

A NEW SPECIES OF *TAKYDROMUS* (REPTILIA: LACERTIDAE) FROM VIETNAM

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ABSTRACT: We describe a green lacertid lizard, *Takydromus hani*, from central Vietnam. It differs from congeners in having 6–8 (versus 1–5) femoral pores on each thigh. The phylogenetic relationships of this continental form seem to be with *T. sauteri* of Taiwan, and *T. toyamai* and *T. smaragdinus* of the Ryukyu Archipelago.

Key words: *Takydromus hani* new species; *Takydromus dorsalis*; *Takydromus keuhnei*; *Takydromus intermedius*; *Takydromus smaragdinus*; *Takydromus toyamai*; *Platyplacopus*; Phylogeny; Biogeography; Vietnam

THE lacertid genus *Takydromus*, commonly known as grass lizards, is widely distributed in the temperate and tropical Far East and northeastern India (Arnold, 1997). In his review and phylogenetic analysis, Arnold (1997) recognized two lineages within the genus *Takydromus*, with *T. keuhnei*, *T. intermedius*, and five green grass lizards in the subgenus *Platyplacopus*, and the other species in the subgenus *Takydromus*. Among the five green grass lizards, *T. sylvaticus* is the only continental taxon, found only in a small area in northwestern Fujian, China (Zhao, 1999; Zhao and Adler, 1993). The others are insular: *T. dorsalis* (previously placed in the genus *Apeltonotus*; Nakamura and Uéno, 1972) from Ishigaki Island, *T. toyamai* from the islands of the Miyako group, *T. smaragdinus* from the islands of the Okinawa group and the Amami group (all of the Ryukyu Archipelago; Takeda and Ota, 1996), and *T. sauteri* from Taiwan and Lanyu (=Orchid Island, an islet southeast of Taiwan; Lin and Cheng, 1990; Ota, 1991). In the present paper, we describe a sixth green species of *Takydromus* based on three specimens from Vietnam. Previously, only non-green grass lizards, *T. sexlineatus*, *T. wolteri* (Bobrov, 1995), and *T. keuhnei* (Ziegler and Bischoff, 1999; Zie-

gler et al., 1998), were recorded in this country. The supposed occurrence of *T. wolteri* could be a case of misidentification (Ziegler and Bischoff, 1999; Ziegler et al., 1998).

MATERIALS AND METHODS

Scale counts and measurements follow Takeda and Ota (1996) and Arnold (1997). Measurements were taken with digital calipers and rounded to the nearest 0.1 mm.

To estimate the phylogenetic relationships of the new species, 23 external characters and the morphology of posterior lateral teeth were coded for the new species and added to the data matrix of Arnold (1997; Table 1). Because examining other skeletal characters would require complicated and damaging dissections, these characters were coded as missing for the new species in our analysis. Polarities and definition of character states follow Arnold (1997), with the exception of the number of femoral pores on each thigh (Character 27) (Appendix I). The new species has 6–8 femoral pores on each side whereas other species have 1–5. The higher number seems to be primitive (Arnold, 1997). Thus, we define the states for this character as follows: 0 = six or more; 1 = three to five; 2 = two; 3 = one. Data for the new species added to Arnold's (1997) data set are listed in Appendix II. Hypotheses of phylogenetic relationships were formulated by parsimony analysis using PAUP

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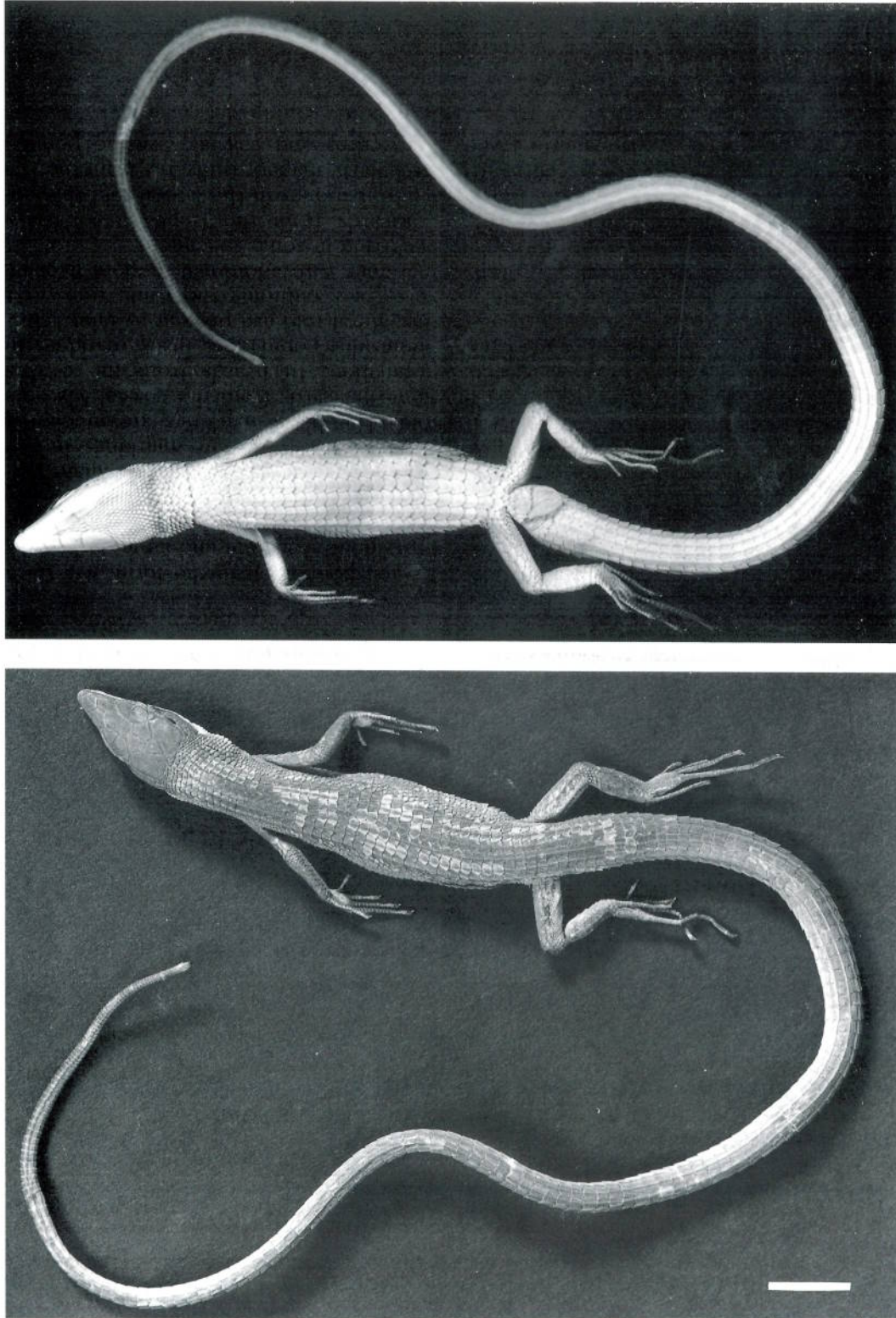


FIG. 1.—(Top) Ventral and (bottom) dorsal views of the holotype of *Takydromus hani* (NMNS 3370, 63.4 mm SVL). Scale = 10 mm.

version 3.1.1 (Swofford, 1993). All characters are ordered and equally weighted following Arnold (1997). The branch-and-bound search option was used to find shortest trees. Nonparametric bootstrapping analysis (Felsenstein, 1985) was performed to evaluate stability of nodes within the tree using 1000 pseudoreplicates. Character state changes were examined on the resulting trees using MacClade 3.07 (Maddison and Maddison, 1997).

Arnold (1997) regarded all known green species of *Takydromus* as a clade, partly on the possession of the derived character state of green dorsal color. Comparisons of morphological characters among green grass lizards of the genus *Takydromus* (Table 1) were based on examining specimens (Appendix III) and characters described from the literature (e.g., Arnold, 1997; Nakamura and Uéno, 1972; Zhao, 1999). Museum acronyms follow Leviton et al. (1985), with the addition of NMNS (National Museum of Natural Science, Taichung, Taiwan) and IEBR (Institute of Ecological and Biological Resources, Hanoi, Vietnam). A key to the green grass lizards of the genus *Takydromus* is presented, based on Arnold (1997) but including the new species.

RESULTS

Species Descriptions

The lacertid specimens collected from central Vietnam apparently represent a distinct species of the genus *Takydromus* described as follows.

Takydromus hani sp. nov.

Holotype.—NMNS 3370 (Fig. 1); an adult male from Vietnam: Ha Tinh Province: Huong Son District: 12 km south of Rao-An Town ($18^{\circ} 20' 56''$ N, $105^{\circ} 14' 47''$ E). Undergrowth of a subtropical forest at an elevation of 900 m (Fig. 2). Collected on 19 July 1998 by W.-H. Chou, Y.-B. Huang, and N. Q. Truong.

Paratypes.—IEBR-L100 (AMNH Field Series 14140); a female from Ha Tinh Province: Huong Son District: 10 km southwest of Rao-An Town ($18^{\circ} 21' 53''$ N, $105^{\circ} 13' 13''$ E), same habitat as that of holotype at an elevation of 200 m; collect-



FIG. 2.—The map showing the type locality (solid square) of *Takydromus hani* (Vietnam: Ha Tinh Province: Huong Son District: 12 km S Rao-An Town; $18^{\circ} 20' 56''$ N, $105^{\circ} 14' 47''$ E; at an elevation of 900 m). Open square (partly concealed by solid square) and triangle represent the localities of the paratypes IEBR-L100 (Vietnam: Ha Tinh Province: Huong Son District: 10 km southwest of Rao-An Town; $18^{\circ} 21' 53''$ N, $105^{\circ} 13' 13''$ E) and IEBR-L101 (Vietnam: Quang Nam Province: Tra My District: Ngoc Linh Mountain; $15^{\circ} 10' 57''$ N, $108^{\circ} 02' 54''$ E), respectively. The broken line denotes the Tropic of Cancer.

ed 13 May 1998 by D. Lunde. IEBR-L101 (AMNH Field Series 14773); a male from Quang Nam Province: Tra My District: Ngoc Linh Mountain ($15^{\circ} 10' 57''$ N, $108^{\circ} 02' 54''$ E), similar habitat as that of holo-

TABLE 1.—Comparisons of morphological characters among green grass lizards of the genus *Takydromus*.

Characters	<i>T. hani</i> sp. nov.	<i>T. dorsalis</i>
No. of postnasal scales	1	1
No. of pairs of chin shields	4	4
Keeling on median gular scales extending anterior to line joining posterior edges of ears	no	no
Dorsal scales on anterior half of body	all large, in obvious longitudinal rows	all small
No. of longitudinal rows of large dorsal scales between hind legs	6	8–10*
Paired vertebral series of scales on tail extending on to body	no	no
No. of longitudinal ventral scales rows	8	6
Enlarged lateral scales	absent	absent
Keels on ventral scales	present on all rows	absent or present on outermost rows*
Prenasal scales divided by suture	no	no
No. of femoral pores on each side	6–8	2–3**/**
No. of rows of large scales under thigh	4 with 4th. reduced	3 with 3rd. reduced
Keels on internal tibial scale rows	present	absent
Posterior temporal scales	large	small
White ventrolateral stripe running between insertions of fore and hind limbs	absent	absent

* From Arnold (1997).

** From Nakamura and Uéno (1972).

*** From Zhao (1999).

type at an elevation of 1450 m; collected 20 March 1999 by N. Q. Truong.

Diagnosis.—This species can be distinguished from all known congeners by having 6–8 femoral pores as opposed to 1–5 femoral pores (Arnold, 1997). Table 1 shows the comparison of *T. hani* with other green congeners. *Takydromus hani* differs further from *T. dorsalis* and *T. sylvaticus* in having large dorsal scales in longitudinal rows on body, fewer longitudinal rows of large dorsal scales between the hind legs (six versus 8–10), more longitudinal ventral scale rows (eight versus six), keeled ventral scales (as opposed to unkeeled or with only outermost row keeled), more large scale rows under the thigh (four versus three), keeled internal tibial scales, and having larger posterior temporal scales. It differs further from *T. toyamai*, *T. smaragdinus*, and *T. sauteri* in having fewer postnasal scales (one versus two), more large scale rows under thigh (four versus 2–3), and lacking enlarged lateral scales.

Description of holotype.—Body slender,

snout-vent length (SVL) 63.4 mm; head elongate, length 15.5 mm, width 8.9 mm, height 7.3 mm; snout acutely pointed (Fig. 3); rostral separated from frontonasal by supranasals; nostril surrounded by supranasal, postnasal, and anteriormost supralabial; one postnasal, six supralabials and six infralabials present on each side; four supraoculars on each side, the anteriormost and posteriormost much smaller than other supraoculars; four supraciliaries on each side, anteriormost in contact with the second supraocular, posteriormost in contact with posteriormost supraocular; eight supraciliary granules on left, 10 on right; two loreals on each side, anterior one shorter than posterior one; two prefrontals, weakly keeled; frontal hexagonal, weakly keeled; two frontoparietals; two parietals, weakly keeled posteriorly, separated from each other by interparietal anteriorly, but contacting posteriorly; five supratemporals on each side, weakly keeled; temporal scales distinctly keeled, and those dorsal and anterodorsal to ear opening enlarged; four pairs of chin shields, anterior two pairs in

TABLE 1.—Extended.

<i>T. sylvaticus</i>	<i>T. toyamai</i>	<i>T. smaragdinus</i>	<i>T. sauteri</i>
2*	2	2	2
4*/***	3	3 or 4*	4
yes*	yes	no	no
all small*/***	all large in obvious longitudinal rows	scales behind forelimbs large, in longitudinal rows	scales behind forelimbs large, in longitudinal rows
8–10*	4	6	6
no*	yes but diverging	yes but diverging	no
6*/***	8	6	6
absent*	present	present	present
absent or present on outermost rows*	present on all rows	present on all rows	present on all rows
no*	yes	yes/no*	yes/no*
2–3* (3***)	1	1	1
3 well developed*	3 well developed	2 or 3 with 3rd reduced*	2
absent*	present	present	present
small*	large	small	small
present*/***	absent	present	present

contact medially for their entire length; collar distinct, with 11 scales; keeling on median gular scales not extending anteriorly to line joining posterior edges of ears; dorsal scales on body enlarged, imbricate, strongly keeled, in six rows, extending anteriorly beyond forelimbs on to neck; lateral body scales small, keeled, slightly imbricate, in 7–8 rows on each side at mid-body, relatively uniform in size; ventrals slightly mucronate; all strongly keeled, obtusely pointed, in eight longitudinal rows, anterior and posterior scales of outer rows gradually diminishing in size; preanal single, with two elongate scales on each side, surrounded by continuous series of smaller scales anteriorly and laterally; seven femoral pores on left and eight on right; scales on anterior and dorsodorsal surfaces of forelimbs and anterodorsal surfaces of hind limbs enlarged, keeled, somewhat rhomboid, and imbricate; four rows of large scales on underside of thigh, second row of scales weakly keeled; main subtibial and internal tibial scale rows with keels. Number of subdigital lamellae under fingers I–V respectively 7 (left)–7 (right), 11–11, 14–14, 19–18, 10–10; number of subdigital la-

mellae under toes I–V respectively 7–7, 12–12, 16–16, 23–23, 15–14. Subdigital lamellae of distal part of both fingers and toes divided. Tail long (length 213.1 mm, 336 % of SVL; posterior 39.2 mm regenerated), with strongly keeled scales in 18 rows at base, dorsal scale rows bordering the mid-line not extending directly on to body.

Color in life.—Pupil golden yellow; dorsal surfaces of head, body and tail green, body slightly paler; ventral surfaces of head, body and tail greenish yellow; lower halves of postnasal and loreal scales, and preocular scales, granules on lower eyelid yellow; a thin black stripe extending posteriorly from preocular region to anterior edge of ear, stripe interrupted by eye; dorsal surfaces of limbs green, distal edges of digital scales dark brown; ventral surfaces of limbs greenish yellow, digits dark brown (Fig. 4).

Color in ethanol.—Green and greenish yellow portions in life faded to pale blue and bluish white respectively; other colors similar to those in life.

Variation.—The type series, including the holotype and two paratypes, are similar in coloration in ethanol. In life, like

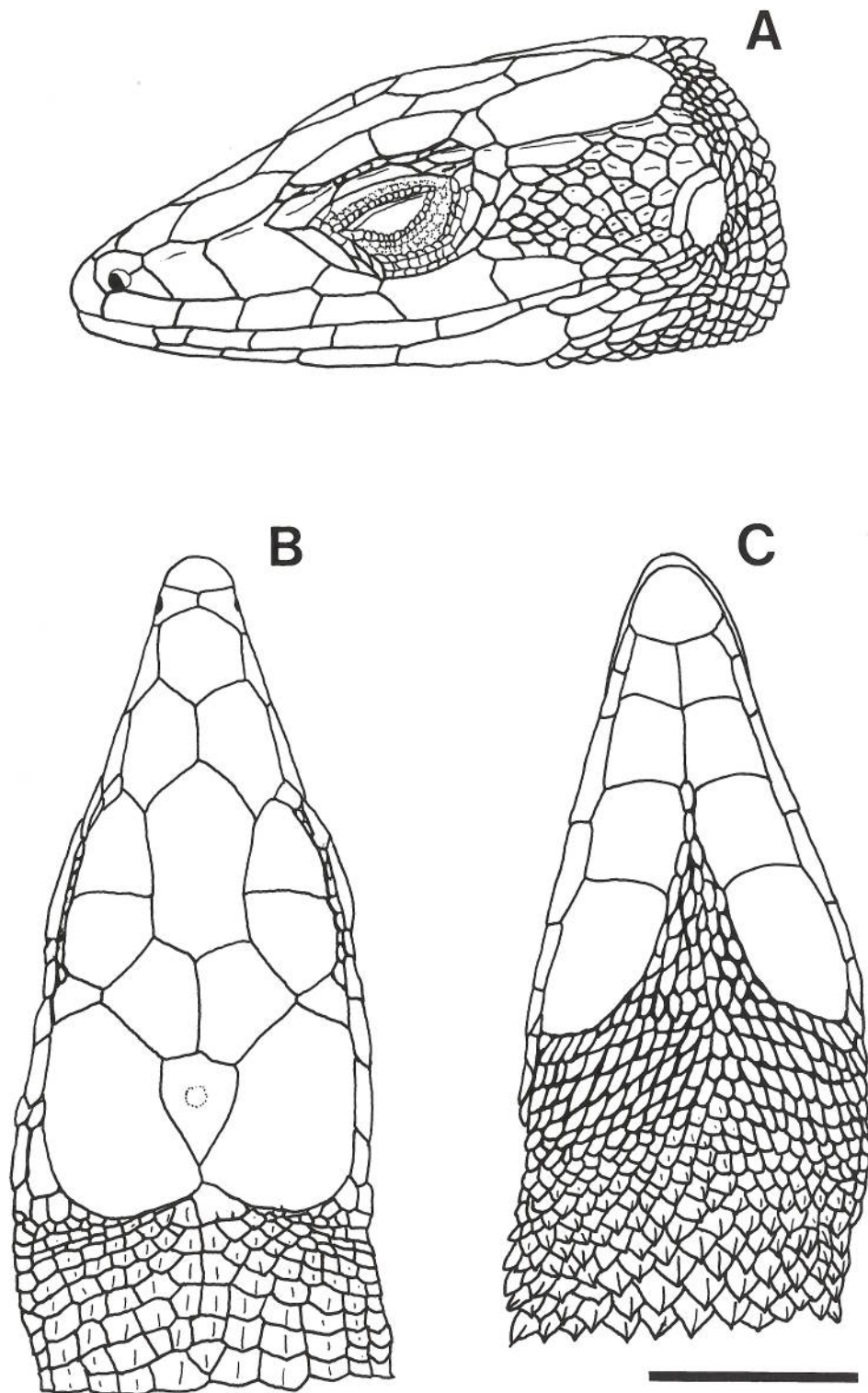


FIG. 3.—(A) Dorsolateral, (B) ventral, and (C) dorsal views of the head of the holotype of *Takydromus hani*. Scale = 5 mm.



FIG. 4.—The holotype of *Takydromus hani* in life. Scale = 10 mm.

the holotype, dorsal surfaces of head, body, and limbs of the individual (IEBR-L101) are basically green, but with a slight brown tinge. The female specimen (IEBR-L100) is 79.0 mm in SVL, longer than those of the males (Table 2). However, the ratios of the head width and head length (female 57.5% versus males 57.4–57.9%; Table 2) vary slightly be-

tween sexes. All the type series have 1/1 postnasal, 6/6 infralabials, 4/4 supraoculars, 4/4 supraciliaries, 2/2 loreals, 5/5 supratemporals, two prefrontals, two frontoparietals, two parietals, 4/4 chin shields, six longitudinal rows of dorsal scales and eight longitudinal rows of ventral scales on body, 4/4 rows of large scales running along underside of thigh, and subdigital

TABLE 2.—Variations of some measurements, scale counts and number of femoral pores among holotype and paratypes.

Characters	Holotype NMNS 3370	Paratype IEBR-L100	Paratype IEBR-L101
Sex	male	female	male
Snout-vent length (mm)	63.4	79.0	51.5
Head length (mm)	15.5	16.5	12.6
Head width (mm)	8.9	9.5	7.3
Head height (mm)	7.3	7.1	5.5
Tail length (mm)	213*	245	145**
No. of supralabials	6	7	6
No. of supraciliary granules (left)	8	10	10
No. of femoral pores (left-right)	7–8	6–6	6–6
No. of subdigital lamellae of finger IV (left-right)	19–18	19–19	19–18

* Posterior 39.2 mm regenerated.

** Tip broken.

lamellae 7–7, 12–12, 16–16, 23–23, 15–14 on toes I, II, III, IV, and V, respectively. Table 2 gives the measurements, scale counts, and number of femoral pores that vary among holotype and paratypes.

Distribution and natural history.—*Takydromus hani* is currently known from Rao-An, Huong Son District, Ha Tinh Province and Ngoc Linh Mountain, Tra My District, Quang Nam Province of central Vietnam (Fig. 2). Little information regarding the natural history of this species is available. The type series was collected during spring and summer from March, May, and July respectively, during the dry season. Specimens were found on undergrowth by streams in primary subtropical forests ranging from 200–1450 m elevation. The holotype was found moving on the branches of bushes at about 0900 h, and one of the paratypes (IEBR-L101) was captured on branches 1–1.5 m above ground. No other specimens were seen during the period of fieldwork. Seminiferous tubules of the left

testis (length 3.2 mm and width 1.6 mm) and the epididymis are visible in the holotype, suggesting that the species is reproductively active in July.

Etymology.—The specific name is a noun in the genitive case and honors Pao-teh Han, the founder and former Director of the National Museum of Natural Science (NMNS), Taiwan, in recognition for establishing NMNS with the Section of Herpetology.

Phylogenetic Relationships

The parsimony analysis resulted in four trees of 87 steps, each with a consistency index (CI) of 0.48 and a retention index (RI) of 0.69. A strict consensus tree (Fig. 5) is similar to that of Arnold (1997). In the subgenus *Platyplacopus*, *T. hani* is grouped with *T. sauteri*, *T. smaragdinus*, and *T. toyamai*, while *T. sylvaticus* and *T. dorsalis* made up another group (Fig. 5). As in the phylogeny proposed by Arnold (1997), the green grass lizards form a monophyletic group.

KEY TO THE GREEN SPECIES OF THE GENUS *TAKYDROMUS*

- 1a. Six longitudinal rows of ventral scales 2
- 1b. Eight longitudinal rows of ventral scales 5
 - 2a. All dorsal scales on anterior half of body small, not in longitudinal rows; body without enlarged lateral scales 3
 - 2b. Dorsal scales posterior to forelimbs large, in longitudinal rows; body with enlarged lateral scales 4
 - 3a. One postnasal scale present; 28–35 dorsal scale rows across mid-body; pale ventrolateral stripe running between insertions of fore and hind limbs absent *T. dorsalis*
 - 3b. Two postnasal scales present; 41–44 dorsal scale rows across mid-body; pale ventrolateral stripe between insertions of fore and hind limbs present ... *T. sylvaticus*
- 4a. Paired vertebral series of scales on tail extending on to body; usually with 4 pairs of chin shields; temporal scales strongly keeled *T. sauteri*
- 4b. Paired vertebral series of scales on tail not extending on to body; usually with 3 pairs of chin shields; temporal scales smooth or weakly keeled ... *T. smaragdinus*
 - 5a. One femoral pore on each side; enlarged lateral scales on body present *T. toyamai*
 - 5b. Six to eight femoral pores on each side; enlarged lateral scales on body absent *T. hani*

DISCUSSION

The biogeographical significance of a new species of green *Takydromus* in central Vietnam is twofold. First, the known distribution of *T. hani* conforms to Arnold's (1997) observation that distributions

of green grass lizards are widely allopatric and restricted to small areas. The distribution of another continental green grass lizard, *T. sylvaticus*, is not only widely separated from *T. hani*, but also narrowly restricted to its type locality, Chungang, Fu-

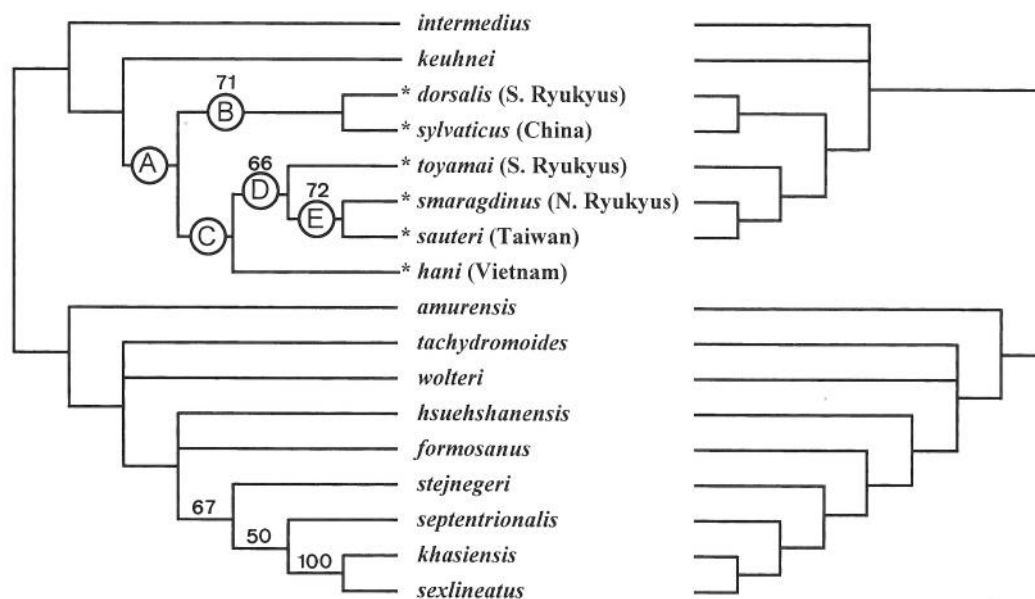


FIG. 5.—Cladograms showing relationships of the species of the genus *Takydromus*. (Left) A strict consensus of four trees from this study, and (Right) a strict consensus tree from Arnold (1997). Asterisks denote green grass lizards. Geographic origin enclosed in parentheses. Numbers at nodes represent bootstrap values (only those >50% are listed). Supporting synapomorphies for each node (corresponding to a letter) are listed below, based on ACCTRAN (accelerated transformation) optimization. Character numbers with asterisks denote synapomorphies with more than one equally parsimonious placement. **A:** 19* = longitudinal series of dorsal scales bordering the mid-line of tail not extending on to body (extending on to body but diverging in *T. toyamai* and *T. smaragdinus*). 32 = dorsum distinctly green. **B:** 17* (reversal) = all dorsal scales on anterior half of body small and not in longitudinal rows. 18 (reversal) = 8–10 longitudinal rows of large dorsal scales between hind legs. 19* (reversal) = longitudinal series of dorsal scales bordering the mid-line of tail not extending on to body. 24* (reversal) = none or outermost row of ventral scales with keels. 28* = three rows of large scales with third reduced running along underside of each thigh. **C:** 8 (reversal) = third cusp of the posterior lateral teeth often very small. 24* = all ventral scales with keels. 30 = internal tibial scale row usually with keels. **D:** 15 = three pairs of chin shields (four in *T. sauteri*). 22 = enlarged lateral scales present. 26 = preanal scale divided by a longitudinal suture. 27 = one femoral pore on each side. 28* = three well developed large scales running along underside of each thigh. **E:** 7 = posteroventral border of external exposure of coronoid bone forming an acute angle. 17* = posterior dorsal scales on anterior half of body large and in longitudinal rows. 25 = series of small scales surrounding the preanal scale interrupted medially. 28* = two rows of large scales running along underside of each thigh.

jian, China (Zhao, 1999; Zhao and Adler, 1993). The remaining green grass lizards are found on islands off the shore of southeastern China (Taiwan, Lanyu, and the Ryukyu Archipelago). No distributional overlap has been found among the island forms. In Taiwan, the largest island in the area, *T. sauteri* occurs only in the southern part (Lin and Cheng, 1990; Ota, 1991). Arnold (1997) proposed that the relictual distribution of green grass lizards on the Asian continent and associated islands might be due to competitive exclusion by species of the subgenus *Takydromus*.

Second, green grass lizards from islands

off the coast of southeastern China can be divided into two lineages, each with a closely related counterpart in the continent, namely *Takydromus sylvaticus* for *T. dorsalis* from Ishigaki Island, and *T. hani* for the group comprising *T. sauteri* from Taiwan and Lanyu, *T. toyamai* from Miyako group, and *T. smaragdinus* from Okinawa and Amami groups (Arnold, 1997; this study). Hypotheses concerning sequence of colonization of island forms, although somewhat speculative, can be discussed on the basis of character evolution and phylogenetic relationships (Grismer, 1999; Thorpe et al., 1994). Several species

from the Ryukyu Archipelago are thought to have reached these islands from continental China via Taiwan (Ota, 1994, 1998) as suggested by close relationships between species from Taiwan and the Ryukyu Islands. Our results of phylogenetic analyses have shown that the relationships among Taiwan and Ryukyu green grass lizards (e.g., *T. sauteri*, *T. smaragdinus*, and *T. toyamai*) are basically similar to the generalized biogeographical patterns of these islands, but the green grass lizard of Taiwan might be colonized from Ryukyu. The sister taxon of *T. dorsalis* from the Yaeyama islands, however, is absent from Taiwan. This may indicate either a direct origin from continental China via a land-bridge connection (Grismer et al., 1994), or extinction of its sister species or failure to find this species on Taiwan.

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Contribution to the knowledge of the grass lizards of Vietnam (Reptilia: Lacertidae: *Takydromus*). *Herpetofauna* 20:24–34.

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APPENDIX I

Characters and Character States for Phylogenetic Analyses

Polarities and definition of character states follow Arnold (1997), with the modification of the number of femoral pores on each thigh (Character 27). The distribution of character states among species is shown in Appendix II.

Skeleton

1. Palatal processes of premaxilla slender and narrow and set at a fairly narrow angle to each other. No (0); yes (1).
2. Premaxillary nasal process. Narrow (0); broad (1).
3. Nasal process of maxilla narrow and extended. No (0); yes (1).
4. Tip of nasal process of maxilla embraced by frontal. No (0); yes (1).
5. Head distinctly depressed. Yes (0); no (1).
6. Squamosal bone contacting parietal. No (0); yes (1).
7. Posteroventral border of external exposure of coronoid bone forming an acute angle. No (0); yes (1).
8. Posterior lateral teeth. Third cusp often very small (0); strongly tricuspid (1).
9. Usually 26 or more presacral vertebrae in males. Yes (0); no (1).
10. Keeling on median gular scales extends anterior to line joining posterior edges of ears. No (0); yes (1).
11. Dorsal scales on anterior half of body. All small, not in obvious longitudinal rows (0); more posterior scales large and in longitudinal rows but not those anterior to forelimbs (1), dorsal scales large and in longitudinal rows extending beyond forelimbs on to neck (2).
12. Longitudinal rows of large dorsal scales between hind legs. Eight to ten (0); six (1); four (2).
13. Longitudinal series of dorsal scales bordering the mid-line of tail. Not extending on to body (0); extending on to body but diverging (1); extending as far as nape without diverging (2).
14. Second longitudinal row of ventral scales on posterior belly usually broader than those bordering it. Yes (0); no (1).
15. Number of longitudinal ventral scale rows. Eight (0); six (1).
16. Enlarged lateral scales. Absent (0); present (1).
17. Enlarged lateral scales adjoining ventral ones as long as these. No (0); yes (1).
18. Keels on ventral scales. Absent or present on outermost row (0); present on all rows (1).
19. Series of smaller scales surrounding the preanal scale. Continuous (0); interrupted medially (1).
20. Preanal scale divided by a longitudinal suture. No (0); yes (1).
21. Number of femoral pores on each side. Six or more (0); three–five (1); two (2); one (3).
22. Number of rows of large scales running along underside of each thigh. Three plus traces of fourth (0); three well developed (1); three with third reduced (2); two (3).
23. Distal part of second row of large scales beneath thigh and main subtibial scale row with keels. No (0); yes (1).
24. Keels on internal tibial scale rows. Absent (0); present (1).
25. Pale dorsolateral stripes. Absent (0); present (1).
26. Dorsum distinctly green. No (0); yes (1).

External Features

10. Snout elongate. No (0); yes (1).
11. Postnasal scales. One (0); sometimes two, the upper usually separating the supranasal scale from the first loreal (1).
12. First supraocular scale. Usually present (0); usually absent, with the second supraocular contacting the loreal (1).
13. Supraciliary granules. Usually present (0); absent (1).
14. Number of supraciliary scales. Usually more than three (0); three (1).
15. Number of pairs of chin shields. Four (0); three (1).

Hemipenis

33. Outer lips of lobe sulci produced into basally directed flaps. No (0); yes (1).
34. Hemipenis with sulci extending into lobes. No (0); yes (1).
35. Transverse section of hemipenial lobe triskelial. No (0); yes (1).

APPENDIX II

Data Matrix for Phylogenetic Analyses

Data set used for phylogenetic analysis follows Arnold (1997) with inclusion of the new species, *Takydromus hani*. Dashes represent missing values or in the case of hypothetical ancestor, that polarity is uncertain.

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Hypothetical ancestor	0	0	0	0	—	0	0	0	0	0	—	0	0	0	0	0	0
<i>T. keuhnei</i>	1	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	1
<i>T. intermedius</i>	—	0	0	0	—	—	—	1	1	0	1	0	0	0	0	0	2
<i>T. dorsalis</i>	1	0	0	1	0	0	0	1	1	1	1	0	0	0	0	0	0
<i>T. sylvaticus</i>	1	0	0	1	0	—	—	1	1	1	1	0	0	0	0	0	0
<i>T. toyamai</i>	1	0	0	0	—	0	0	0	1	1	1	0	0	0	1	1	2
<i>T. smaragdinus</i>	1	0	0	0	0	1	1	0	1	1	1	0	0	0	1	0	1
<i>T. sauteri</i>	1	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	1
<i>T. amurensis</i>	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
<i>T. tachydromoides</i>	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	2
<i>T. wolteri</i>	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
<i>T. hsuehshanensis</i>	0	1	0	0	—	0	0	1	1	0	0	0	0	0	1	0	2
<i>T. formosanus</i>	0	1	0	0	1	0	0	1	1	0	0	0	0	0	1	0	2
<i>T. stejnegeri</i>	0	1	0	1	1	0	0	1	1	0	0	0	0	0	1	0	2
<i>T. septentrionalis</i>	0	1	0	0	1	0	0	1	1	0	0	0	0	0	1	1	2
<i>T. khasiensis</i>	0	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	2
<i>T. sexlineatus</i>	0	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	2
<i>T. hani</i>	—	—	—	—	—	—	—	0	—	1	0	0	0	0	0	0	2

APPENDIX II

Continued.

Character	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Hypothetical ancestor	0	0	—	—	0	0	0	0	0	0	0	0	0	—	—	0	0	0
<i>T. keuhnei</i>	1	2	0	1	0	—	1	0	0	1	0	1	0	0	0	1	1	0
<i>T. intermedius</i>	1	2	0	1	0	—	0	0	0	2	2	0	0	0	0	1	1	0
<i>T. dorsalis</i>	0	0	0	1	0	—	0	0	0	1	2	1	0	0	1	1	1	0
<i>T. sylvaticus</i>	0	0	0	1	0	—	0	0	0	2	2	1	0	0	1	—	—	0
<i>T. toyamai</i>	2	1	0	0	1	0	1	0	1	3	1	1	1	0	1	—	—	—
<i>T. smaragdinus</i>	1	1	0	1	1	0	1	1	1	3	3	1	1	0	1	1	1	0
<i>T. sauteri</i>	1	0	0	1	1	0	1	1	1	3	3	1	1	0	1	—	—	0
<i>T. amurensis</i>	1	2	0	0	1	—	0	0	0	1	0	0	0	0	0	0	0	0
<i>T. tachydromoides</i>	1	2	0	0	1	0	1	0	0	2	0	1	1	0	0	0	0	0
<i>T. wolteri</i>	1	2	1	0	1	0	0	0	0	3	0	1	1	0	0	0	0	0
<i>T. hsuehshanensis</i>	1	2	1	0	1	1	0	0	0	2	1	0	0	0	0	0	0	0
<i>T. formosanus</i>	1	2	1	0	1	1	1	0	0	2	1	1	1	0	0	0	0	0
<i>T. stejnegeri</i>	2	2	1	0	1	1	1	0	0	3	1	1	1	1	0	0	0	0
<i>T. septentrionalis</i>	2	2	1	0	1	0	1	1	0	3	1	1	1	1	0	0	0	0
<i>T. khasiensis</i>	2	2	1	0	1	1	1	0	0	3	1	1	1	1	0	1	1	1
<i>T. sexlineatus</i>	2	2	1	0	1	1	1	1	0	3	1	1	1	1	0	0	1	1
<i>T. hani</i>	1	0	0	0	0	0	1	0	0	0	0	1	1	0	1	—	—	—

APPENDIX III

Examining Specimens of Green Species of *Takydromus*

T. dorsalis.—Ishigaki Shima, Yaeyama Group, Ryukyu Archipelago, Japan (Types: BMNH 1916.12.1.1; 1946.8.4.51).

T. smaragdinus.—"Loo Choo" (Types: BMNH 1946.8.4.53–63, formerly 87.1.31.16–25).

T. toyamai.—Sarahama, Irabujima, Miyako Group, Ryukyu Archipelago, Japan (Paratypes: BMNH 1992.533–534).

T. sauteri.—Lanyu (Orchid Island), Taitung Co., Taiwan (NMNS 3299).