

Papuan Tree Frogs of the *Litoria thesaurensis* Group (Salientia: Hylidae)

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Abstract.—*Litoria impura* has been treated as a junior synonym of *L. thesaurensis*. Two “*thesaurensis*”-like species, sympatric in the Port Moresby area, Papua New Guinea, can be distinguished by their mating calls and by several morphological characteristics. The name *L. impura* is revived for the species restricted to southeastern New Guinea; *L. thesaurensis* occupies this area as well as the remainder of the New Guinean lowlands, the Bismarck Archipelago, the Louisiade and d’Entrecasteaux islands, and most of the Solomon Islands.

Introduction

Frogs of the *thesaurensis* group are medium-sized, brown tree frogs that are widespread throughout the lowlands of New Guinea, the Bismarck Archipelago, and the Solomon Islands. Regional differences in mean adult length and an ontogenetic change in color pattern caused earlier zoologists to recognize several species, which later zoologists tended to synonymize, thereby creating a complex taxonomic history. Much of this history is summarized by Loveridge (1948) and Tyler (1968).

The number of species comprising the *thesaurensis* group remains uncertain. Currently, there are two interpretations: 1) Duellman (1977) following Tyler (1968) recognizes two species, *Litoria lutea* in the northwestern Solomon Islands and *L. thesaurensis* in New Guinea, the Bismarcks, and the Solomon Islands; 2) Tyler and Davies (1978: fig. 26) recognize three species, *L. impura* in New Guinea, *L. lutea* in the northwestern Solomon Islands, and *L. thesaurensis* in the Bismarck Archipelago and the Solomon Islands.

Neither interpretation of the New Guinean frogs is entirely correct, for we wish to demonstrate that two *thesaurensis*-like frogs occur sympatrically in the lowlands of southeastern New Guinea. Although similar, the two frogs are readily distinguishable in the area of sympatry on the basis of adult body length, iris coloration, particularly the pigmentation of the skeleton, male vocalization, and habitat selection. Examination of Peters and Doria’s original description (1878) makes it clear that the

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larger frogs with unpigmented skeletons are *L. impura*, the smaller ones with green skeletons *L. thesaurensis*. Both are valid species.

Materials and Methods

The comparative series of *thesaurensis*-like frogs were collected from rain forest and savanna habitats between East Sepik and Central Province, Papua New Guinea. Measurements were taken in the manner of Tyler (1968). Vocalizations were recorded at night on a Sony tape recorder, analyzed on a Kay Sono-Graph and an oscilloscope/recorder setup, and described in the manner of Straughan and Heyer (1976).

MORPHOLOGICAL SERIES.—*Litoria impura*, UPNG 1340–1342, 1641–1646, 1867–1970, 2005–2006, 2577, USNM 195510–195512 (20); *Litoria thesaurensis*, UPNG 991–999, 1991–1955, USNM 195534–195538 (20); all from within a 50 km north to northwest radius of Port Moresby (Central Prov.).

DISTRIBUTIONAL SERIES.—*Litoria impura*: Papua New Guinea, south and southeast coast; Alotau (Milne Bay Prov.) UPNG 1724, 2219, 2598; Brown River (Central Prov.) AMNH 80900, MCZ 68481; Dogura (Milne Bay Prov.) UPNG 5314–5315; Sogeri (Central Prov.) MCZ 68364; Yule Island (Central Prov.) MCSN 29719A (holotype). *Litoria thesaurensis*: New Guinea north coast; Aitape (West Sepik Prov., PNG) MCZ 25866; Alexishafen (Madang Prov., PNG) UPNG 2290–2291; Anguganak (East Sepik Prov., PNG) UPNG 2802–2805; Cape Vogel (Milne Bay Prov., PNG) AMNH 56666–56713; Erima, (Madang Prov., PNG) RMNH 12271; Hollandia (Irian Jaya) RMNH 12277; Jamoer Lake, (Irian Jaya) RMNH 12276; Kambaramba (East Sepik Prov., PNG) MCZ 71991, AMNH 77781–77789; Mamberamo River (Irian Jaya) RMNH 12278; Milne Bay (Milne Bay Prov., PNG) MCZ 11652 (holotype of *L. milneana*); Moaif (Irian Jaya) RMNH 12274; Normanby Island (Milne Bay Prov., PNG) AMNH 60155–60156; Pindiu (Morobe Prov., PNG) AMNH 75958; Popondetta (Northern Prov., PNG) DNR/WL 731; Simbang (Madang Prov., PNG) NMB 5938; Tanahmerah (Irian Jaya) RMNH 12101; New Guinea, south coast; Karimui (Chimbu Prov., PNG) MCZ 68473; Katow (Western Prov., PNG) BMNH 83.10.23.5; Kiunga (Western Prov., PNG) MCZ 80973; Merauke (Irian Jaya) RMNH 12272; Pawaia (Gulf Prov., PNG) UPNG 2512–2516; Setekwa River (Irian Jaya) BMNH 1913. 11.1, 1954. 8; Uruu (Gulf Prov., PNG) MCZ 68477–68480; New Hanover; NMB 4618–4629; New Britain; Kerevat, UPNG 2830; Solomon Islands; Bougainville, NMB 4479–4480; Guadalcanal, NMB 4079–4161, 4248–4261; New Georgia, NMB 5946; Shortland, NMB 5946; Treasury, BMNH 1947.2.23.4 (holotype of *macrops*). Museum abbreviations: AMNH, American Museum of Natural History; BMNH, British Museum (Natural History); DNR/WL, Wildlife Laboratory, Department of Natural Resources, collection recently transferred to Papua New Guinea National Museum; MCSN, Museo Civico di Storia Naturale; MCZ, Museum of Comparative Zoology, Harvard University; NMB, Naturhistorisches Museum, Basel; RMNH, Rijkmuseum van Natuurlijke Historie; UPNG, University of Papua New Guinea; USNM, United States National Museum of Natural History.

Results

Frogs, which key out to *Litoria thesaurensis* (Tyler, 1968), are common in the rain forest and savanna around Port Moresby. However, the forest and the savanna

frogs show a number of differences. Most obviously, the male breeding calls sound distinctly different. Furthermore, the forest frogs call from vegetation over the water, whereas the savanna frogs call from the water's edge or while floating in the water. Occasionally, the two breed together in localities such as roadside ditches in forested areas. Aside from the differences in skeletal coloration, the savanna (white bones) and

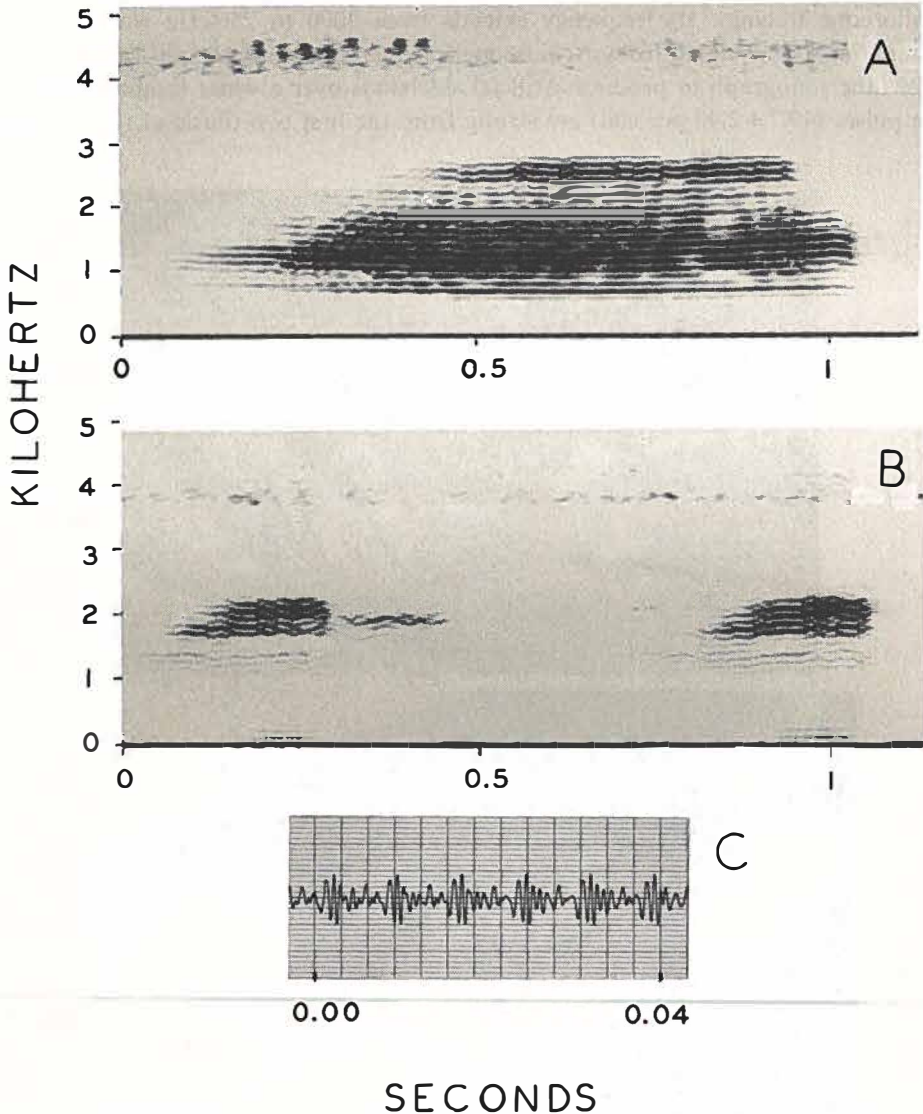


Fig. 1. Sonograms of the breeding calls of *Litoria impura* (A) (Brown River, 29 Apr. 1970, 26°C) and *L. thesaurensis* (B) (Lae, 4 Nov. 1972, no temperature recorded) and a segment of an oscilloscope tracing of a *L. impura* call (C) demonstrating its pulsatile characteristics.

forest (green bones) frogs possess other morphological differences, although they are not as striking.

BREEDING CALLS.—The call of the forest frog (*Litoria thesaurensis*) is a very quiet buzzing, giving the acoustic impression of being broken into short segments—'buzz-buzz-buzz.' Actually, it is a single noted, pulsatile call (Fig. 1B) of approximately 0.4 second length (mean, 0.43, standard deviation, ± 0.04 , from oscilloscope tracing). Its frequency extends from 2000 to 2500 Hz with 2240 Hz dominating as calculated from oscilloscope tracing; apparently the pulses of the call causes the sonograph to produce artificial sidebands over a wider frequency range. The pulses (47.7 ± 2.43 per call) are strong from the first two-thirds of the call and

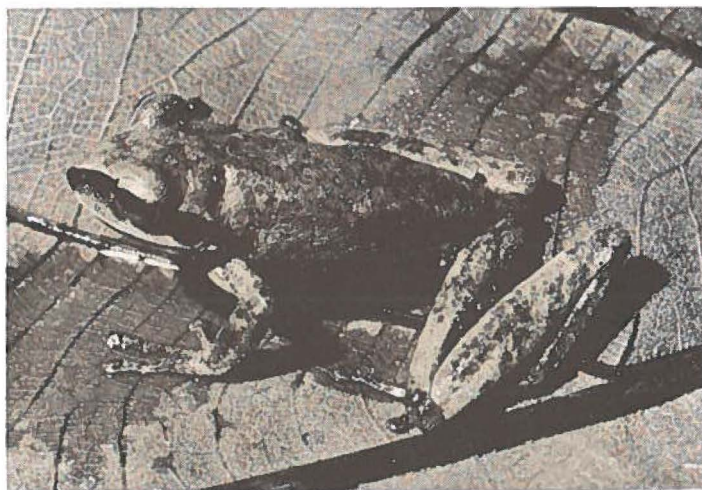


Fig. 2. Photographs of *Litoria impura* (Top. AMNH 80900: Central Dist., Karema. By R. G. Zweifel) and *L. thesaurensis* (Bottom. Central Dist., Port Moresby. By J. I. Menzies).

become indistinct with the drop in call intensity during the last third. Where distinct, the pulses are evenly spaced at approximately 0.0085 s.

In contrast, the call of the savanna frog (*Litoria impura*) is louder and sounds like a sad moan. It is also a single noted, pulsatile call (Fig. 1A and C), but longer—approximately 1 s (0.99 ± 0.13). Its frequency ranges from 800 to 1400 Hz with 1120–1360 Hz dominating. The pulses (115.0 ± 12.9) are distinct throughout the entire call and evenly spaced at approximately 0.0078 s.

MORPHOLOGY.—Aside from the green bones in *L. thesaurensis* (forest frogs) and white bones in *L. impura* (savanna frogs), a number of other pigmentation differences exist (Table 1). The most striking is the chocolate canthal stripe or loreal mask in *L. impura* and its absence in *L. thesaurensis* (Fig. 2). *L. thesaurensis* also tends to be lighter in overall coloration and, if present, spots or markings tend to be dark; whereas *L. impura* is darker and, if present, spots tend to be light (yellow). However, these two latter coloration characteristics are highly variable, and allopatric *L. thesaurensis* occasionally possess *impura*-like coloration.

L. impura is larger than *L. thesaurensis* in the Port Moresby area (Table 2, Fig. 3). In areas of allopatry, *L. thesaurensis* tends to attain longer body length, e.g., females from eastern Papua to 44 mm snout-vent length, from Malaita Island to 67 mm, and from New Britain to 52 mm (Zweifel, 1960). In hindleg length, the tibiofibula is proportionately longer but only slightly so. The fourth toe of the hindfoot is somewhat longer in *L. impura*; the entire foot appears more slender and elongated. The fourth toe of *L. impura* has two phalanges free of webbing, whereas only the terminal phalanx lacks webbing in *L. thesaurensis*. Similarly, the hand of *L. thesaurensis* has slightly more webbing (Fig. 4).

The head lengths of the two species are proportionately equivalent; however, the head width of *L. impura* is somewhat broader (Table 2, Fig. 3). This feature in combination with anterior displacement of the eyes, i.e., reduced eye to naris distance of *L. impura* results in a very similar appearing head shape for the two species. The

Table 1. Comparison of pigmentation in living frogs from the Port Moresby area.

	<i>Litoria impura</i>	<i>Litoria thesaurensis</i>
Dorsal Ground Color	beige to dark brown	greenish beige to brown
Canthal Stripe	chocolate	absent
Thigh	dark brown with yellow spots	olive suffused with yellow
Venter		
Chin	suffuse brown	light yellow
Throat (breeding males)	densely black	deep yellow
Chest and abdomen	ivory	light yellow
Thigh	yellowish brown	greenish yellow
Iris	pinkish copper center bluish green periphery	orangish copper center iridescent green periphery
Bones	unpigmented	green

Table 2. Comparison of meristic features, mean \pm standard deviation (range), in adult frogs from the Port Moresby area. Measurements as in Tyler (1968).

	<i>impura</i> N = 4, 16	<i>thesaurensis</i> N = 6, 14
Snout-vent Length		
♀	49.0 \pm 2.8 (45.4–52.3)	40.2 \pm 2.1 (36.2–42.0)
♂	45.2 \pm 1.5 (42.8–47.6)	36.1 \pm 1.1 (33.5–38.3)
TL/SV		
♀	0.57 \pm 0.03 (0.53–0.59)	0.56 \pm 0.02 (0.54–0.57)
♂	0.56 \pm 0.02 (0.52–0.59)	0.54 \pm 0.02 (0.50–0.56)
HL/HW		
♀	1.01 \pm 0.03 (0.97–1.04)	1.04 \pm 0.03 (1.00–1.07)
♂	1.02 \pm 0.04 (0.96–1.12)	1.09 \pm 0.03 (1.04–1.13)
E-N/IN		
♀	1.17 \pm 0.12 (1.00–1.28)	1.44 \pm 0.16 (1.21–1.67)
♂	1.13 \pm 0.08 (1.03–1.25)	1.34 \pm 0.17 (1.14–1.83)

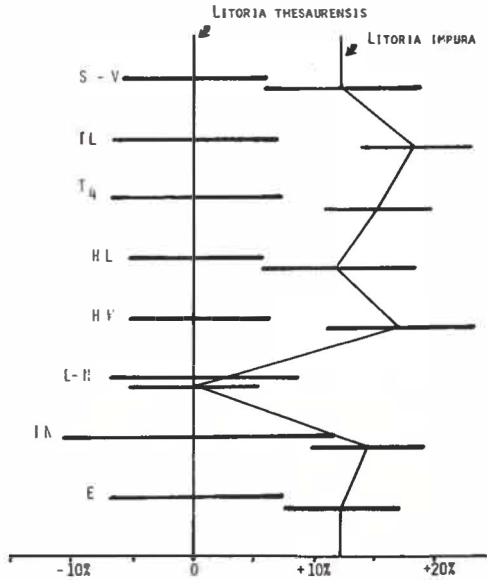


Fig. 3. Ratio diagram comparing body dimensions in male *Litoria thesaurensis* and *L. impura*. Vertical lines connect means; horizontal bars indicate one standard deviation on each side of the mean and is expressed as a percentage of the mean to make all parameters comparable. If *L. impura* were simply larger, the vertical lines of the two species would be parallel.

eye to naris distance also causes the E-N/IN to be significantly different (Table 2), although the internarial distances are proportionately the same in the two species (Fig. 3), as is also eye diameter.

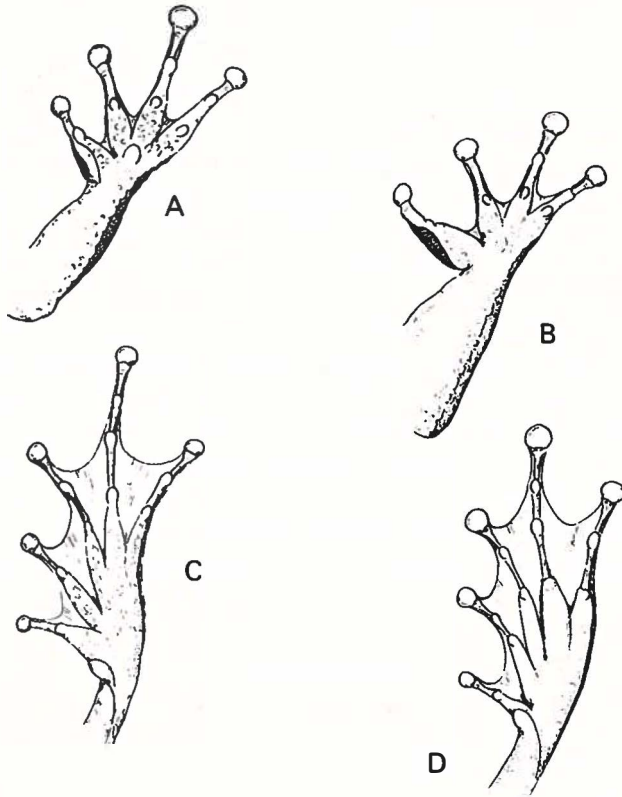


Fig. 4. Hands and feet of (A and C) *Litoria impura* (UPNG 1724, Alotau) and of (B and D) *L. thesaurensis* (UPNG 1966, Brown River).

Discussion

The distinct differences in breeding call, coloration, and morphology clearly demonstrate that the savanna frog (*Litoria impura*) and the forest frog (*L. thesaurensis*) are separate species. Furthermore, examination of the holotype of *L. impura* (by J.I.M.) shows the savanna species to be this species.

Owing to the confusion in name assignment, the distribution of the two species described in the literature is in error. An examination of *thesaurensis*-like frogs in many museums, especially those previously identified as *L. impura* demonstrate that *L. impura* is restricted to the southeastern coast between Yule Island (Central Prov.) and Dogura (Milne Bay Prov.). True *L. thesaurensis* also occurs in this area.

Few early accounts include ecological or behavioral observation but, writing of *Hyla "impura"* from Erima on Astrolabe Bay (Madang Prov.) M  hel  y (1898) says "Their voice is a low creak, so feeble that it is only heard as far as ten stride." However, *L. impura*, as already noted, has a relatively loud voice that can be heard at 100 m distance, thus the identity of the frogs to which M  hel  y referred and which have been examined (J.I.M.) are *L. thesaurensis (sensu stricto)*.

L. thesaurensis is one of the most widely distributed Papuan tree frogs, occurring on all the Solomon Islands except the most southerly ones, the Bismarck Archipelago, Admiralty Islands, the Louisiade and d'Entrecasteaux islands, and the lowlands of mainland New Guinea from one end to the other and to an altitude of approximately 1000 m. It is absent only from the Irian Jaya islands of the Kei and Aru groups and appears to have no close relatives on Cape York in Queensland, Australia. The two sibling species, however, have very restricted ranges: *L. lutea* only in the northern Solomon Islands and *L. impura* only in the southeast coastal savannas of the mainland.

The origin of *L. impura* is enigmatic. Whether it arose prior to or during the Pleistocene, why was it unable to expand into the southern savannas (Fly and Digoel River plains) while other savanna species, e.g., *L. caerulea* and *L. nasuta*, moved the opposite direction? The apparent expansion onto the savannas of the northeastern coast (Dogura) and into man-made pseudosavanna and failure to colonize the Fly River plains suggest *L. impura* is of very recent origin (perhaps in the forest-savanna mosaic that covers much of the Central Province); at any rate, it seems to have evolved after the time of submergence of the central part of the once continuous coastal savanna.

SYNONYMY

Litoria thesaurensis (Peters)

Hyla thesaurensis Peters 1877: 421. Type-locality, "Treasury Island (Salomons Gruppe)."

Hyla macrops Boulenger 1883: 164. Type-locality, "Treasury Island, Solomon group."

Hyla solomonis Vogt 1912: 10. Type-locality, "Bougainville" (= Bougainville).

Nyctimystes milneana Loveridge 1945: 57. Type-locality, "Milne Bay, Eastern Division, Papua."

Litoria impura (Peters and Doria)

Hyla (Litoria) impura Peters and Doria 1878: 426. Type-locality, "Yule Island in Nova Guinea australi."

ACKNOWLEDGMENT

We wish to thank all the museum curators and technicians who have so willingly aided our examination of *thesaurensis*-type frogs in their collections. W. R. Heyer, R. G. Zweifel, and an anonymous reviewer provided us with critical reviews of the manuscript and improved the clarity of the text.

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