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LOWER TELMATOBIINAE  
(ANURA: LEPTODACTYLIDAE):  
GENERIC DIAGNOSES BASED ON  
LARVAL CHARACTERS

by

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As currently recognized, the lower Telmatobiinae includes three tribes and 14 genera (Lynch, 1978; Laurent, 1983; Lavilla, 1983). These are, as follows: Batrachylini (*Batrachyla* and *Thoropa*), Calyptocephalellini (*Caudiverbera* and *Telmatobufo*), and Telmatobiini (*Alsodes*, *Atelognathus*, *Batrachophrynus*, *Eupsophus*, *Hylorina*, *Insuetophrynus*, *Limnomedusa*, *Lynchophrys*, *Somuncuria*, and *Telmatobius*).

Larval characters have been used, often with differing results, in the taxonomic arrangements of anurans. Among the lower Telmatobiinae, for example, there have been some attempts to define genera using features of tadpole morphology (e.g., Lynch [1971] for leptodactyloid genera, Heyer [1975] for leptodactylid genera, and Formas [1975, 1976] for some lower telmatobiine genera).

The following diagnoses include nine morphological units, with 16 characters relating to larval morphology, and two non-morphological units, with four characters relating to reproductive mode and larval behavior. The larvae of all genera except *Lynchophrys* are diagnosed in the accounts that follow.

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## MATERIALS AND METHODS

Descriptions are based on tadpoles in developmental stages 31–35 of Gosner's (1960) table. Characters employed in the generic diagnoses are those that vary intergenerically but show little or no intrageneric variation. Each character is numbered (1–20) and the character states are designated as "A," "B," "C," etc. The rank of sequential character states in no way implies polarities. A data matrix of characters is provided in Table 1.

Table 1.—Character states of lower telmatobiine anuran larvae. See Morphological and Non-Morphological Character States for explanation of characters 1–20 and character states. Taxonomic abbreviations: THOR = *Thoropa*; BCHY = *Batrachyla*; CDVB = *Caudiverbera*; TMBF = *Telmatobufo*; ALSO = *Alsodes*; ATEL = *Ate-lognathus*; BTCO = *Batrachophrynus*; EUPS = *Eupsophus*; HYLO = *Hylorina*; INSU = *Insuetophrynus*; LIMN = *Limnomedusa*; SOMU = *Somuncuria*; TELM = *Telmatobius*. \* = variable character.

Taxon	Character																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
THOR	A	A	A	F	B	B	A	A	A	B	A	A	A	B	A	B*B	B	B	A	
BCHY	A	A	A	C	B	A	A	A	A	A	A	B*B*	A	A	A	B	B	B	A	
CDVB	A	A	A	E	B	A	A	A	B	A	A	A	B	A	A	A	A	A	A	
TMBF	B	A	B	F	A	A	A	A	A	A	A	A	B	B	B	A	A	A	A	
ALSO	A	A*A	C	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	
ATEL	A	A	A	C	B	A	A	B	A	B	A	A	B	A	A	A	A	A	A	
BTCO	A	B	A	A	B	A	A	A	A	A	A	A	B	A	A	A	A	A	A	
EUPS	A	A	A	F	B	A	B	A	A	A	A	A	A	A	A	A	B	B	B	
HYLO	A	A	A	C	B	A	A	A	A	A	A	A	B	A	A	A	B	A	A	
INSU	A	B	A	F	B	A	B	A	A	A	B	A	B	A	A	A	A	A	A	
LIMN	A	A	A	D	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
SOMU	A	A	A	E	B	A	A	A	A	A	A	A	B	A	A	A	A	A	A	
TELM	A	B	A	B	B*	A	A	A	A	A	A	A	B	A	A	A	A	A	A	

## MORPHOLOGICAL CHARACTER STATES

**Oral Disc.** Known also as "lips," the oral disc (Fig. 1) is the fleshy structure that surrounds the mouth in nearly all Type III and IV larvae. Laterally, it is possible to recognize three regions, important in the definition of papillae position. The oral angle region is the midlateral area on either side of the disc along which the oral disc can be folded; the area above the oral angle is termed the supraangular region, and the area below, the infraangular. The upper margin of the oral disc is designated the rostral region and the lower margin, the mental region.

The most important characters related to the oral disc are its size and the presence or absence of constrictions.

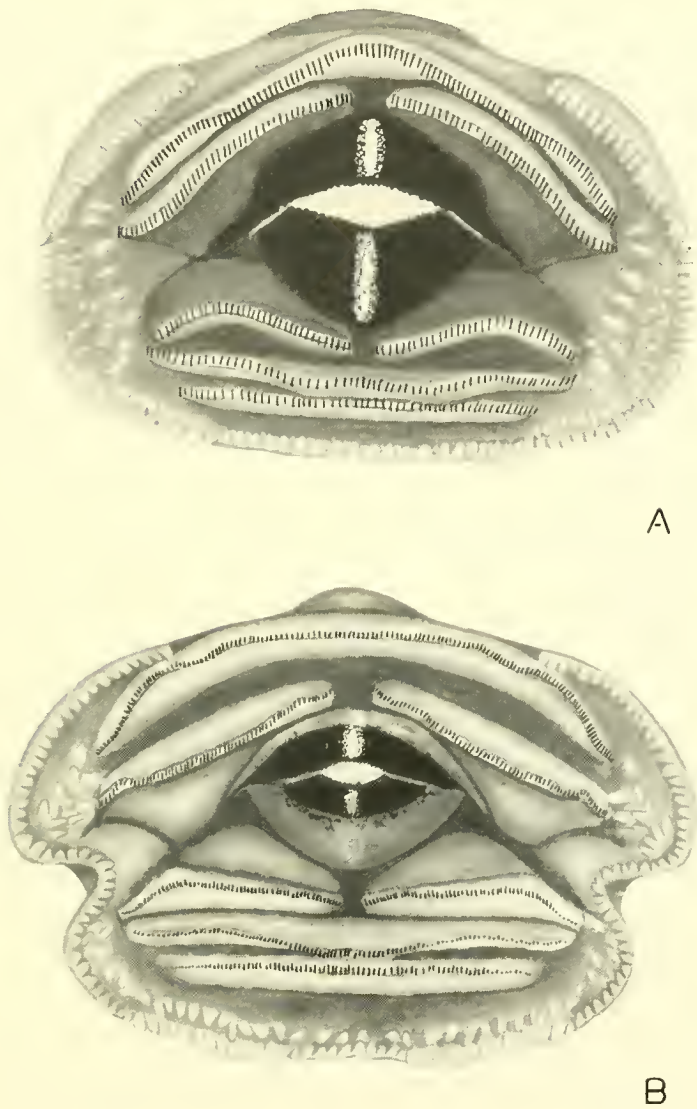


Fig. 1.—Oral discs of lower telmatobiine tadpoles. A. *Telmatobius*, showing transangular margin, intramarginal lateral papillae in angular area, and absence of intramarginal mental row of papillae. B. *Limnomedusa*, showing intranagular margin, intramarginal lateral papillae in supra- and infraangular regions and absence of papillae in angular area, and presence of intramarginal mental row of papillae.

1. *Width of Oral Disc.* A small oral disc has a width less than two-thirds that of maximum body width, whereas the width of a large oral disc is greater than two-thirds maximum body width.

A. Less than two-thirds maximum body width.

B. Greater than two-thirds maximum body width.

2. *Lateral Margins of Oral Disc.* If constrictions are present in the oral angle of the lateral margin, the disc is defined as intraangular, whereas if they are absent, the disc is termed transangular.

A. Intraangular.

B. Transangular.

**Oral Papillae.** Depending upon the distribution of these fleshy projections from the oral disc (Fig. 1), it is possible to recognize two different patterns of papillae. Marginal papillae lie along the periphery of the disc; their presence frequently gives the disc an indented appearance. If marginal papillae are absent in part or all of the rostral region, the gap is known as the rostral gap. Intramarginal papillae are the inner papillae of the oral disc; these may be subdivided regionally into rostral, mental, and lateral intramarginal papillae.

The most important characters related to oral papillae are the presence or absence of a rostral gap and the disposition of the intramarginal rows.

3. *Rostral Gap.*

A. Present.

B. Absent.

4. *Intramarginal Lateral Papillae.*

A. Uninterrupted laterally.

B. Present in the angular region and present or absent in the supra- and infraangular areas; if present in the latter areas, there are fewer papillae than when the intramarginal row is uninterrupted.

C. Papillae present in the infra- and supraangular regions, but absent in the angular area.

D. Papillae present only in the supraangular region.

E. Papillae present only in the infraangular area.

F. Papillae absent.

5. *Intramarginal Mental Papillae.*

A. Present.

B. Absent.

**Rostrodonts.** These keratinized structures (Fig. 2C, D) surrounding the mouth are also known as "horny beaks." I follow the terminology of Van Dijk (1966), who recognized a suprarostrodont (=upper beak) associated with the suprarostril cartilage, and an infrarostrodont (=lower beak) associated with the infrarostril cartilage.

6. *Rostrodont Shape.*

A. Wider than high.

B. Higher than wide.

**Keratodonts.** Van Dijk (1966) applied the name keratodont to the keratinized structures occurring in rows on the oral disc (Fig. 1). They are also known as "horny teeth," "odontoids," and "denticles." I consider a normal complement of keratodonts to be two upper and three lower rows. Animals having fewer rows have a reduced keratodont formula.

7. *Keratodont Formula.*

A. 2/3.

B. Reduced (i.e., fewer than 2/3).

**Nostrils.**

8. *Level of Nostril Aperture* (Fig. 2A, B).

A. Not raised (i.e., flush, or partially or completely depressed).

B. Raised.



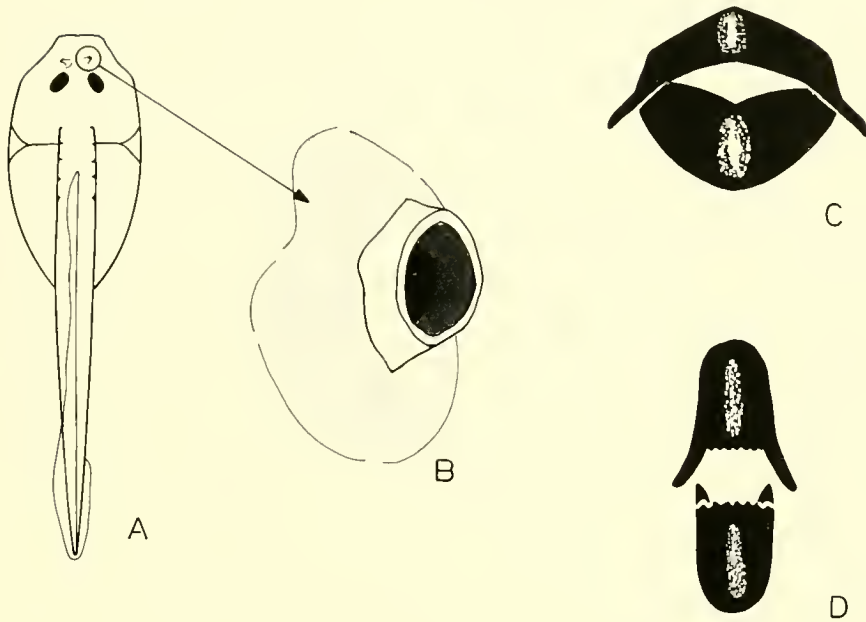


Fig. 2.—Larval characters of lower telmatobiine tadpoles. A. General view of *Atelognathus*, showing raised nostrils. B. Detail of nasal chamber (shaded area) and nasal tube of *Atelognathus*. C. Rostrodont that is wider than high, the general condition of lower telmatobiine larvae. D. Rostrodont that is higher than wide, a feature characterizing *Thoropa*.

The rostronasal position is defined by the ratio between the frontonasal distance (i.e., the distance from tip of snout to anterior border of nostrils; FN) and nasoocular distance (i.e., the distance from the posterior border of nostrils to anterior border of eye; NO).

9. Value of FN/NO Ratio.

- A. Greater than 1.0.
- B. Less than 1.0.

**Spiracle.**

10. Position of Sinistral Spiracle.

- A. Lateral.
- B. Ventral.

The location of the spiracle (Fig. 3) along the longitudinal axis of the body is defined by the ratio between the rostro-spiracular distance (i.e., the distance from the tip of the snout to the midpoint of the spiracular opening; RSD), and the spiracular-posterior position (i.e., the distance from the midpoint of the spiracular opening to the base of the proctodeal tube if it is present. If a proctodeal tube is not present, the posterior limit of the body is interpreted as the border between the body and the caudal musculature, ventrally; SPD).

11. Value of RSD/SPD Ratio.

- A. Greater than 1.0.
- B. Less than 1.0.

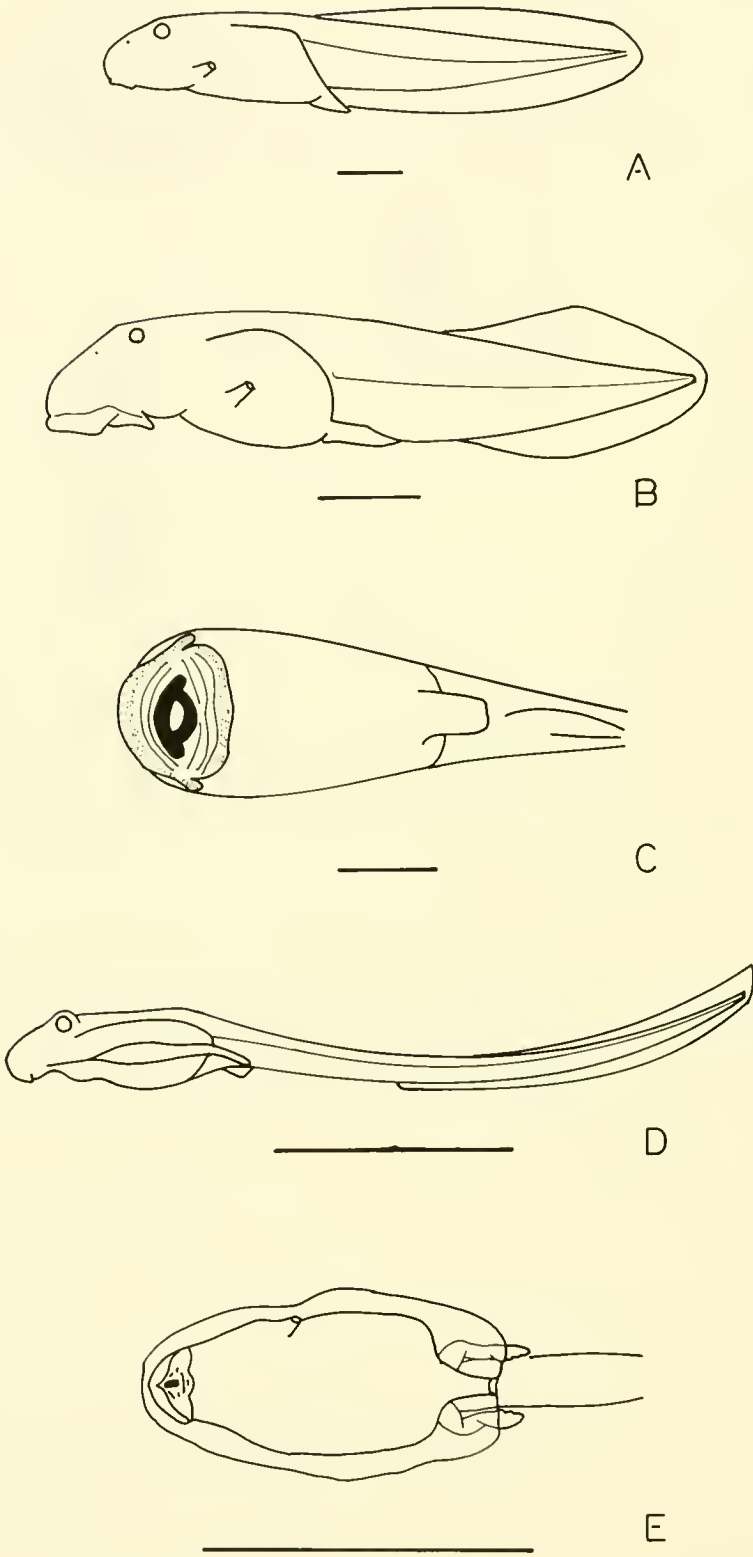


Fig. 3.—Larval characters of lower telmatobiine tadpoles. A. *Telmatobius*; spiracle lateral and sinistral, tail fins not reduced. B. *Telmatobufo*; reduced tail fins, oral disc modified as sucker. C. *Thoropa*; spiracle ventral and sinistral, tail fins reduced, oral disc normal, abdominal sucker present. Bars = 1 cm.

**Vent.**12. *Proctodeal Tube.*

A. Present.

B. Absent.

13. *Orientation of Vent* (Fig. 4).

A. Opening at midline.

B. Opening dextrally.

**Tail.** Usually, the tail fins (Fig. 3) originate on the anterior third of the caudal musculature. If fins are reduced, they originate on the posterior two-thirds of the length of the caudal musculature.

14. *Size of Tail Fins.*

A. Normal.

B. Reduced.

**Special Features.**15. *Oral Disc Modified as Sucker* (Fig. 3).

A. Absent.

B. Present.

16. *Abdominal Sucker* (Fig. 3).

A. Absent.

B. Present.

## NON-MORPHOLOGICAL CHARACTER STATES

**Reproductive Strategies.**17. *Egg Deposition.*

A. In water.

B. Out of water, or in special situations (described in each case).

18. *Larval Hatching.*

A. In water.

B. Out of water, or in special situations (described in each case).

19. *Larval Development.*

A. In water.

B. Out of water, or in special situations (described in each case).

**Larval Behavior.**20. *Larval Feeding.*

A. Active.

B. Non-feeding larvae.

## RESULTS

## GENERIC DIAGNOSES OF LOWER TELMATOBIIINAE

*Thoropa*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae absent; intramarginal mental papillae

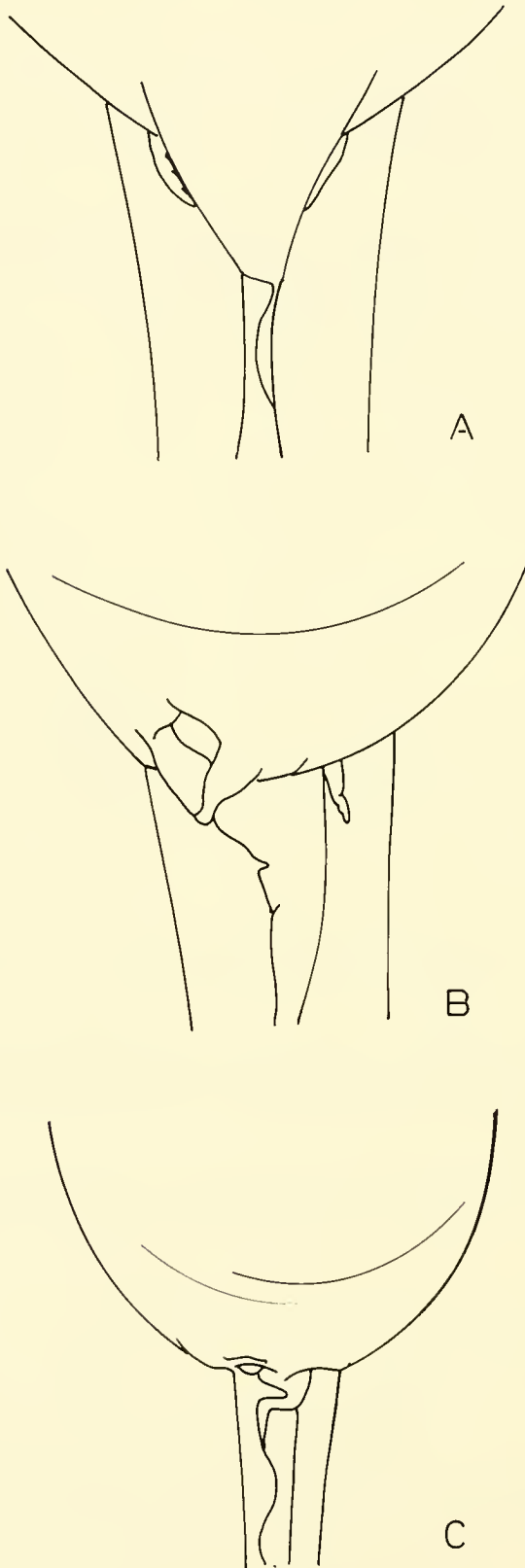


Fig. 4.—Variation in the protodeal tube among lower telmatobiine larvae. A. Tube present and not reduced (most genera). B. Tube reduced (*Hylorina*). C. Tube absent (*Batrachyla*).

absent. Rostrodonts deeper than wide; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position ventrally sinistral; RSD/SPD > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening at midline. Tail fins reduced. Oral disc sucker absent; abdominal sucker present (except in *T. miliaris*). Eggs, hatching, and larval development on wet stones covered by a thin film of water. Larvae active feeders.

**Content.** Four species: *T. lutzi*, *T. miliaris*, *T. megatympanum*, and *T. petropolitana*.

**Distribution.** Mountain ranges of SE Brazil.

**Total length.** 24.7–35.1 mm. The lowest values are shown by *T. miliaris*, and the highest by *T. petropolitana*; *T. megatympanum* was not considered.

### *Batrachyla*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae present in infra- and supraangular regions, but not in angular area; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube absent (except in *B. leptopus*); vent opening dextrally (except in *B. leptopus*). Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs laid in vegetation out of water; hatching and first larval stages out of water; larvae reaching water by active movement. Larvae active feeders.

**Content.** Three species: *B. antartandica*, *B. leptopus*, and *B. taeniata*.

**Distribution.** *Nothofagus* forest in Chile and Argentina. *Batrachyla taeniata* also occurs in nonforested habitat south to Valparaiso (approx. 32° S).

**Total length.** 21.3–36.6 mm. The lowest values are shown by *B. leptopus* and the highest by *B. antartandica*.

### *Caudiverbera*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae present only in infraangular region; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)], poorly developed. Level of nostril aperture not raised; FN/NO < 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** Monotypic: *Caudiverbera caudiverbera*.

**Distribution.** In Chile, from Aconcagua Province to Puerto Mont. Fossils known from Oligocene of Patagonia (Argentina).

**Total length.** 60.5–73.7 mm.

*Telmatobufo*

**Diagnosis.** Oral disc large; lateral margins intraangular; rostral gap absent; intramarginal lateral papillae absent; intramarginal mental papillae present. Rostrodonts wider than deep; keratodont formula normal, fused [(2)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins reduced. Oral disc sucker present; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** Three species: *T. australis*, *T. bullocki*, and *T. venustus*.

**Distribution.** Restricted populations in *Nothofagus* forest in southern Chile.

**Total length.** 52.1–58.8 mm for *T. australis*.

*Alsodes*

**Diagnosis.** Oral disc small, lateral margins intraangular (except *A. monticola*, with transangular margin); rostral gap present; intramarginal lateral papillae present in infra- and supraangular regions, but not in angular area; intramarginal mental papillae present. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** Ten species: *A. barrioi*, *A. gargola* (with two subspecies), *A. laevis*, *A. monticola*, *A. montanus*, *A. nodosus*, *A. pehuenche*, *A. tumultuosus*, *A. vanzolini*, and *A. verrucosus*.

**Distribution.** In *Nothofagus* forest of Chile and Argentina, central Chile, and northern Patagonia (Argentina).

**Total length.** 39.8–77.1 mm. The lowest value is shown by *A. gargola neuquensis*, and the highest by *A. tumultuosus*. The larvae of *A. laevis*, *A. vanzolini*, and *A. verrucosus* were not considered.

*Atelognathus*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae in supra- and infraangular regions but not in angular area; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture raised, opening at tip of a short nasal tube; FN/NO > 1.0. Spiracle position abdominal sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** Seven species: *A. grandisonae*, *A. nitoi*, *A. patagonicus*, *A.*

*praebasalticus* (four subspecies), *A. reberverii*, *A. salai*, and *A. solitarius*.

**Distribution.** *Nothofagus* forest of Chile and Argentina, Patagonia, and Meseta de Somuncura (Argentina).

**Total length.** 38.8–53.3 mm. The lowest value is shown by *A. patagonicus* and the highest by *A. reberverii*. Only these two taxa were considered.

### *Batrachophrynus*

**Diagnosis.** Oral disc small; lateral margins transangular; rostral gap present; intramarginal lateral papillae present uninterrupted in lateral region; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** Monotypic: *Batrachophrynus macrostomus*.

**Distribution.** Departamento Junin, Peru.

**Total length.** 98.6–127.6 mm.

### *Eupsophus*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae absent; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula reduced [(1) (1-1)/(1-1) (1)], poorly developed. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening medially. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in tiny reservoirs of water. Non-feeding larvae.

**Content.** Five species: *E. calcaratus*, *E. insularis*, *E. miqueli*, *E. roseus*, and *E. vitattus*.

**Distribution.** In *Nothofagus* forest of Chile and Argentina.

**Total length.** 16.7–21.5 mm for *E. roseus* (the only species considered).

### *Hylorina*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae present in supra- and infraangular regions but not in angular area; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (1)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present, small; vent opening dextrally. Tail fins not reduced. Oral disc sucker absent; abdominal sucker absent. Eggs laid in vegetation out of water; hatching and larval development in water. Larvae active feeders.

**Content.** Monotypic: *Hylorina sylvatica*.

**Distribution.** *Nothofagus* forest of Chile and Argentina.

**Total length.** 48.1–53.0 mm.

*Insuetophrynus*

**Diagnosis.** Oral disc small, lateral margins transangular; rostral gap present; intramarginal lateral papillae absent; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula reduced [(1) (1-1)/(2-2), with infraangular rows vestigial or absent]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD < 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** Monotypic: *Insuetophrynus acarpicus*.

**Distribution.** *Nothofagus* forest of Valdivia Province, Chile.

**Total length.** 48.7–49.6 mm.

*Limnomedusa*

**Diagnosis.** Oral disc small; margins intraangular; rostral gap present; intramarginal lateral papillae present only in supraangular region; intramarginal mental papillae absent (marginal papillae in multiple rows mentally). Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening medially. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development out of water. Larvae active feeders.

**Content.** Monotypic: *Limnomedusa macroglossa*.

**Distribution.** Uruguay, NE Argentina, SE Brazil, and Paraguay (?).

**Total length.** 40.7–42.5 mm.

*Somuncuria*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap present; intramarginal lateral papillae present only in infraangular region; intramarginal mental papillae absent. Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water.

**Content.** Monotypic: *Somuncuria somuncurensis*.

**Distribution.** Meseta de Somuncura, Rio Negro Province, Argentina.

**Total length.** 35.1–41.8 mm.

*Telmatobius*

**Diagnosis.** Oral disc small; lateral margins intraangular; rostral gap



present; intramarginal lateral papillae present in angular area; present or not in supra- and infraangular regions, but if present, fewer than in *Batrachophrynus*; intramarginal mental papillae following two patterns—present in the most austral taxa (i.e., Argentinian forms), and absent in septentrional taxa (i.e., in Bolivia, Chile, Peru, and Ecuador). Rostrodonts wider than deep; keratodont formula normal [(1) (1-1)/(1-1) (2)]. Level of nostril aperture not raised; FN/NO > 1.0. Spiracle position lateral sinistral; RSD/SPD > 1.0. Proctodeal tube present; vent opening dextrally. Tail fins normal. Oral disc sucker absent; abdominal sucker absent. Eggs, hatching, and larval development in water. Larvae active feeders.

**Content.** About 28 species, and 55 subspecies.

**Distribution.** Highlands of Argentina, Bolivia, Chile, Peru, and Ecuador, from San Juan Province (Argentina) to Imbabura Province (Ecuador).

**Total length.** Extreme measurements for tadpoles of 36 taxa: 46.7–95.9 mm. The lowest value is shown by *T. culeus culeus*, and the highest by *T. marmoratus angustipes*.

## COMMENTS

The genera of lower telmatobiines characteristically have been defined by features of the adults. Larval characters are not concordant with the generic grouping of species in three recognized genera.

*Telmatobius*. In a previous paper (Lavilla, 1985), I proposed the recognition of two “species groups” in *Telmatobius*. The southern group includes those taxa from the highlands of Argentina, characterized by the presence of an intramarginal mental row of papillae in the oral disc (a character shared with *Alsodes*, *Limnomedusa*, and *Telmatobufo*, but not with the northern taxa). The northern group is characterized by the absence of the aforementioned row of papillae and includes the known larvae from Chile, Bolivia, Peru, and Ecuador.

*Alsodes*. Tadpoles of *Alsodes monticola* are morphometrically different from the other species of the genus (Lavilla and Scrocchi, 1986). Moreover, larvae of this taxon have a transangular oral disc, a character shared with *Batrachophrynus*, *Insuetophrynus*, and *Telmatobius*, but not with the other *Alsodes*.

*Batrachyla*. Two species of this genus (*B. antartandica* and *B. taeniata*) are characterized by the absence of a proctodeal tube and presence of a dextral vent. This condition is not shared by *Batrachyla leptopus* which has a short proctodeal tube with median aperture.

## KEY TO THE GENERA OF THE LOWER TELMATOBIINAE BASED ON LARVAL CHARACTERS

- 1a. Oral disc large (>2/3 body width), modified as a sucker; rostral gap absent; keratodont formula [(2)/(1-1) (2)] .....*Telmatobufo*

- 1b. Oral disc small ( $<2/3$  body width), not modified as a sucker; rostral gap present; keratodont formula [(1) (1-1)/(1-1) (2)], or reduced .....2
- 2a. Rostrodonts wider than high; without abdominal sucker; tail fins origin normal; without rupicole habits .....3
- 2b. Rostrodonts higher than wide; generally with abdominal sucker; tail fins origin reduced; with rupicole habits .....*Thoropa*
- 3a. Keratodont formula [(1) (1-1)/(1-1) (2)] .....5
- 3b. Keratodont formula reduced .....4
- 4a. Oral angle constrictions present; ratio RSD/SPD  $> 1$ ; vent opens medially; eggs, hatching, and larval development in tiny water reservoirs; non-feeding larvae .....*Eupsophus*
- 4b. Oral angle constrictions absent; ratio RSD/SPD  $< 1$ ; vent opens dextrally; eggs, hatching, and larval development in normal situations; actively feeding larvae .....*Insuetophrynus*
- 5a. Abdominal spiracle; nostrils raised, at the end of a short nasal tube .....*Atelognathus*
- 5b. Lateral spiracle; nostrils not raised, open totally or partially flush or in a little depression .....6
- 6a. Proctodeal tube absent .....*Batrachyla* (part)
- 6b. Proctodeal tube present .....7
- 7a. Ratio FN/NO  $< 1$  .....*Caudiverbera*
- 7b. Ratio FN/NO  $> 1$  .....8
- 8a. Oral disc intraangular .....9
- 8b. Oral disc transangular .....13
- 9a. Intramarginal mental row of papillae absent .....10
- 9b. Intramarginal row of papillae present .....*Alsodes* (part)
- 10a. Vent median .....*Batrachyla* (part)
- 10b. Vent dextral .....11
- 11a. Intramarginal lateral papillae present in supra- and infraangular regions, but not in angular area; eggs laid out of water .....*Hylorina*
- 11b. Intramarginal lateral papillae present only in one of the two regions; eggs laid in water .....12
- 12a. Intramarginal lateral papillae present only in supraangular region .....*Limnomedusa*
- 12b. Intramarginal lateral papillae present only in infraangular region .....*Somuncuria*

- 13a. Intramarginal mental row of papillae present .....14  
 13b. Intramarginal mental row of papillae absent .....15
- 14a. Intramarginal lateral papillae only in supra-angular region (infraangular papillae mixed with mental row); angular area without papillae .....*Alsodes* (part)  
 14b. Intramarginal lateral papillae in angular area; may be present, in low numbers, in supra- and infraangular regions .....*Telmatobius* (part)
- 15a. Intramarginal lateral papillae uninterrupted in lateral region .....  
 .....*Batrachophrynus*  
 15b. Intramarginal lateral papillae in angular area; may be present, in low numbers, in supra- and infraangular regions .....*Telmatobius* (part)

### LITERATURE ON TELMATOBIINE TADPOLES

The following are references to papers dealing with Telmatobiinae tadpoles.

#### BATRACHYLINI

*Thoropa*.—*lutzi*: Bokermann (1965), Lavilla (1983); *megatypanum*: Caramaschi and Sazima (1984); *miliaris*: Bokermann (1965), Lavilla (1983), Wassersug and Heyer (1983); *petropolitana*: Bokermann (1965), Heyer and Crombie (1979), Lavilla (1983), Wassersug and Heyer (1983).

*Batrachyla*.—*antartandica*: Barrio (1967a), Formas (1976), Cei (1980), Lavilla (1983); *leptopus*: Busse (1971), Formas (1976), Cei (1980), Lavilla (1983); *taeniata*: Cei and Capurro (1958), Cei (1962), Formas (1976), Cei (1980), Lavilla (1983).

#### CALYPTOCEPHALELLINI

*Telmatobufo*.—*australis*: Formas (1972), Lavilla (1983); *venustus*: Diaz et al. (1983).

*Caudiverbera*.—*caudiverbera*: Krieg (1924), Cei (1962), Jorquera and Izquierdo (1964), Lavilla (1983), Diaz and Valencia (1985).

#### TELMATOBIINI

*Alsodes*.—*barrioi*: Veloso et al. (1981), Lavilla (1983); *gargola*: Gallardo (1970), Cei (1980), Lavilla (1983); *monticola*: Formas (1975), Lavilla (1983); *montanus*: Busse (1980), Lavilla (1983), Lavilla and Scrocchi (1986); *nodosus*: Cei (1962), Formas (1975), Lavilla (1983); *pehuenche*: Cei (1980), Lavilla (1983); *tumultuosus*: Lavilla (1983), Diaz and Valencia (1985).

*Atelognathus*.—*patagonicus*: Cei (1965), Cei (1980), Lavilla (1983);

*reberverii*: Cei (1980), Lavilla (1983).

*Batrachophrynus*.—*macrostomus*: Lavilla (1983).

*Eupsophus*.—*roseus*: Formas and Pugin (1978a), Cei (1980), Formas and Vera (1980), Lavilla (1983); *vittatus*: Formas and Pugin (1978b), Formas and Vera (1980).

*Hylorina*.—*sylvatica*: Barrio (1967b), Formas and Pugin (1978b), Cei (1980), Formas and Vera (1980), Lavilla (1983).

*Insuetophrynus*.—*acarpicus*: Formas et al. (1980), Lavilla (1983).

*Limnomedusa*.—*macroglossa*: Cei (1980), Gehrau and de Sa (1980), Gudynas and Gerhau (1981), Lavilla (1983).

*Somuncuria*.—*somuncurensis*: Cei (1980), Lavilla (1983).

*Telmatobius*.—*albiventris*: Vellard (1951), Lavilla (1983, 1985); *arequipensis*: Lavilla (1983, 1985); *atacamensis*: Gallardo (1962), Cei (1980), Lavilla (1983, 1985); *ceiorum*: Cei (1980), Lavilla (1983, 1984b, 1985); *crawfordi*: Vellard (1953), Lavilla (1983, 1985); *culeus*: Lavilla (1983, 1985); *halli*: Cei (1962), Lavilla (1983, 1985); *hauthali*: Koslowsky (1895), Fernandez (1926), Lavilla (1983, 1984a, 1985); *hauthali pisanoi*: Lavilla (1983, 1984b, 1985); *jelski*: Vellard (1951), Lavilla (1983, 1985); *laticeps*: Cei (1980), Lavilla (1983, 1984b); *marmoratus*: Vellard (1951), Cei (1980), Lavilla (1983, 1985); *niger*: Trueb (1979); *oxycephalus*: Cei (1980), Lavilla (1983, 1985); *pefauri*: Lavilla (1983, 1985), Diaz and Valencia (1985); *peruvianus*: Schmidt (1928), Vellard (1951), Cei (1962), Lavilla (1983, 1985); *rimac*: Lavilla (1983, 1985); *schreiteri*: Vellard (1946), Cei (1980), Lavilla (1985); *stephani*: Lavilla (1983, 1985); *vellardi*: Trueb (1979).

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## LITERATURE CITED

- Barrio, A. 1967a. *Batrachyla antartandica* n. sp. (Anura: Leptodactylidae). Descripción y estudio comparativo con la especie genotípica *B. leptopus* Bell. *Physis* (Bs.As.) 27(74):101-109.
- Barrio, A. 1967b. Observaciones eco-etológicas sobre *Hylorina sylvatica* Bell (Anura: Leptodactylidae). *Physis* (Bs.As.) 27(74):153-157.
- Bokermann, W. C. A. 1965. Nota sobre as especies de *Thoropa* Fitzinger (Amphibia: Leptodactylidae). *An. Acad. Bras Ciencias* 57(3-4):525-537.

- Busse, K. 1971. Desarrollo de *Batrachyla leptopus* Bell con observaciones sobre su ecología y comportamiento (Amphibia: Leptodactylidae). *Inv. Zool. Chil.* 15:5–63.
- Busse, K. 1980. Zur Morphologie und Biologie von *Telmatobius montanus* Lataste 1902, nebst Beschreibung seine Larve (Amphibia: Leptodactylidae). *Amphibia-Reptilia* 1:113–125.
- Caramaschi, U. and I. Sazima. 1984. Uma nova especie de *Thoropa* da Serra do Cipó, Minas Gerais, Brazil (Amphibia: Leptodactylidae). *Rev. Bras. Zool.* 2(3):139–146.
- Cei, J. M. 1962. Batracios de Chile. Ed. Universidad de Chile. cviii + 128 pp.
- Cei, J. M. 1965. The tadpole of *Batrachophrynus patagonicus* Gallardo. *Herpetologica* 20(4):242–245.
- Cei, J. M. 1980. Amphibians of Argentina. *Monitore Zool. Ital. (N.S.)*, Monogr. 2:xii + 609 pp.
- Cei, J. M. and L. F. Capurro. 1958. Biología y desarrollo de *Eupsophus taeniatus* Girard. *Inv. Zool. Chil.* 4:77–82.
- Diaz, N., M. Sallaberry, and H. Nuñez. 1983. The tadpole of *Telmatobufo venustus* (Anura: Leptodactylidae) with considerations of generic relationships. *Herpetologica* 39(2):111–113.
- Diaz, N. and J. Valencia. 1985. Larval morphology and phenetic relationships of the Chilean *Alsodes*, *Telmatobius*, *Caudiverbera* and *Insuetophrynus* (Anura: Leptodactylidae). *Copeia* 1985:175–181.
- Fernandez, K. 1926. Sobre la biología y reproducción de batracios argentinos. *Bol. Acad. Nac. Cienc. Córdoba* 29:271–320.
- Formas, J. R. 1972. A second species of Chilean frog genus *Telmatobufo* (Anura: Leptodactylidae). *J. Herpetol.* 6:1–3.
- Formas, J. R. 1975. Las larvas de las especies chilenas pertenecientes al género *Eupsophus* grupo *nodosus* (Anura: Leptodactylidae). *Bol. Soc. Biol. Concepcion* 49:231–237.
- Formas, J. R. 1976. Descriptions of *Batrachyla* tadpoles. *J. Herpetol.* 10:221–225.
- Formas, J. R., N. F. Diaz, and J. Valencia. 1980. The tadpole of the Chilean frog *Insuetophrynus acarpicus*. *Herpetologica* 36(4):316–318.
- Formas, J. R. and E. Pugin. 1978a. Tadpoles of *Eupsophus roseus* and *Bufo variegatus* in southern Chile. *J. Herpetol.* 12:243–246.
- Formas, J. R. and E. Pugin. 1978b. Tadpoles of *Hylorina sylvatica*, *Eupsophus vittatus* and *Bufo rubropunctatus* in southern Chile. *Herpetologica* 34(4):355–358.
- Formas, J. R. and M. A. Vera. 1980. Reproductive patterns of *Eupsophus roseus* and *Eupsophus vittatus*. *J. Herpetol.* 14(1):11–14.
- Gallardo, J. M. 1962. Los géneros *Telmatobius* y *Batrachophrynus* en la Argentina (Amphibia: Leptodactylidae). *Neotropica* 8(26):45–58.
- Gallardo, J. M. 1970. A propósito de los Telmatobiinae (Anura: Leptodactylidae) patagónicos. *Neotropica* 16(50):73–85.
- Gehrau, A. and R. de Sa. 1980. Comunicación preliminar sobre larvas de *Limnodynastes macroglossa* (Amphibia: Leptodactylidae). *Res. J. C. Nat. Montevideo* 1:85–86.
- Gosner, K. L. 1960. A simplified table for staging anuran tadpoles and embryos, with notes on identification. *Herpetologica* 16:183–190.
- Gudynas, E. and A. Gehrau. 1981. Notas sobre la distribución y ecología de

- Limnomedusa macroglossa* (Dumeril & Bibron, 1841) en Uruguay (Anura: Leptodactylidae). IHERINGIA, Ser. Zool., Porto Alegre 60:81–99.
- Heyer, W. R. 1975. A preliminary analysis of the intergeneric relationships of the frog family Leptodactylidae. Smithsonian Cont. Zool. 199:1–55.
- Heyer, W. R. and R. I. Crombie. 1979. Natural history notes on *Craspedoglossa stejneri* and *Thoropa petropolitana* (Amphibia, Salientia: Leptodactylidae). J. Wash. Acad. Sci. 69(1):17–20.
- Jorquera, B. and L. Izquierdo. 1964. Tabla de desarrollo normal de *Calyptocephalella gayi* (rana chilena). Biologica 36:46–53.
- Koslowsky, J. 1895. Batracios y reptiles de Rioja y Catamarca recogidos durante los meses de Febrero a Mayo de 1895. Rev. Mus. La Plata VI:1–14 + 4 pl.
- Krieg, H. 1924. Biologische Reisestudien in Sudamerika. II. *Rhinoderma* und *Calyptocephalus*. Zeitschr. Morph. Okologie der Tiere 3(1):150–168.
- Laurent, R. F. 1983. Heterogeneidad del género *Batrachophrynus* Peters. Acta Zool. Lilloana 37(1):107–113.
- Lavilla, E. O. 1983. Sistemática de larvas de Telmatobiinae (Anura: Leptodactylidae). Ph.D. Dissertation. Fac. Cs. Nat. Univ. Nac. Tucuman, Argentina. v + 354 pp.
- Lavilla, E. O. 1984a. Redescubrimiento de *Telmatobius hauthali* Koslowsky, 1895, y descripción de su larva. Acta Zool. Lilloana 38:51–57.
- Lavilla, E. O. 1984b. Larvas de *Telmatobius* (Anura: Leptodactylidae) de la Provincia de Tucuman (Argentina). Acta Zool. Lilloana 38:69–79.
- Lavilla, E. O. 1985. Diagnósis genérica y agrupación de las especies de *Telmatobius* (Anura: Leptodactylidae) en base a caracteres larvales. Physis (Bs.As.) B 43(105):63–67.
- Lavilla, E. O. and G. J. Scrocchi. 1986. Morfometría larval de los géneros de Telmatobiinae (Anura: Leptodactylidae) de Argentina y Chile. Physis (Bs.As.) B 44(106):39–43.
- Lynch, J. D. 1971. Evolutionary relationships, osteology and zoogeography of Leptodactyloid frogs. Univ. Kansas Mus. Nat. Hist. Misc. Publ. 53:1–238.
- Lynch, J. D. 1978. A re-assessment of the Telmatobiinae leptodactylid frogs of Patagonia. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 72:1–57.
- Philippi, R. A. 1902. Suplemento a los Batraquios chilenos descritos en la Historia Física y Política de Chile de don Claudio Gay. Santiago, Chile. 161 pp.
- Schmidt, K. P. 1928. The Chilean frogs of the genus *Telmatobius*. Rev. Chil. Hist. Nat. 32:98–105.
- Trueb, L. 1979. Leptodactylid frogs of the genus *Telmatobius* in Ecuador, with the description of a new species. Copeia 1979:714–733.
- Van Dijk, D. E. 1966. Systematics and field keys to the families, genera and described species of southern Africa anuran tadpoles. Ann. Natal Mus. 18(2):231–286.
- Vellard, J. 1946. El género *Telmatobius* en la República Argentina. Acta Zool. Lilloana 3:313–326.
- Vellard, J. 1951. Estudios sobre batracios andinos. I. El grupo *Telmatobius* y formas afines. Mem. Mus. Hist. Nat. Javier Prado 1:89 pp.
- Vellard, J. 1953. Estudios sobre batracios andinos. II. El grupo *Marmoratus* y formas afines. Mem. Mus. Hist. Nat. Javier Prado 2:53 pp. + 4 pl.
- Veloso, A. M., N. P. Diaz, P. C. Iturra, and M. V. Penna. 1981. Descripción de una nueva especie de telmatobino del género *Alsodes* (Amphibia: Leptodactylidae) de la Cordillera de Nahuelbuta (sur de Chile). Medio Ambiente 51(2):72–77.

- Wassersug, R. and W. R. Heyer. 1983. Morphological correlates of subaerial existence in Leptodactylid tadpoles associated with flowing water. *Can. J. Zool.* 61(4):761-769.

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