

Observation of limb abnormalities in *Indirana chiravasi* Padhye et al., 2014 from the Western Ghats region of Goa, India

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Amphibians are globally recognized as bioindicators due to their permeable skin, complex life cycles, and sensitivity to environmental changes (Martinez and Botero, 2019). These factors, along with their low mobility and specialized ecological requirements, make amphibians highly sensitive to disturbances, rendering them particularly vulnerable to land-use changes and habitat loss (Lawler et al., 2010; Ficetola et al., 2014; Rojas et al., 2022). Currently about 41% of amphibian species are threatened with extinction (IUCN, 2024), with stream-associated species (46% of global amphibian diversity) the most vulnerable (Stuart et al., 2004; Geyle et al., 2021; Coleman et al., 2024). Amphibian abnormalities, including limb malformations and deformities, have been linked to diverse factors, including chemical contamination, predation, parasitic infections, and ultraviolet (UV) radiation (Silva et al., 2019). While there have been reports of anuran abnormalities from other parts of India (Laurentino et al., 2016; Padhye et al., 2024), no such observations have been documented from the state of Goa. In this study, we report limb abnormality in an endemic frog species, the Amboli Leaping Frog (*Indirana chiravasi*) from the Western Ghats region of Goa.

During a field survey on 20 November 2024 in a secondary forest stream near Morlem Village, Sattari Taluka, Goa, India (15.5863°N, 74.0601°E; elevation 70 m), we encountered an adult *I. chiravasi* lacking a right forelimb. The encounter occurred at night while we were actively searching for frogs along the stream

bank using headlamps. The habitat consisted of moist deciduous forest with mixed plantation, characterised by a perennial tertiary stream that flows heavily during the monsoon season. Environmental parameters were recorded using a ThermoPro TP53 digital hygrometer and included an average temperature of 24.2°C and relative humidity of 81%. Photographs (Fig. 1A, B) were taken in situ using an Apple iPhone 15, and the specimen was collected under valid permits for further examination and photography using a stereomicroscope (Fig. 1C–E). We recorded morphometric characters using Mitutoyo digital Vernier callipers. We confirmed the frog's species identity by sequencing the mitochondrial 16S rRNA gene (GenBank accession number PX909742) following Padhye et al. (2014) and matching it to published reference sequences using the Basic Local Alignment Search Tool (BLAST) on the website of the National Center for Biotechnology Information (accessible [here](#)). The species is currently listed as a species of Least Concern (LC) on the IUCN Red List of Threatened species (IUCN SSC Amphibian Specialist Group, 2023).

The frog lacked its right forelimb (Fig. 1A, B) and there did not appear to be any visible scarring or tissue damage at the expected limb insertion site. The skin was smooth and no signs of regeneration or inflammation were observed, which leads us to rule out predation or injury as the cause. The absence of external injuries suggests that the abnormality is a form of amelia, the congenital malformation resulting from genetic or environmental factors during embryonic development according to classification criteria and the skeletal terminology by Meteyer et al. (2000) and Lunde and Johnson (2012). On the same individual, we noticed hard spiny projections protruding from the proximal end of the left tarsus (Fig. 1C), which were not present on the right hind limb (Fig. 1D). Furthermore, the total lengths of the hind limbs differed by 3.1 mm, with the right and left hind limbs measuring 69.8 mm and 73.0 mm, respectively.

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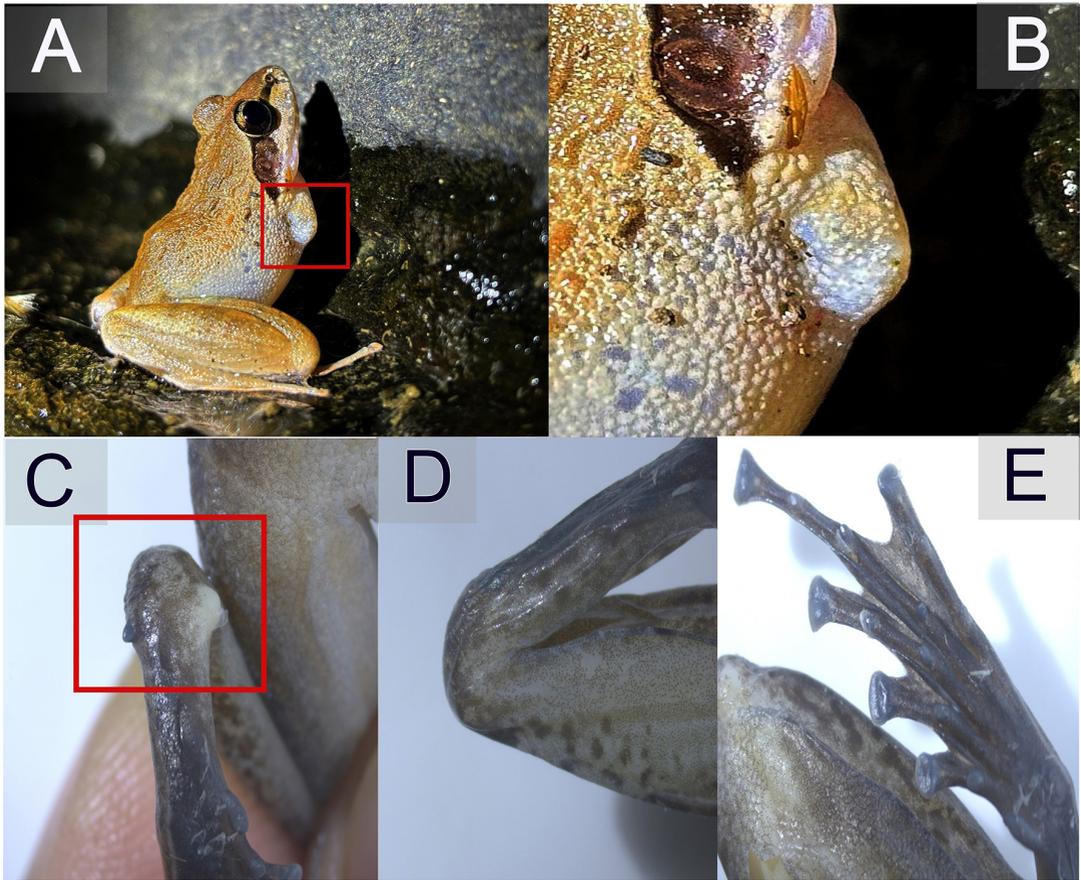


Figure 1. Malformations in an adult *Indirana chiravasi* from Goa, India. (A) The individual in situ, showing that the right forelimb is missing. (B) Close-up of the expected limb insertion site. There does not appear to be any scarring to indicate a traumatic injury. (C) The left knee presents with several hard dermal projections. (D) In comparison, the right knee has no projections. (E) Webbing on right foot is used as species identification character.

Our observation in *I. chiravasi* is consistent with embryopathy arising from multifactorial environmental and low-level anthropogenic influences and not from a single causative agent (Taylor et al., 2005; Silva et al., 2019). These frogs primarily inhabit lateritic rocky outcrops and are often found in crevices and on boulders (Padhye et al., 2014), but as the monsoon subsides, they occupy nearby streams, which makes them one of the ideal candidates for indicating riparian ecosystem health. Global amphibian populations are experiencing rapid declines, with stream frogs at the greatest risk (Coleman et al., 2024), and unprecedented levels of abnormalities have been observed, with natural baseline frequencies of 0–2% being exceeded in many regions (Laurentino et al., 2016). Thus, detecting and documenting such abnormalities in less-studied

regions like Goa is critical for understanding the broader ecological impacts on amphibian populations. Although we could not ascertain the exact cause of the abnormality, this report provides an opportunity for future studies to identify the extent of this phenomenon in other anuran species in the region, which can be pivotal in implementation of conservation strategies to mitigate amphibian declines.

Acknowledgements. We thank the Ministry of Environment Forest and Climate Change, Government of India, for their funding support. We are grateful to the Goa Forest Department for granting the necessary permits to conduct field surveys. We also express our gratitude to Dr. K.P. Dinesh for pre-review of the manuscript. Special thanks go to local Biodiversity Management Committee member Shayeesh Pirankar for his help during surveys.

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