend the protection of these three localities and preservation of habitats of the species, especially in Zarrinshahr area. These areas may be threatened by projected plans for the alignment and diversion of Zayandehrud River, which is the major source of water for the channels and wells of the area. I also recommend the introduction of the species to suitable nearby water bodies and education of local communities. Much basic ecological information is needed for this species, including habitat requirements, life history and reproduction behavior, and surveys of existing populations. This fish is not listed in IUCN's (2013) Red Data Book, but it should be due to criteria such as restricted distribution and destruction of spawning grounds, dam construction, and environmental pollution.

ACKNOWLEDGEMENTS

I would like to thank Mr. Saeed Asadollah for his help during the fieldwork and Mr. Heiko Bleher for providing some photos of the live fish and its

Fig. 5a-b. A park pool in Esfahan containing *Aphanius isfahanensis* together with *Gambusia holbrocki*. Photo by H. Bleher.

habitat. This study was financially supported by Isfahan University of Technology.

REFERENCES

Alavi-Yeganeh, M. S., Seifabadi, S. J., Keivany, Y., Kazemi B. & Wallis, G. P. 2011. Comparison of length-weight relationships in different populations and sexes of Iranian toothcarps. *Journal of Applied Ichthyology* 27: 1401-1403.

Bibak, M., Rakhshani, M., Hosseini, S. A., Koohani M. & Moein, M. 2012. Reproduction of *Aphanius dispar dispar* (Rüppell, 1829) in Dalaki River, Bushehr, South of Iran. *World Journal of Fisheries & Marine Sciences* 4: 594-596.

Coad, B. W. 1996. Systematics of the tooth-carp genus *Aphanius* Nardo, 1827 (Actinopterygii: Cyprinodontidae) in Fars Province, southern Iran. *Biologia Bratislava* 51: 163-172.

Coad, B. W. 2000. Distribution of *Aphanius* species in Iran. *Journal of the American Killifish Association* 33: 183-191.

Esmaeili, H. R., Ebrahimi, M., Teimory, A., Ansary, T. H. 2008. First Karyological Analysis of an Endemic Fish, Isfahan. Tooth-carp, *Aphanius isfahanensis* (Actinopterygii: Cyprinodontidae) from Iran. *Journal of Applied Animal Research* 33: 73-76.

Esmaeili H. R., Ebrahimi, M., Teimori, A. & Ansari, T. H. 2009. First karyological analysis of an endemic fish, Zagros tooth-carp, *Aphanius vladykovi* Coad, 1988 (Actinopterygii: Cyprinodontidae) from Iran. *Iranian Journal of Science & Technology Transaction A* 33: 349-354.

Esmaeili, H. R., Piravar, Z. & Shiva, A. H. 2007. Karyological Analysis of Two Endemic Tooth-Carps, *Aphanius persicus* and *Aphanius sophiae* (Pisces: Cyprinodontidae), from Southwest Iran. *Turkish Journal of Zoology* 31: 69-74.

Esmaeili, H. R. & Shiva, A. H. 2006. Reproductive biology of the Persian Tooth-carp, *Aphanius persicus* (Jenkis, 1910) (Cyprinodontidae) in southern Iran. *Zoology in the Middle East* 37: 39-46.

Esmaeili, H. R., Teimori, A., Gholami, Z. Zarei, Neda & Reichenbacher B. 2012. Re-validation and re description of an endemic and threatened species, *Aphanius pluristriatus* (Jenkins, 1910) (Teleostei, Cyprinodontidae), from southern Iran. *Zootaxa* 3208: 58-67.

Golmoradizadeh, A., Kamrani, E. & Sajjadi, M. M. 2012. Life history traits of *Aphanius ginaonis* Holly, 1929 (Cyprinodontidae) and potential risks of extinction in the Geno hot spring (Iran) population. *Journal of Applied Ichthyology* 28: 31-33.

Hrbek, T. & Meyer, A. 2003. Closing of the Tethys Sea and the phylogeny of Eurasian killifishes (Cyprinodontiformes: Cyprinodontidae). *Journal of Evolutionary Biology* 16: 7-26.

Hrbek, T., Küçük, F., Frickey, T., Stölting, K. N., Wildekamp, R. H. & Meyer, A. 2002. Molecular phylogeny and historical biogeography of the *Aphanius* (Pisces, Cyprinodontiformes) species complex of central Anatolia, Turkey. *Molecular Phylogenetics & Evolution* 25: 125-137.

Hrbek, T., Keivany, Y. & Coad B. W. 2006. New species of *Aphanius* (Teleostei, Cyprinodontidae) from Isfahan province of Iran and a reanalysis of other Iranian species. *Copeia* 2006: 244-255.

IUCN. 2013. IUCN Red List of Threatened Species. www.iucnredlist.org. Downloaded on 12 February 2013

Keivany, Y. & Soofiani, N. M. 2004. Contribution to the biology of Zagros tooth-carp, *Aphanius vladykovi*, in central Iran (Cyprinodontidae). *Environmental Biology of Fishes* 71: 165-169.

Keivany, Y., Nasri, M. & Abbasi, K. 2013. Atlas of inland water fishes of Iran. Iran Department of Environment, Tehran, Iran (In press).

Smith, A. G., Smith, D. G. & Funnell, B. M. 1995. Atlas of Mesozoic and Cenozoic coastlines. Cambridge University Press, New York.

Teimori, A., Esmaeili, H. R., Gholami, Z., Zarei, N., & Reichenbacher, B. 2012. *Aphanius arakensis*, a new species of tooth-carp (Actinopterygii, Cyprinodontidae) from the endorheic Namak Lake basin in Iran. *ZooKeys* 215: 55-76.

Teimori, A., Esmaeili, H. R. & Reichenbacher, B. 2011. *Aphanius farsicus*, A Replacement Name For *A. persicus* (Jenkins, 1910) (Teleostei, Cyprinodontidae). *Zootaxa* 3096: 53-58.

Torabian, S., Ranaei, S., Soofiani, N. M & Asadollah, S. 2010. Some reproductive characteristics of *Aphanius isfahanensis* in Zayandehrud River. Proceedings of the 1st Iranian Ornamental Fish Conference, 20-21 June, 2010, Tehran, Iran, p. 57.