Baseline Assessment of Avifaunal Population of Asan Barrage and Bhimgoda Barrage in Uttaranchal

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MASTER'S DEGREE IN ENVIRONMENTAL SCIENCE

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Contents

INTRODUCTION

Wetlands have long attracted the attention of public and scientists because of the charm, copiousness, visibility and social behavior of the waterbirds, as well as for their recreational and economic importance. Recently, waterbirds have become of interest as indicators of wetland quality and as parameters of restoration success and regional biodiversity.

Each year, a large number of water birds that breeds in areas of Europe and North & Central Asia in summer undertake migratory journey along major river valleys to spend the winter in more hospitable shelters in southerly latitudes. As the wetlands in northern areas become frozen due to the onset of winter and the food disappears under snow cover.

India is one such destination, which provide wintering grounds for migratory waterbirds and has a rich variety of wetland habitats. The total area of wetlands (excluding rivers) in India is 58,286,000 hectares or 18.4 percent of the country, of which 70 percent comprises areas under paddy cultivation. A total of 1,193 wetlands, covering an area of about 3,904,543 hectares was recorded in a preliminary inventory coordinated by the department of Science and technology, of which 572 were natural (Scott, 1989). In this way wetlands are existing places for many reasons, but the birds are more prominent attractions.

Ornithological studies indicate that of 2060 taxa known from the Indian subcontinent about 350 are migrants that include both terrestrial and water birds. Mostly these birds breed outside the subcontinent in the palaearctic region. The most abundant and spectacular winter migrants to the Indian subcontinent are the ducks and gees (anatidae) which constitutes about 85% of migrant winter bird populations of approximately 3 million birds, wading & shorebirds & cranes (Alfred *et al*, 2001).

But the recent studies have shown that the population of the wetland birds is declining (Anil Kumar, 2004) and many wetlands are in jeopardy. This phenomenon is an indication of many environmental changes and possibly

the degradation of the wetlands, as the birds are among the first indicators of dangers ahead for an individual wetland or for a wetland type or a region as a whole. Since birds are the most conspicuous component of a diverse biotic community with complex physical drivers interwoven in an ecosystem that is both unique & important.

Although all habitats respond to water, wetlands have short and long term consequences that dictate the biodiversity & tropic structure of entire community sometimes for hundred of years, but like the perspective of the habitat, it is a concept that must be understood because it will influence the sustainability of life on earth.

The concern for biological diversity is, however, a concern for man himself. All forms of life – human, animal, and plants, are so closely inter linked that disturbance in one gives rise to imbalance in the others. If the species of plants and animals become endangered they signify degradation in the environment, which may threaten man's own existence. (P.C.Joshi and Namita Joshi, 2004).

During recent years bird lovers have been expressing concern over the increasing threat to the waterbirds. Recent studies have shown that the Bhimgoda reservoir in Hardwar and the Asan reservoir in Dehradun are on the major migratory passages of the birds especially, the water birds, often covering thousands of kilometers. Since these wetlands are among the wetlands that are located in more ambient southern latitudes. So they attract a mass influx of birds during winters that breed in Europe & Northern Asia. This results in the arrival of thousands of water birds with the onset of autumn (Aug to Dec) to spend the winter in warm subtropical wetlands of the Indian subcontinent. They return again northwards (from March onwards) towards their homing grounds in Eurasia as it warms up again.

Since the migration is essential for survival of these species, availability of suitable habitats, both on migratory route as feeding/moulting areas as well as on the final destination as wintering sites, is critical to these migratory waterfowls. Therefore one of the very important function the wetlands perform

is to provide suitable habitat for the residential birds as well as for migratory waterfowls. However, these ecologically vital ecosystems are under constant threat due to ever increasing anthropogenic pressures, such as agriculture, land reclamation, as well as uncontrolled silting and weed infestation, which have made wetlands the most threatened habitats all over the world.

Waterbirds are one of the key attributes of the biodiversity of many wetlands, and waterbird counts form one of several elements which are used to identify important wetlands. It is widely accepted that the number of waterbirds using a wetland site is a good indicator of that site's biological importance (e.g. Scott 1980) and waterbird counts have been especially influential in the identification of important wetlands. Bird counts can also provide vital evidence for the protection of wetlands should they become threatened. Kushlan (1993) assessed the value of waterbirds as bio-indicators of wetland change, and one of his conclusions was that “population level data show special promise as sentinel bio-indicators”.

In view of the above facts, this study has been undertaken to draw attention to the plight avifauna of Asan barrage, Dehradun and Bhimgoda barrage, Hardwar. So as to compare the avifauna of the two wetlands with an assessment of reasons and consequences of changing population patterns.

OBJECTIVE

The primary objective of this study is to provide a base line assessment of the present state of the avifaunal population of Asan barrage, Dehradun and Bheemgoda barrage, Hardwar. So as to compare the avifauna of the two wetlands with an assessment of reasons and consequences of changing population patterns and development of strategy for its control.

The main aims of the study are:

1. To document the avian profile of the areas and study habitat utilization by different species of water birds.

2. To study the changes in successive years of avifaunal population.

3. To study the land use patterns and the utilization of the water bodies by local inhabitants.

4. To define the effects of human utilization of the ecosystem with special reference to its bird life.

5. To assess the ill effects of human interference on the conservation values of the area.

6. To provide management recommendations for the conservation of the wetland.

REVIEW OF LITERATURE

India is rich in various types of wetlands with vivid diversity and flora and fauna. The Himalayan region is bestowed with the series of wetlands with diverse types of migratory birds. In the recent past, a number of ornithological studies particularly on water birds have been carried out at and around Asan reservoir. Among the more important being by Osmaston, 1935; Mohan, 1989; Narang, 1990,1994; Narang and Lamba, 1981; Singh 1991,2000; Gandhi and Singh, 1995 and Tak *et al*., 1996,1997 and 1999 etc. to quote a few. These studies revealed that a total of 95 species and sub species (of Asan reservoir) of wetland birds, comprising waterbirds (66 species), wetland dependent birds (14) and reed dwellers (15) have so far been recorded from the reservoir area. The 66 species of waterbirds belong to 39 genera, 13 families and 6 orders. Of these, 30 species are winter visitors and 1-summer visitors and 35 resident. They constitute about 27 % of total inland waterbirds diversity of India (66 out of 245 waterbirds species and subspecies); 37 % of the Northern India (180); and 74 % of Dehradun valley (90).

Arun Kumar (1998) conducted studies on waterbird diversity of the Asan reservoir in Dehradun. HE used Remote Sensing techniques, GIS, and population dynamics of migratory waterfowl and created adequate technical information base for the effective management of the wetland.

Singh *et al*. (*pers. com*), conducted winter waterfowl census on 19 Jan 1991 and gave a combined population of 419+ birds for 11 species of Anatids from Asan reservoir, Dehradun. Studies conducted by Lopez and Mundker, 1997, revealed that more than three million waterfowls migrate to inland wetlands of India from Eurasia and across the Himalayas during every winter (Oct-Mar). A total of 149 species of waterfowl are known to occur throughout the world, of which 62 from Asia (Sonobe & Usui, 1993) and 41 from India (Ali & Ripley, 1978).

Perennou and Santharam (1990) made extensive survey of waterbirds along the southern Coromandel Coast between 3 and 27 Jan 1988. The area covered was approximately 12,6000 sq. Km. Out of an approximate 65,000 sq. Km. Of coastal plains in southern Andhra Pradesh and Tamil Nadu. About 18 major wetlands and waterbirds counted. In addition, the 525 Km of roads travelled during the day and transects were formed from which waterbirds in 100m on either side of road were counted. Several heronries were also visited. In all, sixty small and large wetlands were surveyed and over 2,37,000 waterbirds belonging to 76 species were counted. The two most important wetlands were Pulicat Lagoon and Kaliveli (with 46,000 and 33,000 ducks respectively) which together accounted for 45 sp. of ducks and all the flamingos seen. Nellapattu and Simpson's Estate were the largest heronries. Densities of cattle egrets, {Egretta} egrets and pond herons derived from the road from the road transect which were 3.6, 1.2 and 1.1 individuals per sq. Km respectively. Pulicat and Kaliveli, together with Point Calimere, are likely to be the three most important wetlands in southern India for Trans Himalayan migrants, in addition to holding large populations of local waterbirds.

Southernmost records of the common pochard and tufted ducks were made by Badri Narayanan, 1994. Asad Rahmani (1991) described three

different occasions when little grebes {Podiceps ruficollis} were seen commensally feeding with shoveller, pintail, and wigeon ducks.

Rishad Naoroji (1990) revealed the large scale Predation by {Aquila} eagles, which took place during the 1985-breeding season in Keoladeo Ghana. During this year, water was abundant and painted stork nested in large numbers. {Aquila} migrants arrived at the start of the breeding season and preyed on young storks in their nests and on the ground. Actual killing was not observed. Though unsuccessful attempts were. An estimated minimum of 2.5. of the total number of young herons in the main study area were preyed upon. Predation was not observed when nesting was unsuccessful in the next two years of draught.

Sanjeev Pandey (1993) made comparisons in the waterbird diversity in the Pong Dam reservoir, Himachal Pradesh with the diversity recorded in this area before the construction of this dam. One-day waterbird total counts were during the migratory season from 1988 to 1992. The results of these counts were compared with the data reported in Whistler (1926)'s list of birds of Kangra. The comparisons indicated that waterbird diversity as well as abundance has increased considerably since Whistler's study. A total of 54 species were recorded at the reservoir between 1988 and 1992, of which 39 are now common, compared to 27 species seen by Whistler, of which only 8 were listed as common. The habitats created by the reservoir and their use by waterbirds are described. Measures for the scientific management of the reservoir are suggested.

Barucha and Gogte (1990) monitored the Ujjani dam near Pune for the microflora, microfauna, aquatic vegetation, waterbirds and physico-chemical properties of the water of the dam. Studies showed that the succession was proceeding towards more vegetation on the shores of the lake. This was detrimental to bird species such as flamingos. In addition to monitoring changes in the ecosystem using birds as indicators the authors investigated land and water use by human inhabitants of the area and recommended certain management measures including setting up a sanctuary, controlling farming in the draw down zone, afforestation in the catchment areas, and

other forms of habitat improvement. This was done with a view to provide a strategy to develop a viable nature conservation scheme in a multiple use area in the backwaters of the Ujjani Irrigation Project.

The Western Himalayas, Laddakh and Zanskar region contains a large number of wetlands, which are unique to India in many ways, both the mains one are Chantau, Tso Moran, Noori Chain, Chaasal and Honley. Hutchinson (1937) has studied these wetlands. The important groups of wetlands located in Kashmir valley of Western Himalayas like Dall lake, Anchar lake, Woolaer lake, Hokers lake etc. have been extensively studied by Kaul (1970,1977); Trisal (1977); Kaul *et al, 1978.*

In Jammu area Zutshi and Khan (1977), Khan and Zutshi (1979) studied Mansar and Surinsaar Lake. Some important wetlands situated in the planes of India are Keoladeo Ghana Birds Sanctuary, Bharatpur, Sambhar Lake, Udaypur Lake, Chilka lake, Kolleru lake, Pulike lake, Periyar lake etc. The Keoladeo Ghana system is the best managed wetland and is important in view of the number of birds visiting the place during winter. The wetland is spread over 29 sq. Km. Of which the water spread area is 5 sq. Km. This wetland was investigated by Ali (1979) and Mahajan (1984).

Similar to Keoladeo Ghana wetlands in the south, in Karnataka, there are wetlands consisting of three ponds connected in series, called Gudavi wetlands or bird sanctuary. Among the ponds, two wetlands, namely, Vaddakere and Gudavikere are twin ponds separated by a single bund important for bird fauna. About 14,000 to 20,000 heronry birds, white ibis as the main species, visit the area during July to September and breed every year. This lentic system is spread over 74.6 hectares and the water-spread area is 33 hectares. The wetland was studied by Dayanand *et al* (2001).

Winged visitors to the famous Asan barrage on the Uttaranchal-Himachal Pradesh border were forced to return back to their summer destinations following emptying of the reservoir on Saturday evening. Water started receding following a breach in the earthen dam made at the Asan barrage, disturbing thousands of rare migratory birds. Wildlife and forest

officials who are camping at the barrage site have threatened to act against Irrigation department officials under the Wildlife Conservation Act if the birds are disturbed further. ‘‘A large number of migratory birds are still sitting across the barrage in some water holes, hoping like us that situation would improve after the repair of the earthen dam,’’ said Shrikant Chandola, Uttaranchal Chief Wildlife Warden.(http://www.indianexpress.com).

The report released by Bird Life International, a global wildlife group said that one in eight of the world's bird species face extinction in the next millennium because of destruction to the environment and1, 200 bird species could become extinct in the next 100 years, with 600 to 900 more on the verge of joining the list. Countries with the most risk are Brazil, with 111 species, Indonesia 92, China 82, Colombia 81, Peru 79, and India 70, it said. The report was issued at a meeting of more than 450 conservationists from Bird Life 's 66 partner organizations held in Genting Highlands, 30 miles from Malaysia's capital. (http://www.birdsource.org)

Most people are aware of the fact that the populations of many bird species are decreasing, but few understand the reasons for the declines. Zoologist Askins has synthesized hundreds of scientific papers on bird populations, landscape ecology, botany, and bird biology into an overview of how bird numbers interact with environmental conditions. There is no one cause for the decline of birds across the U.S. or even for the decline of the individual species in a given ecosystem. Askins examines nine different habitat types and describes the disturbances to the functional ecology of each area that have caused the disappearance of the birds. Not surprisingly, all of the landscape changes are human caused, but not all are harmful to birds. Many of the changes caused thousands of years ago by the arrival of the Indians actually benefited many species. Understanding how humans have altered the landscapes, from major perturbations such as forest clearing to the more subtle effects of fire suppression in grasslands, is essential to understanding how to mitigate these changes to restore bird populations. (http://www.archive.ala.org)

Cokinos follows the stories of six vanished species of North American birds by weaving the tale of his journey of how he discovered them with a narrative of how they became extinct. When bird-watching in Kansas, he observed two stray conures, and his curiosity about these vivid green parrots led to his discovery of the existence of the now-extinct Carolina parakeet. Extensive reading of historic manuscripts from both scientists and pioneers revealed five more extinct species: the great auk, Labrador duck, heath hen, ivory-billed woodpecker, and perhaps the most famous of all, the passenger pigeon. The author writes of the tragedy of each species' extinction in a style that is both factual, with quotes from ornithologists, and spiritual, with his ruminations on the loss of the birds and how it could have been prevented. Reading about the extinction of the birds taught Cokinos how to learn from the losses and how to hope in our environmentally complicated time. (http://www.archive.ala.org).

Rao *et al* worked on migratory birds. They found that the solitary knot ({Calidris canutus}) which was trapped and ringed at Pulicat Bird sanctuary on 21.12.1990 was the first record of this species from Andhra Pradesh. Hussain et al (1993) also conducted similar studies and found that an adult grey plover, which was ringed in Russia on August 6, 1989 was recovered five months later in Point Calimere (India) on January 14, 1990.

About 60 percent decline has been observed in the migratory birds' population in Punjab, wildlife department sources said on Wednesday.

Sources said several bird species that used to be in Lahore and in its adjacent areas had vanished because of deforestation, drought and war against terrorism, adding that due to rapid decline in the birds' natural habitats like canals, the birds like parrots, magpies, drongoes, pigeons and doves had become rare.
They said the native and migratory birds that came to Lahore from India and Russia had almost disappeared over the years. In Lahore, excessive plantation of decorative and ornamental plants had led to the disappearance of birds, they added. The plantation of ornamental plants would eventually put

an end to native bird species, sources said. They added that birds avoid ornamental plants, as they find no food there. Sources said the native birds lived on local trees like acacia, sisso, mulberry and poplar, on which they fed. Cutting of trees in the city had made the native bird's lives difficult, they said. Sources said the migratory birds that came from Russia to Lahore includes ducks like pintails, gadwials, wigeons and shovellors. Earlier the birds came to ponds, they said, in Raiwind, Shahdra and near Multan and Kasur Roads, but now the ponds had either been covered up because of construction or had dried up. Sources said a 60 percent decrease in migratory birds had been observed.

Tatu *et al* (1998) developed the methodology for delineation, mapping, and inventorying waterbird population an inland wetland viz. Nal Sarovar (Gujarat). They noticed that waterbird habitats in wetlands are deteriorating due to variety of human activities threatening the survival of waterfowl and suggested that sound management of such habitats is possible if information regarding them available. They found satellite remote sensing to be very useful in providing such information through delineation, mapping, and inventorying of habitats. Suitability and limitations of important aspects of the methodology adopted for preparing habitat distribution map were revealed. Mid winter season (January/February) data of landsat (MMS/TM) and IRS LISS II were developed. IRS LISS II FCC was found to be more effective in distinguishing habitats of emergent aquatic vegetation from the nearby terestrial herbaceous cover during early post monsoon period.

Mehta *et al* observed 206 species of birds at Ropar wetland from January to June 2002. Their twofold status (residential as well as abundance) and habitat wise distribution have been worked out and presented. Even threatened species (3 globally and 8 near threatened0 have been highlighted. Sixty nine species of waterbird, including winter visitors have been emphasized through their ecological grouping and the highest number recorded during the study. An attempt has been made to compare waterbird diversity of Ropar wetland with that of 6 other Indian Ramsar sites.

Singh *et al* (2004) worked on the impact of phumdi proliferation on resident birds of Loktak Lake, Manipur, India. Usha Ganguli (2003) worked on common coot {Fulica atra} from Kyongnosla in east Sikkim.

Santharam and Rangaswami (1999) worked on heronries. Similarly Anish Andheria (1999) worked on the birds of Whitefield and Kodi Tank in Bangalore, India.

Tatu *et al* (1999) conducted extensive studies on monitoring and sustainable management of protected wetland areas on priority basis by applying modern tools and techniques. They found the technique of satellite remote sensing to be very useful for this purpose.

The latest annual report of the Wetland Bird Survey (WeBS), covering the winter of 1996-97, contains a series of graphs showing how the numbers of individual species have varied over the last 30-35 years. Looking at these, one is struck by how many of the lines have an upward trend and how few are heading downwards. Of 36 of the commoner species or populations for which there is data going back to at least 1969-70, no less than 20 have increased compared with just two which have declined, while the remaining 14 have shown little or no change, though some may have fluctuated in the intervening period. I should add that I have not carried out a statistical analysis, but merely "eye-balled" the graphs. (http://www.birdsofbritain.co.uk/bird-guide/index.htm)

Since 1993, the Wildlife Division's Nonharvested Wildlife Program has used a call-response technique in May, June and July to survey wetland birds. In 1999, 20 volunteers surveyed 43 wetland sites located throughout the state. Three of the most secretive wetland nesters, the American bittern, least bittern and pied-billed grebe, were recorded during the survey. As in years past, members of the rail family were detected more frequently than the other wetland birds. Virginia rails, one of the most abundant species, were found at 16 different sites. Sora, king and clapper rails were also detected during the surveys. Willet numbers continue to increase at coastal survey locations. (http://dep.state.ct.us)

In its initial study on the waterbirds in Olango Island, AWB found there were endangered species among the birds that often settled in the island during the wintertime. Among these were the Asiatic Dowitchers, the Chinese Egret, and the Whooping and Red-crowned cranes.

To protect the birds, AWB sought the help of the Philippine Department of Environment and Natural Resources (DENR) to establish a bird sanctuary on a 920-hectare area in Olango Island where the birds are usually found when they visit the island. AWB also sought the help of the Philippine Environmental Journalists Inc. (PEJI) to generate public awareness and help push the realization of the bird sanctuary project . (Manuel S. Satorre, 1990)

MATERIALS AND METHOD

Study Area

I. Asan Barrage (Dehradun)

The Asan reservoir came into being due to the construction of Asan barrage at the confluence of Asan River and the outlet drain channel from Dhalipur Powerhouse in the year 1967. It is a standby reservoir and it is fed from the river Asan and the discharge channel of river Yamuna. Although water level is controlled, it often fluctuates and goes down, thus swampy islands become distinct and attract a variety of marsh loving water birds.

(1) **Location:** Asan reservoir is a man made wetland of about 3.2 Km^2 area, located 40 Km west of Dehradun (Uttaranchal), on Dehradun – Ponta Road.

Geographically, it is situated between latitude 30°25'-26'N and longitude 77°40'- 41'E, near confluence of the rivers Asan and Yamuna.The barrage is 287.5 m long, and the river bed being 389.4 m above sea level with the minimum and maximum of pond levels respectively at 395.95 m and 401.50 m asl.

(2) **Biogeographic province:** Hussain & De Roy (1993) have biogeographically categorized Indian wetlands. Tak, Sati & Kumar (1997) included the Asan Reservoir in biogeographic province 4.8.4 (Indo-Gangetic Monsoon forests).

(3) **Wetland type:** Asan wetland belongs to type 17 (water-storage reservoir, dams) (Tak, Sati & Kumar, 1997).

(4) **Climatic conditions:** North Indian monsoon climate, with distinct summer and winter months. Temp. Summer, max. 38°C, min. 14°C; winter, max. 21°C, min. 2°C; average rainfall 250 cm; SW monsoon during June to September.

(5) **Principal vegetation:** The chief aquatic vegetation of the reservoir comprises *Eichhornia crassipes, Potomageton pectinatus, Typha elephantina* and *Ceratophyllum demersum.* Surrounding bushes include *Ipomea fistulosa* and *Lantana camara.* On the southern side agricultural field surrounds the barrage. Further south there is mixed forest in Siwaliks comprising principally *Shorea robusta, Anogeissus latifolia, Lannea cocomandelica, Dalbergia sisoo* and *Bombax ceiba.*

II. Bhimgoda Barrage (Hardwar)

Bhimgoda barrage is situated between the Neeldhara and the tributaries of the Ganga, in the vicinity of famous Rajaji National in Hardwar. It is a standby reservoir and it is fed from the discharge channel of river Ganga. Although water level is controlled, it often fluctuates and goes down, thus swampy islands become distinct and plays host to thousands of migratory bird sand a variety of marsh loving water birds.

(1) Location: Bhimgoda reservoir is a man made wetland of about 2.5 Km^2 area, located in Hardwar.

Geographically, it is situated in Hardwar between latitude 29°58'N and longitude 78°13'E on transitional zone of Himalayan foothills and plains. The riverbed is 249.7 m above sea level.

(2) Biogeographic province: Hussain & De Roy (1993) have biogeographically categorized Indian wetlands. Bhimgoda Reservoir is in biogeographic province 4.8.4 (Indo-Gangetic Monsoon forests).

(3) Wetland type: Bhimgoda wetland belongs to type 17 (water-storage reservoir, dams)

(4) Climatic conditions: North Indian monsoon climate, with distinct summer and winter months. Temp. Summer, max. 40°C, min. 24°C; winter, max. 22°C, min. 3°C; average rainfall 210 cm; SW monsoon during June to September.

(5) Principal vegetation: The chief aquatic vegetation of the reservoir comprises *Eichhornia crassipes, Potomageton pectinatus, Typha elephantina* and *Ceratophyllum demersum.* Surrounding bushes include *Zizyphus mauritiana, Murraya koenigii* and *Lantana camara.* Herbs present around the reservoir include *Canabis sativa Oxalis corniculata, Parthenium hysperophorus*. Further south there is mixed

forest in Siwaliks comprising principally *Mallotus thillipensis*, Trewia nudiflora, Caseria tomentosa, *Shorea robusta, Anogeissus latifolia, Lannea cocomandelica, Dalbergia sisoo* and *Bombax ceiba.*

METHOD

The study was conducted over a period of three months. Regular field trips were made throughout this period at intervals of two to five days. Field data on waterfowls of reservoir were collected. The identification, counts & photography were carried out by using the following equipment: 7∗35 prismatic field binoculars, tally counter, 50-1000 mm telelens with 35 mm Nikon slr camera & pictorial guides. The identification of birds was done using field guides such as A Pictorial Guide to the Birds of the Indian Subcontinent (Salim Ali, 1983) and Waterbirds of Northern India (Alfred *et al*., 2001).

Bird counts were done by two different methods. Actual head counts were done for bird species that were small in number. For fast moving birds or for birds present in large flocks, a section of the flock was counted, using this as a guide to estimate the total number in the flock.

Repeated surveys were done to correlate ecological data with sociological and economic changes in the life of the local people. These periodic surveys were carried out to elicit the landuse patterns and the utilization of the water bodies by local inhabitants. So as to define the effects of human utilization of the ecosystem with special reference to its bird life.

Based on waterfowl inventory and counts, the waterfowl census data statistics was undertaken by arranging the data on basis of dates of readings.The statistical data was interpreted using Microsoft-Excel.

RESULTS AND DISCUSSION

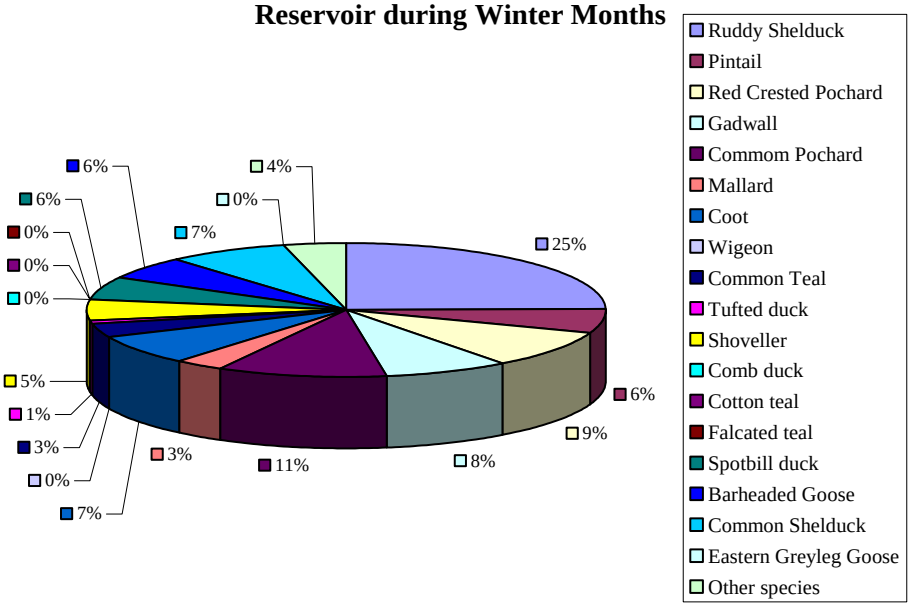
An estimation of the winter migratory bird population at Asan reservoir indicated that about 90% of the water bird population comprises 11 commonest species of waterfowls namely:

(1) Ruddy Shelduck
(2) Pintail
(3) Red Crested Pochard
(4) Gadwall
(5) Common Pochard
(6) Mallard
(7) Coot
(8) Wigeon
(9) Common Teal
(10) Tufted Duck
(11) Shoveller

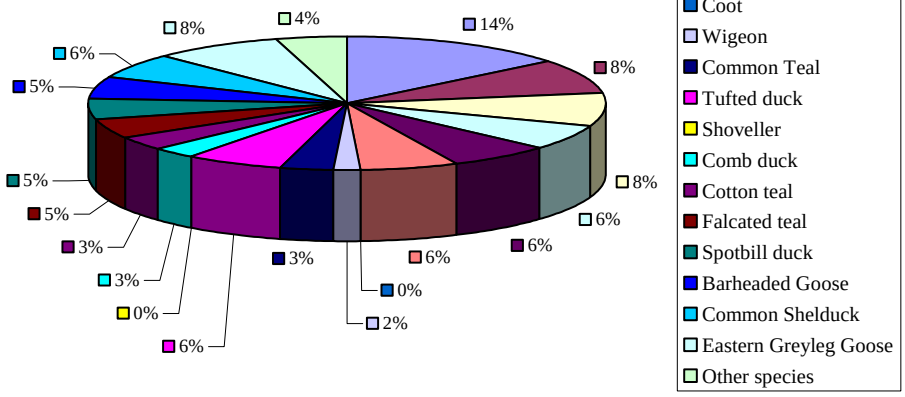
The change estimation of the peak winter population of these species show a distinct downward trend at both the wetlands namely Asan Reservoir, Dehradun and Bhimgoda Reservoir, Hardwar.

It is worthwhile to note that the number of species of migratory waterbirds visiting Bhimgoda Reservoir is more than the number of species of migratory waterbirds visiting Asan Reservoir.

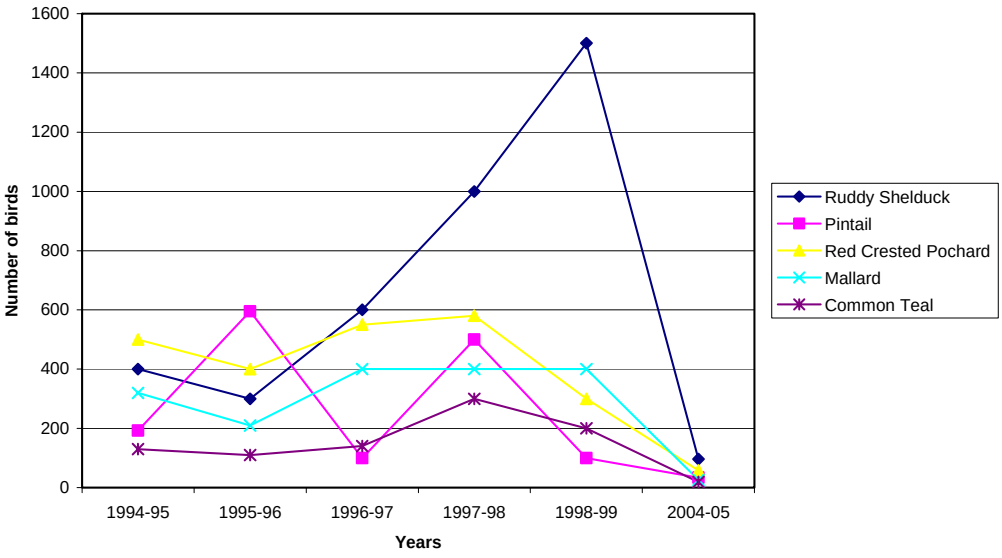
Percentage Composition of Commonest Waterfowls at Asan Reservoir during Winter Months



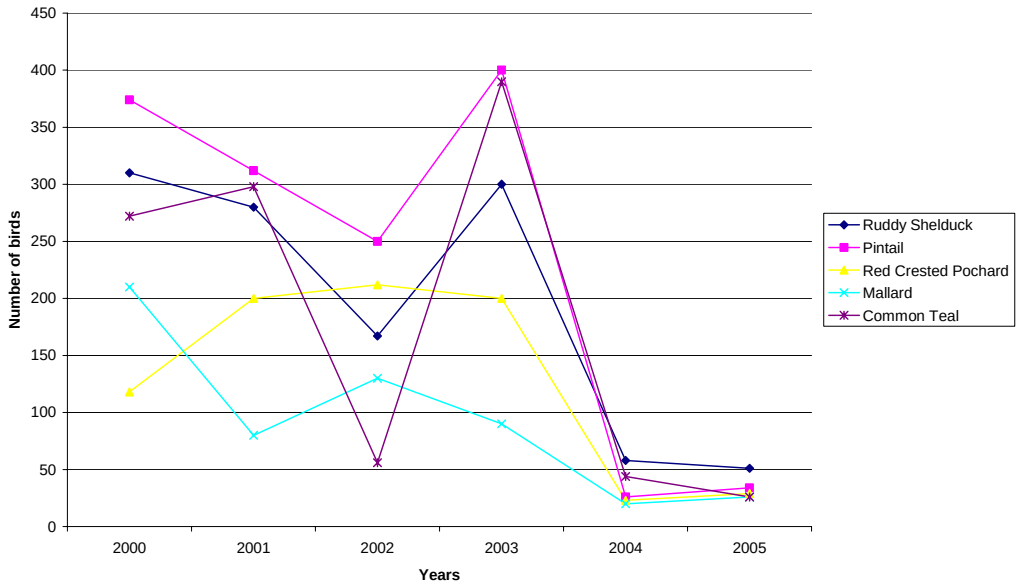
Percentage Composition of Commonest Waterfowls at Bhimgoda Reservoir during Winter Months



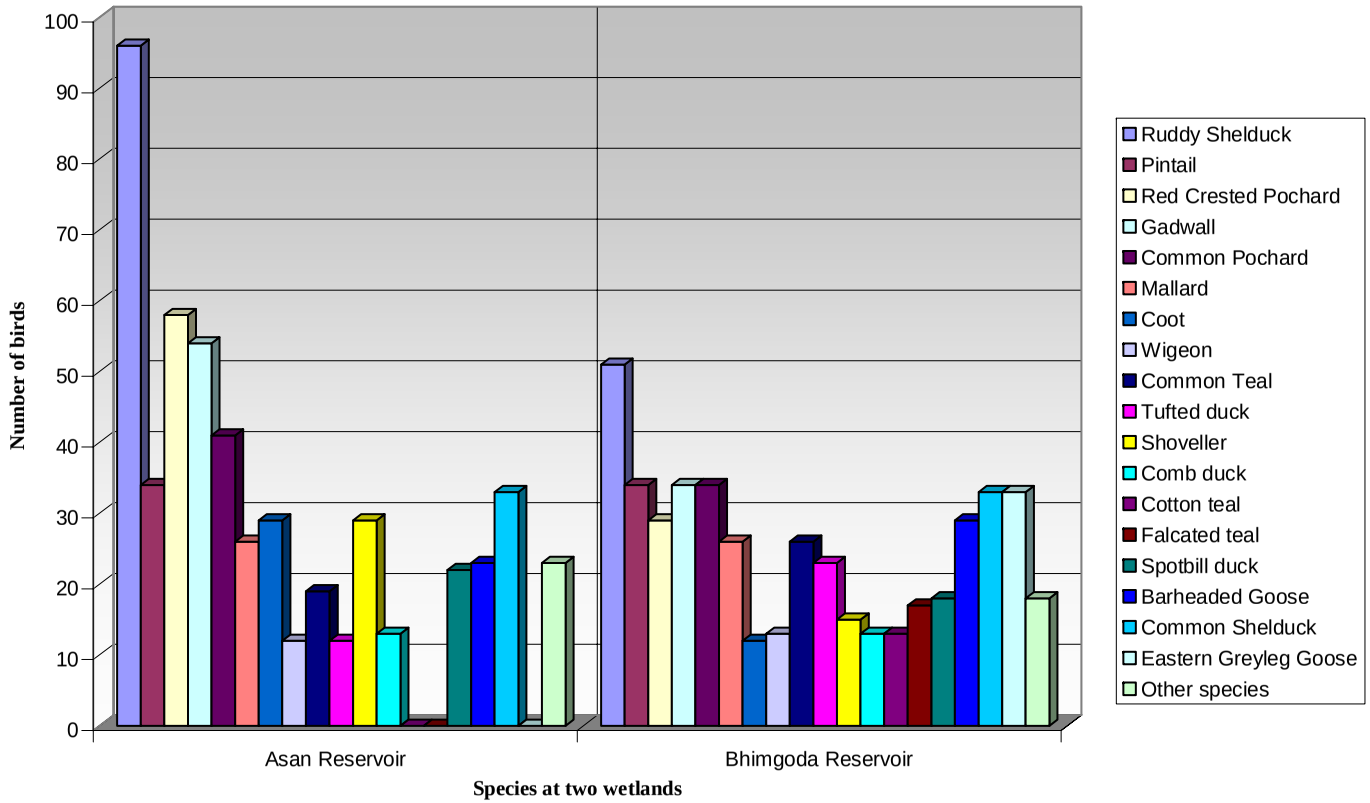
Changes in Population of Some Important Waterbirds of Asan Reservoir, Dehradun



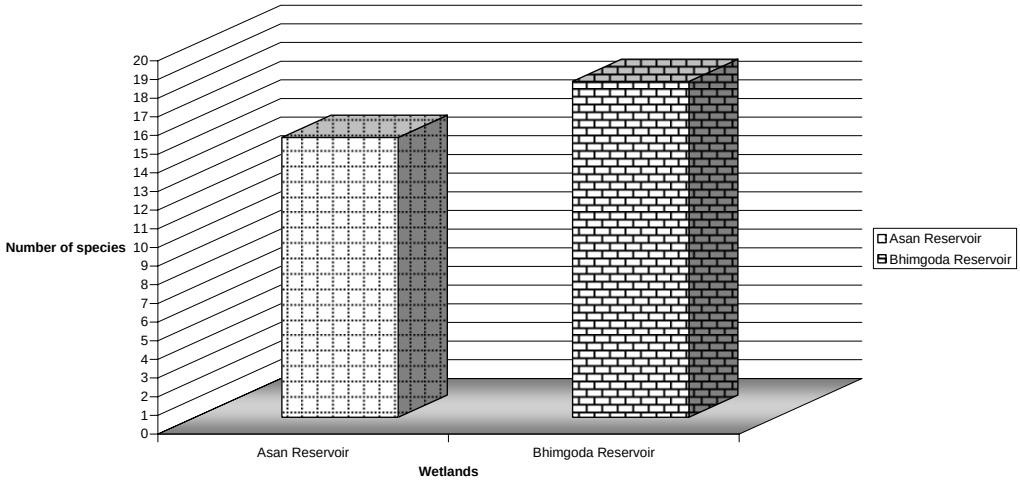
Quantitative Comparison of Population of Some Important Migratory Waterbirds of Bhimgoda Reservoir



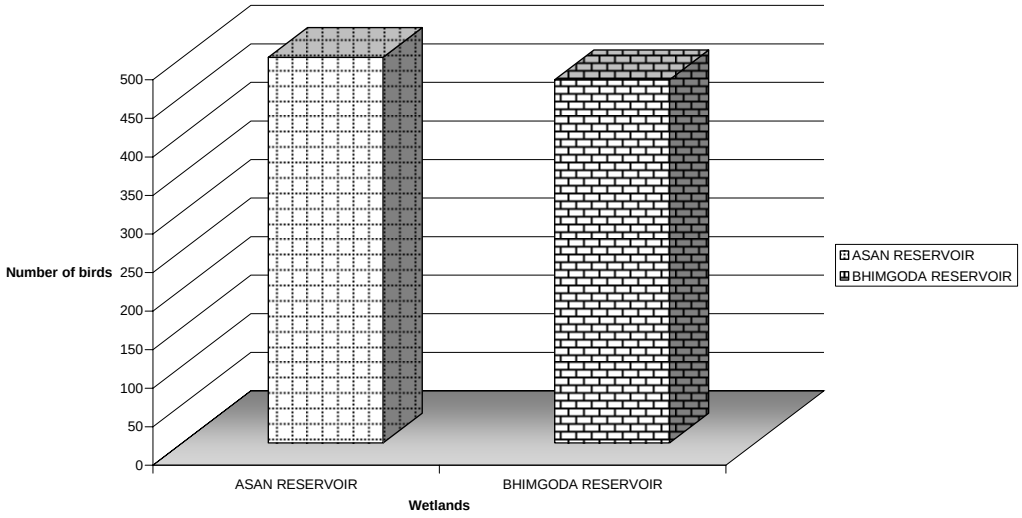
Comparison between the Peak Winter Population of Migratory Waterfowls at the Asan Reservoir and Bhimgoda Reservoir



Comparison Between the Number of Species at Asan Reservoir and Bhimgoda Reservoir



Relative Abundance of the Migratory Waterfowls at Asan Reservoir and Bhimgoda Reservoir



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