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## A New Species of *Pachytriton* from China (Amphibia: Urodela: Salamandridae)

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**Abstract:** A new species of the salamandrid genus *Pachytriton* is described based on two individuals purchased from pet shops in Japan. The original locality of these specimens is known only as “China”, and further details are not known. Morphologically, this species differs from all other congeners in the combination of coloration, body size, snout length, head width, tail length and width, and length of upper jaw tooth series and vomerine tooth series. Genetically, this species is separated from all other congeners by substantial genetic distances in mitochondrial DNA sequences.

Key words: China; DNA bar-coding; New species; *Pachytriton*; Pet trade

### INTRODUCTION

The salamandrid genus *Pachytriton* Boulenger, 1878, occurs in eastern and southeastern China (Fei et al., 2006), and currently consists of six nominal species, *P. archospotus*, *P. brevipes*, *P. feii*, *P. granulatus*, *P. inexpectatus*, and *P. moi* (Nishikawa et al., 2011a). Based on molecular and morphological analyses, Nishikawa et al. (2011a) recognized three unnamed lineages in the genus *Pachytriton* and described two of them as *P. feii* and *P. moi*. However, Nishikawa et al. (2011a) did not name the single remaining lineage in their paper, because it was represented by only two specimens imported from China and obtained from Japanese pet shops, without any more detailed locality information.

After these specimens were obtained from two pet shops in Japan in 2007, we tried to discover their origin by visiting China every year to collect specimens in the wild, but without success. Therefore, we decided to describe the specimens here as a new species, although the number of specimens is small and their exact locality is unknown. A complete sequence of the cytochrome b (hereafter, cyt b) gene of mitochondrial DNA (mtDNA) of the new species has been deposited in GenBank (accession numbers: AB638709 and AB638711). Consequently, future studies will be able to detect wild populations of this new species by comparing these GenBank sequences with those of wild specimens collected.

### MATERIALS AND METHODS

We compared the morphology of two adult male specimens of *Pachytriton* obtained in two pet shops in Japan with that of the six

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TABLE 1. Measurements of types and other specimens of *Pachytriton* examined (means±SD of SVL (in mm) and medians of ratios of characters (R: %SVL) and VTL/VTW, with ranges in parentheses). H: holotype, P: paratype, S: syntype, T: topotype. For character abbreviations, refer to text.

Species	<i>changi</i> sp. nov.		<i>archospotus</i>	<i>brevipes</i>	<i>feii</i>	<i>granulosus</i>	<i>inexpectatus</i>	<i>moi</i>
Types included	H	P	2P	S	H, 17P	9T	H, 2P, 11T	H
n	1	1	3	1	18	9	14	1
SVL	84.2	81.8	86.8±5.9 (81.5–93.1)	87.6	73.3±8.6 (58.5–90.5)	69.0±6.1 (59.0–78.9)	87.8±10.1 (68.6–102.1)	100.2
RHL	25.2	25.4	25.5 (23.5–29.4)	25.6	27.1 (24.5–29.1)	26.6 (24.5–29.0)	28.7 (24.6–31.6)	35.9
RHW	18.8	18.2	21.7 (21.7–22.2)	19.6	20.0 (18.0–21.4)	19.0 (17.0–20.3)	19.8 (18.5–21.7)	23.2
RMXHW	20.5	19.3	24.3 (23.8–24.6)	21.9	21.2 (19.9–22.6)	20.0 (17.9–21.5)	22.3 (20.7–25.2)	25.3
RSL	10.1	9.8	8.0 (7.8–8.3)	8.4	9.7 (8.1–10.8)	8.5 (7.9–9.6)	9.5 (8.6–10.6)	11.3
RLJL	11.9	12.6	11.5 (11.0–12.0)	12.0	13.1 (10.7–14.2)	12.9 (11.7–13.8)	13.5 (11.6–14.9)	17.5
RENL	7.2	7.3	5.7 (5.4–5.9)	6.6	7.2 (6.3–8.2)	6.6 (6.2–7.4)	7.0 (6.4–7.9)	8.6
RIND	7.1	6.8	5.0 (4.9–5.8)	5.3	6.3 (5.7–7.4)	6.0 (4.6–6.4)	6.5 (5.9–7.4)	7.5
RIOD	7.7	7.0	9.3 (8.8–9.6)	8.6	7.6 (6.9–9.3)	6.9 (6.1–8.2)	6.9 (6.4–7.9)	8.0
RUEW	2.4	2.9	1.5 (1.2–1.6)	2.4	2.7 (1.9–3.8)	3.3 (3.0–4.5)	2.5 (2.0–3.2)	2.7
RUEL	4.5	4.9	3.8 (3.7–4.2)	4.8	5.2 (4.3–6.7)	6.1 (4.6–6.8)	4.9 (3.9–6.1)	4.7
ROL	3.7	3.0	2.6 (2.1–2.8)	3.5	3.6 (2.8–4.1)	3.0 (2.7–3.7)	2.9 (2.4–3.5)	3.7
RAGD	51.7	48.5	50.1 (49.2–50.9)	51.6	50.1 (45.7–52.3)	51.7 (48.6–52.9)	49.5 (43.7–53.7)	52.1
RTRL	74.8	74.5	74.5 (70.6–76.5)	74.4	72.9 (70.9–75.5)	73.4 (71.0–75.5)	71.3 (68.4–75.4)	64.1
RTAL	105.1	101.1	95.7 (93.5–95.8)	101.1	97.4 (87.7–105.4)	101.6 (94.7–104.8)	90.6 (85.4–98.7)	90.5
RVL	5.7	6.1	5.0 (4.8–5.0)	7.2	7.3 (4.7–8.7)	8.3 (5.3–9.4)	5.6 (4.6–7.5)	5.2
RBTAW	12.0	12.2	15.8 (15.7–17.2)	14.3	12.4 (10.6–14.3)	14.7 (14.0–15.7)	14.7 (12.3–16.5)	13.2
RMTAW	7.5	8.3	9.8 (8.6–12.5)	10.0	8.9 (7.5–10.5)	12.0 (10.7–15.0)	11.2 (8.9–13.5)	7.8
RBTAH	10.0	10.8	15.9 (14.0–16.0)	12.9	11.5 (10.3–14.2)	12.9 (11.4–13.5)	12.2 (10.3–14.2)	12.8

RMXTAH	15.4	15.0	17.5 (16.1–18.0)	17.1	15.6 (13.0–16.6)	16.2 (13.3–19.1)	14.9 (12.4–15.7)	14.4
RMTAH	15.2	14.7	16.4 (15.0–17.3)	15.9	14.9 (12.9–16.0)	12.9 (11.8–16.5)	13.5 (10.8–14.6)	14.3
RFL	24.5	23.3	23.3 (21.7–24.3)	22.0	25.8 (22.9–29.4)	23.2 (20.7–23.6)	20.3 (18.5–23.6)	22.7
RHLL	26.5	27.8	29.4 (25.9–29.6)	25.9	29.6 (26.1–32.5)	25.3 (23.4–27.4)	24.5 (21.8–35.3)	24.4
RUJTW	11.2	10.6	9.4 (8.2–9.8)	8.7	9.5 (7.8–11.4)	9.3 (7.9–10.1)	9.8 (8.2–10.9)	13.3
RUJTL	9.1	8.6	5.9 (5.2–6.5)	6.3	6.7 (5.1–8.4)	6.3 (4.6–7.1)	7.9 (7.4–8.6)	10.1
RVTW	6.2	5.6	5.8 (5.0–6.0)	3.9	5.9 (4.9–8.2)	4.2 (3.6–5.6)	4.6 (4.0–5.5)	6.8
RVTL	12.1	11.0	8.3 (8.2–9.0)	7.8	9.7 (7.6–11.0)	8.9 (7.4–10.9)	11.7 (10.4–13.0)	16.5
VTL/VTW	2.0	2.0	1.5 (1.4–1.7)	2.0	1.6 (1.3–2.0)	2.1 (1.7–2.4)	2.4 (2.1–2.9)	2.4

nominal species of the genus (Table 1, Appendix I), including type specimens of *P. archospotus*, *P. brevipes*, *P. feii*, *P. inexpectatus*, and *P. moi*, and topotypic specimens of *P. granulosus*, whose holotype was lost.

The following measurements were taken for morphological comparisons: SVL (snout-vent length): from tip of snout to anterior tip of vent; HL (head length): from tip of snout to fold of throat; HW (head width): measured at angle anterior to parotid gland; MXHW (maximum head width): measured at widest point; SL (snout length): from tip of snout to anterior tip of upper eyelid; LJL (lower jaw length): from tip of lower jaw to angle of jaw; ENL (eyelid-nostril length): the minimum distance between eyelid and nostril; IND (internarial distance): the minimum distance between the external nares; IOD (interorbital distance): the minimum distance between the upper eyelids; UEW (upper eyelid width): the greatest width of the upper eyelid; UEL (upper eyelid length): the greatest length of upper eyelid; OL (orbit length): maximum length of orbit; AGD (axilla-groin distance): the minimum distance between axilla and groin; TRL (trunk length): from wrinkle of throat to

anterior tip of vent; TAL (tail length): from anterior tip of vent to tail tip; VL (vent length): from anterior to posterior tip of vent; BTAW (basal tail width): tail width measured at base of tail; MTAW (medial tail width): tail width measured at midpoint; BTAH (basal tail height): tail height measured at base of tail; MXTAH (maximum tail height): tail height measured at highest point; MTAH (medial tail height): tail height measured at midpoint; FLL (forelimb length): distance from axilla to tip of the longest finger; HLL (hindlimb length): distance from groin to tip of the longest toe; UJTW (upper jaw tooth series width): the greatest width of upper jaw tooth series; UJTL (upper jaw tooth series length): the greatest length of upper jaw tooth series; VTW (vomerine tooth series width): the greatest width of vomerine tooth series; VTL (vomerine tooth series length): the greatest length of vomerine tooth series. All measurements were taken to the nearest 0.1 mm with a dial caliper. We used a stereoscopic binocular microscope to measure characters when necessary. The sex and maturity of the specimens were checked by minor dissections.

We examined skull morphology and counted

the number of trunk vertebrae of some specimens (Appendix II). These characters were examined by minor dissection or from soft X-ray photographs using Fuji Medical X-Ray Film.

#### SYSTEMATICS

##### *Pachytriton changi* sp. nov.

Fig. 1

##### *Holotype*

KUHE 39832 (Fig. 1A, B), an adult male purchased at a pet shop in Japan on 22 June 2007 by Kanto Nishikawa. The locality of collection was noted as “China” on the invoice. The GenBank accession number of cyt b sequence is AB638711.

##### *Paratype*

KUHE 39763 (Fig. 1C, D), an adult male

purchased at another pet shop in Japan on 22 May 2007 by Kanto Nishikawa. The locality of collection was noted as “China” on the invoice. The GenBank accession number of cyt b sequence is AB638709.

##### *Etymology*

The specific epithet is dedicated to the late Dr. Mangven L. Y. Chang, who pioneered the modern scientific study of Chinese urodeles in the 1930s.

##### *Diagnosis*

A moderate-sized newt of the genus *Pachytriton*, with SVL of 84.2 and 81.8 mm in two adult males; body slender; skin smooth; head oval and narrow, snout long; limbs thin; tips of forelimbs and hind limbs adpressed to body largely separated; tail long, tip broad; dorsally pale or bright reddish brown; dorso-

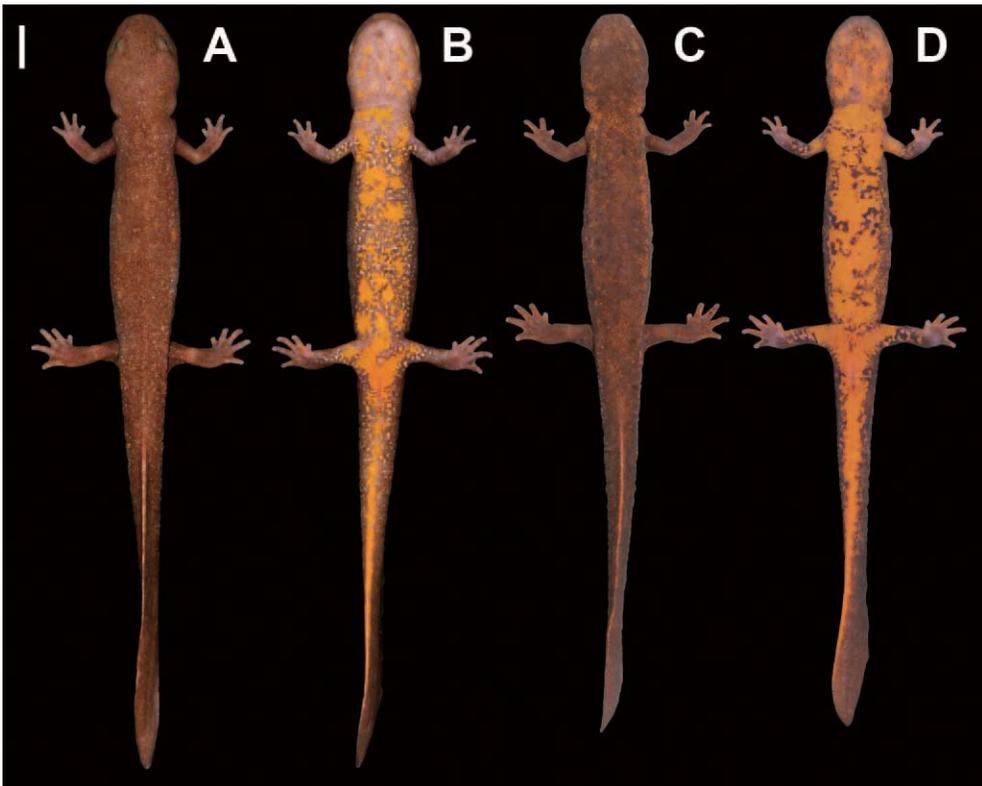


FIG. 1. Male holotype (KUHE 39832: A and B) and paratype (KUHE 39763: C and D) of *Pachytriton changi*; dorsal (A and C) and ventral views (B and D). Scale bar=10 mm.

laterally marked irregularly with bright orange; body dotted with white dorsally and ventrally.

#### *Description of holotype*

Body slender and flat. Skin smooth. Head oval, depressed and nearly flat in profile. Snout truncate, protruding slightly beyond lower jaw. Nostrils close to snout tip. Labial fold evident, especially in posterior half of upper jaw. Skull narrow. Maxillary connecting with pterygoid, forming a nearly straight line. Fronto-squamosal arch complete and robust. Epibranchial long, curving as it wraps around neck dorsolaterally. Vomerine tooth series long, inverted V-shape, tooth rows converging anteriorly and exceeding anterior limit of choanae. Tongue fully attached to mouth floor. Parotoid region evident. Gular fold present, but weak. No vertebral or dorsolateral ridges. Ten costal grooves between axilla and groin. Adpressed limbs separated by 1.5 costal folds. Twelve trunk vertebrae. Fingers and toes without webbing. Tail laterally compressed, with evident dorsal fin posteriorly.

#### *Measurements*

The holotype (KUHE 39832) and the paratype (KUHE 39763), respectively (mm; in preservative): SVL 84.2 and 81.8, HL 21.2 and 20.2, HW 15.8 and 14.9, MXHW 17.3 and 15.8, SL 8.5 and 8.0, LJL 10.0 and 10.3, ENL 6.1 and 6.0, IND 6.0 and 5.6, IOD 6.5 and 5.7, UEW 2.0 and 2.4, UEL 3.8 and 4.0, OL 3.1 and 2.7, AGD 43.5 and 39.7, TRL 63.0 and 61.0, TAL 88.5 and 82.7, VL 4.8 and 5.0, BTAW 10.1 and 10.0, MTAW 6.3 and 6.8, BTAH 8.4 and 8.8, MXTAH 13.0 and 12.3, MTAH 12.8 and 12.0, FLL 20.6 and 19.1, HLL 22.3 and 22.7, UJTW 9.4 and 8.7, UJTL 7.7 and 7.0, VTW 5.2 and 4.8, VTL 10.2 and 9.0. Numbers of upper jaw teeth 99 and 77, lower jaw teeth 80 and 86, vomerine teeth 99 and 86.

#### *Color in life*

Dorsum uniformly pale reddish brown, venter lighter. Body including limbs and tail scattered with numerous white dots dorsally and ven-

trally. Dorsolaterally obscurely spotted with orange. Venter finely marked with reddish orange. Underside of tail and cloaca light orange.

#### *Color in preservative*

Dorsal coloration tending to fade, becoming light brown. White dots becoming indistinct. Ventral bright markings fading to cream.

#### *Variation*

Compared with the holotype, the paratype has a much smaller number of white dots, which can be found only on the ventral sides of the head, upper trunk, and limbs, and has more distinct orange spots dorsolaterally. The paratype has some obscure black spots on the dorsum.

#### *Comparison*

This new species is differentiated from *P. archospotus* and *P. brevipes* by the lack of numerous distinct black spots, from *P. feii* by longer series of upper jaw teeth and vomerine teeth, from *P. granulatus* by larger body, longer snout, and longer series of upper jaw teeth and vomerine teeth. From *P. inexpectatus* and *P. moi*, it differs in having a smaller body, narrower head, and longer and thinner tail.

#### *Range*

China. Exact locality unknown.

## DISCUSSION

Although species of *Pachytriton* have been popular as pets worldwide, their taxonomy has been left unrevised until recently (Nishikawa et al., 2009; Wu et al., 2010). Nishikawa et al. (2011a) revised the genus by analyzing a substantial number of populations from the whole range of distribution, and recognized a total of six nominal species in the genus. This is a significant increase of species diversity for this genus, as only two species had been described prior to 2007. In their revision of the genus, Nishikawa et al. (2011a) suggested distinct species status for the present species,

*P. changi*, but refrained from describing it due to the absence of firm locality data. Description of a new taxon without original distribution data is undesirable. However, considering the recent high competition in China to describe new taxa, often based on insufficient data on one hand, and rapid loss of amphibian habitat on the other, we decided to describe this species based on the available data.

In recent decades, more than a dozen freshwater and land turtles have been reported as new species from China and Southeast Asian countries. These “new species” were described solely on the basis of the unique morphology of specimens derived from the animal trade, and some of them were never found in the wild, notwithstanding intensive efforts by herpetologists and conservationists. Using genetic markers, Parham et al. (2001) compared two such species with congeners and species of related genera, and suggested that they were intergeneric hybrids probably crossed on a local farm. Later, nearly ten such species from China and Southeast Asia were revealed to be artificial hybrids (Dalton, 2003).

In the case of *P. changi*, analyses of the mtDNA sequences (complete cyt b) confirmed its distinct position within *Pachytriton*, differing at a specific level (>6.0% in uncorrected p-distance) from all other congeners whose molecular data are available (Nishikawa et al., 2011a). This fact excludes the possibility that the specimens were hybrids of known congeners or species of related genera. Despite the recent discovery of several new *Pachytriton* species in the wild (Shen et al., 2008; Nishikawa et al., 2011a, b), vast unexplored areas still remain in its range, and it is possible that more undescribed species will be discovered in China. However, we must be careful in describing new species based on pet-trade specimens alone. As with the cases of the turtles mentioned above, the possibility that a given specimen is an artificially hybridized individual cannot be ruled out. In order to confirm taxonomic status of pet-traded specimens, especially those without locality data, combined use of morphological analyses and

proper genetic markers would serve as a powerful tool.

Although hundreds of *Pachytriton* individuals have been annually imported to Japan for the pet trade, we encountered only two individuals of *P. changi* from two pet shops in 2007. It is possible that this species is of restricted range of distribution or has only a small population. Nishikawa et al. (2011a) speculated that the original range of this species was some unexplored region in the northern half of the genus's range. However, this species may occur sympatrically with a congener from well-known localities of the genus as in the case of *P. moi*, which was recently described from northern Guangxi, where it is sympatric with *P. inexpectatus*. It is necessary to continue field surveys to discover *P. changi* in the wild. Such a discovery will not only confirm its taxonomic validity more completely, but will also aid in evaluating conservation measures for wild populations by elucidating its ecology and life history traits.

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## APPENDIX I

*Specimens examined for morphometric comparisons*

*Pachytriton archospotus*: HNUL 870526C, 870526504 (paratypes), and HNUL 790678 from Lingxian, Hunan.

*P. brevipes*: MNHN 5072 (syntype) from Tsitou, Jiangxi.

*P. feii*: CIB 200805012 (holotype), CIB 20070666, CIB 21065, 70, 74, 77–78, 86, 92–96, 102, 106, 108, and KUHE 36808-9 (paratypes) from Huangshan, Anhui.

*P. granulatus*: CIB ZJ200806006, 7, 10, 12, 16–17, 22, and 103–104 from Tiantai, Zhejiang.

*P. inexpectatus*: CIB GX20081006 (holotype), CIB 20071101, CIB GX20081007 (paratypes), CIB 20081002, GX 200905096, 109, CIB 21137, 39–40, 43–45, 47, and 1 unnumbered specimen from Jinxiu, Guangxi.

*P. moi*: CIB GX20070009 (holotype) from Longshen, Guangxi.

## APPENDIX II

*Specimens examined for skull characteristics and number of trunk vertebrae*

KUHE 36808 and 36809 (paratypes of *P. feii*), CIB GX20070009 (holotype of *P. moi*), KUHE 39763 and 39832 (*P. changi*).

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