

Environmental Monitoring Report

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**Emergency Assistance Project
Ecological Assessment Report**

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ASIAN DEVELOPMENT BANK

ECOLOGICAL ASSESSMENT OF SOME SELECTED SITES IN UKHIYA AND TEKNAF, COX'S BAZAR, BANGLADESH

FINAL REPORT



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Acronyms

ADB – Asian Development Bank
BDT – Bangladesh Taka
CBD – Convention on Biological Diversity
DO – Dissolved Oxygen
DPHE – Department of Public Health Engineering
ECA – Ecologically Critical Area
FAO – Food and Agriculture Organization
IEE – Initial Environmental Examination
LGED – Local Government Engineering Department
RHD – Roads and Highways Department
IUCN – International Union for Conservation of Nature
NGO – Non-Governmental Organization
sp. – Species
SPS – Safeguard Policy Statement
TDS – Total Dissolved Solid
UNDP – United Nations Development Programme
UNHCR – United Nations High Commissioner for Refugees
USD – United States Dollars

All photos were taken by the author during the survey in Cox's Bazar (except microscopic photos of planktons). Front cover photo: Waterbody in Whykong, Cox's Bazar, which will be developed to supply water to Unchiprang Rohingya Camp.

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Executive Summary

Bangladesh is committed to conserve biodiversity, so the country is working with the development partners like the Asian Development Bank (ADB) to ensure the conservation and sustainable use of biodiversity. For the last few decades Bangladesh is sheltering huge number of displaced persons, known as Rohingyas, from the neighbouring Myanmar, causing severe ecological degradation across the region. According to Bangladesh Forest Department, a total of 6,163 acres of forest has been damaged due to the settlement of displaced persons and the affected areas include three major protected areas. The globally threatened flagship species Asian Elephant (*Elephas maximus*) population of the region has been fragmented and their natural habitats have been severely damaged. Today a total of 909,868 individuals of displaced persons are residing in several camps in Ukhiya and Teknaf under Cox's Bazar District. As a development partner of Bangladesh the ADB is supporting the Government of Bangladesh in addressing the urgent needs of the displaced persons from Myanmar. The ADB has approved the Emergency Assistance Project (Grant No. G0582) on 06 July 2018 for an amount of USD 100 million from the ADB's grant resources. The high-priority tasks to be taken under this project include improving the water supply and sanitation, and development of access roads within and surrounding areas of the camps, which have covered by this ecological assessment.

Considering the above-mentioned context it was necessary to conduct ecological assessment before the development works so as to ensure safeguards policy compliance in preparing and implementing safeguards frameworks and plans for the Emergency Assistance Project of ADB so that the impact can be minimized, threatened species of animals and plants can be protected, and the developments serve the purpose sustainably. The study was conducted in some selected sites in Ukhiya and Teknaf of Cox's Bazar during April-June 2019 and mainly three methods were followed in the field: i) transect survey, ii) circular plot survey, and iii) interview survey.

A total of 105 local adult persons were interviewed to know their perception regarding the relevant development activities under the Emergency Assistance Project and the overall ecological features of the region. Among the interviewees, a total of 55 (52%) were the local Bengali host communities and 50 (48%) were Rohingyas residing in Unchiprang and Nayapara Camps. Out of the total 105 interviewees, a total of 72 (69%) were men and 33 (31%) were women. It was found that Rohingyas are heavily dependant on wild plants for firewood, but the host communities is heavily dependant on wild plants for building materials. This is because more than 60% of the Rohingyas depend on firewood, whereas the host communities mainly use gas (cylinder), kerosene and electricity. Thankfully, the dependency of both on wildlife was found low. Majority of Rohingyas have no idea about the existence of legally designated protected areas and ecologically critical areas in their vicinity, but majority respondents of the Bengali host communities poorly knew about these.

The Rohingyas were asked about their source of drinking water and the amount of drinking water required per family per day. The response was that they entirely depend on the pump or supply of water provided by the camp managing authorities or NGOs. About 15 litres of drinking water is required per family per day. All respondents very strongly said that the water supply development will be extremely useful since the current water supply is insufficient and they always stand on the queue to get water from the limited supply. The Bengali host communities along the roads to be developed were interviewed to know their perception about those. All except one respondent said that the road development will be very useful, because it will ensure easy movement and transportation, and will boost up the local economy. Only one respondent opposed the road development through the forested area, because he thinks the road development will speed up the deforestation, which is a big problem for the entire region.

The Government declared three protected areas along the hill range of Ukhiya-Teknaf, are the areas relatively rich in biodiversity. The total area covered by three protected areas is 20,425.71 ha (Himchari National Park – 1,729.00 ha, Sheikh Jamal Inani Wildlife Sanctuary – 7,082.14 ha and Teknaf Wildlife Sanctuary – 11,614.57 ha). All three protected areas were visited during the survey and based on the condition of vegetation cover and presence of wildlife, particularly the Asian Elephant (*Elephas maximus*), the best remaining habitats were identified. Among four of the best remaining habitat patches, two are in the core areas of Himchari National Park and Sheikh Jamal Inani Wildlife Sanctuary, and the other two are in two ends of the elongated Teknaf Wildlife Sanctuary (Toynga Hill and Ne-Taung Hill areas).

Waterbody in Whykong

The waterbody in Whykong (also called Panirchhara) will be developed to supply water to Unchiprang Camp, which is 8.55 km away along the road (approx. 3.35 km LGED road, 3.45 km NH1 and 1.75 km camp road). This waterbody covers an area of about 75,000 sq m and it was found very rich in fauna and flora where a total of 130 (23 mammal, 78 bird, 16 reptile and 13 amphibian) species of vertebrate wildlife, 23 species of fish and 79 species of higher plants were recorded. The Asian Elephant (*Elephas maximus*) frequently visits the waterbody at night in order to drink and bathe. The water was found very rich in plankton content, indicating good quality of water. The phytoplankton content was found at 5,600 per litre and zooplankton content 266 per litre. A total of 11 species of phytoplankton and 2 species of zooplankton were recorded. The water quality test results show that the water is alkaline with moderate levels of dissolved oxygen (DO), total dissolved solid (TDS), free carbon dioxide, total alkalinity and total hardness. The water quality is good for humans and majority of other living organisms. This is probably because the catchment area around the waterbody is less degraded and the pollution level is low. A total of 8.55 km long supply line will be established to supply water from the waterbody up to Unchiprang Camp. The supply line route was surveyed and only some common species of animals and plants were recorded.

The development of waterbody in Whykong not only will ensure the water supply in Unchiprang Camp, but will also ensure water for the local host communities and the wildlife and plants of the surrounding areas. Therefore, there is no negative side, provided that the water level is properly maintained. The waterbody should be developed in a way so that minimum artificial structures are used and are restricted to any one side (e.g. dyke side), leaving other sides natural. Any structure must be durable and as low as possible so that the structure is less visible to elephants and other wildlife. Visible structures can be destroyed by elephants. The supply line should be placed underground with some markings on the surface. If the water pumps are to be installed, these must be set sufficiently far from the waterbodies so that these remain safe from elephants and there is no noise pollution in and around the waterbodies. Indigenous trees should be planted in the catchment areas and hills around the waterbody in order to sustain the natural water supply and water quality in the long-term. Rohingyas and host communities should not be allowed to enter the hilly areas around the camp in order to collect the firewood. Movements of elephants and other wildlife in and around the waterbody should be regularly monitored and adaptive measures should be taken as necessary.

Waterbody in Nayapara

The waterbody in Nayapara (also known as waterbody in Shalbagan) is situated just at the west side of Nayapara Camp, which will be developed to supply water to Nayapara Camp. This waterbody is much smaller (about 20,000 sq m) than that of Whykong and much poorer in terms of water quality and biodiversity. A total of 80 (17 mammal, 46 bird, 11 reptile and 6

amphibian) species of vertebrate wildlife and 54 species of higher plants were recorded in and around this waterbody. There was very little water in the waterbody during the survey, so no fish species was recorded. Water quality and natural water supply from catchment areas is poor in Nayapara due to poor vegetation cover in the catchment areas and hills. The visible pollution level, including water pollution, was high in and around the waterbody since it is situated just beside the camp. The water was found poor in plankton content, indicating poor quality of water. The phytoplankton content was found at 2,532 per litre and zooplankton content 200 per litre. A total of 6 species of phytoplankton and 2 species of zooplankton were recorded. The water quality test results show that the water is alkaline with low level of DO and high levels of TDS, free carbon dioxide, total alkalinity and total hardness. The water is of acceptable quality for humans and majority of other living organisms.

The development of waterbody in Nayapara has become very much necessary, mainly because the displaced Rohingyas living in Nayapara Camp use the water of this waterbody, but currently the waterbody does not have the capacity to hold enough water and sustainably provide sufficient water throughout the year. There is no negative side of the development of this waterbody, provided that the water level is properly maintained. Just like in the case of waterbody in Whykong, the waterbody should be developed in a way so that minimum artificial structures are used and are restricted to any one side (e.g. camp side), leaving other sides natural. Any structure must be durable and as low as possible so that the structure is less visible to elephants and other wildlife. Visible structures can be destroyed by elephants. If the water pumps are to be installed, these must be set sufficiently far from the waterbodies. Indigenous trees should be planted in the catchment areas and hills around the waterbody in order to sustain the natural water supply and water quality in the long-term. Rohingyas and host communities should not be allowed to enter the hilly areas around the camp in order to collect the firewood. Movements of elephants and other wildlife in and around the waterbody should be regularly monitored and adaptive measures should be taken as necessary. There are a few shanties of Rohingyas in the southwest side of the waterbody, which should be shifted to the east or north side of the waterbody in order to avoid elephant attacks. The waterbody will lure the elephants when there will be plenty of water. Moreover, strong awareness programme is necessary to stop pollution of the waterbody.

N.I. Chowdhury Road and Foliapara Primary School Road

Development of both N.I. Chowdhury Road (also called Ukhiya-Marine Drive Road) and Foliapara Primary School Road intend to improve the connectivity between Cox's Bazar-Teknaf Highway and Marine Drive. In the first phase a total of 2.51 km of N.I. Chowdhury Road, from Ukhiya proper up to South Foliapara will be developed by widening to 18 ft and turning fully metalled. Currently it is partly metalled and partly brick road. According to LGED office in Ukhiya, the road shall be further extended in the future (not during the ongoing phase) from South Foliapara to Painnasia to eventually link it with Marine Drive. Foliapara Primary School Road, on the other hand, can be considered as a branch of N.I. Chowdhury Road with a total length of 1.03 km. Since both N.I. Chowdhury Road and Foliapara Primary School Road are situated in the same area, the ecological aspects along the roads were studied combindly. A total of 120 (16 mammal, 81 bird, 16 reptile and 7 amphibian) species of vertebrate wildlife and 98 species of higher plants were recorded during the survey.

Both N.I. Chowdhury Road (first part) and Foliapara Primary School Road will benefit the Rohingyas and host communities, and will improve the local connectivity. Since the roads to be developed have passed through the village areas and there are already existing roads, there will be no notable conflict with the local ecosystems and biodiversity.

Palongkhali-Sepotkhali Road

The Palongkhali-Sepotkhali Road aims to be a link between Cox's Bazar-Teknaf Highway (Palongkhali proper) and Marine Drive (Sepotkhali). With a total length of 9.15 km, this road will be widened to 18 ft and will be fully metalled. Major part of this road will pass through the Government forestland under the jurisdiction of the Forest Department, but it will not pass through any protected area declared under the Wildlife Act. The road passed through relatively rich biodiversity area and a total of 253 (35 mammal, 164 bird, 37 reptile and 17 amphibian) species of vertebrate wildlife and 155 species of higher plants were recorded during the survey. Among the notable species, the Asian Elephant and Capped Langur (*Trachypithecus pileatus*) were the most important species since these are globally and nationally threatened species. Among the plants the most notable species were Wild Mango (*Mangifera sylvatica*) and Serpentina (*Rauvolfia serpentina*), which are nationally threatened species.

In general, the area was found quite degraded, but still supports a lot of species including the Asian Elephant. Major part of the road alignment passes through the forestland under the jurisdiction of the Forest Department. The local people very much expect the development of this road, which they think will contribute to the development of local transport, economy and lifestyle. Therefore, the road development issue should be discussed with the Forest Department and other stakeholders to get a complete picture of loss and gain, which can guide to the right decision. A smaller part of the road from Ukhiya proper up to Mocharkhola are already metalled or brick paved and passed through the village area, and has no notable ecological issue.

Cox's Bazar-Teknaf Highway (Unchiprang to Teknaf Shapla Chattar)

The reconstruction and broadening of Cox's Bazar-Teknaf Highway is already underway and the last package of it will cover from Unchiprang to Teknaf Shapla Chattar segment. Under this programme the damaged parts of the highway will be repaired and the highway will be broadened for 0.9 m on each side. After the influx of Rohingya refugees this highway has become very busy due to the movements of various kinds of vehicles including heavy vehicles like trucks and buses. The roadsides have a lot of old planted trees, particularly Siris Tree (*Albizia lebbek*). A total of 207 (30 mammal, 139 bird, 26 reptile and 12 amphibian) species of vertebrate wildlife and 148 species of higher plants were recorded during the survey. Among the notable species, the Asian Elephant was the most important species since it is a globally and nationally threatened species. Moreover, the nationally threatened Long-tailed Macaque (*Macaca fascicularis*), Hog Badger (*Arctonyx collaris*) and Indian Leaf Turtle (*Cyllemys gemeli*) occur in this area. No threatened species of plant was recorded.

Since the Cox's Bazar-Teknaf Highway is an existing highway, the reconstruction and broadening will have no major issue in terms of ecosystems and biodiversity. There are many old Siris Trees and some other trees along the road that will need to be logged, so it is suggested that new roadside plantation should be done soon after the completion of highway development work. No threatened species of plant was found along the roadsides, but the globally and nationally threatened Asian Elephant occasionally comes to the highway area. Considering the fact that the highway is virtually the lifeline of the region and has become ever more important to ensure smooth supply of relief in the Rohingya camps, the development should be done, but mitigation measures should be taken wherever necessary. The elephant corridors that pass through the highway should be demarcated with roadside signboards so that the vehicles can pass through the corridors more carefully.

1. INTRODUCTION

Bangladesh is committed to conserve biodiversity, which is reflected in the Clause 18A of the constitution of Bangladesh where it is mentioned: 'The State shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests and wildlife for the present and future citizens'. As a party to the Convention on Biological Diversity (CBD), Bangladesh is working with the development partners like the Asian Development Bank (ADB) to ensure the conservation and sustainable use of biodiversity. In order to protect the biodiversity, especially the wildlife, in the natural habitats, Bangladesh has a network of designated protected areas declared under the Wildlife (Conservation and Security) Act of 2012, and a network of ecologically critical areas (ECAs) declared under the Bangladesh Environment Conservation Act of 1995.

For the last few decades Bangladesh is sheltering huge number of displaced persons, known as Rohingya refugees, from the neighbouring Myanmar. The number has exacerbated since 2017 when a massive flow of displaced persons entered Bangladesh following the violence in Rakhine State of Myanmar. According to UNHCR (2019), today a total of 909,868 individuals of displaced persons are residing in several camps of Ukhiya and Teknaf, of which only 4% are registered and 96% are counted but not registered. About 80% of the current population had arrived between August and December of 2017 and 67% of them came from Maungdaw township of Rakhine State, Myanmar. Bangladesh gave them shelter on humanitarian ground and international communities provided their support so that the displaced persons can get shelter to save their lives.

As a development partner of Bangladesh the ADB is supporting the Government of Bangladesh in addressing the urgent needs of the displaced persons from Myanmar. The ADB has approved the Emergency Assistance Project (Grant No. G0582) on 06 July 2018 for an amount of USD 100 million from the ADB's grant resources. The project will support the social recovery and will have the outcome of improved living conditions and resilience of the displaced persons. The high-priority tasks to be taken under this project include basic infrastructure and essential services to address the humanitarian crisis within the camps of the displaced persons that include improving the water supply and sanitation, disaster risk management, sustainable energy supply, and access roads within and surrounding areas of the camps.

The displaced persons from Myanmar were sheltered in camps in Ukhiya and Teknaf of Cox's Bazar district, which is close to the border of Myanmar. The area used to be one of the most biodiverse and productive areas in Bangladesh, but the biodiversity and fragile ecosystems formed by the combination of hills, plains and coasts have been severely degraded due to the excessive pressure on resources. According to Bangladesh Forest Department, a total of 6,163 acres of forest (mainly the social forestry areas) have been damaged, worth of BDT 1,865 crore, due to the settlement of displaced persons (Bangladesh Forest Department comm., Daily

Prothom Alo, 21 March 2019; Daily New Age, 21 April 2019). The main reason of this loss is due to their requirement of 6,800 tons of firewood every month.

UNDP (2018) had forecasted the disappearance of 26,000 ha of forestland within the 10 km radius of the Rohingya camps in a year if the Rohingyas were not provided with alternative fuel for cooking. The study found out that Rohingyas used 6,800 tonnes of firewood per month collected from the surrounding forests and each family used about 60 culms of bamboo to build shanties. About 40 hills were cut for developing infrastructure since the beginning of the Rohingya influx in August 2017 and it was evident that after the construction of offices, roads and camps for Rohingyas the adjacent areas became hotter than before.

There are four major protected areas in Cox's Bazar declared under the Wildlife Act, viz. Teknaf Wildlife Sanctuary (area 11,614.57 ha, established in 2010), Sheikh Jamal Inani Wildlife Sanctuary (area 7,082.14 ha, established in 2019), Himchari National Park (area 1,729.00 ha, established in 1980) and Meda-Kacchapia National Park (area 395.92 ha, established in 2004). Moreover, there are three Ecologically Critical Areas (ECAs) in Cox's Bazar declared as such under the Bangladesh Environment Conservation Act, viz. Teknaf Peninsula sea beaches (area 10,465.00 ha, established in 1995), St. Martin's Island (area 590.00 ha, established in 1995) and Sonadia Island (area 4,916.00 ha, established in 1995). All these vital and sensitive areas are under threat, directly or indirectly, due to the excessive pressure of Rohingya refugees in the region, requiring a lot of housing, sanitation, water, fuel and transport facilities.

The globally threatened flagship species Asian Elephant (*Elephas maximus*) population of the region has been fragmented and their natural habitats have been severely damaged due to anthropogenic factors, exerted mostly by the Rohingya refugees. According to a survey conducted by IUCN-Bangladesh (2018), the current mean elephant number in five Forest Ranges in and around Kutupalong Camp is 38, which ranges from 31 to 45. Surveys and maps revealed that elephant movement was frequent along the north-western and western boarder of the Camp, specifically Camps 1, 3, 4, 17, 19 (currently not inhabited), 18, 20, 13, 14, 15, and 16. There are a number of points through which elephants could enter into the Camp, as the whole area is now barren due to high rate of deforestation. Such exposure to elephant interaction and elephant entry are expected to increase in the coming days. Mukul *et al.* (2019) mentioned that the extension of the old Kutupalong Camp has blocked the only corridor used by elephants as a migration route and trapped about 45 elephants in the western side of the camp, with 13 human casualties so far.

Considering the above-mentioned context it is necessary to conduct ecological assessment before the development works so as to ensure safeguards policy compliance in preparing and implementing safeguards frameworks and plans for the Emergency Assistance Project of ADB so that the impact can be minimized, threatened species of animals and plants (if any) can be protected or rehabilitated, and the developments serve the purpose sustainably. The detailed tasks of this consultancy include (but not limited to) the following –

- i) Identify and describe the appropriate methods for the baseline biodiversity study for initial review and approval by ADB.

- ii) Review the existing national and international literature required for understanding the local biodiversity, and biodiversity mitigation and enhancement for the proposed area to be covered by the study including maps.
- iii) Data collection from the field.
- iv) Provide baseline information on all terrestrial and aquatic ecosystems.
- v) Identify and map out the rich and fragile ecosystems, critical habitats, and areas with important species of flora and fauna, and map the possible impact areas of the project, together with the possible levels of impact.
- vi) Identify the types of habitat areas such as critical habitat, natural habitat or modified habitat, in accordance with ADB Safeguard Policy Statement (SPS).
- vii) Assess the nature and level of human dependency on ecological resources.
- viii) Classify the significance of all species of flora and fauna in the project area in accordance with the relevant local acts and policies as well as the IUCN Red List and clearly define whether the species are endemic, critically endangered, endangered or vulnerable globally.
- ix) Attend meetings with the Team Leader.
- x) Identify and propose necessary mitigation and biodiversity enhancement measures such as habitat enhancement based on consultation with the Forest Department officials.
- xi) Prepare an ecological assessment report for the proposed six sub-projects documenting the ecological assessment methods, findings, recommendations and proposed biodiversity enhancement measures.

2. STUDY AREA

The study was conducted in some selected sites Ukhiya and Teknaf Sub-districts (Upazillas) of Cox's Bazar District (Figures 1, 2 and 3; Tables 1 and 2). These two Sub-districts are situated in the far southeast of Bangladesh along the border with Myanmar. The Bay of Bengal is in the south and the bordering Naf River in the east. Cox's Bazar was named after Captain Hiram Cox who conquer the region in the British East India Company period and set up a market ('bazar') that is called the bazar of Cox's by civilians. Geographically, the district is located between 20°35' to 21°50' north latitudes and 91°23' to 92°10' east longitudes. The current Cox's Bazar District was formed in 1984. Earlier it was a part of Chittagong District. The total area of Cox's Bazar is 2,491.85 sq km, and is divided into eight Sub-districts, viz. Cox's Bazar Sadar, Moheskhali, Chakoria, Kutubdia, Ramu, Ukhiya, Teknaf and Pakua containing 71 Unions, 177 Mauzas and 989 Villages. The total human population of Cox's Bazar district is 22,89,990 (male 11,69,604 and female 11,20,386; sex ratio 104:100) with the average density of 919 per sq km and annual growth rate is 2.55%. The Literacy rate in Cox's Bazar is 39.30% (male 40.30% and female 38.20%), School attendance rate is 46.50% for 5 to 24 years age group. Average rainfall of the district is 3,378 mm and average moisture is 83%. The major rivers of Cox's Bazar are Naf, Matamuhari, Bakkhali, Reju, Maheshkhali channel and Kutubdia channel, and the major islands are Maheskhali, Kutubdia, Sonadia and Saint Martin's etc. The main economic activities include agriculture (rice, jute, coconut, betel nut, betel leaf, etc.), fishing, salt farming, poultry and tourism services.

The ecological assessment was conducted in some selected sites under Ukhiya Sub-districts, specifically on the possible impact areas of the following sub-projects supported by ADB –

- i) DPHE: Construction of pipe water systems for the camp in Unchiprang, Teknaf.
- ii) DPHE: Construction of pipe water systems including surface water treatment plants for the camp in Nayapara, Teknaf.
- iii) LGED: Upgradation of existing N.I. Chowdhury Road improving connection between Cox's Bazar-Teknaf Highway and Marine Drive, including construction of bridge/culverts, in Ukhiya.
- iv) LGED: Upgradation of existing Foliapara Primary School Road (a branch of N.I. Chowdhury Road) improving connection between Cox's Bazar-Teknaf Highway and Marine Drive, including construction of bridge/culverts, in Ukhiya.
- v) LGED: Upgradation of existing Palongkhali-Sepotkhali Road connecting Cox's Bazar-Teknaf Highway and Marine Drive, Ukhiya.
- vi) RHD: Reconstruction and widening of critical sections of Cox's Bazar-Teknaf Highway (Unchiprang to Teknaf Shapla Chattar) in Teknaf.

Table 1. Circular plots that were surveyed in Cox's Bazar.

Name of Circular Plot	Radius (m)	Area (sq m)	Coordinate of Centre Point
Whykong Waterbody (to supply water to Unchiprang Camp)	250	78,500	N 21.11820, E 092.16833
Nayapara Waterbody (to supply water to Nayapara Camp)	100	31,400	N 20.94907, E 092.25100

Table 2. Transects surveyed in Cox's Bazar.

Name of Transect	Authority	Present Status	Length (km)	Coordinate of Start Point	Coordinate of End Point
N.I. Chowdhury Road (1 st phase of connecting Cox's Bazar-Teknaf Highway with Marine Drive)	LGED	Narrow metalled road	2.51	N 21.24251, E 092.14078	N 21.22490, E 092.13512
Foliapara Primary School Road (connecting Cox's Bazar-Teknaf Highway with N.I. Chowdhury Road)	LGED	Narrow metalled and brick road	1.03	N 21.24044, E 092.14471	N 21.23882, E 092.13953
Palongkhali- Sepotkhali Road (connecting Cox's Bazar-Teknaf highway with Marine Drive)	LGED	Narrow metalled, brick and earthen road	9.15	N 21.14411, E 092.16062	N 21.10355, E 092.11314
Cox's Bazar-Teknaf Highway – Unchiprang to Teknaf Shapla Chattar (improvement of existing national highway)	RHD	Wide highway, locally damaged	28.76	N 21.09127, E 092.21262	N 20.86796, E 092.29816

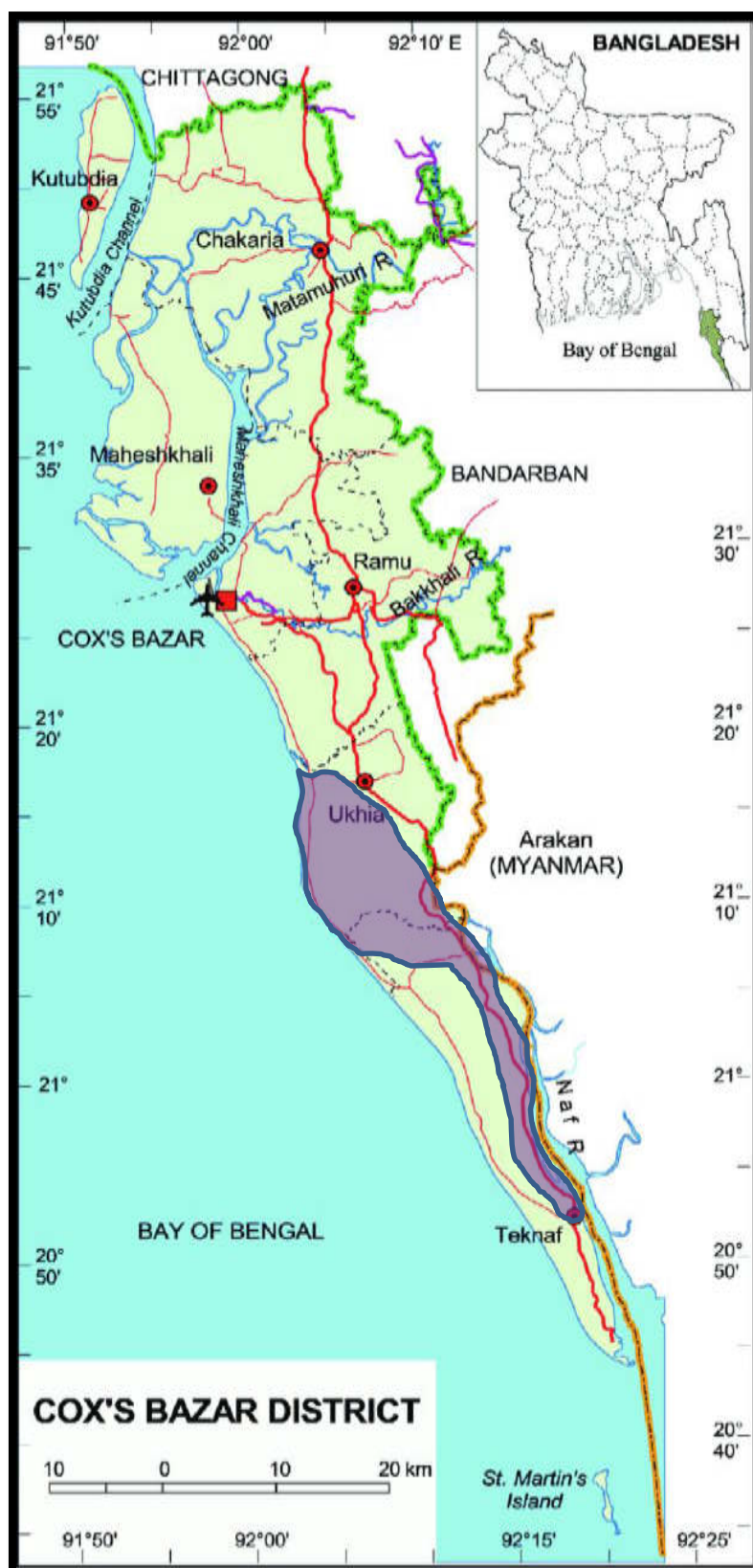


Figure 1. Cox's Bazar showing the study area or subproject influenced area (in purple shade) in Ukhia and Teknaf Sub-districts.

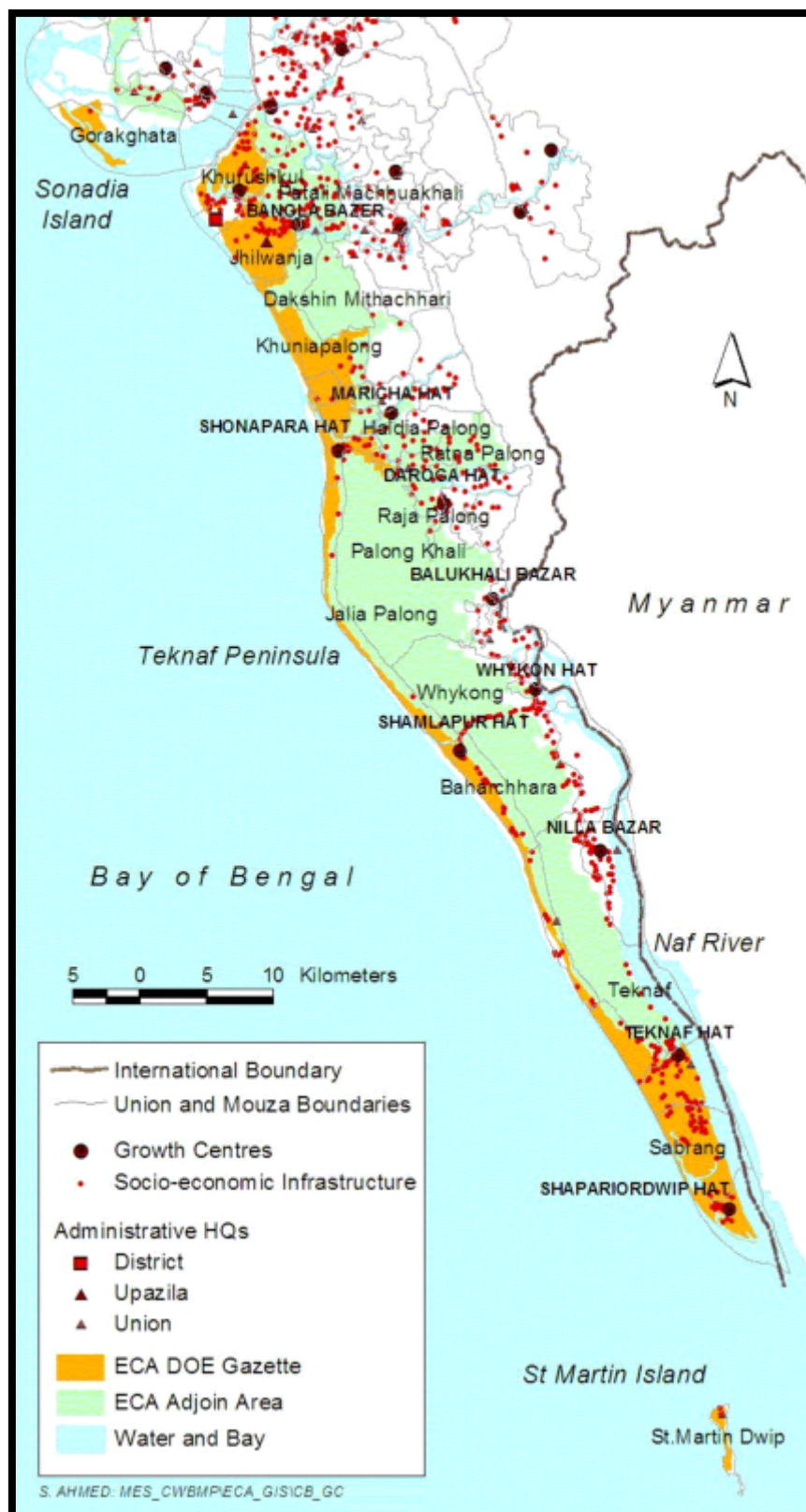


Figure 2. Cox's Bazar showing the Ecologically Critical Areas (ECAs) declared by the Government of Bangladesh.

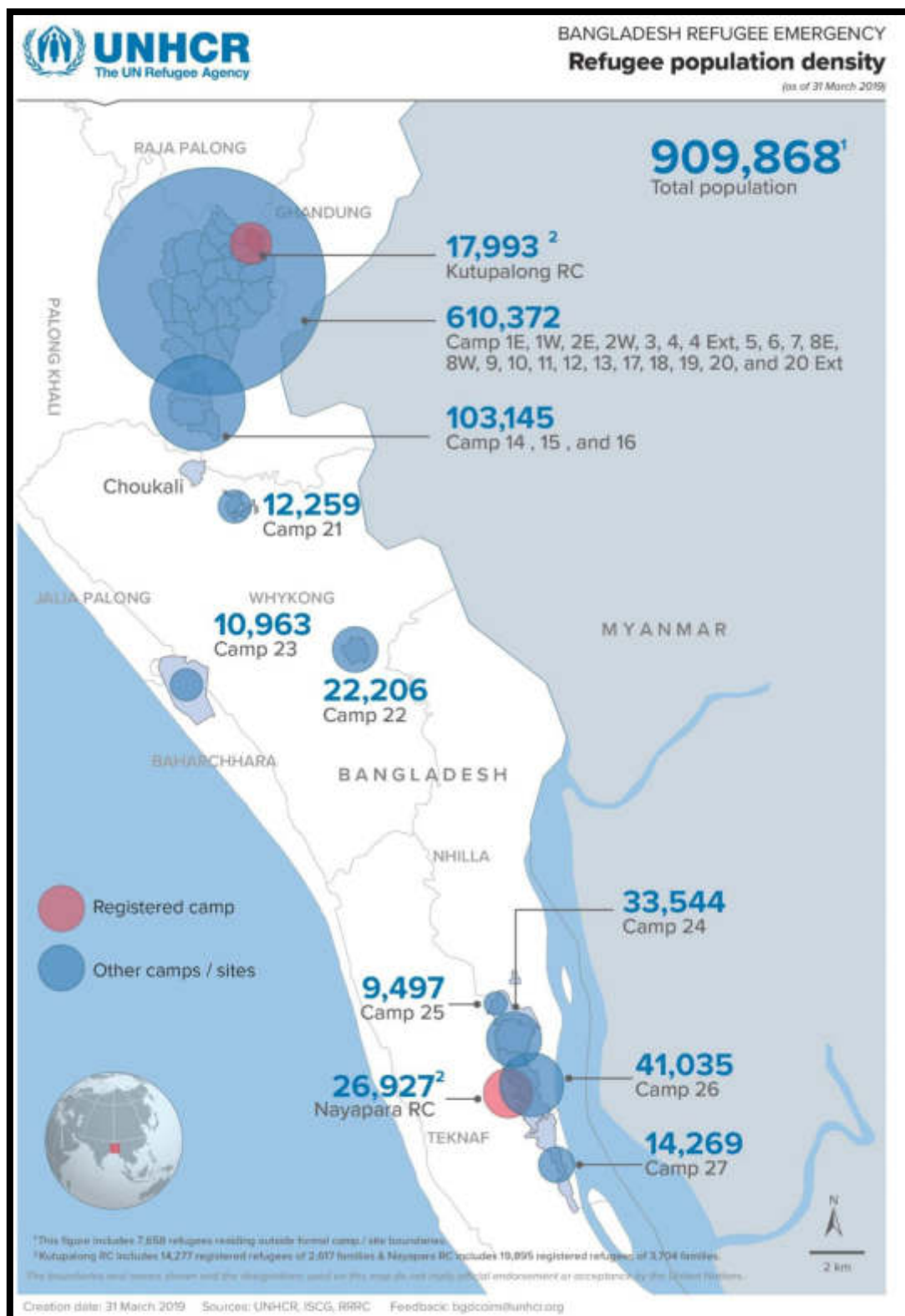


Figure 3. Ukhiya and Teknaf areas showing the locations of Rohingya refugee camps and human population sizes in different camps.

3. METHODS

The study was headed by the Consultant (Prof. M. Monirul H. Khan of the Department of Zoology, Jahangirnagar University) in collaboration with the relevant officials of ADB and the field assistants. Soon after settling the paper work of the consultancy, there was a meeting in ADB to plan for the fieldwork and arrange necessary logistics. All sorts of personal logistics were mobilized, which include laptop, SLR cameras with wide and telephoto lenses, binoculars and GPS. In the light of the consultancy documents, the fieldwork was done in two trips so that the work could be completed in time (Table 3). A total of three reports were submitted during the tenure of this study: Inception Report submitted on 20 April 2019, Draft Final Report (this report) submitted on 21 June 2019, and Final Report is this one submitted on 20 October 2019. Initially, the duration of the contract was from 17 April to 10 July 2019, which was extended.

Table 3. Graphical representation of the activity-wise implementation plan (green) and actual implementation (blue) of the project.

Activity	April 2019 Weeks				May 2019 Weeks				June 2019 Weeks				July 2019 Weeks			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Preparatory meeting with ADB																
INCEPTION REPORT SUBMISSION																
Field visit - 1																
Field visit - 2																
DRAFT FINAL REPORT SUBMISSION																

The methods for studying the ecosystems and human-ecosystem interactions must be scientific and standard enough to facilitate the repeatability. Thus the results will be with a known level of accuracy, precision and margins of error that can be quantified. All the methods followed in this study are scientifically valid, easy to follow, and have already been practiced successfully in some similar studies (Feeroz 2011, Khan and Aziz 2012, Khan *et al.* 2016). Therefore, the usefulness and acceptance of these methods are already proven. However, due to time and resource constraints and due to the fact that multiple data were collected during the same field visit, there was no way but to streamline the sampling effort. The data were recorded on pre-designed data sheets and note books, which were ultimately processed and analyzed in computers to draw the conclusion. All methods were replicable, so the findings will serve as the baseline for future monitoring. Mainly three were followed in the field: 1) transect survey, 2) circular plot survey, and 3) interview survey.

3.1 Transect Survey

Transect survey (Buckland *et al.* 2001) was followed for long and narrow study areas like the roads passing through all types of ecosystems (Appendix I). This survey is conducted along a path and the observer(s) record the occurrence of objects of interest, such as the species of study. Transects can be permanent (for long-term study) or temporary (for short-term study), can be repeated (not on the same day) or not, depending on the objectives and nature of the study. Considering the visibility of the study area a distance of 50 m on either side of the survey trail was covered. There are some areas in Ukhiya and Teknaf with high visibility, but the tree-covered areas have lower visibility. In transect sampling the observers slowly move (ca. 1.5 km/hr) along the trail through the study area and record the objects (e.g. animal and plant species) from both sides. The survey was conducted on foot during the mornings and afternoons when the climatic conditions were good and the wild animals remained most active. The Cox's Bazar-Teknaf Highway segment was a very long transect and could not be covered on foot, so the biodiversity rich areas were covered on foot and the rest were covered from a slowly driven microbus. All types of habitats were covered in transects in order to maximize the recording of species. Other than visual encounters and observation by binoculars, active search involving turning rocks and logs, and moving bush and leaf litter were conducted so that smaller animals (mainly amphibians and reptiles) and minor plants could be observed and recorded. Photographic documentation was made for important fauna and flora, and for the species that requires detailed study for identification.

3.2 Circular Plot Survey

Variable circular plot survey (Esselstyn *et al.* 2002, Gillison 2006) was followed for roughly rounded or irregular-shaped study areas like the waterbodies (Appendix II). This survey is conducted in circular plots of variable radii. If the objects are concentrated in different patchy locations it is suitable to go for variable circular plot survey. Since the waterbody in Whykong was larger than that of Nayapara, the radius of 250 m and 100 m from the centres were followed, respectively. Terrestrial animals depend on vegetation and water for survival, so for most multi-taxa inventories it is

logical to regard the vegetation plot or water source as the focal sample point for all or most taxa. For surveys of birds, herpetofauna and large mammals it is common practice for the researchers to locate sample points well beyond the confines of the vegetation plot. In locating the survey sites, consideration must be given to range distributions of concerned key species and their management practices. Restricted sampling of species ranges is likely to lead to very misleading outcomes for management. The radius of each circular plot depends on the size of potential habitat fragment or the homogeneous fragment as well as on what is being sampled. For example, samples of tree species richness in a tropical forest will require larger plot sizes than samples of mosses. Watershed studies may require one large plot or a series of contiguous plots along the drainage gradients. One of the usual ways to check for sample representativeness is to progressively add sample quadrats until a cumulative species:area curve provides an acceptable asymptote (Gillison 2006). Photographic documentation was made for important fauna and flora, and for the species that requires detailed study for identification.

3.3 Aquatic Organisms and Water Survey

In the cases of particular wetlands in Whykong and Nayapara, the visible aquatic fauna and flora were studied and documented by direct observation and photography, including underwater photography. Moreover, the water samples (total 6 litres; 3 litres from three different locations of each waterbody) were collected and studied under a microscope in the laboratory of the Department of Zoology, Jahangirnagar University, for the identification of planktons. Photographs of some planktons were taken by microscopic camera. The water parameters were studied at the Department of Zoology, Jahangirnagar University. The water parameters that were measured for two waterbodies are pH, TDS (Total Dissolved Solid), DO (Dissolved Oxygen), free carbon dioxide, total alkalinity and total hardness.

3.4 Interview Survey

Interview survey was followed for human-ecosystem interactions and other relevant information (Appendix III). This kind of survey is commonly done when a specific target population is involved in something. Interview surveys are used to get the answers and observe the behavior of the respondents, either individually or as a group. A structured interview survey (FAO 2019) follows a specific questionnaire and is commonly used for quantitative surveys. The answers of respondents are recorded on a questionnaire form during the interview and the completed questionnaires were analysed quantitatively. The respondents were given a brief background as to the nature and purpose of the study in order to bring him/her into the interviewer's confidence. Bias can originate from the respondent and/or the interviewer. Respondent bias can arise from poor memory, exaggeration or dishonesty, a lack of rapport with the interviewer or a misunderstanding over the purpose of the interview, whereas, interview bias commonly occurs due to a lack of objectivity and/or failure to administer questions properly and consistently. Therefore, before the formal interviewing the respondents were carefully chosen by informally interacting and checking if he/she could provide reliable information, and the interviews were done objectively following a structured format so that proper consistency could be maintained.



Transect survey along the road to be developed in Palongkhali-Sepotkhali road



Exploring the waterbody in Whykong by using a boat



Underwater photography in order to study aquatic life in the waterbody of Whykeong



Water samples collected from the waterbodies in Whykong (1A, 1B, 1C) and Nayapara (2A, 2B, 2C)



Interviewing the host community beside Foliapara Primary School Road



Interviewing the Rohingya community in Nayapara Camp



Meeting with the Divisional Fores Officer, Cox's Bazar South Forest Division, Cox's Bazar

4. RESULTS AND DISCUSSION

Based on the field data and information the results were drawn on various aspects of ecology of some selective sites in Ukhiya and Teknaf. A total of 299 species of vertebrate wildlife and 191 species of higher plants were recorded in all the selective sites combined. As observed in the field and received feedbacks from people, no negative side in developing the waterbodies in Whykong and Nayapara. In fact, the development of waterbodies will be useful for people, animals and plants, especially in dry season when the water is scarce in the area. However, it will be tough to establish 8.55 km long supply line from the waterbody in Whykeong up to Unchiprang Camp. Among the two waterbodies it was obvious that the waterbody in Whykong was much richer in species diversity, whereas, among the roads that were surveyed the Palongkhali-Sepotkhali Road was found the richest in species diversity (Figure 4, Appendices IV and V). The total number of species would be more if the survey could be done for a longer period of time covering all seasons. Moreover, wide varieties of invertebrates were encountered in all survey areas during the survey, but it was not possible to record invertebrates in limited period of survey.

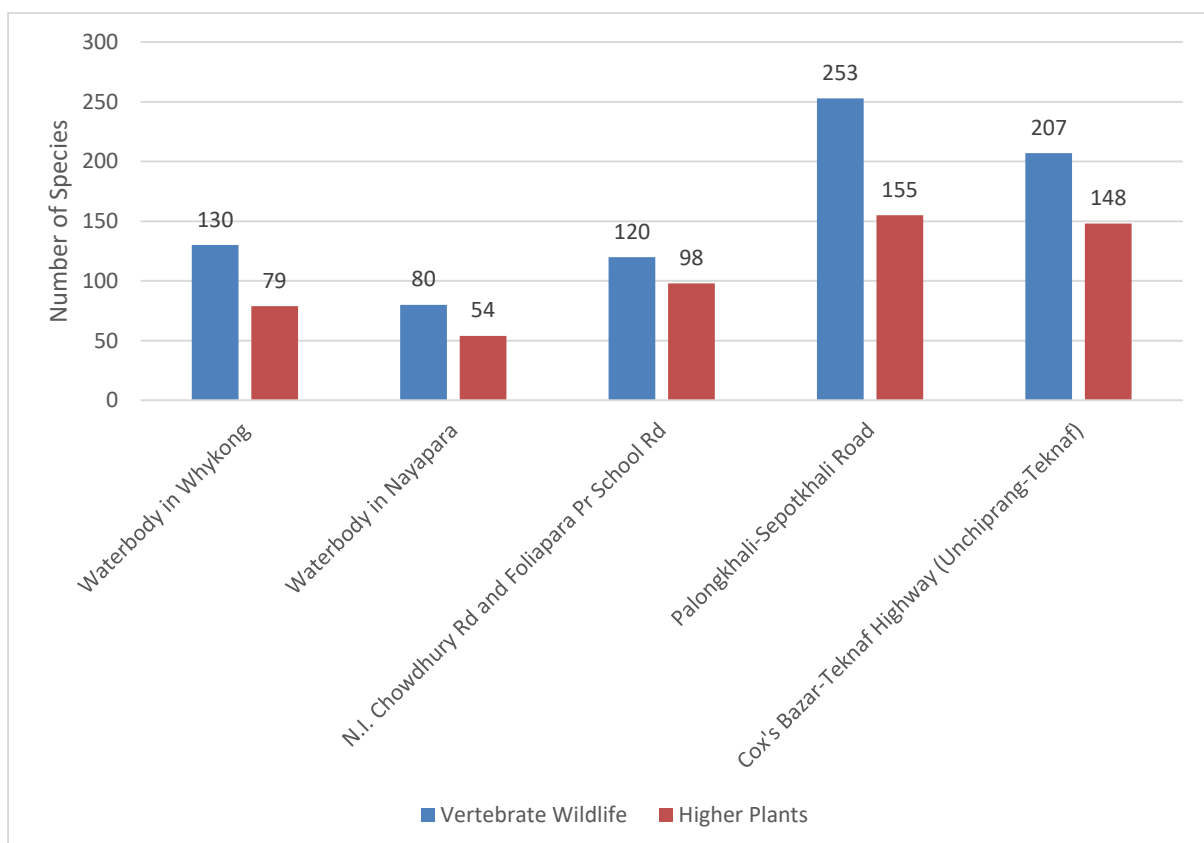


Figure 4. Comparative richness of vertebrate wildlife and higher plant species across the selective sites in Ukhiya and Teknaf.

A total of 105 local adult persons were interviewed to know their perception regarding the relevant development activities under the Emergency Assistance Project and the overall ecological features of the region. Among the interviewees, a total of 55 (52%) were the local Bengali host communities and 50 (48%) were Rohingyas residing in Unchiprang and Nayapara Camps. Out of the total 105 interviewees, a total of 72 (69%) were men and 33 (31%) were women. The reasons why the proportion of women were less than that of men were the less availability of women outside their houses, and many of the women were shy and were not willing to talk to strangers. While interviewing the host communities the main focus was given on proposed roads, but in the case of Rohingyas the main focus was on the development of waterbodies and water supply to be developed. Both communities were asked about their dependency on the wild plants and animals in their vicinity, and it was found that Rohingyas are heavily dependant on wild plants for firewood, but the host communities is heavily dependant on wild plants for building materials (Figure 5). This is because more than 60% of the Rohingyas depend on firewood (the rest use gas provided by NGOs in recycling cylinders), whereas the host communities mainly use gas (cylinder), kerosene and electricity. Thankfully, the dependency of both on wildlife was found low (Figure 5). Majority of Rohingyas have no idea about the existence of legally designated protected areas and ecologically critical areas in their vicinity, but majority respondents of the Bengali host communities poorly knew about these (Figure 6).

The Rohingyas were asked about their source of drinking water and the amount of drinking water required per family per day. The response was that they entirely depend on the pump or supply of water provided by the camp managing authorities or NGOs. About 15 litres of drinking water is required per family per day. Assuming the average family size at five, the drinking water requirement per person per day is about 3 litres. For washhigh and bathing, however, they use any water that is easily accessible like pond water, stream water or supplied water. The Rohingyas were also asked whether they know about ADB's initiative to develop water supply for them, and how much beneficial. None of the interviewees in Unchiprang Camp knew about the initiative, but all of the interviewees in Nayapara knew about it since the waterbody is situated just beside the camp and excavation work was already underway, although they did not know who the authority is. All respondents very strongly said that the water supply development will be extremely useful since the current water supply is insufficient and they always stand on the queue to get water from the limited supply.

The Bengali host communities along the roads to be developed were interviewed to know their perception about those. All except one respondent said that the road development will be very useful, because it will ensure easy movement and transportation, and will boost up the local economy. Only one respondent opposed the road development through the forested area, because he thinks the road development will speed up the deforestation, which is a big problem for the entire region. A total of 29 (64%) out of 45 respondents knew about the road development initiative, but they were not sure about the authorities.

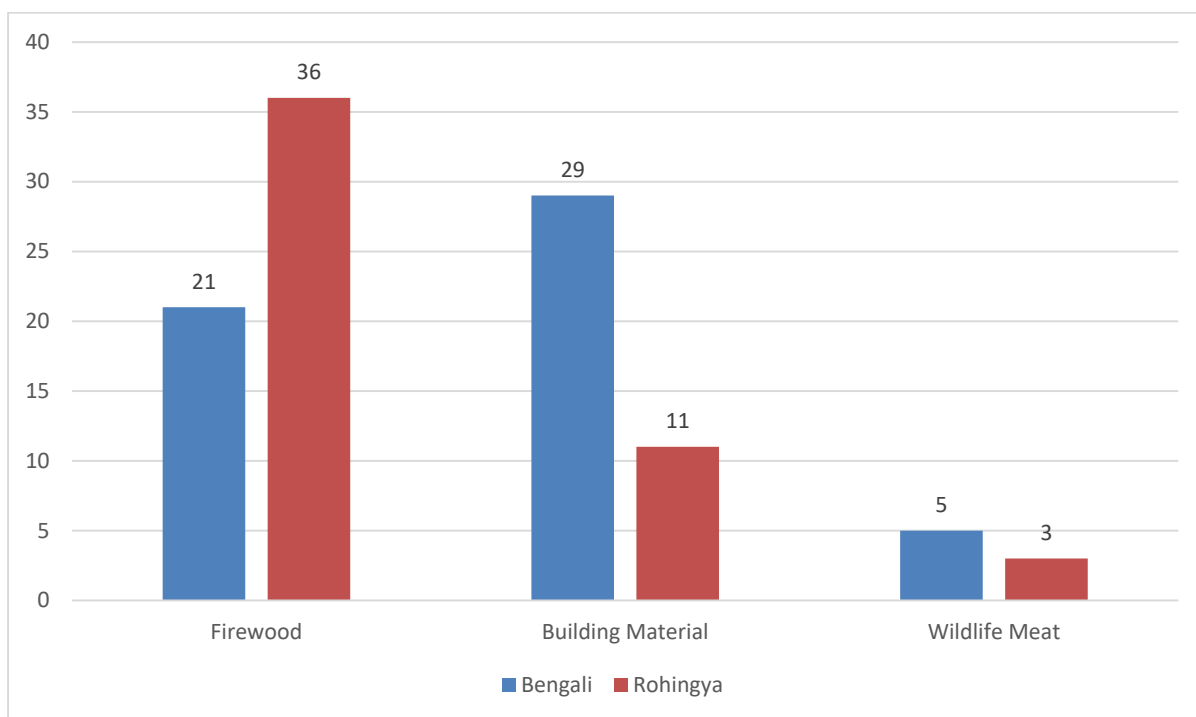


Figure 5. Dependency of the Bengali host communities and the Rohingya refugees on the wild plants and animals in their vicinity.

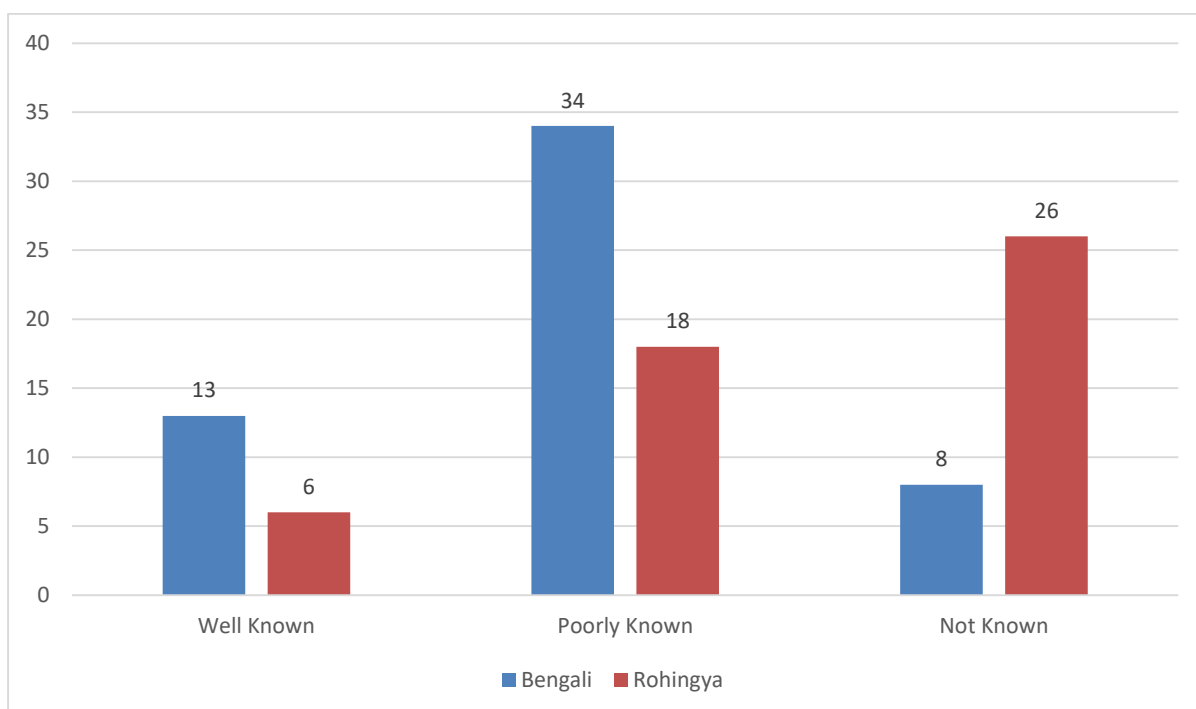


Figure 6. Knowledge of the Bengali host communities and the Rohingya refugees about the existence of protected areas and Ecologically Critical Areas in their vicinity.



Rohingya people returning to the camp with headloads of firewood collected from a nearby hill

A total of three focus group discussions were held with the officials of Cox's Bazar South Forest Division (Ukhiya and Teknaf areas fall under this Division), officials of LGED in Ukhiya and officials of IUCN-Bangladesh working in and around the Rohingya camps. According to the Forest Department officials, the total forest land under Cox's Bazar South Forest Division is 44,174.91 ha, of which plantation covers 5,922.39 ha. Of the total jurisdictional area, a total of 1,047.55 ha were given to other departments of the Government (the highest 723.97 ha was given to Ramu Cantonment) and 2,486.16 ha were 'encroached' (not given officially) by the displaced Rohingyas. The Forest Department officials think that, other than land encroachment, the biggest problem due to the Rohingyas is the collection of huge quantity of firewood from the nearby hills. Other unlawful activities include cutting trees, killing wildlife and polluting water and soil of the region. There is lack of active collaboration between the Forest Department and LGED regarding the development of roads through the forest lands. Therefore, when the Forest Department does not want a road through the forest land, the Forest Department sends letter to the higher authorities to stop the road construction initiative.

The discussion with LGED officials based in Ukhiya reveals that the road (including necessary bridges and culverts) construction plan has produced to develop the links between Cox's Bazar-Teknaf Highway and Marine Drive, and was produced on the basis of the needs of people, which were conveyed by the Local Government representatives. If there is a plan to build road through the forest land and the Forest Department does not want it, LGED sends letter to its higher authorities and the case is settled at the higher level. There is no effective collaboration between LGED and the Forest Department, at least at the field level.

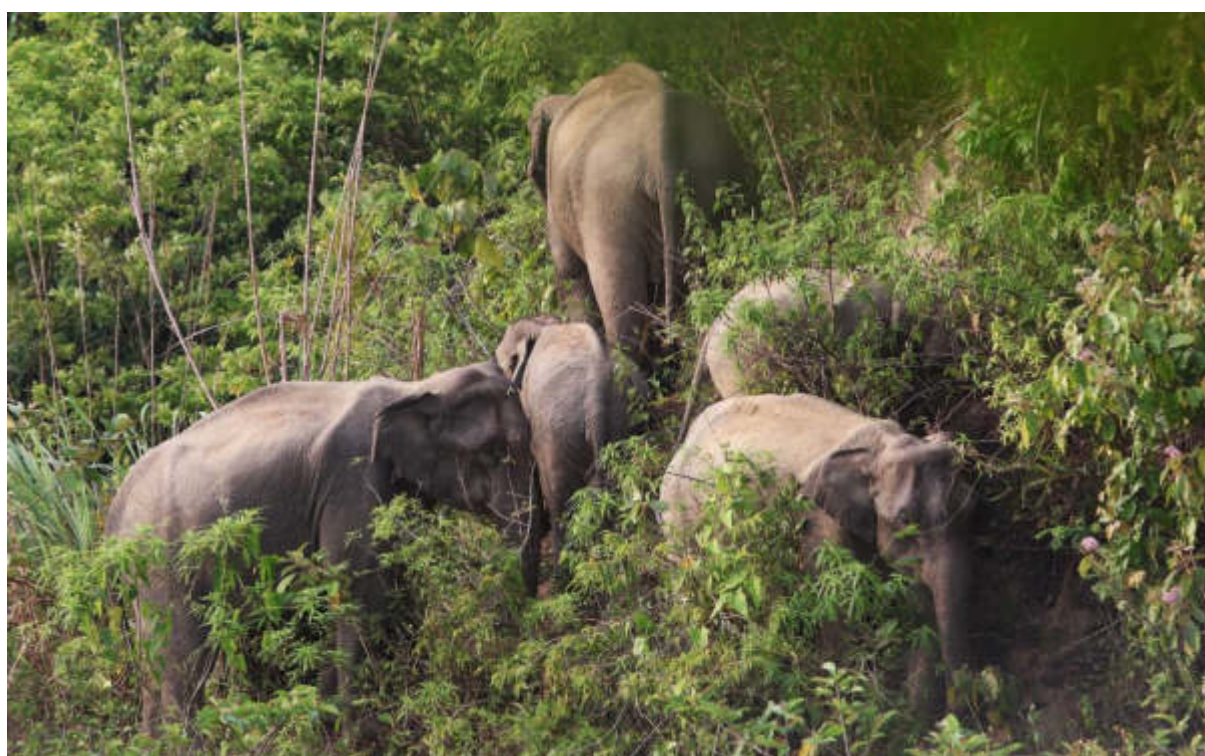


Figure 7. Biodiversity rich areas in Ukhiya and Teknaf under three protected areas (Himchari National Park – blue border, Sheikh Jamal Inani Wildlife Sanctuary – red border, and Teknaf Wildlife Sanctuary – orange border) showing the best remaining habitats in green circles.

A team of IUCN-Bangladesh is working in and around Rohingya camps from the very beginning and has been highly appreciated for the flagship work on reducing conflicts between Rohingyas and elephants. Notably, majority of the Rohingya camps are prone to elephant attacks. A total of 13 Rohingya people have died in elephant attacks in last two years. The field team of IUCN-Bangladesh has very good

experience of working with Rohingyas and they have trained about 800 Rohingyas as volunteers to reduce human-wildlife conflict and assist in nature conservation. According to the field team, poverty and drugs are the main driving forces that force Rohingyas to over-exploit the natural resources. Rohingyas often go out of their camps and there is no effective restriction system. The Rohingya camps scattered in several areas (instead of all camps in one area) is a drawback in keeping Rohingyas in their respective camps. The Rohingyas collect firewood and trees not only for their household uses, but also for sale. Hunting and capturing wildlife are done for meat and for sale to other people. The IUCN team has so far rescued Capped Langur (*Trachypithecus pileatus*), Little Egret (*Egretta garzetta*), Red-vented Bulbul (*Pycnonotus cafer*), Burmese Python (*Python molurus*), Reticulated Python (*Python reticulatus*) and Indian Leaf Turtle (*Cyclemys gemeli*) from Rohingyas and released them in the wild and there are documented records of killing Barking Deer (*Muntiacus muntjak*), King Cobra (*Ophiophagus hannah*) and Indian Rat Snake (*Ptyas mucosa*).

The Government declared three protected areas along the hill range of Ukhiya-Teknaf, running from north to south, are the areas relatively rich in biodiversity. The total area covered by three protected areas is 20,425.71 ha (Himchari National Park – 1,729.00 ha, Sheikh Jamal Inani Wildlife Sanctuary – 7,082.14 ha and Teknaf Wildlife Sanctuary – 11,614.57 ha) (Bangladesh Forest Department 2019, Khan 2018) (Figure 7). All three protected areas were visited during the survey and based on the condition of vegetation cover and presence of wildlife, particularly the Asian Elephant (*Elephas maximus*), the best remaining habitats were identified. Among four of the best remaining habitat patches, two are in the core areas of Himchari National Park and Sheikh Jamal Inani Wildlife Sanctuary, and the other two are in two ends of the elongated Teknaf Wildlife Sanctuary (Toynga Hill and Ne-Taung Hill areas) (Figure 7).



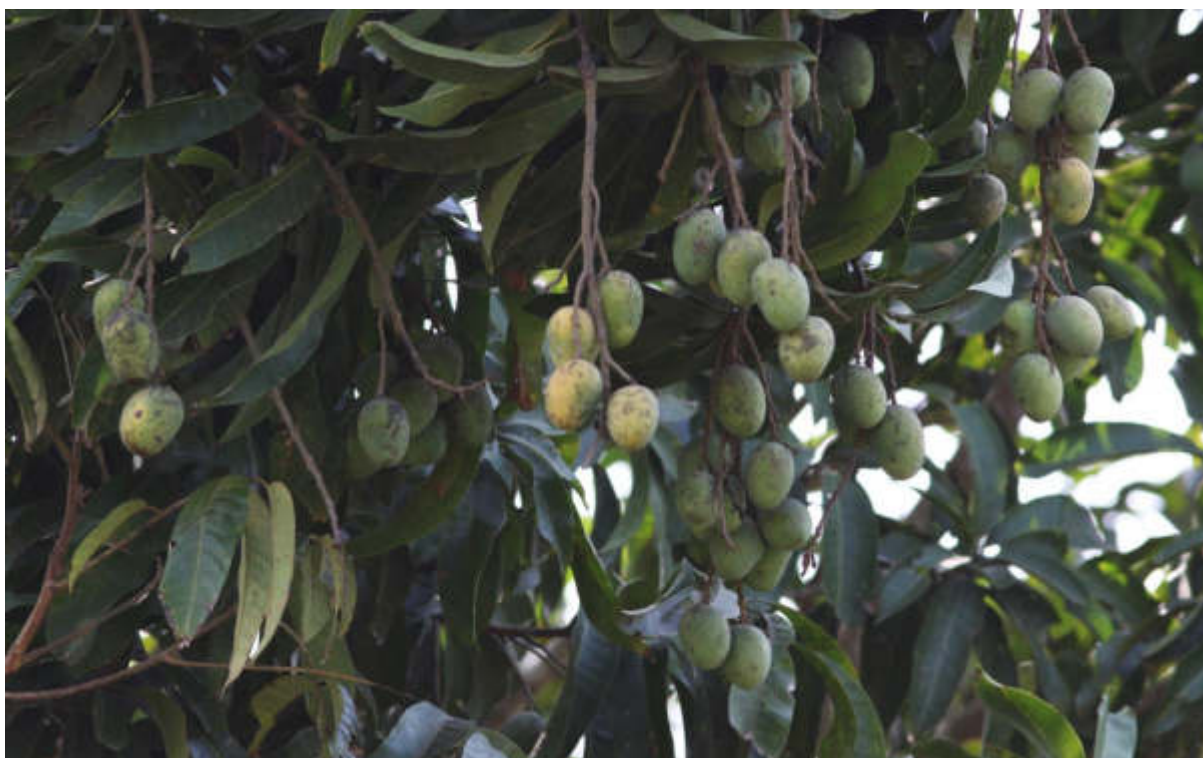
Asian Elephant (*Elephas maximus*) – a globally and nationally threatened species of wildlife occurs along the hill belt of Cox's Bazar not far from Rohingya camps



Capped Langur (*Trachypithecus pileatus*) – a globally and nationally threatened species of mammal found in the natural forests of Cox's Bazar



Indian Leaf Turtle (*Cyclemys gemeli*) – a nationally threatened species of reptile found in the forest streams of Cox's Bazar



Wild Mango (*Mangifera sylvatica*) – a nationally threatened and scientifically valuable fruit tree species that grows in and around the natural forests of Cox's Bazar



Serpentina (*Rauvolfia serpentina*) – a nationally threatened medicinal plant species found in the natural forests and bushes in Cox's Bazar

4.1 Waterbody in Whykong

The waterbody in Whykong (also called Panirchhara) will be developed to supply water to Unchiprang Camp, which is 8.55 km away along the road (approx. 3.35 km LGED road, 3.45 km NH1 and 1.75 km camp road). This waterbody covers an area of about 75,000 sq m and it was found very rich in fauna and flora where a total of 130 (23 mammal, 78 bird, 16 reptile and 13 amphibian) species of vertebrate wildlife and 79 species of higher plants were recorded (Appendices IV and V). A total of 23 fish species were recorded in the waterbody (Appendix VI). There was no visible pollutant in the water or in the hills around the waterbody, because there was no human settlement in the vicinity. The quality of surface water and drinking water are good enough in comparison to the national standards (MoEF 2019).

The Asian Elephant frequently visits the waterbody at night in order to drink and bathe, which was confirmed by the sightings of footprints and interviewing the local people. Elephants commonly visit at night in order to avoid confrontation with people. Elephants (a group of six and a solitary animal) were seen in the forested hills not very far from Rohingya camps. Water is scarce in the hilly area, so this waterbody with plenty of freshwater throughout the year is crucial for the local people as well as the local wildlife and plants.

Table 4. Comparison of water quality of the waterbodies in Whykong and Nayapara.

Parameter	Waterbody in Whykong	Waterbody in Nayapara
pH	8.0	8.5
TDS (ppm)	190.0	520.0
DO (mg/L)	7.6	4.8
Free carbon dioxide (mg/L)	2.0	6.0
Total alkalinity (mg/L)	208.5	627.7
Total hardness (mg/L)	72.1	256.3

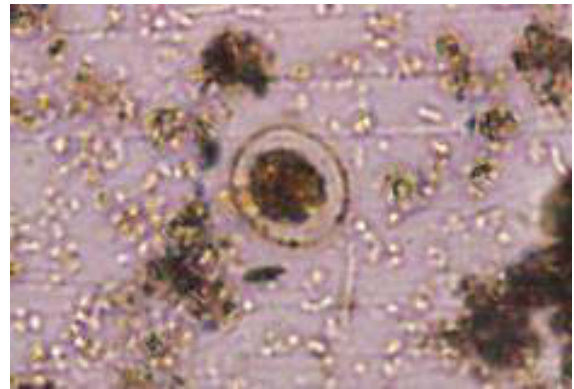
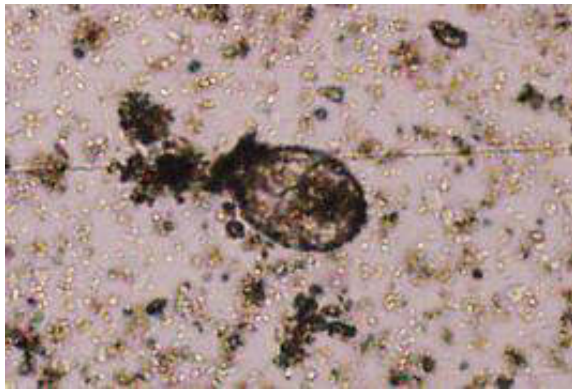
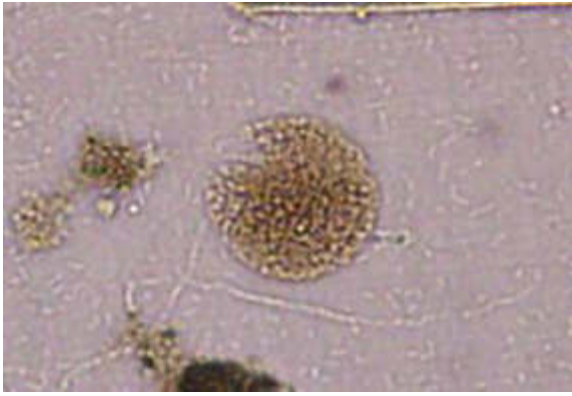
[N.B. TDS = Total Dissolved Solid, DO = Dissolved Oxygen]



Figure 8. Waterbody in Whykong (for supplying water to Unchiprang Camp) showing the geographic feature of the circular plot and surrounding area.



Waterbody in Whykeong, which will be developed to supply water in Unchiprang Camp



Microscopic photos of some planktons found in the waterbodies in Whykong and Nayapara (row-wise from top): *Coelosphaerium* sp., *Coleps* sp., *Haematococcus lacustris*, *Monoraphidium griffithii*, *Chromogaster* sp., *Cyclotella* sp., *Navicula placentula* and *Stauroneis anceps*

The water was found very rich in plankton content, indicating good quality of water. The phytoplankton content was found at 5,600 per litre and zooplankton content 266 per litre. A total of 11 species of phytoplankton (*Coelosphaerium* sp. – 195 per litre, *Euglena acus* – 405 per litre, *Gonatozygon montaenium* – 1388 per litre, *Haematococcus lacustris* – 212 per litre, *Monoraphidium griggithii* – 405 per litre, *Peridinium volzii* – 195 per litre, *Pleurotaenium ehrenberghii* – 585 per litre, *Pseudanabaena constricta* – 815 per litre, *Pseudanabaena schmidlei* – 790 per litre, *Raphidiopsis indica* – 405 per litre and *Strombomonas costata* – 205 per litre) and 2 species of zooplankton (*Canthocamptus* sp. – 100 per litre and *Coleps* sp. – 166 per litre) were recorded.

The water quality test results show that the water is alkaline with moderate levels of dissolved oxygen (DO), total dissolved solid (TDS), free carbon dioxide, total alkalinity and total hardness (Table 4). The higher proportion of DO and lower proportion of TDS, free carbon dioxide, total alkalinity and total hardness clearly indicate that the water quality of the waterbody in Whykong is better for humans and majority of other living organisms compared to that of the waterbody in Nayapara. This is probably because the catchment area around the waterbody in Whykong is less degraded and the pollution level is low.

A total of 8.55 km long supply line will be established to supply water from the waterbody up to Unchiprang Camp. The supply line will be placed underground and it will go along the existing roadside. The supply line route was surveyed and only some common species of animals and plants were recorded, which are widely available in the village areas. No threatened species of animals and plants were recorded.



Underwater photography of aquatic life at the waterbody in Whykong



Footprints of Asian Elephant in the bank of Whykeong waterbody indicating that Asian Elephant frequently visits this waterbody

4.2 Waterbody in Nayapara

The waterbody in Nayapara (also known as waterbody in Shalbagan) is situated just at the west side of Nayapara Camp, which will be developed to supply water to Nayapara Camp. This waterbody is much smaller (about 20,000 sq m) than that of Whykong and much poorer in terms of water quality and biodiversity. A total of 80 (17 mammal, 46 bird, 11 reptile and 6 amphibian) species of vertebrate wildlife and 54 species of higher plants were recorded in and around this waterbody (Appendices IV and V). There was very little water (mostly polluted) in the waterbody during the survey, so no fish species was recorded. Elephants now-a-days rarely visit the waterbody, but it is likely that they will visit frequently in the future when the waterbody will contain plenty of water. Water quality and natural water supply from catchment areas is poor in Nayapara due to poor vegetation cover in the catchment areas and hills. As a consequence the water is muddy and evaporation rate is high. The visible pollution level, including water pollution, especially by single-use plastic and other packaging material, was high in and around the waterbody since it is situated just beside the camp. The quality of surface water and drinking water are poor in comparison to the national standards (MoEF 2019).

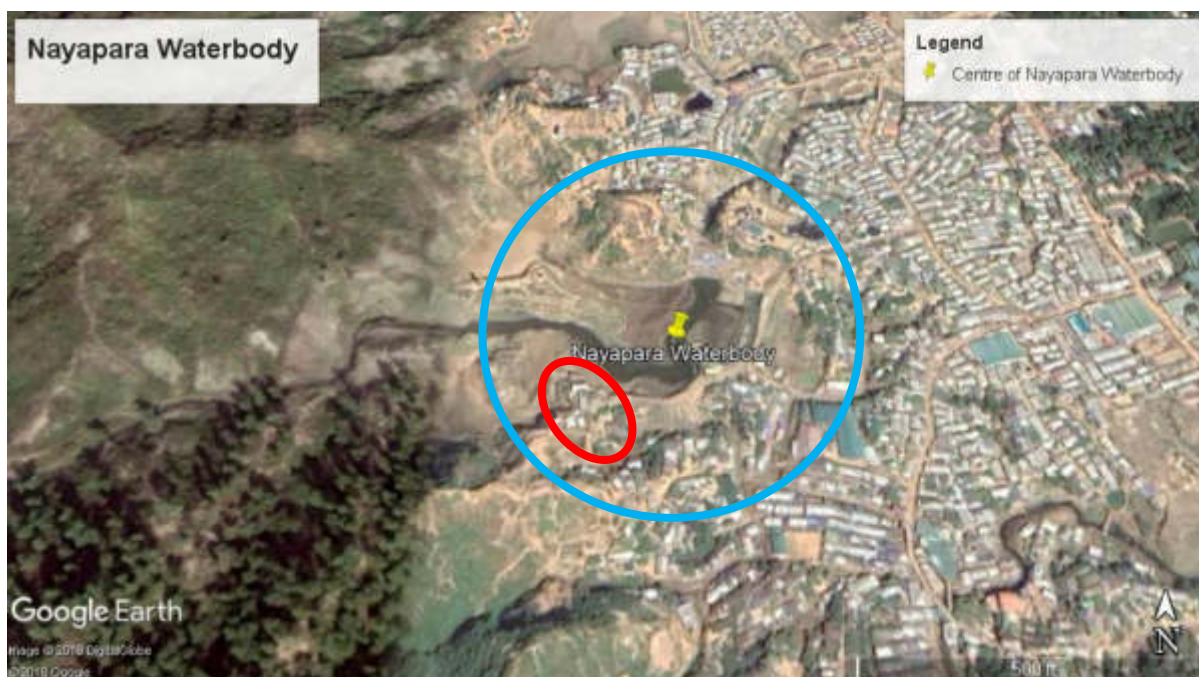


Figure 9. Waterbody in Nayapara (for supplying water to Nayapara Camp) showing the geographic feature of the circular plot and surrounding area. Houses potentially vulnerable to wild elephants are in the red circle.



Waterbody in Nayapara, which will be developed to supply water to Nayapara Camp. Houses potentially vulnerable to wild elephants are in the left side in this photo.

The water was found poor in plankton content, especially in comparison to that of the water of waterbody in Whykong, indicating poor quality of water. The phytoplankton content was found at 2,532 per litre and zooplankton content 200 per litre. A total of 6 species of phytoplankton (*Cyclotella* sp. – 196 per litre, *Monoraphidium griggithii* – 762 per litre, *Navicula placentula* – 585 per litre, *Peridinium* sp. – 204 per litre, *Stauroneis anceps* – 585 per litre and *Strombomonas verrucosa* – 200 per litre) and 2 species of zooplankton (*Chromogaster* sp. – 103 per litre and *Prorodon* sp. – 97 per litre) were recorded, so the plankton diversity in the waterbody of Nayapara was less than that in the waterbody of Whykong. Only one species of plankton (*Monoraphidium griggithii*) was found common in both waterbodies in Whykong and Nayapara.

The water quality test results show that the water is alkaline with low level of DO and high levels of TDS, free carbon dioxide, total alkalinity and total hardness (Table 4). The lower proportion of DO and higher proportion of TDS, free carbon dioxide, total alkalinity and total hardness clearly indicate that the water quality of the waterbody in Nayapara is acceptable for humans and majority of other living organisms, but not as good as the water of the waterbody in Whykong. This is probably because of the degrading natural condition of the catchment area and higher level of pollution from the adjacent Nayapara Camp.

4.3 N.I. Chowdhury Road and Foliapara Primary School Road

Development of both N.I. Chowdhury Road (also called Ukhiya-Marine Drive Road) and Foliapara Primary School Road intend to improve the connectivity between Cox's Bazar-Teknaf highway running along the eastern edge of peninsula and Marine Drive running along the western edge of peninsula along the beach (Figure 10).

In the first phase a total of 2.51 km of N.I. Chowdhury Road, from Ukhiya proper up to South Foliapara will be developed by widening to 18 ft and turning fully metalled. Currently it is partly metalled and partly brick road. According to LGED office in Ukhiya, the road will be further extended in the future from South Foliapara to Painnasia (N 21.27691, E 092.08893). Painnasia is an area along Koat Bazar-Sonarpara Link Road (connecting Cox's Bazar-Teknaf Highway and Marine Drive) 2 km away from Koat Bazar. Currently this segment is narrow earthen road. Therefore, N.I. Chowdhury Road will be an additional link between Cox's Bazar-Teknaf Highway (Ukhiya proper) and Marine Drive (Sonarpara).

Foliapara Primary School Road, on the other hand, can be considered as a branch of N.I. Chowdhury Road. Having a total length of 1.03 km, it is a connection between Cox's Bazar-Teknaf Highway (Ukhiya Police Box) and N.I. Chowdhury Road (Foliapara). Currently it is a narrow, partly metalled and partly brick road that will be widened to 18 ft and be made fully metalled. Since it is connected with N.I. Chowdhury Road, it will ultimately be a part of connectivity network between the eastern and western ends of the peninsula.

Since both N.I. Chowdhury Road and Foliapara Primary School Road are situated in the same area, the ecological aspects along the roads were studied combindly. A total of 120 (16 mammal, 81 bird, 16 reptile and 7 amphibian) species of

vertebrate wildlife and 98 species of higher plants were recorded during the survey (Appendices IV and V).

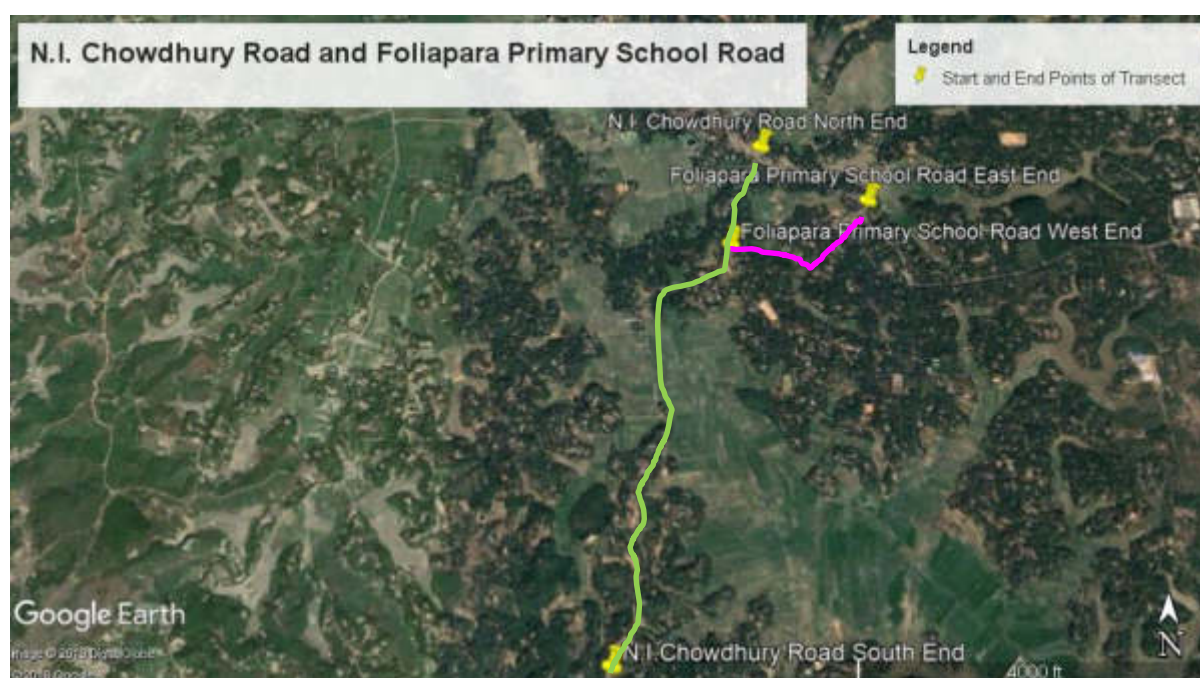


Figure 10. Transects along N.I. Chowdhury Road (parrot green line) and Foliapara Primary School Road (pink line) showing the geographic feature of the area.



N.I. Chowdhury Road showing the road condition and roadside vegetation



Foliapara Primary School Road showing the road condition and roadside vegetation (the school is in the right side of the photo)

4.4 Palongkhali-Sepotkhali Road

The Palongkhali-Sepotkhali Road aims to be a link between Cox's Bazar-Teknaf Highway (Palongkhali proper) and Marine Drive (Sepotkhali). With a total length of 9.15 km, this road will be widened to 18 ft and will be fully metalled. Currently it is mostly earthen road through hillocks covered by bushes and saplings (trees mostly logged illegally), and smaller parts towards the two ends are either metalled or brick paved. Major part of this road will pass through the Government forestland under the jurisdiction of the Forest Department, but it will not pass through any protected area declared under the Wildlife Act (LGED 2019). Although the forests along the road are quite degraded and the pressure on existing vegetation is very high due to the demand of firewood, the wild Asian Elephant still survives in the area, which was confirmed by the sightings of fresh dung and footprints during the survey. The forest still has the potential to recover if human intervention and encroachment can be controlled.

The road passed through relatively rich biodiversity area and a total of 253 (35 mammal, 164 bird, 37 reptile and 17 amphibian) species of vertebrate wildlife and 155 species of higher plants were recorded during the survey (Appendices IV and V). Among the notable species, the Asian Elephant and Capped Langur (*Trachypithecus pileatus*) were the most important species since these are globally and nationally threatened species (IUCN 2019, IUCN-Bangladesh 2015). Among the plants the most notable species was Wild Mango (*Mangifera sylvatica*), which is a nationally threatened species. The species is valuable, because it is the wild variety of a commercially important fruit tree, i.e. Mango. Another nationally threatened species of plant found during the survey was Serpentina (*Rauvolfia serpentina*), which is an important medicinal plant.

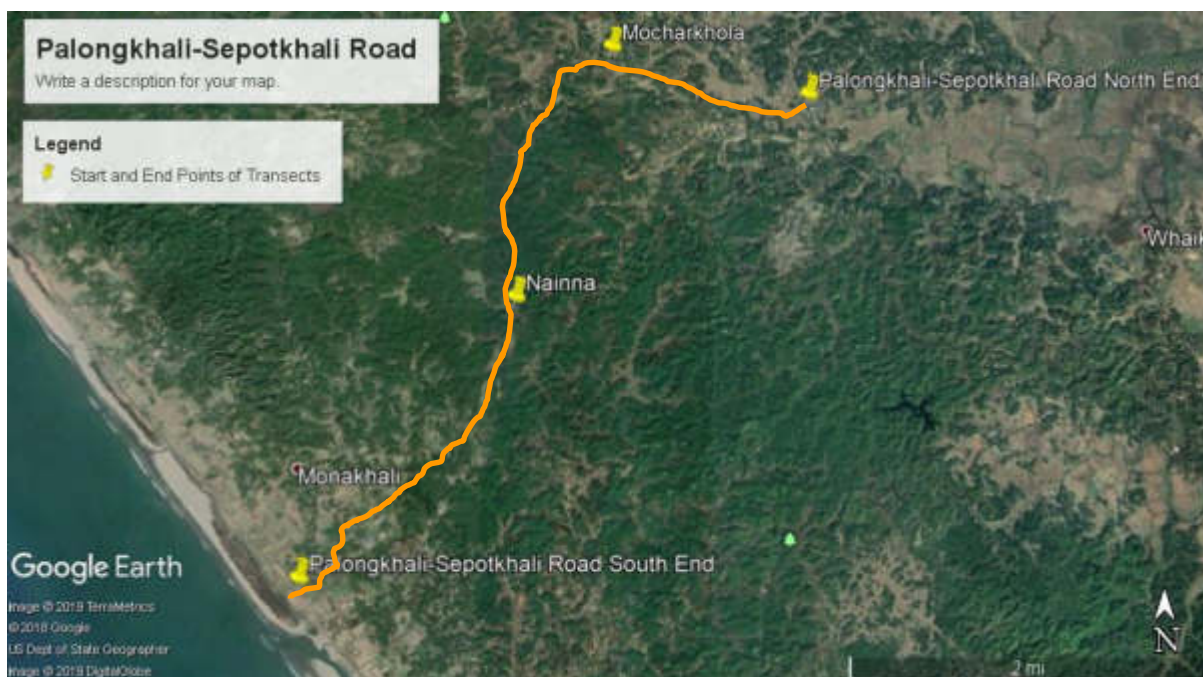


Figure 11. Transect along Palongkhali-Sepotkhali Road (orange line) showing the geographic feature of the area.



Palongkhali-Sepotkhali Road (southern part) showing the road condition, roadside vegetation and elephant dung



Saplings cut by the local villagers and layed for sun-drying, which will be collected later as 'dead' plants

4.5 Cox's Bazar-Teknaf Highway (Unchiprang to Teknaf Shapla Chattar)

The reconstruction and broadening of Cox's Bazar-Teknaf Highway is already underway and the last package of it will cover from Unchiprang to Teknaf Shapla Chattar (Figure 12). Under this programme the damaged parts of the highway will be repaired and the highway will be broadened for 0.9 m on each side, i.e. the highway will be 1.8 m broader than what is now. After the influx of Rohingya refugees this highway has become very busy due to the movements of various kinds of vehicles including heavy vehicles like trucks and buses. Trucks loaded with relief run through this highway and all kinds of public vehicles use this highway, so the pressure on this highway is tremendous and traffic congestion is very common.

As observed during the survey, the roadsides have a lot of old planted trees, particularly Siris Tree (*Albizia lebbek*). There are *Acacia* plantation in many areas along the highway, and in Teknaf area there are forests in the Forest Department lands, which are the richest areas in terms of biodiversity. A total of 207 (30 mammal, 139 bird, 26 reptile and 12 amphibian) species of vertebrate wildlife and 148 species of higher plants were recorded during the survey (Appendices IV and V). Among the notable species, the Asian Elephant was the most important species since it is a globally and nationally threatened species (IUCN 2019, IUCN-Bangladesh 2015). Moreover, the nationally threatened Long-tailed Macaque (*Macaca fascicularis*), Hog Badger (*Arctonyx collaris*) and Indian Leaf Turtle (*Cylemys gemeli*) occur in this area. No threatened species of plant was recorded.

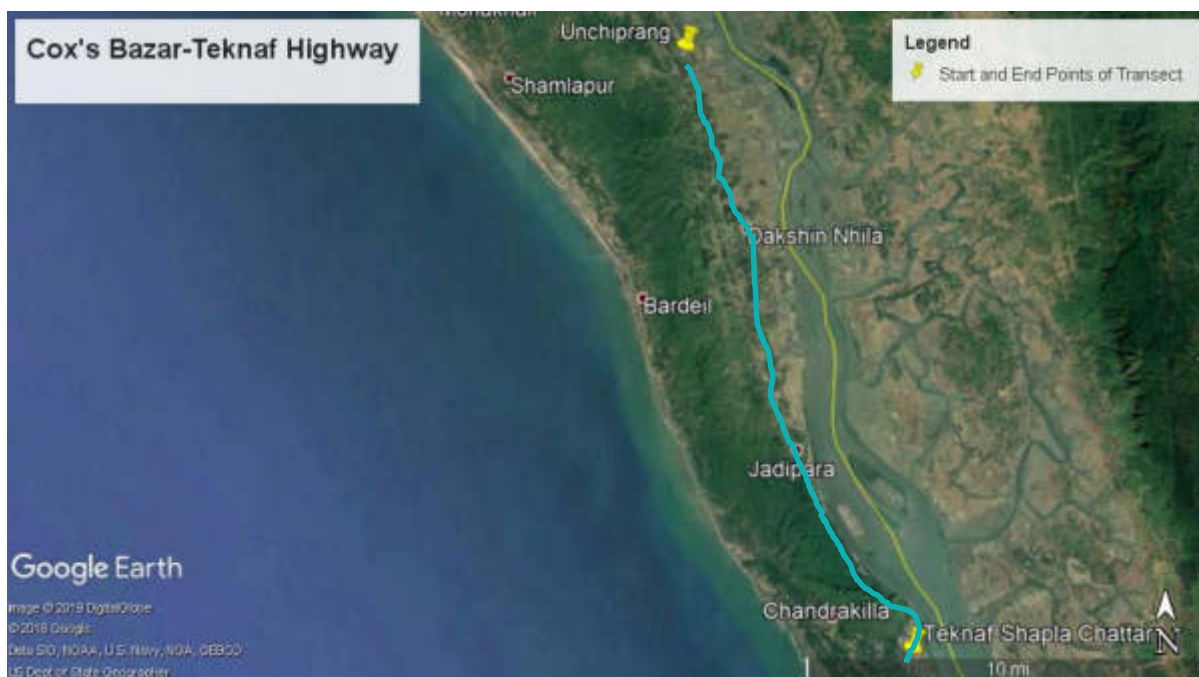


Figure 12. Transect along Cox's Bazar-Teknaf Highway (Unchiprang to Teknaf Shapla Chattar Part) (blue line) showing the geographic feature of the area.



Cox's Bazar-Teknaf Highway showing the road condition and roadside vegetation

5. CONCLUSIONS AND RECOMMENDATIONS

Based on the results and experience of this study the development activities will be done in a guided manner to make sure that the key species and habitats are saved and the displaced Rohingyas residing the the camps of Ukhiya and Teknaf can get the basic needs in an improved manner. The findings and recommendations of this study will be used in the Initial Environmental Examinations (IEEs) to be prepared for six subprojects and will serve as the baseline for any temporal monitoring of biodiversity and ecosystems of the region in the future.

It is very crucial to conserve the fauna (including mammals, birds, reptiles, amphibians and fishes) and flora (including the higher plants) of the aquatic and terrestrial sites where the subproject will be implemented, because the fauna and flora are the most important components of the local ecosystems to maintain the ecological balance. Notably, all the Rohingya camps were established in the forested areas causing a lot of damage and imbalance to the natural ecosystems. Therefore, the region is particularly vulnerable to ecological imbalance leading to landslides, increase of insect pests, spread of disease, and food scarcity. People depend on many plant species and fishes for food and due to the decline of those species the food security of the people are at vulnerable condition. Not only the humans, the mega-fauna of the region like the Asian Elephant is suffering from food shortage, which is evident by their ill health condition. Therefore, the subproject activities should be done with sufficient care so that the ecosystems are safeguarded and compensated.

Based on the results of this study the component-wise conclusions and recommendations of the Emergency Assistance Project of ADB are given below –

5.1 Waterbody in Whykong

The development of waterbody in Whykong not only will ensure the water supply in Unchiprang Camp, but will also ensure water for the local host communities and the wildlife and plants of the surrounding areas. Therefore, there is no negative side, provided that the water level is properly maintained.

The waterbody should be developed in a way so that minimum artificial structures (e.g. concrete and metallic structures) are used. The structures should be restricted to any one side (e.g. dyke side), leaving other sides natural, so that animals do not hesitate to visit the waterbodies and plants can grow along the banks. Any structure must be durable and as low as possible so that the structure is less visible to elephants and other wildlife. Visible structures can be destroyed by elephants. The supply line should be placed underground with some markings on the surface so that people know the existence of underground supply line. If the water pumps are to be installed, these must be set sufficiently far from the waterbodies so that these remain safe from elephants and there is no noise pollution in and around the waterbodies. Notably, noise pollution might scare the wild animals off from the waterbodies. A watchtower can be established near the waterbody, with volunteer watchers watching by rotation, in order to warn the residents if there is any movement of elephants towards the camp.

Indigenous trees should be planted in the catchment areas and hills around the waterbody in order to sustain the natural water supply and water quality in the long-term. Some recommended trees for plantation are Freshwater Mangrove (*Barringtonia acutangula*), fig (*Ficus* spp.), cotton tree (*Bombax* spp.), Monkey Jack (*Artocarpus chama*), Black Berry (*Syzygium cumini*), Sea Apple (*Syzygium grande*) and Champa (*Magnolia champaca*). Rohingyas and local host communities should not be allowed to enter the hilly areas around the camp in order to collect the firewood. This severely affects the regeneration of vegetation, disturbs the wildlife, and increases the human-wildlife conflict. Moreover, illegal hunting of wildlife, especially in and around the waterbody, must be controlled. Movements of elephants and other wildlife in and around the waterbody should be regularly monitored and adaptive measures should be taken as necessary.

5.2 Waterbody in Nayapara

The development of waterbody in Nayapara has become very much necessary, mainly because the displaced Rohingyas living in Nayapara Camp use the water of this waterbody, but currently the waterbody does not have the capacity to hold enough water and sustainably provide sufficient water throughout the year. There is no host community nearby, so the host community might not get the benefit, but other than the Rohingyas the water will greatly benefit the local wildlife and plants, including the Asian Elephant, because these also suffer from water crisis, especially during the dry season. There is no negative side of the development of this waterbody, provided that the water level is properly maintained.

Just like in the case of waterbody in Whykong, the waterbody should be developed in a way so that minimum artificial structures (e.g. concrete and metallic structures) are used. The structures should be restricted to any one side (e.g. camp side), leaving other sides natural, so that animals do not hesitate to visit the waterbodies and plants can grow along the banks. Any structure must be durable and as low as possible so that the structure is less visible to elephants and other wildlife. Visible structures can be destroyed by elephants. If the water pumps are to be installed, these must be set sufficiently far from the waterbodies so that these remain safe from elephants and there is no noise pollution in and around the waterbodies. Notably, noise pollution might scare the wild animals off from the waterbodies. A watchtower can be established near the waterbody, with volunteer watchers watching by rotation, in order to warn the residents if there is any movement of elephants towards the camp.

Indigenous trees should be planted in the catchment areas and hills around the waterbody in order to sustain the natural water supply and water quality in the long-term. Some recommended trees for plantation are Freshwater Mangrove (*Barringtonia acutangula*), fig (*Ficus* spp.), cotton tree (*Bombax* spp.), Monkey Jack (*Artocarpus chama*), Black Berry (*Syzygium cumini*), Sea Apple (*Syzygium grande*) and Champa (*Magnolia champaca*). Rohingyas and local host communities should not be allowed to enter the hilly areas around the camp in order to collect the firewood. This severely affects the regeneration of vegetation, disturbs the wildlife, and increases the human-wildlife conflict. Moreover, illegal hunting of wildlife, especially in and around the waterbody, must be controlled. Movements of elephants and other wildlife in and

around the waterbody should be regularly monitored and adaptive measures should be taken as necessary.

There are a few shanties of Rohingyas in the southwest side of the waterbody, which should be shifted to the east or north side of the waterbody. This is because the waterbody will lure the elephants and the houses in the southwest side are in the possible route of elephants, so those are vulnerable to elephant attack. As observed in the field, the expansion of shanties in the surrounding areas is not well-controlled.

Strong awareness programme is necessary to stop pollution of the waterbody. This waterbody is partly inside the camp area, and it is very likely that plastic and household litter dumped into it. Notably, for the Rohingyas currently residing in Nayapara Camp it is a common practice to throw the litter to the waterbody. The way new shanties are growing, it is likely that soon the waterbody will be surrounded by the shanties and increase the pollution level unless the expansion is strictly controlled.

5.3 N.I. Chowdhury Road and Foliapara Primary School Road

Both N.I. Chowdhury Road (first part) and Foliapara Primary School Road will benefit the Rohingyas and local host communities, and will improve the local connectivity. Since the roads to be developed have passed through the village areas and there are already existing roads (metalled or brick paved), there will be no notable conflict with the local ecosystems and biodiversity. Even the future extension from South Foliapara to Painnasia (in the existing Koat Bazar-Sonarpara Link Road) will be along the existing earthen road through the village area, so there will be no issue of any notable conflict. The elephants do not come to these areas and no threatened species of wildlife or plants were found during the survey.

According to the LGED office in Ukhiya, the initial plan was to build a link road from Ukhiya up to the Marine Drive, but after surveying the possible direct alignment it was realized that the alignment goes through high hills with good forest cover through which building and maintaining a road will be extremely difficult. Therefore, it was unofficially decided that in the next phase the road from South Foliapara will not go straight, instead it may turn northward and follow an existing earthen road up to Painnasia where it will meet with the existing Koat Bazar-Sonarpara Link Road.

After doing the ecological survey of the region it is recommended that the parts to be developed in the first phase has no major ecological concern, but in the future (i.e. in the next phase) N.I. Chowdhury Road should not go straight and turn northward in order to bypass the high hill areas as decided by LGED office in Ukhiya. The high hill area is within Sheikh Jamal Inani National Park, which is a legally designated protected area, and construction of any infrastructure will conflict with the provisions of the Wildlife Act. Only in exceptional circumstances the Forest Department can consider such case. Moreover, the high hill area supports the remaining forest patches and some elephant groups, so the areas are the most sensitive in terms of biodiversity. Any such attempt will disturb the elephant groups and may force them towards the local villages and Rohingya camps, which will increase the human-elephant conflict.

5.4 Palongkhali-Sepotkhali Road

Before the construction of Marine Drive, the Palongkhali-Sepotkhali foot trail was popularly used by the villagers from the sea shore to access the markets and towns of the region. According to the local people, this is an old trail that once passed through very deep forest. Through the course of time the deep forest has vanished, and today the low hills are covered by bushes and saplings. However, the area still supports many species including the Asian Elephant and Capped Langur, which are globally and nationally threatened species. Moreover, Wild Mango and Serpentine were found in the area which are nationally threatened species. Major part of the road alignment passes through the forestland under the jurisdiction of the Forest Department. The local people, on the other hand, very much expect the development of this road, which they think will contribute to the development of local transport, economy and lifestyle. Therefore, the road development issue should be discussed with the Forest Department and other stakeholders to get a complete picture of loss and gain, which can guide to the right decision. If the road is to be constructed, mitigation measures should be taken to reduce the impact by assisting the regeneration of existing degraded forest by ensuring protection from poachers and illegal loggers. The waterbodies and streams must not be filled or blocked, because the water is scarce in the area during the dry season, and the water is crucial for both people and wild animals of the area. Therefore, culverts should be built wherever necessary.

A smaller part of the road from Ukhiya proper up to Mocharkhola are already metalled or brick paved and passed through the village area. This part has no notable ecological issue and no threatened species were found in this part during the survey. Therefore, this part is unlikely to have any conflict with the Forest Department and people will welcome the development of the existing road.

5.5 Cox's Bazar-Teknaf Highway (Unchiprang to Teknaf Shapla Chattar)

Since the Cox's Bazar-Teknaf Highway is an existing highway of the country, the reconstruction and broadening from Unchiprang to Teknaf Shapla Chattar part will have no major issue in terms of ecosystems and biodiversity. There are many old Siris Trees and some other trees along the road that will need to be logged for broadening of the highway and it cannot be avoided since the trees are just beside the existing highway. Therefore, it is suggested that new roadside plantation should be done soon after the completion of highway development work. Indigenous trees should be planted along the roadsides, and sufficient space and slopes should be kept for plantation. The indigenous trees that can be considered for plantation are Siris Tree (*Albizia lebbeck*), White Siris (*A. procera*), North Indian Rosewood (*Dalbergia sissoo*), Garjan-oil Tree (*Dipterocarpus turbinatus*), Champa (*Magnolia champaca*) and fig (*Ficus* spp.). The Forest Department, local NGOs and the local communities can do the plantation on partnership. The additional area (0.9 m on each side) to be required for widening of the highway is probably already under the jurisdiction of the RHD, so any conflict with the local land owners and the Forest Department is unlikely.

No threatened species of plant was found along the roadsides, but the globally and nationally threatened Asian Elephant occasionally comes to the highway area. Moreover, the nationally threatened Long-tailed Macaque, Hog Badger and Indian Leaf Turtle are found in the forests near the highway. Considering the fact that the highway is virtually the lifeline of the region and has become ever more important to ensure smooth supply of relief in the Rohingya camps, the development should be done, but mitigation measures should be taken wherever necessary. The elephant corridors that pass through the highway should be demarked with roadside signboards so that the vehicles can pass through the corridors more carefully.

Appendix I. Data sheet for transect survey in Ukhiya and Teknaf.



Name of Site:
 Name of Transect:
 Location of Transect:
 Length and Width of Transect: km Area of Transect: km²
 Date: Time – Start:, End:
 Name of Observers:

[illegible]

Important/Useful area:
 Human dependency:
 Possible impact of sub-project:
Ad libitum note:

Appendix II. Data sheet for circular plot survey in Ukhiya and Teknaf.



TA-9546 BAN: EMERGENCY ASSISTANCE PROJECT – DPHE-CON-ECO ECOLOGICAL SPECIALIST (52174-001)
ECOLOGICAL ASSESSMENT OF SOME SELECTED SITES IN UKHYA AND TEKNAF, COX'S BAZAR, BANGLADESH

CIRCULAR PLOT SURVEY DATA SHEET

Name of Site:

Name of Circular Plot:

Location of Circular Plot:

Radius of Circular Plot: km Area of Circular Plot: km

Date:

Time – Start: End:

Name of Observers:

[illegible]

Important/Useful area:

Human dependency:

Possible impact of sub-project:

Ad libitum note:

Appendix III. Data sheet for interview survey in Ukhiya and Teknaf.



TA-9546 BAN: EMERGENCY ASSISTANCE PROJECT – DPHE-CON-ECO ECOLOGICAL SPECIALIST (52174-001)
ECOLOGICAL ASSESSMENT OF SOME SELECTED SITES IN UKHIYA AND TEKNAF, COX'S BAZAR, BANGLADESH

INTERVIEW SURVEY DATA SHEET

Name of Interviewee / Focus Group Leader:
Address of Interviewee / Focus Group Leader:
Status of Interviewee / Focus Group: Group / Family Size:
Sex of Interviewee: M / F Age of Interviewee: Young / Middle-aged / Senior
Name of Interviewer:

Question	Answer
How long are you living/working in the area?	
Which fauna are found?	
Which flora are found?	
Are you directly dependant on any fauna/flora?	Yes / No / Not sure. Explain:
Where is source of water?	
How much water you use per day for drinking, bathing and cleaning?	For drinking: For bathing: For cleaning:
Which wildlife do you consider edible?	
Which wildlife do you consider harmful?	
Which area has more vegetation and wildlife?	
Do you know the existence of PAs and ECAs in the vicinity?	Yes / Some idea / No.
Are you familiar with work to be done under ADB sub-project?	Yes / No. If the answer is no, then the sub project will be briefed.
Do you think the sub-project work will be beneficial?	Yes / No / Not sure. Explain:
Do you think the sub-project will be harmful?	Yes / No / Not sure. Explain:

Ad libitum note:

Appendix IV. List of vertebrate wildlife (mammals, birds, reptiles and amphibians) recorded in some selected sites in Ukhiya and Teknaf, Cox's Bazar ('+' means 'recorded'). Key for globally threatened species: CR – Critically Endangered, EN – Endangered and VU – Vulnerable. Notably, there is no endemic species.

MAMMALS

SI No	Scientific Name	English Name	Waterbody in Whykong	Waterbody in Nayapara	N.I. Chowdhury Road and Foliapara Primary School Road	Palongkhali -Sepotkhali Road	Cox's Bazar-Teknaf Highway
	ORDER: LAGOMORPHA						
	Family: Leporidae						
1	<i>Lepus nigricollis</i>	Indian Hare				+	+
	ORDER: RODENTIA						
	Family: Sciuridae						
2	<i>Callosciurus erythraeus</i>	Pallas's Squirrel				+	+
3	<i>Callosciurus pygerythrus</i>	Irrawaddy Squirrel	+				
4	<i>Dremomys lokriah</i>	Orange-bellied Squirrel				+	
	Family: Muridae						
5	<i>Bandicota bengalensis</i>	Lesser Bandicoot Rat	+	+	+	+	+
6	<i>Cannomys badius</i>	Lesser Bamboo Rat				+	+
7	<i>Mus musculus</i>	Eastern House Mouse	+	+	+	+	+
8	<i>Rattus rattus</i>	House Rat	+	+	+	+	+
9	<i>Vandeleuria oleracea</i>	Asiatic Long-tailed Climbing Mouse	+	+	+	+	+
	Family: Hystricidae						
10	<i>Hystrix brachyura</i>	Himalayan Crestless Porcupine	+			+	+
	ORDER: PHOLIDOTA						
	Family: Manidae						
11	<i>Manis pentadactyla</i>	Chinese Pangolin (CR)				+	
	ORDER: CARNIVORA						
	Family: Viverridae						
12	<i>Arctictis binturong</i>	Binturong (VU)				+	
13	<i>Paguma larvata</i>	Masked Palm Civet				+	+
14	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	+	+	+	+	+
15	<i>Viverra zibetha</i>	Large Indian Civet			+	+	+
16	<i>Viverricula indica</i>	Small Indian Civet				+	+
	Family: Felidae						
17	<i>Felis chaus</i>	Jungle Cat	+	+	+	+	+
18	<i>Prionailurus bengalensis</i>	Leopard Cat	+			+	+
19	<i>Prionailurus viverrinus</i>	Fishing Cat (EN)	+			+	
	Family: Herpestidae						
20	<i>Herpestes auropunctatus</i>	Small Indian Mongoose	+	+	+	+	+
21	<i>Herpestes urva</i>	Crab-eating Mongoose				+	
	Family: Canidae						
22	<i>Canis aureus</i>	Golden Jackal	+	+	+	+	+
	Family: Mustelidae						
23	<i>Arctonyx collaris</i>	Hog Badger	+			+	+
	ORDER: SORICOMORPHA						
	Family: Soricidae						
24	<i>Suncus murinus</i>	Asian House Shrew	+	+	+	+	+
	ORDER: CHIROPTERA						
	Family: Pteropodidae						
25	<i>Cynopterus sphinx</i>	Greater Short-nosed Fruit Bat	+	+	+	+	+
26	<i>Pteropus giganteus</i>	Indian Flying Fox	+	+	+	+	+
	Family: Megadermatidae						
27	<i>Megaderma lyra</i>	Greater False Vampire Bat	+	+	+	+	+
	Family: Vespertilionidae						
28	<i>Pipistrellus tenuis</i>	Least Pipistrelle	+	+	+	+	+
29	<i>Scotophilus heathi</i>	Greater Asiatic Yellow Bat	+	+	+	+	+
30	<i>Scotophilus kuhlii</i>	Lesser Asiatic Yellow Bat	+	+	+	+	+
	ORDER: PRIMATES						
	Family: Loridae						
31	<i>Nycticebus bengalensis</i>	Bengal Slow Loris (VU)				+	+
	Family: Cercopithecidae						
32	<i>Macaca fascicularis</i>	Long-tailed Macaque					+
33	<i>Macaca mulatta</i>	Rhesus Macaque				+	+
34	<i>Trachypithecus pileatus</i>	Capped Langur (VU)				+	
	ORDER: SCANDENTIA						
	Family: Tupaiidae						

35	<i>Tupaia belangeri</i>	Northern Tree Shrew	+	+		+	+
	ORDER: ARTIODACTYLA						
	Family: Suidae						
36	<i>Sus scrofa</i>	Eurasian Wild Boar	+			+	+
	Family: Cervidae						
37	<i>Muntiacus muntjak</i>	Barking Deer					
	ORDER: PROBOSCIDEA						
	Family: Elephantidae						
38	<i>Elephas maximus</i>	Asian Elephant (EN)	+	+		+	+

BIRDS

SI No	Scientific Name	English Name	Waterbody in Whykong	Waterbody in Nayapara	N.I. Chowdhury Road and Foliapara Primary School Road	Palongkhali -Sepotkhali Road	Cox's Bazar-Teknaf Highway
	ORDER: GALLIFORMES						
	Family: Phasianidae						
1	<i>Gallus gallus</i>	Red Junglefowl	+			+	+
2	<i>Lophura leucomelanos</i>	Kalij Pheasant				+	+
	ORDER: ANSERIFORMES						
	Family: Anatidae						
3	<i>Dendrocygna javanica</i>	Lesser Whistling-duck	+				
4	<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	+				
	ORDER: PODICIPEDIFORMES						
	Family: Podicipedidae						
5	<i>Tachybaptus ruficollis</i>	Little Grebe	+				
	ORDER: COLUMBIFORMES						
	Family: Columbidae						
6	<i>Chalcophaps indica</i>	Grey-capped Emerald Dove	+			+	+
7	<i>Columba livia</i>	Rock Pigeon	+	+	+	+	+
8	<i>Spilopelia suratensis</i>	Western Spotted Dove	+	+	+	+	+
9	<i>Streptopelia decaocto</i>	Eurasian Collared-dove	+	+	+	+	+
10	<i>Streptopelia tranquebarica</i>	Red Turtle-dove	+	+	+	+	+
11	<i>Treron bicincta</i>	Orange-breasted Green-pigeon				+	+
12	<i>Treron curvirostra</i>	Thick-billed Green-pigeon				+	+
13	<i>Treron phayrei</i>	Ashy-headed Green-pigeon				+	+
14	<i>Treron phoenicopterus</i>	Yellow-footed Green-pigeon			+	+	+
	ORDER: CAPRIMULGIFORMES						
	Family: Caprimulgidae						
15	<i>Caprimulgus macrurus</i>	Large-tailed Nightjar			+	+	+
	Family: Apodidae						
16	<i>Apus nipalensis</i>	House Swift			+	+	+
17	<i>Cypsiurus balasiensis</i>	Asian Palm-swift	+	+	+	+	+
	ORDER: CUCULIFORMES						
	Family: Cuculidae						
18	<i>Cacomantis merulinus</i>	Plaintive Cuckoo	+	+	+	+	+
19	<i>Cacomantis sonneratii</i>	Banded Bay Cuckoo				+	+
20	<i>Centropus bengalensis</i>	Lesser Coucal	+			+	+
21	<i>Centropus sinensis</i>	Greater Coucal	+	+	+	+	+
22	<i>Clamator coromandus</i>	Chestnut-winged Cuckoo				+	
23	<i>Clamator jacobinus</i>	Jacobin Cuckoo	+	+	+	+	+
24	<i>Cuculus canorus</i>	Common Cuckoo					+
25	<i>Cuculus micropterus</i>	Indian Cuckoo	+	+	+	+	+
26	<i>Eudynamis scolopaceus</i>	Western Koel	+	+	+	+	+
27	<i>Hierococcyx varius</i>	Common Hawk-cuckoo	+	+	+	+	+
28	<i>Phaenicophaeus tristis</i>	Green-billed Malkoha	+			+	+
29	<i>Sumiculus lugubris</i>	Square-tailed Drongo-cuckoo				+	
	ORDER: GRUIFORMES						
	Family: Rallidae						

30	<i>Amauornis phoenicurus</i>	White-breasted Waterhen	+				
31	<i>Gallinula chloropus</i>	Common Moorhen	+				
	ORDER: CICONIIFORMES Family: Ciconiidae						
32	<i>Anastomus oscitans</i>	Asian Openbill	+				
	ORDER: PELECANIFORMES Family: Threskiornithidae						
33	<i>Threskiornis melanocephalus</i>	Black-headed Ibis					+
	Family: Ardeidae						
34	<i>Ardea albus</i>	Great Egret	+				
35	<i>Ardea intermedia</i>	Intermediate Egret	+				
36	<i>Ardeola grayii</i>	Indian Pond-heron	+	+	+	+	+
37	<i>Bubulcus ibis</i>	Cattle Egret	+	+	+	+	+
38	<i>Butorides striata</i>	Green-backed Heron	+				
39	<i>Egretta garzetta</i>	Little Egret	+	+	+	+	+
40	<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	+				+
41	<i>Ixobrychus sinensis</i>	Yellow Bittern	+				
42	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	+				
	ORDER: SULIFORMES Family: Phalacrocoracidae						
43	<i>Microcarbo niger</i>	Little Cormorant	+				
44	<i>Phalacrocorax carbo</i>	Great Cormorant	+				
	ORDER: CHARADRIIFORMES Family: Charadriidae						
45	<i>Charadrius dubius</i>	Little Ringed Plover	+				
46	<i>Charadrius mongolus</i>	Lesser Sandplover	+				
47	<i>Pluvialis fulva</i>	Pacific Golden Plover					+
48	<i>Pluvialis squatarola</i>	Grey Plover					
49	<i>Vanellus indicus</i>	Red-wattled Lapwing	+			+	+
	Family: Rostratulidae						
50	<i>Rostratula benghalensis</i>	Greater Painted-snipe	+				+
	Family: Jacanidae						
51	<i>Metopidius indicus</i>	Bronze-winged Jacana	+				
	Family: Scolopacidae						
52	<i>Actitis hypoleucos</i>	Common Sandpiper	+	+			+
53	<i>Gallinago gallinago</i>	Common Snipe	+				
54	<i>Gallinago stenura</i>	Pintail Snipe	+				
55	<i>Tringa glareola</i>	Wood Sandpiper	+				
	Family: Turnicidae						
56	<i>Turnix suscitator</i>	Barred Buttonquail				+	
	ORDER: STRIGIFORMES Family: Tytonidae						
57	<i>Tyto alba</i>	Common Barn-owl			+		+
	Family: Strigidae						
58	<i>Athene brama</i>	Spotted Owlet			+	+	+
59	<i>Glaucidium cuculoides</i>	Asian Barred Owlet			+	+	+
60	<i>Ketupa zeylonensis</i>	Brown Fish-owl					+
61	<i>Ninox scutulata</i>	Brown Boobook			+	+	+
62	<i>Otus lettia</i>	Collared Scops-owl			+	+	
	ORDER: ACCIPITRIFORMES Family: Pandionidae						
63	<i>Pandion haliaetus</i>	Osprey	+				
	Family: Accipitridae						
64	<i>Accipiter badius</i>	Shikra	+			+	+
65	<i>Accipiter virgatus</i>	Besra				+	+
66	<i>Aviceda jerdoni</i>	Jerdon's Baza				+	

67	<i>Aviceda leuphotes</i>	Black Baza				+	
68	<i>Elanus caeruleus</i>	Black-winged Kite			+	+	+
69	<i>Haliastur indus</i>	Brahminy Kite	+	+	+	+	+
70	<i>Milvus migrans</i>	Black Kite		+	+	+	+
71	<i>Nisaetus cirrhatus</i>	Changeable Hawk-eagle				+	
72	<i>Spilornis cheela</i>	Crested Serpent-eagle			+	+	+
	ORDER: TROGONIFORMES						
	Family: Trogonidae						
73	<i>Harpactes erythrocephalus</i>	Red-headed Trogon				+	
	ORDER: BUCEROTIFORMES						
	Family: Upupidae						
74	<i>Upupa epops</i>	Common Hoopoe			+	+	+
	ORDER: CORACIIFORMES						
	Family: Meropidae						
75	<i>Merops leschenaulti</i>	Chestnut-headed Bee-eater	+		+	+	+
76	<i>Merops orientalis</i>	Asian Green Bee-eater	+	+	+	+	+
77	<i>Merops philippinus</i>	Blue-tailed Bee-eater				+	+
	Family: Coraciidae						
78	<i>Coracias benghalensis</i>	Indian Roller			+	+	+
	Family: Alcedinidae						
79	<i>Alcedo atthis</i>	Common Kingfisher	+	+		+	
80	<i>Ceryle rudis</i>	Pied Kingfisher	+				
81	<i>Halcyon smyrnensis</i>	White-breasted Kingfisher	+			+	+
	ORDER: PICIFORMES						
	Family: Megalaimidae						
82	<i>Psilopogon asiaticus</i>	Blue-throated Barbet			+	+	+
83	<i>Psilopogon haemacephalus</i>	Coppersmith Barbet			+	+	+
84	<i>Psilopogon lineatus</i>	Lineated Barbet			+	+	+
	Family: Picidae						
85	<i>Chrysocolaptes guttacristatus</i>	Greater Flameback				+	+
86	<i>Chrysophlegma flavinucha</i>	Greater Yellownape				+	+
87	<i>Dendrocopos macei</i>	Fulvous-breasted Woodpecker			+	+	+
88	<i>Dinopium benghalense</i>	Black-rumped Flameback			+	+	+
89	<i>Jynx torquilla</i>	Eurasian Wryneck				+	
90	<i>Micropternis brachyurus</i>	Rufous Woodpecker			+	+	+
91	<i>Picoides canicapillus</i>	Grey-capped Pygmy Woodpecker				+	+
92	<i>Picus guerini</i>	Black-naped Woodpecker				+	+
	ORDER: FALCONIFORMES						
	Family: Falconidae						
93	<i>Falco peregrinus</i>	Peregrine Falcon				+	
94	<i>Falco tinnunculus</i>	Common Kestrel			+	+	+
	ORDER: PSITTACIFORMES						
	Family: Psittacidae						
95	<i>Psittacula alexandri</i>	Red-breasted Parakeet					
96	<i>Psittacula krameri</i>	Rose-ringed Parakeet					
	ORDER: PASSERIFORMES						
	Family: Pittidae						
97	<i>Pitta sordida</i>	Western Hooded Pitta				+	
	Family: Oriolidae						
98	<i>Oriolus xanthornus</i>	Black-hooded Oriole				+	+
	Family: Campephagidae						
99	<i>Coracina macei</i>	Indian Cuckoo-shrike				+	+
100	<i>Lalage melanoptera</i>	Black-headed Cuckoo-shrike			+	+	
101	<i>Pericrocotus cinnamomeus</i>	Small Minivet			+	+	+
102	<i>Pericrocotus flammeus</i>	Scarlet Minivet				+	+

	Family: Artamidae						
103	<i>Artamus fuscus</i>	Ashy Woodswallow	+	+	+	+	+
	Family: Vangidae						
104	<i>Hemipus picatus</i>	Bar-winged Flycatcher-shrike				+	+
105	<i>Tephrodornis pondicerianus</i>	Common Wood-shrike				+	+
	Family: Aegithinidae						
106	<i>Aegithina tiphia</i>	Common Iora	+	+	+	+	+
	Family: Rhipiduridae						
107	<i>Rhipidura albicollis</i>	White-throated Fantail			+	+	+
	Family: Dicruridae						
108	<i>Dicrurus aeneus</i>	Bronzed Drongo				+	+
109	<i>Dicrurus hottentottus</i>	Hair-crested Drongo				+	
110	<i>Dicrurus leucophaeus</i>	Ashy Drongo			+	+	+
111	<i>Dicrurus macrocercus</i>	Black Drongo	+	+	+	+	+
112	<i>Dicrurus paradiseus</i>	Greater Racquet-tailed Drongo				+	
	Family: Monarchidae						
113	<i>Hypothymis azurea</i>	Black-naped Monarch	+		+	+	+
114	<i>Terpsiphone affinis</i>	Oriental Paradise-flycatcher				+	
	Family: Laniidae						
115	<i>Lanius cristatus</i>	Brown Shrike	+	+	+	+	+
116	<i>Lanius schach</i>	Long-tailed Shrike	+	+	+	+	+
117	<i>Lanius tephronotus</i>	Grey-backed Shrike				+	+
	Family: Corvidae						
118	<i>Cissa chinensis</i>	Common Green Magpie				+	
119	<i>Corvus macrorhynchos</i>	Large-billed Crow	+	+	+	+	+
120	<i>Corvus splendens</i>	House Crow	+	+	+	+	+
121	<i>Dendrocitta vagabunda</i>	Rufous Treepie	+	+	+	+	+
	Family: Stenosteridae						
122	<i>Culicicapa ceylonensis</i>	Grey-headed Canary-flycatcher	+	+	+	+	+
	Family: Paridae						
123	<i>Parus major</i>	Great Tit	+	+	+	+	+
	Family: Alaudidae						
124	<i>Alauda gulgula</i>	Oriental Skylark				+	
125	<i>Mirafra assamica</i>	Bengal Bushlark			+	+	+
	Family: Cisticolidae						
126	<i>Cisticola juncidis</i>	Zitting Cisticola				+	
127	<i>Orthotomus atrogularis</i>	Dark-necked Tailorbird				+	+
128	<i>Orthotomus sutorius</i>	Common Tailorbird	+	+	+	+	+
129	<i>Prinia hodgsonii</i>	Grey-breasted Prinia				+	+
130	<i>Prinia inomata</i>	Plain Prinia			+	+	
131	<i>Prinia rufescens</i>	Rufescent Prinia				+	
	Family: Acrocephalidae						
132	<i>Acrocephalus dumetorum</i>	Blyth's Reed-warbler	+	+	+	+	+
133	<i>Arundinax aedon</i>	Thick-billed Warbler				+	+
	Family: Locustellidae						
134	<i>Megalurus palustris</i>	Striated Grassbird	+			+	+
	Family: Hirundinidae						
135	<i>Hirundo daurica</i>	Red-rumped Swallow				+	+
136	<i>Hirundo rustica</i>	Barn Swallow	+	+	+	+	+
137	<i>Hirundo smithii</i>	Wire-tailed Swallow					
138	<i>Riparia chinensis</i>	Asian Plain Martin				+	+

	Family: Pycnonotidae						
139	<i>Alphoixus flaveolus</i>	White-throated Bulbul				+	+
140	<i>Brachypodius atriceps</i>	Black-headed Bulbul				+	+
141	<i>Iole virescens</i>	Olive Bulbul				+	+
142	<i>Pycnonotus cafer</i>	Red-vented Bulbul	+	+	+	+	+
143	<i>Pycnonotus flaviventris</i>	Black-crested Bulbul				+	+
144	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	+	+	+	+	+
	Family: Phylloscopidae						
145	<i>Phylloscopus affinis</i>	Tickell's Leaf-warbler				+	
146	<i>Phylloscopus fuscatus</i>	Dusky Warbler	+	+	+	+	+
147	<i>Phylloscopus inornatus</i>	Yellow-browed Warbler				+	+
148	<i>Phylloscopus trochiloides</i>	Greenish Warbler				+	+
	Family: Zosteropidae						
149	<i>Zosterops palpebrosus</i>	Oriental White-eye			+	+	+
	Family: Timaliidae						
150	<i>Mixornis gularis</i>	Pin-striped Tit-babbler	+	+	+	+	+
151	<i>Stachyris nigriceps</i>	Grey-throated Babbler				+	+
152	<i>Timalia pileata</i>	Chestnut-capped Babbler				+	
	Family: Pellorneidae						
153	<i>Malacocincla abbotti</i>	Abbott's Babbler	+	+	+	+	+
154	<i>Pellorneum ruficeps</i>	Puff-throated Babbler				+	+
	Family: Leiotrichidae						
155	<i>Argya earlei</i>	Striated Babbler				+	
156	<i>Garrulax leucolophus</i>	White-crested Laughingthrush				+	
157	<i>Garrulax monileger</i>	Lesser Necklaced Laughingthrush				+	
158	<i>Garrulax pectoralis</i>	Greater Necklaced Laughingthrush				+	+
159	<i>Garrulax ruficollis</i>	Rufous-necked Laughingthrush				+	+
160	<i>Turdoides striata</i>	Jungle Babbler	+	+	+	+	+
	Family: Sittidae						
161	<i>Sitta frontalis</i>	Velvet-fronted Nuthatch				+	
	Family: Sturnidae						
162	<i>Acridotheres fuscus</i>	Jungle Myna	+	+	+	+	+
163	<i>Acridotheres tristis</i>	Common Myna	+	+	+	+	+
164	<i>Agropsar sturninus</i>	Purple-backed Starling				+	
165	<i>Aplonis panayensis</i>	Asian Glossy Starling					+
166	<i>Gracula religiosa</i>	Common Hill Myna				+	
167	<i>Gracupia contra</i>	Asian Pied Starling	+	+	+	+	+
168	<i>Sturnia malabarica</i>	Chestnut-tailed Starling	+	+	+	+	+
	Family: Turdidae						
169	<i>Geokichla citrina</i>	Orange-headed Thrush			+	+	+
	Family: Muscicapidae						
170	<i>Calliope calliope</i>	Siberian Rubythroat				+	
171	<i>Copsychus saularis</i>	Oriental Magpie-robin	+	+	+	+	+
172	<i>Cyanecula svecica</i>	Bluethroat				+	+
173	<i>Cyornis poliogenys</i>	Pale-chinned Flycatcher				+	+
174	<i>Cyornis rubeculoides</i>	Blue-throated Blue-flycatcher				+	
175	<i>Enicurus immaculatus</i>	Black-backed Forktail				+	
176	<i>Eumyias thalassinus</i>	Verditer Flycatcher				+	+
177	<i>Ficedula albicilla</i>	Red-throated Flycatcher			+	+	+
178	<i>Kittacincla malabarica</i>	White-rumped Shama				+	+
179	<i>Monticola solitarius</i>	Blue Rock-thrush					+
180	<i>Myophonus caeruleus</i>	Blue Whistling-thrush				+	+

181	<i>Phoenicurus ochruros</i>	Black Redstart				+	+
182	<i>Saxicola torquatus</i>	Common Stonechat				+	+
	Family: Chloropsidae						
183	<i>Chloropsis aurifrons</i>	Golden-fronted Leafbird				+	+
	Family: Dicaeidae						
184	<i>Dicaeum cruentatum</i>	Scarlet-backed Flowerpecker				+	+
185	<i>Dicaeum erythrorhynchos</i>	Pale-billed Flowerpecker			+	+	+
	Family: Nectariniidae						
186	<i>Aethopyga siparaja</i>	Crimson Sunbird	+		+	+	+
187	<i>Arachnothera longirostra</i>	Little Spiderhunter				+	+
188	<i>Cinnyris asiaticus</i>	Purple Sunbird			+	+	+
189	<i>Leptocoma zeylonica</i>	Purple-rumped Sunbird			+	+	+
	Family: Ploceidae						
190	<i>Ploceus philippinus</i>	Baya Weaver			+	+	+
	Family: Estrildidae						
191	<i>Lonchura malabarica</i>	Indian Silverbill				+	
192	<i>Lonchura punctulata</i>	Scaly-breasted Munia			+	+	+
193	<i>Lonchura striata</i>	White-rumped Munia				+	
	Family: Passeridae						
194	<i>Passer domesticus</i>	House Sparrow		+	+	+	+
	Family: Motacillidae						
195	<i>Anthus hodgsoni</i>	Olive-backed Pipit				+	+
196	<i>Anthus rufulus</i>	Paddyfield Pipit			+	+	+
197	<i>Motacilla alba</i>	White Wagtail	+	+	+	+	+
198	<i>Motacilla cinerea</i>	Grey Wagtail				+	
199	<i>Motacilla maderaspatensis</i>	White-browed Wagtail	+	+	+	+	+

REPTILES

SI No	Scientific Name	English Name	Waterbody in Whykong	Waterbody in Nayapara	N.I. Chowdhury Road and Foliapara Primary School Road	Palongkhali -Sepotkhali Road	Cox's Bazar-Teknaf Highway
	ORDER: TESTUDINEA						
	Family: Bataguridae						
1	<i>Cyclemys gemeli</i>	Indian Leaf Turtle				+	
2	<i>Pangshura tecta</i>	Indian Roofed Turtle	+			+	
	Family: Trionychidae						
3	<i>Lissemys punctata</i>	Spotted Flapshell Turtle	+				
	ORDER: SQUAMATA						
	Family: Agamidae						
4	<i>Calotes emma</i>	Forest Crested Lizard	+	+	+	+	>
5	<i>Calotes versicolor</i>	Common Garden Lizard	+	+	+	+	>
6	<i>Draco maculatus</i>	Spotted Flying Lizard				+	>
7	<i>Ptychocheilus gularis</i>	Green Fan-throated Lizard				+	>
	Family: Gekkonidae						
8	<i>Cyrtodactylus ayeyarwadyensis</i>	Ayeyarwady Bent-toed Gecko				+	>
9	<i>Gekko gekko</i>	Tokay Gecko	+	+	+	+	>
10	<i>Hemidactylus bowringii</i>	Bowring's House Gecko				+	
11	<i>Hemidactylus frenatus</i>	Common House Gecko	+	+	+	+	>
12	<i>Hemidactylus garnotii</i>	Garnot's House Gecko				+	
13	<i>Hemidactylus platyurus</i>	Flat-tailed House Gecko					
14	<i>Ptychozoon lionotum</i>	Smooth Parachute Gecko					
	Family: Lacertidae						
15	<i>Takydromus khasiensis</i>	Khasi Hills Long-tailed Lizard				+	>
	Family: Scincidae						
16	<i>Eutropis carinata</i>	Keeled Grass Skink	+	+	+	+	>
17	<i>Eutropis dissimilis</i>	Striped Grass Skink	+				
18	<i>Eutropis macularia</i>	Bronze Grass Skink	+	+	+	+	>
19	<i>Sphenomorphus maculatus</i>	Spotted Litter Skink	+	+	+	+	>
	Family: Varanidae						
20	<i>Varanus bengalensis</i>	Bengal Monitor	+	+	+	+	>

21	<i>Varanus salvator</i>	Water Monitor					>
	Family: Typhlopidae						
22	<i>Ramphotyphlops braminus</i>	Common Blind Snake	+	+	+	+	>
	Family: Boidae						
23	<i>Python molurus</i>	Burmese Python (VU)				+	
24	<i>Python reticulatus</i>	Reticulated Python				+	
	Family: Colubridae						
25	<i>Ahaetulla prasina</i>	Short-nosed Vine Snake				+	
26	<i>Amphiesma stolatum</i>	Striped Keelback			+	+	>
27	<i>Boiga ochracea</i>	Tawny Cat Snake				+	>
28	<i>Chrysopelea ornata</i>	Omate Flying Snake				+	>
29	<i>Coelognathus radiatus</i>	Copper-headed Trinket Snake				+	
30	<i>Dendrelaphis pictus</i>	Painted Bronzeback Tree Snake				+	>
31	<i>Enhydryis enhydryis</i>	Common Smooth Water Snake	+				
32	<i>Lycodon aulicus</i>	Common Wolf Snake	+	+	+	+	>
33	<i>Psammodynastes pulverulentus</i>	Mock Viper				+	
34	<i>Ptyas korros</i>	Indo-Chinese Rat Snake				+	
35	<i>Ptyas mucosa</i>	Indian Rat Snake			+	+	>
36	<i>Rhabdophis subminiatus</i>	Red-necked Keelback				+	
37	<i>Xenochrophis piscator</i>	Checkered Keelback	+	+	+	+	>
	Family: Elapidae						
38	<i>Bungarus caeruleus</i>	Common Krait			+	+	>
39	<i>Bungarus fasciatus</i>	Banded Krait				+	>
40	<i>Bungarus niger</i>	Greater Black Krait				+	>
41	<i>Naja kaouthia</i>	Monocled Cobra			+		
42	<i>Naja naja</i>	Spectacled Cobra			+	+	>
43	<i>Ophiophagus hannah</i>	King Cobra (VU)				+	
	Family: Viperidae						
44	<i>Cryptelytrops erythrurus</i>	Spot-tailed Pit Viper	+			+	>

AMPHIBIANS

SI No	Scientific Name	English Name	Waterbody in Whykong	Waterbody in Nayapara	N.I. Chowdhury Road and Foliapara Primary School Road	Palongkhali -Sepotkhali Road	Cox's Bazar-Teknaf Highway
	ORDER: ANURA						
	Family: Bufonidae						
1	<i>Duttaphrynus melanostictus</i>	Common Toad	+	+	+	+	+
	Family: Megophryidae						
2	<i>Leptobrachium smithi</i>	Smith's Litter Frog	+			+	
3	<i>Megophrys parva</i>	Crown Frog				+	
	Family: Microhylidae						
4	<i>Kaloula pulchra</i>	Asian Painted Frog	+			+	+
5	<i>Microhyla berdmorei</i>	Berdmore's Microhylid Frog	+	+	+	+	+
6	<i>Microhyla mymensinghensis</i>	Mymensingh Microhylid Frog	+			+	+
	Family: Dicroglossidae						
7	<i>Euphlyctis cyanophlyctis</i>	Common Skipper Frog	+	+	+	+	+
8	<i>Fejervarya asmati</i>	Asmat's Cricket Frog	+	+	+	+	+
9	<i>Fejervarya nepalensis</i>	Nepal Cricket Frog	+				
10	<i>Fejervarya pierrei</i>	Pierre's Cricket Frog	+		+	+	+
11	<i>Fejervarya syhadrensis</i>	Syhadra Cricket Frog				+	
12	<i>Hoplobatrachus tigerinus</i>	Indian Bull Frog	+	+	+	+	+
	Family: Ranidae						
13	<i>Clinotarsus alticola</i>	Point-nosed Frog	+			+	+
14	<i>Hylarana leptoglossa</i>	Cope's Frog	+			+	+
15	<i>Hylarana taipehensis</i>	Two-striped Grass Frog				+	
	Family: Rhacophoridae						
16	<i>Chiromantis vittatus</i>	Two-striped Pigmy Tree Frog				+	
17	<i>Polypedates leucomystax</i>	Common Tree Frog	+	+	+	+	+
18	<i>Polypedates maculatus</i>	Maculated Tree Frog				+	+

Appendix V. List of higher plants recorded in some selected sites in Ukhiya and Teknaf, Cox's Bazar ('+' means 'recorded'). Notably, there is no globally threatened pr endemic species.

Sl No	Scientific Name	English Name	Waterbody in Whykong	Waterbody in Nayapara	N.I. Chowdhury Road and Foliapara Primary School Road	Palongkhali-Sepotkhali Road	Cox's Bazar-Teknaf Highway
	Family: Huperziaceae						
1	<i>Phlegmariurus phlegmaria</i>	Common Tassel Fern				+	+
	Family: Selaginellaceae						
2	<i>Selaginella ciliaris</i>	Ciliated Spike Moss					+
	Family: Salviniaceae						
3	<i>Salvinia cucullata</i>	Aquatic Fern	+				
4	<i>Salvinia natans</i>	Aquatic Fern	+				
	Family: Lygodiaceae						
5	<i>Lygodium flexuosum</i>	Climbing Fern	+			+	+
	Family: Pteridaceae						
6	<i>Pteris vittata</i>	Fern	+	+	+	+	+
	Family: Dennstaedtiaceae						
7	<i>Microlepia speluncae</i>	Lacy Fern	+		+	+	+
	Family: Polypodiaceae						
8	<i>Microsorium punctatum</i>	Fern				+	+
9	<i>Drynaria quercifolia</i>	Bird-nest Fern			+	+	+
	Family: Acanthaceae						
10	<i>Acanthus ilicifolius</i>	Holy-leafed Acanthus				+	
11	<i>Dipteracanthus prostratus</i>	-	+			+	
12	<i>Hygrophila schulli</i>	Starthorn	+				
13	<i>Thunbergia grandiflora</i>	Black Clock Vine	+		+	+	+
	Family: Amaranthaceae						
14	<i>Achyranthes aspera</i>	Prickly Chaff-flower	+	+	+	+	+
15	<i>Alternanthera philoxeroides</i>	Alligator Weed	+	+	+	+	+
16	<i>Amaranthus spinosus</i>	Spiny Amaranth	+	+	+	+	+
	Family: Anacardiaceae						
17	<i>Anacardium occidentale</i>	Cashew Nut			+	+	
18	<i>Buchanania lanzan</i>	Cuddapah-almond				+	+
19	<i>Mangifera indica</i>	Mango			+	+	+
20	<i>Mangifera sylvatica</i>	Wild Mango				+	
21	<i>Swintonia floribunda</i>	-				+	
	Family: Annonaceae						
22	<i>Annona reticulata</i>	Bullock's Heart			+		+
23	<i>Desmos chinensis</i>	Dwarf Ylang-ylang				+	
24	<i>Polyalthia suberosa</i>	-	+		+	+	+
	Family: Apiaceae						
25	<i>Centella asiatica</i>	Indian Pennywort	+	+	+	+	+
	Family: Apocynaceae						
26	<i>Allamanda cathartica</i>	Common Allamanda			+		
27	<i>Catharanthus roseus</i>	Madagascar Periwinkle			+	+	
28	<i>Holarrhena antidysenterica</i>	Kurchi Tree				+	+
29	<i>Rauvolfia serpentina</i>	Serpentina				+	
	Family: Asclepiadaceae						
30	<i>Calotropis gigantea</i>	Crown Flower	+	+	+	+	+
31	<i>Pergularia daemia</i>	Pergularia				+	
	Family: Asteraceae						
32	<i>Ageratum conyzoides</i>	Billy Goat Weed	+	+	+	+	+
33	<i>Chromolaena odorata</i>	Triffid Weed	+	+	+	+	+
34	<i>Cirsium arvense</i>	Canada Thistle				+	+
35	<i>Crassocephalum crepidioides</i>	Redflower Ragleaf	+	+	+	+	+
36	<i>Eclipta alba</i>	False Daisy	+	+	+	+	+
37	<i>Enhydra fluctuans</i>	-	+	+			
38	<i>Grangea maderaspatana</i>	-	+	+	+	+	+
39	<i>Sphaeranthus indicus</i>	East Indian Globe-thistle	+	+	+	+	
40	<i>Spilanthes calva</i>	-	+	+		+	
41	<i>Tridax procumbens</i>	Coat Button	+	+	+	+	+
42	<i>Vernonia cinerea</i>	Little Ironweed	+	+	+	+	+
43	<i>Xanthium indicum</i>	Rough Cocklebur	+	+	+	+	+
	Family: Begoniaceae						
44	<i>Basella rubra</i>	Sri Lankan Spinach				+	+
	Family: Bignoniaceae						
45	<i>Oroxylum indicum</i>	Midnight Horror				+	+
	Family: Bombacaceae						
46	<i>Bombax ceiba</i>	Red Silk Cotton Tree			+	+	+
47	<i>Bombax insigne</i>	-				+	+

	Family: Boraginaceae						
48	<i>Cordia dichotoma</i>	Indian Cherry	+			+	+
49	<i>Heliotropium indicum</i>	Indian Heliotrop	+	+	+	+	+
	Family: Burseraceae						
50	<i>Garuga pinnata</i>	Grey Downy Balsam				+	+
51	<i>Protium serratum</i>	Indian Red Pear				+	+
	Family: Caesalpinaceae						
52	<i>Cassia roxburghii</i>	Roxburgh's Cassia				+	+
53	<i>Delonix regia</i>	Peacock Flower			+		+
54	<i>Senna occidentalis</i>	Coffee Senna	+	+	+	+	+
55	<i>Tamarindus indica</i>	Tamarind			+	+	+
	Family: Caricaceae						
56	<i>Carica papaya</i>	Papaya			+		+
	Family: Casuarinaceae						
57	<i>Casuarina equisetifolia</i>	Australian Pine				+	
	Family: Combretaceae						
58	<i>Terminalia catappa</i>	Indian Almond			+	+	+
	Family: Convolvulaceae						
59	<i>Argyreia roxburghii</i>	-	+			+	+
60	<i>Ipomoea aquatica</i>	Swamp Cabbage	+	+	+	+	+
61	<i>Merremia umbellata</i>	-	+			+	+
	Family: Cucurbitaceae						
62	<i>Benincasa hispida</i>	Wax Gourd			+	+	+
63	<i>Citrullus lanatus</i>	Watermelon				+	+
64	<i>Coccinia grandis</i>	Ivy Gourd	+	+	+	+	+
65	<i>Cucurbita maxima</i>	Pumpkin			+		+
66	<i>Lagenaria siceraria</i>	Bottle Gourd			+	+	+
67	<i>Thladiantha cordifolia</i>	Golden Creeper	+	+	+	+	+
	Family: Dilleniaceae						
68	<i>Dillenia indica</i>	Elephant Apple			+	+	+
	Family: Dipterocarpaceae						
69	<i>Dipterocarpus alatus</i>	-			+	+	+
70	<i>Dipterocarpus turbinatus</i>	Garjan-oil Tree			+	+	+
	Family: Euphorbiaceae						
71	<i>Antidesma buniis</i>	-				+	
72	<i>Croton bonplandianus</i>	Bonplant's Croton	+	+	+	+	+
73	<i>Euphorbia hirta</i>	Snake Weed	+	+	+	+	+
74	<i>Glochidion lanceolarium</i>	Large-leaved Abacus Plant				+	
75	<i>Jatropha gossypifolia</i>	Bellyache Nettle Spurge	+		+	+	+
76	<i>Phyllanthus reticulatus</i>	Reticulated Leaf-flaver	+	+	+	+	+
77	<i>Ricinus communis</i>	Castor	+			+	
	Family: Fabaceae						
78	<i>Clitoria ternatea</i>	Butterfly Pea				+	
79	<i>Crotalaria quinquefolia</i>	-	+	+		+	+
80	<i>Desmodium triflorum</i>	-	+	+	+	+	+
81	<i>Erythrina fusca</i>	Erythrina			+		+
82	<i>Erythrina variegata</i>	Indian Coral Tree				+	+
83	<i>Lablab purpureus</i>	Hyacinth Bean				+	+
84	<i>Sesbania grandiflora</i>	-					+
	Family: Lamiaceae						
85	<i>Leucas aspera</i>	-	+	+	+	+	+
86	<i>Ocimum americanum</i>	-	+	+		+	+
	Family: Lentibulariaceae						
87	<i>Utricularia stellaris</i>	Star Bladderwort	+				
	Family: Loranaceae						
88	<i>Dendrophthoe falcata</i>	-			+	+	+
	Family: Lythraceae						
89	<i>Lagerstroemia speciosa</i>	Queen Flower					+
90	<i>Lawsonia inermis</i>	Henna			+		+
	Family: Malvaceae						
91	<i>Abelmoschus moschatus</i>	Musk-mallow				+	
92	<i>Abutilon indicum</i>	Indian Mallow	+	+	+	+	+
93	<i>Hibiscus rosa-sinensis</i>	China Rose			+		+
94	<i>Hibiscus sabdariffa</i>	Roselle				+	+
95	<i>Hibiscus surattensis</i>	Wild Sour	+			+	
96	<i>Malvastrum coromandelianum</i>	Coromandel Malva	+	+	+	+	+
	Family: Melastomataceae						
97	<i>Melastoma malabathricum</i>	Indian Rhododendron	+	+		+	+
	Family: Meliaceae						
98	<i>Swietenia mahagoni</i>	Small-leaved Mahogoni				+	+
	Family: Menyanthaceae						
99	<i>Nymphoides indicum</i>	Water Snowflake	+				
	Family: Mimosaceae						
100	<i>Acacia auriculiformes</i>	Ear-pod Wattle			+		+

101	<i>Albizia lebbeck</i>	Siris Tree			+	+	+
102	<i>Albizia procera</i>	White Siris			+	+	+
103	<i>Mimosa pudica</i>	Sensitive Plant	+	+	+	+	+
104	<i>Samanea saman</i>	Rain Tree				+	+
	Family: Moraceae						
105	<i>Artocarpus chama</i>	Monkey Jack				+	+
106	<i>Artocarpus heterophyllus</i>	Jackfruit			+	+	+
107	<i>Artocarpus lacucha</i>	Monkey Jack			+		+
108	<i>Ficus benghalensis</i>	Banyan Tree			+	+	+
109	<i>Ficus hispida</i>	Opposite-leaved Fig	+	+	+	+	+
110	<i>Ficus racemosa</i>	Cluster Fig				+	+
111	<i>Ficus religiosa</i>	Peepal Tree			+	+	+
	Family: Moringaceae						
112	<i>Moringa oleifera</i>	Drumstick Tree			+	+	+
	Family: Myrtaceae						
113	<i>Callistemon citrinus</i>	Red Bottle Brush					+
114	<i>Eucalyptus citriodora</i>	Lemon-scented Spotted Gum					+
115	<i>Psidium guajava</i>	Guava			+	+	+
116	<i>Syzygium cumini</i>	Black Berry			+	+	+
117	<i>Syzygium fruticosum</i>	-				+	
118	<i>Syzygium samarangense</i>	Wax Jambu			+		+
	Family: Nyctaginaceae						
119	<i>Mirabilis jalapa</i>	Beauty of the Night				+	+
	Family: Nympheaceae						
120	<i>Nymphaea nouchali</i>	Blue Water Lily	+				+
	Family: Onagraceae						
121	<i>Ludwigia adscendens</i>	-	+	+		+	
	Family: Oxalidaceae						
122	<i>Oxalis corniculata</i>	Indian Sorrel	+	+	+	+	+
	Family: Piperaceae						
123	<i>Peperomia pellucida</i>	Peperomia	+	+	+	+	+
124	<i>Piper betle</i>	Betel			+	+	+
	Family: Polygonaceae						
125	<i>Persicaria flaccida</i>	-	+	+	+	+	+
126	<i>Persicaria lapathifolia</i>	Green Smartweed	+	+	+	+	+
127	<i>Persicaria viscosa</i>	Sticky Knotweed	+	+		+	
	Family: Portulacaceae						
128	<i>Portulaca oleracea</i>	Common Purslane	+	+	+	+	+
	Family: Rhamnaceae						
129	<i>Ziziphus mauritiana</i>	Indian Plum			+	+	+
	Family: Rosaceae						
130	<i>Rosa chinensis</i>	Tea Rose			+		+
	Family: Rubiaceae						
131	<i>Gardenia latifolia</i>	-			+		
132	<i>Ixora acuminata</i>	-				+	
133	<i>Mussaenda roxburghii</i>	-				+	+
	Family: Rubiaceae						
134	<i>Neolamarckia cadamba</i>	-				+	+
135	<i>Spermacoce latifolia</i>	-	+			+	
	Family: Rutaceae						
136	<i>Citrus aurantifolia</i>	Common Lime			+		+
137	<i>Citrus maxima</i>	Pummelo			+	+	+
138	<i>Glycosmis pentaphylla</i>	Tooth-brush Plant	+			+	
	Family: Sapindaceae						
139	<i>Litchi chinensis</i>	Litchi			+		+
	Family: Solanaceae						
140	<i>Brugmansia suaveolens</i>	Angel's Trumpet					+
141	<i>Capsicum frutescens</i>	Spur Pepper					+
142	<i>Datura metel</i>	Thorn Apple			+		+
143	<i>Solanum melongena</i>	Brinjal				+	+
144	<i>Solanum sisymbirifolium</i>	Prickly Brinjal				+	+
145	<i>Solanum torvum</i>	Devil's Fig	+			+	
	Family: Urticaceae						
146	<i>Laportea interrupta</i>	-	+	+	+	+	+
	Family: Verbenaceae						
147	<i>Callicarpa arborea</i>	-				+	+
148	<i>Clerodendrum viscosum</i>	-				+	+
149	<i>Lantana camara</i>	Lilac Lantana				+	+
150	<i>Phyla nodiflora</i>	Cape-weed	+	+	+	+	+
151	<i>Premna esculenta</i>	-	+	+		+	
	Family: Araceae						
152	<i>Aglaonema hookerianum</i>	-				+	
153	<i>Alocasia macrorrhizos</i>	Giant Taro			+	+	+
154	<i>Amorphophallus paeoniifolius</i>	Elephant-yam				+	
155	<i>Homalomena aromatica</i>	-				+	+
156	<i>Pistia stratiotes</i>	Water Lettuce	+	+			
157	<i>Rhaphidophora aurea</i>	Money Plant					+
158	<i>Syngonium podophyllum</i>	Arrow-head Vine	+			+	+
	Family: Arecaceae						

159	<i>Areca catechu</i>	Betel-nut Palm			+	+	+
160	<i>Borassus flabellifer</i>	Palmyra Palm					+
161	<i>Caryota urens</i>	Indian Sago Palm				+	
162	<i>Cocos nucifera</i>	Coconut Palm			+	+	+
163	<i>Nypa fruticans</i>	Nipa Palm					+
164	<i>Phoenix sylvestris</i>	Date Palm			+		+
165	<i>Pinanga gracilis</i>	Himalayan Pinanga	+				
	Family: Commelinaceae						
166	<i>Commelina benghalensis</i>	Blue Commelina	+	+	+	+	+
167	<i>Cyanotis cristata</i>	-	+	+	+	+	+
	Family: Costaceae						
168	<i>Costus speciosus</i>	Spiral Ginger	+			+	
	Family: Cyperaceae						
169	<i>Cyperus compressus</i>	Poorland Flat-sedge	+	+	+	+	+
170	<i>Cyperus difformis</i>	Small Flower Umbrella Plant	+	+	+	+	+
171	<i>Fimbristylis dichotoma</i>	Tall Fringe-rush	+	+	+	+	+
	Family: Lemnaceae						
172	<i>Lemna perpusilla</i>	Minute Duckweed	+	+	+	+	+
	Family: Musaceae						
173	<i>Musa ornata</i>	Bronze Banana				+	+
174	<i>Musa paradisiaca</i>	Banana			+	+	+
	Family: Orchidaceae						
175	<i>Acampe ochracea</i>	-				+	
176	<i>Cymbidium aloifolium</i>	-				+	+
177	<i>Papilionanthe teres</i>	-				+	+
178	<i>Rhynchostylis retusa</i>	Fox-tail Orchid			+	+	+
	Family: Poaceae						
179	<i>Bambusa balcooa</i>	Bhalku Bamboo			+	+	+
180	<i>Bambusa tulda</i>	Tulda Bamboo			+	+	+
181	<i>Melocanna baccifera</i>	Berry Bamboo				+	+
182	<i>Chrysopogon aciculatus</i>	Love Grass	+	+	+	+	+
183	<i>Imperata cylindrica</i>	Cogon Grass	+	+	+	+	+
184	<i>Saccharum spontaneum</i>	Wild Sugarcane				+	+
185	<i>Cynodon dactylon</i>	Bahama Grass	+	+	+	+	+
186	<i>Oryza sativa</i>	Rice			+	+	+
	Family: Pontederiaceae						
187	<i>Eichhornia crassipes</i>	Water Hyacinth	+			+	+
188	<i>Monochoria hastata</i>	Arrowleaf False Pickereweed	+			+	
	Family: Typhaceae						
189	<i>Typha domingensis</i>	Cat Tail				+	+
	Family: Zingiberaceae						
190	<i>Curcuma zedoaria</i>	Zedoary				+	+
191	<i>Zingiber officinale</i>	Ginger				+	

Appendix VI. List of fishes recorded in the waterbody of Whykong, Cox's Bazar ('+' means 'recorded'). N.B. i) The waterbody in Nayapara had very little (mostly polluted) water during the survey, so no fish species was recorded. Notably, there is no globally threatened or endemic species.

SI No	Scientific Name	English Name	Waterbody in Whykong	Waterbody in Nayapara
	ORDER: CLUPEIFORMES Family: Clupeidae			
1	<i>Gudusia chapra</i>	Indian River Shad	+	
	ORDER: PERCIFORMES Family: Channidae			
2	<i>Channa orientalis</i>	Asiatic Snakehead	+	
3	<i>Channa punctatus</i>	Spotted Snakehead	+	
4	<i>Channa striatus</i>	Snakehead Murrel	+	
	ORDER: CYPRINIFORMES Family: Cyprinidae			
5	<i>Catla catla</i>	Catla	+	
6	<i>Esomus danricus</i>	Flying Barb	+	
7	<i>Labeo calbasu</i>	Black Rohu	+	
8	<i>Labeo rohita</i>	Rohu	+	
9	<i>Puntius chola</i>	Swamp Barb	+	
10	<i>Puntius ticto</i>	Ticto Barb	+	
	Family: Cobitidae			
11	<i>Lepidocephalichthys annandalei</i>	Annandale Loach	+	
	ORDER: SILURIFORMES Family: Claridae			
12	<i>Clarias batrachus</i>	Walking Catfish	+	
	Family: Heteropneustidae			
13	<i>Heteropneustes fossilis</i>	Stinging Catfish	+	
	ORDER: CYPRINODONTIFORMES Family: Aplocheilidae			
14	<i>Aplocheilichthys panchax</i>	Panchax Minnow	+	
	ORDER: PERCIFORMES Family: Ambassidae			
15	<i>Chanda nama</i>	Elongate Grass-perchlet	+	
16	<i>Pseudambassis ranga</i>	Indian Glassy Fish	+	
	Family: Nandidae			
17	<i>Nandus nandus</i>	Mottled Nandus	+	
	Family: Badidae			
18	<i>Badis badis</i>	Badis	+	
	Family: Anabantidae			
19	<i>Anabas testudineus</i>	Climbing Perch	+	
	Family: Osphronemidae			
20	<i>Colisa fasciata</i>	Striped Gourami	+	
	Family: Belonidae			
21	<i>Xenentodon cancila</i>	Freshwater Garfish	+	
	ORDER: SYNBRANCHIFORMES Family: Mastacembelidae			
22	<i>Macrognathus aculeatus</i>	Lesser Spiny Eel	+	
23	<i>Macrognathus pancalus</i>	Striped Spiny Eel	+	

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