

GENERIC KEY AND SYNOPSES FOR FREE-LIVING LARVAE AND TADPOLES OF MEXICAN AMPHIBIANS

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ABSTRACT

A key to the genera of free-living larvae and tadpoles of Mexican amphibians, accompanied by generic synopses and a bibliography, is presented. The salamander key applies to posthatching specimens with front digits fully formed (ca. 20 mm snout-vent length), while the tadpole key applies to premetamorphic and prometamorphic specimens.

Knowledge of Mexican amphibians has increased rapidly during the last 20 years. Although comprehensive reviews can now be made of some groups (e.g., Tihen, 1958; Duellman, 1963; Duellman and Trueb, 1966), investigation of larval forms has lagged. Once larval taxonomy is stabilized, ecological and behavioral studies of the immature forms can be undertaken. The present key and synopses summarize the characteristics of the genera of free-living larval amphibians of Mexico. Data from the literature are combined with new information. Explanation of new terminology and pertinent figures appear in Altig (1970).

Free-living larval salamanders of 19 species in 4 genera and 3 families inhabit Mexico. At least two species, *Siren intermedia* and *Ambystoma dumerilii*, are paedogenetic. In several species of *Ambystoma* and *Rhyacossiredon*, some or all specimens in some populations breed while retaining larval form and external gills; *Ambystoma mexicanum* usually does. Life histories of many other species are poorly known. Although *Taricha* is unknown in Mexico, it is included here because *T. torosa* possibly occurs in Baja California.

Species of *Bolitoglossa*, *Chiropterotriton*, *Lineatriton*, *Parvimolge*, *Pseudoeurycea*, and *Tborius* (Family Plethodontidae), comprising over two-thirds of the Mexican salamander fauna, have terrestrial eggs and direct development; gills and other larval features are lost before hatching.

Free-living tadpoles of 127 species in 21 genera and 8 families inhabit Mexico. Over half of the species are hylids, with the majority of the remainder being bufonids and ranids. All the eggs are aquatic, except for those of *Pachymedusa*, *Agalychnis*, *Centrolenella*, and *Leptodactylus*. The first three lay arboreal eggs and the latter lays eggs in a foam nest in a terrestrial burrow; *Physalaemus* has a floating foam nest. Due to the incomplete data on tadpoles, future revision of some couplets is inevitable. About 78% of the tadpoles have some descriptive data available. *Rana*, *Bufo*, and certain groups of hylids need special attention. Species of *Eleutherodactylus*, *Hylactophryne*, *Syrrophus*, and *Tomodactylus* (Family Leptodactylidae) have terrestrial eggs, direct development, and lack a free-living tadpole.

KEY

1. Salamander larva or paedogenetic or neotenic adult; external gills present; body form similar to transformed adult 2
2. Anuran tadpole; external gills absent; body globular 5
2. Costal grooves absent
..... *Notophthalmus*
(east coast), *Taricha* (west coast)
Costal grooves present 3

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3. Fewer than 20 costal grooves 4
 More than 28 costal grooves *Siren*
4. Pond-type larva with tail fin extending as far as front legs to form dorsal body fin, reduced to low ridge in some paedogenetic or neotenic adults *Ambystoma*
 Stream-type larva with tail fin terminating at level of hind limbs, although a low ridge may extend one-half the distance to the head *Rhyacosedon*
5. Oral disc and labial teeth absent 6
 Oral disc and labial teeth present 9
6. Jaws without keratinized sheaths; spiracle single (ventromedial) or dual (lateral); body depressed 7
 Jaws with keratinized sheaths; spiracle single and sinistral; body globular *Hyla* (part)
7. Spiracles dual and lateral; oral barbels present *Rhinophrynus*
 Spiracle single and ventromedial; oral barbels absent 8
8. Margins of labial flaps smooth; medial borders of labial flaps parallel or divergent *Gastrophryne*
 Margins of labial flaps scalloped or papillate; medial borders of labial flaps convergent *Hypopachus*
9. Anus medial 10
 Anus dextral 16
10. Tooth row formula 2/4 or larger; papillary border with a narrow ($< \frac{1}{2}$ jaw length) dorsal gap or complete; oral disc not emarginate; spiracle well below longitudinal axis 11
 Tooth row formula 2/3; papillary border with a wide ($\approx$ upper jaw length) dorsal gap or with both dorsal and ventral gaps; oral disc emarginate or not; spiracle at or near longitudinal axis 13
11. Eyes lateral; body globular; A-1 long and with a median gap *Phrynobyas*
 Eyes dorsal; body depressed; A-1 short and without a median gap 12
12. Jaws narrow to medium; jaws never cusped; lower jaw striated; keratinized area on roof of mouth absent; dorsum usually dark brown to black; to 35 mm total length *Scaphiopus*
 Jaws wide; jaws frequently cusped; lower jaw not striated; frequently a small keratinized area on roof of mouth; dorsum typically lightly pigmented; to 75 mm total length *Spea*
13. Papillary border with a dorsal gap 14
 Papillary border with dorsal and ventral gaps; oral disc emarginate *Bufo* (part)
14. Oral disc distinctly emarginate *Bufo* (part)
 Oral disc not emarginate, or with a slight lateral indentation 15
15. Darkly pigmented; eyes appear oval to round in dorsal view; dorsal fin terminates at body; inhabits lentic water *Leptodactylus*
 Lightly pigmented; eyes appear C-shaped in dorsal view; dorsal fin terminates on tail musculature; inhabits lotic water *Centrolenella*
16. Papillary border complete or with a dorsal gap 17
 Papillary border with dorsal and ventral gaps *Bufo* (part)
17. Oral disc emarginate; papillary border with a dorsal gap; eyes dorsal 18
 Oral disc not emarginate; papillary border complete or with a dorsal gap; eyes dorsal or lateral 20
18. Labial tooth row formula 3/3 or larger *Rana* (part)
 Labial tooth row formula 2/3 or smaller 19
19. Total length 35 mm or less; central Veracruz and eastern Oaxaca *Rana* (part), *Physalaemus*
 Total length over 35 mm; widespread *Rana* (part)
20. Papillary border complete 21
 Papillary border with a dorsal gap 26
21. Tooth row formula larger than 2/2; gut coiled 22
 Tooth row formula 2/2; gut not coiled *Anoteca*
22. Two rows of labial teeth on anterior labium 23
 More than two rows of labial teeth on anterior labium 25
23. Three rows of labial teeth on posterior labium 24

- More than three rows of labial teeth on posterior labium *Hyla* (part)
24. Upper jaw cuspsate .. *Plectrohyla* (part)
Upper jaw not cuspsate
..... *Hyla* (part), *Plectrohyla* (part)
25. Three or four rows of labial teeth on anterior labium *Ptychohyla*
More than four rows of labial teeth on anterior labium *Hyla* (part)
26. Tooth row formula 2/3 or less 27
Tooth row formula larger than 2/3
..... *Hyla* (part)
27. Tooth row formula 2/2; medial wall of spiracular tube almost entirely free from body; northeastern region *Acris*
Tooth row formula 2/3; medial wall of spiracular tube attached to body 28
28. Spiracle at or near longitudinal axis, definitely sinistral 29
Spiracle well below longitudinal axis, nearly ventromedial
..... *Agalychnis* (east coast), *Pachymedusa* (west coast)
29. Eyes lateral 30
Eyes dorsal *Hyla* (part)
30. P-3 .75 or more times P-1 31
P-3 .70 or less times P-1
..... *Hyla* (part), *Pseudacris*
31. Marginal papillae uniserial below P-3 32
Marginal papillae biserial below P-3 33
32. Upper jaw with short lateral processes; P-3 longer than upper jaw; tail fin extends to level of spiracle; Yucatan Peninsula plus semiarid areas of coastal Sinaloa and Oaxaca *Triprion*
Upper jaw with long lateral processes; P-3 subequal to upper jaw; tail fin not extending onto body; wet forest of Atlantic drainage from northern Oaxaca to Chiapas
..... *Smilisca* (part)
33. Upper jaw with long lateral processes; widespread in lowlands
..... *Smilisca* (part)
Upper jaw with short lateral processes; arid coastal areas from Sonora to Michoacan *Pternohyla*

GENERIC SYNOPSES

Siren.—Three gill slits; medial gill rami branched with fimbriae arising from branches; hind legs never present; dorsal fin extends to level of front legs in young or terminates near cloaca on paedogenetic adults; 30–40 costal grooves between front legs and cloacal aperture; margins of jaws lack teeth but bear keratinized sheaths; known in Mexico from northern Tamaulipas; 1 species.

Notophthalmus and *Taricha*.—Four gill slits; gill rami not branched; feet without keel on trailing edge or webbing between digits; hind legs present from early stages; dorsal fin extends to level of front legs; *Notophthalmus* in Gulf Coastal Plain from southern Texas to northern Puebla and Veracruz; 1 species; *Taricha torosa* may occur in northwestern Baja California.

Ambystoma.—Four gill slits; gill rami not branched; feet without keel on trailing edge; hind legs present from early stages; 11–15 costal grooves (counting one in each axilla and groin); dorsal fin extends to level of front legs or reduced in neotenic and paedogenetic adults to a low ridge; widespread from southern edge of Mexican Plateau northward; 13 species. Although *A. dumerilii*, endemic to Lake Patzcuaro, Michoacan, was long placed in a separate genus (*Bathysiredon*), it is considered by Tihen (1958, 1969) to be an *Ambystoma*.

Rhyacosiredon.—Four gill slits; gill rami not branched; hind limbs present from early stages; digits long and flattened; a distinct keel on trailing edge of feet; 11–13 costal grooves; dorsal fin reduced, reaching at most only half the distance to the head; mountain streams at southern edge of Mexican Plateau from Michoacan-Mexico border to the Puebla-Mexico border and south to northern Morelos; 4 species.

Rhinophrynus.—Oral disc and labial teeth absent; jaws without keratinized sheaths; anus medial; eyes lateral; body depressed; spiracles dual and lateral oral barbels present; upper lip without a median notch; external nares present; lowlands from Texas to Oaxaca; 1 species.

Gastrophryne.—Oral disc and labial teeth absent; jaws without keratinized sheaths; anus medial; eyes lateral; body depressed; spiracle single and medioventral; oral barbels

absent; labial flaps without papillae and with medial margins parallel or divergent; external nares absent until late in development; widespread in lowlands; 3 species.

Hypopachus.—Oral disc and labial teeth absent; jaws without keratinized sheaths; anus medial; eyes lateral; body depressed; spiracle single and medioventral; oral barbels absent; labial flaps scalloped or papillate and with medial margins convergent; external nares absent until late in development; widespread in lowlands; 1 species.

Scaphiopus.—Oral disc present and not emarginate; jaws thin to medium with keratinized sheaths; jaws never cusped; lower jaw striated; keratinized area on roof of mouth absent; anus medial; eyes dorsal; body slightly depressed to globular; spiracle single, sinistral, but below longitudinal axis; labial tooth row formula $2-6(2-6)/3-6(1-3)$; papillary border complete or with a narrow dorsal gap; darkly pigmented; northern deserts; 1 species.

Spea.—Oral disc present and not emarginate; jaws medium to wide with keratinized sheaths; jaws often cusped; lower jaw not striated; keratinized area on roof of mouth often present; anus medial; eyes dorsal; body depressed; spiracle single, sinistral, but below longitudinal axis; labial tooth row formula $2-6(3-6)/4-6(2-6)$; papillary border complete or with a narrow dorsal gap; often lightly pigmented; to southern edge of Mexican Plateau; 3 species.

Bufo.—Oral disc present and emarginate; jaws thin to medium with keratinized sheaths; anus medial or dextral; eyes dorsal; body globular to slightly depressed; labial tooth row formula $2(2)/2-3[1]$; papillary border with anterior and posterior gaps; typically darkly pigmented; spiracle single and sinistral, at or near longitudinal axis; widespread; 25 species.

Physalaemus.—Oral disc present and emarginate; jaws medium with keratinized sheaths; anus dextral; eyes dorsal; body globular; labial tooth row formula $2(2)/3$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral, and near longitudinal axis; central Veracruz through southern Oaxaca; 1 species.

Leptodactylus.—Oral disc present and not emarginate; jaws thin to moderate with keratinized sheaths; anus medial; eyes dorsal;

body globular; labial tooth row formula $2[2]/3$; papillary border with a wide anterior gap; darkly pigmented; spiracle single, sinistral and near longitudinal axis; widespread in lowlands; 3 species.

Centrolenella.—Oral disc present and not emarginate; jaws thin to medium with keratinized sheaths; anus medial; eyes dorsal and appear C-shaped in dorsal view; body depressed; labial tooth row formula $2(2)/3$; papillary border with an anterior gap; lightly pigmented; spiracle single, sinistral and near longitudinal axis; inhabits mountain streams; eastern and southern areas; 1 species.

Rana.—Oral disc present and emarginate; jaws thin to wide with keratinized sheaths; anus dextral; eyes dorsal; body globular to slightly depressed; spiracle single, sinistral and at or near longitudinal axis; labial tooth row formula $1-7(2-7)/2-6[1]$, commonly $2(2)/3[1]$; papillary border with an anterior gap; darkly pigmented; widespread; 15 species.

Acris.—Oral disc present and not emarginate; jaws medium with keratinized sheaths; anus dextral; eyes dorsolateral to dorsal; body slightly depressed; labial tooth row formula $2(2)/2$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral and near longitudinal axis; tail tip often black and tail musculature often banded dorsally; northeastern area; 1 species.

Agalychnis and *Pachymedusa*.—Oral disc present and slightly emarginate; jaws medium with keratinized sheaths; anus dextral; eyes dorsal; body globular; labial tooth row formula $2(2)/3$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral and far below longitudinal axis; widespread in lowlands; 2 and 1 species.

Anotheca.—Oral disc present and not emarginate; jaws medium with keratinized sheaths; anus dextral; eyes dorsal; body globular; labial tooth row formula $2(2)/2$; papillary border complete; darkly pigmented; spiracle single, sinistral and near longitudinal axis; gut not coiled; Veracruz; 1 species.

Hyla and *Pseudacris*.—Oral disc present [The *H. microcephala* group, including four species, (Duellman and Fouquette, 1968) lacks labial teeth, keratinized jaw sheaths, and all or most of the oral disc.] and not emarginate; jaws thin to wide with keratinized sheaths; anus dextral (median in *len-*

cophyllata group); eyes dorsal or lateral; body globular to depressed; labial tooth row formula $2\text{-}7(2,7)/3\text{-}10[1]$, commonly $2(2)/3$; papillary border complete or with an anterior gap; darkly or lightly pigmented; spiracle single, sinistral and near longitudinal axis; inhabits lentic and lotic water; widespread; 47 species and 1 species.

Phrynobyas.—Oral disc present and not emarginate; jaws medium with keratinized sheaths; anus median; eyes lateral; body globular; labial tooth row formula $4(1\text{-}2,4)/4(1)$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral and near longitudinal axis; widespread; 1 species.

Plectrohyla.—Oral disc present and not emarginate; jaws medium to wide with keratinized sheaths; jaws often cusped; anus dextral; eyes dorsal; body somewhat depressed; labial tooth row formula $2/3[1]$; papillary border complete; darkly pigmented; inhabits mountain streams in southern areas; 5 species.

Pternohyla.—Oral disc present and not emarginate; jaws medium to wide with keratinized sheaths; anus dextral; eyes lateral; body globular; labial tooth row formula $2(2)/3$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral and near longitudinal axis; northwestern area; 2 species.

Ptychohyla.—Oral disc present and not emarginate; jaws medium to wide with keratinized sheaths; anus dextral; eyes dorsal; body globular; labial tooth row formula $4(1)/6\text{-}7(1)$ or $3(1,3)/3(1)$; papillary border complete; darkly pigmented; spiracle single, sinistral and near longitudinal axis; widespread in mountain streams of southern half of country; 4 species.

Smilisca.—Oral disc present and not emarginate; jaws medium with keratinized sheaths; anus dextral; eyes dorsal; body globular; labial tooth row formula $2(2)/3$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral and near longitudinal axis; widespread; 2 species.

Triprion.—Oral disc present and not emarginate; jaws medium with keratinized sheaths; anus dextral; eyes lateral; body globular; labial tooth row formula $2(2)/3$; papillary border with an anterior gap; darkly pigmented; spiracle single, sinistral and near

longitudinal axis; Yucatan Peninsula plus semiarid coastal regions of Sinaloa to Oaxaca; 3 species.

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