

Preserving breeding habitats in socio-ecological systems: insights from the stenotopic toad species *Duttaphrynus hololius*

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Amphibians that depend on both aquatic and terrestrial environments for their life cycle (lentic water breeders) utilise lentic water systems across diverse habitats like rivers, rocks, farms and forests. Successful breeding in these sites relies on natural water regimes, but anthropogenic alterations pose a significant threat. In the present study, we examined the impact of agricultural practices, small-scale granite mining and silt accumulation on the breeding cycle of the range-restricted and stenotopic *Duttaphrynus hololius*. We hypothesised that alterations to breeding pools, such as siltation and reduced water availability, would negatively impact the breeding success of this toad species. Our findings indicate that agriculture and grazing did not have a negative impact on breeding activities. Nevertheless, silt accumulation and granite mining were identified as major factors leading to unsuccessful breeding cycles. These results highlight the importance of conserving breeding habitats within socio-ecological landscapes for the persistence of this amphibian. Sustainable management practices are crucial to ensure the survival of *D. hololius*, particularly those that mitigate the negative impacts of silt accumulation and small-scale granite mining.

use changes and resource exploitation in India often reduce and degrade amphibian breeding pools¹⁰.

Species with highly specialised and narrow habitat requirements pose a challenge for conservation^{11,12}, especially when populations persist outside protected areas^{11–13}, regardless of the targeted species size. Any manipulation of breeding habitats and changes in environmental factors will negatively affect the population of range-restricted animals¹⁴. During the breeding season, different toads in the genus *Duttaphrynus* consider different characteristics of their breeding grounds. For example, *Duttaphrynus himalayanus* (Günther, 1864) lay their eggs in shallow pools near flooding waters¹⁵, *Duttaphrynus melanostictus* (Schneider, 1799) lay egg in perennial water bodies¹⁶, species like *Duttaphrynus arabicus* (Heyden, 1827) and *Duttaphrynus dhufarensis* (Parker, 1931) prefer rainwater pools along roads and mountains¹⁷. Here, we monitored an endemic toad^{18–20}, *Duttaphrynus hololius* (Günther, 1876), that exhibits a highly restricted distribution and is likely a stenotopic inhabitant of the dry, rocky outcrop and boulder landscape of Peninsular India²¹. *Duttaphrynus hololius*'s adults rest inside crevices^{18,21–24} and breed in temporary pools located in the rocky outcrops^{21,25,26}, specifically granite inselbergs intermixed with tropical savannas^{27,28} in the Eastern Ghats, India.

Duttaphrynus hololius is currently listed as a Least