REPTILES & AMPHIBIANS

First Record of Interspecific Amplexus between a Himalayan Toad, *Duttaphrynus himalayanus* (Bufonidae), and a Himalayan Paa Frog, *Nanorana vicina* (Dicroglossidae), from the Western Himalaya of India

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Interspecific amplexus in amphibians has been reported among taxa belonging to different orders (Moldowan et al. 2013; Simović et al. 2014), families (e.g., Sodré et al. 2014; Theis and Caldart 2015; Melo-Sampaio and Da Silva 2017), and genera (e.g., Groffen et al. 2019; Pedro and Nali 2020). In India, interspecific amplexus has been reported previously between the Nicobar Island Frog (*Indosylvirana nicobariensis*) and Berdmore's Narrow-mouthed Frog (*Microhyla berdmorei*) (Decemson et al. 2020); Anamalai Dot Frog (*Uperodon anamalaiensis*), Terrestrial Frog (*Fejervarya* sp.), and Anamallais Indian Frog (*Indirana brachytarsus*) (Harpalani et al. 2015); Malabar Gliding Frog (*Rhacophorus malabaricus*) and Common Indian Treefrog (*Polypedates maculatus*) (Sayyed 2013); Malabar Tree Toad (*Pedostibes tuberculosus*) and Asian Common Toad (*Duttaphrynus melanostictus*) (Sayyed and Nale 2017); Kalakkad Treefrog (*Rhacophorus calcadensis*) and

Fig. 1. Fully (left) and partially submerged (right) interspecific amplexus between a male Himalayan Toad (*Duttaphrynus himalayanus*) and an adult Himalayan Paa Frog (*Nanorana vicina*) of unknown sex in the Binog Mountain Quail Wildlife Sanctuary, Uttarakhand, India. Photographs by V. Jithin.

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R. malabaricus (P. Manoj in Sayyed and Nale 2017); Indian Burrowing Frog (*Sphaerotheca breviceps*) and *D. melanostictus* (Vivek et al. 2014); Terai Treefrog (*Polypedates teraiensis*) and White-lipped Treefrog (*Polypedates braueri*) and Cope's Assam Frog (*Hydrophylax leptoglossa*) (Muansanga et al. 2021); Ghate's Shrub Frog (*Raorchestes ghatei*) and Mottled Globular Frog (*Uperodon mormoratus*) and Ornate Narrow-mouthed Frog (*Microhyla ornata*) (Sayyed and Padhye 2020); and Bombay Bubble-nest Frog (*Raorchestes bombayensis*) and *M. ornata* (Yadav and Yankanchi 2014).

Herein we report the first observation of interspecific amplexus between a Himalayan Toad, *Duttaphrynus himalayanus* (Günther 1864), and a Himalayan Paa Frog, *Nanorana vicina* (Stoliczka 1872). The Himalayan Toad is widely distributed in the Himalayan Region of China, Pakistan, Nepal, Bangladesh, Bhutan, and India (Frost 2021). The mating system of this explosive breeder is not well understood, even though scramble competition among males, and female mate choice are reported to play small roles (Zhang et al. 2020); however, that same study found no apparent size-dependent pairing in the southeastern Tibetan population of the species. At our field site, we have occasionally observed male Himalayan Toads amplecting with other males for periods that last only a few minutes. In this population, males actively search for females, are quick to mate, and satellite males have been observed trying to displace amplecting males. The Himalayan Paa Frog is endemic to the Himalayan Region of India and Pakistan (Ahmed et al. 2020; Gill et al. 2020). Relatively little is known about the reproductive mode and ecology of this montane stream-dwelling species (Sircar 2010).

At 2300 h on 23 March 2021, during a herpetological survey, we observed a male *D. himalayanus* (SVL 73.0 mm) in axillary amplexus (Carvajal-Castro et al. 2020) with an adult *N. vicina* of unknown sex (SVL 91.5 mm) (Fig. 1). The pair was submerged in a pool of a stream in the Binog Mountain Quail (Mussoorie) Wildlife Sanctuary, Uttarakhand, India (30.46781°N; 78.02983°E; WGS84; 1,648 m asl). Water and air temperatures were 9.3–9.5 °C and 9.7–9.8 °C, respectively. After six minutes of observation under a red light, the pair moved slowly and hid under the bedrock. We noticed the frog trying to escape from the toad by pushing it against the edges of the bedrock. After the failed attempt, the pair emerged from under the bedrock, extended their heads above the surface of the water, and remained in a vertical position while holding onto the substrate. They occasionally moved around in the water and were generally quiescent until 0029 h on 24 March 2021, when they disappeared under thick overhanging vegetation. We encountered the same pair on the next day at 2241 h in a running section of the stream, 1 m from the site of the initial observation. We determined that these were the same individuals by examining the mark-

Fig. 2. Mucus secretion observed during the interspecific amplexus between a male Himalayan Toad (*Duttaphrynus himalayanus*) and an adult Himalayan Paa Frog (*Nanorana vicina*) of unknown sex in the Binog Mountain Quail Wildlife Sanctuary, Uttarakhand, India. The inset shows a close-up view of the secretion. Photographs by V. Jithin.

ings on the frog and wart patterns on the toad (Bindhani and Das 2018). This time the pair was partially submerged and the toad's eyes were partially closed (Fig. 2). At this time, we observed mucus secretion near the forelimb of the toad but were unable to confirm whether it was secreted by the toad or the frog. The pair did not move from this position until 0110 h on 25 March 2021. The pair was not seen again during the survey. Assuming that amplexus continued between our two observations, its total duration spanned 26 h and 10 min. Voucher photographs have been deposited in the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, National University of Singapore [ZRC(IMG) 1.233–4].

Absence of species- and sex-recognition in the family Bufonidae has been studied in various species. During mate search, the male Common Toad (*Bufo bufo*) does not discriminate between Iberian Green Frogs (*Pelophylax perezi*) and conspecifics, between sexes or between gravid females of varying body sizes (Marco and Lizana 2002). In lab experiments and in the field, the Asiatic Toad (*Bufo gargarizans*) also lacks sex recognition and mate choice (Yu and Lu 2010; Shin et al. 2020). Heterospecific and multiple amplexus between Smooth-sided Toads (*Rhaebo guttatus*) and Cane Toads (*Rhinella marina*) has been reported from Brazil (Machado and Bernarde 2011). Cases of hybridization have been reported in species that include the Western Toad (*Anaxyrus boreas*), Red-spotted Toad (*Anaxyrus punctatus*), Arizona Toad (*Anaxyrus microscaphus*), and Woodhouse's Toad (*Anaxyrus woodhousii*) (Feder 1979; Sullivan 1986). In addition, anurans of various other families are known to engage in amplexus with bufonids (Vivek et al. 2014; Reilly et al. 2016).

Some of the reasons that appear to increase the likelihood of interspecific amplexus are sympatry, syntopy, temporal overlap of reproductive seasons, short breeding seasons, intense competition between males, and a highly variable Operational Sex Ratio (OSR) (Reading 1984; Engeler and Reyer 2001; Marco and Lizana 2002; Hartel 2005; Hettyey et al. 2005; Beranek 2017; Ferreira et al. 2019). Male toads amplecting with non-conspecifics lose energy, time, and opportunity to mate with gravid female toads (Marco and Lizana 2002). The use of specialized release calls, characteristic body vibrations, or inflation to evade erroneous amplexus have been reported in some anurans (Bowcock et al. 2008; Mollov et al. 2010). Nevertheless, in this case, the frog was unable to repel the toad. Because errant pairings function as reproductive interference and result in negative demographic consequences (Pearl et al. 2005), further studies are required to understand the proximate and ultimate causes and adverse effects on the fitness of the species involved.

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