

A Specimen of *Karsenia koreana* (Caudata: Plethodontidae) Misidentified as *Hynobius leechii* 27 Years before the Species' Description and Additional Historical Record

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Abstract: We describe a specimen of *Karsenia koreana*, the only Asian plethodontid salamander, found in the herpetology collection of Ewha Woman's University Natural History Museum (EWNHM), Republic of Korea. This specimen was collected in Daedun Mountain, North Jeolla Province on 8 May 1978 and subsequently misidentified as *Hynobius leechii*. Therefore, the collection of this particular specimen predates the formal description of the species by 27 years. We also remark on the specimen previously described by Nishikawa (2009) and an observation of *K. koreana* made in Baekun Mountain on 24 August 1999. These records altogether represent fuller historical data on records of this species prior to its formal description.

Key words: *Karsenia koreana*; Korean crevice salamander; Natural History Museum; Plethodontidae; Republic of Korea

INTRODUCTION

The Korean crevice salamander (*Karsenia koreana*) is the only known plethodontid salamander described in Asia and its relationship with other plethodontids is supported by morphological and genetic evidences (Min et al., 2005). Considering that this species is locally abundant, it is suspected that *K.*

koreana specimens were collected prior to its formal description but went unnoticed or misidentified as belonging to other species of salamanders (Nishikawa, 2009).

While examining the collection of salamander specimens at Ewha Womans University Natural History Museum (EWNHM; Sabaj, 2016), we found a specimen labelled "*Hynobius leechii*" collected from Daedun Mountain, North Jeolla Province, Republic of Korea on 8 May 1978. In this study, we morphometrically examined the above specimen to identify it as another historical speci-

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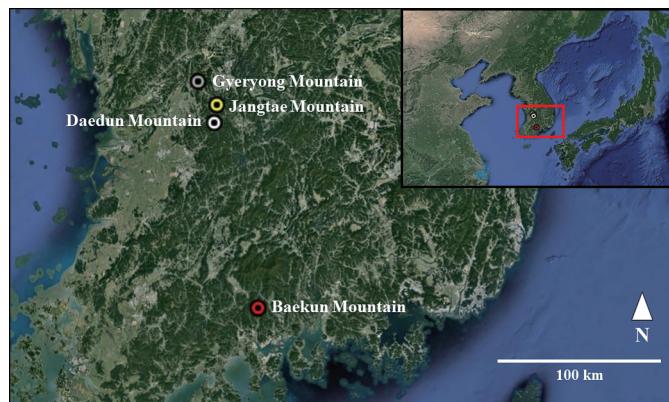


FIG. 1. Map showing *Karsenia koreana* datapoints of this study and that reported by Nishikawa (2009). Daedun Mountain is the location where the specimen in Ewha Womans University Natural History Museum was collected in 1978. Gyeryong Mountain is the location reported by Nishikawa (2009). Baekun Mountain represents the southernmost distribution record for the species. An individual observed in Jangtae Mountain on May 2019 was used for visual comparison against other records reported herein. Map generated using Google Earth Pro (Google Inc., California, USA), with data credits to SIO, NOAA, U.S. Navy, NGA, GEBCC. Image Landsat/Copernicus.

men of *Karsenia koreana* and discussed the importance of specimen curation and web-based databasing in investigating the species' distribution.

MATERIALS AND METHODS

We examined a specimen labelled “*Hynobius leechii*” collected from Daedun Mountain, North Jeolla Province, Republic of Korea on 8 May 1978 by the EWNHM (voucher EWNHM-ANIMAL 6439; Fig. 1). To identify the species, we measured the following morphometric characters, following the definitions used by Tominaga et al. (2005) and Poyarkov et al. (2012): SVL (snout-vent length): from tip of snout to anterior edge of cloaca; TAL (tail length): from the tip of tail to the anterior edge of vent; TOL (total length): sum of SVL and TAL; HL (head length): from tip of snout to the gular fold; HW (head width): measured at the widest part of the head anterior to parotid gland; MXTAH (maximum tail height): measured as perpendicular height at highest part of tail. CGN (costal grooves number): number of

costal grooves between the fore- and hindlimbs. Furthermore, we observed the shapes of tail, limbs, and digits.

RESULTS

Upon closer examination, the specimen (EWNHM-ANIMAL 6439) did not belong to *Hynobius leechii* based on body shape and patterns (Fig. 2). The TOL of this specimen was 93.8 mm, SVL was 47.2 mm, TAL was 46.6 mm, HW was 7.1 mm, HL was 13.6 mm, MXTAH was 2.6 mm, and CGN was 12 on both sides of the body. The tail tip was pointy with a round cross section in contrast to the laterally compressed oar-shaped tails of hynobiid salamanders of Korea. Other morphological characteristics identify this specimen as *K. koreana*: nasolabial grooves present, limbs and digits short, webbings between digits weakly developed, and broad stripe along the dorsal side of body (Fig. 2A, B, and C). We further identified this specimen as *K. koreana* based on comparisons with a live individual photographed in Jangtae Mountain on 4 May 2019 (Fig. 2E).



FIG. 2. Comparisons between the specimens captured or photographed prior to the formal description of *Karsenia koreana* and a live individual observed in 2019. (A, with label) Dorsal view of a specimen of *Karsenia koreana* collected on 8 May 1978 in Daedun Mountain, North Jeolla Province, Republic of Korea (EWNHM-ANIMAL 6439). Ruler scale is in centimeters. (B and C) Closeup of EWNHM-ANIMAL 6439. Note the characteristic short digits and broad dorsal stripe of *Karsenia*. (D) An individual observed in Baekun Mountain, Gwangwang, South Jeolla Province on 24 August 1999. (E) Live individual photographed in Jangtae Mountain, on 4 May 2019.

Although the precise GPS coordinates of the collection site for the mis-labelled specimen presented here is unknown, it is labelled as originating from the area where the paratype specimens of *K. koreana* were collected (MVZ 246033, MVZ 247157; Min et al., 2005). Furthermore, this region is well within the known range of the species (Borzée et al., 2019a; GBIF.org, 2019).

DISCUSSION

Another *Karsenia koreana* specimen collected before the description of the species has been reported by Nishikawa (2009). This specimen was collected in 1971 and is a female with a damaged tail, housed in the collection of the Institute of Amphibian Biology, Hiroshima University, Japan. To date,

the specimen reported by Nishikawa (2009) is the oldest known specimen of *K. koreana* and was collected 34 years before the description of the species. However, the label for the specimen in the collection of Hiroshima University only includes information on collection date and information on collection site is lacking, although it was likely collected from Gyeryong Mountain (Nishikawa, 2009). The specimen from the EWNHM predates the species' description by 27 years, and is seven years younger than the one from Hiroshima University. Nevertheless, the EWNHM specimen is intact and in good condition, with complete information on identification, collection date and location. This specimen further show that more than one *K. koreana* was collected long before its formal description but went unnoticed by researchers.

Additionally, an observation on iNaturalist on 24 August 1999 (iNaturalist.org, 2019) was identified as *K. koreana*. This particular individual was observed in Baekun Mountain in Gwangyang, South Jeolla Province in the Republic of Korea (35.060357°N, 127.594616°E; WGS 84). So far, this observation is the southernmost distribution record of *K. koreana*.

Collectively, these records provide valuable historical data on the presence of this species prior to its formal description. Furthermore, searching herpetology collections of universities and research institutions in Korea and adjacent countries will likely turn up more historical specimens of this species. Such overlooked specimens may provide valuable insights into natural history and distribution of the species. However, old and small collections that receive little attention from researchers are prone to become poorly maintained and degraded. For instance, Nishikawa (2009) noted that many historical specimens curated in Japanese institutions are in bad condition. The situation is similar in the Republic of Korea, where natural history collections in universities are generally poorly curated. These include missing or degraded labels and degraded or damaged specimens.

Our finding of this specimen add further support to the importance of properly maintaining historical collections for future research.

According to the IUCN, *Karsenia koreana* is currently listed as Least Concern (LC), although its conservation status may need to be updated because of decreasing population sizes (IUCN, 2019). Moreover, the species is likely to experience range shifts in the future due to climate change (Borzée et al., 2019a). However, the exact range of the species is still unknown and we recommend the use of citizen science, such as done for *Hynobius* sp. (Borzée et al., 2019b), and incorporating historical data from museums to acquire further information on its distribution. Defining the range of *K. koreana* will be beneficial for research and conservation of the species in the future.

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