

A Preliminary Survey on Anurans of Jamnagar City and Vicinity Areas, Gujarat, India

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Abstract: *The present study attempts to make an inventory of anuran species (Frog and Toad) from Jamnagar city and vicinity areas, Gujarat, India. A preliminary survey was conducted during August to October 2015 with respect to systematics, species composition, diversity indices and conservation status. Total 25 visits were undertaken for field survey by Visual encounter methods (VES) using Line transect and various sizes plotting at random exploring in all the possible microhabitats. All the sampling taxa were identified by various literatures through photographs under Photoshop and close observation during field survey. The results reveal total 14 Anuran species belong to 03 families and 07 genera. Familial population in member of family Dicroglossidae (05 genus and 11 species) represents first position among Bufonidae and Microhylidae. The most abundant species was Skipper Frog (*Euphlyctis cyanophlyctis*) and conservation status reports One Data-deficient species Short Webbed frog (*Minervarya brevipalmata*), One endangered species Nilgiri Frog (*Minervarya nilagirica*) and twelve Least concern as per IUCN red list; two species of Schedule-IV under WPA-1972 category and Only one species Indian bull frog (*Hoplobatrachus tigerinus*) recorded under CITES. Diversity indices and species richness shows that anurans species were significant in Dicroglossidae (Simpson diversity $1-D = 0.58$; Shannon diversity $-H' = 1.36$ and Margalef's species richness $(d) = 1.87$); whereas members of Bufonidae were evenly distributed (evenness - $e^H/S = 1.0$) during study period. This is the first accounts of such studies in this areas and proposed work is aimed to monitoring and conserving biodiversity in urban ecosystem.*

Keywords: Anurans, urban ecosystem, species composition, status, indices, Jamnagar

1. Introduction

A preliminary survey of frog and toad in Order: Anura, Class: Amphibia was recorded in urban ecosystem *Viz* Jamnagar city and vicinity area of Northern Kathiawar Peninsular, Gujarat, India. The members of anurans are considered as "without a tail" and widely considered to be useful as indicator species for health of ecosystem; they play a very important role in the food chain of terrestrial and aquatic ecosystems, as they are highly predatory on insects. They eat insects, spiders, snails, worms, small fish and small land animals.

The standard works on Indian amphibians in the 'Fauna of British India' [1] that provided necessary stimulus to further studies. In India, during 2009 total 271 anurans record out of 299 amphibians [2] thereafter gradual increase reported [3], [4], [5], [6]; recent represents total 384 amphibians include 344 anurans [7]. Very scanty work on amphibian fauna of urban ecosystem from Gujarat state; the first review [8] of the amphibians of Gujarat was published; 09 species of anurans were dealt with, based on the collection of the ZSI. Distribution records of 15 anurans species [9] and 18 species [10] in Gujarat state recorded on base of collections by BNHS and ZSI. Further studies reveal 05 anuran species in Rampara wildlife sanctuary [11], 08 species from Purna wildlife sanctuary [12]. The prime work on herpeto-faunal studies of National Park and Sanctuaries of Gujarat reveals 10 anuran species [13] from Jambughoda wildlife sanctuary, 08 species [14] from Hingolghadh wildlife Sanctuary, 07 species [15] from Narayan Sarovar Sanctuary, 13 species [16] from Vansda national Park, 09 species [17] from Barda wildlife sanctuary and 11 species of anurans reported in and around Shoolpaneshwar Wildlife Sanctuary [18]. Latest, 03 anuran species recorded from Khijadiya Bird sanctuary [19] of Gujarat state. Most of the amphibian study has been taken up in National Parks and Sanctuaries of

Gujarat but very lack of records in urban areas. So, the present work intend to explore a preliminary survey of anurans in urban ecosystem presenting checklist of frogs and toads with species composition and conservation status from Jamnagar city and their vicinity areas.

2. Materials and Methods

2.1 Study Area

Jamnagar is located between 21.42⁰ to 22.57⁰ latitude and 68.57⁰ to 70.37⁰ longitudes at the Northern Kathiawar Peninsular from Western Coast of India in the state of Gujarat and Gulf of Kachchh. The said study areas are bounded by Gulf and Desert of Kutch in the north and Arabian Sea in the west (Figure 1). To survey explored and covered the total landscape areas (562 km²) of the Jamnagar City and vicinities (i.e. from urban to rural gradient level). The climate of Jamnagar city is relatively humid and cool, one of extreme kind with hot summers and cold winters except in the coastal region, where it is generally pleasant all throughout the year. The area receives annual rainfall is erratic in its occurrence, duration and intensity. Annual rainfall is 303 mm of the year 2015 and average high temperature ranges from 25.5°C to 36.5°C and low temperature ranges from 12.6°C to 27.6°C (Source: Pearl-millet Research Station, Junagadh Agricultural University, Jamnagar, 2015). The recorded occurrence sites of Anurans at Jamnagar city and vicinity areas represent several types of micro habitats like river, temporary ponds, water bodies, water reservoirs, seasonal freshwater shallow lake, Inter-tidal mudflats, creeks, salt pans, saline land and mangrove scrub, protected areas such as Khijadiya bird sanctuary and Marine national park, wetlands, vegetation layer, agro land, urban-rural public and private gardens, human habitation (*viz* residential, industrial and commercial buildings), wasteland, damar (Asphalt) and concrete roads. During survey out

of 24 total explored sites only 10 sites and location (Figure 2, using GPS coordinates) represent the occupancy habitat for anurans.

2.2 Sampling

Total 25 visits were conducted during survey of Jamnagar city and vicinity areas in monsoon (August to October-2015). The entire areas were explored and surveyed on urban to rural gradient level selecting macro and micro habitats. The field records followed by Visual encounter survey (VES) method [20], scanning of leaf litter using Line transect (10 x 50m to 20 x 100m) and various sizes plotting (50 x 50m to 250 x 250m) at random; day and night with 03 to 04 man hours per survey (07:00 to 10:00 hrs) by morning, (17:00 to 20:00 hrs) by evening and late night (23:00 to 02:00 and 03:00 to 06:00 hrs) using LED torch for nocturnal species encompassing total 48 sampling units (N=48). To explore the anurans in all the possible microhabitats were surveyed by approaching under the stones and bricks, on shrubs and grass fragments, beneath fallen logs, near the water bodies and temporary bank ponds, puddles, ditches and between the buildings spaces. Extensive photography (with Canon 700D, 1100D DSLR camera and Canon Powershot A2300 Digital camera) were done for detail morphological features. All the sampling taxa were identified using various literatures and field guide [1, 21], [22], [23], [24], [25], [26] followed photographs under Photoshop and close observation during field survey. Data analysis obtained checklist and conservation status with update systematics, familial population up to genus and species level. The species diversity indices like Simpson diversity 1-D; Shannon diversity -H', evenness -e^{H/S} and Margalef's species richness (d) were computed using software PAST (ver.- 3.15 March, 2017) [27]. The morphological features of anurans species are documented in Plate A.

3. Results and Discussion

A total of 198 individual anurans representing 14 species belong to 03 families and 07 genera were recorded during preliminary survey from Jamnagar city and vicinity areas (Table 1, Plate A). Among them 12 species of Frogs and 02 species of Toads were recorded (Table 1). Of these three families Dicroglossidae had the maximum number of species (11 species/185 individuals).

3.1 Species composition

A record of 14 species of amphibians distributed in a single Order: Anura with 03 families (viz Bufonidae, Dicroglossidae and Microhylidae) and 07 genera. Among all Dicroglossidae reveal most dominant population (n=185), genera (n=5) and species (11) (Figure 3).

The conservation status from preliminary survey record 12 species of Least concern (LC) category, 01 species (*Minervarya brevipalmata*) in Data-Deficient (DD) and 01 species (*Minervarya nilagirica*) Endangered (EN) [28]. Total 02 species (*Hoplobatrachus crassus* and *Hoplobatrachus tigerinus*) from anurans include under Schedule IV category [29]. Only one species Indian Bull

Frog (*Hoplobatrachus tigerinus*) from amphibians are comes under Appendix II category in CITES conservation category (Table 1) [30].

Simpson diversity (1-D), Shannon-wiener (H') and Margalef's species richness (d) reveal significant (1-D=0.58, H=1.36, d= 1.87) in Dicroglossidae than Bufonidae and Microhylidae. Although, the evenly distribution of Evenness-J shows higher value in members of Bufonidae (1.00) than Dicroglossidae and Microhylidae (Table 2). Most of the Dicroglossid frogs were recorded in rural areas and diversity shown higher in Dicroglossidae than Bufonidae and Microhylidae family. As most of anurans record from National Park and Sancturies (PA) of Gujarat state ranges between 3 to 13 anuran species record [11], [12], [13], [14], [15], [16], [17], [18]; but the selected study areas report 14 anuran species record. This may reflects less stress in their environment, enough food availability as well as suitability of habitat characteristic due to urbanization.

3.2 Distribution and occurrence

Out of 24 explored sites of urban, sub-urban and rural sites of Jamnagar city and vicinities reveal marked position of anuran species record in rural areas (i.e. nearby villages and water bodies). During entire survey member of Bufonids (toads), Common Indian toad (*Duttaphrynus melanostictus*) and Ferguson's toad (*Duttaphrynus scaber*) (Plate A1, A2) were found at Ranjitsagar Dam, Dhunvav village, Vijarkhi Dam and Chela village sites and their microhabitat in Sugarcane farm, ditches, puddles, crevices of ground surface etc. Among members of Dicroglossid (frogs) Skipper frog (*Euphlyctis cyanophlyctis*) (Plate A3) were sighted at Sasoi and Vijarkhi Dam, Valsura, Chela village, Sarmat village, Khijadiya Bird sanctuary and Jamnagar-Rajkot highway sites mostly from ditches, puddles and water-bodies. Jerdon's Bull frog (*Hoplobatrachus crassus*) and Indian Bull frog (*Hoplobatrachus tigerinus*) (Plate A5, A6) were recorded at Dhinchda village, Chela village, Sasoi and Ranjitsagar Dam sites in puddles, crevices of ground surfaces and grass fragments. Indian cricket frog (*Fejervarya limnocharis*) (Plate A4) was mostly found near the water bodies, ditches and puddles, crevices of ground surface and muddy areas at Dhunvav village, Khijadiya Bird sanctuary, Ranjitsagar and Vijarkhi Dam sites. Indian burrowing frog (*Sphaerotheca breviceps*), Dobson's burrowing frog (*Sphaerotheca dobsonii*) and Southern Burrowing frog (*Sphaerotheca rolandae*) (Plate A11, A12, A13) were found at Dhinchda village, Ranjitsagar and Vijarkhi Dam sites from ditches, crevices of ground surface, grass patches and under the various size of stones and pebbles. The other species Rufescent Burrowing frog (*Minervarya rufescens*), Short Webbed frog (*Minervarya brevipalmata*), Verrucose frog (*Minervarya keralensis*) and Nilgiri frog (*Minervarya nilagirica*) (Plate A10, A7, A8, A9) were found at Dhunvav village, Khijadiya Bird sanctuary, Valsura, Chela village, Ranjitsagar, Vijarkhi and Sasoi Dam sites from microhabitat as small ditches, crevices of soil, grass patches, shallow water and from moist soil. Only single species from Microhylidae, Ornate Narrow-Mouthed frog (*Microhyla ornata*) (Plate A14) recorded in puddles and ditches, moist soil in Dhunvav village and Vijarkhi Dam sites during field survey. Overall the anuran species were

distributed from urban, sub-urban and rural areas of Jamnagar city but the rural sites were dominated than urban and sub-urban areas (Figure 2). This may due to their macro and microhabitat suitability, food availability, climate, physiography. The entire occurrence sites and their habitat provide more water bodies, vegetation layers and fewer disturbances than urban and sub-urban areas. In general, the anurans prefer less disturbing microhabitats for breeding and surviving. Urban and sub-urban areas due to urbanization, transportation, human disturbance, habitat loss, pollution and other anthropogenic activities reflects less number of anurans species.

4. Conclusion

This is the first attempt of such studies in this urban ecosystem reflects relatively divers species survey and their occurrence habitat characteristics reveal that less stress in rural areas than sub-urban and urban sites of Jamnagar city. Since the inventory study was carried out during monsoon, relatively high rainfall, humidity, low temperatures, high vegetation opportunity provide enough food availability to sustain their survival and breeding. The future scope is in direction of impact of urbanization supports positive or negative response to sustainability of amphibian fauna conserving to prevent further loss of species by awareness in people. There is an urgent need to carry out further studies for confirmation regarding diversity, distribution and status of amphibians and implementation of effective strategy for their conservation purposes.

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Tables and Figures

Table 1: Checklist and Status of anurans recorded in Jamnagar city and vicinity areas, Gujarat. (N = 48).

Sr. No.	English Name	Scientific Name	IUCN Red list Global status #	WPA Status	CITES Status
Family:- Bufonidae					
1.	Common Indian Toad	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)	LC	-	-
2.	Ferguson's Toad	<i>Duttaphrynus scaber</i> (Schneider, 1799)	LC	-	-
Family:- Dicroglossidae					
3.	Skipper/Skittering Frog	<i>Euphlyctis cyanophlyctis</i> (Schneider, 1799)	LC	-	-
4.	Indian Cricket Frog	<i>Fejervarya limnocharis</i> (Gravenhorst, 1829)	LC	-	-
5.	Jerdon's Bull Frog	<i>Hoplobatrachus crassus</i> (Jerdon, 1853)	LC	Sch IV	-
6.	Indian Bull Frog	<i>Hoplobatrachus tigerinus</i> (Daudin, 1802)	LC	Sch IV	App.II
7.	Short Webbed Frog	<i>Minervarya brevipalmata</i> (Peters, 1871)	DD	-	-
8.	Verrucose Frog	<i>Minervarya keralensis</i> (Dubois, 1981)	LC	-	-
9.	Nilgiri Frog	<i>Minervarya nilagirica</i> (Jerdon, 1853)	EN	-	-
10.	Rufescent Burrowing Frog	<i>Minervarya rufescens</i> (Jerdon, 1853)	LC	-	-
11.	Indian Burrowing Frog	<i>Sphaerotheca breviceps</i> (Schneider, 1799)	LC	-	-
12.	Dobson's Burrowing Frog	<i>Sphaerothecadobsonii</i> (Boulenger, 1882)	LC	-	-
13.	Southern Burrowing Frog	<i>Sphaerotheca rolandae</i> (Dubois, 1983)	LC	-	-
Family:- Microhylidae					
14.	Ornate Narrow-Mouthed Frog	<i>Microhyla ornata</i> (Dumeril and Bibron, 1841)	LC	-	-

Notes: LC-Least concern, DD- Data deficient, EN- Endangered. # (IUCN Red List, 2017-3). WPA - Indian Wildlife (Protection) Act, 1972; CITES - Convention on International Trade in Endangered Species.

Table 2: Familial diversity indices of anurans during study periods. (N = 48)

Diversity indices	Bufonidae	Dicroglossidae	Microhylidae
Simpson_1-D	0.00	0.58	0.00
Shannon_H'	0.00	1.36	0.00
Evenness_e^H/S	1.00	0.56	0.33
Margalef-d	0.00	1.87	0.00

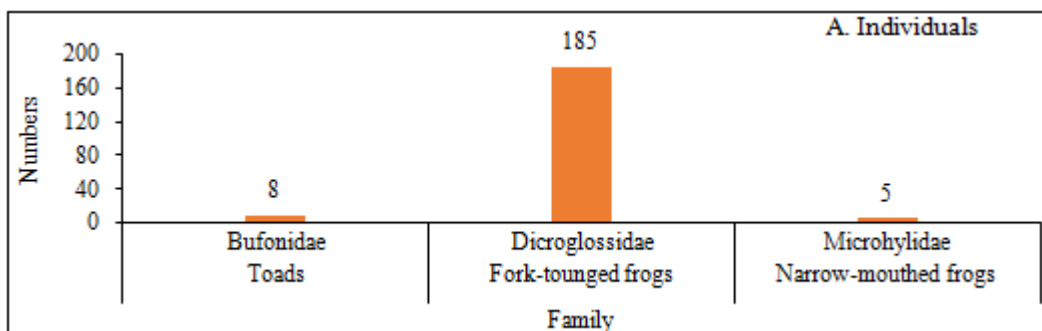


Figure 1: Map showing location of the Study Site. (Jamnagar City in Gujarat State).



Figure 2: Sampling sites of anurans in Jamnagar City and their Vicinity Areas, Gujarat(using Google Earth pro version-7.3). (Line colour Marking: **Red color**-Rural boundary, **Blue color**- Sub-urban boundary, **Yellow color**- Urban boundary as per JMC-Jamnagar Municipal Corporation)

A-Balachadi village, B-Chela Village, C-D.K.V College, D-Dared Village, E-Dhinchda Village, F-Dhunvav Village, G-Gujarat Ayurved University, H-Gulabnagar, I-Jamnagar-Khambhaliya Road, J-Jamnagar-Lalpur Highway, K-Jamnagar-Rajkot Highway, L-Khijadiya Bird Sanctuary, M-Naghedi Village, N-Krishna Nursery, O-Lakhabawal Village, P-Lakhota Lake, Q-Nageshwar, R-Navsarjan Uttar Buniyadi Vidhyalay, S-Ranjitsagar Dam, T-Sangam Baug, U-Sarmat Village, V-Sasoi Dam, W-Valsura, X-Vijarkhi Dam.



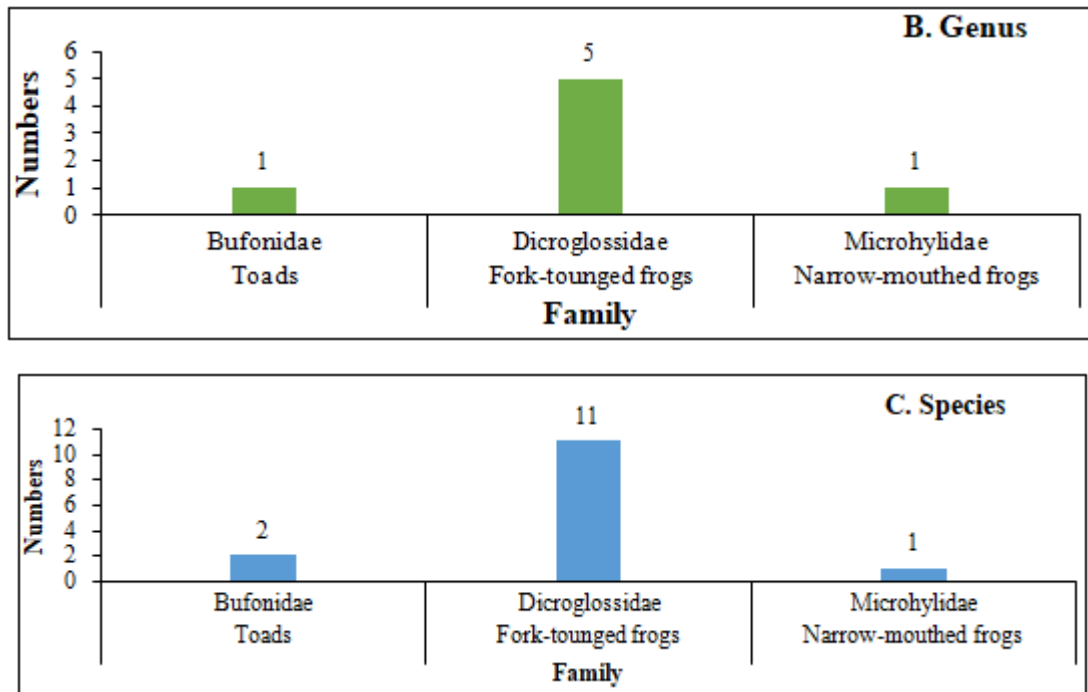
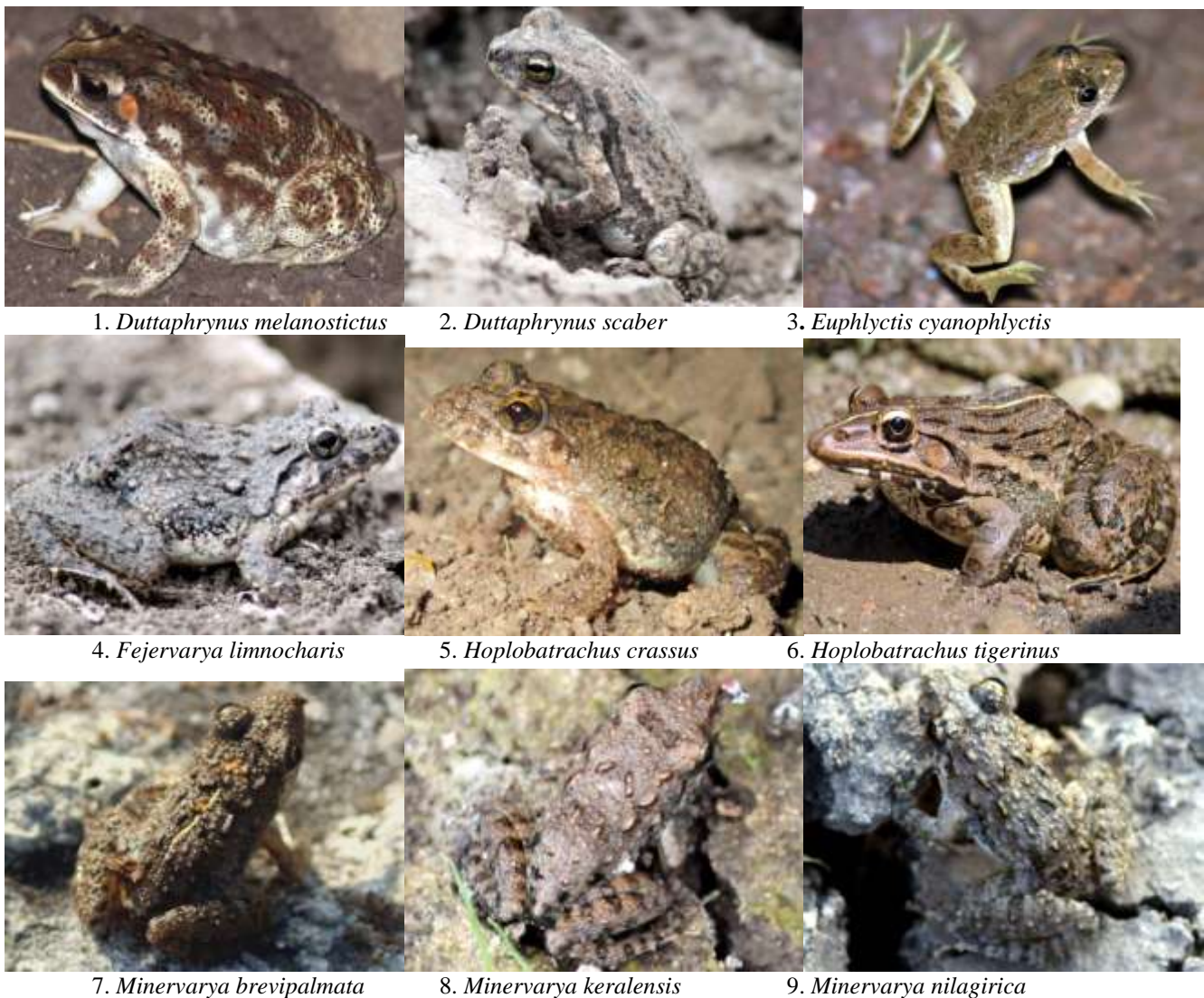


Figure 3: Familial Numbers of Individuals (A), Genus (B) and Species (C) of anurans during survey period (N = 48).





10. *Minervarya rufescens*



11. *Sphaerotheca breviceps*



12. *Sphaerotheca dobsonii*



13. *Sphaerotheca rolandae*



14. *Microhyla ornata*

Plate A1 to 14: Anurans of Jamnagar City and Vicinity Areas.