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A New Species of Gecko (*Sphaerodactylus*) from Central Cuba

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ABSTRACT.—A new species of gecko, *Sphaerodactylus richardi*, is described from near Playa Girón in southern Matanzas Province, Cuba. It is a member of the *scaber* group, and is distinguished by its dorsal body pattern of 5-6 bold crossbands and large, keeled dorsal scales. The taxonomic status of *S. storeyae* is re-evaluated. The *scaber* group now includes four species, all from central Cuba, Isla de Juventud, and the Archipiélago de los Canarreos: *S. oliveri, S. richardi, S. scaber,* and *S. storeyae.*

RESUMEN.—Se describe una nueva especie de salamanquita, *Sphaerodactylus richardi*, que habita en la region cerca de Playa Girón, Matanzas, Cuba. Se distingue del resto de las especies del Grupo *scaber* por los patrones de 5-6 bandas transversales y escamas dorsales grande y aquilladas. El estado taxonómico de *S. storeyae* se reevaluado. El grupo *scaber* inclue quatro especies, todo de Cuba central, Isla de Juventud, y el Archipiélago de los Canarreos: *S. oliveri, S. richardi, S. scaber,* and *S. storeyae.*

The lizard genus *Sphaerodactylus* (approximately 90 species) is confined to the neotropics and a majority of the species are endemic to the West Indies. Of the 16 known Cuban species (Schwartz and Henderson, 1991; Thomas et al., 1992), three relatively large species with marked sexual dimorphism in pattern and a midorsal zone of small, granular scales have been placed in the *scaber* group: *S. oliveri* Grant, *S. scaber* Barbour and Ramsden, and *S. storeyae* Grant (the taxonomic status of the latter taxon is discussed below). Recently, we obtained specimens of a distinctive new species also belonging to this group of geckos restricted to Cuba and Isla de Juventud.

MATERIALS AND METHODS

Museum abbreviations follow standard usage (Copeia 1985:802–832), except for MNHNCU, which refers to the newly formed collection of the Museo Nacional de Historia Natural, Cuba (Havana). Upper labial counts are given as the number of scales between the rostral and a point just below the middle of the eye. Dorsal and ventral scale counts were made to one side of midline and to one side of midventer (respectively), along a line connecting the axilla and groin. Escutcheon counts are reported as (1) the maximum number of scales from anterior to posterior and (2) the maximum number transversely across the patch (including extensions onto the thighs). Sex was determined by gonadal examination, or by the presence of an escutcheon in males. Measurements, except for the new species, were supplemented by those from Schwartz and Garrido (1981) and are reported as $\bar{x} \pm 1$ SE.

Sphaerodactylus richardi sp. nov.
Fig. 1

Holotype.—USNM 325838, adult female from 8.7 km ESE Playa Girón (Caleta Buena), Matanzas Province, Cuba, sea level, collected by Richard Thomas, Emilio Alfaro, Daniel McAllister, and Alfonzo Silva-Lee on 11 July 1990. Original number USNM field series 191510.

Paratypes (19).—MNHNCU 3941 (female), 3942-5 (males), USNM 319137, 319140 (females), 319138, 319139 (males), paratopotypes; USNM 319142 (female), 319141, 319143, KU 220858 (males), same data as holotype except from 12.4 km ESE Playa Girón; MNHNCU 3946–7, KU 220859, USNM 319144, 319145 (males), KU 220860 (female), same data as holotype except 11.4 km ESE Playa Girón, 12 July 1990.

Diagnosis.—A moderate-sized *Sphaerodactylus* (adults 27.2-31.1 mm snout-vent length, SVL) of the *scaber* group, whose members have large non-overlapping dorsal scales, a zone of middorsal granular scales (three scales wide), and a pattern (juveniles and, in some species, adult females) of longitudinal head stripes, scapular ocelli, and neck and body crossbands. Of the three other species (all Cuban) of the *scaber* group with those characteristics, *S. richardi* can be distinguished from *S. scaber* by its single neck band anterior to the scapular ocelli (two in *scaber*), 5-6 dark dorsal bands between limbs (three dark-edged pale bands in *scaber*), and a different head pattern (four dark stripes versus three dark-edged pale stripes in *scaber*). In *S. scaber*, there are usually two postnasals of equal size, whereas in *S. richardi* the lower postnasal is distinctly larger (1.5-2 times) than the upper.

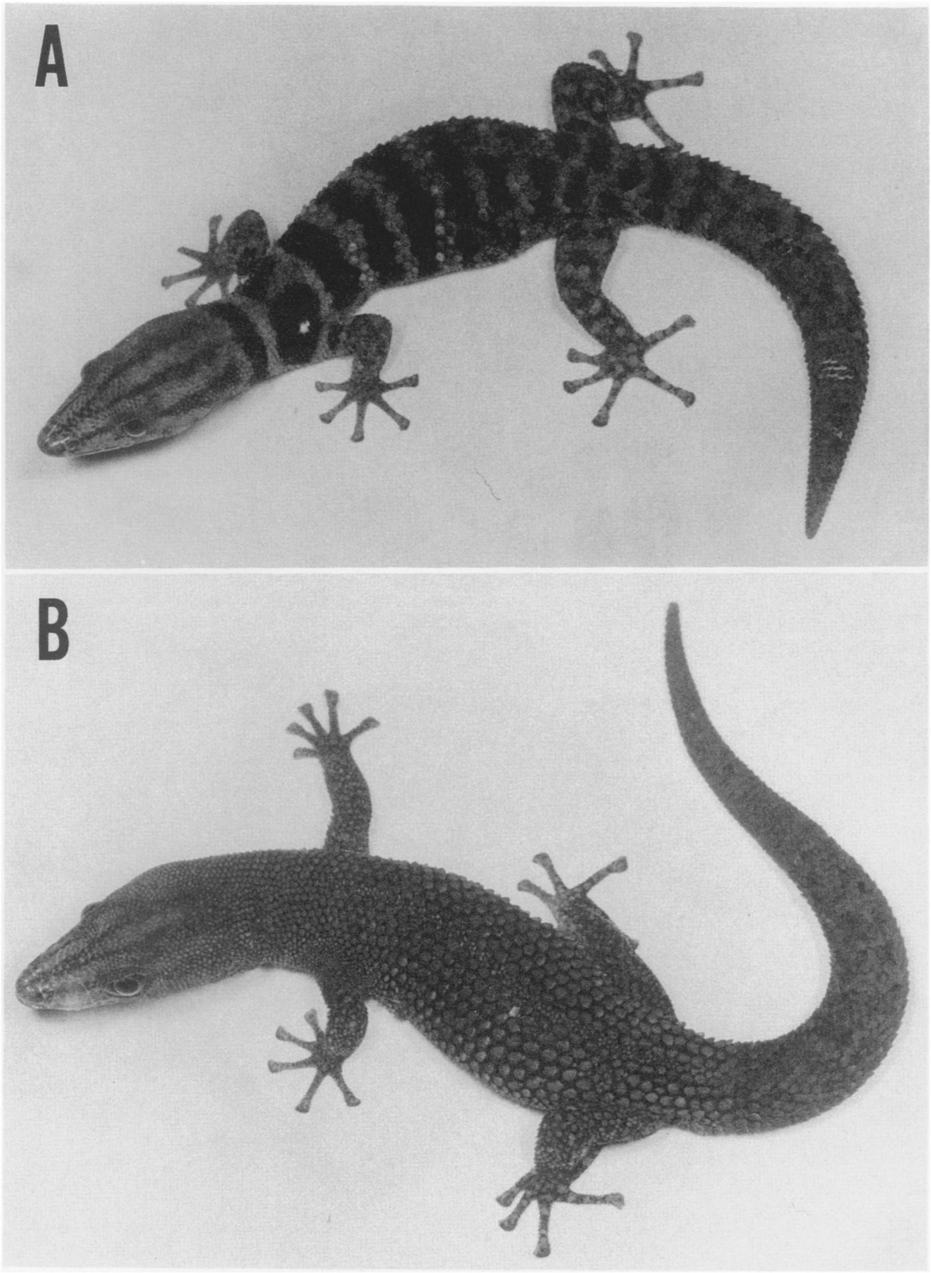

FIG. 1. *Sphaerodactylus richardi*: (A) female, from 12.4 km ESE Playa Girón, Matanzas Province, Cuba; (B) male, USNM 319144, from 11.4 km ESE Playa Girón, Matanzas Province, Cuba.

Adult females of the two remaining species do not possess well-defined body bands as in *S. richardi.* Adult males of *S. richardi* are uniform gray (dark brown in life), as in *S. storeyae*, and differ from most males of *S. oliveri* (spotted) and *S. scaber* (stippled). Additionally, *S. oliveri* has more dorsal scales (27–33, $\bar{x}$ = 30.3 versus 21–25, $\bar{x}$ = 22.8 in *S. richardi*), more ventral scales (27–34, $\bar{x}$ = 29.9 versus 24–30, $\bar{x}$ = 26.8), and more scales around midbody (43–57, $\bar{x}$ = 50.0 versus 35–44, $\bar{x}$ = 39.1) than *S. richardi* (Table 1). *Sphaerodactylus storeyae* is more similar to *S. richardi* in scalation, but the counts are larger (23–28, $\bar{x}$ = 25.7 dorsals versus 21–25, $\bar{x}$ = 22.8 in

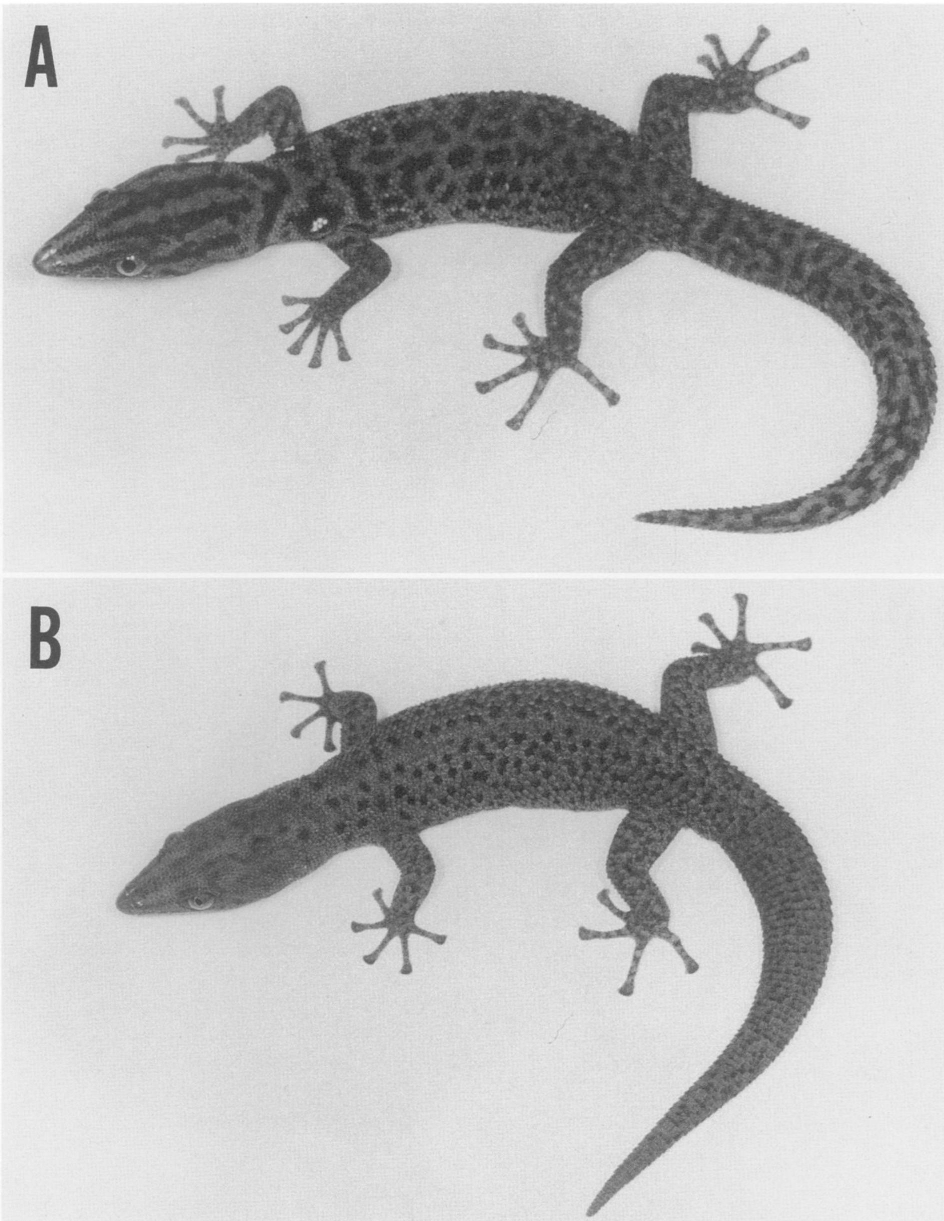

FIG. 2. *Sphaerodactylus oliveri*: (A) female, from Trinidad, Sancti Spiritus Province, Cuba; (B) male, from Manacal, Sancti Spiritus Province, Cuba.

richardi; 25–32, $\bar{x}$ = 28.4 ventrals versus 24–30, $\bar{x}$ = 26.8; 42–49, $\bar{x}$ = 45.1 scales around midbody versus 35–44, $\bar{x}$ = 39.1). Aside from a single specimen (USNM 319137) of *S. richardi* with 44 midbody scales, there is no overlap between the two species in this scale count. The dorsal scales of *S. richardi* are similar to those of *S. scaber* in being swollen and keeled, and differ from those of *S. oliveri* and *S. storeyae*, which have smaller, tectiform scales. Both *S. oliveri* and *S. storeyae* have a distinct row of enlarged scales under the tail (*contra* Schwartz and Henderson, 1991:518), which is not present in either *S. scaber* (some specimens have enlarged scales but never a well-defined row) or *S. richardi*.

Description.—Size of adults 28.7 ± 0.40 (27.2–

TABLE 1. Comparison of four species of Cuban *Sphaerodactylus* (*scaber* group). Measurements and counts are given as mean ± 1 SE (range).

		scaber	*richardi*	*storeyae*	*oliveri*
Adult SVL, mm	♂	29.7 ± 0.45 (26–34)	28.7 ± 0.40 (27–31)	29.4 ± 0.57 (28–32)	30.3 ± 0.58 (28–32)
	♀	29.6 ± 0.43 (27–32)	28.9 ± 0.72 (27–32)	30.7 ± 0.34 (30–31)	30.7 ± 0.51 (28–34)
Dorsal scales[1]		19.3 ± 0.35 (16–24)	22.8 ± 0.22 (21–25)	25.7 ± 0.40 (23–28)	30.3 ± 0.51 (27–33)[2]
Shape		swollen, keeled	swollen, keeled	tectiform	tectiform
Ventral scales[1]		27.9 ± 0.57 (22–36)	26.8 ± 0.32 (24–30)	28.4 ± 0.72 (25–32)	29.9 ± 0.56 (27–34)
Midbody scales		42.0 ± 0.65 (37–51)	39.1 ± 0.52 (35–44)	45.1 ± 0.79 (42–49)	50.0 ± 1.2 (43–57)
Wide ventral caudals		no	no	yes	yes
Postnasal size		upper = lower	upper < lower	upper < lower	upper < lower
Body bands		3 pale	5.3 ± 0.21 (5–6) dark	7.5 ± 0.29 (7–8) dark	5.3 ± 0.25 (5–6) dark
Expression		juvenile, ♀	juvenile, ♀	juvenile	juvenile
Neck rings[3]		2	1	1	1
Head stripes		3 pale	4 dark	4 dark	4 dark
Dorsal color	♂	pale yellow, olive, or chestnut	gray	gray, pale yellow head	gray, pale yellow head
	♀	gray, brown, or sepia	yellowish-tan	yellowish-tan	yellowish-tan
Dorsal pattern	♂	dark stippling	unpatterned	unpatterned	small brown spots
	♀	dark-edged pale bands	bold, solid dark bands	irregular, solid dark bands/spots	irregular, solid dark bands/spots
Sample size		14♀, 19♂, 10 juvenile	6♀, 13♂, 0 juvenile	7♀, 6♂, 3 juvenile	11 ♀, 7 ♂, 10 juvenile

[1] Mean and range, measured from axilla to groin.
[2] Does not include CM 9043, which has an unusually low count (21).
[3] Anterior to scapular ocelli.

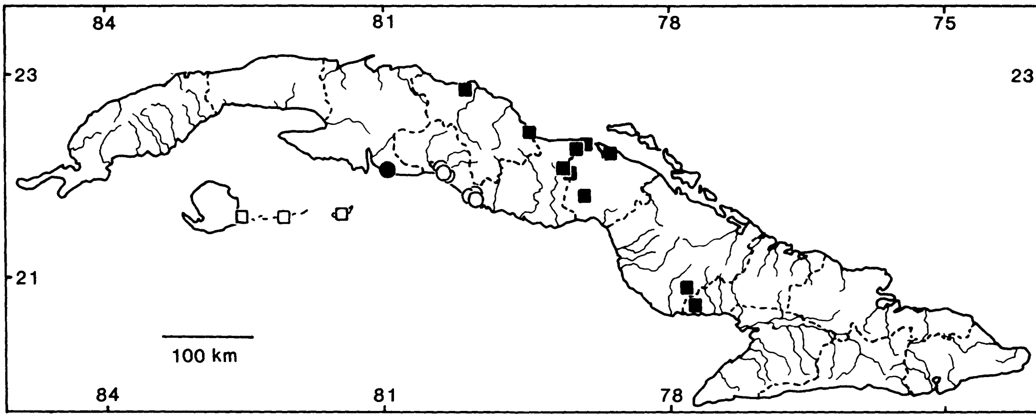

FIG. 3. Localities for the four species of the *Sphaerodactylus scaber* group in Cuba: open circles = *oliveri*, closed circle = *richardi*, open squares = *storeyae*, closed squares = *scaber*.

31.1) mm SVL males, 28.9 ± 0.72 (27.3-32.1) mm SVL females, holotype = 29.5 mm; snout short and blunt, not depressed; rostral broadly rounded (wider than long), a median cleft divides rostral; one small, usually subpentagonal internasal about same size as snout scales, barely indenting rostral, flanked by relatively large, wide, pentagonal but roughly triangular supranasals; upper postnasal short, oblong, oriented dorsoposteriorly; lower postnasal larger (1.5-2 times) than upper; upper labials to mideye 3-4 (mode = 4, holotype = 4); eyelid spine well developed; pupil vertically oval with narrow pale edge; mental large, subpentagonal (rounded anteriorly) with two large subpentagonal or subhexagonal postmentals followed by a short zone of large flat, smooth, cobblelike gulars quickly changing to smaller, more granular but imbricate scales on throat; snout scales small, slightly swollen, smooth (no keels), becoming narrower between eyes, more conical on neck, flattening onto trunk and becoming very large, swollen, non-imbricate on dorsum; upper trunk rows strongly keeled, grading to smaller, tectiform scales on lower trunk rows; middorsal zone of small granular scales, three scales wide; dorsal scales axilla to groin 21-25 ($\bar{x}$ = 22.8 ± 0.22, N = 19; holotype = 23); pectoral and ventral scales smooth, flat, imbricate, ventrals axilla to groin 24-30 ($\bar{x}$ = 26.8 ± 0.32, N = 19; holotype = 28); scales around midbody 35-44 ($\bar{x}$ = 39.1 ± 0.52, N = 19; holotype = 39); unregenerated dorsal scales of tail acute, keeled, flat-lying, imbricate; ventral caudals larger, more rounded on posterior edge, smooth and flat with no enlarged midventral row; escutcheon present but not prominent (3-6 × 5-25); toe pad moderately expanded, wider than adjacent phalangeal segment; subdigital lamellae of fourth digit 9-12 ($\bar{x}$ = 10.1 ± 0.30, N = 15; holotype = 9).

Coloration (in Preservative).—Pattern sexually dichromatic; dorsal ground color yellowish-tan; basic pattern (females, juveniles, and immature males) four light brown longitudinal stripes on head, distinctly paler than dorsal trunk markings; each lateral head stripe beginning at naris, passing "through" eye and stopping just before (not touching) anterior neck band; the two dorsal head stripes begin as one at internasal region, diverging midway along snout, passing just above eyes, and stopping just before anterior neck band; width of head stripes 4-5 (holotype = 4) scales on top of head; a pair of small (3-6 scales, holotype = 4) white ocelli on neck with wide (3-4 scales, holotype = 4) dark brown borders, separated from head stripes by a single dark brown neck band; 5-6 ($\bar{x}$ = 5.3 ± 0.21, N = 6; holotype = 6) dark brown dorsal body bands between limbs, usually solid (e.g., holotype) but occasionally "hollowed" (pale center); irregular light brown markings on tail (not banded, except near base); venter unpatterned. Adult males slate gray above (unpatterned) with dark brown between scales; head pattern, as described above, faint but present in all adult males; venter yellowish-tan with light brown flecks on chin, neck, hands, and feet.

In life, female ground color yellowish-tan with very dark brown bands and ocelli; ventral surface yellowish-tan; iris tan and vertically elliptical. Male ground color uniform dark brown above and below with no markings; iris brown.

Distribution.—Known only from three coastal localities (sea level) to the ESE of Playa Girón, Matanzas Province, Cuba (Fig. 3).

Natural History.—The lizards were found under thatch palm fronds, seagrape leaves, and limestone rocks near the beach and in the adjacent semi-xeric limestone scrub habitat.

Etymology.—This species is named in honor of our friend and colleague, Richard Thomas, who has contributed significantly to the systematics of West Indian amphibians and reptiles, and especially this genus of geckos.

Discussion

The *scaber* group of *Sphaerodactylus* now includes four species, *S. oliveri, S. richardi, S. scaber,* and *S. storeyae,* all of which are restricted to central Cuba, Isla de la Juventud (formerly Isla de Pinos), and the Archipiélago de los Canarreos. This group is characterized by species with moderate to large body size, the presence of large, swollen, non-overlapping dorsal scales, a distinct zone (3 scales wide) of very small middorsal scales ("granules"), a strong sexual dimorphism in pattern and coloration. The large dorsal scales of these species do not overlap (imbricate) and in this respect they differ from *S. copei* of Hispaniola. Also, albumin immunological comparisons (Hass, 1991) suggest that the *scaber* group (represented in that study by *S. oliveri*) is not closely allied with *S. copei.* For these reasons, we follow the taxonomic arrangement of Hass (1991) and distinguish between the *scaber* group and the *copei* group.

Although *S. storeyae* was originally described as a distinct species (Grant, 1944), Schwartz (1961), and Schwartz and Garrido (1981) treated it as a subspecies of *S. oliveri* based on a review of the evidence at that time. A review of newly-collected material representing both taxa lead us to consider *S. storeyae* as a full species. The two taxa (*oliveri* and *storeyae*) differ, although not dramatically, in scale counts and dorsal pattern. The dorsal scales of *S. storeyae* are distinctly larger and this is reflected in lower dorsal and midbody scale counts (Table 1) which barely overlap those of the smaller-scaled *S. oliveri.*

There is some confusion regarding the adult patterns of *S. oliveri* and *S. storeyae.* Schwartz (1961) noted that males of *S. storeyae* are unpatterned whereas those of *S. oliveri* are spotted ("salt and pepper"). However, Schwartz and Garrido (1981) later mentioned that *S. oliveri* never has a "salt and pepper" pattern, a statement which again is repeated in Schwartz and Henderson (1991). Our recent material of *S. oliveri* (e.g., Fig. 2) confirms that at least some males and females of this species are spotted as noted originally by Grant (1944). Grant also mentioned that some males are "plain slate gray" which suggests that dorsal coloration in this species is variable. Most museum specimens of *S. oliveri* are faded or poorly preserved and cannot be checked for dorsal coloration, although dorsal spots are still visible on one large male (MCZ 19568). The most consistent pattern difference separating *S. oliveri* and *S. storeyae* is the number of dorsal body bands (5–6 in *oliveri,* 7–8 in *storeyae*), expressed in juveniles and young females, although it is difficult to obtain consistent counts in larger females as the pattern begins to degenerate. Newly available material from the Archipiélago de los Canarreos, east of Isla de la Juventud, are consistent in scalation and coloration with *S. storeyae* and are not intermediate between that taxon and *S. oliveri.*

The phylogenetic relationships of these four species have not yet been investigated. However, the major dorsal pattern differences between *S. scaber* and the other three species, and its very low scale counts, suggest that it is the most divergent member of the group. Of the three remaining species, *S. oliveri* and *S. storeyae* share several apparently derived traits (wide scale row under tail, smaller dorsal scales, loss of juvenile pattern in adult females) that suggest a sister group relationship.

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APPENDIX 1

Specimens Examined

Sphaerodactylus oliveri.—Cuba: Sancti Spíritus Prov., Trinidad, Loma del Niarin (MCZ 19568); 7 mi. W Trinidad (USNM 140430-39); Finca Morales, 8 mi. NW Trinidad (AMNH 78350); 10 mi. W Trinidad (138018-20); Cienfuegos Prov., near Soledad (MCZ 19901); Soledad (MCZ 22717); Rancho Gavilán, near Cienfuegos (MCZ 52210).

S. scaber.—Cuba: Camagüey Prov., Sierra de Najasa (MCZ 21673), Sierra de Najasa, 3.8 mi. S, 5.1 mi. W Ecuador (AMNH 95982); Ciego de Ávila Prov., Sierra de San Juan de los Perros (MCZ 12304, holotype); Finca La Concepción, near Jicotea (MCZ 57354-58); Sancti Spiritus Prov., Sierra de Jatibonico (MCZ 7952).

S. storeyae.—Cuba: Isla de la Juventud, Punta del Este (AMNH 81191-96); Cueva No. 6, Punta del Este (IZ 4280, 4281, 4298); Archipiélago de los Canarreos, Cayo Ingles (MNHNCU 5-8); Cayo Largo del Sur (MNHNCU 63).

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A Molecular and Functional Evaluation of the Egg Mass Color Polymorphism of the Spotted Salamander, *Ambystoma maculatum*

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ABSTRACT.—**The spotted salamander, *Ambystoma maculatum*, has three types of egg masses; white, clear, and intermediate. White and clear forms are widely-distributed and often sympatric, whereas intermediate forms may be scarce or absent in local populations. Opacity of the egg mass depends on the concentration of hydrophobic protein crystals (1-3 μm in length, 15,400 kD in molecular size) in the outer jelly layers of white and intermediate egg masses. A water soluble protein (14,400 kD) replaces the hydrophobic crystals entirely in outer jelly layers of clear egg masses and partly in intermediate egg masses, and is found in the inner jelly of all three egg mass types. A mitochondrial DNA sequence analysis supports the hypothesis that these variants represent a simple polymorphism of a single gene, rather than the presence of a cryptic species complex. Over a two-year period, the number of total egg masses and the percentage that were clear remained relatively constant within individual ponds. The proportion of total egg masses that was clear was correlated (positively and negatively) with the concentration of some pond cations, although there was considerable annual variation in this relationship. The body lengths, wet masses prior to and after oviposition, and times of egg deposition were similar for females depositing white or clear egg masses. Embryos in white and clear egg masses exposed to low levels of light, simulated episodic environmental changes, and control conditions exhibited similar mean times to hatching and larval sizes. Survival was lower for both morphs in pH 5.2 than at a higher pH, and larvae of both morphs hatched under low light conditions were larger than those under high light conditions. There is as yet no definitive evidence that the "white" protein has a functional role in embryonic development. We suggest that the presence of this polymorphism may be related to differential fitness of the two morphs under low and high nutrient levels.**

A striking polymorphism occurs in the egg jellies of the spotted salamander, *Ambystoma maculatum*, caused by the presence or absence of white crystals in the outer jelly layer. There are three identifiable types: (1) clear egg masses, where embryos (usually between 50 and 200) are clearly visible through the jelly matrix; (2) intermediate or grey egg masses, where the embryos are faintly discernible in a cloudy grey jelly matrix; and (3) white egg masses, where the outer egg jelly is so opaque that embryos are rarely discernible, at least during early stages of development. Hardy and Lucas (1991) were the first to clearly recognize the significance of this polymorphism, and identified the crystals as protein. The genetic basis of this polymor-