COLOUR-PATTERN POLYMORPHISM IN LIZARDS OF THE GENUS *PRASINOHAEMA* (SQUAMATA: SCINCIDAE)

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The scincid genus *Prasinohaema* contains five named species and is restricted to New Guinea, adjacent islands along its southeastern peninsula, and the Solomon Islands (Greer, 1974; Mys, 1988). The most notable feature of this genus is that its members have green blood plasma, a feature caused by high concentrations of biliverdin (Austin & Jessing, 1994) and not found in other amniotes. This imparts a greenish or bluish cast to some internal tissues (Greer & Raizes, 1969). Also noteworthy are that members of the genus have prehensile tails with modified scales at the tip and that they are ovoviviparous (Greer, 1974). Relationships of *Prasinohaema* to other scincids remain uncertain (Allison & Greer, 1986), and no attempt has yet been made to resolve relationships within the genus. Biological information on these species is sparse, barely extending beyond original diagnoses and geographic range data; however, a survey of blood parasites in four of the species from five localities showed infection rates to be very low (Austin & Perkins, 2006).

In addition to their unique blood colour, some species of *Prasinohaema* demonstrate interesting polymorphisms in their colour patterns. Greer and Raizes (1969) mentioned that male *P. prehensicauda* (treated under the name *Scincella prehensicauda*) were predominantly green whereas females were brown with darker crossbands. Further, they noted that *P. flavipes* (treated under the name *Sphenomorphus flavipes*) occurred in three pattern morphs: unicolour brown, brown with darker crossbands, and striped. Woodruff (1972) also mentioned the colour-pattern polymorphism in *P. prehensicauda*, noted that the green colouration of males faded to golden brown in preservative, and provided a black-and-white photograph of preserved specimens of both sexes. The polymorphisms of both species (originally described under the genus *Lygosoma*) initially went unnoticed because type series for both were small, consisting of only two male *P. prehensicauda* (Loveridge, 1945) and a single female *P. flavipes* (Parker, 1936).

Despite the suggestive brief remarks made by Greer and Raizes (1969) and Woodruff (1972), neither detailed descriptions nor colour photographs of these colour-pattern variants have been provided. This is unfortunate because colour-pattern polymorphisms of the magnitude seen in these two species are not common among scleroglossan lizards. I recently obtained series of both species from the vicinity of Kunida, Muller Range of Southern Highlands Province, Papua New Guinea, that allow for a more detailed assessment of colour-pattern variation in both species. These specimens are deposited at the Bernice P. Bishop Museum (BPBM) in Honolulu, Hawaii. I take this opportunity to provide colour illustrations and more detailed descriptions of each so as to stimulate greater awareness of the interesting biology of these lizards.

COLORATION

Prasinohaema flavipes

Unicolour morph. The dorsum and sides are brown with each scale posteriorly margined in darker brown; in life, the sides may have a greenish-yellow cast (Figure 1A) or not (Figure 1B). Animals frequently have a few scattered dark-brown dashes (Figure 1B), most commonly on the sides, which can vary from sparsely to heavily streaked. When dark dashes are present they are sparse mid-dorsally. The venter may be lemon yellow or greenish-yellow in life (Figure 1C) and is dirty

white in preservative; it may be flecked with dark brown laterally, but only in those specimens that are streaked laterally. A short dark-brown dash is present before and after the eye (Figure 1B). Ground colour of the limbs is like the dorsum, and the limbs lack dark dashes but have some vague, paler brown spotting (Figure 1A, B).

Banded morph. Generally similar to the unicolour morph but with many dark-brown dashes that are denser, larger, and more-or-less arrayed in a pattern to comprise irregular crossbands (Figure 1D). These bands are typically broken and irregular and vary from 1 - 3 scales in depth. The dark postocular stripe is larger and better developed than in the unicolour morph and is followed by two or three large dark-brown blotches to the point above the forearm insertion (Figure 1D). These postocular blotches are least developed in the two specimens with the most weakly developed dorsal banding. Dark-brown flecks are also present on the limbs, which impart to the limbs a more spotted appearance than seen in the unicolour morph. The venter is greenish-yellow in life, usually with dark-brown dashes, at least laterally (Figure 1E); it is dirty white in preservative. Three of 12 individuals are heavily covered with these dashes, but most have them confined to the lateral margins of the venter.

Striped morph: The central 7–8 scale rows of the dorsum comprise a field of dark brown with a peppering of small tan dashes that vary from moderate to heavy in concentration (Figure 1F). This dark field is subtended by a tan dorsolateral stripe 2 - 3 scale rows in width. Below this, the ground colour is the same tan or light-brown colour (with a yellower cast ventrally) but is heavily streaked with dark-brown or black dashes of varying length, which impart to the sides a generally darker-brown appearance. White spots are scattered within this lateral field (Figure 1F). The dark postocular bar and blotches seen in the banded morph are usually merged into a single wide, irregular stripe that is more-or-less continuous with the dark lateral field, but these blotches remain distinct in a few animals. In life, the venter is greenish-yellow with scattered brown dashes, but these are sparser than in the banded morph; the venter is white in preservative. The limbs are spotted with both lighter and darker brown scales, as in the banded morph.

The palms and soles of animals of all three colour morphs are yellow, which can vary from bright to dark. The mouth lining has a pale-blue cast, and the tongue is blue-black. The peritoneum of all specimens is dark black dorsally and laterally; ventrally it is also black but not uniformly distributed, which makes the ventral peritoneum appear unevenly blotched. There is no white colour in the peritoneum.

In the sample of 38 specimens obtained by me, 21 are of the unicolour morph, 12 of the banded morph, and five of the striped morph. The total sample of animals, collected from 23 March to 4 April, 2009, consisted of seven immature females, 11 mature females, three immature males, and 16 mature males. Hence, the sex ratio did not differ meaningfully from 1:1. Nor did it do so within colour morphs: there are 11 males vs. 10 females of the unicolour morph, five males vs. seven females of the banded morph, and three males vs. two females of the striped morph. Only two of the mature females contained developing embryos; the remainder contained yolking follicles and expanded, convoluted oviducts. The two gravid females (both of the unicolour morph) each contained four embryos. In the first female, two embryos were unicolour and two were banded. In the second, one embryo was unicolour, two were banded, and one was striped. Hence, all colour morphs can be produced in the same litter.

Prasinohaema prehensicauda

Females: The dorsum is medium brown, flecked with tan, and with narrow dark-brown crossbands on body and tail; these crossbands can vary in number from approximate-

Figure 1. Colour-pattern variation in *Prasinohaema flavipes*. Dorsal views of unicolour morph, BPBM 34219 (A) and BPBM 34235 (B); banded morph, BPBM 34234 (D); and striped morph, BPBM 34238 (F); and ventral views of unicolour morph, BPBM 34216 (C) and banded morph, BPBM 34234 (E).

Figure 2. Sexual dimorphism in *Prasinohaema prehensicauda*. Females BPBM 34249 (A) and BPBM 34255 (B), and male BPBM 34621 (C), showing blue colouration of mouth and tongue of latter (D).

ly 6 - 9 on the body and vary slightly in the degree to which they contrast with the ground colour (Figure 2A, B). In one specimen (BPBM 34256), the dark crossbands are not well differentiated from the ground colour. Greenish-yellow flecks and blotches are densely scattered throughout the dorsum, sides, face, and tail (Figure 2A) or may be limited to the more anterior regions (Figure 2B). The scales encircling the eye are white. The dark crossbands turn to black on the lower flanks. The brown ground colour changes to golden brown in preservative, and the green-yellow flecks become white. The central 7 - 8 scale rows of the venter are white, and these scales are outlined in brown either throughout the venter or only posteriorly. The chin and throat have many dark-brown or black blotches and flecks, as does the ventral side of the tail. This dark ventral flecking is better developed in a mature female specimen than in the two immature ones. The tops of the hands, feet, and digits are brown.

Males: The central 6 - 9 dorsal scale rows are brown (golden brown in preservative), the sides are lime green (Figure 2C) or pale green and are heavily blotched with lemon yellow (Figure 2C) or pale yellow; the scales encircling the eye are lemon yellow (Figure 2C, D). In preservative, the green on the sides becomes pale straw yellow and the yellow blotches fade to white. The brown dorsal stripe contains white flecks in two of five mature males; these flecks were yellow in life. The chin and throat are white with a few tiny brown or black punctations; the central 6 - 9 scale rows of the venter are white, and the scales under the tail are outlined in brown. The tops of the hands and feet are green, whereas the tops of the digits are brown.

Immature male: A single immature male is intermediate in colour pattern between adult males and females. In preservative, it has the mid-dorsal brown ground colour largely limited to the central ten scale rows on the anterior body, but this colour extends ventrally down the sides at midbody and posterior to that. Hence, the sides are yellow anteriorly (presumably green in life) but darker brown after midbody. There are mid-dorsal crosswise blotches anteriorly, which become crossbands extending down the sides posterior to midbody. The sides and dorsum are heavily blotched with white (presumably green-yellow in life). The head is darker golden brown, and the face has some dark-brown blotches. The venter is white, the sides of the chin and throat have dark-brown blotches, and the lower sides of the body and tail also have black blotches. The lips are dusted with dark gray.

The palms and soles of both sexes are bright yellow or orange. The mouth lining is bright blue or greenish-blue (Figure 2D); the tongue may be the same colour or may be blue-gray. The peritoneum of all specimens is dark black dorsally and laterally and is white mid-ventrally, often with black blotches.

In my sample of nine specimens obtained from 17–31 March, 2009, one is a mature female, two are immature females, five are mature males, and one an immature male. The colour pattern of the immature male indicates an ontogenetic change from the brown, crossbanded female pattern to the green-and-yellow pattern of adult males.

DISCUSSION

Colour-pattern polymorphism in lizards appears to be of uneven phylogenetic distribution, but I have found no general treatment of the topic. Sexual dimorphism in colour pattern is common among iguanians (agamids, chamaeleonids, iguanids) and some scleroglossans (e.g., lacertids), with males often having bright display colours that are either subdued or lacking in females. However, not all these colour-pattern polymorphisms (e.g., among lacertids, see Arnold and Ovenden, 2002) are sexually dimorphic. Among skinks, dorsal colour-pattern polymorphisms appear infrequently. Several examples are known for Australian and Pacific skinks, including members of the genera *Carlia* (Greer, 1989), *Caledoniscincus*

(Sadlier, 1986; Sadlier *et al*., 1999), *Celatiscincus* (Sadlier *et al*., 2006), *Egernia* (Donnellan *et al*., 2002; Chapple, 2003), *Emoia* (Bruna *et al*., 1996), *Lamprolepis* (Perry and Buden, 1999; McCoy, 2006), *Lampropholis* (Greer, 1989; Forsman and Shine, 1995), *Lioscincus* (Sadlier and Bauer, 1999; Sadlier *et al*., 2004), *Marmorosphax* (Sadlier and Bauer, 2000), and *Saproscincus* (Sadlier *et al*., 1993). Most of these polymorphisms, however, are not of particularly striking appearance. They usually involve the presence or absence of longitudinal stripes, which may be of varying contrast and conspicuousness, or they involve distinct vs. no contrast between dorsal and lateral colour fields, or they comprise colour differences in an otherwise-conserved pattern (e.g., bright green vs. olive green vs. brown dorsum in *Lamprolepis smaragdina*). None involves such striking differences in colour pattern as described for the two *Prasinohaema* species above. That one of these striking polymorphisms should be sexually dimorphic, while the other is not, merely increases the biological interest of this already intriguing genus.

ACKNOWLEDGMENTS

I thank Glenn Shea for suggesting this note and for providing relevant literature; Pumehana Imada for specimen processing and documentation; Jim Anamiato, Anulpi Aralu, Tarali Bulu, Dickson Gibson, Gideon Petawi, Phil Shearman, Francis Tatabe and Makana Yewa for providing logistical or field assistance during the expedition; the PNG National Museum and Art Gallery for providing in-country collaborative assistance; and the Department of Environment and Conservation, National Research Institute, and Southern Highlands Provincial Government for permission to conduct this research. This research was supported by National Science Foundation grant DEB-0743890. This is contribution 2010-017 from the Pacific Biological Survey at the Bishop Museum.

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