

## On the taxonomy and nomenclature of common Indian cricket frog *Rana agricola* Jerdon, 1853 (Amphibia: Dicroglossidae)

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### ABSTRACT

The Indian cricket frog that is widespread across the plains of peninsular India has thus far been represented as *Fejervarya limnocharis* (Gravenhorst, 1829), a name that has been applied to a multitude of different populations in tropical Asia. An array of taxonomic studies resulted in description and recognition of many species and consequently *F. limnocharis* has been restricted to Java. Our nomenclatural analysis revealed a nomen *Rana agricola* Jerdon, 1853, so far treated as *incertae sedis*; this very senior nomen is the only available nomen erected based on material(s) originating from southern Indian plains. We herein designate a neotype for this species and formally apply this nomen to this population, in the combination *Fejervarya agricola* (Jerdon, 1853) and add some morphological and natural history notes on this species.

**Keywords:** Coromandel Coastal plains, Dicroglossidae, India, neotype, nomen.

### INTRODUCTION

The dicroglossid frog genus *Fejervarya* Bolkay, 1915 sensu Dubois & Ohler, 2000 currently contains 15 nominate species in peninsular India (Biju, 2001; Daniel, 2002; Daniels, 2005; Kuramoto *et al.*, 2008; Dinesh *et al.*, 2015; Garg & Biju, 2017). Recent studies including the genera *Minervarya* Dubois, Ohler & Biju, 2000 and *Zakerana* Howlader, 2011 resulted in these taxa getting subsumed into *Fejervarya* (Ohler *et al.*, 2014; Dinesh *et al.*, 2015). One of the most frequently encountered 'species' names in this genus in India, is *Fejervarya limnocharis* (Gravenhorst, 1829). This species was first described as *Rana limnocharis* based on material originating from the Sundaic island of Java. The taxonomic history and status of this nomen and some associated nomina / taxa of Southeast Asian origin were recently worked upon by Dubois & Ohler (2000) and Veith *et al.* (2001). Previously, this name has been deployed for several south and Southeast Asian taxa (Biju, 2001).

Of late, '*F. limnocharis*' was shown by many authors to be a species-complex and consequent taxonomic studies resulted in the description / recognition of many species-level lineages that were formerly lumped under the catch-all species name *F. limnocharis*: *F. iskandari*, *F. kawamurai*, *F. orissaensis*, *F. sakishimensis*, *F. dhaka*, *F. tiara*, *F. asmata*, *F. sengupti*, *F. caperata*, *F. granosa*, *F. kudremukhensis*, *F. mudduraja* (Dutta, 1997b; Veith *et al.*, 2001; Stuart *et al.*, 2006; Kuramoto *et al.*, 2008; Matsui *et al.*, 2008; Djong *et al.*, 2011; Howlader, 2011; Purkayastha & Matsui, 2012; Howlader *et al.*, 2016). That said about the spate of research on this genus in many Asian countries in general, the

situation has in fact worsened in southeastern India. In this paper, we present nomenclatural and taxonomic notes about the widespread southeast Indian *Fejervarya* population that had unfortunately been misnamed and misidentified many times over by several authors.

Many valid, allopatric congeners restricted to the wet hill forests of the Western Ghats Mountains of southwestern India, were, unsubstantially reported from dry scrub plains of southeastern India, viz: Puducherry (Seshadri *et al.*, 2012), Thollamalle (Amarnath *et al.*, 2013), Kalpakkam (Ramesh *et al.*, 2013). Another such case is the record of the southeast Asian mangrove frog '*Fejervarya cancrivora*' (sic) from Pondichery by Satheeshkumar (2011), which in fact is a Jerdon's bullfrog *Hoplobatrachus crassus* (Jerdon, 1853), a species belonging to a different genus altogether, that lacks the characteristic black lateral lines. Secondly, even those who agreed that *F. limnocharis* is a strict southeast Asian species, referred the widespread Indian taxon as such. Little was it realized that an available nomen named from peninsular India, is still resting in the synonymy of *F. limnocharis* (see Dutta 1997, as *Limnonectes limnocharis*). Jerdon (1853) whilst writing about the "reptiles" (sic) of peninsular India, described, among others, a new species of frog *Rana agricola* thus: "feet not quite webbed to the extremity. Of a greenish colour, mottled with darker. Length of one 2 1/10<sup>th</sup>; hind leg 3 2/10<sup>ths</sup>; foot 1 [inch]. Found in inundated paddy fields and meadows."

Subsequently Günther (1859) referred it under the name *Rana vittigera* Weigmann, 1834. Later, Günther (1864), Boulenger (1882) and Thurston (1888) misallocated this population to *Rana gracilis* (not of

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Gravenhorst, 1829) Weigmann, 1834, an East Asian taxon now known as *Fejervarya multistriata* (Hallowell, 1861) (see Frost, 2017). Theobald (1868) also misattributed *R. agricola* to the species *Fejervarya vittigera* (Weigmann, 1834). Stoliczka (1872) misspelt its species name as *R. lynnocharis*, that he attributed to Boie [? sic]. Later, Boulenger (1890) again listed *R. agricola* in the synonymy of *R. limnocharis*, perhaps owing to the priority of Gravenhorst's (1829) *limnocharis* vs. Weigmann's (1834) *vittigera*. Annandale (1906) referred this population (from Ramnad) as *Rana greeni* Boulenger, 1905, a Sri Lankan wet-zone endemic species (Dutta & Manamendra-Arachchi 1996). Boulenger (1920) still maintained *R. agricola* in the synonymy of *R. limnocharis* and even recent treatises maintain the same arrangement (see Dutta, 1997a). Dubois (1984) placed *R. agricola* as *incertae sedis*. Prompted by Jerdon's mention of greenish colour, Dubois speculated that it could be a juvenile *Hoplobatrachus tigerinus* (Daudin, 1803). However, Jerdon (1853) in the original description clearly stated “feet not quite webbed to the extremity” a character absent in *Hoplobatrachus* (also see *R. crassa* description by Jerdon 1853). Adding support to our interpretation, no literature but for Dubois (1984) associates *R. agricola* to any nomina currently attributed to *Hoplobatrachus*.

Recently, the *F. limnocharis* group being established as a species-complex (as elaborated above), Frost (2018) treats *Rana agricola* as a *nomen inquirendum* with its status being *incertae sedis*. Similarly, as regards Rao's species, although nomina such as *Fejervarya modestus* (Rao, 1920) (see Biju *et al.*, 2011), *R. mysorensis* Rao, 1922, *R. sauriceps* Rao, 1937, *R. parambikulamana* Rao, 1937 were erected they were all based on collections from the Western Ghats. In a nomenclatural sense these nomina are also junior to Jerdon's (1853) *R. agricola*. Although Jerdon's original description lacks a locality, his article's title restricts it to peninsular India. Further evidence for this, comes from Dutta (1997a) who too treated its provenance the same way, when, in the synonymy of *Limnectes limnocharis*, he mentioned the type locality of *R. agricola* as “inundated paddy fields and meadows, S.[outh] India”. Therefore, it is fully credible that Jeron's name *R. agricola* stems from a population of small-bodied frog inhabiting peninsular Indian plains and wetlands. Thus, we here resolve the nomenclature of the widespread plains-dwelling peninsular Indian *Fejervarya* species by applying to it, the nomen *Rana agricola* Jerdon, 1853.

## TAXONOMY

### *Fejervarya agricola* (Jerdon, 1853) **comb. nov.**

*Rana agricola* Jerdon, 1853

*Rana vittigera* Weigmann, 1834 – Günther, 1859 part

*Rana gracilis* (not of Gravenhorst, 1829) Weigmann, 1834 – Günther, 1864 part

*Rana lynnocharis* ‘Boie [?]’ – Stoliczka, 1872 part

*Rana gracilis* (not of Gravenhorst, 1829) Weigmann, 1834 – Thurston, 1888 part

*Rana greeni* (not of Boulenger, 1905) – Annandale, 1906

*Rana limnocharis* (not of Gravenhorst, 1829) –

Boulenger, 1920

*Limnectes limnocharis* (not of Gravenhorst, 1829) – Dutta, 1997a part.

*Fejervarya limnocharis* (not of Gravenhorst, 1829) – Daniels, 2005 part

*Fejervarya brevipalmata* (Peters, 1871) – Sondhi, 2009

*Fejervarya kudremukhensis* (not of Kuramoto *et al.*, 2008) – Seshadri *et al.* 2012

*Fejervarya granosa* (not of Kuramoto *et al.*, 2008) – Seshadri *et al.* 2012

*Fejervarya caperata* (not of Kuramoto *et al.*, 2008) – Ramesh *et al.* 2013; Reddy *et al.* 2013

*Fejervarya rufescens* (not of Jerdon, 1853) – Ramesh *et al.* 2013

## Remarks:

Informed by our personal examinations of some of Jerdon's extant types (S.K. Dutta unpubl. data; Dutta, 1997; also see Ohler & Deuti, 2013) the potential repositories for this nominate taxon could only be the Natural History Museum, London and secondly the Indian Museum, Calcutta (now Zoological Survey of India, Kolkata, India). Our attempt to correspond with these repositories, as well as perusal of their published collection catalogues (Boulenger, 1882; Sclater, 1892; Chanda *et al.*, 2002) indicate that no extant material bearing the collector name as ‘T.C.Jerdon’ of such frogs collected from the region ‘Madras’ exist. Hence we consider the type material of *Rana agricola* to be lost.

In order to stabilise the status of this available name and to provide a nomenclaturally parsimonious solution, we select a neotype as per Art. 75.3 and Recommendations 75 a,b of the Code (ICZN, 1999). The neotype, housed in a nationally recognised repository (ZSI), originates from within the originally conceived geographical range (Madras), fits within the original concept of the nominate taxon (as in Jerdon, 1853; but see below) and as per the prevailing usage of the synonymised nomen within this species-group nomina (see Günther, 1864; Boulenger, 1882, 1920; Dutta, 1997; Frost, 2017; but see Dubois, 1984).

## Neotype (designated herein):

ZSI/SRS/V/A/362 (Zoological Survey of India, Southern Regional Station, Chennai), an adult female (Fig. 1) coll. T.S.N. Murthy on 7th March 1967 from Selaiyur Lake (12.91°N, 80.13°E; 19 m asl) in Madras (now Chennai) [present in Tamil Nadu State] in the Coromandel Coastal Plains of peninsular India.

## Type locality:

Thus far the type locality of *Rana agricola* had been “inundated paddy fields and meadows [of peninsular India]” (after Jerdon, 1853). We herein restrict the type locality to Selaiyur Lake in Madras, by virtue of our neotype designation.

## Etymology:

The specific epithet *agricola* alludes to “a resident of farmlands” in Latin, coined in nominative singular case. Though not mentioned explicitly in the original description (Jerdon, 1853), it is clear from his explanation of the finding and intent that the species was so named after its habitat association.



**Figure 1.** Neotype of *Fejervarya agricola* ZSI/SRS/V/A/362 – (a) lateral view, (b) dorsal view, (c) ventral view, (d) original jar label.

#### Diagnosis:

A species of *Fejervarya* occurring predominantly in the dry plains of eastern peninsular India characterized by the following combination of characters: small [ca. 30 mm] adult body size (vs. large-sized [ $\approx$  45 mm] *F. muduraja*, *F. nilagirica*, *F. brevipalmata*, *F. keralensis*, *F. murthii*, *F. kudremukhensis*), absence of rictal glands (vs. present in *F. sahyadris*, *F. chilapata*, *F. gomantaki*); dorsum lacking the characteristic V-shaped ridge (vs. present in *F. nilagirica*, *F. brevipalmata*, *F. murthii*, *F. kudremukhensis*), lacking four longitudinal dorsal dermal ridges (vs. present in *caperata*), lacking strongly warty tubercles on dorsum (vs. present in *F. rufescens*, *F. cepfi*, *F. neilcoxi*, *F. kadar*, *F. manoharani*, *F. keralensis*) but beset with isolated rounded tubercles; better developed toe webbing, [webbing formula:  $I_{0.5-2}II_{0.5-2}III_{1-2}IV_{2-0.5}V$ ] (vs. poorly developed webbing, not approaching penultimate subarticular tubercle on 4<sup>th</sup> toe in *F. granosa* [ $I_{1-2}II_{1-2}III_{1-2}IV_{2-1}V$ ]) dorsum mottled olive with or without a pale white vertebral stripe from snout to vent, skin with striated and warty protuberances; venter uniform pearly white, smooth; black, paired vocal sacs in adult males.

#### Description of neotype:

**Measurements (in mm):** Head length 9, head width 9, head depth 5, snout-vent length 22, body width 9.5, humeral length 8.5, radio-ulnar length 8.5, carpal length 9.5, femoral length 14, tibial length 16, tarsal length 6, metatarsal length 12, eye diameter (horizontal) 2.2, tympanum diameter 1.6, inter narial distance 2.4, eye-lip distance 2.1, eye-nostril distance 2.2, inetrocular distance 4, upper eyelid width 4.1, relative finger lengths 2, 3, 2, 3; relative toe lengths 2.3, 3.5, 5.5, 8, 5.5.

**Body form:** A rather small-sized frog, fairly robust in build; snout mildly pointed; head as long as its width; snout fairly ovoid, loreal region not concave; canthus rostralis not quite evident; eyes placed fairly laterally than dorsally, set closer to lip than to one another; interocular distance subequal to upper eyelid width; tympanum half the size of eye, set rather close to the eye and the endpoint of jaw angle; pineal ocellus not visible; mentum slightly retracted posteriorly compared to rostrum; nostrils placed fairly dorsally than laterally, its symphyisial knob not evident; a distinct supratympanic fold from posterior orbital border to upto jaw angle; trunk cylindrical, broader anteriorly and mildly narrower posteriorly, converging just before hindlimb insertion, as high as broad; forelimb fairly robust and short, hindlimb longer than the former; adpressed hindlimb reaches near about tympanum; fingers not webbed; digital formula: fingers  $1=2<4<3$ ; toes  $1<2<3<5<4$ ; toes 1/3 webbed; webbing on inner sides of 2nd and 3rd toes, at the level of 1st subarticular tubercle; webbing formula:  $I_{0.5-2}II_{0.5-2}III_{1-2}IV_{2-0.5}V$ .

**Skin:** Overall fairly glossy but not smooth; beset with pustular warts and protuberances except around limb insertions; dorsum studded with larger and sometimes elongated irregular warts particularly in vertebral and paravertebral portions between the fore and hind limbs, laterally fairly smooth between ipsilateral limbs, except near their insertions; ventrally smooth and glossy from snout till abdomen, distinctly shagreened under femoral region, mildly shagreened under tibio-tarsal, humeral and radio-ulnar regions; metapodia and phalanges devoid of supernumerary tubercles. Fejervaryan lateral lines present.

**Colouration in preservative:** After over three decades in preservative its colouration is as follows: dorsum olivaceous dirty brown, with distinct paler and darker marblings on the many warts; a chevron-shaped interocular bar; a V-shaped marking on mid-back; limbs barred with darker shade; venter and lateral regions, especially along lower lips, mid trunk, thigh and lower hindlimbs creamy brown; iris fawn brown, with a black rhomboid pupil.

**Colouration in life (based on live uncollected individuals):** Dorsum dark olive green to dirty brown, with distinct yellow marblings on the many warts; a yellowish white vertebral stripe from prefrontal to groin present or absent; limbs often barred with darker shade; venter and lateral regions, especially along lower lips, mid trunk, thigh and lower hindlimbs white; infralabials dotted with intermediate dark olivaceous spots, gular sac in males grey to black; the region below thighs distinctly flesh coloured, dotted with whitish warts; underside of limbs dirty brown to flesh coloured; iris fawn brown, with a black rhomboid pupil bilaterally edged by black wash (Fig. 2).



**Figure 2.** A live uncollected toptotypical individual of *Fejervarya agricola* from Madras.

**Call characteristics:** The call (Fig. 3) described here is based on a live individual recorded on 12-Dec-2015 from the plains of Pondicherry (11.91°N 79.81°E, < 15 m asl), Southern India, ca. 150 km south of type locality. Calls of *Fejervarya agricola* are composed of a series of multi-pulsed notes ranging from 13–16 pulses/note uttered within a duration of 13s. The interval between two consecutive notes range between 1.39-1.54 s. Mean amplitude of the calls were at -12 dB, with a maximum amplitude of -8 dB. Dominant frequency of the call was at 6 kHz. Each pulse lasted for a mean duration of 0.098±0.014 s with an inter pulse interval of 0.08±0.069 s. Multiple males normally aggregate near small puddles and call for attracting females with the onset of monsoons.

## DISCUSSION

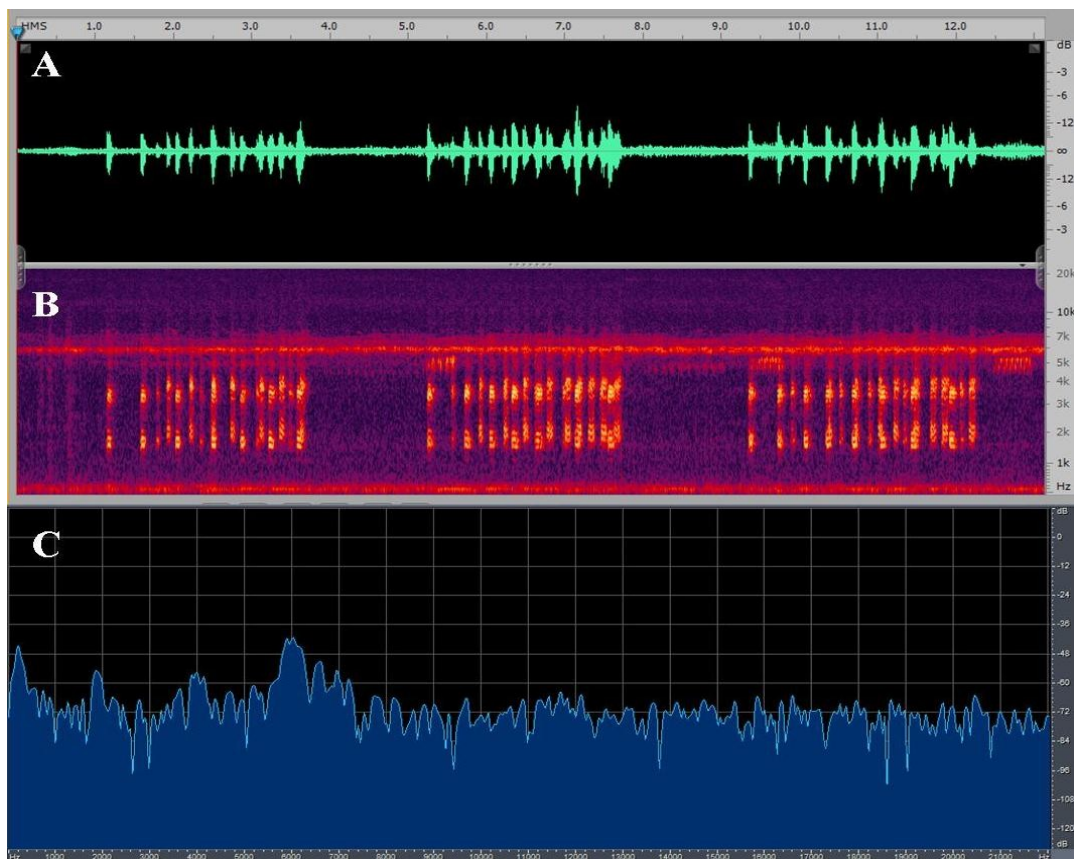
Jerdon (1853) described the nominate taxon *Rana agricola* very briefly. The only precise character states that he defined were the body measurements and toe webbing details. Even here the measurement details given such as

length [in inches] 2 1/10th; hind leg 3 2/10ths; foot 1 are rather coarse data for today's standards, leaving only the toe webbing character as an objective feature. Dubois (1984) without studying the type specimen, postulated that greenish body colour could only apply to a *Hoplobatrachus* and not a *Fejervarya*, despite the clear mention that webbing not quite up to digit tip. Dubois (1984) challenged the historically-prevailing (see Günther, 1864; Theobald, 1868, 1876, Boulenger, 1890, 1920, who are more likely to have seen Jerdon's type material) synonymy of *Rana agricola* with *Fejervarya limnocharis*. Our field work reveals similar-sized (SVL 50 mm) *Hoplobatrachus* to be olivaceous (see Fig. 4) (rather than purely greenish), against Dubois' postulations. Moreover Jerdon's (1853) description of a *Hoplobatrachus* (as *Rana crassa*) clearly stating "feet webbed to the extremity of the toes" explicitly indicates Jerdon's full understanding of webbing and its variations between a *Hoplobatrachus* and a *Fejervarya* even during his days, when they were clumped under *Rana*.

Comparing all the frogs occurring in eastern peninsular India, excluding the Ghats, only *Fejervarya* spp. are greenish mottled and aquatic frogs whereas other dicroglossids such as the genera *Hoplobatrachus* (2 species) and *Euphlyctis* (2 species) have toes fully webbed till the digit tips (see Dutta, 1997, Daniels, 2005). Hence, despite discrepancies in body size (55 mm vs. 30 mm herein), in a taxonomic sense our move of allocating the nomen *agricola* to this *Fejervarya* population appears justifiable. Also, in a nomenclatural sense, conferring Jerdon's historically-associated synonymous nomen *agricola* to this so far innominate population (sensu Veith *et al.*, 2001) best serves to promote nomenclatural parsimony and stability. Shunning down Jerdon's nomen *Rana agricola* to incertae sedis (fide Dubois, 1984) and erecting another new nomen is undesirable. Generic allocations of several frogs of this group is largely in a flux (Dinesh *et al.*, 2015; Ohler *et al.*, 2015) and subject to further studies the generic placement of *F. agricola* might change in future based on the recognition of taxa such as *Minervarya* and / or *Zakerana*. Though aware of such short-term changes that we foresee, we for now take a conservative stance and opt to allocate this taxon to the genus *Fejervarya* sensu lato.

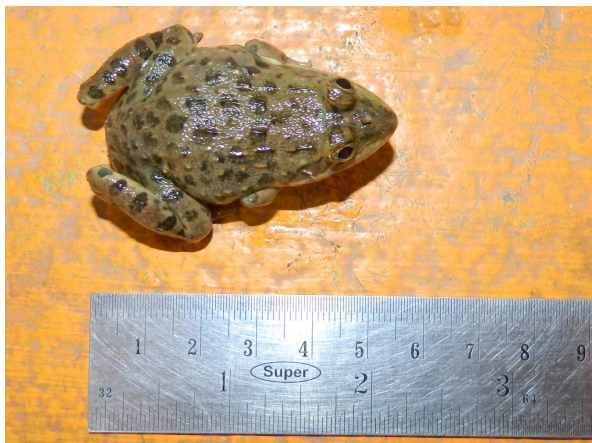
This species is currently known from the plains of peninsular India, mainly along the eastern side. Whether this species occurs in higher (> 300 m asl) hills of this region requires further studies (also see Ganesh & Arumugam, 2016). Some studies that have sampled this species include regions such as Tuticorin (Sondhi, 2009), Mayiladuthurai (Ganesh & Chandramouli, 2007; Nath *et al.*, 2012), Pondichery (Seshadri *et al.*, 2012), Kalpakkam (Ramesh *et al.*, 2013), while some (e.g. Das, 1991) who surveyed within its known distribution range (i.e. Vadanemelli 12.74°N, 80.24°E), surprisingly failed to record this common species. The present work highlights the dearth of knowledge on Indian amphibians even outside the biodiversity hotspots (also see Chandramouli *et al.*, 2011). New species descriptions and taxonomic revisions regularly happens in the Western Ghats amphibian fauna. But our work unveils a rare case of nomenclatural dilemma that had prevailed for over 160 years right from Jerdon's days till today, even after





**Figure 3.** Call characteristics of *Fejervarya agricola* showing (a) waveform, (b) sonogram, (c) power spectrum.

systematic studies on this group elsewhere in the Oriental region (Veith *et al.*, 2001) and within peninsular India (Kuramoto *et al.*, 2008).



**Figure 4.** A live uncollected subadult *Hoplobatarchus crassus* from Madras, showing olivaceous (rather than greenish) body colouration.

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