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FAUNAL DIVERSITY OF BHITARKANIKA MANGROVES, ODISHA

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ABSTRACT

Bhitarkanika presents a variety of habitats, microhabitat and climatic conditions. Therefore, the faunal component and diversity is also extremely high in comparison to other mangrove forests of South east Coast of India. A total of 420 species belonging to five Phylums under 14 classes (Nematoda, Annelida, Mollusca, Arthropoda and Vertebrates) were recorded during the study period. Among all, bird species were recorded high (264). Though many checklist of faunal species of Bhitarkanika are available, but still there is lacking on the various aspects of ecological studies. A research programme is recommended, to monitor the effectiveness of policies and human–crocodile relationships in the Bhitarkanika, Odisha, in order to minimize human–crocodile conflict in the future.

INTRODUCTION

Documentation of faunal resource of a country therefore focuses on developing indicators to be used in the assessment which are reflected in a combination of ecological fundamentals, such as biodiversity, critical habitat and key ecological relationships; site-specific considerations, environmental stress and potential impacts. Assessments and documentation also provide biodiversity values that are recognized and taken into consideration in the planning and decision making process. The documentation of faunal resources will enhance the effective performance of planning and management and also assist in competencies or compensable factors found in evaluating the diversity of the country (Ramakrishna and Alfred, 2007). It is for this reason this work has been taken up in the present instance.

Bhitarkanika presents a variety of habitats, microhabitat and climatic conditions. Therefore, the faunal component and diversity is also extremely high in comparison to other mangrove forest areas of Odisha. The habitat diversity includes agricultural fields, rivers, fresh water ponds, mangrove vegetation, tidal rivers, creek and creeklets, estuaries, mud flats, fresh water and brackish water wetlands, riverine islands, off-shore islands, muddy and sandy coastline etc. which provide home for a varied and large number of animal species. Mangroves serve as roosting, nesting, feeding, and breeding ground for migratory birds. Mangrove plants are the source of rich food for the organisms of the mangrove ecosystem. The animals that are associated with the mangroves cover a wide range of vertebrate and other invertebrates including protozoans and zooplanktons. The vertebrate fauna includes a wide variety of fishes, amphibians, birds, reptiles and mammals including aquatic mammals. Since food and shelter is not a limiting factor in Bhitarkanika the number of animal species are also very rich. Bhitarkanika Sanctuary is home for the largest number of salt water crocodiles in the country. "Bagagahana" the heronry provides

nesting and living space to about 80,000 resident and local migratory birds. Also the numerous wetlands scattered throughout the Sanctuary serve as feeding and wintering grounds for more than 50,000 migratory birds during winter and early summer months.

The faunistic studies on Bhitarkanika Sanctuary are scanty. Notable among them are Kar, 1982; 1999; Pandav, 1997; Kar and Bustard, 1989, 1990, Kar and Behura, 1999; Chadha and Kar, 1999; Gopi and Kar 2005; Gopi and Pandav, 2006; 2007, 2007a; Gopi *et al*., 2006; Kalpana, 2005; Nayak, 2003; 2005;Sahu *et al*., 2012; Jena *et al*., 2013.

DESCRIPTION OF THE STUDY AREA

Bhitarkanika National Park is situated in the lower reaches of the Dhamra-Patsala-Maipura River, is an important patch of mangrove along the East Coast of India (Plate-1). It is a micro-environmental region of Rajnagar Block in Kendrapada district of Odisha, extending over an area of 141.44 km^2 and is located between 20°4′00″ N -20°8′00″ N and 86°45′00″ E - 87°50′00″ E. The estuaries, at the mouth of the river Brahmani, Baitarani, Dhamra, and a large number of ramifying creeks, channels, and distributaries receive tidal water twice a day. Bhitarkanika region has a globally important patch of mangroves along the East Coast of India. Bhitarkanika Wildlife Sanctuary / National Park is the second Ramsar site in Odisha and also a hotspot of rich biological diversity. With 71 species of mangroves and mangrove associates (Mishra *et al*., 2005), the area supports largest population of estuarine crocodiles in the country, largest Indian Lizards, varieties of resident and migratory birds and a number of rare and endangered mammalian species. Gahirmatha beach in this region supports largest known nesting beach of Olive Ridley Sea turtles in the world. The land elevation ranges from 3.66 m to 8.23 m. This area receives annual rainfall of 1683.4 mm of which 80% falls from June to September due to the south-east monsoon. The entire Bhitarkanika region comes under the tropical monsoon climate with well-marked seasons of winter, summer and rain. The maximum temperature rises to 36^0c in the month of April-May while the minimum temperature of the winter is about 15°c. The relative humidity remains between 70 to 85% throughout the year. The rainfall is around 170cm and most of it is received between June-October. Under such eco-climatic situation the weather conditions start to become pleasant after the rains (October-March) and this is the ideal time for a visit to the area. The tidal influenced river systems which drain into the sea along with coastal climatic conditions have enriched Odisha with pockets of mangrove forests.

FLORA

The mangroves of Bhitarakanika can be divided based on topographic differences, tidal influence and salinity. Small variations in these along the estuary bring about difference in distribution and composition. Three distinct sub-forms typical, less pronounced and hinterland mangrove formations can be noticed. The outer estuarine formation is mainly dominated by *Avicennia marina* followed by *Aegialitis rotundifolia, Avicennia alba, Bruguiera cylindrica, B. parviflora, Ceriops tagal, Lumnitzera racemosa, Sonneratia alba, S. griffithii* and sometimes with *Phoenix paludosa*. The newly exposed areas are covered with saline grass, *Porteresia coarctata*. In the hinterland, tidal flats occur with high numbers of creeks and channels, the salinity is lower than the outer estuaries but tidal velocity is higher due to the large number of creeks. It is dominated by *Rhizophora apiculata*, *R. mucronata, Kandelia candel* and *Aegiceras corniculatum* followed by *Xylocarpus granatum, Excoecaria agallocha, Bruguiera gymnorrhiza, Ceriops decandra, Avicennia officinalis, Phoenix paludosa, Merope angulata, Dalbergia spinosa* and some climbers such as *Finlaysonia obovata, Derris scandens, Tylophora tenuis* and *Hoya parasitica.* Tidal flats along the middle part of the inner estuarine areas are away from the bay and near to fresh water sources where salinity is lower due to more influence of fresh water flow. It is dominated by *Heritiera fomes* in association with *Brownlowia tersa, Cynometra iripa*, *Aglaia cucullata*, *Cerbera manghas*, *Bruguiera*

sexangula, *Sonneratia apetala* and *S. caseoloris*. Banerjee and Rao (1990) enumerated 23 species of mangroves from Odisha.

CLIMATE

The region comes under the tropical monsoon climate with three pronounced seasons: winter (October to January), summer (February to May) and rainy (June to September). The maximum temperature is recorded in the month of April and May and the minimum temperature in winter during the month of January. The relative humidity ranges from 70% to 84% throughout the year. Wind speed from March to June is over 20 km. per hour, and the predominant wind direction is from south and south-west. Rainfall is around 1642.34 cm per annum and maximum rainfall is received between June and October. The most important weather phenomenon is the prevalence of tropical cyclones. The mean track of the cyclone passes over this region (Singh and Panda, 1999). Rainfall conditions decide the sequence of mangrove distribution in the different zones in the tidal region. A successive tidal flood inundates the land surface and the subsequent exposure of the soil substratum evaporates the water. This result in thick salt crust on the soil surface and these salt crusts inhibit or limit their generation and growth of the mangroves. Frequent rainwater flushing helps in washing off the surface and leaching down the salt particles and makes the land suitable for growth of mangroves. Tidal amplitude in the Baunsagada River ranges from 1.5 to 2.5 meters in summer months to 3 to 5meters during monsoon months. In the Bhitarkanika River, and especially in creeks such as Khola (which receives tidal water from both ends) tidal amplitude reaches 3- 4 meters in summer and 5-6 meters during rainy season.

SOIL AND GEOLOGY

The soil sediments are divided into two categories, indicating recent or sub-recent forms name das 'newer alluvium' and Pleistocene forms named as 'older alluvium' (GSI, 1974). The recent sediments are represented by sand, silt, and clay with assorted boulders and pebbles. These are dark and loosely compacted with high moisture content. The Pleistocene deposits comprise of clay, sand, silt, and 'kankar', with locally cemented pebbles and gravels. These are reddish brown due to high degree of oxidation (Banerjee & Rao, 1990).

MATERIALS AND METHODS

The samples collected in the present study are mostly dead specimens (Crab, molluscs, and fishes) and many from field photographs (Odonata, lepidoptera, arachinids, reptiles, birds and mammals) as the Odisha Forest department not permitting collection of specimens.

Meiofauna: Sampling was made during low tide, mostly near the mid tide level. Sediment samples were collected using hand corer (3 cm diameter). Meiobenthos was extracted from sediments by decanting with tap water and washing through a 500 mm sieve suspended above a 45 μm sieve (McIntyre, 1969). Animals were stored in 5% formaldehyde solution. Identification of nematodes was carried out to the highest taxonomic level possible using the compound microscope following the standard pictorial keys of NeMys data base.

***Amphibians and Reptile*:** Random surveys were conducted in almost all parts of the study area to document amphibian and reptile species. The streams and marshy areas were surveyed for amphibians. Hand picking was employed for the collection of specimens and pit fall traps also been tried. Dip nets was used for capturing amphibians of the lentic systems. The collected specimens were identified and then they released. The specimens were identified using the field guides (Boulenger 1890, Smith 1933, 1935 and 1943, Daniel 1963.).

***Avifauna*:** Based on the accessibility to the habitats, different techniques were used to census the birds. Area known for higher concentration of birds was measured by direct counts (Spindler *et al*. 1981). In marshy areas and open waters, the total number of birds was estimated from boat (Sjoberg, 1989). In order to avoid double counting or missing birds a vantage point was used. There was a possibility of missing birds reported here were usually found on the edges of the vegetation i.e on the open water vegetation interface. Birds were identified and counted with the help of binocular during early and late hours of the day. Boat was also used wherever it is possible. Counts

were not made on days with rain, strong wind or extreme temperatures to minimize the bias caused by effects of weather (Verner, 1985). Birds were identified using physical features with the help of field guides (Grimmett *et al.*, 1998).

***Mammals*:**

Direct sightings: To record the presence of mammals in different trek path were surveyed by foot. Observation was made during morning and evening.

Indirect evidences: Indirect evidences of animals such as scats, droppings, diggings, feeding signs and scratching marks were identified. In doubtful cases, scats, hair and other materials have been taken to the laboratory and compared with the known samples for identification (Rodgers 1991).

RESULTS AND DISCUSSION

A total of 420 species belonging to five Phylums under 14 classes such as Nematoda, Annelida, Mollusca, Arthropoda and Vertebrate (Pisces, Amphibia, Reptilia, Aves and Mammals were recorded during the survey period and are given in tables (1-3) and Plates (1-6). A detailed analysis with regard to avifauna is presented here and as follows.

A total of Two hundred and sixty four taxa of birds were recorded from the Bhitarkanika mangroves, Odhisa, which belong to 63 Families under 17 Orders (Gopi and Pandav, 2007). Out of these, 161 species were residents, 88 were migrants and three species were local migrant (Table-4). Highest number of species were recorded from Bhitarkanika mangroves comparing other mangroves of East Coast of India i.e., Pichavaram and Muthupet mangroves (Table-5). The Order Passeriformes was highest in dominance followed by Charadriiformes Falconiformes and Ciconiiformes (Fig. 1). Of recorded species seventeen were listed under IUCN threatened categories. (Table-6). Seven, one, and eight species were listed under vulnerable, Endangered and near threatened respectively. Most of the bird species prefer mangrove forest (73%) followed by Open water habitats (16%) for their activities such as feeding, resting and breeding (Fig. 2).

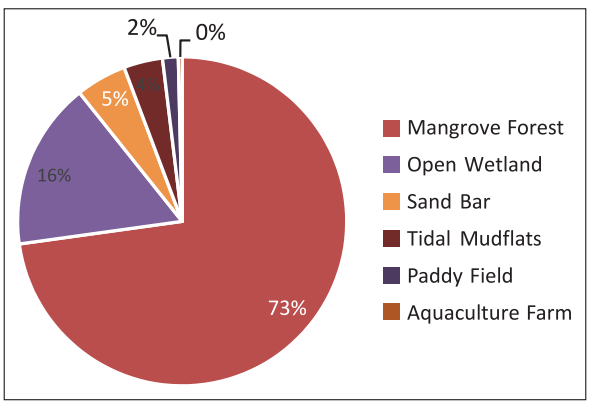

Fig. 2. Habitat Preference of birds

Out of more than 9,000 species of birds of the world, the Indian subcontinent supports about 1,300 species, or over 13 per cent of the world's birds (Grimmett *et al.*, 1998). This subcontinent,

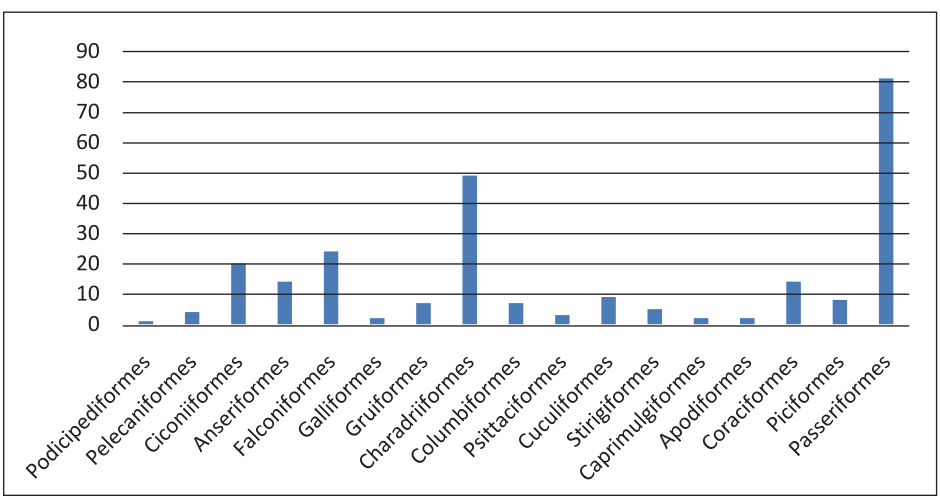

Fig. 1. Orderwise bird species dominance

rich in avifauna also boast of 48 bird families out of the total 75 families in the world. The high avian species richness recorded from the Bhitarkanika is due to the presence of diverse microhabitats and extensive surveys carried out in the past by various ornithologists and amateurs in the coastal wetlands. Avian populations increase considerably during migratory periods in different sites in the East Coast, when large numbers of waterfowl and shorebirds congregate for feeding and resting. Many coastal wetlands in the East and West coasts annually host significant portions of the world populations migratory species. The coastal wetlands of India are the major wintering grounds for migratory shorebirds in the three important flyways namely, Central Asian-Flyway, East Asian-Australasian Flyway and Western Pacific Flyways. The coastal wetlands of Point Calimere, Chilika Lake, and Pulicate Lake in the East Coast support significant number of winter visitor.

MAJOR CONSERVATION ISSUES AND IMPLICATIONS

Aquaculture farms: In the past few decades, aquaculture has experienced rapid growth in India and had been witnessing the same trend. Along the coastal belt of Odisha shrimp farming has been expanding vigorously. The expansion is driven by the high profitability of shrimp farming and attracts a wide range of investors, ranging from individual farmers (converting paddy fields) to multinational companies investing in large-scale semi- intensive and intensive shrimp farming. This fast development of the shrimp farming sector is at the cost of the conversion of flat, agricultural and coastal lands to shrimp ponds. In December 1996, the Supreme Court responded by placing a number of stringent restrictions on shrimp farming in the coastal zone, including: No shrimp culture ponds were to be constructed within 500m of the high tide mark, applicable for all seas, estuaries, creeks, rivers and backwaters; agricultural lands, salt pan lands, mangroves, wetland, forest lands and land for village common purposes were not to be converted into shrimp ponds. However, this is being violated in this region and paddy fields are increasingly being converted to aquaculture farms. A total of 674 aquaculture farms (with total area of 795.45acres) were located along the peripheral region of the National Park alone. This illegal conversion of coastal wetlands will result in loss of foraging grounds and wintering grounds for a variety of bird species (Gopi and Pandav, 2007).

Poisoning and trapping of migratory birds: More than 90 species of birds visit Bhitarkanika with the onset of winter. Some of these birds are either trapped or poisoned by locals for consumption. Poisons are generally mixed in food grains and are kept on broad leaves for the birds to feed.

Conservation of Bhitarkanika birds is not only of local importance but also of global interest. Though many checklists are available on the avifauna of Bhitarkanika, but still there is lacking on the various aspects of ecological studies. It is shown that there is still a lot of important research that needs to be carryout to better understand the ecology, particularly the movements within the ecosystem and studies on different aspects on the ecology and habitat modeling of migratory shorebirds with satellite tracking to be initiated in the coastal wetlands of India. Information on phonological patterns of migratory birds and behavioural eco-physiology of migrating shorebirds also important in this region. Foraging ecology studies with the ultimate goal of understanding the consequences of habitat selection by wintering shorebirds in terms of meeting energy demands. Specifically, the information on Charadriformes diet, foraging rates among habitats and seasons, and food availability are lacking in this region. This study confirms the biodiversity value of these coastal wetlands and suitable habitats for feedings, and breeding ground for wintering threatened waterbirds. Further studies to determine the status and distribution of Indian skimmers, biology of sympatric kingfishers, identification of foraging corridors along with monitoring post dispersal movement patterns of colonial nesting waterbirds.

Loss of mangroves has caused ingression of

saline water especially during flood. The human-crocodile conflict due to fishing activities has its impacts on the reduction in the population of crocodiles. Habitat of crocodiles and sharing of the same habitat by humans and crocodiles are the major reasons for such human–crocodile conflict. The increasing human activities, such as fishing in the mangrove areas, and crossing of creeks without adequate protection, increase the risk of crocodile attacks on humans. The presence of livestock and other domestic animals on the sea shore may also attract crocodiles to inhabited areas. The Department of Environment and Forests should promote crocodile awareness among residents and visitors by disseminating educational information via brochures, pamphlets and warning boards. A public awareness campaign is repeated regularly to minimize crocodile attacks, with sign boards placed at popular beaches. A research programme is recommended, to monitor the effectiveness of policies and human–crocodile relationships in the Bhitarkanika, Odisha, in order to minimize human–crocodile conflict in the future.

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REFERENCES

Banerjee, L.K. and T.A. Rao. 1990. *Mangroves of Orissa Coast and their ecology*. Bishen Singh Mahendra Pal Singh, Dehra Dun, India, 118p.

Boulenger, G.A. 1890. *Fauna of British India including Ceylon and Burma*. Reptilia and Batrachia London.

Chadha.,S and Kar, C.S. 1999. *Bhitarkanika*, Myth and Reality. Nataraj Publishers, Dehra Dun, India.

Daniel, J.C., 1963. Field Guide to the Amphibian of Western India. *J. Bombay Nat. Hist. Soc*., **60**: 415 – 438.

Gopi, G.V. and B. Pandav. 2006. White bellied sea-eagle *Haliaeetus leucogaster* preying on salt-water crocodile *Crocodylu sporosus*. *Indian Birds,* **2**(6):171.

Gopi, G.V. and B. Pandav. 2007. Avifauna of Bhitarkanika Mangroves, India. *Zoos' Print Journal,* **22**(10): 2839-2847.

Gopi, G.V. and B. Pandav. 2007a. Observations on breeding biology of three stork species in Bhitarkanika mangroves, India. *Indian Birds,* **3**(2): 45-50.

Gopi, G.V. and S.K. Kar. 2005. An ecological reconnaissance of colonial nesting birds in Bhitarkanika mangroves, Orissa, progress report no: 1, Unpublished, Wildlife Institute of India, Dehradun, 28pp.

Gopi, G.V. A.K. Jena and B. Pandav. 2006. Bhitarkanika Wildlife Sanctuary (Orissa), a key congregation area for Indian Skimmer *Rhyncops albicollis*. *Birding Asia,* **5**: 78

Grimmett, R., Inskipp, C., and Inskipp, T. 1998. Birds of Indian Subcontinent. Oxford University Press, 888 p.

GSI. 1974. Geological Survey of India. Miscellaneous publication no. 30.

Jena, S.C., S.K. Palitra and M.K. Mahapatra. 2013. Anurans of Bhitarkanika mangroves, East coast of India, *Check list,* **9**(2): 400-403.

Kalpana, A. 2005. Records of Red-winged Cuckoo *Clamator coromandus* from Bitarkanika National Park, Orissa. *Indian Birds,* **1**(5): 118.

Kar, C.S. and R.K. Behura. 1999. Bhitarkanika – An unique mangrove eco-system. Nature and Wildlife Conservation Society of Orissa, Bhubaneshwar, India. Pp 30-43.

Kar, S.K. 1982. Census of Saltwater Crocodile in Bhitarkanika Sanctuary. Pp. 11. In: Indian Crocodiles – conservation and Research (Eds: Singh, L.A.K. & B.C. Choudhury). Proceedings of the first Indian Crocodiles Researcher's symposium, Katerniaghat, Uttar Pradesh, India, Forum of crocodile researchers, India, Hyderabad.

Kar, S.K., and H.R. Bustard. 1989. Status of Saltwater Crocodile (*Crocodylus porosus* Schneider) in the Bhitarkanika Wildlife Sanctuary, Orissa, India. *J. Bombay Nat. Hist. Soc.,* **86**(2): 141-150.

Kar, S.K., and H.R. Bustard. 1990. Pilot restocking of salt water crocodile (*Crocodylus porosus* Schneider) in Bhitarkanika Wildlife sanctuary. *J. Bombay. Nat. Hist. Soc.,* **87**: 195-200.

Kar, S.K. 1999. Conservation, research and management of the estuarine crocodile, *Crocodylus porosus* Schneider in Bhitarkanika Wildlife Sanctuary, Orissa, India during 1975-1992: An overview. 76-82. In: Bhitarkanika – The Wonderland of Orissa (Ed: Behura, B.K.) Nature and Wildlife Conservation Society of Orissa, Bhubaneswar: 123 pp.

McIntyre, A.D., 1969. Ecology of marine meiobenthos. *Biol. Rev*., **44**: 245-290.

Mishra, P.K., J.R. Sahu and V.P. Upadhyay. 2005. Species diversity in Bhitarkanika mangrove ecosystem in Orissa, India. *Lyonia,* **8**(1): 73-87.

Nayak, A. 2003. Nesting ecology of resident birds in the Bhitarkanika Wildlife Sanctuary. *Cheetal,* **41** (3&4): 43-54.

Nayak, A. 2005. Seasonal diversity of Kingfishers in Bhitarkanika National Park, Orissa. *Indian Forester,* **131**(12): 1559-1563

Pandav., B. 1997. Birds of Bhitarkanika mangroves, Eastern India. *Forktail*, **12**(1): 9-20

Ramakrishna and J.R.B. Alfred. 2007. *Faunal resources in India*: 1-427 (Published by the Director, zool. Surv. India, Kolkata.

Rodgers, W.A., 1991. *Techniques for Wildlife Census in India – A field Manual*, Technical Manual: TM-2, Wildlife Institute of India, Dehra Dun. Pp. 82.

Sahu, H.K., S.K. Das and N. Palei. 2012. Some observations on White-bellied Sea Eagle (Haliaeetus leucogaster) in Bhitarkanika National Park, Eastern India, *Tiger Paper,* **39**(1): 6-9.

Singh, D.K. and G.K. Panda. 1999. Bhitarkanika and its environs- a geographical appraisal, in: Bhitarkanika- the wonderland of Orissa. Nature and Wildlife conservation society of Orissa, Bhubaneswar, India, pp. 10-18.

Sjoberg. K 1989. Time related predator / prey interactions between birds and fish in northern Swedish river. *Oecologia,* **67**: 35-39.

Smith, M.A., 1933. *The Fauna of British India including Ceylon and Burma*. Reptilia and Amphibia. Vol. I Loricata Testudiens, Taylor and Francic, London.

Smith, M.A., 1935. *The Fauna of British India including Ceylon and Burma*. Reptilia and Amphibia. Vol. II Sauria, Taylor and Francic, London.

Smith, M.A., 1943. *The Fauna of British India including Ceylon and Burma*. Reptilia and Amphibia. Vol. III, Taylor and Francic, London.

Spindler.M.A., S.M. Murphy, and B. Kessel. 1981. Ground census of waterbird population in the upper Tanana Valley, Alaska, In Miller. F.L & Gunn.A (eds) *Symp on Census and Inventory Methods for Population and Habits*: 133-148. Banff, Alberta: Northwest of the Wildlife Society.

Verner. J. 1985. Assessment of counting techniques. In Johnston R.F (ed) *Current Ornithology*: 247-302. *New York Ptenum Press.*

Table 1. Check list of Meio-fauna species in Bhitrakanika mangroves

Sl.No	Scientific Names	Habalikhati	Bhitarkanika	Kalibanjadia
Phylum NEMATODA				
Class ENOPLIA				
Order ENOPLIDA				
Family ONCHOLAIMIDAE				
1	*Adoncholaimus fuscus* (Bastian, 1865)	+	+	+
Class ADENOPHOREA				
Order DESMODORIDA				
Family DESMODORIDAE				
2	*Desmodorella schulzi* (Gerlach, 1950)	+	+	+
Order ENOPLIDA				
Family ONCHOLAIMIDAE				
3	*Viscosia elegans* Filipjev,1922	+	+	+
4	*Oncholaimellus calvadosicus* de Man, 1890	+	+	+
5	*Oncholaimus oxyurs* Ditlevsen, 1911	+	+	+
Order AREOLAIMIDAE				
Family TRIPYLOIDIDAE				
6	*Bathylaimus stenolaimus* Steckhoven and De Coninck, 1933	+	+	+
Order ENOLIDA				
Family ENOPLIDAE				
7	*Enoplus quadridentatus* Berlin 1853	+	+	+

Table 2. Check list of Macro-faunal species in Bhitrakanika mangroves

Sl. No	Scientific Names	Habalikhati	Bhitarkanika	Kalibanjadia
Phylum ANNELIDA Class POLYCHAETA Order SCOLECIDA Family CAPITELLIDAE				
1	*Heteromastus similis* Southern, 1921	+	+	+
Family MALDANIDAE				
2	*Euclymene annandalei* Southern,1921	+	+	+
Order PHYLLODOCIDA Family: NEREIDEIDAE				
3	*Perinereis* sp	+	+	+
Order SABELLIDA Family SERPULLIDAE				
4	*Ficopomatus enigmaticus* (Fauvel, 1923)	+	+	+

Table 2 contd.

Phylum MOLLUSCA Class GASTROPODA Order ARCHEOGASTROPODA Family NERITIDAE				
1	*Nerita balteata* Reeve, 1855	+	+	+
2	*Neritina (Dostia) violacea* (Gmelin)	+	-	+
Order MESOGASTROPODA Family ASSIMINEIDAE				
3	*Assiminea brevicula* (Pfeifferi, 1855)			
Family POTAMIDIDAE				
4	*Pirenella cingulata* (Gmelin, 1791)	+	+	+
5	*Cerithide aobtusa* (Lamarck,1822)	+	+	+
6	*Telescopium telescopium* (Linnaeus,1758)	+	+	+
Order NEOGASTROPODA Family MELONGENIDAE				
7	*Volegalea cochilidium* (Linnaeus)			
Class BIVALVIA Order MYTILOIDA Family MYTILIDAE				
1	*Brachidontes striatulus* (Hanley,1843)	+	+	+
Order OSTREOIDA Family OSTREIDAE				
2	*Saccostrea cucullata* (Born, 1778)	+	+	+
Family CORBICULIDAE				
3	*Polymesoda bengalensis* (Lamarck,1818)	+	+	+
Phylum ARTHROPODA Class CHILOPODA Family SCOLOPENDRIDAE				
1	*Scolopendra morsitans* Linnaeus,1758	+	+	+
Class ARACHINIDA Order ARANEAE Family TETRAGNITHIDAE				
1	*Tetragnatha mandibulata* Walckenaer,1842	+	+	+
Family SPARASSIDAE				
2	*Sparassus* sp	+	+	+
Class INSECTA Order HYMENNOPERA Suborder APOCRITA Family CHALCIDIDAE				
1	*Brachymeria lasus* (Walker, 1841)	+	+	+

Table 2 contd.

Family PTEROMALIDAE				
2	*Dinarmus maculatus* (Masi, 1924)	+	+	+
3	*Chlorocytus indicus* Sureshan, 2000	+	+	+
Order ODONATA Sub order COENAGRIONIDAE Family LIBELLULIDAE				
1	*Diplacodes trivialis* (Rambur, 1842)	+	+	+
2	*Orthetrum sabina* (Drury, 1770)	+	+	+
3	*Orthetrum pruinosum* (Burmeister, 1839)	+	+	+
4	*Palpopleura sexmaculata* (Fabricius, 1787)	+	+	+
Order LEPIDOPTERA Suborder RHOPALOCERA Family PAPILIONIDAE				
1	*Papilio polytes* Linnaeus, 1758	+	+	+
2	*Papilio clytia* Linnaeus, 1758	+	+	+
Family: PIERIDAE				
4	*Eurema blanda* Boisduval, 1836	+	+	+
5	*Catopsilia pomona* Fabricius, 1775	+	+	+
6	*Catopsilia pyranthe* (Linnaeus, 1758)	+	+	+
7	*Chitoria naga* (Tytler, 1915)	+	+	+
Class CRUSTACEA Order DECAPODA Family LIMULIDAE				
1	*Tachypleus gigas* (O.F. Müller, 1785)	+	-	-
Family PORTUNIDAE				
2	*Scylla serrata* (Forskal, 1775)	+	+	+
3	*Portunus pelagicus* (Linnaeus, 1758)	+	+	+
4	*Portunus sanguinolentus* (Herbst, 1783)		+	+
Family VARUNIDAE				
5	*Episerama versicolor* (Tweedie,1940)	+	+	+
6	*Episerama mederi* (H. Miline Edwards, 1984)	+	+	+
7	*Metaplax dentipes* (Heller, 1865)	+	+	+
8	*Metaplax distinct* H. Milne Edwards, 1852	+	+	+
9	*Varuna literrata* (Fabricius, 1798)	+	+	+
Family SESARMIDAE				
10	*Neosarmatium meinerti* (de Man, 1887)	+	+	+
11	*Parasesarma plicatum* (Latreille, 1803)	+	+	+

Table 2 contd.

Family GRAPSIDAE				
12	*Metopograpsus maculatus* (H. Miline Edwards, 1984)	+	+	+
Family OCYPODIDAE				
13	*Uca annulipes* (H. Milne Edwards, 1837)	+	+	+
14	*Uca rosea* (Tweedie, 1937)	+	+	+
15	*Ocypode ceratophthalma* (Pallas, 1872)	+	+	+
16	*Ocypode macrocera* (H. Milne Edwards, 1834)	+	+	+
Family PENAEIDAE				
17	*Penaeus indicus,* Fabricius, 1798	+	+	+
18	*Penaeus monodon* Fabricius, 1798	+	+	+
19	*Metapenaeus affinis* (H. Milne Edwards, 1837)	+	+	+
PISCES Class ACTINOPTERYGII Order PERCIFORMES Family SCATOPHAGIDAE				
1	*Scatophagus argus* (Linnaeus, 1766)	+	+	+
Family AMBASSIDAE				
2	*Ambassis commersonii* (Lacepede, 1802)	+	+	+
Order BELONIFORMES Family ADRIANICHTHYIDAE				
3	*Oryzias melastigma* (McClelland, 1839)	+	+	+
Family BAGRIDAE				
4	*Mystus gulio* (Hamilton, 1822)			
Family SILLAGINIDAE				
5	*Sillago sihama* (Forsskal, 1755)	+	+	+
Family CARANGIDAE				
6	*Atule mate* (Cuvier, 1833)	+	+	+
7	*Caranx sem* (Bennett, 1830)	+	+	+
8	*Megalapsis cordyla* (Linnaeus, 1758)	+	+	+
Family MENIDAE				
9	*Mene maculata* (Bloch & Schneider, 1801)	+	+	+
Family LEIOGNATHIDAE				
10	*Leiognathus equulus* (Forsskal, 1775)	+	+	+
11	*Secutor insidiator* (Bloch, 1787)	+	+	+
Family LATIDAE				
12	*Lates calcarifer* Bloch, 1790	+	+	+

Table 2 contd.

Family LUTJANIDAE				
13	*Lutjanus lutjanus* Bloch, 1790	+	+	+
14	*Lutjanus johnii* (Bloch, 1792)	+	+	+
Family LETHRINIDAE				
15	*Lethrinus nubulosus* (Forsskal, 1775)	+	+	+
Family TERAPONTIDAE				
16	*Terapon jarbua* (Forsskal, 1775)	+	+	+
Family CHCHLIIDAE				
17	*Etroplus suratensis* (Bloch, 1790)	+	+	+
Family TOXOTIDAE				
18	*Toxotes jaculatrix* (Pallas, 1767)	+	+	+
Family GOBIIDAE				
19	*Periophthalmus* sp.	+	+	+
20	*Boleopthalames* sp.	+	+	+
Order CLUPEIFORMES Family ENGRAULIDAE				
21	*Stolephorus indicus* (van Hasselt, 1823)	+	+	+
22	*Thryssa mystax* (Bloch & Schneider, 1801)	+	+	+
23	*Coilia dussumieri* Valenciennes, 1848	+	+	+
Family CLUPIDAE				
24	*Nematalosa nasus* (Bloch, 1795)	+	+	+
25	*Tenualosa ilisha* (Hamilton, 1802)	+	+	+
Family DUSSUMIERIIDAE				
26	*Dussumeri acuta* Valenciennes, 1847	+	+	+
Order MUGILIFORMES Family MUGILIDAE				
27	*Mugil cephalus* Linnaeus, 1758	+	+	+
Order BELONIFORMES Family HEMIRAMPHIDAE				
28	*Hemiramphus far* (Forsskal, 1775)	+	+	+
Family BELONIDAE				
29	*Strongylura leiura* (Bleeker, 1850)	+	+	+
Order SYNGNATHIFORMES Family SYNGNATHIDAE				
30	*Trachyrhamphus serratus* (Temminck & Scholegel, 1850)	+	+	+
Family FISTULARIIDAE				
31	*Fistularia commersonii* Ruppell, 1838	+	+	+

Table 2 contd.

Order TETRAODONTIFORMES				
Family TETRAODONTIDAE				
32	*Chelonodon patoca* (Hamilton, 1822)	+	+	+
33	*Dichotomyctere fluviatilis* (Hamilton, 1822)	+	+	+
Class AMPHIBIA				
Order ANURA				
Family BUFFONIDAE (Gray)				
1	*Duttaphrynus melanostictus* (Schneider, 1799)	+	+	+
2	*Duttaphrynus stomaticus* (Lutken, 1862)	+	+	+
Family DICROGLOSSIDAE				
3	*Euphlyctis cyanophlyctis* (Schneider, 1799)	+	+	+
4	*Hoplobatrachus crassus* (Jerdon, 1854)	+	+	+
Family RHACOPHORIDAE				
5	*Polypedates maculatus* (Gray, 1834)	+	+	+
Family RANIDAE				
6	*Hylarana tytleri* (Theobald, 1868)	+	+	+
Class REPTILIA				
Order SQUAMATA				
Family AGAMIDAE				
1	*Calotes versicolor* (Daudin, 1802)	+	+	+
2	*Calotes jerdoni* Gunther, 1870	+	+	+
3	*Calotesellioti* Gunther, 1864	+	+	+
4	*Calotes emma* Gray, 1845	+	+	+
5	*Sitana ponticeriana* Cuvier, 1829	+	+	+
Family CHAMAELEONIDAE				
6	*Chamaeleo zeylanicus* Laurenti, 1768	+	+	+
Family SCINCIDAE				
7	*Lygosoma punctata* (Gmelin, 1799)	+	+	+
Family GEKKONIDAE				
8	*Hemidactylus brookii* Gray, 1845	-	+	+
9	*Hemidactylus flaviviridis* Ruppell, 1835	+	-	+
10	*Hemidactylus frenatus* Schlegel, 1836	-	+	+
Family VARANIDAE				
11	*Varanus bengalensis (*Daudin, 1802*)*	+	+	+
12	*Varanus flavescens* (Hardwicke & Gray, 1827)	+	+	+
13	*Varanus salvator* (Laurenti, 1768)	+	+	+
Order SERPENTES				
Family PYTHONIDAE				
14	*Python molurus* (Linnaeus, 1758)	-	-	+

Table 2 contd.

Family COLUBRIDAE				
15	*Ahaetulla nasuta* Bonnaterre,1790	+	+	+
16	*Boiga trigonata* (Schneider, 1802)	+	+	-
17	*Chrysopelea ornata* (Shaw, 1802)	+	+	+
18	*Cerberus rhynchops* (Schneider, 1799)	+	-	+
19	*Ptyas mucosa* (Linnaeus, 1758)	+	+	-
20	*Lycodon striatus* (Shaw, 1802)	-	+	+
Family ELAPIDAE				
21	*Bungarus caeruleus* (Schneider, 1801)	+	+	+
22	*Bungarus fasciatus* (Schneider, 1801)	+	+	+
23	*Enhydrina schistosa* (Daudin, 1803)	+	+	-
24	*Ophiophagus hannah* (Cantor, 1836)	+	+	+
Family NATRICIDAE				
25	*Amphiesma stolata* (Linnaeus, 1758)	-	+	-
Family VIPERIDAE				
26	*Duboia russelii* (Shaw and Nodder, 1797	-	+	-
27	*Trimeresurus gramineus* (Shaw, 1802)	-	-	+
Order TESTUDINES Family GEOMYDIDAE				
28	*Batagur baska* (Gray, 1830)	+	+	+
29	*Pangshura tecta* (Gray, 1830)	+	+	+
30	*Pelochelys bibroni* (Owen, 1853)	+	+	-
Family TRIONYCHIDAE				
31	*Lissemys punctata* (Lacepede, 1788)	-	+	+
32	*Nilssonia gangetica* (Cuvier, 1825)	-	+	+
Family DERMOCHELYIDAE				
33	*Dermochelys coriacea* (Vandelli, 1761)	+	-	-
Family CHELONIIDAE				
34	*Chelonia mydas* (Linnaeus, 1758)	+	-	-
35	*Eretmochelys imbricate* (Linnaeus, 1766)	+	-	-
36	*Lepidochelys olivacea* (Eschscholtz, 1829)	+	+	+
Family CROCODYLIDAE				
37	*Crocodylus porosus* Schneider, 1801	+	+	+
Phylum CHORDATA Class MAMMALIA Order PRIMATES Family CERCOPITHECIDAE				

Table 2 contd.

1	*Macaca mulatta* (Zimmermann, 1780), Rhesus Macaque	+	+	+
Order RODENTIA Family SCIURIDAE				
2	*Funambulus palmarum* (Linnaeus, 1766) Three-striped Palm Squirrel	+	+	+
Order SORICOMORPHA Family SORICIDAE				
3	*Suncus murinus* (Linnaeus, 1766), House Shrew	+	+	+
Family MURIDAE				
4	*Bandicota indica* (Bechstein, 1800) Large Bandicoot-rat	+	+	+
5	*Mus booduga* (Gray, 1837) Common Indian Field Mouse	+	+	+
6	*Rattus rattus* (Linnaeus, 1758) Common House Rat	+	+	+
Family HYSTRICIDAE				
7	*Hystrix indica* Kerr, 1792 Indian Crested Porcupine	+	+	+
Order CHIROPTERA Family PTEROPODIDAE				
8	*Cynopterus sphinx* (Vahl, 1797) Greater Short-nosed Fruit Bat	+	+	+
Family VESPERTILIONIDAE				
9	*Pipistrellus coromandra* (Gray, 1838) Indian Pipistrelle	-	+	-
Order CARNIVORA Family MUSTELIDAE				
10	*Lutrogale perspicillata* (I. Geoffroy Saint-Hilaire, 1826) Smooth-coated Otter	+	+	+
Family CANIDAE				
11	*Canis aureus* Linnaeus, 1758 Golden Jackal	+	+	+
Family FELIDAE				
12	*Felis chaus* Schreber, 1777 Jungle Cat	+	+	+
13	*Prionailurus viverrinus* (Bennett, 1833) Fishing Cat	+	+	+
14	*Prionailurus bengalensis* (Kerr, 1792) Leopard Cat	+	+	+

Table 2 contd.

Family HYAENIDAE				
15	*Hyaena hyaena* (Linnaeus, 1758) Striped Hyaena	+	+	+
Family HERPESTIDAE				
16	*Herpestes edwardsii* (E. Geoffroy Saint-Hilaire, 1818) Indian Grey Mongoose	+	+	+
Family VIVERRIDAE				
17	*Paradoxurus hermaphroditus* (Pallas, 1777) Common Palm Civet	+	+	+
18	*Viverricula indica* (E. Geoffroy Saint-Hilaire, 1803) Small Indian Civet	+	+	+
Order ARTIODACTYLA Family SUIDAE				
19	*Sus scrofa* Linnaeus, 1758 Wild Boar	+	+	+
Family CERVIDAE				
20	*Axis axis* (Erxleben, 1777) Spotted Deer	+	+	+
21	*Rusa unicolor* (Kerr, 1792) Sambar	-	+	+
Family DELPHINIDAE				
22	*Orcaella brevirostris (*Owen, 1866*)* Irrawaddy Dolphin	-	-	+
Family PHOCOENIDAE				
23	*Neophocaena phocaenoides* (G. Cuvier, 1829) Finless Porpoise	+	-	-
Family PLATANISTIDAE				
24	*Platanista gangetica* (Roxburgh, 1801) Gangetic Dolphin	-	-	+

Table 3. Consolidated list of faunal species in Bhitrakanika mangroves

Phylum	Class	Order	Family	Genus	Species
Nematoda	2	5	5	6	7
Annelida	1	3	4	4	4
Mollusca	2	5	7	11	10
Arthropoda	4	5	14	26	35
Chordata	Pisces	7	22	32	33
	Amphibia	1	4	5	6
	Reptiles	3	15	29	37
	Aves	17	63	169	264
	Mammals	6	18	23	24
Total					420

Table 4. Status of bird species recorded from Bhitarkanika mangroves

Sl. No.	Orders	Resident	Resident Migrant	Migrant	Total
1	Podicipediformes	1	-	-	1
2	Pelecaniformes	3	-	1	4
3	Ciconiiformes	17	-	3	20
4	Anseriformes	2	-	12	14
5	Falconiformes	17	-	7	24
6	Galliformes	2	-	-	2
7	Gruiformes	6	-	1	7
8	Charadriiformes	11	-	38	49
9	Columbiformes	7	-	-	7
10	Psittaciformes	3	-	-	3
11	Cuculiformes	7	2	-	9
12	Stirigiformes	5	-	-	5
13	Caprimulgiformes	2	-	-	2
14	Apodiformes	2	-	-	2
15	Coraciformes	12	1	1	14
16	Piciformes	7	-	1	8
17	Passeriformes	57	-	24	81
Total		161	3	88	252

Table 5. Order wise distribution of bird species in mangroves of East coast of India

Sl. No.	Orders	Bhitarkanika	Pichavaram	Muthupet
1	Podicipediformes	1	1	1
2	Pelecaniformes	4	4	4
3	Ciconiiformes	20	18	18
4	Phoenicopteriformes	-	1	1
5	Anseriformes	14	9	9
6	Falconiformes	24	16	16
7	Galliformes	2	7	7
8	Gruiformes	7	-	-
9	Charadriiformes	49	48	47
10	Columbiformes	7	4	4
11	Psittaciformes	3	1	1
12	Cuculiformes	9	4	4
13	Stirigiformes	5	2	2
14	Caprimulgiformes	2	-	-
15	Apodiformes	2	2	2
16	Coraciformes	14	9	9
17	Piciformes	8	2	2
18	Passeriformes	81	49	45
Total		252	177	172

Table 6. List of globally threatened bird species in Bhitarkanika and their status according to lUCN/Birdlife International Red Data List 2006

Species	Category
Spot-billed Pelican *Pelecanus philippensis*	VU
Lesser Adjutant *Leptoptilos Javanicus*	VU
Painted Stork *Mycteria leucocephala*	NT
Black-necked Stork *Ephippiorhynchus asiaticus*	NT
Baer's Pochard *Aythya baeri*	VU
Pallas's Fish-eagle *Haliaeetus leucoryphus*	VU
White-rumped Vulture *Gyps bengalensis*	VR
Greater Spotted Eagle *Aquila clanga*	VU
Spotted Greenshank *Tringa guttifer*	EN
Brown-winged Kingfisher *Halcyon amauroptera*	NT
Indian Skimmer *Rynchops albicollis*	VU
Black-headed Ibis *Threskiornis melanocephalus*	NT
Darter *Anhinga melanogaster*	NT
Pallid Harrier *Circus macrourus*	NT
Pale-capped Pigeon *Columba punicea*	VU
Black-tailed Godwit *Limosa limosa*	NT
Black-bellied Tern *Sterna acuticauda*	NT

Source: Gopi and Pandav (2007)

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PLATE 1

Dangmal

Krishnapriyapur

PLATE 2

ODONATA

Orthetrum sabina

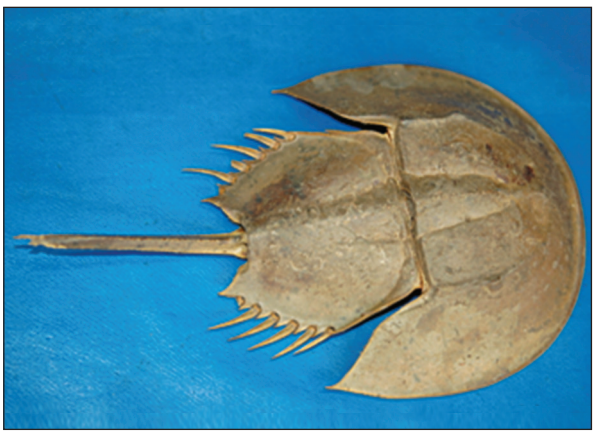
Diplacodes trivialis

LEPIDOPTERA

Papilio polytes

Melanitis leda

CRUSTACEA



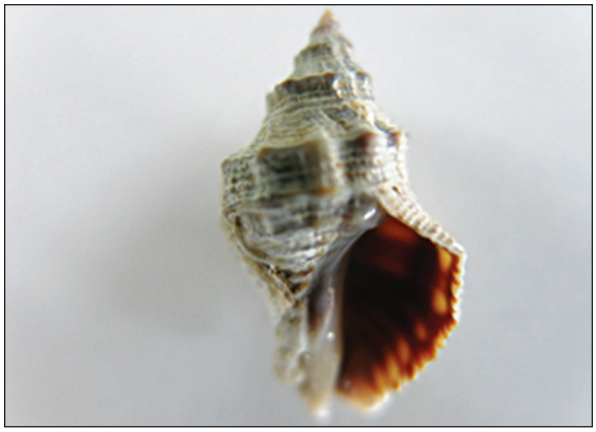
Tachepleus gigas

Uca rosea

PLATE 3

GASTROPODS & BIVALES

Volegalea cochlidium



Thais blanfordi

Cerhidea cingulata

Telescopium telescopium

Nerita articulata

Polymesoda bengalensis-Exterior view

Saccostrea cucullata

PLATE 4

PISCES

Terapon jarbua

Mugil cephalus

Lates calcarifer

Bolepthalames boddarti

REPTILES

Varanus flavescens

Crocodylus porosus

PLATE 5

AVI FAUNA

Anastomus osciatanus Asian Openbill-Stork

Mycteria leucocephala Painted Stork

Phalacrocorax niger Little Cormorant

Numenius arquata Eurasian Curlew

Athene brama Spotted Owlet

Halcyon smyrnensis White-breasted Kingfisher

Charadrius dubias Little ringed Plover

Tringa taotanus Common Redshank

PLATE 6

MAMMALS

Macaca mulatta Rhesus Macaque

Lutrogale perspicillata Smooth-coated Otter

Rusa unicolor Sambar

Axis axis Chital