

**RANGE MAP AND DISTRIBUTION
OF *LUCIOBARBUS BARBULUS* HECKEL 1847
IN THE TIGRIS AND EUPHRATES RIVER BASINS**

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DOI: 10.2478/trser-2020-0004

KEYWORDS: *Luciobarbus barbulus*, type locality, geographical distribution, status, Iran.

ABSTRACT

Luciobarbus barbulus Heckel, 1847 was described from water bodies around Shiraz and the Qara Aqaj River, one of the main rivers in Shiraz City, Iran. In the present study localities, a geographical range map of *Luciobarbus barbulus* and new data on the present status of this species are presented. In our latest sampling we assessed for the first time the presence of this species in the Lesser Zab River where no specimen had been collected in the past on this part of the river. The detailed distribution of *Luciobarbus barbulus*, based on the captured specimens, and literature records of this species are mentioned.

ZUSAMMENFASSUNG: Verbreitungskarte und Verteilung von *Luciobarbus barbulus* Heckel, 1847 in den Einzugsgebieten der Flüsse Tigris und Euphrat.

Die Art *Luciobarbus barbulus* Heckel, 1847 wurde aus dem benachbarten Gewässersystem Shiraz, im Qara Aqaj-Fluss, einem der Hauptflüsse der Stadt Shiraz im Iran festgestellt. Vorliegende Arbeit umfasst die Untersuchungen zu den Fundorten, die Verbreitungskarte von *Luciobarbus barbulus* sowie neue Angaben zum gegenwärtigen Zustand der Populationen der Art. In unserer letzten Bestandaufnahme wurde ein neues Vorkommen der Art im Lesser Zab Fluss festgestellt und zwar in einem Abschnitt, in dem sie bisher nicht vorgefunden wurde. Außerdem sind Einzelheiten zur Verbreitung von *Luciobarbus barbulus* angegeben, die auf den Sammelbelegen und auf Fachliteraturangaben beruhen.

REZUMAT: Harta de răspândire și distribuția speciei *Luciobarbus barbulus* Heckel, 1847 în bazinele hidrografice ale râurilor Tigris și Euphrat.

Luciobarbus barbulus Heckel, 1847 a fost descris din corpuri de apă din jurul Shirazului și din râul Qara Aqaj, unul dintre râurile principale din orașul Shiraz, Iran. Pentru localitățile luate în considerare, au fost prezentate o hartă a distribuției geografice pentru *Luciobarbus barbulus* și noi date asupra statutului prezent al acestei specii. În ultima noastră campanie de prelevare am evaluat pentru prima dată prezența acestei specii în râul Lesser Zab, în care nici un specimen de acest fel nu a mai fost colectat în trecut în această parte a râului. A fost menționată distribuția detaliată a speciei *Luciobarbus barbulus*, bazată pe indivizii capturați și semnalările din literatură.

INTRODUCTION

Fish, a limited resource, are not only a source of food for human consumption but also have many additional benefits, such as ornamental, hygienic, and industrial uses (Coul, 2002, Bănăduc et al., 2016; Del Monte-Luna et al., 2016). Furthermore, they are an important resource for the drug industry (Moyle, 1988). Despite their value, freshwater fish are probably the most threatened of all aquatic vertebrates (Moyle, 1988). The threat against them is likely to worsen as the demand for food and conflicts over their use increase, a consequence of climate change and drought (Valiollahi, 2015). Moyle and Leidy (1992) estimated that 20% of the world's freshwater fish fauna is extinct or in danger of becoming extinct in the near future.

The study of the ichthyofauna of the big rivers of the world is a principal concern among researchers in aquatic biology and ecology (Greenwood, 1976; Rainboth, 1996; Rinne et al., 2005; Tweddle, 2010). The barbel species of Western Iran are environmentally and economically important. Some of them are the largest lotic freshwater species, which will grow in length and weight to 170 cm and 120 kg, respectively. There is little information on the taxonomy, biology, geographical distribution or environmental status of this species. *Luciobarbus barbulus* Heckel, 1847 is one of the important large lotic freshwater fish species in the study area. One of the main spawning habitats and nursery grounds of the genus *Barbus sensu lato* is the Tigris-Euphrates River basin in Iran, Iraq, Turkey, and Syria, from where there are relatively few reports on the fish fauna. (Valiollahi and Shakiba, 2015)

The genus *Barbus sensu lato* Cuvier and Cloquet, 1816 (Cuvier and Valenciennes, 1828-1849) has been split into a number of genera which are now finding general acceptance (Coad, 2019). Some of these genera or subgenera are: *Barbus*, *Luciobarbus*, *Carasobarbus*, and *Arabibarbus*. The aim of this paper is to outline the geographical range map of *Luciobarbus barbulus*. Like many other Cyprinids, the *Barbus* genus was long included in *Barbus*. It appears to be a very close relative of the typical barbells – which include that genus type species *Barbus barbatus*, and may well warrant inclusion in *Barbus*. Many modern authors prefer to consider it a subgenus instead. It is, moreover, not entirely clear what species to place in *Luciobarbus* if it is deemed valid. The IUCN argues for a rather inclusive circumscription. Notwithstanding the taxonomy and systematics of this ill-defined assemblage, their closest living relative is probably *Aulopyge huegelii* (Casal-Lopez et al., 2015).

There are relatively few papers or new information available about *Luciobarbus barbulus* or other related species, except some checklists in the databases of the California University Catalog of Fishes (*, 2018). These papers have been focused on the distribution of these taxa in Tigris and Euphrates basin in Iran, Iraq, Syria, and Turkey.

Despite the economic and conservation importance of this fish species there are some contradictions in the geographical distribution and differentiation of this species and other similar species. During recent decades *Luciobarbus barbulus* has been reported and described several times or has been placed into synonymy with other related species. Also, there have been conflicting views on the morphological character of this species. (Valiollahi, 2000a, b)

The possible syntype of *Luciobarbus barbulus* (NMW 53957) was examined by Almaça (1986). He states that a probable syntype of *Luciobarbus barbulus* (from Kara Agatsch, Iran) was found, but it is in such bad condition that nothing can be recognised by its examination; curiously, all the specimens which could be identified with the original description of *Luciobarbus barbulus* proceed from the Mediterranean coast of Western Asia: Lake Tiberias (Israel), Orontes River and Lake Homs (Syria), and Lake Antakya (Turkey). As *Luciobarbus barbulus* was described from Iran there is here an intriguing geographical

problem which cannot be solved without more information (Almaça, 1983). Regarding similarity and overall morphology, it was realised that there is a close affinity between *Luciobarbus barbulus* and the *bocagei* group (Almaça, 1984b, 1991). Later Almaça (1984a, 1984b, 1986, 1991) retained *barbulus* as a full species known only from the Levant, despite Heckel's record from the Qarah Aqaj (Mand) of Fars, Iran (Coad, 2014). The aim of the current article is to give some real records of catchment for these important taxa.

In 2000 the *Barbus* species of Iran were revised. The revision was based on nearly all *Barbus* specimens that were held at the Canadian Museum of Nature (CMN) and sampled fishes that were caught in water bodies of western Iran from 1996 to 2000. The same fishing programme was repeated from 2013 to 2016 in order to find new records on the present status of *Barbus* species (Valiollah, 2015).

The details of distribution and historical biogeography of *Luciobarbus barbulus* were plotted on maps based on the captured specimens, and available data from literature records.

MATERIAL AND METHODS

Between the years 1995-2000, samples were collected in water bodies of western Iran. The same fishing programme was repeated from 2013 to 2016 in order to find new records on the present status of *Barbus* species. The sites where *Luciobarbus barbulus* was found and the sites from literature review have been recorded together in tables 1 and 2.

The specimens were preserved in 10% formalin for 24 hours then transferred to 70% alcohol, labeled and deposited in the Collection of Environmental Science Laboratory in Sahid Rjaee Teacher Training University (SRTTU) Lavizan, Tehran, Iran.

After identifying the specimens, the longitude and latitude of the sampling stations were transferred on to maps and the longitude and latitude coordinates of fishing stations were plotted.

The distribution of this species is based on the localities of newly caught specimens as well as available data on:

- samples from western Iran, collected by Valiollahi et al. since 1985 (J. V. C. – Jalal Valiollahi Collection).

- specimens in the Canadian Museum of Nature collections (C. M. N.)

The plotting of *Luciobarbus barbulus* distribution has been done based on all specimens that have been caught in the Tigris and Euphrates basins or reported from literature by different authors, and 34 specimens preserved in C. M. N. (the details on catalogue number can be available on request).

RESULTS AND DISCUSSION

The original describer of *Luciobarbus barbulus* Heckel, 1847 (Heckel, 1847) stated that the water systems around Shiraz yielded 15 fish species. *Luciobarbus barbulus* was one of 15 species among specimens collected by Theodor Kotschy (1841-1842), in the water system around Shiraz and was sent to Heckel in the Vienna Museum (N. M. W.). Heckel described these 15 fish species before as barbels of Syria. These nominal species were: *L. mystaceus* Heckel, 1843, *L. scheich* Heckel, 1843, *L. kersin* Heckel, 1843, *L. pectoralis* Heckel, 1843, *L. rajanorum* Heckel, 1843, *L. esocinus* Heckel, 1843, *L. xanthopterus* Heckel, 1843, *Barbus grypus* Heckel, 1843, *Labeobarbus kotschy* Heckel, 1843, *Barbus lacerta* Heckel, 1843, *Barbus scincus* Heckel, 1843, *Barbus luteus* Heckel, 1843, *Barbus plebejus* Bonaparte, 1832, *Barbus sharpeyi* Günther, 1868, and *Barbus subquincunciatus* Günther, 1868.

Description of the type locality

In the literature for *Luciobarbus barbulus* localities, occurred errors during transcriptions and translations, for example Geré is incorrect because around Shiraz there is the name of Gereh that is a mountain with lat./long. 31°52' N – 50°21' E that actually is not the type locality. There is a population in the centre and a branch of a river with the name of Jereh (29°15' N – 51°58' E) that most presumably is the correct name. Pronunciation of Kara-Agatsch in English may be Gharah Aghaj = Qarah Aqaj (means black wood or black tree in Turkish). The type locality of *Luciobarbus barbulus* is near the village of Jereh, the Qarah-Agaj = or Mond River, Fars. Heckle, for the Syrian specimens' locality, refers to the Quwayq, Naher = Strem near Aleppo 35°59' N – 37°02' E. (Heckel, 1846-1849)

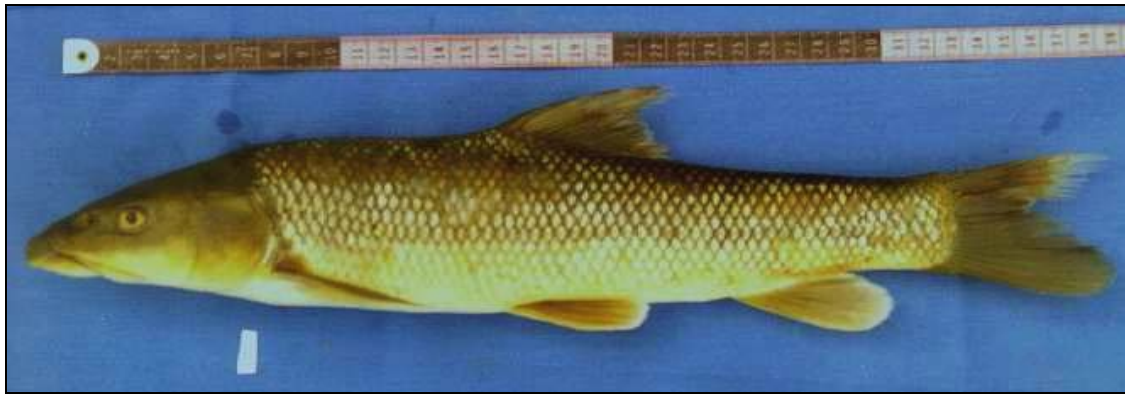


Figure 1: *L. barbulus* TL 402 mm, Gamasiab River; photo Mohammad Ghazi – 1996.



Figure 2: *L. barbulus*, 182 mm, TL, Tag No. 40, Shiraz, Firozabad; photo Izadi – 2000.

Shiraz water bodies

About the local waters in the type locality, Heckel refers to a short introductory note by Kotschy. Heckel states that Shiraz (29°36' N – 52°32' E) is located at an altitude of 1,219.2 m behind two mountain ranges that run parallel to the Persian Gulf; in its vicinity there are three different river systems: Kor, Fahliyan, and Aghaj.

The smallest includes in its area the town of Shiraz (29°45' N – 53°00' E) itself. It is formed by the Kokn Abad Creek and most of its waters flow into the many irrigation canals of the plain, and therefore its actual riverbed dries up completely during the summer. Downstream of the town, this creek combines with the Sadi (29°37' N – 52°35' E), which arises from Cliffside springs, and together they drain into the southward salt lake Namak Daria

(Tabs. 1 and 2). East of Shiraz, the Band-E – Amir, (known as Araxes) flows with its small tributaries through the higher Persepolis Plain. Their waters flow into another salt lake, which according to some information, is supposed to have a subterranean connection with the previously mentioned neighbouring lake. In the high mountains of Kuh-Noor, Northwest of Shiraz, arises the Qareh Agaj River; it flows in a southward arc into the Persian Sea. On the chord of this arc there is a high alpine lake, Dariya-e Kaserun or the lake of Kaserun, and a second lake named Parishan. The waters of both lakes flow into the Qhara-Aqaj. Parishan and Dariya-e Kaserun or Lake Kazerun are both alternative names for Lake Famur (Heckel 1846-1849).

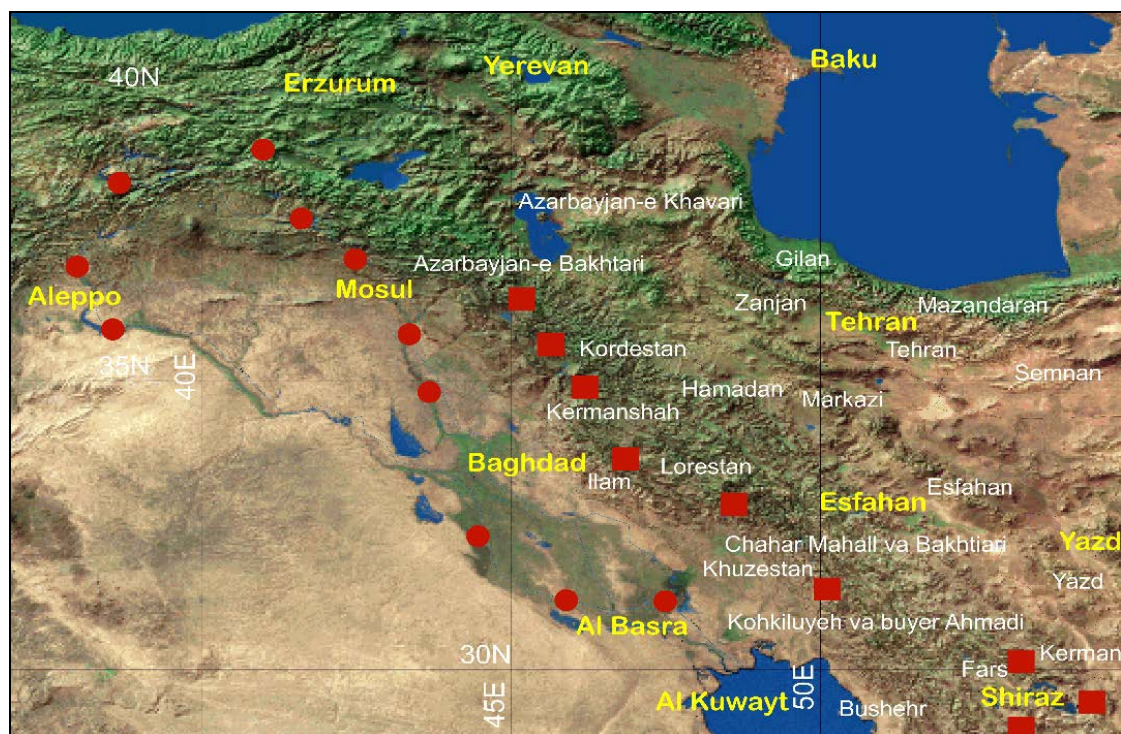


Figure 3: Type locality, and geographical range distribution of *Luciobarbus barbulus*, reported in literature ●, the localities where *Luciobarbus barbulus* has been caught by Valiollahi et al. ■; this map has been prepared by: ArcGIS® 10.3, 2018.

Also, Izadi (2000) and Moradi Esmaeil (2013) reported this species in Shiraz, and Shkiba et al. (2015) reported it in Laser Zab, sampling this species from Zab River. This sampling indicated the wide distribution of this species from the north-west to south-west of Iran (Tab. 1, Figs. 1 and 2). Izadi (2000), carried out a fishery programme to identify the status of the freshwater fishes of Shiraz (Fars Province) during 1998-2000. He reported *Luciobarbus barbulus* at Noor Abad (Pol E, Totestan, Garab Village), Sepedan (Shesh per River), Firoz Abad (Ghaleh Doghtar), Ney Riz (Pahnaveh), and Darab (Cheshmeh Golabi). Noor Abad and Sepedan are in the Zohreh River Basin and Firoz Abad is located in the Mond Basin, and Ney Riz and Darab are located in the Kol Basin (Izadi, 2000). Moradi Esmaei (2013), who carried out another programme of catching fish species at Salman Dam basin and Qara Aqaj River territory and he reported *Barbus* species.

The Qarah Aqaj River is one of the most important rivers in Shiraz, its water used for drinking and agricultural purposes. Constrictions of the Salman Farsi Dam in Gher and Karzeun districts and plans for construction of the Kovar Dam on this river show the importance of this river in Fars Province (Valiollahi and Moradi Kochi, 2013, 2015, unpublished data).

The Zagros Mountain river system in western Iran at some places holds the upper branches of Tigris River and finally joins and flows as the Shatt Al-Arab to the Persian Gulf. The area surrounding the Shatt Al-Arab consists largely of alluvial lands and swamps in the south of Iran (Fig. 3), and is one of the main habitats, spawning, and nursery grounds of *Barbus* species including *Luciobarbus barbulus* and other related species.

Table 1: type locality and geographical range distribution of *Luciobarbus barbulus*, reported in Iran in literature, latitude and longitude are in decimal degrees (DD).

	Province and river	Sample locations with GPS coordinates	Collector and date
Iran	Fars, Qarah Aqaj	Kokn Abad Creek, Sadi Spring, East of Shiraz, known as Araxes, Band-e-Amir, lat.: 29.777532 , long.: 52.851913 , Qarah Aqaj, Fars, Siakh Darengan Rd, Iran, lat.: 29.475921 , long.: 52.346403 , Kazerun, or lake Famur. Fars, Famour-Parishan, Iran lat.: 29.521189 Long.: 51.813498 Dariya-e Kaserun or Lake	Heckel, 1846-1849; Theodor Kotschy 1841-1842
	Fars, Zohreh Basin	Noor Abad, (Pol E, Totestan, Garab Village), Sepenan (Shesh per River), Fars, Yasuj-Shiraz Rd, Iran lat.: 30.173625 , long.: 52.043288	Izadi, 2000
	Fars, Mond Basin	Firoz Abad, (Ghaleh Doghtar) Fars, Kavar-Firuzabad Rd, Iran, lat.: 28.92026 , long.: 52.528762	Izadi, 2000
	Fars, Kol Basin	Ney Riz, (Pahnaveh); Darab (cheshmeh Golabi).	Izadi, 2000

Zoogeography and distribution

Luciobarbus barbulus was reported by different authors, who have tried to describe it. Some examples are: Almaça (1991), Günther (1874), based on Heckel's original description (Heckel, 1846), Sauvage (1884), and Pellegrin (1923), based on specimens from the Orontes (Lake Homs, Hammah, and Antakya), and Khalaf (1961) on specimens from Iraq, all present descriptions of *Luciobarbus barbulus*. Berg (1949a, b), based on Heckel's original description, reported four specimens from Karun Basin in Khuzistan, Iran, that were apparently gathered by Zarudnyi in his travels throughout Iran in 1896, 1900-1901 and 1903-1904. Khalaf (1961) presents *Luciobarbus barbulus* on specimens from Iraq. The Iraqi fish fauna including *Luciobarbus barbulus*, were described by Khalaf (1961) who recorded 45 species, while Mahdi (1962) described the same number of species (Al-Hamed, 1966; Mahdi and Georg, 1969; Al-Nasiri and Shamsul-Hoda, 1976; Al-Daham, 1977; Faddagh et al., 2012).

The Iraqi fish fauna was recently reviewed by Coad (1991, 2009). Faddagh et al. (2012) for their DNA analysis via RAPDs have collected 1,200 specimens of cyprinids, including *Luciobarbus barbulus*, and related species from three separate sites in the Shatt Al-Arab River in the governorate of Basrah contain Al Qurnah 31°017.928 N – 47°26 31.242 E, Garmat Ali and Abul-Khaseeb 30°2652.029 N – 28°455.848 E (Faddagh et al., 2012). Mahdi (1962) from Iraq reported *Luciobarbus barbulus* in Qezilja River (Leaser Zab). Saadati (1977) reported eight specimens from the tributaries of the Saymareh and Tigris rivers.

Jawad (2012a, b), and some other Iraqi researchers has reported the presence of this species in Iraq. Erdoğan et al. (2015), and some other Turkey's researchers report *Luciobarbus barbulus* in Keban, 38°48'15.479 N – 38°45'38.367 E. Kralkizi Dam Lake, 38°21'24.243 N – 40°14.338 E, Hazar Lake, and the Euphrates and Tigris basins in Turkey (Fig. 3; Tabs. 1 and 2). Kefah Naser and Fatima (2017) have caught and examined *Luciobarbus barbulus* along the Tigris River near Al-Graiat region in Baghdad Province during July 2015 – March 2016 (Kefah Naser and Fatima, 2017). Also Laith et al. (2016) have found *Luciobarbus barbulus* in Himreen Lake in summer of 2014 to spring of 2015 (Laith et al., 2016).

Table 2: Localities where *Luciobarbus barbulus* individuals were caught by Valiollahi J. et al.

Province and River	Stations	Collector and date
Kermanshah Ghamasiab	Mir Azizi, AH2, Iran, Gharban, Cham Heydar, Gorgiwand, Samanghan, Hashem Abad Sofla, Ghzarud, Polcheher, Qozevand, Farash, Biston, Amalh, Ali Abad, Nazeliyan, Ghaross	Valiollahi 1995-1997
Harsin Ghamasiab	Polcheher, lat. 34.335685 , long. 47.425455 Sorkhehdeh, Shahmaliky, Azez Abad, Zangichga, Shan Abad	Valiollahi 2013-2015
Kermanshah Razavar River	Khezer Zendehe, Kolocheh, lat. 34.700625 , long. 46.890614 Kholocheh Dam lat. 34.69378 , long. 46.889756	Valiollahi 1995-1997
Kermanshah Gharahso or Quraso River	Ravansar, Rika, Sarab Nelofar, Galanjeh, Karam Ali Bag, Brimavand, Jafar Abad, Gandomiyan, Sarab Jaberi, Garab Sofla, Jan Jani, Pol-e-Naderi, Shorbelagh, Doro Faraman, Dinavar, Boz Abad, Ghovizand	Valiollahi 1995-1997
Kermanshah Mereg River	Kashabah, Jafar Abad, Shakabayan, Poshtareza Bala, Rashbarg, Chahar Zabar Bala	Valiollahi 1995-1997
Kermanshah Alvand River	Ghasershirin, lat. 34.46 , lon. 45.5925	Valiollahi 1995-1997
Lorestan, Saymareh River	Darb Gonbad, lat. 33.706491 , long. 47.152376	Valiollahi 1995-2018
Lorestan, Saymareh	Roberoy Gombad Saymareh dam	Valiollahi 1995-2018
Pyranshaheer Leaser Zab	West Azerbaijan, Mirabad – Piranshahr Rd, Iran lat. 36.555706 , long., 45.249081	Valiollahi Sakiba, 2014
Khuzestan, Karun River	Karkheh	Valiollahi 1995-2018
Dez	Dezful, Shohada Blvd., Iran, lat. 32.411922 , long. 48.432938	Valiollahi 1995-2018

Table 2 (continued): Localities where *Luciobarbus barbulus* individuals were caught by Valiollahi J. et al.

Syria	Quwayq, Naher	Quwayq, Naher = Strem near Aleppo	Heckel, 1846-1849
	Orontes, Lake Homs	Orontes (Lake Homs, Hammah, and Antakya Qattinah, Syria lat. 34.644507 , long. 36.588593	Sauvage, 1884 and Pellegrin 1923
Iran	Pyranshaher Leaser Zab	Qezilja River West Azerbaijan, Iran Kani eshkot, lat. 36.575353 , long. 45.240197	Mahdi Nuri 1962
Iraq	Basrah, Basrah	Qurnah, Iraq, lat. 31.00498 , long. 47.442012 meters Garmat ali, Abul-Khaseeb Basrah, Iraq, lat. 30.458736 , long. 48.033428	Faddagh, et al. 2012
Turkey	Upper Tigris	Keban, Değirmenbaşı Keban/Elâziğ, lat. 38.8043 , long. 38.760656 , Kralkizi Dam Lake, Hazar Lake D885, 23900 Sivrice/Elâziğ, lat. 38.476707 , long. 39.321785 and Euphrates and Tigris river basins part of Turkey	Çiçek et al 2015, Cüneyt Kaya1 2016, Ünlü and Balcı 1993a

CONCLUSIONS

Luciobarbus barbulus was one of the 15 species among the specimens collected by Theodor Kotschy 1841-1842, in the water system around Shiraz and was sent to Heckel in the Vienna Museum (NMW). Heckel 1848 named *Luciobarbus barbulus* when he encountered the samples from Shiraz although he had seen the samples from Kueik or Quiek near Halab or Aleppo in Syria. So for the first time he described the new species (*Luciobarbus barbulus*) from Shiraz, which was similar to the previously described species *Luciobarbus mystacus*. In conclusion *Luciobarbus barbulus* is a valid species and the type locality of this species is Qarah Aqaj River, Shiraz, Iran.

This species has been identified and verified before; in this paper we have reported the recently collected specimens from new localities. The recent record of *Luciobarbus barbulus* shows that this species has a wide distribution range in western Iran, also according to the literature reviewed, from west and north-west Turkey, Iraq and Syria.

ACKNOWLEDGEMENTS

The author would like to dedicate this paper to Dr. Brian W. Coad, research scientist of the Canadian Museum of Nature (CMN), because of his friendly help and encouragement and useful recommendations for improvements of this study. The author would like to express special thanks to his colleagues for the sampling of fish specimens from western Iran: Mohamad Ghazi Harchini, Sasan Shahmahmudi, Bahman Haidari, Ramin Bidel and Mohamad Jaliliyan (1998). This project was approved in Shahid Rajaee Teacher Training University, so it is my duty to thank all of the staff of this institution. The study on new specimens was funded partly by Iran National Science Foundation (INSF), project No. 91001954.

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