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NEW REGIONAL RECORD AND NOTES ON HISTORICAL SPECIMENS OF GÜNTHER'S TOAD *DUTTAPHRYNUS HOLOLIUS* WITH COMMENTS ON OTHER SOUTHEASTERN INDIAN CONGENERS

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Abstract: We report on the finding of the Günther's Toad *Duttaphrynus hololius* from Visakhapatnam and discuss aspects of its distribution based on our species distribution modeling. We also provide data on historically collected specimens and refine its intra-specific variation, provide an up-to-date chresonymy and comment on the validity of earlier reported diagnosis. Lastly, we remark on some misidentification-mediated dubious southern Indian records of another, related congener, the Marbled Toad *D. stomaticus* and correct some misallocations by referring them to another syntopic congener, the Dwarf Toad *D. scaber*.

Keywords: Chresonymy, distribution, *Duttaphrynus stomaticus*, *D. scaber*, *D. hololius*, misidentification, southern India, variation.

Recent studies on amphibians of southeastern India are scarce, contrary to that happening in the Western Ghats (Biju 2001; Gururaja 2012). The available literature (Das 1991; Seshadri et al. 2012) is largely

pertaining to community and behavioural ecology, save for a paper by Ganesh & Chandramouli (2011) that was on polymorphism and phenotypic plasticity. Four species of toads, namely, *Duttaphrynus melanostictus* (Schneider, 1799), *D. scaber* (Schneider, 1799), *D. cf. stomaticus* (Lütken, 1862) (Figs. 2 & 3) and *D. hololius* (Günther, 1876) are known from eastern peninsular India (Dutta 1997; Daniels 2005 in part; Srinivasulu & Das 2008 in part; Chandramouli et al. 2011). *Duttaphrynus melanostictus* is a widespread species that is relatively well known (Dutta 1997; Biju 2001). The remaining species, *D. scaber*, *D. cf. stomaticus* and *D. hololius* are still comparatively poorly known (Daniels 2005).

The Günther's Toad *Duttaphrynus hololius* (Image 1) was originally described as *Bufo hololius* Günther, 1876 from "Malabar" which, as currently understood, is

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Image 1. Günther's Toad *Duttaphrynus hololius* (top left to bottom right): A–C - Holotype BMNH 1947.2.20.50; D–G - historical nontypes MAD unreg. & ZSIM A361; H–J - Visakhapatnam specimen NHM.OU.AMPHI.3/2012

erroneous with regards to the type locality (see Biju et al. 2004). Subsequently, this species was sighted/studied, from drier, low-altitude places in eastern peninsular India, namely, Nellore in the Coramandel coastal plains and Chittoor, Bangalore, Gingee, Thommaguddai, Kundu Reddiyur, Nagarjunasagar in the Eastern Ghats (Thurston 1888; Satyamurthi 1967; Pillai & Ravichandran 1991; Daniels 1992; Chandramouli et al. 2011; Adimallaiah et al. 2012; Kalaimani et al. 2012). Due to paucity of data at that time and pending re-evaluation of specimens assigned to this species in its geographic range (sensu Dubois & Ohler 1999), Srinivasulu & Das (2008), followed Dutta (1997) in considering the specimens from drier habitats of Eastern Ghats (Thurston 1888; Satyamurthi 1967; Pillai & Ravichandran 1991) to be of doubtful identity needing clarifications.

However, recent studies on this species involving both wild-caught and museum materials (Ganesh & Asokan 2010; Chandramouli et al. 2011) have shed light on its identity, in-life colouration and distribution. Following these works, more sightings of *D. hololius* were reported from other places adjoining the Eastern Ghats (Adimallaiah et al. 2012; Kalaimani et al. 2012). Only recently, has the larval characteristics of this species been documented (Ganesh et al. 2013). In this paper, we present a new regional record for *D. hololius* and also discuss some unfortunate cases of published misidentifications of other southeastern Indian toads.

Material and Methods

This work is based on examination of fresh, wild-caught collections (BS, CS), examination of historical museum specimens and photographs of the holotype of *D. hololius* (SRG). Museum abbreviations are as follows: BMNH - Natural History Museum, London; FBS - Freshwater Biology Station, Hyderabad; MAD - Madras Govt. Museum, Chennai; ZSIM Zoological Survey of India, Madras (Chennai); NHM.OU - Natural History Museum of Osmania University, Hyderabad. Morphological examination of toads follows Dutta & Mananmendra-Arachchi (1996), and Dubois & Ohler (1999).

For the species distribution modeling we used the maximum entropy (MaxEnt) model as it is not affected by the limitation of the occurrence records and currently regarded as the most robust (Phillips et al. 2006). MaxEnt uses a maximum entropy approach to integrate model covariate selection and controls for overfitting by using smoothing and identifies how the covariates (i.e., spatial layers representing environmental variables or z) contribute to the model (Phillips et al. 2006; Elith et al. 2011). We utilized 19 bioclimatic and one topographical

variables obtained from the WorldClim database (Hijmans et al. 2005) gridded to 30 arc-second (~1km) resolution for 1950–2000 time period with the following settings: Auto features (feature types are automatically selected depending on the training sample size), perform jackknife tests, logistic output format, random test percentage = 25, regularisation multiplier = 1, maximum iterations = 1000, convergence threshold = 0.0001 and maximum number of background points = 10,000.

Taxonomy

Duttaphrynus hololius (Günther, 1876)

Bufo hololius - Thurston 1888; Satyamurthi 1967; Pillai & Ravichandran 1991

Bufo hololius - Dutta 1997 in part; Dubois & Ohler 1999 in part; Srinivasulu & Das 2008 in part.

Duttaphrynus hololius - van Bocxlaer et al. 2009; Ganesh & Asokan 2010; Chandramouli et al. 2011; Adimallaiah et al. 2012; Kalaimani et al. 2012.

Referred material (examined): NHM. OU.AMPHI/3.2012 coll. Bhargavi Srinivasulu from Scindia, Visakhapatnam, Andhra Pradesh; MAD unreg. coll. unknown, from Nellore, Andhra Pradesh; ZSIM (ex. FBS) A361 don. Dr. Mahator, from Nagarjunasagar, Andhra Pradesh.

Diagnosis: See Pillai & Ravichandran (1991), and Chandramouli et al. (2011) for colouration in life.

Description of NHM.OU.AMPHI/3.2012: A small-sized toad (18.52mm); head wider (6.72mm) than long (5.84mm); flat above; no cephalic ridges seen; canthus rostralis sharp; nostrils circular and oriented laterally situated closer to the tip of the snout (1.01mm) than to the eye (1.31mm) with internarial distance of 1.67mm; pupil horizontally oval; tympanum distinct about 28% of the eye diameter (3.21mm); parotid glands flattened; skin with numerous white dots and scattered scarlet swollen granules; fingers without webbing and toes webbed only at the base; two distinct palmar tubercles seen.

Colour in life: Dorsum dark brownish-grey; skin with numerous minute white dots and bulging scarlet glandules scattered throughout the dorsum; a very feeble vertebral line running from snout to vent; limbs with minute white dots dorsally and also show the presence of scattered bulging scarlet glandules; dorsal surface of both the fore and hind limbs slightly pale greyish to whitish in colour in comparison to the dorsum and with 2–4 black cross bars; venter largely pale grey and with numerous white granules throughout.

Measurements (in mm): Snout-vent length (SVL) 18.52, head width (HW) 6.72, head length (HL) 5.84,

distance from back of mandible to nostril (MN) 5.52, distance from back of mandible to front of eye (MFE) 3.21, distance from back of mandible to back of eye (MBE) 1.39, distance between front of eyes (IFE) 3.13, distance between back of eyes (IBE) 6.07, internarial space (IN) 1.67, distance from nostril to tip of the snout (NS) 1.01, distance from front of eye to nostril (EN) 1.31, eye length (EL) 3.21, tympanum diameter (TYD) 0.91, tympanum to eye distance (TYE) 0.48, minimum distance between upper eyelids (IUE) 2.82, maximum width of upper eyelid (UEW) 5.02, distance from anterior corner of eye to tip of snout (SL) 2.41, forelimb length (from elbow to base of outer palmar tubercle) (FLL) 5.98, hand length (from base of outer palmar tubercle to tip of third finger) (HAL) 4.84, length of third finger from basal border or proximal subarticular tubercle (TFL) 3.82, tibia length (TL) 7.23, Maximum tibia width (TW) 1.36, femur length (from vent to knee) (FL) 7.39, length of tarsus and foot (from base of tarsus to tip of fourth toe) (TFOL) 11.54, foot length (from base of outer palmar tubercle to tip of third finger) (FOL) 7.06, length of fourth toe from basal border of proximal subarticular tubercle (FTL) 4.26, length of inner metatarsal tubercle (IMT) 0.80, inner toe length (ITL) 0.81, distance from distal edge of metatarsal tubercle to maximum incurvation of web between fourth and fifth toe (MTTF) 3.66, distance from distal edge of metatarsal tubercle to maximum incurvation of web between third and fourth toe (MTFF) 4.21, distance from maximum incurvation of web between third and fourth toe to tip of fourth toe (TFTF) 2.33, and distance from maximum incurvation of web between fourth and fifth toe to tip of fourth toe (FFTF) 3.49.

Locality and natural history: The toad was collected

at 12.30hr, in February 2012, from under the prop roots of a large banyan tree abutting a tropical dry deciduous hillock near Scindia (17.68N, 83.29E; 1.2m), ca. 200m from the sea shore in Visakhapatnam (Image 2), Andhra Pradesh State, India. This record is the northeastern most locality and closest to the sea coast.

Furthermore, we provide additional data from historically collected specimens that we studied to establish conspecificity. Additional data on morphometry from the two voucher specimens is as follows (in mm): snout vent length 37.40–39.35; head length 10.48–10.51; head width 13.72–14.26; head depth 5.44–6.19; interorbital distance 7.95–9.55; internarial distance 3.05–4.42; upper eyelid width 3.60–3.75; eye diameter (horizontal) 3.80–5.80; tympanum diameter (horizontal) 3.15–4.40; upper arm length 6.75–8.10; lower arm length 8.50–10.35; palmar length 7.80–8.55; relative finger lengths 3>4>1>2; femoral length 12.90–13.90; tibio-tarsal length 12.90–14.35; metatarsal length 15.50–18.65; relative toe lengths 4>3>5>2>1. Some observed differences between our present measurements and that reported earlier for the same specimens are attributable to preservation artifact.

Discussion

Tympanum and eye relative sizes were considered to be taxonomically meaningful (Daniel 1963) and hence of diagnostic importance. Immature specimens, like in most other animals, have larger eyes with respect to tympanum. In adults, the eye diameter is slightly lesser than the tympanum diameter. Although our data from these old museum specimens is impacted by preservation process, our conclusions on conspecificity

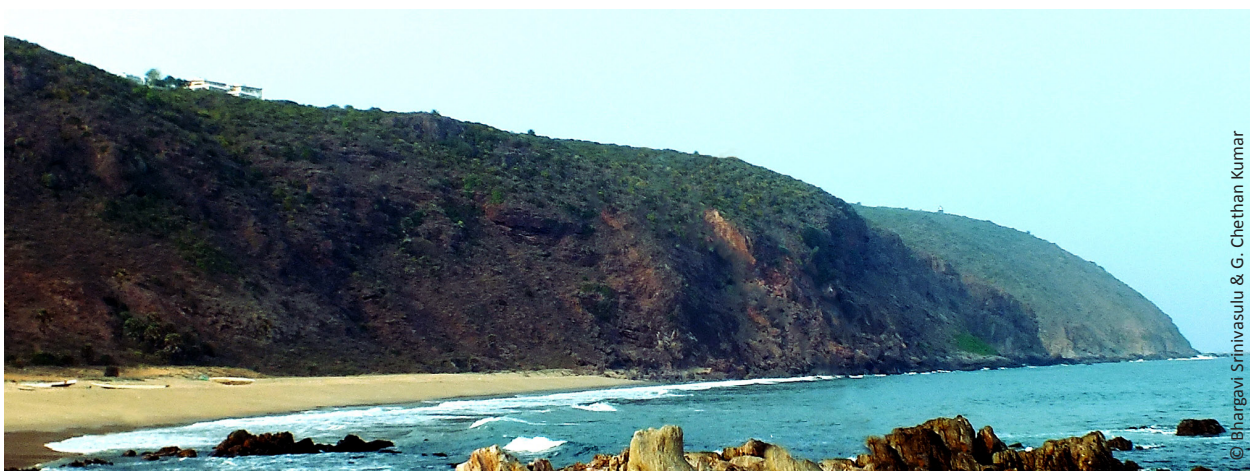


Image 2. Habitat in Visakhapatnam, from where the new record is reported; showing the interface of the Eastern Ghats and the Coromandel Coast.

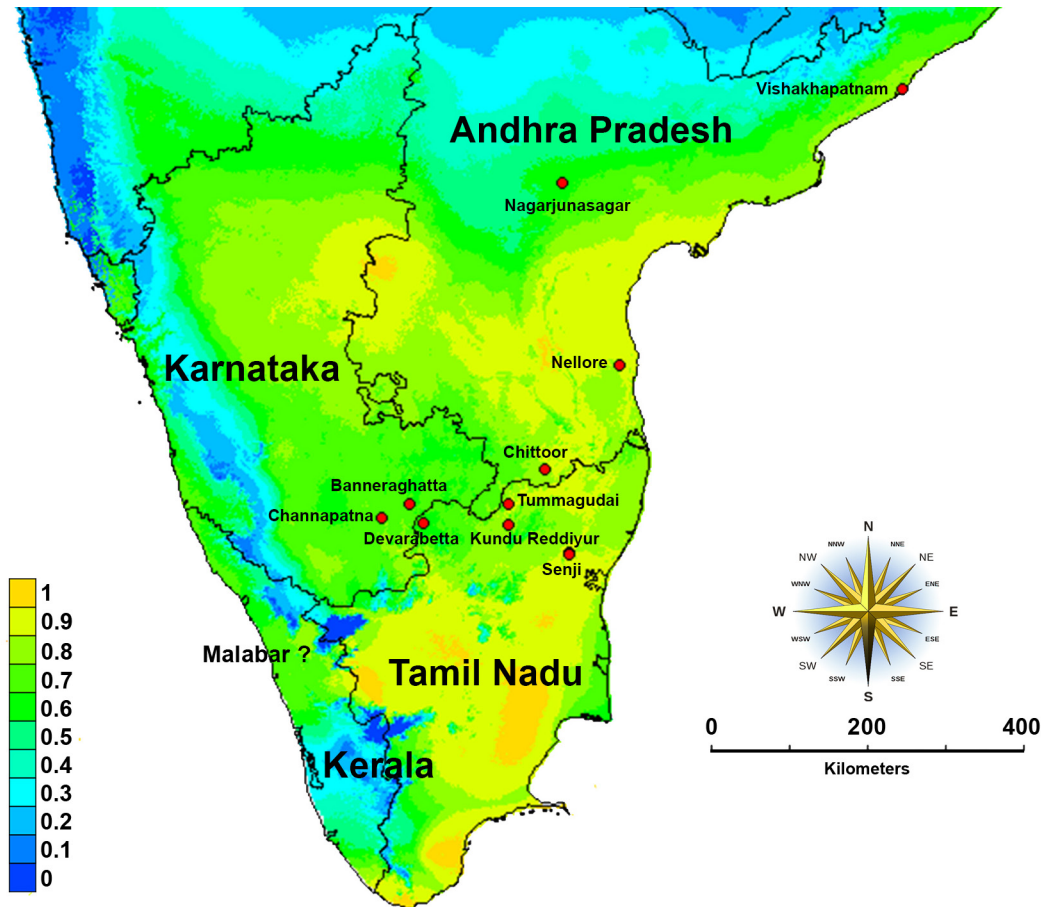


Image 3. Global distribution range of *Duttaphrynus hololius* overlaid on Maximum Entropy Species Distribution Modeling (Phillips et al. 2006) projection onto 19 bioclimatic environmental variables and one altitude variable (Hijmans et al. 2005). The MaxEnt modeling was conducted by randomly selecting 75% of the points to generate the model and 25% to test, the area under the curve (AUC) for the receiver operating characteristic of testing points is 0.962 ± 0.009 . Colours green to orange show predicted probability range of the species between 60 to 100 percent, turquoise 50 percent, and dark blue to light blue between 0 to 40 percent.

and allometric variations are strongly supported by the measurements of live, uncollected *D. hololius* gleaned from recently published literature (Chandramouli et al. 2011).

Since Biju et al. (2004), *Duttaphrynus hololius* has been reported from four locations in southern Eastern Ghats [Devarabetta, Hosur District (Chandramouli et al. 2011), Thommaguddai and Kundu Reddiyur, Vellore District and Gingee, Villupuram District in Tamil Nadu (Kalaimani et al. 2012)] and central Eastern Ghats [Nagarjunasagar, Nalgonda District, Andhra Pradesh (Adimallaiah et al. 2012)] (Image 3). The species distribution model shows that the species might have a broader distribution extent covering the southern parts of peninsular India and the Deccan Plateau, including those of southern Maharashtra bordering Karnataka; most of Karnataka; Tamil Nadu (where the likelihood of species occurrence is high); northern parts of Kerala



Image 4. Marbled Toad *Duttaphrynus stomaticus* a live uncollected specimen from Dehradun, India



Image 5. Dwarf Toad *Duttaphrynus scaber* a live uncollected specimen from Chennai, southeastern India

and all along the Eastern Ghats, the eastern coast of Andhra Pradesh and Tamil Nadu and southern parts of Andhra Pradesh, contrary to what is documented (Image 3). More dedicated surveys would yield a better understanding of its range.

Status of other southeast Indian toads: Unfortunately, there had been some issues on the identification of other sympatric congeners as well. The Marbled Toad *D. stomaticus* (Image 4), a predominantly northern Indian species (Dutta 1997 in part; Daniels 2005 in part; Khan 2006) had been incorrectly reported from southern India in recent times (e.g., Gururaja 2012; Hegde 2012; Seshadri et al. 2012). Daniels (2005) in his treatment of peninsular Indian amphibians, specifically mentions the distribution of *D. stomaticus* to be from “Karnataka, Maharashtra, Orissa, Bihar and West Bengal.” As Daniels (2005) lists *Bufo stomaticus peninsularis* Rao, 1920 in the synonymy of *D. stomaticus*, he had to include its type locality Karnataka in the distribution too. This over-circumscribed concept of ‘*D. stomaticus*’ following the ‘conservative approach’ (as explained in Chandramouli et al. 2011) with “conspecifics” sensu lato originating from outside the known distribution of *D. stomaticus* sensu stricto (e.g., southwestern Karnataka—after Rao 1920; southern Tamil Nadu—after Dutta 1997; Sondhi 2009) had probably resulted in such incorrect records. Our critical examination of captioned-photographs of southern Indian ‘*D. stomaticus*’ in such publications revealed that these were cases of misidentification of *D. scaber* (Schneider, 1799), which seem more widely distributed in western region of peninsular India (Padhye

et al. 2013). We, herein, remove *D. ‘stomaticus’* sensu Gururaja (2012), Hegde (2012) and Seshadri et al. (2012) from the chresonymy of *D. stomaticus* sensu stricto and based on crown structure, densely warted and depressed body (see Dubois & Ohler 1999 for more details) refer them to that of *D. scaber* (Image 5), a species belonging to a different species-group (after Dubois & Ohler 1999) when compared with *D. stomaticus* and *D. hololius* (see Dubois & Ohler 1999; Boxclaer et al. 2009 read with Chandramouli et al. 2011).

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