

Notes on reproduction in three species of *Sphenomorphus* (Squamata: Scincidae) from Papua New Guinea

STEPHEN R. GOLDBERG¹ and FRED KRAUS²

¹Department of Biology, Whittier College, Whittier, California 90608
USA. sgoldberg@whittier.edu [corresponding author]

²Bishop Museum, Department of Natural Sciences, Honolulu, Hawaii 96817 USA.
fkraus@hawaii.edu

SPHENOMORPHUS is a large genus of skinks ranging across much of southeastern Asia and the Papuan region, comprising New Guinea, Bismarck Archipelago, Solomon Islands, and adjacent smaller islands. Lizards referred to the same genus are also present in Central America (Savage, 2002). Approximately 45 species are known from the Papuan region (Papuan Herpetofauna, 2007) and dozens more await formal description. Of these species, *S. granulatus* ranges throughout the Southeast Peninsula from Milne Bay Province to the Huon Peninsula and also occurs on the adjacent D'Entrecasteaux Islands (Zweifel, 1980; Mys, 1988; Kraus & Allison, 2004). *Sphenomorphus jobiensis* (the largest species we studied) ranges widely across most of New Guinea and also occurs on New Britain, New Ireland and the Admiralty, D'Entrecasteaux and Louisiade Islands (Mys, 1988; Kraus & Allison, 2004). It is known to be a complex of closely related species (Donnellan & Aplin, 1989) that is currently undergoing revision (G. Shea pers. comm.), but an updated taxonomy is not currently available. *Sphenomorphus minutus* (the smallest species we studied) has a spotty distribution across the northern versant and central mountains of New Guinea (Mys, 1988) and also occurs in the D'Entrecasteaux and Louisiade islands of Misima and Sudest (Kraus & Allison, 2004; Kraus & Shea, 2005). To our knowledge, there are no published accounts regarding reproduction in these species and little reproductive information exists for any other Papuan *Sphenomorphus*. The purpose of this paper is to report information on the reproductive cycle of the three species listed above from a histological examination of museum specimens collected by FK. This is part of an ongoing series of studies on the reproduction of lizards from Papua New Guinea.

METHODS

Sphenomorphus skinks from Milne Bay Province, Papua New Guinea were examined from the herpetology collection housed at the Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii (see Appendix). Skinks were collected from 2002 to 2004 and were studied from a geographically constrained region so as to allow for examination of seasonal reproductivity without inadvertently introducing confounding geographic variation. The left testis or ovary was removed, processed by standard histological techniques and stained with Harris' hematoxylin followed by eosin counterstain (Presnell & Schreiber 1997). Male maturity was established via evidence of spermiogenesis in progress. Female maturity was recognized via evidence of yolk deposition. Female clutch size was determined by counting enlarging follicles (> 4 mm) or oviductal eggs. Lizard snout-vent length (SVL) was measured to the nearest millimeter after euthanization, just prior to preservation.

RESULTS AND DISCUSSION

The only stage observed in the testicular cycle was spermiogenesis, during which seminiferous tubules are lined by spermatozoa and clusters of metamorphosing spermatids are present.

Sphenomorphus granulatus: The sample ($n = 14$) consisted of 6 females with mean SVL = 52.2 mm \pm 4.5 SD, range = 45–58 mm; 6 males with mean SVL = 50.7 mm \pm 8.2 SD, range = 35–58 mm; and 2 individuals that were presumed to be neonates with mean SVL = 21.0 mm \pm 3.5 SD, range = 18–23 mm. Males undergoing spermiogenesis were collected from the months of April ($n = 4$), May ($n = 1$), and August ($n = 1$). The smallest reproductively active male (BPBM 16010) measured 35 mm SVL and was taken August 2002. Three females from April 2002 were

not reproductively active. One female taken in August 2002 contained 2 enlarged follicles > 4 mm. Of two females taken in September 2002, one contained 2 oviductal eggs, and one contained 2 enlarged follicles > 4 mm. Mean clutch size for these females was 2.0 ± 0.0 SD. The smallest reproductively active female (2 enlarged follicles > 4 mm) measured 45 mm SVL (BPBM 16014) and was taken in September 2002. The two remaining individuals, one taken in April 2002 and one in August 2002 were presumed to be neonates.

Sphenomorphus jobiensis: The sample ($n = 36$) consisted of 12 females with mean SVL = 87.4 mm \pm 7.5 SD, range = 78–98 mm; and 24 males with mean SVL = 88.2 mm \pm 8.1 SD, range = 73–102 mm. Males undergoing spermiogenesis were collected from February ($n = 12$), April ($n = 6$), August ($n = 4$), and September ($n = 2$). The smallest reproductively active males measured 73 mm SVL (BPBM 19010 and 19013) and were taken in April 2002. Two of six females collected in February were reproductively active (one each with 2 and 3 oviductal eggs, four inactive). Both females from April were reproductively active (one with 2 oviductal eggs, the other with corpora lutea). Two of three May females were reproductively active (one undergoing yolk deposition, the other with 2 enlarged ovarian follicles > 4 mm). One August female was reproductively active (3 oviductal eggs). Mean clutch size for 5 females (4 with oviductal eggs, 1 with enlarged follicles) was 2.4 ± 0.55 SD, range = 2–3. The smallest reproductively active female (BPBM 19014), (corpora lutea present) measured 78 mm SVL and was collected in April 2002.

Sphenomorphus minutus: The sample ($n = 18$) consisted of 8 females with mean SVL = 33.1 mm \pm 2.9 SD, range = 29–39 mm; 8 males with mean SVL = 34.3 mm \pm 4.4 SD, range = 27–39 mm; and 2 individuals that were presumed to be neonates, mean SVL = 17.5 mm \pm 2.1 SD, range = 16–19 mm. Reproductively active males were collected in January ($n = 1$), April ($n = 3$), June ($n = 1$), August ($n = 1$), and September ($n = 2$). The smallest reproductive male (BPBM 16040) measured 27 mm SVL and was taken in September 2002. All females were reproductively active: January (1 with an enlarged follicle > 4 mm, 2 each with 1 oviductal egg,) and August (2 undergoing yolk deposition, 1 with an enlarged follicle > 4 mm, 2

each with 1 oviductal egg). Mean clutch size for six females was 1.0 ± 0.0 SD. The smallest reproductively active female (BPBM 16033) measured 29 mm SVL and was taken in August 2002. Both presumed neonates were collected in August 2002.

There is little information currently available regarding reproduction in *Sphenomorphus*. In the Solomon Islands, *Sphenomorphus solomonis* produces clutches of up to 3 eggs and *Sphenomorphus tanneri* lays 2 eggs (McCoy, 2006). In Papua New Guinea, *Sphenomorphus pratti* has been reported to contain three oviductal eggs (Loveridge 1948). *Sphenomorphus tagapayo* from the Phillippine Islands has a brood size of two (Brown *et al.*, 1999). Huang (1997) reported that females of *Sphenomorphus taiwanensis* from a montane habitat (2360 m) in Hualien County, Taiwan, followed a seasonal ovarian cycle in which reproduction was restricted to May–July.

Fitch (1982) reported that for tropical lygosomine skinks from aseasonal rainforests, reproduction generally occurs year-round but is subject to changing levels resulting from variations in temperature and moisture. Our samples confirm extended reproduction for these three species of *Sphenomorphus*: *S. granulatus*, *S. jobiensis* and *S. minutus*. However our samples were too small to identify a peak of activity, if one exists.

We do not know of prior histological investigations into the testicular cycles of Papuan *Sphenomorphus* lizards. However, for other lygosomine skinks from that general region, Zug *et al.* (1982) reported year-round spermatogenesis in the skink *Carlia bicarinata* at Port Moresby, Papua New Guinea, with peaks during March to April and August to October. Wilhoft (1963) reported *Carlia* (as *Leiolopisma*) *rhomboidalis* underwent spermiogenesis throughout the year in tropical Australia. Goldberg & Kraus (2008) reported extended periods of reproduction in five species of *Emoia* from Papua New Guinea. The extended reproductive activity of our three species of *Sphenomorphus*, all derived from low- to mid-elevation rainforest habitats of relatively constant annual mean temperatures, are consistent with this pattern.

In contrast, Huang (1997) reported that *Sphenomorphus taiwanensis* from high-elevation, subtropical Taiwan (2360 m elevation) underwent a

seasonal testicular cycle in which maximum spermiogenesis occurred in September and October, with regressed testes observed in November. This suggests that *Sphenomorphus* testicular cycles vary in response to differing environmental parameters. Whether a similar pattern exists in high-elevation *Sphenomorphus* from New Guinea remains to be seen.

Subsequent investigations on additional species of *Sphenomorphus* will be needed to expand our understanding of variability in the reproductive cycles (clutch sizes, number of clutches and duration of spermiogenesis) exhibited by members of this genus. Of especial interest is whether such variation might correlate to elevation and to identified species groups within this large genus.

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Appendix

Specimens of *Sphenomorphus* from Milne Bay Province, Papua New Guinea examined from BPBM.

Sphenomorphus granulatus ($n = 14$) Cloudy Mountains, along Upaelisafupi Stream, April 2002: BPBM 15617, 15618, 15620-15625; Owen Stanley Mountains, Mt. Pekopekowana, Wailahabahaba Creek, May 2002: 15628, Fergusson Island, Oya Tabu, August 2002: BPBM 16007, 16010; Fergusson Island, Oya Waka, September BPBM 2002: 16013-16015.

Sphenomorphus jobiensis ($n = 36$) Cloudy Mountains, along Upaelisafupi Stream, April 2002: BPBM 15645, 16909-16911, 19006, 19009-19014; May 2002: BPBM 15650-15652, Fergusson Island, August 2002: BPBM 16017, 16020, 16022; Fergusson Island, Oya Waka, September 2002: BPBM 16025; Fergusson Island, Oya

Tabu, August 2002: BPBM 19016, 19017; September 2002: BPBM 19019; Siyomu Village, February 2003: BPBM 19025-19027, 16906, 16907, 16918, 16920-16922; Bunisi Village, February 2003: BPBM 16905, 16914-16916, 16923; Gasu Village, February 2003: BPBM 16917.

Sphenomorphus minutus ($n = 18$) Cloudy Mountains, along Upaelisafupi stream, April BPBM 2002: 15655, 15657; Fergusson Island, Oya Tabu August 2002: BPBM 16031-16036; Fergusson Island, Oya Tabu, August 2002: 16037; Fergusson Island, August 2002, BPBM 16038; Fergusson Island, Oya Waka, September 2002: BPBM 16039; Normanby Island, Samoa, September 2002: BPBM 16040; Misima Island, January 2003: BPBM 16840-16842; Normanby Island, Saidowai. January 2003: BPBM 16843, 16844; Sudest Island, SW slope Mt. Rio, April 2004: BPBM 20057.



Ecogeographical notes on a rare species of false coral snake, *Oxyrhopus doliatus* Duméril, Bibron & Duméril, 1854

LUIS FELIPE ESQUEDA ^{1,5}, MARCO NATERA-MUMA ², SANTOS BAZÓ ³
and ENRIQUE LA MARCA ⁴

^{1,5} *Investigador Asociado, Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida 5101, Venezuela.*

luisfesqueda@gmail.com [corresponding author]

² *Museo de Vertebrados, Centro de Estudios del Llano, Universidad Rómulo Gallegos. Apartado 205, San Juan de Los Morros 2301, estado Guárico, Venezuela. mnateram@yahoo.com*

³ *Investigador Asociado, Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida 5101, Venezuela.*

cocodriolotremo@hotmail.com

⁴ *Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales. Universidad de Los Andes, Mérida 5101, Venezuela. enrique.lamarca@gmail.com*

PREVIOUSLY known as *Oxyrhopus venezuelanus* Shreve, 1947, this snake is a colubrid species belonging to the subfamily Xenodontinae, originally described on the basis of a single specimen from the population 'El Paují', Acosta municipality, Falcón State, Venezuela. A recent revision revealed that this name is a junior synonym of *Oxyrhopus doliatus* Duméril, Bibron & Duméril, 1854 (Zaher & Caramaschi, 2000); however, these authors did not specify the type locality of the species, which will be necessary to ascertain in the future, although Brazil is assumed

to be the locality. The taxon is known from the Aragua, Carabo, Miranda, Vargas and Yaracuy States, and Capital District (Roze, 1966; Peters & Orejas-Miranda, 1970; Manzanilla *et al.*, 1996; Kornacker, 1999; Rivas, 2002). Until the present time, its known distribution was restricted exclusively to the premontane forest, between 10–500 m asl, in the Coastal Range and Serranía of San Luis, respectively. The species was reported for first time in the Venezuelan Andes, specifically in the region of Escuque, Trujillo State, by Esqueda *et al.* (2007:92). Seven