

Exceptional reproductive biology in extremely restricted critically endangered Nimba toad

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Large pregnant female Nimba toad in June, shortly before giving birth. Credit: Dr. Laura Sandberger-Loua

The critically endangered Nimba toad is long known for its exceptional reproductive biology. The females of this unique species give live birth to fully developed juveniles, having for nine months continuously provided nutrition to the foetuses in the womb (matrotrophy). While live birth (viviparity) among frogs and toads is rather an exception than a common characteristic, matrotrophy, in place of alternatives such as the foetus being fed with yolk, unfertilized eggs, or smaller siblings, is what makes the Nimba toad one of a kind.

However, more than 40 years of research had not been comprehensively, accessibly and completely summarised. The gap has recently been filled with a new paper, published in the open access journal *Zoosystematics and Evolution* by German scientists Drs. Laura Sandberger-Loua and Mark-Oliver Rödel, both affiliated with Museum für Naturkunde, Berlin, and Dr. Hendrik Müller, Friedrich-Schiller-Universität Jena.

Studying the phenomenon, the scientists went through the literature published over four decades to gather the scattered details. They have also discussed the relationship between the toad's reproductive biology and its specific habitat of merely 4 km² of high altitude grasslands located at a minimum of 1,200 m in the Nimba mountains, West Africa.

The climate of the area is characterised by a rainy season lasting from April to October and a dry season from November to February/March. These seasons are found to determine the activity of the Nimba toads. The amphibians are only active during the [rainy season](#), when they give birth to their young, mate, and then find shelter underground, where they stay dormant during the dry season.

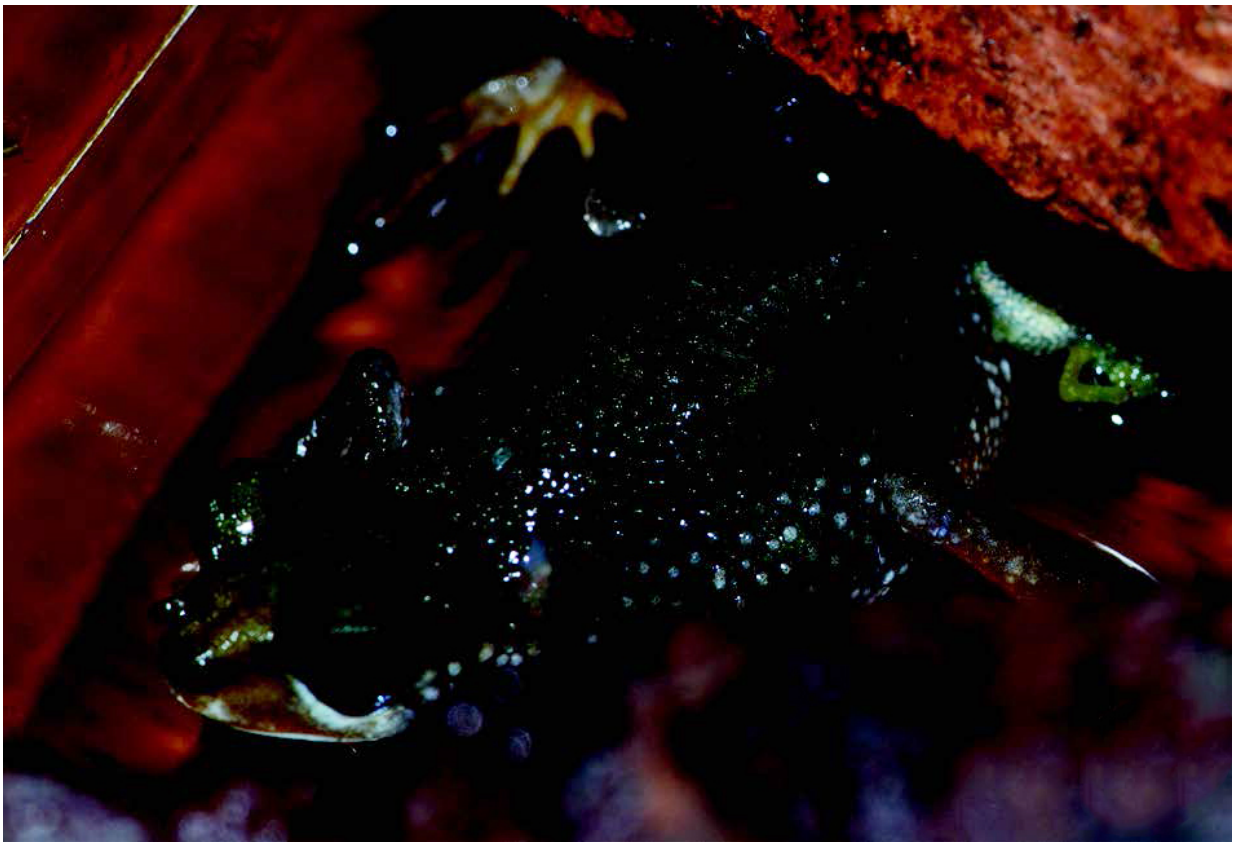


A couple of mating Nimba toads. During the act the female is constantly swaying horizontally. Credit: Dr. Laura Sandberger-Loua

Visibly females can be distinguished from male Nimba toads by their differing cloaca and often larger size, compared to the males. Also, males show darker backs and, during most of their adult life, nuptial pads on their thumbs, which look like spiky swellings. This secondary sex characteristic, in its seasonal change linked to spermatogenesis, is used by the males to grasp tightly the female while mating.

In this species mating occurs without a copulatory organ. Instead, the sperm is transferred through connection of the cloacae, where the male's swells and encloses the female's cloaca. Furthermore, Nimba toads have a unique behavioural repertoire. Males crouch on their front legs and as soon as the female moves, follow her and grab her tightly in the groin. Due to the spiky nuptial pads, the males often injure their partner.

Giving birth in Nimba toads may take over two days, depending on the number of offspring, which can be up to 12 in older females - far fewer than the hundreds of eggs in most toad species. While giving birth, a female assumes a unique "birthing posture" to compensate for the lack of enough muscle power to expel juveniles. By the time the juveniles are ready to be born, they have already taken up nearly all the space in their mother's body. The scientists conclude that the offspring play an active role in the process, as a juvenile toad's death midway in the oviduct leads to the mother dying of sepsis.



Female Nimba toad in a 'birthing posture' with legs forming a double W. Credit: Dr. Mark-Oliver Rödel

Living exclusively in the Nimba mountains, and being listed as Critically Endangered, according to the IUCN, the studied toad is only one of the species restricted to the high altitude grasslands, which led to the declaration of the Nimba mountains as a World Heritage Site by UNESCO. Separated from other mountains, its inhabitants are isolated from external contacts, thus presumably leading to their evolutionary separation from related species. Furthermore, the toad's unique reproductive biology is probably the result of this isolation, argue the authors.

In conclusion, the authors suggest that "it is likely that the harsh unpredictable environment and scarcity of open water promoted viviparity in Nimba toads, or supported the survival of this unique reproductive mode in these special and isolated conditions. Considering their complex life cycle, in which reproductive and seasonal cycles are tightly linked, understanding and protecting the Nimba toad's threatened environment is of utmost importance."

More information: Laura Sandberger-Loua et al, A review of the reproductive biology of the only known matrotrophic viviparous anuran, the West African Nimba toad, *Nimbaphrynoides occidentalis*, *Zoosystematics and Evolution* (2017). [DOI: 10.3897/zse.93.10489](https://doi.org/10.3897/zse.93.10489)

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