

TYLER, M. J., 1968. – Papuan hybrid frogs of the genus *Hyla*. *Zool. Verhandl.*, **96**: 1-203.
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A new species of tree frog (Anura, Hylidae, Litoria) from the mountains of Irian Jaya, Indonesia

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A new species of hybrid frog is described from lower montane rainforest (1070 m in elevation) in the mountains of the Wapoga River, Irian Jaya. The new species shows affinities to some members of the *Litoria nigropunctata* species-group but can be distinguished from all described species in that group by a combination of dark brown colouration on the hidden surfaces of the thighs, groin and axilla, and dorsal colouration which consists (in life) of small yellow spots on a uniform green background. The advertisement call is a short, distinctly pulsed note lasting about 0.2 second, with a dominant frequency of about 2.5 kHz.

INTRODUCTION

The Australopapuan hybrid frog genus *Litoria* reaches its greatest diversity in Australia and mainland New Guinea (FROST, 1985). Although the genus is relatively well documented in Australia (BARKER et al., 1995), the New Guinea fauna remains poorly known. This is particularly true for the Indonesian province of Irian Jaya where fauna surveys have lagged behind those in neighbouring Papua New Guinea (ALLISON & DWYAHRENI, 1997).

Ten small green *Litoria* species have been reported from the mountains of New Guinea. MENZIES (1993) included six of these (*Litoria chloronota*, *L. iris*, *L. harvina*, *L. leucova*, *L. micro* and *L. ollaro*) in the *Litoria nigropunctata* species-group, which was defined (in part) by TYLER & DAVIES (1978) as "small to medium species with short, 1/3-webbed fingers and almost fully webbed toes. Predominantly green in life and may be marked with gold and black." JOHNSON & RICHARDS (1994) subsequently redefined *L. leucova* and suggested that it may be related to torrent-dwelling frogs of the *L. becki* species-group of TYLER & DAVIES (1978). They described an additional member of the *L. nigropunctata* group, *Litoria majkithise*, from the foothills of the Star Mountains.

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atytes. – MZB Amp.3874-3875, SAMA R54595-54598, adult males collected at the same locality as the holotype on 9 April 1998; MZB Amp.3876, adult male collected at the same locality as the holotype on 15 April 1998.

genosis. – A small *Litoria* (males 30.5-32.9 mm SVL) characterised by: (1) snout broadly rounded in dorsal view and bluntly rounded in lateral view; (2) canthus rostralis poorly incised, gently rounded and straight or slightly curved; (3) vomerine teeth present; (4) fingers half webbed; (5) dorsum (in life) green with small yellow spots; (6) axilla, groin and den surfaces of thighs deep purplish brown; and (7) advertisement call a single, distinctly sed note.

cription of holotype. – Head moderately slender (HW/SVL 0.35); head about as wide as g (HL/HW 1.02), slightly more than one-third body length (HL/SVL 0.35). Snout broadly nded in dorsal view, bluntly rounded in lateral view (fig. 1, 3). Dorsal one-fifth of ipanum obscured by gently curving supratympanic fold that extends from posterior edge ye half-way to point of arm insertion. Eye relatively large, prominent (EYE/SV 0.123), thus rostralis poorly defined, gently rounded, slightly curved; loreal region slightly cove. Vomerine teeth in two raised patches between choanae, vocal slits present. Tongue adly cordiform.

Limbs slender. Fingers short, outer fingers one-half webbed; relative lengths of fingers > IV > II > I; terminal discs large, prominent (3FP/3FD 0.64). Subarticular tubercles indly bi-lobed. Brown nuptial pad on each thumb. Legs moderately long (TL/SVL 0.59). s nearly fully webbed; web reaching base of disc except on 4th toe where webbing reaches ultimate tubercle and continues as fringe along toe to base of disc. Toe discs large, nument (4FP/4FD 0.69). Relative lengths of toes IV > III = V > II > I. Subarticular ricles on toes 3-5 bi-lobed.

Dorsum very finely striated (nearly smooth), without tubercles on head or body. Ventral ace finely granular on throat, coarsely granular on belly. Large white tubercles on ventral ace of thighs.

Colour around upper jaw. – Dorsally uniform green with scattered, small yellow spots; narrow, pale w stripe around upper jaw. Ventral surfaces white. Axilla, groin and posterior of thigh r) purplish brown.

Colour in preservative. – Dorsally pale blue with small white spots; a faint white stripe nd upper jaw. Pigmentation in axilla, groin and posterior of thigh dark brown. Brown nent on legs sharply delineated from blue dorsal colouration of limbs by two narrow strips luck and brown pigmentation. Blue pigmentation on arms terminating abruptly in clearly areated line at wrist. Pigment on hands restricted to fine brown stippling on dorsal ace of 3rd and 4th fingers, extremely sparse on 2nd finger. Plantar surfaces with scattered n pigmentation.

Measurements (mm) of holotype. – SVL 30.7; TL 18.2; HW 10.6; EYE 3.8; EN 3.0; :8; TYM 1.6; 3FD 1.7; 3FP 1.1; 4FD 1.6; 4FP 1.1.

ation. – There are seven paratypes, all adult males (SVL 30.5-32.9 mm). Dorsal coloura- of all specimens is pale to dark blue (green in life) with scattered small white (yellow in spots. In some specimens a few spots are very pale blue (pale, yellowish green in life)

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Litoria contrastens is a montane representative of the predominantly lowland *Litoria bicolor* species-group, and two other small green *Litoria*, *L. hulmeri* and *L. longicrus*, are torrent-dwelling frogs that live along steep mountain streams (S. J. Richards, personal observations). TYLER & DAVIES (1978) placed *L. hulmeri* in a monotypic species group and, based solely on morphological characters, erroneously included *L. longicrus* in the *L. bicolor* species-group. Two of these species have been reported from Irian Jaya. *Litoria iris* is widespread along the central mountainous spine of New Guinea, reaching its western limit in the Star Mountains in Irian Jaya (TYLER, 1968). *Litoria chloronota* is endemic to Irian Jaya, being known only from the Arafak Mountains on the Vogelkop Peninsula (TYLER, 1968; MENZIES, 1993).

During a biodiversity survey in the mountainous headwaters region of the Wapoga River, Irian Jaya (MACK & ALONSO, 2000), we collected eight specimens of an undescribed, small green treefrog showing some affinities with the *Litoria nigropunctata* species-group (TYLER & DAVIES, 1978). Here we describe the new species and provide information on its advertisement call and natural history.

MATERIAL AND METHODS

Specimens are deposited in the Museum Zoologic Bogoriense (MZB), Indonesia, and the South Australian Museum (SAMA), Australia. Additional specimens examined for comparisons (see list in app. 1) are in the British Museum (BM) and the Natural Sciences collection of the University of Papua New Guinea (UP). Measurements (to the nearest 0.1 mm) were taken with dial calipers and a stereomicroscope fitted with an ocular micrometer and follow MENZIES (1993). They are: SVL (snout-vent length), TL (tibia length), HW (head width at tympanum), HL (head length from tip of snout to posterior edge of tympanum), EYE (horizontal eye diameter), TYM (horizontal tympanum diameter), IN (inter-narial distance), EN (distance between anterior edge of eye and posterior edge of naris), 3FD (horizontal diameter of 3rd finger disc) and 3FP (narrowest horizontal width of 3rd finger penultimate phalanx), 4TD and 4TP (4th toe disc and penultimate phalanx, as for 3rd finger). For measurements and proportions, the mean (x̄) is given below followed by the standard deviation (s) and the range.

Calls were recorded with a Sony Professional Walkman tape recorder and SMZ-200 microphone, and were analysed with the sound analysis program Avisoft SAS-Lab Pro.

RESULTS

Litoria wapogaensis sp. nov.
(fig. 1-6)

Holotype. – MZB Amp.3873, adult male, collected at Wapoga Alpha exploration camp (136 34.423°E, 3°08.687°S, 1070 m elevation) in the headwaters of the Wapoga River, Irian Jaya Province, Indonesia, on 12 April 1998, by S. Richards & D. Iskandar.

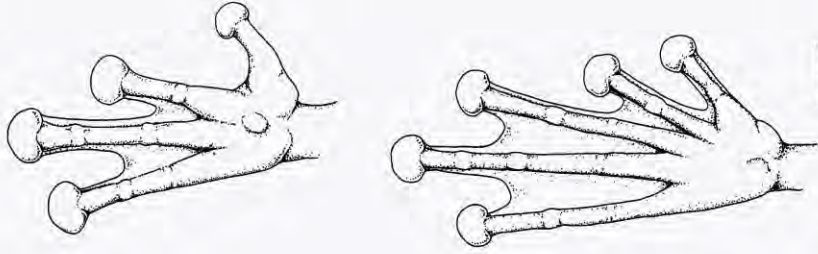


Fig. 2. - Palmar and plantar views of the hand and foot of *Litoria wapogaensis*, paratype (SAMA R54595). Scale bar: 2 mm.

Table 1. - Advertisement call characteristics of *Litoria wapogaensis* sp. nov. Measurements are given as mean (standard deviation) range. See text for description of call types.

Specimen Call Type	SAMA R54595		SAMA R54596		MZB Amp-3876	
	slow	fast	slow	fast	slow	fast
Air temperature (°C)	22.6		22.6		20.4	
n	5	1	5	1	12	4
Length (s)	0.182 (0.019) 0.16-0.20	0.359	0.224 (0.047) 0.176-0.301	0.095	0.214 (0.027) 0.16-0.252	0.115 (0.071) 0.07-0.22
Pulses	8-10	50	8-12	32	7-12	21-36
Pulse rate (pulses/s)	41.71 (1.89) 38.46-43.06	136.5	35.59 (0.9) 34.09-36.54	326.3	43.67 (3.0) 37.5-47.82	238.26 (58.56) 157.6-385.7
Dominant frequency (Hz)	2400 (141.83) 2304-2573	2834	2354 (35.68) 2315-2404	2326	2341 (285) 1735-2659	2142.3 (445) 1707-2708

(1993) and JOHNSTON & RICHARDS (1994) provided detailed descriptions of the calls of *L. iris* and other members of this group.

Litoria contrastens (male SVL 25-30 mm) is smaller than *L. wapogaensis* (male SVL 30.5-33 mm), with an immaculate dorsum (versus yellow-spotted), relatively shorter legs, a projecting longer snout, and without vomerine teeth (tab. 2). The shape of the snout (distinctly projecting in profile) is also quite different from *L. wapogaensis* (bluntly rounded in profile). *Litoria hulmeri* is a torrent-dwelling species (S. J. Richards, unpublished) that is readily distinguished from *L. wapogaensis* by having fingers free of webbing and a broad black lateral band, and is not considered further here. *Litoria longirostris* is a small species (SVL < 30 mm) with a broad white bar beneath the eye and has much longer legs than *L. wapogaensis* (TL/SVL 0.62-0.63 versus 0.53-0.59).

Four lowland species that are partly or entirely green in life are compared with *L. wapogaensis*. *Litoria mystax* is a small species (29.5 mm SVL) known only from the holotype. It can be distinguished from *L. wapogaensis* by its prominent and strongly curved canthus rostralis (versus poorly defined, slightly curved or straight), a broad white bar beneath the eye (absent in *L. wapogaensis*) and yellowish-brown (versus white) venter (TYLER, 1968). *Litoria gracilentia* was described from northeastern Australia and the status of New Guinea populations is unclear (GÜNTHER & RICHARDS, 2000). New Guinea specimens currently referred to *L. gracilentia*, and the recently described *Litoria elkaea*, are small green frogs (male SVL approximately 30 mm) in which the dorsum is frequently spotted with white, and there is a pale canthio-rostral stripe. The concealed surfaces of the thighs are cream or pale yellow in *L. elkaea* (versus dark brown in *L. wapogaensis*) (GÜNTHER & RICHARDS, 2000).

Litoria nigropunctata is a small lowland frog that is predominantly brown or green-inrown in life, and frequently exhibits small black spots on the dorsum. It further differs from

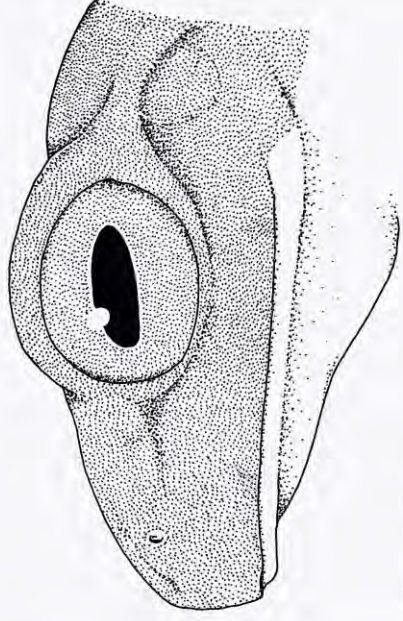


Fig. 1. - Lateral view of the head of *Litoria wapogaensis*, paratype (SAMA R54595). Scale bar: 2 mm.

and several specimens have very small, intensely dark blue (dark green in life) spots concentrated laterally. The dark brown colouration of the concealed surfaces of the thighs and axilla is a conspicuous feature of all specimens and is retained in preservative. All paratypes have a prominent short, raised white ridge below the vent, a feature that is poorly developed in the holotype. In two of the paratypes (SAMA R54596 and 54598), the vomerine teeth are poorly developed.

Measurements (mm) and proportions of the six paratypes ($\bar{x} \pm s$, range). - SVL 31.85 \pm 0.91, 30.5-32.9; TL 18.1 \pm 0.51, 17.4-19.0; HW 10.97 \pm 0.25, 10.5-11.1; EYE 3.81 \pm 0.21, 3.5-4.1; EN 2.95 \pm 0.17, 2.7-3.2; IN 3.81 \pm 0.16, 3.6-4.0; TYM 1.53 \pm 0.05, 1.5-1.6; 3FP 1.05 \pm 0.12, 0.9-1.3; 3FD 1.71 \pm 0.21, 1.4-2.0; 4TP 1.0 \pm 0.15, 0.8-1.2; 4TD 1.52 \pm 0.18, 1.3-1.7; TL/SVL 0.56 \pm 0.02, 0.53-0.59; EYE/SVL 0.12 \pm 0.008, 0.1-0.13; EN/IN 0.77 \pm 0.05, 0.71-0.88; 3FP/3FD 0.62 \pm 0.06, 0.55-0.71; 4FP/4FD 0.65 \pm 0.06, 0.58-0.75.

Advertisement calls. - We recorded 28 calls from three specimens. Two different calls were produced. The most frequently produced call (78.6% of total), and the one that we presume to be the advertisement call, was a single distinctly pulsed note emitted at irregular intervals (fig. 5; tab. 1). The mean length of 22 calls was 0.20 s (s 0.03, range 0.16-0.30). Mean pulse rate was 41.39/s (4.07, 34.0-47.8) and the mean dominant frequency was 2357 Hz (217.7, 1733-2659). The second call type was emitted infrequently, and was possibly produced during



Fig. 3. - *Litoria wapogaensis* male in calling position, Wapoga, Irian Jaya.

inter-male interactions, although further observations are required to confirm this. These calls were shorter (mean length 0.15 s), and had a much higher pulse rate (mean 235.97/s; fig. 5). Detailed analyses are presented in tab. 1.

Natural history. - The collection locality is in closed-canopy lower-montane rainforest. One specimen was collected at night from a *Pandanus* leaf at a height of about 1.0 m in a small *Pandanus* swamp. The remaining specimens were calling at night from fern fronds and other low vegetation along a slow-flowing, shallow and swampy stream (fig. 4). These were the only lenite waterbodies in the area. Despite the abundance of swiftly flowing streams in the region, this species was never collected or observed in lotic habitats.

Comparison with other species. - In its general size, dorsal colouration and extent of finger webbing, *Litoria wapogaensis* shows some affinities with *L. iris* and its allies (as defined by MENZIES, 1993) within the *L. nigropunctata* species-group. A comparison of morphological characters among montane green *Litoria* is presented in tab. 2. Most species can be readily distinguished in life on the basis of thigh colouration. The concealed surfaces of the thighs are brightly coloured (purple, orange, red or blue) in *Litoria chloronota*, *L. iris*, *L. majkithise* and *L. ollanro* (versus dark brown in *L. wapogaensis*). The latter three species also differ in possessing a violet patch in the groin and axilla (versus dark brown). *Litoria lavinia* has bright red thighs, and males are further distinguished from *L. wapogaensis* by the presence of a rostral spike (absent in *L. wapogaensis*). *Litoria wapogaensis* can also be distinguished from all of these species by its advertisement call, which is a single distinctly pulsed note. MENZIES



Fig. 4. – Habitat of *Litoria wapogensis* in lower montane rainforest, Wapoga River headwaters, Irian Jaya.

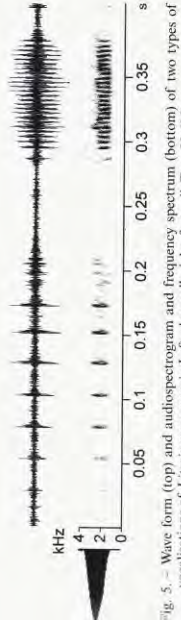


Fig. 5. – Wave form (top) and spectrogram and frequency spectrum (bottom) of two types of vocalisations of *Litoria wapogensis*. Left, slow call; right, fast call. Ta = 22.6°C.

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Litoria iris (Tyler, 1962). – PAPUA NEW GUINEA, Southern Highlands Province, Tari: UP3115-35; Eastern Highlands Province, Ubaiguni: UP8289-90; Enga Province, Pogera: UP7148-67; Sundaun Province, Telefomin: SAMA R5423, 3874. – PAPUA NEW GUINEA, Sundaun Province, Mount Solilo: SAMA R44091-44092, UP 8604-6. *Litoria longicrus* (Boulenger, 1911). – INDONESIA, Irian Jaya Province, Wondensi: syntype BM 1947.2.22.61. *Litoria majkithise* Johnston & Richards, 1994. – PAPUA NEW GUINEA, Western Province, all in general vicinity of Tabubil: holotype SAMA R44093; paratypes UP 6734, UP 7305-9, UP 8501-8, UP 8602-3, SAMA R44094-44101. *Litoria macro* Menzies, 1993. – PAPUA NEW GUINEA, East Sepik Province, near Raui Village: paratypes UP 2741-2743, UP 2745-2756. *Litoria nigropunctata* (Meyer, 1875). – PAPUA NEW GUINEA, Morobe Province, Lae: SAMA R09296; Madang Province, Bineke near Madang: SAMA R11794.

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 1993. – Systematics of *Litoria iris* (Anura: Hyliidae) and its allies in New Guinea and a note on sexual dimorphism in the group. *Aust. J. Zool.*, **41**: 225-255.

Table 2. - Comparisons among *Litoria* occurring in the mountains of New Guinea (excluding *L. bilmeri*: see text).

Species	SVL (mm) (male only)	Thigh colour	Violet in groin and axilla	TL:SVL	ENTN	Advertisement call	Rostral spike (male only)	Vomerine keels	Reference
<i>Litoria wapogensis</i> sp. nov.	30.5-33	Dark brown	-	0.53-0.59	0.71-0.88	Single pulsed note	-	-	This study
<i>Litoria chloronota</i> (Boulenger, 1911)	27-32	Orange	-	0.52-0.58	0.63-0.71	Series of short and long notes	-	-	MENZIES, 1993
<i>Litoria contrivans</i> (Tyler, 1968)	25-30	Orange-red	-	0.45-0.54	0.89-1.17	Clicks followed by series of short notes	-	-	TYLER, 1968; MENZIES, 1993
<i>Litoria havina</i> Menzies, 1993	30-36.5	Cherry-red	-	0.54-0.61	0.63-0.79	Series of whistles and buzzes	-	+	MENZIES, 1993
<i>Litoria iris</i> (Tyler, 1962)	24-36	Purple, red or blue	+	0.46-0.63	0.77-0.97	Series of clicks and buzzes	-	-	MENZIES, 1993
<i>Litoria leucova</i> (Tyler, 1968)	30.5-35.4	Translucent pink with yellow spots	-	0.53-0.55	0.78-0.96	Short and long calls in long series	-	-	JOHNSTON & RICHARDS, 1994
<i>Litoria longicrus</i> (Boulenger, 1911)	27.4	Unpigmented	-	0.623-0.628	0.58-0.61	? Short chirp or harsh "raugh"	-	-	JOHNSTON & RICHARDS, 1994
<i>Litoria majkithise</i> Johnston & Richards, 1994	30.5-33.4	Cinnamon	+	0.53-0.60	0.72-1.03	?	-	+	TYLER, 1968
<i>Litoria macro</i> Menzies, 1993	< 31 mm	Golden-yellow	-	0.51-0.56	0.8-1.1	?	-	-	MENZIES, 1993
<i>Litoria olivacea</i> Menzies, 1993	< 34 mm	Blue	+	0.54-0.59	0.75-0.95	Quiet creaking noise	-	+	MENZIES, 1993

ALYTES 18 (3-4)

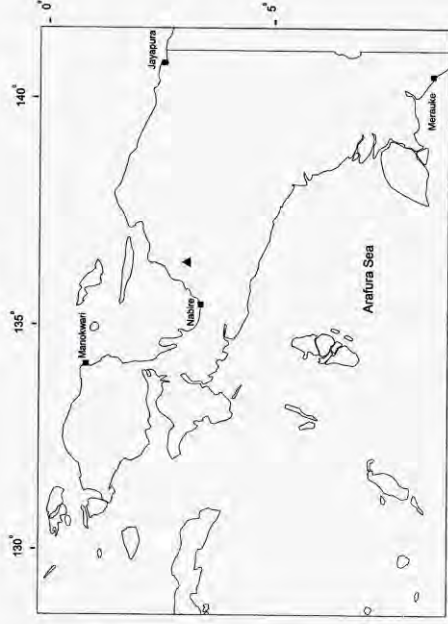


Fig. 6. – Type (and only known) locality of *Litoria wapogensis*, Irian Jaya, Indonesia.

L. wapogensis in having yellow (erroneously reported as black by JOHNSTON & RICHARDS, 1994) in the concealed parts of the thighs, in having a truncate (versus rounded) snout, and in its different advertisement call, which is an "irregular succession of clicks and buzzes" (MENZIES, 1972). Through the courtesy of Mr. David Price, we have examined several specimens and advertisement calls of *Litoria nigropunctata* from the vicinity of the type locality (Yapen Island, Irian Jaya). Morphologically and acoustically these animals agree closely with populations from mainland New Guinea (MENZIES, 1972; S. J. Richards, unpublished) and differ consistently from *L. wapogensis* in the characters described above.

Etymology. – Named for the headwaters of the Wapoga River, the major drainage system for the spectacular rainforest-clad mountains where the new species was collected.

APPENDIX I
ADDITIONAL SPECIMENS EXAMINED

Litoria olivacea Günther & Richards, 2000. – INDONESIA, Irian Jaya Province, Siewa: paratypes MZB Amp.3866-9.
Litoria havina Menzies, 1993. – PAPUA NEW GUINEA, Western Province, OK Ma.: paratypes UP 8406-7.