

Description of a New Species, *Rana multidenticulata* (Anura: Ranidae), from Taiwan

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Wen-Hao Chou and Jun-Yi Lin (1997) Description of a new species, *Rana multidenticulata* (Anura: Ranidae), from Taiwan. *Zoological Studies* 36(3): 222-229. We describe a new ranid frog, *Rana multidenticulata* sp. nov., from the montane areas of the Central Mountain Range of Taiwan. This species seems to be most closely related to *R. sauteri* which occurs in the western lowlands. These presumed sister taxa can be distinguished by oral features of tadpoles and several adult characters. Vocalization and larval morphology of the new species are also described.

Key words: *Rana multidenticulata* sp. nov., *Rana sauteri*, Tadpole, Vocalization, Taiwan.

Rana sauteri was previously divided into 2 subspecies, *R. s. sauteri* of Taiwan and *R. s. johnsi* of Vietnam and southern China (Smith 1921 1924, Zhao and Adler 1993), but its taxonomy remained uncertain (Kuramoto et al. 1984, Zhao and Adler 1993). Kuramoto et al. (1984) speculated that speciation had occurred within Taiwanese *R. sauteri*, recognizing acoustic and serous differences between lowland frogs (i.e., Quantzelin, type locality, ca. 300 m; Boulenger 1909) and frogs of high elevations (i.e., Alisan, Chiayi Co., at 2200 m). Recent examination of geographical variations in adult and larval morphology of Taiwanese *R. sauteri* supports the hypothesis of dichotomous divergence within this taxon (Chou and Lin 1997). We thus concluded that montane populations in higher elevations of the Central Mountain Range represent an evolutionary lineage separated from the lowland form by a relatively narrow intergradation zone (Fig. 1). Therefore, we describe the highland form as a new species.

All specimens examined and measured are from the collections preserved in the National Museum of Natural Science, Taichung, Taiwan, R.O.C. (Appendix I, Chou and Lin 1997). Measurements were taken to the nearest 0.1 mm with dial calipers and a dissecting microscope. Toe webbing of adults was recorded using the formula of Heyer et al. (1990). The following abbreviations of adult characters are used: SVL (snout-vent length), HL (head length), STD (snout-tympanum distance), SND (snout-nostril distance), NED (nostril-eye distance), NTD (nostril-tympanum distance), SED (snout-eye distance), EL (eye length), ETD (eye-tympanum distance), TD (tympanum diameter), HW (head width), IND (internarial distance), IOD (interorbital distance), EW (eyelid width), HLAL (head and lower arm length), TFL (3rd finger length), OPTL (outer palmar tubercle length), IPTL (inner palmar tubercle length; for males), TTL (thenar tubercle length; for females), THIGH (thigh length), TiL (tibia length), FL (foot length), TaL (tarsus length), FTL (4th toe length), and IMTL (inner metatarsal tubercle length). Larval descriptions chiefly follow Inger's (1985) format and terminology

MATERIALS AND METHODS

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with minor modifications from Altig (1970).

Calls were recorded from Wuling (Taichung Co., 48 km NE Hoping; 1650 m elev.) on 23 September 1989 at 1830-2010 h with a Sony TC-D5M cassette recorder and a Byeredynamic M 300N(c)S microphone at a distance of ca. 30 cm from calling males. Air temperatures recorded near the frogs were 18-20 °C. Calls were analyzed using a KAY 5500 DSP Sona-Graph Scale and sonograms were printed by a Kay 5510 Grey Scale Printer. Terminology of calls follows Duellman and Trueb (1986).

***Rana multidenticulata* sp. nov.**

(Fig. 2)

Holotype: NMNS 2802, an adult female from Dayuling, Taichung Co., Taiwan (2560 m, 24°11'02"N, 121°18'17"E) collected by Wen-Hao Chou on 1 July 1986.

Paratypes: There were 14 males collected at the type locality on 1 July 1986: NMNS 00120-1 to 9, and 11 to 15.

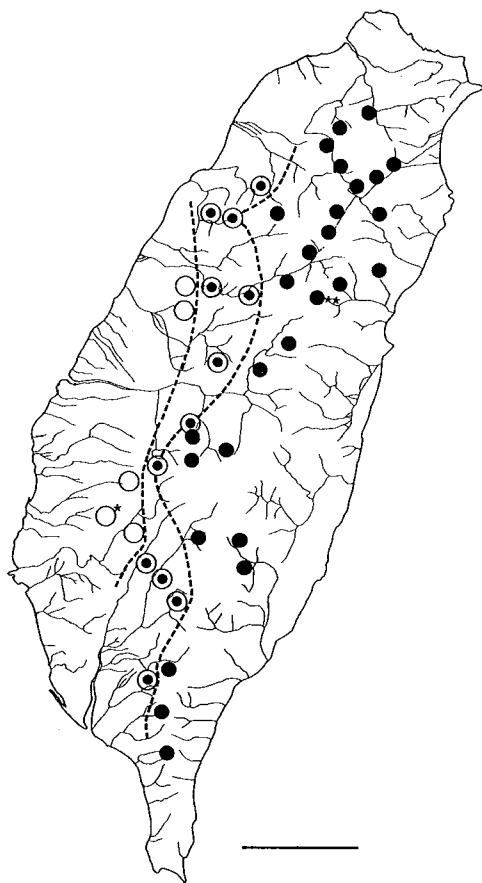


Fig. 1. Map of Taiwan showing sampling locations of *Rana sauteri* (open circles), *R. multidenticulata* sp. nov. (solid circles), and intermediates (compound circles). Broken lines represent postulated borderlines of ranges. Asterisks denote type localities: Quantzelin (*) of *R. sauteri* and Dayuling (**) of *R. multidenticulata* sp. nov. Scale = 50 km.

Diagnosis: The Taiwanese *Rana multidenticulata* and *R. s. sauteri* are distinguishable from their Chinese allies of the subgenus *Pseudorana*, *R. sangzhiensis*, and *R. weiningensis* (Dubois 1992), by having a pair of internal subgular vocal sacs, and from the Vietnamese *R. sauteri johnsi* by having a rounded snout and the 1st finger subequal to the 2nd in length (Smith 1921, Ye et al. 1993). In adults, *R. multidenticulata* is distinguished from *R. s. sauteri* by a combination of characters: shorter nostril-tympanum distance, hand and lower arm length, and head length in males, and shorter nostril-tympanum distance, tympanum diameter, and longer foot in females (Table 3, Chou and Lin 1997). Tadpoles of *R. multidenticulata* can be distinguished from larval *R. sauteri* by the following characters: (1) 3 rows of anterior continuous labial teeth; (2) 4 or 5 rows of anterior discontinuous labial teeth; (3) 6 to 9 continuous posterior labial teeth, and (4) a boomerang-shaped upper jaw sheath (Fig. 3).

Description of holotype: An adult female 47.6 mm SVL. Body slender. Head slightly longer than wide; snout outline rounded from above and in lateral view; nostrils slightly protrudent, directed posterolaterally; canthus rostralis moderately distinct

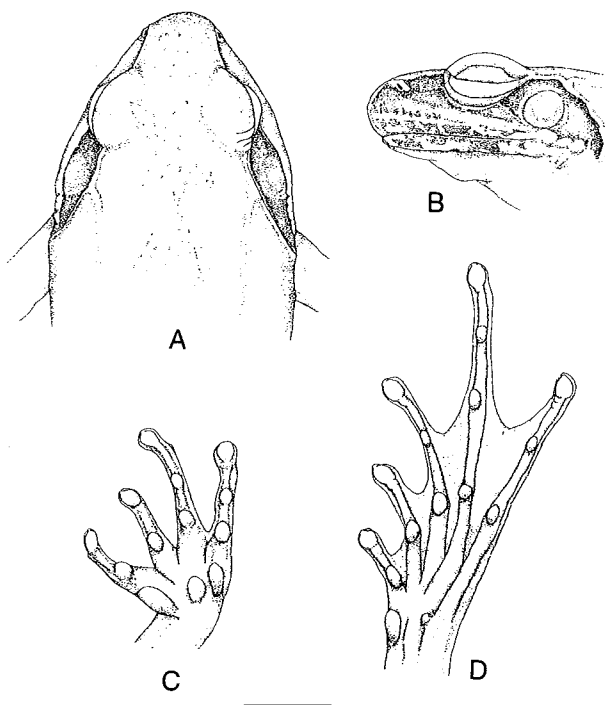


Fig. 2. *Rana multidenticulata* sp. nov., NMNS 2802 (holotype). (A) Dorsal and (B) lateral views of head; ventral views of hand (C) and foot (D). Scale = 1 cm.

and rounded, slightly concave in dorsal view; loreal region concave; interorbital region flat; eyelid width 87% of interorbital distance; internarial distance 1.1 times interorbital distance; tympanum distinct, subcircular, greatest diameter 56% of eye diameter; eye-tympanum distance 41% of greatest tympanum diameter; supratympanic fold moderately well developed, touching tympanum dorsally and posterolaterally, ending at upper part of axilla; vomerine teeth in 2 oval, anteriorly convergent series between choanae, separated by a space nearly as wide as 1 tooth series; choanae large and oval; tongue large, elongate, posterior 1/10 notched.

Forearm moderately slender, hand and lower arm length 50% SVL; fingers relatively long and slender, 3rd finger length 16% SVL, tips weakly dilated with discs separated on dorsal and ventral surfaces by grooves; fingers fringed laterally, lengths I < II < IV < III, 2nd finger extending slightly beyond first; subarticular tubercles large, prominent and round to slightly elongate; thenar tubercle large, elliptic, somewhat visible from above; inner palmar tubercle oval; outer palmar tubercle elliptic, length 75% that of thenar tubercle. Distinct white dermal fringe or fold running along outer edges of 4th finger and forearm.

Hind limbs long and slender, with ca. 1/4 tibiae overlap when hind limbs flexed at right angles to axis of body; thigh length 56% SVL, tibia length 63% SVL, tarsus length 34% SVL, foot length 58% SVL; toe relatively long and slender, 4th toe length 37% SVL; tips similar to those of fingers in structure; toes fringed laterally, lengths I < II < III < V < IV, 5th toe extending slightly beyond

third; webbing formula: $I1^+ - 2\frac{1}{3}II1\frac{1}{2} - 3-III2 - 3\frac{1}{3}IV3\frac{1}{4} - 2-V$; inner metatarsal tubercle elliptic, 3 times as long as wide, length subequal to that of outer palmar tubercle; outer metatarsal tubercle small, round and not evident; subarticular tubercles large, prominent and oval to elliptic. Distinct dermal fringe or fold running along outer edges of tarsus and 5th toe.

Skin on dorsum of body smooth with tiny white spinules scattered on posterior 1/3, dorsum of limbs slightly tuberculate; dorsolateral folds distinct; ventral surface of head, body, and limbs smooth, posterior 1/2 of thigh coarsely wrinkled; skin around vent extremely rugose and dorsoposterior surface of thigh tuberculate.

Color in preservative (70% alcohol) of holotype: Ground color of dorsum yellowish brown, hind limbs somewhat reddish; interorbital triangular marking, chevron marking between shoulders, and crossbars on limbs dark brown with fine spots; vertebral line absent; lores speckled with a dark brown line below and along canthus rostralis from tip of snout to the canthus connecting to 1st labial marking anteriorly, loreal lines on both sides separated by a vertical white stripe; distinct dark brown temporal marking from behind eye, covering tympanum and reaching above arm insertion; flank with spots loosely scattered near dorsolateral folds; region around vent with dark spots; rear of thigh speckled. Ventral surface of head, body, and limbs pale yellowish brown; lower lips with broad dark brown patches; throat speckled with fine spots; chest with large spots; posterior margin of arm or along inner side of dermal fold, anteroventral surface near the knee, posterior margin of tibia, and posteroventral surface of tarsus with dense, large, dark brown spots, largely connecting to form stripes or patches; ventral surface of foot dark brown.

Measurements of holotype (mm): 47.6 SVL, 18.0 HL, 17.6 HW, 5.7 ED, 3.9 EW, 13.2 STD, 3.7 SND, 3.9 NED, 10.5 NTD, 7.3 SED, 1.3 ETD, 5.0 IND, 4.5 IOD, 3.2 TD, 24.0 HLAL, 7.6 TFL, 2.1 TTL, 26.8 THIGH, 30.0 TiL, 16.1 TaL, 27.7 FL, 2.3 IMTL.

Variation: In life, ground color of dorsum may be red, grayish yellow, yellowish brown, gray, or dark gray. Flanks of some individuals with dark tubercles. Throat and chest mostly densely pigmented. Table 1 gives variations of some measurements and comparisons with *R. sauteri* and intermediates.

Vocalization: Frogs that appeared in groups at the edges of noisy streams were mute. Vocalizations recorded near quiet trickling water or ponds

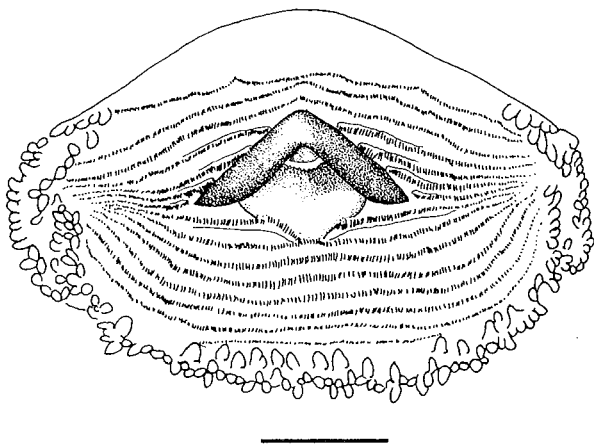


Fig. 3. Oral disc of a larval *Rana multidenticulata* sp. nov. (stage 31). The labial tooth row formula is 7(4-7)/8(1) (Altig 1970). Scale = 1 mm.

Table 1. Comparisons in 25 measurements for male and female *Rana multidenticulata* with Taiwanese *R. sauteri* and intermediates. In each cell, the upper figures are the mean \pm SD, with the ratio to SVL (%) in parentheses underneath; lower figures are the limits of variation, with the ratio to SVL (%) in parentheses underneath. See text for character abbreviations

	Male		<i>p</i>	Female		<i>p</i>
	<i>R. sauteri</i> & Int. (<i>n</i> = 238)	<i>R. multidenticulata</i> (<i>n</i> = 136)		<i>R. sauteri</i> & Int. (<i>n</i> = 28)	<i>R. multidenticulata</i> (<i>n</i> = 38)	
SVL	39.9 \pm 2.7 (30.6 – 46.4)	34.7 \pm 2.3 (27.2 – 40.2)	****	50.6 \pm 3.8 (44.2 – 55.9)	43.9 \pm 4.6 (35.2 – 51.7)	****
HL	15.1 \pm 1.1 (37.8 \pm 1.6) 11.9 – 17.0 (32.1 – 43.1)	13.3 \pm 0.7 (38.2 \pm 1.6) 10.7 – 15.1 (33.8 – 43.6)	**** *	19.1 \pm 1.5 (37.7 \pm 1.1) 16.5 – 21.4 (35.7 – 40.7)	16.3 \pm 1.7 (37.1 \pm 1.4) 13.1 – 19.3 (32.9 – 39.6)	****
STD	11.5 \pm 0.8 (28.9 \pm 1.1) 9.1 – 12.9 (26.0 – 32.2)	10.1 \pm 0.5 (29.1 \pm 1.2) 8.4 – 11.3 (26.1 – 31.7)	****	14.5 \pm 1.2 (28.7 \pm 2.2) 12.7 – 18.0 (26.4 – 38.5)	12.4 \pm 1.0 (28.2 \pm 1.1) 10.0 – 14.6 (25.9 – 30.3)	****
SND	2.7 \pm 0.4 (6.7 \pm 0.8) 1.6 – 3.7 (4.5 – 8.7)	2.6 \pm 0.3 (7.5 \pm 0.8) 2.1 – 3.3 (5.7 – 10.0)	* ****	3.1 \pm 0.5 (6.2 \pm 1.0) 1.4 – 3.9 (3.0 – 8.2)	3.1 \pm 0.3 (7.1 \pm 0.9) 2.3 – 3.7 (5.4 – 10.5)	***
NED	3.5 \pm 0.3 (8.7 \pm 0.8) 2.5 – 4.6 (6.3 – 11.0)	2.9 \pm 0.3 (8.5 \pm 0.8) 2.2 – 3.7 (6.7 – 11.1)	**** ***	4.3 \pm 0.5 (8.5 \pm 0.6) 3.4 – 5.4 (7.5 – 10.0)	3.5 \pm 0.5 (7.9 \pm 0.5) 2.6 – 4.8 (7.1 – 9.4)	**** ****
NTD	9.4 \pm 0.6 (23.7 \pm 1.0) 7.7 – 10.8 (20.6 – 27.7)	8.0 \pm 0.5 (23.2 \pm 1.1) 6.7 – 9.0 (20.2 – 25.4)	**** ****	11.7 \pm 0.9 (23.2 \pm 0.8) 10.1 – 13.3 (21.9 – 25.1)	9.9 \pm 0.9 (21.9 \pm 25.1) 8.1 – 11.9 (20.9 – 24.2)	****
SED	5.9 \pm 0.4 (14.7 \pm 0.8) 4.3 – 6.9 (12.6 – 17.3)	5.4 \pm 0.3 (15.9 \pm 0.9) 4.4 – 6.7 (13.2 – 20.1)	**** ****	7.2 \pm 0.6 (14.2 \pm 0.8) 6.1 – 8.3 (12.3 – 15.5)	6.3 \pm 0.6 (14.4 \pm 0.8) 5.2 – 7.6 (12.9 – 16.1)	****
EL	5.9 \pm 0.4 (14.8 \pm 1.0) 4.3 – 7.0 (12.0 – 18.3)	5.2 \pm 0.4 (15.0 \pm 0.9) 4.1 – 6.2 (12.2 – 17.7)	**** *	6.7 \pm 0.5 (13.3 \pm 1.1) 5.8 – 8.1 (11.0 – 15.9)	5.7 \pm 0.4 (13.1 \pm 0.9) 4.7 – 6.4 (11.4 – 15.8)	****
ETD	1.2 \pm 0.2 (3.0 \pm 0.5) 0.7 – 1.7 (1.9 – 4.4)	1.1 \pm 0.2 (3.1 \pm 0.5) 0.6 – 1.5 (1.7 – 4.8)	****	1.7 \pm 0.3 (3.4 \pm 0.4) 1.3 – 2.2 (2.6 – 4.2)	1.5 \pm 0.3 (3.4 \pm 0.4) 0.9 – 2.3 (2.6 – 4.5)	***
TD	3.5 \pm 0.4 (8.8 \pm 0.7) 2.4 – 4.7 (6.9 – 10.6)	3.0 \pm 0.4 (8.7 \pm 0.8) 2.1 – 3.8 (6.6 – 10.5)	**** *	4.0 \pm 0.4 (7.8 \pm 0.7) 3.1 – 4.7 (6.7 – 9.2)	3.2 \pm 0.4 (7.2 \pm 0.6) 2.3 \pm 4.0 (6.0 – 8.5)	**** ***
HW	13.0 \pm 0.9 (32.6 \pm 1.4) 9.7 – 14.8 (24.1 – 36.2)	11.9 \pm 0.7 (34.2 \pm 1.5) 9.6 – 13.8 (31.0 – 38.7)	**** ****	17.1 \pm 1.4 (33.7 \pm 1.2) 15.0 – 19.4 (32.2 – 37.1)	15.3 \pm 1.7 (34.8 \pm 1.2) 11.9 – 18.3 (31.7 – 37.1)	**** ***
IND	4.1 \pm 0.4 (10.3 \pm 0.7) 3.1 – 4.9 (8.1 \pm 12.8)	3.9 \pm 0.3 (11.3 \pm 0.7) 3.1 – 4.9 (9.4 – 13.8)	**** ****	4.9 \pm 0.5 (9.7 \pm 0.7) 4.0 – 5.8 (8.4 – 11.4)	4.7 \pm 0.6 (10.7 \pm 1.0) 3.0 \pm 5.8 (6.2 – 13.1)	****
IOD	3.4 \pm 0.4 (8.6 \pm 0.9)	3.2 \pm 0.3 (9.2 \pm 0.9)	**** ****	4.4 \pm 0.5 (8.8 \pm 0.9)	4.1 \pm 0.4 (9.5 \pm 0.8)	*** ***

Table 1. (Cont.)

	Male		<i>p</i>	Female		<i>p</i>
	<i>R. sauteri</i> & Int. (<i>n</i> = 238)	<i>R. multidenticulata</i> (<i>n</i> = 136)		<i>R. sauteri</i> & Int. (<i>n</i> = 28)	<i>R. multidenticulata</i> (<i>n</i> = 38)	
IOD	2.3 - 4.5 (6.3 - 11.8)	2.4 - 3.9 (7.0 - 11.2)		3.3 - 5.9 (6.5 - 10.8)	3.0 - 4.9 (8.2 - 11.8)	
EW	3.1 ± 0.3 (7.8 ± 0.8) 2.1 - 4.1 (5.4 - 9.7)	2.6 ± 0.3 (7.6 ± 0.8) 2.0 - 3.3 (5.5 - 9.5)	**** *	3.7 ± 0.5 (7.3 ± 0.9) 2.0 - 4.5 (4.3 ± 8.7)	3.1 ± 0.4 (7.0 ± 0.6) 2.4 - 4.1 (6.0 - 8.5)	****
HLAL	19.0 ± 1.4 (47.7 ± 2.2) 15.2 - 21.9 (36.5 - 52.7)	17.0 ± 1.1 (49.1 ± 2.1) 13.1 - 19.5 (43.8 - 53.5)	**** ****	23.3 ± 2.3 (46.1 ± 3.5) 16.6 - 26.2 (30.0 - 50.4)	21.0 ± 2.3 (47.8 ± 2.6) 16.1 - 25.8 (41.3 - 52.0)	*** *
TFL	5.6 ± 0.5 (14.2 ± 0.9) 4.2 - 7.0 (11.2 - 16.3)	5.4 ± 0.4 (15.6 ± 0.9) 4.2 - 6.5 (12.6 ± 17.8)	**** ****	7.2 ± 0.7 (14.3 ± 0.7) 6.3 - 8.3 (13.2 ± 15.5)	6.9 ± 0.8 (15.7 ± 1.1) 5.3 - 8.7 (12.3 - 17.9)	****
OPTL	2.0 ± 0.3 (5.1 ± 0.7) 1.0 - 3.0 (3.2 - 7.3)	1.7 ± 0.3 (4.9 ± 0.8) 1.2 - 2.8 (3.3 - 8.7)	**** *	2.4 ± 0.3 (4.8 ± 0.7) 1.9 - 2.8 (3.4 - 6.0)	2.1 ± 0.4 (4.7 ± 0.7) 1.5 - 3.1 (3.3 - 6.5)	***
IPTL(σ)	1.9 ± 0.3 (4.8 ± 0.8)	1.8 ± 0.3 (5.2 ± 0.9)	***	2.2 ± 0.3 (4.4 ± 0.6)	2.2 ± 0.3 (5.1 ± 0.6)	****
TTL(♀)	1.0 - 3.3 (2.8 - 7.8)	1.2 - 2.5 (3.6 ± 7.8)	****	1.8 - 2.8 (3.4 - 5.7)	1.6 - 2.9 (3.6 - 6.3)	
THIGH	20.9 ± 1.5 (52.5 ± 3.0) 16.3 - 24.6 (44.7 - 61.7)	18.8 ± 1.3 (54.3 ± 2.7) 14.1 - 23.2 (48.2 - 62.2)	**** ****	26.2 ± 2.1 (51.8 ± 2.3) 22.7 - 30.0 (47.6 - 59.3)	24.5 ± 2.5 (55.9 ± 2.3) 19.0 - 36.6 (51.8 - 59.8)	** ****
TIL	23.6 ± 1.8 (59.3 ± 2.9) 19.0 - 27.4 (51.9 - 66.3)	21.2 ± 1.4 (61.0 ± 2.3) 15.6 - 24.8 (56.1 - 68.1)	**** ****	29.8 ± 2.6 (59.0 ± 2.4) 25.8 - 33.5 (55.1 - 64.7)	27.5 ± 3.0 (62.6 ± 3.9) 19.8 - 34.4 (51.2 - 68.3)	*** ****
FL	21.5 ± 1.6 (53.9 ± 3.0) 15.5 - 25.5 (41.0 - 63.3)	19.5 ± 1.4 (56.2 ± 2.9) 14.6 - 22.9 (48.4 - 63.8)	**** ****	26.7 ± 2.2 (52.4 ± 2.9) 23.2 - 30.4 (45.8 - 57.5)	24.5 ± 2.7 (55.8 ± 2.9) 18.7 - 29.9 (49.7 - 61.4)	*** ****
TAL	11.7 ± 0.9 (29.5 ± 1.9) 8.3 - 14.2 (23.5 - 35.3)	11.1 ± 0.8 (32.0 ± 1.7) 8.1 - 12.9 (26.6 - 36.2)	**** ****	15.0 ± 1.3 (29.6 ± 1.9) 12.8 - 16.9 (25.7 - 34.3)	13.8 ± 1.5 (31.5 ± 2.0) 11.1 - 16.8 (26.6 - 34.8)	*** ***
FTL	13.2 ± 1.1 (33.2 ± 2.0) 9.0 - 16.3 (23.8 - 40.4)	11.8 ± 1.0 (34.0 ± 2.0) 8.4 - 14.3 (27.8 - 39.5)	**** ***	16.2 ± 1.6 (32.1 ± 1.8) 13. - 19.1 (28.1 - 35.2)	15.1 ± 2.2 (34.4 ± 4.3) 11.8 - 23.8 (30.0 - 57.9)	* **
IMTL	1.8 ± 0.2 (4.4 ± 0.5) 1.1 - 2.6 (3.1 - 6.4)	1.6 ± 0.2 (4.5 ± 0.5) 1.2 - 2.0 (3.3 - 5.6)	***	2.1 ± 0.3 (4.2 ± 0.5) 1.6 - 2.6 (3.4 - 5.4)	2.0 ± 0.3 (4.5 ± 0.5) 1.3 - 2.5 (3.3 - 5.7)	**

p denotes significance level of *t*-test: * *p* < 0.05; ** *p* < 0.01; *** *p* < 0.001; **** *p* < 0.0001.

consist of 2 different advertisement calls. The weak, pulsed “gaaa”-like courtship call (Fig. 4A) was usually emitted singularly or in series with up to 7 successive calls. Each call contains 3-27 pulses extending 0.03-0.18 sec (Fig. 5). The calls that contain 16-27 pulses are either triphasic or tetraphasic and span a wide frequency range between 1.5 and 3 kHz. The mean dominant frequency of the pulses is 2467 ± 131 Hz (2056-2663 Hz; $N = 35$). The encounter call is a faint, high-pitched “chu”-like note (Fig. 4B), of which the mean dominant frequency and duration are 2304 ± 146 Hz (2080-2504 Hz; $N = 7$) and 14.1 ± 4.6 ms (6.2-17.2 ms; $N = 10$), respectively. The relatively sporadic encounter call was emitted singularly or in successive series.

Tadpoles: Tadpoles of *R. multidenticulata* are the typical gastromyzophorus type (Altig and Johnston 1989). The following description is based on 73 tadpoles in developmental stages 26-38 (Gosner 1960) obtained from localities listed in Appendix I.—Head-body elongate oval, length 11.7 ± 1.7 mm; snout broadly rounded; body flattened above and below, maximum width before spiracle 0.61 (0.46-0.80) of head-body length; depth 0.51 (0.37-0.64) of width; eyes dorsal, not visible

from below, eye diameter 0.11 (0.09-0.15) of head-body length; interorbital distance less than eye-snout distance; nostrils open, dorsolateral, upper rim raised, closer to tip of snout than to eye; nasolacrimal duct not visible; internarial longer than interorbital. Oral disk (Fig. 2) cup-like, ventral, laterally emarginated, width 0.42 (0.31-0.52) of head-body width; upper lip with wide gap, small papillae aligned in 2 rows at corners, submarginal papillae present; lower lip with short papillae in 2 rows; outer row crowded and continuous, inner row loosely aligned with a median interruption; SCCKF 6-8[(A₄-A₆)-(A₅-A₈)]/7-10[P₁] (Dubois 1995); upper jaw sheath black, finely serrated, boomerang-shaped with a central scraper. Abdominal sucker behind oral disc, length 0.27 (0.14-0.36) of head-body length, width 0.34 (0.39-0.48) of body width. Spiracle sinistral, low on side, directed dorso-posteriorly; tube fused to body wall, length of free portion about 3/4 width of opening; snout-spiracle distance 0.77 (0.68-0.89) of head-body length. Vent tube dextral, short, attached to ventral fin. Tail elongate elliptic or paddle-shaped; both margins weakly convex, deepest at distal 1/3, tip broadly rounded; tail length 1.8 (1.5-2.3) times head-body length, maximum depth 0.29 (0.21-0.38) of tail

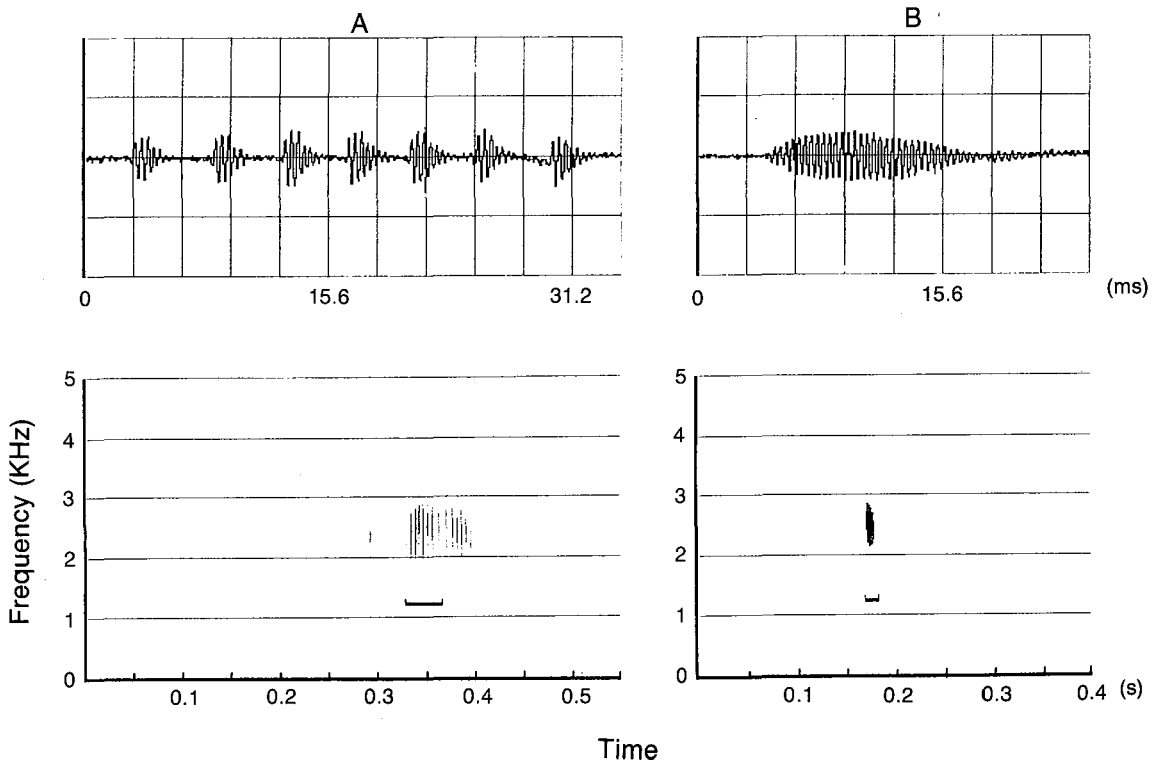


Fig. 4. (A) Courtship call and (B) encounter call of *Rana multidenticulata* sp. nov., recorded from Wuling (1 650 m) at 1830-2010 h; air temperature 18-20 °C. The wave forms (upper) correspond to the marked regions in sonograms (bottom).

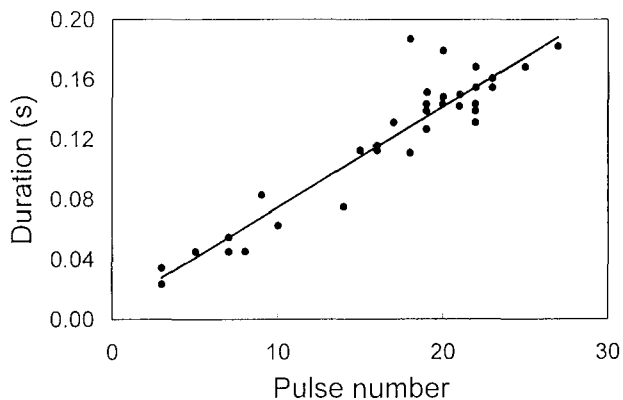


Fig. 5. Regression of duration on pulse number of courtship call of *Rana multidenticulata* sp. nov.. Regression equation is $y = 0.0067 + 0.0078x$, $R^2 = 0.88$, $n = 33$, $p < 0.001$.

length; caudal muscle robust, deeper than either fin in proximal 2/3 of tail; origin of dorsal fin well behind end of body, dorsal deeper than ventral fin throughout. Lateral line pores of supranaso-orbital and preular lines observed. No glands visible. In life head-body dark brown dorsally, ventral white; caudal muscle usually dark brown in proximal 1/2 with a gold patch dorsally; fins yellowish brown, transparent, or with pigmentation in proximal end.

Etymology: The specific name, *multidenticulata*, is a combination of the Latin prefix *multi-* (= many) and the Latin *denticulata* (= having denticles), referring to the greater number of larval labial tooth rows in this species as compared to its presumed sister taxon, *Rana sauteri*.

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Appendix I:

Tadpoles measured for descriptions.—NMNS 838: Ilan Co., 12 km SW Tatung, Chihtwan, 1100 m elev. ($N = 10$); NMNS 537: Taichung Co., 48 km NE Hoping, Wuling, 1650 m elev. ($N = 30$); NMNS 1182: Miaoli Co., 29 km E Taian, Madalahsi, 1700 m elev. ($N = 5$); NMNS 792: Taichung Co., 35 km NE Hoping, Chiayan, 1650 m elev. ($N = 12$); NMNS 44: Chiayi Co., 7.6 km N Wufeng, Alisan, 2200 m elev. ($N = 16$).

臺灣一新種赤蛙 *Rana multidenticulata* (無尾目：赤蛙科) 之記述

周文豪^{1,2} 林俊義²

本文描述一新種赤蛙—多齒赤蛙 *Rana multidenticulata*。牠廣泛分佈於臺灣中央山脈附近的山區，親緣上可能最接近西部丘陵的梭德氏蛙 *R. sauteri*，牠們可以蝌蚪的口器特徵和成體特徵的組合來區別。本文也描述此新種的鳴聲和蝌蚪形態。

關鍵詞：多齒赤蛙，梭德氏蛙，蝌蚪，鳴聲，臺灣。

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