

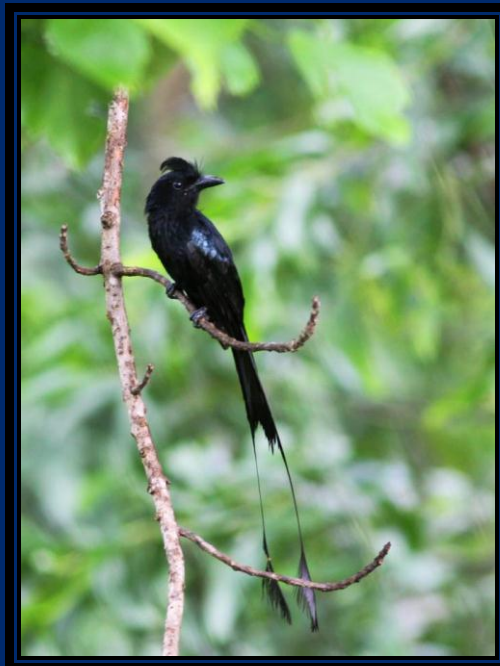


USAID
FROM THE AMERICAN PEOPLE

ipac

INTEGRATED PROTECTED AREA CO-MANAGEMENT (IPAC)

PARTICIPATORY BIRD MONITORING TO ASSESS THE MANAGEMENT
IMPACTS IN INTEGRATED PROTECTED AREA CO-MANAGEMENT SITES:
BASELINE REPORT



03 March 2010

This report was produced for review by the United States Agency for International Development (USAID).

Cover Photo:

Indicator birds are resident forest birds identified as proxy indicators set to portray biophysical changes in forest ecosystem with the advent of co-management approach. This measure has been incorporated in the design of IPAC project under custom indicator 15:- “increase in the density of indicator bird species in wetlands and forested landscapes”. The cover photo is of Greater Racket-tailed Drongo (*Dicrurus paradiseus*) an indicator species selected for four forest PAs covered in the study (Khadimnagar NP, Kaptai NP, Fasiakhali WS and Medakachapia NP).

INTEGRATED PROTECTED AREA CO-MANAGEMENT (IPAC)

PARTICIPATORY BIRD MONITORING TO ASSESS THE MANAGEMENT IMPACTS IN INTEGRATED PROTECTED AREA CO-MANAGEMENT SITES: BASELINE REPORT

USAID Contract N° EPP-I-00-06-00007-00

Task Order No: EPP-I-01-06-00007-00

03 March 2010

Submitted to:
USAID/Bangladesh

Submitted By:

M. Monirul H. Khan, PhD
Associate Professor of Zoology
Jahangirnagar University
Savar, Dhaka 1342, Bangladesh
E-mail: mmhkhan@hotmail.com

International Resources Group (IRG)
With subcontractors:
WWF-USA, dTS, East-West Center
Environmental Law Institute, Epler-Wood International
The WorldFish Center, CNRS, CODEC
BELA, Asiatic M&C, Oasis Transformation, Module Architects, IUB/JU

DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government

CONTENTS

SUMMARY	5
1. Introduction	7
2. Project Sites.....	9
3. Material and Methods	17
3.1. Material Used.....	17
3.2. Selection of Indicator Birds.....	17
3.3. Monitoring Team	20
3.4. Monitoring Methods	20
3.4.1 Strip Transect Sampling.....	22
3.4.2 Opportunistic (Ad Libitum) Sampling.....	23
4. Results and Discussion.....	25
4.1. Population Densities of Indicator Bird Species	25
4.2. Bird Species Diversity	28
4.3. Threats to Birds and Their Habitats	38
References	39
Appendix I.A sample of the data sheet for bird monitoring	41

SUMMARY

Integrated Protected Area Co-management (IPAC) is a project of Bangladesh Forest Department, which is being implemented by International Resources Group (IRG) with its local partners, and it is funded by the United States Agency for International Development (USAID). Participatory bird monitoring was taken as the tool to assess the management impacts of IPAC, initially in five Protected Areas. Birds are relatively more visible and more responsive to any change in their habitats. This was the first year's (March-October 2009; c. 30 observation-days in the field) baseline survey that will be repeated annually. Strip-transect sampling and opportunistic survey methods were followed in the field.

Four of the five sites were mixed-evergreen forests, for which the ten indicator birds were Greater Racket-tailed Drongo (*Dicrurus paradisus*), Crested Serpent Eagle (*Spilornis cheela*), Red Junglefowl (*Gallus gallus*), Green-billed Malkoha (*Phaenicophaeus tristis*), White-rumped Shama (*Copsychus malabaricus*), Hill Myna (*Gracula religiosa*), Puff-throated Babbler (*Pellorneum ruficeps*), Abbott's Babbler (*Malacocincla abbotti*), Scarlet Minivet (*Pericrocotus flammeus*), and Crimson Sunbird (*Aethopyga siparaja*). Their respective densities (no. of individuals/km²) in five IPAC sites were estimated at: Kaptai National Park – 13.7, 2.9, 5.2, 5.5, 13.2, 6.1, 12.3, 24.6, 6.9, 4.3; Fasiakhali Wildlife Sanctuary – 8.3, 1.9, 4.0, 3.4, 9.9, 3.8, 9.7, 17.6, 4.1, 2.7; Meda-Kacchapia National Park – 10.2, 2.3, 4.7, 4.1, 10.2, 4.7, 8.2, 15.5, 6.3, 2.9; Khadimnagar National Park – 11.8, 2.2, 10.7, 4.2, 11.8, 3.3, 9.1, 20.2, 5.9, 4.1; and Madhupur National Park – 6.1, 6.3, 6.9, 9.3, 15.4, 2.8, 3.7, 3.5, 6.1, 5.8.

The only deciduous forest site was Madhupur National Park and the ten indicator birds were Crested Serpent Eagle (*Spilornis cheela*), Red Junglefowl (*Gallus gallus*), Green-billed Malkoha (*Phaenicophaeus tristis*), Spangled Drongo (*Dicrurus hottentottus*), White-rumped Shama (*Copsychus malabaricus*), Black-crested Bulbul (*Pycnonotus melanicterus*), Puff-throated Babbler (*Pellorneum ruficeps*), Abbott's Babbler (*Malacocincla abbotti*), Scarlet Minivet (*Pericrocotus flammeus*), and Crimson Sunbird (*Aethopyga siparaja*). Their respective densities were 6.1, 6.3, 6.9, 9.3, 15.4, 2.8, 3.7, 3.5, 6.1, and 5.8. Out of ten indicator species for four mixed-evergreen forest sites the density was highest for Abbott's Babbler (15.5-24.6/km²). In the only deciduous forest site (Madhupur NP), White-rumped Shama had the highest density (15.4/km²). These baseline estimates of densities of indicator birds will be compared with the coming years' estimates in order to understand the trend of management impacts.

A total of 242 species of birds were recorded in five sites, of which 193 were residents, 39 winter visitors, 6 summer visitors and 4 vagrants. Most (55%) of the birds were insectivorous. Higher proportions of bird species were found to occur in the middle canopy (41%). Most species of birds were relatively rare (35%), which is alarming.

As it was observed in the field, habitat loss in the forms of illegal logging and conversion of forest lands to monoculture plantations and agricultural fields is the biggest threat to birds and other wildlife. To some extent the presence of bird monitoring team as observers, on behalf of IPAC, had discouraged people to illegally log any tree or poach any animal.

1. Introduction

Birds are very good indicators of the ecological changes (Johnston 1956, Morrison 1986, Canterbury *et al.* 2000, Browder 2002), because they are relatively more visible, fast-breeder and more responsive to any change in their habitat. Systematic monitoring of the trend of change in the population density of habitat-specific birds reveals the trend of health of their habitats. The primary assumption was that the population density of a habitat-specific bird will increase, remain unchanged or decrease depending on the improvement, unchange or degradation of that particular habitat. The indicator species of birds must be habitat-specific, i.e. the species that will not survive outside a particular habitat type. It is advised that several species of indicators should be taken so that they represent different strata and different ecological niches. Determination of the extent to which ecological systems are experiencing changes is critical for long-term conservation of biotic diversity in the face of changing landscapes and land use (Canterbury *et al.* 2000).

Bangladesh is exceptionally rich in avifaunal diversity and abundance. Not only is the avifauna, the country is unique in its biodiversity of genetic resources, both wild and domestic. The genetic resources comprise forest resources, agricultural crops, wildlife resources and wetland resources. In an area of only 147,570 km², Siddiqui *et al.* (2008) mentioned the occurrence of 650 species of birds in Bangladesh, and Khan (2008a) mentioned the occurrence of 690 species including 380 residents, 209 winter visitors, 11 summer visitors, and 90 vagrants. This can be compared with the total number of bird species in the whole of Europe, or the United States, which include much bigger area. The total number of bird species recorded in Bangladesh is 50% of the total of the Indian Subcontinent, and 7% of the world's total (Harvey 1990).

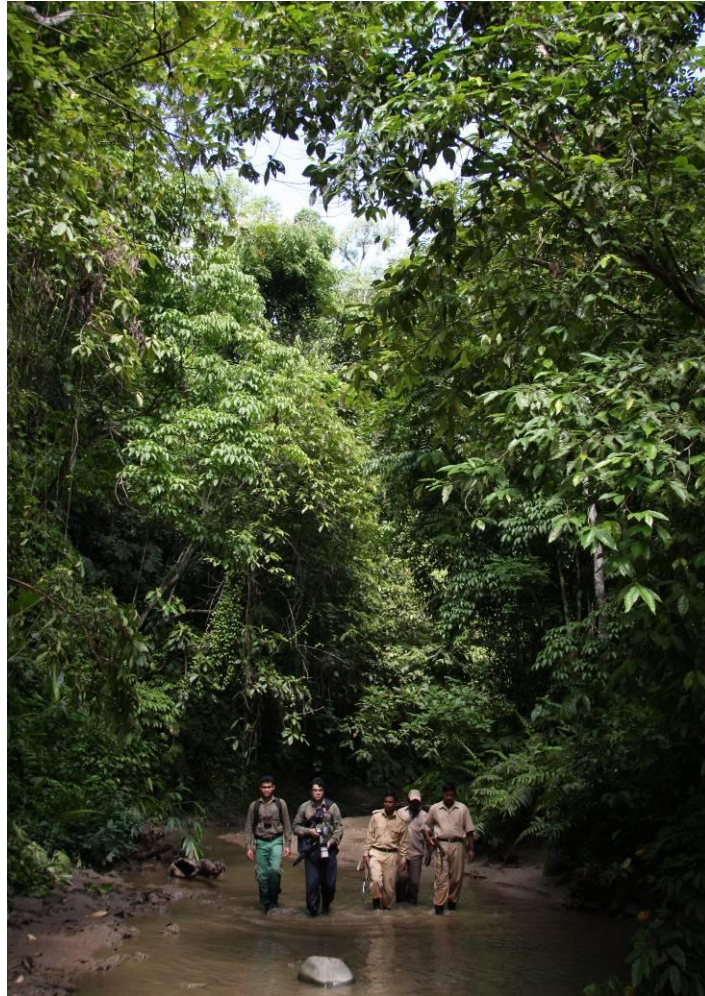
Despite the exceptional richness of avian diversity, and biodiversity in general, the natural forests, wetlands and other wilderness areas of the country are under tremendous pressure of legal and illegal overexploitation, together with improper management. People living around the natural forests and wetlands are largely dependant on the natural resources. Some people almost entirely subsist on the illegal harvest of the timber, bamboo and other forest products. The rate of forest loss in Bangladesh is one of the highest in the world. It is estimated that the forest cover has been reduced to more than 50% since the 1970s (IUCN-Bangladesh 2000). Bangladesh has less than 0.02 ha of forest land per person – one of the lowest forest to population ratios in the world. On the other hand, large areas of wetlands have been converted to agriculture and are overfished.

The urgent need to conserve the remaining natural habitats, together with the biodiversity that these areas support, while developing non-consumptive uses at the same time, gave rise to a unique project,

i.e. Nishorgo Support Project (NSP), in 2004. This five-year project was followed by a similar, but more extensive project, i.e. Integrated Protected Area Co-management (IPAC). The project belongs to Bangladesh Forest Department (FD), Ministry of Environment and Forests, Government of Bangladesh, which is financially supported by the United States Agency for International Development (USAID). The implementing agency of this project is International Resources Group (IRG), with its local partners. The project aims at improving the condition of some forests and wetlands, including the biodiversity, with active participation of the local communities. This will eventually develop a co-management system involving the local communities with the Forest Department.

Like other projects, IPAC requires an assessment of the impact. Systematic annual monitoring of the population density of some selected indicator birds, together with an assessment of overall species diversity of birds, came as the most convenient and useful tool. This is also a way to enrich our knowledge and understanding of birds living in the IPAC sites. Since the fundamental policy of IPAC is to adopt a participatory approach, the bird monitoring followed the same, involving research students, amateur birdwatchers and the people living around the monitoring sites. The participatory bird monitoring had the following objectives –

- Monitor the population density of indicator birds on an annual basis in order to assess the management impacts in IPAC sites.
- Record the status and primary habitats of all the species of birds occur in selected IPAC sites and gather information on the threatened species of birds.
- Train the participants of the monitoring team on the survey method and identification of birds.
- Raise awareness of the general public, especially the stakeholders living around the IPAC sites, to the status of birds and the importance of conservation.



Bird monitoring in the mixed evergreen forest of Kaptai National Park, Rangamati

2. Project Sites

A total of 25 forest and wetland sites are included in IPAC under five clusters, that are situated in different parts of Bangladesh except the northwest. Geographically, Bangladesh is situated between 20°34'-26°33' N latitudes and 88°01'-92°41' E longitudes. The Tropic of Cancer passes through the middle of the country. Bangladesh is almost entirely surrounded by India, which borders Bangladesh to the west, north and east. Bangladesh shares a portion of its southeastern border with Myanmar (Burma). The Bay of Bengal lies to the south. The total area of the country is 147,570 km², where about 140 million people live. This is one of the most densely populated areas in the world. The bigger part of Bangladesh (86%) is composed of floodplains and the rest are hills and highlands. The climate of Bangladesh is tropical monsoon, characterized by marked seasonal variations. Abundant rainfall during the monsoon (July-October) is followed by a cool winter period (November-February), then a hot and dry summer (March-June). In the hot season, the average maximum and minimum

temperatures are 34°C and 21°C, respectively. The average maximum and minimum temperatures in winter are 29°C and 11°C, respectively. The rainfall in the region shows great temporal and spatial variations. It is estimated that 70-80% of the annual rainfall occurs during the monsoon season. The average annual rainfall recorded within Bangladesh varies from 1,100 mm in the extreme west to 5,690 mm in the northeastern corner of the country.

One-tenth (9.8% or 1.45 million ha) of Bangladesh's surface area is under the forest belts (Bangladesh Forest Department and Bangladesh Space Research and Remote Sensing Organization 2008), but the actual coverage of natural forests is less than this, with most of this accounted for by the Sundarbans mangrove forest. There are three classes of natural forests in Bangladesh: a) mangrove forests – situated in the southwest, b) mixed-evergreen forests – situated in the northeast and southeast, and c) deciduous forests – situated in the central, northern and northwestern regions of the country. There are 19 official (declared under Bangladesh Wildlife Act 1974) protected areas in Bangladesh, mostly in the forested areas, with a total area of 2,528.35 km², covering only 1.7% of the total area of Bangladesh.

Bangladesh is a country of wetlands, with 7% (1.03 million ha) of the country permanently always under water, 21% (3.09 million ha) deeply flooded and 35% (5.16 million ha) experiencing shallow inundation during the wet season.

The country has a rich biological heritage as a consequence of its location at the confluence of the two major biotic subregions – the Indo-Himalayas and Indo-China (MacKinnon and MacKinnon 1986). A total of 121 species of mammals, 690 birds, 158 reptiles and 53 amphibians are expected to occur in Bangladesh (Khan 2008a).

Although there are 25 sites under IPAC, the indicator bird monitoring was initially conducted in five priority sites: 1) Kaptai National Park (NP), 2) Fasiakhali Wildlife Sanctuary (WS), 3) Meda-Kacchapia National Park, 4) Khadimnagar National Park, and 5) Madhupur National Park (Table 1, Figures 1 and 2). Notably, all these five sites are under 'New Direct' implementation strategy of IPAC. Two other sites under the same category are Sundarbans East Wildlife Sanctuary and Pablakhali Wildlife Sanctuary, which could not be covered during the monitoring. Currently it is not possible to conduct the monitoring in more than five sites due to lack of necessary support, but as the activities of IPAC will progress, the monitoring will be expanded to other sites, and more local people will be assigned to do it. Moreover, in the areas (e.g. Hail Haor) where systematic counts of birds are conducted by other bodies, the monitoring will be conducted in collaboration.

IPAC Bird Monitoring: Baseline Report

Table 1. Protected areas (National Parks – NP, Wildlife Sanctuaries – WS, and Game Reserve - GR) and other conservation sites under IPAC. Areas where indicator bird monitoring was carried out in 2009 are shown in yellow shades.

Sl. No.	Name of the Area	Type of the Area	Location (District)	Total Area (ha)	Implementation on Strategy*
Sylhet Cluster					
1	Lawachara NP	Mixed-evergreen forest in hillocks	Moulvibazar	1,250	Existing Direct
2	Satchari NP	Mixed-evergreen forest in hillocks	Habiganj	243	Existing Direct
3	Rema-Kalenga WS	Mixed-evergreen forest in hillocks	Habiganj	1,795	Existing Direct
4	Khadimnagar NP	Mixed-evergreen forest in hillocks	Sylhet	679	New Direct
5	Hail Haor	Freshwater wetland	Moulvibazar	13,000	Existing Direct
6	Tanguar Haor (Ecologically Critical Area/ Ramsar Site)	Freshwater wetland	Sunamganj	9,727	New Indirect
7	Hakaluki Haor (Ecologically Critical Area)	Freshwater wetland	Moulvibazar and Sylhet	18,383	New Indirect
Central Cluster					
8	Madhupur NP	Deciduous forest in hillocks	Tangail and Mymensingh	8,436	New Direct
9	Bhawal NP	Deciduous forest in hillocks	Gazipur	5,022	New Indirect
10	Turag-Bangsi	River and floodplain	Gazipur and Tangail	10,000	Existing Direct
11	Kangsa-Malijhi	River and floodplain	Sherpur	8,000	Existing Direct
Southeastern Cluster					
12	Teknaf GR	Mixed-evergreen forest and bamboo in hills	Cox's Bazar	11,615	Existing Direct
13	Teknaf Peninsula (Ecologically Critical Area)	Sea beach and hills	Cox's Bazar	10,465	New Indirect
14	Chunati WS	Bamboo in hills	Chittagong and Cox's Bazar	7,764	Existing Direct
15	Fashiakhali WS	Mixed-evergreen forest in hills	Cox's Bazar	1,302	New Direct
16	Meda-Kacchapia NP	Dipterocarp forest in hillocks	Cox's Bazar	396	New Direct
17	Himchari NP	Mixed evergreen forest in hills	Cox's Bazar	1,729	New Indirect
18	Inani (proposed NP)	Sea beach and hills	Cox's Bazar	7,700	New Indirect
19	Sitakunda Eco-Park	Mixed-evergreen forest in hills	Chittagong	808	New Indirect

IPAC Bird Monitoring: Baseline Report

Sl. No.	Name of the Area	Type of the Area	Location (District)	Total Area (ha)	Implementation Strategy*
Chittagong Hill Tracts Cluster					
20	Kaptai NP	Mixed-evergreen forest in hills	Rangamati	5,464	New Direct
21	Pablakhali WS	Mixed-evergreen forest in hills	Rangamati	42,087	New Direct
Sundarbans Cluster					
22	Sundarbans East WS (World Heritage Site/ Ramsar Site)	Mangrove forest in lowland coast	Bagerhat	31,226	New Direct
23	Sundarbans South WS (World Heritage Site/ Ramsar Site)	Mangrove forest in lowland coast	Khulna	36,970	New Indirect
24	Sundarbans West WS (World Heritage Site/ Ramsar Site)	Mangrove forest in lowland coast	Satkhira	71,502	New Indirect
25	Sundarbans (Ecologically Critical Area)	Mangrove forest in lowland coast and surrounding villages	Bagerhat, Khulna and Satkhira	59,600	New Indirect

* Note: Existing Direct – five sites that were under NSP and now under IPAC, New Direct – high priority sites of IPAC, and New Indirect – low priority sites of IPAC.

IPAC Bird Monitoring: Baseline Report

Table 2. Strip transects in five sites of IPAC where the bird monitoring was conducted

Name of Project Site	Name of Transect	Location in Project Site	Geographic Locations of Two Ends	Landmarks at Two Ends	Length (km)
<i>Kaptai National Park</i>	Rampahar Stream	Northwest	22°29.709' N, 92°11.123' E; 22°30.469' N, 92°10.440' E	Balurchar, intersection	1.80
	Rampahar Hill	West	22°30.469' N, 92°10.440' E; 22°29.880' N, 92°10.583' E	Intersection, culvert	1.10
	Jamaichara	Southwest	22°29.668' N, 92°10.683' E; 22°29.345' N, 92°10.752' E	Karnaphuli south bank, narrow pass	0.61
	Rangamati Road	Centre	22°30.663' N, 92°12.451' E; 22°30.937' N, 92°12.182' E	Milestone, forest end	0.69
	Bangchari	Centre	22°30.040' N, 92°11.697' E; 22°31.576' N, 92°11.138' E	Main road, Debachari	3.00
<i>Fasiakhali Wildlife Sanctuary</i>	Lama Road	Centre	21°43.090' N, 92°05.516' E; 21°42.761' N, 92°06.408' E	Cox's Bazar Road, culvert	1.70
	Natunpahar East	West	21°42.338' N, 92°04.765' E; 21°42.369' N, 92°05.315' E	Natunpahar mosque, Garzanbunia	0.95
<i>Meda-Kacchapia National Park</i>	Meda-Kacchapia East	East	21°38.484' N, 92°04.402' E; 21°38.329' N, 92°05.080' E	Cox's Bazar road, Kurahari	1.20
	Meda-Kacchapia West	West	21°38.632' N, 92°04.392' E; 21°38.783' N, 92°03.592' E	Cox's Bazar Road, Kacchapia office	1.40
<i>Khadimnagar National Park</i>	Kalagool Road	West	24°57.248' N, 91°56.311' E; 24°56.673' N, 91°55.689' E	Khadimnagar office, Kalagool	1.50
	Khadimnagar Central	Centre	24°56.677' N, 91°56.391' E; 24°57.248' N, 91°56.311' E	South border, Khadimnagar office	1.10
	Choragang Road	East	24°57.248' N, 91°56.311' E; 24°56.975' N, 91°57.198' E	Hindur Jhiri, brick field	1.91
<i>Madhupur National Park</i>	Rasulpur	East	24°41.342' N, 90°08.350' E; 24°41.488' N, 90°07.015' E	Rasulpur office, Koia Pukur	2.30
	Jalui	East	24°41.342' N, 90°08.350' E; 24°40.779' N, 90°07.683' E	Rasulpur office, Jalui office	1.50
	Lahoria	Centre	24°41.730' N, 90°06.283' E; 24°41.631' N, 90°05.760' E	Lahoria office, west intersection	0.90
	Monar Bide	West	24°40.211' N, 90°06.287' E; 24°40.811' N, 90°06.137' E	Metalled road, Gaira	1.10

IPAC Clusters and Sites

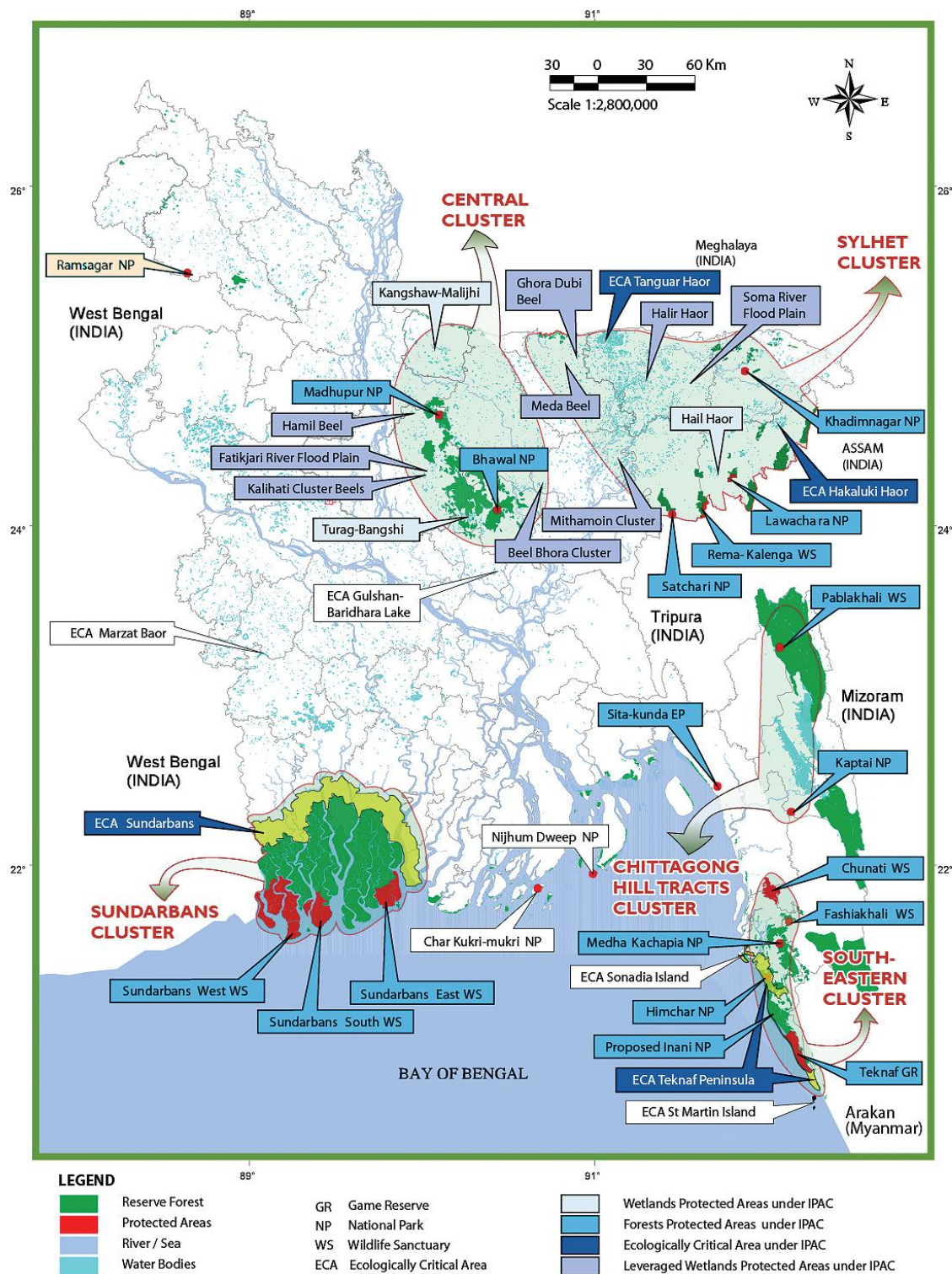
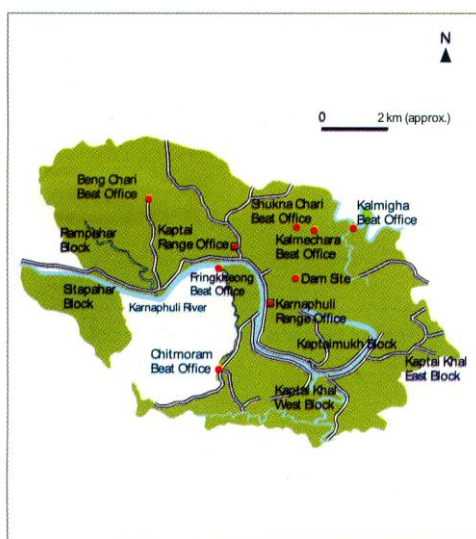
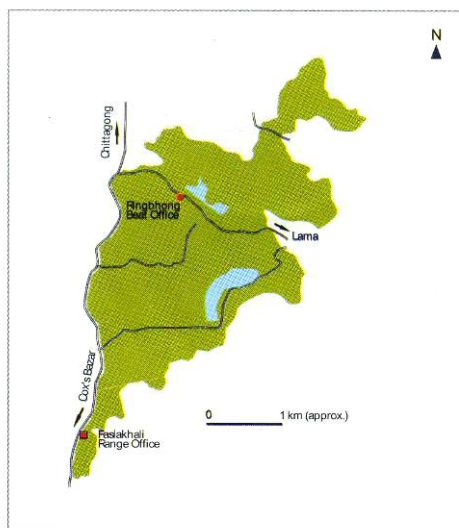


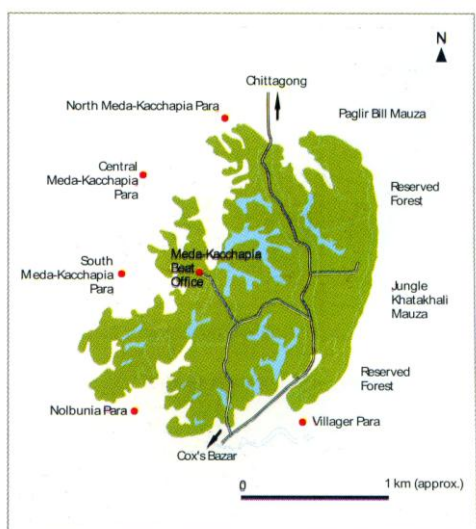
Figure 1. Bangladesh showing the locations of all sites of IPAC under five clusters.



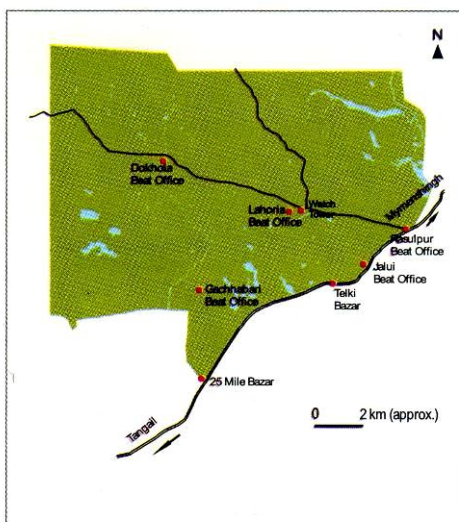
Kaptai National Park



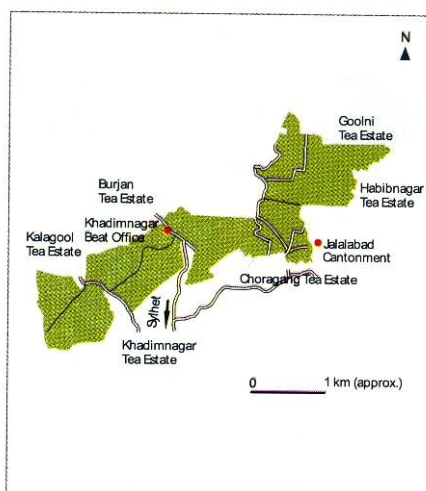
Fasiakhali Wildlife Sanctuary



Meda-Kacchapia National Park



Madhupur National Park



Khadimnagar National Park

Figure 2. Five sites of IPAC where the bird monitoring was conducted.



Views of five sites of IPAC where the bird monitoring was conducted: a) Kaptai NP, b) Fasiakhali WS, c) Meda-Kacchapia NP, d) Khadimnagar NP, and e) Madhupur NP.

3. Material and Methods

3.1. Material Used

Since the monitoring will be conducted by following simple methods (so that the local communities could participate), no sophisticated equipment was necessary for data collection and analyses. A few things that were used in the field are binoculars (Nikon 10x30) for better observation and identification of birds, books (Ali and Ripley 1987, Grimmett *et al.* 1998, Kazmierczak 2000, Rasmussen and Anderton 2005, Siddiqui *et al.* 2008, Khan 2008a) on birds for identification, a GPS (Geographic Positioning System; E-trex Vista C) to mark the start and end points of each transect, and to measure the distance of each transect, a compass to make sure that the monitoring team moves straight (roughly), and standard data sheets (see Appendix I) to record the raw data in the field. Two Canon EOS 50D digital camera bodies, two Canon lenses (300 mm and 17-85 mm) and one Canon Speedlight 580 EX-II-800 were used to take photographs of birds. The sound recorders (Marantz recorder and Sennheizer microphone) were used to record the sounds of birds. The photographs and recorded sounds of birds not only were used to correctly identify the birds, but were good documents. Moreover, a pair of Motorola two-way radios (range: 8 km) were used for communication whenever the monitoring team was scattered.

3.2. Selection of Indicator Birds

A total of ten species of birds were selected as indicators for assessment of the overall condition of wilderness in each of the two different habitat types: a) mixed-evergreen forest, and b) deciduous forest (Tables 2a, 2b). Among these, Greater Racket-tailed Drongo *Dicrurus paradiseus* and Crested Serpent Eagle *Spilornis cheela* were selected as charismatic special indicators for mixed evergreen forests and deciduous forests, respectively. Notably, seven of the indicator birds were common in all the five monitoring sites. The ten indicator species were selected considering the following aspects –

- Habitat-specific birds that will not colonize outside the particular habitat
- Live in different strata or microhabitat and normally feed on different types of food
- Relatively more sensitive to any change in their habitat
- Mostly noisy and colorful birds (least likely to miss during the counts)
- Breeding residents.

Notably, five of the selected indicator birds (Tables 3a, 3b), i.e. Red Junglefowl (*Gallus gallus*), Greater Racket-tailed Drongo (*Dicrurus paradiseus*), White-rumped Shama (*Copsychus malabaricus*), Hill Myna (*Gracula religiosa*) and Puff-throated Babbler (*Pellorneum ruficeps*) were previously used as indicators

during NSP and were found suitable (Khan 2008b). Three other species, i.e. Oriental Pied Hornbill (*Anthracoceros albirostris*), Red-headed Trogon (*Harpactes erythrocephalus*) and White-crested Laughingthrush (*Garrulax leucolophus*), that were used as indicators during NSP, were found unsuitable as indicators since they are either absent or extremely rare in four mixed-evergreen forest sites where the monitoring was conducted.

It is assumed that the improvement or degradation of the forest condition will have a direct impact on the feeding and breeding successes of the indicator birds, which in turn will be reflected in the changes of the population densities of these species (Morrison 1986, Temple and Wiens 1989, Canterbury *et al.* 2000, Browder *et al.* 2002).

Table 3a. Ten indicator bird species for mixed evergreen forest sites

Sl. No.	English Name	Scientific Name	Forest Stratum Where it Primarily Lives	Main Food
1	Greater Racket-tailed Drongo	<i>Dicrurus paradisens</i>	Middle	Insects
2	Crested Serpent Eagle	<i>Spilornis cheela</i>	Middle	Small vertebrates
3	Red Junglefowl	<i>Gallus gallus</i>	Ground	Grains
4	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	Middle	Insects
5	White-rumped Shama	<i>Copsychus malabaricus</i>	Middle	Invertebrates
6	Hill Myna	<i>Gracula religiosa</i>	Upper	Fruits
7	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	Ground	Invertebrates
8	Abbott's Babbler	<i>Malacocincla abbotti</i>	Lower	Invertebrates
9	Scarlet Minivet	<i>Pericrocotus flammens</i>	Upper	Insects
10	Crimson Sunbird	<i>Aethopyga siparaja</i>	Middle	Flower nectar



Indicator bird species for IPAC sites: a) Greater Racket-tailed Drongo, b) Crested Serpent Eagle, c) Red Junglefowl, d) Green-billed Malkoha, e) White-rumped Shama, f) Hill Myna, g) Puff-throated Babbler, h) Abbott's Babbler, i) Scarlet Minivet, j) Crimson Sunbird, k) Spangled Drongo, l) Black-crested Bulbul, and m) Orange-headed Thrush

Table 3b. Ten indicator bird species for deciduous forest sites

Sl. No.	English Name	Scientific Name	Forest Stratum Where it Primarily Lives	Main Food
1	Crested Serpent Eagle	<i>Spilornis cheela</i>	Middle	Small vertebrates
2	Red Junglefowl	<i>Gallus gallus</i>	Ground	Grains
3	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	Middle	Insects
4	Spangled Drongo	<i>Dicrurus hottentottus</i>	Middle	Insects
5	White-rumped Shama	<i>Copsychus malabaricus</i>	Middle	Invertebrates
6	Black-crested Bulbul	<i>Pycnonotus melanicterus</i>	Middle	Fruits
7	Puff-throated Babbler	<i>Pellorneum ruficeps</i>	Ground	Invertebrates
8	Abbott's Babbler	<i>Malacocincla abbotti</i>	Lower	Invertebrates
9	Scarlet Minivet	<i>Pericrocotus flammeus</i>	Upper	Insects
10	Crimson Sunbird	<i>Aethopyga siparaja</i>	Middle	Flower nectar

3.3. Monitoring Team

The monitoring team include research students, birdwatchers (mainly from Bangladesh Bird Club), and the local communities living around or close to the project sites, including the local Ecotour Guides and Co-management Council members of NSP/IPAC, together with the local officials of the Forest Department and IPAC. A wildlife expert (Dr M. Monirul H. Khan) from Jahangirnagar University, Savar, Dhaka, had led the whole team. The team members were informally trained before and during the monitoring so that they could play significant role in the survey.

3.4. Monitoring Methods

The methods for bird monitoring were selected on the basis of simplicity and effectiveness so that even the uneducated local people could participate. It was decided that in the forest sites the survey will be conducted in the rainy season (March-October) when the resident birds mainly breed and call, and in the wetland sites the survey, in the future, will be conducted in the dry season (November-February) in order to cover the migratory waterbirds. Notably, similar monitoring of indicator birds was conducted during NSP and was found effective in representing the trend of management impacts (Khan 2008b). One main concern was to involve local communities and other stakeholders in the monitoring so that they own the survey outcomes. Therefore, it was not very easy to select the monitoring methods that would be simple and feasible, yet reliable to indicate the changes in the population density of indicator birds, and register the status of birds, which in turn will indicate the status of management impacts of IPAC. Taking all these into account, strip transect sampling and

opportunistic survey methods were selected (Table 4). The baseline monitoring was conducted in 2009, with about 30 observation-days in the field. This will be followed by annual surveys in the years to come, until the end of the project, in order to understand the management impacts in IPAC sites.

Table 4. Different methods considered for bird monitoring

Method	Description	Suitability	Decision
<i>Quadrat sampling</i>	Objects are counted from sample quadrats	Suitable for population estimation of less mobile or immobile organisms, e.g. earthworms, plants	Rejected
<i>Strip transect sampling</i>	A combination of quadrat sampling and distance sampling where objects are counted from straight, long and narrow strips	Suitable for population estimation of visible organisms, no problem for mobile organisms, requires no expert knowledge	Accepted
<i>Distance sampling</i>	Objects are counted from two sides of a straight line; no restriction of distance while observing, but the sighting distance and sighting angle for each observation must be recorded	Suitable for population estimation of visible organisms, no problem for mobile organisms, but requires expert knowledge and use of DISTANCE software	Rejected
<i>Point transect sampling</i>	It may be considered as a distance sampling of zero length (i.e. a point) where the sighting (radial) distance of each of the objects are measured from random points	Suitable for areas where transect sampling is difficult due to inaccessibility; no problem for mobile organisms (if visible), but might not sufficiently cover the habitat diversity	Rejected
<i>Oppor-tunistic survey</i>	Any important observation or information is recorded whenever available without following any system	Suitable for recording the species diversity, composition and other important information, but not for population density	Accepted

3.4.1 STRIP TRANSECT SAMPLING

Strip transect sampling (Buckland *et al.* 2001) was found most suitable to estimate the population density of indicator bird species. This method is simple, so even the local people could participate. In this method some permanent strips are selected where the total counts of the objects are made (Figure 3). The observer(s) slowly move (ca. 1.5 km/hr) along a relatively straight line (basal line) through the study area and count the objects from both sides. The observation-range (half-width of the strip) varies depending on the visibility of the study area. For the forest sites the observation-range of 25 m on either side was found suitable, so the width of transect was 50 m. The initial location of the object was considered while counting, because the object often moves away after watching the observer(s). If any object was sighted beyond the pre-decided observation-range, or if the object was seen coming from the back (in order to avoid duplication), the object was not counted. A standard data sheet was used to record the counts of indicator birds (Appendix I).

The monitoring was conducted in early mornings and late afternoons when the birds were most active. Transects were located in areas that are suitable in terms of accessibility and observation. The natural and intact areas of forests were given priority, not only because of the richness of biodiversity but IPAC is focusing more on the management of these areas.

Each strip transect count is actually the total count of an area of the strip [length of the strip X width of the strip (2 X observation-range)]. Suppose there are k number of strips, each of width $2w$ (w is the observation-range on either side of the centre-line), and the total length of all strips (same strips repeated are treated as new strips) is L in a study area. If the total number of recorded objects in all strips is N , the population density D is estimated as –

$$D = N / 2wL$$

Since the project sites are not very big, it was not possible to make very long or many transects. Hence, each transect was repeated, but each of them were treated as a new transect, i.e. a new k . The lengths of transects varied from 0.5-1.5 km.

This method assumes that all objects in the strip are recorded, so the observer(s) were very careful in observing and recording all the objects inside the strips. Even then, the observer(s) might miss some of the objects in the strip, but if it is not more than 5% of the total objects that were actually present, the error is statistically negligible. The more area covered, or more the transects repeated, the less error in mean density estimates. Even if any basal line of a transect is slightly undulated, the observation-strip were maintained straight (roughly) by manipulating the observation distance to that particular area. The birds were observed and identified properly and correctly so that there is no misidentification. In case of any confusion regarding identification, photographs were taken and calls were recorded, if possible,

and the identification was confirmed later on, comparing with other references. The main weakness of this method is that the error cannot be estimated.

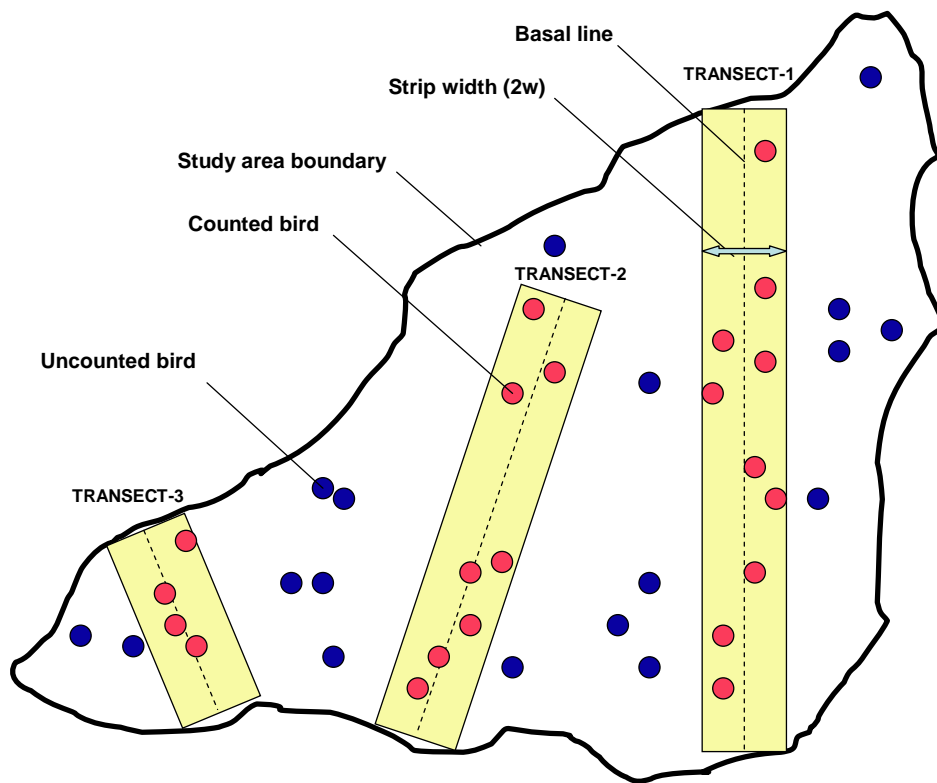


Figure 3. Diagrammatic representation of strip transect sampling to estimate bird population density in a study area.

3.4.2 OPPORTUNISTIC (AD LIBITUM) SAMPLING

In opportunistic or *ad libitum* sampling any important or interesting observation/information is recorded at any time while in the field. This sampling method is suitable for recording the occurrence, relative abundance and distribution of different species of birds and other wildlife (Appendix I). The birds were identified by using some authentic books (e.g., Grimmett *et al.* 1998, Rasmussen and Anderton 2005). The relative abundance of birds (Very Common – 76-100% chance of being identified in its habitat, Common – 51-75% chance of being identified in its habitat, Uncommon – 26-50% chance of being identified in its habitat, and Rare – 25% or less chance of being identified in its habitat) were assessed on the basis of their chances of relative frequencies of sightings in the field, which were verified by interviewing local people.

The 'Resident' species is defined as the species that lives in Bangladesh year-round and breeds in Bangladesh, the 'Winter Visitor' spends the winter in Bangladesh and does not breed in Bangladesh, the 'Summer Visitor' spends the summer in Bangladesh and breeds in Bangladesh, and 'Vagrant' erratically visits Bangladesh and does not normally breed in Bangladesh.

Although the opportunistic sampling is an informal way of collecting information, the outcome can be very rewarding. However, if this is not carried out with sufficient care, wrong information could be incorporated that might lead to biased results. This method is particularly useful in recording bits and pieces of important observations and information on rare and endangered species that could not be studied by any other method due to their rarity. Using opportunistic sampling the following aspects were recorded for different species of birds –

- Principal diet
- Principal foraging guild
- Status or relative abundance
- Breeding season (based on mating, nesting, feeding young, etc.)
- Calls or songs
- Threats (lack of food, lack of nesting place, lack of habitat, hunting and trapping, predation, etc.)

4. Results and Discussion

The results represent the monitoring that was conducted during a eight-month period (March-October) in 2009, with about 30 observation-days in the field. Since this was the first year of yearly monitoring, the baseline estimates of population densities of ten indicator species of birds in each of the five sites was the main outcome. A list of all the bird species (including the indications of their principal diet, principal foraging guild, status, and distribution) recorded in five study sites was produced. Moreover, the main threats to birds and other wildlife, as observed in the field, are mentioned. The same monitoring will be repeated in the years to come so that the temporal changes in the density of indicator birds are known, which will be the indicators of management impacts.

Other than the findings on birds, the research students, birdwatchers and the local people who were involved in the monitoring have learned the monitoring techniques and identification of birds. Now they have the capacity to conduct similar surveys and research.

Since the survey team had ventured the most remote and risky areas, where people normally do not go, and regularly watched the five IPAC sites, they represented IPAC in the remote and risky areas, and the illegal loggers and poachers knew that there are people to watch what is going on in the area and report it. To some extent this had discouraged people to illegally log any tree or poach any animal.

4.1. Population Densities of Indicator Bird Species

The population density, i.e. the average number of individuals per square kilometer, was estimated for each of the indicator bird species in all the five IPAC sites (Figures 4a-e). The charismatic special indicator for mixed evergreen forests, i.e. Greater Racket-tailed Drongo (*Dicrurus paradiseus*), had the highest density (13.7/km²) in Kaptai NP. The charismatic special indicator for deciduous forests was Crested Serpent Eagle (*Spilornis cheela*), which had the density of 6.1/ km² in Madhupur NP. In the four mixed evergreen forest sites (Kaptai NP, Fasiakhali WS, Meda-Kacchapia NP, and Khadimnagar NP) the density was highest for Abbott's Babbler (*Malacocincla abbotti*) (15.5-24.6/km²). Whereas in the only deciduous forest site where the monitoring was conducted (Madhupur NP), White-rumped Shama (*Copsychus malabaricus*) (15.4/km²) had the highest density. These baseline estimates of densities of indicator birds will be compared with the coming years' estimates.

The results of indicator bird monitoring will indicate the trend of management impacts in five IPAC sites where the monitoring was conducted. The trends in the first two years of the project will help in adopting necessary modifications in the approach. Finally, when all the findings from the beginning to the end of IPAC will be compared, it will be a strong assessment of the success of the whole project in improving the wilderness and biodiversity, together with reducing the pressure on the natural resources by generating alternative livelihoods for local communities.

Ecologically, any regeneration process is very complex and dynamic, involving many natural and anthropogenic factors. Therefore, the increase or decrease of the indicator bird densities will only reflect the annual changes in the habitat.

Only the populations of ten breeding resident birds were monitored in each site, because the populations of winter visitors, summer visitors and vagrants depend also on the resource status of other areas that they depend on (Temple and Wiens 1989).

Species associations with habitat type depend partly on the detectability of the species during the count period, because the species are differentially detected depending on the frequency and loudness of their voices, and their relative visibility due both to behavioral and physical traits and the habitat in which they occur (Browder *et al.* 2002). Therefore, the indicator birds selected at the beginning of this study were mainly vocal and conspicuous so that there was very little chance of missing them during strip-transects.

Although birds are widely used as ecological indicators, it is also criticized by some experts (Martin and Li 1992; Martin 1993, 1995). According to them the individual species are questionable indicators of forest community responses, because co-occurring species typically differ in habitat requirements and life histories and can respond independently to environmental variations (James *et al.* 1984). Others think that individual species may function as indicators of a restricted component of the community, such as the abundance of the other members of the same guild (Severinghaus 1981). Moreover, large increase in one or two species can mask the decline or loss of others in the same guild (Mannan *et al.* 1984).

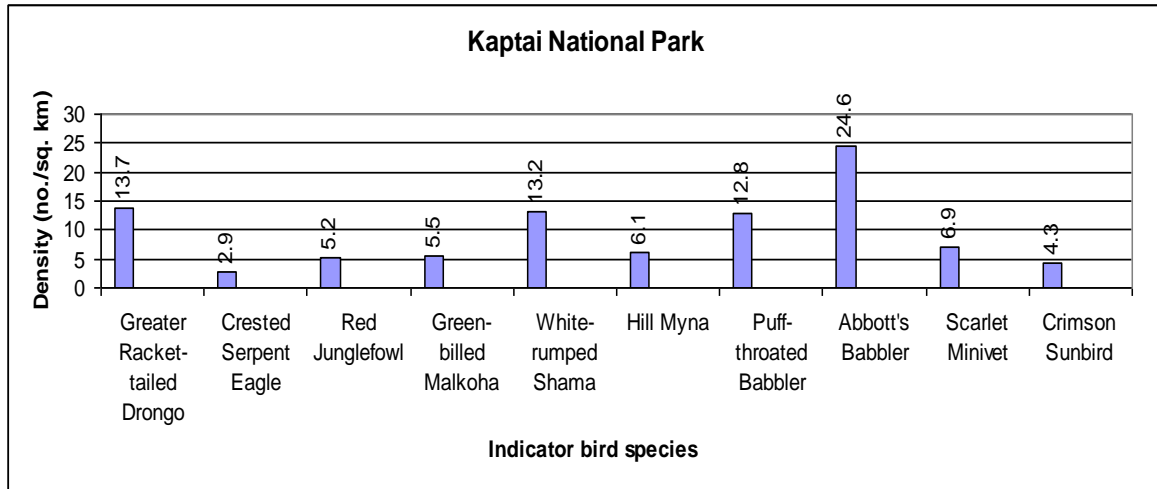


Figure 4a. Population densities (no./sq. km) of ten indicator bird species in Kaptai National Park in 2009.

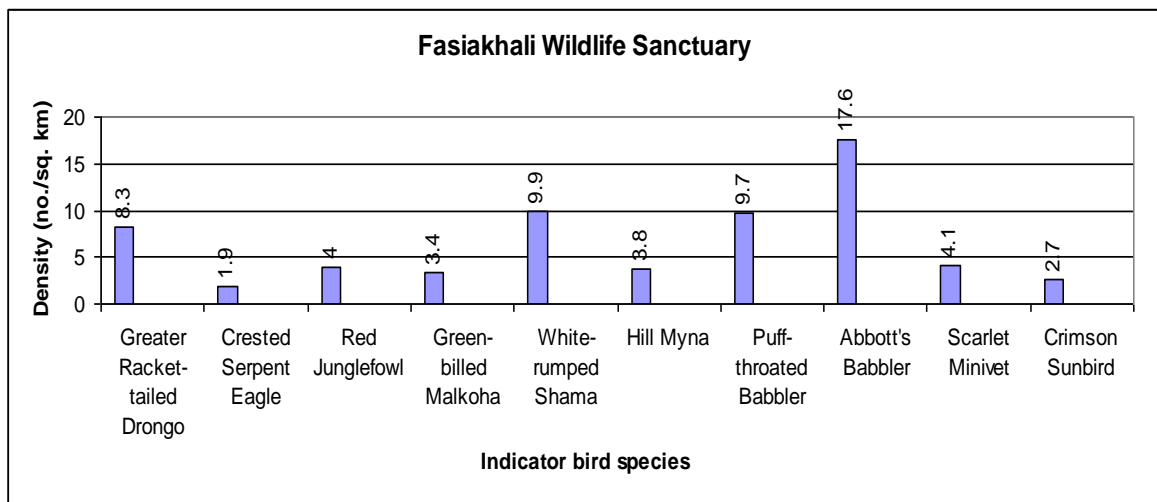


Figure 4b. Population densities (no./sq. km) of ten indicator bird species in Fasiakhali Wildlife Sanctuary in 2009.

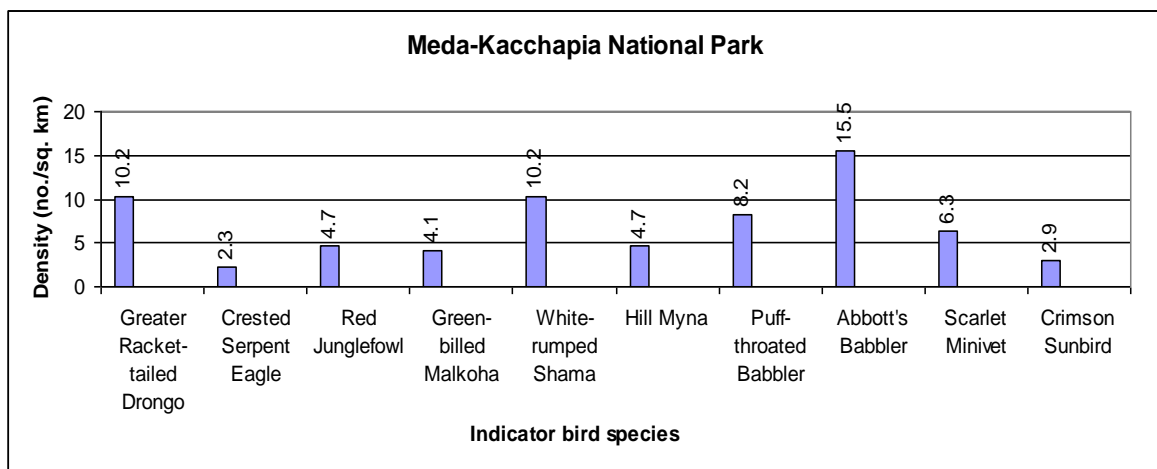


Figure 4c. Population densities (no./sq. km) of ten indicator bird species in Meda-Kacchapia National Park in 2009.

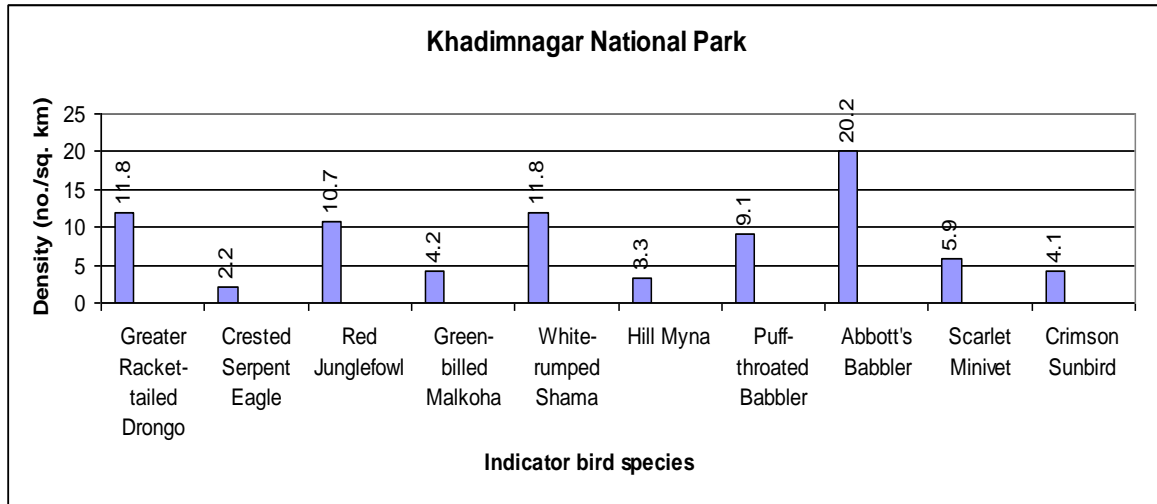


Figure 4d. Population densities (no./sq. km) of ten indicator bird species in Khadimnagar National Park in 2009.

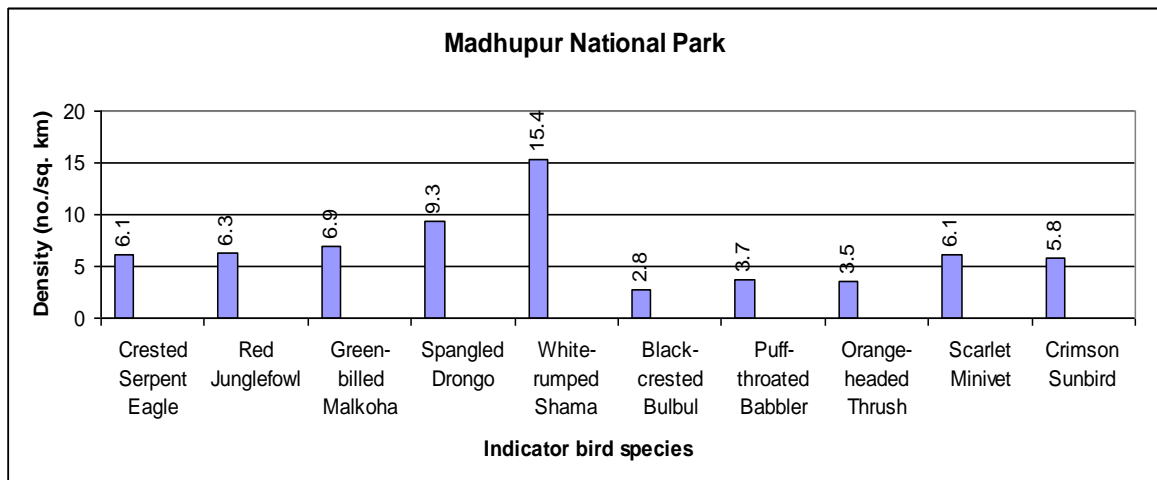


Figure 4e. Population densities (no./sq. km) of ten indicator bird species in Madhupur National Park in 2009.

4.2. Bird Species Diversity

During the monitoring period (March–October 2009), a total of 242 species of birds were recorded in five sites under IPAC, of which 193 were residents, 39 winter visitors, 6 summer visitors and 4 vagrants (Table 5). Most (55%) of the birds were insectivorous (Figure 5). Higher proportions of bird species were found to occur in the middle canopy (41%) (Figure 6). Most species of birds were relatively rare (35%) (Figure 7) and the proportion of rare species has increased gradually over the last four years.

The total bird species (242) recorded in five IPAC sites in a limited period of time represents over 30% of the birds recorded in Bangladesh (Harvey 1990, IUCN-Bangladesh 2000), and almost 3% recorded

in the Indian Subcontinent (Grewal *et al.* 2002). A relatively high ratio of rare birds (35%) emphasizes the need of continuous monitoring of birds and the immediate need of improving the ecological condition of these areas. Similar studies in other areas of the country (Khan *et al.* 1998, Islam *et al.* 1999, Khan and Islam 2000, Das *et al.* 2000, Khan 2005) strengthened the knowledge of bird species diversity and highlighted that a significant proportion of birds are now rare in different parts of the country.

Among 242 species of birds, the total number of species and the total number of primarily forest species were different in five different sites (Figure 8). Very strong correlation ($r = 0.99241$) was found between the total number of bird species and the total number of primarily forest bird species across five monitoring sites.

The checklist of birds (Table 5) that has been produced, together with their respective status, primary habitats, and important notes on their natural history, for each of the five IPAC sites will not only enrich the science of ornithology, but will also help the ecotourists and birdwatchers who will visit these sites. Notably, there is no such checklist of birds for these five IPAC sites are currently available.

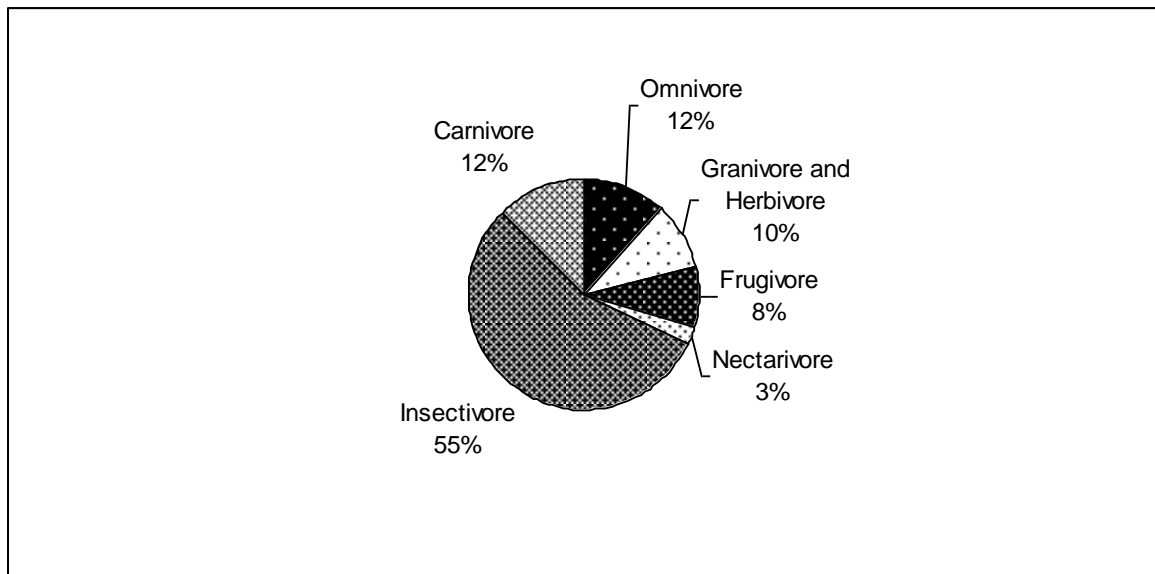


Figure 5. Proportions of bird species of different food habits in five NSP sites.

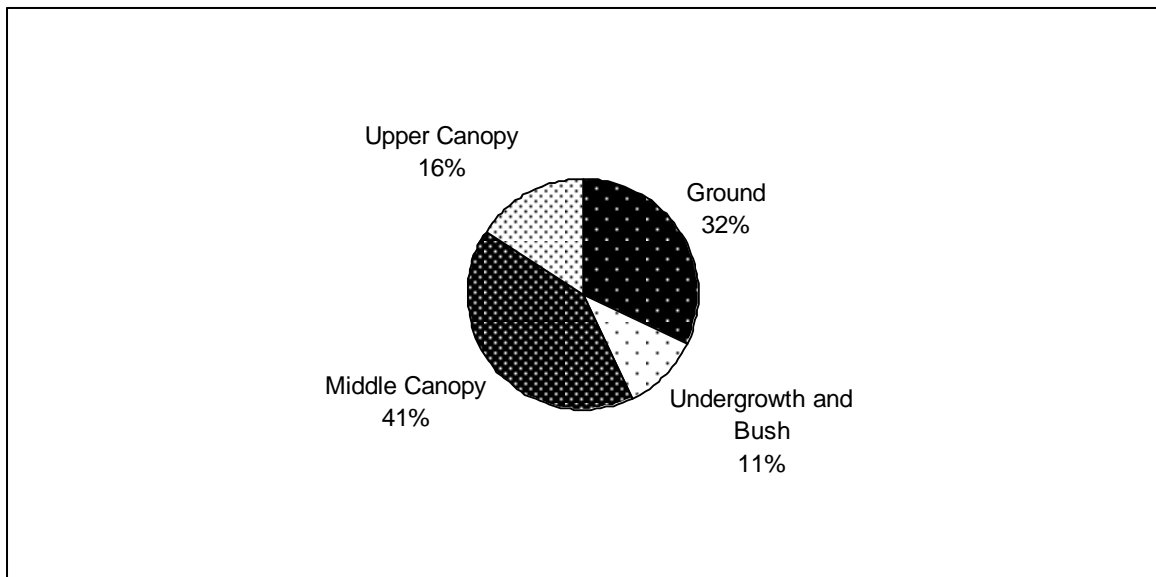


Figure 6. Proportions of different bird species in different strata of the forest in five NSP sites.

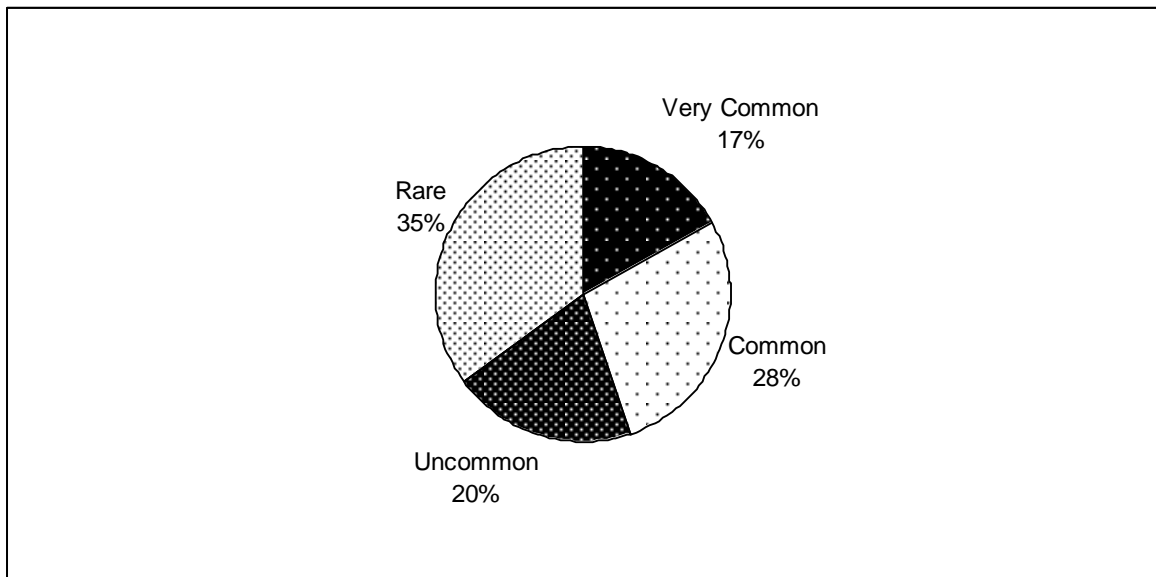


Figure 7. Proportions of Very Common, Common, Uncommon and Rare species of birds in five NSP sites.

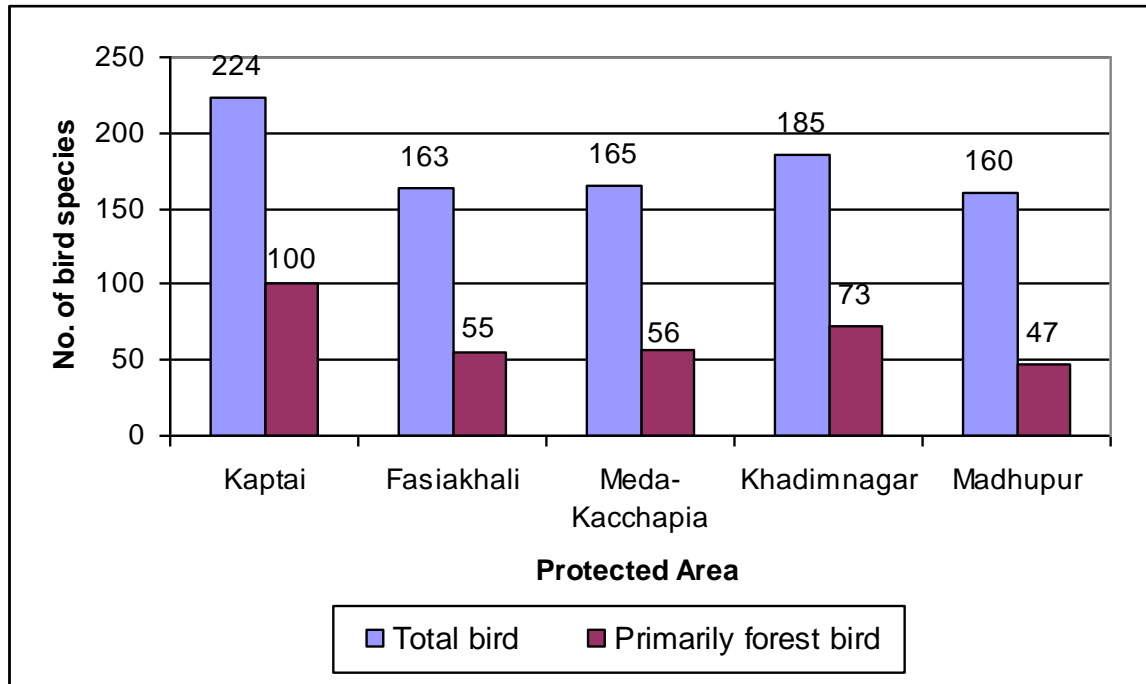


Figure 8. A comparison of the total number of bird species and total number of primarily forest bird species across five study sites of IPAC in 2009.

IPAC Bird Monitoring: Baseline Report

Table 5. List of birds recorded in five protected areas (Kaptai NP, Fasiakhali WS, Meda-Kacchapia NP, Khadimnagar NP, and Madhupur NP) under IPAC during the March-October 2009 [N.B. The systematic followed Inskipp et al. (1996)]

ABBREVIATIONS

Principal Diet: o – Omnivore, g – Granivore and Herbivore, f – Frugivore, n – Nectarivore, i – Insectivore, and c – Carnivore (including Piscivore). Principal Foraging Guild: gr – Ground, b – Bush and Undergrowth, m – Middle Canopy, and u – Upper Canopy. Status: vc – Very Common, co – Common, uc – Uncommon, and ra – Rare (in study sites); R – Resident, W – Winter Visitor, S – Summer Visitor, and V – Vagrant. Distribution: WI – Wide (all study sites), KA – Kaptai NP, FA – Fasiakhali WS, ME – Meda-Kacchapia NP, KH – Khadimnagar NP, and MA – Madhupur NP.

Sl. No.	English and Scientific Name	Principal Diet	Principal Foraging Guild	Status	Distribution
ORDER: GALLIFORMES					
Family: Phasianidae					
1	Blue-breasted Quail <i>Coturnix coromandelica</i>	g	gr	uc, R	KA, ME
2	White-cheeked Partridge <i>Arborophila atrogularis</i> *	g	gr	ra, R	KA
3	Red Junglefowl <i>Gallus gallus</i> *	g	gr	co, R	WI
4	Kalij Pheasant <i>Lophura leucomelanos</i> *	g	gr	uc, R	KA, KH
5	Grey Peacock Pheasant <i>Polyplectron bicalcaratum</i> *	g	gr	ra, R	KA
ORDER: ANSERIFORMES					
Family: Dendrocygnidae					
6	Lesser Whistling-duck <i>Dendrocygna javanica</i> Ψ	g	gr	co, R	KA
Family: Anatidae					
7	Cotton Pygmy-goose <i>Nettapus coromandelianus</i> Ψ	g	gr	ra, R	KA
ORDER: TURNICIFORMES					
Family: Turnicidae					
8	Barred Buttonquail <i>Turnix suscitator</i>	g	gr	uc, R	WI
ORDER: PICIFORMES					
Family: Picidae					
9	Eurasian Wryneck <i>Jynx torquilla</i>	i	gr	uc, W	WI
10	White-browed Piculet <i>Sasia ochracea</i> *	i	m	ra, R	KA, KH
11	Rufous Woodpecker <i>Ceelus brachyurus</i>	i	m	co, R	WI
12	Great Slaty Woodpecker <i>Mulleripicus pulverulentus</i> *	i	u	ra, R	KA, FA, ME
13	Grey-capped Pygmy Woodpecker <i>Dendrocopos canicapillus</i> *	i	m	uc, R	WI
14	Fulvous-breasted Woodpecker <i>Dendrocopos macei</i>	i	m	vc, R	WI
15	Lesser Yellownape <i>Picus chlorolophus</i> *	i	u	ra, R	KA, KH
16	Greater Yellownape <i>Picus flavinucha</i> *	i	u	co, R	KA, FA, ME, KH
17	Grey-headed Woodpecker <i>Picus canus</i>	i	u	ra, R	WI
18	Black-rumped Flameback <i>Dinopium benghalense</i>	i	m	vc, R	WI
19	Greater Flameback <i>Chrysocolaptes lucidus</i> *	i	u	vc, R	WI
Family: Megalaimidae					
20	Lineated Barbet <i>Megalaima lineata</i>	f	u	vc, R	WI

IPAC Bird Monitoring: Baseline Report

21	Blue-throated Barbet <i>Megalaima asiatica</i>	f	u	vc, R	KA, FA, ME, KH
22	Blue-eared Barbet <i>Megalaima australis</i> *	f	u	uc, R	KA, KH
23	Coppersmith barbet <i>Megalaima haemacephala</i>	f	m	vc, R	WI
ORDER: BUCEROTIFORMES					
Family: Bucerotidae					
24	Oriental Pied Hornbill <i>Anthracoceros albirostris</i> *	f	u	uc, R	KA
ORDER: UPUPIFORMES					
Family: Upupidae					
25	Common Hoopoe <i>Upupa epops</i>	i	gr	co, R	WI
ORDER: TROGONIFORMES					
Family: Trogonidae					
26	Red-headed Trogon <i>Harpactes erythrocephalus</i> *	i	m	ra, R	KA
ORDER: CORACIIFORMES					
Family: Coraciidae					
27	Indian Roller <i>Coracias benghalensis</i>	i	gr	co, R	WI
28	Dollarbird <i>Eurystomus orientalis</i> *	i	u	ra, V	KA
Family: Alcedinidae					
29	Common Kingfisher <i>Alcedo atthis</i>	c	gr (water)	co, R	WI
30	Oriental Dwarf Kingfisher <i>Ceyx erithacus</i> *	c	gr (water)	ra, V	KA
Family: Halcyonidae					
31	White-throated Kingfisher <i>Halcyon smyrnensis</i>	c	gr (water)	co, R	WI
Family: Cerylidae					
32	Pied Kingfisher <i>Ceryle rudis</i>	c	gr (water)	ra, R	KA
Family: Meropidae					
33	Blue-bearded Bee-eater <i>Nyctornis athertoni</i> *	i	u	ra, R	KA, KH, MA
34	Green Bee-eater <i>Merops orientalis</i>	i	m	vc, R	WI
35	Blue-tailed Bee-eater <i>Merops philippinus</i> *	i	u	co, R	WI
36	Chestnut-headed Bee-eater <i>Merops leschenaulti</i> *	i	u	vc, R	WI
ORDER: CUCULIFORMES					
Family: Cuculidae					
37	Pied Cuckoo <i>Clamator jacobinus</i>	i	m	ra, S	WI
38	Chestnut-winged Cuckoo <i>Clamator coromandus</i> *	i	m	ra, V	KH
39	Common Hawk Cuckoo <i>Hierococcyx varius</i>	i	m	vc, R	WI
40	Indian Cuckoo <i>Cuculus micropterus</i>	i	m	co, S	WI
41	Plaintive Cuckoo <i>Cacomantis merulinus</i>	i	m	co, R	WI
42	Violet Cuckoo <i>Chrysococcyx xanthurhynchus</i> *	i	m	ra, S	KH
43	Drongo Cuckoo <i>Surniculus lugubris</i> *	i	u	co, R	KA, KH
44	Asian Koel <i>Eudynamis scolopacea</i>	i	m	vc, R	WI
45	Green-billed Malkoha <i>Phaenicophaeus tristis</i> *	i	m	vc, R	WI
Family: Centropodidae					
46	Greater Coucal <i>Centropus sinensis</i>	i	gr	vc, R	WI
47	Lesser Coucal <i>Centropus bengalensis</i> *	i	u	co, R	WI
ORDER: PSITTACIFORMES					
Family: Psittacidae					
48	Vernal Hanging Parrot <i>Loriculus vernalis</i> *	g	m	uc, R	KA, FA, ME, KH
49	Rose-ringed Parakeet <i>Psittacula krameri</i>	f	u	co, R	WI
50	Blossom-headed Parakeet <i>Psittacula roseata</i> *	f	u	uc, R	KH
51	Plum-headed Parakeet <i>Psittacula cyanocephala</i> *	f	u	r, R	MA
52	Grey-headed Parakeet <i>Psittacula finschii</i> *	f	u	r, R	KA
53	Red-breasted Parakeet <i>Psittacula alexandri</i> *	f	m	vc, R	WI
ORDER: APODIFORMES					
Family: Apodidae					
54	Asian Palm Swift <i>Cypsiurus balasiensis</i>	i	u (mid-air)	co, R	WI
ORDER: STRIGIFORMES					

IPAC Bird Monitoring: Baseline Report

Family: Strigidae					
55	Oriental Scops Owl <i>Otus sunia</i> *	i	m	ra, R	WI
56	Collared Scops Owl <i>Otus bakkamoena</i>	i	m	ra, R	WI
57	Mountain Scops Owl <i>Otus spilocephalus</i> *	i	u	ra, R	KA
58	Spot-bellied Eagle Owl <i>Bubo nipalensis</i> *	c	m	ra, R	KA
59	Dusky Eagle Owl <i>Bubo coromandus</i> *	c	m	ra, R	MA
60	Brown Fish Owl <i>Ketupa zeylonensis</i>	c	m	ra, R	WI
61	Buffy Fish Owl <i>Ketupa ketupa</i> *	c	m	ra, R	KA
62	Brown Wood Owl <i>Strix leptogrammica</i> *	c	m	ra, R	MA
63	Asian Barred Owlet <i>Glaucidium cuculoides</i> *	i	m	co, R	KA, FA, ME, KH
64	Spotted Owlet <i>Athene brama</i>	i	m	vc, R	WI
65	Brown Hawk Owl <i>Ninox scutulata</i>	i	m	co, R	WI
Family: Caprimulgidae					
66	Large-tailed Nightjar <i>Caprimulgus macrurus</i> *	i	m (mid-air)	co, R	WI
ORDER: COLUMBIFORMES					
Family: Columbidae					
67	Rock Pigeon <i>Columba livia</i>	g	gr	co, R	WI
68	Green Imperial Pigeon <i>Ducula aenea</i> *	f	u	ra, R	KA
69	Oriental Turtle Dove <i>Streptopelia orientalis</i> *	g	m	ra, R	KA, FA, ME, KH
70	Spotted Dove <i>Streptopelia chinensis</i>	g	gr	vc, R	WI
71	Red Collared Dove <i>Streptopelia tranquebarica</i>	g	gr	co, R	WI
72	Eurasian Collared Dove <i>Streptopelia decaocto</i>	g	gr	co, R	WI
73	Emerald Dove <i>Chalcophaps indica</i> *	g	gr	vc, R	WI
74	Orange-breasted Green Pigeon <i>Treron bicincta</i> *	f	m	ra, R	WI
75	Pompadour Green Pigeon <i>Treron pompadora</i> *	f	m	co, R	WI
76	Thick-billed Green Pigeon <i>Treron curvirostra</i> *	f	m	ra, R	WI
77	Yellow-footed Green Pigeon <i>Treron phoenicoptera</i>	f	m	co, R	WI
78	Wedge-tailed Green Pigeon <i>Treron sphenura</i> *	f	u	ra, R	KA
79	Pin-tailed Green Pigeon <i>Treron apicanda</i> *	f	u	ra, R	KA
ORDER: GRUIFORMES					
Family: Rallidae					
80	White-breasted Waterhen <i>Amaurornis phoenicurus</i>	i	gr	uc, R	WI
81	Slaty-legged Crane <i>Rallina eurizonoides</i>	g	gr	r, W	MA
ORDER: CICONIIFORMES					
Family: Scolopacidae					
82	Pintail Snipe <i>Gallinago stenura</i>	i	gr	ra, W	WI
83	Common Snipe <i>Gallinago gallinago</i>	i	gr	ra, W	WI
84	Green Sandpiper <i>Tringa ochropus</i>	i	gr	ra, W	WI
85	Wood Sandpiper <i>Tringa glareola</i>	i	gr	co, W	WI
86	Common Sandpiper <i>Actitis hypoleucos</i>	i	gr	co, W	WI
Family: Rostratulidae					
87	Greater Painted Snipe <i>Rostratula benghalensis</i>	i	gr	uc, R	WI
Family: Jacanidae					
88	Bronze-winged Jacana <i>Metopidius indicus</i>	g	gr	uc, R	KA, MA
Family: Charadriidae					
89	Little Ringed Plover <i>Charadrius dubius</i>	i	gr	ra, W	KA
90	Red-wattled Lapwing <i>Vanellus indicus</i>	i	gr	uc, R	WI
Family: Laridae					
91	Little Tern <i>Sterna albifrons</i>	c	gr (water)	uc, R	KA
92	Whiskered Tern <i>Chlidonias hybridus</i>	c	gr (water)	uc, W	KA
Family: Accipitridae					
93	Osprey <i>Pandion haliaetus</i>	c	gr (water)	ra, W	KA
94	Jerdon's Baza <i>Aviceda jerdoni</i> *	c	u	ra, R	KA, KH
95	Black Baza <i>Aviceda leuphotes</i> *	c	u	uc, R	KA, KH

IPAC Bird Monitoring: Baseline Report

96	Oriental Honey-buzzard <i>Pernis ptilorhynchus</i>	i (while feeding honey-comb)	m	uc, R	WI
97	Black-shouldered Kite <i>Elanus caeruleus</i>	i	gr	uc, R	WI
98	Black Kite <i>Milvus migrans</i>	c	gr	uc, R	WI
99	Brahminy Kite <i>Haliastur indus</i>	c	gr	co, R	WI
100	White-rumped Vulture <i>Gyps bengalensis</i>	c (carriion)	gr	uc, R	KH
101	Crested Serpent Eagle <i>Spilornis cheela</i> *	c	m	vc, R	WI
102	Shikra <i>Accipiter badius</i> *	c	m	uc, R	WI
103	Besra <i>Accipiter virgatus</i> *	c	m	uc, R	WI
104	Changeable Hawk Eagle <i>Spizaetus cirrhatus</i> *	c	m	ra, R	WI
Family: Falconidae					
105	Common Kestrel <i>Falco tinnunculus</i>	i	gr	uc, W	WI
106	Amur Falcon <i>Falco amurensis</i>	i	u (mid-air)	ra, W	KH
Family: Phalacrocoracidae					
107	Little Cormorant <i>Phalacrocorax niger</i> Ψ	c	gr (water)	ra, R	KA
108	Great Cormorant <i>Phalacrocorax carbo</i>	c	gr (water)	c, R	KA
Family: Ardeidae					
109	Little Egret <i>Egretta garzetta</i>	c	gr	uc, R	WI
110	Cattle Egret <i>Bubulcus ibis</i>	c	gr	uc, R	WI
111	Indian Pond Heron <i>Ardeola grayii</i>	c	gr	vc, R	WI
112	Black-crowned Night Heron <i>Nycticorax nycticorax</i>	c	gr	ra, R	WI
113	Malayan Night Heron <i>Gorsachius melanolophus</i> *	c	gr	ra, V	KA
114	Yellow Bittern <i>Ixobrychus sinensis</i>	c	gr	ra, R	KA
115	Cinnamon Bittern <i>Ixobrychus cinnamomeus</i>	c	gr	uc, R	KA, MA
ORDER: PASSERIFORMES					
Family: Pittidae					
116	Blue-naped Pitta <i>Pitta nipalensis</i> *	i	gr	ra, R	KA
117	Hooded Pitta <i>Pitta sordida</i> *	i	gr	ra, S	KA, KH, MA
118	Indian Pitta <i>Pitta brachyura</i>	i	gr	c, S	MA
Family: Irenidae					
119	Asian Fairy Bluebird <i>Irena puella</i> *	f	m	co, R	KA, KH
120	Blue-winged Leafbird <i>Chloropsis cochinchinensis</i> *	i	m	ra, R	KA, KH
121	Golden-fronted Leafbird <i>Chloropsis aurifrons</i> *	i	m	vc, R	WI
Family: Eurylaimidae					
122	Silver-breasted Broadbill <i>Serilophus lunatus</i> *	i	m	r, R	KA
Family: Laniidae					
123	Brown Shrike <i>Lanius cristatus</i>	i	b	co, W	WI
124	Long-tailed Shrike <i>Lanius schach</i>	i	b	co, R	WI
125	Grey-backed Shrike <i>Lanius tephronotus</i>	i	b	uc, W	WI
Family: Corvidae					
126	Common Green Magpie <i>Cissa chinensis</i> *	o	m	ra, R	KA, KH
127	Rufous Treepie <i>Dendrocitta vagabunda</i>	o	m	co, R	WI
128	Grey Treepie <i>Dendrocitta formosae</i> *	o	m	uc, R	KH
129	House Crow <i>Corvus splendens</i>	o	gr	uc, R	WI
130	Large-billed Crow <i>Corvus macrorhynchos</i>	o	gr	co, R	WI
131	Ashy Woodswallow <i>Artamus fuscus</i>	i	u (mid-air)	uc, R	WI
132	Black-naped Oriole <i>Oriolus chinensis</i> *	o	m	ra, W	KA, FA, ME, KH
133	Black-hooded Oriole <i>Oriolus xanthornus</i>	o	m	vc, R	WI
134	Large Cuckooshrike <i>Corucina macei</i>	o	m	co, R	WI
135	Black-winged Cuckooshrike <i>Coracina melaschistos</i> *	o	m	ra, W	WI
136	Black-headed Cuckooshrike <i>Coracina</i>	o	m	ra, R	WI

IPAC Bird Monitoring: Baseline Report

<i>melanoptera</i>					
137	Rosy Minivet <i>Pericrocotus roseus</i> *	i	u	ra, R	WI
138	Ashy Minivet <i>Pericrocotus divaricatus</i> *	i	u	ra, R	KH
139	Small Minivet <i>Pericrocotus cinnamomeus</i> *	i	u	vc, R	WI
140	Scarlet Minivet <i>Pericrocotus flammeus</i> *	i	u	co, R	WI
141	Bar-winged Flycatcher-shrike <i>Hemipus picatus</i> *	i	m	uc, R	KH
142	White-throated Fantail <i>Rhipidura albicollis</i>	i	b	co, R	WI
143	Black Drongo <i>Dicrurus macrocerus</i>	i	m	vc, R	WI
144	Ashy Drongo <i>Dicrurus leucophaeus</i>	i	m	ra, W	WI
145	Bronzed Drongo <i>Dicrurus aeneus</i> *	i	m	vc, R	WI
146	Lesser Racket-tailed Drongo <i>Dicrurus remifer</i> *	i	u	ra, W	MA
147	Spangled Drongo <i>Dicrurus hottentottus</i> *	i	m	co, R	WI
148	Greater Racket-tailed Drongo <i>Dicrurus paradiseus</i> *	i	u	co, R	KA, FA, ME, KH
149	Black-naped Monarch <i>Hypothymis azurea</i> *	i	b	co, R	WI
150	Common Iora <i>Aegithina tiphia</i>	i	m	vc, R	WI
151	Large Woodshrike <i>Tephradornis gularis</i> *	i	u	co, R	KH
152	Common Woodshrike <i>Tephradornis pondicerianus</i> *	i	m	co, R	WI
Family: Muscicapidae					
153	Blue Rock Thrush <i>Monticola solitarius</i>	i	gr	uc, W	WI
154	Blue Whistling Thrush <i>Myophonus caeruleus</i> *	i	gr	ra, R	KA
155	Orange-headed Thrush <i>Zosterops citrina</i>	i	gr	ra, R	WI
156	Red-throated Flycatcher <i>Ficedula parva</i>	i	m	vc, W	WI
157	Verditer Flycatcher <i>Euomyias thalassina</i> *	i	u	uc, W	WI
158	Pale-chinned Flycatcher <i>Cyornis poliogenys</i> *	i	m	ra, R	WI
159	Grey-headed Canary Flycatcher <i>Culicicapa ceylonensis</i>	i	m	c, R	WI
160	Oriental Magpie Robin <i>Copsychus saularis</i>	i	gr	vc, R	WI
161	White-rumped Shama <i>Copsychus malabaricus</i> *	i	gr	co, R	WI
162	Black Redstart <i>Phoenicurus ochruros</i>	i	b	ra, W	WI
163	Black-backed Forktail <i>Enicurus immaculatus</i> *	i	gr	ra, R	KA
164	Common Stonechat <i>Saxicola torquata</i>	i	b	co, W	WI
165	Pied Bushchat <i>Saxicola caprata</i>	i	b	ra, R	KA
Family: Sturnidae					
166	Asian Glossy Starling <i>Aplonis panayensis</i> *	f	m	ra, W	KA
167	Chestnut-tailed Starling <i>Sturnus malabaricus</i>	f	m	vc, R	WI
168	Asian Pied Starling <i>Sturnus contra</i>	o	gr	vc, R	WI
169	Common Myna <i>Acridotheres tristis</i>	o	gr	vc, R	WI
170	Bank Myna <i>Acridotheres ginginianus</i>	o	gr	ra, R	WI
171	Jungle Myna <i>Acridotheres fuscus</i>	o	m	vc, R	WI
172	Hill Myna <i>Gracula religiosa</i> *	o	u	co, R	KA, FA, ME, KH
Family: Sittidae					
173	Velvet-fronted Nuthatch <i>Sitta frontalis</i> *	i	m	uc, R	WI
Family: Paridae					
174	Great Tit <i>Parus major</i>	i	m	vc, R	WI
Family: Hirundinidae					
175	Barn Swallow <i>Hirundo rustica</i>	i	u (mid-air)	co, W	WI
Family: Pycnonotidae					
176	Black-headed Bulbul <i>Pycnonotus atriceps</i> *	o	m	uc, R	WI
177	Black-crested Bulbul <i>Pycnonotus melanicterus</i> *	o	m	co, R	WI
178	Red-whiskered Bulbul <i>Pycnonotus jocosus</i>	o	m	vc, R	WI
179	Red-vented Bulbul <i>Pycnonotus cafer</i>	o	m	vc, R	WI
180	White-throated Bulbul <i>Alophoixus flaveolus</i> *	o	m	co, R	WI
181	Olive Bulbul <i>Iole virescens</i> *	o	m	ra, R	KA
182	Ashy Bulbul <i>Hemixos flavala</i> *	o	m	ra, R	KA

IPAC Bird Monitoring: Baseline Report

Family: Cisticolidae					
183	Grey-breasted Prinia <i>Prinia hodgsonii</i>	i	b	co, R	WI
184	Plain Prinia <i>Prinia inornata</i>	i	b	uc, R	WI
185	Zitting Cisticola <i>Cisticola juncidis</i>	i	b	co, R	WI
Family: Zosteropidae					
186	Oriental White-eye <i>Zosterops palpebrosus</i>	i	m	vc, R	WI
Family: Sylviidae					
187	Blyth's Reed Warbler <i>Acrocephalus dumetorum</i>	i	b	co, W	WI
188	Striated Grassbird <i>Megalurus palustris</i>	i	b	uc, R	KA
189	Common Tailorbird <i>Orthotomus sutorius</i>	i	b	vc, R	WI
190	Dark-necked Tailorbird <i>Orthotomus atrogularis</i>	i	b	uc, R	KA
191	Dusky Warbler <i>Phylloscopus fuscatus</i>	i	b	uc, W	WI
192	Tickell's Leaf Warbler <i>Phylloscopus affinis</i>	i	m	uc, W	WI
193	Yellow-browed Warbler <i>Phylloscopus inornatus</i>	i	m	co, W	WI
194	Greenish Warbler <i>Phylloscopus trochiloides</i>	i	m	uc, W	WI
195	Blyth's Leaf Warbler <i>Phylloscopus reguloides</i>	i	m	uc, W	WI
196	Yellow-vented Warbler <i>Phylloscopus cantator</i>	i	m	uc, W	KA
197	Golden-spectacled Warbler <i>Seicercus burkii</i>	i	m	ra, S	MA
198	Grey-hooded Warbler <i>Seicercus xanthoschistos</i>	i	m	ra, W	KH
199	White-crested Laughingthrush <i>Garrulax leucolophus</i> *	i	b	ra, R	KA, ME
200	Lesser Necklaced Laughingthrush <i>Garrulax moniliger</i> *	i	m	ra, R	KA, FA, ME, KH
201	Greater Necklaced Laughingthrush <i>Garrulax pectoralis</i> *	i	m	co, R	KA, FA, ME, KH
202	Rufous-necked Laughingthrush <i>Garrulax ruficollis</i> *	i	b	co, R	WI
203	Abbott's Babbler <i>Malacocincla abbotti</i> *	i	b	vc, R	WI
204	Puff-throated Babbler <i>Pellorneum ruficeps</i> *	i	b	co, R	WI
205	Large Scimitar Babbler <i>Pomatorhinus hypoleucos</i> *	i	m	ra, R	KA
206	White-browed Scimitar Babbler <i>Pomatorhinus schisticeps</i> *	i	b	ra, R	KA, KH
207	Grey-throated Babbler <i>Stachyris nigriceps</i> *	i	b	ra, R	KA, FA, ME
208	Striped Tit Babbler <i>Macronous gularis</i> *	i	b	co, R	WI
209	Chestnut-capped Babbler <i>Timalia pileata</i> *	i	b	ra, R	KA, FA, ME, KH
210	Yellow-eyed Babbler <i>Chrysomma sinensis</i> *	i	b	ra, R	KA
211	White-hooded Babbler <i>Gampsorhynchus rufulus</i> *	i	b	ra, R	KA
212	White-bellied Yuhina <i>Yuhina zantboleuca</i> *	i	m	ra, R	KA
213	Brown-cheeked Fulvetta <i>Alcippe poiocephala</i> *	i	m	ra, R	KA
214	Nepal Fulvetta <i>Alcippe nipalensis</i> *	i	m	ra, R	KA
Family: Alaudidae					
215	Rufous-winged Bushlark <i>Mirafra assamica</i>	g	gr	co, R	WI
Family: Nectariniidae					
216	Thick-billed Flowerpecker <i>Dicaeum agile</i>	o	m	uc, R	WI
217	Yellow-vented Flowerpecker <i>Dicaeum chrysorrheum</i> *	o	m	ra, R	KA
218	Orange-bellied Flowerpecker <i>Dicaeum trigonostigma</i> *	o	m	ra, R	KA
219	Pale-billed Flowerpecker <i>Dicaeum erythrorhynchus</i>	o	m	co, R	WI
220	Plain Flowerpecker <i>Dicaeum concolor</i>	o	m	co, R	WI
221	Scarlet-backed Flowerpecker <i>Dicaeum cruentatum</i> *	o	m	vc, R	WI
222	Ruby-cheeked Sunbird <i>Anthreptes singalensis</i> *	n	m	uc, R	WI
223	Purple-rumped Sunbird <i>Nectarinia zeylonica</i>	n	m	uc, R	WI

IPAC Bird Monitoring: Baseline Report

224	Purple-throated Sunbird <i>Nectarinia sperata</i> *	n	m	co, R	KA, FA, ME, KH
225	Purple Sunbird <i>Nectarinia asiatica</i>	n	m	vc, R	WI
226	Crimson Sunbird <i>Aethopyga siparaja</i> *	n	m	vc, R	WI
227	Little Spiderhunter <i>Arachnothera longirostra</i> *	n	m	vc, R	WI
228	Streaked Spiderhunter <i>Arachnothera magna</i> *	n	m	ra, R	KA
Family: Passeridae					
229	House Sparrow <i>Passer domesticus</i>	g	gr	co, R	WI
230	Forest Wagtail <i>Dendronanthus indicus</i> *	i	gr	co, W	WI
231	White Wagtail <i>Motacilla alba</i>	i	gr	co, W	WI
232	White-browed Wagtail <i>Motacilla maderaspatensis</i>	i	gr	co, R	WI
233	Citrine Wagtail <i>Motacilla citreola</i>	i	gr	ra, W	WI
234	Grey Wagtail <i>Motacilla cinerea</i>	i	gr	uc, W	WI
235	Paddyfield Pipit <i>Anthus ruficollis</i>	i	gr	co, R	WI
236	Olive-backed Pipit <i>Anthus hodgsoni</i> *	i	gr	co, W	WI
237	Rosy Pipit <i>Anthus roseatus</i>	i	gr	ra, W	KH
238	Baya Weaver <i>Ploceus philippinus</i>	i	gr	co, R	WI
239	Indian Silverbill <i>Lonchura malabarica</i>	g	gr	ra, R	WI
240	White-rumped Munia <i>Lonchura striata</i> *	g	gr	uc, R	WI
241	Scaly-breasted Munia <i>Lonchura punctulata</i>	g	gr	co, R	WI
242	Black-headed Munia <i>Lonchura malacca</i>	g	gr	ra, R	WI

* Primarily forest species.

Ψ Mainly trespassing species.

4.3. Threats to Birds and Their Habitats

Habitat loss remains as the main threat to the birds in all the five sites where the monitoring was conducted. Illegal felling of trees and bamboo, and conversion of natural forests to monoculture plantations, agricultural fields and wetland for fish culture were witnessed during the monitoring.

Hunting and trapping of birds, together with nestling-theft for selling as cage birds, is the second-most severe threat to the birds. Moreover, large-scale illegal harvest of forest fruits, particularly ‘chaplash’ (*Artocarpus chaplasha*) and ‘latkan’ (*Bixa* sp.), is a growing threat to the frugivorous birds and mammals.

The above-mentioned threats should be reduced in order to maintain healthy status of birds. Despite tremendous efforts, the rate of loss of tree cover is still very alarming in some areas, together with the conversion of lands. The local communities should be motivated and alternative livelihoods (including ecotourism) should be made available in order to reduce the consumptive use of the forest products. Depending on the capacity of the area the number of visitors to these sites must be controlled. The network of poachers and corrupt custodians has to be broken down by making the local young people, conservationists and journalists more aware and vigilant. If these could be done the forests might remain intact, or even improve in the future. However, this is a slow process, so similar projects should continue for longer period of time. The participatory bird monitoring should be repeated in the future in order to assess the overall trend of the condition of these sites over the long-term.

References

- Ali, S. and Ripley, S.D. 1987. *Compact handbook of the birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka*. Oxford University Press, Delhi. 10 vols.
- Bangladesh Forest Department, and Bangladesh Space Research and Remote Sensing Organization 2008. National Forest and Tree Resource Assessment 2005-2007. Bangladesh Forest Department, and Bangladesh Space Research and Remote Sensing Organization, Dhaka, Bangladesh.
- Browder, S.F. Johnson, D.H. and Ball, I.J. 2002. Assemblages of breeding birds as indicators of grassland condition. *Ecol. Indicators* **2(2002)**: 257-270.
- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. 2001. *Introduction to distance sampling: estimating abundance of biological populations*. Oxford University Press, Oxford. 432 pp.
- Canterbury, G.E., Martin, T.E. Petit, D.R., Petit, L.J. and Bradford, D.F. 2000. Bird communities and habitat as ecological indicators of forest condition in regional monitoring. *Conserv. Biol.* **14(2)**: 544-558.
- Das, A.K., Islam, M.A., Kabir, M.M. and Khan, M.M.H. 2000. The birds of Kuakata of Bangladesh. *Bangladesh Journal of Life Sciences* **12(1&2)**: 35-42.
- Grewal, B., Harvey, B. and Pfister, O. 2002. *A photographic guide to the birds of India including Nepal, Sri Lanka, The Maldives, Pakistan, Bangladesh and Bhutan*. Christopher Helm, London. 512 pp.
- Grimmett, R., Inskipp, C. and Inskipp, T. 1998. *Birds of the Indian Subcontinent*. Oxford University Press, Delhi. 888 pp.
- Harvey, W.G. 1990. *Birds in Bangladesh*. University Press Limited, Dhaka. 188 pp.
- Islam, M.A., Khan, M.M.H., Kabir, M.M., Solhoy, T., Joarder, N.B. and Feeroz, M.M. 1999. Birds of the Sundarbans in winter in Bangladesh. *Ecoprint* **6(1)**: 41-49.
- IUCN-Bangladesh 2000. *Red book of threatened birds of Bangladesh*. IUCN – The World Conservation Union, Dhaka. 116 pp.
- James, F.C., Johnston, R.F., Wamer, N.O., Niemi, G.J. and Beck-len, W.J. 1984. The Grinnellian niche of the Wood Thrush. *Amer. Nat.* **124**: 17-47.
- Johnston, D.W., and Odum, E.P. 1956. Breeding bird populations in relation to plant succession on the Piedmont of Georgia. *Ecology* **37**: 50-62.
- Kazmierczak, K. 2000. *A Field Guide to the Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and the Maldives*. OM Book Service, New Delhi, India. 352 pp.
- Khan, M.M.H. 2005. Species diversity, relative abundance and habitat use of the birds in the Sundarbans East Wildlife Sanctuary of Bangladesh. *Forktail* **21(2005)**: 79-86.

- Khan, M.M.H. 2008a. *Protected Areas of Bangladesh – A Guide to Wildlife*. Nishorgo Program, Bangladesh Forest Department, Dhaka. 304 pp.
- Khan, M.M.H. 2008b. Participatory bird survey to assess Protected Area management impacts. Report submitted to the International Resources Group (IRG), Washington D.C., USA.
- Khan, M.M.H. and Islam, M.A. 2000. Status and habitats of the birds of Tangail, Bangladesh. *Bangladesh Journal of Zoology* **28(1)**: 75-88.
- Khan, M.M.H., Das, A.K. and Islam, M.A. 1998. Birds in the northern hilly areas of Jamalpur, Sherpur and Netrakona districts of Bangladesh. *Journal of the Asiatic Society of Bangladesh (Sci.)* **24(2)**: 357-361.
- MacKinnon, J. and MacKinnon, K. 1986. *Review of the Protected Area System of the Afrotropical Realm*. IUCN – The World Conservation Union, Gland and Cambridge.
- Mannan, R.W. and Meslow, E.C. 1984. Bird populations and vegetation characteristics in managed and old-growth forests, northeastern Oregon. *J. Wildl. Manage.* **48**: 1,219-1,238.
- Martin, T.E. 1993. Nest predation and nest sites: new perspectives on old patterns. *BioScience* **43**: 523-532.
- Martin, T.E. 1995. Avian life history evolution in relation to nest sites, nest predation and food. *Ecol. Monogr.* **65**: 101-127.
- Martin, T.E. and Li, P. 1992. Life history traits of open- versus cavity-nesting birds. *Ecology* **73**: 579-592.
- Morrison, M.L. 1986. Bird populations as indicators of environmental changes. *Current Ornith.* **3**: 429-451.
- Rasmussen, P.C. and Anderton, J.C. 2005. *Birds of South Asia – The Ripley Guide*. Vols 1 and 2. Smithsonian Institution and Lynx Edicions, Washington, D.C., USA, and Barcelona, Spain.
- Severinghaus, W.D. 1981. Guild theory development as a mechanism for assessing environmental impacts. *Env. Manage.* **5**: 187-190.
- Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U. Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M. and Rahman, M.M. (eds.) 2008. *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. 26: Birds. Asiatic Society of Bangladesh, Dhaka. 662 pp.
- Temple, S.A. and Wiens, J.A. 1989. Bird populations and environmental changes: can birds be bio-indicators? *Amer. Birds* **43**: 260-270.

USAID's Integrated Protected Area Co-Management (IPAC) Project
House 68 (2nd Floor) Road 1, Block I
Banani, Dhaka-1213, Bangladesh
Tel: +88-02-987-3229
Fax: +88-02-989-6164
Website: www.nishorgo.org