

SUMMARY

The irregular rainfall in semi-arid zone of Gujarat has often resulted into scarcity of water. This had given rise to the concept of “one village one pond” to fulfill the needs for water. To overcome the scarcity of water faced by the farmers for irrigation, in Vadodara (22°17'N, 73°15'E), numerous water/ irrigation reservoirs were constructed during the Majestic rule of His Highness Shrimant Maharaja Sir Sayajirao Gaekwad III of erstwhile State of Baroda. Out of these, two irrigation reservoirs Wadhwana Irrigation Reservoir (WIR) and Timbi Irrigation Reservoir (TIR) and two village ponds: one rural Masar Village Pond (MVP) and one urban Harni Village Pond (HVP) in the outskirts of Vadodara city are selected in the present study. These waterbodies, with their shallow waters are considered as *Wetlands* that support the diverse flora and fauna. These habitats, being the transitional zone between land and water are highly productive and show dynamic characters. Among the diverse flora and fauna supported by the wetlands birds, that are designated as health indicators, form a prominent component used for the assessment of a habitat. It is known that the main factors affecting bird congregations are the habitat characteristics and the availability of prey. Hence, birds are studied in detail with some of the important biotic and abiotic parameters known to influence the productivity of wetland thus in turn the congregation of birds. An attempt is also made to correlate these parameters with bird congregations.

Chapter I: Bird species Diversity and Density

This chapter deals with the waterfowls, the birds that depend on the wetlands either throughout their life or part of their life. As birds have higher dispersal rate they are considered to be the important component of a habitat. For convenience of analysis depending on their feeding habits the waterfowls studied are categorized into four groups Group 1-Divers and Marsh birds Cormorants, Grebes, Moorhens, Coots and Jacanas, Group 2- Ducks, Group 3- Waders and Group 4- Kingfishers and Terns. The bimonthly visit to every wetland has helped in interpreting the seasonal variations in the density as well as the diversity of the birds that is supported by each of the wetlands. At all the four wetlands, the density and the species richness showed highly significant variations over the four seasons. The density of the birds was highest during winter as this is the migratory period. Vadodara, with its rich wetlands as well as being located in the migratory route, supports good density as well as diversity of migratory birds. The lowest density of the birds was observed during monsoon at all the four wetlands. During this period the resident species of waterfowls are busy in their nesting activities and as water is everywhere with abundant supply of food, their visits to wetlands are infrequent. The species richness is also highest during winter and lowest during the monsoon. The dominance of group 1 (Cormorants, Grebes, Moorhens and Jacanas) during summer and postmonsoon at WIR, TIR and HVP suggests the availability of favourable conditions for this group during the said periods. Group 3 birds (Waders) dominated during monsoon mainly because of Egrets and Storks,

which occupy the area during this period. Further, during winter group 2-ducks; dominated WIR with the arrival of migratory population. At TIR the group 1 dominates during this period. It is noteworthy that, MVP being a rural pond was always dominated by the group 2 birds. Whereas the HVP, being an urban pond, was mainly dominated by the group 1 birds. This suggests the difference in habitat utilization by birds as rural and the urban waterbodies. Group 3- Waders that includes largest number of species, was dominating at 3 wetlands with respect to the species richness. However, HVP was dominated by group 1 throughout the year while Group 4 being the smallest group was always in minority at all the wetlands. As far as density/ km² is concerned the undisturbed village pond at Masar supports higher compactness of birds than the large irrigation reservoir (WIR) studied.

It is known that when the species diversity (H') high the birds are less evenly distributed (E is low). However, in the present study H' and E are low at the larger wetland (WIR) with high density and species richness while high at smaller wetland (HVP) with few species and low density of birds. The correlation of bird density with other factors suggests that no common factor is correlated with bird density. At all the Freshwater wetlands of semi arid zone of Gujarat, different abiotic parameters are correlated. Though the larger wetlands support huge congregations of birds smaller ones are equally important as they support a healthy ecosystem with varied biodiversity. This chapter stress the importance of smaller wetlands in urban and rural areas.

Chapter II: Mollusc density and diversity

In this chapter an attempt is made to show that wetlands being dynamic and highly productive ecosystems support the organisms of various trophic hierarchies. Molluscs are one of the major prey base for several species of birds especially the waterfowls. Mollusc shells being made up of calcium carbonate form the major source of calcium for the birds mainly during the breeding season when demand for calcium is high for formation of egg shell.

During present study of the semi arid zone only seven species of mollusc belonging to six families were noted.

Out of these, the *Bellamya bengalensis* was the most widely distributed species that was dominant at three wetlands (WIR, TIR, HVP). Though *B. bengalensis* was the common species, the proportions of species differs at all the wetlands. The major difference in the species composition is noted at WIR and TIR where *Pila globosa* and *Lamellae consobrinus* were sighted occasionally. The Narmada water inundation takes place at both the irrigation reservoirs influencing water levels. At MVP, the *Thiara granifera* species is observed to dominate the wetlands. *T. granifera* prefers brackish water. MVP is only about 15-20 kms. away from the Mahi river estuary and is probably under the influence of under ground water flow from it. This makes the water more saline from late winters till the beginning of monsoon. *Thiara granifera* is known to tolerate the brackish water and hence its dominance at MVP. At HVP the most dominant species is *B. bengalensis* and next dominating species is *Indoplanorbis exustus*. *I. exustus* is known to harbour

several parasites. Thus, HVP, that is under anthropogenic pressure, with sewage input is a favourable habitat for this species.

The variations in density of mollusc are different during all the seasons and indicate that the water cover and not the water level is mainly affecting the density of the molluscs. At WIR, the bird density is high during winter but mollusc density is low. The lower temperature forces the mollusc to move to deeper parts of the soil. Here the densities of birds like Glossy ibis, Godwits and Sandpipers that catch mollusc with their long beak from deeper soils of shallow water are high thereby favouring their congregations.

The mollusc density is correlated with the alkalinity at two wetlands (TIR and MVP). All the four wetlands studied showed different abiotic factors correlated with molluscan density.

A detail study regarding the soil physico chemical parameters and the mollusc density may indicate the relationship of molluscan density to various anthropogenic as well as environmental factors.

Chapter III: The Plankton Density and Diversity.

The interactions between different trophic levels are important in determining the structure of an aquatic community. The trophic structure of a community depends on the basis of available biomass, which in turn is dependent on the available resources and primary productivity. The plankton, forming a major constituent of the productivity and also being at the base of a wetland ecosystem, are considered in chapter III. Being the prey for various organisms in an aquatic ecosystem the

plankton distribution has been considered to be heterogeneous. Plankton serve as food sources directly for several species of birds as well as for other macroorganisms on which birds feed establishing a very healthy food chain. Categorized as phyto and zooplankton, the Zooplankton are further considered depending on the class to which they belong. In the present study the Crustaceans were the dominant group at all the wetland and were found to be maximum during all the seasons. Rotifers, known to thrive in the flowing water ecosystem (Lotic), were noted during some part of year while during winter the Rotifers were either absent or were observed only occasionally.

The seasonal fluctuations in the density of plankton are noted in the present study with highest density during summer at all the wetlands and lowest during the postmonsoon in the case of irrigation reservoirs. During both the monsoons of the study period the high flood levels had created an effect of a lotic ecosystem, less preferred by the Crustaceans and hence low Crustacean density along with total plankton density was low. Similar conditions are created at the village pond during monsoon resulting in the lowest plankton density of the year. The species richness indicates that though all together twenty-two species are observed, during each visit only a few species were visible. Various abiotic parameters are correlated positively or negatively at the four wetlands studied.

Chapter IV: The study of Abiotic Parameters.

In chapter IV the abiotic factors that are known to affect the biotic communities are discussed. In the aquatic ecosystem, apart from the changes in wetlands itself,

but any change in the landscape can influence the ecosystem. The physical and chemical properties of freshwater body are characteristic of the climatic, geochemical, geomorphological and pollution conditions prevailing in the drainage basin and the underlying aquifer. However, in recent days the physical and chemical properties of freshwater are often altered by the human activities, actions which can have positive or negative impacts. Some of the steps like construction the irrigation of reservoir and dam have positive effects while the others like the sewage drainage or the industrial run off, *etc.* have negative impact on the wetland ecosystem.

Several physical aggregate properties such as Temperature, Water cover, Solids, pH, Acidity, Alkalinity, Salinity, Hardness, and the inorganic Non-metallic constituents like Dissolved Oxygen, Carbondioxide, Chloride, Nitrates, Nitrites, Phosphates are discussed in this chapter.

The seasonal fluctuations in the said parameters are observed at all the wetlands. These fluctuations were either because of the seasons, the geographic location, the anthropogenic stress and the inundation of water from a major river (in the case of WIR and TIR). The seasonal changes had its influence on the physical aggregate parameters like Water Temperature, Water cover, Acidity, Bicarbonate Alkalinity, Salinity and Hardness. Such impacts are noted on the inorganic nonmetallic constituents like the Dissolved Oxygen and Nitrates too.

The geographical location also has its influence on the abiotic parameters like the Chlorides, Salinity and Hardness, which is apparent at MVP, the wetland about 15

to 20 km. away from the Mahi river estuary. The ground water influence probably performs a major role in bringing about these significant changes. The change noted in Temperature of water were based on the location of the wetland. The wetlands closer to the city area (TIR and HVP) had higher temperatures, than those in the rural areas (WIR and MVP).

Another important factor is the impact of the water inundation at the reservoirs which contributes to the variations of several abiotic parameters. The hydroperiod, water cover and the water level are major physical components of the water body that could have their influence on the abiotic parameters and as a result the biotic communities. Two wetlands in the present study are irrigation reservoirs that are often inundated with the Narmada River water. This brings about changes in several parameters. As far as Total solids are concerned the water coming from the river either agitates the reservoir water and increases the Solid amount in the water or it may also reduce the solid contents in the reservoir by diluting it. Another change noted is on the Hydroxyl Alkalinity. It is noted that the irrigation reservoirs are more alkaline as compared to the village ponds that are dependent mainly on the rain water.

Two study areas are village ponds (MVP and HVP), having varying degree of domestic dependency on them. However, at MVP in addition probable underground influence of Mahi River Estuary is suggested on the chemistry of water. Whereas at HVP the domestic dependency is extending in the form of sewage

input hence difference in the chemistry of water is correlated positively as well as negatively with several abiotic parameters.