CMPA Technical Report Series

35

Avifaunal Survey to Understand Bird- Habitat Linkages at Khijadiya Wildlife Sanctuary and Gosabara Wetland in Gujarat

August 2017

FOREST DEPARTMENT GOVT. OF GUJARAT

GEER Foundation

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On behalf of:

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

of the Federal Republic of Germany

Indo-German Biodiversity Programme
Conservation and Sustainable Management of Coastal and Marine Protected Areas

CMPA Technical Report Series No. 35
Avifaunal Survey to Understand Bird- Habitat Linkages at Khijadiya Wildlife Sanctuary and Gosabara Wetland in Gujarat

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Disclaimer

This study has been financed through a contract with the Project on “Conservation and Sustainable Management of Existing and Potential Coastal and Marine Protected Areas” (CMPA), of the Indo-German Biodiversity Programme. The Project is jointly implemented by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India, and Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

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1 Context and Scope of the Study

In the global context of India's commitment towards achieving the Convention on Biological Diversity's Aichi Target, the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India has entered into a Technical Cooperation with the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Government of Germany on the project entitled "Conservation and Sustainable Management of Coastal and Marine Protected Areas" (CMPA).

Following approval from the Department of Economic Affairs (DEA), Ministry of Finance, Government of India, the Secretary of MoEFCC has signed an Agreement with GIZ India in October 2013 on the implementation of the aforementioned project.

The CMPA Project is jointly implemented by the C&S Division of MoEFCC and the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) India on behalf of BMUB. It is implemented in selected coastal states in India in close collaboration with respective State Governments in Gujarat, Goa, Maharashtra, and Tamilnadu.

The project's duration is until July 2017 and the project activities will include capacity development, advisory services, consulting support, exchange visits, targeted studies and research.

In the State of Gujarat, the project activities are implemented on the following project sites: Khijadiya Wildlife Sanctuary Jamnagar, Gosabara-Mokar wetland complex, and Madhavpur Turtle area Porbandar.

In Gujarat, the project aims at facilitating measures that result in the following outputs:

- Participatory processes for the management of areas identified for conservation of biodiversity have been implemented.
- A capacity development system for the sustainable management of coastal and marine protected areas has been made available in Gujarat;
- Relevant stakeholders are aware of—and sensitized for—the importance of conserving biodiversity in coastal and marine areas.

2 An Overview of the Available Information on the Subject Area:

2.1 What Is a Wetland?

A wetland is a land area that is saturated with water, either permanently or seasonally. Distinguishing factor of wetland is the characteristic vegetation of aquatic plants, bodies of water and soil conditions of the area. (Abraham et al. 2015). Wetland is the area where

saturation with water is dominant factor determining the nature of soil and the types of plants and animal communities living upon it. (Cowardin, 1979) They are amongst the most productive ecosystems on the Earth (Ghermandi *et al.*, 2008), and provide many important services to human society (ten Brink *et al.*, 2012). However, they are also ecologically sensitive and adaptive systems (Turner *et al.*, 2000). Wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant species, and soil and sediment characteristics (Space Applications Centre, 2011).

Wetlands were categorised into marine (coastal wetlands), estuarine (including deltas, tidal marshes, and mangrove swamps), lacustarine (lakes), riverine (along rivers and streams), and palustarine ('marshy' – marshes, swamps and bogs) based on their hydrological, ecological and geological characteristics (devised by Cowardin *et al.*, 1979).

2.2 The Ramsar Convention

The ramsar convention defines Wetlands as areas with water, natural or artificial; permanent or temporary; static or flowing; fresh, brackish or salty; including areas of marine water the depth of which at low tide does not exceed six meters; and includes all inland waters such as lakes, reservoir, tanks, backwaters, lagoon, creeks, estuaries and manmade wetland; and the zone of direct influence on wetland that is to say the drainage area or catchment region of the wetlands as determined by the authority but does not include main river channels, paddy fields and coastal wetlands". Overall, 1052 sites in Europe; 289 sites in Asia; 359 sites in Africa; 175 sites in South America; 211 sites in North America; and 79 sites in Oceania region have been identified as Ramsar sites or wetlands of International importance (Ramsar Secretariat, 2013).

2.3 Importance of Wetland

- Wetlands plays a number of roles in the environment, such as water purification, flood control and shoreline stability.
- Wetlands provide water, habitat and food, upon which countless species of plants and animals depend for survival.
- Wetlands provide nesting and breeding ground for the migratory birds.

2.4 Wetland Status of Gujarat

Gujarat has the highest proportion (22.8%) of the total wetland area in the country. The extent of watery-lands in Gujarat is about 34,350 sq. km (17.6% of the state's geographical area and 22.9 % of the national wetlands) (National Wetlands Atlas of Gujarat,SAC-2010). About one fourth of the India's wetlands are in Gujarat, which includes *jheels* (lakes), *talav* (ponds), dams, seasonal waterbodies, paddy fields, streams, marsh lands, coastline, mangroves, coral reefs, estuaries and large stretches of mudflats. Contribute significantly to enrich habitat diversity, resulting in rich wetland biota.

Two important wetlands, with high ecological value, are taken into consideration for the study of birds-plants interactions and main aim of the study is to quantify the dependence of key bird species on various plant species of both wetlands. The study titled: 'Avifaunal Survey to Understand Bird-Habitat Linkages at Khijadiya Wildlife Sanctuary and Gosabara Wetland in Gujarat' is funded by The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

2.5 Study Area

2.5.1 Gosabara Wetland Complex

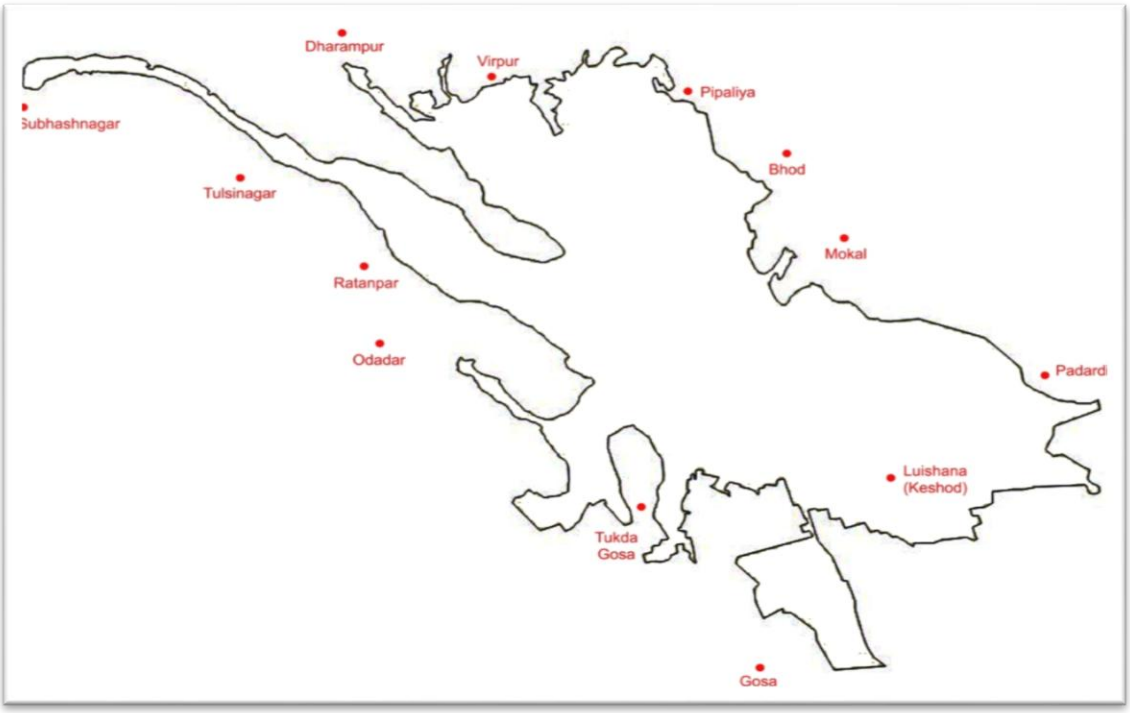


Figure 1: Gosabara Wetland Complex Map Showing All Surrounding Villages

Gosabara Wetland Complex is located in the Porbandar district of Gujarat state of india. The Mokarsagar wetland complex is a group of wetlands, including Medha creek, Kuchhadi, Subhashnagar, Zavar, Kurly I, Karly II, Vanana, Dharampur, Gosabara, Bhadarbara, Mokarsagar, Bardasagar and Amipur of Porbandar District of Gujarat (Nagar et al, 2015). The Wetland complex is a source of fresh water for many farmers and villagers. During winter season, many migratory birds such as demoiselle crane, common crane, pelicans, and ducks can be seen here. After the water dries up, birds such as larks, pipits, and pratincole can be seen. The wetland is formed by Karli Recharge Reservoir and Karli Tidal Regulator (Nagar et al, 2015). There is a combination of Estuary and fresh-water habitat. The wetland is dominated by sedges and other hydrophytic vegetation (Nagar et al, 2015). It is a lifeline for the community and the wetland dependent biodiversity, including both the flora (mangrove, macroalgae and macrophytes) and fauna (birds, reptiles, insects and mammals).

2.5.2 Khijadiya Wetland

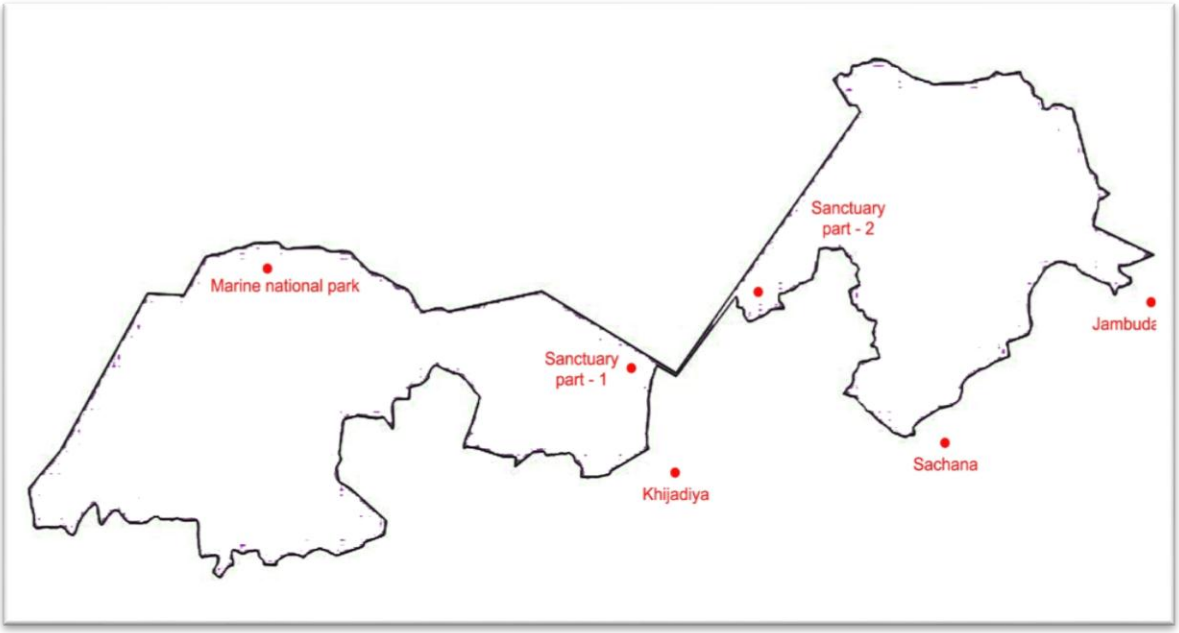


Figure 2: Khijadiya Sanctuary Map Showing All Surrounding Villages

Khijadiya bird sanctuary is located 10 km away from the Jamnagar district of Gujarat, India. It is having the unique habitat with fresh water on one side and salt pans on other side. Also, on the northern side is a large creek that flows from the Gulf of Kutch. This supports mangroves and marine diversity.

Khijadiya Bird Sanctuary is divided into two: Part 1 and Part 2. Vegetation such as *Accacia Nilotica, Salvodora Persica* and *Prosopis Juliflora* are seen in large number. Numbers of migratory birds stop here during the winter. It provides a nesting and breeding ground for the migratory birds. The sanctuary is located at the watershed of Ruparel and Kalindri river at the North East coastal region of Jamnagar district in the Gulf of Kutch (Figure 2).

3 Objectives

The purpose of assignment was to conduct avifaunal survey to understand its interlinkages with habitat and floral components of the ecosystem.

3.1 Bird Diversity and Population Assessment to Understand the Interlinkages with Habitat Features and Floral Components of the Two Wetlands

Conduct a detailed ecological analysis of the key species interactions and ecological significance in the wetlands, and bring out specific information on the following:

- Habitat-wise bird diversity at both wetlands
  The habitat classification for this purpose should be in accordance with the baseline report on floral and faunal diversity available from GIZ.
- Bird preference in aquatic and saline pockets
- Niche for bird habitat across different plant communities
- Change in bird diversity with the change in the depth of water
- Food preference of bird in wetland (food web of birds)
- Status of birds in relation to plant community structure

3.2 Develop Interactive GIS maps

Showing key bird species and their habitat requirements at spatial and temporal scale.

3.3 Coordination with Other Study Teams for Field Visits and Meetings

The study conducted by an expert is part of the overall biodiversity monitoring being conducted by the project at the two wetlands. The ecological elements and interpretation of results are interdependent. Therefore, the expert will be required to work closely and in coordination with other experts working on floral and hydrological studies. For this, the expert must be flexible to schedule field visits at the same time as other experts, and to participate and discuss the results at common meetings for the project.

3.4 Documentation and Reporting

- Photo document different bird species and their habitat and food (e.g. plant communities, and specific habitat features etc), and submit a CD/ external hard disk with all the photos of species with their scientific names as captions.
- The consultant will be required to submit draft reports in accordance with the timelines in Section 6 of this document. The consultant will need to participate in project meeting to present the key results in accordance with the agreed timelines, revise the report based on feedback, and submit the final report and along with an executive summary, and all raw data.

4 Methodology

The study was conducted on two wetlands, the Gosabara wetland complex and the Khijadiya bird sanctuary of Gujarat from November 2016 to June 2017. The following methodlogy was used for each objective:

- **Habitat-Wise Bird Diversity at Both Wetlands**

  The habitat classification for this purpose must be in accordance with the baseline report on floral and faunal diversity available from GIZ.

Habitat classification done by nagar et al, 2015 formed the basis of this objective. All the habitat types were surveyed to determine the no of species inhabiting it.

- **Bird Preference in Aquatic and Saline Pockets**

  Both the wetlands has pockets of both pure water and saline water. To see preference of birds towards either pocket, Ad-libitum observations were made from Januaray 2017 to May 2017.

- **Niche for Bird Habitat Across Different Plant Communities**

  Ad-libitum scan focal sampling (Altmann, 1974) was done at different plant communities to observe behavior and usage of different bird species. This was done from January 2017 to May 2017.

- **Change in Bird Diversity with the Change in the Depth of Water**

  For **water depth**, transect was carried out transversely and vertically along the water body. Water depth was measured every meter using measurement scale. Birds were noted at the same depth.
  Water depth was also estimated from the level of water relative to exposed leg length on the basis of photographs. This relative leg length {Ali (a) 1968 and Ali (b) 1968} was converted to depth from photographs of the birds. (Yaa Ntiamoa-Baidu *et al.* 1994)
  For example, suppose a Greater Flamingo stands 145 cm tall. With the help of photographs, we assumed that if 10% of the legs is inside the water. Then, we calculated the water depth by using the following formula.

  - $\frac{\mathbf{145} \times 10}{100}$ = 14.5 cm

  So, the water depth at which Greater Flamingo is standing will be 14.5cm.
  Considering the total number of photographs studied for calculation per species as n, a minimum 10 photographs of 10 different individuals of all the species were studied. Therefore, we maintained a minimum value of n=10.

- **Food Preference of Bird in Wetland (Food Web of Birds)**

  Ad-libitum scan focal sampling was done to observe the feeding preference of different species of birds(Altmann, 1974). One particular species was observered for a fixed amount of time and the food eaten by it was noted.

- **Status of Birds in Relation to Plant Community Structure**

  Olympus 10 X 50 Binoculars, Nikon Spotting scope was used to make field observations. photography and Videography was done using Nikon 510, Nikon Coolpix and Canon 7D cameras for habitat study, Habitat preference and food preference. Waterbirds were scanned instantaneously, and records were taken of three behavioral categories: (1) Feeding (2) Comfort activities (preening, bathing, stretching) and (3) roosting (sleeping, standing) (Yaa Ntiamoa-Baidu *et al.* 1994)

  For **time-budgeting**, observations were made from particular vantage point during the period between January and March 2017. During this study period, a total of 30 days between January and March were used for diurnal (sunrise to sunset) observations and no nocturnal observations were recorded. An Olympus 10 X 50 binoculars were used for all types of observations and the duration of activity was measured with stopwatch. (Datta, 2014)
  The instantaneous behavior was recorded in one-hour intervals between 0700 and 1900 hours for diurnal observations. Furthermore, a randomly selected bird was followed and its behavior, resting, feeding, walking, swimming etc. were recorded. (Altmann, 1974)
  Six species of birds were selected for the diurnal observation based on their guilds based on foraging behavior (a major determinant of the feeding niche; Piersma 1996a, b).

Information on diet, diurnal habits and habitat characteristics were projected on this guild structure to describe the ecological characteristics of the waterbird community in two wetlands of Gujarat.

The following is our structuring of the waterbird community yielded eight guilds:

- **Guild 1 Herbivorous Rail**
  - Feeds predominantly on water plants
  - Comprises of Eurasian coots and Purple Swamphen
- **Guild 2 Visual Surface-Foraging Waders**
  - Uses predominantly visual means to detect the prey comprises of Ringed Plovers, Common Sandpipers, Whimbrel, Turnstone, Wood Sandpiper and Redshank
- **Guild 3 Tactile Surface-Foraging Waders**
  - Uses predominantly tactile means to find prey
  - Comprises Black-tailed Godwit, Bar-tailed Godwit, Curlew, Little Stint and Curlew Sandpiper
- **Guild 4 Pelagic-Foraging Waders**
  - Uses visual and tactile senses to detect prey
  - Comprises Marsh Sandpiper, Greenshank, Black-winged Stilt and Pied Avocet
- **Guild 5 Stalking Herons**
  - Feeds on fish
  - Comprises Little Egret, Great White Egret, Purple Heron and Grey Heron

- **Guild 6: Fishing Pelicans**
  - Feeds on fish, but obtain their prey differently, compared to Guild 5
  - Comprises White Pelican and Dalmatian Pelican
- **Guild 7 Filter Feeders**
  - Feeds differently, by filtering prey with the help of their beak, and hence called filter feeders
  - Comprises the Greater Flamingo and the Lesser Flamingo
- **Guild 8 Dabbling Ducks**
  - Feeds in shallow water by dabbling and upending
  - Comprises Northern Shoveler, Northern Pintail, and Common Teal

From each guild, we selected one species, which was commonly seen at the study site.

Table 1: Bird Species Selected for Each Guild

Guild	Bird Selected for Time-Budgeting
Herbivorous Rail	Eurasian Coot (*Fulica atra*)
Visual Surface-Foraging Waders	Common Sandpiper (*Actitis hypoleucos*)
Tactile Surface-Foraging Waders	Black-Tailed Godwit (*Limosa limosa*)
Pelagic-Foraging Waders	Black-Winged Stilt (*Himantopus himantopus)*
Stalking Herons	Grey Heron (*Ardea cinerea*)
Fishing Pelicans	Great White Pelican (*Pelecanus onocrotalus)*
Filter Feeders	Greater Flamingo (*Phoenicopterus roseus*)
Dabbling Ducks	Northern Shoveler (*Anas clypeata*)

We were not able to do the time budget activity of Guild 2 and Guild 6, because of low level of level, which dried up early. We did not find the individuals from these Guilds during the duration of the project.

5 Results

A total of 143 species that belong to 43 families were oberserved at Gosabara wetland. A total of166 species that belong to 50 families were observed at Khijadia bird sanctuary during the study period. Checklist of both the wetlands are given in Annexure 1 and 2.

5.1 Habitat-Wise Bird Diversity at Both Wetlands

5.1.1 Gosabara Wetland

Gosabara wetland was classified into following major habitats (based on nagar et al, 2015) and the presence/absence of birds was observed accordingly.

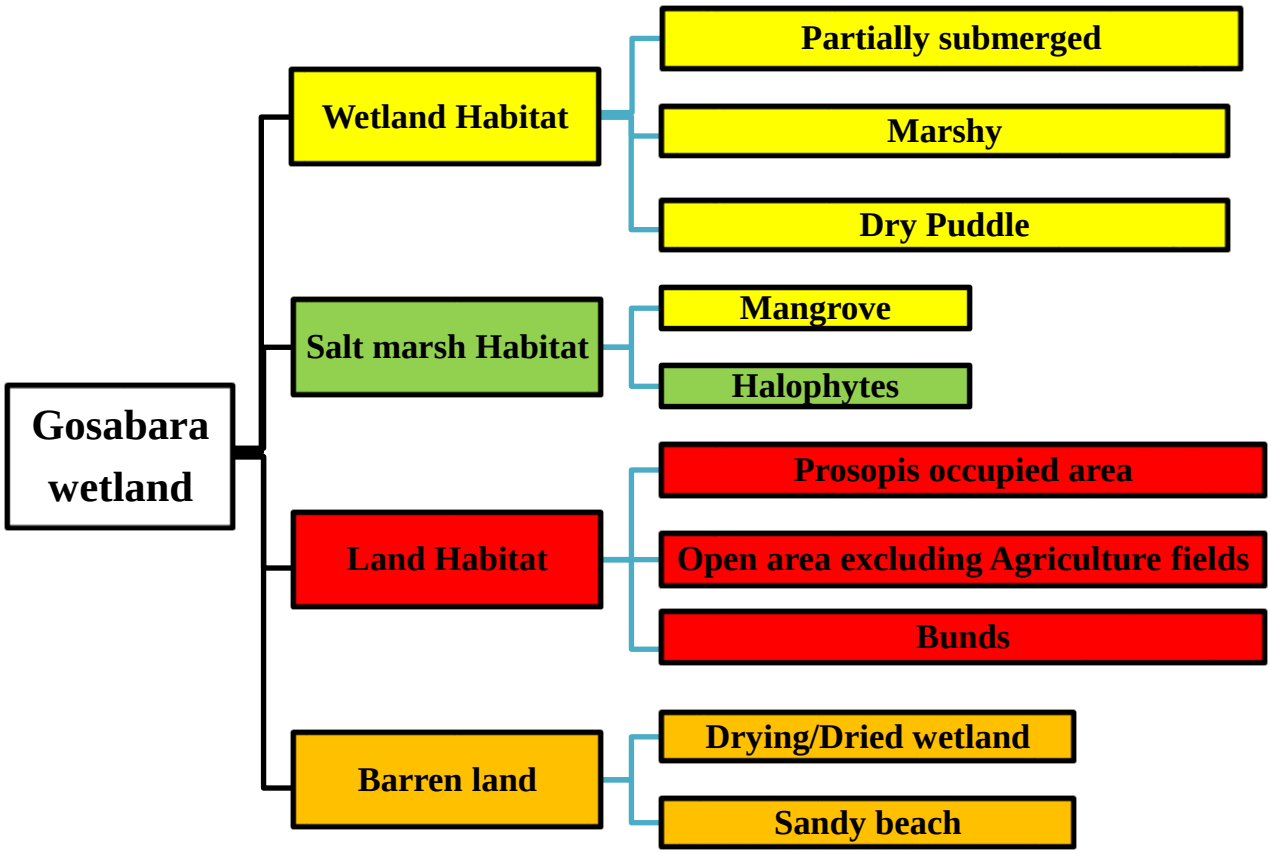


Figure 3: Habitat Classification of Gosabara (Nagar et al, 2015)

1 **Wetland Habitat**
Habitat covered with water was considered as a wetland habitat. This habitat was further divided into 3 sub habitat i.e **(i) Partially submereged habitat (ii) Marshy and (iii) Dry Puddle**

(i) Partially Submereged Habitat
Here, a habitat which had partially submereged plants was taken into consideration.

(ii) Marshy
Marshy wetland implies a wetland that is dominated by herbaceous species, rather than woodland.

(iii) Dry Puddle
A puddle is a small accumulation of water, which dries up early. Here, we considered a dry puddle.

2 Salt Marsh Habitat
Salt marshes are coastal wetlands that are flooded and drained by salt water, brought in by the tides. (National Ocean Service)
This habitat is further divided into two sub-habitats i.e., **(i) Mangroves (ii) Halophytes**

(i) Mangroves
Mangroves are woody plants that grow at the interface between land and sea in tropical and sub-tropical latitudes where they exist in conditions of high salinity, extreme tides, strong winds, high temperatures and muddy, anaerobic soils (Kathiresan *et al*., 2001). Area covered with mangroves was considered as a mangroves habitat.

(ii) Halophytes
Some plants grow and complete their life cycle in the habitats with a high salt content. They are known as salt plants or halophytes (biology discussion).Area covered with halophytes was considered as a Halophytes habitat.

3 Land Habitat
A habitat in which terrestrial birds, animals and plants live is called land habitat. This habitat was further divided into three sub-habitats i.e.

(i) Prosopis Habitat
Area covered by *Prosopis juliflora* was considered as a Prosopis habitat.

(ii) Open Area Excluding Agricultural Fields
Part of a landscape that is not enclosed by trees. Such type of area was considered as open area habitat.

(iii) Bunds
Small boundries such as structure partitioning the wetlands is called bunds. Area with bunds are considered as bund habitat.

4 Barren Land
Barren land is where less vegetation is found, soil is thin, sandy and rocky. This habitat was further divided into two sub-habitats i.e. **(i) Drying/Dried Wetland (ii) Sandy Beach**

(i) Drying/Dried Wetland
Wetland area that dries up, or which is drying, is considered as drying/dried wetland habitat.

(ii) **Sandy Beach**
An area with sandy soil is considered as sandy beach habitat.

Table 2: Bird List According to Habitat Use in Gosabara Wetland Complex

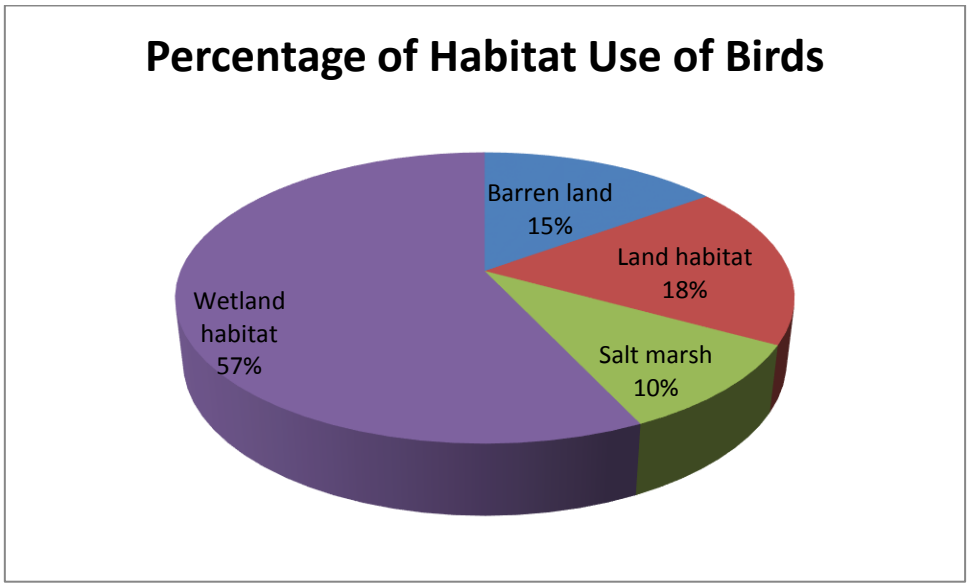
Sr.No	Habitat	Common Name	Scientific Name
1	Wetland Habitat	Common Pochard	*Aythya farina*

	Common Teal	*Anas crecca*
	Northern shoveler	*Anas clypeata*
	Northern Pintail	*Anas acuta*
	Garganey	*Anas querquedula*
	Tufted Duck	*Aythya fuligula*
	Ruddy Shelduck	*Tadorna ferruginea*
	Knob-billed Duck	*Sarkidiornis melanotos*
	Eurasian Wigeon	*Anas Penelope*
	Mallard	*Anas platyrhynchos*
	Indian Spot-billed Duck	*Anas poecilorhyncha*
	Painted Stork	*Mycteria leucocephala*
	Wolly-necked Stork	*Ciconia episcopus*
	Greater Flamingo	*Phoenicopterus roseus*
	Lesser Flamingo	*Phoenicopterus minor*
	Black-headed Ibis	*Threskiornis melanocephalus*
	Red-naped Ibis	*Pseudibis papillosa*
	Glossy Ibis	*Plegadis falcinellus*
	Eurasian Spoonbill	*Platalea leucorodia*
	Little Grebe	*Tachybaptus ruficollis*
	Grey Heron	*Ardea cinerea*
	Purple Heron	*Ardea purpurea*
	Pond Heron	*Ardeola grayii*
	Great White Pelican	*Pelecanus onocrotalus*
	Dalmation Pelican	*Pelecanus crispus*
	Darter	*Anhinga melanogaster*
	Little Cormorant	*Phalacrocorax niger*
	Great Cormorant	*Phalacrocorax carbo*
	Indian Cormorant	*Phalacrocorax fuscicollis*
	Common-ringed Plover	*Charadrius hiaticula*
	Lesser Sand Plover	*Charadrius mongolus*
	Little-ringed Plover	*Charadrius dubius*
	Greater Sand Plover	*Charadrius leschenaultia*
	Ruff	*Philomachus pugnax*

		Black-tailed Godwit	*Limosa limosa*
		Little Stint	*Calidris minuta*
		Sanderling	*Calidris alba*
		Kentish Plover	*Charadrius alexandrines*
		Black-winged Stilt	*Himantopus himantopus*
		Pied-Avocet	*Recurvirostra avosetta*
		Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
		Bronze-winged Jacana	*Metopidius indicus*
		Common Snipe	*Gallinago gallinago*
		Curlew Sandpiper	*Calidris ferruginea*
		Wood Sandpiper	*Tringa glareola*
		Common Sandpiper	*Actitis hypoleucos*
		Marsh Sandpiper	*Tringa stagnatilis*
		Spotted Redshank	*Tringa erythropus*
		Common Greenshank	*Tringa nebularia*
		Common Redshank	*Tringa tetanus*
		Eurasian Curlew	*Numenius arquata*
		Small Pratincole	*Glareola lacteal*
		Oriental Pratincole	*Glareola maldivarum*
		Great Egret	*Areda alba*
		Intermediate Egret	*Mesophoyx intermedia*
		Cattle Egret	*Bubulcus ibis*
		Little Egret	*Egretta garzetta*
		Western Reef Egret	*Egretta gularis*
2	Salt Marsh Habitat	Whiskered Tern	*Chlidonias hybridus*
		Little Tern	*Sterna albifrons*
		Caspian Tern	*Sterna caspia*
		Lesser-crested Tern	*Sterna bengalensis*
		Zitting Cisticola	*Cisticola juncidis*
		Great Egret	*Areda alba*
		Intermediate Egret	*Mesophoyx intermedia*
		Cattle Egret	*Bubulcus ibis*
		Little Egret	*Egretta garzetta*

			Western Reef Egret	*Egretta gularis*
3.	Land Habitat			
	(i)	Prosopis Area	Red-headed Bunting	Emberiza bruniceps
			Black-headed Bunting	Emberiza melanocephala
			Zitting Cisticola	Cisticola juncidis
.			Jungle Babbler	*Acridotheres tristis*
			Common Babbler	*Turdoides caudate*
			Common Myna	*Acridotheres tristis*
			Bank Myna	*Acridotheres ginginianus*
			Rosy Starling	*Pastor roseus*
			Common Stone Chat	*Saxicola rubicola*
			Oriental Magpie Robin	*Copsychus saularis*
			Indian Robin	*Saxicoloides fulicatus*
	(ii)	Open Area Excluding Agricultural Fields	Eurasian Marsh Harrier	*Circus aeruginosus*
			Indian Spotted Eagle	*Aquila hastate*
			Greater Spotted Eagle	*Aquila clanga*
			Indian Courser	*Cursorius coromandelicus*
			Little Swift	*Apus affinis*
	(iii)	Bund Area	Common Kestrel	*Falco tinnununculus*
			Tawny Pipit	*Anthus campestris*
			Paddy Field Pipit	*Anthus rufulus*
4.	Barren Land Habitat			
	(i)	Drying/Dried Wetland	Oriental Pratincole	*Glareola maldivarum*
			Indian Courser	*Cursorius coromandelicus*
			Crested Lark	*Galerida cristata*
			Ashy-crowned Sparrow Lark	*Eremopterix grisea*
			Skye's Lark	*Galerida deva*
			Oriental Skylark	*Alauda gulgula*
			Tawny Pipit	*Anthus campestris*

		Paddy-field Pipit	*Anthus rufulus*
		Yellow Wagtail	*Motacilla flava*
		White Wagtail	*Motacilla alba*
		Great Egret	*Areda alba*
		Intermediate Egret	*Mesophoyx intermedia*
		Cattle Egret	*Bubulcus ibis*
		Little Egret	*Egretta garzetta*
		Western reef egret	*Egretta gularis*
	(ii) Sandy beach Habitat	No birds	



Graph 1: Percentage of Habitat Use of Birds

The pie-chart shows the percentage of birds that use the above-mentioned habitat in Goasabara wetland complex. Field observations suggest that each and every niche is occupied by different set of birds. Water inhabits water birds. Once the water dries up, pipits and larks take over the area with cressa sp, pseuda sp and tamarix sp. Each and every habitat of the wetland is used by birds.

5.1.2 Khijadiya

Khijadiya wetland was classified into the following major habitats and presence/absence of birds was observed accordingly:

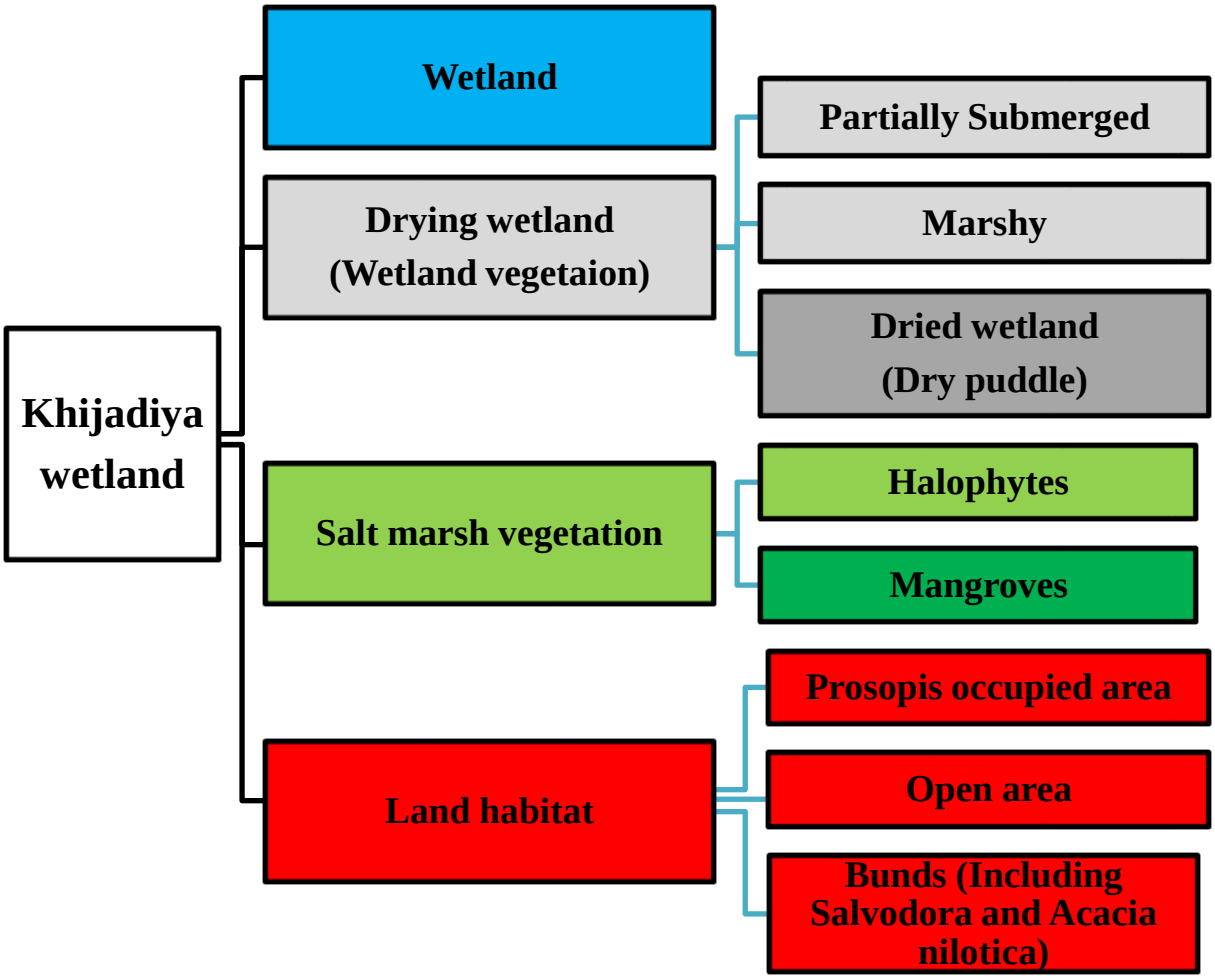


Figure 4: Habitat Classification of Khijadiya (Nagar et al, 2015)

Classification types are explained in the previous section (4.1.1).

Table 3: Bird List According to Habitat Use in Khijadiya Bird Sanctuary

Sr.No	Habitat	Common Name	Scientific Name
1	Wetland	Common Pochard	*Aythya farina*
		Common Teal	*Anas crecca*
		Northern shoveler	*Anas clypeata*
		Northern Pintail	*Anas acuta*
		Garganey	*Anas querquedula*
		Tufted Duck	*Aythya fuligula*
		Ruddy Shelduck	*Tadorna ferruginea*
		Knob-billed Duck	*Sarkidiornis melanotos*
		Eurasian wigeon	*Anas Penelope*
		Mallard	*Anas platyrhynchos*
		Indian Spot-billed Duck	*Anas poecilorhyncha*
		Painted Stork	*Mycteria leucocephala*
		Wolly necked Stork	*Ciconia episcopus*
		Greater Flamingo	*Phoenicopterus roseus*
		Lesser Flamingo	*Phoenicopterus minor*
		Black-headed Ibis	*Threskiornis melanocephalus*

	Red-naped Ibis	*Pseudibis papillosa*
	Glossy Ibis	*Plegadis falcinellus*
	Eurasian Spoonbill	*Platalea leucorodia*
	Little Grebe	*Tachybaptus ruficollis*
	Grey Heron	*Ardea cinerea*
	Purple Heron	*Ardea purpurea*
	Pond Heron	*Ardeola grayii*
	Great White Pelican	*Pelecanus onocrotalus*
	Dalmation Pelican	*Pelecanus crispus*
	Darter	*Anhinga melanogaster*
	Little cormorant	*Phalacrocorax niger*
	Great Cormorant	*Phalacrocorax carbo*
	Indian Cormorant	*Phalacrocorax fuscicollis*
	Eurasian Coot	*Fulica atra*
	Purple swamphen	*Porphyrio porphyria*
	Common Moorhen	*Gallinula chloropuss*
	Lesser sand plover	*Charadrius mongolus*
	Little ringed plover	*Charadrius dubius*
	Greater sand plover	*Charadrius leschenaultia*
	Ruff	*Philomachus pugnax*
	Black tailed godwit	*Limosa limosa*
	Little stint	*Calidris minuta*
	Sanderling	*Calidris alba*
	Kentish Plover	*Charadrius alexandrines*
	Grey Plover	*Pluvialis squatarola*
	Dunlin	*Calidris alpine*
	white tailed lapwing	*Vanellus leucurus*
	Red wattled lapwing	*Vanellus indicus*
	Bar-tailed Godwit	*Limosa lapponica*
	Pacific Golden Plover	*Pluvialis fulva*
	Black-winged Stilt	*Himantopus himantopus*
	Pied-Avocet	*Recurvirostra avosetta*
	Common snipe	*Gallinago gallinago*
	Curlew sandpiper	*Calidris ferruginea*
	Wood sandpiper	*Tringa glareola*
	Common sandpiper	*Actitis hypoleucos*
	Marsh sandpiper	*Tringa stagnatilis*
	Eurasian Curlew	*Numenius arquata*
	Whimbrel	*Numenius phaeopus*
	Spotted Redshank	*Tringa erythropus*
	Common Redshank	*Tringa tetanus*
	Common Greenshank	*Tringa nebularia*
	Terek Sandpiper	*Xenus cinereus*
	Broad-billed Sandpiper	*Eurynorhynchus pygmeus*
	Small pratincole	*Glareola lacteal*
	Common kingfisher	*Alcedo atthis*
	White throated kingfisher	*Halcyon smyrnensis*
	Pied kingfisher	*Ceryle rudis*
	Palla's Gull	*Larus ichthyaetus*
	Black headed gull	*Chroicocephalus ridibundus*

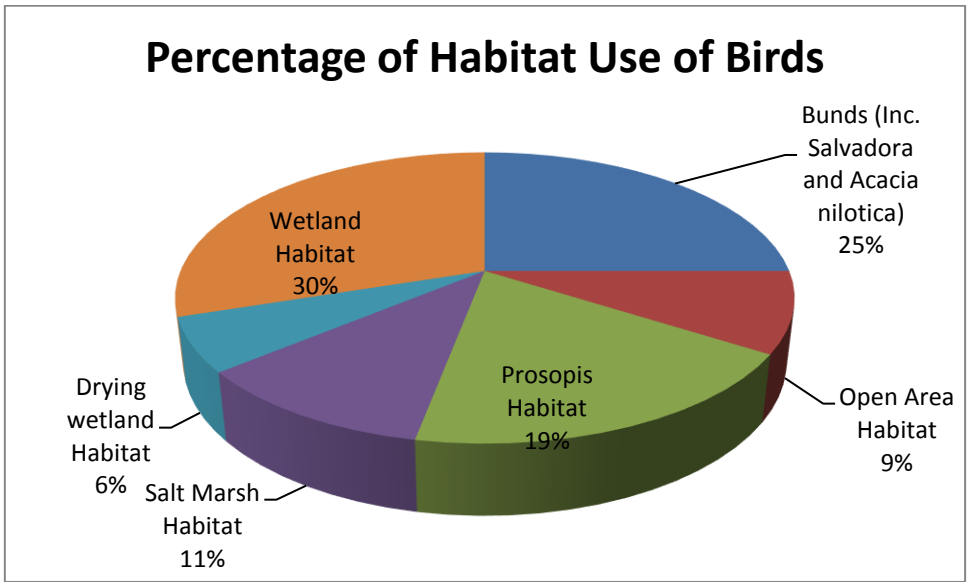
		Brown headed gull	*Chroicocephalus brunnicephalus*
		Slender-billed gull	*Chroicocephalus genei*
		Gull billed tern	*Gelochelidon nilotica*
		Whiskered tern	*Chlidonias hybridus*
		Little tern	*Sterna albifrons*
		Caspian tern	*Sterna caspia*
		Great egret	*Areda alba*
		Intermediate egret	*Mesophoyx intermedia*
		Cattle egret	*Bubulcus ibis*
		Little egret	*Egretta garzetta*
2.	Drying Wetland	Common Teal	*Anas crecca*
		Northern shoveler	*Anas clypeata*
		Eurasian Coot	*Fulica atra*
		Great egret	*Areda alba*
		Intermediate egret	*Mesophoyx intermedia*
		Cattle egret	*Bubulcus ibis*
		Little egret	*Egretta garzetta*
		Black tailed godwit	*Limosa limosa*
		Little stint	*Calidris minuta*
		Black-winged Stilt	*Himantopus himantopus*
		Common snipe	*Gallinago gallinago*
		Indian Courser	*Cursorius coromandelicus*
		Crested Lark	*Galerida cristata*
		Sykes's lark	*Galerida deva*
		Ashy Crowned Sparrow lark	*Eremopterix grisea*
		Sand Lark	*Calandrella raytal*
3.	Salt Marsh	Curlew sandpiper	*Calidris ferruginea*
		Wood sandpiper	*Tringa glareola*
		Common sandpiper	*Actitis hypoleucos*
		Marsh sandpiper	*Tringa stagnatilis*
		Eurasian Curlew	*Numenius arquata*
		Whimbrel	*Numenius phaeopus*
		Spotted Redshank	*Tringa erythropus*
		Common Redshank	*Tringa tetanus*
		Common Greenshank	*Tringa nebularia*
		Terek Sandpiper	*Xenus cinereus*
		Palla's Gull	*Larus ichthyaetus*
		Black headed gull	*Chroicocephalus ridibundus*
		Brown headed gull	*Chroicocephalus brunnicephalus*
		Slender-billed gull	*Chroicocephalus genei*
		Gull billed tern	*Gelochelidon nilotica*
		Whiskered tern	*Chlidonias hybridus*
		Little tern	*Sterna albifrons*
		Caspian tern	*Sterna caspia*
		Crested Lark	*Galerida cristata*
		Sykes's lark	*Galerida deva*
		Macqueen bustard	*Chlamydotis macqueenii*
		Eurasian Oystercatcher	*Haematopus ostralegus*

		Northern shoveler	*Anas clypeata*
		Lesser Flamingo	*Phoenicopterus minor*
		Greater Flamingo	*Phoenicopterus ruber*
		Grey Heron	*Ardea cinerea*
		Pond Heron	*Ardeola grayii*
Land Habitat			
(i)	Prosopis Habitat	Grey Francolin	*Francolinus pondicerianus*
		Indian Bush Quail	*Perdicula asiatica*
		Eurasian Marsh Harrier	*Circus aeruginosus*
		Black winged kite	*Elanus caeruleus*
		Brahminy kite	*Halistur indus*
		Shikra	*Accipiter badius*
		Oriental Honey Buzzard	*Pernis ptilorhyncus*
		Indian Rock pigeon	*Columba livia*
		Laughing dove	*Streptopelia senegalensis*
		Eurasian Collard dove	*Streptopelia decaocto*
		Red Collard dove	*Streptopelia tranquebarica*
		Spotted dove	*Streptopelia chinensis*
		Rose ringed parakeet	*Psittacula krameri*
		Alexandrine parakeet	*Psittacula eupatria*
		Asian koel	*Eudynamys scolopacea*
		Southern Coucal	*Centropus parroti*
		Common hoopoe	*Upupa epops*
		Common kingfisher	*Alcedo atthis*
		White throated kingfisher	*Halcyon smyrnensis*
		Pied kingfisher	*Ceryle rudis*
		Long tailed shrike	*Lanius schach*
		Isabelline shrike	*Lanius isabelliinus*
		Brown shrike	*Lanius cristatus*
		Black drongo	*Dicrurus macrocercus*
		House crow	*Corvus splendens*
		Green bee-eater	*Merops orientalis*
		Red –Vented Bulbul	*Pycnonotus cafer*
		White-eared Bulbul	*Pycnonotus leucotis*
		Clamorous Reed warbler	*Acrocephalus stentoreus*
		Bylth's Reed warbler	*Acrocephalus dumetorum*
		Common Whitethroat	*Sylvia communis*
		Common Chiffchaff	*Phylloscopus collybita*
		Lesser Whitethroat	*Sylvia curruca*
		Jungle Babbler	*Turdoides striata*
		Common Babbler	*Turdoides caudate*
		Yellow-eyed Babblers	*Chrysomma sinense*
		Common Myna	*Acridotheres tristis*
		Bank Myna	*Acridotheres ginginianus*
		Brahminy Starling	*Sturnus pagodarum*
		Rosy Starling	*Sturnus roseus*
		Common Stone chat	*Saxicola caprata*

		Pied Bushchat	*Saxicola caprata*
		Indian Robin	*Saxicoloides fulicata*
		Blue Throat	*Luscinia svecica*
		Oriental Magpie Robin	*Copsychus saularis*
(ii)	Open Area Habitat	Paddy-field Pipit	*Anthus rufulus*
		Yellow Wagtail	*Motacilla flava*
		White Wagtail	*Motacilla alba*
		Great Thick Knee	*Esacus recurvirostris*
		Desert Wheatear	*Oenanthe deserti*
		Isabelline Wheatear	*Oenanthe isabellina*
		Scaly-breasted Munia	*Lonchura punctulata*
		Indian Silverbill	*Lonchura malabarica*
		Chestnut-bellied Sandgrouse	*Pterocles exustus*
		Macqueen Bustard	*Chlamydotis macqueenii*
		Barred Buttonquail	*Turnix suscitator*
		Osprey	*Pandion haliaetus*
		Eurasian Marsh Harrier	*Circus aeruginosus*
		Black-winged Kite	*Elanus caeruleus*
		Brahminy Kite	*Halistur indus*
		Black Kite	*Milvus migrans*
		Shikra	*Accipiter badius*
		Short-toed Snake Eagle	*Circaetus gallicus*
		Black Eared Kite	*Milvus lineatus*
		Pallid Harrier	*Circus macrourus*
		Oriental Honey Buzzard	*Pernis ptilorhyncus*
		Crested Serpent Eagle	*Spilornis minimus*
		Greater Spotted Eagle	*Aquila clanga*
	Bund (Including Salvodora and Acacia nilotica)		
		Osprey	*Pandion haliaetus*
		Eurasian Marsh Harrier	*Circus aeruginosus*
		Black-winged Kite	*Elanus caeruleus*
		Brahminy Kite	*Halistur indus*
		Black Kite	*Milvus migrans*
		Shikra	*Accipiter badius*
		Short-toed Snake Eagle	*Circaetus gallicus*
		Black Eared Kite	*Milvus lineatus*
		Pallid Harrier	*Circus macrourus*
		Oriental Honey Buzzard	*Pernis ptilorhyncus*

	Crested Serpent Eagle	*Spilornis minimus*
	Greater Spotted Eagle	*Aquila clanga*
	Indian Rock Pigeon	*Columba livia*
	Laughing Dove	*Streptopelia senegalensis*
	Eurasian Collard Dove	*Streptopelia decaocto*
	Red Collard Dove	*Streptopelia tranquebarica*
	Spotted Dove	*Streptopelia chinensis*
	Rose-ringed Parakeet	*Psittacula krameri*
	Alexandrine Parakeet	*Psittacula eupatria*
	Asian Koel	*Eudynamys scolopacea*
	Southern Coucal	*Centropus parroti*
	Common Hoopoe	*Upupa epops*
	Common Kingfisher	*Alcedo atthis*
	White-throated Kingfisher	*Halcyon smyrnensis*
	Pied Kingfisher	*Ceryle rudis*
	Long-tailed Shrike	*Lanius schach*
	Isabelline Shrike	*Lanius isabelliinus*
	Brown Shrike	*Lanius cristatus*
	Black Drongo	*Dicrurus macrocercus*
	House Crow	*Corvus splendens*
	Green Bee-eater	*Merops orientalis*
	Red-vented Bulbul	*Pycnonotus cafer*
	White-eared Bulbul	*Pycnonotus leucotis*
	Clamorous Reed Warbler	*Acrocephalus stentoreus*
	Bylth's Reed Warbler	*Acrocephalus dumetorum*
	Common Whitethroat	*Sylvia communis*
	Orphean Warbler	*Sylvia hortensis*
	Common Chiffchaff	*Phylloscopus collybita*
	Lesser Whitethroat	*Sylvia curruca*
	Jungle Babbler	*Turdoides striata*
	Common Babbler	*Turdoides caudate*
	Yellow-eyed Babblers	*Chrysomma sinense*
	Common Myna	*Acridotheres tristis*
	Bank Myna	*Acridotheres ginginianus*
	Brahminy Starling	*Sturnus pagodarum*
	Rosy Starling	*Sturnus roseus*
	Common Stone Chat	*Saxicola caprata*
	Pied Bushchat	*Saxicola caprata*
	Indian Robin	*Saxicoloides fulicata*
	Blue Throat	*Luscinia svecica*
	Oriental Magpie Robin	*Copsychus saularis*
	Asian Paradise Flycatcher	*Terpsiphone paradise*
	Red Breasted Flycatcher	*Ficedula albicilla*
	Black Redstart	*Phoenicurus ochruros*
	Purple Sunbird	*Cinnyris asiaticus*
	House Sparrow	*Passer domesticus*
	Chestnut Shouldered Petronia	*Gymnoris Xanthocollis*
	Oriental White eye	*Zosterops palpebrosus*
	Eurasian Wryneck	*Jynx torquilla*
	Common Woodshrike	*Tephrodornis pondicerianus*

	Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*
	Eurasian Golden Orioles	*Oriolus oriolus*
	Common Rosefinch	*Carpodacus erythrinus*
	Baya Weaver	*Ploceus philippinus*



Graph 2: Percentage of Habitat Use of Birds in Khijadiya Bird Sanctuary

The pie-chart shows the percentage of habitat use of birds in Khijadiya Bird Sanctuary. Salvodora forms a major part of the diet of almost all terrestrial birds. During the fruiting season of Salvadora, many birds can be seen feeding on the fruits.

5.2 Bird Preference in Aquatic and Saline Pockets

The following table summarises field observations on bird preference of aquatic and saline pockets.

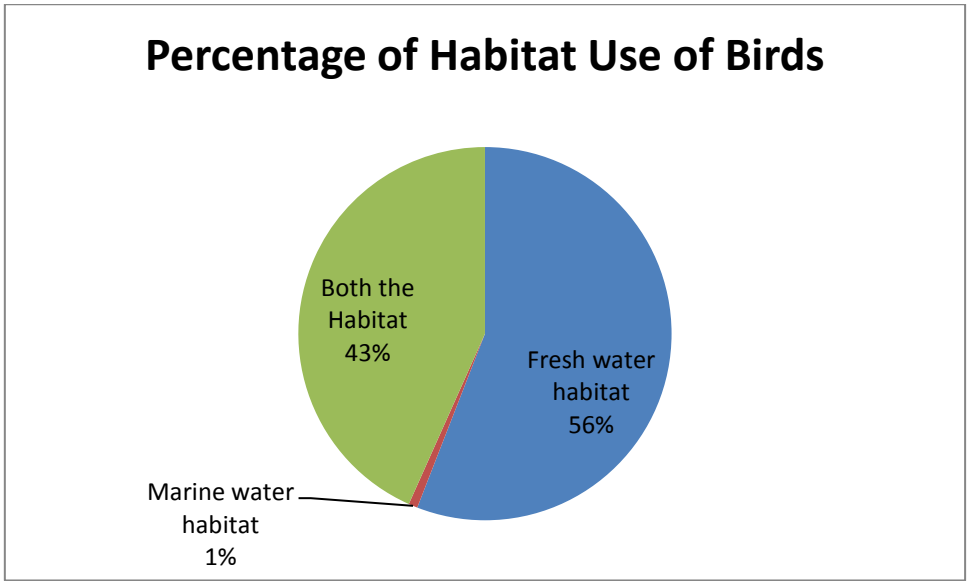
Table 4: List of Bird That Use Fresh Water, Marine or Both Habitats in Gosabara Wetland Complex

Sr.No	Birds	Freshwater	Marine/Saline	Both Habitat
1.	Common Pochard		-	✓
2.	Common Teal	✓	-	-
3.	Northern shoveler		-	✓
4.	Northern Pintail		-	✓
5.	Garganey	✓	-	-
6.	Tufted Duck	✓	-	-
7.	Ruddy Shelduck	✓	-	-
8.	Knob-billed Duck	✓	-	-
9.	Mallard	✓	-	-
10.	Indian Spot-billed Duck	✓	-	-
11.	Gadwall	✓	-	-
12.	Painted Stork		-	✓

13.	Woolly necked Stork		-	✓
14.	Greater Flamingo		-	✓
15.	Lesser Flamingo		-	✓
16.	Black-headed Ibis		-	✓
17.	Red-naped Ibis		-	✓
18.	Glossy Ibis		-	✓
19.	Eurasian Spoonbill		-	✓
20.	Little Grebe	✓	-	-
21.	Grey Heron		-	✓
22.	Purple Heron		-	✓
23.	Pond Heron		-	✓
24.	Great egret		-	✓
25.	Intermediate egret		-	✓
26.	Cattle egret		-	✓
27.	Little egret		-	✓
28.	Western reef egret		-	✓
29.	Great White Pelican		-	✓
30.	Dalmatian Pelican		-	✓
31.	Darter		-	✓
32.	Little cormorant		-	✓
33.	Great Cormorant		-	✓
34.	Indian Cormorant		-	✓
35.	Purple Swamp Hen	✓	-	
36.	Common Crane	✓	-	
37.	Demoiselle crane	✓	-	
38.	Common ringed plover		-	✓
39.	Lesser sand plover		-	✓
40.	Little ringed plover		-	✓
41.	Greater sand plover		-	✓
42.	Ruff		-	✓
43.	Black tailed godwit		-	✓
44.	Little stint		-	✓
45.	Sanderling		-	✓
46.	Kentish Plover		-	✓
47.	Pacific Golden Plover	-	✓	-
48.	Black-winged Stilt		-	✓
49.	Pied-Avocet		-	✓
50.	Pheasant-tailed Jacana		-	✓
51.	Bronze-winged Jacana		-	✓
52.	Common snipe	✓	-	
53.	Curlew sandpiper		-	✓
54.	Wood sandpiper		-	✓
55.	Common sandpiper		-	✓
56.	Marsh sandpiper		-	✓
57.	Spotted Redshank		-	✓
58.	Common Greenshank		-	✓
59.	Common Redshank		-	✓
60.	Eurasian Curlew		-	✓
61.	Small pratincole	✓	-	-
62.	Oriental pratincole	✓	-	-

63.	Indian Courser	✓	-	-
64.	Pallas Gull		-	✓
65.	Black headed gull		-	✓
66.	Brown headed Gull		-	✓
67.	Heuglins Gull		-	✓
68.	Gull billed tern		-	✓
69.	Whiskered tern		-	✓
70.	Little tern		-	✓
71.	Caspian tern		-	✓
72.	Lesser crested tern		-	✓

Total 71 species of bird in Gosabara wetland complex were observed using Fresh Water habitat. A single bird species was found to be using purely Marine/Saline habitat. 55 bird species were found to be using both the Fresh Water and Marine habitats.



Graph 3: Percentage of Habitat Use of Birds in Gosabara Wetland Complex (Fresh/Saline)

As we can see in the graph, more percentage of birds use Fresh Water habitat than Marine habitat. 1% birds use purely Marine habitat. 43% of the birds use both the habitats.

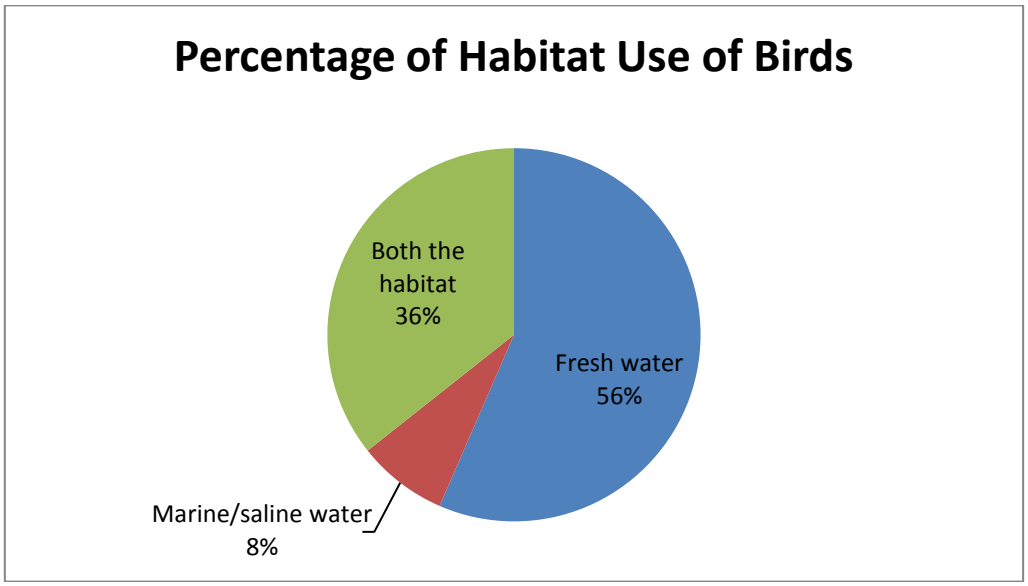
Table 5: List of Birds That Use Fresh Water, Marine, or Both Habitats in Khijadiya Bird Sanctuary

Sr.No	Common Name	Fresh Water Habitat	Marine/Saline Habitat	Both Habitats
1.	Common Teal	✓	-	-
2.	Northern Shoveler	✓	-	✓
3.	Northern Pintail	✓	-	✓
4.	Garganey	✓	-	-
5.	Knob-billed Duck	✓	-	-
6.	Indian Spot-billed Duck	✓	-	-
7.	Greylag Goose	✓	-	-
8.	Painted Stork	✓	-	✓

9.	Black-necked Stork	✓	-	✓
10.	Lesser Flamingo	✓	-	✓
11.	Greater Flamingo	✓	-	✓
12.	Black-headed Ibis	✓	-	-
13.	Red-naped Ibis	✓	-	-
14.	Glossy Ibis	✓	-	-
15.	Eurasian Spoonbill	✓	-	-
16.	Little Grebe	✓	-	-
17.	Grey Heron	✓	-	✓
18.	Purple Heron	✓	-	✓
19.	Pond Heron	✓	-	✓
20.	Black-crowned Night Heron	✓	-	✓
21.	Great Egret	✓	-	✓
22.	Intermediate Egret	✓	-	✓
23.	Cattle Egret	✓	-	✓
24.	Little Egret	✓	-	✓
25.	Great White Pelican	✓	-	✓
26.	Dalmatian Pelican	✓	-	✓
27.	Darter	✓	-	✓
28.	Little Cormorant	✓	-	✓
29.	Great Cormorant	✓	-	✓
30.	Indian Cormorant	✓	-	✓
31.	Eurasian Coot	✓	-	-
32.	Purple Swamphen	✓	-	-
33.	Common Moorhen	✓	-	-
34.	Common Crane	✓	-	✓
35.	Lesser Sand Plover	✓	-	✓
36.	Little-Ringed Plover	✓	-	✓
37.	Greater Sand Plover	✓	-	✓
38.	Ruff	✓	-	✓
39.	Black-tailed Godwit	✓	-	✓
40.	Little Stint	✓	-	✓
41.	Sanderling	✓	-	✓
42.	Kentish Plover	✓	-	✓
43.	Dunlin	✓	-	-
44.	White-tailed Lapwing	✓	-	-
45.	Red wattled Lapwing	✓	-	-
46.	Black-winged Stilt	✓	-	✓
47.	Pied-Avocet	✓	-	✓
48.	Common Snipe	✓	-	-
49.	Curlew Sandpiper	✓	-	✓
50.	Wood Sandpiper	✓	-	✓
51.	Common Sandpiper	✓	-	✓
52.	Marsh Sandpiper	✓	-	✓
53.	Eurasian Curlew	✓	-	✓
54.	Whimbrel	✓	-	✓
55.	Spotted Redshank	✓	-	✓
56.	Common Redshank	✓	-	✓
57.	Common Greenshank	✓	-	✓

58.	Broad-billed Sandpiper	✓	-	-
59.	Small Pratincole	✓	-	-
60.	Gull-Billed Tern	✓	-	✓
61.	Whiskered Tern	✓	-	✓
62.	Little Tern	✓	-	✓
63.	Caspian Tern	✓	-	✓
64.	Yellow Wagtail	✓	-	-
65.	White Wagtail	✓	-	-
66.	Demoiselle Crane	-	✓	-
67.	Grey Plover	-	✓	-
68.	Bar-tailed Godwit	-	✓	-
69.	Pacific Golden Plover	-	✓	-
70.	Terek Sandpiper	-	✓	-
71.	Palla's Gull	-	✓	-
72.	Black headed Gull	-	✓	-
73.	Brown headed Gull	-	✓	-
74.	Slender-billed Gull	-	✓	-
75.	Crab Plover	-	✓	-
76.	Oystercatcher	-	✓	-

A total of 65 numbers of birds species were found to be using fresh water habitat. 11 bird species were observed to be using purely marine habitat, such as salt pans and Marine habitat and 44 bird species were found using both the habitats, such as fresh water and marine.



Graph 4: Percentage of Habitat Use of Birds in Khijadiya Bird Sanctuary (Fresh/Saline)

5.3 Niche for Bird Habitat Across Different Plant Communities

Table 8 represents the data of bird habitat across different plant communities of both the wetlands.

Mainly birds in Gosabara and Khijadiya bird sanctuary uses *Prosopis juliflora, Salvadora persica, Bolboschoenous maritimus, Acacia nilotica* for perching, resting and hiding.

Table 6: Bird Habitat Across Different Plant Communities of Both the Wetlands

Sr.No	Common Name	Scientific Name	Plant Name	Activity
1.	Common Myna	*Acridotheres tristis*	*Prosopis juliflora, Salvadora persica*	Perching, resting
2.	Bank Myna	*Acridotheres ginginianus*	*Prosopis juliflora, Salvadora persica*	Perching, resting
3.	Blyth's Reed Warbler	*Acrocephalus dumetorum*	*Bolboschoenous maritimus*	Perching, hiding
4.	Common Kingfisher	*Alcedo atthis*	*Prosopis juliflora*	Perching
5.	Grey Heron	*Ardea cinerea*	*Prosopis juliflora*	Perching
6.	Great Egret	*Casmerodius albus*	*Lantana camara*	Perching
7.	Greater Coucal	*Centropus sinensis*	*Prosopis juliflora,acacia nilotica*	Perching, hiding
8.	Rock Pigeon	*Columba livia*	*Acacia nilotica*	Perching
9.	Oriental Magpie Robin	*Copsychus saularis*	*Prosopis juliflora*	Perching, hiding
10.	Yellow-crowned Woodpecker	*Leiopicus mahrattensis*	*acacia nilotica*	Perching, hiding
11.	Black Drongo	*Dicrurus macrocercus*	*Prosopis juliflora,acacia nilotica*	Perching
12.	Little Egret	*Egretta garzetta*	*Lantana camara*	Perching
13.	Black-headed Bunting	*Emberiza melanocephala*	*Prosopis juliflora*	Perching, hiding
14.	Asian Koel	*Eudynamys scolopacea*	*Prosopis juliflora*	Perching, hiding
15.	Eurasian Wryneck	*Jynx torquilla*	*Prosopis juliflora*	Perching, hiding

16.	Oriental White-eye	*Zosterops palpebrosus*	*Salvadora persica*	Perching, hiding, resting
17.	Rosy Starling	*Sturnus roseus*	*Prosopis juliflora , Salvadora persica, acacia nilotica*	Perching, hiding, resting
18.	Brahminy Starling	*Sturnus pagodarum*	*Prosopis juliflora , Salvadora persica, acacia nilotica*	Perching
19.	Laughing Dove	*Streptopelia senegalensis*	*Prosopis juliflora, acacia nilotica*	Perching, hiding
20.	Eurasian Collared Dove	*Streptopelia decaocto*	*Prosopis juliflora,acacia nilotica*	Perching
21.	Spotted Dove	*Streptopelia chinensis*	*Prosopis juliflora,acacia nilotica*	Perching, hiding
22.	Pied Bush Chat	*Saxicola caprata*	*Prosopis juliflora*	Perching, hiding
23.	Pond Heron	*Ardeola grayii*	*Lantana camara*	Perching
24.	Common Stonechat	*Saxicola torquatus*	*Bolboschoenous maritimus*	Perching, hiding
25.	Indian Silver bill	*Lonchura malabarica*	*Prosopis juliflora ,Bolboschoenous maritimus*	Perching, hiding, resting
26.	Red Headed Bunting	*Emberiza bruniceps*	*Prosopis juliflora*	Perching, hiding
27.	Plain Prinia	*Prinia inornata*	*Salvadora persica*	Perching, hiding
28.	Isabelline Shrike	*Lanius isabellinus*	*Prosopis juliflora*	Perching
29.	Long-Tailed Shrike	*Lanius schach*	*Prosopis juliflora,acacia nilotica*	Perching
30.	Red-Vented Bulbul	*Pycnonotus cafer*	*Prosopis juliflora, Salvadora persica,acacia nilotica*	Perching, hiding, resting
31.	House Sparrow	*Passer domesticus*	*Prosopis juliflora , Salvadora*	Perching, hiding, resting

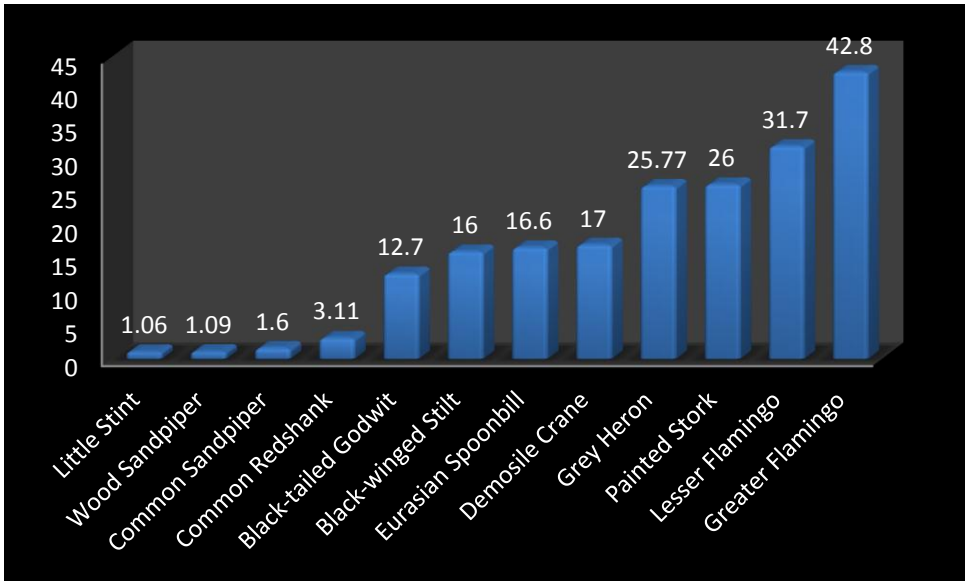
	persica	
32. Larks and pipits	*Tamarix sp*	Resting, hiding

5.4 Change in Bird Diversity with the Change in the Depth of Water

5.4.1 Bird Diversity in Gosabara with Change in the Depth of Water

Table 7: Depth of Water Used by Different Bird Species in Gosabara

Birds Species (n=10)	Water Depth (cm)	Standard Deviation
Small Waders		
Little Stint	1.06	±0.4
Wood Sandpiper	1.09	±0.7
Common Sandpiper	1.6	±0.5
Large waders		
Common Redshank	3.11	±0.83
Black-tailed Godwit	12.7	±3.9
Black-winged Stilt	16	±3.4
Tactile Forager		
Eurasian Spoonbill	16.6	±7
Large-sized Visual Forager		
Demosile Crane	17	±13
Stalking Herons		
Grey Heron	25.77	±18
Painted Stork	26	±13
Filter Feeders		
Lesser Flamingo	31.7	±12
Greater Flamingo	42.8	±15



Graph 5: Bird Diversity in Gosabara with Change in the Depth of Water
(X-Axis – Water Depth in cm, Y-Axis – Bird Species)

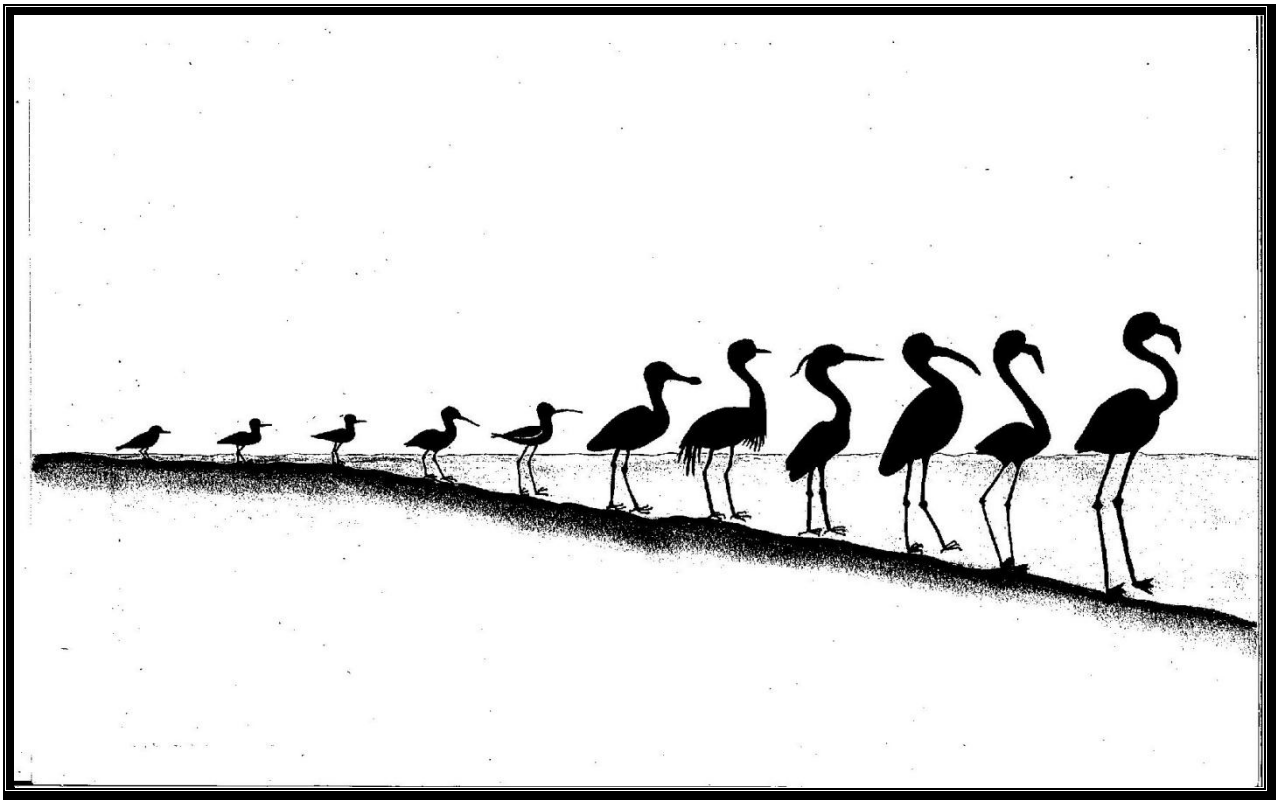


Figure 5: Pictorial Representation of Gosabara Bird Diversity with Change in the Depth of Water (Sketch by Kirnalee Patel)

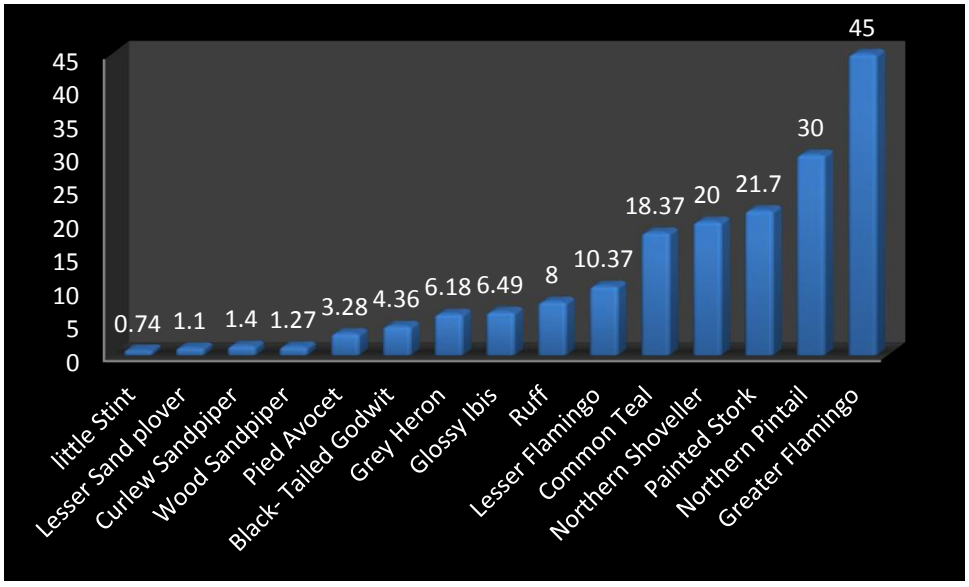
Graph shows the ranges of water depth selected by foraging birds belonging to different guilds. Feeding habitats varied from dry mudflats to wet mud to shallow water and deep water of no more than 50 cm. Small waders, for example. Little Stint, foraged on the dry banks, wet mud and water which was less than 2 cm deep; medium-sized waders such as Black-winged Stilt, Greenshank and Bar-tailed Godwit required water depths up to 16 cm for feeding, while the relatively big egrets and herons fed in water up to 25.77 cm deep. Large birds such as Painted stork, Lesser Flamingo and Greater Flamingo fed in water as deep as 26 to 42.8 cm.

5.4.2 Khijadiya Bird Diversity with Change in the Depth of Water

Table 8: Depth of Water Used by Different Bird Species in Khijadiya

Birds species	Waterdepth (cm)	Standard deviation
Small Waders		

Little Stint	0.74	±0.5
Lesser Sand Plover	1.1	±0.4
Curlew Sandpiper	1.4	±0.6
Wood Sandpiper	1.27	±0.67
Ruff	8	±3.8
Large Waders		
Pied Avocet	3.28	±1.5
Black- Tailed Godwit	4.36	±2.8
Stalking Herons		
Grey Heron	6.18	±4.1
Painted Stork	21.7	±9
Plagic Forager		
Glossy Ibis	6.49	±4.2
Filter Feeders		
Lesser Flamingo	10.37	±4.4
Greater Flamingo	45	±27.5
Dabbling Ducks		
Common Teal	18.37	±9.6
Northern Shoveller	20	±11
Northern Pintail	30	±8



Graph 6: Khijadiya Bird Diversity with Change in the Depth of Water (X-Axis – Water Depth in cm, Y-Axis – Bird Species)

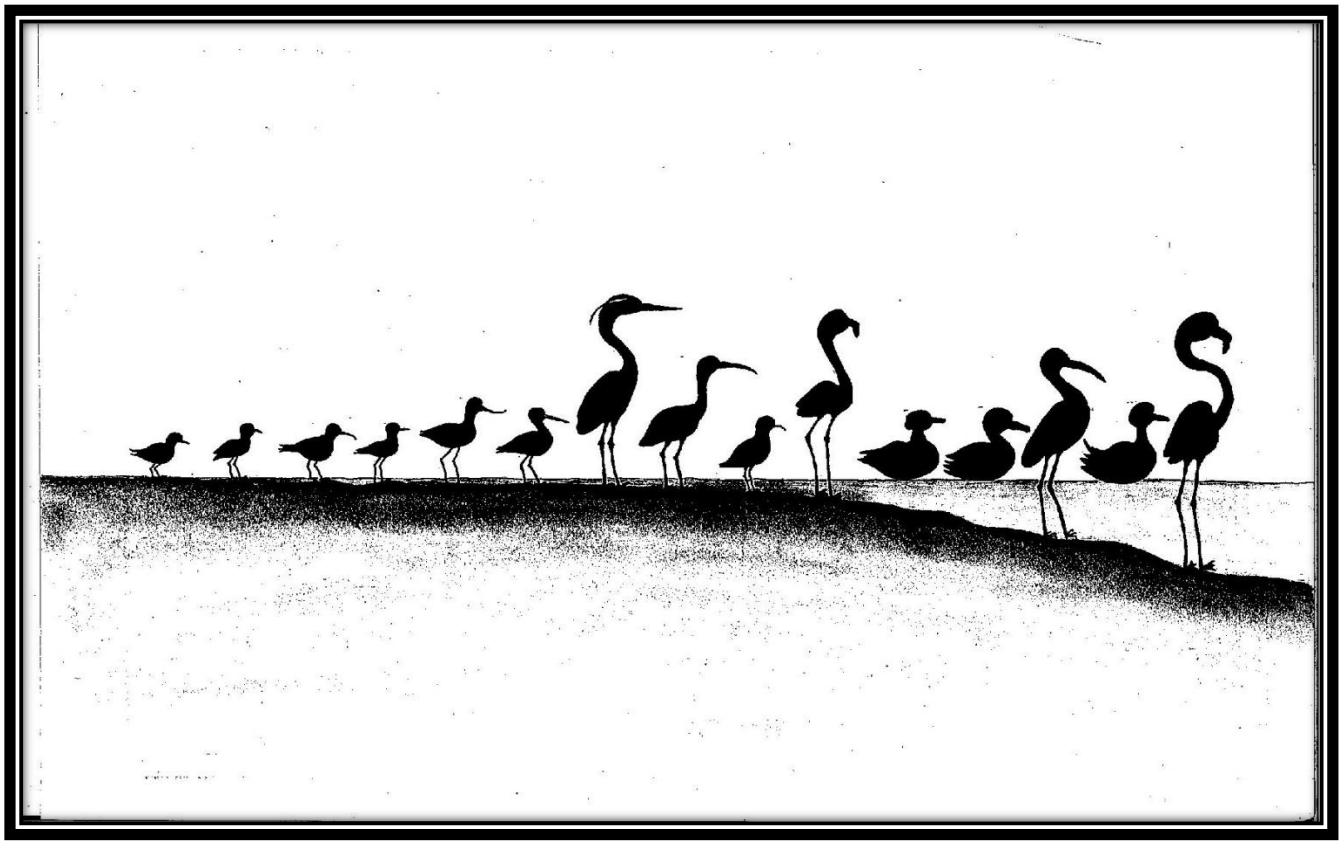


Figure 6: Poctorial Representation of Khijadiya Bird Diversity with Change in the Depth of Water (Sketch by Kirnalee Patel)

The graph shows the ranges of water depth selected by foraging birds belonging to different guilds. Feeding habitats varied from dry mudflats to wet mud to shallow water and deep water of not more than 30 cm. Small waders, such as Little Stint, foraged on the dry banks, wet mud and water that was less than 1.27 cm deep. Medium-sized waders such as Black-winged Stilt, Greenshank and Bar-tailed Godwit required water depths up to 5 cm for feeding, while the relatively big egrets and herons fed in water as deep as 6 to 10 cm. Large birds such as Painted Stork, Lesser Flamingo and Greater Flamingo fed in water 21 to 45 cm deep. Dabbling ducks fed in water from 18 to 30 cm deep.

5.5 Food Preference of Bird in Wetland

On the basis of their feeding habit, feeding guilds are classified.

Feeding Guilds

Birds that have similar feeding and foraging behavior were grouped into same guild. The foraging behaviours of bird species were grouped into nine trophic structures to determine the feeding behaviours of different bird species. The following are the nine feeding guilds (Poulin, et al 1994 *Biotropica*, 187-197):

I. **Frugivore**
   Describes a diet that consists primarily of fruit, including tree fruits as well as berries. Frugivorous birds often have specialized bills to help them eat fruit.
II. **Insectivore**

Describes a diet that consists primarily of insects, including aquatic insects, flying insects, ants, spiders, grasshoppers, caterpillars, dragonflies, butterflies or any combination of similar prey.

III. **Carnivore**

Bird of prey or predatory bird, also known as raptors, refers to several species of birds that hunt and feed on rodents and other small animals.

IV. **Granivore**

Describes a diet that consists primarily of seeds and grains.

V. **Omnivore**

Describes a diet that consists primarily of fruits and insects. Omnivorous bird species often change their diet seasonally for whatever food sources are most readily available.

VI. **Piscivore**

Describes birds whose diet consists largely of fish, but can also include other food sources such as aquatic insects, mollusks and crustaceans.

VII. **Molluscivorous**

Describes birds whose diet consists of mollusks such as snails, oyster and slugs.

VIII. **Mucivorous**

Describes birds whose diet consists mainly of plant juices or sap.

IX. **Nectivorous**

Describes a bird whose diet consists of high percentage of nector. Small quantities of fruit, insects and sap may also be consumed. These types of birds have specialized bills in order to gain access to and extract the nectar from nectar producing flowers.

Table 9: Feeding Habits of Birds in Both the Wetlands

Sr. No	Feeding Guilds	Common Name	Scientific Name	Feeding Habit
1	Frugivore			
		Purple Swamphen	*Porphyrio porphyria*	Feeds on stem and bulb of *Bolboschoenous maritimus*
		Red-vented Bulbul	*Pycnonotus cafer*	Feeds on fruit of *Salvadora persica*
		White-eared Bulbul	*Pycnonotus leucotis*	Feeds on fruit of *Salvadora persica,* Seeds of Avicinia Indica
		Brahminy Starling	*Sturnus pagodarum*	Feeds on fruit of *Salvadora persica*
		Rosy Starling	*Sturnus roseus*	Feeds on fruit of *Salvadora persica*
		Oriental White-eye	*Zosterops palpebrosus*	Feeds on fruit of *Salvadora persica*
		Common White-throat	*Sylvia communis*	Feeds on fruit of *Salvadora persica*
		Bank Myna	*Acridotheres ginginianus*	Fruit of *Salvadora persica*
		Common Myna	*Acridotheres tristis*	Fruit of *Salvadora persica*
2	Insectivore			
		Tawny Pipit	*Anthus campestris*	Feeds on black ants
		Common Sandpiper	*Actitis hypoleucos*	Feeds on Insects
		Green Bee-eater	*Merops orientalis*	Feeds on bees and other insects
		Black Drongo	*Dicrurus macrocercus*	Feeds on dragonfly and insects
		Common Hoopoe	*Upupa epops*	Feeds on insects
		Curlew Sandpiper	*Calidris ferruginea*	Feeds on small insects and small invertebrates
3	Carnivore			
		Crested Serpent Eagle	*Spilornis minimus*	Feeding on snake
		Greater Spotted Eagle	*Aquila clanga*	Feeding on fish
4	Granivore			
		Barred Buttonquail	*Turnix suscitator*	Feeds on seeds and grains
		Common Rosefinch	*Carpodacus erythrinus*	Feeds on seeds and grain
		Indian Rock pigeon	*Columba livia*	Feeds on grains

		Laughing dove	*Streptopelia senegalensis*	Feeds on seeds in near by agricultural fields
		Eurasian Collard dove	*Streptopelia decaocto*	Feeds on seeds in near by agricultural fields
		Red Collard dove	*Streptopelia tranquebarica*	Feeds on seeds in near by agricultural fields
		Spotted dove	*Streptopelia chinensis*	Feeds on seeds in near by agricultural fields
5	Omnivore			
		House Crow	*Corvus splendens*	Fruits of salvodora and also act as a scavenger
		Common Tailorbird	*Orthotomus sutorius*	Feeds on Fruit of *Salvadora persica* and also feeds on small insetcs
6	Piscivore			
		Black-necked Stork	*Ephippiorhynchus asiaticus*	Feeds on fish and small crustaceans
		Great Egret	*Casmerodius albus*	Feeds on fish
		Intermediate Egret	*Mesophoyx intermedia*	Feeds on fish
		Darter	*Anhinga melanogaster*	Feeds on fish
		Great Egret	*Casmerodius albus*	Feeds on fish
7	Mucivorous			
		Lesser Flamingo	*Phoenicopterus minor*	Feeds on algae – spirulina
8	Nectivorous			
		Purple Sunbird	*Cinnyris asiaticus*	Feeds on nector of flower of *Salvadora persica*

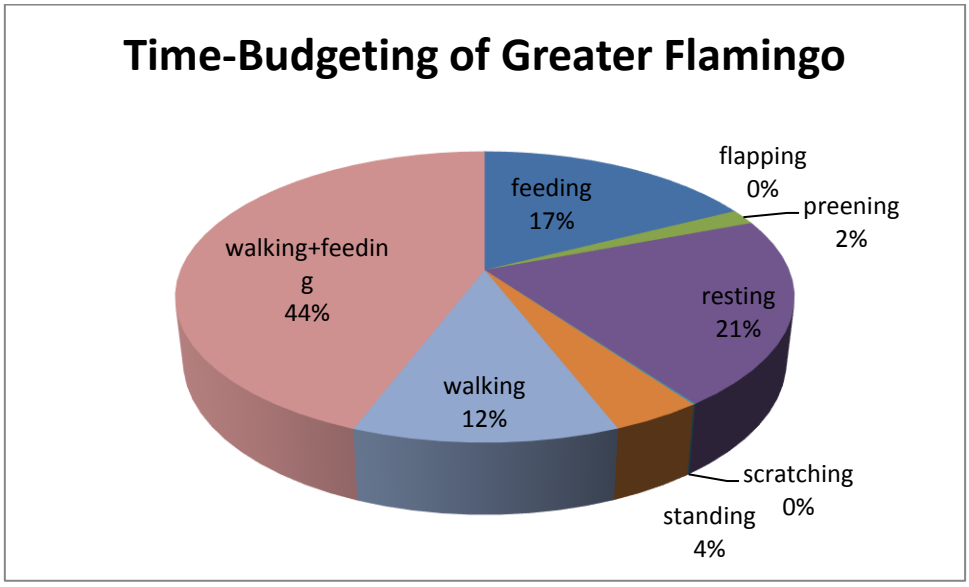
5.6 Diurnal Time Budget of Six Species of Bird

This study investigated the diurnal behavior pattern of six species of bird in Khijadiya Bird Sanctuary, Jamnagar, Gujarat, during the months from January to March, 2017. The six species of birds studied are the following:

5.6.1 Greater Flamingo

Table 10: Time Activity Budget of Great Flamingo

Activity	Percentage
Feeding	17.50%
Flapping	0.00%
Preening	1.70%
Resting	20.80%
Scratching	0.10%
Standing	4.00%
Walking	11.70%
walking+feeding	44.20%



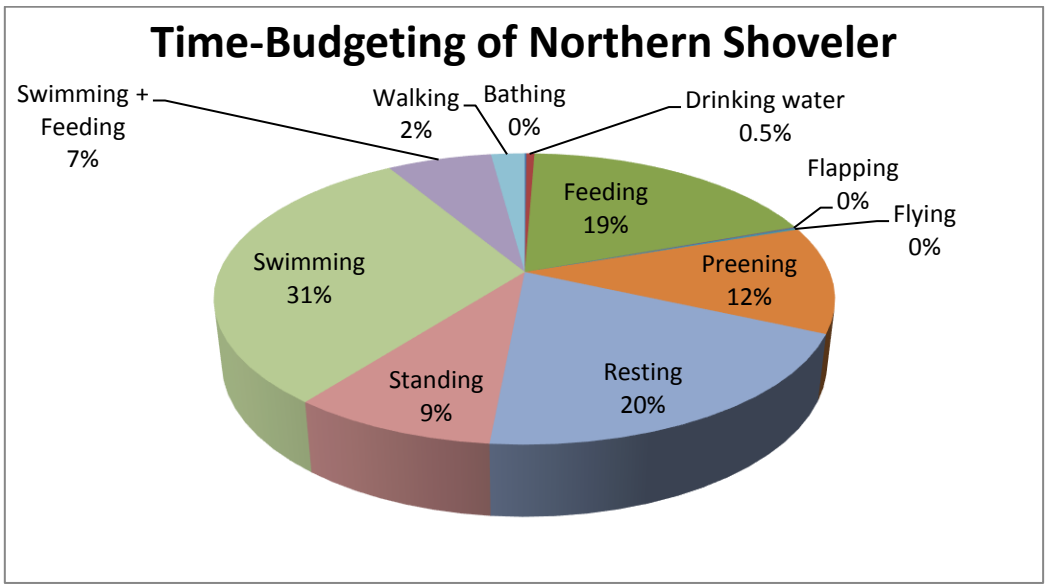
Graph 7: Time-Budget Activities of the Greater Flamingo

Walking+Feeding was the dominant activity in the diurnal time budget of the Greater Flamingo *Phoenicopterus* at Khijadiya Bird Sanctuary, during the months of January to March, 2017. This was followed by resting, feeding, and walking. The rest of the time budget was accorded to standing and preening. Greater Flamingos were using the salt pans for all the listed activites. Only the juveniles were seen thrice using the freshwater patch. During the afternoons, most of the Greater Flamingos spend their time in resting.

5.6.2 Northern Shoveler

Table 11: Time Activity Budget of Northern Shoveler

Activity	Percentage
Bathing	0.10%
Drinking water	0.50%
Feeding	18.90%
Flapping	0.10%
Flying	0.20%
Preening	11.90%
Resting	19.80%
Standing	9.00%
Swimming	30.90%
Swimming + feeding	6.50%
Walking	2.10%



Graph 8: Time-Budget Activities of the Northern Shoveler

Swimming was the dominant activity in the diurnal time budget of the Northern Shoveler *Anas clypeata at* Khijadiya Bird Sanctuary during the months of January to March, 2017. It was followed by resting, feeding, and walking. The rest of the time budget was accorded to standing, walking and swimming+feeding.

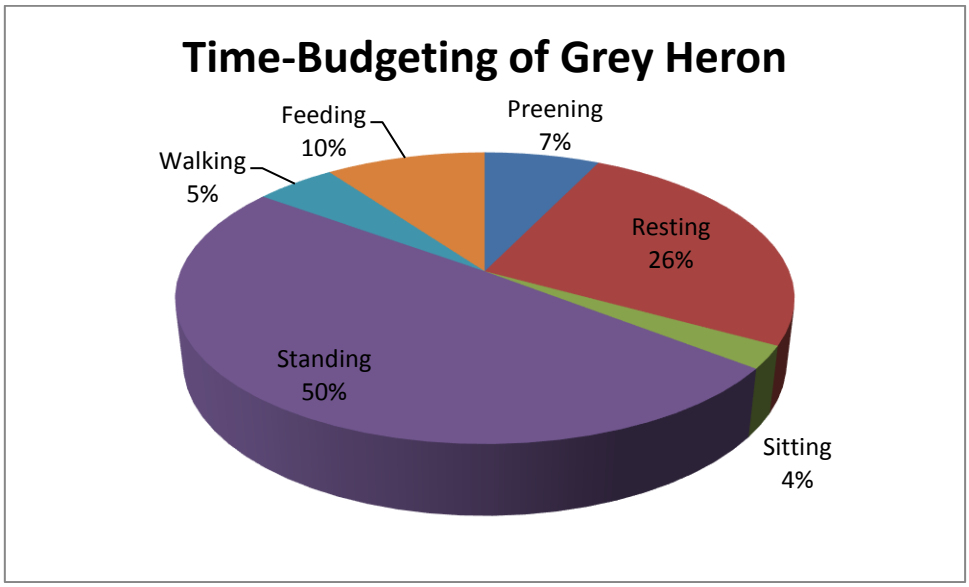
Northern Shoveler used the salt pan during the morning from 7:00 to 8:00 am. During this time, they were not seen in the freshwater habitat. In the evenings, after 19:30 hrs, they were observed to fly away. The study assumes that they might be moving to salt pans for resting in the night.

5.6.3 Grey Heron

Table 12: Time Activity Budget of Grey Heron

Activity	Percentage

Preening	7.20%
Resting	25.80%
Sitting	2.50%
Standing	49.50%
Walking	5.00%
Feeding	10.00%
Activity	Percentage
Preening	7.20%
Resting	25.80%



Graph 9: Time-Budget Activities of the Grey Heron

Standing was the dominant activity in the diurnal time budget of the Grey Heron *at* Khijadiya Bird Sanctuary, during the months of January to March, 2017. This was followed by resting, feeding, preening. The rest of the time budget was accorded to sitting, walking, feeding, stretching and fishing.

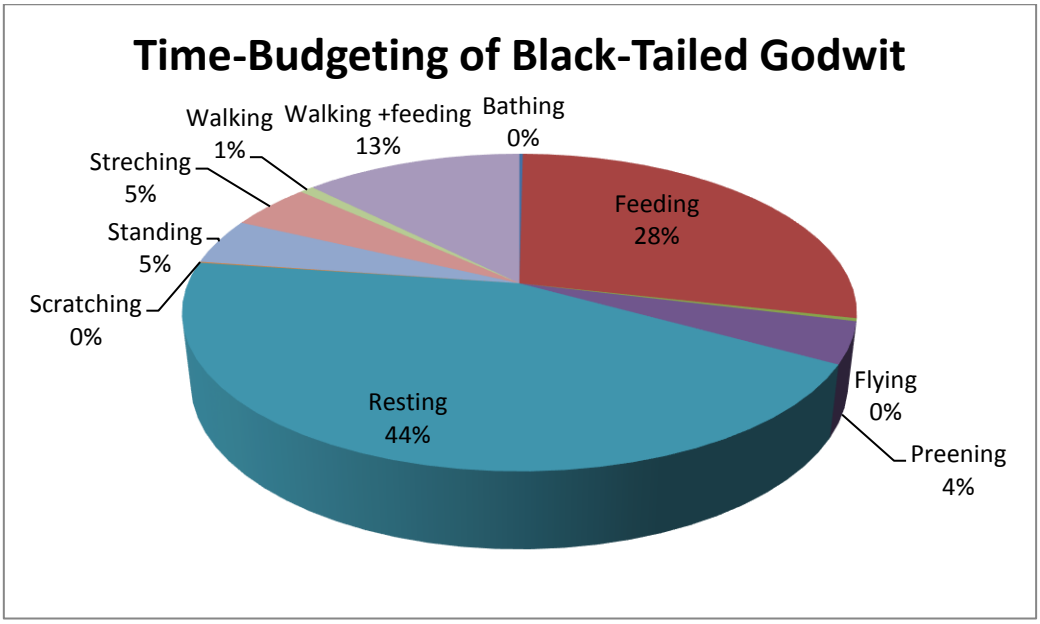
Grey heron was noted using the fresh water habitat most of the time. It was feeding mainly during early mornings. It used to feed mainly on fish. For resting or standing, it used open area or dry branches of Prosopis in water. It was also observed to rest or stand on the branch of the *Acacia nilotica* tree.

5.6.4 Black-Tailed Godwit

Table 13: Time Activity Budget of Black-Tailed Godwit

Activity	**Percentage**
Bathing	0.20%
Feeding	28.30%
Flying	0.30%

Preening	4.20%
Resting	44.20%
Scratching	0.10%
Standing	4.70%
Streching	4.70%
Walking	0.80%
Walking +feeding	12.50%
Bathing	0.20%



Graph 10: Time-Budget Activities of the Black-Tailed Godwit

Resting was the dominant activity in the diurnal time budget of the Black-tailed Godwit at Khijadiya Bird Sanctuary, during the months of January to March, 2017. Then followed by feeding, walking+ preening. The rest of the time budgeted was accorded to stretching, standing, preening and walking.

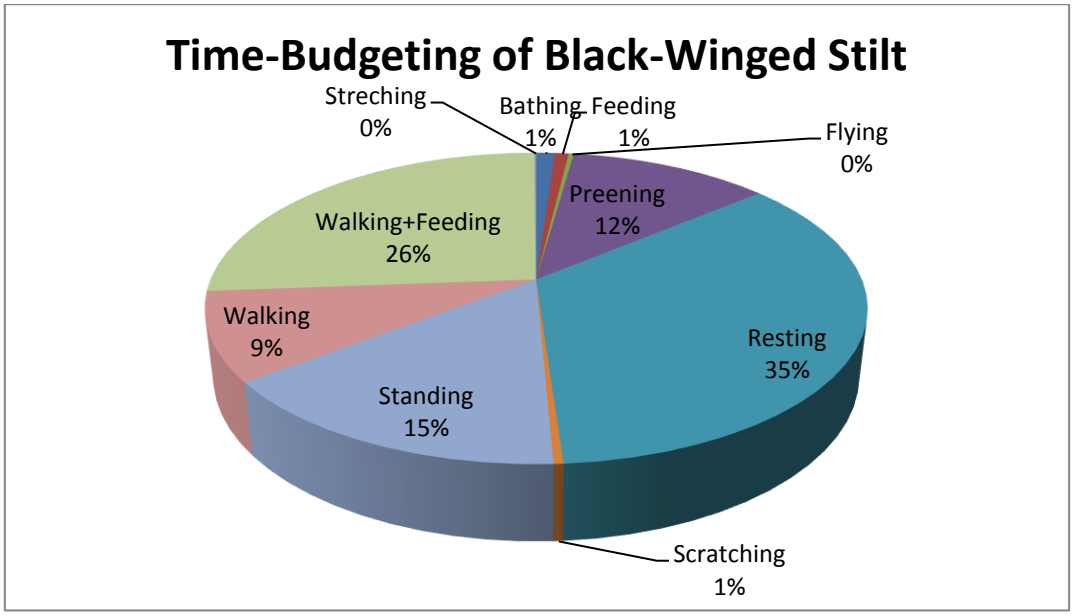
Black-tailed Godwit was observed using both the habitats (Marine and Fresh water), but after 17:30, it was noted to use only salt plans. In salt pans, in the evenings, they used to form groups. Mostly, feeding was carried out in groups. During afternoons, they used to rest.

5.6.5 Black-Winged Stilt

Table 14: Time Activity Budget of Black-winged Stilt

Activity	Percentage
Bathing	1.10%
Feeding	0.80%
Flying	0.30%
Preening	11.70%
Resting	35%

Scratching	0.40%
Standing	15.30%
Walking	9.20%
Walking+Feeding	26.10%
Streching	0.10%



Graph 11: Time-Budget Activities of the Black-Winged Stilt

Resting was the dominant activity in the diurnal time budget of the Black-tailed Godwit *at* Khijadiya Bird Sanctuary during the months of January to March, 2017. This was followed by walking+ feeding, standing. The rest of the time was accorded to preening, walking, feeding and bathing.

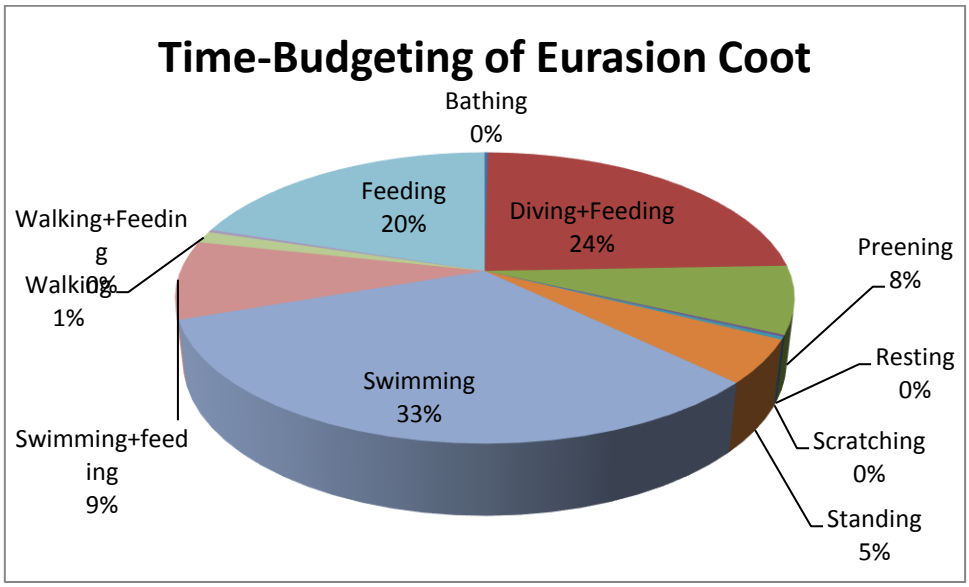
Black-winged Stilt was noted using both the habitat, Freshwater and salt pans. Also, while feeding, it used to use the border of sedges such as *Bolboschoenus maritimus* (bayonet grass).

5.6.6 Eurasian Coot

Table 15: Time Activity Budget of Eurasian Coot

Activity	Percentage
Bathing	0.20%
Diving+Feeding	24.20%
Preening	7.50%
Resting	0.20%
Scratching	0.30%
Standing	4.80%
Swimming	32.50%
Swimming+feeding	8.70%

Walking	1.30%
Walking+Feeding	0.30%
Feeding	20%
Bathing	0.20%
Diving+Feeding	24.20%



Graph 12: Time-Budget Activities of the Eurasian Coot

Swimming was the dominant activity in the diurnal time budget of the Eurasian coot *at* Khijadiya Bird Sanctuary during the months of January to March, 2017. This was followed by diving+feeding, feeding, swimming+feeding, preening, standing. A small percentage of the time was accorded to resting, walking, bathing and scratching.

The Eurasion Coot was noted using purely a Fresh water habitat. It is used to feed on the aquatic plants such as Hydrilla, Potamegeton, and Chara. It also was observed to feed on the edges of the water body. To dry its body or for resting, it uses land.

5.7 New Record from Gosabara Wetland

On 26th January, 2017, at 2:39 PM, the author and Dr. Padamnabhi were carrying out area calculation at a prosopis island in Gosabara wetland. Suddenly, a bird, which looked very different, flew across the author. The author hurriedly followed it and observed it for 10 seconds and photographd it, before it flew out of sight. Later that evening, the bird was identified as Asian Desert Warbler (*Sylvia nana*). Identification of the bird was strengthened by the unique up and down tail movement observed in the field.

Asian Desert Warbler (*Sylvia nana*) is an arid species, which winters in Kutch and Rajasthan. There are a few sporadic records of the species from locations beyond its natural range. The species has never been recorded from Gosabara. Therefore, this sighting forms the first record from Gosabara Wetland.

5.8 Significant Record from Khijadiya Bird Sanctuary

During one of the field days, the author and his team were surveying Part 1 of Khijadiya sanctuary. In the mangrove patch, the team spotted one unusal big-sized bird. After due observation and photographing of the individual, it was identified as Macqueen's Bustard (*Chlamydotis macqueenii*). The bird was also later sighted by local forest department staff.

The species falls under vulnerable category of IUCN Red list category (BirdLife International. 2017). The species has previously been recorded from the area. Sighting of the species during January 2017 forms a significant record from the area.

5.9 Ecosystem Dynamics at the Two Wetlands in a Nutshell

Life at the two wetland starts with the south-west monsoon hitting it. The entire area gets submerged in water. After the monsoon is over, water gradually declines over the next couple of months. When the winter arrives, the level of water is at optimum level for water birds. Birds in large flocks and numbers arrive here. Both the wetlands become a mosaic of water and tall grasses, which forms perfect hiding and nesting grounds for some birds. The wetland harbors life from insects to mammals. As the months pass by, the water dries up and the area which once was full of birds now bursts into green with vegetation and it is time for the terrestrial birds to visit it. During the summer months, almost the entire area dries up and forms very important habitat for birds such as larks and pipits, until the next monsoon. In short, all through the year, the place teems with life, irrespective of the season.

Annexures

Annexure 1: List of Birds of Gosabara Wetland

Sr. no.	Family	Common Name	*Scientific Name*
1	Phasianidae	Grey Francolin	*Francolinus pondicerianus*
		Indian Peafowl	*Pavo cristatus*
2	Anatidae	Common Pochard	*Aythya farina*
		Common Teal	*Anas crecca*
		Northern shoveler	*Anas clypeata*
		Northern Pintail	*Anas acuta*
		Garganey	*Anas querquedula*
		Tufted Duck	*Aythya fuligula*
		Ruddy Shelduck	*Tadorna ferruginea*
		Knob-billed Duck	*Sarkidiornis melanotos*
		Eurasian wigeon	*Anas Penelope*
		Mallard	*Anas platyrhynchos*
		Indian Spot-billed Duck	*Anas poecilorhyncha*
		Gadwall	*Anas strepera*
3	Ciconiidae	Painted Stork	*Mycteria leucocephala*
		Woolly necked Stork	*Ciconia episcopus*
4	Phoenicopteridae	Greater Flamingo	*Phoenicopterus roseus*
		Lesser Flamingo	*Phoenicopterus minor*
5	Threskiornithidae	Black headed Ibis	*Threskiornis melanocephalus*
		Red-naped Ibis	*Pseudibis papillosa*
		Glossy Ibis	*Plegadis falcinellus*
		Eurasian Spoonbill	*Platalea leucorodia*
6	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*
7	Ardeidae	Grey Heron	*Ardea cinerea*
		Purple Heron	*Ardea purpurea*
		Pond Heron	*Ardeola grayii*
		Great Egret	*Areda alba*
		Intermediate Egret	*Mesophoyx intermedia*
		Cattle Egret	*Bubulcus ibis*
		Little Egret	*Egretta garzetta*
		Western Reef Egret	*Egretta gularis*
8	Pelicanidae	Great White Pelican	*Pelecanus onocrotalus*
		Dalmatian Pelican	*Pelecanus crispus*
9	Anhingidae	Darter	*Anhinga melanogaster*
10	Phalacrocoracidae	Little Cormorant	*Phalacrocorax niger*
		Great Cormorant	*Phalacrocorax carbo*
		Indian Cormorant	*Phalacrocorax fuscicollis*
11	Accipitridae	Osprey	*Pandion haliaetus*

		Eurasian Marsh Harrier	*Circus aeruginosus*
		Indian Spotted Eagle	*Aquila hastate*
		Greater Spotted Eagle	*Aquila clanga*
		Black-winged Kite	*Elanus caeruleus*
		Brahminy Kite	*Haliastur indus*
		Black Kite	*Milvus migrans*
		Shikra	*Accipiter badius*
		Common Kestrel	*Falco tinnununculus*
12	Rallidae	Eurasian Coot	*Fulica atra*
		Purple Swamp Hen	*Porphyrio porphyria*
13	Gruidae	Common Crane	*Grus grus*
		Demoiselle Crane	*Grus virgo*
14	Charadriidae	Common Ringed Plover	*Charadrius hiaticula*
		Lesser Sand Plover	*Charadrius mongolus*
		Little-ringed Plover	*Charadrius dubius*
		Greater Sand Plover	*Charadrius leschenaultia*
		Pacific Golden Plover	*Pluvialis fulva*
		Ruff	*Philomachus pugnax*
		Black-tailed Godwit	*Limosa limosa*
		Little Stint	*Calidris minuta*
		Sanderling	*Calidris alba*
		Kentish Plover	*Charadrius alexandrines*
15	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*
		Pied-Avocet	*Recurvirostra avosetta*
16	Jacanidae	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
		Bronze-winged Jacana	*Metopidius indicus*
17	Scolopacidae	Common Snipe	*Gallinago gallinago*
		Curlew Sandpiper	*Calidris ferruginea*
		Wood Sandpiper	*Tringa glareola*
		Common Sandpiper	*Actitis hypoleucos*
		Marsh Sandpiper	*Tringa stagnatilis*
		Spotted Redshank	*Tringa erythropus*
		Common Greenshank	*Tringa nebularia*
		Common Redshank	*Tringa tetanus*
		Eurasian Curlew	*Numenius arquata*
18	Glareolidae	Small Pratincole	*Glareola lacteal*
		Oriental Pratincole	*Glareola maldivarum*
		Indian Courser	*Cursorius coromandelicus*
19	Laridae	Pallas Gull	*Ichthyaetus ichthyaetus*
		Black-headed gull	*Choricocephalus ridibundus*

		Brown-headed Gull	*Larus brunnicephalus*
		Heuglins Gull	*Larus heuglini*
		Gull-billed Tern	*Gelochelidon nilotica*
		Whiskered Tern	*Chlidonias hybridus*
		Little Tern	*Sterna albifrons*
		Caspian Tern	*Sterna caspia*
		Lesser-crested Tern	*Sterna bengalensis*
20	Columbidae	Rock Pigeon	*Columba livia*
		Laughing Dove	*Streptopelia senegalensis*
		Eurasian Collared Dove	*Streptopelia decaocto*
		Oriental Turtle Dove	*Streptopelia orientalis*
21	Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*
22	Cuculidae	Asian Koel	*Eudynamys scolopacea*
		Southern Coucal	*Centropus parroti*
23	Upupidae	Common Hoopoe	*Upupa epops*
24	Alcedinidae	Common Kingfisher	*Alcedo atthis*
		White-throated Kingfisher	*Halcyon smyrnensis*
		Pied Kingfisher	*Ceryle rudis*
25	Laniidae	Long-tailed Shrike	*Lanius schach*
		Isabelline Shrike	*Lanius isabellinus*
		Brown Shrike	*Lanius cristatus*
26	Dicruridae	Black Drongo	*Dicrurus macrocercus*
27	Corvidae	House Crow	*Corvus splendens*
28	Hirundinidae	Sand Martin	*Riparia riparia*
		Pale Martin	*Riparia diluta*
		Barn Swallow	*Hirundo rustica*
		Red-rumped Swallow	*Hirundo daurica*
		Wire-tailed Swallow	*Hirundo smithii*
29	Alaudidae	Crested Lark	*Galerida cristata*
		Ashy-crowned Sparrow Lark	*Eremopterix grisea*
		Skye's Lark	*Galerida deva*
		Oriental Skylark	*Alauda gulgula*
		Rufous Lark	
30	Meropidae	Green Bee-eater	*Merops orientalis*
31	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*
		White-eared Bulbul	*Pycnonotus leucotis*
32	Sylviidae	Clamorous Reed Warbler	*Acrocephalus stentoreus*
		Blyth's Reed Warbler	*Acrocephalus dumetorum*
		Asian Desert Warbler	*Sylvia hortensis*
33	Timaliidae	Jungle Babbler	*Acridotheres tristis*

		Common Babbler	*Turdoides caudate*
34	Sturnidae	Common Myna	*Acridotheres tristis*
		Bank Myna	*Acridotheres ginginianus*
		Rosy Starling	*Pastor roseus*
35	Muscicapidae	Common Stone Chat	*Saxicola rubicola*
		Oriental Magpie Robin	*Copsychus saularis*
		Indian Robin	*Saxicoloides fulicatus*
		Variable Wheatear	*Oenanthe picata*
36	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus*
37	Passeridae	House Sparrow	*Passer domesticus*
38	Motacillidae	Tawny Pipit	*Anthus campestris*
		Paddy-field Pipit	*Anthus rufulus*
		Yellow Wagtail	*Motacilla flava*
		White Wagtail	*Motacilla alba*
		White-browed Wagtail	*Motacilla maderaspatensis*
39	Emberizidae	Red-headed Bunting	*Emberiza bruniceps*
		Black-headed Bunting	*Emberiza melanocephala*
40	Pteroclidae	Chestnut-bellied Sand Grouse	*Pterocles exustus*
41	Caprimulgidae	Indian Nightjar	*Caprimulgus asiaticus*
		Skye's Nightjar	*Caprimulgus mahrattensis*
		Savanna Nightjar	*Caprimulgus affinis*
42	Cisticolidae	Zitting Cisticola	*Cisticola juncidis*
		Plain Prinia	*Prinia inornata*
		Common Tailor Bird	*Orthotomus sutorius*
43	Apodidae	Little Swift	*Apus affinis*

Annexure 2: List of Birds of Khijadiya Bird Sanctuary

	Family	**Common Name**	**Scientific Name**
1	Phasianidae	Grey Francolin	*Francolinus pondicerianus*
		Indian Peafowl	*Pavo cristatus*
		Indian Bush Quail	*Perdicula asiatica*
2	Anatidae	Common Teal	*Anas crecca*
		Northern Shoveler	*Anas clypeata*
		Northern Pintail	*Anas acuta*

		Garganey	*Anas querquedula*
		Knob-billed Duck	*Sarkidiornis melanotos*
		Indian Spot-billed Duck	*Anas poecilorhyncha*
		Greylag Goose	*Anser anser*
3	Ciconiidae	Painted Stork	*Mycteria leucocephala*
		Black-necked Stork	*Ephippiorhynchusasiaticus*
4	Phoenicopteridae	Lesser Flamingo	*Phoenicopterus minor*
		Greater Flamingo	*Phoenicopterus ruber*
5	Threskiornithidae	Black-headed Ibis	*Threskiornis melanocephalus*
		Red-naped Ibis	*Pseuddibis pappilossa*
		Glossy Ibis	*Plegadis falcinellus*
		Eurasian Spoonbill	*Platalea leucorodia*
6	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*
7	Ardeidae	Grey Heron	*Ardea cinerea*
		Purple Heron	*Ardea purpurea*
		Pond Heron	*Ardeola grayii*
		Black-crowned Night Heron	*Nycticorax nycticorax*
		Great Egret	*Areda alba*
		Intermediate Egret	*Mesophoyx intermedia*
		Cattle Egret	*Bubulcus ibis*
		Little Egret	*Egretta garzetta*
8	Pelicanidae	Great White Pelican	*Pelecanus onocrotalus*
		Dalmatian Pelican	*Pelecanus crispus*
9	Anhingidae	Darter	*Anhinga melanogaster*
	Phalacrocoracidae	Little Cormorant	*Phalacrocorax niger*
		Great Cormorant	*Phalacrocorax carbo*
		Indian Cormorant	*Phalacrocorax fuscicollis*
10	Accipitridae	Osprey	*Pandion haliaetus*
		Eurasian Marsh Harrier	*Circus aeruginosus*
		Black-winged Kite	*Elanus caeruleus*
		Brahminy Kite	*Halistur indus*
		Black Kite	*Milvus migrans*
		Shikra	*Accipiter badius*
		Short-toed Snake Eagle	*Circaetus gallicus*
		Black Eared Kite	*Milvus lineatus*
		Pallid Harrier	*Circus macrourus*

		Oriental Honey Buzzard	*Pernis ptilorhyncus*
		Crested Serpent Eagle	*Spilornis minimus*
		Greater Spotted Eagle	*Aquila clanga*
11	Rallidae	Eurasian Coot	*Fulica atra*
		Purple Swamphen	*Porphyrio porphyria*
		Common Moorhen	*Gallinula chloropuss*
12	Gruidae	Common Crane	*Grus grus*
		Demoiselle Crane	*Grus virgo*
13	Charadriidae	Lesser Sand Plover	*Charadrius mongolus*
		Little-Ringed Plover	*Charadrius dubius*
		Greater Sand Plover	*Charadrius leschenaultia*
		Ruff	*Philomachus pugnax*
		Black-Tailed Godwit	*Limosa limosa*
		Little Stint	*Calidris minuta*
		Sanderling	*Calidris alba*
		Kentish Plover	*Charadrius alexandrines*
		Grey Plover	*Pluvialis squatarola*
		Dunlin	*Calidris alpine*
		White-tailed Lapwing	*Vanellus leucurus*
		Red-wattled Lapwing	*Vanellus indicus*
		Bar-tailed Godwit	*Limosa lapponica*
		Pacific Golden Plover	*Pluvialis fulva*
14	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*
		Pied-Avocet	*Recurvirostra avosetta*
15	Scolopacidae	Common Snipe	*Gallinago gallinago*
		Curlew Sandpiper	*Calidris ferruginea*
		Wood Sandpiper	*Tringa glareola*
		Common Sandpiper	*Actitis hypoleucos*
		Marsh Sandpiper	*Tringa stagnatilis*
		Eurasian Curlew	*Numenius arquata*
		Whimbrel	*Numenius phaeopus*
		Spotted Redshank	*Tringa erythropus*
		Common Redshank	*Tringa tetanus*
		Common Greenshank	*Tringa nebularia*
		Terek's Sandpiper	*Xenus cinereus*
		Broad-billed Sandpiper	*Eurynorhynchus pygmeus*
16	Glareolidae	Small Pratincole	*Glareola lacteal*

		Indian Courser	*Cursorius coromandelicus*
17	Laridae	Pallas Gull	*Larus ichthyaetus*
		Black-headed Gull	*Chroicocephalus ridibundus*
		Brown-headed Gull	*Chroicocephalus brunnicephalus*
		Slender-billed Gull	*Chroicocephalus genei*
		Gull-billed Tern	*Gelochelidon nilotica*
		Whiskered Tern	*Chlidonias hybridus*
		Little Tern	*Sterna albifrons*
		Caspian Tern	*Sterna caspia*
18	Columbidae	Indian Rock Pigeon	*Columba livia*
		Laughing Dove	*Streptopelia senegalensis*
		Eurasian Collard Dove	*Streptopelia decaocto*
		Red Collard Dove	*Streptopelia tranquebarica*
		Spotted Dove	*Streptopelia chinensis*
19	Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*
		Alexandrine Parakeet	*Psittacula eupatria*
20	Cuculidae	Asian Koel	*Eudynamys scolopacea*
		Southern Coucal	*Centropus parroti*
21	Upupidae	Common Hoopoe	*Upupa epops*
22	Alcedinidae	Common Kingfisher	*Alcedo atthis*
		White-throated Kingfisher	*Halcyon smyrnensis*
		Pied Kingfisher	*Ceryle rudis*
23	Laniidae	Long-tailed Shrike	*Lanius schach*
		Isabelline Shrike	*Lanius isabelliinus*
		Brown Shrike	*Lanius cristatus*
24	Dicruridae	Black Drongo	*Dicrurus macrocercus*
25	Corvidae	House Crow	*Corvus splendens*
26	Hirundinidae	Dusky-crag Martin	*Hirundo concolor*
		Pale Martin	*Riparia diluta*
		Barn Swallow	*Hirundo rustica*
		Red-rumped Swallow	*Hirundo daurica*
27	Alaudidae	Crested Lark	*Galerida cristata*
		Sykes's Lark	*Galerida deva*
		Ashy Crowned Sparrow lark	*Eremopterix grisea*
		Sand Lark	*Calandrella raytal*
28	Meropidae	Green Bee-eater	*Merops orientalis*

29	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*
		White-eared Bulbul	*Pycnonotus leucotis*
30	Sylviidae	Clamorous Reed Warbler	*Acrocephalus stentoreus*
		Bylth's Reed Warbler	*Acrocephalus dumetorum*
		Common Whitethroat	*Sylvia communis*
		Orphean Warbler	*Sylvia hortensis*
		Common Chiffchaff	*Phylloscopus collybita*
		Lesser Whitethroat	*Sylvia curruca*
31	Timaliidae	Jungle Babbler	*Turdoides striata*
		Common Babbler	*Turdoides caudate*
		Yellow-eyed Babblers	*Chrysomma sinense*
32	Sturnidae	Common Myna	*Acridotheres tristis*
		Bank Myna	*Acridotheres ginginianus*
		Brahminy Starling	*Sturnus pagodarum*
		Rosy Starling	*Sturnus roseus*
33	Muscicapidae	Common Stone Chat	*Saxicola caprata*
		Pied Bushchat	*Saxicola caprata*
		Indian Robin	*Saxicoloides fulicata*
		Blue Throat	*Luscinia svecica*
		Oriental Magpie Robin	*Copsychus saularis*
		Asian Paradise Flycatcher	*Terpsiphone paradise*
		Red Breasted Flycatcher	*Ficedula albicilla*
		Black Redstart	*Phoenicurus ochruros*
34	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus*
35	Passeridae	House Sparrow	*Passer domesticus*
		Chestnut Shouldered Petronia	*Gymnoris Xanthocollis*
36	Motacillidae	Tawny Pipit	*Anthus campestris*
		Paddy-field Pipit	*Anthus rufulus*
		Yellow Wagtail	*Motacilla flava*
		White Wagtail	*Motacilla alba*
37	Burhinidae	Great Thick-knee	*Esacus recurvirostris*
38	Zosteropidae	Oriental White-eye	*Zosterops palpebrosus*
39	Picidae	Eurasian Wryneck	*Jynx torquilla*
		Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*
40	Muscicapidae	Desert Wheatear	*Oenanthe deserti*
		Isabelline Wheatear	*Oenanthe isabellina*
41	Estrildidae	Scaly-breasted Munia	*Lonchura punctulata*

		Indian Silverbill	*Lonchura malabarica*
42	Cisticolidae	Plain Prinia	*Prinia inornata*
		Ashy Prinia	*Prinia socialis*
		Rufous-fronted Prinia	*Prinia buchanani*
		Common Tailor Bird	*Orthotomus sutorius*
43	Pteroclidae	Chestnut-bellied Sandgrouse	*Pterocles exustus*
44	Oriolidae	Eurasian Golden Orioles	*Oriolus oriolus*
45	Otididae	Macqueen Bustard	*Chlamydotis macqueenii*
46	Tephrodornithidae	Common Woodshrike	*Tephrodornis pondicerianus*
47	Haematopodidae	Eurasian Oystercatcher	*Haematopus ostralegus*
48	Ploceidae	Baya Weaver	*Ploceus philippinus*
49	Turnicidae	Barred Buttonquail	*Turnix suscitator*
50	Frigillidae	Common Rosefinch	*Carpodacus erythrinus*

Annexure 3 : Asian Desert Warbler (New Record for Gosabara Wetland)

Annexure 4: Oriental White Eye Feeding on Salvodora Fruit

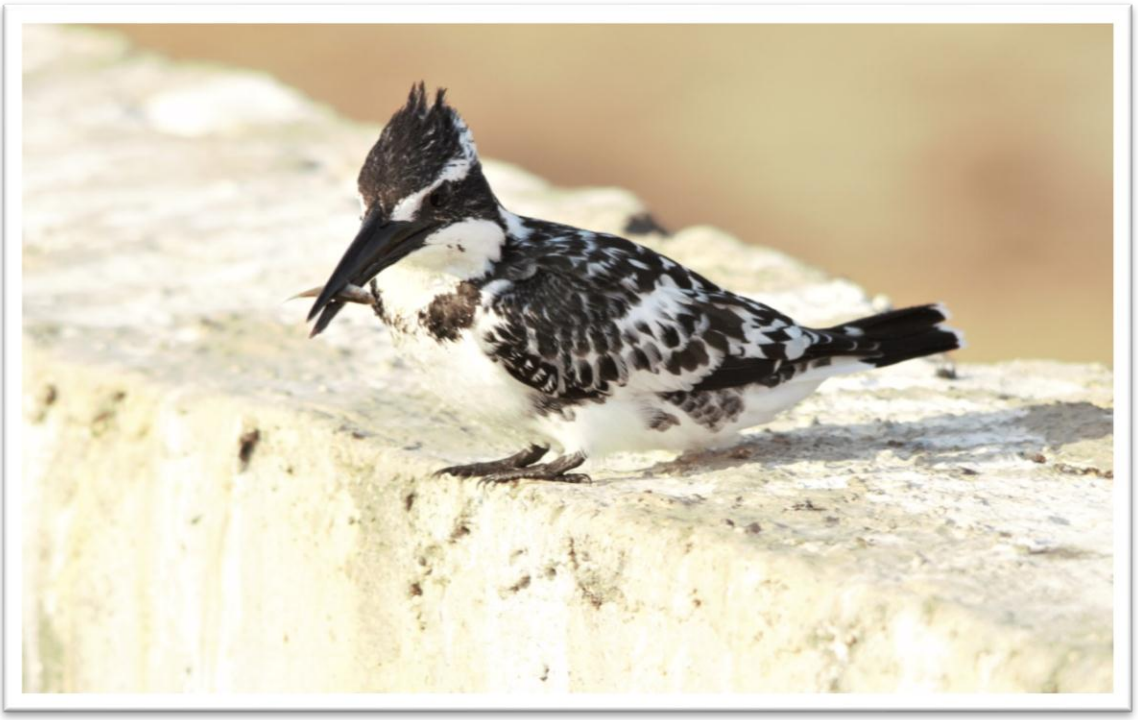
Annexure 5: Greater Flamingo Using Salt Pans in Khijadiya

Annexure 6: Lesser Flamingos at Chaya, Gosabara Wetland

Annexure 7: Group of Northern Pintails Resting in Gosabara Wetland

Annexure 8: Lark Using Benches for Shade in Khijadiya Wetland

Annexure 9: Indian Silver Bill Using Prosopis for Perching



Annexure 10: Pied Kingfisher with Fish

Annexure 11: Group of Great White Pelican in Gosabara Wetland

Annexure 12: Eurasian Coot Feeding on Acquatic Plant

Annexure 13: Red-Naped Ibis Roosting on a Tree in Khijadiya Wetland

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About the Study

The study is part of the overall scientific and technical studies in Gujarat that the CMPA project supported towards effective and sustainable management of coastal and marine protected areas. Avifaunal surveys were conducted with regard to the habitat use of key species, to understand the interlinkages of key bird species with habitat and floral components of the ecosystem. The two wetlands- Khijadya Bird sanctuary and Gosabara Wetland, are proposed to be declared as Ramsar sites, based on the waterbird criteria. A clear understanding of habitat requirements of the key species would be of help for the wetland managers in maintaining the ecological character of the wetland.

The CMPA Project

The Project "Conservation and Sustainable Management of Coastal and Marine Protected Areas" (CMPA) is a project of the Indo-German technical cooperation. It is funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and implemented by the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India, and the *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of BMUB.*

Established to support the achievement of the Aichi targets of the Convention on Biological Diversity, the Project's overall goal is to contribute to conservation and sustainable use of biodiversity in selected areas along the coast of India. Taking into consideration the economic importance of the coastal zone for large segments of the population, the Project's approach is people-centered, thus ensuring the support for conservation by those depending on coastal ecosystems.

CMPA Technical Report Series

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Avifaunal Survey to Understand Bird- Habitat Linkages at Khijadiya Wildlife Sanctuary and Gosabara Wetland in Gujarat

August 2017

FOREST DEPARTMENT GOVT. OF GUJARAT

GEER Foundation

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On behalf of:
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
of the Federal Republic of Germany

Indo-German Biodiversity Programme
Conservation and Sustainable Management of Coastal and Marine Protected Areas