Assessing the distribution and conservation status of Variable Bush Frog (*Raorchestes chalazodes* Gunther, 1876*)* in the Konni Bio-reserve – Shenduruni Wildlife Sanctury (Konni Forest Division, Achankovil Forest Divison , Thenmala Forest Divison and Shenduruni Wildlife Division) of Western Ghats, India

Final report

(2014-2015)

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Summary

Amphibians and their tadpoles are significant in the maintenance of ecosystems, playing a crucial role as secondary consumers in the food chain, nutritional cycle, and pest control. Over the past two decades, amphibian research has gained global attention due to the drastic decline in their populations due to various natural and anthropogenic causes. Several new taxa have been discovered during this period, including in the Western Ghats and Northeast regions of Indian subcontinent. In this backdrop, the detailed account on the population and conservation status of *Raorchestes chalazodes*, a Rhacophorid frog which was rediscovered after a time span of 136 years was studied in detail. Forests of Konni bio reserve - Shenduruni wildlife sanctuary were selected as the study area and recorded the population and breeding behavior of the critically endangered frog.

Introduction

India, which is one of the top biodiversity hotspots of the world, harbors a significant percentage of global biodiversity. Its diverse habitats and climatic conditions are vital for sustaining this rich diversity. India also ranks high in harboring rich amphibian diversity. The country, ironically also holds second place in Asia, in having the most number of threatened amphibian species with close to 25% facing possible extinction (IUCN, 2009). The most recent IUCN assessments have highlighted amphibians as among the most threatened vertebrates globally, with nearly one third (30%) of the world's species being threatened (Hof *et al.,* 2011). Global threats include anthropogenic land use changes that lead to habitat destruction and fragmentation, environmental pollution, direct exploitation for food, increase in ultraviolet B radiation due to anthropogenic ozone depletion, spread of invasive species, and climate change that may also interact with the deadly disease Chytridiomycosis (caused by the chytrid fungus *Batrachochytrium dendrobatidis*) which is devastating amphibian populations worldwide (Hof et al., 2011).

The Western Ghats mountain range supports the greatest diversity of endemic amphibians in India, with five families and a subfamily being endemic to the region. Almost 90% (158 out of 181) of the amphibian species found in the Western Ghats are endemic, with 75 new species described over a period of 10 years (2003–2012), which is an increase

of almost 70% (Biju at al., 2013). This upsurge in novelties is a result of intensive surveys and the advent of molecular tools (eg. Biju & Bossuyt, 2009; Nair *et al*., 2012; Van Bocxlaer *et al*. 2012; Abraham *et al*., 2013). As one of the most important landscapes for amphibian diversity in the Western Ghats, the state of Kerala needs special attention. A comprehensive list of amphibian diversity and their distributional range is still lacking for many protected areas of the state.

Studies on amphibians in Kerala dates back to early descriptions in the volumes of the Fauna of British India (Boulenger 1882, Boulenger 1890, Boulenger 1892) as well as treatises by T. C. Jerdon and Albert Gunther. These were followed by a list of taxa in Batrachians of Travancore (Kanyakumari to present Munnar (Devikulam Taluk)) by Ferguson (1904) and also tadpole descriptions by Annandale & Rao (1916, 1917). Other significant work on amphibians of Kerala state are by Pillai & Pattabiraman (1981, 1990), Inger (1984), Biju (2001), Biju & Bossuyt (2003), Easa (2003) and Sivaprasad (2013). Since then, several taxonomic revisions and new species have been described by Biju & Bossuyt (2005a, 2005b, 2005c), Biju *et al*. (2007), Gururaja *et al*. (2007), Biju & Bossuyt (2009), Biju *et al*. (2010), Zachariah *et al*. (2011a, 2011b), Biju *et al*. (2011), Abraham *et al*. (2013), Biju *et al*. (2014a, 2014b), Vijayakumar *et al*. (2014), and Peloso *et al*. (2014). In addition, a checklist of the amphibians of Kerala, with 104 species, was published by Dinesh *et al*. (2010). Finally, the threat statuses of these amphibians were assessed in order to understand what kind of challenges afflicts the various taxa within the protected areas.

As much of the historical range of endemic frogs has undergone widespread reduction, and with threats such as impact from climate change, it is imperative to develop a scientific understanding of these species, which are relict Gondwanan clades. Understanding baseline ecological patterns of these amphibians can help to recognize and conserve other related taxa in this region, on which we have no information. Most of frog species belonging to endemic families are associated with streams and leaf litter habitats of Western Ghats, where much of their original habitat is still mostly intact. But, broad threats exist, such as large dams (submergence of vast tracts), check dams (smaller dams obstruct flow of smaller streams, thus affecting stream ecology), roads (tourism and pilgrimage activities could cause numerous amphibian road kills) and exotic tree plantations (Acacia

and Eucalyptus plantations which can cause unknown impacts on amphibians). But the impact of such threats to different amphibian species even in protected areas is unknown. Habitat in much of the historical range of these species, outside of the protected area network has been decimated and converted to large monocultures of tea and cardamom, as well as human habitations.

The lack of baseline ecological information on such important species has hampered past and contemporary conservation attempts. The absence of information on larval types and habitats make monitoring of entire life stages of amphibians impossible, but threats such as disease, pollution and check dams could have wide reaching impacts on the various life stages. Mortality at the larval stage can impact recruitment of populations and have serious consequences, which are presently unrecognized.

Raorchestes chalazodes (chalazodes bubble-nest frog, white-spotted bush frog, or Günther's bush frog) is a species of frog in the Rhacophoridae family. The specific name *chalazodes* is composed of the Greek word chalaza meaning grain and odes for the derived adjective, reflecting white granulation of the body (Frost, Darrel R. (2013). Using 'chalazodes' in the common name, as if it were a proper noun, is probably a misinterpretation. Albert C. L. G. Günther described *Raorchestes chalazodes* (as Ixalus chalazodes) based on a single female collected by Colonel Richard Henry Beddome from 'Travancore'. The original holotype, a female, was 28 mm (1.1 in) in snout-vent length. Ventral region is purplish white and there are dark black-blue spots on the groin region. A unique distinctive trait is its black iris with golden patches. In life, overall body coloration of Raorchestes chalazodes is green.

Chalazodes Bubble-nest Frog (*Raorchestes chalazodes*) is listed as a Critically Endangered Species. After its rediscovery after 136 years, it is not yet recorded in the south part of Western Ghats after the Aryankavu Gap in the Kollam district, Kerala. Konni Reserve Forest comes within the vicinity of 100 sq. Km. to Aryankavu Gap. But Shenduruni Wls have an extensive population of *Raorchestes chalazodes*. *Raorchestes chalazodes* has a highly restricted range where the extent of occurrence is less than 100 Sq. Km and the area of occupancy is less than 10 Sq. Km. It’s population is enormously decreasing and there is a

continuing decline in its extent. Its habitat is severely fragmented mainly due to the conversion of natural forest to cultivation and plantation. As it is not known with certainty from any protected areas, improved protection of remaining habitat is recommended by IUCN.

Study Area

Konni Reserve Forest

The Konni Reserve Forest of Western Ghats is one of the hotspots of diversity and endemism for several frog species. It falls between 9^{o} 1'32" - 9^{o} 21'57" N and 76^{o} 47'30" - 77^{o} 12'18". The Konni Forest Division is composed of different forest types, mainly due to the influence of elevation, rainfall and temperature. The division owns a total area of 331.65 km^2, which includes 320.553 km^2 of reserved forests, 11.021 km^2 of reserve land, and 0.076 km^2 of government lands. The largest portion of the forest type is moist deciduous, covering an area of 557.16 ha, and then semi evergreen (730.32ha), tree savanna/grassland (675. 01ha), evergreen (194.12ha), plantation (1642.55ha) and remaining portion covered by settlements and water bodies.

Achencovil Forest Division

Achencovil Forest Division falls under Kollam and Pathanamthitta Revenue Districts. Achencovil River that serves as the inter-district boundary flows almost east to west, dividing the tract into two segments. The northern segment comprising Kallar and Kanayar Ranges and the North Section of Achencovil Range comes within the Aravappulam Village in Kozhenchery Taluk of Pathanamthitta District, while the southern segment, consisting of the remaining portion of the Achencovil Range (South Section) falls within the Arienkavu Village in Pathanapuram Taluk of Kollam District. Similarly, the northern and southern segments fall within the Aravappulam Grama Panchayat and Arienkavu Grama Panchayat respectively. The Headquarters of the Division is Achencovil, which is a Forest Village situated about 43 Kms east of Punalur. The other nearby town is Shencotta, lying about 30 Kms away on the eastern side in Tamil Nadu State. The Punalur – Alimukku – Achencovil - Shencotta Road connects these towns. The tract lies within 9° to 9° 15" North Latitude and

77° to 77° 16” 30’ East Longitudes. This Division is blessed with vast expanse of natural forests. It is estimated that the extent of the natural forests will be about 210 Km^2, comprising evergreen, semi-evergreen, and deciduous type of forests. Total area of the Division is 285.868 Km^2. Which is further divided into three Ranges, viz., Achencovil Range, Kallar Range and Kanayar Range.

Thenmala Division

The net effective area of Thenmala Division is 14075.24 Ha consisting Kulathupuzha, Aryankavu and Edamon teak plantation and reserve forests. The Division is surrounded by Achencoil Forest Division in the North, Thiruvananthapuram Forest Division in the South, Shenduruni Wildlife Sanctuary in the East and Punalur Forest Division in the West.

It is a verdant belt of dense forest that gets good rain, moderate temperature and well drained soil that support substantial vegetation. The diverse forest ecosystem is being highly fragmented due to deforestation, human settlements, monoculture plantations and hydro-electric projects, which pose greatest peril to the threatened species. It provides good habitat for several bush frogs, many of which are endemic and threatened.

- Map

Objectives

- To determine the population size, distribution, habitat association and identify the anthropogenic threats encountered by *Raorchestes chalozodes* in Konni bio reserve forest –Shenduruni Wildlife sanctuary forests. (Konni Forest Division, Achankovil Forest Division, Thenmala Forest Division and Shenduruni Wildlife Division)
- To generate data on the natural history information such as reproduction information, micro habitat used by species, ecological parameters and egg deposition
- To determine conservation status of the species in Konni bio reserve forest-Shenduruni Wildlife Sanctuary forest Areas. (Konni Forest Division, Achankovil Forest Divison, Thenmala Forest Divison and Shenduruny Wildlife Division.)
- To formulate an *in situ* and *ex situ* conservation action plan to save the endangered population

Methodology

Transect survey methods with direct sighting and call recording were followed for the survey. As most of the frogs are nocturnal and easily detected by their calls, surveys should generally be undertaken at night after first rain. Pre-monsoon and Monsoon seasons are the breeding seasons of the frogs; as surveys are weather dependent, several potential survey dates should be set aside. All transects that were selected depend upon the vegetation type of the forests, especially reed brakes. The visual encounter surveys with headlamp surveys were conducted along the truck paths through the reed brakes, and actively looked for exposed or active frogs and their call. This method was very successful during night, just following a rain. Calls were recorded in DSLR camera and were played back to locate frogs on top of the tall reed bamboos. Measurements (rounded to 0.1 mm) were made with a Mitutoyo Digimatic caliper.

Project output

Population size of the species

Manneera

Manneera is one of the low elevation forest areas in Konni forest divison with moist deciduous and degraded forests and plantations. Two transects were selected in East and West directions of the Mundomuzhi Forest Station. Both transects has clumps of *Ochlandra travancorica*. A survey was conducted after the first summer rain on 7th and 8th of May 2015. *Pseudophilautus kani* is the most common bush frog species sighted in the transects. 25 individuals were seen. Other frog species seen were *Racophorus malabaricus, Hylarana temporalis, Hylarana aurantica, Euphlyctis cyanophlyctis, Hoplobatrachus tigrinus, Zakerana sp. And Nyctibatrachus sp. etc*. No individuals of *Raorchestes chalazodes* were recorded in the transect survey.

Species Recorded at Manneera

Sl.No.	Species	Family	Total no. recorded
1.	*Duttaphrynus melanostictus*	Bufonidae	1
2.	*Euphlyctis cyanophlyctis*	Dicroglossidae	6
3	*Hoplobatrachus tigerinus*	Dicroglossidae	1
4.	*Zakarana sp.*	Dicroglossidae	1
5.	*Nyctibatrachus sp.*	Nyctibatrachidae	1
6.	*Hylarana aurantiaca*	Ranidae	15
7.	*Hylarana temporalis*	Ranidae	10
8.	*Indirana sp.*	Ranixalidae	1
9.	*Pseudophilatus kani*	Rhacophoridae	25
10.	*Rhacophorus malabaricus*	Rhacophoridae	1

Pandimotta

Pandimotta is the high elevation forest area in Shenduruny wildlife sanctuary. Some of the hillocks in the Pandimotta have dense growth of reeds, sometimes growing as pure

patches. Thick reed brakes are also seen in the lower valleys, along the streams and fire burnt areas. Reed species like *Ochlandra travancorica var. hirsute, O. ebracteata, O. scriptoria* and *O. wightii* of which *Ochlandra travancorica var. hirsute* and *O. scriptoria* grows in the higher riches. Amphibian diversity is very rich in Pandimotta. Rhacophoridae dominated with *Racophorus malabaricus, Rachphorus calakadensis, Raorchestes beddomii, Raorchestes manohari, Raorchestes agasthyensis, Raorchestes ponmudi, Raorchestes joncee*, and good number of *Raorchestes chalazodes* were recorded during the transect survey.

The first survey was conducted at 26-28 May 2015. The transect stretched from the stream near the Pandmotta shelter to Anachantha. The Survey was conducted between 18:45 to 02:30. The weather was very pleasant without rain and mist. No individuals or call of *R. chalazodes* was spotted during the first day. In the second day six calls were spotted on the way to Anachantha at 20:00 and an individual frog was spotted on a reed. Breeding holes was also spotted and photographed. On the last day of survey 10 calls were spotted. One call was also observed on a reed clump near the Pandimotta shelter. Measurements and photographs were taken during this time. Adult males of the species enter hollow internodes of the reed bamboo where they call out to attract mates. Females drawn by the calls follow suit, and more than one may mate with the male to lay up to eight eggs per clutch inside the bamboo. The father stays in the bamboo to take care of the eggs, which develop directly into froglets. *R. chalazodes* breeds only in bamboo with openings at the base of the internode as plants with openings at the top would collect rainwater, possibly flooding the eggs or drowning the froglets. Egg number and clutch size were also recorded. Second survey was conducted on 18-20 June 2015. Only four individuals were recorded during this time.

Species Recorded at Pandimotta 26-05-2015 – 29-05-2015

Sl.No.	**Species**	**Family**	**Total no. recorded**
1.	*Duttaphrynus melanostictus*	Bufonidae	1
2.	*Nyctibatrachus sp.*	Nyctibatrachidae	1
3	*Polypedates pseudocrusiger*	Rhacophoridae	4
4.	*Raorchestes agesthyaensis*	Rhacophoridae	2
5.	*Raorchestes beddomii*	Rhacophoridae	10

6.	*Raorchestes bobingeri*	Rhacophoridae	5
7.	*Raorchestes chalazodes*	Rhacophoridae	16
8.	*Raorchestes johnceei*	Rhacophoridae	25
9.	*Rhacophorus calacadensis*	Rhacophoridae	2
10.	*Rhacophorus malabaricus*	Rhacophoridae	2

Species Recorded at Pandimotta 18-06-2015 – 20-06-2015

Sl.No.	Species	Family	Total no. recorded
1.	*Duttaphrynus melanostictus*	Bufonidae	0
2.	*Nyctibatrachus pillai*	Nyctibatrachidae	2
3	*Polypedates pseudocrusiger*	Rhacophoridae	2
4.	*Raorchestes agesthyaensis*	Rhacophoridae	1
5.	*Raorchestes beddomii*	Rhacophoridae	6
6.	*Raorchestes bobingeri*	Rhacophoridae	0
7.	*Raorchestes chalazodes*	Rhacophoridae	4
8.	*Raorchestes johnceei*	Rhacophoridae	2
9.	*Rhacophorus calacadensis*	Rhacophoridae	22
10.	*Rhacophorus malabaricus*	Rhacophoridae	4
11.	*Raorchestes graminirupes*	Rhacophoridae	6
12.	*Raorchestes ponmudi*	Rhacophoridae	1
13.	*Rhacophoridae archeos*	Rhacophoridae	2
14.	*Ramanella sp.*	Microhylidae	2

Achankovil Reserve Forest

The first survey was in Achankovil forest division from 21st July to 23rd July 2015. Two transects were selected in the forest, rich with thick reed brakes; Achankovil to Kottavassal and Pulikkayam. Kottavassal is 422M ASL. Pulikkayam is a mixed forest with moist deciduous forests and teak plantations. Individuals or call of R. chalazodes were not spotted during the survey.

Species Recorded at Achankovil 21-07-2015 – 23-07-2015

Sl.no.	Species	Family	Total no. recorded
1.	*Duttaphrynus melanostictus*	Bufonidae	3
2.	*Duttaphrynus sp*	Bufonidae	1
3.	*Nyctibatrachus sp*	Nyctibatrachidae	4
4.	*Raorchestes ochlandrae*	Rhacophoridae	6
5	*pseudophilautus kani*	Rhacophoridae	60+
5.	*Indirana sp*	Ranixalidae	

6.	*Hoplobatrachus tigerinus*	Dicroglossidae	1

From the whole survey *R. chalazodes* was spotted from Pandimotta forest of Shenduruni wildlife sanctuary. It indicates the restricted distribution of the species and conservation priority of the reed ecosystems of Pandimotta region.

Reproduction of *Raorchestes chalozodes*

There is a high diversity in the reproductive modes shown by the amphibians in the Western Ghats. Anurans exceptionally exhibit 40 different reproductive modes. Reproductive modes are differentiated based on egg deposition sites, egg type, and patterns of embryonic/larval development. *Raorchestes chalazodes* shows a unique reproductive mode for an arboreal frog. *Raorchestes chalazodes* (bush frog), has a new reproductive mode, breeding and laying direct developing eggs in live bamboo with narrow openings. These openings are mostly made by insects or rodents. The frogs lay egg inside a hollow bamboo internode without stagnant water and with a narrow entry/exit opening and they lay eggs only in bamboos with openings.

The male frog tracks the internodes with openings and vocalizes to attract females. Female frogs are attracted to the calls and follow suit, laying about 5 to 8 eggs inside the bamboo. Egg (5-8 eggs) can be found deposited approximately 25 cm above the opening and multiple egg clutches can be found in the same internode (measurement were given in fig. 2). The adult males can be always found in the internode and they are found vocalizing frequently. The study identified *Ochlandra travancoria* as the bamboo species used by the frogs for laying eggs. Morphology and nest characteristics identified shows that the eggs are found on upward end of internodes and openings are near the downward end of internodes. Internodes on top will result in collection of water and can flood and drown the eggs. The eggs of the species are spherical and transparent with creamy white yolks and are attached to the inner walls of bamboo with a mucilaginous strand. These eggs undergo direct development.

Other females may also choose to mate with the male frog and deposit egg clutches in the bamboo. Females are found to be polyandrous and hence they move from one internode to

the next. The male stays in the bamboo to take care of the eggs, which develop directly into froglets. The adult frog is 24 millimetres in length.

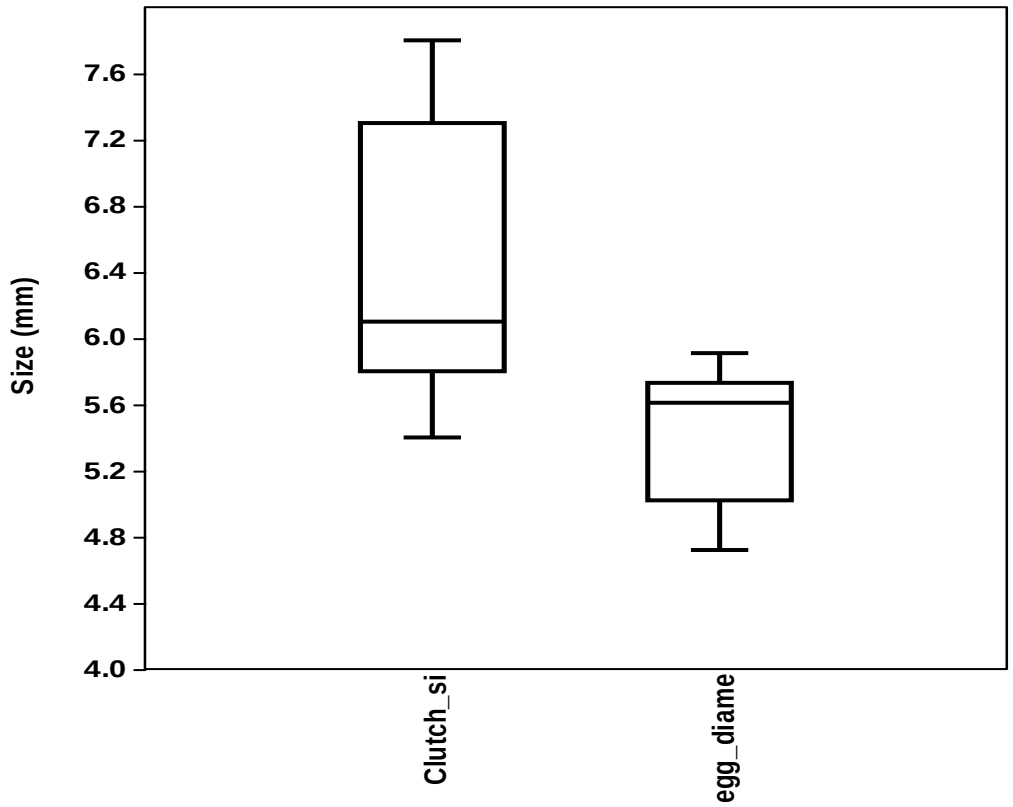

Figure 2: Clutch size and egg diameter of *Raorchestes Chalazodes*

Checklist of amphibians of the area

SL. NO.	SPECIES NAME	FAMILY
1	*Duttaphrynus melanostictus* Schneider, 1799	Bufonidae
2	*Duttaphrynus parietalis* Boulenger, 1882	Bufonidae
3	*Duttaphrynus beddomii* Gunther, 1875	Bufonidae
4	*Pedostibes tuberculosis* Gunthetr, 1875	Bufonidae
5	*Euphlyctis cyanophlyctis* Schneider, 1799	Dicroglossidae
6	*Euphlyctis hexadactylus* Lesson, 1834	Dicroglossidae

7	*Fejervarya keralensis* Dubois, 1980	Dicroglossidae
8	*Hoplobatrachus tigerinus* Daudin, 1803	Dicroglossidae
9	*Micrixalus sali* Biju *et al*., 2014	Micrixalidae
10	*Micrixalus herrei* Biju *et al*., 2014	Micrixalidae
11	*Micrixalus fuscus* Boulenger, 1882	Micrixalidae
12	*Uperodon sp*	Microhylidae
13	*Uperodon anamalaensis* Rao, 1937	Microhylidae
14	*Nyctibatrachus beddomii* Boulenger, 1882	Nyctibatrachidae
15	*Nyctibatrachus aliciae* Inger *et al.,* 1984	Nyctibatrachidae
16	*Nyctibatrachus minor* Inger *et al*., 1984	Nyctibatrachidae
17	*Nyctibatrachus major* Boulenger, 1882	Nyctibatrachidae
18	*Nyctibatrachus pillai/vasanthi*	Nyctibatrachidae
19	*Indosylviranamagna* Biju *et al*., 2014	Ranidae
20	*Indosylviranasreeni* Biju *et al*., 2014	Ranidae
21	*Indosylvirana aurantiaca* Boulenger, 1904	Ranidae
22	*Clinotarsus curtipes* Jerdon, 1853	Ranidae
23	*Indirana sp*	Ranixalidae
24	*Indirana diplostica* Gunther, 1875	Ranixalidae
25	*Rhacophorus calcadensis* Ahl, 1927	Rhacophoridae
26	*Rhacophorus malabaricus* Jerdon, 1870	Rhacophoridae
27	*Polypedates pseudocruciger* Das and Ravichandran, 1998	Rhacophoridae
28	*Polypedates maculatus* Gray, 1834	Rhacophoridae
29	*Mercurana myristicapalustris* Abraham et al., 2013	Rhacophoridae
30	*Pseudophilautus kani* Biju and Bossuyt, 2009	Rhacophoridae
31	*Raorchestes akroparallagi* Biju and Bossuyt, 2009	Rhacophoridae
32	*Raorchestes anili* Biju and Bossuyt, 2005	Rhacophoridae
33	*Raorchestes bobingeri* Biju and Bossuyt, 2005	Rhacophoridae
34	*Raorchestes chotta* Biju and Bossuyt, 2009	Rhacophoridae
35	*Raorchestes chalazodes* Gunther, 1876	Rhacophoridae

36	*Raorchestes graminirupes* Biju and Bossuyt, 2005	Rhacophoridae
37	*Raorchestes agasthyaensis* Zachariah *et al*. 2011	Rhacophoridae
38	*Raorchestes crustai* Zachariah et al. 2011	Rhacophoridae
39	*Raorchestes beddomii* Gunther, 1876	Rhacophoridae
40	*Raorchestes johnceei* Zachariah *et al*., 2011	Rhacophoridae
41	*Raorchestes manohari* Zachariah *et al*., 2011	Rhacophoridae
42	*Raorchestes archeos* Vijayakumar *et al*., 2014	Rhacophoridae
43	*Raorchestes ponmudi* Biju and Bossuyt, 2005	Rhacophoridae
44	*Raorchestes kakachi* Seshadri et al., 2012	Rhacophoridae
45	*Raorchestes nerostagona* Biju and Bossuyt, 2005	Rhacophoridae
46	*Raorchestes ochlandrae* Gururaja *et al*., 2007	Rhacophoridae
47	*Ichthyophis tricolor* Annandale, 1909	Ichthyophiidae
48	*Uraeotyphlus oommeni* Gower and Wilkinson, 2007	Ichthyophiidae

Major recommendations

R. chalazodes is considered as the most critically endangered among bamboo nesting frogs. It is recorded as critically endangered because its extent of occurrence is less than 100 km^2, distribution is severely fragmented and there is a continuing decline in the extent and quality of its forest habitat. The habitat and ecology of the species is described as – A nocturnal, arboreal species associated with the understory of tropical moist evergreen forest occurring in secondary or disturbed habitat. It breeds through direct development and dwells in terrestrial systems. Its geographic range spreads from Munnar, Kerala, on the South-Western slopes of the Cardomom hills, Kerala and was collected at an altitude of 1400m asl. Further study is needed to reconfirm its existence from other places including Parambikulam Wildlife Sanctuary in Kerala and Anaimalai Hills in Tamil Nadu (IUCN).

High elevation montane forest and reed ecotone habitat a critical ecosystem for reed associated frogs

Reed vegetation on the margins of shola forest is a unique micro habitat that supports a variety of frogs. Continuous stretches of reed vegetation dominated by *Ochlandra*

ebracteata Raizada & Chatterjee, *Ochlandra keralensis* Muktesh, Remesh & Stephen, O*chlandra scriptoria*(Dennst.) C.E.C. Fisch., *Ochlandra travancorica* (Bedd.) Benth. ex Gamble, *etc*, dominate such habitats across several hill ranges of the southern Western Ghats. This habitat is most prominently seen in the high altitude regions immediately north and south of the Shencottah Gap. Endemic frogs like *Raorchestes chalazodes*, *Raorchestes ochlandrae*, *Raorchestes graminirupes*, *Raorchestes manohari*, *Raorchestes uthamani*, *Raorchestes johnceei*, *Raorchestes bobingeri*, *Raorchestes agasthyensis*, *Raorchestes archeos*, *Indirana diplosticta*, *Nyctibatrachus vasanthi*, *Duttaphrynus beddomii*, *etc* were closely associated with this microhabitat in the higher reaches of the Ashambu Hills. Their distribution and breeding is also dependent on several dynamics of this unique habitat. Microhabitat like reed-shola ecotone should be protected especially in the Pandimotta and Katlapara regions, respectively. Transport of vehicles in the private areas especially in the Kallar estate region should be restricted in the monsoon season to avoid road kills.

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