

First country record of Sonja's Spiny Frog, *Acanthixalus sonjae* Rödel et al., 2003, from Liberia, West Africa, with observations on breeding-site use

Nono L. Gonwouo^{1,*}, Mark-Oliver Rödel², and Johannes Penner^{2,3}

The range of many cryptic amphibian species within the Upper Guinea forests of West Africa is not well known (Rödel et al., 2021). This is particularly true for Liberia, where only the amphibians of the Nimba Mountains have been comprehensively studied (Guibé and Lamotte, 1958, 1963; Xavier, 1978; Rödel et al., 2010; Sandberger et al., 2010). Although various publications report on the amphibian fauna of some areas (Barbour and Loveridge, 1927, 1930; Loveridge, 1941; Taylor and Weyer, 1958; Schiøtz, 1968; Hillers and Rödel, 2007; Rödel and Glos, 2019), large portions of south-eastern and north-western Liberia remain unexplored. Much of these areas are now deforested (2.9% forest loss in 1986–2000 and 7.9% in 2002–2023; Christie et al., 2007; GFW, 2025). Given its position within the Upper Guinea biodiversity hotspot (Myers et al., 2000), Liberia is predicted to harbour a rich amphibian fauna (Penner et al., 2019), as supported by recent new discoveries (Rödel and Glos, 2019; Griesbaum et al., 2023).

Spiny frogs (genus *Acanthixalus*) have a lichen-like colouration, are particularly hard to find (Amiet, 2012; Channing and Rödel, 2019), and comprise two species that are morphologically very similar (Rödel et al., 2003). *Acanthixalus spinosus* (Buchholz and Peters, 1875) is widely distributed throughout much of the Lower Guinean and the western Congo Basin forests (Noble, 1924; Perret, 1961; Schmitz et al., 1999; Amiet,

2012; Sánchez-Vialas et al., 2020; Blackburn et al., 2022). In contrast, the second species *A. sonjae* Rödel et al., 2003, has a disjunct range within the Upper Guinea forests. So far it is only known from very few sites in Côte d'Ivoire and Ghana (Rödel et al., 2003, 2005). Both species seem to exhibit a similar natural history, inhabiting primary and secondary forests, living and breeding in water-filled tree-holes (Perret, 1961; Affa'a et al., 1996; Rödel et al., 2003; Amiet, 2012; Channing and Rödel, 2019), or ecologically equivalent habitats such as buckets or barrels (Rödel et al., 2003; Blackburn et al., 2022). *Acanthixalus* spend the daytime in water-filled cavities and forage at night for arthropods in adjacent vegetation (Rödel et al., 2003, 2005). Clutches are glued to surfaces above the water inside these cavities. Tadpoles are carnivorous but not cannibalistic, can produce sound, and may take up to 18 months to reach metamorphosis (Rödel et al., 2003; Channing et al., 2012). Adults seem to lack advertisement calls and may communicate chemically (Perret, 1961; Drewes, 1984; Rödel et al., 2003), although Amiet and Goutte (2017) published an *A. spinosus* call with unknown function.

Herein, we report the first country record of *A. sonjae* from Liberia and provide some observations on breeding-site use. On 4 September 2012 at 16:45 h we detected two individuals in a tree-hole at ca. 1.5 m height in primary forest on the ridge of Mount Ghi (5.6578°N, 8.2151°W, elevation 476 m). We first detected clutch remnants. Two individuals emerged from water after stirring it (Fig. 1A). Both individuals were collected, anaesthetised (chlorobutanol solution), preserved (75% ethanol), and deposited in the collection of the Museum für Naturkunde Berlin (ZMB 88917–18). The 70 cm deep tree-hole contained approximately 1.6 litres of brownish-clear water (estimated from cavity dimensions), with rotten leaves, debris, and sediment at the bottom (Fig. 1B). The clutch remnants were attached 15 cm above water surface at the tree-hole ceiling and contained one egg wrapped in gelatinous mass. The embryo

¹ Laboratory of Zoology, Faculty of Science, University of Yaoundé I, P.O. Box 812, Yaoundé, Cameroon.

² Museum für Naturkunde Berlin, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Invalidenstraße 43, 10115 Berlin, Germany.

³ Frogs & Friends, Großbeerenstraße 84, 10963 Berlin, Germany.

* Corresponding author. E-mail: lgonwouo@gmail.com

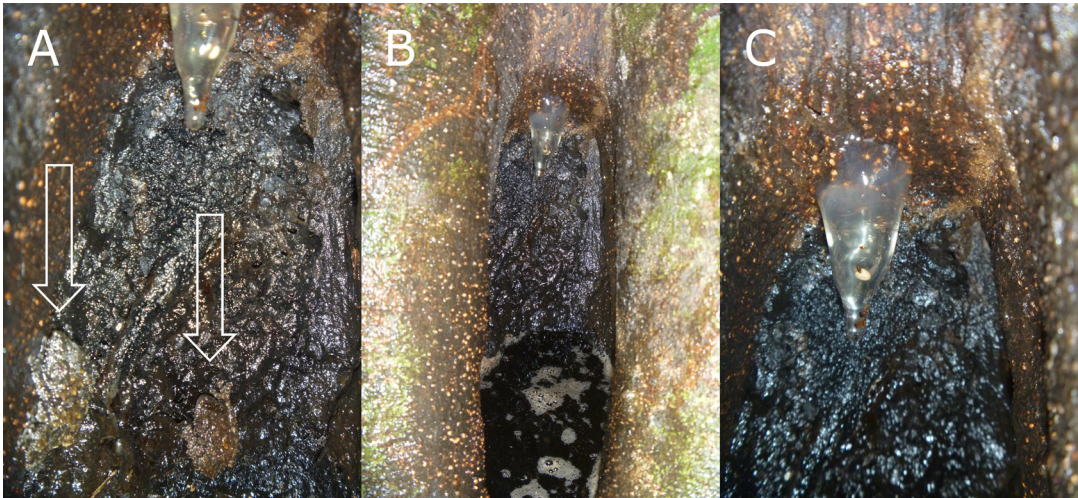


Figure 1. (A) Pair of *Acanthixalus sonjae*, a clutch is visible above them; (B) water-filled tree-hole with tadpoles; (C) the first clutch with an embryo in an advanced stage of development. Photos by Nono LeGrand Gonwouo.

was in an advanced developmental stage, presumably ready to drop into water within days (Fig. 1C). To avoid further disturbance, we refrained from searching for tadpoles.

One month later, on 5 October 2012 at 19:04 h, we revisited the site (Fig. 2A) and found a new clutch at the same position as the previous one containing five eggs at an early developmental stage (Fig. 2B). As the pre-

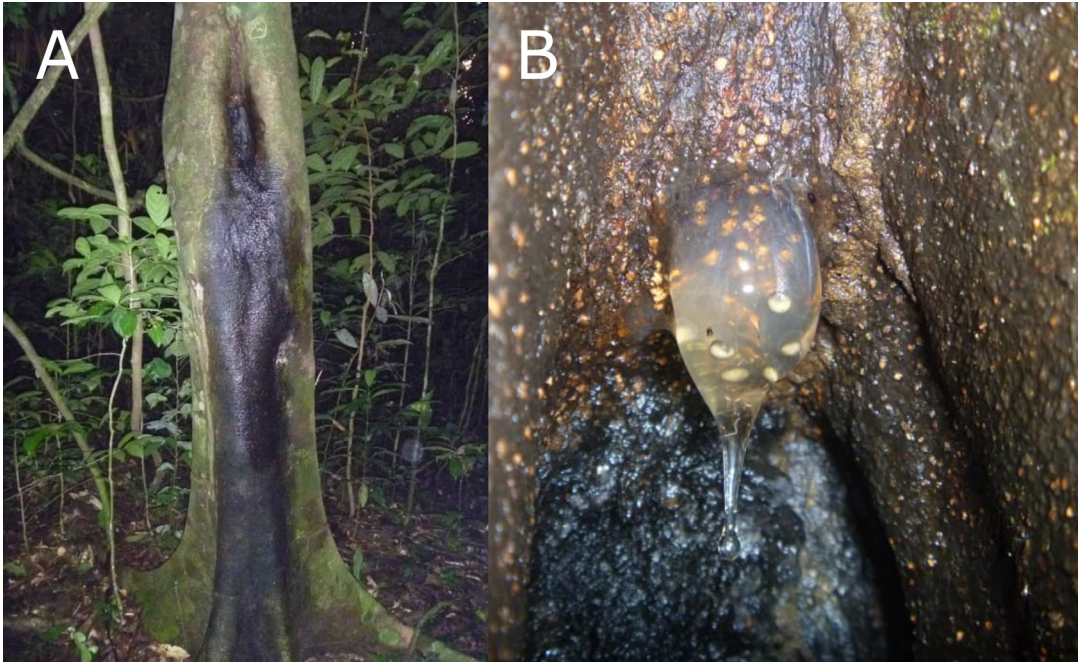


Figure 2. (A) Lower part of the tree showing the position of the tree hole. (B) the second clutch of *Acanthixalus sonjae* containing five eggs at an early stage. Photos by Nono LeGrand Gonwouo.

vious pair had been collected (Fig. 3), this observation suggests rapid breeding site detection and recolonisation or that other adults remained undiscovered during our first visit. Rödel et al. (2003) found more than six adults in a tree-hole with numerous juveniles and about 300 tadpoles of various developmental stages, although that habitat contained several hundred litres of water and fighting among frogs was reported. Our tree-hole appeared to be one of the smallest used by *A. sonjae*, suggesting that only two adults had been living there, however, larger tree holes might house several couples.

Our observation extends the known range of *A. sonjae* westwards by about 120 km. The species is now known from only eight localities (Table 1, Fig. 4) but is predicted to occur more widely in Upper Guinean wet evergreen, lowland forests (Rödel et al., 2003, 2005; Penner et al., 2019), and tolerates only some degree of forest degradation (by authors). Unfortunately, its hidden lifestyle, cryptic appearance, lack of advertisement calls, and hard-to-detect microhabitat make recording its presence difficult. The easiest method to find them is searching water-filled tree-holes for clutches and tadpoles.

Our two clutches, with one and five eggs respectively, were among the smaller clutches known for *A. sonjae*. Rödel et al. (2003) reported eight clutches with 5–13 eggs, with one female ovipositing three clutches (eight, ten, and 11 eggs) within 21 days. As the embryo of our

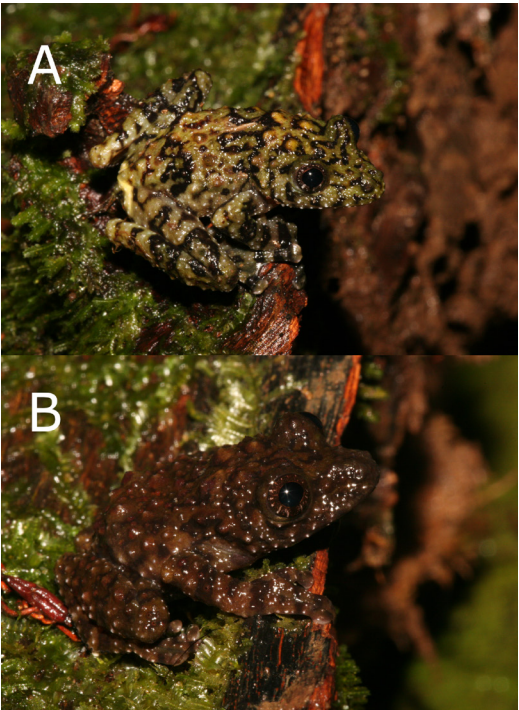


Figure 3. *Acanthixalus sonjae* from Mount Ghi: note the warty, spiny skin, resembling the tree bark and/or lichens. The female displays a highly distinct green and black colouration (A), the male a brown pattern (B). Photos by Johannes Penner.

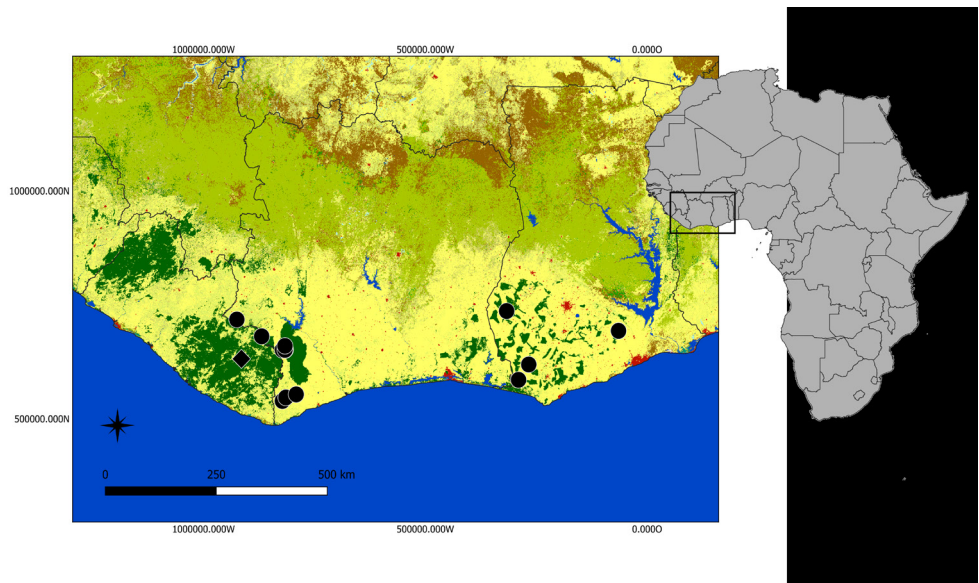


Figure 4. Map showing the known localities of *Acanthixalus sonjae* in the Upper Guinea forests of West Africa (in green). Previously documented localities are indicated by circles and the new locality for this study as a diamond.

Table 1. Known *Acanthixalus sonjae* sites in Guinea forests of West Africa. Elevation, survey periods, and references provided. Asterisk (*) indicates mean elevation data only.

Locality	Elevation (m)	Survey period	Reference
Forêt Classé de Haute Dodo, Côte d'Ivoire	220–415	March 2002	Rödel and Branch, 2002
Forêt Classé de Cavally, Côte d'Ivoire	360–381	April 2002	Rödel and Branch, 2002
Taï National Park, Côte d'Ivoire	N/A	September 2000	Rödel et al., 2003
Ankasa Conservation Area, Ghana	75*	October 2004	Rödel et al., 2005
Atiwiredu, Atewa range, Ghana	817	2006	unpublished data; ZMB 79555 as part of the survey of Kouamé et al., 2007
Krokosua Hills, Ghana	209–610	November 2004	Rödel et al., 2005
Mt. Ghi, Liberia	476	September/October 2012	this study

first clutch was very advanced, it is likely that other tadpoles already hatched. Previous researchers reported that *Acanthixalus* reproduce in large water-filled cavities of living trees (Lamotte et al., 1959; Perret, 1961; Amiet, 1986), and Rödel et al. (2003) emphasised that *A. sonjae* may depend on large water bodies. However, our breeding site was more comparable to the small water-filled tree-hole on Mount Kupé, Cameroon, reported for *A. spinosus* by Schmitz et al. (1999), which may indicate that *A. sonjae* can occupy a broader ecological niche than previously assumed. This might also imply competition with *Phrynobatrachus guineensis*, a species known to often inhabit small tree-holes with less than one litre of water (Rödel et al., 2004; Rudolf and Rödel, 2005). Because of its relatively long tadpole phase (Rödel et al., 2003), use of holes with long lasting water content is probably a preferred strategy of *A. sonjae*. Suitable forest for *A. sonjae* still exists in other parts of Liberia, neighbouring Sierra Leone, and south-eastern Guinea, and it is likely that the species is present there.

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