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A NEW LIZARD OF THE GENUS *LEPIDODACTYLUS* (REPTILIA: GEKKONIDAE) FROM BATAN ISLAND, PHILIPPINES

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Abstract.—A new species of *Lepidodactylus, L. balioburius,* is described from Batan Island in the northernmost archipelago of the Philippines. It is most closely related to the recently described *L. yami* from Lanyu Island, Taiwan. Morphological variation in both species is analyzed.

The herpetofauna of mountainous northern Luzon and the island groups stretching north toward Taiwan remains poorly known, despite intensive field work in other parts of the Philippines during the past 20–30 years. The Batan Island group, the northernmost archipelago in the Philippines, is of considerable zoogeographic interest since it is located almost midway between the Philippines and Taiwan (220 km north of Luzon and 200 km south of Lanyu Island, see Fig. 1). A few specimens from Batan reported in the literature perished when the Bureau of Science collection in Manila was destroyed during World War II. During May and June 1985, a multidisciplinary team of biologists, coordinated by Angel C. Alcala (Silliman University) and Charles A. Ross (Smithsonian Institution), collected on several islands in the Batan Group. Their collections contained a small series of a distinctive new species of *Lepidodactylus,* a genus unreported from the extreme northern Philippines. The new species is superficially similar to the recently described *L. yami* from Lanyu Island, Taiwan (Ota 1987).

Materials and Methods

Data were taken from the series of *Lepidodactylus* from Batan Island (n = 14) and all other Philippine/Taiwanese species of the genus (see Specimens Examined). Additional information was taken from Brown & Alcala (1978). Nine meristic and 21 morphometric characters were used for comparisons. The meristic characters are the number of: upper labials (UL), lower labials (LL), internasal scales (INS), interorbital scales (IOS), midbody scale rows (MSR), enlarged preanal and femoral scales (PFS), preanal and femoral pores in males (PFP), toe I scansors (TIS), toe IV scansors (TIVS). The mensural characters are: snout to vent length (SVL), head length (HL), head width (HW), head depth (HD), snout to eye length (SEL), eye diameter (ED), eye to ear length (EEL), internasal distance (IND), interorbital distance (IOD), snout to arm length (SAL), axilla to groin length (AGL), body width (BW), body depth (BD), thigh length (THL), tibia length (TBL), toe I length (TIL), toe IV length (TIVL), toe IV width (TIVW), the length of scansor series beneath toe IV (SL), tail width (TW), and tail depth (TD). All morphometric characters were measured to the nearest 0.1 mm with dial calipers. Meristics were compared using Wilcoxon's 2-sample test and morphometric characters were examined by principal component analysis, using the PRICOMP procedure of SAS (1985) with correlation ma-

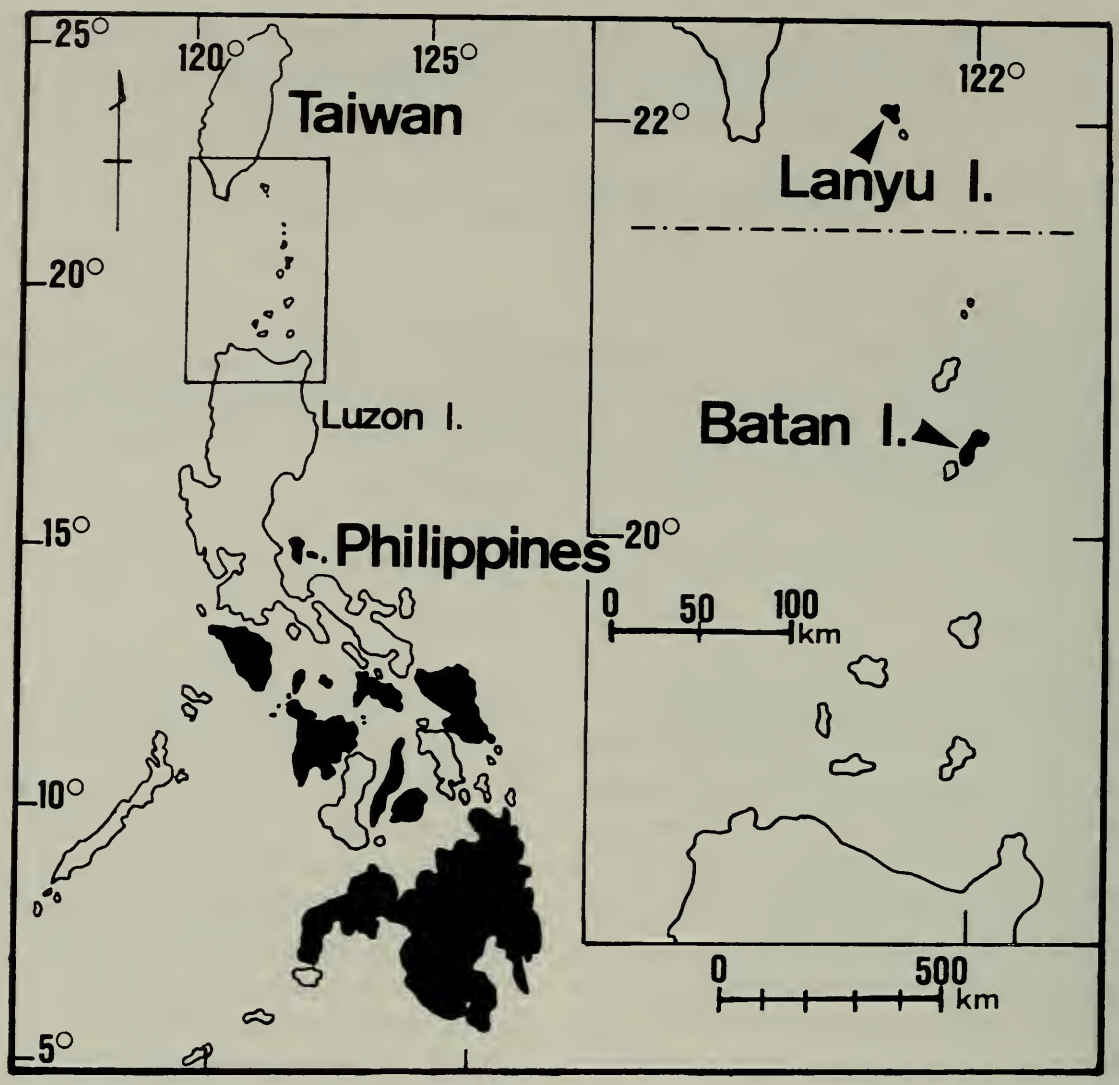

Fig. 1. Map of the Philippines and Taiwan, showing the type locality of *Lepidodactylus balioburius* sp. nov. (Batan Island, inset), in relation to the distribution of its close relative *L. yami* (Lanyu Island, inset) and *L. planicaudus* (shaded portions in the central and the southern Philippines).

trix. Skeletal characters were examined in radiographs. Museum acronyms follow Leviton et al. (1985).

Lepidodactylus balioburius, new species
Fig. 2

Holotype.—Philippine National Museum (PNM) 984 (Original number USNM-FS 121559), an adult male collected 2 km (by road) SE of Mahatao, Mahatao Municipality, Batan Island, Batanes Province, Philippines, on 6 Jun 1985, by Angel C. Alcala, Ven Samarita, and Braulio Gargar.

Paratypes.—(n = 13, all from Batan Island). USNM 266559, 3 km NE of Basco, collected by Charles A. Ross & B. Gargar on 28 May 1985; OMNH 2349 (USNM-FS 121200), 1–2 km E of Basco along road to Balugdh Bay, A. C. Alcala & D. Catada, 27 May 1985; USNM 266560–61, 2.5 km ENE of Basco on W slope of Mt. Iraya, 150 m, Robert S. Kennedy & Fred G. Thompson, 30 May 1985; OMNH 2348 (USNM-FS 121372), Basco, C. A. Ross, 31 May 1985; USNM 266562, 1.5 km N of Basco, near airstrip, C. A. Ross & A. C. Alcala, 4 Jun 1985; USNM 266563, Itbud, C. A. Ross & B. Gargar, 5 Jun 1985; USNM 266564, 3 km ENE of Basco, W slope Mt. Iraya, 150 m, C. A. Ross & R. S. Kennedy, 7 Jun 1985; CAS 162489, Mahatao, A. C. Alcala, 8 Jun 1985; USNM 266565–67, CAS 162490, 2 km E of Mahatao, C. A. Ross & A. C. Alcala,

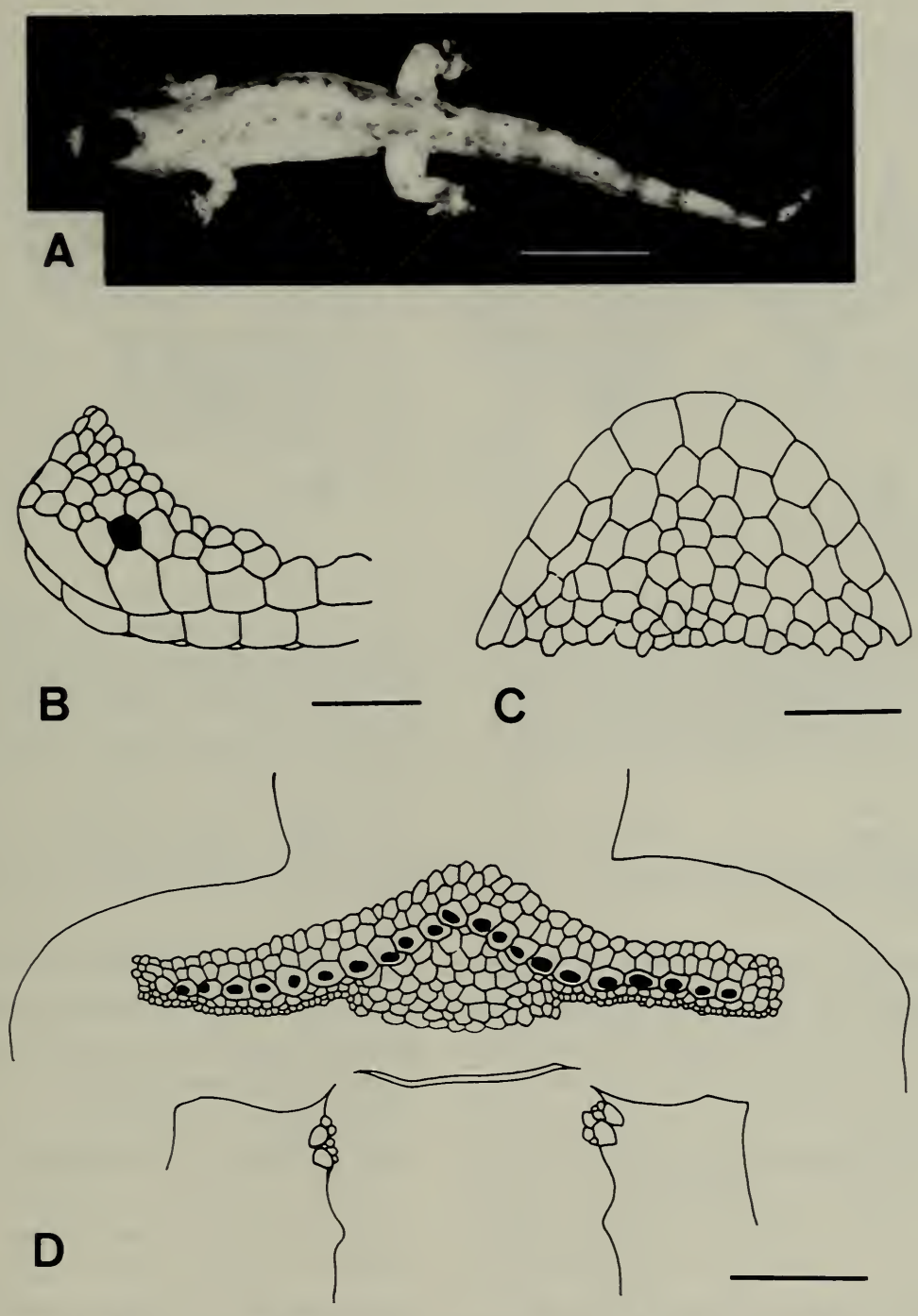

Fig. 2. Holotype (PNM 984) of *Lepidodactylus balioburius,* adult male. A) dorsal view (scale = 10 mm), B) lateral and C) ventral views of snout (scale = 1 mm), D) ventral view of the preanal and femoral region, showing pores and enlarged scales (scale = 2 mm).

6 Jun 1985. (five males and eight females, all adults).

Etymology.—The specific name is derived from the Latin roots balius (brown) and burius (beast), an appropriate descriptor for this species. The name also acknowledges the significant contributions to Philippine herpetology by Walter C. Brown and Charles A. Ross.

Diagnosis.—A small (males 27.2–34.9, females 33.5–38.7 mm), bisexual, Group III (sensu Brown & Parker 1977) species of *Lepidodactylus,* characterized by slight but distinct digital webbing, relatively few enlarged scales and pores in the femoral/preanal region, the rostral separated from the nostril by a scale, presence of lateral serration on the tail, and the absence of distinctive pattern elements (see Figs. 2, 3).

Description of holotype.—Habitus mod-

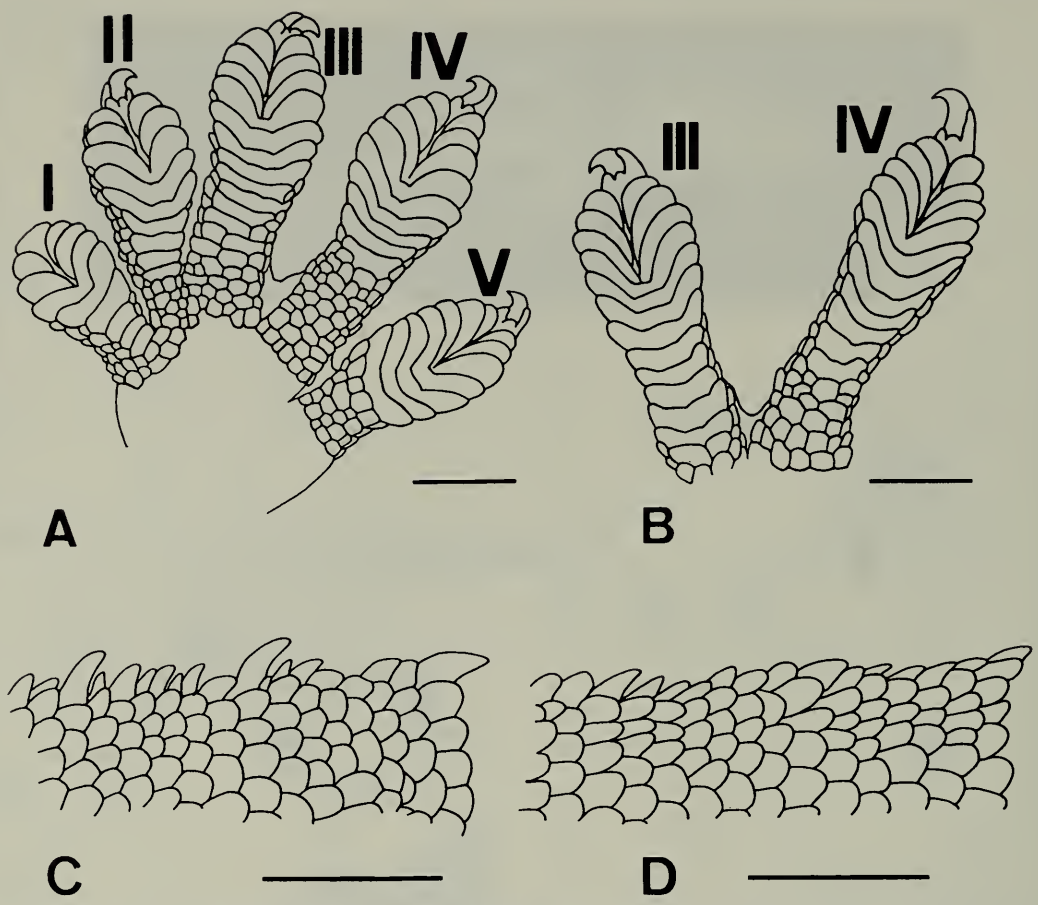

Fig. 3. Ventral view of toes and lateral tail margins of *Lepidodactylus balioburius* (A & C) and *L. yami* (B & D).

erately depressed, SVL 30.4 mm. Snout tapering, rounded at tip, length 3.9 mm. Eye diameter 2.1 mm. Internasal distance 1.6 mm. Rostral separated from nostril by a small quadrangular scale. Nostril surrounded by two supranasals, first upper labial, one small scale anteriorly and a slightly enlarged scale posteriorly. Anterior supranasals separated by two small scales that border the rostral. Eleven upper labials on the right, 12 on the left, the 9th beneath the center of the orbit; the last 2 only about twice as large as the surrounding scales. Eleven lower labials. Mental triangular, smaller than adjacent labials. Three to 5 rows of slightly enlarged scales on anterior part of chin. Scales on the snout larger than those on the dorsal surface of the body. Dorsal and lateral body scales very small, granular, with no enlarged tubercles. Forty-one interorbital scale rows at the midpoint of orbits, 131 scale rows at midbody. Ventral scales flat, cycloid, distinctly larger than dorsals.

Length of extended hind limb 11.0 mm. Digits moderately dilated, distal three-fifths to three-quarters of undersurface bearing scansors as follows: fingers—I 7, II 8, III 10, IV 11 (right) or 12 (left), V 8; toes—I 8, II 9, III 11 (left) or 12 (right), IV 9 (right) or 10 (left), V 8 (left) or 9 (right). Distal two to three scansors, including the terminal one, divided on all digits except the first. First digit with complete terminal and two divided subterminal scansors. All digits except the first clawed. Compressed claw-bearing phalanges arising from distal margin of the dilated part and extending only a short distance beyond. Phalangeal formula of hand and foot 2-3-4-5-3. Webbing slight but evident between toes III and IV, extending to about one-eighth to one-fifth length of toe IV.

Twenty-three enlarged preanal and femoral scales bearing a continuous series of 21 pores, extending over proximal 60% of thigh. Series of pore-bearing scales followed by one

row of slightly enlarged scales on thigh, and four to five rows of enlarged scales in preanal region. Two pairs of cloacal spurs on both sides of vent. Tail unregenerated, moderately depressed; its depth just posterior to the basal swollen area 73% of its width; lateral flange of skin lacking, but enlarged, spine-like scales present every five to seven marginal scales. Scales on the ventral surface of the tail slightly larger than those on dorsal surface. Interclavicle dagger-shaped, without lateral projections. Clavicles perforated. Twenty-six presacral vertebrae. Nasals fused at midline.

Color in alcohol.—Dorsal ground color light grayish tan, with numerous minute dark dots; slightly darker areas on snout and between orbits; a wide, indistinct, dark band from the tip of the snout, through the nostril, eye, along the dorsal margin of the ear, and fading out between the ear and forelimb. Several dark spots on upper and lower labial regions. Indistinct rusty gray markings forming vague dorso-lateral lines. Venter creamy white, with minute blackish dots, much sparser than those on dorsum. Tail with 10 dark gray annular bands.

Variation.—Variation in counts and measurements of the type series is presented in Tables 1 and 2. In the five specimens with regenerated tails the enlarged, spine-like lateral scales are absent.

Coloration in the series is variable. In two specimens, the dorsal ground color is much darker and more rusty than the holotype, with a lighter middorsal region forming a broad longitudinal stripe. The dark dorsolateral markings and annular bands on the tail are indistinct or absent in seven specimens. In two others, however, these markings are more distinct than in the holotype. Four specimens have black spots on the lateral region of the original tail and on the neck.

Natural history.—Specimens were collected in both disturbed and forested habitats from sea level to 150 m on Mt. Iraya. The field notes of C. A. Ross indicate that

Table 1.—Comparison of nine meristic characters in *L. balioburius* sp. nov., *L. yami*, and other Philippine congeners. See the text for abbreviations. Data marked with an * taken from Brown and Alcala (1978:82–101 + table 6), but note that numbers in the text do not always agree with those in the table. In these cases, inclusive values were used.

Species		UL	LL	INS	IOS	MSR	PFS	PFP	TIS	TIVS
L. balioburius	$\bar{x}$	11.57	10.07	4.71	40.00	138.57	22.79	21.33	7.71	10.00
	SD	0.94	0.83	0.47	3.57	5.32	1.37	1.37	0.83	0.68
	range	10–14	9–11	4–5	34–46	131–151	20–25	19–23	6–9	9–11
L. yami	$\bar{x}$	12.07	10.93	4.20	43.27	139.60	22.55	19.63	8.40	11.73
	SD	0.80	0.88	0.68	3.81	7.53	1.51	1.92	0.74	1.28
	range	11–14	10–12	3–5	36–49	126–151	19–24	15–21	7–9	10–15
L. planicaudus	range	10–13*	10–12*	3–5*	34–42*	135–145*	18–26*	18–34*	7–9*	7–12*
L. christiani	range	10–13*	10–12*	4–5*	40–41	165–168	20–28*	20–27*	6–9*	7–9*
L. aureolineatus	range	11–13*	9–13*	3–5*	38–42	120–140*	30–40*	26–40*	9–10*	11–16*
L. herrei	range	10–13*	9–13*	3–5*	24–34*	78–108*	32–40*	28–46*	9–11*	12–17*
L. lugubris	range	10–13*	9–12*	3–5*	32–40*	120–140*	28–35*	21–32*	9–13*	12–18*

Table 2.—Comparison of 21 morphometric characters of *Lepidodactylus balioburius* sp. nov. and *L. yami*, and the factor loadings on the first three principal components. See text for abbreviations.

	L. balioburius			*L. yami*					
Characters	$\bar{x}$	SD	Range	$\bar{x}$	SD	Range	PRIN I	PRIN II	PRIN III
SVL	34.08	3.81	27.2–38.7	36.16	2.71	31.7–42.1	0.27	0.08	−0.94
HL	8.69	0.67	7.6–9.6	9.47	0.69	8.6–10.9	0.27	−0.01	−0.03
HW	6.36	0.47	5.6–7.1	6.76	0.95	6.0–9.8	0.25	0.15	0.10
HD	3.59	0.28	3.1–3.9	4.23	1.19	3.4–7.1	0.25	0.04	−0.13
SEL	4.11	0.35	3.5–4.6	4.19	0.28	3.9–4.8	0.25	0.11	0.02
ED	2.20	0.20	2.0–2.6	2.29	0.23	2.0–2.6	0.23	0.02	0.13
EEL	2.83	0.17	2.5–3.0	3.02	0.13	2.8–3.4	0.24	−0.07	0.00
IND	1.63	0.13	1.4–1.8	1.68	0.14	1.5–2.0	0.23	0.08	0.06
IOD	4.16	0.29	3.7–4.7	4.59	0.36	4.0–5.0	0.17	−0.23	−0.11
SAL	12.59	1.30	10.6–14.8	13.44	1.05	11.5–15.1	0.24	0.10	0.15
AGL	16.19	2.13	12.7–19.3	17.81	1.82	14.9–21.5	0.24	0.04	−0.38
BW	8.23	1.25	6.2–9.9	7.04	1.23	5.6–9.4	0.05	0.48	−0.35
BD	4.23	0.86	2.8–5.4	5.25	1.17	4.0–8.6	0.23	0.01	−0.36
THL	4.43	0.60	3.5–5.3	4.80	0.68	3.5–5.8	0.24	0.06	−0.10
TBL	4.38	0.38	3.6–4.8	4.90	0.36	4.3–5.4	0.26	−0.11	−0.09
TIL	1.65	0.21	1.4–2.1	1.95	0.16	1.7–2.2	0.22	−0.19	0.12
TIVL	3.05	0.37	2.4–3.7	3.72	0.34	3.0–4.2	0.22	−0.21	0.29
TIVW	1.17	0.17	1.0–1.6	1.19	0.14	0.9–1.5	0.20	0.00	0.51
SL	2.12	0.36	1.6–2.9	2.70	0.21	2.2–2.9	0.19	−0.29	−0.00
TW	4.51	0.64	2.9–5.6	3.50	0.45	2.7–4.1	0.02	0.53	0.11
TD	2.97	0.32	2.3–3.4	2.82	0.37	2.1–3.6	0.06	0.44	0.34
Eigenvalue							12.34	3.20	1.15
Difference							9.13	2.06	0.23
Proportion							0.59	0.15	0.05
Cum. prop.							0.59	0.74	0.79

the species was commonly found under loose bark on trees during the day, in disturbed areas of fields and gardens, in coastal vegetation, and along a forested stream. Of those found after dark, one was active on the guest house in Basco, and another was on the underside of a banana leaf in forest on Mt. Iraya. Two eggs (USNM 266568), four hatched eggshells (not collected), and an adult were found under bark in a ravine running through a garden area, eventually leading to forest. Other gekkonids collected with *L. balioburius* include *Hemidactylus frenatus, Gehyra mutilata,* and *Gekko porosus.* Since *L. balioburius* is ecologically tolerant and not restricted to forest, it is likely that it will be found on other islands in the Batan group, none of which has been adequately collected to date.

Distribution.—Known only from Batan Island, Batanes Province, Philippines, but expected on other islands in the group (see above).

Remarks.—Brown & Alcala (1978) conveniently separated the Philippine species of *Lepidodactylus* into two species complexes (=Sections), based largely on digital morphology, habitus, and caudal scalation. Section A (consisting of *aureolineatus, herrei* and *lugubris*) was characterized by high scansor counts (11–18, usually more than 12), the scansors covering most of the moderately to broadly dilated digits, slight digital webbing, moderately depressed habitus, and a slightly to moderately flattened tail with lateral denticulation. Section B species (*christiani, planicaudus*) have fewer scansors (7–10, usually less than 10), confined to the distal half of broadly dilated and strongly webbed digits. The body and tail are strongly flattened, the latter with a broad flange of skin.

Ota (1987) placed his new species, *L. yami* from Lanyu Island, Taiwan, in Section A, but with some reservations. He also restressed the importance of the nostril position relative to the rostral (in contact in Section A species, separated by a scale in *christiani* and *yami,* separated or in contact in *planicaudus*). Brown & Alcala (1978:81) dismissed this character as having "little significance at the species level," due to the variation in *planicaudus,* but our data indicate that it may be more useful than Brown & Alcala thought.

Lepidodactylus balioburius shares the nasal-rostral separation character with *L. yami* and the Section B species, but has little else in common with the latter. Consequently, it requires comparison only with Section A species. Within this group, *L. balioburius* has lower PFS, PFP, TIS, and TIVS counts than all species except *L. yami* (see Table 1). *Lepidodactylus aureolineatus* and *herrei* are further distinguished by the presence of bright head stripes beginning on the snout and extending to near the ear. *Lepidodactylus lugubris* is a functionally all-female, parthenogenetic species; the few males reported to date have been sterile (Cuellar & Kluge 1972, Pasteur et al. 1987). In color and pattern, *L. lugubris* is often very pale, almost white, with a variable pattern of dark spots, occasionally resembling those in the much darker *L. balioburius. Lepidodactylus lugubris* is capable of color change, however. When in the dark phase, a more complex, ladder-like pattern becomes obvious, but this pattern is distinctly different from the plain brown, spotted *balioburius.*

Lepidodactylus balioburius and *L. yami* share a number of characters unique in Section A species. Both are small, brown, unspecialized species isolated on small islands far to the north of their Philippine congeners (reports of *L. lugubris* from Taiwan and associated islands are possibly recent introductions [Ota 1986, Cheng 1987]). Besides the similar habitus, coloration, and nostril-rostral separation, UL, MSR, PFS, and PFP showed no statistically significant differences between the two species ($P \geq 0.05$). Although the ranges overlapped somewhat, the means of LL, INS, IOS, TIS, and TIVS were significantly different (Table 1); INS of *L. balioburius* was larger than *yami* ($P \leq 0.05$), whereas LL ($P \leq 0.05$), IOS (0.05), TIS (0.05), and TIVS (0.001) were larger in *L. yami.* Principal component analysis of morphometric characters revealed approximately 80% of the total variation in shape as expressed in the first three components—PRINs I, II and III. Of these, PRIN I was of little use in separating *L. balioburius* from *L. yami.* This component consists wholly of positive variable loadings, and is primarily a size component (Table 2). PRIN II, accounting for about 15% of the total variance, tends to discriminate *L. balioburius* from *L. yami* more strongly. Variable loadings on this component revealed several characters chiefly contributing to the shape. The greatest proportion of the variance on PRIN II was expressed by differences in TW. The BW and TD were also heavily loaded, and followed by SL, IOD, TIVL, TIL and HW in descending order. Outlines of scatter plots of the component scores on PRINs I and II separated *L. balioburius* from *L. yami* without overlap (Fig. 4). The two species can also be distinguished by toe webbing and lateral caudal scalation, although these two characters are more subjective. *Lepidodactylus balioburius* has slightly more extensive webbing than *L. yami* (Fig. 3A, B) and the lateral denticulation of the original tail of *balioburius* consists of strongly enlarged, spine-like scales (Fig. 3C). In *L. yami,* slightly enlarged scales are present along the lateral tail edge, but they are neither projecting nor spinose (Fig. 3D). We originally intended to summarize and discuss the relationships of Philippine-Taiwanese *Lepidodactylus* in this paper. Unfortunately, the unprecedented variation in *L. planicaudus* requires further re-evaluation so we defer our taxonomic summary and key to a later paper.

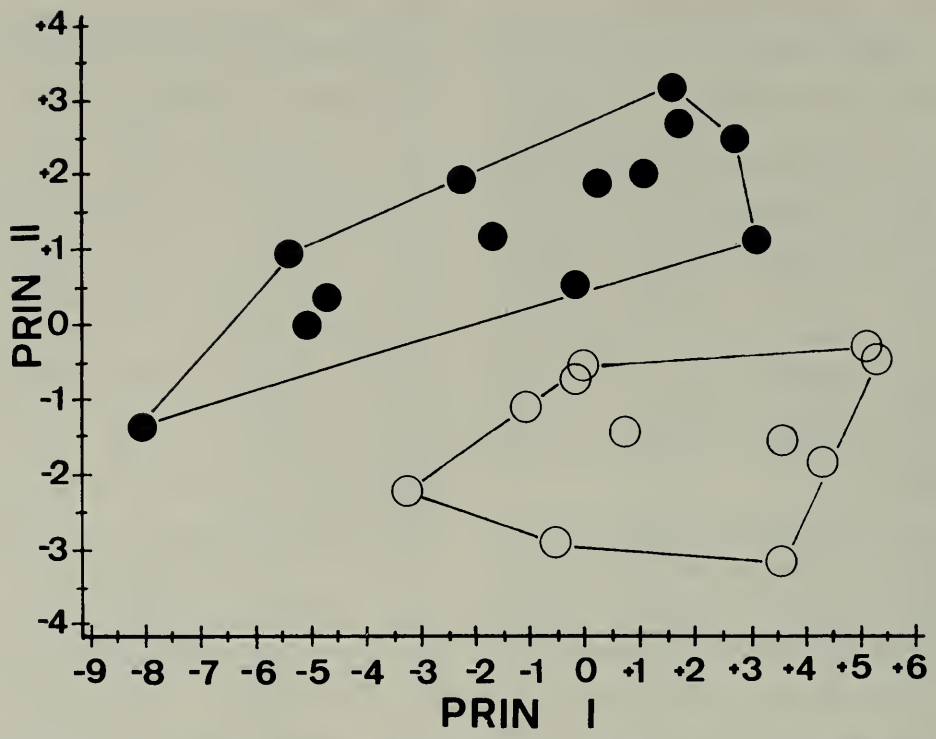

Fig. 4. Two-dimensional plots of scores of *Lepidodactylus balioburius* (closed circles) and *L. yami* (open circles) on principal components (PRINs) I and II. See Table 2 for the factor loadings of each component.

The apparent absence of *Lepidodactylus* from the large island of Luzon is zoogeographically puzzling. Although *L. planicaudus* is found on small islands both east and southwest of Luzon (Brown & Alcala 1978, see also Fig. 1), the genus remains unreported from the entire large island; even the widespread human commensal *L. lugubris* is absent from its towns and cities. Although Luzon has been reasonably well collected (Taylor 1922; Brown & Alcala 1970, 1978), this hiatus may not be real. Many Philippine *Lepidodactylus* are ecologically restricted and difficult to collect. They may inhabit axils of palms or aerial ferns 10 meters or more from the ground. The montane areas of northern Luzon have never been adequately sampled and we would not be surprised if a new species allied to *L. balioburius* and *yami* is eventually discovered in that area.

Specimens examined.—*L. yami:* Osaka Museum of Natural History (OMNH) R2291 (holotype), 690, 691, R2855–61, California Academy of Sciences (CAS) 158254 (paratypes), USNM 267943–44; *L. planicaudus:* CAS 60570, 128566, 139930, 139931, *L. christiani:* CAS 128877, 128878. *L. aureolineatus:* CAS-SU 28411, 26127, CAS 60226, 139941. *L. h. herrei:* CAS-SU 24228, 26342. *L. h. medianus:* CAS 125239, 131856 (paratypes). *L. lugubris:* OMNH R1772, 2201, 2202, 2320, 2321, CAS 158255, 60595, 137835, Australian Museum (AMS) R82602–82610, 82724–82730, 109804–109809, 110141–110146, 110238–110242.

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