

Amphibians of Agro-Climatic Zones of Maharashtra with Updated Checklist for the State

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Abstract

So far, 52 species of Amphibia are known from Maharashtra. Considering the subsequent findings and eliminating the inaccuracies found in that checklist, the current checklist proposes 43 species of Amphibia for the State with the categorization of the amphibian species according to agro-climatic zones of the state to facilitate the future conservation strategies and inventorization.

Keywords: Agro-Climatic Zones, Amphibia, Checklist, Maharashtra

Introduction

Amphibian research in the State of Maharashtra was initiated in the late pre-independence era of British India. The first species of Amphibia described from the state was *Indirana leithii* (as *Rana leithii*) from Matheran, Bombay Presidency by Boulenger (1888) followed by *Fejervarya syhadrensis* (as *Rana limnocharis syhadrensis*) from the Poona and Nasik districts by Annandale in 1919 (Dinesh *et al.*, 2019; Frost, 2019).

In the post-independence era of India, the first species of amphibian described from Maharashtra was *Nyctibatrachus humayuni* by Bhaduri and Kripalani (1955). This was followed by *Indotyphlus battersbyi* by Taylor (1960); *Xanthophryne koynayensis* (as *Bufo koynayensis*) by Soman (1963); *Ansonia kamblei* (now junior synonym of *Duttaphrynus melanostictus*) by Ravichandran and Pillai (1990); *Gegeneophis danieli* by Giri, Wilkinson and Gower (2003); *Gegeneophis seshachari* by Ravichandran, Gower and Wilkinson (2003); *Indotyphlus maharashtraensis* by Giri, Gower and Wilkinson (2004); *Xanthophryne tigrinus* by Biju *et al.* (2009); *Pseudophilautus amboli* by Biju and Bossuyt (2009); *Nyctibatrachus danieli* by Biju *et al.* (2011); *Raorchestes ghatei* by Padhye *et al.* (2013); *Micrixalus*

uttaraghati by Biju *et al.* (2014a); *Indosylvirana caesari* by Biju *et al.* (2014b); *Indirana chiravasi* by Padhye, Modak, and Dahanukar (2014); *Hydrophylax bahuvistara* by Padhye *et al.* (2015); *Fejervarya cepfi* by Garg and Biju (2017); *Sphaerotheca pashchima* by Padhye *et al.* (2017) and *Fejervarya marathi* by Phuge *et al.* (2019). To date, a total of 20 species (18 are valid species) of amphibians are described from the political boundaries of the Maharashtra (Dinesh *et al.*, 2019; Frost, 2019).

The first amphibian checklist of Maharashtra was made by Padhye and Ghate (2012) based on published literature and their field studies between 1990 to 2011. They documented 52 species classified under 2 orders, 9 families and 22 genera. Among the 52 species documented 8 species and 2 genera turned out to be endemic to the state.

The landscape of India is highly heterogeneous from the coastal plains to the high elevated mountain hill ranges directly influenced by different climate and climatic seasons (Gajbhiye & Mandal, 2000). India has been classified into 15 different Agro-Climatic Zones in 1998 by the Planning commission of India based on the bioclimatic classification and land suitability for agriculture (FAO, 1983; Subramaniam, 1983; Krishnan,

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1988; Venkateswarlu *et al.*, 1996; Gajbhiye & Mandal, 2000; Mandal, *et al.*, 2016).

Physiographically the Maharashtra can be divided into three major regions, the Konkan (Konkan Coastal Strip), the Deccan hill range or the Western Ghats (Sahyadri Range) and the Maharashtra Plateau (Deccan Plateau). Across these physiographic regions there is considerable variation in the rainfall pattern which influences the vegetation and other edaphic factors; accordingly the state has been divided in to nine different agro-climatic zones (Table 1) (Dakhore *et al.*, 2017; Anonymous, 2013).

Since amphibians are considered as 'ecological indicators' (Simon *et al.*, 2011) their presence or absence adds value to the ecosystem they inhabit. With this backdrop, a maiden attempt has been made here to categorize the amphibian diversity in the nine different agro-climatic zones of Maharashtra based on literature studies and our field observations.

Material and Methods

The mapping and classification of Amphibian diversity presented here are based on Padhye & Ghatge (2012); Dinesh *et al.* (2019); Frost (2019); Garg *et al.* (2018); Phuge *et al.* (2019) the new species descriptions published from the state in the recent past as well as the different agro-climatic zones (Table 2) (Dakhore *et al.*, 2017; Anonymous, 2013) made for the Maharashtra.

Results

There have been no specific reports of Amphibian species from an Agro-climatic zone perspective / classification so far from Maharashtra. Therefore here we assign the species known so far from the state to the various agro-climatic zones in Maharashtra (Figure 1).

In the present analysis for anuran species *Duttaphrynus melanostictus*, *D. scaber*, *Euphlyctis cyanophlyctis*, *Fejervarya granosa*, *Hoplobatrachus tigerinus*, *Sphaerotheca pashchima*,

Table 1. Agro-climatic zones of Maharashtra (Dakhore *et al.*, 2017; Anonymous, 2013) (Figure 1).

Sl. No.	Agro-climatic zones in Maharashtra	Name of the Zone	Amphibian species diversity in numbers (percentage to total state diversity)
1.	Very high rainfall zone with lateritic soils (VRL)	South Konkan Coastal Zone	20 (47.6%)
2.	Very high rainfall zone with non lateritic soils (VRN)	North Konkan Coastal Zone	14 (33.3%)
3.	Ghat Zone (GH)	Western Ghat Zone / Ghat zone	36 (83.7%)
4.	Transition Zone 1 (TR1)	Sub Montane Zone/ Transition Zone 1	15 (35.7%)
5.	Transition Zone 2 (TR2)	Western Maharashtra Plain Zone / Transition-2	14 (33.3%)
6.	Scarcity Zone (SC)	Western Maharashtra Scarcity Zone/ Scarcity Zone	11 (26.2%)
7.	Assured Rainfall Zone (AR)	Central Maharashtra Plateau Zone / Assured Rainfall Zone	11 (26.2%)
8.	Moderate Rainfall Zone (MR)	Central Vidarbha Zone /Zone of Moderate Rainfall	13 (31.0%)
9.	High Rainfall Zone with soils from mixed parent material (HRM)	Eastern Vidharbha Zone/ High Rainfall Zone	13 (31.0%)

Table 2. Updated checklist of amphibians of Maharashtra considered under the nine different agro-climatic zones of Maharashtra

Sl. No.	Family	Species	IUCN Red List Category	VRL [#]	VRN [#]	GH [#]	TR1 [#]	TR2 [#]	SC [#]	AR [#]	MR [#]	HRM [#]
1.	Bufonidae	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes
2.	Bufonidae	<i>Duttaphrynus scaber</i> (Schneider, 1799)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes
3.	Bufonidae	<i>Duttaphrynus stomaticus</i> (Lutken, 1864)	LC	no	no	no	yes	yes	no	no	no	no
4.	Bufonidae	<i>Pedostibes tuberculatus</i> Gunther, 1875	EN	no	no	yes	no	no	no	no	no	no
5.	Bufonidae	<i>Xanthophryne koynayensis</i> (Soman, 1963)*	EN	no	no	yes	no	no	no	no	no	no
6.	Bufonidae	<i>Xanthophryne tigerina</i> Biju, Bocxlaer, Giri, Loader & Bossuyt, 2009*	CE	no	no	yes	no	no	no	no	no	no
7.	Dicroglossidae	<i>Euphlyctis cyanophlyctis</i> (Schneider, 1799)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes
8.	Dicroglossidae	<i>Fejervarya cepfi</i> Garg & Biju, 2017	NA	yes	yes	yes	no	no	no	no	no	no
9.	Dicroglossidae	<i>Fejervarya gomantaki</i> Dinesh, Vijayakumar, Channakeshavamurthy, Toreskar, Kulkarni & Shankar, 2015	NA	yes	no	yes	no	no	no	no	no	no
10.	Dicroglossidae	<i>Fejervarya granosa</i> Kuramoto, Joshy, Kurabayashi & Sumida, 2007	NA	yes	yes	yes	yes	yes	yes	yes	yes	yes
11.	Dicroglossidae	<i>Fejervarya marathi</i> Phuge, Dinesh, Andhale, Hakare & Pandit, 2019*	NA	no	no	yes	no	no	no	no	no	no
12.	Dicroglossidae	<i>Fejervarya syhadrensis</i> (Annandale, 1919)	LC	yes	yes	yes	yes	yes	no	no	no	no
13.	Dicroglossidae	<i>Hoplobatrachus tigerinus</i> (Daudin, 1802)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes
14.	Dicroglossidae	<i>Sphaerotheca dobsonii</i> (Boulenger, 1882)	LC	yes	no	no	no	no	no	no	no	no

15.	Dicroglossidae	<i>Sphaerotheca pashchima</i> Padhye, Dahanukar, Sulakhe, Dandekar, Limaye & Jamdade, 2017	NA	yes	yes	yes	yes	yes	yes	yes	yes	yes
16.	Micrixalidae	<i>Micrixalus uttaraghathi</i> Biju, Garg, Gururaja, Souche & Walujkar, 2014*	NA	no	no	yes	no	no	no	no	no	no
17.	Microhylidae	<i>Microhyla nilphamariensis</i> Howlader, Nair, Gopalan & Merilä, 2015	NA	yes	yes	yes	yes	yes	yes	yes	yes	yes
18.	Microhylidae	<i>Microhyla ornata</i> (Dumeril & Bibron, 1841)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes
19.	Microhylidae	<i>Microhyla rubra</i> (Jerdon, 1854)	LC	no	no	no	yes	no	no	no	no	no
20.	Microhylidae	<i>Uperodon globulosus</i> (Gunther, 1864)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes
21.	Microhylidae	<i>Uperodon mormorata</i> (Rao, 1937)	EN	no	no	yes	no	no	no	no	no	no
22.	Microhylidae	<i>Uperodon systoma</i> (Schneider, 1799)	LC	no	no	no	yes	yes	no	no	no	no
23.	Microhylidae	<i>Uperodon taprobanicus</i> (Parker, 1934)	LC	no	no	no	no	no	no	no	yes	yes
24.	Microhylidae	<i>Uperodon variegatus</i> (Stoliczka, 1872)	LC	no	no	no	no	no	no	no	yes	yes
25.	Nyctibatrachidae	<i>Nyctibatrachus danieli</i> Biju, Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri & Bossuyt, 2011*	NA	no	no	yes	no	no	no	no	no	no
26.	Nyctibatrachidae	<i>Nyctibatrachus humayuni</i> Bhaduri & Kripalani, 1955*	VU	yes	no	yes	no	no	no	no	no	no
27.	Nyctibatrachidae	<i>Nyctibatrachus petraeus</i> Das & Kunte, 2005	LC	no	no	yes	no	no	no	no	no	no
28.	Ranidae	<i>Clinotarsus curtipes</i> (Jerdon, 1853)	NT	no	no	yes	no	no	no	no	no	no

29.	Ranidae	<i>Hydrophylax bahuvistara</i> Padhye, Jadhav, Modak, Nameer & Dahanukar, 2015	NA	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
30.	Ranidae	<i>Indosylvirana caesari</i> (Biju, Garg, Mahony, Wijayathilak, Senevirathne & Meegaskumbura, 2014)	NA	no	no	yes	no	no	no	no	no	no	no
31	Ranixalidae	<i>Indirana chiravasi</i> Padhye, Modak & Dahanukar, 2014*	NA	no	no	yes	no	no	no	no	no	no	no
32.	Ranixalidae	<i>Indirana leithii</i> (Boulenger, 1888)*	VU	no	no	yes	no	no	no	no	no	no	no
33.	Ranixalidae	<i>Indirana salelkari</i> Modak, Dahanukar, Gosavi & Padhye, 2015	NA	no	no	yes	no	no	no	no	no	no	no
34.	Rhacophoridae	<i>Polypedates maculatus</i> (Gray, 1830)	LC	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
35.	Rhacophoridae	<i>Pseudophilautus amboli</i> (Biju and Bossuyt, 2009)	CE	yes	no	yes	no	no	no	no	no	no	no
36.	Rhacophoridae	<i>Raorchestes bombayensis</i> (Annandale, 1919)	VU	yes	no	yes	no	no	no	no	no	no	no
37.	Rhacophoridae	<i>Raorchestes ghatei</i> Padhye, Sayyed, Jadhav & Dahanukar, 2013*	NA	no	no	yes	no	no	no	no	no	no	no
38..	Ichthyophiidae	<i>Ichthyophis bombayensis</i> Taylor, 1960	LC	yes	yes	yes	no	no	no	no	no	no	no
39.	Ichthyophiidae	<i>Ichthyophis davidi</i> Bhatta, Dinesh, Prashanth, Kulkarni & Radhakrishna, 2011	NA	no	no	yes	no	no	no	no	no	no	no
40.	Indotyphlidae	<i>Gegeneophis danieli</i> Giri, Wilkinson & Gower, 2003	DD	no	no	yes	no	no	no	no	no	no	no
41.	Indotyphlidae	<i>Gegeneophis seshachari</i> Ravichandran, Gower & Wilkinson, 2003*	DD	yes	no	no	no	no	no	no	no	no	no
42.	Indotyphlidae	<i>Indotyphlus battersbyi</i> Taylor, 1960*	DD	no	no	yes	no	no	no	no	no	no	no

43.	Indotyphlidae	<i>Indotyphlus maharashtraensis</i> Giri, Gower & Wilkinson, 2004*	DD	no	no	yes	no	no	no	no	no	no
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*refer Table 1 for the codes of nine different agro-climatic zones for the state Maharashtra); here ‘no’ refers for absence and ‘yes’ refers for presence of an species from the respective agro-climatic zone; *refers to the species endemic to the state Maharashtra; CE = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NA = Not Assessed.

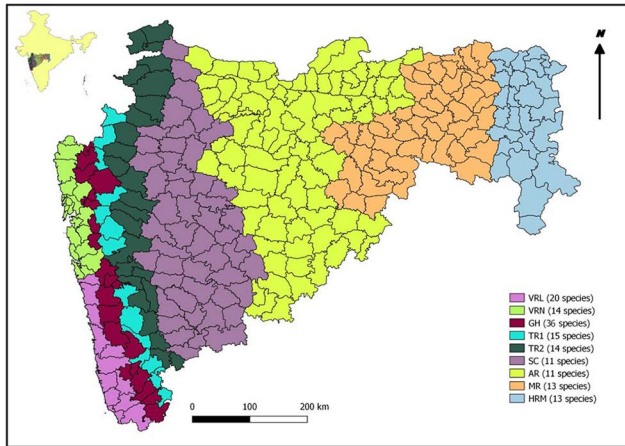


Figure 1. Map showing Agro-climatic zones in the state of Maharashtra with the details of species categorized against each zone (Details in Table 1).

Microhyla nilphamariensis (Garg et al., 2018), *Microhyla ornata*, *Uperodon globulosus*, *Hydrophylax bahuvistara* and *Polypedates maculatus* are represented in all the nine agro-climatic zones of Maharashtra.

Most of the endemic species (*Xanthophryne koynayensis*, *X. tigerina*, *Micrixalus uttaraghati*, *Nyctibatrachus danieli*, *N. humayuni*, *Indirana chiravasi*, *I. leithii*, *Raorchestes ghatei*, *Gegeneophis seshachari*, *Indotyphlus battersbyi*, *I. maharashtraensis*) of amphibians are restricted to the Ghat zones highlighting the preference of forested high altitude, low temperature and high rainfall areas.

Pertaining to the IUCN Red list category (IUCN, 2018) 2 species fall under the Critically Endangered, 3 species under Endangered, 3 species under Vulnerable, 1 species under Near Threatened, 16 species under Least Concern, 14 species under Data Deficient and 14 species under the Not Assessed category.

Though Padhye & Ghate (2012) enlisted 52 species from Maharashtra, in the current updated checklist we are documenting only 43 species classified under 21 genera and 10 families. From the work of Padhye & Ghate (2012) we are not considering the following species for the state Maharashtra: *Duttaphrynus beddomii*, *D. microtypanum* and *D. parietalis* (their range of distribution being restricted to the central and southern Western Ghats); *Euphylyctis hexadactylus* (species restricted to east coast of India); *Fejervarya limnocharis* (species restricted to south east Asia); *F. brevipalmata*, *F. keralensis*, *F. nilagirica*, *F. rufescens* and *F. sahyadris* (species restricted to central and southern Western Ghats); *Sphaerotheca rolandae* (species restricted to Sri Lanka and south India); *Ramanella montana* (now *Uperodon montanus*), *Nyctibatrachus major*, *Hylarana aurantiaca* (now *Indosylvirana aurantiaca*) and *Hylarana malabarica* (now *Hydrophylax malabarica*) (species restricted to central and southern Western Ghats); *Hylarana temporalis* (now *Indosylvirana temporalis*) (species restricted to Sri Lanka); *Indirana beddomii* and *I. phrynoderma* (species restricted to central and southern Western Ghats); *Polypedates leucomystax* (species restricted to north east India and South east Asia); *Raorchestes glandulosus* and *R. tuberothumerus* (species restricted to central and southern Western Ghats).

Discussion

The amphibian data classification of Maharashtra based on the agro-climatic zones is expected to assist the researchers, the biodiversity managers, State Forest Department and State Biodiversity Board in drawing the conservation status of the Amphibian species of the state. As the boundaries of the agro-climatic zones are dicey and majority of the amphibians are habitat specialists, a holistic, systematic, agro-climatic zone based survey/exploratory studies are warranted in the near future to decipher the exact amphibian diversity of the agro-climatic zones in Maharashtra.

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