Review of Literatures:

2.1. General Profile of the Study Stretch

2.1.1. Bay of Bengal and its associated riverine flows:

The Bay of Bengal, the largest bay in the world, forms the northeastern part of the Indian Ocean and occupies approximately an area of 2,172,000 km^2. This Bay receives an average annual run off of 2329 km^3 and approximately 2000 million tones of suspended matter from the peninsular Indian rivers like the Ganges and its distributaries such as Padma and Hooghly, the Brahmaputra and its distributaries such as Jamuna and Meghna, others rivers such as Irrawaddy river, Godavari, Mahanandi, Krishna and Cauvery flow into the Bay of Bengal. Other than these, several small rivers like Subarnarekha, Burahbalanga, Kushabhadra, Devi, Bhargavi, Rushikulya, Bahuda etc also empty their contents into the Bay. The fan of sediments of the Ganges River is the widest- 8 to 11 km and thickest in the world (Subramanian, 1996 and Overeem *et al.*, 2014). Except Ganga (Hoogly) all other rivers are seasonal, and negligible fresh water discharge takes place in the Bay during January to May resulting into substantial turbidity in the study areas (Holeman, 1968; Milliman and Meade, 1983; Sahu, 1990). The tremendous freshwater influx together with monsoon wind strongly influences the circulation, stratification, productivity and sedimentation pattern of Bay of Bengal (Rao, 1977). Monsoon circulations have a considerable influence on the hydro dynamics of the Bay, producing a warm, low saline, nutrient and oxygen rich layer at a depth of 100 meters and thereby creating a virtual estuarine condition in the surface water (Benshila *et al.*, 2014).

2.1.2. Coastal Belt of West Bengal:

The state, West Bengal extends from the Himalayas to the Bay of Bengal. The coastal zone of West Bengal constitutes the lower part of the Bengal basin and geographically encompasses three southern districts of the state, *viz*. Midnapore (East), in the western part (covering about 27% of the coast line) and the south 24 Parganas and North 24 Parganas under the central and eastern parts (covering about 73% of the coast

line). The state has a coastline of 158.2 km. Midnapore coast is characterized by long shore currents, sand dunes, minor river discharges, less turbid but high saline sea water influence, cuspate delta of the Subarnarekha, and neotectonic depressions in the west. The Sunderbans in the South-24 Parganas have an intricate coastline, clusters of deltas with interlinked channels, estuaries and creeks. Deltaic regions are mostly clayey due to high deposition of sediments (8 million tones/yr) through the Hooghly – Matla estuarine system. The beaches and inlets, creeks, and mangrove swamps, mudflats, coastal dunes and sand flats are the characteristics of the area.

Geographically coastal Midnapore is a continuous part of deltaic Sundarbans of global importance limiting the Hooghly estuary on the western front. Only centuries ago like Sundarbans this area supported lush green canopy of mangroves comprising of varying halophytic species (Banerjee and Sen, 1998) expressing old age anthropogenic and environmental stresses. Coastal erosion coupled with unwanted accretion, dumping of solid and liquid wastes (of both industrial and municipal origin), receiving of inland waters loaded with chemical fertilizers and pesticides through run off and land drainage, intensive aquaculture practices and other major developments like Shankarpur fishing harbour, Digha tourism centre, Kolaghat thermal power plant, Haldia petrochemicals with associated industries have resulted considerable eco degradation during last three decades coupled with the decline in the diversity of fauna and flora (Mukherjee and Chatterjee,1997; Chakraborty, 2010).

Studies on coastal environment, coastal biodiversity, costal geomorphology and conservation management strategy etc have been carried out by several authors at international, national and state level like- Blasco, 1977; Brunn *et al*., 1980; Chandramohan *et al.*, 1996; Mukherjee and Chatterjee, 1997; Niering, 1997; Bandopahyay *et al*., 1998; Chakraborty, 1998; Bhattachrya, 2000; Chang *et al*., 2000; Choi, 2000; Paul, 2002; Chandra *et al.*, 2003; Chakraborti, 2003; Ingole, 2005; Nayak, 2005; Sridhar and Bhagya 2007; Mascarenhas and Jayakumar, 2008 and Namboothri *et al.*, 2008; Manoharan *et al*., 2011; Goff *et al*., 2009; Marale and Mishra, 2011; Venkataraman, 2008; Wafar *et al*., 2011; Stephenson and Brander, 2003; Davidson-Arnott, 2010; Kwadjosse. 2009, Mohan *et al*., 2013.

2.1.3. Estuary and intertidal mudflats of North Eastern coast of India:

An estuary is a place where fresh water meets the sea. In its broader meaning, an estuary is that part of the mouth of a stream in which the water level is influenced by the lake or sea into which the stream flows (Fortner and Ron Mischler, 1997). According to Pritchard, 1967 an "estuary is a semi enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage". A large number of research works on estuarine benthic fauna, their habitat ecology, population dynamics, food web interactions relationship with physicochemical parameters etc have been conducted and well documented by various authors globally. Among these some pioneering works were done by Smith and Mcintyre, 1954; khan, 1957; Ansari, 1974; Parulekar, 1973; Walting, 1975; Choudhury *et al*., 1980; Bhunia and Choudhury, 1981; Chakraborty and Choudhury, 1985; Ansari *et al.*, 1986; Elliott *et al.*, 1987; Patra *et al.*, 1990; Alongi, 1990; Vijaya Kumar *et al.*, 1991; Chakraborty and Choudhury, 1992; Jones *et al.*, 1994; Mees *et al.*, 1995; Dauer, 1997; Herman and Heip, 1999; Joydas and Damodaran, 2001; Beukema, 2002; Ysebaert *et al* ., 2003; Vopel, 2003; Ajmal *et al.*, 2005; Fujii, 2007; Geetha and Bijoy Nandan, 2014; Manna *et al.*, 2010; Bharadhirajan *et al.*, 2015; Gowda, 2009; Sooria *et al.*, 2015; Tagliapietra and Sigovini, 2010; Kumar and Khan, 2013.

Tidal flats are intertidal, non vegetated, soft sediment habitats, found between mean high water and mean low water spring tide datum (Dyer *et. al.*, 2000) and are generally located in estuaries and other low energy marine environments. Tidal flats supports a diverse biotic assemblage ranging from microscopic organisms found adhering to and living within interstitial spaces of sediment particles to large epibenthic forms such as crabs, fish and wading birds (Paterson *et al*, 2009). The geomorphology, sediment characteristics floristic and faunistic compositions of intertidal mud flats and sand flats have been well established throughout the world by several scientists like Morgan, 1970; Mc Intyre, 1970; Brenchley, 1981; Luckenbach, 1986; Simenstad *et al.*, 1988; Grassle and Maciolek, 1992; Fernandez *et al.*, 1993; Olafsson *et al.*, 1994; Heip *et al.*, 1995; Borja *et al.*, 2000;

Widdows and Brinsley, 2002; Cai *et al.*, 2003; Newell and Koch ,2004; Holsman *et al.*, 2006; Byre'n *et al.*, 2006; Bigot *et al.*, 2008; Ossa- Carretero *et al.*, 2009; Bertness, 1999; Little, 2000; Volvoikar and Nayak, 2014; Maekinnon *et al.*, 2012; Murray *et al.*, 2014 and kundu *et al.*, 2012.

2.2. Back ground information of benthic faunal components of West Bengal coast:

The pioneering work on the faunal components in the Gangetic delta and Chilka Lake had been down by Annandale and Kemp in 1915. The pioneering work on benthic macrofauna at national and international level was carried out by Petersen and Boysen, 1911 and Thorson, 1957. Goswami and Bharati, 1992 reported on the marine fauna of Digha coast of West Bengal, India. Some other work on benthic macrofauna also have been conducted along the West Bengal coastal track by Rao and Misra, 1996; Rao, 1981; Mishra *et al.*, 1983; Nandi and Choudhury, 1983; Subba Rao *et al.*, 1992; Mitra *et al* ., 1992; Sarkar *et al* ., *1994; Sarkar* et al ., 1999[a] and 1999[b] and Chatterjee and Mitra, 2003. The benthic fauna of Chilka Lake was studied by Ranjan, 1964. Parulekar, 1973 has studies the quantitative distribution of benthic fauna in the shelf of central west coast of India. Choudhury *et al* ., 1980 have performed a quantitative assessment of benthic macrofauna in the intertidal mudflats of Sagar Island. Chakraborty and Choudhury, 1994 have studied community structures of macrobenthic polychaetes of intertidal region of Sagar Island. Chakraborty *et al.*, (2009), have studied the species diversity of macro benthos of Sagar Island, have studied on impact of eco restoration on the biodiversity of Sundarban mangrove ecosystem. Chandra and Chakraborty (2008) published on distribution, density and community ecology of macrobenthic intertidal polychaetes in the coastal tract of Midnapore, West Bengal, India, Khalua *et al.*, 2008 published a paper on "Community structure of macrobenthic molluscs of three contrasting intertidal belts of Midnapore Coast, West Bengal, India". Earlier works on macro benthic species inhabiting in the mangrove forest floor, sand flats and mudflats of mangrove estuarine systems were concentrated mainly on the qualitative analysis, based on taxonomic status, faunal diversity etc. Review of literatures have also revealed that several works had been carried out throughout the world on macrobenthic faunal abundance, their ecology and

population dynamics by Van Dalfsen *et al.*, 2000; Talman and Keough, 2001; Carey and Keough, 2002; Hagberg *et al.*, 2003; Palomo *et al.*, 2004; Brockerhoff and McLay, 2005; Dye, 2006; Essink *et al.*, 2006; Fujii, 2007; Yousuf *et al.*, 2012; Sundaravarman *et al.*, 2012; Pandey *et al.*, 2014 and Muthuvelu *et al.*, 2013. Andrew *et al*., 1987 Sampled and gave description of spatial pattern in marine ecology. Damotharan, Perumal and Perumal (2010) studied on seasonal variation of physicochemical characteristics of Point Calimere coastal waters (South east coast of India).

2.3. Molluscs a unique macro faunal component at Digha coast:

Molluscs are found 10190 meter deep in the ocean to an elevation of 5000 meter. It is a highly diversified group, differs in size, shape, number as well as its habit and habitat. Winckworth (1940), estimates 24503 numbers of terrestrial molluscs, 31643 numbers of marine molluscs and 8765 numbers of freshwater mollusks, making a total numbers of 64,911 molluscan species (approx. 65,000). Subba Rao (1998) made a conservative estimate 66535 numbers of molluscan species of which the Indian contribution is 5070 numbers of molluscan species, among them1487 terrestrial mollusks, 3400 marine mollusks and 183 fresh water molluscs.

Nair and Rao (1974) studied the commercial molluscs of India. Subba Rao, Dey and Barua (1992) studied the marine and estuarine molluscs fauna of West Bengal. Subba Rao, Dey and Barua (1992) studied the molluscs in Hoogly - Matla Estuary of West Bengal. Goswami (1992) surveyed about the marine fauna of Digha coast of West Bengal, India. Talukdar *et al.* (1995) studied the biology of Cephalopods of Digha coast and presented very interesting results. Talukder, Chatterjee, Ramakrishna and Brahmachary (1995) studied the Biology of Cephalopods (Decapoda) at Digha Coast (West Bengal). Ramkrishna, Sarkar and Talukdar (2003) studied in details about the marine invertebrates of Digha coast and some recommendation on their conservation. They got 331 numbers of invertebrates species available at Digha coast. Ramakrishna and Dey (2010) surveyed about the marine molluscs available in India. They wrote a book named ‘Annotated check list of Indian Marine Molluscs’ here it is mentioned about 267 numbers of marine molluscs found in different marine resources in India. Hadi, Idris,

Mustafa Kamal, Sing (2012) studied the Diversity of Edible Mollusc (Gastropoda and Bivalvia) at Selected Division of Sarawak, Malaysia. Jones (2013) surveyed and published a paper named 'Molluscan Fishery Resources of India'. Pal, Panigrahi and Tripathy (2014) studyed the marine molluscs with respect to their diversity, relative abundance and species richness in North-East coast of India, they got 32 bivalves and 32 gastropods species at Digha, Sankarpur, Chandipur, Bakkhali of West Bengal and Talsari of Odisha. Yennawar and Tudu (2014) surveyed and published a paper named 'Study of Macrobenthic (Invertebrate) Fauna around Digha Coast. There it is found about 141 numbers of Macro benthic invertebrate fauna at Digha coast. Aller (1988) studied the benthic fauna and biogeochemical processes in marine sediments. Ansari *et al* (1979) studies on dimensional relationships in green mussel Mytilus (=Perna) viridis from environments. Anvar Batcha (1997) studies on intertidal and benthic macrofauna of Damman cornice and Half moon Bay beaches of the Arabian Gulf. Bouchet *et al*., (2008) studied on influence of oyster culture practices and environmental conditions on the ecological quality of intertidal mudflats. Cameron (2016) studied on Slugs and snail. Chakraborty and Choudhury (1994) conducted a study on community structure of macrobenthic polychaetes of intertidal region of Sagar Island, Hoogly Estuary, Sunderbans, India. Chakraborty, Poddar and chaudhury (1994) showed species diversity of macrozoobenthos of Sagar Island, Sunderbans, India. Yennawar and Tudu (2014) studied on macrobenthic (invertibrate) fauna around Digha Coast.

2.4. Biochemical study:

Biochemical analysis is the process of partitioning of components in a feed into six categories based on the chemical properties of the components. The six categories are: moisture, ash, crude protein, crude fat, carbohydrate and minerals. Studies on proximate analysis of different faunal components have been carried out by Ackman, 1989; Bruyer *et al*., 1990; Alikunhi, *et al*., 2010; Conesa *et al*., 2003; Doty, 1969, 1970; Garcia *et al*., 2006; Hendriks *et al*., 2002; Hua *et al*., 2005; Kristein, 1999; Lapidus *et al*., 1958; Lucking and Marchen, 1996; Nuckles *et al*., 1990, Ehigiator and Oterai, 2012, Fatima, 1996, Nurjahan, Hafiluddin, Nurhayati Tati, Nugraha Rini. 2012; Baby, Hassan, Kabir

and Naser. 2010; Osibona, Kusemiju and Akande. 2006, Kumari and Nair. 1989; Nagabhushanan and Talikhedkar. 1977; Sarvaiya. 1989; Beyza, Hulya. 2010; Siddiqui and Ahmed. 2002; Osibona, Kusemiju, and Akande. 2006; Bayne, Salkald and Worrall. 1983; Sahu, Achary, Satpathy, Mohanty, Biswas and Prasad. 2011; Tenjing Sing, Krishnamoorthy and Trippeswamy. 2012; Chattopadhyay, Rathie and Das. 2013; Nair and Rao. 1974; Aziz *et al.*, 2013. Banerjee and Chattopadhyay. 1980; Giese. 1969;