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Lists of Species

Anurans from wetlands of Puducherry, along the East Coast of India

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Abstract: Anurans of Puducherry, a union territory measuring 293 km^2, on the East coast of India are understudied. In this communication, we provide a comprehensive list of anurans encountered in and around wetlands across this union territory. Visual Encounter Surveys during the rainy season in 17 wetlands yielded a total of 14 species belonging to four families. This diversity is relatively low compared to other urban areas like Bangalore or Pune having 16 and 31 species respectively. Possible reasons for this low diversity and scope for future studies have been emphasized.

Introduction

Information of anuran species richness and diversity is becoming increasingly important in the context of global amphibian decline (Kiesecker 2010). Anurans are sensitive to changes in the environment due to their biphasic lifestyle and changes in either of the two stages can have negative effects (Crump 2010). Some of the major threats concerning anurans in human dominated landscapes are rapid urbanization resulting in land use changes, loss and modification of habitat, pollution of available habitats and traffic noise (Aravind and Gururaja 2011). Amphibians in India are highly diverse with 337 species of which 301 are anurans (Dinesh *et al*. 2011; Anil *et al.* 2011; Biju *et al.* 2011). This can be attributed to the availability of diverse habitats throughout India. Most of the studies on amphibians have been concentrated in the Western Ghats (biodiversity hotspot) on the west coast of India and other areas remain understudied (Aravind and Gururaja 2011).

The large expanses of agricultural lands, urban parks and numerous man-made wetlands to help irrigation which exist across India have become important habitats for anurans. These landscapes are now being modified and the habitat is being altered with increasing urbanization. Few attempts have been made to document the richness and diversity of anurans in such urban landscapes of India (Karthikeyan 1999; Padhye and Ghate 2002; Padhye *et al.* 2002). Puducherry is a union territory which consists of four enclaves (Puducherry, Karaikal, Yanam on the East coast of India and Mahé on the West coast of India). This study was carried out in the largest enclave Puducherry located on the East coast of India. The present knowledge of anurans is restricted to Pondicherry University campus (Davidar *et al.* 2010) and anuran richness and diversity have not been systematically documented throughout the region. In this study, we present a comprehensive list of anuran species in and around wetlands of the study area.

Materials and Methods

Study area

Puducherry enclave is located on the East coast of India between 12°00' N, 79°66' E and 11°77' N, 79°79' E. It covers an area of 293 km^2 with elevation ranging between 0–15 m asl (North East Monsoon Action plan 2009). The average temperature is about 30° C but ranges between 17–41°C with the highest temperature during the months of May-June. The area receives annual rainfall of 1172–1311 mm concentrated during the months of October–December due to the North East monsoon (Padmavathy *et al*. 2010). The landscape is dominated by agricultural lands and wetlands which are either rain fed or reservoir fed. Wetlands are used mainly for irrigation and also for domestic and various industrial purposes (Davidar *et al*. 2007).

Amphibian sampling

This study was carried out during August to November 2010, coinciding with the breeding season when anurans are most active (Duellman and Trueb 1994). Seventeen wetlands, spread across Puducherry enclave were chosen randomly for species enumeration (Figure 1). Two of these water bodies were located in the administrative boundary of neighboring Tamil Nadu state but were still considered as part of this study since they were within a distance of one kilometer from Puducherry's political boundary. Visual encounter surveys (VES) were carried out for 30 minute duration between 18:30 h–21:00 h. Each wetland was sampled twice with a gap of 15 days between consecutive sampling. Two observers walked along the perimeter of the water body and all species sighted were recorded. No specimens were collected but each species was photographed for reference. The species were identified based on photographs referring to keys and original publications (Kuramoto *et al.* 2007; Daniels 2005).

Results and Discussion

Fourteen species of anurans belonging to four families were recorded in the study. The number of species was found to reach an asymptote of 14 species (Figure 2) and the observed species richness was in close comparison to that estimated using Mao tau richness estimator (Colwell *et al.* 2004).

Of the four families, Dicroglossidae had the highest number of species (eight species) followed by Microhylidae (four species), Bufonidae (two species) and Rhacophoridae (one species). Among the fourteen species, *Euphlyctis hexadactylus* and *Fejervarya kudremukhensis* were most common. *Euphlyctis hexadactylus* was found in all wetlands while *F. kudremukhensis* was found in fifteen wetlands out of the seventeen. *Sphaerotheca breviceps* was a rare species being found only in one wetland surveyed (Table 1; Figures 3–4).

Anurans detected during and outside the sampling period were broadly categorized as being found in three micro habitats: Shore line of wetlands, Water and Cultivation areas (Table 1). The highest number of species was sighted on shore line (13 species) followed by cultivation areas (eigth species) and the least in water (four species). *Euphlyctis cyanophlyctis* and *Hoplobatrachus crassus* were the two species which were found in all three microhabitats and *E. hexadactylus* was found only in water or in water logged cultivation areas.

Most of the wetlands are managed by the local governing body, Irrigation department and Public Works Department and they undertake maintenance work. However, some of the wetlands have been affected by overgrowth of exotic

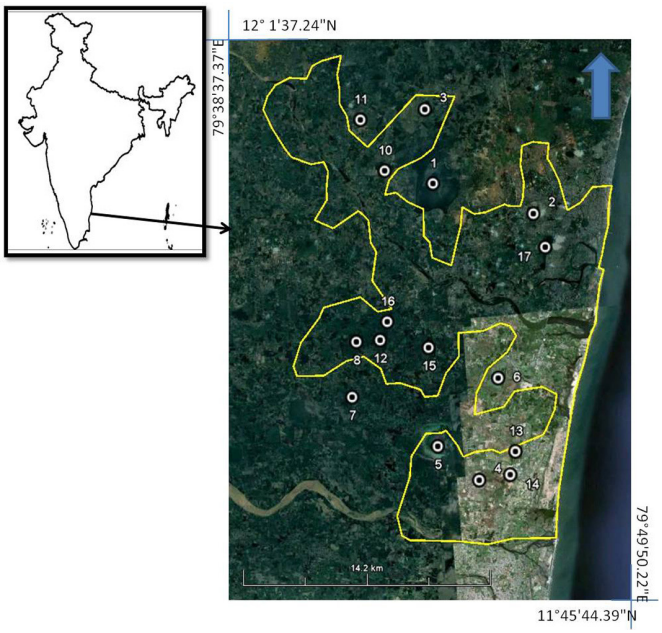

Figure 1. Map showing location of Puducherry. Yellow line forms administrative boundary and Points 1-17 indicate order in which wetlands were sampled: 1) Ousteri; 2) Kanakaneri; 3) Sedrapet aeri; 4) Sitteri; 5) Bahour aeri; 6) Abisegapakkam; 7) Chinnakolam; 8) Nallathur aeri; 9) Thavalakuppam; 10) Valeri; 11) Valudavour; 12) Embalam; 13) Kirumapakkam; 14) Kathupakkam; 15) Korkad aeri; 16) Melsadamangalam and 17) Velrampetai. Wetlands 7 and 11 are outside Puducherry administrative boundary.

Table 1. Anuran species recorded across sampled wetlands and micro-habitats. Numbers 1-17 indicate individual wetlands as in Figure 1; + indicates presence; SL: shore line; W: water and C: cultivation area.

TAXA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	MICRO-HABITATS
Bufonidae																		
Duttaphrynus melanostictus (Schneider, 1799)	+	+		+	+	+	+									+	+	Sl, C
Duttaphrynus stomaticus (Lutken, 1862)	+															+		Sl
Dicroglossidae																		
Euphlyctis cyanophlyctis (Schneider, 1799)	+	+	+	+	+		+			+	+		+			+		W, Sl,C
Euphlyctis hexadactylus (Lesson, 1834)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	W, C
Fejervarya kudremukhensis (Kuramoto, Joshy, Kurabayashi and Sumida, 2007)	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	Sl,C
Fejervarya granosa (Kuramoto, Joshy, Kurabayashi and Sumida, 2007)								+			+							Sl,C
Hoplobatrachus crassus (Jerdon, 1853)	+		+	+	+	+	+	+		+	+	+	+	+		+		W, Sl,C
Sphaerotheca breviceps (Schneider, 1799)											+							Sl
Sphaerotheca rolandae (Dubois, 1983)											+						+	Sl
Microhylidae																		
Kaloula taprobanica (Parker, 1934)		+													+			Sl
Microhyla ornata (Dumeril and Bibron, 1841)	+	+		+	+	+	+	+		+	+		+	+		+		Sl, C
Microhyla rubra (Jerdon, 1854)				+							+		+					Sl, c
Ramanella variegata (Stoliczka, 1872)															+		+	W, Sl
Rhacophoridae																		
Polypedates maculatus (Gray, 1834)					+		+	+			+		+		+			Sl

invasive weeds like *Eichhornia crassipes* and *Ipomea carnea.* Few others have been encroached and converted to Paddy fields (pers. obs.). All the sampled wetlands were extensively used for domestic purposes. The activities included open defecation, garbage dump, commercial fish culture and harvesting, bathing, washing cattle and drinking water. Some large wetlands like Ousteri were also used for recreational boating activity. Increasing urbanization around most of the surveyed tanks had led to encroachment at various levels and setting up of few industries around the wetlands had resulted in the release of effluents into these wetlands.

A casual conversation with local residents has indicated that *E. hexadactylus* is commonly being hunted for consumption of frog legs in the local market. We were informed that the largest frogs (often the female) are caught easily using a noose tied to a small stick. The smaller frogs (males) would be caught later when the large sized frogs are caught. These incidents were common across all the wetlands surveyed and an investigation of this uncontrolled activity will yield insights on the impacts of hunting on the population of *E. hexadactylus*.

Habitat loss and modification is considered to be one of the reasons for amphibian declines (Gardner *et al*. 2007). In India, the available habitat for amphibians are either deteriorated or lost due to increased urbanization. Padhye *et al.* (2002) report that about 33% of the amphibians were eliminated from the city limits, largely owing to urbanization. The union territory of Puducherry has also undergone increased urbanization in the recent years (pers. obs.). This has resulted in reduction of habitat available for amphibians. However, comparisons cannot be made due to the absence of any previous baselines.

A total of 16 species has been documented in Bangalore City (Karthikeyan 1999). In the city of Pune, Padhye *et al.* (2002) report a total of 31 species. Both these cities are largely urbanized and form a matrix of wetland, agriculture and human settlements which is similar to our study site where we recorded 14 species of anurans.

Even though all the species documented during this study are common and widely distributed across the peninsular India, many could be threatened and may face population declines due to uncontrolled hunting activities and increased urbanization which could negatively affect them. Efforts to understand variations in richness and diversity in view of such disturbances need to be undertaken in future for conserving anurans and the fragile wetland ecosystems in human dominated landscapes.

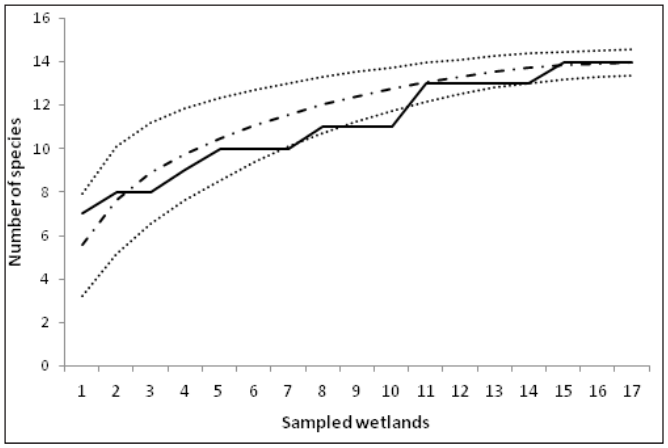

Figure 2. Species accumulation curves indicating observed and Mao Tau estimated species richness with 95% confidence limits. Dark line: Observed; Dash dot: Expected; Dotted lines: upper and lower CI.

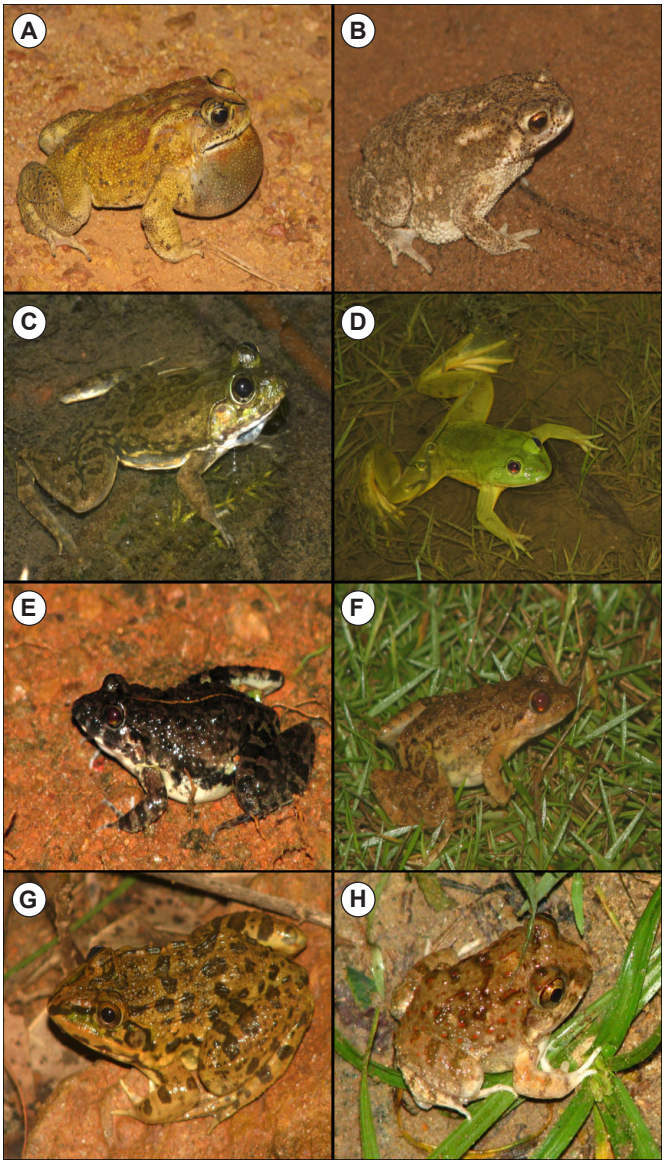

Figure 3. Anurans recorded from the study area. A) *Duttaphrynus melanostictus*; B) *Duttaphrynus stomaticus*; C) *Euphlyctis cyanophlyctis*; D) *Euphlyctis hexadactylus*; E) *Fejervarya kudremukhensis*; F) *Fejervarya granosa*; G) *Hoplobatrachus crassus*; H) *Sphaerotheca breviceps*.

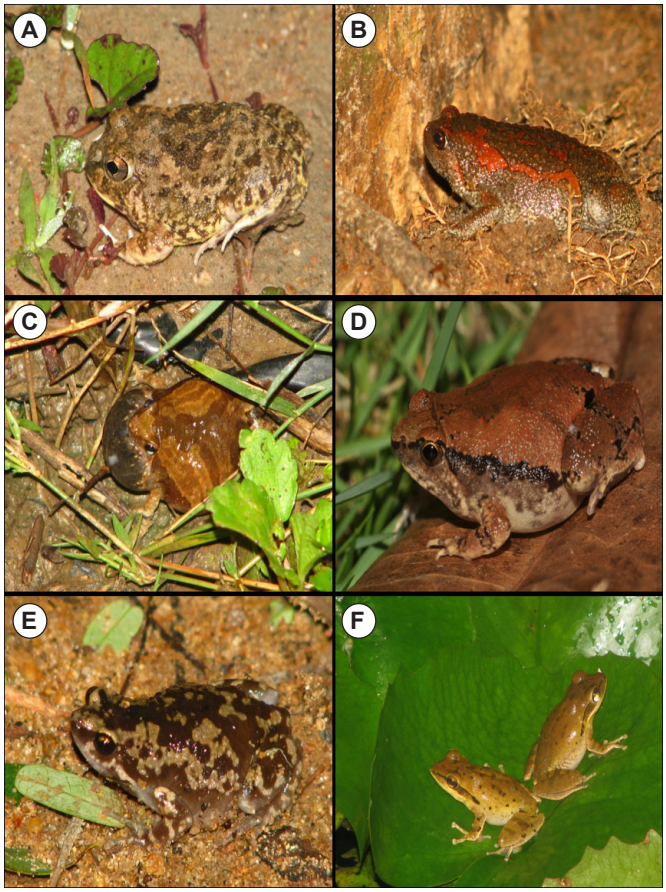

Figure 4. Anurans recorded from the study area. A) *Sphaerotheca rolandae*; B) *Kaloula taprobanica*; C) *Microhyla ornata*; D) *Microhyla rubra*; E) *Ramanella variegata*; F) *Polypedates maculatus*.

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