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Title Four cases of limb malformation in *Triturus karelinii* from the Hyrcanian forest, Northern Iran

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Malformation and deformation in amphibians' limbs, particularly those affecting digits, are of great interest to researchers due to their diverse causes and implications, including parasitic infections, environmental pollution, UV exposure, physical injury (Blaustein and Johnson 2003; Johnson et al. 2010), genetic mutations (Castro-Bastidas et al. 2025), and teratogenic factors (Henle and Dubois 2017). In some cases, the deformity may result from predator attacks or cannibalistic interactions during early developmental stages (Crump et al. 1992; Bohl 1997). Additionally, prenatal stress and genetic predisposition are significant contributors (Blaustein and Johnson 2003). In certain species, such as newts, improper regeneration following digit loss has also been observed to cause extra digits over time (Maginnis 2006). Polydactyly and polyphalangy are two of the most frequently observed abnormalities. Polydactyly refers to the presence of additional metatarsals, while polyphalangy describes the duplication of phalangeal segments (Rothschild et al. 2012). These conditions have been documented in several populations of *Triturus cristatus* (Arntzen and Wallis 1991; Jarvis 2011) and *Triturus carnifex* (Zaffaroni et al. 1996; Gatti and Sannolo 2014). According to this definition, the hexadactyl Karelin's Crested Newt reported by Kami (1997) was a polyphalangeal case on the fifth toe of the right hind limb.

Among the seven native newt species in Iran, Karelin's Crested Newt (*Triturus karelinii* (Strauch, 1870)) is one of only three known to inhabit in Hyrcanian forests (Safaei-Mahroo et al. 2025). On 29 March 2025, we conducted a nighttime field survey in Sefid Cheshmeh, 5 km south of Daland, Golestan Province, Iran (36.993117°N, 55.062278°E) elv. 120 m a.s.l. at 19:00 for two hours. At the edge of the forest, this habitat has a permanent spring that feeds a pond used to irrigate farms. We collected ten adult females of *T. karelinii* using dip nets and flashlights. After determining sex, and taking photographs, we released them in the same spot as they were captured. Four of these individuals had malformed limbs — the dorsal and ventral views of the limbs are deposited in MorphoBank (<http://www.morphobank.org>, Project 4159; M958394~M958401). The first specimen had oligodactyly on the right hind limb (Fig. 1A–B). The left hind limb of the second malformed individual also had two cases of polyphalangy, with an additional phalanx present on the third toe and a very small phalanx present on the fourth toe (Fig. 1C–D). The third specimen had ectrodactyly: the fourth toe of the right hind limb was completely missing, with no indication of regrowth (Fig. 1E–F). Similarly, the fourth specimen had ectrodactyly: a missing fourth digit on the right fore limb, also without signs of regeneration (Fig. 1G–H). The syntopic amphibians and reptiles were Eastern Tree Frog (*Hyla orientalis*), Eichwald's Toad (*Bufo eichwaldi*), the Persian Marsh Frog (*Pelophylax persicus*), the Hyrcanian Wood Frog (*Rana pseudodalmatina*), and the Persian Grass Snake (*Natrix natrix persa*).

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Figure 1: Limb malformation records of *Triturus karelinii*; **A-B**. Dorsal and ventral view of oligodactyly on hind limb; **C-D**. Dorsal and ventral view of polyphalangeal toes of hind limb; **E-F**. Dorsal and ventral view of ectrodactyly in hind limb; **G-H**. Dorsal and ventral view of ectrodactyly in fore limb. Photography by B. Safaei-Mahroo.

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