

## A Brief Report on the Life History of *Batrachuperus taibaiensis* at Ping He Liang of Tsinling Mts.

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**Abstract.**- *Batrachuperus taibaiensis* is a high-mountain, stream salamander endemic to China, and compared to congeners, is more northeastern in distribution and found at lower elevations. The distribution, life history and measurements of the larva and adult of this species were recorded from 2005 to 2006 at Ping He Liang of Tsinling Mts. The life history of the genus is discussed in the context of refining species definitions for those *Batrachuperus* found in the Tsinling Mts. Past surveys carried out in Tsinling Mts found several different *Batrachuperus* species and there is a need to clarify which species really exist. The distribution of *Batrachuperus taibaiensis* is discussed in the paper.

**Keywords.**- Life history, stream salamander, *Batrachuperus taibaiensis*.

### Introduction

Much of the taxonomy and phylogeny of the Chinese Amphibia remain unresolved, as is much of the knowledge on their basic natural history, generally because observations on natural history are not considered to be worthy of publication and the gathering observations is often time intensive (Greene, 1993). Nevertheless, these observations may contribute to phylogenetically informative characters (de Queiroz and Wimberger, 1993) and data critical for developing conservation and management strategies (Mendelson et al., 1999).

The high-mountain stream salamanders, genus *Batrachuperus* Boulenger, 1878, contains seven species that occur in Western China and adjacent Myanmar (Frost, 2007). The natural history of the species in this genus remains largely unknown or unpublished because individuals generally hide under stones in small mountain streams at high altitude, although reports on the common species *B. pinchonii* (David) have been made by Liu (1945).

Recently, one new species (*Batrachuperus taibaiensis*) was found in the upper Heihe River in the Tsinling Mts. of Shaanxi Province, China. Compared to congeners, this salamander is more northeastern distribution and found at lower elevations (Song et al., 2001). During collecting trips (1987–2005) along the rivers and streams of Ping He Liang, the senior author collected several *B. taibaiensis* and collected data on their natural history. The following is a brief excerpt from the results of a series of herpetological surveys made from 2005 to 2006.

### Materials and Methods

Amphibian surveys were made on the south side of the Tsinling Mts. (33° 36' N, 108° 28' E, 1800–2000 m) between Huo Di Tang and Xun Yang Ba of Ningshan County, Shaanxi province, China, from April 2005 to June 2006. Ping He Liang reaches an altitude of 2160 m at the National Way. *Batrachuperus taibaiensis* was also surveyed at its type locality on the north side of the Tsinling Mts in April 2005.

Adult specimens were stored in 10% formalin. Larvae and egg cases were observed live in the lab.

### Results

**Identification.**- *Batrachuperus taibaiensis* (Fig. 1) can be separated from congeners by its relatively large body size and lack of horny covers on the palms and tarsi.

**Distribution.**- The distribution of *Batrachuperus taibaiensis* is concentrated in the upper part of two rivers and their associated streams on the northern and southern sides of Ping He Liang (Fig. 1). The pH of the water was somewhat acidic (pH = 5.5–6.0). Specimens were found under rocks in river headwaters and streams in the study area 2–3 km from the top of Ping He Liang (above 1800 m).

In the streams and rivers where *Batrachuperus taibaiensis* was found, adults of a number of other amphibians occurred: *Ranodon tsinpaensis* Liu and Hu, *Bufo gargarizans* Cantor, *Rana chensinensis* David, *Paa quadrana* (Liu, Hu and Yang), *Bufo andrewsi* Schmidt. Tadpoles of *Bufo andrewsi* and *S. ningshanensis* Fang

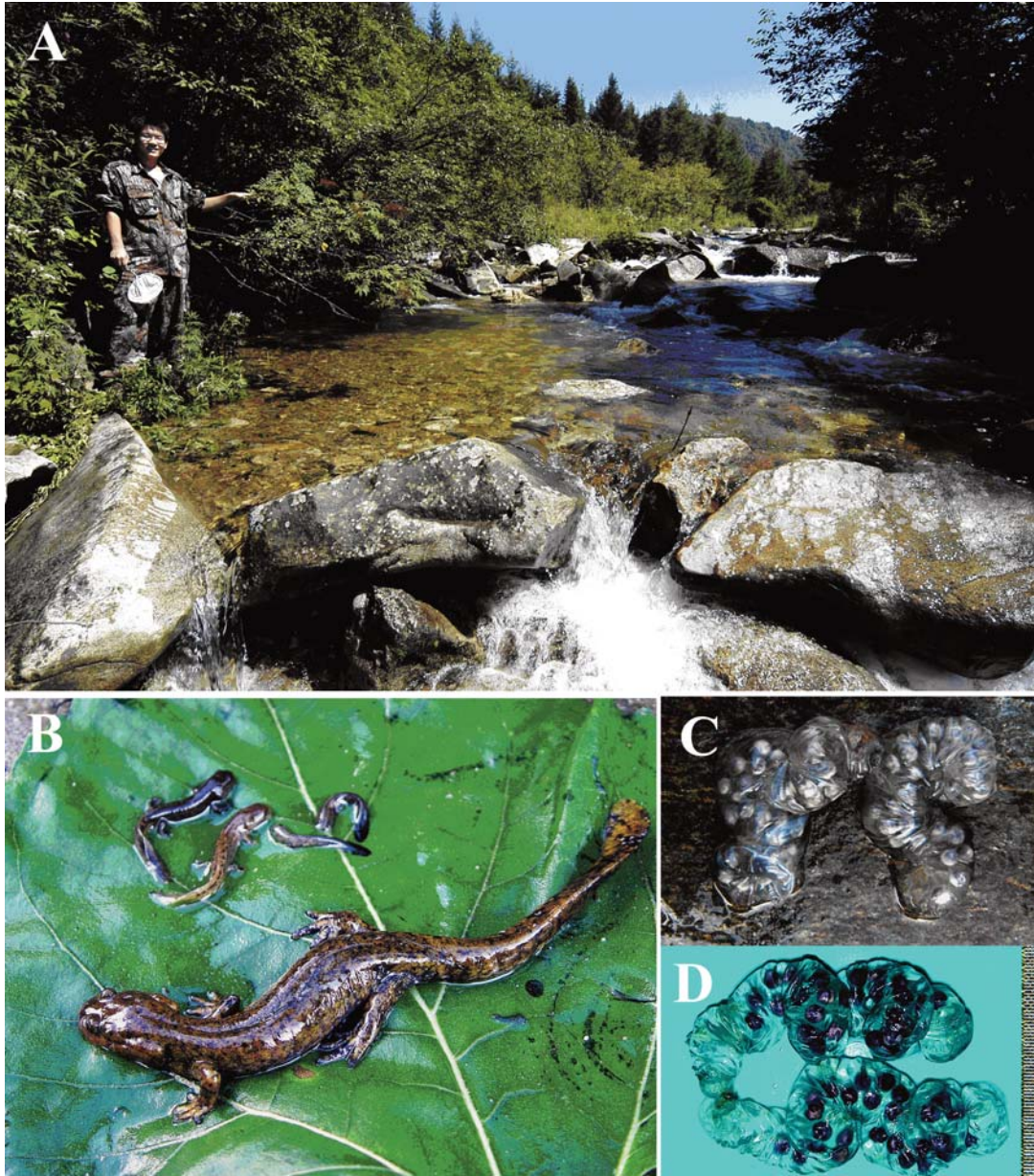


Figure 1. (A) Habitat of *Batrachuperus taibaiensis*. (B) Adult and larvae of *B. taibaiensis* from Ping He Liang. (C) and (D) are egg cases of *B. taibaiensis*.

were also observed, the latter of which has its type locality in the same region. *Hyla tsinlingensis* Liu and Hu, another endemic Chinese amphibian, was found in nearby ponds. *Bufo gargarizans* Cantor, *Bufo andrewsi* Schmidt, *H. tsinlingensis* Liu and Hu, *Rana chensinensis* David, *P. quadrana* (Liu, Hu and Yang) and *Batrachuperus pinchonii* were more widespread at lower elevations near the study area.

The study area encompassed approximately 15 km<sup>2</sup> of Subalpine conifer habitat covered with well-developed vegetation. The canopy often arched over the rivers and streams.

**Reproduction and growth.**- The breeding season most likely occurs from April to July, as the youngest larvae with external gills and the most number of young salamanders in different stages of development were collected on August 3<sup>rd</sup>, 2005; young salamanders were not collected after April 16<sup>th</sup>, 2005.

Egg-cases, previously unknown for this species, were found adhered to the under-side of rocks in the river in April 16<sup>th</sup>, 2005. The body of the egg-case was a curled columnar tube with tapered ends; the case was smooth and almost entirely transparent with thin longitudinal striations; fresh cases were the color of milk; for-

Table 1. Measurements of *Batrachuperus taibaiensis* (n=3)

|                  | larvae |       |       | adults |       |
|------------------|--------|-------|-------|--------|-------|
|                  | A      | B     | C     | ♂      | ♀     |
| Body-Length (mm) | 19.47  | 30.27 | 40.94 | 93.77  | 96.08 |
| Head-Length (%)  | 26.3   | 32.58 | 34.96 | 23.91  | 24.69 |
| Head-Width (%)   | 21.73  | 24.29 | 24.54 | 20.56  | 19.85 |
| Length-Eye (%)   | 6.27   | 6.26  | 6.03  | 5.18   | 4.73  |
| Trunk-Length (%) | 44.94  | 43.99 | 41.28 | 54.85  | 53.44 |
| For-Leg (%)      | 15     | 20.45 | 26.21 | 27.17  | 23.09 |
| Hind-Leg (%)     | 11.61  | 20.34 | 31.45 | 29.43  | 31.51 |
| Tail Length (%)  | 58.04  | 69.82 | 78.47 | 99.62  | 93.17 |
| Tail Width (%)   | 9.14   | 12.59 | 12.41 | 12.16  | 11.82 |
| Tail Height (%)  | 20.54  | 22.52 | 18.38 | 13.85  | 12.92 |

A: larva just after hatching; B: developed larva; C: larva with full shriveling

malin-fixed cases became brittle. The cup-like cap at the free end of the case was more soft and delicate than the remainder of the case (Fig. 1). Cases were 15.0–17.0 mm in length with a diameter of 18.0–20.0 mm. There were 27–29 eggs or embryos in each egg case. Egg diameter was 5.0–5.5 mm.

Free larvae appeared at stream edges under small stones at the beginning of August. The early larvae, compared to developed larvae, juveniles and adults, in that the color was lighter gray with the dorsum yellowish-green and the venter yellowish; the dorsal pigment faded after fixation. The forelimb of the early larva was fully developed with four formed fingers; the fourth toe bud appeared after formation of the first three toes. The fore limbs developed earlier than the hind limbs. The labial folds were well-developed and the pores of the lateral line organ were visible on the head. Eyes were small, black and covered with a transparent membrane; eyelids were absent. Balancers were absent from the side of head. There were four pairs of external gills (decreasing in size posteriorly); the filaments of the last gill were very short, white and hidden beneath the third gill; the first to third gills resemble those of *Batrachuperus pinchonii* (Liu, 1945). The vertebral groove was distinct along the length of the trunk. The tail was much higher and shorter than that of the adult.

The developed larva was blacker than the younger larva, and larvae with gill regeneration were nearly black. Pores of the lateral line organs were more conspicuous in the head and shoulder regions. Eyelids were well developed (as in *Batrachuperus pinchonii* [Liu, 1945]). Gill filaments were blacker and longer than those seen in earlier larva, but shorter than larva with gill regeneration. Fingers and toes were well-developed.

Fifteen specimens from various developmental

stages were measured (Table 1). Larval head length was 26.3%, 32.58% and 34.96% of total body length, while adults head length was 23.91% in the male and 24.69% in the female. Larval eye length was slightly larger than that of adults.

## Discussion

**Need for clarification of *Batrachuperus* species in Tsinling Mts.**— Song (1983) and Yuan (1984) reported *Batrachuperus pinchonii* from the Tsinling Mts. in Mao Tai Zi, Liuba County, and Huo Di Tang Forest, Ningshan County. Later, from 1985 to 1989, the senior author and a colleague from Shaanxi Normal University collected two species of *Batrachuperus* from Huo Di Tang and Xun Yang Ba Forests, Ningshan County, which are on the northern and southern slopes of the same Mountain: *B. pinchonii* was collected at lower elevations while *B. tibetanus* was collected at higher elevations (Li and Fang, 1993 and unpublished data). At the same time, Song collected a new species of *Batrachuperus* from Zhouzi County - *B. taibaiensis* – which was supported by sequence data from cytochrome b (Song et al., 2001). Unfortunately, these species were either excluded (Fei et al., 2005) or treated under incorrect names (Han and Lu, 2003; Zhang and Jia, 2002) in subsequent publications.

*Batrachuperus* occurs throughout the Tsinling Mts., extending to Foping, Zhouzi, Zashui and Ningshan Counties. *Batrachuperus taibaiensis* has also been found in Kangxian, Wenxian and Fenxian in Gansu Province, as well as Liuba and Nanjiang in northern Sichuan Province (Zeng, 2004); these identifications were made using molecular techniques because it is often difficult to identify species of *Batrachuperus* using traditional methods (Zeng, 2004).

Based on what is now known about the biology, morphology and distribution of *Batrachuperus taibaiensis*, we consider that all specimens of *B. tibetanus* collected from the Tsinling Mts south to Shaanxi, Southeastern Gansu and the North Sichuan Provinces (such as Micanshan and Dabashan) are actually representatives of *B. taibaiensis*. Considering this, the full range of *B. taibaiensis* may actually extend as far as southeastern Shaanxi Province and the Shenlongjia Mts in northwestern Hubei Province. To corroborate these assumptions, it will be necessary to re-examine previously collected specimens from these localities to verify their identity. Further fieldwork and molecular analyses will likely be necessary.

**The need to focus on *Batrachuperus* life history.**— The high-mountain stream salamander *Batrachuperus* currently was considered to contain seven species that occur in Western China and adjacent Myanmar (Frost,

2007). Most of these species are restricted to China, and *B. tibetanus* and *B. pinchonii* are significant in their use as experimental animals in embryological, morphological and ecological investigations (Li and Fang, 1993; Xu, 1992, 1993; Zhang and Jia, 2002; Han and Lu, 2003; Fei et al., 2005).

Excluding one report by Liu (1945) on *Batrachuperus pinchonii*, little data on life history has previously been available for species in this genus. Limited notes on *B. longdongensis* Liu and Tian, 1978, *B. cochraniae* Liu, 1950 and *B. yenyuanensis* Liu, 1950 have also been published for populations in White-dragon-pool at Chin-ting (Jinding) of Mt. Omei, Pao-hsinghsien (Baoting County), Yen-yuan-hsien (Yanyuan County) and Tien-shui (Tianshui) and Sia-ho (Xiahe) Counties of Gansu Province. Data from Fei et al. (2005) are also useful for understanding the biology of these native animals.

Here we have reported additional life history data for a new species in the genus, *Batrachuperus taibaiensis*, one of the largest stream salamanders in China. The tube-like egg case is longer and thicker than those in other species, it is strongly coiled and contains more (27–29) eggs. In comparison, the egg case of *B. pinchonii* is cylindrical and cayenne-shaped with 7–12 eggs (Liu, 1945); the case of *B. yenyuanensis* is linear and has 6–13 eggs (Zhao and Yang, 1997). The larvae of this species are also unique.

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