*Rec. zool. Surv. India:* Vol. 123(4)/361-375, 2023
DOI: 10.26515/rzsi/v123/i4/2023/169220

ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

# Amphibians of agro-climatic zones of Karnataka with an updated checklist for the state

**P. Deepak[1, 3], K. P. Dinesh[2*], K. S. Chetan Nag[4] and J. S. Ashadevi[1]**

*[1]Genetics Research Laboratory, Department of Zoology, Yuvaraja's College, University of Mysore, Mysore – 570005, Karnataka, India*
*[2]Zoological Survey of India (ZSI), Western Regional Centre (WRC), Pune – 411044, Maharashtra, India; kpdineshzsi@gmail.com*
*[3]Mount Carmel College, Bengaluru – 560052, Karnataka, India*
*[4]Centre for Urban Ecology, Bio-Diversity, Evolution and Climate Change (CUBEC), JAIN (Deemed- to- be-UNIVERSITY), Bengaluru – 560078, Karnataka, India*

## Abstract

The British carried out the amphibian study in pre-independence India, and it was only in the 1920s that Indian researchers, such as Rao, initiated the studies, which were largely conducted in the Western Ghats. The first amphibian species described from the state of Karnataka was in 1853. Since then, amphibian discoveries in Karnataka have seen a dramatic rise, with the number of new species discovered has now reached 61 species. The amphibian checklist for the state Karnataka was first made in 2013 with 88 species, later in 2015 it accounted for 92 species and now it is 102 species. In the present checklist for the Karnataka state, species diversity has been categorised into the state's agro-climatic zones. Our studies suggested that the highest species diversity was encountered in the Hilly Agro-climatic zones of Karnataka (HZ) with 89 species, followed by the Southern Transition Zone (STZ) with 24 species; the least species diversity was encountered in the North Eastern Transition Zone (NETZ) and North Eastern Dry Zone (NEDZ) with six species diversity. Among the 'Threatened species category' four species were categorised as Critically Endangered, 14 as Endangered and five species as Vulnerable.

**Keywords:** Agro-climate zone, Coastal Zone, Hilly Zone, Deccan plateau, Transition Zone, Western Ghats

## Introduction

Amphibian studies in India date back to the colonial era when Schneider first described and documented five species of anurans in the year 1799 (Dinesh *et al*., 2020). Since then, amphibian studies in India spiked up and a total of 169 species of amphibians were discovered and documented during the pre-independence era where most of the contributions were done by Boulenger (38 species), Günther (18 species), Jerdon (18 species), Rao (17 species), and Annandale (12 species) (Dinesh *et al*., 2020). From the post-independence era till the 20th century, there was a lacuna in amphibian taxonomy during which only 67 species were described and documented (Dinesh *et al*., 2020). The 21st century revolutionised Amphibian studies in India due to advancements in the application of molecular tools and techniques which led to the discovery of 217 species to date (Dinesh *et al*., 2020; Dinesh *et al*., 2023; Frost, 2023).

Amphibian research in Karnataka dates back to the colonial period during 1853 with the description of the *Minervarya rufescens* (as *Pyxicephalus rufescens*) and the latest being in 2022 with the description of *Nyctibatrachus tunga*. So far, a total of 102 species of amphibians have been reported from the state (Table 3). Among the 102 species reported for the state 61 species are described from the state having their type localities within the political boundaries of the state (Table 2), remaining 41 species which are described from the adjacent states and countries have their distribution in the state.

Apart from amphibian discoveries, various research about taxonomic revisions were carried out in the state such as Rao, 1920; Rao, 1922; Rao, 1937; Dutta, 1985;

* *Author for correspondence*

Krishnamurthy and Shakantula, 1993; Dutta and Ray, 2000; Kuramoto and Joshy, 2003; Dinesh *et al.,* 2007; Wilkinson *et al.,* 2007; Dinesh *et al.,* 2008; Joshy *et al.,* 2009; Biju *et al.,* 2011; Biju *et al.,* 2014a; Biju *et al.,* 2014b; Gururaja *et al.,* 2014; Vijayakumar *et al.,* 2014; Dinesh *et al.,* 2015; Garg and Biju 2016; Priti *et al.,* 2016a; Priti *et al.,* 2016b; Seshadri *et al.,* 2016; Raj *et al.,* 2018; Venu *et al.,* 2020; Deepak *et al.,* 2020.

The Indian Subcontinent has a unique landmass that is highly diversified from the Coastal plains to the hilly regions, the plateaus, the deserts, and the islands due to various climatological influences (Rodgers and Panwar, 1988; Gajbhiye & Mandal, 2000). Based on the abiotic factors such as soil, physiography features, and bioclimatic features the Planning Commission of India divided the subcontinent into 15 Agro-Climatic Zones in 1989 (Anonymous 1989). These zones are further divided into 73 sub-zones to refine the agro-climatic and socio-economic features within the state (FAO, 1983; Subramaniam, 1983; Venkateswarlu *et al*., 1996; Gajbhiye and Mandal, 2000; Pandya and Bharadwaj, 2000; Mandal *et al*., 2016; Ahmad *et al*., 2017).

Amphibians are excellent ecological indicators (Simon *et al.*, 2011), as they are vulnerable to any change in the environment. Their presence and absence indicate the health of an ecosystem. With this backdrop, in the present account of amphibian species described from the state, the total species of amphibians documented from the state and their pattern of distribution as per the ten different agro-climatic zones for Karnataka (Department of Agriculture, Government of Karnataka 2010, https://farmech.dac.gov.in/FarmerGuide/KK/Introduction.htm) (Table 1) are discussed.

## Materials and Methods

### *Study Area*

Karnataka State is situated between 11.083 and 18.083 north latitude and 74.000 and 78.083 east longitude (ENVIS Karnataka) in the centre of western peninsular India, covering an area of 1,91,791 sq. km and accounts for 5.8% of the country's total geographic area and a total of 38,724 sq. km as forest area (Ramachandra, 2007; Karnataka State profile). Physio-graphically the state can be divided into three regions, the Coastal plains (Karavali region) comprising of the mangroves with estuaries, the Malanad region (Hilly region) comprising of Rain forests lined with the Western Ghats, and the Maidan region (Deccan plateau) which is further divided into Northern dry region and the Southern dry region comprising of dry deciduous scrub forests. The National Commission on Agriculture (Anonymous, 1976) classified Karnataka into 26 rainfall regions based on rainfall patterns received during the pre-monsoon, monsoon, and post-monsoon periods. The annual rainfall ranges between 3000 to 4500 mm in the coastal region, 900 to 3600 mm in the Western Ghats, and 400-1200 mm in the Deccan plateau region. The state has six different types of soils based on agricultural capability *viz.,* red soil, lateritic soil, black soil, alluvio-colluvial soil, forest soils, and coastal soils (Krishna Murthy, 2015). The State is gifted with a diverse climate, topography, and soil types. Based on this, the state was classified into 10 agro-climatic zones (Department of Agriculture, Government of Karnataka 2010, https://farmech.dac.gov.in/FarmerGuide/KK/Introduction.htm) (Table 1).

The amphibian diversity presented here for the state of Karnataka was based on Dinesh *et al*., 2009; Dinesh *et al*., 2013; Dinesh *et al*., 2020; Frost, 2023. Amphibian species discovered till 2024 were considered in the present study following the systematics of Dinesh *et al.,* 2023 and Frost 2023. Agroclimatic zone classification was based on the Department of Agriculture, Government of Karnataka 2010 (Figure 1).

## Result

Although amphibians are seasonal in activity, they are found in almost all parts of India with varying species diversity across different habitats and physiographic zones. Earlier, amphibian species representations from an Agro-climatic zone perspective were first prepared by Sreekumar and Dinesh, 2020 for the state of Maharashtra.

In the current study *Duttaphrynus melanostictus*, *Euphlyctis cyanophlyctis*, *Hoplobatrachus tigerinus*, and *Minervarya sahyadrensis* were known from all the ten agro-climatic zones of the state. A minimum of six species diversity was recorded for the North Eastern Transition Zone (NETZ) and North Eastern Dry Zone (NEDZ) and the maximum of 89 species of amphibian diversity was recorded for the Hilly Zone (HZ) regions of Karnataka, which is a part of one of the biodiversity hotspots of India (the Western Ghats). *Euphlyctis karaavali*, *Sphaerotheca dobsonii*, *Microhyla kodial*, *Microhyla laterite*, *Gegeneophis*

**Table 1.** Agro Climatic Zones of Karnataka (Figure 1) and the corresponding species diversity in each zone

| Sl. No. | Agro-climatic zones of Karnataka | Taluks involved in the zones | Amphibian species diversity in numbers (percentage to total state diversity) |
|---|---|---|---|
| 1 | North Eastern Transition Zone (NETZ) | Aland, Bhalki, Basavakalyan, Bidar, Chincholi, Humnabad, Aurad | 6 (5.8%) |
| 2 | North Eastern Dry Zone (NEDZ) | Afzalpur, Chitapur, Gulbarga, Jewargi, Sedam, Shorapur, Shahapur, Yadgir, Raichur, Devdurga, Manvi | 6 (5.8%) |
| 3 | Northern Dry Zone (NDZ) | Gangavathi, Koppal, Kushtagi, Lingasur, Sindhanur, Yelbarga, Badami, Bagalkote, Bagewadi, Bilgi, Bijapur, Hunagund, Indi, Jhamakhandi, Mudhol, Muddebhihal, Sindagi, Bellary, Hagaribommanahalli, Harapannahalli, Hadagali, Hospet, Kudligi, Sandur, Siruguppa, Ron, Navalgund, Naragund, Gadag, Mundargi, Ramadurga, Gokak, Raibag, Soundatti, Athani | 9 (8.8 %) |
| 4 | Central Dry Zone (CDZ) | Challakere, Chitradurga, Davangere, Harihara, Hiriyur, Hosadurga, Holalkere, Jagalur, Molakalmur, Arasikere, Kadur, Madhugiri, Pavagada, Korategere, C. N. Hally, Sira, Tiptur | 10 (9.8%) |
| 5 | Eastern Dry Zone (EDZ) | Gubbi, Tumkur, Anekal, Bangalore-N, Bangalore-S, Channapatna, Devanahally, Doddaballapur, Hoskote, Kanakapura, Magadi, Nelamangala, Ramnagar, Bagepalli, Bangarpet, Chikkaballapur, Chintamani, Gudibande, Gowribindanur, Kolar, Malur, Mulbagal, Shidlaghatta, Srinivaspur | 16 (15.6%) |
| 6 | Southern Dry Zone (SDZ) | K. R. Nagar, T. Narasipur, Mysore, Kollegal, Nanjangud, Turuvekere, Kunigal, Nagamangala, Srirangapatna, Malavalli, Maddur, Mandya, Pandavapura, K. R.Pet, Channarayapatna, Hassan, Chamrajnagar, Yelandur, Gundlupet | 12 (11.7%) |
| 7 | Southern Transition Zone (STZ) | H. D. Kote, Hunsur, Piriyapatna, H. N. Pura, Alur, Arakalgud, Tarikere, Bhadravathi, Shimoga, Honnali, Shikaripura, Channagiri | 24 (23.5%) |
| 8 | Northern Transition Zone (NTZ) | Hukkeri, Chikkodi, Bylhongal, Belgaum, Haveri, Shiggoan, Shirahatti, Kundgol, Savanur, Hubli, Dharwad, Byadgi, Hirekerur, Ranibennur | 12 (11.7%) |
| 9 | Hilly Zone (HZ) | Sirsi, Siddapur, Yellapur, Supa, Haliyal, Mundgod, Khanapur, Soraba, Thirthahally, Koppa, Sringeri, Mudigere, Narasimharajapura, Chikmagalur, Kalaghatgi, Hanagal, Sakaleshpur, Virajpet, Somvarpet, Madikeri | 89 (87.2%) |
| 10 | Coastal Zone (CZ) | Karwar, Kumta, Honnavar, Bhatkal, Ankola, Bantwal, Udupi, Belthangadi, Karkala, Kundapur, Mangalore, Puttur, Sulya | 18 (17.6%) |

**Table 2.** Details of the new species described from the Karnataka and the current status

| Sl. No. | Original name | Taxonomically valid name | Current Status | Type Locality |
|---|---|---|---|---|
| | | | | |
| 1 | *Pyxicephalus rufescens* Jerdon, 1853 | *Minervarya rufescens* (Jerdon, 1853) | Valid | Gundia, Kemphole Forest, Sakleshpur, Hassan, India |
| 2 | *Ansonia ornata* Günther, 1876 | *Blaira ornata* (Günther, 1876) | Valid | Brahmagiri Hills of Kodagu (Coorg) |
| 3 | *Rana dobsonii* Boulenger, 1882 | *Sphaerotheca dobsonii* (Boulenger, 1882) | Valid | Mangalore, west coast of Karnataka, India |
| 4 | *Ixalus bombayensis* Annandale, 1919 | *Raorchestes bombayensis* (Annandale, 1919) | Valid | Castle Rock, Uttara Kannada district, Karnataka, India |
| 5 | *Bufo stomaticus peninsularis* Rao, 1920 | *Firouzophrynus peninsularis* (Rao, 1920) | Valid | Mavinakote, Watekolle, Coorg, Karnataka, India |
| 6 | *Nyctibatrachus sancti-palustris* Rao, 1920 | *Nyctibatrachus sanctipalustris* Rao, 1920 | Valid | Talacauvery, Brahmagiri Hills, Coorg", Karnataka, India |
| 7 | *Nyctibatrachus sanctipalustris var. modestus* Rao, 1920 | ---------- | Synonym of *Minervarya syhadrensis* | Jog, Shivamogga |
| 8 | *Rana (Rana) limnocharis mysorensis* Rao, 1922 | *Minervarya mysorensis* (Rao, 1922) | Valid | Watercourses in the forests of Jog, Shivamogga, Karnataka, India |
| 9 | *Rana (Hylorana) gracilis montanus* Rao, 1922 | *Hylarana montana* (Rao, 1922) | Valid | Hill forests of Bhagamandala, Coorg, Karnataka, India |
| 10 | *Bufo brevirostris* Rao, 1937 | *Duttaphrynus brevirostris* (Rao, 1937) | Valid | Kempholey forests, Hassan, Karnataka, India |
| 11 | *Rana (Hylorana) intermedius* Rao, 1937 | *Hylarana intermedia* (Rao, 1937) | Valid | Sakleshpur, Hassan, Karnataka, India |
| 12 | *Philautus longicrus* Rao, 1937 | *Indirana longicrus* (Rao, 1937) | Valid | Kempholey, Hassan, Karnataka, India |
| 13 | *Philautus elegans* Rao, 1937 | *Micrixalus elegans* (Rao, 1937) | Valid | Kempholey, Hassan, Karnataka, India |
| 14 | *Philautus kottigeharensis* Rao, 1937 | *Micrixalus kottigeharensis* (Rao, 1937) | Valid | Kottigehar, Kadur, Karnataka, India |
| 15 | *Nannobatrachus kempholeyensis* Rao, 1937 | *Nyctibatrachus kempholeyensis* (Rao, 1937) | Valid | Hills of Kempholey Ghats, Hassan, Mysore, Karnataka, India |
| 16 | *Nyctibatrachus sylvaticus* Rao, 1937 | *Nyctibatrachus sylvaticus* Rao, 1937 | Valid | Forests of Kempholey, Saklespur, Hassan |
| 17 | *Philautus charius* Rao, 1937 | *Raorchestes charius* (Rao, 1937) | Valid | Kottigehar, Kadur, Karnataka, India |
| 18 | *Rana leucorhynchus* Rao, 1937 | *Sphaerotheca leucorhynchus* (Rao, 1937) | Valid | Wattakole, Coorg, Karnataka, India |
| 19 | *Rana (Hylorana) sauriceps* Rao, 1937 | ---------- | Junior synonym of *Minervarya mysorensis* | Wattekole, Coorg |

| Sl. No. | Original name | Taxonomically valid name | Current Status | Type Locality |
|---|---|---|---|---|
| 20 | *Ramanella mormorata* Rao, 1937 | *Uperodon mormoratus* (Rao, 1937) | Valid | Saklespur, Hassan, Karnataka, India |
| 21 | *Philautus montanus* Rao, 1937 | *Raorchestes hassanensis* (Dutta, 1985) | Valid | Kempholey, Hassan, Karnataka, India |
| 22 | *Ranixalus gundia* Dubois, 1986 | *Indirana gundia* (Dubois, 1986) | Valid | Gundia, forests of Kempholey, Sakleshpur, Karnataka, |
| 23 | *Gegeneophis krishni* Pillai and Ravichandran, 1999 | *Gegeneophis krishni* Pillai and Ravichandran, 1999 | Valid | Krishna Farms, Gurpur, Karnataka, India |
| 24 | *Microhyla sholigari* Dutta and Ray, 2000 | *Microhyla sholigari* Dutta and Ray, 2000 | Valid | Biligirirangan Hills, Chamrajanagar, Karnataka, India |
| 25 | *Minervarya sahyadris* Dubois, Ohler, and Biju, 2001 | *Minervarya sahyadris* Dubois, Ohler, and Biju, 2001 | Valid | Kempholey forest, Hassan, Karnataka, India |
| 26 | *Philautus luteolus* Kuramoto and Joshy, 2003 | *Raorchestes luteolus* (Kuramoto and Joshy, 2003) | Valid | Kirundadu, Kodagu, Karnataka, India |
| 27 | *Philautus tuberohumerus* Kuramoto and Joshy, 2003 | *Raorchestes tuberohumerus* (Kuramoto and Joshy, 2003) | Valid | Kudremukh, Chikumagalur, Karnataka, India |
| 28 | *Philautus neelanethrus* Gururaja, Aravind, Ali, Ramachandra, Velavan, Krishnakumar, and Aggarwal, 2007 | ---------- | Junior synonym of *Raorchestes luteolus* | Arodi, Sagara, Shivamogga |
| 29 | *Gegeneophis madhavai* Bhatta and Srinivasa, 2004 | *Gegeneophis madhavai* Bhatta and Srinivasa, 2004 | Valid | Doddinaguli, Mudur Village, Kundapura, Udupi, Karnataka, India |
| 30 | *Nyctibatrachus petraeus* Das and Kunte, 2005 | *Nyctibatrachus petraeus* Das and Kunte, 2005 | Valid | Castle Rock, Karwar, Karnataka, India |
| 31 | *Nyctibatrachus hussaini* Krishnamurthy, Manjunatha Reddy, and Gururaja, 2001 | *Nyctibatrachus karnatakaensis* Dinesh, Radhakrishnan, Manjunatha Reddy, and Gururaja, 2007 | Valid | Kudremukh National Park, Karnataka, India |
| 32 | *Gegeneophis mhadeiensis* Bhatta, Dinesh, Prashanth, and Kulkarni, 2007 | *Gegeneophis mhadeiensis* Bhatta, Dinesh, Prashanth, and Kulkarni, 2007 | Valid | Chorla, Khanapur, Belgaum, Karnataka, India |
| 33 | *Ichthyophis kodaguensis* Wilkinson, Gower, Govindappa, and Venkatachalaiah, 2007 | *Ichthyophis kodaguensis* Wilkinson, Gower, Govindappa, and Venkatachalaiah, 2007 | Valid | Venkidds Valley Estate Madikeri, Kodagu, Karnataka, India |
| 34 | *Fejervarya mudduraja* Kuramoto, Joshy, Kurabayashi, and Sumida, 2008 | ---------- | Junior synonym of *Minervarya nilagirica* | Kodagu, Karnataka |
| 35 | *Fejervarya kudremukhensis* Kuramoto, Joshy, Kurabayashi, and Sumida, 2008 | ---------- | Junior synonym of *Minervarya mysorensis* | Kudremukh, Karnataka |

| Sl. No. | Original name | Taxonomically valid name | Current Status | Type Locality |
|---|---|---|---|---|
| 36 | *Fejervarya granosa Kuramoto,* Joshy, Kurabayashi, and Sumida, 2008 | ---------- | Junior synonym of *Minervarya agricola* | Kodagu, Karnataka |
| 37 | *Fejervarya caperata* Kuramoto, Joshy, Kurabayashi, and Sumida, 2008 | ---------- | Junior synonym of *Minervarya syhadrensis* | Kodagu, Karnataka |
| 38 | *Nyctibatrachus dattatreyaensis* Dinesh, Radhakrishnan, and Bhatta, 2008 | *Nyctibatrachus dattatreyaensis* Dinesh, Radhakrishnan, and Bhatta, 2008 | Valid | Dattatreya Peeta, Bhadra Wildlife Sanctuary, Chickmagalur, Karnataka, India |
| 39 | *Euphlyctis aloysii* Joshy, Alam, Kurabayashi, Sumida, and Kuramoto, 2009 | *Phrynoderma aloysii* (Joshy, Alam, Kurabayashi, Sumida, and Kuramoto, 2009) | Valid | Bajpe, Mangalore, Karnataka, India |
| 40 | *Euphlyctis mudigere* Joshy, Alam, Kurabayashi, Sumida, and Kuramoto, 2009 | ---------- | Junior synonym of *Euphlyctis cyanophlyctis* | Mudigere, Karnataka |
| 41 | *Nyctibatrachus jog* Biju, Van Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri, and Bossuyt, 2011 | *Nyctibatrachus jog* Biju, Van Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri, and Bossuyt, 2011 | Valid | Jog Falls, Mavingundi, Shimoga, Karnataka, India |
| 42 | *Nyctibatrachus shiradi* Biju, Van Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri, and Bossuyt, 2011 | *Nyctibatrachus shiradi* Biju, Van Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri, and Bossuyt, 2011 | Valid | Kottigehara, Chikkamagaluru, Karnataka, India |
| 43 | *Ichthyophis davidi* Bhatta, Dinesh, Prashanth, Kulkarni, and Radhakrishnan, 2011 | *Ichthyophis davidi* Bhatta, Dinesh, Prashanth, Kulkarni, and Radhakrishnan, 2011 | Valid | Chorla village, Khanapur, Belgaum, Karnataka |
| 44 | *Micrixalus candidus* Biju, Garg, Gururaja, Shouche, and Walujkar, 2014 | *Micrixalus candidus* Biju, Garg, Gururaja, Shouche, and Walujkar, 2014 | Valid | Kemmanagundi, Chikmagalur, Karanataka, India |
| 45 | *Micrixalus niluvasei* Biju, Garg, Gururaja, Shouche, and Walujkar, 2014 | *Micrixalus niluvasei* Biju, Garg, Gururaja, Shouche, and Walujkar, 2014 | Valid | Niluvase, Shimoga, Karnataka, India |
| 46 | *Micrixalus specca* Biju, Garg, Gururaja, Shouche, and Walujkar, 2014 | *Micrixalus specca* Biju, Garg, Gururaja, Shouche, and Walujkar, 2014 | Valid | Charmadi Ghats, Dakshina Kannada, Karnataka, India |
| 47 | *Nyctibatrachus kumbara* Gururaja, Dinesh, Priti, and Ravikanth, 2014 | *Nyctibatrachus kumbara* Gururaja, Dinesh, Priti, and Ravikanth, 2014 | Valid | Kathalekan, Uttara Kannada, Karnataka, India |
| 48 | *Hylarana indica* Biju, Garg, Mahony, Wijayathilaka, Senevirathne, and Meegaskumbura, 2014 | *Hylarana indica* (Biju, Garg, Mahony, Wijayathilaka, Senevirathne, and Meegaskumbura, 2014) | Valid | Charmadi Ghats, Chikmagalur, Karnataka, India |

| Sl. No. | Original name | Taxonomically valid name | Current Status | Type Locality |
|---|---|---|---|---|
| 49 | *Raorchestes echinatus* Vijayakumar, Dinesh, Prabhu, and Shanker, 2014 | *Raorchestes echinatus* Vijayakumar, Dinesh, Prabhu, and Shanker, 2014 | Valid | Baba Budan hills, Chikmagalur, Karnataka, India |
| 50 | *Raorchestes indigo* Vijayakumar, Dinesh, Prabhu, and Shanker, 2014 | *Raorchestes indigo* Vijayakumar, Dinesh, Prabhu, and Shanker, 2014 | Valid | Kudremukh, Chikmagalur, Karnataka, India |
| 51 | *Fejervarya gomantaki* Dinesh, Vijayakumar, Channakeshavamurthy, Torsekar, Kulkarni, and Shanker, 2015 | *Minervarya gomantaki* (Dinesh, Vijayakumar, Channakeshavamurthy, Torsekar, Kulkarni, and Shanker, 2015) | Valid | Chigule village, Belgaum, Karnataka, India |
| 52 | *Euphlyctis karaavali* Priti, Naik, Seshadri, Singal, Vidisha, Ravikanth, and Gururaja, 2016 | *Phrynoderma karaavali* (Priti, Naik, Seshadri, Singal, Vidisha, Ravikanth, and Gururaja, 2016) | Valid | Sanikatta village, Kumta, Uttara Kannada, Karnataka, India. |
| 53 | *Microhyla laterite* Seshadri, Singal, Priti, Ravikanth, Vidisha, Saurabh, Pratik, and Gururaja, 2016 | *Microhyla laterite* Seshadri, Singal, Priti, Ravikanth, Vidisha, Saurabh, Pratik, and Gururaja, 2016 | Valid | Kodanga, Herga village, Manipal, Udupi, Karnataka, India |
| 54 | *Indirana bhadrai* Garg and Biju, 2016 | *Indirana bhadrai* Garg and Biju, 2016 | Valid | Bhadra Wildlife Sanctuary, Chikmagalur, Karnataka, India. |
| 55 | *Indirana duboisi* Dahanukar, Modak, Krutha, Nameer, Padhye, and Molur, 2016 | *Indirana duboisi* Dahanukar, Modak, Krutha, Nameer, Padhye, and Molur, 2016 | Valid | Kerekatte, Kudremukh National Park, Chikmagalur Karnataka, India |
| 56 | *Raorchestes honnametti* Gururaja, Priti, Roshmi, and Aravind, 2016 | *Raorchestes honnametti* Gururaja, Priti, Roshmi, and Aravind, 2016 | Valid | Honnametti, Biligiri Rangaswamy hills, Karnataka, India |
| 57 | *Fejervarya krishnan* Raj, Dinesh, Das, Dutta, Kar, and Mohapatra, 2018 | *Minervarya krishnan* (Raj, Dinesh, Das, Dutta, Kar, and Mohapatra, 2018) | Valid | Shimoga, Karnataka, India |
| 58 | *Microhyla kodial* Vineeth, Radhakrishna, Godwin, Anwesha, Rajashekhar, and Aravind, 2018 | *Microhyla kodial* Vineeth, Radhakrishna, Godwin, Anwesha, Rajashekhar, and Aravind, 2018 | Valid | Baikampady, Mangaluru, Dakshina Kannada, Karnataka, India |
| 59 | *Sphaerotheca bengaluru* Deepak, Dinesh, Ohler, Shanker, Channakeshavamurthy, and Ashadevi, 2020 | *Sphaerotheca bengaluru* Deepak, Dinesh, Ohler, Shanker, Channakeshavamurthy, and Ashadevi, 2020 | Valid | Budumanahalli, Bengaluru, Karnataka, India |
| 60 | *Nyctibatrachus tunga* Pavan Kumar, Vishwajith, Anisha, Dayananda, Gururaja, and Priti, 2022 | *Nyctibatrachus tunga* Pavan Kumar, Vishwajith, Anisha, Dayananda, Gururaja, and Priti, 2022 | Valid | Siddaramata, Koppa, Chikmagalur, Karnataka, India |
| 61 | *Sphaerotheca varshaabhu* Deepak, Dinesh, Chetan Nag, Ohler, Shanker, Souza, Prasad, and Ashadevi, 2024 | *Sphaerotheca varshaabhu* Deepak, Dinesh, Chetan Nag, Ohler, Shanker, Souza, Prasad, and Ashadevi, 2024 | Valid | Budumanahalli, Bengaluru, Karnataka, India |

**Table 3.** Updated checklist of amphibians of Karnataka considered under the ten different agro-climatic zones of Karnataka

| Sl. No. | Family | Species | NETZ* | NEDZ* | NDZ* | CDZ* | EDZ* | SDZ* | STZ* | NTZ* | HZ* | CZ* | IUCN Red List Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bufonidae | *Blaira ornata* (Günther, 1876) | no | no | no | no | no | no | no | no | yes | no | EN |
| 2 | Bufonidae | *Duttaphrynus brevirostris* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | DD |
| 3 | Bufonidae | *Duttaphrynus melanostictus* (Schneider, 1799) | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | LC |
| 4 | Bufonidae | *Duttaphrynus parietalis* (Boulenger, 1882) | no | no | no | no | no | no | no | no | yes | no | NT |
| 5 | Bufonidae | *Duttaphrynus scaber* (Schneider, 1799) | no | no | yes | yes | no | yes | yes | yes | yes | no | LC |
| 6 | Bufonidae | *Firouzophrynus hololius* (Günther, 1876) | no | no | no | no | yes | no | no | no | no | no | DD |
| 7 | Bufonidae | *Firouzophrynus peninsularis* (Rao, 1920) | no | no | no | no | no | no | no | no | yes | no | NA |
| 8 | Bufonidae | *Pedostibes tuberculosus (*Günther, 1875) | no | no | no | no | no | no | no | no | yes | no | EN |
| 9 | Dicroglossidae | *Euphlyctis cyanophlyctis* (Schneider, 1799) | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | LC |
| 10 | Dicroglossidae | *Euphlyctis jaladhara (*Dinesh, Channakeshavamurthy, Deepak, Shabnam, Ghosh, and Deuti, 2022) | no | no | no | no | no | no | no | no | no | yes | DD |
| 11 | Dicroglossidae | *Hoplobatrachus crassus* (Jerdon, 1853) | no | no | yes | yes | yes | yes | yes | no | yes | no | LC |
| 12 | Dicroglossidae | *Hoplobatrachus tigerinus* (Daudin, 1802) | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | LC |
| 13 | Dicroglossidae | *Minervarya agricola* (Jerdon, 1853) | no | no | yes | yes | yes | yes | yes | yes | yes | yes | NA |
| 14 | Dicroglossidae | *Minervarya goemchi* (Dinesh, Kulkarni, Swamy and Deepak, 2018) | no | no | no | no | no | no | no | no | yes | no | NA |
| 15 | Dicroglossidae | *Minervarya gomantaki* (Dinesh, Vijayakumar, Channakeshavamurthy, Toreskar, Kulkarni and Shankar, 2015) | no | no | no | no | no | no | no | no | yes | no | DD |
| 16 | Dicroglossidae | *Minervarya krishnan* (Raj, Dinesh, Das, Dutta, Kar and Mohapatra, 2018) | no | no | no | no | no | no | no | no | yes | no | NA |
| 17 | Dicroglossidae | *Minervarya mysorensis* (Rao, 1922) | no | no | no | no | no | no | no | no | yes | no | DD |
| 18 | Dicroglossidae | *Minervarya nilagirica* (Jerdon, 1854) | no | no | no | no | no | no | no | no | yes | no | EN |
| 19 | Dicroglossidae | *Minervarya rufescens* (Jerdon, 1854) | no | no | no | no | no | no | yes | no | yes | yes | LC |
| 20 | Dicroglossidae | *Minervarya sahyadris* (Dubois, Ohler and Biju, 2001) | no | no | no | no | no | no | no | no | yes | no | EN |
| 21 | Dicroglossidae | *Minervarya syhadrensis* (Annandale, 1919) | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | LC |
| 22 | Dicroglossidae | *Phrynoderma aloysii* (Joshy, Alam, Kurabayashi, Sumida and Kuramoto, 2009) | no | no | no | no | no | no | no | no | yes | yes | NA |
| 23 | Dicroglossidae | *Phrynoderma hexadactylum* (Lesson, 1834) | no | no | no | no | yes | no | no | no | yes | no | LC |

| Sl. No. | Family | Species | NETZ* | NEDZ* | NDZ* | CDZ* | EDZ* | SDZ* | STZ* | NTZ* | HZ* | CZ* | IUCN Red List Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | Dicroglossidae | *Phrynoderma karaavali* (Priti, Naik, Seshadri, Singhal, Vidisha, Ravikanth and Gururaja, 2016) | no | no | no | no | no | no | no | no | no | yes | EN |
| 25 | Dicroglossidae | *Sphaerotheca bengaluru* (Deepak, Dinesh, Ohler, Shanker, Channakeshavamurthy and Ashadevi, 2020) | no | no | no | no | yes | no | no | no | no | no | DD |
| 26 | Dicroglossidae | *Sphaerotheca dobsonii* (Boulenger, 1882) | no | no | no | no | no | no | no | no | no | yes | LC |
| 27 | Dicroglossidae | *Sphaerotheca leucorhynchus* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | DD |
| 28 | Dicroglossidae | *Sphaerotheca maskeyi* (Schleich and Anders, 1998) | yes | yes | no | no | no | no | yes | no | yes | no | NA |
| 29 | Dicroglossidae | *Sphaerotheca varshaabhu* (Deepak, Dinesh, Chetan Nag, Ohler, Shanker, Souza, Prasad, and Ashadevi, 2024) | no | no | no | no | yes | no | no | no | no | no | NA |
| 30 | Micrixalidae | *Micrixalus candidus* (Biju, Garg, Gururaja, Souche and Walujkar, 2014) | no | no | no | no | no | no | yes | no | yes | no | NA |
| 31 | Micrixalidae | *Micrixalus elegans* (Rao, 1937) | no | no | no | no | no | no | yes | no | yes | no | DD |
| 32 | Micrixalidae | *Micrixalus kottigeharensis* (Rao, 1937) | no | no | no | no | no | no | yes | no | yes | no | CE |
| 33 | Micrixalidae | *Micrixalus niluvasei* (Biju, Garg, Gururaja, Souche and Walujkar, 2014) | no | no | no | no | no | no | yes | no | yes | no | NA |
| 34 | Micrixalidae | *Micrixalus saxicola* (Jerdon, 1853) | no | no | no | no | no | no | yes | no | yes | no | VU |
| 35 | Micrixalidae | *Micrixalus specca* (Biju, Garg, Gururaja, Souche and Walujkar, 2014) | no | no | no | no | no | no | yes | no | yes | no | NA |
| 36 | Microhylidae | *Microhyla kodial* (Vineeth, Radhakrishna, Godwin, Anwesha, Rajashekhar, and Aravind, 2018) | no | no | no | no | no | no | no | no | no | yes | NA |
| 37 | Microhylidae | *Microhyla laterite* (Seshadri, Singal, Priti, Ravikanth, Vidisha, Saurabh, Pratik and Gururaja, 2016) | no | no | no | no | no | no | no | no | no | yes | EN |
| 38 | Microhylidae | *Microhyla nilphamariensis* (Howlader, Nair, Gopalan, and Merilä, 2015) | yes | yes | yes | yes | no | no | yes | yes | yes | yes | NA |
| 39 | Microhylidae | *Microhyla ornata* (Dumeril and Bibron, 1841) | no | no | yes | yes | yes | yes | yes | yes | yes | no | LC |
| 40 | Microhylidae | *Microhyla rubra* (Jerdon, 1854) | no | no | no | no | yes | yes | yes | no | no | no | LC |
| 41 | Microhylidae | *Microhyla sholigari* (Dutta and Ray, 2000) | no | no | no | no | no | yes | yes | no | yes | no | EN |
| 42 | Microhylidae | *Uperodon anamalaiensis* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | DD |
| 43 | Microhylidae | *Uperodon globulosus* (Günther, 1864) | no | no | no | no | no | no | no | no | yes | no | LC |
| 44 | Microhylidae | *Uperodon montanus* (Jerdon, 1853) | no | no | no | no | no | no | no | no | yes | no | NT |
| 45 | Microhylidae | *Uperodon mormoratus* (Rao, 1937) | no | no | no | no | no | no | no | yes | yes | no | EN |

| Sl. No. | Family | Species | NETZ* | NEDZ* | NDZ* | CDZ* | EDZ* | SDZ* | STZ* | NTZ* | HZ* | CZ* | IUCN Red List Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | Microhylidae | *Uperodon systoma* (Schneider, 1799) | no | no | no | yes | yes | yes | yes | yes | yes | yes | LC |
| 47 | Microhylidae | *Uperodon taprobanicus* (Parker, 1934) | no | no | no | no | yes | no | yes | no | no | no | LC |
| 48 | Microhylidae | *Uperodon triangularis* (Günther, 1875) | no | no | no | no | no | no | no | no | yes | no | VU |
| 49 | Microhylidae | *Uperodon variegatus* (Stoliczka, 1872) | no | no | no | no | yes | no | no | no | no | no | LC |
| 50 | Nyctibatrachidae | *Nyctibatrachus dattatreyaensis* Dinesh, Radhakrishnan and Bhatta, 2008 | no | no | no | no | no | no | no | no | yes | no | CE |
| 51 | Nyctibatrachidae | *Nyctibatrachus grandis* Biju, Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri and Bossuyt, 2011 | no | no | no | no | no | no | no | no | yes | no | NA |
| 52 | Nyctibatrachidae | *Nyctibatrachus jog* Biju, Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri and Bossuyt, 2011 | no | no | no | no | no | no | no | no | yes | no | NA |
| 53 | Nyctibatrachidae | *Nyctibatrachus karnatakaensis* Dinesh, Radhakrishnan, Reddy and Gururaja, 2007 | no | no | no | no | no | no | no | no | yes | no | EN |
| 54 | Nyctibatrachidae | *Nyctibatrachus kempholeyensis* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | DD |
| 55 | Nyctibatrachidae | *Nyctibatrachus kumbara* Gururaja, Dinesh, Preethi and Ravikanth, 2014 | no | no | no | no | no | no | no | no | yes | no | NA |
| 56 | Nyctibatrachidae | *Nyctibatrachus petraeus* Das and Kunte, 2005 | no | no | no | no | no | no | no | no | yes | no | LC |
| 57 | Nyctibatrachidae | *Nyctibatrachus sanctipalustris* Rao, 1920 | no | no | no | no | no | no | no | no | yes | no | EN |
| 58 | Nyctibatrachidae | *Nyctibatrachus shiradi* Biju, Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri and Bossuyt, 2011 | no | no | no | no | no | no | no | no | yes | no | NA |
| 59 | Nyctibatrachidae | *Nyctibatrachus sylvaticus* Rao, 1937 | no | no | no | no | no | no | no | no | yes | no | DD |
| 60 | Nyctibatrachidae | *Nyctibatrachus tunga* Pavan Kumar, Vishwajith, Anisha, Dayananda, Gururaja, and Priti, 2022 | no | no | no | no | no | no | no | no | yes | no | NA |
| 61 | Ranidae | *Clinotarsus curtipes* (Jerdon, 1853) | no | no | no | no | no | no | yes | no | yes | no | NT |
| 62 | Ranidae | *Hylarana bahuvistara* (Padhye, Jadhav, Modak, Nameer and Dahanukar, 2015) | no | no | no | no | no | no | yes | yes | yes | yes | NA |
| 63 | Ranidae | *Hylarana flavescens* (Jerdon, 1853) | no | no | no | no | no | no | no | no | yes | no | NA |
| 64 | Ranidae | *Hylarana indica* (Biju, Garg, Mahony, Wijayathilaka, Senevirathne and Meegaskumbura, 2014) | no | no | no | no | no | no | no | no | yes | no | NA |
| 65 | Ranidae | *Hylarana intermedia* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | NA |
| 66 | Ranidae | *Hylarana montana* (Rao, 1922) | no | no | no | no | no | no | no | no | yes | no | NA |
| 67 | Ranixalidae | *Indirana bhadrai* Garg and Biju, 2016 | no | no | no | no | no | no | no | no | yes | no | NA |

| Sl. No. | Family | Species | NETZ* | NEDZ* | NDZ* | CDZ* | EDZ* | SDZ* | STZ* | NTZ* | HZ* | CZ* | IUCN Red List Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68 | Ranixalidae | *Indirana duboisi* Dahanukar, Modak, Krutha, Nameer, Padhye and Molur, 2016 | no | no | no | no | no | no | no | no | yes | no | NA |
| 69 | Ranixalidae | *Indirana gundia* (Dubois, 1986) | no | no | no | no | no | no | no | no | yes | no | CE |
| 70 | Ranixalidae | *Indirana longicrus* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | DD |
| 71 | Ranixalidae | *Indirana tysoni* Dahanukar, Modak, Krutha, Nameer, Padhye and Molur, 2016 | no | no | no | no | no | no | no | no | yes | no | NA |
| 72 | Rhacophoridae | *Polypedates maculatus* (Gray, 1830) | no | no | no | no | yes | yes | yes | yes | yes | yes | LC |
| 73 | Rhacophoridae | *Polypedates occidentalis* Das and Dutta, 2006 | no | no | no | no | no | no | no | no | yes | no | DD |
| 74 | Rhacophoridae | *Pseudophilautus amboli* (Biju and Bossuyt, 2009) | no | no | no | no | no | no | no | no | yes | no | CE |
| 75 | Rhacophoridae | *Pseudophilautus wynaadensis* (Jerdon, 1853) | no | no | no | no | no | no | no | no | yes | no | EN |
| 76 | Rhacophoridae | *Raorchestes akroparallagi* (Biju and Bossuyt, 2009) | no | no | no | no | no | no | no | no | yes | no | LC |
| 77 | Rhacophoridae | *Raorchestes anili* (Biju and Bossuyt, 2006) | no | no | no | no | no | no | no | no | yes | no | LC |
| 78 | Rhacophoridae | *Raorchestes bombayensis* (Annandale, 1919) | no | no | no | no | no | no | no | no | yes | no | VU |
| 79 | Rhacophoridae | *Raorchestes charius* (Rao, 1937) | no | no | no | no | no | no | no | no | yes | no | EN |
| 80 | Rhacophoridae | *Raorchestes chromasynchysi* (Biju and Bossuyt, 2009) | no | no | no | no | no | no | no | no | yes | no | VU |
| 81 | Rhacophoridae | *Raorchestes echinatus* Vijayakumar, Dinesh, Prabhu and Shanker, 2014 | no | no | no | no | no | no | no | no | yes | no | NA |
| 82 | Rhacophoridae | *Raorchestes glandulosus* (Jerdon, 1853) | no | no | no | no | no | no | no | no | yes | no | VU |
| 83 | Rhacophoridae | *Raorchestes hassanensis* (Dutta, 1985) | no | no | no | no | no | no | no | no | yes | no | NA |
| 84 | Rhacophoridae | *Raorchestes honnametti* Gururaja,Priti, Roshmi and Aravind, 2016 | no | no | no | no | no | no | no | no | yes | no | NA |
| 85 | Rhacophoridae | *Raorchestes indigo* Vijayakumar, Dinesh, Prabhu and Shanker, 2014 | no | no | no | no | no | no | no | no | yes | no | NA |
| 86 | Rhacophoridae | *Raorchestes luteolus* (Kuramoto and Joshy, 2003) | no | no | no | no | no | no | no | no | yes | no | DD |
| 87 | Rhacophoridae | *Raorchestes nerostagona* (Biju and Bossuyt, 2005) | no | no | no | no | no | no | no | no | yes | no | EN |
| 88 | Rhacophoridae | *Raorchestes ochlandrae* (Gururaja, Dinesh, Palot, Radhakrishnan and Ramachandra, 2007) | no | no | no | no | no | no | no | no | yes | no | DD |
| 89 | Rhacophoridae | *Raorchestes tuberohumerus* (Kuramoto and Joshy, 2003) | no | no | no | no | no | no | no | no | yes | no | DD |
| 90 | Rhacophoridae | *Rhacophorus lateralis* Boulenger, 1883 | no | no | no | no | no | no | no | no | yes | no | EN |
| 91 | Rhacophoridae | *Rhacophorus malabaricus* Jerdon, 1870 | no | no | no | no | no | no | no | no | yes | no | LC |
| 92 | Grandisoniidae | *Gegeneophis carnosus* (Beddome, 1870) | no | no | no | no | no | no | no | no | yes | no | DD |
| 93 | Grandisoniidae | *Gegeneophis krishni* Pillai and Ravichandran, 1999 | no | no | no | no | no | no | no | no | no | yes | DD |

| Sl. No. | Family | Species | NETZ* | NEDZ* | NDZ* | CDZ* | EDZ* | SDZ* | STZ* | NTZ* | HZ* | CZ* | IUCN Red List Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 94 | Grandisoniidae | *Gegeneophis madhavai* Bhatta and Srinivasa, 2004 | no | no | no | no | no | no | no | no | no | yes | DD |
| 95 | Grandisoniidae | *Gegeneophis mhadeiensis* Bhatta, Dinesh, Prashanth and Kulkarni, 2007 | no | no | no | no | no | no | no | no | yes | no | DD |
| 96 | Ichthyophiidae | *Ichthyophis beddomei* Peters, 1879 | no | no | no | no | no | no | no | no | yes | no | LC |
| 97 | Ichthyophiidae | *Ichthyophis davidi* Bhatta, Dinesh, Prashanth, Kulkarni and Radhakrishan, 2011 | no | no | no | no | no | no | no | no | yes | no | NA |
| 98 | Ichthyophiidae | *Ichthyophis kodaguensis* Wilkinson, Gower, Govindappa and Venkatachalaiah, 2007 | no | no | no | no | no | no | no | no | yes | no | DD |
| 99 | Ichthyophiidae | *Ichthyophis longicephalus* Pillai, 1986 | no | no | no | no | no | no | no | no | yes | no | DD |
| 100 | Ichthyophiidae | *Uraeotyphlus bombayensis* (Taylor, 1960) | no | no | no | no | no | no | no | no | yes | no | LC |
| 101 | Ichthyophiidae | *Uraeotyphlus interruptus* Pillai and Ravichandran, 1999 | no | no | no | no | no | no | no | no | yes | no | DD |
| 102 | Ichthyophiidae | *Uraeotyphlus narayani* Seshachar, 1939 | no | no | no | no | no | no | no | no | yes | no | DD |

*NETZ: North Eastern Transition Zone; NEDZ: North Eastern Dry Zone; NDZ: Northern Dry Zone; CDZ: Central Dry Zone; EDZ: Eastern Dry Zone; SDZ: Southern Dry Zone; STZ: Southern Transition Zone; NTZ: Northern Transition; HZ: Hilly Zone; CZ: Coastal Zone.

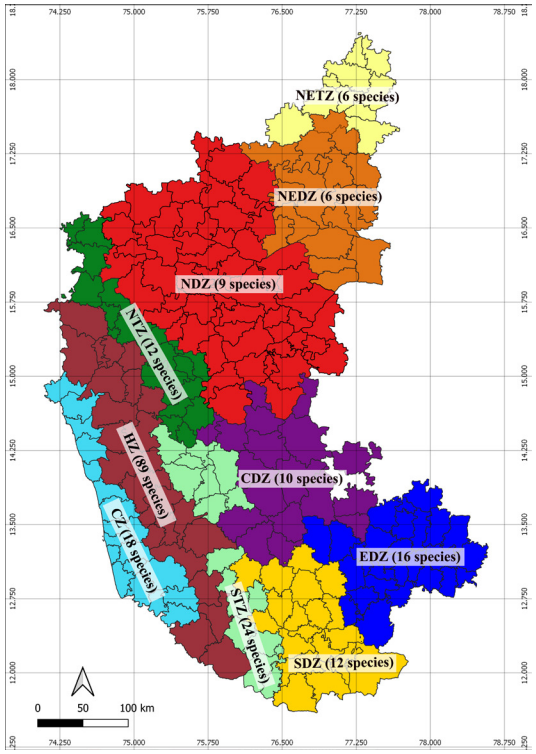


**Figure 1.** Map showing Agro-climatic zones in Karnataka with corresponding number of Amphibian species (Table 3).

*krishni*, and *Gegeneophis madhavai* were the unique species of amphibians reported for the Coastal Zone (CZ) of Karnataka.

As per the IUCN red list category assessment (IUCN, 2018) for amphibians, 4 species are categorised as Critically Endangered, 14 species as Endangered, 5 species as Vulnerable, 3 species as Near Threatened, 22 species as Least concern, 24 species as Data deficient, and a total of 28 species under Not assessed category.

Most of the amphibian studies in Karnataka were primarily focused on the Western Ghats region. There are reports and surveys carried out district-wise but not as a whole. Dinesh *et al.*, 2013 provided the maiden Amphibian checklist for the state where they reported 88 amphibian species of which 28 species were endemic to the state.

Here, we enlist a total of 102 species of amphibians for the state, of which 31 species are endemic to Karnataka. Due to taxonomic revisions, the species *Duttaphrynus microtympanum*, *Duttaphrynus stomaticus, Hylarana malabarica*, *Hylarana temporalis*, *Sphaerotheca rolandae* and *Indirana beddomii* earlier reported for Karnataka have not been taken into consideration in the present study.

## Discussion

In the amphibian species documentation and exploration history most of the species' discoveries from India were initiated during the 1920s by Rao during the British rule in India. Since then, a good number of amphibian species are being discovered at a regular phase. While earlier the discoveries mostly focused from the Western Ghats, now there are new species reports from Coastal Zones (Vineeth *et al.,* 2018) as well as the Deccan Plateau region (Deepak *et al*., 2020). In the current study highest amphibian species diversity is recorded in the Hilly Zone (HZ) with 89 species, followed by Southern Transition Zone (STZ) with 24 species; Coastal Zone (CZ) with 18 species; Eastern Dry Zone (EDZ) with 16 species; Southern Dry Zone (SDZ) and Northern Transition Zone (NTZ) with 12 species; Central Dry Zone (CDZ) with 10 species; Northern Dry Zone (NDZ) with 9 species; North Eastern Transition Zone (NETZ) and North Eastern Dry Zone (NEDZ) with 6 species.

The Occurrence of more species in the Hilly agroclimatic zone could be due to the higher elevations, moisture and a greater number of wet days. Zone (HZ), wherein in most of these species exhibit narrow endemicity within the state. Compared to other agroclimatic zones of Karnataka agriculture related activities are relatively less in the Hilly agroclimatic zone.

Habitat fragmentation is a severe threat to the dispersal of amphibians and their survival as they require both land and water for their survival and completion of the life cycle. Provisions of water bodies in the vicinity of agricultural landscapes support the viable populations of already available species in these regions. Additionally, pond ecosystems and wet lands ecosystems available within these agroclimatic zone need immediate conservation measures for the conservation of amphibians in Karnataka.

Amphibians are among the most diverse vertebrate groups on Earth, but many broad-scale approaches in ecology and evolution are still scarce for many amphibian species. The amphibian diversity from an agro-climatic zone perspective for Karnataka state will help in the development of monitoring techniques on which the status of amphibian species of the state can be assessed. Further, the ability to assess how well a species is faring is critical to ensure its future conservation. These surveys provide information on amphibian status trends around the state.

## Acknowledgements

KPD is thankful to the Director, Zoological Survey of India (ZSI), Kolkata; the Officer-in-charge, ZSI, WRC, Pune for the facilities and encouragement. CN is thankful to the Joint Registrar, Jain University (Bengaluru) for support and encouragement. PD is grateful to Rahmath Ataaz, Jayashankar, Scott Solomon, Alexander and Amit Hegde, for their support in field studies. PD is indebted to the Principal and the Head Department of Zoology, Mount Carmel College, Autonomous, Bengaluru for their support and grateful to Karnataka Forest Department for the field study permissions. We acknowledge the support of Sreejith Sreekumar ZSI, WGRC, Kozhikode for the studies. We are thankful to the anonymous reviewers for their suggestions and comments which greatly improved the first version of the manuscript.

## References

Ahmad, L., Habib Kanth, R., Parvaze, S. and Sheraz Mahdi, S. 2017. Agro-climatic and Agro ecological Zones of India. In: Experimental Agrometeorology: A Practical Manual. *Springer*, Cham. pp. 99-118. https://doi.org/10.1007/978-3-319-69185-5_15 PMCid:PMC5673532

Anonymous. 1976, Government of India, Ministry of agriculture and irrigation, Report of the climate and agriculture, part IV, *National Commission on Agriculture*, New Delhi.

Anonymous. 1989. Planning Commission of India, Agro-climatic Zones of India, pp. 1985-1990.

Biju, S.D., Garg, S., Gururaja, K.V., Shouche, Y.S. and Walujkar, S.A. 2014a. DNA barcoding reveals unprecedented diversity in Dancing Frogs of India (Micrixalidae, *Micrixalus*): a taxonomic revision with description of 14 new species. *Ceylon Journal of Science, Biological Sciences*, **43**(1): 87**.** https://doi.org/10.4038/cjsbs.v43i1.6850

Biju, S.D., Garg, S., Mahony, S., Wijayathilaka, N., Senevirathne, G. and Meegaskumbura, M. 2014b. DNA barcoding, phylogeny and systematics of Golden-backed frogs (*Hylarana*, Ranidae) of the Western Ghats-Sri Lanka biodiversity hotspot, with the description of seven new species. *Conributions to Zoology*, Amsterdam, **83**: 269–335. https://doi.org/10.1163/18759866-08304004

Biju, S.D., Van Bocxlaer, I., Mahony, S., Dinesh, K.P., Radhakrishnan, C., Zachariah, A., Giri, V.B. and Bossuyt, F. 2011. A taxonomic review of the Night Frog genus *Nyctibatrachus* Boulenger, 1882 in the Western Ghats, India (Anura: Nyctibatrachidae) with description of twelve new species. *Zootaxa*, **3029**: 1–96. https://doi.org/10.11646/zootaxa.3029.1.1

Deepak, P., Dinesh, K.P., Ohler, A., Shanker, K., Channakeshavamurthy, B.H. and Ashadevi, J.S. 2020. A new species of *Sphaerotheca* Günther, 1859 (Anura: Dicroglossidae) from the degraded urban ecosystems of Bengaluru, Deccan Plateau, India. *Zootaxa*, **4885**: 423–436 https://doi.org/10.11646/zootaxa.4885.3.6 PMid:33311271

Dinesh, K.P., Radhakrishnan, C. and Bhatta, G. 2008. A new species of *Nyctibatrachus* Boulenger (Amphibia: Anura: Nyctibatrachidae) from the surroundings of Bhadra Wildlife Sanctuary, Western Ghats, India. *Zootaxa*, **1914**: 45–56. https://doi.org/10.11646/zootaxa.1914.1.3

Dinesh, K.P., Radhakrishnan, C and Nirmal U Kulkarni. 2020. Amphibian Species Discovery Pattern in India: Past, Present and Future Trends, *In*: Exploring Cities and Countries of the World. **Vol. 2**; Eds. Kathie Summers, Nova Publishers, 187-198.

Dinesh, K.P., Radhakrishnan, C., Gururaja, K.V. and Bhatta, G.K. 2009. An annotated checklist of Amphibia of India with some insights into the patterns of species discoveries, distribution and endemism. *Records of Zoological Survey of India*, Occasional Paper No. **302**: 1-153pp.

Dinesh, K.P., Radhakrishnan, C., Manjunatha Reddy, A.H. and Gururaja, K.V. 2007. *Nyctibatrachus karnatakaensis* nom. nov., a replacement name for the giant wrinkled frog from the Western Ghats. *Current Science*, Bangalore, **93**: 246–250.

Dinesh, K.P., Radhakrishnan, C., Ray, S., Sethy, P.G.S. and Bhatta, G. K. 2013. Amphibia. In, Fauna of Karnataka, State Fauna Series 21. *Zoological Survey of India*, Kolkata: 389-434.

Dinesh, K.P., Vijayakumar, S.P., Channakeshavamurthy, B.H., Torsekar, V.R., Kulkarni, N.U. and Shanker. K. 2015. Systematic status of *Fejervarya* (Amphibia, Anura, Dicroglossidae) from South and SE Asia with the description of a new species from the Western Ghats of Peninsular India. *Zootaxa*, **3999**: 79–94. https://doi.org/10.11646/zootaxa.3999.1.5 PMid:26250327

Dinesh, K.P., Radhakrishnan, C., Deepak, P. and Kulkarni, N.U. 2023. A Checklist of Indian Amphibians with Common names for the country and their IUCN Conservation Status. pp 1–19. Version 5.0 (updated till January 2023) available at http://zsi.gov.in (online only).

Dutta, S.K. 1985. Replacement names for two Indian species of *Philautus* (Anura: Rhacophoridae). *Journal of the Bombay Natural History Society*, **82**: 219–220.

Dutta, S.K. and Ray, P. 2000. *Microhyla sholigari*, a new species of microhylid frog (Anura: Microhylidae) from Karnataka, India. *Hamadryad*, **25**(1): 38-44.

FAO. 1983. FAO, Guidelines: Land Evaluation for Rainfed Agriculture. Soils Bull. No. 52, FAO, Rome, p. 237.

Frost, D.R. 2023. Amphibian Species of the World: an Online Reference. Version 6.2 (date of access, 04/10/2023). Electronic Database accessible at https://amphibiansoftheworld.amnh.org/index.php. American Museum of Natural History, New York, USA. doi.org/10.5531/db.vz.0001

Gajbhiye, K.S. and Mandal, C. 2000. Agro-Ecological Zones, their Soil Resource and Cropping Systems. In: Status of Farm Mechanization in India, (CED Documentation Series K 30). *National Bureau of Soil Survey and Land Use Planning*, Nagpur.

Garg, S. and Biju, S.D. 2016. Molecular and morphological study of Leaping Frogs (Anura, Ranixalidae) with description of two new species. *PLoS One*, **11**: 1–36. https://doi.org/10.1371/journal.pone.0166326 PMid:27851823 PMCid:PMC5112961

Gururaja, K. V., Dinesh, K. P., Priti, H. and Ravikanth, G. 2014. Mud-packing frog: a novel breeding behaviour and parental care in a stream dwelling new species of *Nyctibatrachus* (Amphibia, Anura, Nyctibatrachidae). *Zootaxa*, **3796**(1): 33-61. https://doi.org/10.11646/zootaxa.3796.1.2 PMid:24870664

IUCN. 2018. The IUCN Red List of Threatened Species. 2017, Version 2017-1. www.iucnredlist.org.

Joshy, S.H., Alam, M.S., Kurabayashi, A., Sumida, M. and Kuramoto, M. 2009. Two new species of the genus *Euphlyctis* (Anura, Ranidae) from southwestern India, revealed by molecular and morphological comparisons. *Alytes*, **26**: 97-116.

Krishna Murthy, B.N. 2015. Comprehensive Hydrogeological Studies of South Bangalore Metropolitan Region using Remote Sensing and Geographic Information System Techniques. Thesis, Bangalore University.

Krishnamurthy, S. V. and Shakuntala, K. 1993. Amphibian fauna of Sringeri taluk (Chickamagalure district: Karnataka). *Journal of the Indian Institute of Science*, **73**(5): 443.

Kuramoto, M and Joshy, S. H. 2003. Two new species of the genus *Philautus* (Anura: Rhacophoridae) from the Western Ghats, Southwestern India. *Current Herpetology*, **22**: 51-60. https://doi.org/10.5358/hsj.22.51

Mandal, D.K., Mandal, C. and Singh, S.K. 2016. Agro-Ecological Regions of India (Revised), NBSS&LUP Publ. No. 170. ICARNBSS&LUP, Nagpur, India; p. 89. Date accessed on 25/05/2020. http://www.agriinfo.in/?page=topic&superid=1&topicid=425.

Pandya, H.B. and Bharadwaj, V.P. 2000. Agricultural productions and functions - Food vs Non-food Crops in India, Thesis, Gujarat University.

Priti, H., Roshmi, R.S., Ramya, B., Sudhira, H.S., Ravikanth, G., Aravind, N.A. and Gururaja, K.V. 2016a. Integrative taxonomic approach for describing a new cryptic species of bush frog (*Raorchestes*: Anura: Rhacophoridae) from the Western Ghats, India. *PloS one*, **11**(3): e0149382. https://doi.org/10.1371/journal.pone.0149382 PMid:26934213 PMCid:PMC4774957

Priti, H., Naik, C.R., Seshadri, K.S., Singal, R., Vidisha, M.K., Ravikanth, G. and Gururaja, K.V. 2016b. A New Species of *Euphlyctis* (Amphibia, Anura, Dicroglossidae) from the West Coastal Plains of India. *Asian Herpetological Research*, **7**: 229-241.

Raj, P., Dinesh, K.P., Das, A., Dutta, S.K., Kar, N.B. and Mohapatra, P.P. 2018. Two new species of cricket frogs of the genus *Fejervarya* Bolkay, 1915 (Anura: Dicroglossidae) from the Peninsular India. *Records of the Zoological Survey of India*, **118**: 1–21. https://doi.org/10.26515/rzsi/v118/i1/2018/121436

Ramachandra, T.V. 2007. Geospatial mapping of Bioenergy in Karnataka India. *Journal of energy and environment*, **6**: 28-44.

Rao, C.R.N. 1920. Some South Indian batrachians. *Journal of the Bombay Natural History Society*, **27**: 119–127.

Rao, C.R.N. 1922. Notes on Batrachia. *Journal of the Bombay Natural History Society*, **28**: 439–447.

Rao, C.R.N. 1937. On some new forms of Batrachia from S. India. *Proceedings of the Indian Academy of Sciences*, Section B **6**: 387–427. https://doi.org/10.1007/BF03051434

Rodgers, W.A. and Panwar, H.S. 1988. Planning a wildlife protected area network in India. 2 volumes, Project FO: IND/82/003, FAO, Dehradun, India, 339 pp.

Seshadri, K.S., Singal, R., Priti, H., Ravikanth, G., Vidisha, M.K., Saurabh, S., Pratik, M. and Gururaja, K.V. 2016. *Microhyla laterite* sp. nov., a new species of *Microhyla* Tschudi, 1838 (Amphibia: Anura: Microhylidae) from a laterite rock formation in South West India. *PloS one*, **11**(3): e0149727. https://doi.org/10.1371/journal.pone.0149727 PMid:26960208 PMCid:PMC4784882

Simon, E., Puky, M., Braun, M. and Tóthmérész, B. 2011. Frogs and toads as indicators in environmental assessment, In: Frogs: Biology, Ecology and Uses, Editor: James L. Murray, Nova Science Publishers, Inc.

Sreekumar, S. and Dinesh, K.P. 2020. Amphibians of Agro-Climatic Zones of Maharashtra with Updated Checklist for the State. *Records of the Zoological Survey of India*, **120**(1): 33-40.

Subramaniam, A.R. 1983. Agro-ecological zones of India, Archives of Meteorology, Geophysics, and Bioclimatology Series B, **32**(2-3): 329-333. https://doi.org/10.1007/BF02273984.

Venkateswarlu, J., Ramakrishna, Y.S. and Rao, A.S. 1996. Agro-climatic Zones of India. *Annals of Arid Zone*, **35**(1): 1-7.

Venu, G., Raju, N.G., Wilkinson, M., Browne, R.K., Varadh, K., Balakrishna, G.N. and Venkatachalaiah, G. 2020. First records of the Long-headed Caecilian, *Ichthyophis longicephalus* Pillai, 1986 (Gymnophiona: Ichthyophiidae) from the states of Karnataka and Tamil Nadu, India with comments on its conservation status. *Journal of Animal Diversity*, **2** (3): 5-10.

Vijayakumar, S.P., Dinesh, K.P., Prabhu, M.V. and Shanker, K. 2014. Lineage delimitation and description of nine new species of bush frogs (Anura: *Raorchestes*, Rhacophoridae) from the Western Ghats Escarpment. *Zootaxa*, **3893**: 451–488. https://doi.org/10.11646/zootaxa.3893.4.1 PMid:25544534

Vineeth, K.K., Radhakrishna, U.K., Godwin, R.D., Anwesha, S., Rajashekhar, K.P. and Aravind, N.A. 2018. A new species of *Microhyla* Tschudi, 1838 (Anura: Microhylidae) from West Coast of India: an integrative taxonomic approach. *Zootaxa*, **4420**(2): 151-179. https://doi.org/10.11646/zootaxa.4420.2.1 PMid:30313540

Wilkinson, M., Gower, D.J., Venu, G. and Venkatachalaiah, G. 2007. A new species of *Ichthyophis* (Amphibia: Gymnophiona: Ichthyophiidae) from Karnataka, India. *Herpetologica,* **63**: 511–518. https://doi.org/10.1655/0018-0831(2007)63[511:ANSOIA]2.0.CO;2