

Range extension of the Persian krait *Bungarus persicus* to south-eastern Iran

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The ecology of venomous snakes is understudied, particularly in the Middle East, despite the region being a global hotspot of species richness for such snakes. Kraits (*Bungarus* spp.) are venomous elapid snakes, crepuscular and nocturnal in habit, that are widely distributed in the south and south-east Asia, with their westernmost limit in Iran (Abtin et al., 2014). The Persian krait *Bungarus persicus* (Fig. 1), is believed to belong to the *Bungarus sindanus* complex, although further molecular studies on Iranian *Bungarus* spp. are needed to clarify the validity of *B. persicus* and evaluate its similarity to congeners (Shahi et al., 2022); this would confirm its status as endemic to Iran. One peculiarity of *B. persicus* is that the holotype has a small loreal scale on each side of the head, which is very unusual for an elapid snake, however, the paratype lacks loreals but both specimens have a characteristic black pigmented spot in the loreal area (Abtin et al., 2014). The related species *B. sindanus* is found up to 900 m above sea level and is distributed across Afghanistan, Pakistan and India (Srinivasulu et al., 2021). There was no record of Persian krait in Iran until 2013 (Abtin et al., 2014) and as yet the species has not been assessed by the IUCN.

After the discovery of the first specimen of *B. persicus* in Hormozgan province on 11 October 2020 in Benk village, Minab county (Arianejad & Ghasemi, 2021), we initiated a study from 2020 to 2023 to gain a deeper understanding of the species' ecology, and in this report give details of the extent of the distribution of *B. persicus* in Kerman and Hormozgan provinces of south-eastern Iran with the help of specimens collected by local people.

The study area was in the Kerman and Hormozgan provinces of south-eastern Iran (Fig. 2) where the main economic activities are smallholder agriculture, traditional ranching and fishing. The area has an average annual precipitation of < 150 mm making it one of the driest habitats for kraits globally. The region has two rainy periods, including January and February with winter rainfall, and late July to October (higher temperature) with monsoon

rainfall. It is covered in open woodlands and scrublands and does not include any protected areas.

We asked a few hundred local residents in Minab, Bashagard, Rudan counties in Hormozgan province and Manujan county in Kerman province, whom we met during a Persian Leopard Conservation Project, about where they find kraits in order to document those locations. We trained local residents to catch kraits alive using large bags and a long stick, to avoid killing them if possible, and to record the time of capture (Fig. 1S, in Supplementary Material). Local people kept the live captures and any kraits that had been killed for checking by the senior author, which were then photographed. We documented the locations and altitudes for these snakes (GPS, Garmin 60CSx), as well as the date and time of day of these observation. We prepared a species distribution map of the region using QGIS 3.34.

During 2020–2023, we collected a total of 24 records of *B. persicus*, of these 22 came from Hormozgan province (Minab, $n = 8$ and Beshagard, $n = 14$ counties) and two from Kerman province (Manujan county, $n = 2$) (Figs. 1 & 2, also see Supplementary Material Table 1S for detailed co-ordinates and altitudes. The specimens displayed the darkly pigment spot in the 'loreal area' (Fig. 1) but no actual loreal scales were observed.

Of the 24 *B. persicus* records, 21 were contributed by local residents and 3 were from separate field work. Our findings extend the distribution range of the species west as far as Minab county, located in Hormozgan province; these records of the krait are the westernmost distribution limit of the species worldwide. According to our findings, it is possible that *B. persicus* is also present in the north and west of Hormozgan province or the other counties of Kerman province.

The altitude range of our records was from 342 m a.s.l. (Chah Shahi in Manujan) up to 1,629 m a.s.l. (Chakbor in Bashagard) with an average altitude of 975 m (standard deviation ± 417 m). The altitude distribution of *B. persicus* is notably higher than from similar species. For instance,



Figure 1. Persian krait *Bungarus persicus* - **A.** Live captured specimen from Bashagard, Hormozgan province, **B.** Lateral view of head, red arrow showing the position of the darkly pigmented spot in the 'lore area'

the highest record of the species in Iran is 729 m higher than the 900 m a.s.l. published altitude of *B. sindanus* (Srinivasulu et al., 2021), while the highest altitude recorded for *Bungarus walli* is only 150 m a.s.l. (Ghosh et al., 2022).

Our observations on *B. persicus* were all made from May to October (Table 1S in Supplementary Material) suggesting that this is the period in which the species is most active. All records were made at dusk or later and the majority of the records were documented before midnight or at midnight (Table 1S in Supplementary Material), the typical crepuscular and nocturnal behaviour of *Bungarus* spp..

Bungarus persicus has not yet been assessed by the IUCN but it is protected by the Iranian Department of the Environment, and killing it is subject to a fine of 59,219,000 IRR (70 USD). Unfortunately, this fine is imposed even though local people receive no information on snakes and the health infrastructure to treat snakebite victims is lacking. An unknown number of *B. persicus* are killed annually by local people due to fear of snakebite to themselves or livestock. As *B. persicus* was only recently discovered in south-eastern Iran there remains a need for studies on its phylogeny, ecology, human-krait conflict, conservation and antivenom production.

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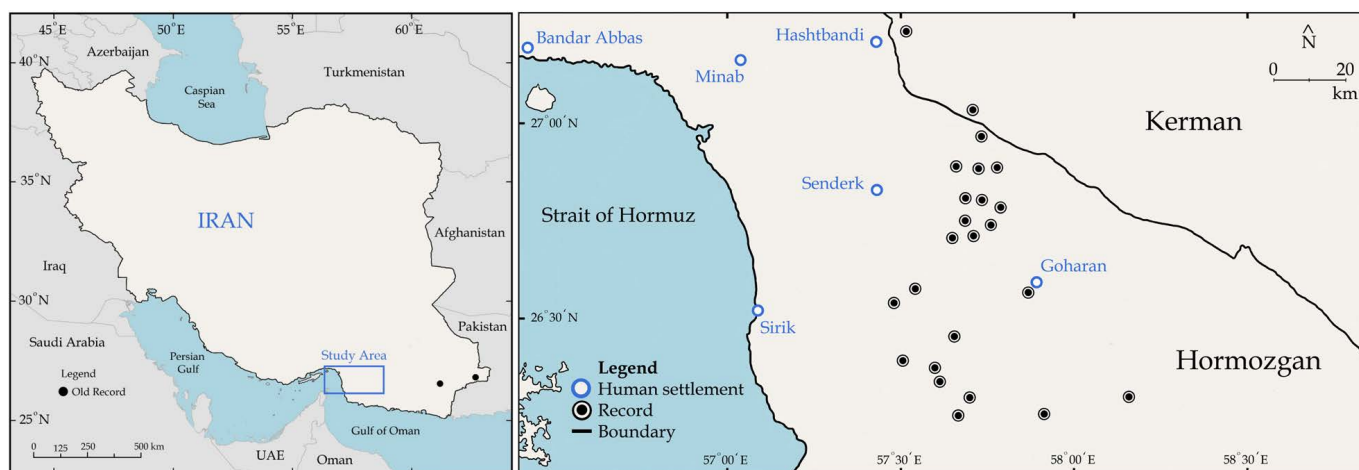


Figure 2. Old records of *Bungarus persicus* in south-eastern Iran (left, from Abtin et al., 2014); new records of *B. persicus*, in Kerman and Hormozgan provinces (right, see Supplementary Material Table 1S for details)

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