

RESEARCH ARTICLE

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Distribution and habitats of Near Threatened Iranian stream salamander *Paradactylodon persicus* (Eiselt & Steiner, 1970) (Caudata: Hynobiidae)

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Abstract

The mountain salamanders of the genus *Paradactylodon* Risch, 1984 of the family Hynobiidae with three known species are distributed in Iran and Afghanistan. Based on morphological characteristics, the genus *Paradactylodon* consists of three species *P. mustersi* (Afghanistan), *P. persicus* and *P. gorganensis* (Iran); the Iranian stream salamander *P. persicus* was first reported from the Talesh Mountains and then the Gorgan cave salamander *P. gorganensis* was described from the eastern Alborz Mountains; the two Iranian *Paradactylodon* species are distinct based on morphological characteristics. Due to its conservation significance and numerous threats, this taxon is classified as Near Threatened on the IUCN Red List. The distribution range of *P. persicus* is Ardabil, Guilan, and Mazandaran Provinces, and *P. gorganensis* is Golestan Province. Initially, the study involved reviewing previous research, consulting local residents and experts, and conducting field visits to collect data and photographs of both known and newly discovered habitats. Two specimens of the Persian salamander (*Paradactylodon persicus*) were reported on 8 May and 4 August 2024 from Masal Mountain, Chesli Village (37°16'49" N and 49°2'17" E; 375 m above sea level) from Guilan Province (western part of Alborz Mountain Range, northern Iran). The first report of this species in 1970, was based on five salamander larvae found in a stream at an altitude of 800 meters in the Asalem region of the Talesh Mountain Range in the western Alborz Mountains. this research aims to find new habitats and assess the conservation status of the Iranian salamander *Paradactylodon persicus*, and suggests that habitat changes should be prevented population decline and further protect this species.

Keywords: Iranian salamander, habitat, distribution, *Paradactylodon persicus*, Guilan Province.

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INTRODUCTION

Amphibians are a group of vertebrates that are evolutionarily after fish and before reptiles ([Kent & Miller, 1997](#)). The habitat of all Iranian tailed amphibians is in the mountainous areas or the edge of the Alborz and Zagros forests ([Safaei-Mehro, 2014](#)). Among these areas (habitats) are the western Alborz mountain range (Ardabil, Guilan and Mazandaran Provinces) and the eastern Alborz (Golestan Province). [Schmidtler and Schmidtler \(1971\)](#) collected a number of larvae from the type locality; they gave a brief description of the young salamanders after their metamorphosis in captivity. In 1978, a new population of Hynobiid salamanders was discovered by Clergue-Gazeau and Thorn in the eastern Alborz mountains in Golestan Province; the species *Paradactylodon gorganensis* was described based on morphological features of a single adult specimen ([Clergue-Gazeau & Thorn, 1978](#)). The second Iranian Hynobiid taxon

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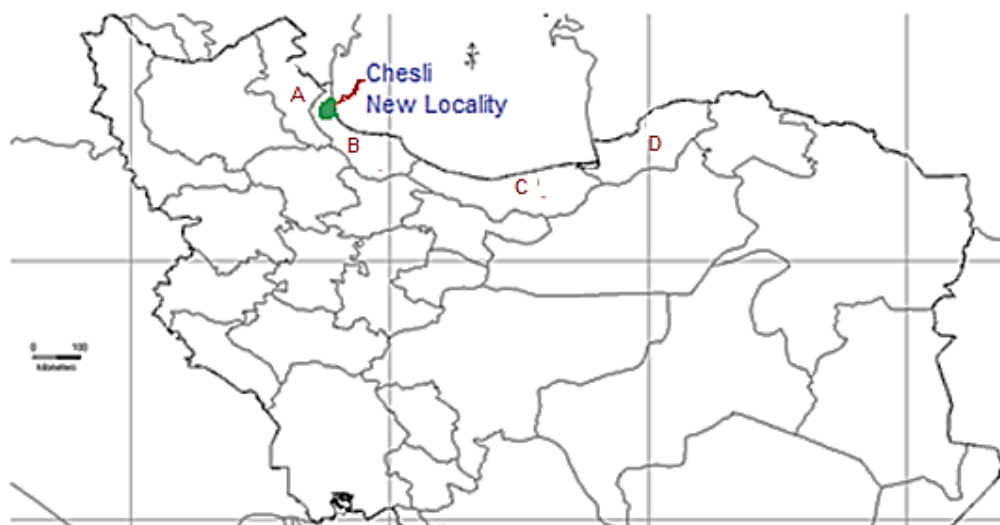


FIGURE 1. Distribution of *Paradactylodon persicus* in Ardabil (A), Guilan (B) and Mazandaran (C) Provinces and distribution of *Paradactylodon gorganensis* in Golestan Province (D). (Green dot on the map of Guilan Province is the new location of the description of two salamander specimens) (Chesli, Masal, Guilan).

is based on 23 cm long adult male specimen kept in the National museum of Natural History in Paris (MNHN); this cave salamander was discovered on the eastern edge of the Hyrcanian Corridor (Shirabad cave, Golestan Province) and was only later described as *Batrachuperus gorganensis* (Clergue-Gazeau & Farcy, 1978). Based on a study conducted by Risch (1984), the salamanders taken between Gorgan and Aliabad were introduced with the name *Paradactylodon gorganensis* and he considered the name *Paradactylodon* as a valid name. However, the morphological evidence for such a decision was not convincing enough and the name was quickly synonymized with *Batrachuperus* by Reilly (1987). The first species of this genus, *Paradactylodon mustersi*, was described by Smith (1940) from the Paghman Mountains near Kabul, Afghanistan. Stöck (1999) compared the morphological features of larval and subadult topotype specimens of *P. persicus* and *P. gorganensis* and introduced *P. gorganensis* as a subspecies. The Iranian stream salamander was reported by Kami (2004) and Ebrahimi et al. (2004) from two locations: the village of Vissar in southeastern Chalus, Mazandaran Province, and the village of Deilmadeh in southeastern Khalkhal, Ardabil Province. The Iranian stream salamander *Batrachuperus persicus* has been transferred to the genus *Paradactylodon* based on genetic studies by Zhang et al. (2006). The name *Iranodon* has also been used for the genus *Paradactylodon* by a group of authors (Zhang et al. 2006; Raffaëlli, 2007; Poyarkov, 2010; Dubois & Raffaëlli, 2012). Ahmadzadeh et al. (2011) reported *Paradactylodon persicus* in the Dasht-e Doman region of Rezvanshahr, Guilan Province. This species is a protected species under national laws. The Gorgani cave salamander is one of the endangered species, the only habitat of this species is a cave in Shirabad, Golestan Province (Yousefi siyahkalroudi et al., 2015). Using the skeletochronology method, the age structure of *Paradactylodon gorganensis* has been investigated, and the lifespan of females is 13 years and that of males is 11 years (Zivari & Kami, 2017). Stöck et al. (2019) have investigated the genetic structure of the western (*P. persicus*) and eastern (*P. gorganensis*) taxa and proposed that they belong to a single species *P. persicus s.l.* The distribution range of *P. persicus* is Ardabil, Guilan and Mazandaran Provinces and *P. gorganensis* Golestan Province. The aim of this study is to report a new record of the distribution of the western taxon (*P. persicus*) in the Guilan and Ardabil regions and to compare the morphological and biometric characteristics of the specimens studied in these regions.



FIGURE 2. Adult Persian Salamander *Paradactylodon persicus*, 8 May 2024 (Chesli, Masal, Guilan Province).

MATERIAL AND METHODS

This research was conducted in the form of a field visit to the areas and stations of Guilan Province in the months of May, June, July, August and September, using previous sources (research and articles) and obtaining information from experts and local people. By describing and showing people photos of the salamander, awareness of its presence or absence in a specific area was obtained. Then, with great effort, the desired location was reached and the samples collected in their habitat were recorded, photographed, biometrics and tissue samples from the fingers and tail were obtained. In order to protect them, the species were released alive in the same place where they lived. A new record of the Iranian salamander in the Masal mountains and Chesli village of Guilan Province (western part of the Alborz mountain range, northern Iran), of which two specimens of the Iranian salamander (*Paradactylodon persicus*), the first specimen was reported on 8 May and the second specimen on 4 August 2024. After collecting the samples by hand, they were identified based on morphological identification key [Yousefi Siahkalroodi et al. \(2013\)](#). These Iranian salamander specimen was reported in a salmon pond in the village of Chesli, which is located about 15 Km from Masal and at an altitude of about 375 m above sea level. This pond is located in the heart of the forest and its water supply is also from springs in the upper regions; Since the only way water enters this pool is through the canal and water pipe, it seems that these salamanders entered this pool through the canal and water pipe, which was then identified and diagnostic traits were reported ([Fig. 1](#)).

Habitat: This species lives in cold streams and small pools among dense Hyrcanian forests and highlands where the water temperature is 13-15°C.

RESULTS

From two specimens of the Persian salamander (*P. persicus*) that were caught on and in the village of Chesli, Masal County, Guilan Province, at an altitude of about 375 m above sea level, the time interval between the two specimens was about 88 days, and both specimens had passed the larval stage and breathed by the lungs and were in the juvenile stage, and both specimens were almost similar in terms of age, size, and appearance ([Fig. 2](#)). Both specimens entered the pond space from a spring located in higher areas through canal water, meaning that the spawning and larval stages and entry into the juvenile stage took place in the same upstream spring and then entered the pond through canal water ([Fig. 3](#)). In macroscopic examination, the specimens have a large and broad head that gradually compressed towards the neck, palatal blade teeth arranged in two arcuate rows, the locomotor organs have four fingers without nails, a wide tail compressed from the sides and a dorsal ridge in the upper area that extends along the entire length of the tail. This apparent structure of the tail helps the animal in swimming; it has 10



FIGURE 3. Habitat and new locality report of the Iranian salamander *Paradactylodon persicus* (Chesli, Masal, Guilan).



FIGURE 4. Young Persian salamander *Paradactylodon persicus* (Gilvan, Khalkhal, Ardabil Province).

lateral grooves and a distinct vertebral groove .It has smooth skin and numerous pores that play a role in the animal's skin respiration. The dorsal area is dark or light brown and sometimes yellowish, but the lower body and sides are lighter and often pinkish or yellow .Also, irregular light yellowish, pinkish or orange lines or spots are seen in the specimens. This coloring is uniform throughout the body .The eyes are black, large and prominent .The background color of the body in living specimens is yellowish gray or deep purple with a metallic sheen with pale yellow spots. In part of the body and in the tail area, it has blackish brown spots and the abdominal area is somewhat brighter and more transparent .In these young specimens, the skin is completely smooth. The length of the tail in adult specimens is smaller or larger than the total length of the head and body .Four fingers are seen on the forelimbs and also four fingers on the hind limbs, all of which are pale, thick and circular ([Table 1](#)).



FIGURE 5. Habitat of the Persian salamander *Paradactylodon persicus* (Gilvan, Khalkhal, Ardabil Province).

The salamanders described from Gilvan village, Khalkhal county, Ardabil Province in September 2024 ($37^{\circ} 18' 6''$ N and $48^{\circ} 48' 41''$ E); altitude about 1735 m above sea level, compared to the sample of the newts reported from Chesli village, the dorsal area is darker (difference) and also irregular lines or spots of yellowish, pinkish or orange color are seen in the samples from both Ardabil and Guilan Provinces ([Fig. 4](#)). This coloring is the same throughout the body of the salamanders from both Guilan and Ardabil Provinces (similarity). It seems that this difference is due to the habitat of the salamander, the geographical conditions of the village of Gilvan khalkhal and the altitude above sea level. Due to its high latitude, Ardabil Province is considered as one of the cold Provinces of the country and it should be noted that the annual air temperature of Ardabil Province is cooler in summer and colder in winter than that of Guilan ([Fig. 5](#)). The approximate distance from the place of description of the Gilvan Khalkhal salamanders from Ardabil Province to the place of description and report of the salamanders of the village of Chesli Masal, Guilan Province, is about 60 km ([Table 1](#)).

TABLE 1. Metric characters of specimens of the Persian salamander *Paradactylodon persicus* (Guilan and Ardabil province).

	Collection date	Fishing location	Hind legs mm	Front legs mm	Tail size mm	Head size mm	Body size (head and Trunk) mm
1	8 May 2024	Chesli, Masal, Guilan	11.23	9.75	39.41	11.75	44.03
2	4 August 2024	Chesli, Masal, Guilan	9.79	9.04	31.71	10.20	40.18
3	6 September 2024	Gilvan, Khalkhal, Ardabil	12.75	12.03	47.75	10.22	50.57
4	6 September 2024	Gilvan, Khalkhal, Ardabil	14.59	12.22	46.47	13.10	57.90

DISCUSSION

Batrachuperus Boulenger, 1878 are mainly distributed in the Hengduan Mountains, southwest China with the most complex topography on Earth; *Batrachuperus* species Boulenger, 1878 occupy mountain streams at altitudes of 1500 to 4200 m above sea level and are aquatic all year round ([Zhao & Yang 1997](#)). The genus *Paradactylodon* is widespread in the mountainous regions of the Middle East. This genus consists of three species: *Paradactylodon mustersi* (Afghanistan), *Paradactylodon persicus*, and

Paradactylodon gorganensis (Iran). Initially, *P. persicus* was reported from the Talesh Mountains, and then *P. gorganensis* was described from the eastern Alborz Mountains; The two Iranian *Paradactylodon* species are distinct based on morphological features; According to species distribution models (SDMs) and molecular (two mitochondrial DNA markers, 16S and COI) analyses the Iranian *Paradactylodon* populations were affected by the Quaternary glaciation and, based on haplotype networks, haplotype diversity was higher in the western part of the species range and, given the low genetic distance among all specimens; It has been suggested that *Paradactylodon gorganensis* is synonymous with *Paradactylodon persicus*; but Populations from the eastern Alborz Mountains of Iran have long been known as *Paradactylodon gorganensis*; [Ahmadzadeh et al. \(2020\)](#) used mitochondrial DNA markers to study geographic diversity and placed *Paradactylodon gorganensis* within *Paradactylodon persicus*; [Dubois and Raffaelli \(2012\)](#) considered the name *Paradactylodon* invalid and replaced it with the name *Iranodon*; but the amphibian website (Amphibia Web.org) still uses the name *Paradactylodon*. The Hyrcanian forests are a unique Tertiary relict ecosystem covering the northern slopes of the Alborz and Talesh (Iran, Azerbaijan) and are a unique biodiversity hotspot with many cryptic species that have not been studied ([Stöck et al. 2019](#)). According to the International Union for Conservation of Nature (IUCN) Red List, these two Iranian hynobiid species are considered “critically endangered” (*P. gorganensis*) or “near threatened” (*P. persicus*); These salamanders can be considered as biological indicators for “intact and healthy” riverine ecosystems of Hyrcanian forests; however, in some cases, *Paradactylodon persicus* may survive for decades, even after human deforestation has long destroyed native vegetation ([Ahmadzadeh & Kami, 2009](#)). As long as intact streams or springs allow remnant populations to survive, these Hynobiids have survived in the Hyrcanian forests since the Tertiary; Therefore, humans bear a great responsibility for the long-term conservation of these species in their ecosystems, along with the unique biodiversity of their habitats ([Akhani et al., 2010](#)). This record represents the first record of the *P. persicus* ([Eiselt & Steiner, 1970](#)), from Northern Iran. The range extension is approximately more 80 km Northern from the closest previously known locality in Asalam area in Talash mountain range of Gilan Province of Iran ([Ahmadzadeh et al., 2011](#)); According to SVL measurements, our specimens were a few small than previously measured specimens from Gilan ([Baloutch & Kami, 1995](#)) and Ardabil Provinces ([Ahmadzadeh & Kami, 2009](#)); but color pattern they are similar with previously specimens.

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