Diversity of Bird Fauna

Birds are formally classified as members of the class Aves, subphylum Vertebrata, phylum Chordata, Kingdom of Animalia. They are characterized as being generally small vertebrates with feathers, scaly legs and no teeth (except in few fossil forms). They have well developed air breathing lungs, a four chambered heart and maintain a constant body temperature of about 380C - 440C. At present, biodiversity is better understood for birds in many respect than any other major group of organisms because they probably inspire more interest in humans, are often spectacular,relatively easily observed and not too cryptic to identify. In order to understand the importance of a site for birds, it is necessary to examine its significance in terms of the presence and abundance of species that occur there in different seasons.The status and nature of these species also need to be taken into account. Threat status,breeding, vulnerability through congregation and the proportion of the total population of each species that occur at the site. In an era of rapid industrial growth, species economic zone and development, it is important to have an up to date knowledge of the diversity and status of birds.

Dr. Ishwar Baburao Ghorade is Assistant Profesor of Environmental Science in the Government College of Engineering , Aurangabad, Maharashtra (India). He received his Ph.D in Environmental Science from Dr. B.A.M. University, Aurangabad. He has published 44 research papers (International 41 with Impact Factor and National-03).

978-3-639-66764-6

Diversity of Bird Fauna

Scholars' Press

Ishwar Baburao Ghorade
Kirti Sadhurao Niralwad
Satish Sudhakarrao Patil

Diversity of Bird Fauna

Ishwar Baburao Ghorade
Kirti Sadhurao Niralwad
Satish Sudhakarrao Patil

Diversity of Bird Fauna

Ishwar Baburao Ghorade
Kirti Sadhurao Niralwad
Satish Sudhakarrao Patil

Diversity of Bird Fauna

Scholar's Press

Impressum / Imprint
Bibliografische Information der Deutschen Nationalbibliothek: Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.d-nb.de abrufbar.

Bibliographic information published by the Deutsche Nationalbibliothek: The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Coverbild / Cover image: www.ingimage.com

Verlag / Publisher:
Scholar's Press
ist ein Imprint der / is a trademark of
OmniScriptum GmbH & Co. KG
Heinrich-Böcking-Str. 6-8, 66121 Saarbrücken, Deutschland / Germany
Email: info@scholars-press.com

Herstellung: siehe letzte Seite /
Printed at: see last page
ISBN: 978-3-639-66764-6

Zugl. / Approved by: Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S) INDIA., 2014.

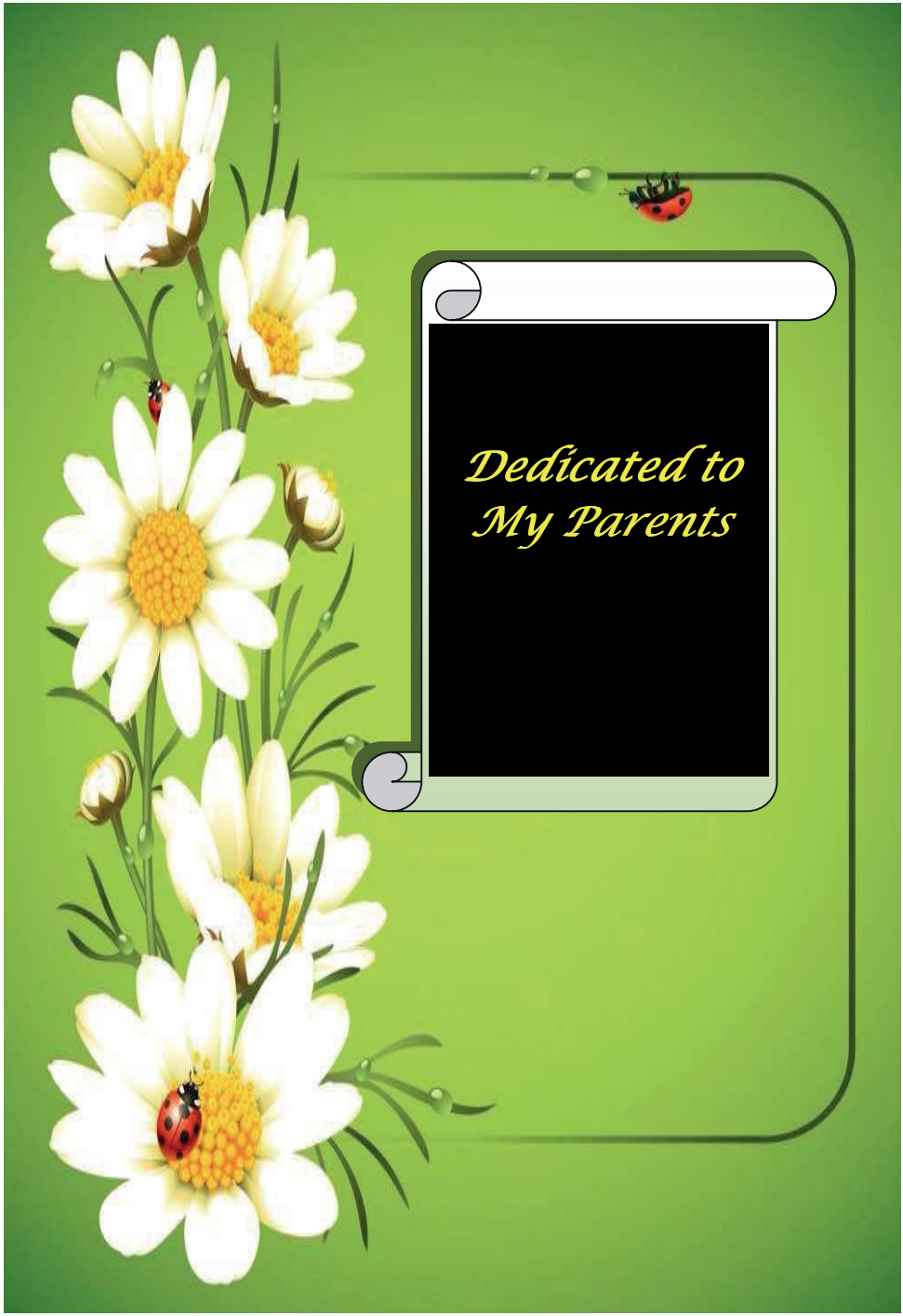
DIVERSITY OF BIRD FAUNA

Dr. Ishwar B. Ghorade
Dr. Kirti S. Niralwad
Dr. Satish S. Patil

Dr. Ishwar Baburao Ghorade (M.Sc., Ph.D)
Assitant Professor
Government College of Engineering
Aurangabad, India.

Dr. Kirti Sadhurao Niralwad (M.Sc., Ph.D)
Assistat Professor and Head
Department of Chemistry, Nutan Mahavidyalaya, Sailu,
Dist-Parbhani, India

Dr. Satish Sudhakarrao Patil (M.Sc., Ph.D)
Professor
Department of Environmental Science, Dr. Babasaheb
Ambedkar Marathwada University, Aurangabad, India


Dedicated to
My Parents

PREFACE

Birds are formally classified as members of the class Aves, subphylum Vertebrata, phylum Chordata, Kingdom of Animalia. They are characterized as being generally small vertebrates with feathers, scaly legs and no teeth (except in few fossil forms). They have well developed air breathing lungs, a four chambered heart and maintain a constant body temperature of about 38^0C - 44^0C. At present, biodiversity is better understood for birds in many respect than any other major group of organisms because they probably inspire more interest in humans, are often spectacular, relatively easily observed and not too cryptic to identify. In order to understand the importance of a site for birds, it is necessary to examine its significance in terms of the presence and abundance of species that occur there in different seasons. The status and nature of these species also need to be taken into account. Threat status, breeding, vulnerability through congregation and the proportion of the total population of each species that occur at the site. In an era of rapid industrial growth, species economic zone and development, it is important to have an up to date knowledge of the diversity and status of birds. Birds have play a unique role in the growth, protection and restoration of natural environmental and thus there important significance in the maintenance of clean and healthy environment is of high odor and it is great important to man. Studies of bird migration and distribution during the several decades have emphasized questions related to the mechanism and development (proximal causation) of migration, whereas questions related to the evaluation and function (ultimate caution) of migration and distribution have received considerably less attention from ornithologists. The Proximal causation bias has failed to emphasize the diversity of avian migration systems that have evolved as results of temporal and spatial changes in the environment.

(Dr. Ishwar B. Ghorade)

INDEX

Chapter-I

INTRODUCTION

Birds are formally classified as members of the class Aves, subphylum Vertebrata, phylum Chordata, Kingdom of Animalia. They are characterized as being generally small vertebrates with feathers, scaly legs and no teeth (except in few fossil forms). They have well developed air breathing lungs, a four chambered heart and maintain a constant body temperature of about 38^0C - 44^0C. Birds reproduce by laying comparatively large, hard-shelled eggs.

Amongst all other factors, the bird is a very important factor, which helps in maintaining the nature's balance. The French writer Michele said that, birds might live on this earth even if there were no men, but men couldn't live without birds." What he said is no more than the bare factual truth. Birds are an integral part of the whole system of life on this earth. Their importance is in no way less than of plants and animals (Reena and Abhijit, 2005).

The use of birds are so important that, nearly all birds feed on insects and worms, thus birds helps by keeping down the number of pests without disturbing ecological balance, e.g. White stork. Some birds are very good scavengers which not only clean the environment but also release the locked up nutrients in the dead organic matter. e.g. Kites, Vultures, Crows. Many of beautiful flowering trees are pollinated by birds, e.g. sunbirds, flower packers. Vermin's do enormous damage to crop and agriculture products; also carry diseases often fatal to the man. Many of the birds feed largely on these and help to farmers, e.g. owls, kites. They play predominant part in the dispersal of seed and distribution of plant life, e.g. bulbul, white-eye, koel. The fish eating birds have their own way of helping farmers and agriculturist, e.g. Cormorant *(Reena and Abhijit, 2005)*.

Natural population of birds are simultaneously affected by so many factors of the environment, that their effect can be determined only by long term studies. Changes in weather, vegetation, pathogens, predators, competitors, they all affect the well being of a population, and it requires many years of study and census work to determine the relative importance of each of these factors (Reena and Abhijit, 2005).

Analysis of current avian distribution and geography is essentially concerned with two populations, the resident and the migrant. Thus, migrant birds seen in the Oriental Region in winter are dependent on the status of habitat in their summer habitat and vice versa. Resident birds in the Oriental region are related to Ethiopian, Malayan and Chinese avifauna in their mutual palaeontological histories.

At present, biodiversity is better understood for birds in many respect than any other major group of organisms because they probably inspire more interest in humans, are often spectacular, relatively easily observed and not too cryptic to identify. In order to understand the importance of a site for birds, it is necessary to examine its significance in terms of the presence and abundance of species that occur there in different seasons. The status and nature of these species also need to be taken into account. Threat status, breeding, vulnerability through congregation and the proportion of the total population of each species that occur at the site, are all important factors in determining a sites importance. In an era of rapid industrial growth, species economic zone and development, it is important to have an up to date knowledge of the diversity and status of birds (Yardi, 2011).

Ecosystem functioning is dictated to a large extent by diversity and the community structure that result from such a richness and evenness of diversity (Yardi, 2011.) Thus, recent studies in biology focus more on quantitative aspects of biodiversity that further helps in prioritization of areas for conservation. Birds are ideal bio-indicators and useful model for studying a variety of environmental problems. As increasingly more attraction is now given to conservation, monitoring and ecological studies.

Developing scientifically sound census programmers is essential in describing long term trends in bird populations, highlighting species decline and unraveling the underlying causes (Yardi, 2011). While in the developed world there has been extensive research on the standardization of birds count technique (Verner, 1975). One of the major priorities in conserving animals is monitoring changes in their population to find prescriptions for their long-term survival (Yardi, 2011). Long-term changes in birds communities in Japan were examined by using binary data based similarly index of community-the Phi

Coefficient, which is useful for examining long term changes in avian communities amenable to hypothesis testing (Yardi, 2011).

Kumar (2000) stated that there are 9932 living species of birds found in the world. Human activities resulting from habitats loss and fragmentation have seriously threatened many birds and other fauna to the point of extinction. Almost 20% of bird's species were categorized as either endangered or 'nearly threatened' species in 1996 IUCN Red Data Book (Nagata, 1999). While according to IUCN report there are about 1200 threatened species of birds, further divided into rare, vulnerable, endangered, critical and extinct. Besides, there are numbers of insufficiently known species of birds at global level.

An extensive work on senses of birds, made by various organizations, checklist of birds from San Diego Country, California presented by biodiversity research center of California, which covers all species and subspecies of birds reported reliability in San Diego Country, the destruction status of each species. Whereas updated current checklist of their birds of insular newfound land and its continental shelf water studied by Mactavish *et. al.,* (2003), which replaced the Natural History Society of Newfound land and Labrador publication checklist (1999). The species are named in accordance with American ornithologist's union check list of North American birds, seventh edition (1998) and supplement up to and including the forty -forth supplement of the American ornithologists union check list North edition birds (2003). Such documentation provides a tool for legislators and administrator to compare current or planted work that is essential to conserve avifauna, which play important role in natural ecosystem and provides recreation to millions of citizens, who watch them as backyard birds.

In India, the avifaunal study was initiated by Blanford, (1889), Baker, (1922) and Whistler, (1949). While the pioneer work in the field of ornithology, has been carried out by Salim Ali (1968-1987) in Indian Subcontinent. Avifauna of Jamwa Ramgarh lake, Jaipur (Rajasthan) covers an area of 297 sq. miles and attracts a larger numbers both domestic and migratory birds in winter season (Yardi, 2011). The Himalayas due to their scenic beauty, forested hilly terrains, verity of plants and animals life, coupled with a healthy climate have always fascinated mankind. There are a number of hill stations throughout the Himalayan range and Shimla is one of beautiful hilly terrain, located in the map

of the North-west Himalayas and is rich in floral and faunal biodiversity. Summer Hill, a suburb at the western end of shimla city, Himachal Pradesh Campus, Indian Institute of Advanced Studies, Chadwick fall and Potter's Hill area rich in avian fauna (Yardi, 2011). A systematic list of feathered biped vertebrates from Periyar Tiger Reserve, Karala (South India) prepared by Srivastava *et. al.,* (1993) and observed that, there were rarity of larger birds of prey may be due to their low population in nature or the agriculture practices in the surrounding areas.

Gole, (1980, 1984) recorded birds from Poona city and polluted Mutha river meanders through Poona city, Maharashtra. An extensive work on birds has been carried out by Rahmani and Manakadan (1990) during BNHS's five year project on ecology and distribution of the Great Indian Bustard visited local area of Vaijapur and noted only presence of the Bustard.

One of the most spectacular events in the life history of numbers of birds is the migration, which has been intrigued mankind for many centuries. It is most enthralling subject of the study of birds life. Migration in perhaps its broadest sense, as defined by "a periodic passing form one place to another." Yardi, (2011), would add to this the concept of some correlation with environmental periodicities or some stage in the life history of the individuals making the migration. Others would limit its use to two way journeys of birds under their own power. An eminent authority, described bird migration as "changes of habitats periodically recurring and alternating in direction, which tend to secure optimum environmental conditions at all times" (Yardi, 2011). The clockwork regularity with which the arrivals and departure of migratory birds taken place every year, the countless millions of individual involved in this mass movement and the vast distances they travel over trackless land to reach their seasonal abode, have exited the wonder of man through the ages.

Migration is deep seated physiological phenomenon. It probably sprang from dispersal and retreat as cyclic ecological events took place and resulted in more efficient utilization of the environment which periodically becomes inclement or hostile.

Most of the migratory birds are seen within India only during the winter months, they arrive in autumn, chiefly between September and November, and leave again for their northern breeding grounds before our hot weather

commences, in March or April. Among them are regular winter visitors both common and rare, and casual vagrants as well as accident strays. It is generally assumed and rightly so, that winter weather and the consequent scarcity of food, particularly insect, cause birds to seek more favorable climates for winter. Many theories have even advanced to explain the origin and perpetuation of migratory habit in birds. None of them is entirely adequate, probably there is no single factor or workable hypothesis explaining migration as a whole, which is presumably a phenomenon of multiple origins, but each contributes something to our understating of the problem involved (Pandya and Daniel, 2005).

Studies on bird populations are very important to understand the factors that influence the number of birds in a habitat and the comparative abundance of some species over the others. The number of individuals or pairs per unit area is known as the population density. Bird populations are quite stable and their densities fluctuate within a narrow range. If for some reason the density falls drastically the populations recovers very rapidly. This rapid recovery indicates that bird populations generally have a high potential to increasing numbers. This potential is not reached in natural populations. The main constraint to this potential is the carrying capacity of the environment which is related to the availability of resources. Food is the main limiting resource for many species while for other it could be nesting sites or territories.

Flocks are aggregation of birds which may come together for a variety of reasons. It may be merely by chance at a concentration of a resource they all want , it may be for large scale movements, better defend themselves against predators, or to improve their ability to get at, a scarce resource, or gain it may be to defend a common group territory against conspecifics. For instance, many insectivorous birds such as white eyes and minuets feed in flocks and larer mixed hunting parties including nuthatches, woodpeckers, drongos, mynas, tits etc. in our forests. Some species of babblers such as the common jungle, Large grey occur in small cohesive flocks which seem to defend group territories against other babblers, and have helpers who feed chicks at nests along with their parents. (Reena and Abhijit, 2005).

The choice of a species as indicator of a certain habitat is based on various requirements. Some species are identified with specific habitat types, such as the pheasants in temperate Himalayan communities. Species in the

tropic levels, i.e. secondary consumers such as the tiger or eagles are useful indicators because of their habitat. Ensuring their long term survival implies that their communities and habitats are also protected. It is the norm to select larger animal species, especially mammals as indicators. Birds having attracted professional as well as amateur bird watchers for centuries, their habitat preferences and behaviors' are also well known and bird lists of most areas are available. Thus, birds can be useful as indicator species. While selecting index species it must be stressed that conservation cannot be done without having information on the distribution, behavior and abundance of the species. For majority of the organisms such information is not available, while in some cases our knowledge is limited. But, some species have historically attracted in-depth studies either due to their beauty and grandeur or due to commercial importance. Therefore, it is more convenient to use such species as indicators of their habitat. The concept of indicator species is flexible in its definition but, may prove to be a significant tool for identifying the need for, as well as gauging the success of conservation efforts (Reena and Abhijit, 2005).

Birds are in some ways the highest of the vertebrate animals. They represent the climax of that passage from water to land, which the backboned series illustrates. Their skeleton differs from the general type more than that of mammals; their arrangements for movement, breathing, and nutrition are certainly not less perfect, their body temperature, higher than that of any other animals, is an index to the intense activity of their general life (Reena and Abhijit, 2005).

Scientists from the Bombay Natural History Society at various field stations have continuously studied bird migration in Indian subcontinent. Water birds like cranes, ducks, and waders, along with non-passerines and passerines, like wagtails, cuckoos and raptors, have been captured and banded with aluminum rings over the previous years. A number of bird species of diverse orders and families and with a diversity of habits and habitats roost together for at least a part of the year (Gadgil and Ali, 1975). The phenomena of communal roosting in birds has been studied various workers of bird ecology (Rudebeck, 1955; Siegfried, 1971; Sengupta, 1973; Balda *et. al.,* 1977; Clarke, 1990, 1996a, 1996b). A few have reported on migratory harriers (Auti, 2002; Matkar, 2008; Yardi, 2011).

All studies of communal roosts in the Indian subcontinent have so far concentrated on resident birds (Sengupta, 1973; Gadgil and Ali, 1975) while a few have reported cursorily on roosting and movement pattern of migratory harriers (Rahmani and Manakadan, 1987; Satheesan and Rao, 1990). It is observed that many cities have made same mistake of neglecting their bird life and decreasing the biodiversity of birds very fast.

Hence, there is a need to set up the special committees of experts for protecting and improving of roosting, nesting and feeding habitat of birds. The most important and easiest way is to plant more and more trees to attract the bird life. Some pockets should be reserved and meticulously developed to nurture the bird species.

Birds have played a unique role in the growth of the conservation movement and the quest for a valid environmental ethics (Imnoden, 1994; Bock, 1997). Ornithologically based conservation efforts the information about birds can really be a public opinion (Bock, 1997). Bird populations provide a sensitive indicator of pollution in terrestrial ecosystems (Gaston, 1974). Ornithologists in particular are being asked by people to bring all that science can bring to bear on the conservation scene (Senner and Drennan, 1995). Moreever, Ornithologist is being asked to become advocates, not only for birds but also for their habitats and for all the diversity of life. Ornithologists historically played a key role in addressing environmental issues, because birds are highly visible and of interest to a large portion of the public, they often have served as focal points either in efforts to alleviate specific environmental problems, for example DDT's effect on Peregrine falcons or help to conserve entire ecosystems (Yardi, 2011).

Birds are part of the natural habitat of the Indian Subcontinent, a region teeming with winged resident. In India, there is no off-season for Ornithology, native birds more or less perennially visible. Migratory birds arrive annually for a winter vacation. The countryside is hot and dry in summer. The migratory birds in the lake seem to shrivel up. A good monsoon is rewarded by October. There is explosion in bird population by the beginning of winter. India and its neighborhood countries now play host to migratory birds. As the temperature falls in the northern latitudes, birds that have nested in the summer are unable to find food, they move south to more hospitable terrain. Birds are warm-blooded,

egg-laying vertebrate covered with Feathers. The forelimbs are modified as wings, make them most strongly adapted for flying.

The food of the birds varies, not only in different birds, but also to some extent at different seasons. Some are vegetarians, feeding on the green parts of plants, and in these the intestine is usually long. Some are notoriously carnivorous, or feed upon fish, molluscs, insects, etc.

In India, much of the research work has been done in the fields of agriculture, horticulture and traditional forestry with regard to insect pests and their control. The vital importance of birds as biocontrol agents of insects and rodent pests has been long established. However, birds are more efficient as insect controllers due to their higher rate of metabolism (Tara Gandhi, 1995).

Studies of bird migration and distribution during the last several decades have emphasized questions related to the mechanisms and development (proximal causation) of migration, whereas questions related to the evolution and function (ultimate causion) of migration and distribution have received considerably less attention from ornithologists (Gauthreaux, 1979). The proximal causation bias has failed to emphasize the diversity of avian migration systems that have evolved as a result of temporal and spatial changes in the environment (Gauthreauz, 1982).

Bird habitats are strongly influenced by climatic changes and immediate human impact. When consequent environmental changes exceed the tolerance limits of species, habitat change could also become an ultimate cause for long-term changes in bird distributions. The changes in geographical distributions, both simple expansions of species' ranges, and the other an expansion in one direction coupled with a withdrawal from another, was seen to be mixed in the Salim Ali Lake (Auti, 2002).

Habitat selection and distribution of bird species within their geographical range might occur in response to food alone, if food differs predictably from habitat to habitat (Verner, 1975). Other simple factors such as the openness or denseness of the habitat in relation to a bird's ability to move about in it (Hilden, 1965; Morse, 1980) may provide clues that facilitate habitat selection which results in improved reproductive success for the species.

Various authors have theorized on the principle of heterogeneous summation in habitat selection (Seitz, 1940; Hilden, 1965; Morse, 1980). The

habitat selection depending on the internal motivation of an organism would be modified by the external stimuli in the environment, both positive and negative, as perceived by the organism. Every habitat possesses all the feature characteristics of the ideal environment, the overriding factor being that combined effect exceeds the heterogeneous summation of an organism in selection of its habitat (Morse, 1980).

Many natural habitats in the study area are undergoing changes as a result of human activities. Under this regime, the numbers of many species are declining precipitously. Yet, other species prosper, often occupying habitats, which only recently were either rare or nonexistent. To conserve birds and their habitats, there is a need to understand their life cycles, their habitat requirements and the environments in which they live (Burnham *et. al.,* 1994).

Birds, like all other animals, are dependent for food and shelter on the kind of environment to which each species is adapted by evolution (Mountford, 1988). Undisturbed and well-protected grasslands, which cover almost a quarter of the earth's area, (Shantz, 1954; Shankar, 1960;) are vital for the group. Such habitats are under tremendous pressure due to various anthropogenic activities, especially the conversion of such localities into erable lands and built up areas (Hoyo, *et al.,* 1994).

A species distribution can be expressed simply as its presence or absence, or by some measure of abundance. The sample units may be on a regular grid such as in most bird atlas studies, or a random point within a habitat, at which data has been collected. There are essentially three types of distribution of animal species and communities; random distributions as they are distributed independently of features on ground and independently of the presence of other birds. Further, resources that birds exploit are rarely, randomly distributed (Auti, 2002).

The distribution of bird species is important because the distribution can be related to land-use, the value of sites of conservation importance and vulnerable can be assessed with respect to their bird fauna and baseline information is generated against which changes can be assessed. Distribution studies can be used to identify local, regional, national and international ranges of birds, habitat determinates bird numbers, the effects of weather, arrival times of migrants, the extent of partial migration, patterns of influx by species,

conservation importance of a particular species, threats to a site and a sites value to conservation.

Distributions are based on presence-absence information, but the absence of a species form an area may reflect a distributional fact or a simple failure to record its actual presence during the survey. When a certain number of bird species listed in the study area would not be consistently or frequently recorded infield surveys, it would indicate that these species are uncommon in abundance, have a localized distribution, or are very difficult to detect. Though field surveys are unable to offer definite or any information on population trends and distributions for bird species in a particular area, lack of records indicate and or confirm the rarity and localized distribution of such species.

The paucity of records for many birds however is evidenced of their rarity. The number of individuals of each species can never be recorded in any study for a given area. Such data can only be judged sufficient or otherwise to show detailed population trends for the most common species. The drainage of marshes for land reclamation and the pollution of lakes from effluent discharges have affected the water bodies, thus deteriorating the environment still further. A dubious, though classic example has been the polluting of the Kolleru Lake resulting in the desertion of the largest known breeding colony of Spotted-billed Pelicans in India. The tremendous spread of agriculture and social forestry schemes together with the degradation of habitats have brought about changes in the distribution of quite a few species of birds, especially graminivores and insectivores. The true effect of these changes in the environment to the avifauna can only be evaluated after a careful and detailed study.

Many vital rivers and reservoirs are fast getting silted up, overgrazed and highly degraded with consequent soil erosion in most of the areas. Illegal encroachments for shifting cultivation are widespread. All this naturally affects not only the local faunal populations but also the tribals and the total ecology of the region. Large birds such as peafowl, jungle fowl, partridges, quails and hornbills have either disappeared from large areas or related to few patches of sheltered forests, (Auti, 2002, Matkar, 2008; Yardi, 2011).

Indian subcontinent represents 2094 forms belonging to 1200 species of avifauna (Ali and Ripley, 1983). This abundance and diversity of avifauna community obviously indicate the high ecological diversity of the country.

Certain ecological aspects of the aquatic birds have been worked out by (Raj *et. al.,* 1987; Saikia *et. al.,* 1987, 88, 89, 1990a, 1990b; Bhattacharjee *et. al.,* 1988; Prashant kumar, 1993; Yardi, 1999 and Dixit, 2000, 2001; Matkar, 2008; Yardi, 2011).

A basic problem of field ecology is to determine the causes of abundance and distribution of organisms with relation to the environment. The aim of this work is to obtain some observations on the relationship between the environmental parameters and bird community in Jaikwadi reservoir at Paithan district, Aurangabad.

Birds can be seen in various habitats such as terrestrial, aquatic, cold zone. High mountains on both poles streams to lakes and rivers. The Birds dependent on water are known as water birds. (Yardi, 2011). This includes birds like waterfowls, shore birds like waders. Some birds not fully depend on water but they always prefer the water body (wetland) such as Kingfisher Swallows, Pipits. Lapwing etc.

The area of wetland having sufficient water helps to increase the aquatic vegetation ultimately number of species of the water birds can be seen around wetland. Thus, this helps to increase the population and species of water birds and wetland dependent avifauna of that particular wetland. Such wetland provides food, shelter, resting places breeding grounds, roosting sites to variety of the birds (Anil Mahabal, 2005).

Water birds play a significant role in food chain. They play an important role in controlling agricultural pests also as destroyers of other vermin. As scavengers; as flower pollination agents, as seed dispersers, birds support the wetland ecosystem. Biodiversity is basic of sustainability of the diverse ecosystem give rise to diverse culture. However, the diversity of ecosystem life form, way of life of different communities are under threat, habitats have been eroded cutting and isolating biodiversity rich habitat into islands encourage the species isolation.

Avain diversity is the part and parcel of biodiversity; therefore investigation on avian diversity and its bioecological aspects of birds is an essential pre-requisite for its conservation and further management (Anil Mahabal, 2005).

In the present study (Station S1- Nandur-Madhemeshwar Dam, S2- Kaygaon Toka and S3- Jaikwadi Dam) identification and monitoring the different ecological aspects of avian diversity particularly local and migratory birds has undertaken for future planning to protect.

Jaykawadi wetland has been recognized a wetland of international significance (proposed Ramsar site). It is well known for its rich biodiversity, today this valuable natural asset is highly threatened due to the phenomenon of urbanization. The present study mainly focused on understanding the rate of wetland habitat using water birds as the biological indicator. Study of water quality with social survey supplemented by the results of statistical analysis of birds data helped to understand the issues regarding this wetland.

Living organisms are sensitive to the changes in the state of their environment. Therefore, changes in their abundance are used to analyze the state of the environment, monitoring the presence, abundance as well as nature of bird species in the study area not only tells us about the current state of an environment but repeated monitoring showed a drastic change in this wetland ecosystem.

To act as indicators of ecological changes three set of secondary data on water birds are taken from the study area on three different period/season spending over last three decades. Table for three different periods are prepared. The data indicates that there is destruction in the wetland habitat for which the human activities are chiefly responsible, land use and cover data shows highly fragmented wetlands. Secondary, release of urban waste, waste including industrial waste has resulted in to change in wetland habitat, water birds are now mostly found in the relatively undisturbed area, in some instance it was found that the nearby areas with natural vegetative cover attracting the water birds away from the wetland e.g. Barheaded goose, Shelduck.

This manmade water bodies have formed new ecological niche and now supports greater part of water birds wintering (migratory birds) in this wetland indicates the siltation, pollution and growth of salinity. Hence, such manmade lakes needed to be monitored together with natural habitat to identify population changes and threats for water birds. To ensure the effectiveness and sustainability of conservation efforts they should be coordinated with, plans of water management authority.

Nandur Madhmeshwar bird sanctuary:-

Nandur Madhmeshwar bird sanctuary, situated about 40 kms from Nasik in Niphad Taluka is a paradise for bird lovers which was established in 1950. Spreads over an area of nearly 10,000 hectares of land, the sanctuary comprising of evergreen forest and trees at the confluence of the Godavari and Kadwa rivers is a home to many endangered species of birds. More than 220 species of birds - both resident as well as migratory birds, 400 species of vegetation, 24 species of fishes and several small mammals are located here. White stork, glossy ibis, spoonbills, flamingo, goose brahminy duck, pintails, cranes shanks, godwits, weavers etc. are the migratory birds found here and the resident birds include black ibis, spot bills, teals, little grebe, cormorants, egrets, herons, stork, kites, vultures etc.

Jaikwadi Bird Sanctuary:

The present wetland Jaikwadi reservoir is situated 40 kms south of Aurangabad at Paithan. This town is situated on the right bank of river Godavari and is at latitude $19^0$39'19" north and longitude $75^0$26'2" east. The name itself shows Pratisthan or Capital city. Today, Paithan attains importance through the important pilgrimage of Sant Eknath Maharaj. In this river Godavari, the ashes of dead bodies are brought for spiritual performance.

At the base of the dam, 12 mega watt generating capacity hydro-electric plant is set up and the turbines are reversible. Pisciculture is being developed to yield huge fish catches regularly from this water body. The dam water serves a perennial source to the entire population of Aurangabad city.

Back water of Jaikwadi Dam "Nathsagar" has attracted a number of birds both resident and migratory. As per the criteria set in the Ramsar convention this water body holds migratory birds from all over the globe and their number exceed over 10,000. Migratory birds have been on record from Jaikwadi area as back as from 1976. In the year 1989 as many as 150 species of birds were recorded.

Government of Maharashtra declared in November 1986 the area of Jaikwadi Reservoir as a bird sanctuary as per wildlife protection act 1972. The Deputy Conservator of Forests and Regional Forest Officer stationed at Aurangabad hold the charge of this wetland. The total area of this bird sanctuary

is 341.05 sq. kms which approximates only to the full reservoir level of the water body. The area of the wetland is not completely filled up due to less rain.

The water catchment area is 21,750 sq. kms with depth ranging from 1 meter to 30 meters. The shoreline of backwater is wavy. It is clear that the dam was constructed by displacing some nearby villages (which are submerged). The main town like Aurangabad, Paithan and Shevgaon are on the way and near to the dam site.

The morphometric features are also given in the table are as follows:

1	Total Area of water reservoir	35,000 hectares
2.	Catchemet area	21,750 sq. k.
3.	Source of water	River Godavari
4.	Latitude	19^0.39'19"
1.	Longitude	75^0.26'-2"
6.	Gross Storage Capacity	2909 M^3
7.	Controlling level of the dam	463.50 M
8.	Mamimum height of the dam above the lowest point of foundation	37 meters.

Wetland is partially polluted by domestic sewage besides washing and bathing purposes. A small locality called as "Kayegaon" is also adjacent to this dam on Pune Aurangabad road where two rivers Godavari and Pravara join each other.

Climate of Aurangabad district is characterized by hot summer and general dryness throughout the year except during south east monsoon. The year may be divided into four seasons. Cold season from December to February is followed by the hot season from March to May. The period of June to September generally monsoon showed its occurrence. October & November forms the post monsoon season.

Average rainfall at Aurangabad is recorded 725mm and for Ahmednagar district it is about 578 mm. The variation in the annual rainfall from year to year is very large. December is the coldest month and there is a rapid rise in the both

day and night temperatures and in May it touches to highest. There is a record of rise of daily temperature to 45^0C to 46^0C also. Winds are generally moderate with increase in speed during the later half of the hot season and in monsoon season.

The main forest type corresponds to Group A. Southern Indian tropical dry deciduous forests. The bird fauna of this wetland is quite rich. Several birds were seen during this survey.

Chapter-II

MATERIAL AND METHODS

In the present study (Station S1- Nandur-Madhemeshwar Dam, S2- Kaigaon Toka and S3- Jaikwadi Dam) identification and monitoring the different ecological aspects of avian diversity particularly local and migratory birds has undertaken for future planning to protect.

NandurMadhmeshwar bird sanctuary, situated about 40 kms from Nasik in Niphad Taluka is a paradise for bird lovers which was established in 1950. Spreads over an area of nearly 10,000 hectares of land, the sanctuary comprising of evergreen forest and trees at the confluence of the Godavari and Kadwa rivers is a home to many endangered species of birds. More than 220 species of birds - both resident as well as migratory birds, 400 species of vegetation, 24 species of fishes and several small mammals are located here. White stork, glossy ibis, spoonbills, flamingo, goose brahminy duck, pintails, cranes shanks, godwits, weavers etc. are the migratory birds found here and the resident birds include black ibis, spot bills, teals, little grebe, cormorants, egrets, herons, stork, kites, vultures etc.

Jaikwadi Dam, near Paithan situated at longitude $75^0$26' and latitude $19^0$39. The Jaikwadi sanctuary is a man-made reservoir that was created after the construction of a dam in 1975 on the upper reaches of river Godavari. The dam was constructed mainly to overcome irrigation and drinking water scarcity in the drought prone area in Marathwada region. In the absence of natural depressions and hilly terrain, this dam had been constructed on almost flat land, because of which the impounded water spread is large, approximately 55 km long and 27 km wide. This shallow water spread, with receding water line is very attractive to a large number of waterfowl, the Government of Maharashtra declared this waterland as Jaikwadi bird sanctuary in 1986. The aquatic vegetation includes mainly the species of *Chara*, *Spirogyra, Hydrilla, Potamogeton, Vallisneria. Argemone mexicana* and *ipomoea fistulosa* are found in the surrounding area. Nearby areas are irrigated agricultural fields. The newly created reservoir has changed ecological conditions from semi-arid to rich cultivated fields.

The sanctuary is rich in bird fauna associated with it that includes some migratory species and ecologically an important landmark. The study on bird habits, habitat, number and seasonality were carried out by regular field visits to the Nandur-Madhemeshwar dam, Kaigaon Toka and Jaikwadi Dam in the morning between 6.30 and 9.30 am. The birds were also observed sometimes in the evening hour by using the binoculars of magnification 8x40. Special features of residential and non residential birds and their habit and habitat along with their seasonal dominance were studied. The identification and checklist of identified birds were made in winter, summer and monsoon according to (Salim Ali, 1996; Mankadan and Pittie, 2001; Matkar, 2008; Yardi, 2011) and photographed. Bird visiting the dam as a visitor in winter, summer and monsoon and some passes through the dam are also recorded. The status of each species is categorized as residential (R), Migratory (M) and local migratory. (LM).

Chapter-III

RESULTS

The study area Nandur-Madhemeshwar Dam (S1), Kaigaon Toka (S2) and Jaikwadi Dam (S3) these bird sanctuaries are observed to be rich in bird fauna. The study on bird habits, habitat, number and seasonality were observed by regular field visits at all stations during study period and the identification of 83 birds species and the checklist of residential and non-residental bird were prepared **(Table No. 1.1)**

Observations of Bird fauna at Stations:
Nandur-Madhemeshwar Dam (S1)
Kaigaon Toka (S2) and
Jaikwadi Dam (S3): (Fig. 1.1-1.83)

1. Little Grebe or Dabchick (*Tachybaptus ruficollis*) (Fig. 1.1): The size of this bird is ±23 cm. It is a good swimmer and expert diver; Vanishes below the surface with astounding rapidity, leaving scarcely a ripple behind. It is a drab colored, plump and squat litter, water bird with silky white under parts. The bill is short but pointed. It's a tailless bird. Normally feeds on insects, larvae, frogs and crustaceans. It breeds between April and October. It lays 3 to 5 eggs, white but soon becoming brown-stained through contact with the sodden weeds with which the bird usually covers them up before leaving the nest in alarm or to feed.

2. Little Cormorant (*phalacrocorax niger*) (Fig. 1.2): It was found in large groups about 30 to 40.The size of this bird is 50 ± cm, it is much smaller bird than the large cormorant. It is blackish in color, with a long stiff tail. A small white patch on throat, found in large numbers in colonies. It is a great diver and sumarine swimmer. It lives exclusively on fish. It is monsoon breeding bird. The nest is a shallow twig platform, like a crow. It lays four to five eggs, pale bluish green, with a chalky surface.

3. Grey Heron (*Ardea cinerea*) (Fig. 1.3): The size of this bird is ± 98 cm. It is a ashy grey above with white crown and the neck is grayish white in below, with long slander S-shaped neck. The head is narrow with pointed dagger bill. A long black occipital crest and elongated white feathers on the breast with some black streaks. It flies with steady wing beats; neck is folded back and head

drawn in between the shoulders, the long legs trailing behind. It breeds mainly in the month of July to September. The nest is a twig platform with the central depression lined with grass, etc. It lays 3 to 6 eggs, deep sea green in color. Both male and female are share all domestic duties.

4. Paddy Bird or Pond Heron (*Ardeola grayii*) (Fig. 1.4): It was found in the periphery of the reservoir. It is about ± 45 cm in size. It is an Egret like bird. It is Muddy brown in color. When the bird is in flight, its white colored wings can be seen. Found everywhere there is water. It is often seen in alone but becomes a social bird during the breeding season. The Pond Heron loves frogs, fish, insects and crabs. This bird breeds mainly from May to September. Not necessarily near the water, its nest is made of twigs of small size in an untidy manner. It lays three to five eggs, pale greenish blue in color.

5. Cattle Egret (*Bubulcus ibis*) (Fig. 1.5): It was found along the periphery of the reservoir. It is a slender white bird with a long neck and very stable legs which keep it mounted on the head and back of these animals. Orange–buff plumes appear on its head, neck and back during the breeding season which distinguishes it from all other egret species. Mostly seen with grazing cattle's, running in and out between their legs or riding upon their backs, and lunging out to seize insects disturbed by their movements amongst the grass, chiefly grasshoppers, other insects also frogs, fish, etc. It breeds between the months of June and August. The nest is an untidy twig platform like crows. In mixed colonies with Cormorants, Paddy Birds, etc in large leafy trees not necessarily near the water. It lays four to five eggs, pale skim milk blue.

6. Little Egret (*Egretta garzetta*) (Fig. 1.6): It was found on the edges of the reservoir. This bird is ± 62 cm in size. Long legged and long necked, with white feathers. It also has ornamental feathers on the back as well as on its breast. Flies with steady wing beats, neck pulled in like a Heron, roosts in trees. Feeding on small fish, frogs, insects, etc. It too, monsoon breeding bird. The nest is a shallow twig platform, like a crow, lined with straw, leaves, etc. It lays four or five eggs which are sea green or bluish green in color.

7. Night Heron (*Nycticorax nycticorax*) (Fig. 1.7): It is nearly 50 cm in size. Grey colored, with white on the face and on the under surface. It has a greenish black crown with the black being distinctive. It is largely nocturnal in its habits. The day is mostly passed under the cover of some trees or bushes,

sleeping. It feeds on crabs, fish, frogs, aquatic insects, etc. It breeds from April to September. It lays four to five eggs during the breeding season. The color of eggs is pale sea-green. Both sexes share all domestic duties.

8. Openbilled Stork (*Anastomus oscitans*) (Fig. 1.8): It was found in the periphery of Jayakwadi wetland in mudflats. It is about 76 cm in size. It is a small white, grayish stork with black in the wings. It may have to do with opening the thick shells of the large *Ampullaria* snails found on marshes, the soft body and viscera of which form a large proportion of its food in due season. It also eats forgs, crabs, large insects and other small living things. It breeds in July to September. It lays 2 to 4 eggs, of white, close textured.

9. Whitenecked Stork (*Ciconia episcopus*) (Fig. 1.9): It is 90 cm in size. It is a shiny blackish blue bird with a white neck and a black skullcap. It has long red-colored legs and a black bill. Affects well. Watered plains country. Partial to waterlogged ground, and the environs of rivers, jheels and ponds. It feeds on fish, frogs, large insects, etc. It is a solitary nester, building its nest in a large tree. It breeds partically all year. It lays three to four white eggs.

10. White Ibis (*Threskiornis aethiopica*) (Fig. 1.10): It is large white marsh bird with naked black head. The bill is curlew like stout, black down curved. It walks about actively on marshy land probing with its bill into the soft mud, mandibles partly open like forceps. Often feeds in shallow water with the head momentarily submerged. Like storks and spoonbill, it lacks true voice producing mechanism and is silent except for peculiar ventriloquial grunts uttered when nesting. It breeds in June to August. It lays 2 to 4 eggs, bluish or greenish white, sometimes with delicate spot of yellowish brown.

11. Balck Ibis (*Pseudibis papillosa*) (Fig. 1.11): It mostly seen alone but some times found in groups. The Black Ibis is $\pm$ 68 cm in size. It is black in color. It has a bare head, long curved beak and conspicuous white wing patch. The legs are red with a special triangular patch of crimson on the head. Once in flight its formation is like that of Geese and Cranes. Affects marshes and jheels, mud banks in rivers and lakes. Feeds actively in the morning and evenings. It feeds on insects, small reptiles, etc. It rests and breeds on trees. It breeds between March to October. It lays three or four eggs.

12. Glossy Ibis (*Plegadis fulcinellus*) (Fig. 1.12): Found along the dege of water while feeding. It is found in groups. This bird is $\pm$ 55 cm in size. Brick

red-brown with shining tints on its plumage. It is a smaller than Black Ibis. It is a gregarious bird found in groups. Feeds along edge of water with head often completely submerged. Roosts on trees. It feeds on crustaceans, insects, etc. It breeds on trees. Its nest is built of small sticks. It lays two to three blue green eggs.

13. Spoonbill (*Platalea leucorodia*) (Fig. 1.13): The bird is ± 85 cm in size. This bird is tall, white, long legged bird. The color of neck is yellowish brown and the most distinctive feature is the black and yellow colored spoon like bill. The bill is flat and broad at the tip. The color of the leg is black. It feeds with its neck stretched outwards and the beak half-immense in water, turning from side to side in a regular sweeping action. It feeds on vegetable substance, aquatic insects, larvae, frogs and small fishes. It breeds from July to November. It lays four or five eggs.

14. Flamingo (*Phoenicopterus roseus*) (Fig. 1.14): It was found in flocks at tidal mudflats of Jayakwadi reservoir. It is about ± 125 cm in size. It is a long legged, long necked rosy white stork-like bird, with a heavy pink bill turned down at an angle ('broken') from about half of its length. In flight the long outstretched legs and neck, and the black-bordered brilliant scarlet wings are diagnostic. It feeds in shallow water with the slender neck bent down between the legs and head completely submerged. The curious bill is inverted so that the ridge of the culmen scrapes the ground. The upper mandible thus forms a hallow scoop into which the churned up liquid bottom mud is collected and strained by means of the lamellae and the fleshy tongue, sifting the minute food particles. It feeds mainly on crustaceans, worms, insect larvae, seeds of marsh plants, and organic ooze. It gives a loud goose like honk; a constant babbling uttered while feeding in company. Flocks fly in V-formation, in diagonal wavy ribbons, or in single file. It breeds in September to April. Its nest is a truncated conical mound of hard sun-baked mud 15 to 30 cm in height with a slight pan-like depression at top. It lays 1 or 2 eggs, white with a faint bluish tinge.

15. Ruddy Shelduck or Brahminy duck (*Tadorna ferruginea*) (Fig. 1.15): It was found on sandbanks while resting. It was found in pairs only. It is as big as the Goose, being 65 cm in length. It is bright orange – brown, with the head and neck slightly pepper in shade. This species of duck loves large water body with fresh and clear waters, and sandbanks to rest on. It is at nighttime that it

feeds on vegetable matter. Nesting season of Brahminy is from April to June. It lays six to ten off white eggs.

16. Pintail (*Anas acuta*) (Fig. 1.16): It was found in flocks in fairly open waters. Found in large groups. The size of this bird is ± 60-65 cm. This elegant species among duck has all good qualities: it is alert, active and silent. It is a slender bird with a long neck and sharply painted tail. It has a brown head. During the day it spends a great deal of time in resting in water, mostly dozing. It stays mainly in flocks in fairly open waters. It feeds on waterweeds, crustaceans and grains. This duck breeds mainly in the month of May - July. It lays seven to twelve eggs on open marshy land.

17. Spotbill or Grey duck (*Anas poecilorhyncha*) (Fig. 1.17): It was found in small weedy place. It was mostly found in pairs or in small groups sometimes. It is 60 cm in size. It is generally gray in color due to which it is also called the Grey Duck. It has scaly light and dark brown plumes. The Spotbill is not a social duck and rarely associates with other species of ducks. Freshwater is essential for the Spotbill. It is a fast and strong flyer. It is a vegetable eater, but also feeds on frogs, worms and insects. It is a resident breeding bird and its season is form July to September. It lays six to twelve eggs. Its nest is a pad of weeds or grass lined with feathers.

18. Wigeon (*Anas Penelope*) (Fig. 1.18): It is a domestic duck, general aspect of darke grey. The chestnut head is with cream colored patch on forecrown, brownish pink breast and black tail-coverts. A large white horizontal patch on its closed wings. Its bill is small narrow and blue grey in color. In flight a broad white shoulder-patch near leading edge of wing, and the whitish 'bald' forecrown, are conspicuous. It is a mixed surface feeder, largely vegetarian. Besides up ending in shallow water for food, is often seen walking about on marshes grazing on grass shoots and aquatic weeds in the manner of goose. It is a swift and powerful flier, with a peculiar rustling sound of wings.

19. Gargeny or Blue winged Teal (*Anas querquedula*) (Fig. 1.19): It was found on the edge of water. It is a small bird, 37 cm in size. It has a pink-brown head and conspicuous broad white eyebrows. It wings and shoulders are bluish-green. This is one of the earliest migrants to India It is swift flyer. It is largely vegetarian. It is largely vegetarian. It breeds in the month of May and June. It lays six to ten eggs.

20. Shoveller (*Anas clypeata*) (Fig. 1.20): It was found in open water. It was found in congregating in flocks. It is 50 cm in size. It has a green head, a heavy spatulate beak, white breast and scapular line. Its under part is chestnut in color. It is mainly a freshwater bird, while swimming it keeps its head down, often with the bill touching the surface of the water. Its bill is for the purpose of sieving mud and muddy water from the small living organisms and aquatic weeds. The Shoveller is a weak swimmer and diver, but a strong flyer. It feeds largely on animal matters. It breeding season is from of April and June. It lays seven to sixteen eggs in a pond of grass on marshy land.

21. Red Creasted Pochard (*Netta rufina*) (Fig. 1.21): It was found swimming away in water. It was found in small groups. It is 50 cm in size. It is a very pretty duck. It has a reddish orange head, crimson bill, glossy black underparts, white wing-bars and a white shoulder patch. The wings of the Red Creasted Pochard are short and beat in quick succession, a heavy spatulate beak, white breast and scapular line. It's under part is chestnut in color. It is does not believe in traveling in formation like other ducks, but flies in a mass. On its normal flying routine it is slow to rise from the water, but once it gains height, it becomes strong and flies straight. It feeds on insects and on the roots of water plants. Breeds in Southern Palaeartic Region.

22. Common Pochard (*Aythya ferina*) (Fig. 1.22): It was found in open waters. It was found in large flocks. It was seen just like Domestic Duck. The tip and base of the bill is black. Head and neck is chestnut-red. Rump and tail coverts black. One of the commonest diving ducks. Seen in large flocks. Commonly winter visitor. Omnivorous but largely vegetarian.

23. Tufted Pochard (*Aythya fuligula*) (Fig. 1.23): It is a domestic duck, about same as Gadwall. It was found in the reservoir. It is black and white plumage of the drake. In flight a broad white band along trailing edge of wing in both sexes. Feeds in deep water by diving, hence often seen on open expanses in the middle of the lake. It mainly feeds on molluscs, crustaceans, water insects, also water wees, etc.

24. Barheaded Goose (*Anser indicus*) (Fig. 1.24): It is a grey, brownish and white goose, with white head and sides of neck, and two distinct broad black bars across nape. It congregates in large gaggles when grazing in young gram fields or when resting during the daytime on sandbanks in the middle of large

rivers. It is usually excessively wary and difficult to circumvent. Skeins flight in V formation or in straight ribbons over a wide front to and from their feeding grounds. It chiefly feeds on green shoots of winter crops such as wheat of gram. It gives a musical *aang, aang.* It breeds in April to June. Its nest is a depression in lush herbage bordering the high altitude lakes, thickly lined with down and feathers. It lays 3 or 4 ivory white eggs.

25. Common Pariah Kite (*Milvus migrans*) (Fig. 1.25): It was found near the open waters. It is 65 cm in size. It is much large than other kites. It is brown in color, with the head and the back of the neck being paler. The sides of the wings are darker in color. It has a forked tail by which one can easily identify it. Usually found in the neighborhood of human habitation. Offal and garbage, earthworms, mice, lizards, etc. It breeds between September and April. It lays two to four eggs. It builds its nest on a tree on the top of a building.

26. Shikra (*Accipiter badius*) (Fig. 1.26): It was found sitting on a tree waiting for its prey. It is small in size (33 cm). It is gray above and rusty below, with whitish bars. It has fierce-looking orange eyes and a beak livid at the base and bluish black at the top. The cere and legs are yellow and the claws black. It avoids dense forests and can be sighted soaring high up in the sky. It feeds on lizards, frogs, and small birds like sparrow. It breeds in the month of April, May and June. It lays three to five eggs in a nest made of twigs, built on a tree.

27. Marsh Harrier (*Circus aeruginosus*) (Fig. 1.27): Male harrier is dark brown with pale rufous head, neck and breast, dark rufous in below. Its tail and wings are silvery grey with black tipped. Female is dark chocolate brown with creamy buff cap on head and buff at leading edge of wing at shoulder. It flies leisurely a few meters above the marsh vegetation occasionally droppings to seize its prey. Unlike other harriers it spends considerable time sitting on the ground or soaring aloft with wings held in a wide V above the body. It feeds on frogs, fish, small birds, mammals and carrion & snakes.

28. Osprey (*Pandion haliaetus*) (Fig. 1.28): It is a dark brown hawk with a brown and white head and white under parts. Across the upper breast is a broad brown band or necklace which is diagnostic both when the bird is at rest and on the wing. It is a fish eating hawk. It flies up and down over the water scanning the surface for any fish coming up within striking depth. Occasionally hovers like a kestrel to investigate more closely with legs dangling below in readiness.

At a suitable opportunity the bird closes its wings and hurls itself upon the quarry, striking the water with a great splash and often becoming completely submerged. It gives a seldom heard in its winter quarters; described as a clear *kai, kai, kai.* It breeds in April to June.

29. White Backed Vulture (*Gyps bengalensis*) (Fig. 1.29): It is a heavy dirty blackish brown vulture with scrawny, naked head and neck. In during flight a whitish band stretching along underside of wings, broken in the middle by the brown body also helps its identification. Sub adults birds are brown, without white back and easily confused with long billed vulture (Gyps indicus) species. It collects animal carcasses with astonishing promptness and demolishes them with incredible speed. It breeds in October to March. It lays a singleton, white occasionally speckled and spotted with reddish brown.

30. Red Headed Merlin (*Falco chicquera*) (Fig. 1.30): It is an elegant little falcon, bluish grey above, white below closely barred with balckish on abdomen and flanks. In flight the narrow white edging to end of tail, preceded by a broad black band are useful clues. The conspicuous chestnut head is diagnostic. Male and female frequently hunt in concert, one driving and heading off the quarry while the other pursues and strikes it down. Flight is straight and swift gained by rapid and regular wing beats as in sparrow hawk. It feeds on small birds, rats, mice, lizards and insects, occasionally also bats. It gives a high-pitched squeal. Principally it breeds in January to May. Its nest is fairly well-made cup or platform of twigs lines with grass and roots, up in a tree or a top a building. Usually old twig nests to other birds. It lays 3 or 4 pale reddish white thickly speckled with reddish brown.

31. Grey Partridge (*Francolinus pondicerianus*) (Fig. 1.31): It is about 60 cm in size. It is a plump sub tailed grayish brown game bird with chestnut blotching above and fine wavy black and buff vermiculations, and chestnet tail. Its throat is rufous-biff circumscribed by a broken blackish line. It coveys scratch the ground or cattle dung for food, grain, seeds, termites, beetle larvae etc. Largely terrestrial, but roosts in babul and similar trees. Its flight is swift and 'gamey' consisting of a few rapid beats of the rounded wings, followed by a short glide. Usually it trusts to its legs for escape, being a very fast runner. It gives a ringing high pitched musical *kateetar, kattetar* or *pateela, pateela* quickly repeated. The female has a less challenging *pela, pela, pela,* etc.

Practically it breeds through a year. Its nest is a grass lined scrape in scrub jungle, ploughed field of grass land. It lays 4 to 8 cream colored or café au lait eggs.

32. Common Peafowl (*Pavo cristatus*) (Fig. 1.32): It is the gorgeous ocellated tail of the adult cock of 1 to 1.5 m long, is in reality the abnormally lengthened upper tail-coverts. Hen is also crested like cock, but smaller mottled brown with some metallic green on lower neck, and lacking the ornamental train. It is polygamous, usually parties of one cock with 4 or 5 hens, but seasonally of the sexes separately. It is always excessively shy and alert. It slinks away through the undergrowth of its legs, and flies only when suddenly come upon or to cross a ravine or open river bed. It roosts at night in large trees. It feeds on grain, vegetable shoots, insects, lizards and snakes. It gives a loud harsh, screaming may-awe, and short gasping shrieks *ka ann* repeated rapidly 6 to 8 times with a puming action of head and neck. It breeds in January to October. Its nest is a shallow scrape in the ground in a dense thicket, lined with sticks and leaves. It lays 3 to 5, glossy pale cream eggs or café-au-lait in color.

33. White breasted Waterhen (*Amaurornis phoenicurus*) (Fig. 1.33): It was found in single or pairs. It is much similar to partridge. It is a familiar slaty gray sub-tailed long-legged marsh bird with prominent white face and breast. Affects moist ground overgrown with tangles of bushes, ordinarily shy and silent, but exceedingly noisy during the rainy season when it breeds. It feeds on insects, worms, grain and shoots of paddy and marsh plants. It breeds in rainy season form June to October. It lays six to seven cream or pinkish eggs.

34. Purple Moorhen (*Porphyrio porphyrio*) (Fig. 1.34): It was found in beside the reservoir water while searching for food. It was found in small groups. It is purplish blue in color, with a bright red heavy bill. The legs and toes are long and red. It has a white patch under the tail. This white patch moves up and down with every step the bird takes. It seldom flies and is mostly seen bobbing or walking on its toes on floating vegetation in small groups. It feeds on insects, shoots, etc. It breeds from June to September. It lays three to seven eggs in a nest made up of interwoven reeds and other vegetaion on any floating object.

35. Coot (*Fulica atra*) (Fig. 1.35): It is found while swimming in the lake. It is found in large groups (20-30).It is 40 cm in length. It is much like a duck

when it is in water. It is more aquatic in nature than the rest of the family. It is blackish gray in color, with a very prominent white shield on its forehead. Its bill is white, with the shield coming and joining it. The legs of the coot are greenish. Skitters along the water to take off, half running half flying. It feeds on grass, aquatic weeds and insects, etc. Breeds practically all year around, but found here all the year. It lays three to four eggs.

36. Redwattled Lapwing (*Vanellus indicus*) (Fig. 1.36): It is found while swimming in the lake. It is found in large groups (20-30). This bird is brown above and white below. Its head and neck up to the breast are black. There is a flashy, red-colored wattle in front of each eye and a white bond running from behind the eyes to the underparts. Its bill is red and legs bright yellow. It avoids deserts and dense forests and can be spotted in open cultivated lands and grazing areas. Never perches on trees but flies well. It calls on both on the ground and during flight. It feeds on insects, grubs, etc. It breeds form March to April. It lays four eggs. On bare ground.

37. Littleringed Plover (*Charadrius dubius*) (Fig. 1.37): It was found in mud flats. It was found in single or some tine in small parties. This Plover is 15 cm in size. It has black band on the head and breast. This band is divided by a white ring round the neck. The birds upper parts are brown and the under carriage white. The bill is black and the legs yellow. Essentially a bird of mudflats, scattered parties run about in short spurts with a swift mincing gait. It feeds mainly on insects, tiny crabs, etc. It breeds from March to May. It lays four eggs.

38. Blacktailed Godwit (*Limosa limosa*) (Fig. 1.38): It is variegated brown and white wader very like the Hhimbrel or Curlew in general effect, but with a slender, straight, slightly upcurved bill. In flight the broad black band across end of white tail, and a white band along the trailing edge of the wings are diagnostic points. In summer its plumage, sometimes acquired before parties or large flocks on tidal mudflats. It is similar to those of Curlew and Whimbrel. It keeps to marshes of both fresh and brackish water, often in large close-packed flocks and in association with other waders. It feeds on worms, molluscs, crabs, and insects. Godwits are excellent for the table, and this combined with their swift flight and ever watchful alertness makes them good sporting birds, eagerly sought by sportsmen.

39. Common Sandpiper (*Tringa hypoleucos*) (Fig. 1.39): It is grayish olive brown in above, white in below with pale dusky breast and a few dark streaks on fore neck. In flight the brown rump and tail distinguish it from the spotted sandpiper. Also a prominent wing bar is usually present. It never collect in flocks, but a few scattered examples sometimes seen together as when driven up the seashore rocks by the rising tide. It gives uttering a shrill piping *tee-tee-tee*. Besides this flushing note has a pretty, long-drawn till *wheeit, wheeit,* repeated several times when the bird is perfectly undisturbed. It feeds on insects, worms, molluscs, etc. It breeds in May to June. Its nest is a slight depression sparsely lined with leaves and rubbish, on a shingle bank or islet at midstream. It lays 4 eggs, yellowish buff or stone-color, blotched and speckled with reddish brown, with phantom marks of lavender or pinkish grey.

40. Wood Sandpiper (*Tringa glareola*) (Fig. 1.40): It is about 36 cm in size. It is a snipe like wader, sepia brown above indistinctly spotted with white. Its lower back and rump are white. Its breast is pale brownish. It has whitish stripe above eye from bill to nape. In flight the white rump and barred brown and white tail diagnostic. It is one of the commonest and also most gregarious of the group of little wading birds found near inland waters and at marshes, flooded paddy fields and tidal mudflats, popularly and collectively known as 'snippets'. They run along on the squelchy mud picking up tit-bits, or probe with their bills for food; insects larvae, worms and molluscs, wagging the tail end of the body ridiculously up and down. It breeds in May to June. Its nest is a scantily lined depression on a dry patch in marshy grass-covered localities.

41. Ruff and Reeve (*Philomachus pugnax*) (Fig. 1.41): It is a rather dumpy grayish brown wader with bold scaly patterned upper plumage and relatively short sandpiper like bill. In flight a narrow white wing-band and whitish patches on either side at base of tail, suggestive clues. In summer plumage, sometimes it partially acquired before emigration. Ruff is extremely variable with much black, white, purple, chestnut, and buff in it, and with a peculiar ruff and ear tufts. Mostly found in flocks on marshes and tidal mudflats. It is a good sporting bird. Ruff best known for its promiscuous breeding habits and its fantastic communal sparring tournaments or courtship displays. Ready to breed, females visit the hills from time to time and mate with the Ruff of their choice. He takes no part in the nesting choice.

42. Great Thick-knee *(Esacus magnirostris)* (Fig. 1.42): The Great Stone-curlew or Great thick-knee is a large wader which is a resident breeder in tropical southern Asia from India, Pakistan, Sri Lanka into South-east Asia. This species prefers gravel banks along rivers or large lakes, and also beaches. A single egg is laid in a bare scrape on the open shingle.

It is mainly nocturnal or crepuscular like other stone-curlews, but can frequently be seen foraging during the day, moving slowly and deliberately, with occasional short runs. It tends to be wary and flies off into the distance ahead of the observer, employing powerful, rather stiff wingbeats.

The Great thick-knee is a large wader at 49–55 cm, and has a massive 7 cm upturned bill. It has unstreaked grey-brown upperparts and breast, with rest of the underparts whitish. The face has a striking black and white pattern, and the bill is black with a yellow base. The eyes are bright yellow and the legs a duller greenish-yellow.

In flight, the Great thick-knee shows black and white flight feathers on the upperwing, and a mainly white underwing. Sexes are similar, but young birds are slightly paler than adults.

The call is a wailing whistle, given mainly at night, as with other birds in this family. The Great Thick-knee eats crabs, large insects, and other animal prey.

43. Demoiselle Crane (*Anthropoides virgo*) (Fig. 1.43): It is a dainty little grey crane with black head and neck. Feathers of its lower neck are long and lanceolate and falling over breast. It is one of our most prominent and well known winter migrants. Flocks rest on sandbanks in reservoir during the midday heat, or soar in circles at great heights. It is a fine sporting bird, exceedingly wary and difficult to circumvent and eagerly sought by sportsman. Cranes are flying in broad V formation, neck and legs fully extended. It gives a loud, musical high pitched trumpet to far-reaching quality. The din of a great concourse of *koonj* taking off the ground with their *kur, kurr* calls uttered in varying keys, has been aptly likened to the distant roaring of the sea. Besides shoots and grain it feeds on insects and small reptiles. It lays 2 eggs; yellowish grey blotched with reddish brown and grey.

44. Avocet (*Recurvirostra avosetta*) (Fig. 1.44): It is an elegant black and white marsh bird with long bare bluish legs. Its chief diagnostic feature is the slender black upcurved bill. It was found in pairs parties, at marshes and on tidal

mudflats, etc. It runs about actively on squelchy ground and wades into shallow water for food. The partially webbed toes enable it also to swim with ease. In feeding the curiously upturned bill is wielded rather like a hockey stick, the curved part skimming the semi liquid mud with a back and fore rotatory or churning motion, washing out the food particle; small crustacean, worms, aquatic insects etc. It gives a clear loud high-pitched *kleet* repeated quickly, usually on the wing. It lays 4 eggs, closely resembling those of both the stilt and the Redwattled Lapwing in shape, color and markings.

45. Blackwinged Stilt (*Himantopus himantopus*) (Fig. 1.45): It was found in sandy surface. This bird was found in small groups. This is about 37 cm in size. It is a slender, black and white bird with a straight, long bill and long and red legs. The stilt, with its long bill and legs, is able to move freely in deep water to find food. Also swims well. Flight weak and flapping with neck extended and long red legs trailing key and the tail. A weak flier. Generally, avoid flying. It feeds on worms, aquatic insects. It breeds from April to August. It lays three to four eggs on a raised platform.

46. Small Pranticole or Swallow Plover (*Glareola lactea*) (Fig. 1.46): It is a sandy grey riverside bird with pointed swallow like wings and squarish tail. It's under parts are rufous-tinged sooty brown, belly white and black band from eye to bill. When flying overhead the whitish under parts are black wing lining and short black tipped white tail are leading pointers. Normally it feeds on insects. It gives a gecko like *tuck-tuck-tuck;* a soft *tiririt, tiririt, tiririt,* etc when a flock is disturbed and flying about agitatedly. It breeds in February to April its nest is shallow scrape in a dry sandy riverbed. It lays 2 or 3 eggs, pale sandy grey spotted and blotched with some shade of brown, admirably camouflaged. Both sexes incubate and tend the young.

47. Brown Headed Gull (*Larus ichthyaetus*) (Fig. 1.47): It is a domestic duck. It is largest among the gulls. Bill is yellow with a bright red patch at angle. In winter, head is white with brown streaks, turns black by February. Immature birds are mottled pale brown with almost white head. It is usually solitary. Occasionally in small flocks. It feeds on fish and crustaceans. It gives a loud raucous *kraa-a* like that of a raven's rarely heard it its winter quarters.

48. Gull Billed Tern (*Gelochelidon nilotica*) (Fig. 1.48): It is a common grey and white tern with deep forked white tail and stout gull like black bill. Its

black bill and black legs distinguish it from all other terns. Its head is white, streaked with black and a black patch round eye and above ear coverts in winter. In summer its head and up to nape is jet black. It is gregarious but usually seen singly or in small flocks, quartering the mudflats to scoop up tidbits. It affects coastal mudflats, creeks, etc. It feeds on crabs, prawns, insects, etc. It gives a scolding high-pitched *hik, hik, hik.* It breeds in April to June. Its nest is a slight depression in the sand lined with debris. Its nest is mixed in colonies. It lays 2 or 3 eggs, pale yellow or greenish the stone blotched with purple, red, blackish brown. Both sexes share parental duties.

49. Caspian Tern (*Hydroprogne caspia*) (Fig. 1.49): It is our largest tern, recognized also by its very large size, stout coral-red bill and black legs and feet. In winter plumage head largely white, streaked on crown with black. It is chiefly winter visitor, not very different from other terns. Usually found in twos or threes in company with other species. Sometimes alights on water like a gull, but normally rests on ground. It feeds on fish, prawns, swimming crabs, etc captured by plunging from air. It gives a loud raucous call *krake-kra.* It breeds in May to June. It lays 2 or 3 eggs, pale yellowish to dark grayish stone color, blotched with blackish and grey. Both sexes incubate.

50. River Tern (*Sterna aurantia*) (Fig. 1.50): This was found in the periphery of the lake. A slender, graceful, grey and white tern with long deeply forked shallow tail. It flies a few feet above the ater with deliberate beats of the long, slender, pointed wings intently scanning the surface for fish venturing within striking depth. It breeds mainly between March to May. It lays 3 greenish grey eggs.

51. Lesserpied Kingfisher (*Ceryle rudis*) (Fig. 1.51): It was found on trees. It was found single or in pairs. The House Swift is 15 cm in size. It has black and white plumage, which is speckled and barred. The bird has a sharp black bill and black legs. Hovering over, it spots its kill and then with a sudden dive, comes up with a fish in its bill. It feeds on fish, frogs and aquatic insects. It breeds from October to May. It lays 5 to 6 eggs.

52. Samll blue Kingfisher (Alcedo atthis) (Fig. 1.52): It was found in the periphery of the lake. The bird is 18 cm in size. Its plumage brilliant blue and green above and chestnut colored below. The under part of the ear is chestnut red, and the chin and neck white. The bill is black, with a tinge of orangish-red

at the lower base. The legs are a dull red. It is mainly a freshwater bird. Its normal method of hunting is to drop bill foremost upon its quarry from an overhanging perch. It feeds on small fish, tadpoles and aquatic insects. It breeds from March to June. It lays 5 to 6 eggs.

53. White breasted Kingfisher (*Halcyon smyrnensis*) (Fig. 1.53): It was found in periphery of the reservoir. It was found in singular. This bird is 30 cm in size. Its head, neck and underparts are brown. The upper plumage is brownish and greenish blue. As the name indicates, it has a white breast, which can be seen during its flight, and a dull red bill. Most familiar of our kingfishers and also the least dependent upon water. It feeds on fish, insects and frogs. It breeds from March to July. It lays 4 to 7 eggs.

54. Green bee-eater (*Merops oreintailis*) (Fig. 1.54): It was found in periphery of the reservoir. It was found in small flocks. This bird is 22 cm in size. It is green in color, with a few brown head and neck. Sometimes shiny blue can also be seen. The bill is slender, slightly curved, and black. These birds avoid forests and wet conditions. Roosting on trees in the company of other bird. It is a social bird, found in flocks. It is good and graceful flyers. It feeds on insects and bees. It breeds from February to March. It lays 4 to 7 eggs.

55. Blue Jay Roller (*Coracias benghalensis*) (Fig. 1.55): It is a stiking Oxford-and-Cambridge-blue bird, with biggish head, heavy black bill, rufous-brown breast, and pale blue abdomen and under tail. The dark and pale blue portions of the wings show up as brilliant bands in flight. Form a lookout on a telegraph wire or other point of vantage it pounces upon some large insect, frog or lizard on the ground, returning with it either to the same perch or flying leisurely across to another nearby. It highly beneficial to the agriculture since it destroys vast quantities of injurious insects. It has a variety of loud raucous croaks and chuckles. It breeds chiefly March to July. Its nest is a collection of straw, rags and rubbish in a natural tree hallow at moderate heights; sometimes in a hole in wall of building. It lays 4 or 5 eggs, glossy white, roundish ovals.

56. Hoopoe (*Upupa epops*) (Fig. 1.56): It was found on ground in periphery of the reservoir. It was found in singular or in pairs. This bird is 30 cm in size. Fawn plumage and black and white marketing's on its back, wings and tail. It has a fan-shaped crest on the head and a long curved bill. It can be seen walking and digging on the ground. It is probing in to the soil for food with bill. Partly

opens like forceps when digging, the crest is folded back and projects in point behind the head. It feeds on insects, grubs and pupae; hence is beneficial to agriculture. It breeds from February to May. It lays 5 to 6, white eggs.

57. Grey Horn Bill (*Tockus birostris*) (Fig. 1.57): It is a clumsy brownish grey bird with an enormous black and white curved bill surmounted by a peculiar protuberance or casque and long graduated tail. In female the casuqe is smaller. It is in small parties, in lightly-wooded country with groves of ancient trees. It is commonly met with among fig-laden banyan and peepul trees along roadsides or near villages, feeding in company with green pigeons and other frugivorous birds, or flying across from one tree to another in follow-my-leader fashion. Flight is typical of the hornbills, labored, undulating and noisy – a few rapid wing strokes followed by a dipping glide with the primaries upturned. It feeds mainly on fruits but also large insects lizards, young mice etc. It gives a loud, cackling *k-k-k-kae* and a variety of squealing and chattering conversational notes. It breeds principally in March to June. It lays 2 or 3 eggs, dull glossless and white in colour.

58. Crimson breasted barbet (*Megalaima haemacephala*) (Fig. 1.58): It was found on trees surrounding the Jaikwadi reservoir. This is a small bird (15 cm in size). It is a stocky little greenish bird. It has a crimson breast and forehead, a yellow throat, greenish parts under streaked with yellowish color. It has got a heavy blackish billy with moustaches. It has coral red legs and black claws. It loves fruit. The bird flight direction is straight It is fully at ease when doing a marathon flight or flying short distances form tree to tree. It feeds on fruits, berries and figs of the peepul and banyan tress. It breeds from January to June. It lays 3 eggs in a dug out hole in a softwood tree.

59. Smallsky Lark (*Alauda gulgula*) (Fig. 1.59): It is sparrow-like lark, broad dark streaks in the fulvous of the upper plumage. Its breast is fulvous narrowly streaked with blackish brown on breast. It resembles the pipit generally in having the outer most tail-feathers largely white. It feeds on ground on seeds and insects. It has a peculiar fluttering flight. The song, delivered on the wing, is the skylarks chief claim to distinction. From the ground the bird springs almost vertically upwards on fluttering wings; rising higher and higher till it becomes a speck in the sky. There it remains more or less stationary on rapidly vibrating wings and pours forth a deluge of spirited, melodious

warbling, often for over 10 minutes at a stretch. It breeds mainly in February to July. Its nest is a cup like depression in the ground, or a hoof-print, lined with grass under shelter of a cold or grass tussock. It lays 2 or 4 eggs, pale brownish grey or whitish, spotted and streaked with brown.

60. Crested Lark (*Galerida cristata*) (Fig. 1.60): It is the larger size and prominent pointed crest distinguish it from most other larks. It runs about in search of food: grass seeds, small beetles and other insects, etc. It gives a normal call note a pleasant *tee-ur*. A short, pleasant song uttered during the display flight which consists of soaring a few meters up on leisurely fluttering wings. It breeds in the month of March to June. It nest is a shallow cup of grass, lined with hair, etc. It lays 3 or 4 eggs, dull yellowish white, blotched with brown and purple. Both sexes share in building the nest and tending the young. Female is alone believed to incubate.

61. Dusk Crag Martin (*Hirundo Confolor skyes*) (Fig. 1.61): It was found in the periphery of the reservoir. It is a small bird, 13 cm in size. With a brown or dark sooty brown plumage. It has rows of white spots on its tail. It has a brown, weak, flat bill. It has a close relation of the swallows. It keeps calling 'chit-chit, chit-chit' even during flight. It feeds on insects. It breeding season is from June to October. It lays 2 to 3 eggs, in a nest made of mud.

62. Wire tailed Swallow (*Hirundo smithii*) (Fig. 1.62): It is glossy steel blue in above, with a chestnut cap. It readily distinguished from other swallow by its glistening white under parts and two long, fine wires in the tail. It is typical of the swallows, but is more confined to the neighborhood of water. It's seldom encountered away from streams, tanks, reservoirs, etc. or in large flocks. It utters a lively chit-chit while hawking midges over a jheel or ploughed field. Male has a pretty tittering song in breeding season. Principally it breeds in March to September. It lays 3 to 5 eggs, like those of the common swallow. Both sexes share in building nest and feeding the young.

63. Baybacked shrike (*Lanius yittatus*) (Fig. 1.63): It was found in the periphery of the reservoir. It is a small bird, 17 cm in length. It has a white head with a broad band across the forehead running across the eyes. It is chestnut-maroon at the black and white below and has a black and white sharply marked tail. It avoids pure desert area as well as humid forest. It feeds on locusts, insects and lizards. It breeding season is from April to September. It lays 4 eggs.

64. Golden Oriole (*Oriolus oriolus*) (Fig. 1.64): It was found on trees near the reservoir. It is a medium sized bird, 25 cm in size. It has a brilliant golden yellow wings and a black tail. It has a dark-pink bill with a black streak through the birds head covering the eyes. The bird is shy by nature and is on arboreal species. It has strong dipping flight. It feeds on berries, figs of the banyan and peepul trees, fruits and also on insects. It breeding season is from April to July. It lays 2 to 3 eggs in a woven nest.

65. Black Drongo (*Dicrurus adsimilis*) (Fig. 1.65): It was found on a tree surrounding the lake. It is 30 cm in size. It is a glossy black color with a long forked tail. The tail's feature is its shape, which is like a fish tail. The bird is seen very often in cultivated lands. One finds it swooping around for insects and grasshoppers, which are its main food. It feeds on insects, flower nectars also occasionally small birds. It breeds from April to August. It lays 3 to 5 eggs, in a nest, which is made on a large tree.

66. Rosy Pastor (*Sturnus roseus*) (Fig. 1.66): It is a rose pink myna like bird with glistening black head, neck and upper breast, wings and tail. It is a long, recumbent, pointed crest on crown and nape, sometimes erected. Young birds and adults in winter plumage are duller and browner. It is one of the earliest winter visitors. It was found in small flocks or 'clouds' of up to 500 or more individuals keep in the vicinity of cultivation, particularly *jowari,* and do considerable damage to ripening grain crops. They destroy locusts on a large scale and to that extent are beneficial to agriculture. The birds do useful service in cross pollinating these. It breeds in May to June.

67. Red Vented Bulbul (*Pycnontus cafer*) (Fig. 1.67): It was found in the periphery of the reservoir. It was found in pairs. It is 20 cm in size. A perky smoke-brown bird with partially creasted black head, scale-like marketings on breast and black a conspicuous crimson patch below root of tail, and a white rump, the last particularly noticeable in flight. Large numbers collect to feed on banyan and peepul figs and winged termite swarms. Its pugnacity makes it a favourite with fanciers as a fighting bird, and large stakes are wagered on bulbul fights. It breeds from February to May.It lays 2 or 3 pinkish white eggs.

68. Ashy Wren-Warbler (*Prinia socialis*) (Fig. 1.68): It was found at the periphery of the reservoir. It was found in pairs. It is 13 cm in size. Ashy slate above, fulvous white below. The loose, longish, graduated, black and white

tipped tail is carried partially erect and constantly shaken up and down. Frequents shrubbery in gardens. Hops about quietly amongst bushes, shaking its tail loosely up and down. It feeds mainly on insects. It breeds from March to September. It lays 3 or 4, glossy brick red eggs.

69. Whitrethroat (*Sylvia curruca*) (Fig. 1.69): It is earthy brown in above, whitish below, purer white on the throat. The darker, greyer cap on the head contrasting with brown back and sharply cut off from the throat serves to accentuate the latter's whiteness. It is similar in general to those of the Orphean Wrabler. It creeps or flits restlessly amongst tangles of twigs and foliage in search of caterpillars and insects. In common with leaf and tree warblers has an amusing trick, while hunting, of lunging out at an insect just out of reach of the bill and nearly toppling over in the attempt. It also feeds regularly on the nectar of *Capparis* flowers. It gives a subdued *tek…tek* like the low clicking of one's tongue against the palate, utterd very few seconds.

70. Tailor bird (*Orthotomus sutorius*) (Fig. 1.70): It was found in the periphery of the reservoir. It was found in single or sometimes in pairs. It is a small bird 13cm in size. It is green above with a rufous cap on the head, and white below. The tail is long and pointed, and held erect over the back. Tailor birds are mostly seen locally and do not migrate from place to place. It feeds on insects and nectar. It breeds from April to September. It lays 3 to 4 eggs in a cup shaped nest.

71. Pied Bush Chat (*Saxicola caprata*) (Fig. 1.71): It was found in the periphery of the wetland. It was found in single or sometimes in pairs. It is 13cm in size. It is black bird with white patches on its rump, abdomen and wings. The female is earthy-brown, with a pale rust rump. It is mostly seen perched on grasses and bushes to pick up insects and ants. At intervals the bird flies down to the ground to feed. It feeds on insects and ants. It breeds from February to May. It lays 3 to 5 eggs.

72. Indian Robin (*Saxicoloides fulicata*) (Fig. 1.72): It is found in the periphery of reservoir. It is a small bird 16 cm in size. It is a glossy black bird with a very prominent white patch on its wings. It has a rusty red plumage below the base of the tail, which is always erect. The female is ash-brown in color. Familiar and confiding. It feeds on insects, insect eggs and spiders. It breeds from April to June. It lays two to three eggs.

73. Indian tree Pipit, (*Anthus hodgsoni*) (Fig. 1.73): The Indian tree Pipit, *Anthus hodgsoni*, is a small bird of the pipit (*Anthus*) genus, the size is sparrow (ca. 15cm) Appearance: Greenish brown streaked with darker brown above. Supercilium, double wingbar and outer rectrices whitish. Whitish to buff below streaked with dark brown on breast and flanks. Sexes alike Habits: Seen singly or pairs. Runs about on the ground in search of food and flies up into trees when disturbed. Flight jerky and undulating. Call: Song lark-like and uttered on the wing, similar to the Tree Pipit, but faster and higher pitched. A single *tseep* or *spek*, Food: Insects, grass and weed seeds.Food: Largely insects, but will also take seeds.

74. Black Headed Yellow Wagtail (*Motacilla flava melanogrisea*) (Fig. 1.74): It is found in the periphery of reservoir. It is 18 cm in size. This Wagtail is yellowish bird with an olive-greeinish coloring above and yellow below. The head of the bird is black. Running in a marshy area with its tail bobbing up and down. The bobbing is a continuous process except when the bird is in flight. Once ready to take to its wings, it does a 'vertical take off' from the ground. It feeds on insects, and flies.

75. Grey Wagtail (*Motacilla cinerea*) (Fig. 1.75): It was found in the periphery of the reservoir. It is 17 cm in size. It is slim long tailed bird chiefly grey and yellow running about singly on ground near rocky streams and trickles in wooded country and forest glades. Runs about briskly in spurts chasing tiny insects, turning and twisting with agility in their pursuit and often springing up into the air to capture winged ones. The breeding season of this bird is from May to July. It lays 4 to 6, yellowish grey or greenish eggs. Both parents tend the young.

76. White Wagtail (*Motacilla alba*) (Fig. 1.76): In non breeding or winter plumage the black bib is much reduced or wanting, the chin and throat being white like the underparts. IT is winter visitor. It runs about swiftly, wagging tail incessantly up and down, to pick up tiny insects on ploughed fields, fallow land, golf links, maidans and lawns even in the midst of populous towns. It roosts at night in large mixed gatherings with other wagtails and swallows in reed-beds, sungrace fields and leafy trees. It breeds in May to July. It lays 4 to 6, white, freckled and spotted with reddish brown.

77. Large pied Wagtail (*Motacilla maderaspatensis*) (Fig. 1.77): It is found in the periphery of reservoir. It is found in pairs near the water. It is a big Wagtail 21 cm in size. A large Wagtail of black and white plumage, resembling in pattern that of the familiar Robin, but with a prominent white eye brow. In the female the black portions are duller and browner. It is usually tame and confiding. It affects clear, shingly or rocky smooth-running streams with diminutive grass-covered islets here and there. It feeds on insects, and flies. It breeds from March to September. It lays three to four eggs.

78. Purple Rumped Sunbird (*Nectarinia zeylonica*) (Fig. 1.78): Its underparts and breast glistening metallic crimson, green and purple and lower parts are yellow. Rumps are metallic and bluish purple. Breeding and non breeding plumages are alike. Female is similar to that of purple sunbird, but with chin grayish white and rest of lower parts brighter yellow. In quest of nectar it is responsible for cross pollinating numerous species to flowers, one of great economic harmfulness being the pernicious tree parasite *Dendrophthoe*. Its breeding season is not well defined. Its nest is an oblong pouch of soft grasses, rubbish and cobwebs, draped with pieces of bark, woody refuse and caterpillars' droppings, with a projecting portico above the lateral entrance hole. It lays 2 eggs, white with a ring of reddish spots. Female alone builds and incubates; male helps to feed the young.

79. Purple Sunbird (*Nectarinia zeylonica*) (Fig. 1.79): It is found in the periphery of the reservoir. This bird is 10 cm in size. At a distance bird looks all black. Male in non-breeding plumage like female-brown to olive brown above, pale dull yellow below –but with darker wings and a broad black stripe running down middle of breast. It feeds particularly upon insects and spiders and very largely flower nectar. This bird breeds between March to May. It lays 2 or 3 eggs.

80. White eye (*Zosterops palpebrosa*) (Fig. 1.80): It is found in the periphery of reservoir. It is found mostly in flocks or more than ten birds. It is very small 10 cm in size. It is greenish yellow, with a touch of bright yellow above and white below. It has a white ring around its eyes and a pointed bill. The white eye is a slightly less active bird as it purely arboreal. It feeds mainly insects on trees. It breeds from April to July. It lays two to three eggs.

81. House sparrow (*Passer domesticus*) (Fig. 1.81): It is found in the periphery resident buildings. It is found mostly in flocks or more than ten birds. It is also a small bird, 15 cm in size. The House Sparrow has an ashy grey head. Its upper plumage is a chestnut colour streaked with black. Its cheeks and the rest of the lower plumage is white. The chin to upper breast is black. The female is ashy grey brown with streaks of black and rufous above and ash white below. Non-breeding birds have favorite community roosts in leafy trees, where large numbers foregather with much noisy every evening. Sometimes collect in enormous flocks and does damage to ripening crops and in market and gardens. It is omnivorous, feeding on insects, grain, fruit buds, flowers, nectar, kitchen scrap etc. It breeds throughout the year. It lays three to five, pale greenish white, with stippled and blotched with brown eggs.

82. Baya Weaver Bird (*Ploceus philippinus*) (Fig. 1.82): It is found in the periphery of reservoir. It is found in flocks. It is a small bird, 15 cm in size. Breeding male has bright yellow crown and upper parts dark brown streaked with yellow. Stout conical bill and Short Square cut tail. Occasionally damages ripening crops. Roosts in enormous number in reed- beds bordering the lake. It feeds mainly on insects and nectars. It breeds from May to September. It lays two to four eggs, in hanging nest.

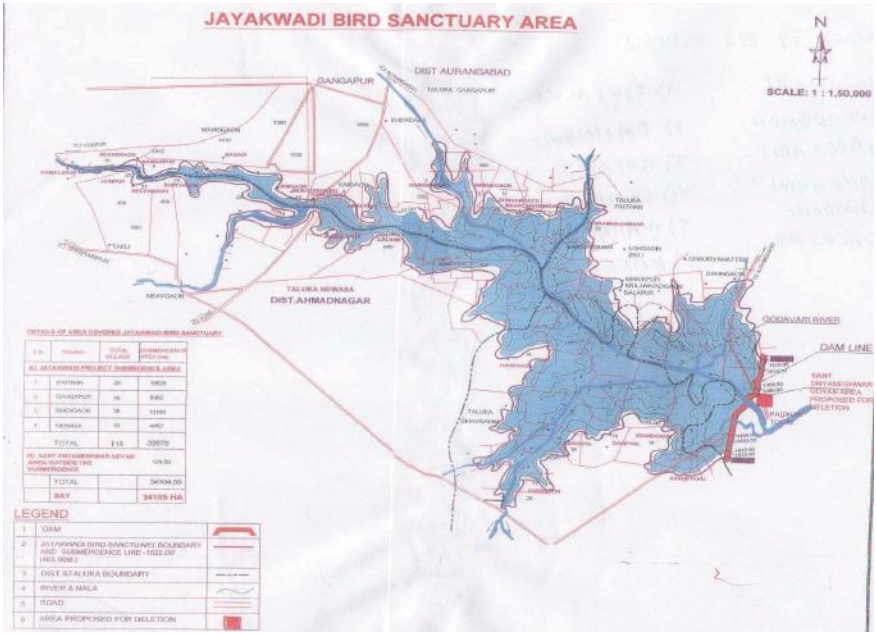
83. Creasted Buntings (*Melophus lathami*) (Fig. 1.83): It is found in the periphery of reservoir. It is found either in singly or pairs. It is 15 cm in size. The male Buting is black bird, with chestnut wings and tail. It has a conspicuous pointed crest. The female is dark brown with cinnamon-colored wings and tail. The bird also has a crest. It is flying up in to bushes when disturbed. They feed on, and at times destroy, the ripening crops. They can be pests for farmers. It feeds mainly on grass seeds and grains on the ground. It breeds form April to August. It lays three to four eggs.

The monthly occurrence of birds at Sation S1, S2 & S3 for the both years of the study period (2010-2011 and 2011-2012) was observed in **Table 1.2.** The occurrence of birds at all the sites was more in November, December, January, and February early summer month i.e. in March for both the years where as it was found low at all the stations in May, June, July August and September of the both years.

The use of different habitats by the different species/ families of the birds was open water, water edge, rocks, midstream, backwater, meadows, scrubland and woodland. The birds are using one or more types of habitats for their roosting, resting, feeding and nesting and accordingly now the birds are also classified **Table 1.3** during the study period.

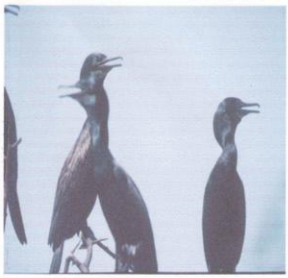
The observation was also made on food and feeding behaviour of the birds from the study area and their breeding period in **Table 1.4** for residential and non-residential birds.

Map of Jayakwadi Bird Sanctuary Area:



Bird fauna from station Nandur-Madhemeshwar reservoir (S1), Kaigaon Toka (S2) and Jaikwadi reservoir (S3) Fig. No. 1.1 – 1.83

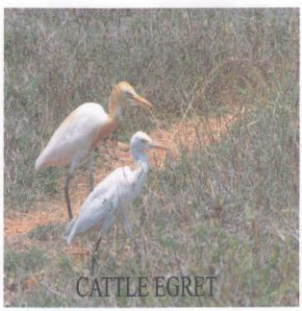
1.1.Little Grebe (Tachybaptus ruficollis)



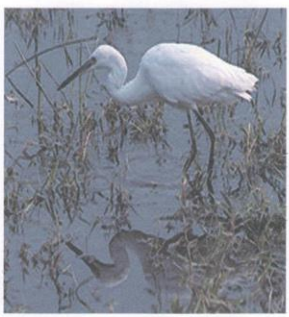
1.2.little Cormorant (phalacrocorax niger)

1.3.Grey Heron (Ardea cinerea)

1.4.Indian Pond Heron (Ardeola grayii)

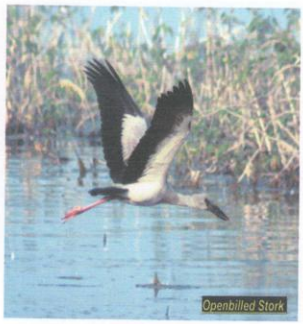


1.5.Cattle Egret (Bubulcus ibis)



1.6.Little Egret (Egretta garzetta)

1.7. Night Heron (Nycticorax nycticorax)



1.8.Asian Openbill (Anastomus oscitans)

1.9.Woolly-necked Stork (Ciconia episcopus)

1.10.White Ibis (Threskiornis aethiopica)

1.11. Balck Ibis (Pseudibis papillosa)

1.12.Glossy Ibis (Plegadis fulcinellus)

1.13 Spoon-bill (Platalea leucorodia)

1. 14. Flamingo (Phoenicopterus roseus)

1.15. Ruddy Shelduck or Brahminy duck (Tadorna ferruginea)

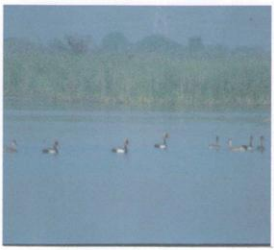
1.16. Pintail (Anas acuta):

1.17. Spotbill or Grey duck (Anas poecilorhyncha)

1.18. Wigeon (Anas Penelope)

1.19. Gargeny or Blue winged Teal (Anas querquedula)

1.20. Shoveller (Anas clypeata)

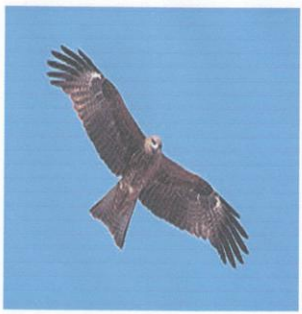


1.21. Red Creasted Pochard (Netta rufina)

1.22. Common Pochard (Aythya ferina):

1.23. Tufted Pochard (Aythya fuligula

1.24. Barheaded Goose (Anser indicus)

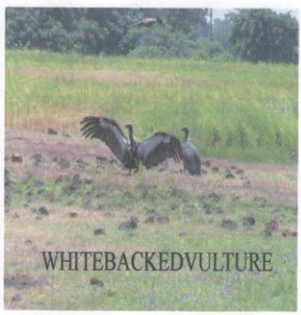


1.25. Common Pariah Kite
(Milvus migrans)

1.26. Shikra (Accipiter badius)

1.27. Marsh Harrier (Circus aeruginosus)

1.28. Osprey (Pandion haliaetus)



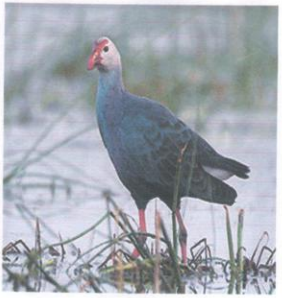
1.29. White Backed Vulture (Gyps bengalensis)

1.30. Red Headed Merlin
(Falco chicquera)

1.31. Grey Partridge (Francolinus pondicerianus)

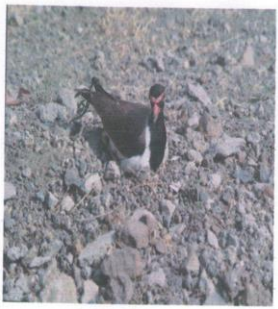
1.32. Common Peafowl (Pavo cristatus)

1.33. White breasted Waterhen
(Amaurornis phoenicurus)

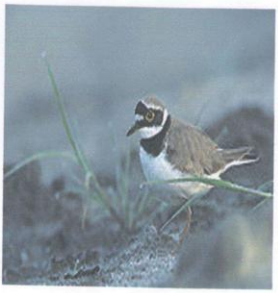


1.34. Purple Moorhen (Porphyrio porphyrio)

1.35. Coot (Fulica atra)



1.36. Redwattled Lapwing (Vanellus indicus)



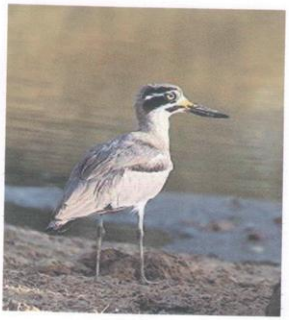
1.37. Littleringed Plover (Charadrius dubius)

1.38. Blacktailed Godwit (Limosa limosa)

1.39. Common Sandpiper (Tringa hypoleucos)

1.40. Wood Sandpiper (Tringa nebularia)

1.41. Ruff and Reeve (Philomachus pugnax)



1.42. Great Thick-knee (*Esacus recurvirostris*)

1. 43. Demoiselle Crane (Anthropoides virgo)

1.44. Avocet (Recurvirostra avosetta)

1.45.Blackwinged Stilt (Himantopus himantopus)

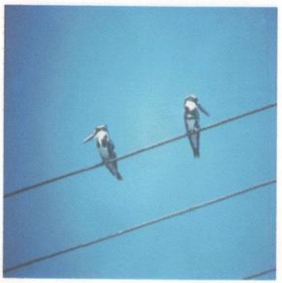
1.46. Small Pranticole or Swallow Plover (Glareola lactea)

1.47. Brown Headed Gull (Larus ichthyaetus)

1.48. Gull Billed Tern (Gelochelidon nilotica)

1.49. Caspian Tern (Hydroprogne caspia)

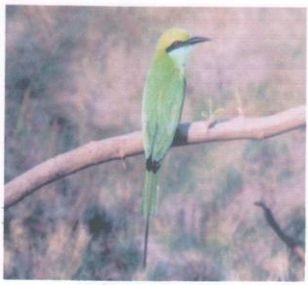
1.50. River Tern (Sterna aurantia)

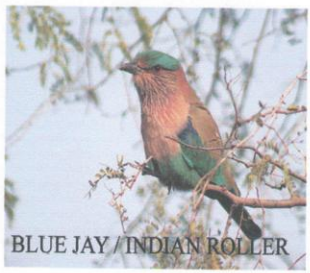


1.51. Lesserpied Kingfisher (Ceryle rudis)

1.52 Small blue Kingfisher (Alceko-atthis)

1.53. White breasted Kingfisher (Halcyon smyrnensis)





1.54. Green bee-eater (Merops oreintailis) **1.55. Blue Jay or Roller** (Coracias benghalensis)

1.56. Hoopoe (Upupa epops)

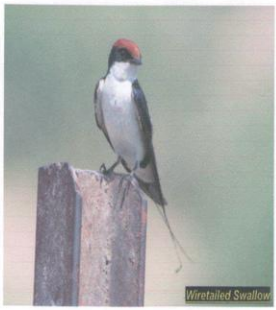
1.57. Grey Horn Bill (Tockus birostris)

1.58. Crimson breasted barbet (Megalaima haemacephala)

1.59. Smallsky Lark (Alauda gulgula)

1.60. Crested Lark (Galerida cristata)

1.61. Dusk Crag Martin
(Hirundo Confolor skyes)



1.62. Wire tailed Swallow (Hirundo smithii)

1.63. Baybacked shrike (Lanius uittatus)

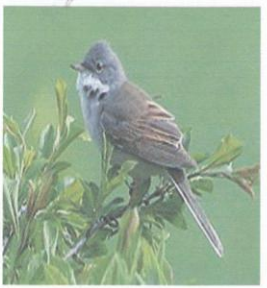
1.64. Golden Oriole (Oriolus oriolus)

1.65. Black Drongo (Dicrurus adsimilis)

1.66. Rosy Pastor (Sturnus roseus)

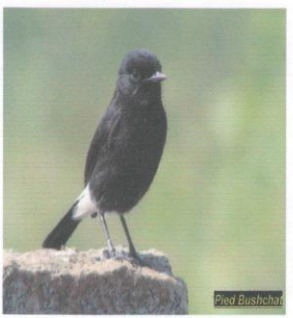
1.67. Red Vented Bulbul (Pycnontus cafer)

1.68. Ashy Wren-Warbler (Prinia socialis)



1.69. Whitrethroat (Sylvia curruca)

1.70. Tailor bird (Orthotomus sutorius)



1.71.Pied Bush Chat (Saxicola caprata)

1.72. Indian Robin (Saxicoloides fulicata)

1.73. IndianTree Pipit (Anthus hodgsoni)

1.74. Black headed Yellow Wagtail (Motacilla-melangrisea)

1.75.Grey Wagtail (Motacilla cinerea)

1.76. White Wagtail (Motacilla alba)

1.77. Large pied Wagtail (Motacilla maderaspatensis)

1.78. Purple Rumped Sunbird (Nectarinia zeylonica)

1.79. Purple Sunbird (Nectarinia asitica)

1.80. White eye (Zosterops palpebrosa)

1.81. House sparrow (Passer domesticus)

1.82. Baya Weaver Bird (Ploceus philippinus)

1.83. Creasted Buntings (Melophus lathami)

Table No. 1.1 Check list of the Birds observed during 2010- 2011 & 2011-2012 at Station S1, S2 and S3.

No Sr.	Common Name	Zoological Name
1	2	3
	GREBE (PODICIPEDIDAE)	
1	Little Grebe	Tachy baptus-ruficollis
	CORMORANTS (PHALACROCOPACIDAE)	
2	Little cormorant	Pholacrocorax –niger
	HERONS AND EGRET (ARDEIDAE)	
3	Grey-Heron	Ardea-cinerea
4	Pond-Heron	Ardeola-grayii
5	Cattle-Egret	Bubulcus-ibis
6	Little-Egret	Egretta-garzetta
7	Night-heron	Nycticorax-nycticorax
	STORKS (CICONIIDAE)	
8	Asian Open billed-stork	Anastomus-oscitans
9	White-necked-stork	Ciconia-episcopus
	IBIS / SPOONBILLS (THRESKIORNITHIDAE)	
10	White-Ibis	Threskiornis-aethiopica
11	Black-Ibis	Pseudibis-papillosa
12	Glossy-ibis	Plegadis-falcinellus
13	Spoon-bill	Platalea-leucorodia
	FLAMINGO (PHOENICOPTERIDAE)	
14	Flamingo	Phoenicopterus-roseus
	DUCKS/ GEESE (ANATIDAE)	
15	Brahminy Duck	Tadorna-ferruginea
16	Pintail	Anas-actua
17	Spot-bill	Anas-poecilorhyncha
18	Wigeon	Anas-penelope
19	Garganey	Anas- querquedula
20	Shoveller	Anas-clypeata
21	Red crested-Pochard	Netta-rufina

22	Common-pochard	Aythya-ferina
23	Tufted-duck	Aythya-fuligula
24	Barheaded-Goose	Anser-indicus
	BIRDS OF PREY (ACCIPITRADAE)	
25	Common-pariah-kite	Milvus-migrans
26	Shikra	Accipiter-badius
27	Marsh -Harrier	Circus- aeruginosus
28	Osprey	Pandion-haliaetus
29	Indian white backed vulture	Gyps-bengalensis
	FALCONS (FALCONDIAE)	
30	Red-headed merlin	Falco-chicquera
	PARTRIDGES AND QUAILLS (PHASIANIDAE)	
31	Grey-partridge	Francolinus-pondicerianus
32	Common peafowl	Pavo- cristatus
	MOORHEN/ COOT (RALLIDAE)	
33	White breasted water hen	Amauronis-phoenicurus
34	Purple moorhen	Porphyrio- porphyrio
35	Coot	Fulica- atra
	SNIPE, PLOVER, SANDPIPER (CHARADRIIDAE)	
36	Red wattled Lapwing	Vanellus-indicus
37	Little Ringed-plover	Charadrius-dubius
38	Black tailed Godwit	Limosa-limosa
39	Common sand piper	Tringa-hypoleucos
40	Wood or spotted sand piper	Tringa-glareola
41	Ruff & Reeve	Philomachus-pugnax
	CURLEWS (BURHIVIDA)	
42	Great stone plover (Thick knee)	Esacus - magnirostris
	CRANES (GRUIDAE)	
43	Demoiselle-crane	Anthropoides-virgo
	STILT (RECURVISROSTRIDAE)	
44	Avocet	Recurvirostra- avosetta
45	Black winged stilt	Himantopus-himantopus
	COURSER (GLAREOLIDAE)	
46	Small Indian pratincole	Glareola-lactea

	GULLS -TERNS (LARIDAE)	
47	Brown Headed gull	Larus-brunnicephalus
48	Gull billed tern	Gelochelidon-nilotica
49	Caspian-tern	Hydroprogne-caspia
50	Indian-River tern	Sterna-aurantia
	KINGFISHERS(ALCEDINIDAE)	
51	Pied king fisher	Ceryle-rudis
52	Small Blue king fisher	Alcedo-atthis
53	White breasted kingfisher	Halcyon-smyrnensis
	BEE-EATERS (MEROPIDAE)	
54	Small Green bee eater	Merops-orientalis
	ROLLER (CORACIIDAE	
55	Roller or Blue jay	Coracias-beghalensis
	HOOPOE (UPUPIDAE)	
56	Hoopoe	Upupa-epops
	HORN BILLS (BUCEROTIDAE)	
57	Common Grey Hornbill	Tockus-birostris
	BARBETS (CAPITONIDAE)	
58	Crimson breasted Barbet (Copper smith)	Megalaima-haemacephala
	LARKS (ALAUDIDAE)	
59	Small Sky lark	Alauda-gulgula
60	Creasted lark	Galerida-cirstata
	SWALLOWS (HIRUNDINIDAE)	
61	Dusky crag martin	Hirundo-concolor
62	Wire tailed swallow	Hirundo-smithii
	SHRIKES (LANIIDAE)	
63	Bay backed shrike	Lanius-uittatus
	ORIOLES (ORIOLIDAE)	
64	Golden oriole	Oriolus- oriolus
	DRONGOS (DICRURIDA)	
65	Black drongo	Dicrurus-adsimilis
	MYNAS (STURNIDAE)	
66	Rosy pastor	Sturnus roseus
	BULBULS (PYCNONOTIDAE)	
67	Redvented bulbul	Pycnonotus cafer
	WARBLERS (SYLVIINAE)	

68	Ashy wren warbler	Prinia socialis
69	Lesser White throated	Sylvia curruca
70	Tailor bird	Orthotomus sutorius
	THRUSHES -CHATS(TURDINAE)	
71	Pied bush chat	Saxicola caprata
72	Indian robin	Saxicoloides fulicata
	PIPITS (MOTACILLIDAE)	
73	Indian tree pipit	Anthus hodgsoni
74	Black headed yellow wagtail	Motacilla melangrisea
75	Grey wagtail	Motacilla cinerea
76	White wagtail	Motacilla alba
77	Large pied wagtail	Motacilla maderas patensis
	SUNBIRDS (NECTARINIDAE)	
78	Purple rumped sun bird	Nectarinia zeylonica
79	Purple sun bird	Nectarinia asiatica
	Zosteropidae	
80	White eye	Zosterops palpebrosa
	SPARROWS /MUNIAS (PLOCEIDAE)	
81	House sparrow	Passer domesticus
82	Baya	Ploceus philippinus
	BUNTINGS (EMBERIZIDAE)	
83	Crested bunting	Melophus lathami

Table No 1.2 Month Wise Occurrence of birds at Station S1, S2 & S3. 2010-11 to 2011-12

Sr. No	Common Name	Zoological Name												
1	2	3	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	GREBE (PODICIPEDIDAE)													
1	Little Grebe	Tachybaptus-ruficollis	+	+	+	+	+	+	+	+	+	+	+	+
	CORMORANTS (PHALACROCOPACIDAE)													
2	Little cormorant	Phalacrocorax – niger	+	+	+	+	-	-	-	-	-	+	+	+
	HERONS AND EGRET (ARDEIDAE)													
3	Grey-Heron	Ardea-cinerea	+	+	+	+	+	+	+	+	+	+	+	+
4	Pond-Heron	Ardeala-grayii	+	+	+	+	+	+	+	+	+	+	+	+
5	Cattle-Egret	Bubulcus-ibis	+	+	+	+	+	+	+	+	+	+	+	+
6	Little-Egret	Egretta-garzetta	+	+	+	+	+	+	+	+	+	+	+	+
7	Night-heron	Nyctico rax-nyctic orax	+	+	-	-	-	-	+	+	+	+	+	+
	STORKS													

	(CICONIIDAE)													
8	Open billed-stork	Anastomus-oscitans	+	+	+	+	+	+	+	+	+	+	+	+
9	White-necked-stork	Ciconia-episcopus	+	+	+	+	+	+	+	+	+	+	+	+
	IBIS/ SPOONBILLS (THRESKIORNITHIDAE)													
10	White-Ibis	Threskiornis-aethiopica	+	+	+	+	-	-	-	-	-	+	+	+
11	Black-Ibis	Pseudibis-papillosa	+	+	+	+	+	+	+	+	+	+	+	+
12	Glossy-ibis	Plegadis-falcinellus	+	+	+	+	-	-	-	-	+	+	+	+
13	Spoon-bill	Platalea-leucorodia	+	+	+	+	+	-	-	-	-	-	-	-
	FLAMINGO (PHOENICOPTERIDAE)													
15	Flamingo	Phoenicopterus-roseus	+	+	+	+	-	-	-	-	-	+	+	+
	DUCKS/ GEESE (ANATIDAE)													
16	Brahminy Duck	Tadorna-ferruginea	+	+	+	+	-	-	-	-	-	+	+	+
17	Pintail	Anas-actua	+	+	+	+	-	-	-	-	-	+	+	+

18	Spot-bill	Anas-poecilorhyncha	+	+	+	+	+	+	+	+	+	+	+	+
19	Wigeon	Anas-penelope	+	+	+	-	-	-	-	-	-	+	+	+
20	Garganey	Anas-querquedula	+	+	+	-	-	-	-	-	-	+	+	+
21	Shoveller	Anas-clypeata	+	+	+	-	-	-	-	-	-	+	+	+
22	Red crested-pochard	Neta-rufina	+	+	+	-	-	-	-	-	-	+	+	+
23	Common-pochard	Aythya-ferina	+	+	+	-	-	-	-	-	-	+	+	+
24	Tufted-duck	Aythya-fuliguna	+	+	+	-	-	-	-	-	-	+	+	+
25	Barheaded-Goose	Anser-indicus	+	+	+	-	-	-	-	-	-	-	-	-
	BIRDS OF PREY (ACCIPITRADAE)													
26	Common-pariah-kite	Milvus-migrans Govinda	+	+	+	+	+	+	+	+	+	+	+	+
27	Shikra	Accipiter-badius	+	+	+	+	+	+	+	+	+	+	+	+
28	Marsh - Harrier	Circus-aeruginosus	+	+	+	+	-	-	-	-	-	-	+	+
29	Osprey	Pandion-haliaetus	+	+	+	-	-	-	-	-	-	-	+	+
30	Indian white	Gyps-benga	+	+	+	+	+	+	+	+	+	+	+	+

	backed vulture	lensis												
	FALCONS (FALCONDIAE)													
31	Red-headed merlin	Falco - chicquera	+	+	+	+	-	-	-	-	+	+	+	+
	PARTRIDGES AND QUAILLS (PHASIANIDAE)													
32	Grey-partridge	Francolinus - pondicerianus	+	+	+	+	+	+	+	+	+	+	+	+
33	Common peafowl	Pavo-cristatus	+	+	+	+	+	+	+	+	+	+	+	+
	MOORHEN/ COOT (RALLIDAE)													
34	White breasted water hen	Amauronis-phoenicurus	+	+	+	+	+	+	+	+	+	+	+	+
35	Purple moorhen	Porphyrio-porphyrio	+	+	+	+	+	+	+	+	+	+	+	+
36	Coot	Fulica - atra	+	+	+	+	+	+	+	+	+	+	+	+
	SNIPE, PLOVER, SANDPIPER (CHARADRIIDAE)													
37	Red wattled Lapwing	Vanellus-indicus	+	+	+	+	+	+	+	+	+	+	+	+

38	Little Ringed-plover	Charadrius-dubius	+	+	+	-	-	-	-	-	-	+	+	+
39	Black tailed Godwit	Limosa-limosa	+	+	+	-	-	-	-	-	-	+	+	+
40	Common sand piper	Tringa-hypoleucos	+	+	+	+	-	-	-	-	-	+	+	+
41	Wood or spotted sand piper	Tringa-glareola	+	+	+	+	-	-	-	-	-	+	+	+
42	Ruff & Reeve	Philomachus-pugnax	+	+	+	-	-	-	-	-	-	+	+	+
	CURLEWS (BURHIVIDA)													
43	Great stone plover (Thick knee)	Esacus - magnirostris	+	+	+	+	+	+	+	+	+	+	+	+
	CRANES (GRUIDAE)													
44	Demoiselle-crane	Anthropoides-virgo	+	+	+	-	-	-	-	-	-	+	+	+
	STILT (RECURVISROSTRIDAE)													
45	Avocet	Recurvirostra-avosetta	+	+	+	-	-	-	-	-	-	-	+	+
46	Black winged stilt	Himantopus-himantopus	+	+	+	-	-	-	-	-	+	+	+	+
	COURS													

	ER (GLAREOLIDAE)													
47	Small Indian pratincole	Glareola-lactea	+	+	+	-	-	-	-	-	-	+	+	+
	GULLS-TERNS (LARIDAE)													
48	Brown Headed gull	Larus-brunnicephalus	+	+	+	-	-	-	-	-	-	+	+	+
49	Gull billed tern	Gelochelidon-nilotica	+	+	+	-	-	-	-	-	-	+	+	+
50	Caspian-tern	Hydroprogne-caspia	+	+	+	-	-	-	-	-	-	-	+	+
51	Indian-River tern	Sterna-aurantia	+	+	+	+	+	+	+	+	+	+	+	+
	KINGFISHERS(ALCEDINIDAE)													
52	Pied king fisher	Ceryle-rudis	+	+	+	+	+	+	+	+	+	+	+	+
53	Small Blue king fisher	Alcedo-atthis	+	+	+	+	+	+	+	+	+	+	+	+
54	White breasted king fisher	Halcyon-smyrensis	+	+	+	+	+	+	+	+	+	+	+	+
	BEE-EATERS (MEROPIDAE)													
55	Small Green bee eater	Merops-orient	+	+	+	+	+	+	+	+	+	+	+	+

		alis												
	ROLLER (CORACIIDAE													
56	Indian Roller	Coracias-begha lensis	+	+	+	+	+	+	+	+	+	+	+	+
	HOOPOE (UPUPIDAE)													
57	Hoopoe	Upupa-epops	+	+	+	+	+	+	+	+	+	+	+	+
	HORNBILLS (BUCEROTIDAE)													
58	Common Grey Hornbill	Tockus-birostris	+	+	+	+	+	+	+	+	+	+	+	+
	BARBETS (CAPITONIDAE)													
59	Crimson breasted Barbet (Coppersmith)	Megalaima-haemacephala	+	+	+	+	+	+	+	+	+	+	+	+
	LARKS (ALAUDIDAE)													
60	Small Sky lark	Alauda-gulgula	+	+	+	+	+	+	+	+	+	+	+	+
61	Creasted lark	Galerida-daya	+	+	+	+	+	+	+	+	+	+	+	+
	SWALLOWS (HIRUNDINIDAE)													
62	Dusky crag martin	Hirundo-conco	+	+	+	+	+	+	+	+	+	+	+	+

		lor												
63	Wire tailed swallow	Hirundo-smithii	+	+	+	+	-	-	-	-	-	-	+	+
	SHRIKES (LANIIDAE)													
64	Bay backed shrike	Lanius-vittatus	+	+	+	+	+	+	+	+	+	+	+	+
	ORIOLES (ORIOLIDAE)													
65	Golden oriole	Oriolus-oriolus	+	+	+	+	+	+	+	+	+	+	+	+
	DRONGOS (DICRURIDA)													
66	Black drongo	Dicrurus-adsimilis	+	+	+	+	+	+	+	+	+	+	+	+
	MYNAS (STURNIDAE)													
67	Rosy pastor	Sturnus roseus	+	+	+	-	-	-	-	-	-	+	+	+
	BULBULS (PYCNONOTIDAE)													
68	Redvented bulbul	Pycnonotus cafer	+	+	+	+	+	+	+	+	+	+	+	+
	WARBLERS (SYLVIINAE)													
69	Ashy wren warbler	Prinia socialis	+	+	+	+	+	+	+	+	+	+	+	+
70	White throated warbler	Sylvia comm	+	+	+	+	-	-	-	-	-	+	+	+

		unsis												
71	Tailor bird	Orthotomus sutorius	+	+	+	+	+	+	+	+	+	+	+	+
	THRUSHES - CHATS(TURDINAE)													
72	Pied bush chat	Saxicola caprata	+	+	+	+	+	+	+	+	+	+	+	+
73	Indian robin	Saxicoloides fulicata	+	+	+	+	+	+	+	+	+	+	+	+
	PIPITS (MOTACILLIDAE)													
74	Indian tree pipit	Anthus hodgsoni	+	+	+	+	+	+	+	+	+	+	+	+
75	Black headed yellow wagtail	Motacilla melangrisea	+	+	+	+	-	-	-	-		+	+	+
76	Grey wagtail	Motacilla cinerea	+	+	+	-	-	-	-	-		+	+	+
77	White wagtail	Motacilla alba	+	+	+	+	-	-	-	-	-	+	+	+
78	Large pied wagtail	Motacilla maderaspatensis	+	+	+	+	+	+	+	+	+	+	+	+
	SUNBIRDS (NECTARINIDAE)													
79	Purple rumped sun bird	Nectarinia zeylonica	+	+	+	+	+	+	+	+	+	+	+	+
80	Purple	Necta	+	+	+	+	+	+	+	+	+	+	+	+

	sun bird	rinia asiatica												
	Zosteropidae													
81	White eye	Zosterops palpebrosa	+	+	+	+	+	+	+	+	+	+	+	+
	SPARROWS /MUNIAS (PLOCEIDAE)													
82	House sparrow	Passer domesticus	+	+	+	+	+	+	+	+	+	+	+	+
83	Baya	Ploceus philippinus	+	+	+	+	+	+	+	+	+	+	+	+
	BUNTINGS (EMBERIZIDAE)													
84	Crested bunting	Melophus lathami	+	+	+	+	+	+	+	+	+	+	+	+

Table No. 1.3Classification of the birds according to Habitat-Use at Station S1, S2 & S3

F = Feeding **R = Roosting / Resting** **N = Nesting**

Sr. No	Common Name	Zoological name	HABITAT WITH VEGITATION						
1	2	3	1 Open Water Hydrilla Vallisneria Lemna Potamogeton Chara	2 Water Edge Cryptocoryne Plygonum Typha	3 Rocks Midstream Ipomoea Marselia	4 Back Water Cyanophyceae Bacillariophyceae Azolla pinnata	5 Meadows Polygonm	6 Scrub Land Acacia Lanatana	7 Woodland Bauhinia Leucaena
	GREBE (PODICIPEDIDAE)								
1	Little Grebe	Tachybaptus-ruficollis	F	FRN	-	-	-	-	-
	CORMORANTS (PHALACROCOPACIDAE)								
2	Little cormorant	Pholacrocorax – niger	F	-	RN	-	-	-	-
	HERONS AND EGRET (ARDEIDAE)								
3	Grey-Heron	Ardea-cinerea	-	F	R	F	-	RN	RN
4	Pond-Heron	Ardeala-grayii	-	RF	RF	F	F	RN	RN
5	Cattle-Egret	Bubulcus-ibis	-	F	RF	F	F	RN	RN
6	Little-Egret	Egretta-garzetta	-	F	RF	F	F	RN	RN
7	Night-heron	Nycticorax-nycticorax	-	F	-	-	F	RN	RN
	STORKS (CICONIIDAE)								

8	Open billed-stork	Anastomus-oscitans	-	RF	RF	-	-	N	N
9	White-necked-stork	Ciconia-episcopus	-	F	F	-	F	-	N
	IBIS/ SPOONBILLS (THRESKIORNITHIDAE)								
10	White-Ibis	Threskiornis-aethiopica	-	F	F	-	-	R	-
11	Black-Ibis	Pseudibis-papillosa	-	F	F	-	-	-	RN
12	Glossy-ibis	Plegadis-falcinellus	-	F	F	-	-	-	RN
13	Spoon-bill	Platalea-leucorodia	F	F	RF	F	-	-	-
	FLAMINGO (PHOENICOPTERIDAE)								
15	Flamingo	Phoenicopterus-roseus	RF	F	-	F	-	-	-
	DUCKS/ GEESE (ANATIDAE)								
16	Brahminy Duck	Tadorna-ferruginea	F	F	RF	-	-	-	-
17	Pintail	Anas-actua	F	RF	RF	-	-	-	-
18	Spot-bill	Anas-poecilorhyncha	F	RF	RF	-	-	N	-
19	Wigeon	Anas-penelope	F	RF	-	-	-	-	-
20	Garganey	Anas-querquedula	F	RF	RF	F	-	-	-
21	Shoveller	Anas-clypeata	F	RF	R	-	-	-	-
22	Red crested-pochard	Netarufina	F	-	R	F	-	-	-

23	Common-pochard	Aythya-ferina	F	F	R	F	-	-	-
24	Tufted-duck	Aythya-fuligunga	F	-	-	RF	-	-	-
25	Barheaded-Goose	Anser-indicus	F	F	R	-	-	-	-
	BIRDS OF PREY (ACCIPITRADAE)								
26	Common-pariah-kite	Milvus-migrans Govinda	-	-	RF	F	F	F	-
27	Shikra	Accipiter-badius	-	-	-	-	-	F	RFN
28	Marsh - Harrier	Circus-aerugi nosus	-	F	RF	-	F	-	-
29	Osprey	Pandion-haliaetus	F	R	RF	F	F	-	-
30	Indian white backed vulture	Gyps-bengalensis	-	F	-	-	-	F	F
	FALCONS (FALCONDIAE)								
31	Red-headed merlin	Falco-chicquera	-	-	F	-	-	F	RF
	PARTRIDGES AND QUAILLS (PHASIANIDAE)								
32	Grey-partridge	Francolinus-pondicerianus	-	-	-	-	F	F	R
33	Common peafowl	Pavo-cristatus	-	-	-	-	-	FN	R
	MOORHEN / COOT (RALLIDAE)								
34	White breasted water hen	Amauronis-phoenicurus	-	FN	RF	F	-	-	-
35	Purple moorhen	Porphyrio-porphyrio	-	FN	RF	-	-	-	-

36	Coot	Fulica-atra	F	RFN	RF	-	-	-	-
	SNIPE, PLOVER, SANDPIPER (CHARADRIIDAE)								
37	Red wattled Lapwing	Vanellus-indicus	-	RFN	RFN	F	F	F	-
38	Little Ringed-plover	Charadrius-dubius	-	F	RF	F	-	-	-
39	Black tailed Godwit	Limosa-limosa	-	F	RF	F	-	-	-
40	Common sand piper	Tringa-hypoleucos	-	F	RF	F	-	-	-
41	Wood or spotted sand piper	Tringa-glareola	-	F	RF	F	-	-	-
42	Ruff & Reeve	Philomachus-pugnax	-	F	RF	F	-	-	-
	CURLEWS (BURHIVIDA)								
43	Great stone plover (Thick knee)	Esacus-magnirostris	-	F	RF	F	-	-	-
	CRANES (GRUIDAE)								
44	Demoiselle-crane	Anthropoides-virgo	R	R	R	-	-	-	-
	STILT (RECURVIROSTRIDAE)								
45	Avocet	Recurvirostra-avosetta	F	R	-	-	-	-	-
46	Black winged stilt	Himantopus-himantopus	F	RF	RF	F	F	-	-
	COURSER (GLAREOLIDAE)								
47	Small Indian pratincole	Glareola-lactea	-	RF	R	-	-	-	-
	GULLS - TERNS								

	(LARIDAE)								
48	Brown Headed gull	Larus-brunni cephal us	F	R	R	R	F	-	-
49	Gull billed tern	Geloch elidon-nilotic a	F	-	RF	-	-	-	-
50	Caspian-tern	Hydro progne -caspia	F	-	RF	-	-	-	-
51	Indian-River tern	Sterna-auranti a	F	-	RF	-	-	-	-
	KINGFISH ERS(ALCE DINIDAE)								
52	Pied king fisher	Ceryle -rudis	F	RF	R	-	-	-	-
53	Small Blue king fisher	Alcedo -atthis	F	RF	RF	F	F	-	-
54	White breasted king fisher	Halcyo n-smyre nsis	-	RF	RF	F	F	F	R
	BEE-EATERS (MEROPID AE)								
55	Small Green bee eater	Merop s-orienta lis	-	-	-	-	-	F	F
	ROLLER (CORACIID AE								
56	Indian Roller	Coraci as-beghal ensis	-	-	-	-	-	F	RF
	HOOPOE (UPUPIDAE)								
57	Hoopoe	Upupa -epops	-	-	-	-	F	F	RF
	HORN BILLS (BUCEROT IDAE)								
58	Common Grey Hornbill	Tocku s-birostri s	-	-	-	-	-	-	F
	BARBETS (CAPITON IDAE)								
59	Crimson breasted Barbet (Copper smith)	Megalai ma-haemac ephala	-	-	-	-	-	-	F

	LARKS (ALAUDIDAE)								
60	Small Sky lark	Alauda-gulgula	-	FN	-	-	-	F	-
61	Creasted lark	Galerida-daya	-	F	-	-	-	F	-
	SWALLOWS (HIRUNDINIDAE)								
62	Dusky crag martin	Hirundo-concolor	-	-	-	-	-	F	F
63	Wire tailed swallow	Hirundo-smithii	F	F	F	-	-	-	-
	SHRIKES (LANIIDAE)								
64	Bay backed shrike	Lanius-vittatus	-	-	-	-	-	F	F
	ORIOLES (ORIOLIDAE)								
65	Golden oriole	Oriolus-oriolus	-	-	-	-	-	-	F
	DRONGOS (DICRURIDA)								
66	Black drongo	Dicrurus-adsimilis	-	-	-	-	-	F	F
	MYNAS (STURNIDAE)								
67	Rosy pastor	Sturnus roseus	-	-	-	-	-	RF	F
	BULBULS (PYCNONOTIDAE)								
68	Redvented bulbul	Pycnonotus cafer	-	-	F	-	-	RF	F
	WARBLERS (SYLVIINAE)								
69	Ashy wren warbler	Prinia socialis	-	-	-	-	-	RF	RFN
70	White throated warbler	Sylvia communsis	-	F	-	-	-	RF	F
71	Tailor bird	Orthotomus sutorius	-	-	-	-	-	RF	RFN
	THRUSHES - CHATS(TURDINAE)								

72	Pied bush chat	Saxicola caprata	-	-	-	-	-	F	F
73	Indian robin	Saxicoloides fulicata	-	-	-	-	-	F	F
	PIPITS (MOTACILLIDAE)								
74	Indian tree pipit	Anthus hodgsoni	-	F	RF	-	-	F	-
75	Black headed yellow wagtail	Motacilla melangrisea	-	F	F	F	F	-	-
76	Grey wagtail	Motacilla cinerea	-	-	-	F	-	F	-
77	White wagtail	Motacilla alba	-	-	-	F	F	F	-
78	Large pied wagtail	Motacilla maderas patensis	-	F	F	-	-	-	-
	SUNBIRDS (NECTARINIDAE)								
79	Purple rumped sun bird	Nectarinia zeylonica	-	-	-	-	-	FN	F
80	Purple sun bird	Nectarinia asiatica	-	-	-	-	-	FN	F
	Zosteropidae (White eyes)								
81	White eye	Zosterops palpebrosa	-	-	-	-	-	F	F
	SPARROWS /MUNIAS (PLOCEIDAE)								
82	House sparrow	Passer domesticus	-	F	F	-	-	F	F
83	Baya	Ploceus philippinus	-	-	-	F	F	F	N
	BUNTINGS (EMBERIZIDAE)								
84	Crested bunting	Melophus lathami	-	-	-	-	-	RF	-

Table No. 1.4: Feeding & Breeding behavior of the birds observed at Station S1, S2 and S3.

Sr. No.	English Name		Scientific Name	Food	Period of Breeding	Eggs/ Breeding place
1	Little Grebe	R	Tachybaptus ruficollis	Insects larvae frog	April to Oct	3/5 white
2	Little cormorant	L M	Phalacrocorax niger	Fish	July to Feb	4-5 Bluish green
3	Grey Heron	R	Ardea cinerea	Fish, Frog	July to Sept.	3-6 Deep sea green,
4	Pond Heron	R	Ardeola grayii	Fish, Frog, Crabs	May to Sep	3-5 greenish Blue
5	Cattle Egret	R	Bubulcus ibis	Insects/grassho ppers	July to Aug	3-5 Milk-blue
6	Little Egret	R	Egretta garzetta	Insect, Fish, Frog	July to Aug.	4- Pale. bluish green
7	Night heron	R	Nycticorax nycticorax	Crab, Fish etc.	April to Sep.	4-5 Pale sea green
8	Asian Openbill stork	L M	Anastomus oscitans	Fish, Frog, Crab	July to Sept.	2-4 White
9	White necked stork	R	Ciconia episcopus	Fish, Frog, Crab	All year	3-4 white ovan
10	White ibis	L M	Threskiornis aethiopica	Fish, Frog, Crab	June to Aug.	2-4 bluish
11	Black ibis	R	Pseudibis papillosa	Grain, Small reptiles, Insects etc.	March to Oct.	2-4 Pale green
12	Glossylbis	R	Plegadis falcinellus	Molluscs-crustaceas	May to July	2-3 Blue green
13	Spoon bill	R	Platalea leucorodia	Molluscs-crustaceas vegetable mater	July to Nov	4 spotted, white
14	Flamingo	M	Phoenicopterus roseus	Marshi plants worms organic ooze	April to May	Greatr Rann of Kutch
15	Ruddy shelduck	M	Tadorna ferruginea	Vegetable matter	April-June	Ladakh, Nepal, Tibet, C. Asia.
16	Pintail	M	Anas acuta	Vegetarian	May-July	Europe. N & C Asia
17	Spot bill	R	Anas Poecilorhyncha	Vegetarian	July to Sep.	6-12 greenish Blue
18	Wigeon	M	Anas Penelope	Vegetarian	May-Sept.	North region
19	Garganey	M	Anas querquedula	Vegetarian	May-Sept.	North region (North Europe to E. Siberia)
20	Shoveller	M	Anas clypeata	Animal matter	April-Sept.	N. Europe, E. Siberia
21	Red crested Pochard	M	Netta rufina	Shoots water plant	April-Oct.	Southern Palaearctic Region

22	Common Pochard	M	Avthya ferina	Vegetarian	April- Oct	Extralmital British Isles to Siberia.
23	Tufted Pochard	M	Aythya Fuligula	Water weed/insect	April-Oct	E. Europe (Asia W. & Central Siberia)
24	Bar headed goose	M	Anser indicus	Green shoots of crops	April-Oct.	Tibet, Ladakh
25	Common Pariah Kite	R	Milvus migrans	Garbage	Sept.-April	2-4 Pinkish white
26	Shikra	R	Accipiter badius	Squirrels, birds	March to June	3-4 Bluish white
27	Marsh Harrier	M	Circus aeruginosus	Small bird, snake, frog	May- June	Extralimital
28	Osprey	M	Pandion haliaetus	Small bird, snake, frog	April- June	Europe
29	Wliite backd vulture	R	Gyps bengalenis's	Dead animal	Oct. to March	01 white
30	Red headed Merlin	R	Falco chicquera	Small birds	Jan to May	3-4 pale reddish white
31	Grey Partridge	R	Francolinus Pondicerianus	Food grain larvae	All year	4-8 cream.
32	Common Peafowl	R	Pavo cristatus	Vegetable shoot snake	Jan. to Oct.	3-5 glossy pale
33	White breasted water hen	R	Amaurornis phoenicurus	Insect worms mollucs India S. Asia	June to Oct	6-7 Cream
34	Purple moorhen	R	Porphyrio porphyrio	Shoot vegetable matter mollusks.	June to Sept.	3-7 reddish
35	Coot	R	Fulica atra	Shoot vegetable matter mollusks.	July to Aug	6-10 store
36	Red wattle Lapwing	R	Vanellus indicus	Mollugcs S. Asia	March to Aug	4 spotted brown
37	Little Ring Plover	R	Charadubius	Insect	March-May	4 greenish
38	Blacktailed Godwit	M	Limosa limosa	Worm crabs	March-Aug.	N. Europe E. Siberia to Japan
39	Common Sandpiper	M	Tringa, hyploucos	Insect	May-June	4 Yellowish, Kishmer, Garhwal
40	Wood sandpipoc	M	Tringa glareola	Insect	May-June	Europe N.Asia
41	Ruff & Reeve	M	Philomachus Pugnax	Insect worm etc	April-Sept.	Temperate Europe & N. Asia
42	Great Stone Plover	R	Esacus magnirostris	Insect. Central Asia	June-July	02 Pale
43	Demoiselle	M	Anthropoides	Insects grain	April-Sept	S. Europe N. Africa

	crane		virgo	etc.		
44	Avocet	M	Recurvirostra avosetta	Insect worm etc.	April-Sept	Rann of kutch central Asia
45	Black winged stilt	M	Himantopus himantopus	Insect worm etc.	April-August.	South Asia
46	Small Pranticole Or Swallow Plovor	L M	Glareola Lactea	Insect	April-May	2-3 green spoted
47	Brown head gull	M	Larus brunnicephalus	Fish	April-Sept	Tibet ladakh
48	Gullbilled Tern.	L M	Gelochelidon nilotica	Insect	April-Sept	2-3 Purple red
49	Caspian Tern	M	Hydroprogne caspia	Fish crab prawn	April- Oct	Baluchistan
50	River Tern	R	Sterna aurantia	Insect S. India	March-May	03 greenish grey
51	Pied kingfisher	R	Ceryle rudis	Fish. Frog	Oct- May	5-6 glass white
52	Small Blue Kingfisher	R	Alcedo atthis	Small Tadpole	March-June	5-7 white
53	White breasted kingfisher	R	Halcyon smyrnensis	Fish Lizzard etc	March- July	4-7 White
54	Small green bee eater	R	Merops Orien talis	Insect	Feb-May	5-7 white
55	Blue jay Roller	R	Coracias benghalensis	Insect	March-July	4 white
56	Hoopoe	R	Upupa epops	Paupae Insect	Feb- May	5-6 White
57	Grey Horn Bill	R	Tockus birostris	Fruit/Large insect	March-June	2-3 dell white
58	Crimsonbreasted Barbet or coppersmith	R	Megalaima haemacephala	Fruits & barriers	Jan-June	03 white
59	Small sky lark	R	Alauda gulgula	Seeds	Feb-July	2-4 brownish gray
60	Crested lark	R	Galerida cirstata	Grass seed insects	May-June	3-4 yellowish white
61	Dusky crag martin	R	Hirundo concolor	Insect in air	June-Oct	2-3 white
62	Wiretailed swallow	R	Hirundo smithii	Insect in air	May-Sep.	3 to 5
63	Bay backed shrike	R	Lanius vittatus	Locusts lizard	April- Sep.	3-6 Greenish white
64	Golden Oriole	R	Oriolus oriolus	Insect Banyan fruit etc.	April-July	2-3 white
65	Black Drongo	R	Dicrurius adsimilis	Insects berries etc.	April-August	3-5 whitish
66	Rosy Pastoor	M	Sturnus roseus	Locusts lantana	April-Sept	C. Asia, E. Europe
67	Redvented Bulbul	R	Pycnonotus cafer	Larvae & insects	Feb-May	2-3 pinkish- white

68	Ashy Wren Warbler	R	Prinia Socialis	Insects, larvae	March-Sep.	3-4 Glossy torick red
69	Lesser Whitethroat	M	Sylvia curruca	Insects Flies	April-July	E. Siberia
70	Tailor Bird	R	Orthotomus sustorius	Insects Eggs, larvae	April-Sep.	3-4 reddish
71	Pied Bush chat	R	Saxicola caprata	Insects Eggs, larvae	March-May	3 pale grey
72	Indian Robin	R	Saxicoloides fulicata	Insects Eggs, larvae	April-June	2-3 Creamy white
73	Indian tree pipit	R	Anthus hodgsoni	Insects Eggs, larvae	Feb-Oct	3-4 yellowish
74	Black headed yellow Wagtail.	L M	Motcilla melangrisea	Insects	May-Sep	Himalaya
75	Grey Wagtail	L M	Motacilla cinerea	Insect	May-Sep	Himalaya
76	White Wagtail	L M	Motacilla alba	Insect	May-Sep	Himalaya
77	Large Pied Wagtail	R	Motacilla maderaspeatensis	Insects Eggs, larvae	March-Sep.	3-4 grayish brownish
78	Parplerumped Sunbird	R	Nectarinia zeylonica	Neckter Insects	All year	2 white
79	Purple sunbird	R	Nectarinia asiatica	Neckter Insects	March-May	2 brownish white
80	White eye	R	Zosterops palpebrosa	Neckter Insects	April-May	2-3 Pale, Blue
81	House sparrow	R	Passer domesticus	Grains insects	All year	3-5 Pale green
82	Baya Weaver Bird	R	Ploceus philippinus	Grains	May-Sep.	2-4 White
83	Crested Bunting	R	Melophus lathami	Grass seed	April-August	3-4 Pale green

M - Migratory
L.M. - Local Migratory (Breeds in India)
R - Residential (Breeds in India)

Chapter-IV

DISCUSSION

On Godavari river, Jaikwadi wetland was declared as a protected area by the forest department of Maharashtra in 1986. Shallow water habituated use by number of migratory birds such as black winged stilts and Garganeys together with residence birds were thus protected. The banks of the Jaikwadi stony, unplanned with grass and thorn once scrub attracted by yellow wagtails. While the deciduous forest that occupies most of the flat land attracts arboreal birds such as Golden oriole, Coppersmith, Flowerspeckers , and even Green Pigeons that were not found in this reservoir before. Gole, (1984).

Thus, by bringing about a change in the habituated structure at a particular place the composition of birds species was also changed. This is neighter "conscious management" nor does it have any scientific basis. One should mention of target species that the proposal want to protect. Intend to propose usually desired protection to a particular place with all the species that use the habitats existing at that place. Such place may be a wetland or woodland or a combination of the two. No conscious management, except maintenance of the status quo, be desired. However, the maintenance of the status quo does involve management as the balance of existing habitats is likely to change by extraneous forces beyond the control of the manager.

The study area has different types of characteristics like depth water spread, open water, water weed. Shallow water etc. which is favorable sites for wintering migratory birds. The bird indicates the states of wetland and the cormorants are very important intermediate, their presence for e.g. link in food web and a factor which facilitate the dislocation of matter between aquatic and terrestrial ecosystems. These birds could be positive indicator of lakes threatened by eutorophication, because nutrients (N.P.) are excluded from aquatic food chains. However, the concentration of bird's excreta on small area of colony may cause disturbance in soil sorption capacity and nutrients leading back to aquatic ecosystem.

The 83 species that more commonly occurred are taken for consideration. The reserve area consists of a stretch of Godavari river near Paithan and Shavagaon city. Birds start congregating there every October and remain there

in number till the water rises during the rainy season and the usual shallow water habitat gets disturbed.

The following bird habitats are available for birds in this reserve.

Sr. No.	Name of Habitat	Dominant Plant Community
1.	Open water	Hydrilla verticillate, Lemna gibba, Ceratophylum demersum, Vallisneria spirallis, Potamogeton crispum and P. incicu.
2.	Water Edges	Cryptocoryne retrospirallis, Cyperus Pangorei, Polygonum glabrum and typha angustata
3.	Midstream rocks & Islands	Ipomoea sp. Portulata oleracea, Marselia Rorripa indica.
4.	Backwaters and pools in rocks	Rotulla tennui
1.	Meadows, wet & dry	Polygonum glabrum, cynodon dactylon, Alternanthrea sessilis
6.	Grass & Scrub	Lantana Camera, Acacia Arabica
7.	Woodland	Erythrina sp. Cassia sp. Dalbergia sisoo, Leucaena leucocephala.

However, the reservoir is well known for the numbers of migrants it attracts in winter. These include ducks (*Garganey*, *Pintail* and *Common Teal*) Waders (*Black winged stilts, Sand-pipers* and *Ruff* and *Reeve* etc.), Birds of prey terns, wagtails etc. Ducks and wader visits the reserve from October to March. A number of resident birds also use the above habitats for feeding and resting or

roosting. Species that breed here are however, few viz *Little Brown Dove, Indian Robin* and *Ashy Wren Werbler*, and *Little Grebe*.

The population of bird was observed to be maximum i.e. from 81-83 at all the stations during October, November, December, 2010-11 to 2011-12 and January (83), February (83) and March (82) 2010-11 to 2011-12. The habitat wise bird population was observed at S1, S2 & S3 on the basis of feeding, roosting and nesting period. This situation may be considered as typical of all the wetland reserves that have been proposed in recent years. A list of 83 birds occurring at this place was observed. There have been some changes in this status of certain species over the year (**Table No. 1.1**). The list and the types of habitats available will make obvious two broad management objectives. To improve the quality of habitats so as to attract greater numbers of migrate birds, and to induce more resident birds to stay and breed in the reserve.

However, the reserve being very close to the city, certain factors which are beyond the control of the managers impinge and have to be considered. These are:

1. Human use: The reservoir is used by people for bathing, washing cloths and utensils and for fishing as a commercial activity. Birds appear to be used to the presence of the people. Though hunting and trapping are no major threats, a certain amount of grazing by cattle, sheep and goats, is also carried on. However, this has not materially altered the character of any habitat.
2. Quality of reservoir water and the level: The quality of water depends on the quantity of sewage and other factors; like chemical fertilizer and pesticide used by the farmers around the reservoir. The water level depends on the quantity of the water that receives from the reservoir upstream.
3. In recent years prospus and Ipomia has rapidly spread along the entire the periphery of the reservoir.

It may now be worthwhile to classify birds according to life forms. This will bring into focus species that use the same habitats for feeding and reproduction and indicate the diverse species that will be affected if a particular habitats interfear with. However, reproduction being not an important activity in the reserve at present, resting and/or roosting is considered in its place. A number of migrant birds spend the night in the reserve itself these include some ducks, *Black-winged stilts*, waders, terns etc. Waders like *Godwit, Prantincole*,

and *Ruff* forged on the sandflat. Waders showed a significant dependence of Polycheates, hermit crabs etc.

The *Flamingos* are naturally seen feeding and roosting in this region during winter and summer season. Flamingo obtains their food from crustaceans to blue green algae to diatoms. The physicochemical properties of water and soil show significant growth multiplication and diversity of the algae during summer season. Hence, the *Flamingo* population indicates the change in the seasonal availability of food.

The *Lapwing* and Stone plovers are common resident bird at all stations. The water is essential for breeding and rearing of the chicks of these birds. The population of chicks and juveniles of stone plover decreases due to which catering of the wild vegetation, filling of water body, and change in land use of wetland etc. Hence it is clear that in near future, there is possibility of vanishing the species of these birds.

In the present study month wise occurrence of the birds at station S1, S2 & S3 during the study period was varied from 47 (June) to 83 (Jan, Feb).

During the month of January, February and March the bird population was almost similar at all stations S1, S2 and S3, from April onwards its population started decreasing upto September like in April (55), May (48), June (47), July (48), August (48) and September (51) and from October to December it again increased significantly like October (76), November (81) and December (81) during both the years of study period.

The significant population of tufted pochard help in rotation of water which helps in mixing of surface O_2 to bottom side of lake, which ultimately helps in purification of water. Large number of tufted pochard plays vital role in purification of water, as they are diving ducks for their feeding purpose they go deep in to the water and come back on surface. This cycle helps in mixing the surface O_2 to the bottom side of reservoir Gole, (1984).

Cranes are locally called as a “kurkrji”, the study carried out during 2010-2011 to 2011-2012 indicate that the birds do-not arrive at the same time but their population birds up gradually by the third or fourth week of November.

The birds started arriving at the site around 9.30 am. In groups of 8:12. Their numbers reaching a peak by 12.00 am to 4.00 pm. The birds were observed standing around the water body and were noticed feeding on the seeds

of crops. They spend night around the water body and fly off for foraging on the standing crop to the near by fields around 4.00 to 6.15 am (Nimita Priyaarshee, 1996). Crane are the most endangered family of birds. Hunting, egg collection and destruction for wetland and grassland habitats have been catastrophic events for Cranes world wide (Yardi, 2011).

Waterfowl are one of the most diversified groups of wetland birds, several species of waterfowl congregate in wintering habitats in large numbers; however the mechanism of their coexistence is poorly known (Matkar, 2008 amd Yardi, 2011).

Almost all the bank of the stations has been affected by human encroachment, siltation, Social forestry, weed infestation agricultural runoff, eutrophication, over grazing, poaching besides these prevalence of over 50% illiteracy among the people of the area is shown to be one of the major factor for deterioration of the water body and subsequent decline of their flora and fauna. The pressure for land, change in land use, shortsighted development plans, uncontrolled use of chemical fertilizers and pesticides etc. are working havoc in this unique wetland system. The increasing pressures on wetland habitats and the inadequate knowledge of waterfowl distribution and ecology are concern for which a number of activities relating to waterfowl survey census, research programs and workshops are essential.

This water body has vast biotic potential of 215 taxa of algae are recorded belongs to chlorophycae -89 bacillariophyce- 79 and cynophyaceae-47, pterldophyces 2 & Agiosperm 17 were observed and 67 sp. of fishes, 83 sp. of avifuna resident and migratory have been recorded in much of the open water stretches of the dam are not infested with macrophytes Andhale, (2008).

The Jaikwadi dam water body is an important stop over point for passage migrants was declared as a bird sanctuary by the Government of Maharashtra. The wetland is home to many local and migratory birds. The system needs an action plan to conserve it's entirely rather than in patches and segments.

It is well known fact that water is universal solvent though the chemical composition of the water is combination of hydrogen and oxygen i.e. H_2O but natural water contain much more things than only oxygen and hydrogen, it is comprise of many mineral nutrient of different metal. Unicellular multicultural organism's life, phytoplankton, zooplankton, flooring plant, algae's, submerge

plant quality, lotus etc. The dissolved nutrients are provided through water to plant community and then by using sunlight as energy source plant produces the food for all the living animals on the earth. Thus, water is one of the most important natural resources for all the living organisms, since it required for their various metabolic activities. 3/4th surface of the earth is occupied by the water of this about 95% is present in ocean, 4% in the form of ice and just 1% in the form of fresh water available for metabolic activities of the living organisms. About 52% fresh water is found in lakes 38% as soil moisture 8% as atmospheric water vapor 1% in river and 1% accessible water in plants (Gayatri Prakash and Jai Prakash, 2001). Hence, stored water in the lake, reservoir and pond plays as important role in sustainability is present on the earth. The growth of life in the water depends on the nutrients and oxygen present in the water. The large number of algae and some aquatic plants serves as food for the fishes, other aquatic animals and birds found in the vicinity of the water body Andhale, (2008).

The demand for creation of bird sanctuaries has surfaced from groups and associations of birds watchers. In Maharashtra the movement gathered momentum after the inauguration of Mula-Mutha birds reserve by Dr. Salim Ali in 1977. All Maharashtra bird watcher meet which is an annual event, has recommended creation of birds sanctuaries at Mayani, about 70 k.m north of Sangli, at Jaikwadi about 50km. south of Aurangabad and at Nundur-Madh-meshwar 60 km east of Nashik all these three wetlands (irrigation reservoirs and their environs) have been declared as protected areas.

Such activities may or may not adversely affect wild birds that are found at a particular place. On the whole, however, the competition of birds species found at such place undergoes a change as a result of such actions. For example in 1977 in presence of Dr. Salim Ali a stretch of about 2 km on the banks of the Mula-Mutha in Yerawada, was declared a protected area by the forest department of Maharashtra. Shallow water habituated used by number of migratory birds such as black winged stilts, other wards and Gatganeys together with residence birds were thus protected. On their north bank of the river stony unplanned with grass and thorn once scrub attracted by yellow wagtails. However, in subsequent years there was a marked decline in the numbers of yellow wagtails as there was variety of trees planted on this plateau. A few

wagtails now use frings of tree on this plateau. While the deciduous forest that occupies most of the flat land attracts arboreal birds such as Koel, Golden Oriole, Coppersmith, Flowerspeckers, and even Green Pigeons that were not found in this reservoir before Gole, (1984).

In the Jaikwadi reservoir the level of water is crucial to the maintenance of shallow water habitats used by numbers of wader. However, demand for water for irrigation in the downstream areas increased more water is now realized from reservoirs. This action flooded and drowned many of the wet meadows used by snipes. These birds have progressively become rare in reserves. Also villagers and cities around expanded, the ungrounded sewage system become overburdened and the quantity of sewage entering the river increased. This change the water quality of sewage entering the river increased markedly. This changed the water quality attracting more scavenging birds such as black winged stilts and Gill billed terns that picked up organisms thriving in the fertilized water and driven away such birds as bronze-winge and Pheasant tailed Jaana (Gole, 1984). Moreover, the spread of ipomia is increasing year after years, reducing the open water areas used by migratory ducks such as Garganey and pintail for foraging and resting. The composition of birds and habitats is no longer remained same when the reserve was created.

Endanger is to place in danger, to expose to loss or injury, hence endangered species of birds are those which are threatened or in danger of extinction. Between A. D. 1600 and the present day 94 species of birds have become extinct on earth and more than 190 species face imminent extinction. Of these less than 25 per cent declined or died out from natural causes. Most of them were inhabitants of oceanic islands. But even on the continents some birds have vanished or are vanishing, mainly due to mans activities. In addition a number of other species are known to have disappeared in the centuries prior to recorded history. About the total bird species are threatened in the world, 79 species of birds are threatened in India alone (Reena and Abhijit, 2005).

It is interesting to note that man is surely responsible for the end of only 2 of the 9 continental species which are extinct, the passenger pigeon and Carolina parakeet and that of 88 percent of the extinction of full species have been on large and small islands, where the natural evolution rate is probably greater and the expectation of species life lower that on the continents.

In the present study period 2010-2011 and 2011-2012 at Jaikwadi bird sanctuary, according to bird international red data book (2001) the conservation status of Asian open bill strok (Anastomas oscitans) oriental white ibis is near threatened. Whereas according to wildlife (protection) Act 1972 (amended in 1993) the conservation stapes of *Asian openbill strok; Oriental white ibis, Black ibis, Yellow- wattled lapwing* and *Prawn headed gull* are included in schedule IV. The most important special Eurasian spoonbill western margin harrier and osprey are included in schedule I part III of the wildlife (protection) Act. 1972 amongst all the species Osprey has been mentioned as vulnerable species in the bird life international red data book.

Conservation status of water birds and wetland dependent birds of Nathsagar wetland.

Sr. No.	Common species Name	*Bird life international red data book (2001)	** CITES (2002)	Wildlife (protection) Act, 1972 (amended upto 1993)
I	Water Birds:			
1.	Family CICONIIDAE Asian Openbill Stork, Anastomus oscitans	Near Threatened	-	Schedule IV
	Family: THRESKIORNITHIDAE		-	-
2.	Oriental White Ibis, threskiornis Melanocephalus	-do-	-	-do-
3.	Black Ibis, Pseudibis Papillosa	-do- & Biome 1]: Restricted species (Indo-Malayan Tropical Dry Zone)	-	-do-
4.	Eurasian Spoonbill, Platalea leucorodia	-	Appendix II	Scheduler I, Part III
1.	Family CHARADRIIDAE Yellow-wattled Lapwing, Vanellus brunnicephalus	Endemic & Biome 1]: (IndoMalayan Tropical Dry Zone)	-	Schedule IV
6.	Family LARIDAE Brown-headed Gull, Larus brunnicephalus	Biome 05: (Eurasian High Montane)	-	-do-
II	Wetland Dependent Birds:		-	
7.	Western Marsh Harrier, Circus aeruginosus	-	-	Schedule I, Part III

Arun Kumar *et. al.,* (2003)

Late Dr. Salim Ali was responsible in declaring Bharatpur as a Bird sanctuary in 1956, keoladeo National park in Bharatpur district of Rajasthan is

one of the finest water fowl reserves in the world. The place was a private hunting ground of the Bharatpur Maharaja. More than 300 species of birds are found within the sanctuary area of 29 square km and the largest congregation being of migratory ducks. A particular noteworthy visitor is the Siberian crane, who's only known wintering ground in India in this national park.

According to IBA programme carried out by B.N.H.S. and Royal Society for Protection of Birds of the total 1300 species in the Indian subcontinent, nearly 69 species have been listed in birds to watch a listing of species under different perceivable threats. These 69 species constitute about 24% of the total Asian birds that are threatened. The important bird areas exercise is an effort to identify areas rich in bird species and biodiversity. It is reported that nearly 20% of total bird species are confined to just 2% of the world's geographical area and this small area contains nearly 70% of the worlds threatened birds.

Birds have been given recognition through the release of postal stamps from time to time. Postal stamps are one of the effective means to create awareness about the birds of particular region. In addition, people who pursue stamp collection as their hobby could also contribute towards creating awareness about birds, which are facing danger due to various anthropological reasons (Pandya and Daniel, 2005).

According to Malcom Coutter, (1996) there are twenty species of storks, twenty-seven ibises and six spoonbills dissipated throughout the world. The largest numbers are found in the tropics of Africa, Asia and South America. Twelve species are endangered or threatened and of these most (9) are found in Asia and three in Africa. In addition, there is concern for subspecies or populations of others species. Major threats are loss and degradation of habitat along with human disturbance, hunting and the effects of pesticides.

Among the thirteen species of birds found in India three are endangered or threatened. The Grater Adjutant stork is one of the rarest storks in the world. A population of about 400 birds persists in Assam and a smaller population persists in Southeast Asia. The endangered *Oriental White Storks*, birds of east central and northern Asia is only rarely seen in India. There is concern for other is often little census data determine short or long term trends.

Thus, from the above study it is found that the most residential birds are adjusted to stations S1, S2 & S3 for habitat. The main food for the residential

birds was insects, fishes, crabs, frogs, grasshoppers, worms and marshy plants, etc. The most of the residential as well as non-residential birds are found to be carnivorous, while species like Golden oriol, Red vented bulbul, etc. were observed as frugivores bird.

Among the migratory ducks, large congregations of Pintail, Tufted Pochard, arrived on the statons S1, S2 & S3. Tufted pochard and Common pochard were the first to arrive in late September and leave by Janaury end. Pintail and Shoveler arrived in mid-October and remained till mid February & there main food is algaes.

The lake had green water showing high levels of algae and algal blooms, which ecologically to attract and sustain large numbers of water birds. Many of the birds were observed in the evening till they retired for the night. The trees are used for roosting. Usually before roosting, the pair perch and preen are found in the thick canopy of a tree or bush. Usually the pair roost side by side on the same tree or bush or one partner of a pair roosts on a nearby tree.

The nesting period for residential birds varies from species to species. Nesting period for *Small blue Kingfisher* and *White breasted Kingfisher* is from March to July (Salim Ali, 1996). While *Little cormorant* is found to be a monsoon breeding bird. Some residential birds such as *Spotted dove, Egrets, Sparrow hawk, Lapwing, Herons,* etc. are found breeding in this area. Most of the birds had asynchronous nesting and the breeding season extended from March to September without any peak nesting period. Variability in reproductive success could proximately arise from any combination of variation in four principle factors such as clutch size, loss of eggs or nestling through predation, human interference which in turn vary with annual changes in environmental parameters such as humidity, food availability, etc. and vegetation cover.

Non-residential birds in staton S1, S2 & S3 such as, *Brahminy duck, Red Creasted Pochard, Blue winged Teal or Gargany, Wagtails, Spoonbill*, etc. have used this reservoir habitat for the resting purpose. This bird visits the lake only in winter season and leaves the habitat till February end. These birds are abundant in Tibet, Ladakh, and North Europe to east Siberia, Bangladesh, Pakistan and Srilanka and visits regularly to Jaikwadi reservoir. The population

of overall bird increases in December and declines form January as the water level recedes.

It was also found that the increase in the water scare areas and habitat edges has a direct impact on the breeding activity of the residential birds as well as on the abundance of non-residential birds.

Indian Subcontinent represents 2094 forms belonging to 1200 species of avifauna (Ripley, 1982; Ali and Ripley, 1983). This abundance and diversity of avian community obviously indicate the high ecological diversity of the country. The diverse aquatic ecosystems of India represent 417 forms (19.9%) belonging to 318 species (26.5%) and 146 genera (36.5%) of the avifauna of the sub-continent Vijayan, (1986).

A basic problem of field ecology is to determine the causes of abundance and distribution of organisms with relation to the environment. The present study is carried out to obtain some preliminary observations on the relationship between the environmental parameters and bird community in study area station S1, S2 & S3 during 2010-2011 & 2011-2012. Survey of birds and checklist has been practiced to ascertain the status of bird population in an area. The data obtained were classified and represented in the form of checklist.

The density and diversity of water birds are influenced by rainfall, temperature, humidity and cloudiness (Custer and Osborne, 1977; Goss-custard, 1985; Teylor and Tullock, 1985; and Briggs and Holmes, 1988). Rainfall has great influence on the bird population (Baylis, 1989). Water depth is reported to influence the population of migratory water birds (Sayre, 1984; Poysa, 1989 and Vijayan et.al, 1990). In the present study, availability of suitable nesting sites, dispersal pattern of the young, differential rate of fledgling, survival and changes in the environmental conditions may also influence the species as observed by Santharam and Menno (1991). Observations on the Indian river Tern indicated that they are the good breeders here as they are observed throughout the study period (Personal observation).

Chakravarthy and Tejasvi (1993) recorded a total of 59 species of water birds in freshwater tanks in Chickmagalur. Planting of trees in the watershed areas, desilting and creation of perch and nesting sites in certain tanks and maintenance of shallow water zone and share space helped to sustain water birds in and around Chickmagalur town.

The birds migration has been categorized into winter migrants, and passage migrants. Birds visiting the lake between November to February are the winter visitors. Some pass through study area during the winter are called passage migrants. Due to the huge congregation of aquatic birds in this area, special emphasis was given to collect data from the stuy area. The study gives preliminary account of the status, composition, distribution, food and feeding activities and migration pattern of the aquatic birds to know the study area ecological interrelationship between physico-chemical properties of water, silt deposit, floral and faunal composition and above all, the 'socio-economic' problems to preserve its rich biodiversity. (Kar and Sahu, 1993).

The study area stations S1, S2 & S3 are freshwater bodies with mud flats. Overall 52 residential and 31 migratory species were recorded during the study period (2010-2011 and 2011-2012). The information on the occurrence of birds in each month obtained from the census was used for seasonality analysis.

Two common species found most abundant in the lake are coot and Indian River tern. These two species are found throughout the study period. A good number of works on wetlands in relation to birds have been done in India (Sampath, 1989; Sampaht and Krishnamurthy, 1989, 1993; Vijayan, 1991; Prashant Kumar, 1993; and Yardi, 1999). In the present study the habitat of the birds in study area S1, S2 & S3 has observed as under, shore water covered with weed (*Egrets, Herons, Purple Moorhen*), Shallow Clear water (*Pintail, Shoveller, Brahminy Duck, Spotbill Duck*), Deep Water (*Coot, Common Pochard, Tufted Pochard, Redcreasted Pocahrd, Grebe*), Rocky lands (*Cormorants*, Raptor birds).

In winter, the migratory birds like the *Ruddy Shelduck, Pintail, Gargany, Shoveller, Red Creasted Pochard, Wagtails*, etc are observed in the periphery of the reservoir. Among these, migratory birds like a *Pintail* is essentially a freshwater duck and it feeds on young shoots of water plants, its head below water and long tail elevated, thus affording easy means of identification. It is usually seen in small flocks. It may be noted that *White necked stork, Black Ibis, Spoonbill* are recorded in Jaikwadi reservoir are considered to be threatened / endangered species in India (Sridhar and Srinivasa, 1992).

The *Shikra, Marsh Harrier and Osprey* are the prey birds observed in study area S1, S2 & S3 Birds of prey are defined as Raptors distinguished by their

hooked bills, distinctively keen eyes and powerful grasping claws. They are more often referred to as hawks or eagles and kites. Most raptors are very selective in determining both the type of tree and the location that nests are built. For example, *Brahminy Kites* and *Sparrow hawk* builds a large stick nest in a tall, tree, usually in an exposed position close to suitable feeding habitat (rivers, lakes). The availability and protection of trees that meet the specific requirements of individual birds for nest locations is a major factor in successful breeding and rising of young. Both these species and many other raptors and water birds also require the protection of surrounding trees for nest protection, roosting and perching of adult birds and fledglings and collection of nesting materials Stephen Debus, (1998).

Colonial Water birds are birds that are strongly sociable in their behavior in that they generally forage, roost and nest in flocks. In particular, large breeding colonies may form containing tens and hundreds of birds often with several species nesting together. These species are usually found near water or in swamps and wetlands but may also forage in open paddocks. Roosting and nesting usually occurs within or immediately adjacent to water (wetlands, swamps, damps, rivers or lakes). Locating suitable nest trees and building large stick nests is a considerable task for birds during the breeding season. The suitability of the nest location is critical to successive breeding of fledging birds. Additionally, of extreme important is the protection of adjoining vegetation for nest security, roosting and perching of adult birds and fledglings and collection of nesting materials. In particular, birds are very sensitive during the breeding season to any disturbance within close proximity to the nest tree and may abandon the nest if disturbance occurs. Trees with nests should be preserved as often these nests are utilized over many breeding season (The National Photography Index of Australian Wildlife, 1985; Stephen Debus, 1998).

The feeding grounds of Jaikwadi reservoir for birds are spread around 341.05 sq km. On irrigating the crop fields and puddiling the soil, the farm yard manure and the garbage used to get rotten and supported millions of micro organisms on which the molluscs, crustaceans, toads, frogs, fishes, water insects, earthworms, etc thrive the life and breed in the water of the transplanted crop field provides food in the ecosystem for the breeding birds.

Water birds use as an habitats, ranging from swimming pools and sewage ponds to swamps, lagoons, mudflats, estuaries, embayments and open shores, freshwater and salt lakes, floodpains and dams (Lavery, 1970b, 1971; Braithwaite, 1975; Maher, 1981; Frith, 1957a; Lane, 1987; Norman and Corrick, 1988; Marchant and Higgins, 1990; Maddock, 2000).

Most natural wetlands reflect the geomorphology, local and regional rainfall and the flow regime of the rivers that supply them. These factors vary across the continent at a wide range of temporal and spatial scales and with abiotic, physical (size, shape and depth) and chemical variables, influence the abundance and diversity of water birds (Kingsford, 1992; Halse *et al.* 1993a; Kingsford *et. al.*,1997, 1999a). Biotic factors also affect water bird population (Kingsford and Norman, 2002). Further, water bird numbers, densities and numbers of species are usually higher on natural wetlands than on large reservoirs. Habitat requirements are known broadly for many water bird species (Braithwaite, 1975; Frith, 1957a; Marchant and Higgins, 1990; Maddock, 2000). A more quantitative assessment of hypothesis about distribution of water birds, in relation to biogeographic variables (e.g. temperature, climate, wetland type and availability) is of primary importance. Studies of water bird numbers over long periods on individual or a series of wetlands have consistently shown considerable temporal and spatial variation (Briggs, 1977a; Gosper *et. al.,* 1983; Kingsford and Porter, 1994; Halse *et. al.,* 1998; Roshier *et. al.,* 2001a).

The spatial and temporal availability of wetland habitat (Roshier *et. al.,* 2001b) and available food resources are probably the most important factors determining the abundance of water birds (Roshier *et. al.,* in press). Water birds may be considered as herbivores, invertebrate feeders, piscivores or omnivores that feed on both plant and animal material (Norman and Mumford, 1982). Closely related species of water birds may use different habitats but consume the same or different prey (Carrick, 1959; Miller, 1979; Dostine and Morton, 1988). Diet requirements affect behavior and use of habitat. Thus, herbivorous water birds have to feed for extended periods (Kingsford, 1986b; Briggs, 1990) because of indigestibility of fibrous plant material (Marriot and Forbes, 1970; Dawson *et. al.,2000*). The composition and abundance of water bird communities on a wetland often reflects the availability of food (Kingsford and Porter, 1994; Mcdougall and Timms, 2001). Abundance food for water birds

usually coincides with flooding patterns or rainfall, producing wetland habitat (Maher, 1984; Briggs *et. al.,* 1985b; Crome and Carpenter, 1988; Kingsford, 1989b; Boulton and Lloyd, 1992; Puckridge *et al.,*2000). Duck, an obligatory plankton feeder, probably reflects the temporary abundance of major food taxa in temporary or permanent wetlands (Frith, 1957a; Kingsford, 1996). Where food availability is most variable, water birds need to balance the increasing risk that a particular food source may be depleted with the increased benefit of its future availability. A migratory wader changes their diet to suit differences in prey composition and availability at an international scale while for species with a continental range the availability of food varies correspondingly. Kantrud and Stewart (1977) found that permanent wetlands were used by all major breeding waterfowl species in North Dakota, but only the lesser scaup reached its maximum breeding density on these wetlands. Available data suggested that permanent wetlands showed a high degree of use by breeding birds but their importance for avian production, particularly by waterfowl, can be argued. Because of relatively constant water depth and low amount of nutrient cycling on permanent wetland, food productivity is limited. Stewart (1975) listed 11 breeding bird species considered primary indicators of the eastern mixed grass fields. Overall conditions of Jaikwadi reservoir are more favorable for birds in winter season because the lake held more food for birds due to nutrients and climatic conditions which may favors the nesting and breeding for most of the birds.

Rainfall and subsequent flooding affect timing and duration of reproductive effort and its success, among and within water bird species. Some water bird breeds after heavy rains (Lavery, 1970b; Maddock and Baxter, 1991; Mckilligan, 2001). Ducks breeds in autumn and spring with sufficient rainfall (Kingsford, 1989b). Wetlands fill, liberating nutrients that allow rapid increases in productivity, ultimately providing food that may initiate and support breeding. In contrast, prolonged dry periods may stop or extensively modify breeding of water birds. Apart from abundant food, water birds also require suitable nest sites for breeding, which may be specialized (Marchant and Higgins, 1990, 1993, 1996). For many herons, egrets, ibises and bitterns, dense vegetation is essential for breeding (Firth, 1957a; Marchant and Higgins, 1990) and such areas are confined to relatively few wetlands (Mckilligan, 1975;

Cowling and Lowe, 1981; Marchant and Higgins, 1990; Kingsford and Jhonson, 1998; Chatto, 2000). The breeding ecology of most species of water birds in Jaikwadi reservoir exhibits plasticity reflective of spatial and temporal availability of habitat and food resources.

Most dominant species in study area of S1, S2 & S3 were observed as *Coot, Moorhen purple, Egrets, Black ibis* etc. There is no change in the breeding behavior of the other birds viz, *Indian River tern, Spotbill*, etc. Sometimes the Grey Heron is seen on the exposed rocks of the Jaikwadi reservoir in summer but it has also been observed that they do not breed here (Personal observations).

In India much more research work has been done in the fields of agriculture, horticulture and traditional forestry with regard to insect pests and their control, than in natural ecosystems. The vital importance of birds as biocontrol agents of insects and rodent pests have been long established. Of late their importance in controlling insects in forestry plantation and in fruit crop plantations (CSIR, 1990) is being recognized. Similar studies in wild areas and in the uncultivated countryside are few, creating a lacuna in data relating to insect pest control in nature. Birds as well as insect-eating animals like squirrels; bats, are responsible for controlling these insects' pests in natural areas. However, birds are more efficient as insect controllers because their rate of metabolism is higher. Owls and diurnal birds of prey, the hawks, are highly beneficial in keeping down the population of rats and mice which are most injurious to plants since they chew up roots, stems, shoots and seeds. It has been estimated that a single pair of rats can multiply to 880 within a year. However, fortunately, such numbers can never be reached in nature thanks to effective biocontrol by their natural predators, the most important of which are snakes, birds and smaller members of the cat family. Some of the owls such as the Great Horned Owl or Eagle Owl (Bubo bubo) can consume several rats or mice during a single night's hunt. Other owls that control rodent pests are the Dusky Horned Owl Bubo coromandus, the Brown Fish Owl Zeylonesis, the Barn Owl which protects agricultural crops and the smaller sized Collared Scops Owl Ottus bakkamoena, and the familiar little Spotted Owlet Athene brama, Shikra, Kestre, Redheaded Merlin (Falco chiquera), Blackwinged Kite (Elanus caeruleus) and White-eyed Buzzard also perform the invaluable service, and are specially adapted to

catching animal prey possessing powerful talons, hooked bills, sharp eyesight and acute hearing. All these birds of prey regularly eat locusts, grasshoppers and crickets as well, which redoubles their value as agents of pest control (Tara Gandhi, 1995).

Birds and plants have co-evolved to adapt to one another forming mutually beneficial associations. Plants provide food for nesting sites and shelter for birds. But their growth can be severely hampered by factors such as deficiency of soil nutrients, pests and diseases. Birds are beneficial to plants such as aid germination and growth by enriching the soil with nutrients, Enable plants to reproduce by fertilizing and pollinating their flowers, Help in wider distribution by dispersing their seeds, from the time of germination till maturity, protect plants from insect and rodent pests. The main modes of transportation of plant seeds by birds as a external or epizootic carriage by physical attachment to feathers or other parts of the birds body, and internal or endozooic carriage inside the birds digestive system (Tara Gandhi, 1995).

Water birds, particularly migratory wetland species, play an important role in dispersal, carrying seeds over long distances. Sedges and grasses found by the waterside are dispersed in this manner and there have been cases recorded of such plants appearing unexpectedly along margins of isolated ponds where they are normally not found. This has been attributed to transportation by birds (Yardi, 2011). The hundreds of species of fruit-eating birds that are found all over the country contribute largely to this kind of dispersal, thereby giving us the great services to natural afforestation. Razi, (1950) has recorded 102 plant genera form the Mysore State alone, that birds dispersed. Frugivorous birds generally swallow the fruit whole along with the seeds or stones. Typically frugivourous birds like barbets, koel and hornbills play a very important role in the dispersal of their food plants. Omnivorous birds like orioles, mynas and bulbuls are also important seed dispersers. Birds rely on their eyesight while foraging for food, as their sense of smell is poorly developed. Bright colours are known to attract birds. Most bird-dispersed plants produce fruits with colours adapted to catch the attention of birds.

Insects such as termites, beetles, wood-bores, lepidopterous caterpillars, ants and locusts cause untold damage to growing plants as well as to established trees. These are effectively checked by a large number of insectivorous birds.

Of the 1200 species of birds in India, nearly 85% are either wholly or partially insectivorous (CSIR, 1990). Studies in a tropical forest have shown the seedlings are vulnerable to attack by weevils, larvae and adults of fruit beetles, as well as ants and rodents that eat the stems, leaves, roots and seedlings.

The excreta of birds are rich in minerals, particularly phosphorus and nitrogen that provide nutrients for plant growth. Guano, the accumulated droppings of sea birds on oceanic islands or cliffs at the edge of the ocean, has been used for centuries as a fertilizer. Colonial water birds like cormorants, herons, storks and pelicans that nest near inland water bodies also produce considerable amounts of this natural manuare. Apart from fertilizing water bodies, birds also add nutrients directly to the soil. This is particularly valuable for forest soil, which are notoriously poor in nutrients. The droppings of forest birds slowly permeate the soil with rainwater, and being concentrated rich manure; even minute quantities are sufficient to make a significant contribution to plant growth.

Symptomatic anthropogenic impact on wetlands and rivers may also affect the habitat of water birds. They include increasing levels of salinity (Murray-Darling Basin Ministerial Council, 1999) and cyanobacterial blooms. Salinity can cause profound changes in aquatic fauna (Hart *et al.* 1990) and flora (Froend *et. al.,* 1987) and influence distribution and abundance of water birds (Halse, 1987), Grazing by livestock changes aquatic vegetation (Robertson, 1997;) and the cropping cereals on arid zone lakes as floods recede (Briggs and Jenkins, 1997) have ecological impacts. Additionally, harvesting of trees on flood plains may also reduce breeding sites for hole-nesting species of waterfowl. Changes in climate could affect the distribution of local wetlands and hence water birds.

Accepting the reality of an increase in global temperatures, the consequent decreases projected for the amounts of water in the lake will probably mean that the area of lake will decline further, affecting water bird breeding and feeding. (Kingsford and Norman, 2002). A most serious threatening process for water birds is the loss of habitat. A measure of reducing habitat loss is the protection of wetlands through establishment of conservation reserves and listing them as wetlands of international importance under the terms of the Ramsar Convention (Davis, 1994). Form the above observations in the present study it is observed

that the habitat and the breeding behavior of the birds from dam has changed by most of the birds e.g. Black ibis have started nesting from January to March instead of their earlier breeding season was March to October at study area of S1, S2 & S3. There is definite indication of serious changes in the habitat conditions and breeding behavior of the birds in the lake due to domestic pollutional load.

Large infestations of weeds and successions of plant growth have resulted in the loss of much of the area of the reservoir, destroying considerable habitat for wetland species. Remedial measures should be taken to control plant growth, which includes the manual removal of weeds. Efforts should take to remove siltation, as the study area of S1, S2 & S3 is a unique treasure, it has been maintained over the years as the habitat for numerous species. As an artificial area of the site requires considerable management efforts to maintain the conditions necessary to continue to attract wildlife. A management plan for the site is now under consideration.

Analysis of available information indicates that variation in the number and type of species nesting in different status in India and habitats in which the nest sites occur, with a number of heronries associated with human habitations. Seasonal variations in the nesting of certain species exist in different regions of the country (Subramanya, 1996). Over the last century, about 170 sites have been lost due to various factors and the existing sites are prone to a numbers of threats and disturbances. Distributions of heronries indicated that their occurrence in different parts of the country is closely linked to the availability of suitable feeding conditions. Current status and future options for conservation of heronries in India are discussed Subramanya, (1996).

Reckless use of pesticides often has detrimental impact on non target organisms including birds. Fish eating birds are especially vulnerable due to their position in the food chain. Accumulation of persistent chemical in bird tissues may result in impaired reproduction. Residues of organochlorine group of pesticides and their impact on the population of many species of fish eating birds have been well documented in several western countries (Murlidharan, 1996).

Although a little information is available on the level of these pesticides in eggs of few species of terrestrial birds, no work has been carried out on the

impact of organochlorine on fish eating birds in India, except the study carried out on eight species in Keoladeo National Park, viz. the large Cormorant Phalacrocorax carob, Indian shag P. fucicollis, Darter Anhinga rufa, Grey Heron Ardea cinerea, cattle Egreat Bubulcus ibis. Large alba, painted stork Mycteria leucocephala and spoonbill Platalea Leucorodia.

The organophosphonorous and carbamate group of pesticides affect central nervous system of birds while the organochlorine due to their chemical nature, remain stored in the fat and largely disturb calcium metabolism. (Muralidharan, 1996).

Parasharya *et. al.,* (1996) stated that heronries of cattle egrets were left undisturbed by the local people. With increasing irrigation facility and year round cultivation, the population of cattle egrets and other ardeids is likely to increase provided their beneficial role, in controlling insect pests of agricultural crops is highlighted and such heronries are encouraged.

On the basis of continuous survey and monitoring of the population of heronry species over a decade, Sridhar *et. al.,* (1996) observed and stated that the well water tracts, major and river courses around villages should be left undisturbed for waterfowl. River course should be kept free from disturbance and pollution. Some of the above lakes can be declared as protected by the state government. The feasibility of erecting artificial nesting platforms on experimental basis is explored. Factors such as tree cutting, hunting, water pollution, etc. are checked. Provision of plastic sleeves around live wire in the proximity of heronry trees is urgently required. The carp Cyprinus carpio, Catla Calta, are some of the primary food fishes. Stocking of such species in important water bodies around the heronry will be helpful.

Vijayan, (1996) Stated that man has been making use of the vast resources of wetlands for millennia, apparently without conflicts, since his demands did not exceed the availability of resources . The major river systems of the world, namely the Niger, Nile, Tigers –Euphrates and Gangas among them have supported rich human civilization, which relied on the productive wetland ecosystem of their delta. However, of late, the scenario has undergone drastic changes. Draining and reclamation and construction of dams, excessive fishing and discharge of agriculture and industries wastes pose serious threats to the survival of many major wetland the most productive ecosystem of the world.

Available statistics showed that India has about 67,429 wetlands, each 100 ha or more in area, covering a total of 58.20 million hectares. This is gross underestimate as there are many wetlands below 100 ha. A reasonable estimate based on a recently concluded study in Etawa and Mainpuri districts of Uttar Pradesh showed that India has 20-25 million ha. under wetland protection and conservation, of the country entire wetland is impossible and not warranted. A pragmatic system has to be evolved to protect the biodiversity of selected wetland for long conservation and suitable use. (Inland Wetland, 2006).

Indian now has a well formulated protected Area Network for forest system, representing all the major forest types from each of the 11 biogeography zone. Such a network is lacking for the wetlands, although they are more productive and sustain a sizeable human population.

To identify the wetlands complex with required area to support the maximum diversity of plant and birds species. Three approaches already available were used. Their consistency and efficiency were compared and a new approach was devised and tried. They are 1) extrapolate a simple species area curve from the data, 2) cumulatively tally species list as one proceeds from the smallest to largest habitat until the desired numbers of species is reached. 3) Selectively picking from the sites so as to reach the numbers of species obtained by the two previous methods and finally 4) constructing and ldendeogram from inter-distance matrix of wetlands, keeping the perennial and largest wetland as the focal one and select the satellite wetlands till the desired numbers of species is reached so that the maximum diversity of plants and birds can be conserved.

Counting birds using visual observations, calls, and other indirect methods is fascinating and challenging. A variety of census methods are used for sampling bird populations depending on the species, habitat and terrain type. The census methodology that works in temperate region may not be as effective in tropical regions similarly the methodology in the plains may not give accuracy in the hills. Given the usefulness efficacy and the study goals, an appropriate method chosen to sample the birds of the area. Bird census data, either from surveys or intensive studies have been used to project the current population levels and in estimation of densities. These have been integral part of the most avian community studies. Density and diversity are very useful

attributes and valuable indicators of habitat quality and have greater significance from management perspective (Reena and Abhijit, 2005).

In the study area of S1, S2 & S3, birds live in different habitats, have varied social structures and also show behavioral response. Birds may live in open areas like grasslands or agricultural systems, and are easy to see. Conversely, they may inhabit dense vegetation, which obstruct a straightforward view. Some birds may be gregarious and may live in flocks of thousands, whereas others may be solitary or in pairs. Behavior too may vary, with certain species being very bold while others are very shy and skulking. Applying a single method to count such a variety of birds is neither feasible nor advisable. (Yardi, 2011). The most popular methods to count birds in their natural habitats are of immediate importance. The manual field methods for bird surveys by Salim Javed and Rahul Kaul (2002) are a step in that direction which is most useful and commonly applied method for censusing birds which provides invaluable information and feed into a National inventory for future comparisons.

Seasonality and timing of the count is very important. Often short surveys suffer from seasonal or temporal bias. Counts conducted during short duration surveys are usually confined to very short periods in particular seasons i.e. winter or summer. This sometimes gives a fairly biased view of the importance of the site or presence or absence of a species. One of the common activities that most surveyors do during winter surveys for waterfowl in India is to count water birds at different water bodies in winter only. The resulting data may be highly biased if sites are to be ranked. Large reservoirs or tanks may get high ranks. In order to avoid such biases, survey in the breeding season (if there are no financial constraints) will allow real assessment of sites both for wintering and breeding birds.

Different census methods are used for sampling bird populations depending on the species, habitat and terrain type. The census methodology that works in temperate region may not be very effective in tropical regions; similarly the methodology that works in temperate region may not be very effective in tropical regions; similarly the methodology in the plains may not give accuracy in the hills. There are some methods which are applicable only in certain habitats and in certain seasons, e.g. spot mapping of territories is

restricted to breeding season. Given the usefulness, efficacy and the study goals, an appropriate method should be chosen to sample the birds of the area.

Density and diversity are very useful attributes and valuable indicators of habitat quality and have great significance from the management perspective.

Distance sampling involves collection of data where distances of birds are estimated or measured. A simple explanation of distance sampling using line transects and point transects methods to collect such data and use it for meaningful analysis and interpretation. Distance sampling is relatively simple it also accounts for variation in detecting birds at different distances in different habitats, and hence allows better comparison between species in the same habitat and across different habitats (Yardi, 2011).

Counting Water birds has to be done by some of the counts discussed in the preceding sections may also apply to census water birds, but they need to be used with caution. Because of the very nature of the water birds and the openness of the habitat as compared to land birds forest grass dwelling water birds are relatively easy to census (Yardi, 2011).

Water birds are often used as symbols for conservation as they are more visible, easily accessible and are in important recreational resource. Their dependency on water bodies and their role as indicators of wasteland health make them the first choice for any study assessing the importance of wetlands. Agencies need to have data on colonies, number of species and total population to assist them in making decisions about the protection of any area. Documenting the status and trends of selected populations of water birds at local, regional, and national level provides useful information about changes and status of water land habitats over a period of time. (Yardi, 2011).

Determination of indices of relative annual abundance, rather than exhaustive population censuses, is suitable for most purpose to document wetland birds. For reasonably accurate estimates of breeding bird richness in a wetland, three visits spread over the breeding season may be desirable. (Yardi, 2011). As water birds, especially most waterfowl and waders, are easily visible in study area S1, S2 & S3 are counted directly using binoculars or telescope, total count is ideal. The need for sampling does not arise, and hence there is no need for any sampling strategy. Total count involves counting all the birds in vicinity Table.

Total count is simple and the easiest except in areas where the size of the water body and number of birds which may be several thousands may make the count time consuming. In such areas, the best way is to divide the water body into unit's blocks and to count water birds in each block in succession on the same visit. In such sites, prominent places, such as an elevated post or platform can be used as vantage points for an effective count. (Yardi, 2011).

Surveys can be conducted from ground level or from elevated observation posts. In the case of species that nest or roost colonially and in exposed locations, photography are used to assist counting of individuals. For species such as cormorants, counts are conducted either by estimating numbers flushed from the ground or trees or by estimating the number of birds once they land in the water near the colony. As cormorants fly in line, they are easier to estimate than many other water birds with direct count method.

All the species present in the study area, wetland are counted. Number of individuals of each species is counted as absolute values, rather than ranges 5000-6000.

At all stations S1, S2 & S3 information has gathered on the condition of the wetland water level, aquatic vegetation and surrounding terrestrial vegetating, fishing and hunting activities and the general level of disturbance from other human activities as these can also be useful while interpreting results.

The waterfowl data can be presented in many ways. Counts of species and individuals of each species allow calculation of abundance, richness and diversity. Additionally, when data is available from different seasons and different years. Interesting comparisons is made on population trends of key waterbirds. Comparison of species diversity and richness across sites can also be made from such data. Monthly variations in waterfowl population by number of species and number of individuals at each site are recorded. The data on other parameters are available, and count data is used to detect relationships between bird species diversity, composition and environmental attributes Yardi (2011).

Data on water birds, collected systematically, is very useful for conservation planning at several levels. Many water birds by virtue of being congregatory, easy to observe and easily accessible many water bodies are found in the middle of cities, or close to human habitation are important tools for public education

and awareness. Both long term and short term data can be used effectively in making useful decisions that may help in conserving the areas locally, besides contributing to a national or global effort to document the diversity of avifauna. Programmes such as Important Bird Areas (IBA) have effectively used water birds as a simple invaluable tool to highlight the importance of several areas for conservation. Thus, simple count data on wetland birds goes a long way in identifying and prioritizing sites for conservation, which ultimately leads to the protection of birds and overall biodiversity of wetland systems. (Yardi, 2011).

Infrastructural development causing habitat degradation and disturbance appear to be serious threat to the long term survival of various birds, for the future conservation strategies there is need of ecological study of birds. The major priorities in conserving birds are to keep watch on monitoring changes in population and to find out prescriptions for their long term survival.

It is well known that all animals are directly or indirectly dependant on plant for nourishment. But birds, as a group seem to be feed mainly on animals and only a rather small proportion of the birds of the world have become sufficiently specialized to utilize food first hand. One indication that plant eating is a secondary specialization is found in the fact that most plant eating birds start their newly hatched young on an animals diet, then gradually changes them to a plant diet, except few highly specialized plants, feeding species (Tyne and Berger, 1976). Birds food items as a whole recorded by Samil Ali, (2002). In the number of Indian avian species studies on the food and feeding behavior of birds is now getting sizable importance. The role of feeding habits of birds for the betterment of rural economy, and its relevance in diversifying traditional agriculture, for better use of birds feeding habits in agriculture, is one of the aspects supporting to the eco-friendly agriculture. Main Vavrina, (2001) studied the role of wading birds in agriculture. Salim Ali (2002) mentioned that the large proportion of the normal food of birds consists of insects, including many that are in the highest degree injurious to man and his concerns.

In a country like India, which is largely dependant upon agriculture and forestry, research on the economic status of birds obviously deserves high priority.

Climate refers to the aggregate of weather events over the long term. The effects of weather events over the long term. The effects of weather on the birds

are well known Crick, (2004), being both diverse and important. Consequently birds are highly sensitive and are indicators of climate and weather change. The quintessential "canaries in the coal mine" various workers were already linking climate changes to decline in populations around the globe, for some groups of birds, the effects are drastic. Birds have severed as reliable indicators of environment changes for centuries and now indicate that global warming has set in motion a powerful chain of effects in ecosystem worldwide. In this global status of climate changes affect birds behavior, ability to reproduce and even to survive. There are many example of the effects of climate changes on birds from around the world, which taken together, provide compelling evidence that climate changes is already affecting birds in diverse ways. It is these proximate responses that drive the ultimate impacts of climate changes on species. The significant changes to range that will be catastrophic for many species. Extreme weather events, a feature of global warming, appear to be increasing in frequency and magnitude (Yardi, 2011). The radical 97 percent breeding decline of California arid-land birds during a record 2002 drought potently illustrate the highly destructive and disproportionate effect of climate extremes on birds (Bolger *et. al.,* 2005). Climate is one of the most important factors in determining birds ranges and abundance. Thus, there are numbers of evidences showed that birds are responding to climate change, which makes them ideal indicators for changes related to climate and weather.

The overall object of the present study was to census the migratory birds accurately; identify their species and population of migratory water birds, which would provide data for threatened birds. Therefore, the activities were concentrated over general pattern of arrival and departure of migratory water birds from the local area. Simultaneously, attention was diverted over external environment factors such as photoperiod, humidity of food in the form of zooplankton and phytoplankton during study period to analyses reasons for their migration.

For conservation, management and protection of the birds of study areas are surveyed and species composition, diversity, abundance and distribution of birds and other biota are recorded. The reservoir and its adjoining area need to be protected. The areas of regular fishing should be fixed. Encroachment should

be stopped. The aquatic weeds must be controlled. In the entired area of the reservoir human exploitation should be stopped.

Plantation of tree (Acacia) for fuel by local people, grazing of cattle and boating should also be avoided in the lake, More island showed be provided for the birds to rest and feed, planting of trees to attract roosting of birds should be encouraged and inlet of domestic sewage should be strictly prohibited.

After careful observation and analysis, it has been found that the extinction of the some of the migratory birds fauna form the study area due to sudden climatic change, new diseases, reduced breeding potential, human interferences, habitat change, poarching, commercial and recreational exploitation of the lake, reclamation and encroachment of the lake for Government planning, lack of proper legislation and administrative lapses, lack of proper environmental education and training of the people.

Species of trees, which are beneficial to birds, fruit bearing and nectar providing species, are to be generally recommended for plantation where the birds mainly arrive for roosting and breeding.

Primary facility for tourists are lacking in this area. Tourists visiting the area would like to know more about the details of the birds inhabiting the reservoir. Authorities should take positive role in developing proper educational facilities for tourists.

Certain minimum infrastructure and arrangement at study area is necessary to justify its status are:

❖ Monitoring of the numbers and variety of migratory birds in winter. A birds count should be carried out on the both the banks at least once during each winter. Knowledgeable local bird-watcher may be provided facilities such as transports, binoculars and telescopes to carried out the count.

❖ A mobile laboratory with equipment to test water and soil quality analyses water samples, collect weather data, sample of vegetation including aquatic plants, monitor the quality of the sewage, industrial and agriculture effluents and the behavior and study of birds be provided.

❖ A suitable site on the peripheri of the reservoir be selected to set up a birds and environmental observatory. The site should have minimum disturbance from human movement, cattle ect. And should provide access to major concentrations on birds. The observatory should monitor and collect data

on all the aspects of environment, carry out experiments in improving the environment though proper plantations, water management prepare models for environment development at other similar sites.

❖ It is very necessary that the project is put under the changes of officers who possesses recorded of environment awareness and is interested in nature. Suitable staff including trained ornithologists should be appointed to carry out monitoring and research.

a) Monitoring water, flora, fauna and habitats around the study area.
b) Identify movements of migratory water foal passing though the central continental land mass of India.
c) Provide floral and fauna data useful for the sound management of the study area.
d) Evolve management model to reconcile the interest of human being and wild life dependent on the use of study area.
e) To maintain contacts and exchange information with other scientific bodies of national and international importance.
f) To create the awareness about the need of conserves nature and help conserve flora and fauna typical of the region.
g) To encourage nature education through nature trails and camps, posters, popular articles etc.
h) To encourage nature base tourism (Eco-tourism) for students and the journal public.

Steps to meet Management Goals:

The improvement in the quality of their habitats to attracts greater numbers of migrant birds such as ducks and waders. Many of these use mid-streak rocks for resting and roosting, feed in the open water or shallows nearby and also along the edges of reservoir. The shallow open water habitat is used by species for feeding. These include a number of migratory ducks. The main treat to this habitat comes from the spread of prosopus and Ipomia which tends to cover open water area. Its timely removal will benefit ducks and other species that use this habitat.

The use of the open water habitats by birds is also dependent on the quality of aquatic vegetation. The dominant aquatic plants communities found at

present may be the result of increase fertility of water due to greater inflow of sewage. Their food value and use by birds need investigation. Once this information is available the managers can be selective in eliminating some vegetation in performance to some other species with better potential of birds use. Similarly vegetation at the edges of water also needs to be examined from the same point of view.

Besides ducks the other important group of migrants is waders. They feed in shallow water or in mud along the water's edge and some of them roost on the rock mid-stream. In the last few due to the maintenances of higher water level. Such mud-filled shallow areas have contracted. The manager can examine the edges of water to see if at places such areas can be created.

The second issue mainly concerns with resident birds. As already noted the activity of plantation on the bank has on the whole benefited the resident's birds. Several new species have been attracted though the activities. Proved inimical to the larger flocks of yellow wagtail that used the grass and scrub area plantation on the banks can be made more attractive to birds by planting more nectar producing flowers trees, more trees that produce berries and gradually eliminating exotic, quick growing trees that were planted simply because they grow very quickly.

A look at the habitats use of birds should convince the manger of the importance of meadows and shrubber species use these habitats for roosting while species seek food here. By studying the feeding habitats of these birds the manger can enhance the habitats usefulness to birds. Again certain species can be taken up. The need for a continuous study of birds should once again be emphasized.

The proper management of meadows and scrubland will help birds such as partidges and quails and many attract other ground – nesting birds as well as birds that nest in shrubs. However, solitude and absence of disturbance are necessary to ensure breeding success. The manger will do well to keep certain pockets away from human disturbance. Likewise near the water's edge pockets of dense typha or other water side thickets will provide shelter and breeding place fir coot, Indian and Purple Moorhen etc.

At present number of breeding species is low and tree-nesting are fewer. But as the forest on the banks matures it may provide suitable place for some

more species. However, between the sanctuary and the private estate. There is a buffer zone which provides the necessary solitude to nesting birds. This is not yet adequately planted up. If suitable nesting trees such as ficus, Acacia etc. are planted here, they may eventually provide nesting space to such colonial nesting as cormorants, Egrets, herons and storks. However, these will not breed unless adequate food is made available to feed their nesting. The managers should consult fisheries experts to enable him, to augment fish in waters.

The basic data that are presented here thus provide the manager a working base on which to build up his management practices. Continuous research on birds that are placed under this care will open up new vistas and suggest noel ideas that will enrich his experience and place near tools in his hands to reach management goals. His task becomes immensely easier if he is backed by a team of competent ornithologists. For the development of the science of birds Sanctuary Management, it is necessary to attract this unfettered biped who alone can study feathered bipeds.

Chapter-V

SUMMARY AND CONCLUSION

The study on bird habits, habitat, number and seasonality were carried out by regular field visits to the study area. The monthly observation sites were fixed. Maximum numbers of species were observed in winter season compared to monsoon and summer. In winter, greater food availability with favorable climatic conditions for nesting, roosting and breeding of the bird species exist. A total of 83 species was observed during the study period of (2010-11 and 2011-12) of which 52 species were observed as permanent residential, while 31 non-residential (migratory) bird species were observed in the Nandur-Madhemeshwar, Kaigaon Toka and Jaikwadi bird sanctuary.

The population of bird was observed to be maximum i.e. from 81-83 at all the stations during October, November, December, 2010-11 to 2011-12 and January (83), February (83) and March (82) 2010-11 to 2011-12. The habitat wise bird population was observed at S5, S2 & S3 on the basis of feeding, roosting and nesting period. This situation may be considered as typical of all the wetland reserves that have been proposed in recent years. The month wise occurrence of the birds at station S1, S2 & S3 during the study period was varied from 47 (June) to 83 (Jan, Feb).

During the month of January, February and March the bird population was almost similar at all stations S1, S2 and S3, from April onwards its population started decreasing upto September like in April (55), May (48), June (47), July (48), August (48) and September (51) and from October to December it again increased significantly like October (76), November (81) and December (81) during both the years of study period.

Birds visit the stations S3 i.e Jaikwadi dam waters in winter, as well as a few in summer and monsoon seasons. The main food for the birds was found to be insects, fishes, crabs, frogs, grasshoppers, worms and marshy plants. Some birds like, Red vented bulbul, etc. were observed as frugivorous. Most of the sampling sites were found to be green, showing higher population of algae and algal blooms ecologically, to attract and sustain large numbers of water birds. The non-residential birds use this habitat for the resting purpose. These birds visit to the dam waters in winter season and leave this habitat in early summer.

These birds are abundant in Ladakh, North Europe to east Siberia, Bangladesh, Shri Lanka etc. and visits the reservoir waters regularly. The overall population of bird increases in December and declines from January as the water level recedes.

Conversion of the dam areas into terrestrial land seriously affects the food availability of water birds. Effort may be initiated to remove the waste materials from the dam and clean the area. The total number of species of bird was low during the study period (2010-11 & 2011-12). Only 83 species were observed in dam waters. This can be attributed to the heavy pressure of tourism on dam. The impact of tourism has become increasingly evident. The demand for motorized boating and land development are the immediate threats to bird and their habitats. Apart from these the mud flats in these sites have been severely degraded by burning, drainage and clearing. This has affected the abundance of avifauna that depends on the mudflats as well as on the hydrological values and functions of the mud flats. Reclamation of reservoir lands during inter-tidal cropping affects on roosting and breeding of water birds like Little Cormorant, Indian Pond- Heron, Purple Heron and Night- Heron. Putting harvested fields on fire also kills many birds. Every year, during the summer months, sugarcane farmers burn the field residue and the grasses on the bunds, by which nests of breeding birds like Warblers (Prinia hodgsonii, Prinia inornata and Acrocephalus stentoreus), Tailorbirds (Orthotomus sutorius) are destroyed. Fishing is frequent in the reservoir and is usually carried out using nets of small mesh size that reduces the food availability for the birds. It is already a known fact that heavy use of pesticides causes mortality of birds.

From the study it is to be observed that the disappearance and extinction of the migratory bird fauna from the reservoirs are mainly due to sudden climatic changes, reduced breeding potential, habitat change, commercial and recreational exploitation of the dam, reclamation and encroachment of the dam water, lack of proper legislation, administrative lapses, lack of proper environmental education and training of the people. A portion of the reservoir needs to be declared as a protected area and human exploitation should be stopped.

The density and diversity of water birds are influenced by rainfall, temperature, humidity and cloudiness (Custer and Osborne, 1977; Goss-custard,

1985; Teylor and Tullock, 1985; and Briggs and Holmes, 1988). Rainfall has great influence on the bird population (Baylis, 1989). Water depth is reported to influence the population of migratory water birds (Sayre, 1984; Poysa, 1989 and Vijayan, 1990). In the present study, availability of suitable nesting sites, dispersal pattern of the young, differential rate of fledgling survival and changes in the environmental conditions may also influence the species as observed by Santharam and Menno, (1991). Observations on the Indian river Tern indicated that they are the good breeders here as they are observed throughout the study period (Personal observation).

After careful observation and analysis, it has been found that the extinction of the some of the migratory birds fauna form these reservoirs are due to sudden climatic change, new diseases, reduced breeding potential, human interferences, habitat change, poarching, commercial and recreational exploitation of the lakes, reclamation and encroachment of the lake for Government planning, lack of proper legislation and administrative lapses, lack of proper environmental education and training of the people.

Urgent and decisive action is needed to conserve and maintain genes, species and ecosystem, in view of the sustainable management and use of biological resources. Capacities for the assessment, study, systematic observation and evaluation of biodiversity need to be reinforced at national and international levels, cooperation sought for the in situ protection of ecosystems, as also for the ex-situ conservation of biological and genetic resources and enhancement of ecosystem functions. The participation and support of local communities are essential to the success of such an approach.

The conservation of dam is in the interest of man as it's ecological, cultural and tourist value is immense. This study will help in understanding the amount of toxic compounds (heavy metals) being received in the dam reservoir and its biological magnification in animals, particularly those at the lower level of food chain. This study will also help to make aware those local people or adjacent farmers for proper management of waste disposal and also to minimize use of synthetic inputs. The study indicated that increase in toxic waste day by day in dam reservoir produced biological magnification in food chain, which is a challenge to scientists, policy makers, administrators and all those involved in the conservation of the environment. These reservoirs do not attain its full

capacity every year. It is filled once in a period of 3 or 4 years. Over the years, intense agricultural activities in the vicinity of this reservoir and influx of domestic and industrial waste have caused a multiple increase of productivity of this lake. Pollution is taking its toll on the lake habitat that harbours different aquatic and land vegetation, indigenous fish fauna, and many types of the waterfowl. Efforts at restoration of the habitat need to be carried out in a time bound manner, so as to prevent any further degradation of this ecosystem. Bank restoration at the left and right edges of the reservoir has to be expressly carried out A 50 meters strip of grasses could be developed from the water edge on to the land at left and right banks. This, supplemented with 6 to 8 rows of Acacia trees, would reduce the agricultural runoff pouring into the reservoirs. Pitching, wherever necessary, is carried out so as to protect the natural sand bars and mud flats. An effective control on sand excavation will help the restoration to a greater extent. The Jaikwadi reservoir has a huge catchment area admeasuring 21,000 sq.kms. For control of excessive rain runoff that also brings in the silt, methodical catchment area development programmes need to be undertaken, with extensive tree plantation on the ridges and slopes in the catchment. Construction activity near the left and right banks of the reservoir needs to be checked, encroachments removed, and encroachers suitably resettled elsewhere. This will improve the drainage, and reduce pollution. However, a participatory approach in the management of the water body is desirable. Creating awareness among the people in the neighborhood, and attempting reorientation of the stakeholders towards the cause of conservation of the reservoirs are important from this point of view.

REFERENCES

Ali, S. and Ripley, D.S. (1983): Handbook of the Birds of India and Pakistan. *Oxford University Press. Oxford*, pp. 737.

Andhale, S.B. (2008): Studies on the flora of Jaikwadi Bird Sanctuary. Ph.D. Thesis. Dr. B.A.M. University, Aurangabad.

Anil Mahabal (2005): Fauna of Nathsagar wetland and Jaikwadi bird sanctuary (Maharashtra) – Zoological survey of India, Kolkata.

Arun Kumar, Sati J. P. and Tak, P. C. (2003): Checklist of Indian Waterbirds. Buceros; ENVIS News letter: Avian Ecology & Inland Wetlands, 8 (1): 1 – 30; Bombay Natural History Society, Mumbai.

Auti, R.G. (2002): Seasonal variations in the water characteristics and macrofaunal distribution of Salim Ali Lake near Delhi gate, Aurangabad. Ph.D. Thesis. Dr. B.A.M. University, Aurangabad.

Balda R.P., Morrison, M.L., And Bement, T.R., (1977). Roosting behaviour of the pinon Jay in autumn and winter, *The Auk*, 94 : 404-494.

Baylis, P. (1989): Population dynamics of magpie geese in relation to rainfall and density: Implications for harvest models in fluctuating environment. *J. Appl. Ecology*, 26: 913-924.

Bhattacharjee, P. C., P. Sakia and M. Raj, (1988): Status of wetland and water birds of Lower Assam, outside the natural reserve *Wetland and waterfowl- Newsletter* (B.N.H.S.) 1: 29-31.

Bock, C.E. (1997): The role of ornithology in conservation of the American West. *The Condor*, 99 (1): 1-6.

Boulton, A.J. and L.N. Lloyd (1992): Flooding frequency and invertebrate emergence from dry floodplain sediments of the River Murray, Austrlia. Regulated Rivers: *Research and Management* (7): 137-151.

Braithwaite, L.W. (1975): Managing waterfowl in Australia. In Proceedings of the Ecological Society of Australia 8, 107-128

Braithwaite, L.W. (1975): Managing waterfowl in Australia. In Proceedings of the Ecological Society of Australia 8, 107-128

Briggs, S.V. (1977a): Variation in waterbird numbers at four swamps on the northern tablelands of NSW. *Australian Wildlife Research* (4): 301-309.

Briggs, S.V. (1990): Sexual and annual differences in activity budgets of Maned Duck Chenonetta jubata. *Emu* 90, 190-194.

Briggs, S.V. and J.E. Holmes (1988): Bag size of water fowl research in New Southwales and their relation to antecedent rainfall. *Australian Wild Life Research*, 15: 459-468.

Briggs, S.V. and K. Jenkins (1997): Guidelines for managing cropping on lakes in the Murray-Darling Basin. *National Parks and Wildlife Service*, Canberra.

Briggs, S.V., M.T. Maher and D.S. Tongway (1985b): Dry matter and nutrients loss from decomposing *Vallisneria spiralis L. Aquatic Botany* 22: 387-392.

Burnham, W. P. Jenny and D. Whitcare (1994): The Maya project: use of birds of prey as Tool for conservation and ecological monitoring of biological diversity. Pp. 257-264.

Carrick, R. (1959): The food and feeding habitats of the Straw-necked Ibis, Threskiornis spinicollis (Jameson), and the White Ibis, T. molluscca (Cuvier), in Australia. *CSIRO Wildlife Research* 4, 69-92.

Chakravarthy, A.K. and K.P.P. Tejasvi (1993): Birds of Hill Region of Karnataka: An Introduction. Navabharath Enterprises, Seshadripuram, Banglore, pp.148.

Chatto, R. (2000): Water bird breeding colonies in the top end of the Northern Territory. Parks and Wildlife Commission of the Northern Territory, Technical Report No. 69.

Clarke, R. (1990): Harriers of the British Isles. C.I. Thomas and Sons (Haverfordwest) Ltd.

Clarke, R. (1996a): Preliminary observations on the importance of a large communal roost of wintering harriers in Gujrat (NW. Indai) and comparison with a roost in Senegal (W.Africa). *J. Bombay Nat. Hist. Soc.* 93 (1) : 44-50.

Clarke, R.(1996b): ontagu's Harrier. Arlequin Press. U.K.

Cowling, S.J. and K.W. Lowe (1981): Studies of ibises in Victoria, I: Records of breeding since 1955. *Emu* 81, 33-39.

Crome, F.H.J., and S.M. Carpenter (1988): Plankton community cycling and recovery after drought-dynamics in a basin on a flood plain. *Hydrobiologia*, 164, 193-211.

CSIR (1990): Birds: Supplement to Wealth of India, Raw Materials. II B. Baxter, G.S. 1994. The location and status of egret colonies in coastal New South Wales. *Emu*, 94, 255-262.

Custer, T.W. and R.G.Osborne, (1977): Wading birds as biological Indicators: 1975 Colony survey. U.S. *Fish and Wildlife Service*, Washington, D.C.

Davis, T.J. (1994): 'The Ramsar Convention Manual. A Guide to the Convention of Wetlands of International Importance Especially as waterfowl Habitat'. (Ramsar Convention Bureau: Gland, Switezerland.)

Dawson, T., P.J. Whitehead., A. McLean., F.D. Fanning and W.R. Dawson (2000): Digestive function in Australian Magpie Geese (Anseranas semipalmata). *Australian Journal of Zoology* 48, 265-279.

Del, Hoyo, J., A.E. Elliot., J.Sargatal (1994): Handbook of the birds of the world. Vol. 2. New world Vultures to Guineafowl. Lynx Edicions. Barcelona.

Dostine, P.L. and S.R. Morton (1988): Notes on the food and feeding habits of cormorants on a tropical floodplain. *Emu* 88, 263-266.

Frith, H.J. (1957a): Breeding and movements of wild ducks in inland New South Wales. *CSIRO Wildlife Research* 2, 19-31.

Froend, R.H., E.M. Heddle., D.T. Bell and A.J. McComb (1987): Effects of salinity and waterlogging on the vegetation of Lake Toolibin, Western Australia. *Australian Journal of Ecology* 12, 281-298.

Gadgil, M. and Ali, S. (1975). Communal roosting habits of Indian birds. J. Bombay Nat. Hist. Soc., 72 : 716-727.

Gaston, A.J. (1974): Methods for estimating bird populations. J. Bombay *Nat. Hist. Soc.* 72 (2): 271-283.

Gauthreaux, S.A. (1979): Priorities in bird migration studies. *Auk* 96: 813-815.

Gauthreauz, S. A. (1982): The ecology and evolution of avian migration systems. In 'Avian Biology Vol. VI'. (Eds D.S. Farner, J.R.King and K.C.Parkers.) pp. 93-168. (Academic Press Inc.: New York).

Gole P. (1984): Birds of a Polluted River. Journal of BNHS, Vol 81(3), December 1984.

Gosper, D.G., S.V. Briggs and S.M. Carpenter (1983): Water bird Dynamics in the Richmond Valley. NSW, 1974-77. *Australian Wildlife Research* 10, 319-327.

Goss-custard, J.D., (1985): Foraging behavior of wading birds and the carrying capacity of estuaries. In: Behavioral ecology: Ecological Consequences of adaptive behavior (Eds. R.M. Sibly and R.H. Smith), *Blackwell Scientific Publications,* Oxford, pp. 169-188.

Halse, S.A. (1987): Probable effect of increased salinity on the waterbirds of Lake Toolibin. Weastern Australian Department of Conservation and Land Management Technical Report No. 15.

Halse, S.A., G.B. Pearson and W.R. Kay (1998): Arid zone networks in time and space: water-bird use of Lake Gregory in north-western Australia. *International Journal of Ecology and Environmental Sciences* 24: 207-222.

Halse, S.A., M.R. Williams., R.P. Jaensch and J.A.K. Lane (1993a): Wetland characteristics and water-bird use of wetlands in south western *Australia. Wildlife Research* 20: 103-126.

Hart, B.T., P. Bailey., R. Edwards., K. Hortle., K. James., A. Mcmohan., C. Meredith and K. Swadling (1990). Effects of salinity on river, stream and wetland ecosystems in Victoria, Australia. *Water Research* 24, 1103 - 1117.

Hilden, O. (1965): Habitat selection in birds. Annales Zoological Fennici. 2: 53-75.

Imnoden, H. (1994): Birds as indicators of un-sustainability. Pp 61-68 in G. Bennett, ed. Conserving Europe's natural heritage: towards a European ecological network. London: Graham and Trotman.

Inland-Wetland of India (2006): Salim Ali center for orinithology and National History 1 to 9. *Jr. of B.N.H.S:* 23-35.

Kantrud, H.A., and R.E. Stewart (1977): Use of natural basin wetlands by breeding waterfowl in North Dakota. *J. Wild. Manage.* 41: 243-253.

Kar, S.K. and H.K. Sahu (1993): Preliminary study on Ecology of Aquatic Birds in Chilika Lake, Orissa. First national seminar on *Ecology and Conservation*, Banglore.

Kingsford, R.T. (1986b): Reproductive biology and habitat use of the Maned Duck Chenonetta jubata (Latham). Ph. D. Thesis, University of Sydney.

Kingsford, R.T. (1989b): The effect of drought on duckling survival of Maned Ducks. *Australian Wildlife Research* 16: 405-412.

Kingsford, R.T. (1992): Maned ducks and farm dams: a success story. *Emu* 92:163-169.

Kingsford, R.T. (1996): Wildfowl (Anatidae) movements in arid Australia. Gibier Faune Sauvage 13: 141-155.

Kingsford, R.T. and F.I. Norman (2002): Australian water birds-products of the continent's ecology. *Emu*, 102: 47-69.

Kingsford, R.T. and J.L. Porter (1994): Waterbirds on an adjacent freshwater lake and salt lake in arid Australia. *Biological Conservation* 69: 219-228.

Kingsford, R.T. and W.J. Jhonson (1998): The impact of water diversions on colonially nesting waterbirds in the Macquarie Marshes in arid Australia. Colonial Waterbirds 21, 159-170.

Kingsford, R.T., A.L. Curtin., and J. Porter (1999a): Water flows on Cooper Creek in arid Australia determine 'boom' and 'bust' periods for waterbirds. *Biological Conservation* 88: 231-248.

Kingsford, R.T., R.F. Thomas., and P.S. Wong (1997): 'Significant wetlands for waterbirds in the Murray-Darling Basin.' (Murray-Darling Basin Commission: Canberra).

Kumar V. (2000): Biodiversity Principles and conservation. published by Agrobios (India) 2000 P.7.

Lane, B.A. (1987):'Shorebirds in Australia'. (Nelson: Melbourne).

Lavery, H.J. (1970a): The comparative ecology of waterfowl in north Queenland. *Wildfowl* 21: 69-77.

Lavery, H.J. (1970b): Studies of waterfowl (Antaidae) in North Queenland 5. Breeding. Queenland *Journal of Agriculture and Animal Science* 27: 425-436.

Maddock, M. (2000): Herons in Australia and Oceania. In 'Heron Conservation'. (*Eds. J. Kushlan and H. Hafner*.) pp. 123-149.

Maddock, M. and G.S. Baxter (1991): Breeding success of egrets related to rainfall: a six year Australian study. Colonial *Waterbirds* 14: 133-139.

Maher, M. (1981): Response of waterfowl to hunting pressure: A Preliminary study. *Australian Wildlife Research* 9: 527-531.

Maher, M. (1984): Benthic studies of waterfowl breeding habitat in South-western New South Wales. The fauna, Australian. *Journal of Marine and Freshwater Research* 35: 85-96.

Marchant, S and P.J. Higgins (Eds) (1990): 'Handbook of Australian New Zealand and Antartic Birds. Vol. I. Ratities to Ducks'. *(Oxford University press: Melbourne).*

Marchant, S and P.J. Higgins (Eds) (1990): 'Handbook of Australian New Zealand and Antartic Birds. Vol. I. Ratities to Ducks'. *(Oxford University press: Melbourne).*

Marchant, S. and Higgins, P.J. (Eds) (1993): 'Handbook of Australian New Zealand and Antarctic Birds. Vol. 2. Raptors to Lapwings'. (Oxford University Press: Melbourne).

Marchant, S. and Higgins, P.J. (Eds) (1996): 'Handbook of Australian, University and Antarctic Birds. Vol. 3. Snipe to Pigeons'. (Oxford University Press: Melbourne).

Marriot, R.W., and D.K. Forbes (1970): The digestion of lucerne chaff by Cape Barren Geese, Cereopsis novaehollandiae Latham. *Australian Journal of Zoology* 18: 257-263.

Mcdougall, A., and Timms, B. (2001): The influence of turbid waters on waterbird numbers and diversity: a comparison of Lakes Yumberarra and Karatta. Currawinya National Park, south-west Queensland. Corella 25. 25-31.

Mckilligan, N. (2001): Population dynamics of the Cattle Egret (Ardea ibis) in south-east Queensland: a 20 year study. *Emu* 101: 1-5.

Mckilligan, N.G. (1975): Breeding and movements of Straw-necked Ibis in Australia. *Emu* 75: 199-212.

Miller, B. (1979): Ecology of Little Black Cormorant Phalacrocorax.

Morse, D. (1980): Behavioral mechanisms in ecology. Harvard *University press.*

Muralidharan S (1996): Impact of pesticide contamination on fish eating birds an India scenario division of ecotoxicology SICON. Coimbator.

Murray-Darling Basin Ministerial Council, (1999): 'The salinity Audit of the Murray-Darling Basin. A 100-year Perspective, 1999.' (Murray-Darling Basin Commission: Canberra).

Norman, F.I. and A.H. Corrick (1988): Wetlands in Victoria: a brief review. In 'The Conservation of Australian Wetlands'. (*Eds A.J. McComb and P.S.Lake.) pp. 17-34. (Survey Beatty: Sydney).*

Norman, F.I. and L. Mumford (1982): Food of the Chestnut Teal, Anas castanea, in the Gippsland Lakes Region of Victoria. *Australian Wildlife Research* 9, 151-55.

Pandya and Daniel (2005): Introduction to Avifuna by Conservation Education Center Mumbai P. 36-37.

Parasharya, B.M. T.V. Patel, S. B. Patel, & D.N. Yadav (1996): Regional variation in the diet of the nestlings of cattle egret Gujarat Agricultural University. Anand. B.N. H.S. P 30.

Poysa, H. (1989): Effects of grouping on foraging exploitation and dynamics in dabbling ducks: *Proc. Of 8th Int. Waterfowl Feeding Ecology Symposium, Ribe, Denmark*, 18-21, September 1989: pp.48.

Prashant, Kumar Saikia and Parimal C. Bhattacharjee (1993): Status, Diversity and Decline of Waterbirds in Brahmaputra Valley, Assam India. *Bird Conservation*: pp 20-23.

Puckridge, T., K.F.K. Walker and J.F. Costelloe (2000): Hydro-biological Persistence and the ecology of dryland rivers. Regulated Rivers: *Research and Management* 16: 385-402.

Rahmani, A.R. and Manakadan, R. (1987) A large roost of Harriers in Andhra Pradesh, India. J. Bombay Nat. Hist. Soc. 83 : 203-204.

Raj, M., B. Saikia and P.C. Bhattacharjee, (1987): Status of aquatic birds on the beels of Goalpara district, Assam, outside of natural reserve. *J. Trop. Ecol.* (special volume on Wildlife). *In press*.

Reena and Abhijit (2005): Biodivesity the species life published by conservation education center P. 1-39.

Robertson, A.I. (1997): Land-water linkages in floodplain river systems: the influence of domestic stock. In 'Frontiers in Ecology: Building the Links.' (Eds N. Klomp and I. Lunt) pp. 207-218.

Roshier, D.A., A.I. Robertson., R.T. Kingsford (in press, 2000): Responses of waterbirds to flooding in an arid region of Australia, and implications for conservation. *Biological Conservation.*

Roshier, D.A., A.I. Robertson., R.T. Kingsford., and D.G. Green (2001a): Continental-scale interactions with temporary resources may explain the paradox of large populations of desert waterbirds in Australia. Landscape *Ecology* 16: 547-556.

Roshier, D.A., P.H. Whetton., R.J. Allan., and A.I. Robertson, (2001b): Distribution and persistence of temporary wetland habitats in arid Australia in relation to climate. *Austral Ecology*, 26: 371-384.

Rudebeck, G. (1955). Some observations at a roost of European Swallows and other birds in the south-eastern Transvaal. *Ibis* 97: 572-580.

Saikia, P. and P.C. Bhattacharjee (1987): Study of the avifauna of Deeperbeel a potential bird sanctuary of Assam. Waterfowl Conservation in Asia. Procd, *IWRB*, 188-195.

Saikia, P. and P.C. Bhattacharjee (1988): Observation on the winter migratory birds of Jayasagar Tank, Assam, *Hornbill* (BNHS).

Saikia, P. and P.C. Bhattacharjee (1989): Adjutant stork at risk in Assam. *SIS-Newsletter* (IUCN specialist), 2 (1&2): 6-8.

Saikia, P. and P.C. Bhattacharjee (1990a): A Preliminary report on the status of Adjutant Storks of the Brahmaputra valley, Assam. *AWB-Newsletter* (accepted).

Saikia, P. and P.C. Bhattacharjee (1990b): Nesting records of the Greater Adjutant Storks in Assam. *SIS-Newletter* (accepted).

Salim Ali (2002): The Book of Indian Birds, Bombay Natural History Society, Oxford.

Salim Ali, (1996): The book of Indian birds. Revised Edition. *Bombay Natural History Society*, Mumbai. pp. 1-330.

Sampath, K. (1989): Studies on the ecology of shorebirds (Aves: Charadriiformes) of the Great Vedaranyam Salt Swamp and the Pichavaram Mangroves of India. Ph.D. Thesis, Annamalai University, India: 202 pp.

Sampath, K. and K. Krishnamurthy, (1989): Shorebirds at the Great Vedaranyam Salt Swamp, Tamil Nadu, India. Stilt, 15: 20-23.

Sampath, K. and K. Krishnamurthy, (1993): Birds of the Pichavaram Mangroves and the adjoining coastal environs. *J. Ecological Society*, 6: 23-28.

Santharam, V., and R.K. Menon (1991): Some observations on the waterbirds populations of the Vedathagal Bird Sanctuary. *Newsletter for Birdwatchers*, 31: 11-12, 6-8.

Satheesan, S.M. and P. Rao (1990): Roosting and feeding of harriers in Secundarabad, Andhra Pradesh: 120-140.

Sayre, W.M. and W.D. Rindle., (1984): Comparison of habitat use by Migrant sores and Virginia rails. J. Wild. Manage. 48 (2):599-605.

Seitz, A. (1940). Die paarbildiung bei einigen Cichliden. I, Die paarbildung bei Astatotilapia atrigigena Pfeffer. Zeithschrift fur *Tierpsychologie* 4: 40-84.

Sengupta, S. (1973): Significance of communal roosting in the Common Myna Acridotheres tristis (Linn.). *J. Bombay Nat. Hist. Soc*. 70 (1): 204-206.

Senner, S.E. and S.R. Drennan (1995): Conservation commentary: Ornithology and the Natioanl Biological Survey. *Auk* 112: 804-806.

Shankar, J.V. (1960): Manorial studies on the grasslands of Bombay. Ph.D. Thesis, University of Bombay.

Shantz, H.L. (1954): The place of grasslands in the earth's cover of Vegetation. *Ecology* 35: 143-151.

Sridhar S., A.K. Chakravarthy, K. Shridhar and N.A. Prakash (1996): Priorities for conservation of Kokre Bellur Herronary in Karnatka, south India, University of Agri. Sci. Banglore. B.N.H.S. P. 31.

Sridhar, S. and Srinivasa, T.S. (1992): Asian Mid-Winter Waterfowl Science. *Newletter for Birdwatchers*, 32 (11&12): 1 and 18.

Srivastava O.N. and Mukherjee, D. (1993): Some desmids from Purulia (West Bengal). J. Indian bot. Soc. 72: 293-297.

Stephen Debus, (1998): The Birds of Prey of Australia. *A field guide*: 1-450.

Stewart, R.E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, *Fargo,* N.D. 295 pp.

Subramanya S. (1996): Status and conservation of Indian hewnries G.K.V.K. University fo Agricultural Sci. B.N.H.S. P. 25.

Tara Gandhi, (1995): Bird-aided Natural Regeneration of Vegetation. Bird *Diversity and Conservation* pp. 32-44.

Teylor, J.A. and D. Bullock, (1985): Rainfall in wet-dry tropics. Extreme events at Darvin and similarities between years during the period 1870-1973-inclusive *Australian Journal of Ecology*, 10: 281-295.

Verner, J. (1975): Avian behavior and habitat management. In Proceedings of the symposium on management of forest and range habitats for non-game birds. Washington DC, USDA *Forest Sevice*: pp. 39-58.

Vijayan, V.S. (1986): On conserving the Bird fajuna of Indian wetland Proc. Indian Acad. Science (Animal Science, Plant Science Suppl.), November, 1986: 91-101.

Vijayan, V.S. (1991): Keoladeo National Park Ecology Study 1980-1990. *Fina. Report. Bombay Nat. Hist. Soc., Bombay*, Pp 337.

Vijayan, V.S., V. Lalihta, V. Sridharan, N.K. Ramachandran, S. Bhupathy and C. Sivasubramanian, (1990): Comparative abundance of waterfowl in Keoladeo National Park. Pp. 115. In: Proc. of Seminar on Wetland Ecology and management *B.N.H.S Keoladeo* Bharapud 23-25, Feb.1990, pp.154.

Yardi, D. (1999): Collection of records of migratory birds and local birds in Dr. Salim Ali Sarovar, Sukhna and Jayakwadi Project, Aurangabad, Lonar lake Dist. Buldhana. Submitted to Forest Dept. Aurangabad.

Yardi, D. (2011): Eco-Sustainability Assessment of Jaikwadi Dam with refrance to Bird Sanctuary. Ph.D. Dr.B.A.M.University, Aurangabad.