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MONITORING THE SPATIAL DISTRIBUTION OF THE SELECTED BIRDS SPECIES IN WETLANDS OF SINDH (A FRAMEWORK OF REMOTE SENSING-AND GIS)

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ABSTRACT

Satellite Remote Sensing and GIS techniques are very useful for the study about the Wetlands and the spatial distribution of animal species like avifauna as discussed in this paper. Wetlands are amongst the most productive and dynamic ecosystems and essential part of our landscape. Wetlands provide countless benefits that include rich floral and faunal habitat, improved water quality, flood abatement, water storage and groundwater recharge, support of fisheries, and opportunities for education and recreation. Pakistan, due to its diverse weather and varied land is home to some of the rare and exclusive birds in the world. Its wetlands and lakes attract millions of migratory birds from across the globe. Out of total 19 RAMSAR sites in Pakistan, 10 sites including Hab Dam are located in Sindh. The selected Birds of the study are the common Birds, listed as Least Threatened except the Dalmatian Pelican found in Hub Dam area, listed as Vulnerable by IUCN.

Key Words: Remote Sensing, GIS and Wetland

INTRODUCTION

A wetland is an area of land whose soil is saturated with water either permanently or seasonally. Wetlands are amongst the most productive and dynamic ecosystems and essential part of our landscape. Owing to their extensive and rich food webs, biological, ecological and cultural diversity, they are sometimes referred to as 'super-markets of biodiversity' (Mitsch and Gosselink, 1993). Wetlands provide countless benefits that include rich floral and faunal habitat, improved water quality, flood abatement, water storage and groundwater recharge, support of fisheries, and opportunities for education and recreation. Wetlands are dynamic ecosystems with complex interrelationships of hydrology, soils and vegetation. In Pakistan, wetlands cover approximately 9.7% (78,000 sq.km.) of its total area. However like other green areas these wetlands are also under tremendous environmental degradation. As a result, this important environmental source is depleting at an alarming rate (Kazmi *et al*, 2006).

According to Ramsar definition"Areas of marsh, fen, peat-land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters".

Wetlands are categorized by their characteristic vegetation, which is adapted to these unique soil onditions. The water found in wetlands can be saltwater, freshwater, or brackish. Wetlands include swamps, marshes, and bogs, among others.

Satellite Remote Sensing (SRS) has become an important tool in wetland monitoring. A wide variety of remote-sensing sensors are available, from airborne devices to earth observation satellites. Remote sensing can be used in a number of ways by providing input on identification, classification, inventory and ecological studies. The hydrologic parameters of wetlands change regularly and dynamically. Therefore, a timely, repetitive coverage made possible with earth-observation satellites are an attractive source of monitoring information.

On the other side it is difficult to gather this information by using traditional field surveys because wetlands are extremely difficult to access. Fortunately, it has been revealed that Remote Sensing technology is a promising solution to this problem of accessibility. Some more critical advantages regarding the use of satellite data are the cartographic consistency of the satellite data, the ability to computationally manipulate the digital data and the fact that satellite detectors measure physical properties that can be converted to meaningful physical measurements under the proper condition (Kazmi *et al*, 2006).

Sources of high-resolution satellite imagery exist that could be used for monitoring change. Using a synergistic approach of combining imagery data sets — such as IKONOS, Landsat, SPOT, IRS and RADARSAT fine beam mode data — would capture the seasonal and spatial information necessary for monitoring. In this study Landsat TM data set has been selected because of high spectral resolution, synoptic coverage and low cost, and also Quickbird data for its low cost and high spatial resolution.

Kazmi *et al.* (2006), reported that the area of the wetlands is declining at an alarming rate due to environmental deteriorations. Further analysis by multi-spectral and multi-temporal SRS data would certainly explore the best use of this technology. They emphasize on the importance of satellite remote sensing techniques for the study of

wetlands. They studied the some wetlands of lower Sindh, like Keejhar Lake, Haleji Lake and Hab Dam, using Remote sensing data. Utilization of SRS/GIS techniques can see in this paper. They identified the temporal changes in the Land Cover of the respective wetlands by using LANDSAT Data of 1990 and 2000.

In district Sanghar Rais *et al*. (2008) observed that species composition has changed over time, they found after the comparison with past available data. According to them Forty four new records of bird species were found in that area while thirty four previously recorded species were not observed. Nine more notable wetlands were identified that had been created due to seepage from the water storage reservoir and irrigation canals. Hunting of threatened species, new infrastructural development and overexploitation of existing resources are the major causes of changes in species composition.

Rice *et al*. (2011), studied a total of 203 fauna species including 32 mammals, 136 birds, 32 reptiles and three amphibians belonging to 29 orders and 78 families were recorded in Chotiari Reservoir, Sanghar, Sindh. As many as 136 bird species belonging to 19 orders and 48 families were recorded. Around 32.82 % birds were abundant, 52.20 % common, 8.08 % frequent and 2.94 % were scarce. Out of the total, summer and winter bird species constituted 69.11 % and 34.55%, respectively which included, 39% water birds, 9.5% birds of prey, 35% passerines and 16% forest/game birds. A few threatened birds *i.e*., Pallas's Fishing Eagle, Houbara Bustard, Eurasian Black Vulture and Great White-fronted Goose were also recorded.

According to them major threats to the wildlife of the reservoir area; changes in land use practices, habitat modification, hunting, unregulated fishing and overexpolitation. In their Qualitative Study they develop the wildlife inventory in this area and present at a table. Also give very useful suggestion to the development of wetland areas.

According to them the extension of the irrigated canal system and converting surrounding lands into croplands has favored species such as *Bubulcus ibis* (Cattle Egret), *Ardeola grayii* (Indian pond heron), Black Francolin, gray Francolin, *Acridotheres tristis* (Common myna) and *Passer domesticus* (House sparrow). Abundance and distribution range of these species are likely to increase in future.

According to Gabol *et al.* (2005), total 37 faunal species belonging to 6 orders and 9 families have so far been recorded from the Drigh Lake, Sindh, out of them are migratory, resident, 1 passage migrant, and 2 are straggler. They record data from the area during 1998-2003, which includes some rare and threatened species. The status of each bird species has also been recorded. Their study also is qualitative.

STUDY AREA

Pakistan has an adequate number of recognized and unrecognized wetlands in the arid and semi-arid zones that are spread all over Pakistan that cover approximately 78,000 sq. Km in area. This area represents 9.7% of the landmass of the country. In Pakistan, once these sites were the home of biodiversity and safe grounds for migratory birds but now unfortunately these wetlands continue to be among the world's most threatened ecosystems, owing mainly to: embanking of the river, over exploitation of ground water resources, building dams, eutrophication and industrial sources which increases levels of nutrients; and pesticides which seriously impair ecological processes. (Fig.1).

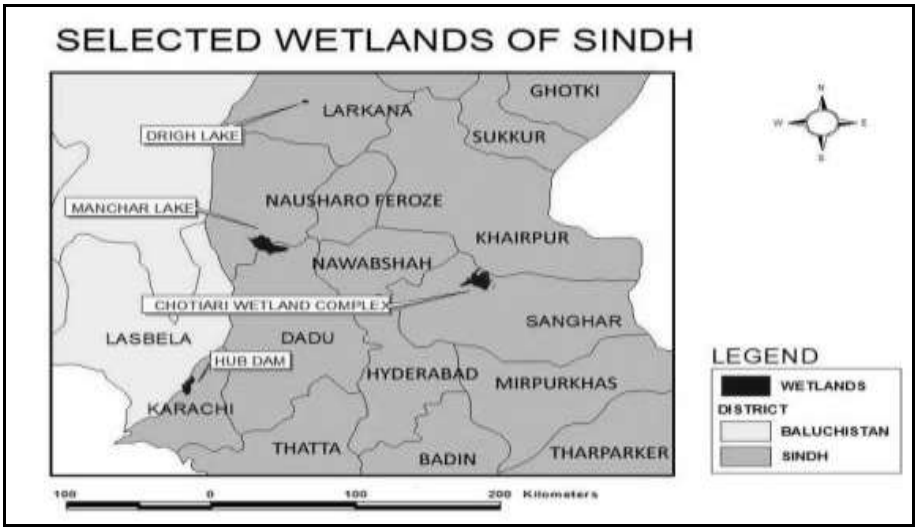


Fig.1. Study Area.

Selected Wetlands

Selected Wetlands for this study are given below as shown in figure 9 **(Table 1).** These wetlands selected due to the availability of resources especially avifaunal data.

Table 1. Selected Wetlands.

S.No.	***SELECTED WETLADS***
1	Chotiari Wetland Complex
2	Drigh Lake(RAMSAR SITE)
3	Hab Dam (RAMSAR SITE)
4	Manchar Lake

Chotiari Wetlands Complex

Chotiari wetlands complex lies in Sindh province on western flanks of Nara desert commonly called as *Achhro Thar* (white sandy desert) at about 30 - 35 km northeast of Sanghar Town. The Reservoir occupies an area of about 18,000 hectares and has a water storage capacity of 0.75 million acre feet (MAF) flooding an area of approximately 160 km^2. The climate of this area is of tropical to subtropical type. The hottest months are May and June when the average maximum daily temperature exceeds 40°C. The coolest months are December to February, when the maximum daily temperatures range from 25 to 30°C. Rainfall is sparse and erratic and is most frequent between July and August when it averages 40 mm monthly (Khan, 2005).

Drigh Lake

Drigh Lake is located in the province of Sindh, 18 km west of Larkana. This Lake is a brackish water and semi-natural wetland, supporting a rich and diverse aquatic vegetation. The site regularly hosts over 20,000 waterbirds in winter. It is a breeding and wintering area for a wide variety of waterbirds, and an important roosting site for night-heron *Nycticorax nycticorax*. The lake regularly held over 20,000 wintering waterbirds in the early 1970s, but numbers were generally much lower in the late 1970s and throughout the 1990s. The site is under mixed state and private ownership. There are livestock grazing at the site, and some cutting of shrubs for fuel. Surrounding fields are mainly used for rice cultivation and livestock grazing. This Lake was designated as a Wildlife Sanctuary in 1972. The lake had decreased in size in recent years due to water diversion for rice cultivation (Khan, 2005).

Hab Dam

Hab Dam is located in the districts of Karachi and Lasbella, in Sindh and Balochistan. The wetland is an important wintering area for pelicans, ducks, cranes and coots. It regularly supports over 45,000 waterbirds. A total number of 128 bird species have so far been recorded from the area. The reservoir is an important spawning ground and source of food for fish. It contains a variety of fish species, which increase in abundance during periods of high water levels. One of the most important freshwater game fish Tor putitora breeds in the Hab River. Hab Dam is fed by the Hab River and mountain springs. The wetland is surrounded by hills on three sides. The water body is relatively shallow with a maximum depth of 9.6 m. The reservoir is government-owned, while the adjacent areas are privately owned communal lands. The reservoir supplies water for irrigation in Lasbella district and drinking water in Karachi. Commercial, licensed fishing occurs on a seasonal basis. Illegal fishing is also undertaken by some local inhabitants. The reservoir is protected within the Hab Dam Wildlife Sanctuary established in 1972 (Khan, 2005).

Manchar Lake

Manchar Lake located at a distance of about 18 kms from Sehwan Sharif, district Dadu, west of the River Indus is by far the largest freshwater lake in Pakistan and one of the largest in Asia. It is a vast natural depression flanked by the Khirthar hills in the west and the Laki hills in the south. The area of the lake fluctuates with the seasons from as little as 350 km² to 520 km². The lake collects water from numerous small streams in the Kirthar Mountains and empties into the Indus River. It provided a livelihood for a large number of fishermen, irrigation water for various crops and aquatic plants including lotus. The lake was created in the 1930's when the Sukkur Barrage was constructed on the river Indus. The lake is fed by two canals , the Aral Wah Canal and the Danister Canal from the river Indus. Until recently the lake supported thousands of fisher folk who depended on the freshwater fish they

caught in the lake. However, the lake is now undergoing environmental degradation resulting in the water becoming saline killing off the fish and forcing the fisher folk to look elsewhere for employment. Until recently, the lake was a stop-off on the Indus flyway for Siberian migratory birds, but now the numbers have fallen from 25,000 birds counted in 1988 to just 2800 birds counted in 2002, because the lake no longer provides the birds' main food, the lake fish. In the place of the birds, the lake now hosts a saline water reed (Khan, 2005).

OBJECTIVES

The objectives of the study are as follows:

- To identify the Temporal Land cover Changes in Hab Dam from 2003-2009 through Satellite Remote Sensing Techniques.
- To study the avifauna (Selected species) in the four selected wetlands of Sindh.
- To relate the Land cover changes and Spatial Distribution of these species in selected wetlands.
- To study the Existing Habitat of Selected Birds through Satellite Remote Sensing Techniques.

METHODOLOGY

Data Sources

Earth resources satellite Landsat provides an ideal dataset for the landscape classification. For temporal evaluation of Hab Dam and its environs, satellite images of Landsat TM, obtained from Department of Geography, University of Karachi, have been utilized. For current situation of all four selected wetlands, satellite images of Quickbird obtained from Google Earth. Qualitative Data of Birds Species of respective wetlands has collected through the published research papers.

Data Processing

It is very difficult and time consuming to apply Remote Sensing techniques to whole Satellite Images of Landsat TM 2003 and 2009, so for making the process simple and less time consuming, AOI (Area of Interest) have created first. Software ERDAS Imagine has utilized for the creation of AOI. Images obtained from Google Earth have stitched together by using Software Adobe Photoshop. After the Image Mosaicing and Subset Creation, both of these datasets then aligned through geometric corrections; UTM coordinate system has been chosen for this purpose. The raw image of satellite Landsat TM since 2009 have been enhanced by using Image Sharpen tool by ArcView 3.2 Image Analysis menu (Fig. 2).

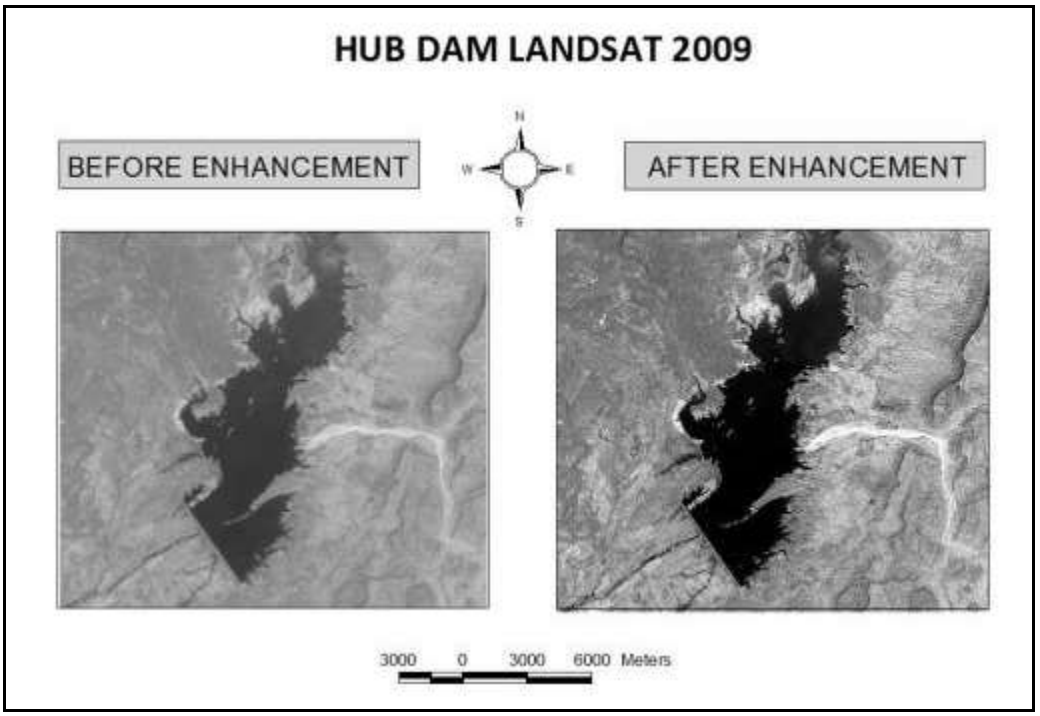


Fig. 2. Image Enhancement.

Data Analysis

Land Cover Classification: For temporal evaluation of Hab Dam and its environs, satellite images of Landsat TM, with acquisition years of 2003 and 2009 have been classified by using Software ERDAS Imagine 8.6 Unsupervised classifiers used to classify the image into four classes. Four selected wetlands also mention through Image Classification by using Software ERDAS Imagine. The Satellite Images of wetlands-Chotiari, Drigh, Hab and Manchar-utilized are of years 2011, 2010, 2009 and 2010 respectively.

NDVI (Normalized Difference Vegetation Index): The Normalized Difference Vegetation Index (NDVI) is a simple graphical indicator that can be used to analyze remote sensing measurements, typically but not necessarily from a space platform, and assess whether the target being observed contains live green vegetation or not. The values of NDVI range from -1 to +1. NDVI has calculated through ArcView 3.2 of Landsat TM data of Hab Dam for both the period of 2003 and 2009.

Change Detection: Change detection is a technique, which used to obtain differences between two Satellite Images of same sensor. Images should cover the same geographical area but different time. For this purpose the software ERDAS Imagine 8.6 is utilized.

Technique for change detection has done by the interpreter, from this permanent raster format is obtained. This raster format further process in ArcMap 9.3 and classify for obtaining the change of the respective raster data.

RESULTS AND DISCUSSION

Land Cover Classification

The extracted areas in percent of the classified images of Hab Dam (Fig. 3) shown in the following table (Table 2). Temporal comparison of the land-covers type also mentioned in the Fig. 4.

Table 2. Hab Dam: Comparison of Land Cover (2003-2009).

LAND COVER	AREA (%) 2003	AREA (%) 2009
WATER	5.124073643	13.99954
VEGETATION	5.197407493	5.97361
OPENLAND	83.74415782	73.75268
BARE SOIL	5.934361039	6.274176

Hab Dam is low land lake and physically categorized into low land Ephemeral river class and is a part of Arid Sub-Tropical Forest Eco-Region of Pakistan. The open or unused land covers highest percent of the selected area of the Hab Dam in both periods (2003 and 2009). The percent of Water cover is next to the open land but higher in 2009 than that of 2003, this higher ratio of water covers in 2009 because the satellite image was of the after monsoon season, the month of November. The satellite image of 2003 is about the month of March i.e. The pre-monsoon season that's why the water cover and vegetation cover is less than that of 2009.

Following are the further Classified Images of four selected wetlands showing the Land Cover situations, the QuickBird Images have taken from Google Earth.

These wetlands provide habitat for many Birds species, some of the species are resident and some they are a winter visitor to these areas. Due to the climatic condition of these wetlands, the birds visit in the winters and Breeding season **(Fig. 5).** Similar techniques were also adopted by **Kazmi *et al.*** (2006) for Keejhar Lake, Haleji Lake and Hab Dam and also by Afsar (2011) to study the Karachi, Pakistan have used land use land cover classification.

Normalized Difference Vegetation Index (NDVI)

Vegetation gone very prominent by applying the NDVI on LANDSAT Images of Hab Dam provides habitat for many water birds in the wetland area (Fig. 6). A similar technique was also adopted by Afsar (2011) for Karachi, Pakistan has used NDVI.

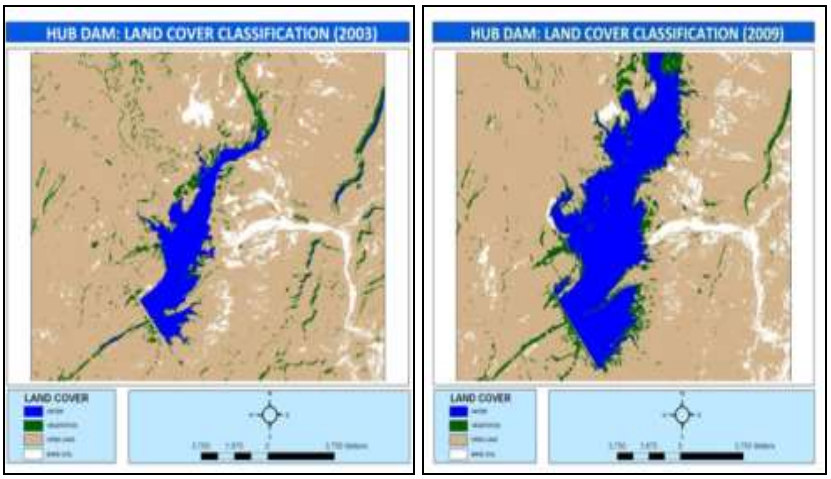


Fig. 3. Hab Dam: landcover Classification 2003 and 2009.

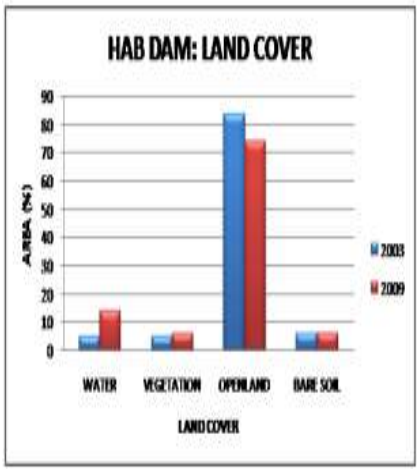


Fig. 4. Hab Dam: Land Cover.

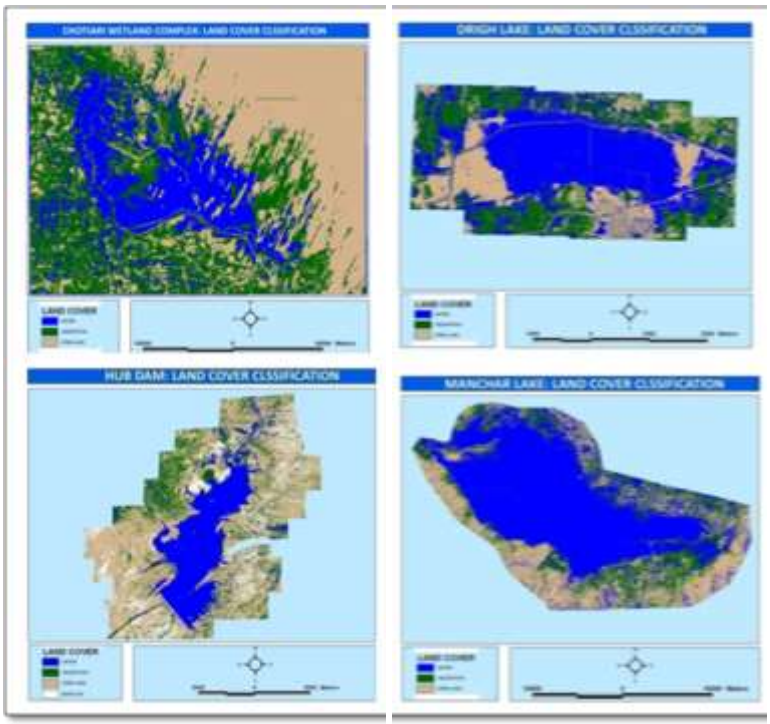
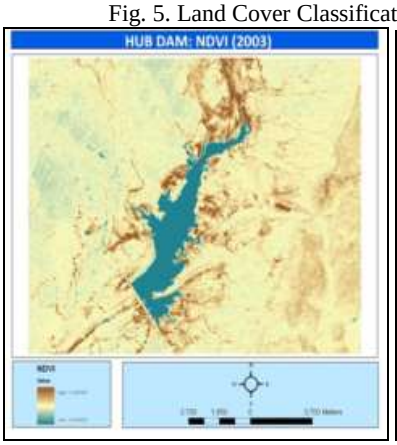


Fig. 5. Land Cover Classification of Chotiari Wetland Complex, Drigh Lake, Hab Dam and Manchar Lake.



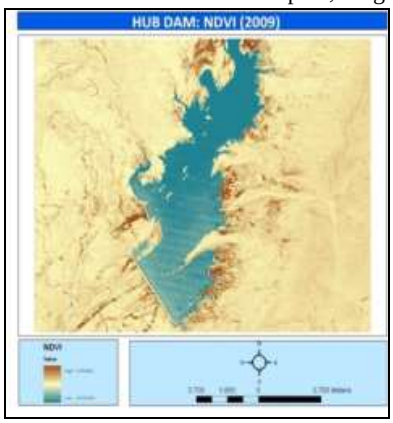


Fig. 6. NDVI 2003 and 2009.

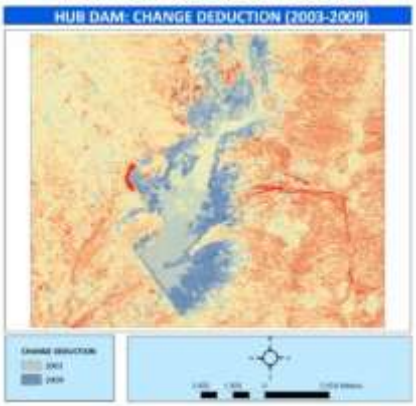


Fig. 7. Change Detection (2003-2009).

Change Detection

The major area in which changes occur is Water and next to the water is the vegetation which can be easily seen in the above image of change detection (Fig. 7).

World Distribution of Selected Birds Species

1. Mallard (*Anas platyrhynchos)*

The Mallard or Wild Duck (*Anas platyrhynchos*) is a dabbling duck which breeds throughout the temperate and subtropical Americas, Europe, Asia, and North Africa, and has been introduced to New Zealand and Australia.

The male birds have a bright green or blue head, while the female's is light brown. The Mallard lives in wetlands, eats water plants, and is gregarious. The Mallard is the ancestor of most domestic ducks, and can interbreed with other species of genus *Anas*. Among close relatives of the Mallard this hybridization can cause genetic dilution, which is contributing the decline of rare species of ducks.

The Mallard is widely distributed across the Northern Hemisphere, North America from southern and central Alaska to Mexico, the Hawaiian Islands, and across Eurasia, from Iceland and southern Greenland and parts of Morocco (North Africa) in the west, Scandinavia to the north, and to Siberia, Japan, and China in the east. It is strongly migratory in the northern parts of its breeding range, and winters farther south. For example, in North America it winters south to Mexico, but also regularly strays in Central America and the Caribbean between September and May.

The Mallard inhabits a wide range of habitat and climates, from the Arctic Tundra to subtropical regions. It is found in both fresh- and saltwater wetlands, including parks, small ponds, rivers, lakes and estuaries, as well as shallow inlets and open sea within sight of the coastline. Water depths of less than 1 meter (3.3 ft) are preferred, birds avoiding areas more than a few meters deep. They are attracted to bodies of water with aquatic vegetation (Fig. 8).

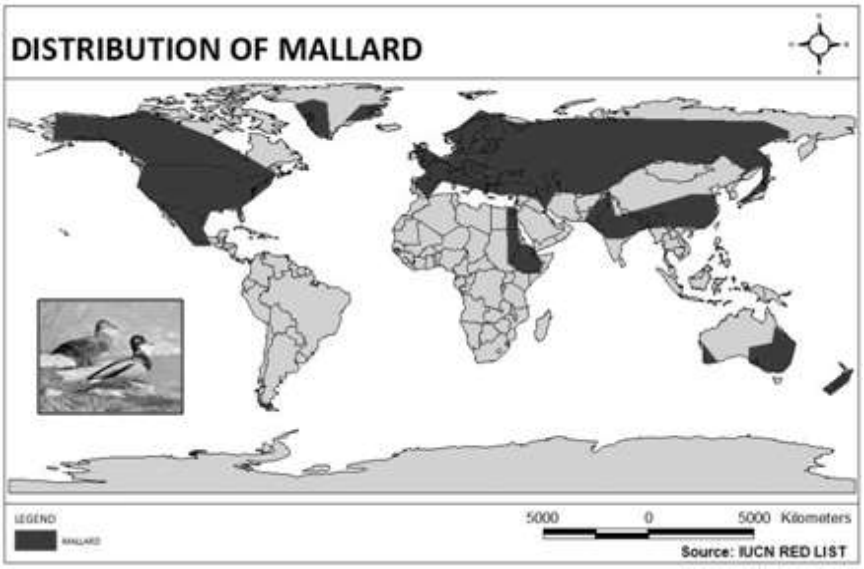


Fig. 8. Female (left) and Male (right) (Source; Wikipedia) and Spatial Distribution of Mallard

2. Little cormorant (*Microcarbo Niger*)

The **Little Cormorant** (*Phalacrocorax Niger*) is a member of the Cormorant family of seabirds: Aptly named, the Little Cormorant is small in comparison with other cormorants, only 55 cm in length with an average mass of 442.5 g.

It is a resident species in most of tropical southern Asia, commonly found in Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, and Viet Nam; additionally, it is a vagrant species in Afghanistan. The estimated population was 280,000 - 350,000 in 2009: Due to its large population and extremely wide geographic range the Little Cormorant is

categorized as least concerned by the IUCN. The Little Cormorant is not a migratory bird; it dwells year-round in trees near a water source (Fig. 9).

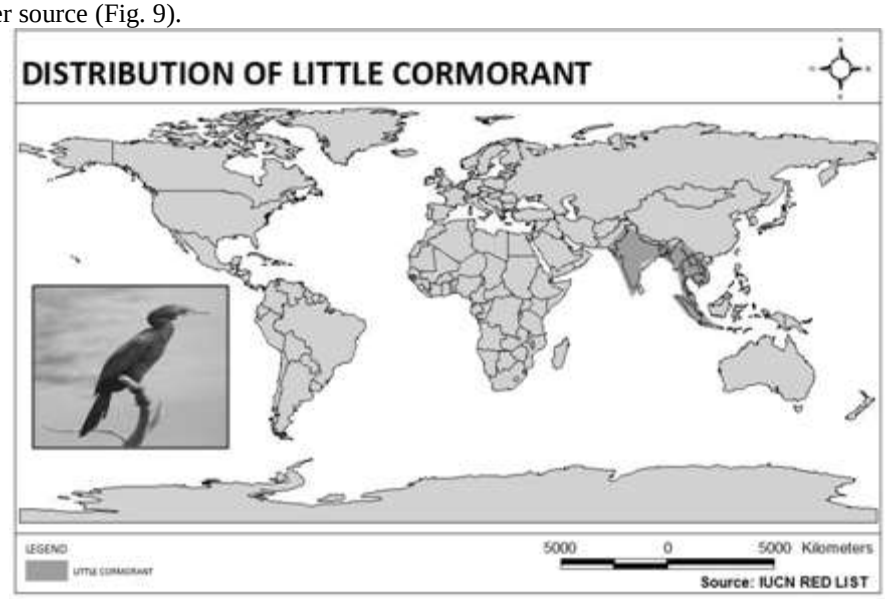


Fig. 9. Little Cormorant (Source; Wikipedia) and Spatial Distribution of Little Cormorant

3. Great White Pelican (*Pelecanus onocrotalus*)

The **Great White Pelican**, *Pelecanus onocrotalus* also known as the **Eastern White Pelican** or **White Pelican** is a bird in the pelican family. It breeds from southeastern Europe through Asia and in Africa in swamps and shallow lakes.

Well scattered groups occur from the eastern Mediterranean through to Vietnam and south to South Africa. Sedentary populations are found year-round in Africa, south of the Sahara Desert although these are patchy, occurring mainly in coastal, estuarine areas and around very large inland water bodies. Migratory populations are found from Eastern Europe to Kazakhstan during the breeding season and from northeast Africa through Iraq to north India in the winter. More than 50% of Great White Pelicans breed in the Danube Delta in Romania **(Fig. 10).**

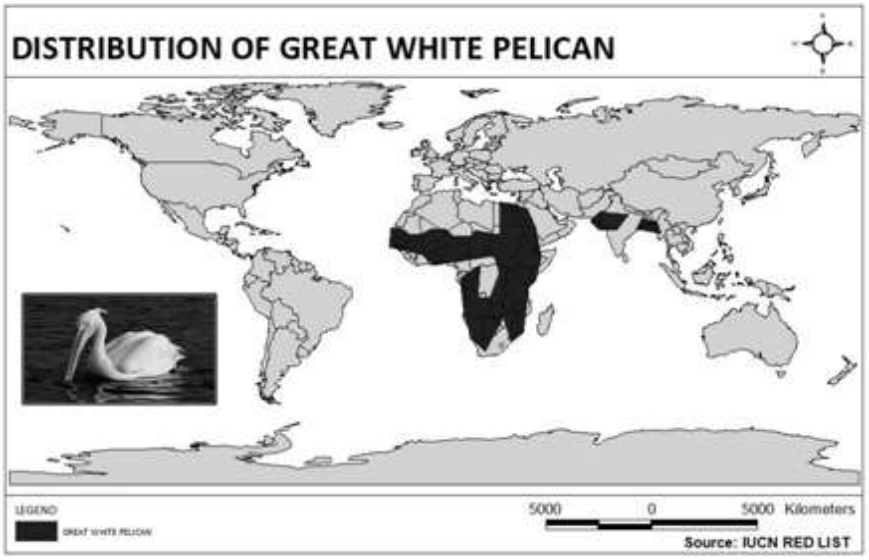


Fig. 10. Great White Pelican (Source; Wikipedia) and Spatial Distribution of Great White Pelican

4. Dalmatian Pelican (*Pelecanus Crispus*)

Status: Vulnerable (IUCN 3.1)

The **Dalmatian Pelican** (*Pelecanus Crispus*) is a member of the pelican family. It breeds from southeastern Europe to India and China in swamps and shallow lakes. The nest is a crude heap of vegetation. This pelican migrates short distances. In flight, it is an elegant soaring bird, with the flock moving in synchrony. The neck is then held back like a heron's.

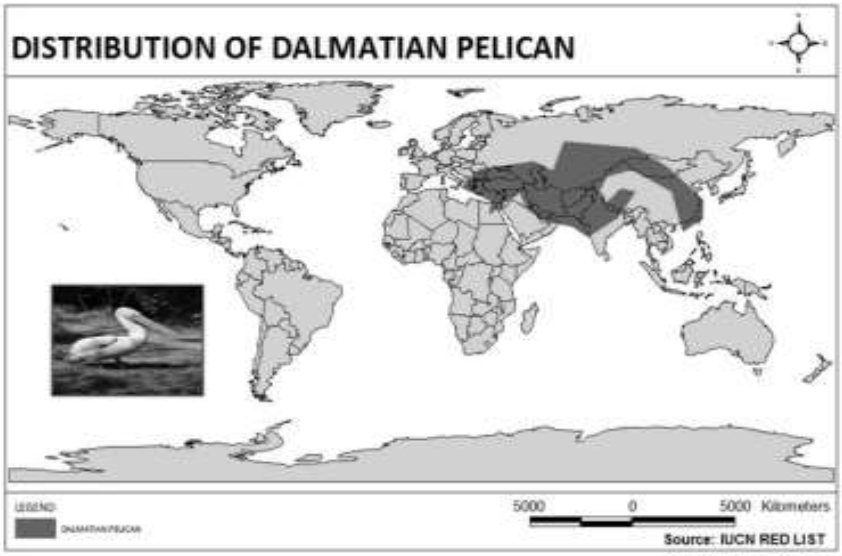


Fig. 11. Dalmatian Pelican (Source; Wikipedia) and Spatial Distribution of Dalmatian Pelican.

This pelican eats fish and small birds. Like the White Pelican, this species has declined greatly through habitat loss and persecution As of 1994, there are around 1,000 breeding pairs in Europe, most of them in Ukraine, Russia, Greece, Romania, Bulgaria and Albania (Karavasta Lagoon) (Fig.11).

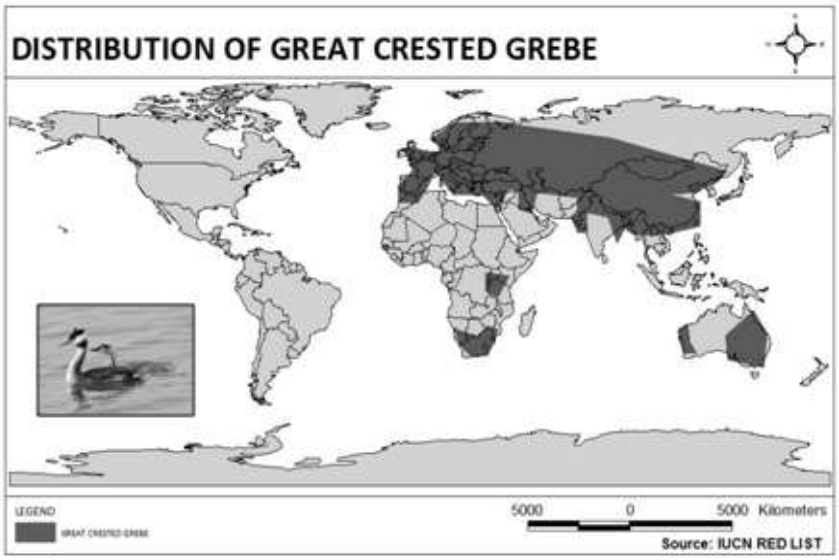


Fig. 12. Juvenile Great Crested Grebe with Adult (Source; Wikipedia) and Spatial Distribution of Great Crested Grebe.

5. Great Crested Grebe (*Podiceps cristatus*)

The **Great Crested Grebe** (*Podiceps cristatus*) is a member of the grebe family of water birds.

The Great Crested Grebe breeds in vegetated areas of freshwater lakes. The subspecies *P. c. Cristatus* is found across Europe and Asia. It is resident in the milder west of its range, but migrates from the colder regions. It winters on freshwater lakes and reservoirs or the coast. The African subspecies *P. c. Infuscatus* and the Australasian subspecies *P. c. Australis* is mainly sedentary (**Fig. 12).**

6. Little Grebe (*Tachybaptus ruficollis*)

The **Little Grebe** (*Tachybaptus ruficollis*), also known as **Dabchick**, is one of the members of the grebe family of water birds. At 23 to 29 cm in length it is the smallest European member of its family. It is commonly found in open bodies of water across most of its range.

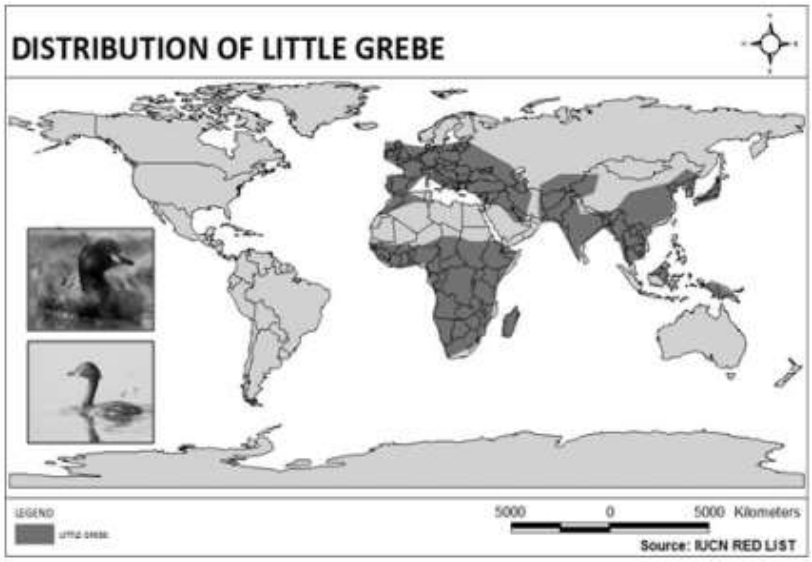


Fig. 13. Little Grebe; in Breeding Plumage and Non-Breeding Plumage (Source; Wikipedia) And spatial Distribution of Little Grebe

This bird breeds in small colonies in heavily vegetated areas of freshwater lakes across Europe, much of Asia down to New Guinea, and most of Africa. Most birds move to more open or coastal waters in winter, but it is only migratory in those parts of its range where the waters freeze. Outside of breeding season, it moves into more open water, occasionally even appearing on the coast in small bays (Fig. 13).

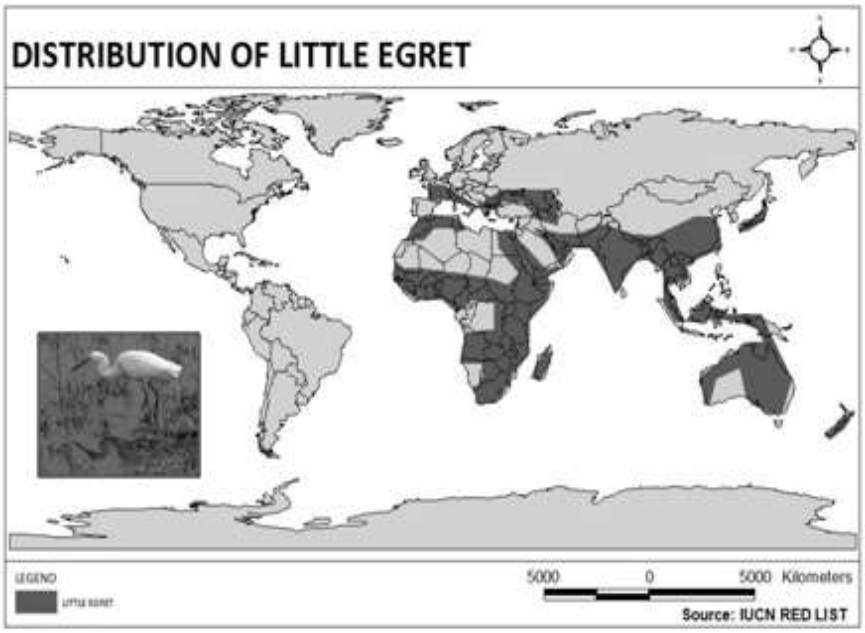


Fig.14. Little Egret (Source; Wikipedia) and Spatial Distribution of Little Egret.

7. Little Egret (*Egretta garzetta*)

The **Little Egret** (***Egretta garzetta***) is a small white heron. It is the Old World counterpart to the very similar New World Snowy Egret. Depending on authority, two or three subspecies of Little Egret are currently accepted.

- ***Egretta garzetta garzetta*** – Europe, Africa, and most of Asia except the Southeast
- ***Egretta garzetta nigripes*** – Indonesia east to New Guinea
- ***Egretta garzetta Immaculata*** – Australia and (non-breeding) New Zealand, often considered synonymous with *E. g. Nigripes*

Its breeding distribution is in wetlands in warm temperate to tropical parts of Europe, Africa, Asia, and Australia. In warmer locations, most birds are permanent residents; northern populations, including many European birds, migrate to Africa and southern Asia. They may also wander north in late summer after the breeding season, which may have assisted its current range expansion. Globally, the Little Egret is not listed as a threatened species (Fig. 14).

8. Cattle Egret (*Bubulcus ibis*)

The **Cattle Egret** (*Bubulcus ibis*) is a cosmopolitan species of heron (family Ardeidae) found in the tropics, subtropics and warm temperate zones. It is the only member of the monotypic genus ***Bubulcus***, although some authorities regard its two subspecies as full species, the **Western Cattle Egret** and the **Eastern Cattle Egret**.

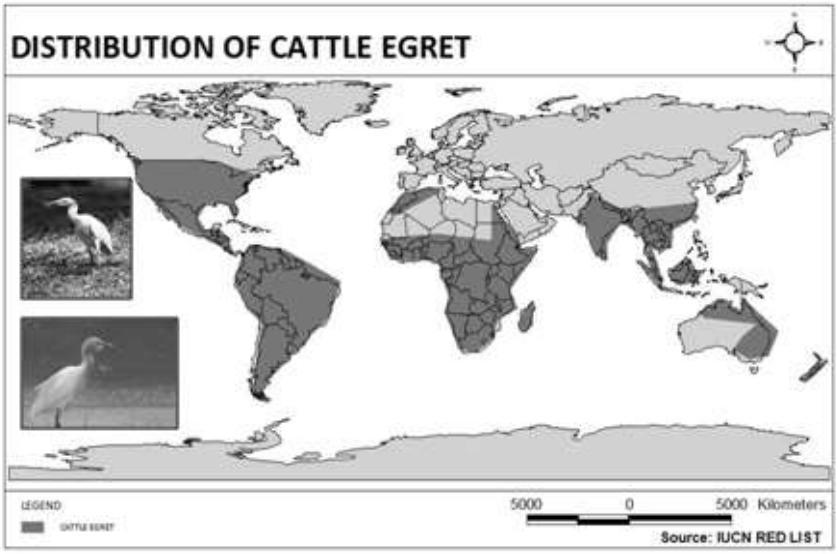


Fig. 15. Cattle Egret; Non-Breeding and Breeding Adult (Source; Wikipedia) and Spatial Distribution of Cattle Egret.

The Cattle Egret has undergone one of the most rapid and wide reaching natural expansions of any bird species. It was originally native to parts of Southern Spain and Portugal, tropical and subtropical Africa and humid tropical and subtropical Asia.

The species first arrived in North America in 1941, bred in Florida in 1953, and spread rapidly, breeding for the first time in Canada in 1962. It was first recorded breeding in Cuba in 1957, in Costa Rica in 1958, and in Mexico in 1963. In Europe the species had historically declined in Spain and Portugal, but in the latter part of the 20th century it expanded back through the Iberian Peninsula, and then began to colonize other parts of Europe; southern France in 1958, northern France in 1981 and Italy in 1985. Breeding in the United Kingdom was recorded for the first time in 2008 only a year after an influx seen in the previous year. In 2008 cattle egrets were also reported as having moved into Ireland for the first time.

In Australia the colonization began in the 1940s, with the species establishing itself in the north and East of the continent. It began to regularly visit New Zealand in the 1960s. Since 1948 the Cattle Egret has been permanently resident in Israel. Prior to 1948 it was only a winter visitor.

The massive and rapid expansion of the Cattle Egret's range is due to its relationship with humans and their domesticated animals. Originally adapted to a commensally relationship with large browsing animals, it was easily

able to switch to domesticated cattle and horses. As livestock keeping spread throughout the world it was able to occupy otherwise empty niches. Many populations of Cattle Egrets are highly migratory and dispersive, and this has helped the species' range expansion. The species has been seen as a vagrant in various sub-Antarctic islands, including South Georgia, Marion Island, the South Sandwich Islands and the South Orkney Islands. A small flock of eight birds was also seen in Fiji in 2008.

In addition to the natural expansion of its range, Cattle Egrets have been introduced into a few areas. The species was introduced to Hawaii in 1959 and to the Chagos Archipelago in 1955. Successful releases were also made in the Seychelles and Rodrigues, but attempts to introduce the species to Mauritius failed. Numerous birds were also released from Whipsnade Zoo in England, but the species never established.

Although the Cattle Egret sometimes feeds in shallow water, unlike most herons it is typically found in fields and dry grassy habitats, reflecting its greater dietary reliance on terrestrial insects rather than aquatic prey (Fig. 15).

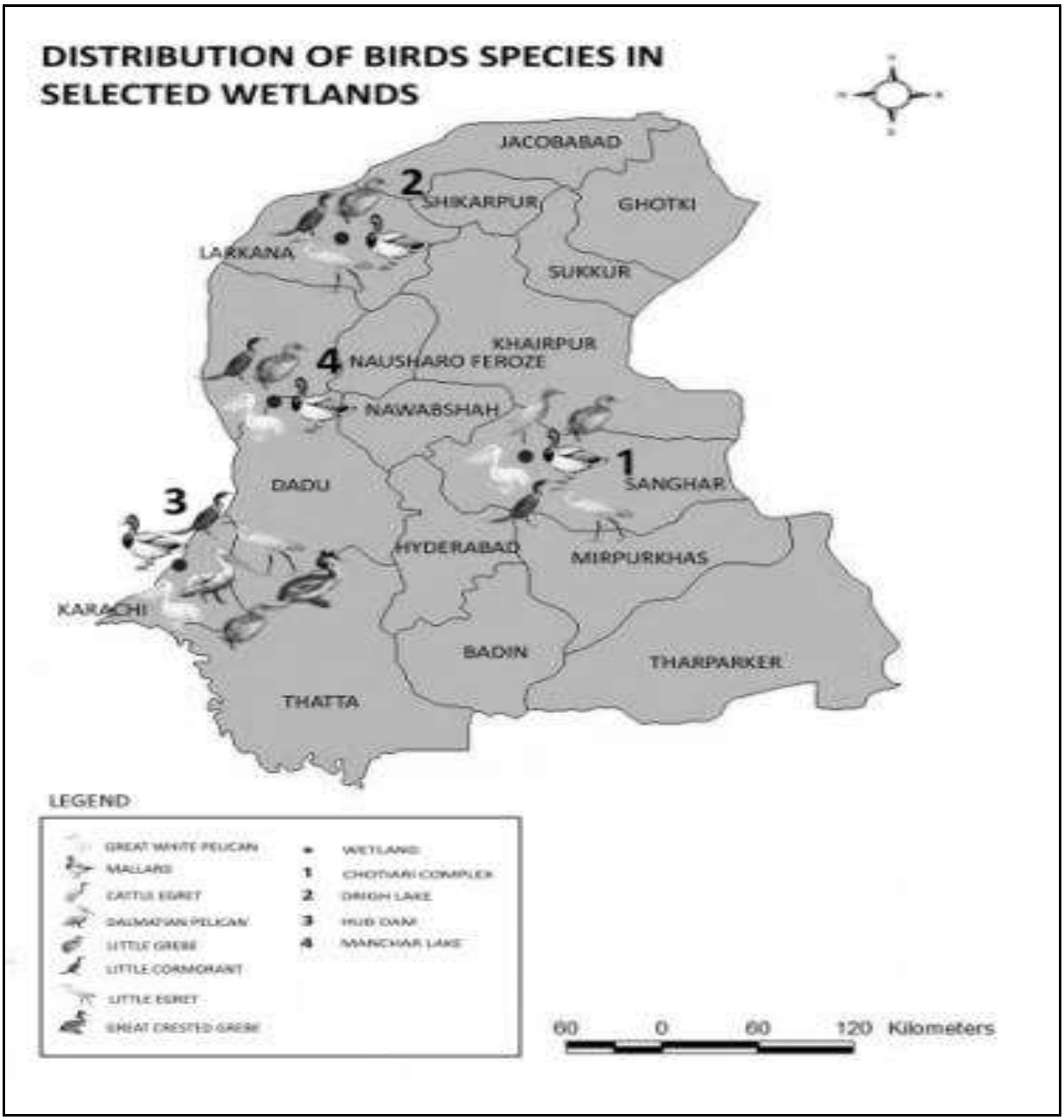


Fig. 16. Distribution of Birds Species.

Distribution of Selected BirdsSpecies of the Study Area

Pakistan, due to its diverse weather and varied land is home to some of the rare and exclusive birds in the world. Its wetlands and lakes attract millions of migratory birds from across the globe, especially Siberia each year, which besides its own native birds in their natural habitat in the jungles and mountains.

The avifauna of Pakistan includes a total of 786 species, of which 39 are rare or accidental. 1 species listed are extirpated in Pakistan and are not included in the species count. The **Chukar *(Alectoris chukar)*** is the national bird of Pakistan, whilst the **Peregrine falcon** is the military state-bird of the Pakistan Air Force.

In Pakistan, an estimated population of one million birds migrates during winter. Most of them land on the wetlands along the Indus River in the Sind Province. These freshwater wetlands provide suitable habitats and feeding opportunities to a wide variety of waterbirds passing through Indus flyway. Nara canal with associated marshlands in Khairpur, Drigh Lake in Larkana, Haleji and Keenjhar Lakes in Thatta, are some of the favourite wintering abodes of migratory water-birds. These include many species of duck family like Mallards, and Grebes etc. Other wading birds like Pelicans can also be sighted on both upcountry wetlands and on tidal estuaries along the seashores.

Selected four wetlands are among the very important areas for bird. The environmental degradation in Manchar Lake causes the number birds decreasing for breeding and visiting due to the loss of their natural habitat and food resources. Many of water birds depend on water animal for food like fishes due to the environmental situation in Manchar Lake the count of fishes declining and cause an ultimate decline in the Birds' population.

Other three wetlands also support the population of Birds, better than Manchar Lake. The selected Birds of the study are the common Birds, listed as Least Threatened except the Dalmatian Pelican found in Hab Dam area, listed as Vulnerable by IUCN.

The Generalized distribution of the selected Birds Species has shown in the following Map (**Fig. 16).**

CONCLUSION AND RECOMMENDATION

Satellite Remote Sensing and GIS techniques are very useful for the study about the Wetlands and the distribution of animal species like avifauna as discussed in this study. Through Satellite Remote Sensing Data especially that of Muti-Spectral like Landsat can very effectively utilized and very useful data can be extracted through different Remote Sensing techniques. Wetlands are very important areas regarding to our natural environment. Their support number of wildlife species especially birds. Degradation of environment is a very serious threat to the wetlands. The major causes are the pollution, illegal hunting activities, over fishing, cutting off tree etc, affects the composition and distribution of Birds Species. The authorities should take the serious incentives for conserving these natural habitats and provide alternative job and food resources for the local community for sustainability.

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