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Masafumi MATSUI

In recent years the evolutional history of the genus *Bufo* and its allies has been investigated with the new standpoint of view by Blair and his co-workers, and their results were compiled in Blair 1972. In their researches the representants of the North and South America have been intensively studied, while the species of the Eurasian continent remain insufficiently investigated (Inger, 1972).

Toad species inhabiting in and near Japan was first argued by Stejneger (1907), but the subsequent researchers understood his opinion incompletely or even misunderstood it and added further taxonomic confusions (Okada, 1930 and 1931) to it. Meanwhile, Liu et Hu (1961) of China and Nakamura et Uéno (1963) of Japan have reviewed these previous opinions and solved many taxonomic problems regarding Chinese and Japanese toads. But there still remain many problems, which have been firstly pointed out by Stejneger.

In undertaking the systematic studies of the toad, *Bufo bufo* and its allies, I have found a stream-type tadpoles from several localities of Honshu, the main island of Japan, which were hitherto unknown to our herpetologists. They are clearly distinguished both morphologically and ecologically from the Japanese common toad (Matsui, 1975). Further researches on good series of larvae and adults of these toads have revealed that they represent an apparently undescribed new species, which must be named herewith as:

***Bufo torrenticola* M. MATSUI** sp. nov.

1955. *Bufo vulgaris montana*: Okada and Kakuda, Nature of Ohsugi-dani and Ohdaigahara, 14.

1963. *Bufo bufo japonicus* (part): Nakamura and Uéno, Jap. Amph. and Rept. Color, 27—28, pl. 7, fig. 20a.

1966. *Bufo bufo montanus* (part): Okada, Fauna Japonica, Anura, 23–25.

Holotype.—OMNH (Osaka Museum of Natural History) Am 4202, adult male, collected at Shiokara-dani Valley, 1400 metres on Mt. Hidegatake, Ohdaigahara, Nara Prefecture, Japan, by M. Matsui and M. Tôyama, July 17, 1975.

Allotype.—OMNH Am 4203, from 1550 metres on Mt. Hidegatake, Ohdaigahara, by M. Matsui, July 19, 1974.

Paratypes.—OMNH Am 2272–2275: 4 females, from Masaki—Shiokara-dani Valley, Ohdaigahara (1400–1600 metres), by Y. Tsutsui, August 18, 1964; OMNH Am 4204: 1 female, from 450 metres on Mt. Nôgô-Hakusan, Ohgawara, Neo, Gifu Pref., by T. Itô, June 5, 1972; OMNH Am 4205: 1 male, from 1400 metres on Mt.

Hidegatake, Ohdaigahara, by M. Matsui, July 17, 1975; OMNH Am 4208: 1 female, from the same locality with the holotype, May 11, 1975; OMNH Am 4206–4207, 4209–4221, USNM (United States National Museum) 198427–198428, NSMT (National Science Museum of Tokyo)-H-03774–03775, AMNH (American Museum of Natural History) 90768–90769, SMF (Museum und Forschungs-Institut Senckenberg) 68201–68202: 20 females and 3 males, from 1400 to 1600 metres on Mt. Hidegatake, Ohdaigahara, by M. Matsui, T. Hikida, T. Satow, S. Watanabe and M. Aimi, June 15 and July 19, 1974.

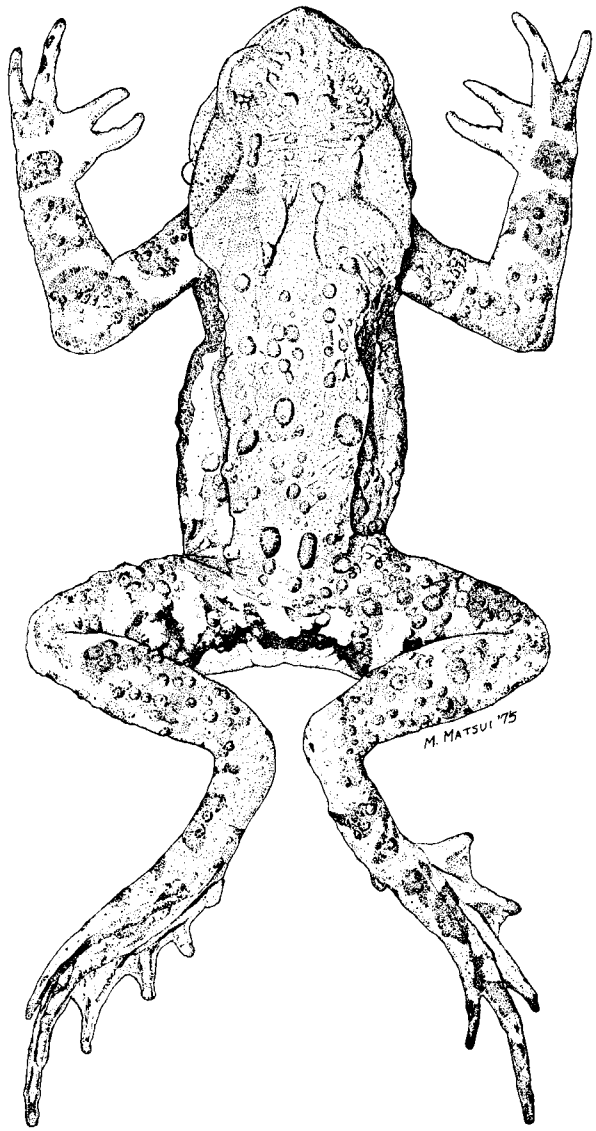

Fig. 1. Dorsal view of holotype of *Bufo torrenticola*, male (OMNH Am 4202). ×1.

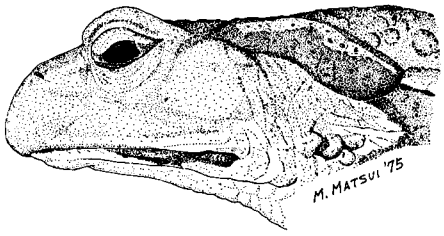

Fig. 2. Lateral view of head of *Bufo torrenticola*, male (OMNH Am 4202). ×1.5.

Diagnosis.—Moderate- to large-sized toad (male 87 mm, female 103 mm); cranial crests absent; close relative of *Bufo bufo*, from which it is distinguished by longer fore- and hind-limbs, smaller and indistinct tympanum, less divergent parotoids, peculiar color pattern and stream-dwelling habit of larvae.

Description of holotype.—Adult male, with traces of nupital excrescenses, forearm stout. Snout-vent length (S-VL) 89 mm; tibia length 36.3 mm, 40.8 per cent of S-VL; foot length 49.7 mm, 55.8 per cent of S-VL; head length 29.2 mm, 32.8 per cent of S-VL; head width 30.9 mm, 34.7 per cent of S-VL; snout rather obtusely acuminate in lateral and dorsal profiles (Figs. 1 and 2), canthus rostralis well-marked and loreal region slightly concave; lips slightly flared laterally; nostrils located closer to anterior margin of upper eyelid than to tip of snout, their distance from each other 6.3 mm, greater than their distance from eyes, 4.6 mm, but less than width of upper eyelid, 7.8 mm; interorbital space 8.8 mm, very slightly concave, slightly wider than upper eyelid, and 1.4 times the internarial distance; tympanum small and indistinct, obliquely oval, upper edge hidden by parotoid gland, its diameter 2.2 mm, considerably shorter than its distance from eye 3.9 mm; parotoid gland moderately developed, elliptical, only slightly diverged posteriorly, its transverse axis 5.6 mm, about one-third the long axis 17.8 mm; forearm rather long, 68.2 mm, 76.6 per cent of S-VL; fingers, in order of length from shortest to longest: 2-1-4-3, without webs at base, tips conically pointed; two large palmer tubercules, inner one 3.7 mm, particularly prominent with a cutting edge, on base of inner margin of first finger, and outer one 5.7 mm, on base of third and fourth fingers, large and elliptical, about 1.5 times the inner one in size; traces of nupital asperities on inner and upper sides of first and second fingers and on inner surface of third finger; hind-limb 136.2 mm, 153.0 per cent of S-VL, about twice the forearm, heels overlapping when folded at right angles to body, tibio-tarsal articulation reaching rather anteriorly to middle of parotoid when hind-limb carried forwards along body; toes, in order of increasing length: 1-2-5-3-4; third and fifth toes with one phalanx free of web, fourth toe with three phalanges free; inner matatarsal tubercle elliptical, with prominent cutting edge, its long axis 5.3 mm, shorter than total length of first toe, outer metatarsal tubercle on base of fifth toe, smaller and less prominent than inner one, circular; tarsal fold absent; some of subarticular tubercles bifid both under fingers and toes; back covered by numerous round tubercles of various sizes, larger ones as large as tympanum, all rather smooth and not arranged symmetrically; a row of distinct tubercles running longitudinally on sides, from posterior margin of

tympanum to groin; surface of snout nearly smooth, with weak tubercles irregularly distributed, while a group of enlarged tubercles behind rictus; tubercles on upper surface of legs surmounted by conical brown spots; underside coarsely granular over whole surface.

Color (in life) orangish brown on dorsum, with faintly suggested light yellowish longitudinal bands on sacrum and urostyle regions; from posterior corner of eye backward, margining lower edge of parotoid and along sides of body to groin wide, sharply contrasted, reddish-black band; above the latter on side distinct creamy border running along its whole length; upper surfaces of limbs including webbing

Table 1. Measurements (in millimetres) and ratios of *Bufo torrenticola* sp. nov. and means followed by extremes in parenthesis, and all other measurements represented with means and standard deviations.

Species	*B. torrenticola*		*B. b. montanus*
Sex	♂	♀	♂
Locality	Ohdaigahara; Neo, GIFU; Mt. Hakusan	Ohdaigahara, NARA	Hokodate, Mt. Chôkai AKITA
Sample size	N=14	N=33	N=2
Snout-vent length	86.5 (70.5–108.2)	103.2 (91.0–118.2)	76.9 (74.5–79.2)
Head length	28.4 (32.8%)	34.1 (33.1%)	25.0 (32.5%)
Head width	31.8 (36.8%)	39.4 (38.1%)	27.4 (35.6%)
Hand length	24.7 (28.5%)	30.5 (29.5%)	20.3 (26.4%)
Radial-ulnar length	47.9 (55.3%)	55.7 (54.0%)	37.9 (49.3%)
Fore-leg length	61.8 (71.3%)	70.4 (68.2%)	49.4 (64.2%)
Foot length (FL)	43.4 (50.1%)	48.2 (46.7%)	37.4 (48.6%)
Tibia length (TL)	33.5 (38.8%)	37.8 (36.6%)	27.9 (36.2%)
Hind-leg length	120.8 (139.6%)	137.7 (133.5%)	104.1 (135.5%)
Diameter of tympanum (DT)	2.5 (2.8%)	2.7 (2.6%)	6.5 (8.5%)
Eye to tympanum (ET)	3.9 (4.5%)	4.9 (4.7%)	1.8 (2.3%)
Parotoid gland length (PL)	15.5 (17.9%)	18.1 (17.5%)	17.1 (22.3%)
Interparotoid space (IPS)	21.3 (24.7%)	25.3 (24.5%)	18.0 (23.4%)
TL/FL	0.773±0.028	0.783±0.025	0.747±0.046
DT/ET	0.641±0.137	0.529±0.138	3.772±1.849
IPS/PL	1.417±0.141	1.408±0.141	1.053±0.025

* Adopted from LIU and HU (1961).

reddish brown, with distinct creamy markings forming transverse bands; upper surfaces of fingers and toes creamy, with reddish transverse bands; a narrow black streak on lower jaw along its whole length; underside of body and limbs yellowish, with medium-sized strongly defined black spots; palmer and planter surface creamy tan with creamy palmer and metatarsal tubercles.

Color (in alcohol) of dorsum grayish brown, paler on limbs; black lateral band with red spots on flanks; narrow creamy band where gray of dorsum meets black band of flanks; venter and ventral surfaces of limbs light yellowish, with black markings; palmer and planter surface light gray.

allied taxa of Japan and China. Snout-vent length (S-VL) is represented with with means, followed by percentage ratios to S-VL in parenthesis. Ratios are

B. b. japonicus		*B. b. formosus*		*B. b. andrewsi**	
♂	♀	♂	♀	♂	♀
Momoyama, KYOTO	Momoyama, KYOTO	Neo, GIFU	Neo, GIFU	Chengtu, SZECHWAN	Chengtu, SZECHWAN
N=23	N=20	N=19	N=4	N=23	N=37
99.4 (87.0–116.5)	108.9 (94.0–134.8)	141.5 (110.0–158.0)	150.8 (142.5–159.2)	73.2 (63–89.5)	99.8 (85–116)
30.9 (31.1%)	34.5 (31.7%)	45.0 (31.8%)	51.2 (33.7%)	22 (30%)	30.9 (31%)
34.2 (34.5%)	40.9 (37.5%)	51.4 (36.3%)	58.9 (39.1%)	25.6 (35%)	38.5 (38.6%)
23.9 (24.1%)	28.1 (25.8%)	36.3 (25.7%)	41.9 (27.5%)	19.6 (26.8%)	27.2 (27.3%)
49.5 (49.8%)	54.1 (49.7%)	70.4 (49.8%)	78.3 (51.9%)	38 (51.9%)	49.8 (49.9%)
65.8 (66.2%)	70.1 (64.4%)	93.2 (65.9%)	102.9 (68.3%)	—	—
45.6 (45.9%)	44.0 (40.4%)	64.0 (45.2%)	63.1 (41.9%)	33.4 (45.6%)	39.2 (39.3%)
37.8 (38.0%)	39.3 (36.1%)	53.6 (37.9%)	55.8 (37.0%)	30.1 (41.1%)	39.4 (39.5%)
133.6 (134.4%)	135.0 (124.0%)	187.6 (132.6%)	194.4 (129.0%)	108.6 (148.3%)	129 (129.3%)
4.6 (4.6%)	5.1 (4.7%)	10.2 (7.2%)	9.3 (6.2%)	2.6 (3.6%)	3.3 (3.3%)
3.8 (3.9%)	4.3 (3.9%)	3.7 (2.6%)	4.7 (3.1%)	—	—
21.6 (21.8%)	24.2 (22.2%)	30.8 (21.8%)	31.1 (20.6%)	—	—
23.3 (23.4%)	26.4 (24.2%)	31.5 (22.3%)	35.0 (23.0%)	—	—
0.828±0.030	0.896±0.038	0.838±0.032	0.884±0.036	0.901	1.005
1.194±0.190	1.214±0.230	2.772±0.585	1.984±0.070	—	—
1.084±0.084	1.094±0.084	1.026±0.063	1.065±0.018	—	—

Descriptive remarks.—Average measurements of 33 adult females and 14 adult males are shown on Table 1. The allotype is an adult female, with S-VL 111 mm, nupital excrescences lacking. It has a blunt snout in contrast to acuminate snout of holotype; also, it has wider head and shorter limbs than holotype; back is grayish brown with large red spots behind parotoids; partial vertebral stripe present; upper surfaces of limbs with faint creamy transverse bands; black markings of venter less in number than holotype, but each of them large and strongly defined; other characteristics and coloration are like those described for holotype. Variation in color is conspicuous in this species: the dorsal coloration of paratypes in life is as follows: OMNH Am 4206, 4218, uniformly red; USNM 198427, AMNH 90769, OMNH Am 4204, 4209, 4214, NSMT-H-03775, red with grayish markings; OMNH Am 4205, 4212, SMF 68201, orangish brown with red markings; AMNH 90768, brown with creamy markings; OMNH Am 4207, 4208, 4211, 4213, grayish brown with dark markings; USNM 198428, NSMT-H-03774, grayish brown with red markings. Back of females tends to grayish and juviniles reddish. Those of adult males in general red or orangish brown. Dorsal markings usually indistinct and variable, but two to four rows of $\wedge$-shaped markings are occasionally distinct between shoulder and sacral regions (OMNH Am 4205, 4209). A partial or complete vertebral stripe may be present. Wide black or red lateral bands usually distinct on flanks (OMNH Am 4218, 4219, SMF 68202), but sometimes faded (OMNH Am 4214) or almost absent (NSMT-H-03774). Creamy borders above these lateral bands especially distinct in females. Black mottlings on venter varies from many, strongly defined (OMNH Am 4209) to almost absent (NSMT-H-03775, OMNH Am 4219). In some specimens (USNM 198427, OMNH Am 4207, SMF 68202), throat region is pale to strongly reddish. Variations other than coloration are as follows: tympanum partly covered with skin in some specimens (NSMT-H-03774, OMNH Am 4210, 4211, 4215, SMF 68201); tibio-tarsal articulation reaching from mid level (OMNH Am 2273) to posterior corner (AMNH 90769) of parotoid; tubercles on back and upper surfaces of limbs varies individually, and in general juviniles (OMNH Am 4218, 4219) tend to have more spiny tubercles than adults; in one adult female (MC Bt 0008) almost all tubercles including minute granules on belly spiny; top of tubercles on back and upper surfaces of limbs usually covered with black skin layer, but some lacks this covering (USNM 198427). Though a tendency of increasing in body size towards northern localities is suggested by specimens from Mt. Hakusan (1 male, MC Bt 0001, S-VL 108.2 mm and 1 female, MC Bt 0002, S-VL 122.8 mm) and Ashu (1 female, MC Bt 0073, S-VL 137.5 mm), more materials are needed for dealing with geographic variations.

Etymology.—The specific name is derived from the Latin *torrens,* meaning a swift stream, and *col,* meaning to inhabit, with reference to the stream-type tadpole of this species.

Distribution.—*Bufo torrenticola* is known from the montane to sub-alpine regions of the Kinki and the western Chubu districts of Honshu, the main island of Japan (Fig. 3).

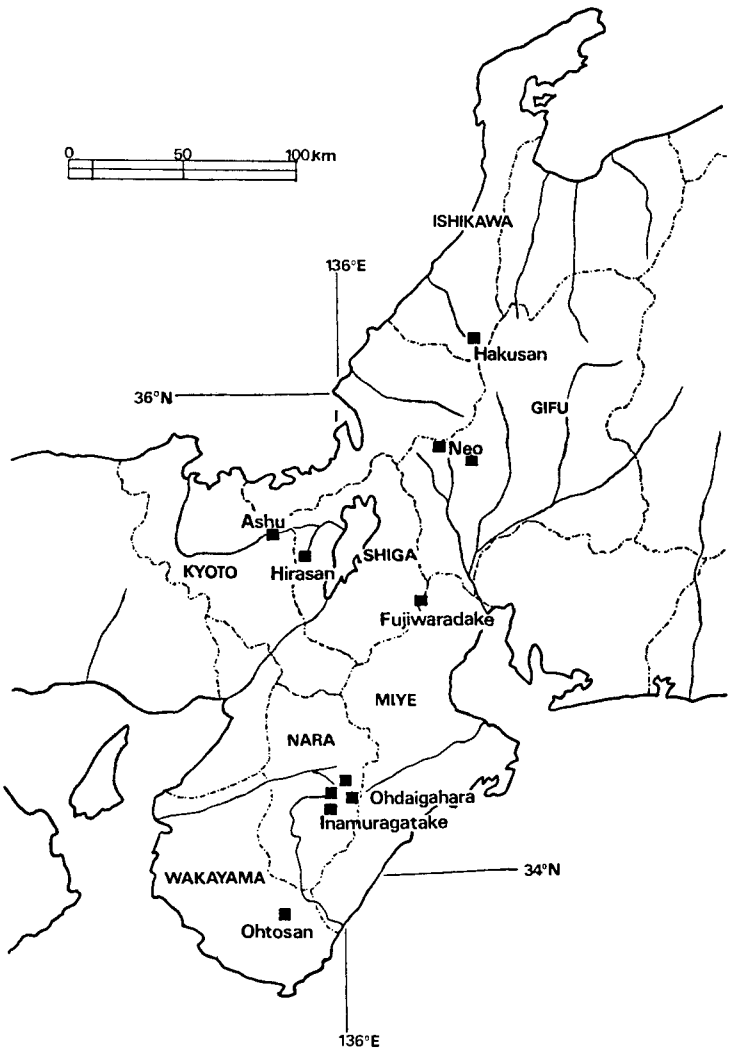

Fig. 3. Map of Kinki and western Chubu of Honshu, showing locality records of *Bufo torrenticola*.

Comparison and affinities.—*Bufo torrenticola* closely resembles wide spread common toad, *Bufo bufo*, and has been confused with *B. b. montanus*, a Japanese montane form of the latter species, in Okada et Kakuda (1955) and Okada (1966). However, it is clearly distinguished by its peculiar larval morphology and ecology from all forms of *B. bufo* except for Chinese *B. b. andrewsi* (Matsui, 1975). Though the latter subspecies should also be treated as a full species because it occupies the same niche in China as *B. torrenticola* in Japan does. The taxonomic relations of the forms of *B. bufo* is still incompletely established, but *B. torrenticola* warrants specific recognition as it distributes sympatrically with *B. bufo formosus* and ecologically isolated from the

latter at several localities of Honshu. From all forms of Japanese *B. bufo*, *B. torrenticola* is separated by its small and indistinct tympanum, shorter and less divergent parotoid gland, larger hand and foot (Table 1) and its light yellowish abdomen in life. It differs from *B. andrewsi* by the absence of tarsal fold. Although phylogenetic relationships are at present uncertain, *B. torrenticola* assuredly belongs to *B. bufo* species group, and may have derived from common stock with Chinese *andrewsi*.

Natural History.—A little natural history information is available. At Ohdaigahara, Nara Pref., this species appears at the end of April and lays eggs in early May. Many strings of eggs were found in deeps of a rocky torrent. Envelopes were either tied round medium-sized stones or deposited in the slits of large rocks so as not being swept away by the stream. Habits of tadpoles have been reported (Matsui, 1975). Metamorphosis is taken place at the middle of August to early September. A large series of specimens collected in July consists of two rather distinct size groups (S-VL about 60 mm and 100 mm), plus some apparently one year juviniles (S-VL about 30 mm). The latter was obtained by day on the ground of clearings apart from any body of water. Almost all young and adult toads were obtained at night either on the ground in coniferous forests far from water or on the rocks in torrents. Some males uttered when handled.

At Ohgawara, Neo, Gifu Pref., a marked habitat segregation was observed between this species and *B. b. formosus*. From mid April to early May, the latter species was seen aggregating in great numbers for breeding, but none of *B. torrenticola* was mingled in such colonies. As few ponds or marshes are present in this montane region, *B. b. formosus* lays eggs in temporary pools and ditches on the road formed by rainfall or by the melting snow. Probably half of these eggs may be dried up and the survivors metamorphose by the end of June, while *B. torrenticola* spends long larval life in the wide river, where tadpoles with short hind-limbs were seen clinging to rocks at the beginning of July. Though few is known about actual breeding habits of *B. torrenticola* at Neo, one male was found laying in the bottom of deeps of the river at the middle of May, which might have been waiting for breeding. Collecting at night along the road failed to get any of this species, though a number of *B. b. formosus* were seen in every occasions. Thus most of the specimens of *B. torrenticola* were obtained by day at rocky river bank or in the shallow water.

Specimens examined.—(118) ISHIKAWA Pref.: Mitsutani, W. slope of Mt. Hakusan, 600 m, MC Bt 0001–0002. GIFU Pref.: Ohgawara, Neo, SE. slope of Mt. Nôgô-Hakusan, 450–550 m, MC Bt 0003–0008, OMNH Am 4204; Nakagoshi, Miyama-Cho, 500 m, MC Bt 0009. SHIGA Pref.: Meo-dani, W. slope of Mt. Hirasan, 400 m, (12 tadpoles). KYÔTO Pref.: Ashu, SW. slope of Mt. Mikunidake, 700 m, MC Bt 0071–0073. MIYE Pref.: NE. slope of Mt. Fujiwaradake, 300 m, MC Bt 0069. NARA Pref.: Ohdaigahara, SW. slope of Mt. Hidegatake, 1400–1690 m, OMNH Am 2272–2275, 4202–4203, 4205–4221, 4730–4731, NSMT-H-03774–03775, AMNH 90768–90769, USNM 198427–198428, SMF 68201–68202, MC Bt 0010–0064; Kitamata, upp. reaches of Riv. Yoshino, 500 m, MC Bt 0074; Mt.

Inamuragatake, 1500 m, OMNH Am 672, 4161; Jindoji-dani, SE. slope of Mt. Inamuragatake, 800 m, MC Bt 0075–0086. WAKAYAMA Pref.: Ohsugi-dani, SW. slope of Mt. Ohtosan, 580 m, MC Bt 0070.

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