

## Croak, croak, croak: Are there more frogs to be discovered in the Western Ghats?

Perhaps nothing in the recent past has stirred so much euphoria among the Indian taxonomists and scientists working on biodiversity as have the few reports on the dramatic discovery of new species of frogs from the two regions, the Western Ghats in India and Sri Lanka (see ref. 1 for more details). While one group from the Sri Lankan region reported 200 new species<sup>2</sup> (but only 100 species in their recent report)<sup>3</sup>, another study in the Western Ghats region of India reported 115 species mostly from the genus *Philautus* – all new to science!<sup>4</sup> Accordingly, it has been argued that the Western Ghats along with Sri Lanka could represent the global hotspot of amphibian radiation and that there could be many more species waiting to be discovered by herpetologists working in these regions. A recent discovery of a Gondwanaland relic frog family *Nasikabatrachidae*<sup>5,6</sup> has only reinforced this notion.

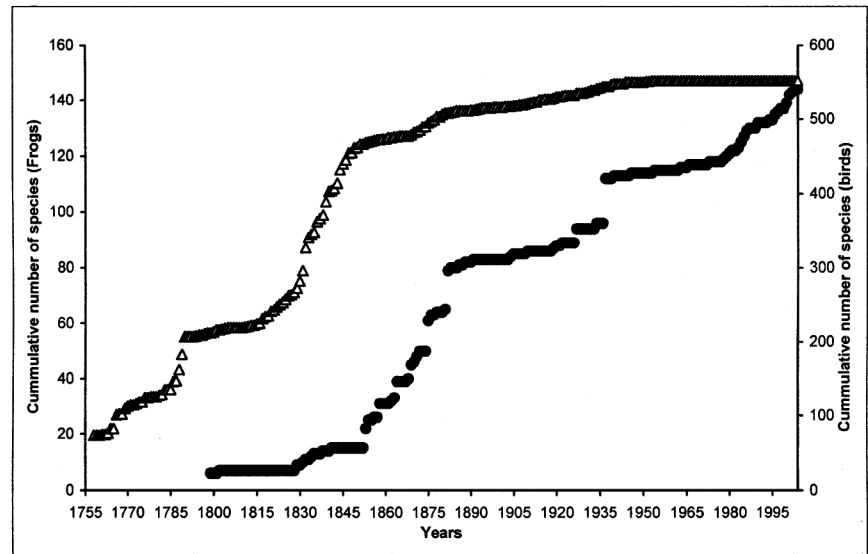
While these reports are by themselves interesting, several obvious questions emerge immediately: How did this large set of species escape the attention of the taxonomists till now? Do these species reflect a recent and a phenomenally rapid radiation in amphibians, in conformity with the well known but controversial concept of punctuated equilibrium theory of evolution?<sup>7</sup> Are these discoveries a consequence of a change in the taxonomic philosophy of, and methodology followed by, herpetologists?<sup>1</sup> Or is it a combination of some or all of these possibilities?

We were prompted to address these questions and did so by analysing the temporal patterns of discovery of frog species especially in the Western Ghats. It is well known that as more time is spent in collecting and describing the fauna and flora of an area, the total number of described species from the area reaches an asymptote. We tested if this has been achieved for the frogs of the Western Ghats. Information on the discovery of species of frogs from Linnaeus (from 1750 corresponding to the publication of the binomial nomenclature) to date (except the recent reports, which have yet to formally describe the species) was obtained from various published sources<sup>5,8-10</sup> and online database maintained by American Museum of Natural History<sup>11</sup>. We plotted

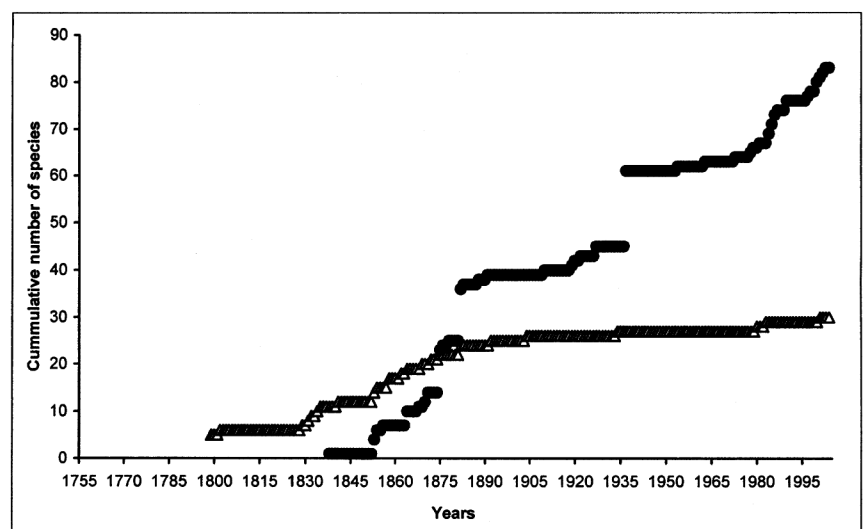
the cumulative species discovered for all frogs known from the Western Ghats. The analysis was also done separately for endemic and non-endemic species of the area. We compared the resultant patterns

with those of birds of the Western Ghats – a group that has been extensively studied.

A few interesting patterns emerged: (1) Till recently, a total of 144 species of



**Figure 1.** Temporal discovery pattern of birds from Western Ghats, India (open triangles) and frog species (closed circles) from Western Ghats and Sri Lanka. Note that the discovery curve for birds has saturated and the last bird species described from this region was in 1953. But the discovery curve for frogs has not attained an asymptote, promising the discovery of more species in the region.



**Figure 2.** Temporal discovery patterns of non-endemic (open triangle) and endemic frog species (closed circles) of the Western Ghats, India.

## CORRESPONDENCE

frogs were reported from both Western Ghats<sup>10,12</sup> and Sri Lanka<sup>13</sup> of which 112 species are endemic to this hotspot. (2) Unlike in birds, the species accumulation curve for frogs has not yet reached a plateau in the Western Ghats (Figure 1). (3) The species accumulation curve for the common (non-endemic) species of frogs has reached a plateau almost a century ago while for the endemics, the curve appears to be still in the log phase (Figure 2). (4) The average number of years for discovery of the endemic species (161 years) is significantly higher compared to that for the non-endemic species (105 years; *t* test; *P* < 0.001). In fact it took nearly 90 years since Linnaeus for the first endemic species of frog to be discovered (1838) in the Western Ghats, compared to ~40 years for the first non-endemic species (1799).

The results suggest that the temporal discovery curve of frogs of Western Ghats region is not yet saturated and there has always been a chance for new species to be discovered. Further, most of those discovered are likely to be endemic. In other words, the recent reports on the discovery of an unusually high number of new species of frogs from the Western Ghats hotspot is not surprising and perhaps it was always waiting to happen! Accordingly, these recent reports may not

be a consequence of an altered protocol of the amphibian taxonomy or of unusually high rates of local radiation among frogs. The new species may represent the genuine existence of hitherto undiscovered species. In summary, there could be more frogs out there to be discovered – herpetologists, get ready with your backpacks!

1. Chaitra, M. S., Vasudevan, K. and Shanker, K., *Curr. Sci.*, 2004, **86**, 897–899.
2. Pethiyagoda, R. and Manamendra-Arachchi, M., *Evaluating Sri Lanka's Amphibian Diversity*, Occasional papers of Wildlife Heritage Trust of Sri Lanka, 1998.
3. Meegaskumbura, M., Bossuyt, F., Pethiyagoda, R., Manamendra-Arachchi, K., Bahir, M., Milinkovitch, M. C. and Schneider, C. J., *Science*, 2002, **298**, 379.
4. Biju, S. D., *A Synopsis of Frog Fauna of Western Ghats of India*, Occasional publication 201, ISCB, TBGRI, Tiruvananthapuram, 2001.
5. Biju, S. D. and Bossuyt, F., *Nature*, 2003, **425**, 711–714.
6. Dutta, S. K., Vasudevan, K., Chaitra, M. S., Shanker, K. and Aggarwal, R. K., *Curr. Sci.*, 2004, **86**, 211–216.
7. Gould, S. J. and Eldridge, N., *Paleobiology*, 1977, **3**, 115.
8. Dubois, A., Ohler, A. and Biju, S. D., *Alytes*, 2001, **19**, 53–79.

9. Krishnamurthy, S. V., Manjunatha Reddy, A. H. and Gururaja, K. V., *Curr. Sci.*, 2001, **80**, 887–891.
10. Chanda, S. K., *Handbook: Indian Amphibians*, Zoological Survey of India, Calcutta, 2002.
11. <http://research.amnh.org/herpetology/amphibia/index.html>
12. Gururaja, K. V., <http://wgbis.ces.iisc.ernet.in/biodiversity/newsletter/issue6/index.htm>, 2004.
13. [http://www.benthic.com/sri\\_lanka/amphibians.htm](http://www.benthic.com/sri_lanka/amphibians.htm).

N. A. ARAVIND<sup>1</sup>  
R. UMA SHAANKER<sup>1,2,4,\*</sup>  
K. N. GANESHIAH<sup>1,3,4</sup>

<sup>1</sup>*Ashoka Trust for Research in Ecology and the Environment, Hebbal, Bangalore 560 024, India*

<sup>2</sup>*Department of Crop Physiology and*  
<sup>3</sup>*Department of Genetics and Plant Breeding,*

*University of Agricultural Sciences, GKVK, Bangalore 560 065, India*

<sup>4</sup>*Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur, Bangalore 560 064, India*

*\*For correspondence. e-mail: rus@vsnl.com*