

in Western Province, the 2000 wet season lasted well into July. Nevertheless, humidity levels were moderate (50–60%), and the environment was generally dry and warm (29–31°C). Though we have no direct evidence of the diet of this python in PNG, there were numerous geckos (*Hemidactylus frenatus*) between the same metal sheets.

The live specimen was left in the live collection at the Papua New Guinea National Museum and Art Gallery under the care of Ilaiah Bigilale. It has subsequently died and been accessioned into the museum collection (PNGM 25085).

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#### LITERATURE CITED

- BARKER, D. AND T. BARKER. 1994. *Pythons of the World. Volume I, Australia*. AVS Books, Escondido, California.
- COGGER, H. G. 2000. *Reptiles and Amphibians of Australia*. 6th edition. Reed Pty., Sydney.
- DE ROOIJ, N. 1915. *Reptiles of the Indo-Australian Archipelago*. E. J. Brill, Leiden.
- O’SHEA, M. 1996. *A Guide to the Snakes of Papua New Guinea*. Independent Publishing, Port Moresby.
- SMITH, L. 1985. A revision of the *Liasis childreni* species-group (Serpentes: Boidae). *Rec. West. Austr. Mus.* 12(3):257–276.

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## Description of the Female of the Enigmatic Lizard, *Liolaemus heliodermis* (Iguania: Liolaemidae)

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The lizard genus *Liolaemus* has experienced remarkable growth in recent years. In the past decade an average of four new species has been described each year and dozens more await description (Etheridge and Espinoza 2000). Given this trend, and recent estimates of cryptic diversity in some clades (e.g., Lobo and Espinoza 1999; Morando et al. 2003), *Liolaemus* may someday surpass even *Anolis* (sensu lato) in species richness. Currently, *Liolaemus* includes approximately 160 species. A recent molecular phylogenetic analysis (Schulte et al. 2000) of 60 species representing all major *Liolaemus* lineages recovered two similarly sized clades and corroborated the results of several morphological studies (reviewed by Etheridge 1995). One of these major clades, the

*chiliensis* group, includes approximately 80 species and has been further divided into numerous subgroups (Etheridge 1995; Lobo 2001). One of these subgroups, the *elongatus-kriegi* group (sensu Morando et al. 2003; see also Cei 1979), has experienced recent growth with the addition of seven species since 2000 (Avila et al. 2003, 2004; Cei and Videla 2003; Espinoza et al. 2000; Espinoza and Lobo 2003). Moreover, molecular analyses of populations in southern Argentina suggest that the *elongatus-kriegi* group may include as many as three times the number of species currently recognized (Morando et al. 2003). Given their recent discovery and remarkable diversity, the natural and life history of most species belonging to this group is poorly understood.

Among members of the *elongatus-kriegi* group, *L. heliodermis* is likely the most enigmatic. This species belongs to a recently diagnosed clade (Espinoza and Lobo 2003) that consists of four species (*L. capillitas*, *L. dicktracyi*, *L. heliodermis*, and *L. umbrifer*; but see Avila et al. 2004 for a more inclusive definition). In contrast to the other three species belonging to this northern radiation, and to the *elongatus-kriegi* group on whole, *L. heliodermis* is an unusually rare lizard (Espinoza et al. 2000). The species was described from just three specimens: two adult males and a juvenile female. The coloration of male *L. heliodermis* is unlike that of virtually all other *Liolaemus*: black heads with vibrant sulfur-yellow torsos (see Espinoza et al. 2000 for a color illustration). Interestingly, the juvenile female paratype is brown, but because no adult female was available for study, only speculation could be offered regarding the occurrence and ontogeny of sexual dichromatism in this species. Documenting sexual dichromatism in *L. heliodermis* may be the first step toward revealing related aspects of the lives of these poorly known lizards because sexual dimorphism is absent in most other members of this lineage (Espinoza and Lobo 2003). Here we describe an adult female *L. heliodermis* to provide much needed information on variation in squamation of this enigmatic taxon. Second, we address the hypotheses posed by Espinoza et al. (2000) regarding the ontogeny and intersexual occurrence of sexual dichromatism in this species.

On 25 January 2000, an adult female *Liolaemus heliodermis* (deposited at the Fundación Miguel Lillo, Tucumán, Argentina; FML 8974) was found at km 98 on Ruta Provincial 307, Departamento Tafí del Valle, Provincia de Tucumán, Argentina, just 3 km from the type locality. The specimen was dead and had been trapped in the freshly paved asphalt of this provincial highway (G. Scrocchi, pers. comm.). The lizard likely succumbed to exposure after adhering to the tar (Hubbs and Walker 1947). Before preservation, gasoline was used to remove tar from the lizard, which resulted in loss of some scales. The specimen is otherwise in good condition with the exception of the loss of approximately three quarters of the tail. Notes on color were taken prior to preservation.

The following description adopts terminology for squamation from Smith (1946) as modified by Espinoza et al. (2000) and Espinoza and Lobo (2003). We followed Frost (1992) for definitions of neck folds. Snout–vent length (76.05 mm), tail length (13.55 mm, autotomized), axilla–groin distance (34.05 mm). Head (anterior border of auditory meatus to the tip of the snout 17.94 mm), head width (anterior border of auditory meatus 13.64 mm), snout length (posterior margin of canthal to tip of snout 5.14 mm), intraorbital distance 4.34 mm, tibial length (16.23 mm), foot length

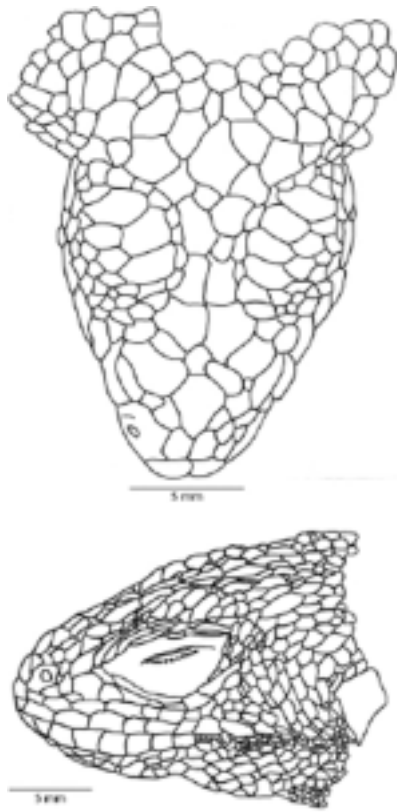


FIG. 1. Dorsal and lateral views of the head of an adult female *Liolaemus heliodermis* (FML 8974).

(22.34 mm).

Dorsal and lateral views of the head are provided in Fig. 1. Dorsal head scales smooth, 15 between occiput at the level of the anterior border of auditory meatus and rostral. Nine smooth temporals, most with a scale organ at their posterior margin. Interparietal subpentagonal, of similar size to the parietals, surrounded by seven scales. Frontal scale divided longitudinally, forming two scale rows between circumorbitals. Five scales between frontal and rostral. Two postrostrals. Each postrostral with 12–13 scale organs. Supraorbital semicircles complete. Four/five (right/left) enlarged supraoculars. Five scales between frontal and superciliaries. Five/six flat, elongate superciliaries. Canthal separated from nasal by one or two scales. Loreal region flat. Eight scales surrounding nasals. Nasal in slight contact with rostral. Eight/nine lorilabials, fourth through eighth/nine in contact with subocular. Six/seven supralabials. Fourth/fifth supralabial curved upward posteriorly but not in contact with subocular. Infralabials five, slightly taller than supralabials. Four internasals. Orbit with 16 upper and 15 lower ciliaries. Orbit diameter 3.5 mm (measured between upper and lower ciliaries). Subocular scale elongate. Preocular unfragmented. Longitudinal ridge along upper margin of the three ocular scales. Rostral scale wider (3.88 mm) than high (1.39 mm) fragmented along left side. Mental wider (2.03 mm) than long (3.46 mm), followed posteriorly by two rows of 4/5 chinshields. Chinshields in contact with first infralabial. Scales of throat between chinshields juxtaposed, becoming slightly imbricate toward the auditory meatus. Fifty gulars between auditory meatus. Three/four scales along anterior border of auditory meatus project outward. Auditory meatus higher (4.12 mm) than wide

(2.28 mm). Lateral scales of neck granular. Subdermal fat bodies give inflated appearance to neck region. Antehumeral fold distinct. Rictal, postauricular, and longitudinal folds present but less conspicuous than antehumeral. Thirty-nine scales between auditory meatus and antehumeral fold (counted along postauricular and longitudinal folds).

Scales of neck region smaller than dorsals. Sixty-four dorsal scales between occiput and anterior surface of thighs. Dorsal body scales round to rhomboidal, very weakly keeled. Fifteen to 17 longitudinal keeled scale rows over dorsum of trunk. Scales become increasingly rounded laterally and along flanks. Sixty-nine scales around midbody. Ventral scales of similar size to dorsals, 110 between mental and mid-thigh. Ventral surface of thighs with enlarged, laminar imbricate scales anteriorly, abruptly changing to smaller granular scales posteriorly at mid thigh. No precloacal pores. Fourth finger with 23 tridentate, subdigital lamellae. Claw relatively straight, moderately short, pointed, opaque brown. Fourth toe with 28 subdigital lamellae. Claw similar to that of fourth finger.

At the time of collection the specimen was dead, but apparently not for long (G. Scrocchi, pers. comm.), so its color in life was probably reasonably well preserved. Dorsally, head to near insertion of the forelimbs black. Laterally, head black with some barely noticeable gray scales. Throat charcoal black with black margins and many small, irregularly dispersed black spots. Dorsal torso gray with many small yellow flecks. Vertebral field (sensu Lobo and Espinoza 1999) much darker than remainder of dorsal body. Color much lighter from hind limbs to portion of tail not autotomized than for remainder of dorsal body. Dorsal forelimbs black with yellow flecks. Hind limbs much lighter than forelimbs. Ventrally gray, abdominal region gray with larger flecks of black and laterally with flecks of yellow. Ventral forelimbs gray with very few yellow flecks; ventral hind limbs much lighter. Overall the brightness of the yellow on this specimen was considerably less vibrant or extensive on the trunk compared to the two males described previously (G. Scrocchi, pers. comm.).

After 2.5 years in preservative (70% EtOH) the color is somewhat faded: black extends to shoulders, beyond which, dorsal scales grade to pale cream-yellow on torso. Yellow color of torso extends to first quarter of tail (last three quarters of tail autotomized). Ventral surface light gray with dark gray to charcoal flecks becoming denser laterally. Flank with larger charcoal gray marks flecked with scales of cream-yellow. Throat darker than belly, densely flecked with gray marks especially along perimeter. Ventral surfaces of thighs with a longitudinal band of pale cream scales.

The only other known female of *L. heliodermis*—a juvenile (paratype; FML 6007)—has a brown head and lighter brown dorsal torso with flecks of cream-colored scales. This is in stark contrast to the black head and sulfur-yellow torso exhibited by adult males of this species (Espinoza et al. 2000). Consequently, at the time of the original description, only speculations could be made about the development and occurrence of sexual dichromatism of this species. Three possibilities were offered to account for the marked differences in coloration in this species: (1) males and females are sexually dichromatic, wherein females retained the brown coloration of juvenile described above, (2) the species is not sexually dichromatic, and the bright coloration develops ontogenetically in both sexes, or (3) sexual dichromatism is present and develops ontogenetically for both sexes, perhaps with females

becoming less brightly colored than the males. The description of the adult female *L. heliodermis* provided above suggests that sexual dichromatism, although present, is not as dramatic as would be the case if the juvenile coloration were retained into adulthood for females. Although females undergo a dramatic change in coloration ontogenetically (brown → yellow), the yellow coloration could brighten to levels not detected in specimens collected to date. For example, females may develop brighter coloration when gravid, as is apparent in other *Liolaemus* (Espinoza and Lobo 2003; Etheridge 2000; R. E. Espinoza, pers. observ.) and numerous other iguanian lizards (Cooper and Greenberg 1992). Consequently, the apparent dichromatism, at least in color saturation, may be apparent only during portions of the breeding season. Collection of a juvenile male is required to resolve the question of the ontogeny of male coloration. We predict, as in females, juvenile males are brown and also undergo an ontogenetic change in coloration.

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#### LITERATURE CITED

- AVILA, L. J., C. H. F. PEREZ, AND M. MORANDO. 2003. A new species of *Liolaemus* (Squamata: Iguania: Liolaemidae) from northwestern Patagonia (Neuquén, Argentina). *Herpetologica* 59:534–545.
- , M. MORANDO, C. H. F. PEREZ, AND J. W. SITES, JR. 2004. Phylogenetic relationships of lizards of the *Liolaemus petrophilus* group (Squamata, Liolaemidae), with description of two new species from western Argentina. *Herpetologica* 60:187–203.
- CEI, J. M. 1979. The Patagonian herpetofauna. In W. E. Duellman (ed.), *The South American Herpetofauna: Its Origin, Evolution, and Dispersal*, pp. 309–329. Univ. Kansas Mus. Nat. Hist. Monogr. 7.
- , AND F. VIDELA. 2003. A new species of *Liolaemus* lacking preloacal pores in males from the Andean south-eastern mountains of Mendoza Province, Argentina (Liolaemidae, Iguania, Lacertilia, Reptilia). *Boll. Mus. Reg. Sci. Nat., Torino* 20:275–290.
- COOPER, W. E., AND N. GREENBERG. 1992. Reptilian coloration and behavior. In C. Gans and D. Crews (eds.), *Biology of the Reptilia*, Vol. 18, pp. 298–422. Univ. Chicago Press, Chicago, Illinois.
- ESPINOZA, R. E. AND F. LOBO. 2003. Two new species of *Liolaemus* lizards from northwestern Argentina: speciation within the northern subclade of the *elongatus* group (Iguania: Liolaemidae). *Herpetologica* 59:89–105.
- , AND F. B. CRUZ. 2000. *Liolaemus heliodermis*, a new lizard from northwestern Argentina with remarks on the content of the *elongatus* group (Iguania: Tropicuridae). *Herpetologica* 56:235–244.
- ETHERIDGE, R. 1995. Redescription of *Ctenoblepharys adpersa* Tschudi 1845, and the taxonomy of the Liolaeminae (Reptilia: Squamata: Tropicuridae). *Am. Mus. Novit.* 3142:1–34.
- . 2000. A review of the lizards of the *Liolaemus wiegmanni* group (Squamata, Iguania, Tropicuridae), and a history of morphological change in the sand-dwelling species. *Herpetol. Monogr.* 14:293–352.
- , AND R. E. ESPINOZA. 2000. Taxonomy of the Liolaeminae (Squamata: Iguania: Tropicuridae) and a semi-annotated bibliography. *Smithsonian Herpetol. Info. Serv.* 126:1–64.
- FROST, D. R. 1992. Phylogenetic analysis and taxonomy of the *Tropicurus* group of lizards (Iguania: Tropicuridae). *Am. Mus. Novit.* 3033:1–68.
- HUBBS, C. L., AND B. W. WALKER. 1947. Abundance of desert animals indicated by capture in fresh road tar. *Ecology* 28:464–466.
- LOBO, F. 2001. A phylogenetic analysis of lizards of the *Liolaemus chiliensis* group (Iguania: Tropicuridae). *Herpetol. J.* 11:137–150.
- , AND R. E. ESPINOZA. 1999. Two new cryptic species of *Liolaemus*

(Iguania: Tropicuridae) from northwestern Argentina: resolution of the purported reproductive bimodality of *Liolaemus alticolor*. *Copeia* 1999:122–140.

- MORANDO, M., L. J. AVILA, AND J. W. SITES, JR. 2003. Sampling strategies for delimiting species: genes, individuals, and populations in the *Liolaemus elongatus-kriegi* complex (Squamata: Liolaemidae) in Andean–Patagonian South America. *Syst. Biol.* 52:159–185.
- SCHULTE, J. A. II, J. R. MACEY, R. E. ESPINOZA, AND A. LARSON. 2000. Phylogenetic relationships in the iguanid lizard genus *Liolaemus*: multiple origins of viviparous reproduction and evidence for recurring Andean vicariance and dispersal. *Biol. J. Linn. Soc.* 69:75–102.
- SMITH, H. M. 1946. *Handbook of Lizards: Lizards of the United States and of Canada*. Comstock, Ithaca, New York. 557 pp.

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## Handling Stress and Plasma Corticosterone Levels in Captive Male Western Diamond-backed Rattlesnakes (*Crotalus atrox*)

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Reptiles are similar to other vertebrates in that they show both behavioral and physiological stress responses to a wide variety of stimuli (reviewed by Greenberg and Wingfield 1987; Lance 1990; Guillette et al. 1995; Wingfield and Romero 2001; Greenberg 2002; Greenberg et al. 2002; Moore and Jessop 2003). Frequently reported stressors include extreme temperature (Jessop et al. 2000), crowding (Hayes 1997), social dominance (Alberts et al. 1994; Matter et al. 1998; Schuett et al. 1996; Greenberg 2002, 2003), starvation (Romero and Wikelski 2001), as well as a range of anthropogenic factors (Hofer and East 1998) including capture and handling (Moore et al. 1991; Kreger and Mench 1993; Cash et al. 1997; Lance and Elsey 1999; Cree et al. 2000; Moore et al. 2000; Gregory and Schmid 2001; Mathies et al. 2001; Franklin et al. 2003; Jessop et al. 2003).

The hypothalamo-pituitary-adrenal (HPA) axis is unquestionably the best-studied system with regard to the stress response, and there is a relatively long history on adrenal hormones (glucocorticoids) in reptiles (Seyle 1973; Greenberg and Wingfield 1987; Lance 1990). Cortisol and corticosterone (CORT) are adrenal glucocorticoids released in response to stressors, and when elevated have important metabolic functions in converting stored energy (e.g., lipids and proteins) to available glucose for escape or defense (Dallman et al. 1995; Guillette et al. 1995). Chronically high levels, however, can have profoundly negative downstream ef-