

Threatened species of Bush frogs of the genus *Raorchestes* (Amphibia: Anura) in India

Ugrožene vrste žaba roda *Raorchestes* (Amphibia: Anura) u Indiji

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Abstract

The genus *Raorchestes* belongs to the Rhacophoridae family. A total of 52 species were reported from India, nine of which were described in 2014. This frog genus is under grave threats, especially due to the habitat degradation caused by the cultivation of eucalyptus, coffee and tea plantations, deforestation, agricultural practices and unplanned tourism.

Key words: frogs, diversity, distribution

Sažetak

Rod *Raorchestes* spada u porodicu Rhacophoridae. Ukupno 52 vrste ovog roda su do sada zabilježene u Indiji, od kojih je devet opisano u 2014. godini. Ovaj rod se nalazi pod velikim prijetnjama, posebno radi degradacije staništa uzrokovane plantažama eukaliptusa, kave i čaja, agrikulturom i neplanskim turizmom.

Ključne riječi: žabe, raznolikost, distribucija

The species belonging to the genus *Raorchestes* are characterised by adult snout-vent length between 15 and 45 mm, no vomerine teeth, a large transparent gular pouch while croaking, nocturnal activity and direct development occurring within the egg membrane and without free-swimming tadpoles (Biju et al. 2010). This genus was named in honour of C. R. Narayan Rao in recognition of his contribution to Indian batrachology. How poorly this genus is known is evident in the fact that nine new species of bush frog have been discovered (reported on 10 December 2014) in the Western Ghats, a mountainous region in southern India, which is a biodiversity hotspot. Some of these newly discovered frogs are as small as a thumbnail while others are brilliantly coloured or plain coloured (Vijayakumar et al. 2014). The newly described species are: *Raorchestes archeos* Vijayakumar, Dinesh, Prabhu & Shanker, 2014, *Raorchestes aureus* Vijayakumar, Dinesh, Prabhu & Shanker, 2014, *Raorchestes blandus* Vijayakumar, Dinesh, Prabhu & Shanker, 2014, *Raorchestes echinatus* Vijayakumar, Dinesh, Prabhu & Shanker, 2014, *Raorchestes emeraldi* Vijayakumar, Dinesh, Prabhu & Shanker, 2014., *Raorchestes flaviocularis* Vijayakumar, Dinesh, Prabhu & Shanker, 2014, *Raorchestes indigo* Vijayakumar, Dinesh, Prabhu & Shanker, 2014, *Raorchestes leucolatus* Vijayakumar, Dinesh, Prabhu & Shanker, 2014 and *Raorchestes primarrumpfi* Vijayakumar, Dinesh, Prabhu & Shanker, 2014. The total number of bush frog species in the Western Ghats is increased to a total of 55, with 52 species under the genus *Raorchestes* (Vijayakumar et al. 2014).

According to the IUCN (2013) Red list of threatened species 78 species of amphibians are

considered as threatened in India. Of those, 23,68 % are considered to be Data Deficient; 30,12 % Least Concern; 2,63 % Near Threatened; 7,02 % Vulnerable; 9,36 % Endangered; 4,97 % Critically Endangered and 0.29 % Extinct (Venkataraman & Deuti 2014).

Raorchestes chlorosomma (Biju & Bossuyt 2009) is known only from 1410 m a.s.l. in Munnar, Kerala, on an area less than 100 km². The species' habitat is lost to large-scale tea, eucalyptus and wattle plantations. The demanding tourism industry is also becoming a serious concern. Though the species seems to be adaptable, its tolerance to degraded habitats is not specifically known. It is considered to be Critically Endangered (Venkataraman & Deuti 2014).

Raorchestes griet (Bossuyt 2002) is found in bushes above 1000 m a.s.l. in the Western Ghats. This endemic frog is considered as Critically Endangered because of its limited extent of occurrence (EOO). Currently all individuals are found in a single habitat which is influenced by habitat fragmentations due to tea and eucalyptus plantation.

The Kaikatti Bush frog, *Raorchestes kaikatti* (Biju & Bossuyt 2009) is arboreal and nocturnal. It is listed as Critically Endangered because of its EOO and area of occupancy (AOO), estimated to be less than 10 km². Habitat loss due to deforestation, agricultural practices and unplanned tourism are the major threats to this species.

Raorchestes marki (Biju & Bossuyt 2009) is considered as Critically Endangered because of its

AOO estimated to be less than 10 km² (Venkataraman & Deuti 2014). This species is reported only from the Kaikatti – Nelliampathi hills. Agricultural practices and destruction of green forest are a serious threat to this species.

Raorchestes munnarensis (Biju and Bossuyt 2009) breeds by direct development. This species is considered as Critically Endangered because of its EOO which is less than 100 km². One of the major threats to the natural habitats of this species are the tea plantations.

The Ponnudi Bush frog, *Raorchestes ponmudi* (Biju & Bossuyt 2005) is known from a patch of evergreen forest surrounded by grassland and considered as Critically Endangered because of its EOO which is less than 100 km² (Venkataraman & Deuti 2014). Habitat destruction is the major threat to this species.

Raorchestes resplendens (Biju et al. 2010) is restricted to only a 3 km² patch at the top of Anamudi peak. It is considered to be Critically Endangered because of its EOO and AOO. Less than 300 individuals were observed over the last six years.

Raorchestes shillongensis (Pillai & Chanda 1973) is only known from the surroundings of Shilong, Khasi hills, and Meghalaya in north-eastern India. Due to its less than 100 km² EOO it is considered as Critically Endangered. Collection of wood for subsistence use, clearing of undergrowth and urbanization are the major threats to this species.

Raorchestes sushili (Biju & Bossuyt 2009) is considered as Critically Endangered because of its EOO which is less than 100 km². One of the major

threats to this species are tea and cardamom plantations.

Raorchestes charius (Rao 1937) is often found within leaf litter. This species is listed as Endangered because its AOO is less than 500 km². The major threat is habitat loss due to agricultural practices.

Raorchestes nerostagona (Biju & Bossuyt 2005) is considered as Endangered because its EOO is less than 5000 km² (Venkataraman & Deuti 2014). Accumulation lakes for hydroelectric powerplants are one of the threats to this species.

Raorchestes signatus (Boulenger 1882) is considered Endangered because of the clearing of native forests for intensively cultivated areas.

Raorchestes tinniens (Jerdon 1853) is found in leaf litter and under ground cover. Considered as Endangered because its EOO is less than 5000 km² (Venkataraman & Deuti 2014). Local infrastructural development is the main threat to this species.

Raorchestes bobingeri (Biju & Bossuyt 2005) is listed as Vulnerable. Expansion of surrounding tea plantations is the major threat for its habitat destruction.

Raorchestes bombayensis (Annandale 1919) is Vulnerable because its EOO is less than 20 000 km² and its AOO is less than 2 000 km². Unplanned tourism, deforestation, and infrastructure expansion are main threats to this species.

Raorchestes chromasynchysi (Biju & Bossuyt 2009) (Fig. 1) is placed under Vulnerable because its extent of occurrence is estimated to be

7204 km². The major threats are habitat loss, coffee plantations and road traffic in the Coorg area (Venkataraman & Deuti 2014).

Raorchestes luteolus (Kuramoto & Joshy 2003) (Figure 2.) is listed as Data Deficient because it has been described only recently.

Raorchestes tuberochelus (Kuramoto & Joshy 2003) (Figure 3.) is listed as Data Deficient because there is very little information on its extent of occurrence, status and ecological requirements.

Raorchestes dubois (Biju & Bossuyt 2006) is known only from a single location - Kodaikanal in Dindigul Anna District, Tamil Nadu State, in the southern Western Ghats of India.

Raorchestes glandulosus (Jerdon 1853) (Figure 4.) is Vulnerable because its EOO is less than 20 000 km²; its distribution is greatly fragmented. It is threatened by the conversion of native forest to intensively cultivated areas.

Raorchestes graminirupes (Biju & Bossuyt 2005) is known only from a single location - Ponmudi Hill in the northern part of the Agasthyamala Hill range. One of the major threats to this species are deforestation, agricultural practices and unplanned tourism (Venkataraman & Deuti 2014).

It has been considered that the issues like carrying capacity, land degradation, pollution, deforestation, climate change, solid wastes etc. are the main problems the bush frogs face. From the various studies it is clear that the environmental effect of tourism development in India differs from

region to region. One cannot study and plan the same for all the regions.

Bush frogs of the genus *Raorchestes* are distributed mostly in the Western Ghats Escarpment of Peninsular India. The knowledge about the species in this genus is not complete and there is doubt in the systematic status of species recognized only by external morphology. In this paper I have documented all extant valid species of genus *Raorchestes* from India along with its conservation status.

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Western Ghats Escarpment. Zootaxa 3893(4): 451-488.



Figure 1. *Raorchestes chromasynchysi* Photo by Vipin Bhaliga.

Slika 1. *Raorchestes chromasynchysi* Fotografirao Vipin Bhaliga.



Figure 2. *Raorchestes luteolus* Photo by Vipin Bhaliga.

Slika 2. *Raorchestes luteolus* Fotografirao Vipin Bhaliga.



Figure 3. *Raorchestes tuberochumerus* Photo by Vipin Bhaliga.

Slika 3. *Raorchestes tuberochumerus* Fotografirao Vipin Bhaliga.



Figure 4. *Raorchestes glandulosus* Photo by Vipin Bhaliga.

Slika 4. *Raorchestes glandulosus* Fotografirao Vipin Bhaliga.

Table 1. List of species of genus *Raorchestes* occurring in India with their conservation status according to the IUCN Red List.

Tablica 1. Popis vrsta roda *Raorchestes* prisutne u Indiji sa njihovim statusom ugroženosti prema IUCN Crvenom popisu.

	Species name	Conservation status
1	<i>Raorchestes agasthyaensis</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
2	<i>Raorchestes akroparallagi</i> (Biju and Bossuyt, 2009)	NE
3	<i>Raorchestes anili</i> (Biju and Bossuyt, 2006)	LC
4	<i>Raorchestes archaeos</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
5	<i>Raorchestes aureus</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
6	<i>Raorchestes beddomii</i> (Günther, 1876)	NE
7	<i>Raorchestes blandus</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
8	<i>Raorchestes bobingeri</i> (Biju and Bossuyt, 2005)	VU
9	<i>Raorchestes bombayensis</i> (Annandale, 1919)	VU
10	<i>Raorchestes chalazodes</i> (Günther, 1876)	NE
11	<i>Raorchestes charius</i> (Rao, 1937)	EN
12	<i>Raorchestes chlorosomma</i> (Biju and Bossuyt, 2009)	CE
13	<i>Raorchestes chotta</i> (Biju and Bossuyt, 2009)	DD
14	<i>Raorchestes chromasynchysi</i> (Biju and Bossuyt, 2009)	VU
15	<i>Raorchestes coonoorensis</i> (Biju and Bossuyt, 2009)	LC
16	<i>Raorchestes crustai</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
17	<i>Raorchestes dubois</i> (Biju and Bossuyt, 2006)	VU
18	<i>Raorchestes echinatus</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
19	<i>Raorchestes emeraldi</i> sp. nov.	NE
20	<i>Raorchestes flaviventris</i> (Boulenger, 1882)	DD
21	<i>Raorchestes flaviocularis</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
22	<i>Raorchestes ghatei</i> Padhye, Sayyed, Jadhav and Dahanukar, 2013	NE
23	<i>Raorchestes glandulosus</i> (Jerdon, 1853)	VU
24	<i>Raorchestes graminirupes</i> (Biju and Bossuyt, 2005)	VU
25	<i>Raorchestes griet</i> (Bossuyt, 2002)	CE
26	<i>Raorchestes hassanensis</i> (Dutta, 1985)	NE
27	<i>Raorchestes indigo</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
28	<i>Raorchestes jayarami</i> (Biju and Bossuyt, 2009)	NE
29	<i>Raorchestes johnceei</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
30	<i>Raorchestes kadalarensis</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
31	<i>Raorchestes kaikatti</i> (Biju & Bossuyt, 2009)	CE
32	<i>Raorchestes kakachi</i> Seshadri, Gururaja and Aravind, 2012	NE
33	<i>Raorchestes leucolatus</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
34	<i>Raorchestes luteolus</i> (Kuramoto and Joshy, 2003)	DD
35	<i>Raorchestes manohari</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
36	<i>Raorchestes marki</i> (Biju and Bossuyt, 2009)	CE
37	<i>Raorchestes montanus</i> (Jerdon, 1875)	NE
38	<i>Raorchestes munnarensis</i> (Biju and Bossuyt, 2009)	CE
39	<i>Raorchestes nerostagona</i> (Biju and Bossuyt, 2005)	EN

	Species name	Conservation status
40	<i>Raorchestes ochlandrae</i> (Gururaja, Dinesh, Palot, Radhakrishnan and Ramachandra, 2007)	DD
41	<i>Raorchestes ponmudi</i> (Biju and Bossuyt, 2005)	CE
42	<i>Raorchestes primarrumpfi</i> Vijayakumar, Dinesh, Prabhu and Shanker, 2014	NE
43	<i>Raorchestes ravii</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
44	<i>Raorchestes resplendens</i> Biju, Shouche, Dubois, Dutta and Bossuyt, 2010	CE
45	<i>Raorchestes signatus</i> (Boulenger, 1882)	EN
46	<i>Raorchestes sushili</i> (Biju and Bossuyt, 2009)	CE
47	<i>Raorchestes theuerkaufi</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
48	<i>Raorchestes thodai</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE
49	<i>Raorchestes tinniens</i> (Jerdon, 1854)	EN
50	<i>Raorchestes travancoricus</i> (Boulenger, 1891)	
51	<i>Raorchestes tuberothumerus</i> (Kuramoto and Joshy, 2003)	DD
52	<i>Raorchestes uthamani</i> Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot and Kalesh, 2011	NE