PHYSIOGRAPHY OF THE STUDY AREAS

The eastern, western and southern coast of the peninsular India is ornamented by majestic rivers having extensive and highly productive estuarine areas. India's most of the largest rivers like Ganga, Subarnarekha, Mahanadi and Godavari etc. carry a vast amount freshwater to the Bay of Bengal passing through West Bengal, Orissa and Andhra Pradesh, the three south-eastern coastal states respectively. The Hooghly-Matla estuarine complex, marked as an important spot on the global map for its famous deltaic Sundarbans and luxuriant mangrove vegetation, is the richest and biggest in the world. This environmental complex supports a galaxy of benthic fauna of which horseshoe crabs are most conspicuous.

The Indian part of Sundarbans is located geographically between 21° to 22°30'N latitudes and 88° to 89°29'E longitude. Its coastal zone is in the form of low, swampy terrain characterized by extensive fluvio-marine plains with network pattern of creeks and parallel beach ridges with intervening estuaries and mudflats (Mangrove Report, 1987).

The total coast line from Sundarbans to Baitarani delta (Fig.182) of about 300 km, is interrupted by large estuaries, Hugli (Hooghly), Matla, Saptamukhi and Gosaba in 24-parganas, Rasulpur river in Midnapur of West Bengal; Subarnarekha, Burhabalanga, Baitarani and Mahanadi rivers in coastal Orissa. The eastern coast of West Bengal is characterized by sand and mud bottoms, while the coastal plains of Midnapur in West Bengal and Balasore, Cuttack and Berhampur districts of Orissa are characterized by the sandy shores mainly. But from the Godavari river mouth towards the south-eastern part of Andhra its coast is characterized mostly by rocky shores. A brief physiographical description of major field areas in regard to horseshoe crab studies is given below:

A) Prentice island:

It is an elongated and narrow, slightly bent, virgin island; situated between the latitude 21°43' to 21°46'N and the longitude 88°10' to 88°19'E in Sundarbans. This mangrove island is surrounded on all
sides with the river Saptamukhi that has a link with Moorigonga via the Hatania - Doania Khal dividing Namkhana into two halves on the west. On the east and south-east, there are two islands - Pathar Pratima containing a National Crocodile Project (established in 1982) at Bhagabatpur and the Luthiah island with a bird sanctuary, respectively. Prentice island with its rich but shorter mangrove vegetations and numerous creeks and inlets provides a model ecosystem for the study of various micro-and macro-fauna including the horseshoe crab, *Carcinoscorpius rotundicauda*.

B) Sagar island:

The largest delta in the western sector of Sundarbans, is situated nearly 85 km south of Calcutta in deltaic West Bengal. The island extends from 21°38' to 21°57'N latitude and from 88°2.35' to 88°11'E longitude and covers an area of about 235 km². This is a tide-dominated island where the tidal range varies from 5 to 6 mt. and the island is only 6.5 mts. above the sea level (Mukherjee, 1983). It is surrounded by a large bodies of water, river Hooghly in the north and western side and river Mooriganga in the eastern side. The southern part of the island faces the open sea, Bay of Bengal. It has 12 tidal creeks amongst which the Chemaguri creek has a broad mud-flat enriched with artificial mangroves that support the luxuriant population of *C. rotundicauda* as the breeding ground.

C) Digha:

A prominent tourist place of Kanthi coastal plain of Midnapur district directly facing the Bay of Bengal. The micro-physiographic features of Digha are i) beach and runnel (channel) topography in the foreshore regions, ii) dunes and sand flats and iii) tidal creeks, silt flat and marshy lands of east and west.

The diurnal type of tidal action (two high tides and low tides) wash the beach everyday with a cyclic of erosion and deposition. During high tides the rolling waves transport maximum sediments and deposited in the back shore areas. The long and wide sea beach (slope measured 1.0-1.5°) is interrupted by small and narrow tidal runnels by
which the tidal water enters the dune flats. Dunes are migrating in nature and to check the northward migration of the dunes the Government organizations like Department of Irrigation and Forest planted Casuarina equisetifolia in rows, on the dune surface. Near the Subarnarekha delta and in the mouth of Talshari Khal, tidal creeks, marshy lands, mud and salt flats, and terraces are the important morphological features.

The growing need of tourism causes severe human interference in to the beach and overfishing all along the shore line prevents the migration of Tachypleus gigas to its breeding ground situated at the shore and at present the natural population is so reduced that for collection of fewer horseshoe crabs one has to depend on the fishing net.

D) Chandipur :

A recently growing sea resort, situated in Balasore district, about 10 kms. away from the township. The surface of the Balasore coastal plain is more or less terraced, the lowest terrace along the sea margin being impregnated with salt where the present Chandipur is situated. Probably the sea beach of Chandipur is almost flat one and widest (about 4 kms.) in India with only 0.4 to 0.5° slope. Foredunes are developed on the margin of highest high water level. Water mass remains on the beach behind the sand bars even after receding of water during ebb tide.

To the north-east of Chandipur, a short and narrow estuary, called the Burhabalange, is situated (Fig. 2A). The estuary gradually becoming narrower the shore line was straightened and the river bank shifted south-west; the successive positions of shift are marked by sand ridges of indefinite origin and by small scraps. The mouth is marked by huge sand bars. Chandipur seashore harbours a considerable population of Tachypleus gigas.

E) Dhamra :

This estuary is an unique mangrove ecosystem, situated at the junctional complex between rivers Baitarani and Brahmani in coastal
Balasore of Orissa. The study area was at the north-eastern part of the main estuary. Wide mangrove land and mud-flat extended up to 5000 mts. down to the littoral zone. Slope of the beach was found 0.9° at every 1000 mts. (measured by Clinometer) i.e. the total slope, thus, stands 4.5 to 5° for the entire beach extended up to the lowest tide mark. Between infra and supra-littoral zones, comparatively shorter mangrove plants, grasses etc. grow.

This is the only place that harbours both C. rotundicauda and T. gigas in the inlet creeks or on the mud flat.

About 280 km. long coast line of Balasore, Midnapur and 24-Parganas (deltaic Sundarbans) are being eroded in different rates in different seasons and the rate of erosion is estimated to be higher in Digha, Junput, Sagar Island and Bakkali than in the Balasore coast line (Paul, 1986).

HYDROLOGY

The aquatic environment of estuarine Sundarbans appeared to be more or less stable during January to June, when the salinity was highly fluctuating ranged from 8.2 to 28‰ as compared to the water temperature 20 to 34°C (Mangrove Report, 1987).

On the other hand, the sea shores of Digha and Chandipur, if compared hydrologically, featured an almost similar aquatic environment where the salinity ranged from 19.0 to 31.0 ‰ with the temperature ranging from 24 to 35°C. But in estuarine Dhamra and Mahanadi delta near Paradip port the salinity ranged between 10.5 to 29.0 ‰ with the range of water temperature varied from 23 to 34°C (Source: Marine Survey Deptt. Paradip Port Trust, 1985).
Fig. 1. Shows the coastal West Bengal (the Kanthi coastal plain west to the River Hugli = Hooghly and the estuarine Sundarbans to the east) with three study areas (A, B & C) :

A. Prentice island, dots represent collecting sites, B. Chemaguri creek mouth (Sagar Island) and C. Digha sea shore.
Fig. 2. Shows the coastal Orissa with two study sites (A & B).
A. The Chandipur sea shore (District Balasore) and B. Koithkola mud flat at estuarine Dhamra (District Cuttack).