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A point endemic no more; a range extension for *Oreolalax sterlingae* (Nguyen et al., 2013) in Bat Xat District, Lao Cai Province, northern Vietnam

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Sterling's toothed toad, (*Oreolalax sterlingae* Nguyen et al., 2013), is the only member of the genus known from Vietnam. The species is thought to be endemic to Mount Fansipan, Lai Cao Province in northern Vietnam (Nguyen et al., 2013; IUCN, 2015) and occurs in elfin moss and bamboo forest habitats and is associated with rocky rivulets and rocky streams at elevations exceeding 2700 m a.s.l. (Nguyen et al., 2013; IUCN, 2015; Tapley et al., 2017). The tadpoles of *O. sterlingae* can be observed year-round and they develop within large pools in rocky streams (Rowley et al., 2017; L. Nguyen unpubl. data). *Oreolalax sterlingae* is one of just two "Critically Endangered" amphibians currently known from Vietnam (IUCN, 2015; IUCN, 2019) and has an "Extent of Occurrence" (EOO) of just 8 km^2. The species is threatened by habitat degradation associated with tourism (IUCN, 2015); the stream used by the species at the type locality is polluted by garbage and runoff from a campsite and toilets used by tourists ascending Mount Fansipan (Rowley et al., 2013). The recent construction of a cable car and associated infrastructure development in the summit area of Mount Fansipan, inclusive of mining construction materials from the stream bed at the type locality, are likely to be detrimental to this species at this site (Fig. 1A; Tapley et al., 2017). Historically, the summit of Mount Fansipan was believed to be covered in forest (Nguyen & Harder, 1996) but the habitat has been heavily degraded by burning which is likely to have reduced the extent and quality of available habitat for the species. One of the current recommended conservation actions for the species is to determine its distribution (IUCN, 2015). To this end, we surveyed other sites on Mount Fansipan and high elevation sites in the Hoang Lien Range, Mount Ky Quan San and Mount Pu Ta Leng (both incorporated within the newly designated Bat Xat Nature Reserve (NR), Bat Xat District, Lao Cai Province, Vietnam).

On 09 September 2017 we surveyed Mount Ky Quan San (22.499496°N, 103.601587°E, 2668 m a.s.l.). The habitat was heavily degraded due to fuel wood collection and livestock grazing, and large rocky streams were not present at our survey site. *Oreolalax sterlingae* was not encountered. On 21 June 2016 we surveyed the construction site on the summit of Mount Fansipan and encountered a live *O. sterlingae* that was missing the right hind limb (22.3038°N, 103.7754°E, 3099 m a.s.l) and a dead *O. sterlingae* in a water conduit (22.3037°N, 103.7758°E, 3108 m a.s.l). On 14 and 15 September 2017 we surveyed several sites at lower elevation on Mount Fansipan including a lower elevation portion of the stream connected to the type locality (22.3153°N, 103.7688°E, 2625 m a.s.l.) and an unconnected rocky stream 2.9 km away from the type locality (22.3153°N, 103.785717°E, 2700 m a.s.l.). On 29 March 2018, we surveyed another rocky stream (22.2959ºN, 103.8042ºE, 2511 m a.s.l; Fig. 1B), 4.5 km away from the type locality and unconnected to it. Adult *O. sterlingae* were encountered at all sites.

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Figure 1. (A) Macrohabitat of *Oreolalax sterlingae* at the type locality, note the gravel mining in the stream at the bottom of the image; (B) Microhabitat of *O. sterlingae* at a relatively undisturbed site on Mount Fansipan at 2511 m a.s.l.

Voucher specimens were not collected as the species is easily identifiable, the specimens were not a substantial distance away from the type locality and morphological characters conformed with those in the original species description (Nguyen et al., 2013). On 21 March 2018, we surveyed Mount Pu Ta Leng, Bat Xat NR, Bat Xat District, Lao Cai Province, Vietnam (22.4325° N, 103.6300° E, 2345 m a.s.l.), 20 km northeast of the type locality. We observed several *O. sterlingae* tadpoles (but no adults) in a large pool in a 2 m wide stream in lightly disturbed evergreen forest. A tissue sample (tail clip) for molecular analyses was taken from a freshly euthanised tadpole at Stage 27 (Gosner, 1960) prior to formalin fixation; the specimen was deposited at the Vietnam National Museum of Nature (VNMN 2019.006). Our survey effort was limited due to the rugged topography of the area and logistical constraints and we did not identify any suitable habitat between 2500–2900 m a.s.l. However, the species is likely present at higher elevations than we found it on Mount Pu Ta Leng as better quality habitat was present in the area relative to known habitat on Mount Fansipan. It may also occur on Mount Ky Quan San but further survey work is needed.

The tadpoles were identified as *O. sterlingae* based on the following morphological features (1) ovoid body, slightly flattened above, (2) snout rounded in dorsal and lateral views; (3) eyes positioned dorsally; (4) large anteroventral oral disc; (5) convex, notable serrated jaw sheaths; (6) black body with obvious neuromasts in lines concentrated around eyes and nares; (7) pale tail fins with golden stripe along anterior half of upper and lower margins. Species identity of the tadpoles was confirmed using molecular analysis (following the methodology in Rowley et al., 2017). The new 16S rDNA sequence generated from the tadpole specimen was identical to that from two adult specimens collected 20 km away on Mount Fansipan (GenBank accession numbers KC569982 and KC569981). The new sequence was deposited in GenBank under the accession number MT119263.

An updated species range map was created in ArcMap 10.2.2 (Fig. 2) and the elevation range within which *O. sterlingae* is likely to occur was estimated by adding a buffer of 50 m to the lowest and highest known elevation records of the species. Areas of habitat were deemed suitable and included in maps if they are within the species' estimated elevation range, are covered with forest and are not separated from known localities by any continuous stretch of unsuitable habitat with a distance equal to or above 1 km. EOO was measured using the IUCN EOO Calculator tool v1.2 (IUCN, 2012). The new

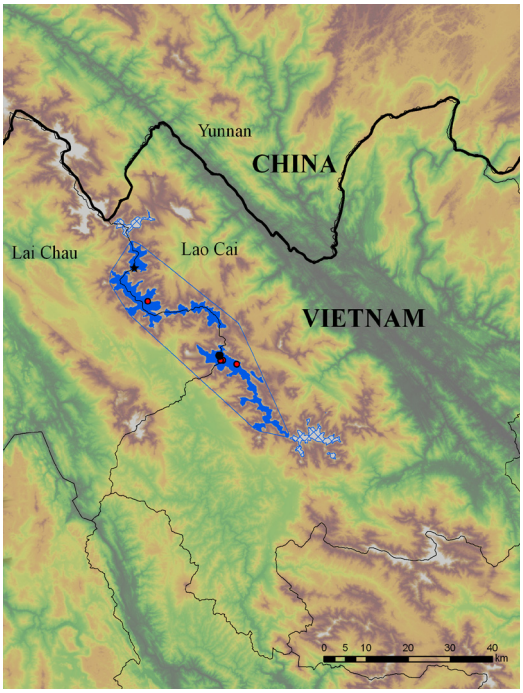

Figure 2. Distribution of *Oreolalax sterlingae* in the Hoang Lien Range, northern Vietnam. Red points represent the collection sites in this study, the black point represents the type locality (Mount Fansipan) and the black star represents the survey site where *O. sterlingae* was not encountered (Mount Ky Quan San). Solid blue area represents presumed range and cross-hatched blue area denotes areas where this species may be possibly extant. Blue outline denotes EOO.

records greatly increase both the elevation range of the species (from 2900 m a.s.l to 2345–3108 m a.s.l) and the EOO (from 8 km^2 to 639 km^2). The data presented here have been explicitly formatted so that they can be easily assimilated by the regional IUCN amphibian Red List authority, but we suggest that *O. sterlingae* is reassessed as Endangered (IUCN, 2012) in accordance with the IUCN Red List of Threatened Species categories and criteria B1ab(iii).

This species is still likely to be endemic to Vietnam. The habitat at the new locations where *O. sterlingae* have been encountered on Mount Fansipan and in Bat Xat District is more intact with good forest cover and less pollution than at the type locality. However, the site at 2511 m a.sl. on Mount Fansipan is in close proximity to a hiking trail and accommodation for hikers. It is important that the presence of this threatened species is considered in any future development of infrastructure within both known sites for the species; Hoang Lien National Park and Bat Xat NR. Our observations of heavily degraded habitat at higher elevations in both Bat Xat and Sa Pa districts indicates that the habitat within the predicted distribution is likely to be highly fragmented. The habitat within the predicted range of the species should be further surveyed to determine suitability for and presence of *O. sterlingae*, as the quality of habitat throughout the area is poorly known. Unfortunately, the population size of *O. sterlingae* and population trends are unknown and future research should address these key areas.

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