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## The Genus *Nyctimystes* (Anura: Hylidae) in Australia

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**ABSTRACT.** Three species of hylid frogs of the genus *Nyctimystes* have been reported from Australia. With evidence from morphology and field work, we conclude there is only one species. The earliest available name for this taxon is *Hyla dayi* Günther 1897, the holotype of which is missing. We refer the species to *Nyctimystes* and, to stabilise the nomenclature, we designate a neotype.

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Since Tyler (1968), it has been generally accepted that there are three species of *Nyctimystes* in Australia: *N. hosmeri*, *N. tympanocryptis* and *N. vestigea* (e.g. Barker & Grigg, 1977; Cogger, 1983; Cogger *et al.*, 1983). Our field observations in northeast Queensland — at the type localities and others — suggested that there was only one Australian species. An examination of a large series of preserved material, including all extant types, confirmed our suspicions: we found continuous variation in all characters previously thought to be diagnostic of the three species.

Measurements are given in millimetres and ratios are expressed as percentages. The following standard abbreviations are used: SV, snout-vent length; HW, width of the head at the broadest part; HL, distance from the tip of the snout to the middle of the head above the angle of the jaws; EN, distance between the external nostril and anterior border of eye; IN, distance between two external nostrils; ED, diameter of the eye between anterior and posterior borders; IO, interorbital width at narrowest part of frontoparietal; TW, tympanum width; TL, tibial length. Description of webbing on hands and feet follows the formula of Schiøtz (1967). Specimens examined are housed in the Australian Museum (AM), Queensland Museum (QM), American Museum of Natural History (AMNH), Rijksmuseum van Natuurlijke Historie (RMNH), and Naturhistorisches Museum, Wien (NHMW).

### HISTORY

The nomenclatural history of the Australian frogs presently assigned to *Nyctimystes* is complex. There are two separate issues: 1. the number of species of *Nyctimystes*, and 2. the identity of *Hyla dayi*. Günther (1897) described a frog, *Hyla dayi*, from Bartle Frere Mountains, NE Queensland — the holotype of which has not been located subsequently (Tyler, 1968; Liem, 1974; Duellman, 1977; Cogger *et al.*, 1983). Andersson (1916) described *Hyla tympanocryptis* from Malanda on the Atherton Tableland near Mt Bartle Frere. Loveridge (1935) and Copland (1957) considered these names to be synonymous but both noted problems with the identity of the name-bearing specimen of *Hyla dayi*. Even so, they referred specimens to a taxon of that name. Tyler (1964) first noted the presence of the genus *Nyctimystes* in Australia and described two new species: *Nyctimystes hosmeri* from Tully Falls on the southern edge of the Atherton Tablelands, and *N. vestigea* from Mt Bartle Frere. (Cogger *et al.* [1983] gave the name as “*vestigia*”. It was spelt “*vestigia*” in the header to Tyler’s description, but this was obviously a printing error. In the text, and in later papers, Tyler used “*vestigea*”). Tyler (1968) showed that *Hyla tympanocryptis* was a *Nyctimystes* and stated that it was a valid species separable from both *N. hosmeri* and *N. vestigea*. He also noted difficulties with the identity of *Hyla dayi*. There were differences between the description of the holotype and the frogs

Loveridge (1935) and Copland (1957) had referred to this name. For practical purposes, Tyler decided that there was justification for considering the differences unimportant.

Liem (1974) studied the differences between the type description of *Hyla dayi* and members of the *Litoria nannotis* species group. He was convinced that *Hyla dayi* referred to an indeterminate species of *Nyctimystes*, while the frogs traditionally referred to *Hyla dayi* were a new species: these he described as *Litoria rheocolus*. Liem left the identity of the name-bearing specimen of *Hyla dayi* in abeyance because the type description did not have enough detail to assign it to any *Nyctimystes*. Cogger (1975), Tyler (1976), Duellman (1977), Tyler & Davies (1978, 1979), and Ingram & Covacevich (1981) accepted Liem's decisions. Barker & Grigg (1977), however, while listing Liem's (1974) paper, did not use his new name. Instead, they used *Litoria dayi* in the traditional sense of *Hyla dayi*. Duellman (1977, 1985) apparently accepted Liem's argument, but went further. He listed a fourth species of *Nyctimystes* from Australia: *N. dayi*.

### SPECIES

Even though three species of *Nyctimystes* in Australia have been generally accepted, some doubts have been raised about the validity of the taxa. Grigg & Barker (1977) said there was little to distinguish *N. tympanocryptis* from *N. hosmeri*. Cogger (1975) said that the status of one or two of the species is doubtful; he also thought that *N. tympanocryptis* was closely allied to *N. vestigea*. Liem (1974) said he intended to discuss the validity of *vestigea* in a subsequent paper.

In the field, we have heard little difference among the breeding calls of *Nyctimystes* throughout north-east Queensland. We have also visited the type localities of the purported three species. Further, using the keys in both Cogger (1975) and Grigg & Barker (1977), we have identified the three 'species' giving the same call: even within the one chorus. Also, there were many individuals that were impossible to key out. They exhibited character states that proved intermediate between the diagnostic characters given by the various authors. From our field experience, we thought it likely that there was only one species. To test this, we examined a large number of spirit specimens.

*N. hosmeri* purportedly differed from *N. vestigea* in palpebral venation (thick reticulum vs fine lines), dorsal colouration of head and body (dark brown with large cream spots vs light brown), and webbing of the fingers (one-half webbed vs two-thirds webbed) (Tyler, 1964). It should be noted that, at the time, only one specimen of each of the taxa were available. Since then, many more specimens have been collected. This

paper is based upon 167 males and seven females. An examination of these show that the palpebral venation is always reticulated, and there is continuous variation in the intensity of the colour. One specimen (QM J25219) exhibits the extremes of the variation; one eyelid has an 'open' reticulum, the other has a dense one. Dorsal colouration varies from brown, through grey, to grey-green and cream; brown or white spots may be absent, and, if present, vary in size. The webbing on the fingers varies from half to two-thirds webbed. This intraspecific variation in webbing is not unusual (for example, *Litoria rheocola* and *L. nyakalensis* in Liem, 1974).

The striking differences between *N. tympanocryptis* and *N. vestigea* were in the shape of the head (triangular and subacuminate vs tip of snout evenly rounded) and the prominence of the eye (ED<EN vs ED>EN) (Tyler, 1968). This was based upon one female specimen of *N. tympanocryptis* and three of *N. vestigea*. In the specimens we examined, there is continuous variation from an acuminate snout to a rounded one. Also, we found that ED was always greater than EN (our specimens also included the holotype of *tympanocryptis*). There were other diagnostic characters that purportedly separated *N. tympanocryptis* from both *N. hosmeri* and *N. vestigea* (Tyler *loc. cit.*, Table 1). The more important of these, which also are used in the first couplet of Cogger's (1975) key, are the obviousness of the tympanum (invisible externally vs visible) and the dermal fold on the heel (large vs absent, or small if present). We have found that in all specimens the tympanum is covered by skin, but the tympanic annulus may be obscure to distinct. Furthermore, the outward appearance of the ear may be altered by preservation. If a specimen is set in a strong fixative, the tympanic annulus can become more prominent. Of the dermal fold on the heel, it may be absent, be present as a series of low tubercles, or be more fully developed as a distinct fold.

From these examinations, we are convinced that there is only one species of *Nyctimystes* in Australia. We accept Liem's (1974) argument that the name-bearing specimen of *Hyla dayi* is a *Nyctimystes*. Therefore it is the earliest available name for the Australian species. But, as can be seen from the foregoing, there is a difficulty with the name '*Hyla dayi*' — it has been applied as a valid name several times. To avoid instability of the nomenclature, we have selected NHMW 17187 as the neotype of *Hyla dayi* Günther, 1897. This specimen is also the holotype of *Nyctimystes vestigea* Tyler (1964). Tyler provided a description of the specimen (p. 113) and an illustration (pl. 1). The specimen came from Mt Bartle Frere, which we have assumed in the same locality as the "Bartle Frere Mountains" of Günther. We think it appropriate to choose one of Tyler's specimens because the selection acknowledges his contribution towards elucidating this difficult genus of frogs.

*Nyctimystes dayi* (Günther)

*Hyla dayi* Günther, 1897: 406. Mt Bartle Frere, north-east Queensland. Neotype NHMW 17187 (here designated).

*Hyla tympanocryptis* Andersson, 1916: 19. Malanda, north-east Queensland. Holotype RMNH 1649.

*Nyctimystes hosmeri* Tyler, 1964: 111. Tully Falls, north-east Queensland. Holotype AMNH 65538.

*Nyctimystes vestigea* Tyler, 1964: 113. Mt Bartle Frere, north-east Queensland. Holotype NHMW 17187.

**Material examined.** Home Rule (QM J24857); Wallaby Creek, Home Rule, south of Cooktown (QM J25147-50, J25219); Home Rule Falls (QM J25261-2); Slaty Creek, Home Rule (AM R26778-9); The Granites, Home Rule, 30 km south of Cooktown (QM J25277); Little Forks, near Shiptons Flat (QM J27151, J27163, J27259); Bloomfield River (QM J36324-5); Cape Tribulation (QM J36323, J36326-9); Mulgrave River (QM J30905-6, J30908-12, J32068, J32091, J32096, J32101-2, J32130, J32166, J32168); Upper Russell River, west slope Mt Bartle Frere (AM R61388); Headwaters of Russel River, near base of Mt Bartle Frere (QM J30914, J32072, J32093-4, J32099, J32113, J32119, J32119, J32124, J32133-4, J32170-2); Mt Bartle Frere (NHMW 17187); Atherton (AM R39722); The Boulders, via Babinda (QM J36330-1); Malanda (RMNH 1649); The Crater (QM J24529); Mt Hypipamee (QM J24530); Dinner Falls, The Crater (AM R53954), Atherton-Ravenshoe road near The Crater National Park (QM

J29524-5, J30700, J30917-9, J32095); 6 km east of The Crater on Atherton-Ravenshoe road (QM J32164-5); Atherton Tableland (QM J25080, J25085); 34 km west of Innisfail (QM J29717-24); Palmerston Highway, near Milla Milla (QM J31966, J32066-7, J32080, J32098, J32131-2, J32139); Boulder Creek, Palmerston National Park (QM J36314, J36315-7, J36338-47); Henrietta Creek, Palmerston National Park (QM J25570-1, J36332-7); Maalan State Forest (QM J31181); McHugh Bridge, approx 42.8 km E. of Ravenshoe (QM J29670-6); Tully Falls (AMNH 65538, QM J29258, J32065, J32092, J32100, J32169, J32174, J36308, J36312-3, J36321-2); Koombaloo Dam (QM J29559-62, J29573-5); Mt Spec, via Paluma (QM J36309-11, J36318-9); Paluma (QM J29593-6, J30899, J32097, J32122, J32173).

**Diagnosis.** *Nyctimystes dayi* may be readily distinguished from all other Australian frogs by the presence of a palpebral venation.

**Description and variation.** One hundred and sixty-seven males: SV, 30–42 ( $\bar{x}$  = 34.6); TL/SV, 49–65 ( $\bar{x}$  = 56.8); HW/SV, 28–40 ( $\bar{x}$  = 35.6); IO/IN, 103–192 ( $\bar{x}$  = 134.8); HW/HL, 90–112 ( $\bar{x}$  = 101.1); EN/IN, 106–149 ( $\bar{x}$  = 128.1); ED/EN, 106–152 ( $\bar{x}$  = 127.4); TW/ED, 29–40 ( $\bar{x}$  = 34.2). Seven females: SV, 45–55 ( $\bar{x}$  = 49.4); TL/SV, 52–58 ( $\bar{x}$  = 54.7); HW/SV, 31–37 ( $\bar{x}$  = 34.9); IO/IN, 127–156 ( $\bar{x}$  = 134.6); HW/HL, 105–110 ( $\bar{x}$  = 107.3); EN/IN, 117–131 ( $\bar{x}$  = 124.5); ED/EN, 107–126 ( $\bar{x}$  = 117.2); TW/ED, 31–41 ( $\bar{x}$  = 35.6).

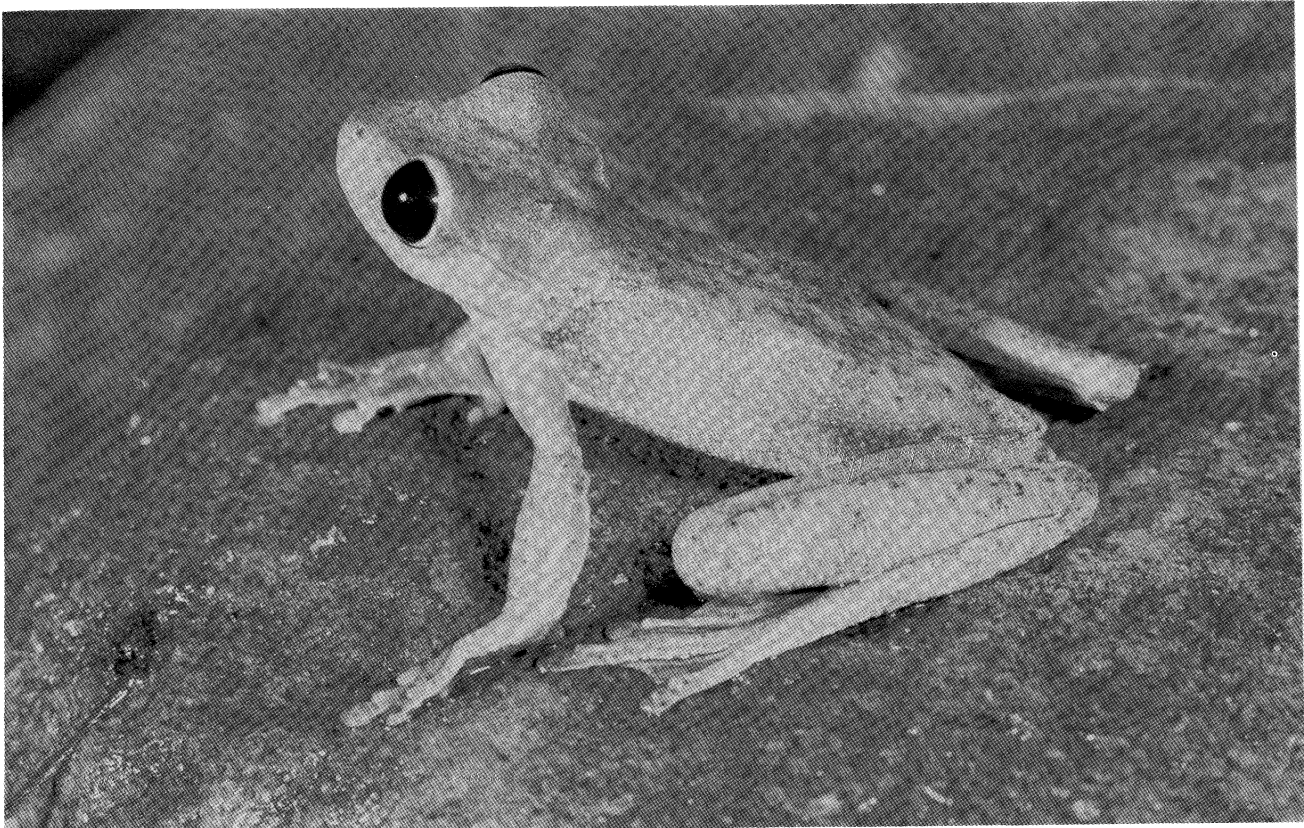


Figure 1. *N. dayi*, Wallaby Creek, South of Cooktown, NEQ.

Eye large and prominent. Iris dark brown in life. Pupil vertically elliptical.

Snout shape variable, ranging from acuminate to rounded. The former condition is more common in northern populations. Canthus rostralis prominent, usually straight, but may be slightly curved in females. Loreal region sloping to slightly concave. Tympanum is covered by skin. The tympanic annulus may be obscure or prominent; this character is often altered by method of preservation. Supratympanic fold present, often obscuring anterior margin of tympanum. Palpebral venation subject to both individual and population variation, as well as method of preservation; brown to pearl to silver in colour, forming moderately dense to dense reticula that are mostly vertically oriented. Numerous short horizontal connections may be present; if these are absent, the reticulum is 'open' and consists of a few vertical lines. One specimen (QM J25219) exhibits both degrees of density.

Vomerine tooth rows in 2 separate oval series posterior to choanae; rarely touching medially. One specimen (QM J32169) with only 1 row.

Subarticular tubercles on hand rounded, 1 each on first and second fingers and 2 each on third and fourth fingers; 1 outer metacarpal tubercle (rarely reduced or absent). Subarticular tubercles on feet rounded. One each on first and second toe, 2 on third toe, 2–3 on

fourth and fifth toes with the third tubercle, when present, poorly defined. Two metatarsal tubercles, outer small; inner elongated and rarely absent.

Distinct dermal flap may be present on the heel or absent and replaced by 2–3 low tubercles. Series of tubercles also present along posterior margin of tarsus. Distinct, usually prominent fold along posterior margin of forelimb; series of tubercles present along humeral fold, giving posterior margins of limbs serrated, crenulated or scalloped appearance.

Hands moderately webbed: 1 ( $1\frac{1}{2}$ – $1\frac{2}{3}$ ), 2i ( $1\frac{1}{2}$ – $1\frac{2}{3}$ ), 2e ( $0$ – $\frac{1}{2}$ ), 3i ( $1\frac{1}{2}$ – $2$ ), 3e (1), 4 (1). Feet extensively webbed: 1 ( $0$ – $\frac{2}{3}$ ), 2i ( $0$ – $1\frac{1}{2}$ ), 2e (0), 3i ( $0$ – $\frac{1}{2}$ ), 3e ( $0$ – $\frac{1}{3}$ ), 4i ( $\frac{1}{2}$ – $1$ ), 4e ( $\frac{1}{2}$ – $1$ ), 5 (0). Toe discs subequal to slightly smaller than finger discs.

Dorsal surface of skin, shagreened, finely granular to smooth; ventral surfaces coarsely granular.

Colouration and pattern of dorsum variable (see Figs 1,2). Dorsum may be: 1. uniform brown, 2. brown with irregular light brown markings, 3. brown with cream reticulations, 4. uniform grey-brown, 5. fawn-brown with dark brown spots, 6. grey with dark brown spots, 7. cream, 8. grey with white spots that may have black centres, 9. brown with white spots that may have black centres, 10. uniform reddish brown, 11. uniform dull grey-green, 12. uniform light grey. Spots, when present, varying in size and shape,



Figure 2. *N. dayi*, Atherton Tablelands, NEQ.



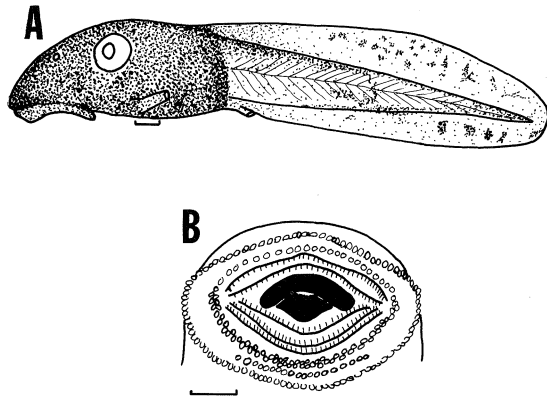


Figure 3. Tadpole of *N. dayi*. A, Lateral view. B, Mouthparts.

often having appearance of lichen. Although considerable intrapopulation variation exists, there may be a north-south cline in ground colour of dorsum, from predominantly creamish or grey in the north to dark brown in the south.

**Life History.** *N. dayi* breeds from October to April. Amplexus is axillary. In chorus, the advertising call of the breeding male is a drawn out “eeeeeee” that inflects downwards at the end. This is given three to four times in succession. Solitary males can voice a short, sharp “ee” every five to six seconds, sometimes over long periods.

Large individually encapsulated unpigmented eggs are laid on rocks in water (some may be laid just above water line). Tadpole is torrent adapted with flattened body and head; strong muscular tail; tail tip round (Fig. 3A). Upper jaw strong, slightly curved inward and lower jaw V-shaped. Large suctorial mouth (Fig. 3B). Two complete rows of papillae surrounding outer margin of labia; inner row close to labial tooth row, posteriorly, with two layers of papillae. A short medial row of papillae between posterior inner and outer rows. Labial tooth rows: two complete upper and three lower rows; outer upper and lower labial rows weak. Anal opening median; spiracle on left, ventrolateral side of body. Sides and dorsal portions of body and head uniformly black; cream patch present between eyes and nostrils; tail cream with dark pigmentation dorsally on muscular tail.

The skewed sex ratio of frogs examined here (males 167 vs females 7) is not significant. This only indicates that the males have an advertising call and thus are much easier to locate and collect than the silent females.

**Habitat.** *Nyctimystes dayi* is essentially a frog of rainforest or rainforest margins throughout its range. In montane areas these frogs show a preference for fast-flowing, rocky streams although they also frequent slower watercourses where ample vegetation exists along the margins. At lower elevations, favoured situations include rocks soaks, narrow ephemeral streams and rock outcrops in larger

watercourses. In many areas *N. dayi* is a conspicuous occupant of waterfalls and torrents along with tree-frogs of the *Litoria nannotis* complex.

Resting and calling males may be located on rocks and boulders both within the water and along the water's edge, low stream-side vegetation or overhanging branches. Non-amplexing females have been found on large mossy boulders and tall vegetation surrounding those watercourses where males were calling.

**Distribution.** In rainforests from the Bloomfield area, near Cooktown, south to Paluma, north to Townsville.

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## Errata

### Volume 39 Number 5

Colour frontispiece: Caption C refers to Figure D.

Caption D refers to Figure C.

p. 283, Insert after 1st paragraph, Column 2: **Distribution.** Japan, South China Sea, north-western Australia to Queensland, Lord Howe Island, Malaysia, 55–270 m.

p. 330, 2nd column, ref. Wicksten & Mendez, last line read: the Eastern Pacific Ocean.

Bulletin of the Southern California Academy of Sciences 8(3): 106–120.

p. 333, 1st column, line 4, Barker & Grigg, 1977 read: Grigg & Barker, 1977

p. 334, 1st column, line 17, Barker & Grigg, 1977 read: Grigg & Barker, 1977

p. 337, References, reference 2, Barker & Grigg, 1977 read: Grigg & Barker, 1977

### Volume 39 Number 6

p. 343, figure caption Figure 5 refers to Figure 6 (p. 344)

p. 344, figure caption Figure 6 refers to Figure 5 (p. 343)