FIELD OBSERVATIONS OF OVIPOSTION AND EARLY DEVELOPMENT FOR THE COASTAL TAILED FROG (*ASCAPHUS TRUEI*)

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Introduction

Tailed frogs (genus *Ascaphus*), stream amphibians endemic to the Pacific Northwest, are thought to represent the sister taxon of all living anurans. Tailed frogs are the only anurans known to engage in copulation that includes internal fertilization, an adaptation thought to be linked to living in fast-flowing streams. In addition, the sperm storage capability of females allows temporal separation between breeding and oviposition, resulting in females depositing eggs alone.

Knowledge of tailed frog oviposition sites, which are always concealed in streambeds, is limited. What is known is based on the opportunistic discovery of sites during the examination of instream substrates, a standard procedure for various types of stream surveys. These haphazard discoveries have resulted in encountering various stages of clutch development, but have never involved field observation of oviposition. Observations of development from oviposition also have been restricted to females laying eggs in a laboratory via hormonal induction. Here we report the 1st field observation of oviposition by tailed frogs, and selected field data on early development.

Methods

In the course of rubble-rouse sampling for stream-associated amphibians (SAAs) during a Forests and Fish Adaptive Management study designed to examine the effects of maintaining different levels of shade on SAAs, we stumbled across a female *A. truei* in the process of laying eggs. Our observations were made on Miller Creek, a 3rd-order non-fish-bearing stream on the east side of the Olympic Peninsula near Lake Cushman (Mason County, Washington State). The site of our observations was a long riffle with steady fast-moving water. Adjacent uplands were 2nd-growth managed Douglas-fir (*Pseudotsuga menziesii*)-Western Hemlock (*Tsuga heterophylla*) forest. Lithology is mostly glacial till with large-clast material contributed from intrusive basalts upstream.

Prior to rolling the oviposition boulder on the 2nd visit, we placed fine-mesh (1.25 × 1.90 mm) soft nylon screen across the stream to intercept unattached eggs that might move downstream. We placed loose eggs intercepted by the screen in an enclosure with a rocky matrix simulating streambed conditions. The enclosure was a 50 × 37 × 16 cm plastic box placed near the oviposition site (FIG. 1). The site and enclosure was then revisited 8 additional times over the interval 27 August-8 October 2008.

At each revisit, remaining eggs or larvae hatched from the original eggs in the enclosure were measured (SVL, total length [TL], and mass) and observations were recorded. Data collected are presented as the mean ± standard deviation and ranges. We provide only means for growth data because animals were not individually marked. For larval growth, we assessed the fit of regression models for both SVL and TL on time, and describe the data only for the SVL and TL model that was both simplest and had the most explanatory power: fewest terms and largest coefficient of determination (r^2).

Later examination of photographs at 10-15× magnification allowed us to estimate clutch size based on egg size, development and distribution, and identify jelly strand connections and termini. Over our 71-day period of observation, we obtained water temperatures from a datalogger recording every 0.5 h located 11 m downstream of the oviposition site.

FIG. 1

Results

On 29 July 2008, we rolled a large (65 × 60 × 44 cm) boulder that was imbedded about 10 cm in surrounding gravel and sand. Four adult female *A. truei* were found under it; one was actively laying next to a large number of eggs (FIG. 2). A spot water temperature taken at ~11:00 was 12.0ºC. A separate group of 24 eggs was found under a 2nd boulder (55 × 40 × 24 cm) <1 m downstream. A 5th female *A. truei* was found nearby.

We estimated the large group of eggs to comprise 3 clutches. The female depositing eggs was associated with 68 eggs (hereafter Clutch A; FIG. 2). She also extruded 2 eggs into the plastic bag used for temporary handling, so her minimum clutch size was 70. The ovipositing female was 40.0 mm snout-vent length (SVL) with a mass of 7.7 g (taken with the 2 eggs still attached); the 3 non-ovipositing females had visibly deflated abdomens. We interpreted remaining eggs to represent clutches of 68 and 47 (hereafter Clutches B and C, respectively; FIG. 2). After these initial observations, we replaced the boulder, and the females. On our follow-up visit, we intercepted 7 loose eggs and placed them into the enclosure for monitoring growth.

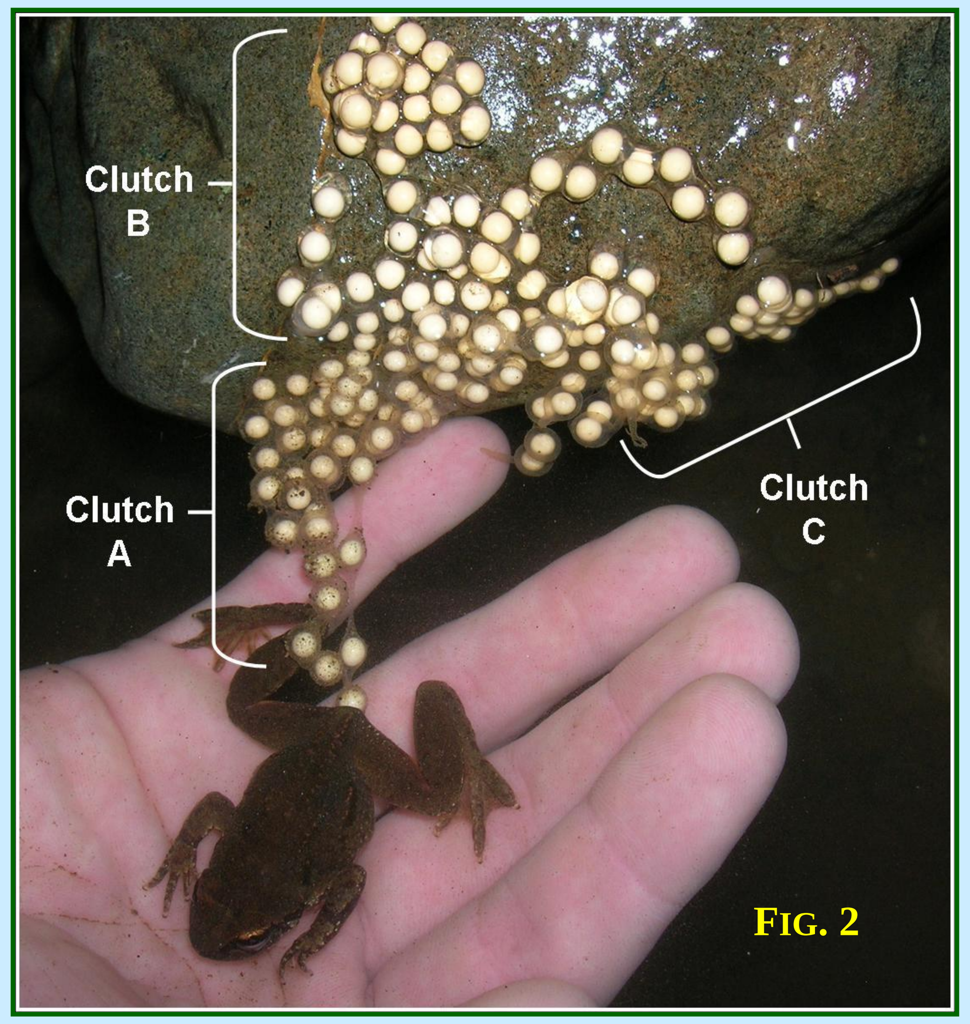

FIG. 2

We interpreted the separate group of 24 eggs found beneath the 2nd boulder to constitute a 4th clutch. These eggs appeared slightly more advanced in development than those in the other 3 clutches.

On 12 August, embryos from Clutch A had developed to the muscular response stage and averaged 7 and 4 mm in capsular and yolk diameter, respectively (FIG. 3). Over the 2-week interval from oviposition to 12 August, water temperatures averaged 12.9 ± 0.7°C.

FIG. 3

By 27 August, all individuals had hatched and were translucent white and lacked pigmentation except for their eyes. The 6 hatchlings we measured were <0.1 g, and averaged 16.9 ± 1.2 mm TL and 6.8 ± 0.4 mm SVL. Water temperatures averaged 13.4 ± 0.9°C (range: 11.6 to 16.0°C) from the date of oviposition to when all embryos had hatched.

By the 15 September, 1 larvae was beginning to develop the darker pigmentation typical of older larvae; the other 6 larvae showed this pattern on the next revisit. On 1 October, all 7 larvae averaged 25.3 ± 0.9 mm TL and 8.6 ± 0.3 mm SVL, and were ~0.2 g. Over the 35 days of our post-hatching observations (27 August-1 October), larvae grew an average of 8.4 mm TL and 1.8 mm SVL, with TL increasing faster than SVL (Fig. 4) and water temperatures averaging 12.4 ± 0.7°C (range: 10.8 to 14.7°C).

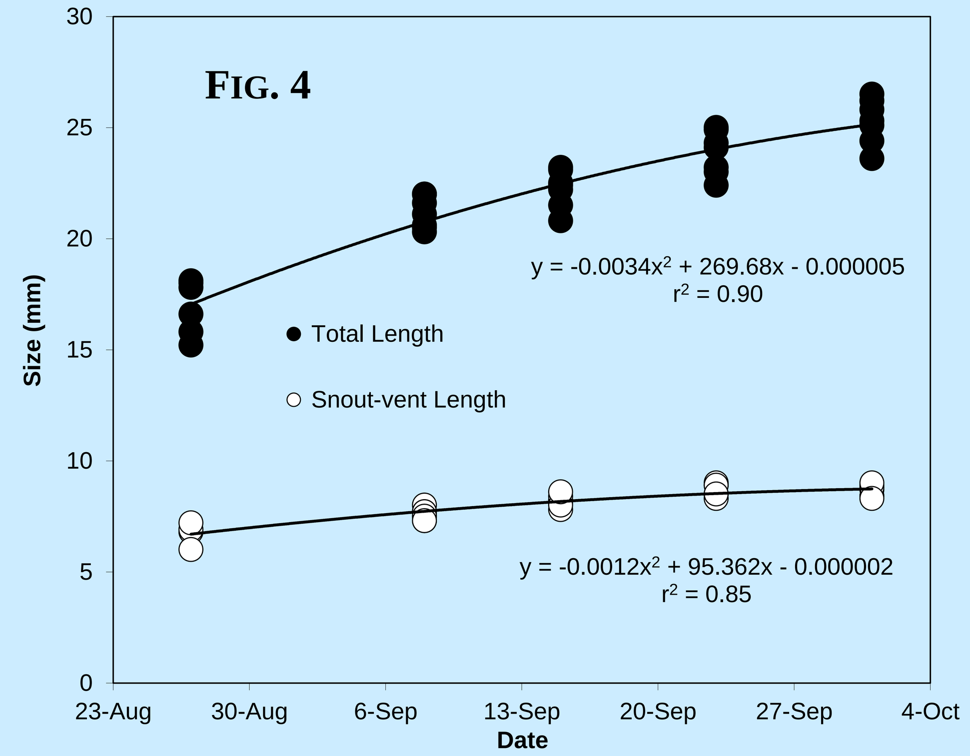

FIG. 4

Conclusion

The oviposition sites we found are similar to sites previously described. Oviposition beneath larger rocks may help protect developing embryos from damage during scour or substrate movement. We also recorded communal oviposition, a phenomenon rarely reported for tailed frogs. The frequency of communal oviposition may be underestimated due to larger rocks not be overturned during surveys. However, we believe that defining communal oviposition to what is laid on a single rock (Karraker et al. 2006) may compound underestimation of its frequency.

The faster growth rate of TL vs SVL may represent the biological need to grow the muscular tail quickly to negotiate stream flows. Growth rates of our field larvae were similar to the lab data of Brown (1975). We also recorded a similar decrease in growth rate following the maximal growth rate interval (FIG. 5). The significance of this pattern is unclear, but it may reflect the transition from the lipid/protein rich yolk diet of hatchlings to the less nutritious diet (diatoms/detritus) of actively feeding young larvae.

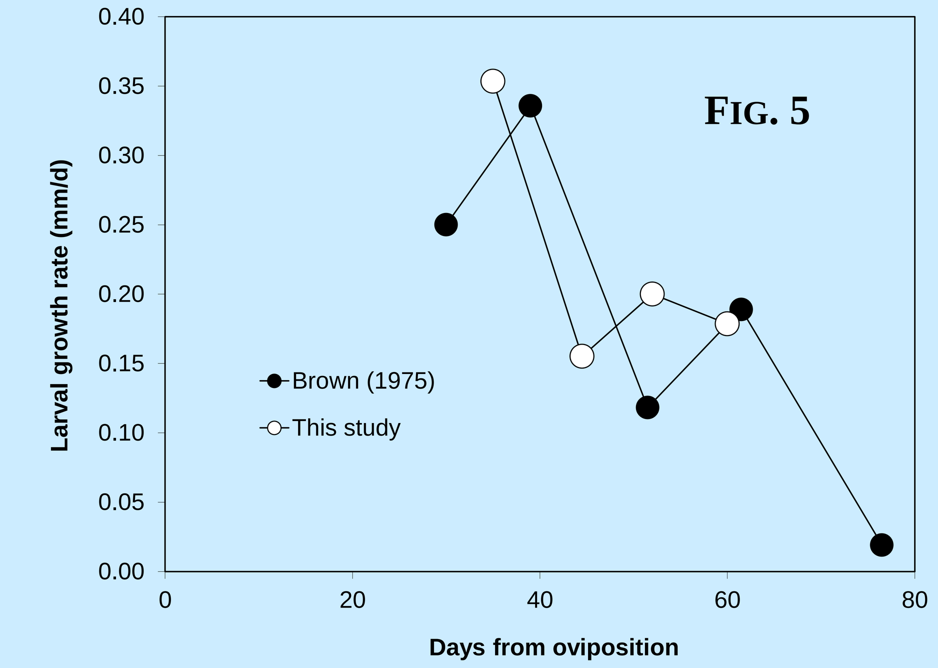

FIG. 5

Literature Cited

BROWN HA. 1975. Temperature and development of the tailed frog, *Ascaphus truei*. *Comparative Biochemistry and Physiology* 50:397-405.

KARRAKER NE ET AL. 2006. Taxonomic variation in oviposition by tailed frogs (*Ascaphus* spp.). *Northwestern Naturalist* 87:87-97.

Acknowledgements

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