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The tadpole of *Atelognathus salai* Cei, 1984 (Leptodactylidae: Telmatobiinae)

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The genus *Atelognathus* is currently represented by eight species with narrow distribution areas restricted to Patagonia, southern Argentina and Chile (Basso, 1998). Four of the *Atelognathus* species live in extra-Andean basaltic tablelands (*A. patagonicus*, *A. praebasalticus*, *A. reverberii* and *A. solitarius*), while the other four species inhabit the austral

temperate forests (*A. nitoi* and *A. grandisonae*) or its ecotone with the Patagonian steppe (*A. salai* and *A. ceii*).

Of the eight species in the genus, so far only the larvae of *Atelognathus patagonicus* (Cei, 1965), *Atelognathus reverberii* (Cei, 1969) and *Atelognathus nitoi* (Basso and Úbeda, 1997) have been described. This paper describes the *Atelognathus salai* larva based on specimens from the type locality, and discusses its similarities to and differences from the other three known larvae in the genus.

Atelognathus salai Cei, 1984 is known only from its type locality, a pond known as Laguna de los Gendarmes, located in the Patagonian Andes, and other nearby ponds (Úbeda and Basso, pers. obs.), in the northwest of Santa Cruz Province, Lago Buenos Aires Department, Argentina (46°6′S, 71°41′W, ca. 1050 m elevation).

On January 21, 1997, thirteen tadpoles of *A. salai* at development stages 36 to 41 (Gosner, 1960) were collected from a small pond close to the type locality. The area is a hilly landscape with endorheic ponds located on the ecotone between the Patagonian steppe and the temperate austral forest, represented by a deciduous forest of austral beech (lenga, *Nothofagus pumilio*). Aside from the collected specimens, a development series of tadpoles from stage 36 to recently metamorphed froglets was observed at the pond, giving us certainty about their specific assignation.

Specimens were fixed in 10% neutral-buffered formalin after being anesthetized with benzocaine in an aqueous solution, and deposited at the herpetological collection of the Museo de La Plata (MLP A 2373-2383) and at the Facultad de Ciencias Exactas y Naturales de la Universidad de Buenos Aires (LARV-DDE-FCEN 228-229). Terminology follows Van Dijk (1966) and Lavilla (1983, 1988). Measurements were taken under a Carl Zeiss Jena stereoscopic microscope with micrometric ocular to the nearest 0.01 mm. Drawings were made with the aid of a Carl Zeiss camera lucida attached to the stereoscopic microscope. Larvae of the following species were also examined: *Atelognathus patagonicus* (MLP A 1222: three specimens), *A. reverberii* (Museo Argentino de Ciencias Naturales, MACN 28467-8) and *A. nitoi* (MLP A 1223, 43 specimens, MACN 36695, 36767).

The following description is based on specimens at developmental stages 36 to 39 (Gosner, 1960), MLP A 2373-2383; LARV-DDE-FCEN 228, 229:

Type IV tadpoles (Orton, 1953) (fig. 1, table 1). Medium-sized to large, total length of largest specimen of the series (stage 41) 62 mm; body length 0.4 times of total length; body shape oval, somewhat depressed, 2.3 times longer than high and 1.2 times wider than high; some specimens with a slight constriction between head and trunk; snout rounded in dorsal and lateral profile; eyes medium sized, dorsolaterally positioned (extraocular distance 0.62 times body width at eye level), dorsolaterally directed; eye diameter 0.2 times of head width at eye level; interorbital distance 1.3 times greater than eye diameter and 0.25 times of maximum body width; nostrils oval to subcircular, dorsal position and protuberant, raised mainly at the anterior edge; nostrils closer to eye than to tip of snout (rostronasal distance 1.3 times orbitonasal distance), openings dorsolaterally directed; internarial distance approximately 6.75 times greater than nostril diameter and 0.6 times of interorbital distance; orbitonasal line visible; gill chambers large; spiracle sinistral, conspicuous, joined to the body along its entire extent; spiracular tube and opening ventral, not visible dorsally; spiracular opening oval and smaller than tube diameter, directed posterolaterally, located at 0.57 times of body length; vent tube conspicuous but short, 0.09 times of body length; vent opening dextral; caudal musculature robust anteriorly, becoming

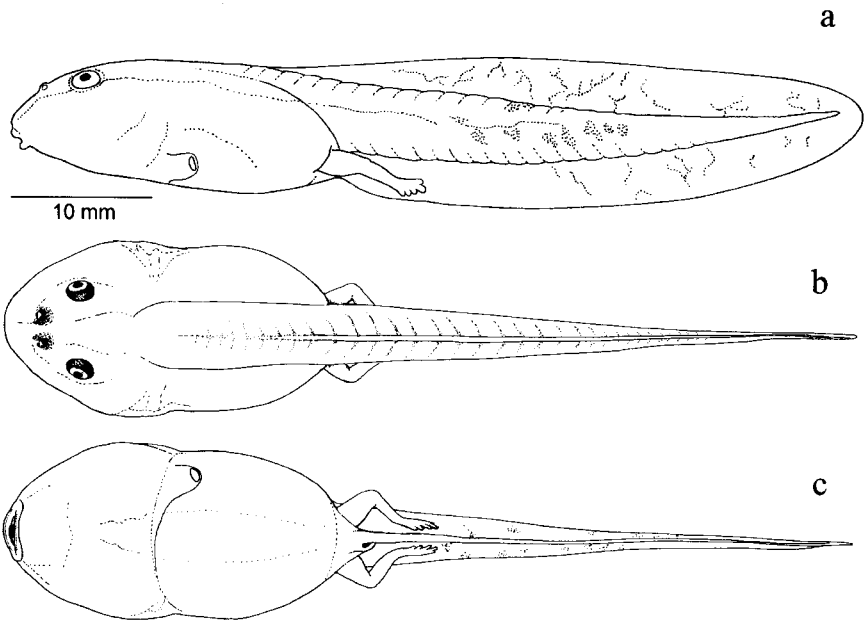

Figure 1. *Atelognathus salai* larva, (MLP A 2375, 58.8 mm, stage 36, type locality, January 21, 1997): a) lateral view; b) dorsal view; c) ventral view.

narrower gradually toward tip of tail, not reaching the end of tail; myotomes clearly visible; height of musculature at the base of the tail approximately half maximum body height; dorsal and ventral fins well and equally developed, with slightly curved margins, matching the caudal musculature; dorsal fin arises as a low, fleshy crest at body-tail junction; ventral fin arises posterior to vent tube; tail height equal to body height; maximum tail height approximately in the middle of its length; tail axis straight (eutiural); tip of tail rounded.

Oral disc anteroventral, not visible dorsally; disc small, slightly wider than interorbital distance, about 0.35 times of maximum body width; disc with angular constrictions (emarginate) (fig. 2, table 1); one row of marginal papillae in mental region, double row in lateral regions; with medium-sized rostral gap, about 0.6 times of oral disc width; intramarginal lateral papillae present, up to eight papillae in supra- and infra-angular regions; up to two papillae in intra-angular regions; intramarginal mental papillae absent; keratodonts numerous, well developed and keratinized; keratodont formula 2(2)/3(1); rostrodonts well developed and keratinized, wider than high, margins blunt serrated; suprarostrodont gently curved; infrarostrodont curved in a more noticeable angle. Suprarostrodont length 1.26 infrarostrodont length.

Coloration. In life, dorsum and body sides yellowish-brown speckled with guanophores producing a golden sheen; ventral surface golden, anteroventral region of head translucent; caudal musculature with a few dark, blurred patches on a yellowish-brown background; fins transparent; melanophore rows mark courses of blood vessels in fins and tail mus-

Table 1. Average ± standard deviation of the morphometric variables of *Atelognathus salai* larva. Stages were assigned according to Gosner (1960). Measurements are expressed in mm.

Stages	36	37	38	39	41
n	3	1	4	3	2
Total length	57.07 ± 2.5	56.85	55.11 ± 2.08	61.06 ± 0.37	58.54 ± 4.57
Body length	20.94 ± 1.89	23.14	21.79 ± 0.37	24.29 ± 0.9	22.43 ± 1.1
Tail length	35.06 ± 1.98	33.71	33.07 ± 2.14	37.19 ± 0.38	36.11 ± 3.48
Maximum body height	9.42 ± 0.28	9.87	9.46 ± 0.79	11.15 ± 0.41	9.72 ± 0.48
Maximum tail height	9.7 ± 1	10.4	9.33 ± 0.92	10.59 ± 1.61	9.2 ± 0.81
Caudal musculature height (at the base)	4.39 ± 0.25	5.12	4.65 ± 0.22	5.08 ± 0.51	5.65 ± 0.03
Maximum body width	11.89 ± 0.64	12.3	11.47 ± 1.01	13.4 ± 0.42	12.04 ± 1.89
Eye diameter	1.97 ± 0.06	2.1	2.13 ± 0.1	2.4 ± 0.1	2.45 ± 0.07
Interorbital distance	3.1 ± 0.14	3.4	2.85 ± 0.1	3.07 ± 0.12	2.75 ± 0.21
Extraocular distance	6.55 ± 0.07	6.8	6.3 ± 0.45	7.03 ± 0.15	6.8 ± 0.42
Body width (eye level)	10.69 ± 0.01	10.73	10.14 ± 0.42	11.67 ± 0.32	11.79 ± 1.29
Nostril diameter	0.23 ± 0.03	0.3	0.29 ± 0.03	0.35 ± 0.05	0.25 ± 0
Internarial distance	1.95 ± 0.08	1.95	1.79 ± 0.04	1.88 ± 0.05	1.64 ± 0.23
Extranarial distance	2.6 ± 0.14	2.6	2.48 ± 0.05	2.6 ± 0.1	2.35 ± 0.21
Body width (nostril level)	7.45 ± 0.21	7.9	7.25 ± 0.45	8.4 ± 0.1	8.63 ± 1.6
Rostronasal distance	2.27 ± 0.25	2.4	2.33 ± 0.17	2.73 ± 0.15	2.2 ± 0.14
Orbitonasal distance	1.9 ± 0.1	2.1	1.9 ± 0.18	1.87 ± 0.06	1.95 ± 0.21
Rostroorbital distance	4.6 ± 0.57	4.5	4.5 ± 0.29	4.97 ± 0.12	4.6 ± 0
Rostro-spiracular distance	12.28 ± 0.84	12.3	12.19 ± 0.59	14.2 ± 0.65	13.12 ± 0.73
Vent tube length	2.07 ± 0.06	2.00	1.93 ± 0.15	1.77 ± 0.25	–
Oral disc width	4.1 ± 0.1	4.2	4.05 ± 0.24	4.67 ± 0.15	4.45 ± 0.35
Rostral gap width	2.28 ± 0.3	2.38	2.53 ± 0.06	2.77 ± 0.15	3 ± 0.28
Suprarostrodont length	2.5 ± 0.17	2.6	2.68 ± 0.17	2.9 ± 0.1	2.85 ± 0.35
Infrarostrodont length	2.05 ± 0.35	–	2.15 ± 0.07	2.2 ± 0	2.25 ± 0.07

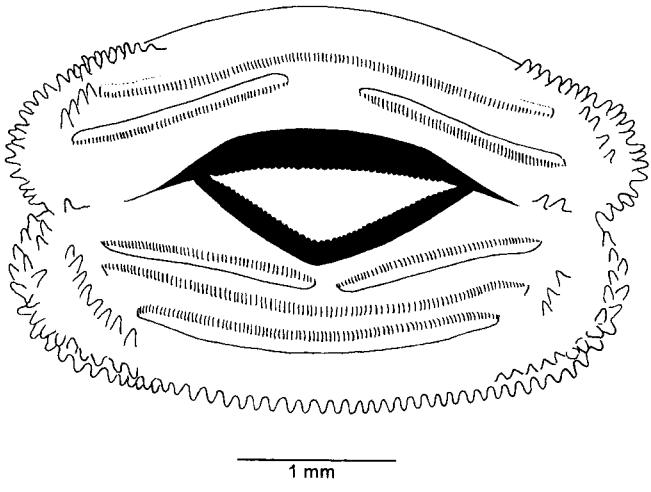

Figure 2. Oral disc of *Atelognathus salai* larva (MLP A 2373, 55.3 mm, stage 36, type locality, January 21, 1997).

culature; nostrils dark brown in median and posterior areas; iris dark, with golden flecks and reticulations; spiracular tube and vent tube translucent; keratinized structures of oral disc dark brown. In preserved specimens, the pattern of spots remains; abdomen dark; fins translucent with little pigmentation; eyes black.

Atelognathus salai larvae have the morphological and morphometric characteristics recognized by Lavilla (1988) as diagnostic for the genus *Atelognathus*, except for presence of intramarginal papillae in the angular region. The *A. salai* larva is different from the larvae of the other three known *Atelognathus* species because its vent tube is not covered by a fold of the ventral fin, and it has a double row of marginal papillae on the angular regions (see Cei, 1965, 1969; Echeverría et al., 2001). It is different from *A. patagonicus* and *A. reverberii* in having a narrower oral disc and a rounded snout in dorsal view (truncate in *patagonicus* and *reverberii*). Although Cei (1965, 1969), compiled by Altig and McDiarmid (1999), figured *A. patagonicus* and *A. reverberii* larvae with a pointed caudal end, the preserved material observed (MLP A 1222 and MACN 28467-8) clearly shows that the caudal end is rounded in both species, as well as in *A. salai* and *A. nitoi*. Like the other larvae described for the genus, *A. salai* nostrils are closer to the eyes than to the end of the snout (differing from the indication by Altig and McDiarmid, 1999).

According to its external morphology, the *A. salai* larva corresponds to the "generalized pond" form according to the classification by Orton (1953). According to its characteristics, it corresponds to benthic ecomorphological guild within exotrophic tadpoles of lentic systems (Section II.12) proposed by Altig and Johnston (1989).

Natural history. *Atelognathus salai* tadpoles develop in permanent endorheic ponds located in the hollows of a hilly area located at about 1000 m above sea level, in the ecotone between the Patagonian steppe and the temperate austral forest. Although the ponds are surrounded by steppe vegetation, they are very close to the high deciduous forest of austral beech (lenga, *Nothofagus pumilio*). The size of the two ponds where the tadpoles were seen, varies from 50 to over 200 m across; their beds and shores are made of volcanic rock, or in some parts, volcanic sand. The pond surface freezes in winter. In summer (January 21) the temperature of the waters was 17° to 18°C at 5:00 p.m. and the pH was 7.1. There are abundant submerged macrophytes (*Myriophyllum* sp.), but no fish. The ponds host a large migratory aquatic avifauna (Phoenicopteridae, Anatidae and aquatic and wading Charadriiformes).

There is very little knowledge of the reproductive biology of *Atelognathus salai*. Mating call, amplexus type and egg laying are still unknown. Larval development is entirely aquatic and the larva is an active feeder.

The tadpoles can swim fast and vigorously. Although larvae were not observed on the rocks at the bottom of the pond during the day, the presence of a large quantity of faeces on these rocks indicates that they are frequented, probably for feeding. When disturbed, tadpoles seek shelter among the cracks in the angular volcanic rocks at the bottom of

pond, where they are completely concealed. Larvae in advanced metamorphosis and relatively large newly metamorphosed juveniles (25-26 mm) were found during December and January (austral summer) in Laguna de los Gendarmes and a smaller, nearby pond. According to the size and degree of development of the larvae collected in January and the presence of recently metamorphosed juveniles in December, it may be inferred that they spend one winter in the pond and attain metamorphosis the following spring.

Juveniles stay under rocks on the shores of the ponds; while adults can be found under rocks in very dry areas, hundreds of meters away from the pond.

The other amphibian present in the area is *Pleurodema bufoninum*. Its larva is easy to distinguish from the *A. salai* larva, because *P. bufoninum* has a sinistral spiracular tube in a lateral position and its vent tube is medial and conspicuous.

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