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AMPHIBIANS OF THE MANGROVE AREAS OF ODISHA WITH A NEW RECORD TO INDIA

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ABSTRACT

The amphibian fauna of the mangrove areas of Odisha was found to be quite rich with 14 species belonging to 9 genera and 5 families of Anurans. An important aspect of the study is that 5 species were recorded for the first time from the mangrove areas of Odisha. These included *Duttaphrynus stomaticus* (Bufonidae), *Fejervarya moodiei*, *Hoplobatrachus crassus* and *Sphaerotheca rolandae* (Dicroglossidae) and *Hylarana tytleri* (Ranidae). The Taylor's crab-eating frog (*Fejervarya moodiei*) was the first record of the species from India.

INTRODUCTION

Amphibians play a very important role in the food chain of both terrestrial and aquatic ecosystems and are widely considered to be useful as bio-indicators. Amphibian diversity in mangroves is comparatively low and limited to fresh-water species intruding into the area (Alfred & Ramakrishna, 2004). Amphibians in India are highly diverse with 384 species of which 344 species are anurans (Dinesh *et al,* 2015). Most of the studies on amphibians have been concentrated in the Western Ghats and other areas remain understudied (Aravind & Gururaja, 2011). Of the 26 species of frogs found in Odisha, only 5 species, belonging to 3 genera and 3 families had been reported from Bhitarkanika (Chadha & Kar, 1999). Dutta (2007) noted 14 species of amphibians from Dhamra port area of Bhadrak district. Painted frog (*Kaloula taprobanica*) was reported from a tree-hole in a mangrove swamp at Bhitarkanika (Sengupta *et al.*, 2009).

The present project was undertaken to study the diversity and distribution of amphibians in mangrove ecosystems of Odisha. Three surveys were undertaken between 2013 and 2015 and 69 specimens of amphibians belonging to 14 species, 9 genera and 5 families were collected from different mangrove areas of Odisha. The detailed species accounts of these amphibian species along with their registration numbers, diagnostic features, colour, habitat and status and distribution have been noted. This forms the first comprehensive scientific document of the amphibians of the mangrove areas of Odisha with a new record to India.

Geographical Distribution of the mangrove areas of Odisha

The mangroves areas of Odisha State are distributed all along the coastal areas of Odisha in Baleswar, Bhadrak, Kendrapara, Jagatsinghpur, Puri, Khurdah and Ganjam districts. The major mangrove areas are concentrated in Bhitarkanika area of Kendrapara district (at the mouth of Brahmani-Baitarani rivers), Mahanadi river estuary of Jagatsinghpur district, Devi river mouth of Puri district, Subarnarekha river mouth of Baleswar district and Rusikulya river mouth of Ganjam district.

Bhitarkanika National Park in Kendrapara district is an important patch of mangroves along the east coast of India. The estuaries at the mouth of the rivers Brahmani, Baitarani, Dhamra, Patsala and Maipura with its large number of ramifying creeks, channels and distributaries extend over an

area of 142 sq km and receive tidal water influx twice a day. This area receives annual rainfall of about 1700 mm of which 80% falls between June and September due to the south-east monsoons. In summer, atmospheric temperature ranges from 27-41°C (minimum and maximum respectively), whereas during winter it ranges from 12-26°C (minimum and maximum respectively). Relative humidity stays between 75-85% throughout the year. This hot and humid weather condition creates the most suitable condition for a high diversity of insect and other invertebrate fauna and results in a large number of amphibian species that can tolerate the brackish water environment of the mangroves.

Flora and Fauna of the mangrove areas of Odisha:

The coastal vegetation in Odisha is mainly of littoral and tidal forest types. This is a unique and typical type of vegetation especially found in river deltas, where there is admixture of river water and sea water. In the coastal region of Odisha, estuarine vegetation is commonly found in the river deltas of Burabalam, Brahmani, Baitarani, Subarnarekha, Mahanadi and Devi. The vegetation in the river estuary of Brahmani and Baitarani is very rich and abundant due to the enforcement of a Wildlife Protection Act, since the estuary was declared as a sanctuary in 1974. But the vegetation in the Mahanadi delta is denuded due to the construction of Paradeep Port (1965) and the Paradeep Phosphate factory and construction of residential complexes. Many species have been wiped out and some are on the verge of extinction.

In Bhitarkanika, the mangrove formation is seen along the creeks, channels and islands. Generally two-storey system is observed in this mangrove forests since the ground flora is very poor. The dominant mangrove taxa constituting the top canopy are *Sonneratia apetala, Avicennia officinalis, Avicennia alba, Excoecaria agallocha, Heritiera fomes* etc. *S. apetala* and *A. officinalis* are gregarious and luxuriant, colonising the banks of river and creeks. *Xylocarpus granatum* is sometimes observed in this habitat. *Pongamia pinnata* is also found in abundance, usually away from the water bodies. In more elevated areas mixed forest of *Excoecaria agallocha* and *H. fomes* are seen in asso-ciation with *Phoenix paludosa* and *Tamarix troupii* in the peripheral regions. The second storey is composed of the shrubby elements and under-trees such as *Brownlowia tersa, Kandelia candel, Lumnitzera racemosa, Rhizophora mucronata, Ceriops decandra, Cynometra iripa, Clerodendrum inerme, Aegiceras corniculatum* and *Hibiscus tiliaceus*. These elements flourish where there is tidal influence as well as a high degree of salinity. *R. mucronata* trees with their interwoven knee roots are observed in the muddy flats. In the terrestrial and swampy areas *Flagellaria indica, Salvadora persica, Phoenix paludosa, Bruguiera gymnorrhyza* etc. are quite common.

Common climbers of this mangrove forest are *Derris trifoliata, Derris scandens, Finlaysonia obovata* and *Mucuna gigantea* etc. Among the narrow and defuncted creeks usually *Acrosticum aureum* (a pteridophyte), *Acanthus ilicifolius* are seen in close association. *Caesalpinia crista* is also not uncommon in such localities. The ground flora is rather very poor. Usually in the muddy flats, *Myriostachya wightiana* is found in pure formation. *Porteresia coarctata* is also found in patches but less dominant. Other notable herbaceous elements are *Suaeda maritima, S. nudiflora, Salicornia brachiata*, etc. *Tylophora tenuissima, Eugenia bracteata, Fimbristylis* spp. is found in more dry and elevated areas.

In the Devi river estuary, a good patch of mangrove forests is observed. The top canopy consists of *A. officinalis, S. apetala, B. gymnorhyza, E. agallocha, K. candel* and *C. decandra*, etc. The second storey consists of shrubby elements like *A. corniculatum*, *A. ilicifolius, Dalbergia spinosa, P. paludosa, T. troupii, H. tiliaceus, C. inerme*, etc. In the mud-flats, *P. coarctata* and *M. wightiana* are gregarious. The notable climbers are *D. scandens, Derris trifoliata* and *Ipomoea cymosa*. Among the sand dunes *C. crista, S. littoreus, Solanum trilobatum, I. pes-caprae, S. portulacastrum, E. bracteata* etc. are worth mentioning.

In the Paradeep and the neighbourhood of the Mahanadi delta, shrubby elements are gregarious except a few tree species like *A. officinalis* and

S. apetala. The shrubby elements namely *A. ilicifolius, E. agallocha, C. crista, D. spinosa, T. troupii, A. corniculatum* etc. are commonly seen. *Sarcolobus carinatus, D. trifoliata, D. scandens, S. trilobatum, I. cymosa*, *S. tiliifolia* are the notable climbers, where the salinity is comparatively low as the creeks and channels are completely closed due to the pure formation of *P. paludosa*. So, the sea water does not reach these areas during tide.

In the Dhamra estuary, degraded mangrove forests are seen along with some of the associates in small patches. The true mangroves are *A. officinalis*, *C. decandra*, *S. apetala*, which exhibit very stunted growth giving the appearance of small bushy trees. The associates consist of *A. ilicifolius*, *E. agallocha*, *D. trifoliata*, *P. paludosa, T. populnea*, etc. *P. coarctata* is usually abundant here, where as *M. wightiana* is found comparatively in lesser abundance. Both species have a great role in checking soil erosion.

The Subarnarekha river estuary is endowed with a few species of *C. decandra* and *B. parviflora*. Concurrently, *A. ilicifolius*, *E. agallocha*, *D. trifoliata*, etc. are found as associate species. The ground flora and sand dune vegetation are completely absent in this region except some herbaceous species like *C. arenarius*, *C. platystylis* and *F. ferruginea* etc.

The Burabalam river estuary harbours only the devastated as well as degraded mangrove forests, which consists of *A. officinalis* and *C. decandra*. The shrubby taxa of this area are *A. ilicifolius*, *D. trifoliata*, *D. scandens* and *T. populnea* etc. This region is completely devoid of ground flora and sand dune vegetation.

In the Rusikulya river estuary, no significant mangrove formation is observed. Only pure stands of *S. maritima* are very common. Among the sand dunes, *S. littoreus, S. trilobatum, I. pes-caprae* are very common.

The fauna of the mangrove areas of Odisha is extensive but depends in species and numbers on the type of area, vegetational cover and amount of protection. The fauna of the Bhitarkanika National Park is the most varied and includes the Estuarine or salt-water crocodile (*Crocodylus porosus*), the Water monitor lizard (*Varanus salvator*), several species of fresh-water turtles and the Olive Ridley Sea turtle (*Lepidochelys olivacea*), King Cobra (*Ophiophagus hannah*) and many other poisonous and non-poisonous snakes, Spotted deer (*Axis axis*), Sambhar (*Cervus unicolor*), Rhesus macaque (*Macaca mulatta*), Irrawady Dolphin (*Orcaela brevirostris*); about 300 species of mangrove-associated birds including many colony-nesting and migratory birds, hundreds of species of estuarine, marine and fresh-water fishes besides large number of invertebrate fauna like fiddler crabs, littoral mud crabs and thousands of species of insects.

OBJECTIVES OF THE STUDY

1. To determine the diversity (number of species) of amphibians in the mangrove areas of Odisha.
2. To determine the taxonomic groups of the amphibians in the mangrove areas of Odisha (i.e., the number of Orders, Families and Genera these different species belong).
3. To locate the different micro-habitats in which these amphibian species live (i.e., terrestrial, fossorial, aquatic, semi-aquatic, arboreal etc) in the mangrove areas of Odisha.
4. To determine the distribution pattern of the amphibian species in the mangrove areas of Odisha.
5. To determine if there are any unreported species (new records) to Odisha State, India or to Science from this part of the country.
6. To photograph the different species and record their breeding calls.

DETAILED METHODOLOGY

To determine the amphibian diversity of the mangrove areas of Odisha, three short surveys were conducted in the mangrove areas of Odisha, by a team of three amphibian researchers from Zoological Survey of India, Kolkata. The first survey was conducted from 28.06.2013 to 10.07.2013 in the Bhitarkanika National Park and Pattamundai area of Kendrapara district of Odisha; the second survey was conducted from 12.09.2014 to 28.09.2014 in Kalibhanjadia Island

of Bhitarkanika National Park, Chilika lagoon area, Devi river mouth and Bichitrapur mangroves of Subarnarekha river mouth, Baleswar district of Odisha; the third survey was conducted from 19.12.2015 to 02.01.2016 in Burabalam river mouth of Baleswar district, Mahanadi river mouth in Paradeep area of Jagatsinghpur district and Rusikulya river mouth in Ganjam district of Odisha.

1. After reaching a particular locality the survey team conducts a recce survey during the daytime with a local field guide. This is to familiarize with the surrounding area and human communities, to determine the possible study and collection sites like mangrove creeks, ditches, pools, ponds and other wetlands.
2. After locating the possible study and collection localities, the survey team visits these sites during the evening between 6 pm – 11 pm.
3. Often breeding calls of the different amphibian species help in locating the particular species. The calls are recorded using a SONY ICD P-520 Digital Sound Recorder with a uni-directional microphone.
4. These species are then searched using powerful 4-cell search-lights and Petzl headlights. After locating them, they are photographed in the field using a Nikon D7000 Digital SLR camera with a 105 Macro Lens while they are calling, mating or breeding.
5. Then some of these species are collected as voucher specimens for the National Zoological Collections of the Amphibia Section of Zoological Survey of India, Kolkata by using hand nets or long-handle nets but often only by hand.
6. Sometimes eggs and tadpoles of these species are found and collected also.
7. The collected samples are kept in plastic bags, brought back to the field camp, anasthesized with alcohol or chloroform and fixed in 4% formaldehyde solution. Before fixation, tissue samples are collected from liver or thigh muscles for DNA sequencing in the molecular taxonomy laboratory of ZSI.
8. After keeping for two days, the preserved specimens are washed thoroughly with running tap water, stretched properly and injected with 70% alcohol. They are then preserved in rectified spirit and brought back to ZSI laboratory. Later these were transferred to 70% ethyl alcahol for permanent preservation.

RESULTS

69 specimens of amphibians belonging to 14 species, 9 genera and 5 families were collected from different mangrove areas of Odisha as mentioned below. The detailed species accounts of these amphibian species are given below along with their scientific names, common names, original citations, measurements with registration numbers, diagnostic features, colour, secondary sexual characters, habitat and status and distribution (remarks) in the mangrove areas of Odisha. This forms the first scientific document of the amphibians of the mangrove areas of Odisha with a new record to India.

SPECIES ACCOUNTS

Family BUFONIDAE

1. *Duttaphrynus melanostictus* (Schneider, 1799)

1799. *Bufo melanostictus* Schneider, *Hist. Amph*., **1**: 216.

Common Name: Common Indian Toad (English).

Specimens Examined: A 11576 from Tantiapal, Kendrapara district, Odisha (20º51´973˝N, 86º72´409˝E) collected on 01.vii.2013; A 11591 from Kendrapara, Kendrapara district, Odisha (20º74´385˝N, E 86º86´663˝E) collected on 06.vii.2013; A 12157-A 12158 from Sahana Reserve Forest, Astaranga area of Devi river mouth, Puri district, Odhisa (19°57´399˝N, 86°20´002˝E) collected on 22.ix.2014; A 12159 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odisha (20°36´024˝N, 86°11´721˝E) collected on 18.ix.2014; A 12578 from Burabalam river mouth, Baleswar district, Odisha collected on 21.xii.2015; A 12579 from Mahanadi river mouth, Paradeep area, Jagatsinghpur district, Odisha collected on 24.xii.2015 and A 12580 from Rusikulya river mouth, Ganjam district, Odisha collected on 30.xii.2015. The measurements of the toads collected are given next page in millimeters:

Reg No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11576	39.91	12.05	14.65	5.98	3.19	5.04	4.21	3.32	16.10
A11591	65.48	13.43	23.16	8.53	4.48	5.48	6.62	3.70	23.48
A12157	76.34	22.94	31.04	11.83	6.38	9.04	7.43	6.25	33.40
A12158	65.30	20.42	25.48	8.57	5.31	8.52	5.10	4.92	27.62
A12159	40.04	12.34	15.31	6.63	3.66	5.05	3.76	2.91	14.81
A12578	41.10	13.09	15.40	6.52	2.64	5.82	4.34	3.42	16.23
A12579	48.34	9.56	17.65	6.87	4.87	4.87	5.35	2.10	17.87
A12580	52.74	10.65	18.56	7.28	5.12	4.97	5.64	2.37	18.74

Size: 40-105 mm (snout-vent length).

Distinguishing features: Medium to large sized toads readily identified by the black-tipped horny warts on the skin on the upper (dorsal) side. The lower (ventral) side is coarsely granular except the throat and the chin. Head is broader than long and with cornified (bony) ridges. Snout is rounded. Nostril is nearer to the tip of the snout than the eye. Tympanum is distinct, circular or oval and nearly two-third the diameter of the eye. Parotoid glands are elliptical and bean-shaped. Fingers are without webbing. Toes are almost two-third webbed with two segments of the fourth toe free. Both the inner and outer metatarsal tubercles on the sole of the feet are equal in size with sharp edges. The males have a single external vocal sac.

Colour: Dorsal side brownish-grey or blackish with yellowish or reddish markings. Horny warts on dorsum black-tipped. Cornified (bony) ridges on head also black. Ventral side yellowish.

Habitat: Found in all the mangrove areas of the Odisha over leaf-litter, beside rain-water pools and also on the muddy and slushy ground surface at the base of the mangrove plant roots (pneumatophores). They hide in moist holes and huddle together in crevices of tree-trunks. Except during the breeding season they spend the day in any convenient cranny which is cool and dark.

Remarks: Very common throughout the mangrove areas of Odisha. Terrestrial and nocturnal, they have limited powers of hopping and usually walk. They are usually solitary but congregate during the breeding season near water-bodies. The species is a prolific breeder laying a few thousand eggs in long translucent strings which is entwined round the stems of aquatic plants. The tadpoles are black and are gregarious. Juveniles wander on land during mornings and afternoons, if the air-temperature is sufficiently low.

2. ***Duttaphrynus stomaticus*** (Lutken, 1862)

1862. *Bufo stomaticus* Lutken, *Vidensk. Meddr. Dansk. Naturhist. Foren*., Ser 2, **4**: 305.

Common Name: Marbled Toad (English).

Specimens Examined: A 11598 from Hatapatana, Kendrapara district, Odhisa (20°51′973″N, 86°72′409″E) collected on 08.vii.2013. The measurements of the toad collected are given below in millimeters:

Size: 38-76 mm (snout-vent length).

Distinguishing features: Medium-sized toads readily identified by the overall texture of the skin. The skin lacks the horny warts typical of the Common Indian toads. There are several irregular flat warts on the upper side. The lower side is coarsely granular except the throat and the chin.

Reg No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11598	51.64	9.25	17.76	6.24	4.34	4.97	5.63	2.57	34.31

Head is broader than long and without any bony ridges. Snout is rounded. Ear-drum is distinct, circular or oval and nearly half the diameter of the eye. Parotoid glands are elongated and elliptical but not bean-shaped.

Colour: Dorsal side brownish or olive-yellow or olive-grey with or without darker markings. Ventral side including the upper lip is whitish.

Habitat: Drier forest areas preferred but are seen near water bodies especially during the breeding season.

Remarks: The species is rare in most of the mangrove areas. They are terrestrial and nocturnal. However during the breeding season they can be seen moving around during the day. Breeding occurs between June and August and the call of the male is distinctive and can be easily distinguished from that of the Common Indian Toad. The eggs are laid in translucent strings and are pale yellowish green in colour. The tadpoles are small and black with shiny silver spots on the body.

Family MICROHYLIDAE

3. ***Microhyla ornata*** (Dumeril & Bibron, 1841)

1841. *Engystoma ornatum* Dumeril & Bibron, *Erp. Gen.,* **8**: 745.

Common Name: Ornate narrow-mouthed frog (English).

Specimens Examined: A 11580 from Gupti, Bhitarkanika National Park, Kendrapara district, Odhisa (20º65´311´´N, 86º85´178´´E) collected on 02.vii.2013; A 11583 – A 11584 from Sasanpeta, Kendrapara district, Odhisa (20º49´460´´N, 86º73´837´´E) collected on 03.vii.2013; A 11592 from Kendrapara, Kendrapara district Odhisa (20º74´385´´N, E 86º86´663´´E) collected on 06.vii.2013; A 11599 from Hatapatana, Kendrapara district, Odhisa (20°51´973´´N, 86°72´409´´E) collected on 08.vii.2013 and A 12132–A 12136 from Dangamal, Bhitarkanika National Park, Kendrapara district Odhisa (20°36´024´´N, 86°11´721´´E) collected on 19.ix.2014. The measurements of the frogs collected are given below in millimeters:

Size: 19-26 mm (snout-vent length).

Distinguishing features: Small-sized, vividly patterned, squat and active frogs with bulging eyes. The head is rather small with a narrow pointed snout which projects beyond the mouth. Ear-drum is indistinct. Tips of the fingers and toes are flattened and blunt but the fingers and toes do not bear enlarged discs. Rudiment of webbing between the toes. Two small but distinct and oval inner and outer pedal tubercles are present. The skin is smooth.

Colour: Upperside is light brown to bronze with distinct dark brown diamond-shaped marking over the back, beginning between the eyes, narrowing behind the head and widening above the shoulder, then narrowing again and finally broadening out. A dark streak extends along the sides from behind the eye to the shoulder. Limbs are with dark cross

Reg No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11580	19.16	4.18	5.46	2.49	1.51	1.98	2.86	hidden	8.51
A11583	20.39	5.18	6.52	3.53	1.48	2.31	2.05	hidden	10.26
A11584	21.31	4.36	6.55	3.25	1.61	2.48	2.02	hidden	10.64
A11592	20.80	4.95	5.96	3.30	1.62	2.38	2.05	hidden	8.35
A11599	20.35	4.35	5.82	2.73	1.59	2.17	2.54	hidden	9.10
A12132	21.89	4.32	5.86	2.71	2.04	2.41	2.07	hidden	9.58
A12133	19.28	4.86	5.43	2.59	1.85	2.19	2.08	hidden	8.76
A12134	19.03	5.09	5.61	2.66	1.81	1.93	2.02	hidden	8.22
A12135	19.78	4.54	5.76	2.82	1.94	2.05	1.84	hidden	9.56
A12136	17.43	4.14	5.08	2.57	1.64	1.67	1.83	hidden	7.96

bars. The belly is dull white and the throat and chest are black in breeding males.

Habitat: Found among moist leaf-litter all over the mangrove areas. It is found throughout the year in areas with adequate cover and moisture. Juveniles are seen in dried up beds of temporary rain-water pools well after the monsoon season.

Remarks: Very common throughout the mangrove areas of Odisha. Can call very loud and jump tremendously when compared to its small size. Breeding commences just after the arrival of the monsoon rains. Several males can be heard calling from evening near temporary rain-water pools. However the call is ventriloquistic and makes location of the small frog quite difficult. The male remains stationary and is located by the female by its call. About 200 eggs are laid in mucilaginous masses floating in water. The tadpoles are transparent and have a golden-coloured diamond-shaped mark on the head.

4. ***Kaloula taprobanica*** Parker, 1934

1934. *Kaloula pulchra taprobanica* Parker, *Monogr. Frogs Fam. Microhylidae:* 86-87.

Common Name: Painted Frog, Indian Painted Frog, Painted Kaloula (English).

Specimens Examined: A 11593 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36′024″N, 86°11′721″E) collected on 07.vii.2013 and A 12211 from Kalibhanjadia Island, Bhitarkanika National Park, Kendrapara district, Odhisa (20°44′268″N, 86°34′019″E) collected on 19.ix.2014. The measurements of the frogs collected are given below in millimeters:

Size: 28-58 mm (snout-vent length).

Distinguishing features: Medium-sized, colourful, stocky-built, stout-bodied, short-legged frog. Head is broader than long, snout is rounded. The ear-drum is hidden. Fingers are without webs, the tips of the fingers bear short well-developed triangular discs. Toes are about one-third webbed and terminated with dilated triangular discs. Inner pedal tubercle is well-developed, large and shovel-shaped. Outer pedal tubercle is small. Skin is wrinkled on the belly but granular on the throat and underside of the thighs.

Colour: The upperside is blackish-brown with deep red irregular patches margined with black. These patches form a dark reddish lateral band running on each side from the eyes to the groin. The belly is grayish, finely spotted with brown. In breeding males, the throat is black.

Habitat: Village areas at the edge of forests. Breeds in dirty ponds and pools.

Remarks: Uncommon in the mangrove areas. The species is very colourful. They are terrestrial, burrowing and nocturnal, emerging from their burrows during the early monsoon and are often seen to climb up trees, where they are found in holes in tree-trunks, infested with ants, about one and a half meters above the ground. The call is distinctive and seems like the grating of a coconut.

Reg No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11593	52.19	10.27	15.31	5.56	3.17	4.77	5.61	hidden	13.88
A12211	48.94	10.24	15.52	5.17	3.18	4.53	5.13	hidden	14.94

Family DICROGLOSSIDAE

5. ***Euphlyctis cyanophlyctis*** (Schneider, 1799)

1799. *Rana cyanophlyctis* Schneider, *Hist. Amph. Nat*, **1**: 137.

Common Name: Skittering Frog, Skipping Frog, Skipper Frog, Water frog (English).

Specimens Examined: A 11581 from Gupti, Bhitarkanika National Park, Kendrapara district, Odhisa (20º65′311″N, 86º85′178″E) collected on 02.vii.2013; A 11587 from Khola, Bhitarkanika National Park, Kendrapara district, Odhisa (20º71′717″N, 86º82′411″E) collected on 04.vii.2013; A 12152–A 12156 from Sahana Reserve Forest, Astaranga area of Devi river mouth, Puri district, Odhisa (19°57′399″N, 86°20′002″E) collected on 21-22.ix.2014; A 12581 from Burabalam river mouth, Baleswar district, Odisha

Reg No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11581	42.74	12.06	13.89	6.88	4.88	4.41	2.13	3.14	19.51
A11587	38.07	10.02	13.13	5.41	4.88	4.21	2.98	3.58	20.11
A12152	40.91	13.56	14.12	6.72	3.10	5.03	2.96	3.83	21.64
A12153	39.79	12.88	14.52	6.98	3.41	4.47	2.39	3.98	20.85
A12154	38.11	13.21	14.20	6.45	3.09	4.64	3.39	3.59	19.45
A12155	41.89	15.63	15.20	6.67	3.07	4.61	3.25	3.62	20.46
A12156	68.82	25.11	25.63	10.30	4.59	7.26	5.08	5.72	30.58
A12581	46.56	15.11	17.70	7.97	3.45	5.25	2.77	4.60	24.60
A12582	30.88	11.44	12.17	5.40	2.74	3.52	2.44	2.85	16.40
A12583	31.17	10.58	11.49	5.21	2.48	3.49	2.15	2.79	15.64

collected on 22.xii.2015; A 12582 from Mahanadi river mouth, Paradeep area, Jagatsinghpur district, Odisha collected on 25.xii.2015 and A 12583 from Rusikulya river mouth, Ganjam district, Odisha collected on 31.xii.2015.The measurements of the frogs collected are given above in millimeters:

Size: 30-70 mm (snout-vent length).

Distinguishing features: Medium-sized aquatic frogs, normally seen floating in open water. The eyes are placed above the head and protrudes out of the water when the frog is floating. Snout is rounded. Nostril is equidistant between the tip of the snout and the eye and projects upwards. Fingers are without webbing, the tips of the fingers are pointed. Toes are fully webbed, appearing more like that of ducks. Skin on the back is smooth but some small warts are present. A prominent skin fold runs from behind the eye to the shoulder. Belly is smooth with a single row of porous warts on each flank.

Colour: The dorsum is dark olive-brown or grayish-brown or grayish-black with darker rounded spots on the back and stripes on the limbs. Belly is white with black spots on the flanks. The vocal sacs in males are bluish and visible on either side of the throat when the males call.

Habitat: Found in all types of water-bodies in the mangrove areas especially the permanent ones with standing water. The species is also seen in rain-pools and puddles. They are active throughout the year and are both nocturnal as well as diurnal. They spend most of their time in the water or in the vicinity of water-bodies.

Remarks: One of the commonest frogs of the mangrove areas. They float passively in water with only the nostrils projecting above the surface but when disturbed, can skip smoothly over the water for some distance and then float above the surface with the hind legs held parallel. While calling, the inflated bluish-white vocal sacs of the male project through slits on the floor of the mouth. The call is distinctive and can be heard throughout the year. The eggs are laid in a frothy mass in standing water.

6. ***Euphlyctis hexadactylus*** (Lesson, 1834)

1799. *Rana hexadactyla* Lesson, in Belanger (ed). *Voy. Indes-Orientalis. N. Eur. Caucase Georgie Perse Zool*: 331.

Common Name: Green Pond Frog.

Specimens Examined: A 11582 from Gupti, Bhitarkanika National Park, Kendrapara district, Odhisa (20º65´311´´N, 86º85´178´´E) collected on 02.vii.2013 and A 11586 from Khola, Bhitarkanika National Park, Kendrapara district, Odhisa (20º71´717´´N, 86º82´411´´E) collected on 04.vii.2013. The measurements of the frogs collected are given in next page millimeters:

Size: 60-140 mm (snout-vent length).

Distinguishing features: A giant leaf-green frog, which spends most of the time in water. The eyes are placed on the top of the head and the ear-drum is large and distinct, nearly equal

Reg. No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11582	58.16	20.39	24.32	11.51	4.34	6.90	4.65	5.38	34.31
A11586	73.90	24.22	26.52	12.26	5.32	7.69	6.57	6.52	36.78

to the diameter of the eye. Head is as long as broad. Snout is flat and rounded. Nostril is nearer to the tip of the snout than the eye and projected upwards. Fingers are without webbing, the tips of the fingers and toes are pointed. Toes are fully webbed. There is strong dermal fringe on the outer toes. A distinct finger-like inner pedal tubercle is present on the inner aspect of the sole (hence named as hexadactylus, literally meaning six-toed). Skin is smooth above but granules and warts are present on the throat, belly and under the thighs. A distinct skin fold runs from behind the eye to the shoulder.

Colour: Olive-green or deep grass green on the back, mostly with a pale yellowish-white median streak. The sides and webbing on the toes are yellow as is the throat which may be stippled with brown. Under parts are white or yellowish-white.

Habitat: Tends to stay within the cover of floating aquatic plants and camoufling totally with the background of those water plants. Found more in ponds, canals and ditches choked with aquatic plants. They are mostly seen in the stagnant waters of the coastal regions.

Remarks: They are agile and can leap a considerable distance on land where they come at night in search of food. They also leap out of water when pursued splashing loudly. The adults have the unique habit of feeding on aquatic plants. Feed mainly on weeds but also on various insects, snails, small fishes and smaller frogs are also found in the stomach.

7. ***Hoplobatrachus tigerinus*** (Daudin, 1802)

1802. *Rana tigerina* Daudin, *Hist. Nat. Rain. Gren. Crap., Quarto*, **1**: 42.

Common Name: Bull Frog, Indian Bull Frog (English).

Specimens Examined: A 11572 from Rajnagar, Kendrapara district, Odhisa (20º57´485´´N, 86º70´847´´E) collected on 30.vi.2013; A 12170 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36´024´´N, 86°11´721´´E) collected on 19.ix.2014. A 12584 from Burabalam river mouth, Baleswar district, Odisha collected on 23.xii.2015. The measurements of the frogs collected are given below in millimeters:

Size: 60-150 mm (snout-vent length).

Distinguishing features: Large frogs with smooth skin and longitudinal glandular folds on the back. They are very bulky with long and muscular limbs. Head is somewhat pointed and projects beyond the mouth. A skin fold runs from behind the eye to the shoulder. Fingers are without webbing, the tips of the fingers and toes are not sharply pointed. Toes are extensively webbed but the webbing does not reach to the tip of the fourth toe. Belly is smooth with no porous warts on the flanks. Vocal sacs in males are external and blue in colour.

Colour: Yellowish or olive-green with darker leopard-like spots and patches. A yellowish median stripe runs from the tip of the snout to the vent. A broad white band runs along the side. The breeding males turn bright lemon yellow.

Habitat: Found among grasses and bushes and inside hollows at the edge of ponds and ditches. Seen frequently on the edges of ponds during breeding season into which they leap headlong at the least sign of danger.

Reg. No	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11572	85.48	29.52	29.61	15.42	5.81	8.79	6.12	6.46	44.06
A12170	102.68	33.89	35.19	19.15	8.05	11.24	6.43	8.32	57.17
A12584	98.92	35.33	39.07	18.98	7.03	10.56	7.19	8.51	59.91

Remarks: Very common species in the mangrove areas. They are solitary creatures, which aggregate only during the breeding season. In the non-breeding season, they are silent and difficult to locate but with the appearance of the rainy season their highly resonant call can be heard throughout the night. Croaking loudly the males await the arrival of the females. The eggs are laid in ponds and pools where they float first but sink later. The tadpoles are bottom-feeders.

8. ***Hoplobatrachus crassus*** (Jerdon, 1853)

1853. *Rana crassa* Jerdon, *J. Asiat. Soc. Beng*., **22**: 531.

Common Name: Jerdon's Bull Frog (English).

Specimens Examined: A 11588 from Krishnapriyapur, Kendrapara district, Odisha (20º61´934´´N, 86º85´397´´E) collected on 05.vii.2013; A 12171 and A 12172 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36´024´´N, 86°11´721´´E) collected on 19.ix.2014. The measurements of the frogs collected are given below in millimeters:

Size: 40-86 mm (snout-vent length).

Distinguishing features: Medium to large-sized flabby-shaped frogs with numerous interrupted glandular longitudinal folds on the back and sides. Snout is generally pointed and projects beyond the mouth. Tympanum is large and distinct, nearly equal to the diameter of the eye. Fingers are without webbing but the toes are almost fully webbed. Legs are comparatively shorter than those of the Indian Bull frog. A large shovel-shaped inner pedal tubercle is present but the outer pedal tubercle is absent. Belly is smooth.

Colour: Greyish or greenish-brown with darker patches on the back. The undersides are white with deep brown stripes or bars on the upper jaw in front of the eyes and on the lower jaw. The legs are cross-barred with deep brown or black stripes or blotches. The vocal sacs in the males are external and turn black at the time of breeding.

Habitat: They spend the day hiding inside crevices on elevated banks of ponds and ditches. They are found during breeding season in temporary rain-water pools.

Remarks: The species is quite common in the mangrove areas. They are terrestrial, nocturnal and also burrow in the ground.

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11588	69.33	22.36	23.45	11.84	5.46	8.12	5.79	5.53	31.06
A12171	59.10	19.48	20.76	10.21	4.72	5.89	3.89	3.98	31.84
A12172	48.22	16.15	16.22	8.55	4.42	4.81	3.38	3.61	24.37

9. ***Fejervarya orissaensis*** (Dutta, 1997)

1997. *Limnonectes orissaensis* Dutta, *Hamadryad*., **22**(1): 1-8.

Common Name: Orissa Cricket Frog (English).

Specimens Examined: A 11573 from Rajnagar, Kendrapara district, Odhisa (20º57´485´´N, 86º70´847´´E) collected on 30.vi.2013; A 11578 from Tantiapal, Kendrapara district, Odisha (20º51´973´´N, 86º72´409´´E) collected on 01.vii.2013; A 11585 from Sasanpeta, Kendrapara district, Odisha (20º49´460´´N, 86º73´837´´E) collected on 03.vii.2013; A 12167–A 12169 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36´024´´N, 86°11´721´´E) collected on 19.ix.2014; A 12585 from Mahanadi river mouth, Paradeep area, Jagatsinghpur district, Odisha collected on 25.xii.2015 and A 12586 from Rusikulya river mouth, Ganjam district, Odisha collected on 30.xii.2015. The measurements of the frogs collected are given next page in millimeters:

Size: males (36–47 mm), females (34–53 mm).

Diagnostic features: Medium-sized frogs with interrupted longitudinal folds on dorsum, and smooth ventrum. Head longer than wide, depressed. Snout pointed, extending beyond the mouth. Tympanum distinct, rounded, diameter less than eye diameter with supratympanic fold extending from posterior corner of eye to forelimbs. Fingers not webbed. Shorter hind limbs,

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11573	42.24	12.94	13.38	7.07	3.46	5.21	3.79	3.14	21.76
A11578	36.83	10.64	10.76	6.21	3.01	4.14	3.04	1.80	18.57
A11585	46.67	11.97	14.69	6.93	3.66	6.18	4.16	2.79	21.97
A12167	35.76	11.29	10.73	5.26	3.73	4.14	3.19	2.57	15.86
A12168	41.37	14.25	13.98	6.72	3.27	4.29	3.16	3.02	21.96
A12169	37.40	11.46	12.66	6.28	2.96	4.36	2.62	2.24	20.49
A12585	36.26	11.76	12.45	6.24	2.98	4.41	2.72	2.58	18.70
A12586	36.32	12.23	12.39	6.31	3.03	4.68	2.49	2.61	19.76

more rounded finger and toe tips and a greater degree of webbing on the toes. Two metatarsal tubercles. Inner metatarsal tubercle is oval and larger than the outer metatarsal tubercle. Skin on dorsum of head smooth but body covered with interrupted, longitudinal ridges with small rounded ridges towards posterior border of body. Skin on flanks and chin smooth. Skin on belly and proximal ventral surfaces of thigh is smooth.

Colour: Dorsum brown, grey or brick red. A V-shaped marking between eyes which is interrupted by a vertebral band, with or without yellowish narrow or wide vertebral band extending from tip of snout to vent. An X-shaped black patch on the middle of the body. Limbs with complete or incomplete dark cross bars. The sides of the thighs are yellowish white with black speckles. Margins of jaws are with black vertical bars.

Habitat: Found during monsoon on grassy lands near water pools and on the banks of the mangrove creeks. They take shelter in mud holes near water.

Remarks: The species is very common in the mangrove areas of Odisha. When disturbed they jump into water but immediately return to the edges. They are active at night and hide in grass and in small holes near water during the day. Eggs are laid in open temporary rain-water pools, the larvae are free-swimming.

10. ***Fejervarya syhadrensis*** (Annandale, 1919)

1919. *Rana limnocharis syhadrensis* Annandale, *Rec. Ind. Mus.,* **16**: 121-125.

Common Name: Small Cricket Frog (English).

Specimens Examined: A 11574 from Rajnagar, Kendrapara district, Odhisa (20º57´485˝N, 86º70´847˝E) collected on 30.vi.2013; A 11577 from Tantiapal, Kendrapara district, Odisha (20º51´973˝N, 86º72´409˝E) collected on 01.vii.2013; A 11590 from Krishnapriyapur, Kendrapara district, Odisha (20º61´934˝N**,** 86º85´397˝E) collected on 05.vii.2013; A 12212–A 12216 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36´024˝N, 86°11´721˝E) collected on 19.ix.2014; A 12587 from Burabalam river mouth, Baleswar district, Odisha collected on 22.xii.2015 and A 12588 from Rusikulya river mouth, Ganjam district, Odisha collected on 31.xii.2015. The measurements of the frogs collected are given next page in millimeters:

Size: Snout-vent length: 27-32 mm (males) and 29-40 mm (females).

Distinguishing features: Small to medium-sized mostly terrestrial frogs. Head is longer than broad. Snout is pointed and projects beyond the mouth. The ear-drum is distinct. Fingers are without webbing. The hind limbs are short and the webbing is very slight on the toes. A prominent skin-fold runs from behind the eye to the shoulder. Some short and interrupted longitudinal glandular folds are present on the back. Belly is smooth.

Colour: Olive-brown above usually with darker markings which assume irregular patterns. A pale yellow vertebral stripe is present along the back and lips and limbs are barred. The underside is white except on the throat, which is black in breeding males.

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11574	34.12	10.15	10.24	5.73	2.11	4.83	2.93	2.09	16.32
A11577	26.42	8.72	9.05	4.87	2.62	3.59	2.64	1.76	14.41
A11590	36.45	10.53	11.24	5.35	3.09	3.96	3.28	2.31	19.71
A12212	28.38	9.27	9.24	4.57	2.82	3.46	2.53	2.26	14.72
A12213	23.32	10.31	9.04	4.33	2.42	3.67	2.38	1.61	12.91
A12214	22.23	7.26	7.68	4.13	2.46	2.73	2.18	1.98	11.21
A12215	20.82	8.01	7.87	4.21	1.92	2.83	1.61	1.58	9.81
A12216	22.72	8.76	8.32	4.17	2.69	2.86	2.46	1.41	13.63
A12587	16.79	6.17	6.65	3.21	1.94	2.28	1.79	1.34	9.26
A12588	15.91	5.82	5.54	2.78	1.71	2.55	1.68	1.23	8.59

Habitat: Prefers vicinity of water without being really aquatic. They can be encountered far away from water-bodies in open grassland, pools and ditches.

Remarks: One of the commonest species found throughout the mangrove areas. Partly diurnal but only calls nocturnally. Males call in the evening and night and are easy to locate.

11. ***Fejervarya moodiei*** (Taylor, 1920)

1920. *Rana moodiei* Taylor, *Phillip. J. Sci.,* **16**: 234.

Common Name: Taylor's mangrove crab-eating Frog (English).

Specimens Examined: A 11594–A 11595 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36′024″N, 86°11′721″E) collected on 07.vii.2013; A 12151 from Bichitrapur mangroves, Subarnarekha estuary, Baleswar district, Odisha (21°35′378″N, 87°25′158″E) collected on 24.ix.2014 and A 12163 from Kalibhanjadia Island, Bhitarkanika National Park, Kendrapara district, Odhisa (20°44′268″N, 86°34′019″E) collected on 19.ix.2014. The measurements of the frogs collected are given below in millimeters:

Size: 45-55 mm (snout-vent length).

Distinguishing features: Medium-sized mostly terrestrial frogs. Head is almost as long as wide but depressed. Snout is pointed and projects beyond the mouth. Nostril is upwardly directed and nearer to the snout tip than the eye. The ear-drum is distinct and rounded, smaller than the diameter of the eye. Fingers are without webbing. Palmer tubercles are distinct. First finger is large, almost as large as third. The hind limbs are short but the webbing is extensive on the toes, extending from outer side of every toe tip to the last phalange of inner side of next, except the fourth toe where both inner and outer last phalange is free. Tips of the fingers and toes are pointed. Very prominent sub-articular tubercles present on fingers and toes. Inner metatarsal tubercle is large and prominent. A well-developed supra-tympanic fold runs from behind the eye, broadening to the shoulder. Some short and interrupted longitudinal glandular folds are present on the dorsum. Belly is smooth.

Colour: Mostly grayish-brown on the dorsum with small brown patches. The upper and lower lips are heavily cross-barred. The shank and tarsus

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11594	45.75	14.20	14.82	7.23	4.08	5.35	3.17	3.43	22.92
A11595	46.23	14.23	14.71	8.33	4.35	5.03	3.81	3.62	22.65
A12151	53.78	20.39	21.78	10.70	4.36	6.95	3.81	4.92	28.96
A12163	45.44	17.06	18.79	9.08	3.81	5.44	3.11	3.58	22.15

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
1998.0005	73.37	24.22	24.40	12.80	4.98	7.08	5.03	4.84	36.38
1998.4456	109.20	32.54	36.37	17.50	5.73	10.44	5.63	4.84	55.12
1891.83	95.36	31.94	34.72	17.62	5.93	9.72	5.72	7.54	49.89
1891.84	71.58	24.23	24.49	13.31	4.77	7.99	4.47	5.23	38.07
1891.85	74.84	24.30	26.48	12.97	4.59	9.85	3.47	6.15	38.81
1891.86	66.54	21.46	22.33	11.88	4.03	6.80	3.81	4.71	35.89

are also cross-barred. The ventral part of thighs are maculated / spotted. The ventrum and underside of the fore and hind limbs are white.

Habitat: Common in the mangrove areas of Odisha where they hide inside mud-holes at the base of the pneumatophores (emerging breathing roots) on mud banks of mangrove creeks during the day and emerge mostly in the early evening and night to feed on mangroves littoral crabs (*Metapograpsus* sp) found in plenty in the mangrove areas.

Remarks: The Taylor's mangrove crab-eating frog was observed breeding in good numbers on Kalibhanjadia Island where its tadpoles were seen in the pools of brackish water on the island. Earlier this species was wrongly reported as Crab-eating Frog (*Fejervarya cancrivora*) by some workers (Jena, Palita & Mahapatra, 2013). This is therefore the first definitive new record of the Taylor's mangove crab-eating frog (*Fejervarya moodiei*) from India. It was earlier known from Phillipines, Thailand, Myanmar and Bangladesh.

During October, 2013 the first author had the opportunity to examine and measure 6 specimens of the Crab-eating Frog (*Fejervarya cancrivora*) at the Department of Systematics et Evolution, Museum National d'Histoire Naturelle, Paris, France. These measurements are given below for comparison with *Fejervarya moodiei*. *Fejervarya cancrivora* are much larger than *Fejervarya moodiei*.

Specimens Examined: 1998.0005 from Ao Phany Nga, Phang Nga Province, Thailand; 1998.4456 from Java, Indonesia; 1891.83 from Borneo; 1891.84 from Borneo; 1891.85 from Borneo and 1891.86 from Borneo. The measurements of the frogs measured are given above in millimeters:

12. ***Sphaerotheca rolandae*** (Dubois, 1983)

1983. *Rana* (*Tomopterna*) *breviceps rolandae* Dubois, *Alytes.,* **2**(4): 163-170.

Common Name: Roland's Burrowing Frog (English).

Specimens Examined: A 11597 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36´024´´N, 86°11´721´´E) collected on 07.vii.2013. The measurements of the frog collected are given below in millimeters:

Size: 24-38 mm (snout-vent length).

Distinguishing features: Small to medium-sized, generally stout and sluggish, burrowing frogs with a rather blunt toad-like snout. Snout is short and rounded, not projecting beyond the mouth. Ear-drum is distinct, more or less half the diameter of the eye. Fingers are without webbing. Tips of the fingers are swollen but not disc-like. The hind limbs are very short with little webbing on the feet. A large shovel-shaped digging appendage (inner pedal tubercle) is present on the inner side of the sole. Skin is smooth on the back but granular on the belly and underside of the thighs.

Colour: The back is yellowish-brown or dark brown with black irregular blotches on the body

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11597	36.62	9.49	12.47	4.97	3.82	4.08	2.76	2.20	13.86

and limbs. The upper lip is with dark vertical bars and the limbs are with irregular dark cross bars.

Habitat: Wet mangrove creeks where it buries itself in the muddy bank. Calling males stay close to the water.

Remarks: Secretive species in the mangrove areas, spending most of its time underground. They are rarely seen at night, especially after the early monsoon rains.

Family RANIDAE

13. ***Hylarana tytleri*** Theobald, 1868

1838. *Hylorana tytleri* Theobald, *J. Asiat. Soc. Bengal,* 37 suppl: 7-88 + iii pp, 4 pl.

Common Name: Reed Frog (English).

Specimens Examined: A 11596 from from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36'024"N, 86°11'721"E) collected on 07.vii.2013. The measurements of the frog collected is given below in millimeters

Size: 35-45 mm (snout-vent length).

Distinguishing features: A medium-sized semi-aquatic frog with smooth skin, long legs with digital disks on the fingers and toes without circum-marginal groove. Body is elongated and torpedo-shaped. The snout is pointed. The nostril is nearer to the snout tip than the eye. The ear-drum is quite large as big as the diameter of the eye. No supra-tympanic fold but two dorso-lateral folds run from above the eyes on both side of the body up to the groin. Fingers and toes are slender and elongated. Fingers without webbing but toes partly webbed. Tips of fingers and toes with rounded disks.

Colour: Dorsum light green with two golden-yellow bands on each side of the body. The upper one running from above the eye on up to the groin. The lower one from the upper lip to below the ear-drum up to the belly. The area in between the two bands is chocolate-brown. The eyes are black with the upper portion golden-yellow. The ear-drum is flesh-coloured. The ventrum is white.

Habitat: Floating weeds inside wetlands are its preferred habitat. Also seen on emergent reed beds and vegetation on the banks of the wetlands.

Remarks: Rare in the mangrove areas of Odisha. The little frog nicely camouflages among the green weeds and reed stems in the mangrove areas. The breeding season is throughout the monsoons when it emits a chirping call.

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11596	40.73	11.73	12.36	7.12	3.99	4.41	6.34	3.02	21.42

Family RHACOPHORIDAE

14. ***Polypedates maculatus*** (Gray, 1834)

1834. *Hyla maculata* Gray, *Illustrations of Indian Zoology*, **1**: 82.

Common Name: Common Tree Frog, Common Indian Tree frog (English)

Specimens Examined: A 11575 from Rajnagar, Kendrapara district, Odhisa (20º57´485˝N, 86º70´847˝E) collected on 30.vi.2013; A 11579 from Gupti, Bhitarkanika National Park, Kendrapara district, Odhisa (20º65´311˝N, 86º85´178˝E) collected on 02.vii.2013; A 11589 from Krishnapriyapur, Kendrapara district, Odisha (20º61´934˝N, 86º85´397˝E) collected on 05.vii.2013; A 11600 from Hatapatana, Kendrapara district, Odhisa (20°51´973˝N, 86°72´409˝E) collected on 08.vii.2013; A 12160 – A 12162 from Dangamal, Bhitarkanika National Park, Kendrapara district, Odhisa (20°36´024˝N, 86°11´721˝E) collected on 18-19.ix.2014. The measurements of the frogs collected are given next page in millimeters:

Size: Snout-vent length: 35-55 mm (males), 50-75 mm (females).

Distinguishing features: Medium-sized, slim, narrow-waisted tree frogs with slender elongated limbs and goggling eyes. Snout is somewhat pointed and projects a little beyond the mouth. The ear-drum is distinct and almost as large as the eye. Fingers are with rudimentary webbing.

PLATE 1

Fig. 1. Mangrove vegetation at Mahanadi river mouth

Fig. 2. Mangroves at Devi river mouth

Fig. 3. Mangrove Creek at Bhitarkanika

Fig. 4. Mangrove roots (pnematophores)

Fig. 5. Mangrove roots at high tide

Fig. 6. Mangrove roots at low tide

PLATE 2

Fig. 7. Mudskipper on mudflat

Fig. 8. Fiddler Crab (*Uca rosea*)

Fig. 9. Mangrove Crab (*Metapograpsus sp*)

Fig. 10. Collecting crabs among mangroves

Fig. 11. Fishing in the mangroves

Fig. 12. Spotted deer (*Axis axis*) among mangroves

Fig. 13. Common Indian Toad (*Duttaphrynus elanostictus*)

Fig. 14. Marbled Toad (*Duttaphrynus stomaticus*)

PLATE 3

Fig. 15. Ornate narrow-mouthed Frog (*Microhyla ornata*)

Fig. 16. *Kaloula taprobanica* (climbing inside tree stem)

Fig. 17. Skittering Frog (*Euphlyctis cyanophlyctis*)

Fig. 18. Green Pond Frog (*Euphlyctis hexadactylus*)

Fig. 19. Indian Bull Frog (*Hoplobatrachus tigerinus*)

Fig. 20. Jerdon's Bull Frog (*Hoplobatrachus crassus*)

Fig. 21. Orissa Cricket Frog (*Fejervarya orissaensis*)

Fig. 22. Mangrove Frog (*Fejervarya moodiei*)

PLATE 4

Fig. 23. Mangrove Frog (*Fejervarya moodiei*) at Dangma

Fig. 24. Specimen of Crab-eating Frog *(Fejervarya cancrivora)* at Paris Museum

Fig. 25. Burrowing Frog (*Sphaerotheca rolandae*)

Fig. 26. Reed Frog (*Hylarana tytleri*) among water hyacinth

Fig. 27. Common Tree Frog (*Polyedates maculatus*) on foam-nest

Fig. 28. Estuarine Crocodile (*Crocodylus porosus*)

Fig. 29. Water monitor lizard (*Varanus salvator*)

Fig. 30. Glossy Marsh Snake (*Gerardia prevostiana*)

Reg. No.	Snout-vent length	Head length	Head width	Snout length	Inter-narial length	Eye diameter	Inter-orbital length	Tympanum diameter	Tibial length
A11575	47.07	14.63	15.97	8.12	4.60	5.56	6.65	3.65	23.53
A11579	47.55	14.92	15.25	8.02	5.16	5.19	5.73	3.47	21.04
A11589	39.32	13.26	14.04	7.57	3.98	5.22	4.92	3.26	21.12
A11600	53.44	16.78	18.89	9.33	5.36	6.20	8.25	4.97	27.92
A12160	43.36	14.71	13.54	7.96	4.66	5.77	5.40	4.59	26.19
A12161	70.63	23.41	23.82	12.18	6.13	7.71	9.45	5.33	39.88
A12162	40.57	16.95	14.91	8.72	4.33	5.30	5.54	4.16	22.36

Toes are almost half-webbed with two segments of the fourth toe free. Tips of fingers and toes are dilated into flattened spherical adhesive discs. Skin on the back is smooth but granular on the belly and underside of the thighs. The single vocal sac is clearly visible when the males call.

Colour: The overall colour is dark brown to grayish-yellow with a distinct chocolate-brown band extending from the tip of the nostril on both sides of the head, passing through the eyes, up to the middle of the belly. The underparts are white. The limbs are cross-barred and the rear side of the thighs are yellow with dark brown spots.

Habitat: On trees, bushes, shrubs and in the breeding season sometimes on the ground beside ponds, creeks etc. Enters village houses where it finds the moist atmosphere of bathrooms very congenial.

Remarks: A very common tree-frog in the mangrove areas seen on trees and bushes about 1-6 meters above the ground. When resting, all four legs are tucked in well under the body. Lays eggs in pendulous foam-nests over hanging water in which the tadpoles fall and develop. These foam-nests measure 7-11 cm in diameter.

CONCLUSION

The amphibian fauna of the mangrove areas of Odisha was found to be quite rich with at least 14 species belonging to 9 genera and 5 families of Anurans (2 species of Bufonidae, 2 species of Microhylidae, 8 species of Dicroglossidae, 1 species of Ranidae and 1 species of Rhacophoridae). An important aspect of the study is that 5 species were recorded for the first time from the mangrove areas of Odisha. These included *Duttaphrynus stomaticus* (Bufonidae), *Fejervarya moodiei*, *Hoplobatrachus crassus* and *Sphaerotheca rolandae* (Dicroglossidae) and *Hylarana tytleri* (Ranidae). The Taylor's crab-eating frog (*Fejervarya moodiei*) was recorded from saline creeks throughout the study areas, with a maximum number of individuals at Kalibhanjadia Island of Bhitarkanika National Park. This is the first record of the species from India. *Duttaphrynus stomaticus*, *Sphaerotheca rolandae* and *Hylarana tytleri* were observed to be rare. All other species were found throughout the study area in good numbers.

Globally, little is known of the amphibian fauna inhabiting mangroves (Kathiresan and Bingham, 2001). Amphibians are generally intolerant of saline conditions found within mangroves, although some species are associated with estuarine habitats (Hedges and Thomas, 1992). Kathiresan and Rajendran (2004) reported occurrence of 13 species of amphibians from Indian mangroves. One species of frog was reported in the Vellar Estuary mangroves and five species of amphibians from Hooghly Estuary (Rao, 2004). Dev Roy and Sivaperuman (2012) reported 11 species of amphibians from Sundarban mangrove ecosystem in India. Pillai (1991) first recorded the mangrove crab-eating frog *Fejervarya cancrivora* from Andaman & Nicobar Islands. Satheeshkumar (2011) then reported the species from Pondichery mangroves, India. Recently (Jena, Palita & Mahapatra, 2013) reported it again from Bhitarkanika mangroves of Odisha. The above literature indicates that the amphibian diversity of mangrove environments is understudied. Our

study forms the first comprehensive scientific document of the amphibians of the mangrove areas of Odisha, reporting 14 species of anuran amphibians, including new records for five species from mangrove areas and a new record for India (*Fejervarya moodiei*).

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