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Invertebrates and their Ecosystem services in Bangladesh Sundarban

An invertebrate is an animal that has no vertebral column or backbone to support its body.The invertebrates are the most diverse and important group of animals on our planet. Humans as well as all the vertebrates, animals having vertebral column or backbone, could rarely survive without invertebrates. But unfortunately, they are neglected in large part in the formulation of policies concerning conservation studies especially in Bangladesh. This statement is also true for the Bangladesh part of Sundarban, a treasured UNESCO World Heritage Site. Roles of invertebrates in this mangrove forest have never been considered seriously and as a result, our knowledge on this group of animals is poor. Accordingly, efforts are made to review the invertebrate diversity and their ecosystem services in

By **Bidhan Chandra Das**

Bangladesh part of the Sundarban. Altogether 358 invertebrate species under 271 genera of 131 families belonging to four Phyla, viz. Rotifera, Mollusca, Annelida and Arthropoda have been reported till date from Bangladesh part of Sundarban. Ecosystem services provided by some groups of invertebrates, viz. shrimps, crabs, mollusks and insects are also reviewed. Local people think that the ecosystem services provided by different groups of invertebrates in the Sundarban has decreased. The necessity of research works on invertebrates in the Sundarban vis-à-vis Bangladesh is discussed.

1. Introduction

Invertebrates are important components of the ecosystem (Ormerod *et al*., 2009; Graça, 2001; Kellert, 1993) and eclipse all other forms of life on Earth, not only in sheer numbers, diversity, and biomass, but also in their importance to functioning ecosystems (Black *et al*., 2001). They are the primary driving force in ecosystems function, and from the perspective of biodiversity, invertebrates make up 99% of animal species (Lunney, 1992). In ecosystem food chains, they constitute prey for higher trophic levels and acting also as herbivores, predators, and parasitoids (Jokimäki, 1998). Invertebrates participate actively in the interactions that develop in soil among physical, chemical and biological processes (Lavelle *et al*., 2006). Although invertebrates are vitally important, they are often overlooked (Black *et al*., 2001) and ignored (Lavelle *et al*., 2006). Invertebrates play important roles to wetlands biodiversity, food webs, and nutrient cycling (Batzer *et al*., 1999, Keiper *et al*., 2002) and they colonise newly constructed aquatic habitats quickly (Keiper and Walton, 2002; Wissinger *et al*., 2001). However, in spite of their great importance, until recently they have been very poorly studied, evaluated and understood especially in the mangrove forest of Bangladesh. Accordingly, an effort is made in this paper to evaluate them in relation to their diversity and ecosystem services in the Sundarban.

1.1. Mangrove Invertebrates

Mangrove invertebrates have traditionally been regarded as taxonomically diverse and numerically abundant (EPA, 2001; Wells,

1983). The complex matrices of mangrove result very high habitat heterogeneity in the mangrove ecosystems (Brij and Chauhan, 2006). They typically demonstrate vertical and horizontal zonation within mangrove forest. Mangrove invertebrates are classified into four general trophic groups (Odum *et al*., 1982): (1) direct grazers such as insects and mangrove tree crabs; (2) filter feeders such as sessile invertebrates, which feed on phytoplankton and detritus; (3) deposit feeders such as mobile invertebrates that consume detritus, algae, and small organisms from the sediment surface; and (4) carnivores such as highly mobile invertebrates that feed upon all the other group.

1.2. Diversity

In spite of immense importance of invertebrates, unfortunately our knowledge on this group in the Sundarban, especially in Bangladesh part is very poor. Serious efforts to explore invertebrate fauna of the Sundarban have not yet been made. As a result it is really difficult to prepare any consolidated account of invertebrates for this part of the Sundarban.

The present account of invertebrates from Bangladesh part of Sundarban (Table 1) is prepared on the basis of insufficient information (Biswas and Raychaudhuri, 2012; Hossain, 2012; Magny *et al*., 2011; Baksha, 2008; Bernacsek *et al*., 2001; Biswas, 1997; Ahmed, 1990; Jahan *et al*., 1990, 1998; Chowdhury, 1995) and personal communications with relevant biologists. However, data on collection and observations from a series of field research trips by the present author are also included here.

Table1: Invertebrates of Bangladesh Sundarban

Phylum: Rotifera		Family	Genus	Species
	Class: Eurotatoria			
	Order: Ploima	4	6	6
	Order: Floscullariaceae	1	1	1
Total		5	7	7
Phylum: Mollusca				
	Class: Polyplacophora			
	Order: Neoloricata	1	1	1
	Class: Gastropoda	0	0	0
	Order: Neritopsina	1	3	9
	Order: Neotaenioglossa	6	8	11

Phylum: Rotifera		Family	Genus	Species
	Order: Neogastropoda	7	8	9
	Order: Archaeopulmonata	1	2	2
	Order: Architaenioglossa	1	1	1
	Order: Basommatophora	1	1	1
	Order: ystellommatophora	1	1	2
	Order: Archaeogastropoda	1	1	1
Class: Bivalvia		0	0	0
	Order: Myoida	3	4	4
	Order: Ostreoida	3	4	5
	Order: Unionoida	1	1	1
	Order: Mytiloida	1	3	3
	Order: Veneroida	6	8	9
	Order: Arcoida	1	1	1
Class: Cephalopoda		0	0	0
	Order: Sepiida	1	1	1
	Order: Teuthida	1	2	2
	Order: Nautilida	1	1	1
Total		38	51	64
Phylum: Annelida				
Class: Oligochaeta				
	Order: Opisthopora	1	2	2
Class: Polychaeta				
	Order: Aciculata	5	9	13
	Order: Canalipalpata	2	2	2
Total		8	13	17
Phylum: Arthropoda				
Class: Arachnida				
	Order: Araneae	3	4	6
Class: Merostomata		0	0	0
	Order: Xiphosura	1	1	1
Class: Malacostraca		0	0	0
	Order: Decapoda	10	17	30
	Order: Stomatopoda	1	1	1
Class: Branchiopoda		0	0	0
	Order: Diplostraca	1	3	5
Class: Maxillopoda		0	0	0
	Order: Cyclopoida	1	3	3
Class: Ostracoda		0	0	0
	Order: Podocopida	1	1	1
Class: Insecta		0	0	0
	Order: Odonata	3	10	14
	Order: Orthoptera	2	8	10
	Order: Isoptera	1	4	4

Phylum: Rotifera		Family	Genus	Species
	Order: Thysanoptera	1	1	1
	Order: Hemiptera	7	8	8
	Order: Coleoptera	13	61	88
	Order: Hymenoptera	4	6	8
	Order: Lepidoptera	26	65	81
	Order: Diptera	5	7	9
Total		80	200	270
Grand Total		131	271	358

Table 2. Invertebrates of Indian Sundarban (Brij and Chauhan, 2006)

Phylum	Class	Number of Species
Porifera		1
Cnidaria		33
Ctenophora		2
Platyhelminthes		41
	Turbellaria	1
	Monogenera	21
	Trematoda	13
	Cestoda	6
Nemathelminthes		68
Acanthocephala		3
Nemertinea		2
Rotifera		4
Mollusca		143
Sipuncula		2
Echiura		3
Annelida		78
	Polychaeta	69
	Oligochaeta	6
	Hirudinea	3
Arthropoda		476
	Crustacea	240
	Insecta	201
	Merostomata	2
Entoprocta		1
Bryozoa		3
Brachiopoda		1
Chaetognatha		4
Echinodermata		20
Grand Total		885

: Bidhan Chandra Das

Till to date only 358 invertebrate species under 271 genera of 131 families under four Phyla, viz. Rotifera, Mollusca, Annelida and Arthropoda have been reported from Bangladesh part of Sundarban (Table 1). However, from Indian part of the Sundarban, altogether 885 invertebrate species under 18 Phyla, viz. Porifera, Cnidaria, Ctenophora, Platyhelminthes, Nemathelminthes, Acanthocephala, Nemertinea, Rotifera, Mollusca, Sipuncula, Echiura, Annelida, Arthropoda, Entoprocta, Bryozoa, Brachiopoda, Chaetognatha and Echinodermata are recorded (Table 2). This statistics is surprising since area of Bangladesh Sundarban (599,330 ha) is higher than that of Indian Sundarban (426,300 ha).

It is generally considered that the species composition of Indian and Bangladesh Sundarban are more or less similar, however; variation in salinity concentration as well as freshwater flow from west to east influence the distribution of biota (Gopal and Chauhan, 2006). Moreover, anthropogenic activities and management procedures are not same in Indian and Bangladesh Sundarban. As a result diversity, abundance and distribution of biodiversity likely to differ between the countries. For example, the Bangladesh Sundarban is dominated by Genwa (*Excoecaria agallocha*) and Sundori (*Heritiera fomes*), whereas the Indian side is dominated by *Genwa* and *Goran* (*Ceriops decandra*) (Gopal and Chauhan 2006; Iftekhar 2008). Bangladesh part of the Sundarban is still managed as a continuous block of mangrove forests with no human habitation inside, whereas out of 102 islands in the Indian part of the Sundarban, 54 are inhabited by 2.5 million people according to 1981 census (Rahman, 2003).

2. Ecosystem services

Ecosystem services are the set of ecological functions that are critical for human survival (Daily *et al.*, 2000) or in other words these are the benefits that people obtain from ecosystems (MA, 2003). Role of invertebrates as ecosystem service providers in the Sundarban has not yet been investigated. In fact, they are badly neglected in terms of exploration and evaluation. Ecosystem services of invertebrates in the Sundarban can be discussed under the following headings:

2.1. Provisioning Services – Produce goods

A number of groups of invertebrates can be recognized as very important sources of human food and minor forest produce, viz. beeswax, limes in the Sundarban.

2.1.1. Food

2.1.1.1 Shrimp/Prawn

Shrimp/prawn (many people use the words shrimp and prawn interchangeably) is one of the important groups of invertebrate that has high nutrition is preferred by people throughout the world. For this reason it is commercially a very important group of invertebrates in the Sundarban. About 300 metric tons of shrimps/prawns are harvested from the Sundarban each year (Banik, 2004). *Penaeus monodon* Fabricius, the giant tiger shrimp is the most widely cultured shrimp species in the coastal region of Bangladesh, whose fries till early nineties of the last century used to come from the Sundarban. Till date quite a large number of inhabitants along the border lines of the Sundarban carry out their livelihoods by catching and selling fries of this shrimp.

However, nowadays shrimps harvesting from the Sundarban (especially tiger shrimp) are declined and fry catching are confined along the rivers outside the boundary of the Sundarban.

According to Holthuis (1980), the shrimps include about 2,500 species, of which less than 300 species are of economic interest throughout the world. However, in the Sundarban altogether 23 species of shrimps under 10 genera and 6 families are found. These are: Penaeidae [*Penaeus monodon* Fabricius; *Fenneropenaeus indicus* H. Milne Edwards; *Penaeus indicus* H. Milne Edwards; *F. merguiensis* De Man; *Penaeus merguiensis* De Man; *Metapenaeus affinis* H. Milne Edwards; *M. brevicornis* H. Milne Edwards; *M. lysianassa* De Man; *M. monoceros* Fabricius; *M. spinulatus* Kubo; *Parapenaeopsis hardwickii* Miers; *P. sculptilis* Heller; *P. stylifera* H. Milne Edwards; *P. uncta* Alcock; Solenoceridae [*Solenocera crassicornis* H. Milne Edwards]; Sergestidae [*Acetes indicus* H. Milne Edwards]; Squillidae [*Oratosquillina perpensa* Kemp]; Palaemonidae [*Exopalaemon styliferus* H. Milne-Edwards; *Macrobrachium birmanicum* Schenkel; *M. lamarrei* H. Milne-Edwards; *M. mirabile* Kemp; *M. rosenbergii* De Man; *M. rude* Heller and *M.*

villosimanus Tiwari] and Alpheidae [*Alpheus euphrosyne* De Man].

Shrimp species other than *P. monodon* in the Sundarban are also important both commercially and local consumption.

Table 3. Number of tiger shrimp fries caught from the Sundarban (1999-2000 to 2011- 2012; Source: Forest Department, Khulna Circle, Bangladesh).

Financial Year	Quantity (number)
1999-2000	–
2000-2001	–
2001-2002	3436940
2002-2003	9828200
2003-2004	54900
2004-2005	–
2005-2006	–
2006-2007	–
2007-2008	569560
2008-2009	1175020
2009-2010	434200
2010-2011	73200
2011-2012	–

2.1.1.2 Crab

Crabs are another important fisheries item in the Sundarban. Lot of people catches crabs using various types of traps in Sundarban. Banik (2004) reported that 312 tons of crabs are harvested from the Sundarban each year. *Scylla serrata* (Forskål), is the most important species of crab in Sundarban, which has high commercial value. Many people along the border side of Sundarban fattening this species collecting young crabs from Sundarban.

Altogether 12 species of crabs under 10 genera and 5 families are found in the Sundarban. These are:

Grapsidae [*Episesarma mederi* Edwards; *Varuna litterata* Fabricius; *Metaplax crenulata* Gerstaecker; *M. elegans* De Man], Limulidae [*Carcinoscorpius rotundicauda* Latreille], Matutidae [*Matuta victor* Fabricius], Ocypodidae [*Gelasimus annulipes* Latreille, *Macrophthalmus brevis* Herbst; *Uca dussumieri* Milne Edwards; *U. forcipata* Adams & White; Portunidae [*Scylla serrata* Forskål; *Portunus sanguinolentus* Herbst].

As per the local people, crab populations have decreased in the Sundarban.

Table 4. Amount of crabs caught from the Sundarban (1999-2000 to 2011- 2012; Source: Forest Department, Khulna Circle, Bangladesh).

Financial Year	Quantity (Metric Ton)
1999-2000	–
2000-2001	–
2001-2002	364.20
2002-2003	1384.0
2003-2004	2144.0
2004-2005	2924.0
2005-2006	2998.0
2006-2007	2135.0
2007-2008	4014.84
2008-2009	3625.19
2009-2010	15397.37
2010-2011	3106.93
2011-2012	1301.56

2.1.1.3 Mollusk

The Munda people along the border line of the Sundarban eat shellfish. Head, foot, mantle and columellar muscle of the shellfish are consumed by them. *Telescopium telescopium* (L.) is a popular food among the Munda people and approximately 386.45 metric ton of meat of this snail collected from the Sundarban are consumed by them (Zaman, 2011).

Molluscan meat is also used as the food for prawn and crab, poultry and catfish, crab and as fishing baits. Shells are used in poultry and fish feeding, construction materials, ornamental and show peaces (Zaman, 2011).

Cattle fish and squids [Sepiidae (*Sepia* sp.), Loliginidae (*Loliolus hardwickei)* Gray, and Brachioteuthidae (*Brachioteuthis* sp.)] are also found in the Sundarban. However, they are not eaten by the local people, although they have demand in overseas sea food market.

Processed shell lime is used for human consumption along with betel leaf.

2.1.1.4 Honey producing Insects – *Apis dorsata* Fabricius, *A. cerana* Fabricius and *A. florea* Fabricius produce honey in the Sundarban, however; honey is collected only from the comb of A. dorsata. The people, who collect/harvest honey from the Sundarban, are locally called 'Mowali'. They, usually collect honey from mid

March to mid June. However, it is conjectured that the quantity of honey production has decreased in the Sundarban, which suggests that abundance and distribution of A. dorsata has also declined.

Table 5. Quantity of honey harvested from Sundarban (1999-2000 to 2011- 2012; Source: Forest Department, Khulna Circle, Bangladesh).

Financial Year	Quantity (Metric Ton)
1999-2000	555.20
2000-2001	346.50
2001-2002	234.10
2002-2003	279.60
2003-2004	337.80
2004-2005	396.20
2005-2006	321.80
2006-2007	599.40
2007-2008	374.00
2008-2009	304.22
2009-2010	175.65
2010-2011	361.50
2011-2012	165.45

2.1.2. Non-food Items

2.1.2.1. Shell lime

For lime production, molluscan shells are traditionally collected from the Sundarban. Mainly nine molluscan species, viz. *Telescopium telescopium* (L.), *Crassostrea madrasensis* (Preston), *Meretrix meretrix* (L.), *Cerithidea cingulata* (Gmelin), *C. obtusa* (Lamarck), *Pugilina cochlidium* (L.), Polymesoda bengalensis (Lamarck), *Neritina* sp. and *Anadara* sp. of Sundarban are used in lime production. Lime is prepared by the local people following indigenous method by heating them to high temperature. Shell collectors and lime producers are locally known as *Jongrakhota* and *Chunary* respectively (Zaman, 2011). Other than human consumption, shell lime is used for water purification, calcimining, curing materials, and masonry works. However, *Jongrakhota* and *Chunary* people think that the abundance and distribution of different types of mollusks are declining in the Sundarban.

In Sundarban, there are as many as 60 species of mollusks including snails, oysters, mussels and clams under 44 genera of 33 families from which lime can be produced. Nonetheless, local people

think that most of these, except above-mentioned nine species, are not commercially viable. These species are as follows:

Anomiidae [*Enigmonia aenigmatica* Holten]; Arcidae [*Anadara* sp.]; Babyloniidae [*Babylonia spirata* Linnaeus]; Bursidae [*Bufonaria rana* Linnaeus]; Cassidae [*Phalium granulatum* Born, 1778]; Corbiculidae [*Polymesoda bengalensis* Lamarck]; Costellariidae [*Zierliana* sp.]; Donacidae, *Donax* sp.; Ellobiidae [*Cassidula aurisfellis* Bruguière, *C. nucleus* Gmelin; *C. multiplicata* Von Martens; *Ellobium gangetica* Benson; *Pythia plicata* Férussac]; Fasciolariidae [*Latrius* sp.]; Littorinidae [*Littoraria melanostoma* Gray; *L. scabra* Linnaeus]; Mactridae [*Spisula solidissima* Dillwyn]; Melongenidae [*Pugilina cochlidium* Linnaeus; Muricidae [*Cymia lacera* Born, *C. tissoti Thais blanfordi* Melvill]; Myidae [*Sphenia* sp.]; Mytilidae [*Perna viridis* Linnaeus; *Modiolus striatulus* Hanley; *Brachiodontes* sp.]; Nacellidae [*Cellana radiate* Born]; Nassariidae [*Nassarius nodiferus* Powys; *Nassarius* sp.]; Naticidae [*Polinices didyma* Roding]; Nautilidae [*Nautilus pompilius* Linnaeus]; Neritidae; *Nerita articulata* Gould; *N. balteata* Reeve; *N. fulgurans* Gmelin; *N. polita* Linnaeus; *Neritina cornucopia* Benson; *N. smithi* Wood; *N. violacca* Gmelim; *Neritina* sp.; Onchidiidae [*Onchidium tigrinum* Stoliczka; *O. Tenerum* Stoliczka]; Ostreidae [*Crassostrea belcheri* Sowerby; *C. Gryphoides* Schlotheim; *Crassostrea madrasensis* Preston; *Dendostrea folium* Linnaeus]; Pectinidae [*Pecten* sp.]; Pholadidae [*Pholas* sp.]; Planorbidae [*Indoplanorbis exustus* Deshayes]; Potamididae [*Cerithidea alata* Philippi; *C. cingulata* Gmelim; *C. obtusa* Lamarck; *Telescopium telescopium* Linnaeus]; Psammobiidae [*Gari* sp.]; Tellinidae [*Macoma birmanica* Philippi]; Thiaridae [*Thiara tuberculata* Mueller]; Unionidae [*Lamellidens marginalis* Lamarck]; Veneridae [*Bassina calophylla* Philippi; *Meretrix meretrix* Linnaeus; *Marcia opima* Gmelin; *Periglypta* sp.]; Viviparidae [*Bellamya bengalensis* Lamarck]

Table 6. Quantity of snails caught from Sundarban (1999-2000 to 2011- 2012; Source: Forest Department, Khulna Circle, Bangladesh).

Financial Year	Quantity (Metric Ton)
1999-2000	6089.80
2000-2001	6007.90
2001-2002	3250.30
2002-2003	774.60
2003-2004	1531.00

Financial Year	Quantity (Metric Ton)
2004-2005	2362.90
2005-2006	3230.30
2006-2007	203.60
2007-2008	134.60
2008-2009	01.10
2009-2010	00.30
2010-2011	1028.90
2011-2012	1036.58

2.1.2.2. Beeswax

Beeswax is a natural *wax* produced by the bees. In the Sundarban beeswax are also harvested during the honey collecting by the *'Mowali'*. Although Apis dorsata Fabricius, A. cerana Fabricius and A. florea Fabricius make combs in the Sundarban, however; beeswax is collected mainly from the comb of A. dorsata since other two species are not commercially viable.

Table 7. Quantity of beeswax harvested from Sundarban (1999-2000 to 2011- 2012; Source: Forest Department, Khulna Circle, Bangladesh).

Financial Year	Quantity (Metric Ton)
1999-2000	138.90
2000-2001	86.60
2001-2002	61.90
2002-2003	64.20
2003-2004	84.44
2004-2005	98.92
2005-2006	80.00
2006-2007	141.50
2007-2008	93.51
2008-2009	68.02
2009-2010	69.69
2010-2011	81.29
2011-2012	41.74

2.2. Regulating Services – Eliminate climate regulation.

2.2.1. Pollination

Insects play an important role in pollination biology of the Sundarban. Honeybees regularly visit and pollinate different mangrove species in the Sundarban. Generally, honeybees produce honey by gathering nectar from flowers of *Avicennia*, *Ceriops* and *Sonneratia* in the Sundarban that has high commercial value.

Information on pollinating insects in Sundarban is almost nil except these three honeybees. However, the present author observed other insects as flower visitors under the Orders, Lepidoptera, Hymenoptera, Diptera and Coleoptera during his repeated research tours in the Sundarban.

2.2.2. Pest and disease control

Information on invertebrates, which act as predator, parasites or parasitoids is really nil for Sundarban mangrove forest. Anyway, there could be a good number of invertebrate species that regulate other species in the Sundarban. For example, 14 odonate species recorded from the Sundarban act as predator since all members under this order are carnivorous throughout their life, mostly feeding on smaller insects and crustacean larvae and thus regulate other animals' numbers. The odonate species are: Coenagrionidae – *Ceriagrion cerinorubellum* Brauer; *Ceriagrion coromandelianum* Fabricius; *Pseudagrion decorum* Rambur; *Ischnura aurora aurora* Brauer; *Onychargia atrocyana* Selys;

Libellulidae – *Brachythemis contaminata* Fabricius; *Brachydiplax sobrina* Rambur; *Crocothemis servilia servilia* Drury: *Diplacodes trivialis* Rambur; *Neurothemis tullia tullia* Drury; *Orthetrum sabina sabina* Drury; *Pantala flavescens* Fabricius; *Tramea virginia* Rambur; *Tholymis tillarga* Fabricius; *Rhyothemis variegata variegata* Linnaeus; and *Urothemis signata signata* Rambur.

Fireflies (Coleoptera- Lampyridae) population is high in the Sundarban and their larvae are carnivorous, living off smaller insects, snails and slugs. Ants (Formicidae: Hymenoptera) are also important predators in the Sundarban forest. In fact, a wide range of predatory and parasitic insects with diverse hosts and habits occur in mangrove habitats. These include predatory larvae and adult insects, which prey on other organisms, parasitoids that feed within a single host and eventually kill it, hyperparasitoids that parasitize parasitoids, and blood-sucking parasites of vertebrates. They can be found throughout the mangroves, from the soil to the water surface and on mangrove plants, where they exert a restraining influence on populations of herbivorous and saprophagous organisms (Nagelkerken *et al*., 2008).

Other invertebrates especially members under the Phyla Platyhelminthes, Nemathelminthes and Arthropoda in the Sundarban also act as parasites or parasitoids or predators of other animals. But

unfortunately no work has yet been carried out in the Sundarban to explore these facts.

2.3. Supporting Services

2.3.1 Nutrient cycling and decomposition

The nutrient cycle of the Sundarban is mainly dependent on the invertebrates and leaf litters. Invertebrates play important role to run nutrient cycle in balanced way in the Sundarban. Crabs and other invertebrates can modify the mangrove sediment have the potential to mediate mangrove vegetation structure and productivity (Ashton *et al*., 2003). Crabs influence mangrove community dynamics by facilitating the conversion of organic nitrogen to ammonia (Alongi *et al*., 1992), helping decomposition of organic matter (Robertson and Daniel, 1989; Micheli *et al*., 1991; Lee, 1998), grazing on leaf material (Onuf *et al*., 1977; Beever, 1979), aerating anoxic soils through burrowing (Smith *et al*., 1991) and altering soil microtopography by producing mounds (Warren and Underwood, 1986; Minchinton, 2001). Moreover, predation of propagules and seeds by crabs can be highly important in controlling recruitment (Smith, 1987; Allen *et al*., 2003). That is why crabs are called as ecosystem engineers. However, the foundation for the idea of crabs as ecosystem engineers had just been laid when other invertebrate taxa, such as mollusks and insects, went on the stage much earlier (Cannicci *et al*., 2008).

2.4. Cultural services

Invertebrates have great values in relation to aesthetic, recreational and ritual aspects. Honey is an essential item for worship of Hindu Community. Few molluscan shells are used in marriage and funeral events and also for worship in Hindu Community. Butterflies and coloured beetles give pleasure to the tourists of the Sundarban. In the dark night, the present author and his research team members were amazed several times by the beautiful light from millions of fireflies (Coleoptera- Lampyridae) in the Sundarban. Few molluscan shells and insects are used as decorative pieces. Shells are also used as ornaments. Diverse invertebrates in the Sundarban have also educational value.

3. Conclusion

Biodiversity related activities in the Sundarban as well as in Bangladesh are mainly centred on charismatic animals, e.g. tigers, monkeys, deer, snakes, frogs, crocodiles, birds, dolphins, fishes, etc. Non-charismatic or invertebrates animals viz. spongees, jellyfishes, helminths, earthworms, rotifers, insects, arachnids, molluscs, echinoderms, etc., are badly neglected in Bangladesh, as if they have no importance to the ecosystem. Statistics show that these neglected groups represent 77.19% of total explored organisms of the world followed by higher plants (14.49%), whereas the so called charismatic group of animals represent only 3.26%, almost close to fungi (2.91%). Most of the researchers, activists and media workers in Bangladesh are interested in this minor group (3.26%) of animals (charismatic). Almost 99% funding goes to this minor group related works. As a result we do not have any idea regarding the exact animal diversity and their status in the Sundarban as well as in Bangladesh. Local people think that ecosystem services provided by the different groups of invertebrates in the Sundarban are decreasing. Moreover, we do not have any national collection of voucher specimens of our recorded animals. Many authorities (!) in Bangladesh have published animal names from time to time, whose authentication or their further study cannot be done due to this problem. We have to be careful about the consequences of this as McGuinness (2001) mentioned it clearly, *"Invertebrates are extremely important components of the world's biota. They help maintain ecosystem functions through activities such as the cycling of nutrients, breaking down of pollutants, and production of soil. They are an important source of food for many animals and may also constitute a source of food for humans. Invertebrates are also vital to the fertilisation of a vast number of plants. In short, "without invertebrates, much of the life on earth today would cease to exist…."*

Accordingly, we have to do much research on these neglected groups of animals and funding opportunity should also be increased by the authorities towards these groups. In this connection establishment of a National Biodiversity Research Centre/Natural History Museum in Bangladesh is a crying need of the day. If we really mean to conserve our natural resources, we must have to change our attitudes of neglecting

small and minute animals, i.e. invertebrates that constitute the lion share and integral part of the biota.

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