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A NEW SPECIES OF *PLATYMANTIS* (AMPHIBIA: ANURA: RANIDAE) FROM PANAY ISLAND, PHILIPPINES

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ABSTRACT: We describe a new species of forest frog (genus *Platymantis*) from 180–300 m above sea level on Mt. Lihidan in the northwestern part of Panay Island, Philippines. It is assigned to the *Platymantis dorsalis* species group and is distinguished from congeners by external morphology, various spectral and temporal components of the advertisement call, and a preference for terrestrial, limestone microhabitat. Unique morphological characters include a moderately large body (27.7–34.3 mm SVL for 15 males), slightly expanded terminal finger and toe discs, distinctly rugose dorsal and lateral skin, pronounced supratympanic fold, protuberant rictal tubercle cluster, hidden dorsal and posterior edges of tympanum, and unique coloration.

Key words: Advertisement calls; Biodiversity; Cryptic species; Endemism; Limestone frogs; Philippines; *Platymantis dorsalis* species group; SW Pacific

ANURANS of the genus *Platymantis* have two major centers of diversity, one in the Solomon (Brown, 1952), Bismarck (Allison and Kraus, 2001; Foufopoulos and Brown, 2004; Zweifel, 1960, 1975), and Admiralty archipelagos (21 species; Allison, 1996), and the second in the Philippines (27 species; Alcala and Brown, 1998, 1999; Brown et al., 1997*a*; Brown and Gonzales, in press). In addition, several species occur outside of these major archipelagos. One species occurs in Palau (Crombie and Pregill, 1999), seven in New Guinea (Allison, 1996; Günther, 1999, 2005; Zweifel, 1969), two to four in eastern Indonesia (Edgar and Lilley, 1993; Menzies, 1982*a*,*b*), and two in Fiji (Gorham, 1965; Morrison, 2003).

In October 2004 and November 2005, we conducted herpetological field surveys in the lower-elevation forest of Mt. Lihidan in NW Panay Island (Fig. 1). Two individuals of an undescribed species of *Platymantis*, along with a recording of its advertisement call, were collected in 2004 at an elevation of 300 m. Thirteen additional specimens and four additional acoustic recordings were obtained at lower elevations in 2005. In this paper we describe the new species and report on its natural history, ecology, habitat, and unusual advertisement call.

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MATERIALS AND METHODS

We recorded morphometric data from alcohol-preserved specimens that were originally fixed in 10% formalin (Appendix 1). Sex was determined by gonadal inspection when possible, and measurements were taken with

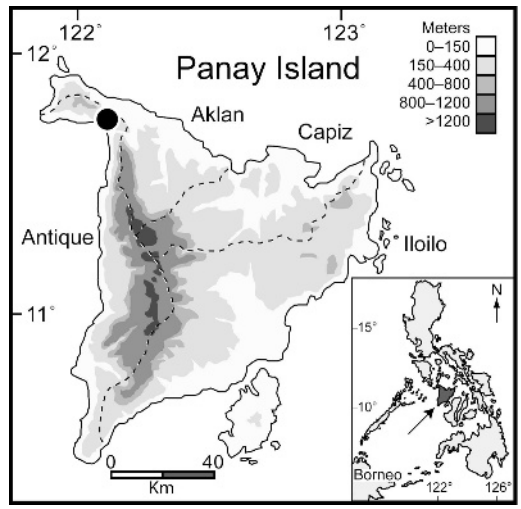

FIG. 1.—Known distribution of *Platymantis paengi* on Mt. Lihidan, NW Panay Island, Philippines. The inset shows the location of Panay Island (colored black) within the Philippines. The type locality (Mt. Lihidan, Municipality of Pandan, Antique Province) is indicated by a black dot. The four provinces of Panay Island are indicated by dashed lines.

digital calipers to the nearest 0.1 mm. To minimize inter-observer bias and other sources of potential error (Hayek et al., 2001; Lee, 1982), all measurements were scored by CDS.

Characters measured include: snout–vent length (SVL, from snout tip to posterior margin of vent), head length (from tip of snout to posterior margin of jaw articulation), eye–narial distance (from anterior margin of eye to posterior margin of nares), snout length (from anterior margin of eye to tip of snout), interorbital distance (between orbits at their midpoint), internarial distance (from dorsal aspect between most laterally distal edges of nares), eye diameter (at widest point), horizontal tympanic annulus diameter (at widest point), eye–tympanum distance (from posterior margin of eye to anterior margin of tympanum), head width (widest measure of head width measured at jaw articulations), upper arm length (from margin of body insertion to elbow tip), forearm length (from elbow to proximal end of outer metacarpal tubercle), tibia length (from knee to heel of flexed leg), femur length (from cloaca to the outer surface of the flexed knee), tarsus length (from knee to proximal edge of metatarsal tubercle), pes length (from proximal edge of outer metatarsal tubercle to tip of Toe IV), manus length (from tip of Finger III to proximal margin of the outer metacarpal tubercle), Toe IV length (from distal margin of metatarsal tubercle to Toe IV tip), Finger I length (from proximal margin of palmar tubercle to Finger I tip), Finger III length (from distal margin of outer metacarpal tubercle to Finger III tip), Finger I disc width (at widest point), Finger III disc width (at widest point), Toe IV disc width (at widest point), and widths of penultimate phalanges of third finger and the fourth toe (at midpoint of penultimate phalanges). In the description, ranges are followed by mean ± SD in parentheses.

Advertisement calls were recorded with a Sony™ PCM-M1 Professional Digital Audio Recorder with a Sennheiser™ ME80 condenser microphone (equipped with K3U power module). Calls were recorded by CDS at distances of 1–4 m from calling frogs; ambient, substrate, and cloacal temperatures were collected immediately after calls were recorded. Calls were digitized using Soundedit© (Macromedia, 1995) and analyzed using Raven© (Charif et al., 2004) software. Temperature corrections were not deemed necessary because ambient temperature was the same for all recordings, and all frogs were recorded in close proximity to one another. We examined oscillograms (waveforms), audiospectrograms (sonograms), and results of the Fast Fourier Transformation (FFT; power spectrum) for a series of spectral and temporal call characteristics (Brown et al., 2003; Diesmos et al., 2002; Foufopoulos and Brown, 2004). Definitions of advertisement call terminology follow Ron (2005). For this description, we follow Kraus and Allison (in press) in maintaining the masculine formations of species' names within the genus *Platymantis*.

Results

Platymantis **paengi** *sp. nov.* (Figs. 2–4)

Holotype.—PNM 9239 (field no. CDS 1585; Fig. 2), an adult male collected at 20:15 h on 26 November 2005 at 180 m elevation in an area known locally as "Mt. Lihidan" (11° 24′ 52.74″ N, 122° 06′ 16.74″ E; WGS-84) Barangay Duyong, Municipality of Pandan, Antique Province, Panay Island, Philippines, by Cameron D. Siler and Charles W. Linkem.

Paratopotypes.—KU 300206–13, PNM 9240–43, 12 males, collected on 25 and 26 November 2005.

Paratypes.—KU 300204–05, two males collected between 2000 and 2300 h on 16 May 2004 at the same general locality as holotype and paratopotypes at 300 m in the foothills of "Mt. Lihidan" (11° 45′ 39.3″ N, 122° 02′ 28.26″ E; WGS-84) by Cameron D. Siler, L. Averia, and A. Ong.

Diagnosis.—*Platymantis paengi* can be distinguished from other Philippine congeners by the following combination of characters: body moderately large in males (27.7–34.3 mm SVL, $n = 15$); digital discs of fingers (1.3–2.0 [1.6 ± 0.2] × width of penultimate phalange) and toes (1.4–2.5 [2.0 ± 0.3] × width of penultimate phalange) slightly ex-

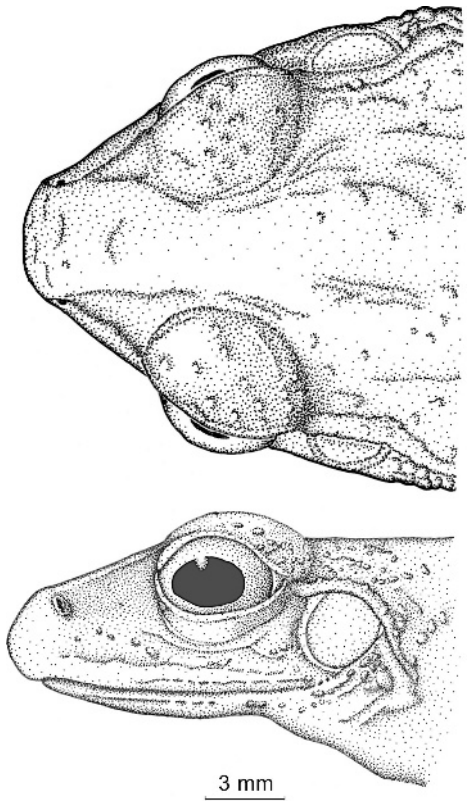

FIG. 2.—Head of male holotype of *Platymantis paengi* (PNM 9239) in dorsal and lateral views. Illustration by CDS.

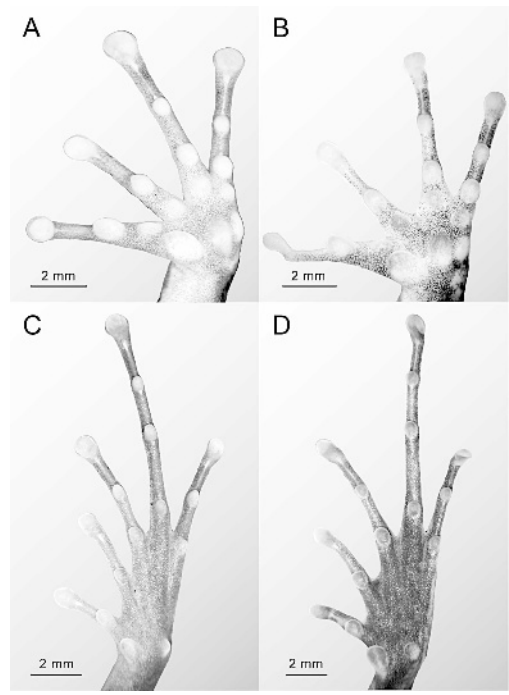

FIG. 3.—Ventral views of hand (A) and foot (C) of male *Platymantis paengi* (KU 300209), and of hand (B) and foot (D) of male *Platymantis dorsalis* (KU 300356).

panded (Fig. 3); skin rugose on dorsal and ventral surfaces; rictal tubercle cluster protuberant; supratympanic fold rugose and protuberant; tympanic annulus large (9% SVL); and advertisement call consisting of frequency sweeps (change in call frequency over time) and amplitude modulation (varying note amplitudes across a single call) (Table 1).

Comparisons.—Three species groups within Philippine *Platymantis* were proposed by Brown et al. (1997*a*,*c*) on the basis of external morphology: the *P. dorsalis* Group, the *P. hazelae* Group, and the *P. guentheri* Group. The new species is a member of the *P. dorsalis* Group (*P. dorsalis, P. corrugatus, P. levigatus, P. cagayensis, P. taylori, P. pseudodorsalis, P. indeprensis, P. spelaeus, P. mimulus, P. naomiae*, and *P. pygmaeus*), with the following combination of characters: digital discs only slightly to moderately expanded and smaller in fingers than in toes, Fingers II and III approximately equal in length, proximal portions of digits round in cross section, large subarticular tubercles pointed and highly protuberant, and a terrestrial microhabitat preference.

Platymantis paengi and *P. spelaeus* are the only species of the *P. dorsalis* Group that are found exclusively in limestone forest. The remaining species occur on soil dominated forest floors (*P. pygmaeus, P. naomiae*, and *P. mimulus, P. pseudodorsalis, P. dorsalis*) and/or shrub layer vegetation (*P. cagayensis* and *P. indeprensis*), and banks of fast-flowing streams (*P. levigatus*). In addition, *Platymantis paengi* produces a unique advertisement call, consisting of a series of slight frequency modulated notes, with the first note being the longest (Fig. 5E). The remaining species of the *P. dorsalis* Group produce single pulse calls (*P. pygmaeus*), complex, multi-syllable calls (*P. naomiae, P. mimulus, P. corrugatus, P. cagayensis, P. taylori, P. indeprensis*, and *P. spelaeus*), or pure-tone, frequency sweep calls (*P. dorsalis, P. levigatus*, and *P. pseudodorsalis*).

FIG. 4.—Photographs in life of *Platymantis paengi* paratopotypes exhibiting two color patterns: (A) the completely mottled phase (PNM 9241), male, SVL 34.3 mm, Photo: CWL; and (B) the solid rusty-orange dorsal phase (KU 300206), male, SVL 34.0 mm, Photo: CDS.

TABLE 1.—Summary of qualitative diagnostic characters (present, absent) in *Platymantis paengi* and male specimens of other members of the *P. dorsalis* species group. Sample size, body size of males, and general geographical distribution (PAIC = Pleistocene Aggregate Island Complexes, sensu Brown and Diesmos, 2002) are included for reference (SVL given as range over mean ± standard deviation; TAD/SVL given as percentage over mean ± standard deviation). *P. mimula, P. naomiae*, and *P. pygmaea* were not included because of their smaller body size, and *P. spelaea* is included due to microhabitat similarity.

	paengi (15)	*dorsalis* (13)	*corrugata* (17)	*levigata* (14)	*cagayensis* (9)	*pseudodorsalis* (4)	*taylori* (4)	*indeprensa* (7)	*spelaea* (4)
SVL (mm)	27.7–34.3 (31.8 ± 2.0)	24.9–35.4 (28.3 ± 2.6)	27.2–33.9 (28.3 ± 2.6)	24.1–33.2 (28.5 ± 3.1)	24.0–28.0 (26.5 ± 1.4)	23.1–29.8 (27.7 ± 3.1)	27.1–33.0 (29.0 ± 2.3)	25.5–27.9 (26.6 ± 0.8)	37.1–44.3 (41.3 ± 3.2)
TAD/SVL	8.0–10.0 (0.09 ± 0.01)	8.0–10.0 (0.07 ± 0.01)	5.0–7.0 (0.06 ± 0.01)	4.0–7.0 (0.05 ± 0.01)	5.0–7.0 (0.07 ± 0.01)	5.0–8.0 (0.07 ± 0.01)	7.0 (0.07 ± 0.00)	6.0–8.0 (0.07 ± 0.01)	6.0–8.0 (0.07 ± 0.01)
Range	NW Panay Island	Philippines	Philippines	Romblon Island Group	Luzon PAIC	Luzon PAIC	Luzon PAIC	Luzon PAIC	SW Negros Island
Digital disk expansion	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present
Rictal tubercle cluster size	Present, large	Present, often 1 tubercle	Absent	Present, 1–2 tubercles	Present or absent	Present, small	Absent to very small	Present, small	Present, often 1 tubercle
Dorsal skin rugosity	Present	Present or absent	Absent to present, less prominent	Absent	Absent	Present or absent	Absent	Present or absent	Present or Absent
Dorsal dermal Tubercles	Present	Present or absent	Absent	Absent	Absent	Absent	Present, small, infrequent	Absent	Present, small
Dorsal folds/ridges	Present, irregular	Present, irregular	Present, 2 continuous, irregular	Absent	present, irregular, low	Absent	Present, small, infrequent	Present, small	Absent
Tympanum hidden	Dorsal/ posterior edge	No	No	No	No	No	Dorsal edge	Dorsal edge	No to dorsal edge
Supratympanic fold	Highly rugose, prominent	Smooth, less prominent	Smooth, less prominent	Low to indistinct	Less prominent	Moderately prominent	Moderately prominent	Smooth, less prominent	Less prominent
Palmar metacarpal tubercle size/ separation	Large/present	Large/present to absent	Large/present	Axial very small/present	Large/present	Large/present	Large/present	Large/present	Large/present
Microhabitat preference	Karst, limestone	Forest	Forest	River bank, rocks	Forest	Forest	Forest	Forest	Karst, limestone
Advertisement call	Frequency sweep/amplitude modulation	Pure-tone frequency sweep	Complex, multi-syllable	Pure-tone frequency sweep	Complex, multi-syllable	Pure-tone frequency sweep	Complex, multi-syllable	Complex, multi-syllable	Complex, multi-syllable

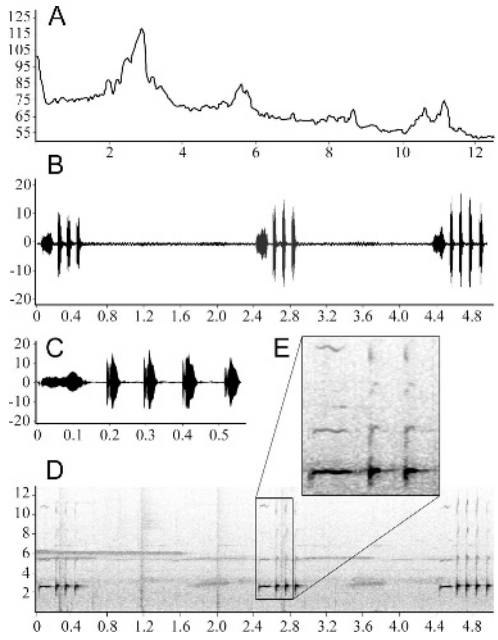

FIG. 5.—The advertisement call of *Platymantis paengi* (Holotype, PNM 9239) recorded at ambient temperature of 25.0 C, perch temperature of 25.0 C, and cloacal temperature of 26.2 C on 26 November 2005: (A) power spectrum (Fast Fourier Transformation; relative intensity in dB vs. frequency in kHz), (B) an oscillogram (relative amplitude vs. time in s) of the final three calls from one call group, (C) an expanded waveform (relative amplitude vs. time in ms) of a single call within a call group, (D) an audiospectrogram (frequency in kHz vs. time in s), and (E) an expanded audiospectrogram of three notes showing slight frequency modulation over time.

The new species differs from *P. mimulus, P. naomiae*, and *P. pygmaeus* by its larger body size (male *P. paengi*, SVL = 27.7–34.3 mm, vs. 14.1–15.7 mm in *P. pygmaeus* [Alcala et al., 1998], 20.3–23.9 mm in *P. naomiae* [Alcala et al., 1998], and 19.0–24.5 mm in *P. mimulus* [Brown et al., 1997*b*]), and microhabitat preference (limestone forest vs. soil dominated forest floor, and/or herb-layer vegetation). From larger members of the *P. dorsalis* Group, *Platymantis. paengi* is distinguished from *P. pseudodorsalis* by its slightly expanded (vs. narrow) terminal discs; a large, highly protuberant (vs. small, and less pronounced) cluster of rictal tubercles; having the dorsal and posterior edges of the tympanic annulus covered (vs. completely distinct from) by the supratympanic fold; the presence (vs. absence) of dorsal folds and ridges; and the presence (vs. absence) of dorsal dermal tubercles. From *P. cagayensis* and *P. indeprensis, P. paengi* is distinguished by the presence (vs. absence) of heavily tuberculate dorsal and lateral skin, the presence of a large (vs. absence or small) rictal tubercle cluster, and the presence (vs. absence) of a protuberant, rugose supratympanic fold.

Platymantis paengi is distinguished from *P. spelaeus* by its smaller size (male *P. paengi*, SVL = 27.7–34.3 mm vs. 37.1–44.3 mm in *P. spelaeus*); a large, highly protuberant rictal tubercle cluster (vs. small, and often consisting of a single tubercle); the presence of larger and more abundant (vs. smaller and less abundant) dorsal dermal tubercles; and the presence (vs. absence) of dorsal folds and ridges. The new species differs from *P. corrugatus* by the absence (vs. presence) of a dark, pigmented bar covering the lateral portion of the head; numerous, small supernumerary tubercles across the ventral surface of the foot; and two to five long, discontinuous folds down the dorsal surface. From *P. levigatus*, the new species differs by having the dorsal and posterior edges of the tympanic annulus covered (vs. completely distinct from) by the supratympanic fold; a supratympanic fold that extends fully to (vs. terminating well before) the supra-axillary region; a sharply angular (vs. rounded) canthus rostralis; and highly rugose (vs. smooth) dorsal and lateral skin. The new species is distinguished from *P. dorsalis* by having slightly expanded (vs. narrow) terminal discs (Fig. 3); a large, highly protuberant (vs. small, and less pronounced) cluster of rictal tubercles; dorsal and posterior edges of the tympanic annulus covered by (vs. completely distinct from) the supratympanic fold; highly tuberculate (vs. smooth to slightly tuberculate) dorsal and lateral skin; a distinct (vs. absent or less well defined) banding pattern on the limbs.

Description of holotype.—A mature male; habitus robust; head only slightly broader than body, head length 37.1% SVL; head length 87.1% head width; snout protruding moderately beyond lower jaw, snout tip rounded in dorsal and lateral aspect (Fig. 2); eyes protruding laterally; lips moderately flared and swollen; interorbital region flat; eye diameter 80.5% snout length, 1.3 × eye-nares distance;

pupil horizontally elliptical; canthus rostralis laterally concave in dorsal aspect; loreal region concave, sloping ventrolaterally to labium; nostrils oriented posterolaterally; eye-nares distance 2.8 × nostril–tip of snout distance; internarial region slightly concave; tympanic annulus distinct, its diameter 0.78 × eye diameter; dorsal and posterodorsal margin of tympanic annulus concealed by supratympanic fold; fold strongly protuberant, extending from posterior corner of eye across dorsal margin of tympanum to supra-axillary region.

Tongue elongate, wider posteriorly, with deep posterior notch and narrow anterior attachment; choanae situated at anterolateral edge of palate, round, widely separated by distance four to five times greater than diameter of single choana; dentigerous process of vomer distinct, with six teeth; dentigerous process angled slightly anterolaterally, approximately at 20–30° incline with closest (posterior) points separated by distance equal to 1.5 times diameter of single choana, their most distant (anterior) ends separated by distance equal to three times diameter of single choana; short vocal slits at posteroventral margin of mouth.

Skin of dorsal surfaces of trunk and head distinctly shagreen, bearing heterogeneous tubercles (tiny and barely perceptible to large and highly pronounced) and highly pronounced dorsal ridges; ridges irregular in length, none spanning entire body length, and concentrated in suprascapular and sacral region of dorsum; ventral surfaces of head smooth; lateral and ventral surfaces of limbs finely granular with dorsal surfaces moderately tuberculate; flanks shagreen.

Manus length 50.5% pes length; tibia length 99.5% pes length; tibia length 55.6% SVL; fingers slender, long; terminal discs slightly to moderately expanded (Fig. 3A) with pronounced distal, circummarginal groove; dorsal surfaces of terminal phalanges with small, cutaneous supra-articular flaps between ultimate and penultimate phalanges; relative lengths of fingers: II = IV < I < III; subarticular tubercles prominent, convex, velvety in texture; one subarticular tubercle below Digits I and II, two tubercles under Digits III and IV; supernumerary tubercles distinct, round, prominent; present at base of Digits I–IV; thenar (inner metacarpal) tubercle enlarged, elongate, ovoid; palmar (outer metacarpal) tubercle completely divided into following: preaxial tubercle large, oval, prominently raised; postaxial tubercle oval, half the size of preaxial metacarpal tubercle; nuptial pads absent, forearms slender.

Tarsus smooth, lacking folds, flaps, or tubercles; terminal discs of toes moderately expanded, with circummarginal grooves; supra-articular cutaneous flaps above ultimate-penultimate phalangeal articulations; plantar surfaces of foot smooth, with well-developed, prominently rounded to pointed subarticular tubercles (Fig. 3C); relative lengths of toes: I < II < V < III < IV; outer metatarsal tubercle small, round, pointed; inner metatarsal tubercle prominent, with sharp plantar edge, length equal to distance from base of Toe I to first subarticular tubercle; toes barely webbed basally (not extending to level of the proximal subarticular tubercles); cloacal region glandular, lacking tubercles or supracloacal flaps.

Coloration of holotype in preservative.—Dominant dorsal color on head and body nearly uniform dark brown with distinct, pale gray patches; dorsal surfaces of limbs medium brown with transverse, dark brown bars; interorbital bar faint, slightly paler, bordered posteriorly by dark brown and anteriorly by slightly paler snout; wide black bar extending from nares through canthal, preocular, postocular, and tympanic regions, wrapping ventrally around posterior edge of tympanic annulus where it expands to cover anteroventral edge of tympanum; dark coloration continues through forelimb insertion and posteroventrally across the flank where it fades; temporal region dorsally black and lighter gray to tan ventrally, divided along diagonal line from anterior end of supratympanic fold, across center of tympanum, to the point of forelimb insertion; lips black with vertically transverse pale cream labial bars, bordered anteriorly by paler brown lower edge of canthus and subocular regions; transverse, dark brown bars on limbs similar in color to dorsum, coalescing into large spots on elbows and knees; three bars on forearms, four on thigh, three on tibia, two on tarsus; mottled flanks, blending into the darker

border (above) and lighter border (below) of dominant color pattern; dorsal surfaces of manus, pes, and digits dark brown with paler blotches above each joint; dorsal surfaces of inner two toes slightly paler brown than outer.

Throat marbled dark brown and dark gray with distinct white flecks; periphery of throat and lower lips darker; chest pale brown with black wrapping around anteroventral edges of upper arms; paler gray ventral coloration limited to thin strip on ventral surfaces of forelimbs; preaxial ventral strips of upper- and forearms cream; venter pale gray with distinct, dark gray spots that decrease in size posteriorly until blending with uniformly gray groin; ventral surfaces of thigh medium reddish brown, gray ventral surface of tibia and tarsus uniform brown; palmar and plantar surfaces of hands and feet dark brown with gray subarticular tubercles; iris pale gray above and dark gray below pupil.

Coloration of holotype in life.—(differences from preserved specimens observed in digital photographs and field notes of CDS and CWL) Dorsum and head dark brown, lacking dorsal color pattern save for dark cream interorbital bar, slightly paler snout, and scattered white flecks; dorsal surfaces of limbs golden brown with black transverse bars; head with golden flecks along edge of canthus rostralis, along vertical labial bars, at tip of snout, in subocular region, and along diagonal stripe across black tympanum; dorsal surfaces of digits of manus and pes black with golden brown blotches and cross bars at joints; lateral series of blotches across flanks black; throat and sternal region purplish brown, with distinct, pale cream spots on venter (fading posteriorly), groin uniform purplish gray; ventral surfaces of fore- and hind limbs medium gray with darker peripheries; iris bright gold above and darker golden brown below pupil.

Measurements of holotype (mm).—SVL 32.9; head length 12.2; head width 14.0; snout length 5.2; internarial distance 3.4; interorbital distance 3.0; eye diameter 4.1; eye–nares distance 3.3; tympanic annulus diameter 3.2; eye–tympanum distance 0.5; upper arm length 6.1; forearm length 7.3; femur length 17.9; tibia length 18.3; tarsus length 10.0; manus length 9.3; pes length 18.4; Finger I length 6.2; Finger III length 9.3; Toe IV length 17.2; Finger III disc width 0.9; Toe IV disc width 1.1; Finger III penultimate phalange width 0.7; Toe IV penultimate phalange width 0.7.

Variation.—We observed three dorsal color patterns in our sample of 15 male specimens. The holotype, eight paratopotypes (PNM 9240–41, 9242, 9243; KU 300207, 300210–12), and two paratypes (KU 300204–05) have a dorsum mottled with shades of dark brown, grayish tan, and light hues of brownish green (Fig. 4A). Two paratopotypes (KU 300206, 300213) are distinctively colored with a rusty-red and orange dorsum with small patches of black and a sharp stratification between the red dorsum and dark flanks (Fig. 4B). The ventral half of the flanks are marbled brown, tan, and brownish green. Rictal tubercle clusters vary from orange to red, and limbs and dorsals surfaces of the hands and feet have irregular patches of red and orange. There is a distinct orange patch on the heels. Two other paratopotypes (KU 300208–09) have two light cream, dorsolateral stripes, one on each side of the body, running from the posterior portion of eye to the hind-limb insertion. The stripes are widest anteriorly and narrow posteriorly, and the dorsal surfaces between the stripes bears a dark brown and black mottled pattern (darker than that of the first color pattern).

The throat, chest, and belly exhibit two different patterns. The first pattern (PNM 9240–41, 9243; KU 300204, 300206–08) is moderately to darkly mottled with tan, gray, dark brown or black patches irregularly interspersed. Posterolateral portions of the throat have two darker brown patches that sometimes extend well onto the chest and anterior and ventral portions of the upper arm. The chest and belly are tan with darker brown markings ranging from small spots to irregular, medium-sized patches. The second pattern is observed on PNM 9239, 9242 and KU 300205, 300209–13. The throat, chest, and stomach are homogeneously tan, and only on the posterior and lateral portions of the throat are there slightly darker patches of gray to brown of varying distinctiveness. In KU 300213, there is a single dark gray patch

observed at the anterior tip of the throat, ventral to the tip of the snout.

Transverse bars on the limbs vary from distinct with sharp edges (PNM 9239–40; KU 300204, 300208, 300210–13) to less distinct or difficult to differentiate from the dark brown ground color of the limbs (PNM 9241–43; KU 300205, 300206–07, 300209). When bars are distinct from background limb color, they are intermixed with small, black flecks.

All specimens have five transverse dark bars on the thigh, four on the tibia, two on the tarsus, and three on the forearms. Palmar surfaces of the hands and plantar surfaces of the feet are dark gray with lighter subarticular tubercles; supernumerary tubercles vary from light to dark gray.

Among the type series (15 males including holotype), SVL 27.7–34.3 (31.8 ± 2.0), head length 30.9–39.6% (34.6 ± 0.02) of SVL, head length 73.0–91.8% (81.8 ± 0.05) of head width, eye diameter 70.2–106% (80.6 ± 0.1) of snout length, 1.0–1.6 (1.3 ± 0.15) × eye–nares distance, tympanic annulus diameter 0.6–0.8 (0.7 ± 0.06) × eye diameter, manus length 47.6–54.5% (51.2 ± 0.02) of pes length, pes length 96.8–105% (101 ± 0.02) of tibia length, tibia length 54.5–61.5% (57.4 ± 0.02) of SVL.

Advertisement call.—At the type locality, visited during the "dry" season, November–May, calling activity was heard only during, and shortly following, rainfall. Wind and advertisement calls of congeners did not disrupt the activity of calling males. Calling activity began shortly after sunset (1830–1930 h) and lasted 3–5 h. Frogs called intermittently from either atop limestone outcrops or from within crevices in the rock. Males adjacent to other males called more frequently. Single males were heard making intermittent sound that sometimes resembled the advertisement call and at other times merely consisted of a simple tone. Periods of calling activity were separated by 3–10 min of silence before males would begin calling again.

The following description is based on calls of two collected males (PNM 9239; KU 300211) and three males that were not collected. All advertisement calls were recorded at the same site and at an ambient temperature of 25.0 C, with cloacal temperatures measured following recordings for the two collected = 26.2 and 26.0 C, respectively. Because each of the five recordings was made at the same locality and in almost identical abiotic conditions, we included all of them in the following analysis. Variation in measurements of acoustic characters is given in Table 2.

Males produce a unique advertisement call that sounds like a series of sharp whistles (the first held longer, sweeping in frequency, followed by a rapid set of short whistles) to the human ear. The first note is a slight frequency modulated note terminating with a longer tonal signal, followed by short amplitude modulated pulses (Fig. 5). During recording segments, males called intermittently in call groups. Each group consists of 4–12 (7.3 ± 2.5; $n = 17$) calls per group. Duration of call groups are 6.7–34.3 (17.8 ± 7.2; $n = 17$) s. Call groups are separated by intervals of silence, or intergroup intervals, of 7.3–66.3 (24.9 ± 16.4; $n = 12$) s. Calling group rate [(total number of call groups − 1)/time from beginning of first group to beginning of last] ranges from 0.012–0.029 (0.022 ± 0.008; $n = 4$) groups/s.

Within call groups, calling rate [(total number of calls − 1)/time from beginning of first call to beginning of last] is 0.20–0.49 (0.38 ± 0.09; $n = 17$) calls/s, with calls delivered more rapidly toward the end of the call group (intervals between calls decline through call groups). With two exceptions, final intervals between calls are shorter than the first, with the interval length difference [first inter-call interval length–last inter-call interval length] being 0.71–6.9 (3.1 ± 2.3; $n = 15$) s. Final intervals between calls are longer than the first intervals between calls during the third call groups in KU 300211 (0.5 s difference) and in the second of three non-vouchered recordings (0.6 s difference). Call intensity is relatively homogeneous across calls in each group, with each call throughout call groups accounting for 88–100% (96.5 ± 0.03; $n = 95$) of maximum amplitude.

All calls contain an initial note with slight frequency modulation, followed by a sequence of rapid amplitude modulated notes. There are 0–6 notes following the elongate initial note, with an increase in the number of notes

TABLE 2.—Summary of advertisement call characters for the two recordings with voucher specimens and three recordings where voucher specimens were not collected. When appropriate, sample size is provided and a range is shown followed by mean ± standard deviation. The first non-vouchered recording consisted of only one call group and therefore cannot be evaluated for several categories in this table.

	PNM 9239	KU 300211	First non-vouchered recording	Second non-vouchered recording	Third non-vouchered recording
Calls per group	(8.0 ± 4.2), $n = 2$	(7.1 ± 2.5), $n = 7$	(7.0 ± 0.0), $n = 1$	(7.0 ± 3.3), $n = 5$	(8.0 ± 0.0), $n = 2$
Intergroup interval	28.9 s	7.3–28.0 s, (18.8 ± 7.3), $n = 6$	Not applicable	11.9–45.6 s, (22.6 ± 15.5), $n = 4$	66.3 s
Calling group rate	0.0192 groups/s	0.0294 groups/s	Not applicable	0.0258 groups/s	0.0122 groups/s
Within-group calling rate	0.43–0.45 calls/s, (0.44 ± 0.01), $n = 2$	0.31–0.49 calls/s, (18.8 ± 7.3), $n = 6$	0.45, $n = 1$	0.20–0.43 calls/s, (0.31 ± 0.08), $n = 5$	0.28–0.49 calls/s, (0.38 ± 0.15), $n = 2$
Intercall interval difference	0.8–2.1 s, (1.5 ± 1.0), $n = 2$	0.7–5.9 s, (2.4 ± 2.4), $n = 6$	1.5 s, $n = 1$	2.1–6.3 s, (4.7 ± 1.9), $n = 4$	2.3–6.9 s, (4.6 ± 3.2), $n = 2$
Call intensity	88–100% maximum amplitude, (94.6 ± 3.8), $n = 14$	93–100% maximum amplitude, (97.6 ± 2.0), $n = 44$	96–100% maximum amplitude, (98.5 ± 1.5), $n = 6$	91–100% maximum amplitude, (95.1 ± 2.7), $n = 24$	94–100% maximum amplitude, (96.3 ± 1.8), $n = 7$
Final call pulse number	2–5 pulses, (3.5 ± 2.1), $n = 2$	2–5 pulses, (3.7 ± 1.0), $n = 7$	6, $n = 1$	2–5 pulses, (3.4 ± 1.3), $n = 5$	3–5 pulses, (4.0 ± 1.4), $n = 2$
FFT power spectrum peaks	3.6 kHz	3.6 kHz	3.6 kHz	3.0 kHz	3.0 kHz
Harmonic peaks	6.1, 9.0, and 11.7 kHz	6.4 and 9.4 kHz	6.0 and 8.6 kHz	6.0 and 9.0 kHz	5.7 and 8.9 kHz

per call across call groups. Call groups usually begin with a call containing only one note and conclude with longer calls of between three and six notes. The number of final call notes is 2–6 (3.8 ± 1.3; $n = 17$). Note-repetition rate [(total number of notes per call − 1)/time from beginning of first note to beginning of last], (excluding the initial, frequency modulated note) decreases in the latter calls of each call group. In KU 300211, call groups began with initial calls with note-repetition rates of 8.0–9.0 (8.5 ± 0.5, $n = 6$) notes/s, and call groups end with final calls that have note-repetition rates of 7.8–9.0 (8.3 ± 0.4, $n = 7$) pulses/s. Similar rates also are observed in the second non-vouchered recording, with initial note-repetition rates of 9.3 (9.3 ± 0.0, $n = 3$) notes/s, and final calls have note-repetition rates of 8.3–9.3 (8.9 ± 0.4, $n = 5$) notes/s. The initial frequency modulated note does not vary significantly in duration between the first and last call of each call group; this tonal syllable lasts 0.07–0.18 (0.14 ± 0.02, $n = 34$) s.

The calls of *P. paengi* have distinct spectral components (Fig. 5A–D; Table 2), with an emphasized (= dominant) fundamental frequency and multiple harmonics (multiples of the fundamental). The FFT (power spectrum) demonstrates that the majority of energy in each call is found in the fundamental frequency. There were two detectable harmonics in all recordings, except for the holotype, in which there were three detectable harmonics.

Distribution.—*Platymantis paengi* is known only from 180–300 m above sea level on the mountain known locally as "Mt. Lihidan" (11° 24′ 52.74″ N, 122° 06′ 16.74″ E; WGS-84), Municipality of Pandan, Antique Province, NW Peninsula of Panay Island, the Philippines (Fig. 1).

Etymology.—We take great pleasure in naming the new species for our friend and colleague Rafe M. Brown, in recognition of his 15 years of contribution to herpetology, his work on the forest frogs of the genus *Platymantis*, and for his endless support toward international collaboration. The genitive masculine name "Paeng" is a Tagalog nickname for Rafael. Suggested common name = Panay Limestone Frog.

Ecology and natural history.—*Platymantis paengi* is currently known from 180–300 m above sea level in a small patch of disturbed, secondary-growth forest in karst habitat. Males were observed calling from either the top of rock outcroppings or from within crevices in the rock formations.

Calling males were easily disturbed by human presence, and we found it difficult to approach an individual without the frog escaping into limestone crevices. No egg masses, females, or juveniles were found; other species of *Platymantis* have direct development (Brown and Alcala, 1982*a*,*b*).

Other sympatric anuran species include *Limnonectes visayanus, Platymantis dorsalis, P. corrugatus, P. negrosensis, Polypedates leucomystax, Kaloula* cf. *kalingensis, Bufo marinus*, and *Occidozyga laevis*. Amphibians encountered at nearby lower elevations in more disturbed habitats included *Fejervarya vittigera* and *Rana erythraea* (Ferner et al., 2001; Gaulke et al., 2003).

Conservation.—*Platymantis paengi* is known from a restricted portion of disturbed habitat in the NW mountain range of Panay Island. The species was observed between 180–300 m above sea level; however, we suspect that the species may possess a wider elevational range and geographical distribution. It is our assumption that one of the main limiting factors to this species' range is distribution of limestone forest. In the region surveyed, we witnessed widespread habitat destruction from agricultural fields and local farms, and all forest patches in which we observed the new species were regenerated second growth. Currently, we recognize our inability to make a proper conservation assessment for this new species because of a lack of adequate surveys. We suggest immediate surveys of karst habitat be conducted across Panay Island in the rainy season. Such efforts would enable conservation assessments of *Platymantis paengi* as well as other obligate limestone species.

Discussion

With the new species described here, there are 27 species of Philippine *Platymantis*. The number of Philippine *Platymantis* has increased in several bursts, from seven species (Inger, 1954; Brown and Alcala, 1970*a*,*b*), to 12 species (Brown and Alcala, 1982*a*), to 25–27 species (Alcala and Brown, 1998, 1999;

Brown et al., 2002; R. Brown, personal communication). We expect that this total is still an underestimate of the actual diversity of Philippine *Platymantis* (Brown et al., 2002; R. Brown, A. Diesmos, and A. Alcala, unpublished data). The Philippine radiation is characterized by a high degree of documented cryptic diversity (Alcala et al., 1998; Brown et al., 1997*b*, 1999), which has only recently begun to be resolved because of analyses of advertisement-call diversity, microhabitat preferences, molecular evidence, and morphological characters that are currently recognized as important in the delineation between species groups and species boundaries (R. Brown, A. Diesmos, and A. Alcala, unpublished data).

Platymantis paengi is the third Philippine limestone frog to be described. Others include *P. spelaeus* from SW Negros Island and *P. insulatus* from the Gigantes Islands. These species appear to have restricted microhabitat preferences for limestone forest habitat, and so far all occur in the Visayan (Central) Philippine islands. Within these limited geographic ranges, the species are quite common in the rainy season, but can seem to be quite rare in times of high temperature and aridity (Brown and Alcala, 2000; Brown et al., 2003).

The heavily mottled, dominant morphotype of *Platymantis paengi* is similar in appearance to both *P. spelaeus* and *P. insulatus*. With all three species having unique preferences for rocky, limestone habitat, the similarity in color pattern may be a result of convergent selection. All three frogs have expanded terminal digital discs; however, *P. insulatus* has widely expanded discs, a feature that allies the species with the *P. guentheri* Group (sensu Brown et al., 1997*a*). It is unclear as to which species *Platymantis paengi* is most closely related; a comprehensive molecular phylogenetic analysis will be needed to test current species-group relationships (R. Brown, A. Diesmos, and A. Alcala, unpublished data).

The discovery of a new species of limestone frog within the NW peninsula of Panay Island highlights this region as an important component of the diversity of amphibians and reptiles within the Visayan Islands and the Philippines. Although surveys at varying elevations in forested sites are still needed before accurate statements on the diversity of Philippine *Platymantis* can be made, we suggest that simultaneous efforts be focused on surveys within fragmented and forest edge habitat throughout the Visayan Islands and the Philippines. Additional surveys conducted in limestone habitats of Panay are necessary to document fully the geographic range of this new species.

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Appendix I

Specimens Examined

All specimens examined are from the Philippines. Numbers in parentheses indicate the number of specimens examined for each species. *Platymantis banahao*.—(6) LUZON ISLAND, Quezon Province, *Municipality of Tayabas*, Baragany Lalo, Mt. Banahao: TNHC 61968–71, PNM 9248–49. *Platymantis cagayanensis*.—(9) LUZON ISLAND, Cagayan Province, "Tagat Forest Reserve near Santa Praxedes Town:" PNM 7564, 7578, 7496–99, 7506, 7608, 7526. *Platymantis cornuta*.—(2) LUZON ISLAND, Kalinga Province, *Municipality of Balbalan*, Barangay Balbalan: CAS 61476 (Holotype); CAS 231498. *Platymantis corrugatus*.—(22) CAMIGUIN ISLAND, Camiguin Province, *Municipality of Guinsiliban*, Barangay Cabuan: KU 300351, 300355; POLILLO ISLAND, Quezon Province, *Municipality of Polillo*, Barangay Pinaglubayan, 62 m elevation, 14° 45′ 9.3″ N, 121° 58′ 5.52″ E: KU 300350, 300352–54; NEGROS ISLAND, Negros Oriental Province, *Municipality of Valencia*, Barangay Bongbong, Camp Lookout, Cuernos de Negros Mt. Range, Mt. Talinis, 500 m elevation: TNHC 61972–87. *Platymantis dorsalis*.—(22) NEGROS ISLAND, Negros Oriental Province, *Municipality of Valencia*, Barangay Bongbong, Sitio Tagaytay, Mt. Talinis, 1150 m elevation, 9° 15′ 36″ N, 123° 12′ 196″ E: KU 300356–300377. *Platymantis guentheri*.—(8) BOHOL ISLAND, Bohol Province, *Municipality of Carmen*, Barangay Riverside: TNHC 56407; *Municipality of Bilar*, Barangay Logarito: PNM 9250–56. *Platymantis hazelae*.—(13) NEGROS ISLAND, Negros Oriental Province, *Municipality of Valencia*, Barangay Bongbong, Sitio Tagaytay, Mt. Talinis, 1150 m elevation: KU 300403–15. *Platymantis indeprensis*.—(8) LUZON ISLAND, Quezon Province, *Municipality of Tayabas*, Barangay Lalo, Mt. Banahao: TNHC 061956–60; PNM 9257–59. *Platymantis insulatus*.—(12) SOUTH GIGANTE ISLAND, Iloilo Province, *Municipality of Carles*, Barangay Gabi: CAS 117441 (Holotype), 119967–69 (Paratypes); KU 300338–44, 300346; NORTH GIGANTE ISLAND, Iloilo Province, *Municipality of Carles*, Barangay Granada: KU 300345, 300347–49. *Platymantis isarog*.—(7) LUZON ISLAND, Camarine Sur Province, *Municipality of Naga City*, Barangay Panicuason, Mt. Isarog National Park, Mt. Isarog: TNHC 61961–67. *Platymantis lawtoni*.—(1) TABLAS ISLAND, Romblon Province, *Municipality of San Agustin*, Mt. Progreso: CAS 135733. *Platymantis levigatus*.—(15) SIBUYAN ISLAND, Romblon Province, *Municipality of Magdiwang*, Barangay Talaba, Mt. Guiting-Guiting Natural Park, 0 m elevation: KU 300416–30. *Platymantis luzonensis*.—(16) LUZON ISLAND, Laguna Province, *Municipality of Los Baños*, Barangay Batong Malake, Mt. Makiling: CAS 196364, 196369–70, 200404–08, 210544–45 (Paratypes); Camarines Sur Province, *Municipality of Naga City*, Mt. Isarog: FMNH 251643–44; TNHC 62006–09. *Platymantis mimulus*.—(12) LUZON ISLAND, Laguna Province, *Municipality of Los Baños*, Barangay Batong Malake, Mt. Makiling: TNHC 54930–31; PNM 9260–69. *Platymantis montana*.—(13) LUZON ISLAND, Quezon Province, *Municipality of Tayabas*, Barangay Lalo, Mt. Banahao: TNHC 62149–58; CAS 200998–1000. *Platymantis naomiae*.—(3) LUZON ISLAND, Quezon Province, *Municipality of Tayabas*, Baragany Lalo, Mt. Banahao: TNHC 62169–71. *Platymantis negrosensis*.—(7) NEGROS ISLAND, Negros Oriental Province, Cuernos de Negros Mountain Range, Mt. Talinis, 750 m elevation: KU 300439–45. *Platymantis panayensis*.—(2) PANAY ISLAND, Aklan Province, *Municipality of Nabas*: CAS 137641–42. *Platymantis pseudodorsalis*.—(4) LUZON ISLAND, Quezon Province, *Municipality of Tayabas*, Baragany Lalo, Mt. Banahao: KU 207455–57, 207459 (Paratypes). *Platymantis pygmaeus*.—(5) LUZON ISLAND, Cagayan Province, *Municipality of Calveria*, Barangay Mabnang, Mabnang Falls: PNM 7523; SIBUYAN ISLAND, Romblon Province, *Municipality of Magdiwang*, Barangay Talaba, Mt. Guiting-Guiting Natural Park, 0 m elevation, 12° 27′ 40.38″ N, 122° 39′ 51.66″ E: KU 300431–34. *Platymantis rabori*.—(3) MINDANAO ISLAND, New Bataan Province, Mt. Puting Bato: CMNH 2305, 2350; Davao City Province, *Municipality of toril*, Barangay Baracatan, Sitio Upper Baracatan: CMNH 1462. *Platymantis sierramadrensis*.—(6) LUZON ISLAND, Aurora Province, *Municipality of San Luis*; Dipiningan branch of the Cobatangan River drainage; 15° 40′ 12″ N, 121° 20′ 48″ E: CMNH 5678–79, 5904; Isabela Province, *Municipality of Palanan*, Barangay Didian, Sitio Natap Dukan, Northern Sierra Madre National Park, 16° 57′ 55.8″ N, 122° 24′ 13.8″ E: CAS 204739–41. *Platymantis spelaeus*.—(7) NEGROS ISLAND, Negros Oriental Province, *Municipality of Basay*, Tiyabanan Barrio: CAS 153477–78, 153482 (Paratypes); Negros Occidental Province, *Municipality of Cauayan*, Sitio Banso, Barangay Camalandaan, 320 m elevation: KU 300435–38. *Platymantis subterrestris*.—(3) LUZON ISLAND, Mountain Province, Mt Data: CAS 204319–204321. *Platymantis taylori*.—(4) LUZON ISLAND, Isabela Province, *Municipality of Palanan*, Barangay Didian, Sitio Natapdukan: CAS 207443–207446 (Paratypes).