CHAPTER 3
STUDY AREA

The field study on the Bhitarkanika heronry was conducted in the Bhitarkanika Wildlife Sanctuary, Orissa. Bhitarkanika mangroves, located on the east coast of India (between 20°04'-20°08'N and 86°45'-87°50'E) represent one of the finest remaining patches of mangrove forests in India. (Map 3.1). The general elevation above mean sea level is between 1.5 to 2 meters. Higher ground extends to 3-4 meters. The field study in Bhitarkanika commenced in March 2004.

Map 3.1. Map of Bhitarkanika Wildlife Sanctuary and location of the heronry inside the National Park
3.1 Location
The Bhitarkanika Mangroves are located in the deltaic region of Brahmani and Baitarani rivers in the Kendrapara district of Orissa. The Bhitarkanika Wildlife sanctuary is situated near the former port, Chandabali, which is about 50 km from the Bhadrakh railway station. The sanctuary is bounded by rivers Dhamara to the north, Maipura to the south, Brahmani to the west and the Bay of Bengal in the east. The 35 km coast line from the mouth of river Maipura till Barunei forms the eastern boundary of the sanctuary. The annual rainfall ranges from 920 to 3000 mm.

3.2 The Bhitarkanika heronry
This is the one of the oldest and largest mixed species colony in India (Subramanaya 1996). Over 30,000 birds breed every year in this heronry, a single unbroken patch with an approximate area of less than 5 ha area comprising 3800 – 4200 trees are used for nesting. Birds use five species of mangrove trees for nesting which include *Excoecaria agallocha* (Guan), *Heritiera fomes* (Bada Sundari), *Cynometra iripa* (Singada), *Hibiscus tiliaceus* (Bania), *Tamarix troupii* (Jagula) for nesting in the heronry. The breeding birds in this mixed species colony are Asian openbill stork, Great Egret, Intermediate Egret, Little Egret, Cattle Egret, Grey Heron, Purple Heron, Black-crowned Night Heron, Little Cormorant, Darter, and Black-headed Ibis. The Asian Openbill is the most abundant species nesting in the heronry (66%) and the least abundant being the little egret (0.8%). Abundant food resources in and around the heronry and the minimal disturbance due to the remoteness of the area are speculated to be the principal factors for this large congregation of breeding birds.

3.3 Physical features
(e.g. geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth water permanence; fluctuations in water level; tidal variations; catchment area; downstream area; climate). The Bhitarkanika mangroves are in the deltaic region of Brahmani and Baitarani River in the state of Orissa along the Bay of Bengal of which the most protected and
representative area is the Bhitarkanika Wildlife Sanctuary. The natural boundaries of the sanctuary are rivers and the Bay of Bengal. The sanctuary is bounded by rivers Dhamara to the north, Maipura to the south, Brahmani to the west and the Bay of Bengal in the east. The 35 km coast line from the mouth of river Maipura till Barunei forms the eastern boundary of the sanctuary. The rivers Baitarani and Brahmani after meeting together near Dangamal flow into the Bay of Bengal at Palmyra point under the name of Dhamra estuary. The river Pathsala, a tributary of river Brahmani produces two main distributaries, Kanika and Baunsagarha, and enters the sea to form the Maipura estuary in the north east part of Kendrapara district. The estuarine region of Bhitarkanika can be divided into two parts: an outer funnel shaped region known as estuarine zone and a narrow inner region known as inner estuary or river part. The habitats of the two parts are distinctly separated with the changing effect of interacting environmental factors and degree of protection from the Bay. The sanctuary is interspersed with numerous rivers, creeks and creek lets. The area is influenced by heavy alluvial silt brought down by the rivers and deposited in the deltaic areas due to regular tidal inundation. The entire area is further influenced by high detritus content of the tidal material resulting from fallen mangrove leaves. The soil is clayey loam with sand, overlaid by rich humus layer. The mosaic of rivers and creeks are influenced twice daily both by high and low tides at approximately six hours interval. The tidal level varies from the outer estuarine part towards the inland areas according to lunar cycle and is also subjected to wide seasonal variation. The climate of the area is tropical. In general there are three main seasons prevalent in this region. Summer begins from February and extends up to June. The rainy season usually starts in June and extends up to October. November to January is the winter season. The annual rainfall ranges from 920 to 3000 mm. and the main rainy months are August and September. In winter the temperature dips down to 10° C minimum and in summer the maximum temperature reaches up to 40° C. Wind velocity becomes 40 km per hour during the monsoon which ranges between 15 and 25 km per hour in winter. The area is prone to severe cyclonic storms twice almost every year during April to May and October to
November and also, there are occasional tidal bores. The humidity of the area varies between 35 to 95%.

3.4 Hydrological values

(groundwater recharge, flood control, sediment trapping, stabilization, etc.)

The Bhitarkanika mangroves along the north eastern coast of India plays a key protecting the area and the human habitation adjoining it from devastating cyclones surges. The dense mangrove forests along the coast slows down the force of tidal thereby protecting life of millions of coastal inhabitants. Mangroves help in accretion. They stabilize newly formed mud and silt deposits near river mouth. Mangrove restricts and slows down erosion process on tidal river banks. The trees well equipped deep root system, pneumatophores, knee and stilt roots reduce the high wave and tidal action. Mangroves have also been useful in treating effluent, as the plants absorb nitrates and phosphates thereby preventing contamination of near shore waters.

3.5 Ecological features

The Bhitarkanika mangroves comprise of a wide variety of habitats ranging from the tidal rivers and creek to riverine islands, coastal wetlands and inter tidal zones. The low lying mangrove forests of Bhitarkanika are subjected to regular tidal inundation twice daily. Bhitarkanika has a wide network of tidal rivers and creeks. The riverine islands within the mangrove reserve are favourite roosting sites of wintering water fowls. The coastal wetlands along the eastern boundary hosts a large number of migratory water fowl during winter. These are open wetlands and are influenced by monsoon rain and regular tidal inundation. The intertidal zones near mouth of rivers Maipura and Dhamra hosts a wide variety of residents as well as migratory wading birds. The vegetation of Bhitarkanika is broadly classified into (i) mangrove formation and (ii) salt bush formation (Choudhury 1990). The salt bush formation is found along the littoral tract of Satbhaya and Gahirmatha sea shore where the soil is sandy and is not subjected to inundation. The coastline here is characterized by sand dunes reaching upto 70 - 80 ft high. Principal
vegetation on these dunes includes *Ipomea pescaprae*, *Hydrophylax maritima*, *Spinifex littoreus*, *Launaea sarmentosa* and *Gisekia pharmaceoides*. Notable vegetation on these sand dunes are the extensive Casuarina plantation. Mangrove formation in the sanctuary has been classified into two categories: (1) vegetation of the estuarine bank and (2) vegetation of the inner estuarine bank (Banerjee and Rao 1990). The outer estuarine bank vegetation is found near the mouth of Dhamara and Maipura rivers. Plants in the outer estuarine region are subjected to high salinity and wave action. *Avicennia marina*, about 10 m tall with compact crown is very common and characteristically forms a pioneer tree stand along the lower inter tidal zone of estuarine bank. *Sonneratia griffithii* with widest trunk is found at low gradient mud flats along the lower inter tidal zone in mixed association with *Avicennia alba*, *Bruguiera parviflora*, *B. cylindrica* and *Aegialitis rotundifolia*. These species with increased water storage mechanism in their leaves tolerate high saline conditions and are found more commonly along the central part of the funnel shaped estuarine bank. *Sonneratia griffithii* and *Sonneratia alba* form the top canopy in this area. The second canopy is formed by *Avicennia alba*, *Lumintzera racemosa*, *Ceriops tagal* and *Bruguiera cylindrica* and the third canopy is formed by *Aegialitis rotundifolia*, *Bruguiera parviflora* and *Phoenix paludosa* (Banerjee and Rao 1990). The inner estuarine bank is strongly dissected by several creeks and creek lets. The force of the sea surf is broken due to the presence of several creeks and the vegetation here is subjected to moderate salinity. These conditions make a favourable habitat for many mangrove species and the flora is rich and diversified in this region. The dominant mangrove species in this region are *Avicennia officinalis*, *Sonneratia apetala*, *Excoecaria agallocha*, *Heritiera fomes*, *Heritiera littoralis*, *Kandelia kandel*, *Xylocarpus granatum*, *X. molucensis*, *X. mekongensis*, *Rhizophora mucronata*, *R. apiculata*, *Aegiceras corniculatum*, *Merope angulata* and *Cerbera manghas*. Pure formations of many of these tree species occur in the inner estuarine bank.
3.6  Flora

58 species of mangroves have so far been recorded in India of which 55 are found in Bhitarkanika (Bannerjee and Rao 1990). Compared to the Sunderbans, India's largest tract of mangrove forest, Bhitarkanika represents a wide diversity of mangrove flora. The *Heritiera* formation of Champion and Seth (Type 4B/TS-4, 1968) comprising the brackish water association of *Heritiera, Cynometra, Aglaia, Cerbera*, and *Intsia* is not found in the present Sunderbans of Indian territory but are well represented in Bhitarkanika. *Rhizophora stylosa, Sonneratia griffithii* and *Heritiera littoralis* have been recorded new for Indian mangroves from Bhitarkanika (Bannerjee and Rao 1990). This association is unique only to Bhitarkanika mangroves. In Bhitarkanika a variety of wild rice (*Potresia coarctata*) grows abundantly in tidal mud flats. Based on the genetic strain of this wild rice several saline and flood resistant varieties of rice have been developed. This has led to a tremendous economic impact making it very important.

3.7  Fauna

Bhitarkanika harbours one of the largest populations of endangered saltwater crocodile (*Crocodylus porosus*) in India and is globally unique in that 10% of the adults exceed 6 m length. Nearly 1500 saltwater crocodiles inhabit the rivers and creeks of Bhitarkanika today (Kar and Pattnaik 1999, Gopi and Pandav 2009). The eastern boundary of Bhitarknika supports the largest nesting ground of the endangered olive ridley sea turtle in the world (Bustard, 1976). Nearly half a million olive ridleys on an average nest every year along the Gahirmatha coast of Bhitarkanika (Dash and Kar 1990). The water monitor lizard (*Varanus salvator*) otherwise rare in most part of India, commonly occurs here. Besides water monitor, two other species namely common (*V. bengalensis*) and yellow (*V.flavescens*) monitors are also sympatric here (Biswas and Kar 1981). Notable among other reptiles of Bhitarkanika are king cobra (*Ophiophagus hannah*), Burmese python (*Python molurus bivittatus*), banded krait (*Bungarus fasciatus*), common krait (*Bungarus caeruleus*) and golden tree snake (*Chrysopelia ornata*). Extremely high congregations of migratory waterfowls are observed in the coastal
wetlands around Satbhaya village and in the Bhitarkanika forest block of the Sanctuary during December and January. The mangrove forests of Bhitarkanika harbours one of the largest congregations of breeding water birds in the country (Subramanya 1996). Eleven species of Ciconiiformes are known to nest in this multi species nesting colony (Pandav 1997). The breeding birds in this mixed species colony are Asian Openbill (*Anastomus oscitans*), Great Egret (*Casmerodius albus*), Intermediate Egret (*Mesophoyx intermedia*), Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), Grey Heron (*Ardea cinerea*), Purple Heron (*Ardea purpurea*), Black-crowned Night Heron (*Nycticorax nycticorax*), Little Cormorant (*Phalacrocorax niger*), Darter (*Anhinga melanogaster*), and Blackheaded Ibis (*Threskiornis melanocephalus*). The endangered Lesser Adjutant Stork (*Leptoptilous javanicus*) also breeds in Bhitarkanika. Seven species of kingfishers, Black-capped (*Halcyon pileata*), White-breasted (*H. smirnensis*), Brownwinged (*H. amauroptera*), Collared (*Todiramphus chloris*) Common (*Alcedo atthis*), Stork-billed (*Pelargopsis capensis*) and Pied (*Ceryle rudis*) are sympatric here. Bhitarkanika Wildlife Sanctuary has recently been identified as an important bird area (IBA) of the country. Bhitarkanika is also home for several mammals. Five species of marine dolphins have been recorded from the area. The commonest species encountered in this area is the Indo-pacific humpbacked dolphin (*Sousa chinensis*). The other four species of marine dolphins that are found in the coastal waters off Gahirmatha are Irrawady dolphin (*Orcaella brevirostris*), Pantropical spotted dolphin (*Stenella attenuate*), Common dolphin (*Delphinus delphis*) and Finless black porpoise (*Neophocaena phocaenoides*). Notable among the other mammalian fauna of Bhitarkanika are Striped Hyena (*Hyaena hyaena*), Fishing cat (*Felis viverrina*), Jungle cat (*Felis chaus*), Smooth-coated otter (*Lutra perspiciliata*), Common palm civet (*Paradoxurus hermaphroditus*), Small Indian civet (*Vivericula indica*), Indian Porcupine (*Hystrix indica*), Wild boar (*Sus scrofa*), Spotted deer (*Cervus axis*) and Sambar (*Cervus unicolor*). The Bhitarkanika mangroves also harbour ecologically significant biodiversity and was recently found to be an important habitat for the endangered horseshoe crab (Dutta, 2007)
3.8 Social and cultural values
Mangrove ecosystems have traditionally been sustainably managed by local populations for the production of food, medicines, tanins, fuel wood and construction materials. Most of the villagers living around Bhitarkanika derive benefits from the mangrove forests in one way or the other. The entire fishing industry in the area that provides employment to local communities is dependent on the rivers and the coastal waters adjoining the mangrove forests. Some of the commercially important fishes found in Bhitarkanika are *Hilsa illisha*, *Lates calcarifer*, *Mystus gulio* and *Mullet* sp. The area is also an important source of prawn such as *Penaeus indicus* and *Penaeus monodon*. The mangrove forests of Bhitarkanika are an important source of honey. Nearly 3,000 to 5,000 kg of honey is collected from Bhitarkanika every year during February to May (Chadha and Kar 1990). A local community in this region known as ‘Dalei’ is specialised honey collectors and has been collecting honey for generations. Several plant species found in Bhitarkanika also provide direct employment to local communities. *Myriostachia wightiana*, a species of grass (locally known as Nalia) growing in the tidal banks and *Flagellaria indica*, a climber (locally known as Bahumurga) growing inside the mangrove forest are used for basket and rope making. Co-operative societies have been established in surrounding villages to market these products. *Phoenix paludosa*, a species of the family Palmaceae grows abundantly in Bhitarkanika. The shoot and leaves of Phoenix are widely used in the area for thatching purpose. Bhitarkanika mangroves harbour wild strains of Paddy, which is tolerant of long duration saline inundation and has significant genetic research value for the staple rice-eating community of east coast of India.

3.9 Avifaunal Research in Bhitarkanika
Notes on the avifauna of Bhitarkanika mangroves occur at random through the literature but an initial checklist list of the birds of Bhitarkanika was attempted in early nineties by Dani and Kar (1992) and then Pandav (1996) published a check list on the birds of the Bhitarkanika mangroves. He listed a total of 169 bird species to occur in Bhitarkanika. Some other studies include Nayak 2003 and Nayak 2005, who described about the ecology of resident
Plate no. 1  Bhitarkanika heronry is one of India’s largest mixed species heronry with over 30,000 birds breeding in this small patch of < 5 ha area (Photo © Gopi.G.V)

Plate no. 2  Breeding birds use 4 mangrove trees to nest in Bhitarkanika heronry (Photo © Gopi.G.V)

*Excoecaria agallocha*  *Heritiera fomes*  *Hibiscus tilliaceus*  *Cynometra lripa*