

New Species of *Nyctibatrachus* (Anura: Ranidae) from Castle Rock, Karnataka State, Southwest India

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ABSTRACT.—A new species of ranid frog of the genus *Nyctibatrachus* is described from Castle Rock, Karnataka State, Southwest India. The new species is compared with all known congeners and is diagnosed by the following combination of characters: head wider than long; snout projecting beyond mouth; supratympanic fold poorly defined; webbing on toes reaching base of disks except on Toe IV, where it reaches distal subarticular tubercle; tips of digits on fingers and toes flattened to form disks with distinct grooves separating dorsum of disks from venter; and femoral gland present. The largest specimen in the type series has a snout-vent length of 43.2 mm. *Nyctibatrachus hussaini* Krishnamurthy, Reddy and Gururaja, 2001, is shown to be an invalid nomen, for lack of typification.

The genus *Nyctibatrachus* Boulenger, 1882 (type species: *Nyctibatrachus major* Boulenger, 1882, by subsequent designation of Myers, 1942) contains 11 nominal species currently considered valid (Duellman, 1993; Frost, 1985; Dutta, 1997; Glaw et al., 2000). Dubois (1987 “1986”) allocated the genus to the subfamily Raninae, tribe Ranixalini, and subsequently (Dubois, 1992), to the subfamily Ranixalinae. Members of the genus are restricted to the Western Ghats, the interrupted mountain ridge that runs along the west coast of peninsular India, a region known for its distinctive amphibian fauna (see Inger and Dutta, 1986; Daniels, 1992; Biju, 2001; Biju and Bossuyt, 2003).

Species of *Nyctibatrachus* are recognizable by the following suite of characters: contracted pupil rhomboidal; habitus short, squat; omosternum and sternum with a bony style; tongue free, notched posteriorly; tympanum concealed; dorsum with longitudinal (transversely widened) skin folds; and tips of fingers and toes widened.

In this paper, we describe a new species of *Nyctibatrachus* from Castle Rock, Karnataka State, Southwest India.

MATERIALS AND METHODS

The type series was fixed in formalin, and subsequently washed in water and transferred to 70% ethanol. The following measurements were taken with Mitutoyo™ dial vernier calipers (to the nearest 0.1 mm), approximately 4.5 years after collection: snout–vent length (SVL, from tip of snout to vent); tibia length (TBL, distance between surface of knee to surface of heel, with both tibia

and tarsus flexed); head length (HL, distance between angle of jaws and snout-tip); head width (HW, measured at angle of jaws); head depth (HD, greatest transverse depth of head, taken posterior of the orbital region); eye diameter (ED, horizontal diameter of the eyes); interorbital distance (IO, least distance between upper eyelids); internarial distance (IN, distance between nostrils); eye to snout distance (E–S, distance between anteriormost point of eyes and tip of snout); eye to nostril distance (E–N, distance between anteriormost point of eyes and nostrils); axilla to groin distance (A–G, distance between posterior edge of forelimb at its insertion to body to anterior edge of hind limb at its insertion to body); and body width (BW, greatest width of body). Color notes on live animals were taken from scanned images generated from slide transparencies.

Comparative materials examined are listed in Appendix 1. Sources of additional data on character states and distribution of congeneric species include the following works: Bhaduri and Kripalani (1954); Boulenger (1882); Chanda (2002); Chanda and Das (1997); Daniels (1997); Inger et al. (1984); Krishnamurthy et al. (1992, 2001); Pillai (1978); Rao (1920, 1922); Ravichandran (1997); and Shaffer (1988). Museum abbreviations, where available, follow Leviton et al. (1985).

SYSTEMATICS

Nyctibatrachus petraeus sp. nov.

Figures 1–3

Type Series.—ZSI A.10070 (holotype) from Castle Rock, 15°25'N; 74°19'E, approximately

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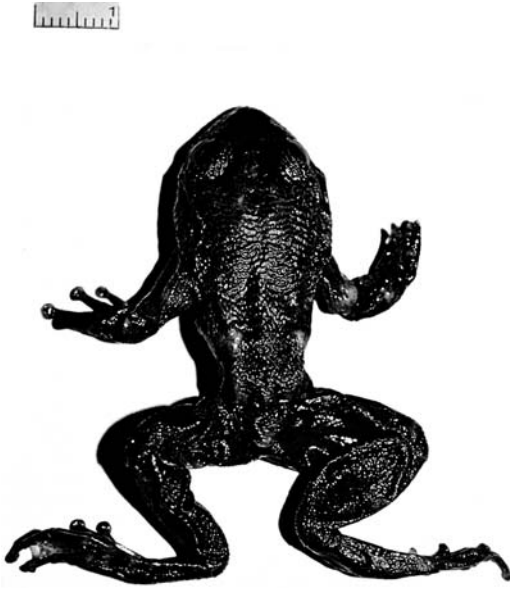


FIG. 1. Dorsal view of holotype of *Nyctibatrachus petraeus* sp. nov. (ZSI A.10070). Marker = 10 mm.

300 m a.s.l., Taluk Joida, Karwar District, Karnataka State, Southwest India, K. Kunte, collector, adult female; 28–29 September 1999; ZSI A.10071–75 (five paratypes); same collection data as holotype; one adult male; three adult females; and one unsexed juvenile.

Diagnosis.—A large (SVL to 43.2 mm) species of *Nyctibatrachus*, diagnosable from congeneric species by the following combination of characters: head wider than long; snout projecting beyond mouth; supratympanic fold poorly defined; webbing on toes reaching base of disks except on toe IV, where it reaches distal subarticular tubercle; tips of digits on fingers and toes flattened to form disks with distinct grooves separating dorsum of disks from venter; and femoral gland present.

Description of the Holotype (Adult Female).—A large species of *Nyctibatrachus*, SVL 43.2 mm; body short and stout, with a relatively narrow waist (Fig. 1); head much wider than long (HW/HL ratio 1.55), depressed; snout blunt, extending beyond mandible, and sloping forward in lateral view; snout with a longitudinal narrow fold from upper lip to level of nostrils where it bifurcates, running toward anterior corner of eyes; a short transverse fold connecting two upper eyelids; nares oval, not elevated, dorsolaterally positioned, nearer tip of snout than to orbit of eye (E–N:E–S ratio 0.89); internarial distance less than distance from anterior margin of eye to nostril (IN:E–N ratio 0.80); eyes large (ED:HL ratio 0.41); its diameter less than eye to nostril distance (ED:E–N ratio 0.75); upper eyelids small; skin not co-ossified to bony elements of the cranium;

pineal ocellus absent; interorbital width more than twice upper eyelid width (IO:UE ratio 2.59); canthus rostralis weak; loreal region sloping; maxillary teeth present; a weak W-shaped notch (= symphyseal knob) on anterior edge of mandible; mouth extending to posterior corner of eye; tongue subtriangular, with papillae, bifid apically, lacking a median lingual process, free posteriorly; choanae located close to anterior edge of palate; vomerine ridges large, in two oblique series, beginning at anterior proximal margin of choana, separated by a distance approximately 0.3 of their own length; each patch of vomerine ridge bearing 11 teeth; contracted pupils rhomboidal; several small glandular structures on rectal region; tympanum indistinct; a weak fold extending from posterior corner of eyelid to above insertion of forearm; supraclavical fold and postclavical tubercles absent; dorsum, including upper eyelids and upper surfaces of limbs with transverse skin folds; dermal folds absent on flanks.

Arm short and stout; fingers (Fig. 2 left) long and stout, lacking webbing; relative length of fingers (longest to shortest): III > IV > II > I; tips of finger dilated, with circummarginal grooves; width of disk on Finger III wider than other disks on fingers; subarticular tubercles prominent, rounded, subequal on fingers and toes, numbering one on first and second fingers, and two on third and fourth fingers; palmar tubercles present; hind limbs relatively short and stout, failing to overlap when folded right angle to axis of body; toes (Fig. 2 right) long and thin; webbing on all toes to base of disks, except on Toe IV, where webbing is up to distal subarticular tubercle on both inner and outer sides; relative length of toes (longest to shortest): IV > III > VI > II > I; toe tips rounded, with circummarginal grooves; subarticular tubercles well developed, rounded, numbering one on first and second toes; two on third and fifth toes; and three on fourth toe; slender, elongated inner metatarsal tubercle; outer metatarsal tubercle absent; disks on fingers as wide as those on toes; heels with postaxial fold; and femoral glands present.

Osteological Notes.—Maxillary teeth present, small and regularly arranged; omosternon and sternum with a bony style (in ZSI A.10072).

Color in Preservative.—Dorsum medium brown, with a dark-brown saddle-shaped mark from interorbital to above sacral region; throat brown; no light dorsolateral bands present; rest of venter an unpatterned uniform cream; fore and hind limbs medium brown, with dark-brown bars; thighs with obscure pale-orange markings; undersurfaces of upper arm cream; undersurfaces of lower arm brown; undersurfaces of thighs pale brown; tongue unpigmented pinkish-yellow.

Data on coloration of live individuals were taken of nonvouchered specimens (adult male,

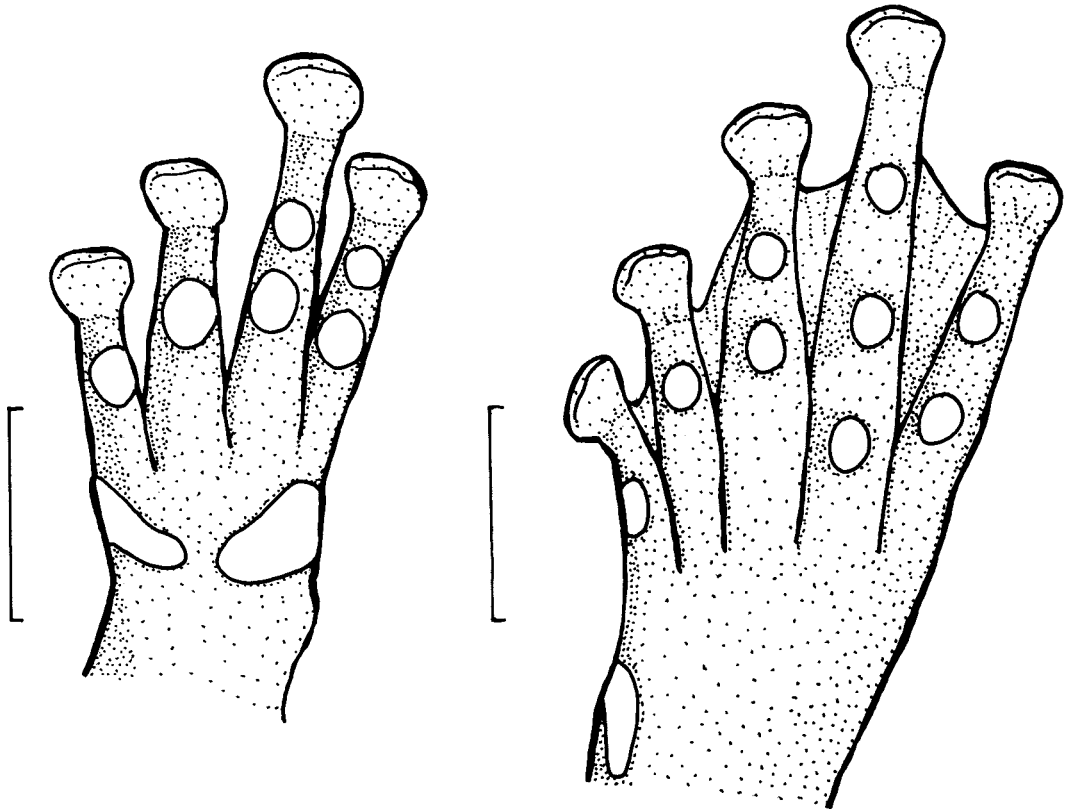


FIG. 2. Hand (left) and feet (right) of holotype of *Nyctibatrachus petraeus* sp. nov. (ZSI A.10070). Markers = 5 mm.

adult female and an unsexed juvenile). Dorsum medium brown, with a grayish-brown saddle, starting from the interorbital region, and extending to above vent; limbs medium brown with grayish-brown bands; pupil black, with golden-yellow sclera; a juvenile had extensive pale orange markings, including an interorbital bar, a bar across rostrum and along the edges of the dorsal saddle; throat cream.

Measurements.—Measurements in millimetres. Holotype followed by the range of paratypes in parentheses (see also Table 1). SVL 43.2 (27.5–43.2); HL 10.3 (7.3–11.4); HW 16.0 (11.2–16.0); HD 7.8 (3.9–7.8); BW 12.8 (7.8–12.8); TBL 18.7 (13.0–18.9); ED 4.2 (3.4–4.9); UE 3.2 (1.7–3.2); IN 4.5 (2.8–4.6); IO 8.3 (4.5–8.5); E–S 6.3 (4.0–6.3); E–N 5.6 (2.9–5.6); and A–G 15.0 (9.8–15.0).

Etymology.—Greek *petraeus* for rock, after the type locality, as well as referring to the rocky substrata of the collection locality.

Sexual Dimorphism.—Adult males can be separated from juveniles and adult females in showing bilaterally symmetrical, elongated femoral glands on the inner side of thighs. In one of the male paratypes, the femoral gland on the left hind limb measures 8.9×4.5 mm; in another,

10.4×5.0 mm. Males lack external vocal sacs and nuptial pads on fingers, and show internal vocal sacs, with openings on each side of the tongue. There is no sexual size dimorphism, SVL of 29 calling males was 42.08 ± 3.24 mm (range 32–47 mm); that of 15 adult females 41.42 ± 2.61 (range 37–45.5 mm).



FIG. 3. Adult female of *Nyctibatrachus petraeus* sp. nov. in life (unpreserved).

TABLE 1. Measurements (in millimeters) of the type series of *Nyctibatrachus petraeus* sp. nov. See text for details. Abbreviations: SVL = snout-vent length; HL = head length; HW = head width; HD = head depth; BW = body width; TBL = tibia length; ED = eye diameter; UE = upper eyelid width; IN = internarial distance; IO = interorbital distance; E-S = eye to snout distance; E-N = eye to nostril distance; and A-G = axilla to groin distance.

	ZSI A.10070 holotype	ZSI A.10071 paratype	ZSI A.10072 paratype	ZSI A.10073 paratype	ZSI A.10074 paratype	ZSI A.10075 paratype
Sex	Female	Male	Male	Subadult	Female	Female
SVL	43.2	40.7	39.0	27.5	35.9	37.4
HL	10.3	11.4	11.4	7.3	10.5	9.6
HW	16.0	14.0	13.2	11.2	14.6	14.7
HD	7.8	7.6	7.0	3.9	5.8	7.0
BW	12.8	11.2	10.0	7.8	11.7	11.4
TBL	18.7	18.9	18.1	13.0	18.4	17.4
ED	4.2	4.9	4.4	3.7	3.7	3.4
UE	3.2	2.7	2.3	1.7	2.6	2.2
IN	4.5	4.6	4.2	2.8	3.2	3.4
IO	8.3	8.5	8.0	4.5	7.6	8.0
E-S	6.3	5.7	6.3	4.0	5.5	6.2
E-N	5.6	3.4	4.0	2.9	3.3	3.6
A-G	15.0	14.6	12.7	9.8	12.5	14.5

Ecological Notes.—The type series was collected between 1930–2130 h. Both adult males that are part of the type series were calling. The presence of tadpoles confirms that the species breeds during the southeast monsoon, between June and November. The females and one subadult were found in a side stream; the adult males in a 1–2 m wide stream, flowing through a semievergreen forest, in hilly terrain with steep slopes. Observations of the natural history of the species (as *Nyctibatrachus* cf. *humayuni*) have been reported by Kunte (2004). Highlights of its ecology include territoriality in adult males, and the absence of amplexus. Its call can be described as a soft and melodious “OA OORsss”, the first note low and thus audible only at close proximity.

COMPARISONS

We compare the new species with all congeners, listing only opposing suites of characters. *Nyctibatrachus aliciae* Inger, Shaffer, Koshy, and Bakde, 1984 (Tamil Nadu, Karnataka, and Kerala States), a medium-sized species, SVL of adult males 22.7 mm, that of adult females 26.5 mm (vide Inger et al., 1984); supratympanic fold well defined; webbing on toe IV between middle and distal tubercles; outer metatarsal tubercle present; and dorsal pattern brown and tan with light dorsolateral bands; *Nyctibatrachus beddomii* (Boulenger, 1882; Tamil Nadu, Karnataka, and Kerala States), a small species, SVL of adult females 14.5–17.1 mm, those of adult males, 13.6–15.2 mm in the sample studied by Inger et al. (1984); skin of dorsum smooth; toes slender, unwebbed; fingers lacking circummarginal grooves; and

a pale bluish-white stripe behind and below eyes; *Nyctibatrachus deccanensis* Dubois, 1984 (high elevations of the Western Ghats in the Anaimalai Range of Kerala and Tamil Nadu States), snout very short; irregular dorsolateral folds; fingers and toes lacking enlarged disks; and toe webbing reaching middle subarticular tubercle in some individuals, between middle and distal subarticular tubercle in others; *Nyctibatrachus humayuni* Bhaduri and Kripalani, 1955 (north Canara, Mahabaleswar, and Khandala regions of Maharashtra), snout not projecting beyond mouth; snout equals in length to eye diameter; vomerine teeth patches with 6–8 teeth; and adult size to 48 mm; *Nyctibatrachus hussaini* Krishnamurthy, Reddy, and Gururaja, 2001 (Kudremukh National Park, Karnataka State: see nomenclatural comments below), large adult size, SVL 52–84 mm; supratympanic fold distinct; a dermal fold from lower eyelids to angle of jaws; vomerine teeth rows 9–10; and adult males with a pale thumb pad; *Nyctibatrachus kempholeyensis* (Rao, 1937; Kempholey Ghats, Hassan, Karnataka State), dorsum bronze or black; throat of male yellow; iris red; skin lacking folds; and males with large external vocal sacs; *Nyctibatrachus major* Boulenger, 1882 (Malabar and Wynaad regions of Kerala State), disks of digits with shallow, poorly defined circummarginal grooves; lips with narrow white stripes; and pale dorsolateral bands present; *Nyctibatrachus minor* Inger, Shaffer, Koshy, and Bakde, 1984 (Kerala and Tamil Nadu States), circummarginal groove absent on weakly swollen fingers; dorsolateral glandular fold present; toes free of webbing; and femoral glands absent in adult males; *Nyctibatrachus sanctipalustris* Rao, 1920 (Brahmagiri Hills

of Karnataka State), toe webbing to middle subarticular tubercle; canthus rostralis absent; and dorsum reddish-brown; *Nyctibatrachus sylvaticus* Rao, 1937 (Kempohley and Shakleshpur, Karnataka State), head as broad as long; lower lips barred; tympanum partially visible; toe webbing reaching middle subarticular tubercle; and inner metatarsal tubercle spadelike; and *Nyctibatrachus vasanthi* Ravichandran, 1997 (Kalakad Tiger Reserve, Tamil Nadu State), skin of dorsum smooth; vomerine teeth rows oval; disks on fingers lack circummarginal grooves; subarticular tubercles indistinct; flanks with dermal folds; and toes webbed to base of disks.

It is appropriate to assess the validity of the name *Nyctibatrachus hussaini* Krishnamurthy, Reddy and Gururaja, 2001, the most recently described previous member of this genus, the description of which was based on four adult females and one adult male from Kudremukh National Park, Karnataka State. Only one of these specimens, found to be "dead in the process of sampling," had been preserved and subsequently deposited in the office of the Range Forest Officer (Wildlife Division), State Forest Department, Chickmagalore District. No holotype or syntypes were designated as required for species group taxa established after 1999 by Articles 16.4 and 72.3 of the International Code of Zoological Nomenclature (International Commission of Zoological Nomenclature, 1999, hereafter, The Code). Indeed, the words "holotype" or "syntype" nowhere occur in the work (Krishnamurthy, Reddy, and Gururaja, 2001). *Nyctibatrachus hussaini* Krishnamurthy, Reddy, and Gururaja, 2001, although available in terms of Articles 10–20 of The Code, should, therefore, be considered an invalid name in terms of Articles 16.4 and 72.3 of The Code.

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APPENDIX 1

List of Comparative Material Examined

- Nyctibatrachus aliciae* Inger, Shaffer, Koshy, and Bakde, 1984. ZSI Chennai VA 768, 788, 81. Kalakad Tiger Reserve, Tamil Nadu, India.
- Nyctibatrachus beddomii* (Boulenger, 1882). CAS-SU 7198–7204. Puthutotam Estate, Valparai, Anaimalai Hills, Tamil Nadu, India (paratypes of *Nannobatrachus anamallaiensis* Myers, 1942); ZSI Chennai VA 475, 508, Silent Valley, Kerala, India.
- Nyctibatrachus humayuni* Bhaduri and Kripalani, 1955. BNHS 4151. Matheran, Maharashtra, India; ZSI 20628. Mahableshwar, Maharashtra, India (holotype of *Nyctibatrachus humayuni* Bhaduri and Kripalani, 1955).
- Nyctibatrachus major* Boulenger, 1882. BMNH 74.4. 29.619–621 (syntypes of *Nyctibatrachus major* Boulenger, 1882). “Malabar, South India”; ZSI uncat. Kerala, India; ZSI uncat. Vanjikadavu, Kerala, India; ZSIM VA 61. Manamtoddy, Kerala, India; ZSI Chennai VA 412, 417, Sabarigiri, Kerala, India.
- Nyctibatrachus sanctipalustris* Rao, 1920. ZSI 19183. Brahmagiri Hills, Coorg, Mysore, India (holotype of *Nyctibatrachus sanctipalustris* Rao, 1920); ZSI 19179, Jog, Shimoga, Mysore, India (holotype of *Nyctibatrachus sanctipalustris modestus* Rao, 1920).
- Nyctibatrachus vasanthi* Ravichandran, 1997: ZSI Chennai VA 1074 (holotype of *Nyctibatrachus vasanthi* Ravichandran, 1997). “Solipalam Aru (Kakachi), Kalakad Tiger Reserve, Tirunelveli District, Tamil Nadu, south India, altitude approximately 1120 m above msl.”