



Species list and distribution map of the genus *Alburnus* Rafinesque, 1820 (Cyprinidae: Leuciscinae) in Iran

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Abstract: The genus *Alburnus*, which belongs to the largest teleost family, Cyprinidae, comprises 38 valid species distributed from Europe to northern parts of Southwest Asia. Herein we provide an updated list of the *Alburnus* seven valid species registered from Iran.

Key words: bleak, shemaya, distribution pattern, species diversity, ichthyology, Iran

INTRODUCTION

Freshwater fishes are confined to drainage systems and cannot disperse without connections of freshwater systems, which makes these fauna an interesting group for studies on zoogeographical patterns (Berra 2007). Distribution patterns of fishes can be affected by both physical and chemical changes in river systems and evolutionary processes within freshwater fauna in general (Watanabe 1998). However, anthropogenic effects have played a significant role in changing distribution patterns of freshwater fishes, especially in the past few decades (Esmaeili et al. 2014). Within this context, we discuss the distribution patterns of seven *Alburnus* species registered to Iran.

The genus *Alburnus* Rafinesque, 1820 (Bleaks and Shemayas) belongs to the largest teleost family, Cyprinidae, and comprises 38 recognized species distributed from Europe to northern parts of Southwest Asia (Freyhof and Kottelat 2007). The genus *Alburnus* is an excellent example for high diversity and endemism in the western Palearctic freshwater fishes. Freyhof and Kottelat (2007a, 2007b) and Kottelat and Freyhof (2007) reviewed the European species of *Alburnus* in a part of Palearctic region. Turkey, with 20 recorded species,

and especially Anatolia, with 10 species, are centers of diversity of the genus (Özuluğ and Freyhof 2007; Elp et al. 2013). Despite their wide distribution, taxonomy, systematic and actual distribution of bleaks of *Alburnus* species are still not well known (Buj et al. 2010). The genus has greater diversity (about 20 species) in Turkey (Özuluğ and Freyhof 2007) while seven confirmed species have been reported from Iran (Esmaeili et al. 2010a). These reported species include *Alburnus atropatenae* Berg, 1925, endemic to Lake Urmia basin; *Alburnus caeruleus* Heckel, 1843, found in the Tigris-Euphrates and Quwayq (or Quweiq) river systems; *Alburnus chalcoides* (Güldenstädt, 1772), distributed from central Europe to the basins of the Black, western and southern Caspian and Aral seas; *Alburnus filippii* Kessler, 1877, or Kura Bleak, found only in the Caspian Sea basin; *Alburnus hohenackeri* Kessler, 1870, distributed in Europe and Asia, Western and southern Caspian basin, from Kura to Atrak drainages; *Alburnus mossulensis* Heckel, 1843, the Southern Kingfish, widely distributed in Tigris-Euphrates basin and adjacent basins and *Alburnus zagrosensis* Coad, 2009, distributed in the upper Karun River basin.

The present study aims to access the spatial distribution pattern of the species that belong to *Alburnus* within Iran territory, providing an updated distribution map with comments.

MATERIAL AND METHODS

Herein the distribution pattern of *Alburnus* species from the entire drainage basins of Iran was mapped. Materials for this study are resulted from (I) available published data (Saadati 1977; Armantrout 1980; Abdoli 2000; Abbasi 2009; Coad 2009, 2014; Esmaeili et al.

2010a, 2011a, Zareian et al. 2013; Mehraban et al. 2014), (II) extensive fieldworks that provided the geographic coordinate datasets for *Alburnus* distribution (mainly from ZM_CBSU data bank provided by H.R. Esmaeili) and (III) samples collected during 2013 and 2014 by T. Mohammadian using an electrofishing device, cast net, beach seine and hand net (scoop net). All specimens were identified following the available descriptions and keys (Kottelat and Freyhof 2007; Coad 2009, 2014). The distribution map for species of *Alburnus* was constructed with DIVA-GIS (7.5.0) software (Hijmans et al. 2012) in which the new record for eastern distribution of *A. hohenackeri* has been shown.

RESULTS

The collected specimens were identified according to Kottelat and Freyhof (2007) and Coad (2009, 2014) based on the following morphological key characters: *Alburnus atropatena* is distinguished from other Iranian species of *Alburnus* by having 9–12 branched anal fin rays; 46–63 lateral line scales; exposed fleshy keel in front of the anus (about 1–4 scales lengths); 11–16 gill rakers; strong and sharp midlateral stripe as wide as the pupil of the eye, extending onto the head as far as the eye and back to the middle of the caudal fin. *Alburnus caeruleus* from Tigris River basin was identified from others by having 13–18, usually 14–16 branched anal

fin rays; gill rakers 10–13; 43–58 scales along the lateral line; deep body, 2.9–3.5 in standard length with a slight nuchal hump; flanks, even lower flanks and head heavily speckled; lateral line moderately to strongly decurved. *Alburnus chalcoides* from Caspian Sea basin could be distinguished from others by having 54–67 lateral line scales; 12–17 branched anal fin rays; 18–31 gill rakers; no dark midlateral stripe. *Alburnus filippii*, another species distributed in the Caspian Sea basin is distinguished from other species by having modally 7 branched dorsal fin rays; 9–13 usually 10–12 branched rays in anal fin; lateral line scales 46–64; gill rakers 12–17; a dark streak, as wide as the eye, runs along mid-flank. *Alburnus hohenackeri*, the third *Alburnus* species of Caspian Sea basin was identified by having 12–16 anal fin branched rays; lateral line scales 36–50; 16–29 gill rakers; ventral keel is exposed or partially or completely scaled. *Alburnus mossulensis* from Tigris, Kor, Kol and Maharlou basins could be distinguished from the other *Alburnus* species by having 10–13 branched anal fin rays; 58–89 lateral line scales; 11–18 gill rakers; short, naked ventral keel. *Alburnus zagrosensis*, a species from upper reaches of Tigris basin is distinguished from other Iranian and Tigris-Euphrates basin *Alburnus* by 67–83 lateral line scale count; 9–10 anal fin branched ray count; total gill raker count 12–14; ventral keel almost absent to almost complete; absence of a prominent mid-flank stripe.

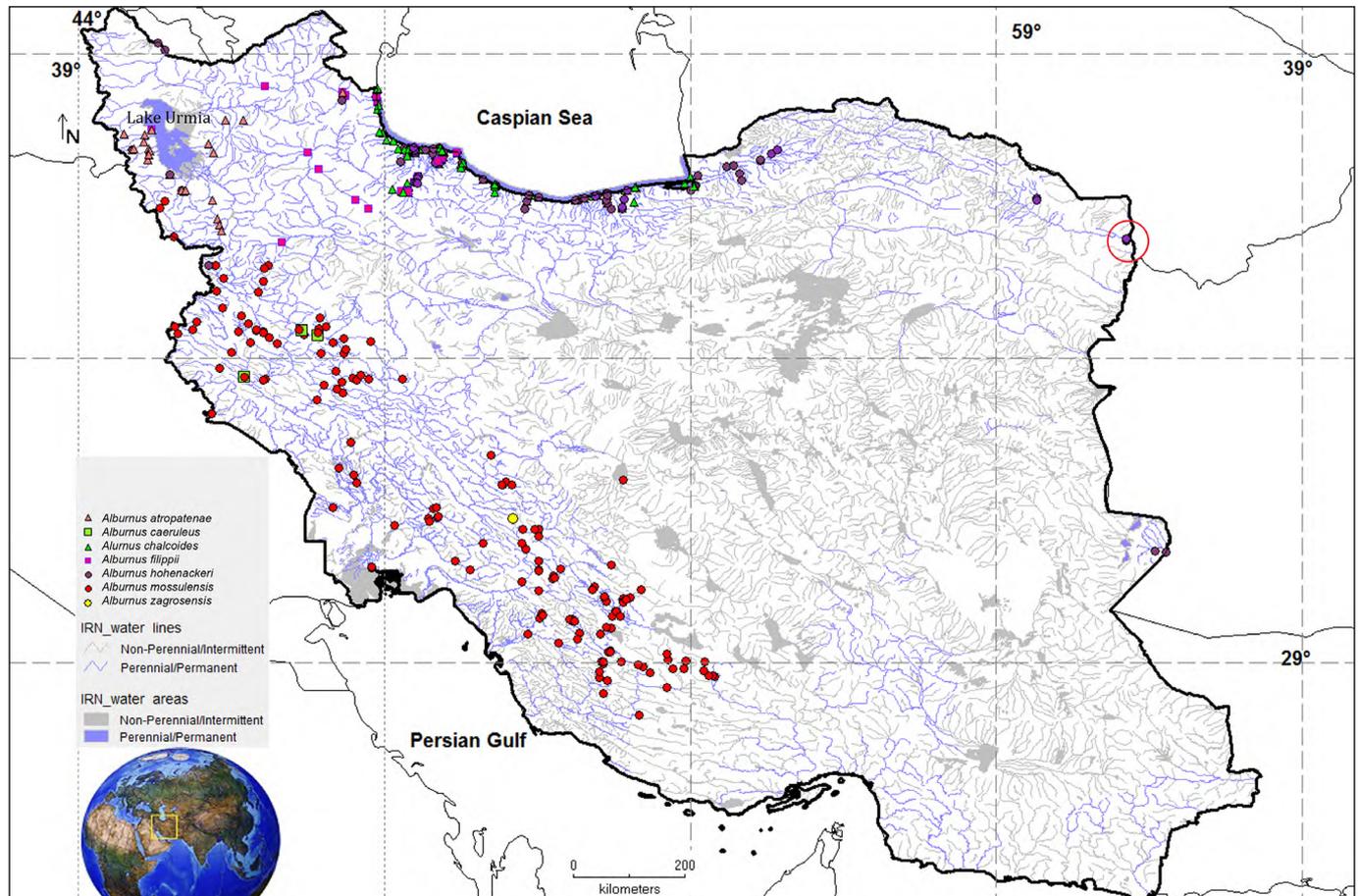


Figure 1. Geographic distribution map of *Alburnus* species in Iran. Red circle shows new distribution record of *A. hohenackeri*.



Figure 2. *Alburnus hohenackeri*, Harirud, Iran. Scale bar = 1 cm.

Based on the collected materials, the distribution of the genus *Alburnus* (Figure 1) can be summarized as follows: *A. atropatense* is found in the Urmia basin, western Iran and is known only from a few localities south, east and west of Lake Urmia; *A. caeruleus* is known from a few localities in Tigris basin, Gamasiab and Doab that are tributaries of Karkhe River; *A. chalcoides* is recorded from the entire southern coast of the Caspian Sea and its rivers, including Aras, Sefidrud, Lisar, Gazafrud, Shirud, Haraz, Gharasu, Tajan, Atrak, Anzali Lagoon and Gorgan Bay. *Alburnus flippii* is also known only from Aras and Sefidrud in southern Caspian Sea and Anzali Lagoon. *Alburnus hohenackeri* is widely distributed in Caspian Sea basin and adjacent basins particularly, occurs along the Caspian coast from Aras River in the western part of this basin to Atrak River in the eastern part. *Alburnus hohenackeri* is also reported from Urmia (Mahabad River, Ghodarchay and Shahrchay), and also widely introduced to some other basins including Tigris (Karkhe River, Chaghakhor Lagoon and Zarivar Lake), Zayandeh River of the Esfahan basin, Dasht-e Kavir basin, and Sistan basin (Abdoli 2000). *Alburnus mossulensis* is recorded from the Tigris River (Karun, Karkhe, Sirvan, Jarahi, Zohre and Gamasiab rivers), Persis or Persian Gulf (Mond and Helleh Rivers), Lake Maharlu, Kor River (Kor and Pulvar (Sivand)), and a few Qanats in this basin) and upper parts of the Hormuz basin. *Alburnus zagrosensis*, as mentioned above, was first described from a stream in Chahar Mahall va Bakhtiari west of Boldaji. This stream is dried up now, but according to our data this species' present distribution is restricted to Gandoman Lagoon in the upper Karun River basin.

During a survey in 2013, we collected some specimens of *A. hohenackeri* (Pearl Fish) in Tedzhen River (Harirud or Hari River), which forms the northern part of the border between Afghanistan and Iran and southeastern part of the border between Iran and Turkmenistan (Figure 2).

The discovery of this species at this site is not unexpected because it very likely was imported from Caspian Sea basin into Doosti Reservoir Dam with commercial fish species.

At the Tedzhen River (Harirud or Hari River) site, the river is about 15 m wide, with coarse gravel and boulder



Figure 3. *Alburnus hohenackeri* habitat in Harirud (Hari River), Iran.

substrate, and with fast-flowing and semi-transparent water. No submerged vegetation was present but epilithic algae were visible on stones along the riverbanks. There was low riparian vegetation (Figure 3).

This species has also been reported by Zareian et al. (2013) from Kardeh Dam in Harirud basin in Iran. Zareian et al. (2013) argued that Pearl Fish were very likely translocated from its native range in the Caspian basin by yearly restocking of commercial species such as *Cyprinus carpio* Linnaeus, 1758, *Hypophthalmichthys molitrix* (Valenciennes, 1844), *Hypophthalmichthys nobilis* (Richardson, 1844) and *Ctenopharyngodon idella* (Valenciennes, 1844). It is translocated from the Caspian Sea to many other basins of Iran (Zareian et al. 2013; Mehraban et al. 2014). This is the first report of occurrence of the genus *Alburnus* in Hari River itself. The previous reported locality for this species in Hari River basin is about 167 km away from this new locality.

DISCUSSION

Natural distribution of fishes may be affected by both historical and ecological factors. However, evaluation of the natural distribution is often complicated by recent faunal modification. The distribution range of such fishes as the Common Carp (*Cyprinus carpio*), Silver Carp (*Hypophthalmichthys molitrix*), Bighead Carp (*H. nobilis*), Grass Carp (*Ctenopharyngodon idella*) and Rainbow Trout, *Oncorhynchus mykiss* (Walbaum, 1792), has been modified by fish culture activities. Many species have been widely introduced accidentally along with the species mentioned above [e.g., *Alburnus hohenackeri*, *Pseudorasbora parva* (Temminck & Schlegel in Siebold, 1842 and *Carassius auratus* (Linnaeus, 1758)]. Some species have been widely introduced and distributed to control malaria (*Gambusia holbrooki* Girard, 1859) and other ones have been released from aquariums [e.g., *Amatitlania nigrofasciata* (Günther, 1867), *Xiphophorus hellerii* Heckel, 1848 and *Carassius auratus*] (Esmaili et al. 2010a, 2010b, 2011b, 2013, 2014).

Historical events, such as tectonics and Zagros and

Alburz mountains formation that have formed the current hydrographic basins could be exclusively used to explain freshwater fish distribution. However, a variety of ecological factors may also play a basic role in the fish distribution and set the range limits of species to create biogeographic patterns, especially at smaller time scale. (Carmona et al. 1999, Wiens 2011). Two main areas could be established in Iran on the basis of distribution of *Alburnus* species:

(1) Caspian-Urmia region: with a fish fauna consisting of many native and endemic fishes (*Alburnus filippii*, *A. chalcoides*, *A. hohenackeri* and *A. atropatense*).

(2) Persian Gulf-Kor: with lower diversity and low or high distribution range (*Alburnus mossulensis*, *A. zagrosensis* and *A. caeruleus*).

Present available data reveals that these species could also be categorized in three major groups based on their natural distribution range: (I) narrow distribution range (*Alburnus zagrosensis* and *A. caeruleus*), (II) medium distribution range (*Alburnus filippii*, *A. chalcoides* and *A. atropatense*), and (III) wide distribution range (*A. mossulensis* and *A. hohenackeri*).

The global distribution of species diversity and richness has been of interest to naturalists for centuries and remains an important research topic in ecology (Gaston 2000). It has been shown that having the knowledge of natural distribution and zoogeographic features of freshwater fishes is the first step to identify hotspots of biodiversity and endemism for conservation priority planning. Many freshwater fish species of Iran are poorly known and their ecology and habitat requirements would have to be examined for conservation assessment. *Alburnus atropatense*, *A. caeruleus* and *A. zagrosensis* are instances of such poorly known species. Populations of *A. chalcoides* (Caspian Shemaya) have significantly decreased over the last decades and this species is Near-Threatened in the south Caspian Sea basin according to IUCN criteria. Overfishing and loss of habitat quality are most important reasons of its decline (Kiabi et al. 1999). Kiabi et al. (1999) classified *A. filippii*, as Least Concern in the south Caspian Sea basin. The sympatric distribution of *A. filippii* and *A. hohenackeri* and the presence of hybrid individuals of these two species in Safidrud and the Kumbashinka (Azerbaijan) (Petrov 1926), need further study.

This study is a good example of the diverse freshwater fish fauna of Iran and region, which needs more attention and further study on the historical biogeography and distribution of its species.

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LITERATURE CITED

- Abbasi, K. 2009. First report of *Alburnus caeruleus* Heckel, 1834 from inland waters of Iran. Iranian Fisheries Research Organization Newsletter 57: 2.
- Abdoli, A. 2000. The inland water fishes of Iran. Tehran: Iranian Museum of Nature and Wildlife. 378 pp.
- Armantrout, N.B. 1980. The freshwater fishes of Iran [Ph.D. thesis]. Corvallis: Oregon State University. xx + 472 pp.
- Berra, T.M. 2001. Freshwater fish distribution. San Diego: Academic Press. 604 pp.
- Buj, I., J. Vukić, R. Šanda, S. Perea, M. Čaleta, Z. Marčić, I. Bogut, M. Povž and M. Mrakovčić. 2010. Morphological comparison of bleaks (*Alburnus*, Cyprinidae) from the Adriatic Basin with the description of a new species. Folia Zoologica 59(2): 129–141. http://www.ivb.cz/folia/59/2/7_ms_1466_buj.pdf
- Carmona, J. A., Doadrio, I., Márquez, A. L., Real, R., Hugueny, B., and J. M. Vargas. 1999. Distribution patterns of indigenous freshwater fishes in the Tagus River basin, Spain. Environmental Biology of Fishes 54(4): 371–387. doi: 10.1023/A:1007535200837
- Coad, B.W. 2009. *Alburnus zagrosensis* n. sp., a new species of fish from the Zagros Mountains of Iran (Actinopterygii: Cyprinidae). Zoology in the Middle East 48: 63–70. doi: 10.1080/09397140.2009.10638367
- Coad, B.W. 2014. Freshwater fishes of Iran. Accessed at <http://www.briancoad.com>, 28 April 2014.
- Elp, M., M. Özulug, F. Şen and J. Freyhof. 2013. Validation of *Alburnus timarensis* from the Lake Van basin, eastern Anatolia (Teleostei: Cyprinidae). Zoology in the Middle East 59(3): 235–244. doi: 10.1080/09397140.2013.841430
- Esmaili, H.R., B.W. Coad, A. Gholamifard, N. Nazari and A. Teimory. 2010a. Annotated checklist of the freshwater fishes of Iran. Zootaxa 2517: 361–386. doi: http://mbrc.shirazu.ac.ir/article_2517_504.html
- Esmaili, H.R., A. Gholamifard, A. Teimori, S. Baghbani, and B.W. Coad. 2010b. *Xiphophorus hellerii* Heckel, 1848 (Cyprinodontiformes, Poeciliidae), a newly introduced fish recorded from natural freshwaters of Iran. Journal of Applied Ichthyology 26: 937–938. doi: 10.1111/j.1439-0426.2010.01515.x
- Esmaili, H.R., A. Gholamifard, and J. Freyhof. 2011a. Ichthyofauna of Zarivar Lake (Tigris River basin, Iran) with the first records of *Hemiculter leucisculus* and *Alburnus hohenackeri* in the Tigris basin. Electronic Journal of Ichthyology 7(1): 1–6. http://ichthyology.tau.ac.il/2011/Esmaili_Gholamifard_Freyhof.pdf
- Esmaili, H.R., N. Nazari, A. Gholamifard, G. Gholamhosseini, A. Teimori and B.W. Coad. 2011b. Range extension and translocation for *Rhodeus amarus* (Bloch, 1782) (Actinopterygii: Cyprinidae) in northwest Iran. Turkish Journal of Zoology 35(6): 883–886. doi: 10.3906/zoo-0906-34
- Esmaili, H.R., A. Gholamifard, A. Sayyadzadeh, G. Parsi, B. Mirghiyasi and S. Ghasemian. 2013. New record of the convict cichlid, *Amatitlania nigrofasciata* (Günther, 1867), from the Middle East (Actinopterygii: Cichlidae). Aqua, International Journal of Ichthyology 19: 225–229. http://www.aqua-aquapress.com/product/aqua-19-4-_amatitlania-nigrofasciata/
- Esmaili, H.R., A. Teimory, F. Owfi, K. Abbasi and B.W. Coad. 2014. Alien and invasive freshwater fish species in Iran: Diversity, environmental impacts and management. Iranian Journal of Ichthyology 1(2): 62–72. <http://ijichthyol.org/index.php/iji/article/view/4/2>
- Freyhof, J. and M. Kottelat. 2007a. *Alburnus vistonicus*, a new species of shemaya from eastern Greece, with remarks on *Chalcalburnus macedonicus* from Lake Volvi (Teleostei: Cyprinidae). Ichthyological Exploration of Freshwaters 18: 205–212. http://verlag-pfeil.de/04biol/pdf/ief18_3_03.pdf
- Freyhof, J. and M. Kottelat. 2007b. Review of the *Alburnus mento*

- species group with description of two new species (Teleostei: Cyprinidae). *Ichthyological Exploration of Freshwaters* 18: 213–225. http://www.pfeil-verlag.de/o4biol/pdf/ief18_3_04.pdf
- Gaston, K.J. 2000. Global patterns in biodiversity. *Nature* 405: 220–227. doi: [10.1038/35012228](https://doi.org/10.1038/35012228)
- Hijmans, R.J., L. Guarino and P. Mathur. 2012. DIVA-GIS. A geographic information system for the analysis of species distribution data. Version 7.5. Accessed at <http://www.diva-gis.org>, 29 August 2013.
- Kiabi, B.H., A. Abdoli and M. Naderi. 1999. Status of the fish fauna in the South Caspian Basin of Iran. *Zoology in the Middle East* 18: 57–65. doi: [10.1080/09397140.1999.10637782](https://doi.org/10.1080/09397140.1999.10637782)
- Kottelat, M. and J. Freyhof. 2007. *Handbook of European freshwater fishes*. Kottelat, Cornol, Switzerland/Berlin: privately published and Freyhof, Berlin, Germany. xiii + 646 pp.
- Mehraban, H.R., G. Sayyadzadeh, H. Malekzahi and A. Ahmadi. 2014. First report of infection with the Tapeworm *Ligula intestinalis* (Linnaeus, 1758) plerocercoids in Persian bleak, *Alburnus hohenaekeri* Kessler, 1870 in southeastern Iran. *Iranian Journal of Ichthyology* 1: 12–16. <http://ijichthyol.org/index.php/iji/article/view/11/9>
- Özuluğ, M. and J. Freyhof. 2007. *Alburnus demiri*, a new species of bleak from Western Anatolia, Turkey (Teleostei: Cyprinidae). *Ichthyological Exploration of Freshwaters* 18: 307–312. http://www.pfeilbook.com/o4biol/pdf/ief18_4_03.pdf
- Petrov, V.V. 1926. Kpoznaniiyu kavkazskikh ukleyek (genus *Alburnus* Heck.). [To the knowledge of the Caucasian bleaks (genus *Alburnus* Heck)]. *Izvestiya Bakinskoi Ikhtiologicheskoi Laboratorii* 2(1): 133–160.
- Saadati, M.A.G. 1977. Taxonomy and distribution of the freshwater fishes of Iran [M.Sc. dissertation]. Fort Collins: Colorado State University. xiii + 212 pp.
- Watanabe, K. 1998. Parsimony analysis of the distribution pattern of Japanese primary freshwater fishes, and its application to the distribution of the bagrid catfishes. *Ichthyological Research* 45: 259–270. doi: [10.1007/bf02673924](https://doi.org/10.1007/bf02673924)
- Werner, R.G. 2004. *Freshwater fishes of the northeastern United States: a field guide*. Syracuse: Syracuse University Press. 335 pp.
- Wiens, J. J., 2011. The niche, biogeography and species interactions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 366: 2336–2350. doi: [10.1098/rstb.2011.0059](https://doi.org/10.1098/rstb.2011.0059)
- Zareian, H., H. R. Esmaeili, A. Gholamhosseini and G. Sayyadzadeh. 2013. New records and geographical distribution of *Alburnus hohenaekeri* Kessler, 1870 (Teleostei: Cyprinidae) in Iran. *Check List* 9(4): 829–831. doi: [10.15560/9.4.829](https://doi.org/10.15560/9.4.829)

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