

## SHORT NOTE

# THE DISCOVERY OF METAMORPHOSED JUVENILES OF FORMOSAN SALAMANDER (*HYNOBIUS FORMOSANUS*) IN YU-SHAN NATIONAL PARK

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**Kuang-Yang Lue and Kuo-Shou Chuang (1991)** The discovery of metamorphosed juveniles of Formosan salamanders (*Hynobius formosanus*) in Yu-shan National Park. In March, 1991 the authors discovered two clutches of five and seven metamorphosed juveniles of *Hynobius formosanus* near the peak of Yu-Shan (Jade mountain), approximately 3, 630m above sea level. The mean snout-vent length of these juveniles were 19.0 mm in nest one and 15.9 mm in nest two; larval survival rates were 35% and 48%, respectively. We estimated that the breeding season occurred from November to January.

**Key-words:** *Hynobius formosanus*, Metamorphosed juvenile, Clutch.

The Formosan salamander, *Hynobius formosanus*, is an amphibian species endemic to Taiwan; it occurs only in high mountain regions. In 1987, Chen and Lue reviewed its taxonomy, morphology, and distribution. Lue *et al.* (1989) and Yeh (1991) conducted ecological and population studies of *H. formosanus* in the Alishan area. Yeh *et al.* (1988) investigated its antipredator behavior. Clutch size and larval characteristics of this species were first reported by Kakegawa *et al.* (1989). However, no field record or data exists concerning the Formosan salamander. On March 28, 1991 the authors found two clutches of metamorphosed *H. formosanus* juveniles in Yu-shan National Park and made observations for the following report.

## MATERIALS AND METHODS

Discovery sites were near the peak of

Yu-Shan, elevation of almost 3, 600m above sea level. Morphological measurements were taken and are presented in Tables 1 and 2. The hatching rates of these two clutches were estimated based on clutch sizes reported by Kakegawa *et al.* (1989). In addition, collections of *Ambystoma californiensis*, *Onychodactylus fisheri*, *Hynobius retardatus*, *H. peropus*, and *H. tsuensis* from the California Academy of Science were checked for comparison.

## RESULTS AND DISCUSSION

Both broods were found under stones at sites where the ambient temperature was 8° c. The altitudes of the two sites were 3, 625m and 3, 630m above sea level. Vegetation type in the surrounding area is alpine grassland dominated by *Yuahania niitakayamensis* and *Juniperus squamata*. On the day of discovery, the snow on the ground was melting and seeping into the mountain

Table 1  
Measurements of *Hynobius formosanus* from Nest one

No.	SVL	TL	HL	HW	IOD	SL	BW
1	65	45	14	10	3	4	4.17
2	69	47	16	11	3	4	5.60
3	18	10	—	—	—	—	0.15
4	16	9	—	—	—	—	0.10
5	20	11	—	—	—	—	0.22
6	24	15	—	—	—	—	0.42
7	17	11	—	—	—	—	0.45
Mean <sup>a</sup> :	19.0	11.2					0.208

Key: SVL, Snout-Vent Length; TL, Tail Length; HL, Head length; Hw, Head Width; IOD, Interorbital Distance; SL, Snout Length; BW, Body Weight. All measurements except for body weight (g) are in mm.

a. Calculated from individuals No.3-7 only.

Table 2  
Measurements of *Hynobius formosanus* from Nest Two

No.	SVL	TL	HL	HW	IOD	SL	BW
1	15	10	—	—	—	—	0.15
2	14	11	—	—	—	—	0.15
3	20	12	—	—	—	—	0.22
4	16	12	—	—	—	—	0.18
5	16	12	—	—	—	—	0.15
6	15	10	—	—	—	—	0.12
7	15	11	—	—	—	—	0.16
Mean:	15.9	11.1					0.208

Key: SVL, Snout-Vent Length; TL, Tail Length; HL, Head length; Hw, Head Width; IOD, Interorbital Distance; SL, Snout Length; BW, Body Weight. All measurements except for body weight (g) are in mm.

slope. Based on the observed *in situ* environmental conditions, it appears *Hynobius formosanus* is a cold mountainous species, as well as a lotic breeding species found in seepage areas (Sato, 1943; Zhao *et al.*, 1988).

There is little information on the life history of Formosan salamanders. However, Kakegawa *et al.* (1989) reported clutches of sixteen eggs of *H. sonani* and fourteen and one-half eggs of *H. formosanus* obtained

from artificially-induced spawning. Formosan salamander larvae take about two months to complete their metamorphosis (Kakegawa *et al.*, 1989). The mean SVL (Snout-vent length) of our observed juveniles was 14.5 mm. Since the data from the present study (Tables 1 and 2) are close to those collected from laboratory-reared juveniles, the individuals on here reported might be metamorphosed juveniles. By comparing our larvae with the larvae of other species (Table 3),

Table 3

Measurements taken from larvae of various species of salamanders from California Academy of Science, San Francisco.

species	<i>A. c.</i>	<i>O. f.</i>	<i>H. r.</i>	<i>H. p.</i>	<i>H. t.</i>
Number <sup>a</sup>	#1352519	#26712	#25990	#26708	#26551 #26556 #26561
TL <sup>b</sup>	106	76	42	45	42 <sup>c</sup>
SVL	60	40	26	30	24
TLL	46	36	16	15	18
Coloration	light brown	yellow with brown dots	light yellow	light yellow	light yellow

Species: *A. c.*, *Ambystoma californiensis*; *O. f.*, *Onychodactylus fisheri*; *H. r.*, *Hynobius retardatus*; *H. p.*, *H. peropus*; *H. t.*, *H. tsuensis*.

Key: TL, Total Length; SVL, Snout-Vent Length; TLL, Tail Length

a. specimen numbers from California Academy of Science.

b. all measurements are in mm.

c. mean of three individuals.

we found that the larval size of Formosan salamanders is smaller. The breeding season of *H. formosanus* in the Yu-Shan area is estimated to be the period between November and January, which is also the dry season at Yu-Shan National Park. The suggested

breeding season is in agreement with that given by Kakegawa *et al.* (1989).

Based on clutch size (Kakegawa *et al.*, 1989) and number of young (Tables 1 and 2), the estimated survival rates for both broods were 35% and 48%. These are higher



Fig. 1. Juveniles of *Hynobius formosanus* from the second brood found in Yu-Shan National Park.

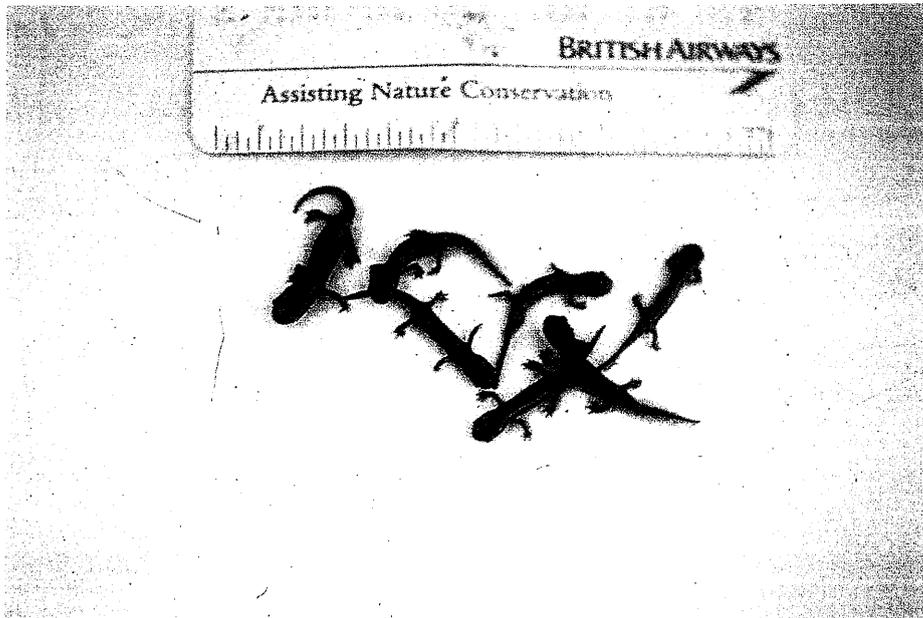


Fig. 2. Two adults of *Hynobius formosanus* found along with five metamorphosed juveniles in Yu-Shan National Park, implying the performance of parental care behavior.

rates than those of *H. nebulosus* and *Cryptobranchus alleganiensis* (Duellman and Trueb, 1985). Parental care behavior in frog and salamanders, as reviewed by Duellman and Trueb (1986), are very similar in species with terrestrial modes of reproduction and small clutch sizes. Formosan salamanders in the harsh environment of high altitude area do face some selective pressure; they can increase survival by taking care of their eggs or young. Since the Formosan salamander is a solitary species (Yeh *et al.*, 1988; Chen and Lue, 1986; yeh, 1991), the two adults living with the five metamorphosed juveniles in nest one are not adequate for reliable research. A further investigation is required.

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## 記玉山國家公園內臺灣山椒魚(*Hynobius formosanus*)剛變態幼體之發現

呂光洋 莊國碩

在 1991 年三月，筆者等在玉山主峰附近發現二窩分別有五隻及七隻剛變態不久的幼小臺灣山椒魚(*Hynobius formosanus*)。發現的海拔高度為 3630 公尺左右，這些小山椒魚的吻肛平均長度為 19mm 及 15.8mm。據文獻上該種的窩卵數，我們推算出其野外的幼體存活率為 35% 及 48%。生殖交配受孕則發生在十一月至一月之間。臺灣山椒魚通常獨立生活，而在第一巢同時有二隻成體山椒魚和五隻幼體在一起，筆者推測這二隻可能有護幼的行為。