IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

REPORT OF SOME KNOWN MARINE FREE-LIVING NEMATODES OF PADDY FIELD FROM INDIA WITH ITS ECOLOGICAL IMPACT

Some Known Marine Free-Living Nematodes of Paddy Field

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Abstract: Some free-living nematodes are *Thoracostoma*, Eberth,1863, *Ironus* Bastian, 1865, *Minolaimus* Vitiello, 1970, *Filitonchus* Platt,1982, *Macrolaimellus longicauda* Rashid et al. 1985. There redescription is also given hereunder. This recent finding from paddy rhizospheric soil of Sunderban, situated in the coastal part of Bay of Bengal, in summer season, demonstrate the hike of salinity of paddy field beyond the normal level. This is threatening for the existence of other plants and corresponding animals, as it renders less water availability to plants due to the increase of osmotic pressure. Mainly mangroves as well as carbon sinks are in threatened condition due to increase of salinity.

Index Terms **- Ecological indicator, Inland salinity hike, Threatening for ecosystem, Sunderban.**

I. INTRODUCTION

Nematodes are the most numerous of all the multicellular organisms (Platt et al., 1984). Almost 500,000 species of nematodes are known world-wide (Hyman, 1951). They occur in every habitat which can support life. Nematodes depend on the water films around soil or organic material and more within existing pathways of soil pores of 25 to 100 µm diameter (Neher, 2010). They are the most diverse among marine metazoan taxa (Platt and Warwick, 1980). The free-living nematodes of aquatic environments although highly abundant, often numbering millions per m2, remained relatively unstudied (Heip et al., 1985). Nematodes are among the most abundant organism on earth, and have important roles in terrestrial, freshwater and marine ecosystem. Soil inhibiting nematodes predominate over all other soil animal, both in numbers and species. Free-living marine nematodes are among the best bioindicators owing to their worldwide distributions, abundance, and responses to environmental pollution.

Rice is staple food of over 50% of people of world (www.fao.org). India is 2nd largest producer of rice in the world. In India, 1.2 billion people depending on rice and rice is derived from paddy (www.asiasociety.org). Hike of salinity impact on paddy production as well as sterile grain also produced (Dam et al., 2019).

So, salinity as well as nematodes, both is important factors in agriculture. Salinity is one of the important factors which restricts economical utilization of land resources of inland and coastal areas of the World (Maas, 1986). Salinity affects the plant, which is a host to so many nematodes. The chemical composition of soil solution directly affects nematodes (Bird, 1977). The habitat of mud-dwelling estuarine nematodes consists of essentially an extremely complex mixture of inorganic and organic particles surrounded by interstitial water (Baver, 1948). The species composition of nematode communities in estuarine environment is a function of salinity and the sand grain size (Heip et al., 1985). Salinity hike also effects on the carbon sink as it maintained by m angrooves of coastal area.

Thoracostoma, Eberth,1863, *Ironus* Bastian, 1865, *Minolaimus* Vitiello, 1970, *Filitonchus* Platt,1982, *Macrolaimellus longicauda* Rashid et al. 1985 are those very rare marine nematodes, that are reported herein due to their presence of paddy (*Oryza sativa* L.cv. Dudheswar) field rhizospheric soil in a sound number. They are identified up to genus, except one. They are all firstly reported from India as well as from Sunderland of West Bengal.

It was found in the research study that, salinity is increasing in the Sundarban due to weather change, sea level growth and other human caused reasons (Brown et al., 2015). The agricultural lands will be losing utility for the soil salinity (Jabir et al., 2021). The finding of marine nematodes shows about the inland soil salinity increase, which is too much harmful for paddy cultivation. These is the burning issue of Sunder ban. Edaphic factors viz. pH, soil type, average salinity, nitrogen, phosphate, potassium level and their correlations are also estimated. These demonstrate the hike of salinity of paddy field as well as inland soil beyond the normal level.

3.1 SOURCES OF DATA

The area of the Sundarbans (lat. 21°57´N, long. 89°11´E) is about 10,000 km^2, whichis shared by Bangladesh and India. Among the total area, about 6,000 km^2 are in the southwestpart of Bangladesh and the rest are in India (Getzner *et al*. 2013). (See Fig.1.)

Sagar Island is positioned at 21°39′10″N 88°04′31″E. It has a usual raise of 4 meters (13 ft). Sagar Island is an islet in the Ganges delta, two-faced on the Inland Sill of Bay of Bengal about 100 km (54 nautical miles) south of Kolkata. Although Sagar Island is a partof Sundarbans, it does not have any tiger habitation or mangrove forests or small river tributaries as is characteristic of the overall Sundarban delta.

Patharpratima CD block is located at 21°47′39″N 88°21′20″E. It has an average elevation of 4 metres (13 ft). Patharpratima CD block has 241.9 km of mounds, the 2nd highestamong the 12 Sundarban CD blocks. Dams elevated along rivers are of dangerous standing for the protection of survives and shield of yields, in contradiction of daily waves and tidal rush.

During faunistic study in Pathar Pratima Island and Sagar Island blocks of Sunderban of WestBengal, India, which is situated near Bay of Bengal, the nematodes were extracted from rhizospheric soil samples (250 gm) of paddy (*Oryza sativa* L.cv. Dudheswar) following sievingby Cobb's sieving technique (Cobb1918) and decanting method followed by 'ModifiedBearman's Funnel Method (Christie & Perry, 1951).

3.2 RESEARCH METHODOLOGY

Nematodes obtained in water and then were killed as well as fixed by FAA solution following'Seinhorst's method of rapid glycerin dehydration technique' (Seinhorst, 1959). Permanent slides of nematodes were prepared in anhydrous glycerin and sealed. Measurements were taken with the help of an ocular micrometer using Olympus research microscope with drawingtube attachment; model no. BX41. Dimensions were tabulated in accordance with DeMan's formula (De Man 1884).

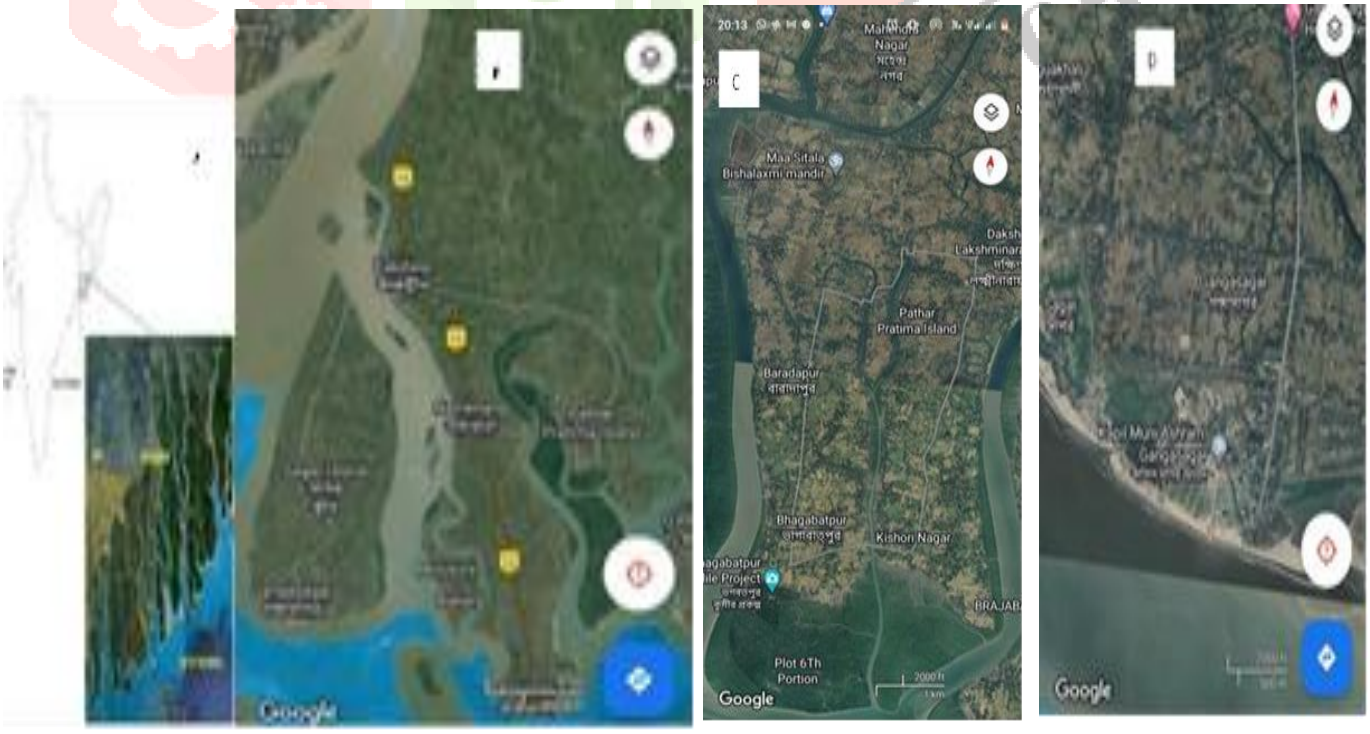


Figure.1. Map of Sunderban. A. position of Sunderban in India, B. Position of Pathar pratima and Sagar block under South 24 Parganas district, C. Pathar Pratima island, D. Ganga sagar ofSagar Island.

4. RESULT AND DISCUSSIONS:

Different edaphic factors of Pathar Pratima and Sagar block of Sunderban of West Bengal, India, are shown inTable.1.

4.1 Soli pattern.

Data reveals that soil of these blocks are highly saline than normal level and basic in nature. Organic matter also very low in both of these blocks. Average nitrogen level, phosphate level and potassium level are also very low. Nitrogen, phosphate and potassium are three basic important element of plant survival. All two block consist sandy soil clog. This soil type is not so suitable for paddy cultivation properly though in monsoon season and winter time here paddy cultivation occurs. Some selective salinity tolerant varieties *viz*. Dudheswar are selected for cultivation here.

Table 1 Average edhaphic factors and salinity of paddy field rhizosperic zone of different blocks of Sunderban, West Bengal. (ppt. parts per million).

Soil pattern of Different blocks of South 24 Parganas	**Edhaphic Factors**						
Name of blocksof South 24 Pargana	**Avg. ph**	**Avg.soil type**	**Avg.Salinity**	**Avg.Organic matter**	**Avg.Nitrogen**	**Avg.Phospate**	**Avg. Pottassium**
Patharpratima	9	Sandy	39ppt	0.20%	15mg/kg	9ppm	14ppm
Sagar	9.5	Sandy	45ppt	0.10%	20mg/kg	5ppm	10ppm

4.2 Morphological descriptions of those Nematodes.

4.2.1. Order Enoplida Filipjev, 1929
Suborder Ironina (De Ley et al., 2006) (Hodda, 2011)
Family Leptosomatidae Filipjev, 1916
Subfamily Thoracostomatinae De Coninck, 1965
***Thoracostoma* Eberth, 1863** (Fig.2)
Type locality
Sagar island, WB, IndiaDescription
Female. A long bodied (4-5mm) nematode with a blunt tail and anterior end. Sclerotized cephalic pod, an armor-shaped amphidial fovea, and two separate eyespots with pigment demitasse persevere. Cephalic capsule prominent in cephalic region. It is made up of six simplelobes *i.e*., two lateral including one dorsal and one ventral. Lobes are with little furrows. Cervical setae also prominent. Subdorsal cephalic projections present. Females are amphidelphic with reflexed ovaries. Vulva situated dorsally. Presence of thick cuticular vagina.Maximum body width is 120-140 µm, anal body width is 80-100 µm. Nerve ring prominent with excretory pore situated aside.
Male. Not found.Remark. It is first recorded from paddy field of Sunderban Delta as well as India. 10 number of females found from here. Species is not identified for lacking supportive papers. Collected specimens on slide will be submitted in National Zoological Collections (NZC) of ZoologicalSurvey of India (ZSI).

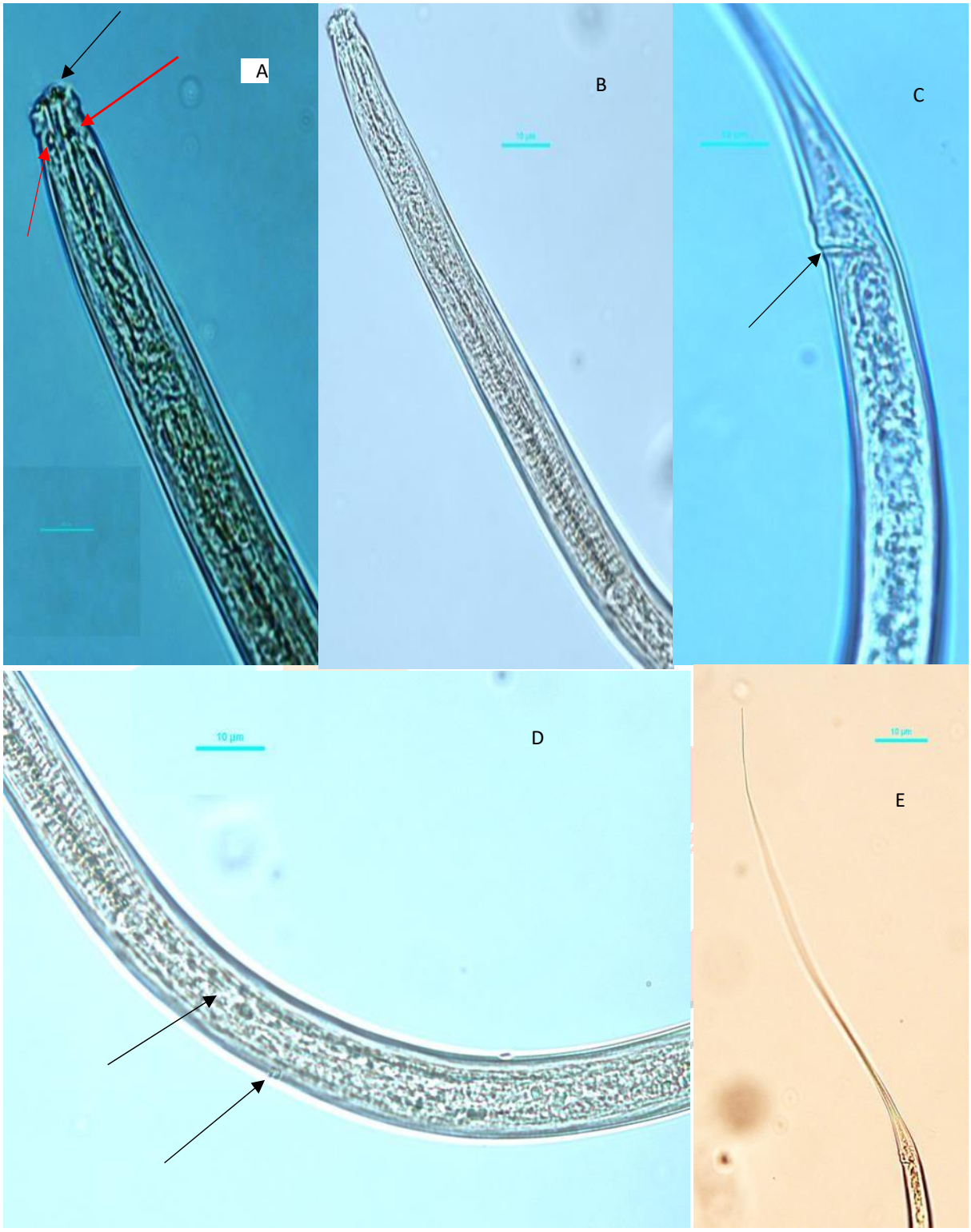


Figure.2. Photomicrographs of *Thoracostoma* female A. Mouth parts showing two eyespots(by red arrow) and subdorsal cephalic projection, which is the remarkable feature in 60x, B. Anterior part of female showing tooth pattern and cylindrical pharynx with cardia, in 60x, C. Posterior part of body showing anus in 60x, D. Dorsal Vulva with anterior ovary, arrow point the vulva and oocytes, in 60x, E. Extreme tail point in 60x, (Photomicrographs are taken by Nikon eclipse Ni-u Microscope)

4.2.2. Order Enoplida Filipjev, 1929
Suborder Ironina (De Ley et al., 2006) (Hodda, 2011)
Family: Ironidae De Man 1876
***Ironus*, Bastian, 1865 (Fig.3)**
Type locality
Sagar island, WB, India
Description
Female. Body long and narrow, with long tapering tail, slender figure with smooth cuticle. Body ventrally curved after heat fixed. Head bears apical papillae, forming shallow constrictions, stoma extended, canular and hollow fenced by three orifices positioned

at the frontal foundational zone; cup like amphid situated at the base level of head setae. Teeth are existing. Pharynx long cylindrical, from the mid portion of stroma its musculature begins. Nerve ring prominent. Cardia triangular. Vulva longitudinal, gonads didelphic - amphidelphic,but no caudal glands present. Tail with linear fine extremity. Caudal glands and spinneret obscure.
Male. Not found.

Remark. These are predators as they bear teeth. 30 number of creatures are found, and all are female, thus, parthenogenesis can occur in their population. Species identification cannot occur. Collected specimens on slide will be submitted in National Zoological Collections (NZC) of Zoological Survey of India (ZSI).

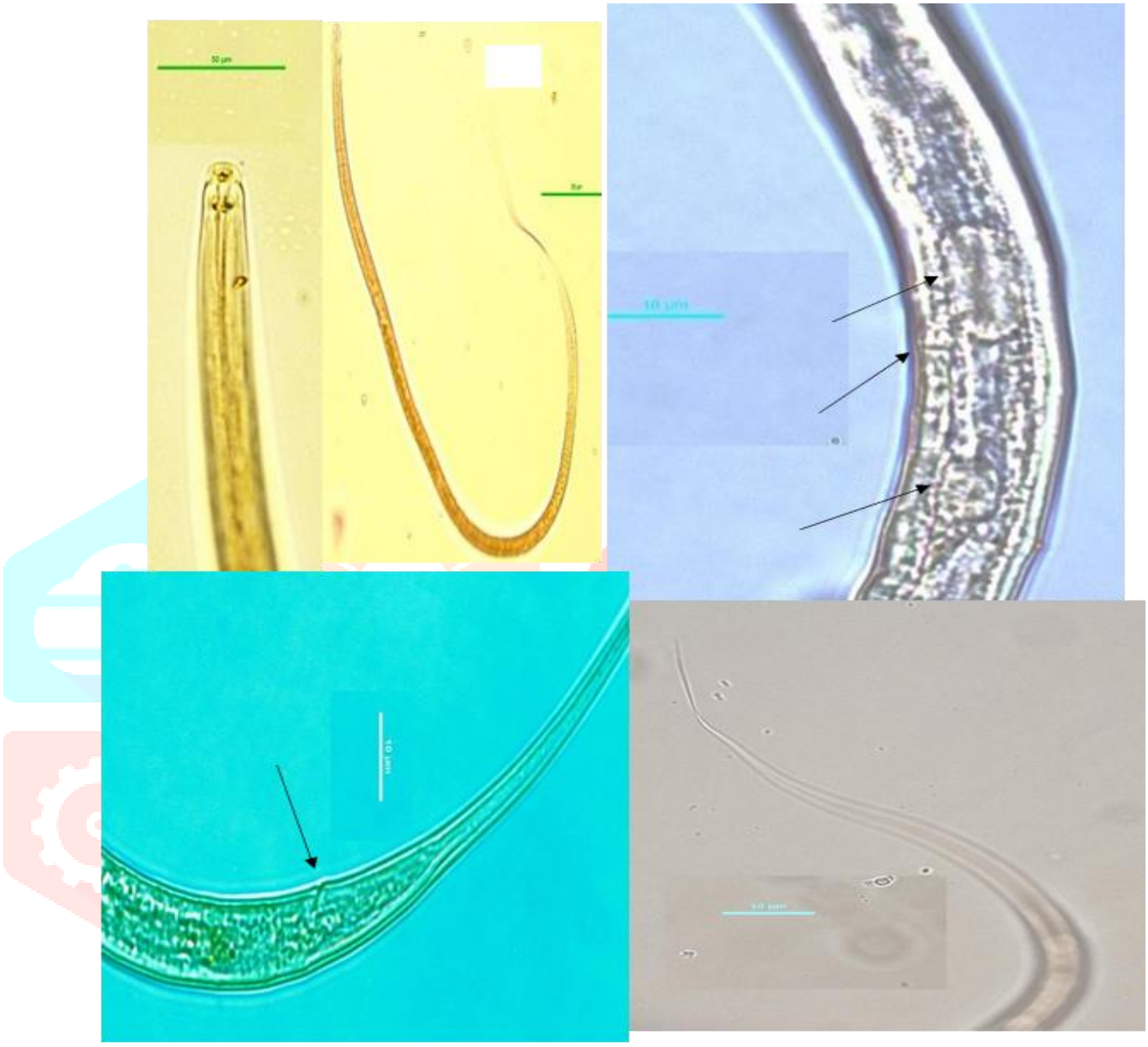


Figure.3. Photomicrographs of *Ironus* female A. Anterior part of female showing tooth patternand cylindrical pharynx in 60x, B. Whole body, in 20x C. Vulva with anterior ovary, arrow point the vulva and oocytes, in 60x, D. Lip structure in 60x, E. Posterior part of body showinganus in 60x, F. Extreme tail point in 60x, (Photomicrographs are taken by Nikon eclipse Ni-u Microscope)

4.2.3. Order Araeolaimida De Coninck, & Schuurmans Stekhoven, 1933
Superfamily Axonolaimoidea De Coninck & Schuurmans Stekhoven, 1933
Family Comesomatidae Filipjev, 1918
Subfamily Sabatieriinae Filipjev, 1934
***Minolaimus* Vitiello, 1970 (Fig. 4)**
Type locality
Pathar pratima island, WB, IndiaDescription
Female. Cuticle with punctations; transverse striations present or absent. Head is without helmet. Three longitudinal commotions of larger dots from the middle of pharynx to the conical portion of tail and a longitudinal row of pores in the pharyngeal region and precloacal region; Buccalcavity is minor without teeth and minuscule in shape. Outer labial and cephalic sensilla setiform of the same length, and nearly at the same level on the head. Cuticle with lateral differentiation of three longitudinal rows of larger dots from the middle of pharynx to the conical portion of tail and a longitudinal row of pores in the pharyngeal region and precloacal region;

spiral amphidial fovea with four turns and close to anterior end; pharynx cylindrical with oval posterior bulb. Posterior end of the pharynx formed by bundles of muscles and pharyngeal glands and usually enlarged, but not forming a distinct muscular bulb. Precloacal supplements cup shaped. Tail conical-cylindrical with slightly enlarged tip.

Male. Precloacal supplements weakly cuticularized, narrow tubes; lateral differentiation present. Male precloacal supplements complex, consisting of several elements.

Remark. It is first recorded from Sunderban Delta. Marine species but found from paddy fieldof Sunderban Delta. Nearly 25 number of specimens are collected from here.Species is not identified. It is the first report from India. Collected specimens on slide will be submitted in National Zoological Collections (NZC) of Zoological Survey of India (ZSI).

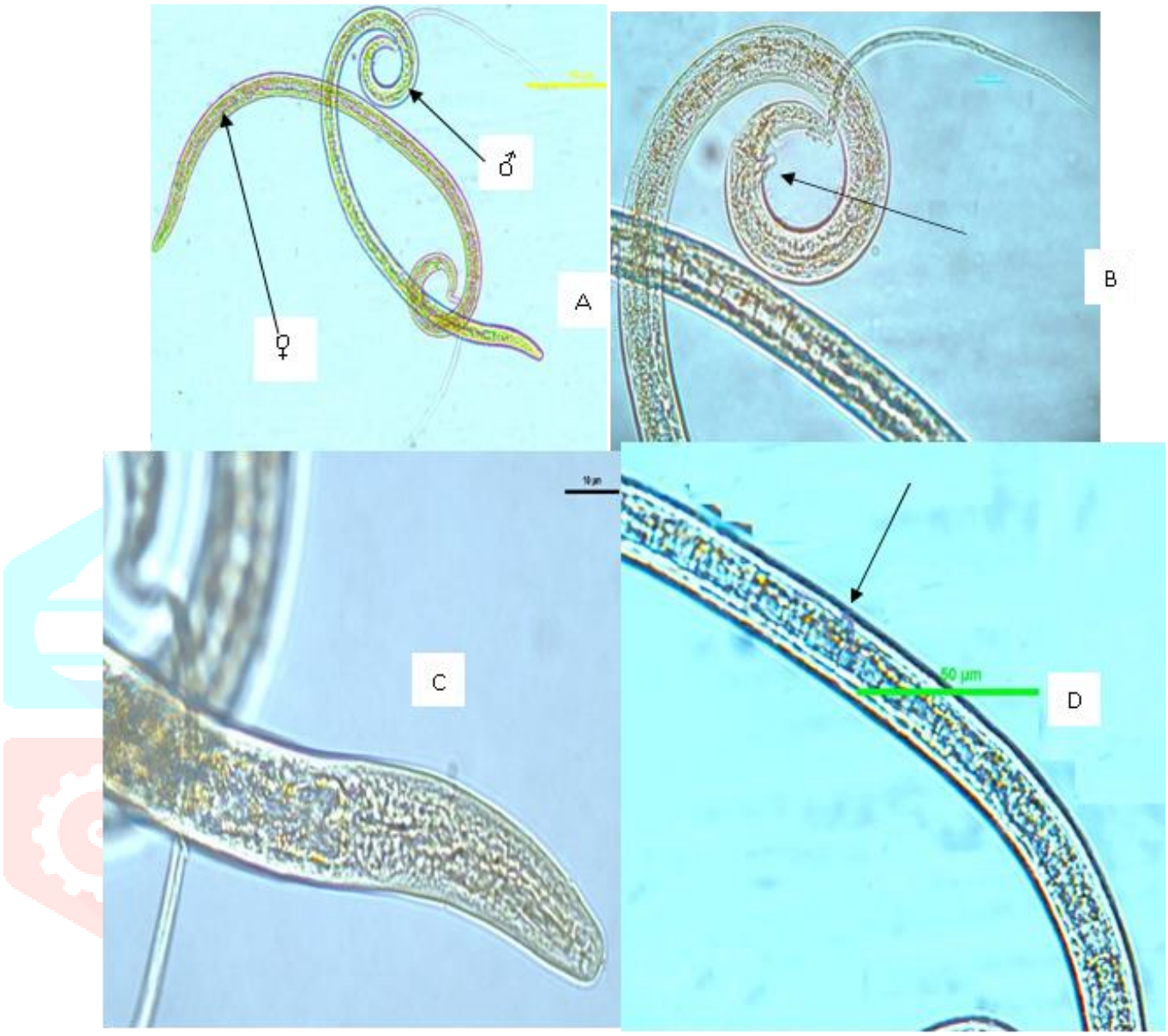


Figure.4. Photomicrographs of *Minolaimus* A. Whole body of female (♀) and male (♂), in 20x, B. Posterior region of body with anus of male, arrow shows the spicules, in 60x, C. Anterior part of female in 60x, D. Vulva with posterior ovary, arrow point the vulva, in 60x. (Photomicrographs are taken by Nikon eclipse Ni-u Microscope)

4.2.4. Order Chromadorida Chitwood, 1933
Suborder Chromadorina Filipjev, 1929
Superfamily Chromadoroidea Filipjev, 1917
Family Ethmolaimidae Filipjev & Schuurmans Stekhoven, 1941
Subfamily Neotonchinae Wieser & Hopper, 1966

***Filitonchus* Platt,1982 (Fig.5)**

Type locality
Pathar pratima island, WB, India
Description

Female. Cuticle with punctations; transverse striations present or absent. Head without helmet.Teeth, appear as a single dorsal tooth and a single dorsal tooth. Oesophagus with posterior bulb.In female body, vulva is very minute and without any vaginal papillae, it is transverse, gonad is mono-opisthodelphic, pronounced ovary. Tail long conoid and bulbous at tip.

Male. not found.

Remark. It is first recorded from Sunderban Delta. Marine species but found from paddy fieldof Sunderban Delta. Species is not identified. It is the first report from India. Collected specimens on slide will be submitted in National Zoological Collections (NZC) of ZoologicalSurvey of India (ZSI)

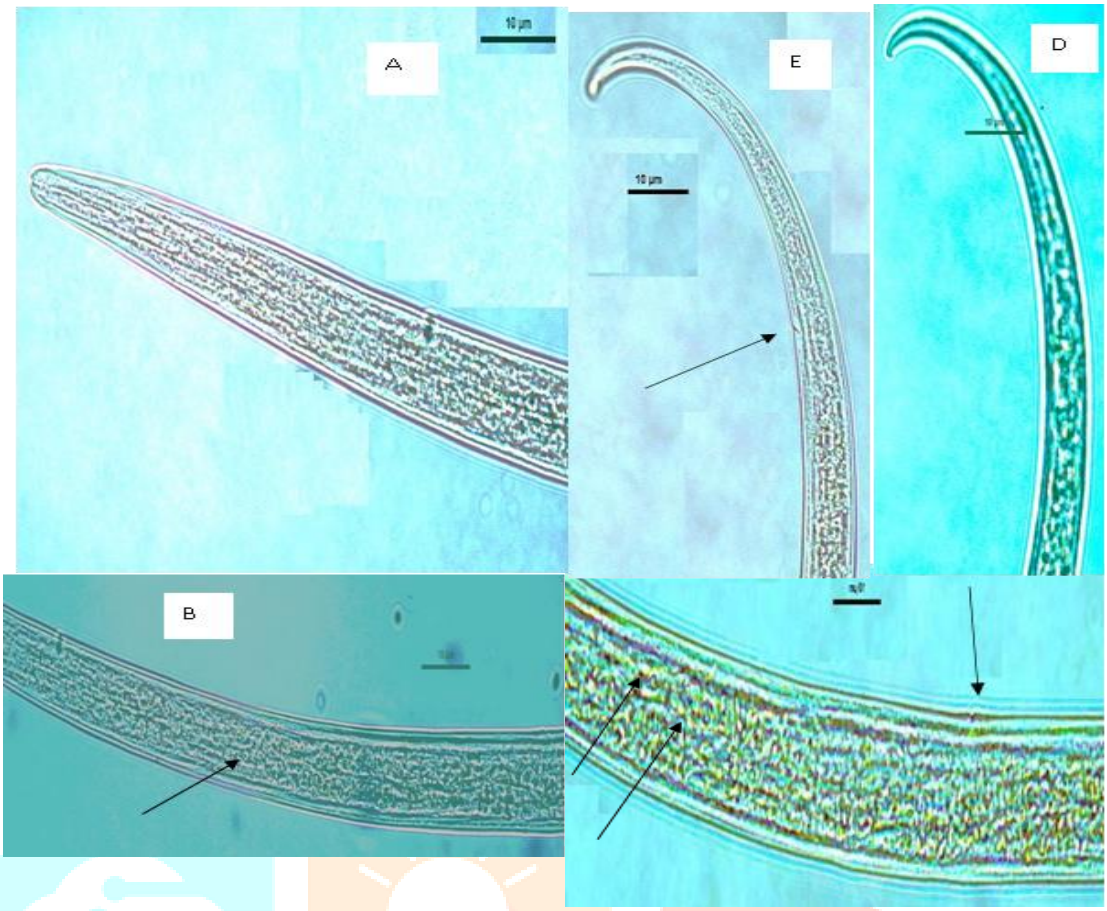


Figure.5. Photomicrographs of *Filitonchus* female A. Anterior part of female in 60x, B. Pharyngo-intestinal junction in 60x, C. Vulva with posterior ovary, arrow point the vulva and oocytes, in 60x, D. Extreme tail point in 60x, E. Posterior part of body showing anus in 60x. (Photomicrographs are taken by Nikon eclipse Ni-u Microscope)

4.2.5. Order Rhabditida Chitwood, 1933

Suborder Tylenchina Siddiqi · 2000
Superfamily Cephaloboidea Filipjev, 1934
Family Cephalobidae Filipjev, 1934
Subfamily Cephalobinae Filipjev, 1934
Genus *Macrolaimellus* Andrassy, 1966

***Macrolaimellus longicauda* Rashid *et al*. 1985** (Fig.6)

Type locality
Pathar pratima island, WB, IndiaDescription

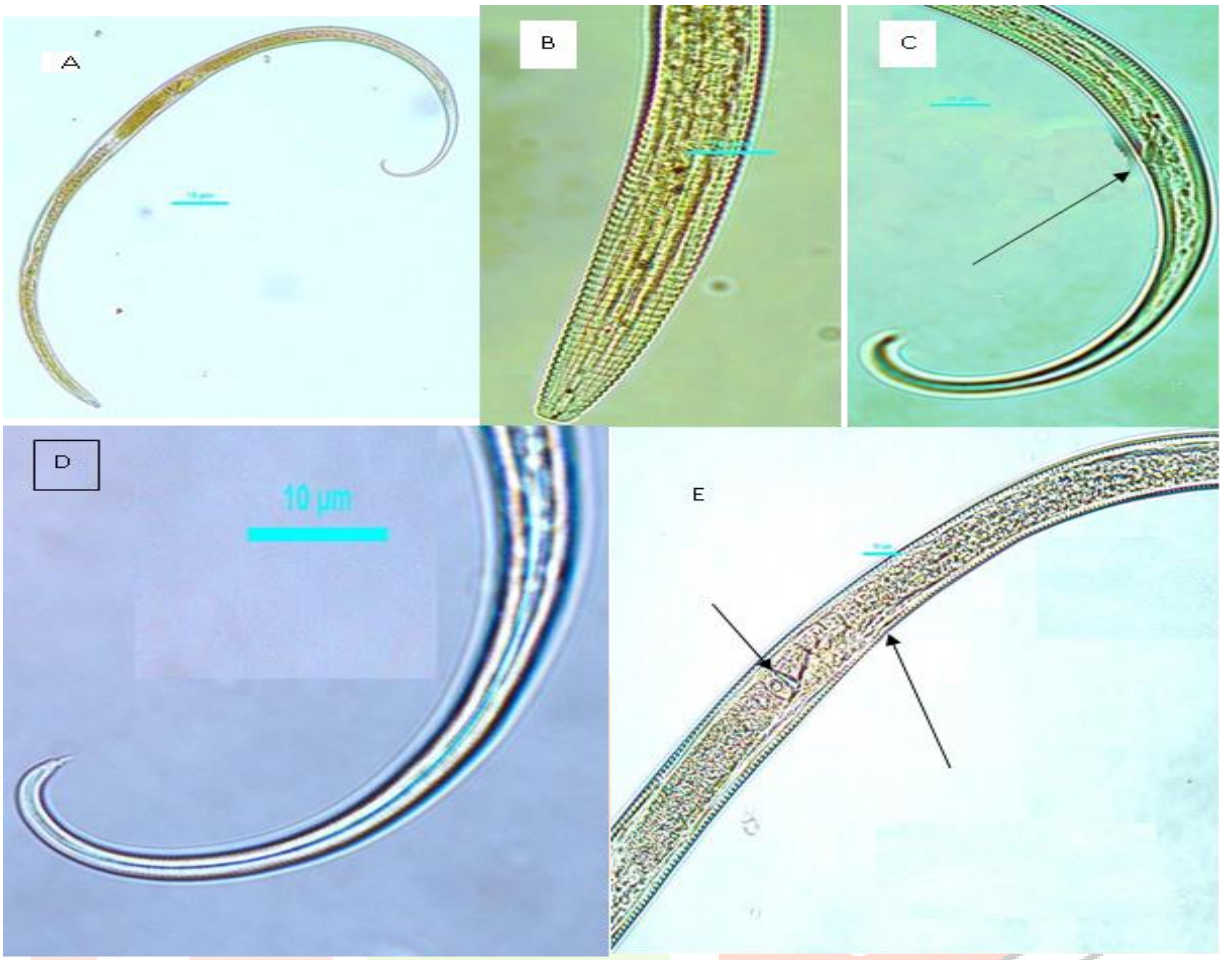
Measurements: Females: L=1.2mm, a=25, b=4, c=5.2, c`=10, total pharynx=281µm, maximum body width= 50µm, vulval height=13µm, V=56, stoma=9.4µm, excretory pore= 60µm, tail length=160µm. number of specimens=245 (all are females and juveniles).

Female. Body is arcuate, ventrally curved, after fixation. Annulae prominent in thick cuticle. Button shaped head which distinct from neck by offset. Amalgamated lip lateral with presenceof papillae. Pharynx cylindrical in shape. Amphid is tiny, rounded structure. Stoma sclerotised;metastome and telostome not sclerotized; isthmus prominent. Cardia disc shaped. Vulva transverse, gonad amphidelphic with pronounced spermatheca. Tail conoid to filiform respectively from posterior to anterior end, ventrally meander with a long spinneret or mucro like projection. Anus large, slit like.

Male. not found.

Remark. Specimens are long than the first report which was done by Rashid *et al.*, 1985, but original measurement differ from these specimens due to presence of their long tail, approx. 160 µm (vs. 60-90 µm) and long body (vs.0.38mm). It is also a marine specimen. It is first recorded from paddy field of Sunderban Delta. It is the first report from India. It is the first report from India. 245 numbers of females and juveniles are collected, but no male existence found, that proves parthenogenesis occur in their population. Collected specimens on slide will be submitted in National Zoological Collections (NZC) of Zoological Survey of India (ZSI).

Figure.6.



Photomicrographs of *Macrolaimellus* female A. Whole body in 20x, B. Anterior part of female in 60x, C. Posterior part of body showing anus in 60x, D. Extreme tail point showing the spinneret, in 60x E. Vulva with ovaries, arrow point the vulva and oocytes, in 60x, (Photomicrographs are taken by Nikon eclipse Ni-u Microscope)

5. CONCLUSION

Nematodes are the most diverse and abundant representative of meiofauna in many marine environments (Getzner, M., & Islam, M. S. (2013)). They are small but especially important inthe ecology of seas and rivers and agricultural ecosystems. In benthic environment, nematodesare important from energy-flow-viewpoint in the ecosystem being significant part of diet of many aquatic organisms (Gee, J.M. (1989)), and facilitating the mineralization of organic matter (Riera and Hubas, 2003). This persistence of marine species notifies us about the drasticchange in ecosystem.

Salinity is an important impediment on the growth of mangrove forest and distribution. The physiographic nature of the soil and water is being changed by the salinity intrusion, which affects supporting services of the flora, fauna and fisheries such as habitat. Therefore, habitat loss of plants and animals are occurring frequently for salinity intrusion. Salinity in the water will seriously hinder the irrigation process in agricultural lands (Haque et al.2017). Global climate change is affecting the whole country. Consequently, the sea level is rising, and the freshwater resources are becoming more saline. The change or increase in temperature is also leading to greater evapotranspiration water and thus raising salinity levels in the remaining freshwater bodies (rivers) and aquifers (IPCC. (2014).). Sea level rise is an important reason for salinity intrusion in the fresh water. The fresh water becomes scarce due to salinity. With sea level rise, the ground water also becomes salinized. Along with the water, the soil also absorbs salt, which creates soil salinity. The soil and water salinity effect on the physical characteristics of the soil and water in the coastal parts due to sea level rise (Haque et al.2015).

Increase of salinity is also harmful for medium tolerable mangroves. The mangroves are an important source of carbon sink. University of Calcutta conducted research and found that 4,150,000,000 tons Carbon dioxide had been soaked by the Sundarbans, that had a value of $79 billion in the international market (Mahadevia et al, 2012). They continually take and confiscate carbon out of the atmosphere through the process of photosynthesis. Sequestered carbon is then accumulated in the form of biomass, deadwood, litter, and in the forest soil. According to FAO's Forest Resources Assessment, the total carbon content in forest ecosystems for the year 2005 was 638 Gt C (1 Gt C equals to 1 billion metric tons of carbon). If the mangrove species are reduced due to salinity, the amount of carbon will increase resulting the disturbance of ecological balance. That causes a fatal impact on Sunderban Ecosystem.

II. ACKNOWLEDGMENT

The corresponding author is thankful to the Director of Zoological Survey of India, Dr. Dhriti Banerjee for pursuing her research works.

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