Habitat Management Plan and Conservation of Threaten WaterBirds in Sonadia Island

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INTRODUCTION

Sonadia Island is located in south eastern Bangladesh, north-west of Cox's Bazaar. Island was declared an Ecologically Critical Area (ECA) by the Government of Bangladesh in 1999 which includes Sonadia Island in its entirety and most of Ghotivanga Mouza in adjacent Moheshkhali Island. Around 4916 ha in area, the site is mostly government-owned land. In past, land use was limited due to the effects of natural disasters the recent conversion of mangrove and mudflats to shrimp farming and salt pans has had a large impact on the current state of the site. The local community of around 1176 people is highly dependent on the natural resources of the site including agriculture, shrimp fry collection and fishing. Literacy rate is only 12.3%. (National Population Survey Report, 2011). There are no indigenous people in this Island. There is very little tourism or educational use of the site, however researchers have been attracted in small numbers mostly for mangrove, turtle and bird surveying. The site is rich in species despite its small size. The important habitats and communities at the site include mangrove, mudflats, beaches and sand dunes, canals and lagoons and marine habitat. The site supports the last remaining remnant of natural mangrove forest in south-east Bangladesh. The site lies on the East Asian Australasian and Central Asian Flyways and the mangrove and shallow shoals surrounding the island provide an excellent wintering area for migratory waterfowl and shorebirds, including three globally threatened species. The sandy beaches and sand dunes support one globally threatened marine turtle species. Other important species include Irrawaddy dolphin and crustacean species, a wild grass relative of rice, fishes and mollusks.

MIGRATORY BIRDS

A study on the status of waders and their habitat at Sonadia Island, Bangladesh with special emphasis on Globally Threatened species: Spoon-billed Sandpiper, Nordmann's Greenshank and Great Knot were conducted at Sonadia Island under Moheshkhali upazilla of Cox's Bazar district between October 2014 and May 2015. The research was conducted under the project *'Habitat Management Plan and Conservation Action for the Critically Endangered Spoon-billed Sandpiper at its Wintering Ground at Sonadia Island, Bangladesh'* implemented by Bangladesh Forest Department under the financial support of World Bank.

Spoon-billed Sandpiper was first sighted on October 2014 at Taziakata and was only one individual. The number peaked in February 2015 at Kaladia, when it was, at least, a total of 20 individuals. First Nordmann's Greenshank sighting was also on October 2014, 2 individuals at Taziakata and 1 in Kaladia, and peaked with 12 individuals in February 2015 at Kaladia. First Great Knot sighting was in December 2014 with 2 individuals at Taziakata, 3 individuals at Balakerdia and 4 individuals at Kaladia. Peak sighting was in February 2015 at Kaladia with 12 individuals. A total of 30 different species of waders was recorded during our study period. The highest number of birds was recorded in March at Kaladia with around 3600 individuals under 2 families: 5 species under family Charadriidae, 25 species under family Scolopacidae. On 15 December 2014, an adult Spoon-billed Sandpiper with a lime-green flag on its left tibia engraved '09' has been spotted for the first time at Balakerdia and this is the first record for Bangladesh.

Spoon-bill Sandpiper
Calidri spygmaea
Critically Endangered

Nordmann's Greenshank
Tringa guttifer
Endangered

Great Knot
Calidris tenuirostris
Vulnerable

Taziakata and Kaladia are known to be the feeding grounds for the waders while the nearby Moghchar and Balakerdia are the roosting grounds respectively. Feeding ground Taziakata present beside roosting ground Moghchar and feeding ground Kaladia present beside the roosting ground Belekardia. Roosting grounds are comparatively highland then the feeding grounds.

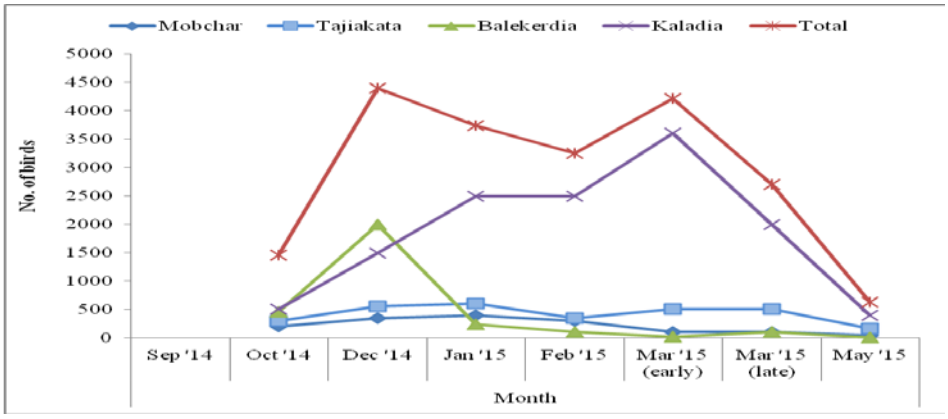


Fig. Individuals of threatened species sighted in different months in different study sites

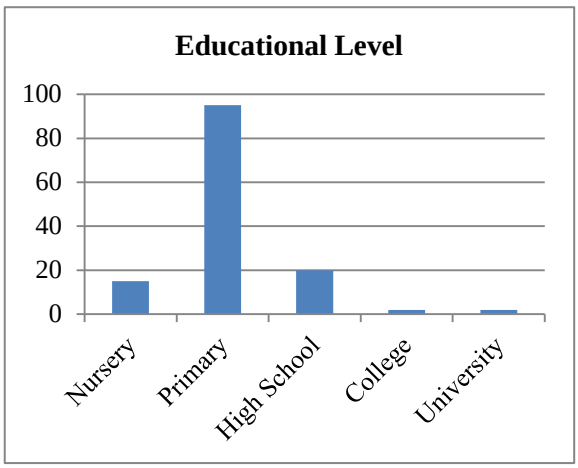
Sl	Month	Number of Individuals sighted			Sighted at*
		Spoon-billed Sandpiper	Nordmann's Greenshank	Great Knot	
1	October 2014	1	3	0	T,K
2	December 2014	10	12	9	T,B,K
3	January 2015	13	12	14	T,B,K
4	February 2015	20	17	12	T,K
5	March 2015 (Survey 1)	9	8	11	T,K
6	March 2015 (Survey 2)	11	5	13	T,K
7	May 2015	3	0	3	k

* M= Moghchar, T= Taziakata, B= Balakerdia and K= Kaladia

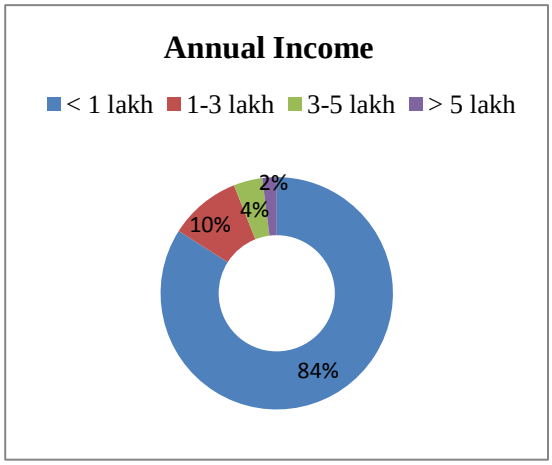
Map: Feeding and roosting ground of migratory birds

SOCIO-ECONOMIC SCENARIO

The local community of around 1176 people is highly dependent on the natural resources of the site including agriculture, shrimp fry collection and fishing. Literacy rate is only 12.3% (National Population Survey Report, 2011). There are no indigenous people in this Island. Majority percent people are underprivileged and do not have enough fascination about education.



Educational level of local people of the Island



Average annual income of family

The stakeholders are involved in mostly fishing, agriculture, and working in the salt pan. Some people are also driving speed boat, rearing livestock, doing some small business, working in the trawler and causal labor.

Profession	*Percentage (%)*
Fisherman	40
Speed boat driver	4
Agriculture	16
Livestock rearing	16
Small business	6
Working salt farm	36
Kobiraj (Village doctor)	2
Private job	2
Working in Trawler	13
Causal labor	5

Most of the stakeholders are depended on forest resources for their accommodation facilities. They build house by wood, bamboos, leaves, sun grass, mud, plastic etc. Now a day's few cemented and tin shed house can be seen.

House made by	Wooden	Mud	Cemented	Fence	Tin-shed
Percentage (%)	28	40	8	20	4

VEGETATION ANALYSIS ALONG MUDFLAT HABITATS

Plant biodiversity is a crucial part of the coastal biodiversity. Floristic inventory and diversity assessments are a prior requirement to understand the present diversity status and conservation of plant biodiversity. The Global Biodiversity Strategy was set off for understanding and evaluating biodiversity (Miller et al., 1999). As a signatory member of the Convention on Biological Diversity (CBD), the Ministry of Environment and Forests (MoEF) has given emphasis on the co-management and management of biodiversity as well as plant biodiversity in Bangladesh.

Mangroves are the dominant vegetation in Sonadia Island. The distribution of mangroves is largely on the inland part of the site with a very narrow distribution in the intertidal areas on the edge of the estuary. The total area of mangroves was 1300 ha. long before (POUSH, 2006a). However, the present land use practice posses a great threat to the sustainability of mangroves. Some of anthropogenic activities including conversion of mangrove forest to shrimp farm and salt pan, illegal logging, and buffalo grazing results in a detrimental effect on the vegetation health and diversity. Consequently, the present total mangrove area is about 500 ha (POUSH, 2006a). In order to recover the loss of mangrove forest, the Forest Department (Coastal) afforested 410 ha of mangrove along the existing intertidal zone at the site between 1979 and 2005 (CMWBP, 2006). The Bangladesh Forest Department has initiated a mangrove afforestation programme along the coastal embankments since 1966, which is considered to be the world's biggest mangrove plantation effort across the world (Saenger and Siddiqi, 1993). The core objectives of this initiative involve to the protection of the residents of shoreline and their property against natural disaster. In South-East Asia, many countries have taken the afforestation programme in mudflat habitat with varying objectives (Erftemeijer and Lewis, 1999). Having the benefit of afforestation programme, it is, however, considered as a threat to a mudflat ecosystem, especially to Island ecosystem. Mangrove plantation leads to stabilize the soil and, thereby, alter the mudflat habitat to another. According to Custodio (1996), habitat alternation is the most important threat to shorebirds. Therefore, the efforts of

mangrove plantation on mudflat remain questionable on ecological point of view.

The phytosociological studies of these sites were carried out between November 2014 and March 2015. The vegetation survey was conducted along intertidal mudflats using the quadrate method. All the locations of sampling plots were recorded using a Global Positioning System (GPS). A total of 60 quadrate plots were placed along mudflats for conducting vegetation survey. 10 quadrates (10m x 10m) were randomly placed at each site for the purpose of studying trees (> 2.5 cm in diameter). Trees were counted in each quadrate. The height of stands and diameter at 1.3 m above ground (D_{130}) were measured. Five sub-quadrates (1m x 1m) were also placed inside (10m x 10m) quadrate plot for the purpose of studying herbaceous and grass species. Visual estimation of cover (%) for herbaceous and grass species was recorded from each sub-quadrate. In doing visual estimation, the space inside the sub-quadrate was taken as 100 percent and the cover of each plant of each species within the frame was mentally aggregated into a single percentage value for that species. The total area of all species and bare soil were equated to one hundred percent. Samplings with circumference breast height <10 cm (Pande et al., 1988) were also counted in each sub-quadrate for the purpose of studying the regeneration status.

Mangroves on mudflats in the Sonadia Island are not natural rather plantation. During the study six mudflat habitats were investigated and found that all the sites except Tajiakata had tree stands consisting of three mangrove species. However, the sites were mainly dominated by either *Avicennia alba* or *Avicennia marina*. Sonadia Purbapara and Kaladia were dominated by *A. marina*, while *A. alba* was the dominant species in Mogchar, Sonadia Paschimpara, and Belekardia. Another mangrove species *Aegialitis rotundifolia* was the least abundant species at all the sites. The dominance pattern of species such as *A. alba* > *A. marina* > *Aegialitis rotundifolia* and *A. marina* > *A. alba* > *Aegialitis rotundifolia* might be resulted from the selection of one or two species for mangrove plantation in these sites. It was clear that Sonadia Paschimpara had the more developed forest structural than the other sites. Disturbances might inhibit the recruitment of new cohorts into the Sonadia Paschimpara forest despite this site had a high sapling density. The PCA based result also supported this reason showing Sonadia Paschimpara was the most disturbed localities amongst the studied sites. Whereas, another disturbed area Sonadia Purbapara also contained young forest stands with the lower basal area. Disturbances were caused due to local people residing near these two sites. On the contrary, less disturbed areas, namely Mogchar, Belekerdia and Kaladia contained a consistently developing forest structure. Among them, forest stands in Belekerdia showed high stem and sapling density, enhancing a structural development towards a mature forest stands. Kaladia also had a developed forest structure with a low stem density, while Mogchar contained comparatively young forest with low Complexity Index (CI) value but high stem density. On the basis of the structural development of forest stands, it can be presumed that mangroves could promote accretion of mudflats. Because, adventitious roots of mangroves slow tidal flows and encourage sediment deposition (Pidgeon 1940; Chapman 1974). Presence of saplings into a non-planted site (Tajiakata) indicated the dispersal and establishment ability of mangrove species across the Island. Additionally, saplings of *Avicennia officinalis* provided an insight of their dispersal ability over longer distance. On the floor of mudflat, high canopy of halophytic wild rice *Porteresia coarcata* found in Tajiakata. Also, one herb species, e.g. *Sesuvium portulacastrum* found in Kaladia and Belekerdia that might promote survival and growth of mangrove seedlings through an improving physiochemical condition. Consequently, the prolific spread of this grass and herbaceous species might ameliorate the quality of the mudflats so that mangrove seedlings could easily able to trap and establish themselves in the sites.

Sites	Species	Abundance	Density (Relative value)	Frequency (Relative value)	Basal area (Relative value, m^2/ ha.)	IVI (300)	Mean height (m)	Complexity Index
Tajiakata	*No tree stands*	0	0	0	0	0	0	0
Mogchar	*Avicennia alba*	38.4	38.4 (88)	1.0 (59)	0.13 (56)	203	1.7	0.04
	A. marina	7.1	5.0 (12)	0.7(41)	0.11(44)	97		
	Total	**45.5**	**43.4(100)**	**1.7 (100)**	**0.24 (100)**	**300**		
Sonadia Purbapara	*A. alba*	4.3	3.9 (19)	0.9 (47)	0.0026 (34)	100	1.7	0.08
	A. marina	18.4	16.6 (80)	0.9 (47)	0.0039 (52)	180		
	Aegialitis rotundifolia	2.0	0.2	0.1	0.0010	20		
	Total	**24.8**	**20.7 (100)**	**1.9 (100)**	**0.75 (100)**	**300**		
Sonadia Paschimpara	*A. alba*	27.0	27.0 (84)	1.0 (48)	0.0280 (52)	183	4.2	2.2
	A. marina	4.9	4.9 (15)	1.0 (48)	0.0090 (17)	80		
	A. rotundifolia	3.0	0.3(1)	0.1 (5)	0.0170 (31)	37		
	Total	**34.9**	**32.2 (100)**	**2.1 (100)**	**5.39 (100)**	**300**		
Belekerdia	*A. alba*	56.8	56.8 (77.9)	1.0 (48)	0.0096 (67)	193	2.5	0.76
	A. marina	15.9	15.9 (21.8)	1.0 (48)	0.0042 (30)	99		
	A. rotundifolia	2.0	0.2 (0.3)	0.1(5)	0.0004(3)	8		
	Total	**74.7**	**72.9 (100)**	**2.1 (100)**	**1.42 (100)**	**300**		
Kaladia	*A. alba*	4.4	4.0(15)	0.9(45)	0.132 (60)	120	2.8	0.48
	A. marina	21.7	21.7 (83)	1.0 (49)	0.54 (25)	158		
	A. rotundifolia	3.0	0.3 (1)	0.1(6)	0.33 (15)	22		
	Total	**29.14**	**26 (100)**	**2.01 (100)**	**2.19 (100)**	**300**		

Table: Absolute and relative abundance, frequency and density of mangrove species (tree stands) in six mudflat habitats. Relative values are expressed as %.

DISTURBED AREAS

The first two axes of the PCA explained 89.6% of the variation (75.9% by first axis and 13.8% by the second axis. The PCA results showed a clear grouping of sites between disturbed and undisturbed sites. Most of the sites in Tajiakata, Mogchar, Belekerdia and Kaladia were positively related to the undisturbed sites. However, most of the sites in Sonadia Purbapara and Sonadia Paschimpara were grouped in the disturbed sites arising from the activities of human, cattle and birds. Disturbance caused by cattle mainly occurred at the sites of Sonadia Purbapara. Human presence and bird droppings that caused habitat disturbances were mostly identified at Sonadia Purbapara.

Map: Human Disturb Area

PHYSIOCHEMICAL PROPERTIES OF WATER

The maximum P^H value of 7.8 was measured and the minimum P^H value (7.3) was recorded in Sonadia Purbapara and Sonadia Paschimpara respectively. Salinity ranged from 30.3 – 34.0. Water from Sonadia Paschimpara had maximum salinity (34 ppm) while both Sonadia Purbapara and Kaladia had the minimum water salinity of 30.3. Likewise salinity, Sonadia Paschimpara had the highest electrical conductivity of 40.4 $mScm^{-1}$ in water. Total Na and K content ranged from 13.4 – 24.6 mgL^{-1} and 6.1 – 10.2 mgL^{-1} respectively (Table 9). According to the repeated ANOVA result, there was a significance difference ($F=9.07$, $P<0.05$) between sites for all variables derived from water samples.

Parameters / Sites	P^H	Salinity (ppm)	Conductivity ($mS\ cm^{-1}$)	Na (mgL^{-1})	K (mgL^{-1})
Tajiakata	7.8	31.3	39.1	18.9	10.2
Mogchar	7.6	31.3	38.4	13.4	8.3
Sonadia Purbapara	7.3	30.3	39.3	24.6	9.1
Sonadia Paschimpara	7.3	34.0	40.4	17.7	6.1
Belekerdia	7.4	31.3	38.6	19.5	8.9
Kaladia	7.6	30.3	38.1	24.8	9.1

Table. Mean value of five parameters of water from six sites

PHYSIOCHEMICAL PROPERTIES OF SOIL

Soil P^H varied from 6.5 to 7.30 in which P^H value was higher in Belekerdia amounting 7.30 in both soil layers. Salinity was very low in six sites ranging from 0-2. Soil collected from Sonadia Purbapara showed high electrical conductivity of 3.6$mScm^{-1}$ in the upper layer and low conductivity was 1.47 $mScm^{-1}$ in the lower layer of soil in Belekerdia. Mogchar contained a high amount of moisture content (8gm) in soil. However, this site contained a low amount of organic carbon (%) and organic matter (%) representing 0.02% and 0.03% respectively. Unlike Mogchar, soil collected from Sonadia Paschimpara contained a low amount of moisture content (6.16gm) but high amounts of organic carbon (0.53%) and organic matter (0.91%). Sonadia Paschimpara also had a maximum amount of Na (32.75 mgL^{-1}) and K (35.91 mgL^{-1}) in the lower layer of soils. While an upper layer of soil from Mogchar contained a minimum level of Na

(22.60 mgL^{-1}). In Kaladia, upper layer of soil contained the minimum amount of Ca but the maximum amount of Mg amounting 1.04 mgL^{-1} and 1.75mgL^{-1}. While maximum amount of Ca (3.92 mgL^{-1}) and minimum amount of Mg (0.06 mgL^{-1}) measured in the upper layer of soils in Mogchar. Four trace elements, namely Fe, Mn, Zn and Pb were analyzed in which only lower layer of soil in Tajiakata and the upper layer of soil in Kaladia contained the maximum amount of Fe (1.95 mgL^{-1}) and minimum amount of Zn (0.10 mgL^{-1}) respectively. Whereas the maximum amount of other trace metal Mn (1.07 mgL^{-1}) in Kaladia and both Pb (0.78 mgL^{-1}) and Zn (0.84mgL^{-1}) were found in Sonadia Paschimpara. Below detection level of Pb, along with the minimum level of Mn (0.26 mgL^{-1}) was obtained from the lower layer of soil in Mogchar. The ANOVA result showed that there was significant variation amongst soil parameters (F=378.265, p=0.05) but no significant variation was obtained between upper and lower layers in the amount of soil variables.

Parameters \ Sites	Tajiakata		Mogchar		Sonadia Purbapara		Sonadia Paschimpara		Belekerdia		Kaladia	
	UL	LL	UL	LL	UL	LL	UL	LL	UL	LL	UL	LL
P^H	6.90	6.70	6.80	6.50	6.70	6.70	7.30	7.10	7.30	7.30	7.10	6.90
Salinity (ppm)	0.00	1.00	0.00	0.00	2.00	2.00	1.00	1.00	0.00	0.00	1.00	0.00
Conductivity ($mScm^{-1}$)	1.82	1.85	1.56	2.15	3.60	3.60	1.68	2.48	1.90	1.47	2.17	2.09
Moisture content (gm)	7.68	7.03	8.00	7.77	6.55	6.48	2.48	6.16	7.93	7.72	7.96	8.07
% Organic C	0.05	0.09	0.02	0.09	0.11	0.12	0.04	0.53	0.04	0.02	0.02	0.16
% OM	0.09	0.15	0.03	0.15	0.18	0.21	0.06	0.91	0.06	0.03	0.03	0.27
Na (mgL^{-1})	23.99	28.14	22.60	26.29	27.22	23.53	24.45	32.75	27.68	26.76	27.22	27.68
K (mgL^{-1})	20.91	26.36	19.55	21.82	20.45	26.82	28.18	35.91	27.73	28.18	25.45	25.45
Ca (mgL^{-1})	2.85	1.43	3.92	2.63	2.01	1.28	1.79	1.52	2.24	3.13	1.04	1.77
Mg (mgL^{-1})	0.67	0.87	0.60	0.71	0.57	0.75	1.07	1.47	0.91	1.22	1.75	1.10
Fe (mgL^{-1})	1.87	1.95	1.18	1.26	1.15	1.10	0.81	2.55	2.12	2.11	1.92	1.72
Mn (mg/L^{-1})	0.34	0.49	0.31	0.26	0.30	0.42	0.72	0.78	0.31	0.44	1.07	0.26
Pb (mg/L^{-1})	0.54	0.20	0.49	BDL	0.45	0.23	0.78	0.49	0.63	0.39	0.60	0.45
Zn (mg/L^{-1})	0.18	0.18	0.14	0.12	0.20	0.25	0.84	0.77	0.48	0.61	0.10	0.35

Table: Physiochemical properties of soil from six sites. UL and LL represents upper layer and lower layer respectively. BDL = Below Detection Level.

THREATS AND POSSIBLE MEASURES FOR THE PROTECTION OF WADERS AND HABITAT IN SONADIA

IUCN has defined the conservation as the management of human use of the Biosphere so that it may yield the greatest sustainable benefit to present Generations while maintaining its potential to meet the needs and aspiration of Future generations. It's not only a subject of biology. The subject conservation economics, sociology, entomology, archaeology biology, math, physical science etc. so that for conservation issues of a species must cover the Knowledge of all surroundings of the species The world's present million or so species are the modem-day survivors of an estimated several billion species that have ever existed. While species extinction's have occurred periodically in the geological record the present rate of loss of the world's biological diversity is at its greatest since life began (Wilson, 1988).

PROBLEMS AND THREATS

A coastal belt is an ecotone. As it has various types of natural resources the use of this land is too high. The coastal land is one of an unlucky land with the high rate of its resource used. The survival problems of a species are net-linked. Shorebirds of the present study area are suffering from various problems. Some important points are noted here;

⌗ *Habitat loss*

Bangladesh is an over populated country. In the present social economic condition, to fulfill many wants our demos are intensely depending on her forest resources. Consequently, our forest resources are under a high pressure and it is declining day by day. Here it can be exposed that this condition is alive in Sonadia Island too. Random logging of coastline trees for fuel- wood or other purposes often responsible for habitat degradation of shorebirds as they usually take shelter on those trees during night fall. Localized conversion of intertidal habitats to saltpans, shrimp-ponds and unplanned mangrove plantation additively impact large areas of Bangladesh's coastline. The extent to which these processes affect habitats is dependent on the overall rate of conversion in one of the fastest accreting systems on earth. If conversion is slower than mud/sand flat creation the impact on shorebirds is likely to be minimal, particularly if shorebirds are adapted to move between these ephemeral habitats as areas are rendered unsuitable by succession and others become available. However, if rates of conversion are faster than accretion of new habitat, then conversion may represent a threat within Bangladesh.

⌗ *Trapping, capturing and hunting*

Trapping, capturing and hunting is one of the major threats to shorebirds. Sometimes localities used to hunt shorebirds for their delicacy or any recreational purpose. A recent shorebird hunting survey shows that about 30 bird trappers are active on Sonadia Island and a few of them claim to have captured Spoon-billed Sandpipers and other globally significant species (Chowdhury, 2010).

⌗ *Construction of deep sea port*

The status of a proposed deep-water port at Sonadia Island is still unclear (P. Thompson pers. comm. 2010). If constructed, it might have a severe impact on the value of the island for shorebirds and other wildlife.

⌗ *Food shortage*

Due to overfishing and vegetation extermination caused by geographical change and man-made factor shortage of food often occurred for the shorebirds.

⌗ *Human disturbance*

In the study area it was found that the people of the surrounding, especially the young men and boys were collecting the nest and eggs of birds. Sometimes they were patching and disturbing various kinds of birds as a fun. Moreover noise produced by mechanical boat disturbs the shorebirds.

⌗ *Oil spill*

Oil pollution is also affecting the environment of the Sonadia. Crude oil slicks delivered from the mechanical boats, trawlers passing through the mangrove plantation areas and the oil spills from the

shipwreck yard of adjacent Chittagong coast affect considerable part of the coastal plantations (Canonized, 1998). More over the oil pollution creates a big problem upon the aquatic wildlife e.g. frogs, turtles, waders, dolphin etc., Of the Sonadia Coastal area by diminishing them in number. The decreasing of the fish resources makes the migratory shore birds unwilling to stay there. So the number of the migratory birds is decreasing day by day.

- ***Lack of awareness and literacy***

In the present study area only 12.3 % (National population survey report, 2011) people are literate. The illiterate people have no idea about the importance of wildlife. As a result they frequently get involved with the unwanted deed which may ring hamper for the wildlife and the shorebirds as well.

- ***Poverty***

For the conservation of wildlife species capital is one of the paramount problems. In coastal areas people have to earn money their existence in any way, either it be helpful for nature or not. Their poor economic condition is the sole reason of it. During the study period, there the conflict between the forest officials and local people was usual.

- ***Sea level rise***

Nowadays it is proved that due to the large scale deforestation all over the world, the global climate is changing very fast. If this changing is not protected immediately, global worming as well as greenhouse effect, excessive rainfall, and drought will be brought out in future. According to the scientist, under the global warming and greenhouse effect like many other coastal areas of Bangladesh Sonadia coastal area will go under water completely. Consequently the present existence of the animals of that area will be extinct and then, their conservation will be hampered.

CONSERVATION INITIATIVES

To motivate stakeholders and policy makers towards the species and habitat conservation with their sturdy involvement some conservation initiatives have taken already by the Bangladesh Forest Department.

- **Bird Protection Committee (BPC)**

A voluntary bird protection team has been formed in consist of 06 members. Team members have been chosen on the basis of migratory birds feeding and roosting sites.

- **Conservation Education, Awareness Program and AIG Support**

For long term sustainability Bangladesh Forest Department has taken initiatives under the SRCWP project funded by the World Bank to motivate and direct involvement of stakeholders towards species and habitat conservation respectively in Sonadia East Para, Soandia West Para, Tajiakata, Ghotivanga, Borodia and Moheshkhali. School campaign and awareness program is going on. 90 multi-disciplinary stakeholders received AIG training.

Habitat and Species Conservation Management Plan

A management plan preparation is going on under the SRCWP project with the help of local support groups, for long term conservation of Spoon-billed Sandpiper in Bangladesh with active participation of local people for bird protection and its habitat conservation.

RECOMMENDATIONS

- Mudflat is the core feeding and roosting ground for the birds. In this regard, mudflats should keep free from plantation and natural regeneration. Plantation can be done only in the sand dune.
- The study site can be designated as Ramsar site as it fulfils all the criterions.
- An educational awareness centre can be established to creation educational awareness among the people about the value of wildlife is a vital issue in this aspect.
- Government and non-government organization should increase the public awareness about the conservation of the wildlife species through film show, newspaper, radio, television and publicity, leaflet and meeting.
- More environment impact assessment should be carried out in collaboration with the Forest Department before constructing deep sea port.
- Enforcement of Wildlife (Conservation and Security) Act, 2012 inside the area thus ending the illegal habitat destruction and killing, capturing, trapping and disturbing.

CONCLUSION

The main threats to biodiversity at the site include sand dune vegetation for fuel wood, the degradation of mangrove and sand dunes habitats due to grazing, the conversion of mangrove and mudflat habitat to agriculture, aquaculture and salt pans, destructive fishing methods including shrimp fry collection, hunting of shorebirds and eggs, illegal settlement and pollution and land degradation from boat discharges. This pressure is further exacerbated by a lack of legally instituted protection measures for ECAs, field-level management that is only in the initial stages, limited meaningful participation by local communities in resource-use decision making, limited information on the status and functioning of critical ecosystems, no integrated management planning for ECAs, limited opportunities for alternative sustainable livelihoods, a lack of alternative sources of fuel wood and fodder, limited public awareness of environmental issues, a lack of technical knowledge and capacity, poor enforcement of fisheries and wildlife protection acts and a lack of integrated coastal zone management.

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