CHAPTER 3

Agamid Lizards of India: Emphasis on Distribution and Conservation Status of Endemic and Rare Species

P. D. Venugopal*

Department of Entomology, University of Maryland, 4124 Plant Sciences Bldg, College Park, MD 20742-4454, USA

Abstract: The agamid lizards in India are morphologically and ecologically diverse, inhabiting varied range of altitudes and habitats. Currently, 48 agamid species comprising of 17 Genera and including 20 endemic species have been reported from India. High species diversity of Indian agamids corresponds to regions with evergreen forests, particularly the Himalayas extending in the north-east portions of India (15 species), north eastern states (13 species) and the Western Ghats (14 species). About one-third of the 48 species, are currently classified as critically endangered, endangered and vulnerable according to IUCN, and the remaining species are at lower risk or lacking information. Recent changes in distribution and taxonomy have resulted in more number for species requiring assessments. The non-availability of conservation status assessments for 18 species are a grim reminder that reiterate the need for new and updated assessments. Currently, there is a scarcity of detailed information on the ecology and natural history of most Indian agamid lizards. In this chapter, I emphasize the need for ecological studies on individual species, which are imperative for species conservation, while providing a comprehensive compilation of information on a few rare, endemic and threatened agamid lizard species.

Keywords: Reptilia, Sauria, Agamidae, lizards, India, endemic, endangered, rare, distribution, conservation, biogeographic zones, *Pseudocalotes austeniana*, abor hills agama, *Calotes aurantolabium*, orange-lipped forest lizard, *Otocryptis beddomii*, Indian kangaroo lizard, natural history, IUCN categories, taxonomy.

1. INTRODUCTION

The Family Agamidae (Reptilia: Sauria) are a highly diverse group of lizards represented by 54 genera in two subfamilies and they comprise of the Acrodonta

***Address correspondence to P. D. Venugopal:** University of Maryland, 4124 Plant Sciences Bldg, College Park, MD 20742-4454, USA; Tel: +1 301-405-7523; Fax: +1 301-314-9290; E-mail: dilip@umd.edu

Natarajan Singaravelan (Ed)

lizards with acrodont dentition. Currently numbering about 424 species [1], they are distributed in Africa, Asia, the eastern Mediterranean region and Australia [2]. It has been hypothesized that the agamid lizards rafted with the Gondwanan plates, thereby suggesting that the African/West Asian clade is of African or Indian origin, and the South Asian clade is either of Indian or Southeast Asian origin [3]. The oldest possible stem group members were found in Triassic and Jurassic of India [4] and the first agamid species were known from Cretaceous of Asia [2]. The south-east Asian and Asian regions are main centers of agamid diversity, and currently in India including subfamilies Agaminae and Leiolepinae, 48 species of agamid lizards are reported [5]. The agamid lizards in India are morphologically and ecologically diverse, and occur across a broad range of altitudes and habitats including the high altitude cold deserts in the Himalayas to the coastal plains. In this chapter, I have provided the general patterns of distributions of agamid lizards in India, with patterns of species richness across different biogeographic zones of India. The conservation status of these lizards, in juxtaposition to their general distributional patterns has also been presented. Additionally, consistent with the theme of this eBook, detailed notes on a few rare, endemic and threatened agamid lizards of India have also been included.

I referred publications including technical reports, which formed the primary source for locality records. However, reports in newsletters, unpublished reports, personal field observations and personal communications in writing (*in lit.)* with other field workers have also been taken into account. Information on species distribution and taxonomy has been complied from literature published through Sept 2009 and updated for individual species wherever required. The taxonomy used primarily follows recent publication on lizards of India [5], except for *Psuedocalotes* which is now synonymous to Genus formerly called *Mictopholis* [6]. Recent biogeographic zonal classification of India [7] has been used as the basis for providing the zone wise agamid lizard species distribution. The IUCN conservation status has been derived from the conservation assessment and management camp for reptiles [8].

2. PATTERNS OF AGAMID LIZARD DIVERSITY AND ENDEMISM

Based on the taxonomy and distributional information currently available, the agamid lizards of India are comprised of 18 Genera. Of these, more than half

(54%) of the species diversity is represented by three Genera *Calotes* (12 spp.), *Japalura* (9 spp.) and *Laudakia* (5 spp.). The other 15 Genera include *Bronchocela* and *Draco* which are represented by three species, while *Psammophilus*, *Salea* and *Trapelus* comprise of two species each. The other Genera *Brachysaura*, *Bufoniceps*, *Coryphophylax*, *Oriocalotes*, *Otocryptis*, *Phrynocephalus*, *Pseudocalotes*, *Ptyctolaemus*, *Sitana* and *Uromastyx* are all represented by a single species. Among the monotypic genera (represented by single species) *Bufoniceps* is endemic to India, while *Oriocalotes* and *Brachysaura* are non-endemic. Looking at the overall species richness of agamid lizards in India, of the 48 species, 20 (42%) are endemic to India.

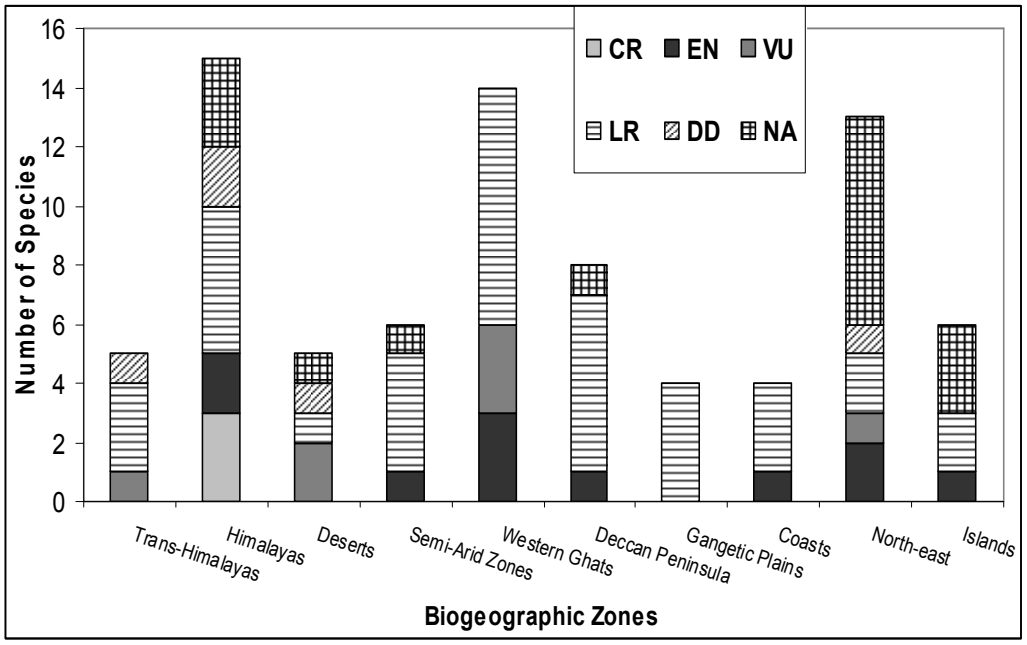
3. BIOGEOGRAPHIC ZONAL DISTRIBUTION AND CONSERVATION STATUS

The overall species richness in the different biogeographic zones (based on [6]) is provided in Fig. **1**. High species diversity of Indian agamids correspond to regions with evergreen forests, particularly the Himalayas extending in the north-east portions of India (15 species), north eastern states (13 species) and the Western Ghats (14 species).

The overall conservation status of the agamid lizards of India is given in Table **1**, while the zone-wise distribution of species in various IUCN categories is provided in Fig. **1**. About one-third of the 48 species, are currently listed as threatened (including critically endangered, endangered and vulnerable). The remaining species are at lower risk, data deficient for assessment or assessment information not available. The lack of conservation assessment status for 18 species, including those for which sufficient data is not available, clearly emphasize the need for new and updated assessments. This is particularly true for agamid lizards from particular regions like north-east India where there is no IUCN conservation information available about half of the species present in that region.

Herpetological research efforts in India still focus on surveys and taxonomic descriptions, while ecological studies on individual species, which are imperative for species conservation, still remain to be very few in number. In the following paragraphs detailed notes on a few rare, threatened and endemic agamid lizards

has been provided. It would be evident to the reader that there is a big lacuna in detailed ecological and natural history information about these colorful and beautiful lizards.



Figuer 1: Overall agamid diversity in the different biogeographic zones of India and the conservation status of the lizards in the different zones. The IUCN categories [8] include the three threatened categories, namely Critically Endangered (CR), Endangered (EN) and Vulnerable (VU), and Low Risk (LR), Data Deficient (DD) and No information available (NA). Biogeographic zonal classification follows Rodgers *et al.* (2002).

Table 1: Overall IUCN Conservation Status of the Agamid Lizards Currently known from India. The IUCN Categories are Based on Molur & Walker (1998)

IUCN Category	**Endemic**	**Non-Endemic**	**Total**
Threatened Categories			
Critically Endangered (CR)	2	1	3
Endangered (EN)	4	2	6
Vulnerable (VU)	4	3	7
Low Risk Category			
Lower Risk (LR)	6	8	14
Data Deficient (DD)		4	4
No information Available	4	10	14

Pseudocalotes austeniana (Annandale, 1908)

Abor Hills Agama

The taxonomic status of the Genus *Mictopholis* has been revised recently and it is now considered a synonym of *Pseudocalotes* [6]. *Mictopholis* was a monotypic genus erected [9] from *Salea austeniana* Annandale, 1908. However, only homoplastic characters were considered and a comparison with similar Genera was not performed [6]. The Holotype (Accession number ZSI 3976) recorded from Harmatti in Dafla hills [10], remained to be the only known specimen for *ca*. 125 years till it was recently rediscovered in Arunachal Pradesh [11, 12]. Based on recent assessments of freshly obtained specimen, the Genus *Mictopholis* was proposed as synonymous to *Pseudocalotes*, and treated thence here.

Figure 2(a & b): *Pseudocalotes austeniana;* Photos: Abhijit Das.

The specific epithet *austeniana* is a patronym after Colonel Henry Haversham Godwin-Austen. The lizard currently endemic to India is olive-green dorsally, head with dark green lines and the neck with dark stripes (Figs. **2a** & **2b**). The ventral side is uniformly bright yellowish-green with the scales unequal in size. The tail is comprised of green bands, with brown coloration on the basal third and distally being dark brown. Pupil is black with a narrow pale ring, with a reddish-brown iris. A broad post-ocular stripe is seen, and an olive-white stripe running from posterior of nostril, below the orbit of eye to below the tympanum, is also observed. While it possesses an exposed tympanum, the femoral pores are absent in this lizard. Morphometric measurements of this lizard have been provided in Table **2**.

Table 2: Morphometric Measurements of *Pseudocalotes austeniana*. Compiled from Smith (1935), Athreya (2006) and Das & Das (2007)

Morphometric Characters	**Measurements**
Snout-Vent length	85 - 117 mm
Head length	23.9 - 31 mm
Head width	14 - 24 mm
Head depth	12.5 mm
Tail length	170 - 257 mm
Tail width at base	11.5 mm
Supralabials	6 - 8 nos.
Infralabials	6 - 9 nos.
Scales from eye to tympanum	3 - 4 nos.
Eye diameter	8.52 mm

The current distributional range for this species is limited to the montane evergreen forests of west Kameng district, Arunachal Pradesh in Eastern Himalayas of northeastern India (See Fig. **3**). The exact locality records (Fig. **3**) for this species include Harmatti in Dafla hills (Annandale 1908), the type locality presently in Itanagar (*fide* [12]). Recent rediscovery reports are from Bomdila and Sangti Valley in Dirang [12] in the foothills of the eastern Himalayas and from Bompu campsite, Lama Camp and Alabari village in Eagle nest wildlife sanctuary [11].

Information on the natural history and ecology of the Abor Hills Agama is minimal, and are mainly restricted to anecdotal observations recorded during the rediscovery. The lizard is arboreal, observed to be comfortable on twigs and adept at jumping from one branch to another, while using its tail to aid in balancing. The size of the eggs recorded from preserved museum specimens, measured an average of 160 x 90 mm in length and 220 x 120 mm along the circumference [11]. It has been categorized as Critically Endangered (CR) in the wild, due to the highly restricted extant of its geographic occurrence [8].

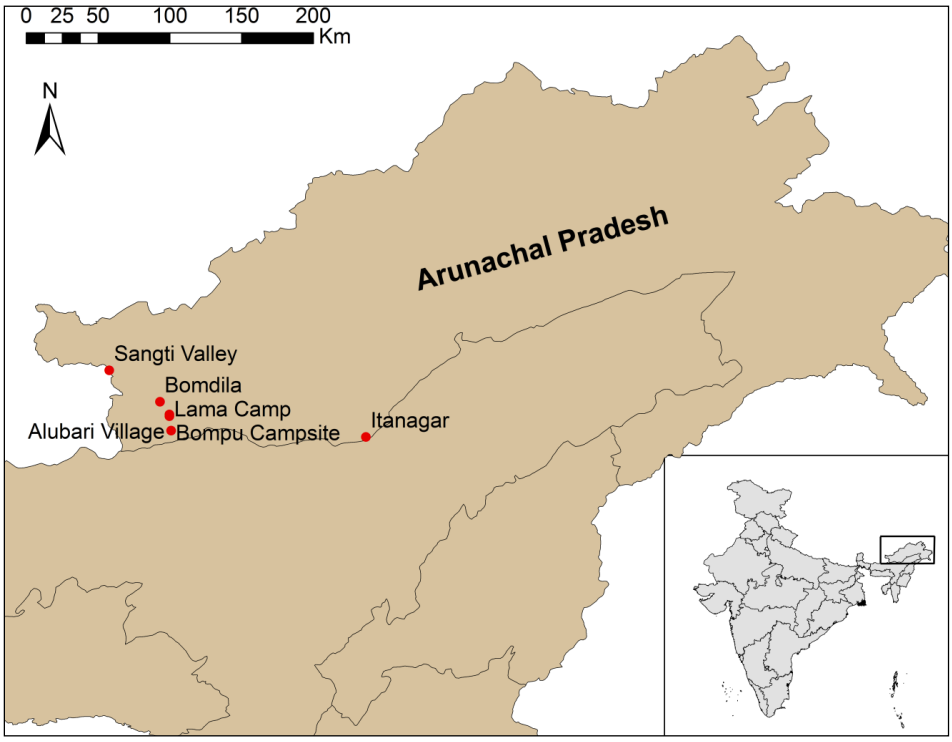


Figure 3: Locality records of *Pseudocalotes austeniana* from north-east India.

Calotes aurantolabium Krishnan, 2008

Orange-Lipped Forest Lizard

Calotes aurantolabium is an agamid lizard recently described [13]. The species was formerly included in *Calotes andamanensis* of the Andaman Islands. During his surveys N.M. Ishwar discovered an arboreal agamid which was identified to be *Calotes andamanensis* Boulenger, 1891 [14].

Subsequently it was concluded that *C. andamanensis* belonged to the peninsular Indian and Sri Lankan lineage of *Calotes* and its distribution was accordingly emended. However, the Holotype had not been examined during its redescription [14] but comparisons were made only with specimen misidentified as *C. andamanensis* (BNHM 710); resultantly it was erroneously attributed to *C. andamanensis* [13]. Recently this error was rectified when the specimens wrongly identified as *C. andamanensis* [14] were assigned to a new species *Calotes aurantolabium* [13].

The Holotype specimen is currently housed at Bombay Natural History Society (BNHS; 1436) an adult female, collected by N. M. Ishwar in Kalakkad Mundanthurai Tiger Reserve (KMTR), Tamil Nadu, India in 1997. This lizard is light green dorsally with bluish supralabials. An orange stripe between supralabials and orbital, orange stripe on thighs and black spots on trailing edges was also observed [14]. Morphological characteristics of *Calotes aurantolabium* include orange colored upper lips, green body; acutely keeled scales over body (dorsally & ventrally), head, and throat; postero-ventral orientation of the dorsal scales; absence of antehumeral pit; 63 scales around midbody; small tympanum (5.5% HL); and subequal toes III and IV (Fig. **4a** & **4b**). Morphometric measurements for the species have been provided in Table **3**.

Table 3: Morphometric Measurements of *Calotes aurantolabium*, from Krishnan (2008)

Morphometric Characters	**Measurements**
Snout Vent Length	67.88
Weight	6.25mg
Head Length	18.20
Head Widht	11.23
Head Width: Head Length	0.62
Head height	9.79
Nasal Width	4.66
Tympanum Diameter	1.00
Posterior Margin of Orbit	4.91
Horizontal Length of Orbit	7.25
Torso	32.49
Shoulder Height	10.32

Table 3: contd…

Hip Height	7.86
Humerus	11.40
Ulna	12.77
Femur	16.10
Tibia	13.79
Hind limb : Snout Vent Length	0.44
Femur Length	18.09

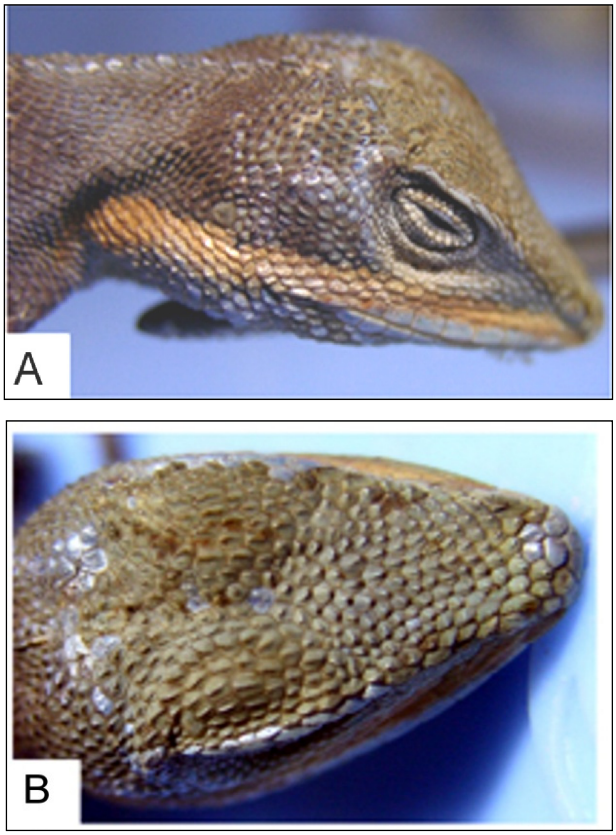


Figure 4(a & b): *Calotes aurantolabium*. Photos: Shreyas Krishnan.

This lizard is currently reported only from the wet evergreen forests of Kakkachi (Fig. **5**) in KMTR in the southern tip of Western Ghats, though unconfirmed reports from Sengaltheri in KMTR also exists (Sunita Ram, Pers. Comm.). Other than basic detail that it inhabits evergreen forests and is sympatric with other agamid lizards such as *C. grandisquamis*, *C. nemoricola*, *C. elliotti* and *Draco*

dussumieri, there is no information available on the natural history and ecology of the species. Four eggs were produced by both specimens [14].

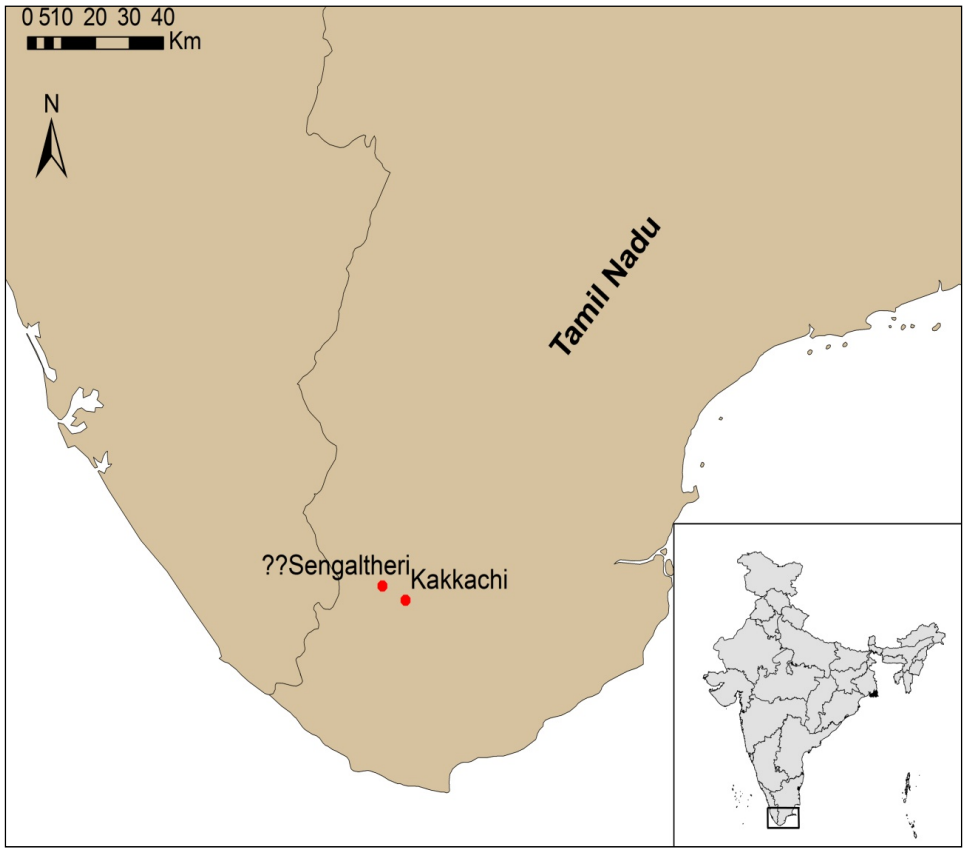


Figure 5: Locality records of *Calotes aurantolabium*, including unconfirmed reports.

Otocryptis beddomii Boulenger, 1885

Indian Kangaroo Lizard

This species was first described based on specimen from Sivagiri Ghats in Cardamom hills of the Western Ghats [15]. The closest relative of this lizard is found in Sri Lanka, and in India, it is represented by a single species (monotypic). As is typical with this Genus, some of the characteristic features of this species are a compressed body, very long limbs with the fifth toe being very short. Dorsal crest and gular folds are absent, while the scales are keeled and the dorsal scaling being heterogenous.

The upper head scales of this lizard are sharply keeled and a small pit is found on each side of the neck, in front of the shoulders. The tail is rounded, slender, is not twice as long as head and body, and is covered with equal strongly keeled scales. General body coloration is a light brownish olive, uniform, or with small scattered dark-brown spots on the back and limbs (Fig. **6**). A more or less distinct light dark-edged oblique band can be found below the eye continuing to the mouth; the ventral body surface is whitish and the throat is brownish colored in the young. The males have a nuchal crest and a large folding gular appendage that is covered with large scale and extends backwards to the belly. The ears are concealed and this lizard does not have pre anal or femoral pores. While most of the evergreen agamid lizards are arboreal, this lizard prefers the forest leaf litter [16] as its microhabitat and it has the reputation of running on its hind limbs when chased (hence the name the Kangaroo lizard).

Figure 6: *Otocryptis beddomii;* Photo: Dhaval Momaya.

It has been reported from the low elevation evergreen forests of southern Western Ghats in Kerala and Tamil Nadu and seems to be restricted to this habitat. After its description, there have not been many reports of this species. It is reported to have been common at Balamore estate in Kanyakumari district [17] in 1960's but not so currently, probably due to habitat conversion. Recently it has been recorded from forests in Palaruvi and Rosemala of Thenmala Division [16], and Dharbakulam in Shendurny Wildlife Sanctuary in Kerala (Dhaval Mommaya, Pers. Comm.). It has also been reported from Kodaikanal (2100 m) [18], which is further north of currently known range limits (Fig. **7**). However, there have been

no other reports from the same locality and this needs verification and validation. Recorded measurement for one of largest female of this lizard in museum, measured 45mm from snout to vent and the tail was 80mm long [9] and the clutch size comprises of 3-5 lizards [19].

Information on the natural history and ecology of this lizard is scarce. The restricted distribution of this species makes the low elevation rainforest fragments in the Thenmala Forest Division and adjoining forests in Tamil Nadu very important areas for its continued survival [16].

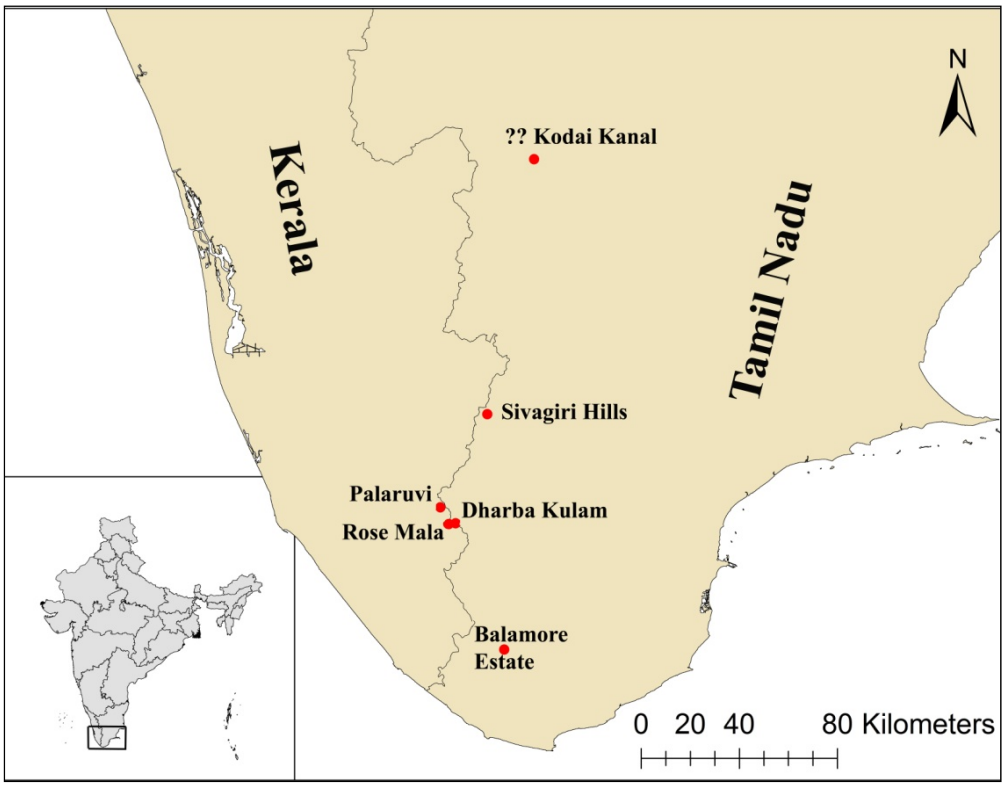


Figure 7: Locality records of *Otocryptis beddomii* including questionable reports.

ACKNOWLEDGEMENTS

I am thankful to authors who sent me their publications and references. I also thank individuals who contributed their photographs for this chapter. Comments from Sara Lombardi helped improve the manuscript.

CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES

[1] Uetz P, Hallermann, J. http://www.reptile-database.org/. 2010. Accessed on 18th July, 2010.
[2] Holmes RB, Murray AM, Chathrath P, Attia YS, Simons EL. Agamid lizard (Agamidae: Uromastycinae) from the lower Oligocene of Egypt. Hist Biol 2010; 22: 215-223.
[3] Macey RJ, Schulte JA, Larson A *et al.* Evaluating Trans-Tethys migration: an example using acrodont lizard phylogenetics. Syst Biol 2000; 49:233-256.
[4] Datta PM, Ray S. Earliest lizard from the late Triassic of India. J Vertebr Paleontol 2006; 26:795-800.
[5] Venugopal PD. An updated and annotated list of Indian lizards based on a review of distribution records and checklist of Indian reptiles. J Threatened Taxa 2010; 2:725-738.
[6] Mahony S. Systematic and taxomonic revaluation of four little known Asian agamid species, *Calotes kingdonwardi* Smith, 1935, *Japalura kaulbacki* Smith, 1937, *Salea kakhienensis* Anderson, 1879 and the monotypic genus *Mictopholis* Smith, 1935 (Reptilia: Agamidae). Zootaxa 2010; 2514:1-23.
[7] Rodgers WA, Panwar HS, Mathur VB. Wildlife Protected Area Network in India—A Review: Executive Summary; 2002: Wildlife Institute of India, Dehradun, India.
[8] Molur S, Walker S. Report of BCCP CAMP on Reptiles of India. 1998; Zoo Outreach Organisation, Coimbatore, India.
[9] Smith MA. The fauna of British India including Ceylon and Burma. Reptilia and Amphibia. Vol II Sauria. London. Taylor and Francis 1935.
[10] Das I, Dattagupta B, Gayen NC. Systematic status of *Lygosoma himalayanum tragbulensis* Alcock "1897" 1898 (Sauria: Scincidae) collected by the Pamir Boundary Commission 1885. Russ J Herpetol 1998; 5: 147-150.
[11] Athreya R. Eaglenest Biodiversity Project (2003 – 2006): Conservation resources for Eaglenest wildlife sanctuary. Pune. Kaati Trust 2006.
[12] Das A, Das I. Rediscovery of *Mictopholis austeniana* (Annandale, 1908) (Squamata: Agamidae). Curr Herpetol 2007; 26: 45–47.
[13] Krishnan S. New Species of *Calotes* (Reptilia: Squamata: Agamidae) from the Southern Western Ghats India. J Herpetol 2008; 42: 530-535.
[14] Ishwar NM, Das I. Rediscovery of *Calotes andamanensis* Boulenger 1891, and a reassessment of the type locality. J Bomb Nat Hist Soc 1998; 95: 513-514.
[15] Boulenger GA. Catalogue of the Lizards in the British Museum (Nat. Hist.) I. *Geckonidae, Eublepharidae, Uroplatidae, Pygopodidae, Agamidae*. London, 1885.
[16] Kumar A, Chellam R, Choudhury BC *et al.* Impact of Rainforest Fragmentation on Small Mammals and Herpetofauna in the Western Ghats, South India. Final technical report. Dehradun: Wildlife Institute of India. 2002.
[17] Daniels RJR. Ecology and status of a little known lizard *Otocryptis beddomii* (Boulenger). Cobra 1991; 5: 3–4.
[18] Murthy TSN. Recent re-discovery of the rare agamid lizard *Otocryptis beddomii*. J Bomb Nat Hist Soc 1980; 77: 343-344.

[19] Das I. A photographic guide to snakes and other reptiles of India., United Kingdom: New Holland Publishers Limited 2002.