Chapter-I

INTRODUCTION

The present work deals with ichthyofaunal study in Bhandardara reservoir related to water quality parameter. Hydrobiology of Bhandardara reservoir is a source of drinking and irrigation for many villages of Ahmednagar district of Maharashtra state of India. This water is also used for generation of electricity. Although no serious studies have so far been conducted on the ichthyofauna and hydrobiology of this reservoir. Bhandardara reservoir constructed by British government in tribal area for purpose of drinking and soil irrigation and food but ecosystem in reservoir depends on seasonal variation, which affect flora and fauna of the system. The significance and background of this research work cannot be appreciated without discussing some of basic issues of fresh water reservoir.

Wilson Dam is located at Bhandardara in western part of the Ahmednagar district in Maharashtra. It is also commonly known as Bhandardara Dam. It is built across the river Pravara, near the village Bhandardara. This is one of the oldest existing dam in the state. Mr. Arthur Hill discovered the site for this dam in 1903. The creation of this dam was started in 1910 and it was finished in 1926. The catchment area of dam is 12200 Sq.kms. The live storage is of water is 11.039 TMC and dead storage is 3 TMC. The depth of the dam is 270 feet. The base width of the dam wall is 260.10 feet. The main source of water for dam is streams, rivers, fountains etc. The annual rainfall up to Ghatghar is 5460 mm. and on dam 3225 mm. The total irrigated area under the dam is 23077 hectares.

Algae are the important part of the food web and provide shelter to other organisms. Thus they are the major part in aquatic ecosystems. They play a crucial role in the aquatic ecosystem to absorb nutrients, toxic material, heavy metals and convert it into simplest form. Saha and Choudhary, (1985) studied the phytoplankton diversity in relation to abiotic aspects of a pond at Bagalpur, India. The primary producers are the base of aquatic ecosystem. They occur in the lentic (standing water) as well as lotic water (running water). Sarode, and Kamat, (1983), investigated the diatoms flora of Marathwada, Maharashtra. In the present study diatoms were correlated with these references. Tiwari and Chauhan (2006) reported the seasonal phytoplanktonic diversity of Kithamlake, Agra. Biological assessment is a beneficial alternative for assessing the environmental quality of aquatic ecosystems meanwhile biological communities integrate the environmental effects of water chemistry, the physical and geomorphological
characteristics of Rivers and lakes Stevenson (1999). Zooplankton have many economic importance in nature they constitute major portion of food for many of the larger fish. Abundance of zooplankton in estuarine habitats acts as breeding ground for many commercially important fishes and shrimps. Many species of zooplankton in general and copepod in particular are parasites on fish and other animals.

They also serve as intermediate hosts to complete life cycle of many worms. Zooplankton are important source of industrial products such chitin and its derivatives. Zooplankton are ideal organisms for toxicological studies and environmental monitoring due to their short life and wide distribution. Many zooplankton act as ecological indicators. The zooplankton community has import role in aquaculture productivity in aquatic ecosystem. Zooplankton are the most fascinating group of microorganism found in aquatic body. Zooplankton has been a subject study in India. Several workers like Ajah, (2002) Sreenivasan (1974), Ramamurthy (1975), Vasishta and Sharma (1975), Yousuf and Gudri (1986), Nath and Dey (1989) Michael (1973) etc. have contributed to our understanding of zooplankton.

The zooplankton in water belongs to four main taxonomic groups such as Rotifera, Copepod, Ostracoda and Cladocera. Copepod and Cladocera are the dominate represented groups of crustacean in fresh water habitats. They are abundant in the shallow areas of reservoir but only few species are abundant in the open water. The occurrence and abundances of zooplankton in a pond depend on its productivity which intern is influenced by physico chemical parameters and the level of nutrients. Zooplanktons occupy an intermediate position in food webs. Many of them feed on algae and bacterial and interns are fed by numerous invertebrate and fishes.

Zooplankton occupies a key position in the ecological energy pyramids and their role in trophodynamics is noteworthy. Henson (1887) described plankton’s means wandering, to describe the suspended microscopic materials at the mercy of the wind currents and tide. Planktons are pelagic floating organisms that have very flexible locomotors organs and simply drift with the water currents.

Water is a soul of nature it is one of the basic need of mankind. It is most important environmental factor and is essential for well being of the living world. Life originated in water and most of the biological phenomenon takes place in liquid medium. Wherever water exist in nature it always hold life. So study of water body is the study of life as well. Water is the
essential at all level that is cellular to ecosystem and within the body of each living things. Water is key substance for existence and continuity of life. Human being depends on this resource for all their needs. For existence and survival of aquatic fauna like phytoplankton and zooplankton which are the major element of food chain in aquatic ecosystem this resource play key role

Zooplankton have many economic importance, in nature they constitute major portion of food for many of the larger fish. Abundance of zooplankton in estuarine habits acts as breeding ground for many commercially important fishes and shrimps. Many species of zooplankton in general and copepod in particular are parasites on fisher and other animals. They also serve as intermediate hosts to complete life cycle of many worms. Zooplanktons are important source of industrial products such as chitin and its derivatives. Zooplankton are ideal organisms for toxicological studies and environmental monitoring due to their short life and wide distribution. Many zooplankton acts as ecological indicators. The biological parameters such as phytoplankton, zooplankton and aquatic microorganisms are much more important in any water body, because they acquire important position in the trophic structure of that ecosystem. Moreover several species of phytoplankton and zooplankton and aquatic saprophytes can play a great role in early detection and monitoring the pollution.

The reservoir is a unique man-made ecosystem. Thus there is a large variation in its qualities caused by fresh water influx of tributaries and land drainage. These make the reservoirs a unique ecosystem and life in such environment is possible only for those organisms which can adapt themselves to the varied conditions. The productivity of reservoir ecosystem is dependent on several characteristics of water. Of these, most important ones are the nutrient available for phytoplankton production, which in turn determine the level of animal production in the reservoir ecosystem and its production potential, it is necessary to study the inter relationships and interactions among physic-chemical and biological factors of the environment.

There water bodies store the fresh water from adjoining area during rainy season and are important to impound surface water excess for the requirement of various purposes are located in agro-climatic regions. They are spread over on different types of soils and are exposed to various climatic conditions. It plays a vital role in any ecosystem. The fresh water is a finite and limited resource. Water parameters are very important for understanding of the metabolic proceedings in aquatic ecosystem. The parameters influence each other and also the sediment parameters as well as they govern the abundance and distribution of flora and the found. It has become obligatory to
analyze at minimum the significant water parameters when ecological studies on aquatic ecosystem are carried out. Such studies when done from time to indicate the favorable / unfavorable changes occurring in the ecosystem.

On the earth has more amount of water, it is not equally distributed on the earth. As much as 2/3 of the earth is surrounded by water. Of the total water found on earth, 97.47 percent is deposited in the oceans, seas, lakes and rivers, the most important freshwater resources, account for a measly 2.53 percent. The amount of fresh water on earth is very small compared to seawater of which 69.0% is locked away in continental ice, 30.0% in underground aquifers, and 0.26% in rivers and lakes. Lakes in particular occupy less than 0.007% of the worlds freshwater.

Microscopic plants and animals are able to spend their whole life floating in the water. These suspended organism form plankton. Plankton consisting animal part is called zooplankton and plant part is called as phytoplankton. The plankton can also be classified according to size of the constituents. The smallest planktonic animals and plants are called microplankton. Microplankton have size less than 3mm. Large number of zooplanktonic organisms like Protozoa, Rotifers, Crustaceans such as Cladocerans, Copepods and Ostracods. The largest planktonic forms are known as various invertebrates larvae. Plankton in stream is derived from lake or ponds. Rotifera and Cladocera are common zooplankton mainly found in standing water, but also in swift streams. Lakes at high latitudes have more plankton as compared to temperate region. Lake of low altitudes is extremely variable in their planktons. Horizontal distribution of plankton in the lake is irregular due to the current of water.

Fresh water habitats occupy a relatively small portion of earth's surface as compared to marine and terrestrial habitats. These are distributed in rural and urban areas of the country and are useful to mankind in many respects such as source of drinking water, irrigation, washing, bathing and for fish production. Moreover, scientifically speaking fresh water bodies has great Aquaculture, Ecological and Recreational potential, therefore such water bodies are becoming a symbol of environmental status. Year 2003 is declared by United Nations as the International year of freshwater to globally focus the issue of emerging water crisis all over the world. Fresh water, its availability, equity and sustainability is posing a global challenge and there is an all-round acceptance of the fact that world is facing freshwater crisis Kodarkar, (2003).
Precipitation is the chief source of soil water. The water available to plants and animals from soil comes as a result of rainfall. There occurs an interchange of water between the earth's surface and the atmosphere, forming the water or hydrologic cycle. The two important events, which are involved in this cycle, are precipitation and evaporation. In fact, water during rainfall is directly of little or no use to the organisms. It is used only after reaching to the soil. Precipitation is the result of gravitational pull on the vapor in atmosphere. Precipitation occurs in various forms. These are drizzle, rain, snow, dew and frost, sleet and hail. Drizzle involves minute drops appearing as to float in air. Rain is the drop of liquid water, which is larger than drizzle and also heavier. Snow is the moisture as solid state, and dew and frost is formed due to condensation of moisture directly on the surfaces of objects, plants, animals, soil etc. Sleet is the form of small grains or pellets of ice, whereas hail consists of balls or lumps of ice. Snow are injurious to plants, breaking tender branches, flowers and fruits. Hail and sleet also cause similar damage. Of all the above, precipitation, the rain is the most important. It is the source of soil water and also affects humidity of atmosphere. Rain in India is caused by monsoon. About 45% of the water available during annual precipitation flows into rivers, 20% percolates into the ground and remaining 35% is lost by evaporation. Sharma, (1998).

When both, biotic and abiotic components are considered, the basic structural and functional units of nature are ecosystems. Discrete biological units consist of populations and communities, including biomes. Each population occupies a specific niche, a unique functional position with respect to other organisms with which it interacts.

Successful growth of the organism is governed by limiting factors. For success in growth and reproduction with a particular habitat, an organism requires various essential factors from its environment. The success of an organism is limited not only by the deficiencies in substances or conditions but also by excesses. The minimum and maximum levels of tolerance for all ecological factors of a species vary seasonally, geographically and according to the age of the population. Sharma, (1998).

Such limnological investigations involves mapping the shape and depth of the water body and observations on the physicochemical parameters and effect of pollution if any, however, little is known about the water bodies of the tropical countries which are either underdeveloped or developing. Thus, there is void in our knowledge about the tropical inland waters. Even the
basic floristic and faunastic studies have not been carried out in a planned way. The literature on fresh water fauna and physicochemical parameters is too scattered. VijayKumar, (1999)

In aquatic ecosystem physico-chemical environment exert profound influence on its biotic components. It controls biodiversity, biomass and spatial distribution of biotic communities in time and space. The physical and chemical parameters exert their influence both, individually and collectively and their interaction creates a biotic environment, which ultimately conditions the origin, development and finally succession of the biotic communities. Salaskar, (1997).

Therefore, the evaluation of the physico-chemical parameters and its annual minimum and maximum range in an aquatic ecosystem is very significant to determine the implementation of species composition of fish, in order to obtain the maximum possible output in terms of fish from such water bodies. Physical parameters defined those characteristics of water that respond to the senses of sight, touch, taste and smell. Temperature, turbidity, suspended solids, color, and odor fall in this category. Water has been called as universal solvent, and chemical parameters are related to the solvent of water. Total dissolved solids, pH, alkalinity, hardness; metals, organics and nutrients are chemical parameters of concern in water-quality management. Abbasi, (1998).

Among the chemical factors, it is increased production of fish are mentioned the differences in the chemical constitution of waters which are primarily responsible for varying fertility of the aquatic soil, on which entire fish food cycle is based. Phosphates, nitrates and silicates, which are released in to water from bottom sediments due to microbial degradation of the highly complex dead organic substances which are utilized by the chlorophyll-bearing plant organisms for their assimilation. These organisms form the food of zooplankton, which in turn form the food of fish.

The presence of above inorganic nutrient substances is therefore, essential for increasing the fish food. Whenever they are absent in lakes and ponds, frequent manuring with appropriate fertilizers, until there is a formation of plankton bloom in water must restore their deficiency. The nature of bottom deposits is extremely important in the formation of nutrient substances of biological significance. If the sediments are composed of rotting organic matter derived from dead animals and plants found in the pond and fine black silt containing essentially black ferrous
sulphide, the effect of the fertilizer spread at such bottom will last for a longer period than the sediments of sand and mud. If productivity is to be augmented, mud bottom consisting of rotting vegetation and fine silt, should, therefore be created where there are none in fishponds. Along with the above substances, addition of calcium salts is also necessary for increasing fish production. It has been found that, fish production in "soft" waters is far lower than in "hard" waters. Waters with higher concentration of carbonates tend to produce more crustaceans and mollusks, which form the food of fish. Belsare, (1986)

We may study the aquatic ecosystem by conveniently dividing it into some basic components such as abiotic and biotic. The abiotic components includes the parameters such as heat, light, pH value of water, and the basic inorganic and organic compounds, such as water itself, nitrogen, phosphates, amino acids carbon dioxide, oxygen, calcium, humic acid etc. Some proportions of nutrients are in solution state but, most of them are present as a particulate matter as well as in living organisms. The amount of minerals present at any time in the physical environment of the pond- 'standing state' may be estimated by appropriate methods. The light intensity is measured by Lux-photometer. Turbidity index of water at different depths is obtained by a Secchi disc. Rates of evapo-transpiration are calculated. The pH of water and mud is determined by an electric pH meter. Dissolved oxygen content, free carbon dioxide content, solute contents including colloidal suspensions, phosphate and nitrogen contents of water and plants and animal matters are estimated by using appropriate methods.

The various organisms that constitute the biotic component of an aquatic ecosystem are classified as –

A) Producers- These are green plants and some photosynthetic bacteria and autotrophic. The producers fix the radiant energy and with the help of minerals derived from the water and mud, they manufacture complex organic substances as carbohydrates, proteins, lipids etc. Producers are of following types-

1) Macrophytes: These are mainly rooted larger plants, which include partly or completely submerged, floating and emergent hydrophytes. The common plants are the species of Typha, Sagittaria, Vallisneria, Nymphaea, Potamogeton, Chara, Hydrilla, Utricularia. Besides them some free floating forms as Azolla, Salvinia, Wolffia, Eichornia, Spirodella, Lemna etc. also occur in reservoir.
2) Phytoplanktons- These are minute, floating or suspended lower plants. Majority of them are filamentous algae as *Cladophora* and *Oedogonium*. Besides them, there are also present some Chlorococcales, *Zygema, Ulothrix, Spirogyra, Closterium, Cosmarium, Scenedesmus, Volvox, Diatoms, Anabaena*, some Chlorococcales, *Gloeotricha, Microcystis, Oscillatoha, Chlamydomonas, Spirulina* etc. and also some flagellates.

**B) Consumers-** These forms in aquatic ecosystems are heterotrophs, which depend for their nutrition on the organic food manufactured by producers, the green plants, a few of insects and large fishes are carnivores feeding on herbivores. Some fish also feed on other carnivores as well. The consumers of an aquatic ecosystem are distinguished as - Primary consumers- also known as primary macro consumers. Secondary consumers- these are carnivores, which feed on primary consumers including insects and fish. Tertiary consumer- these are large fish as game fish feed on the smaller fish and become tertiary.

Turbidity in natural waters is caused by the presence of suspended matters such as clay, silt, colloidal organic particles and phytoplankton. It is actually an expression of light scattering and light absorbing properties of the water and often referred as an evaluable limiting factor in the biological productivity of the water bodies. Turbidity when largely due to phytoplankton is considered as an index of productivity but on the contrary when it is because of suspended matter, it restricts the light in water, resulting reduced primary production. Turbid water has aesthetically displeasing opaqueness and "milky" colouration. The colloidal material associated with turbidity provides adsorption site for chemicals that may be harmful or cause undesirable taste and odour and for biological organisms that may be harmful. Disinfections of turbid waters is difficult because of the adsorptive property of some colloids and because the solids may partially shield organisms from the disinfectant. In natural water bodies turbidity may impart brown or other colour to the water, depending on the light absorbing properties of the solids, and may interfere with light penetration and photosynthetic reactions in lakes and streams. Accumulation of turbidity causing particles in porous streambeds results in sediment deposits that can adversely affect the flora and fauna of the stream. Abbasi, (1998).

Total dissolved solids are defined as the material remaining in the water after filtration for the suspended solids analysis is considered to be dissolved. The material is left as solid residue upon evaporation of the water and constitutes a part of total solids. Inorganic substances,
which may be dissolved in water, include minerals, metals, and gases. Water may come in contact with these substances in the atmosphere, on surfaces, and within the chemicals, and from the organic gases are common organic dissolved constituents of water. Many dissolved substances are undesirable in water.

Dissolved $\text{O}_2$, gases, and constituents may produce aesthetically displeasing colour, taste, and odour. Some chemicals may be toxic, and some of the dissolved organic constituents have been shown to be carcinogenic. Quite often, two or more dissolved substances—especially organic substances and member of the halogen group—will combine to form a compound whose characteristics are more objectionable than those of either of the original materials. Not all substances are undesirable in water.

It is needless to highlight the importance of water in our life. We need water for different purposes. We need water for drinking, for industries, for swimming for irrigation, etc. Thus water for different resolves has its own requirements for the composition and purity and each body of water has to be analyzed on a regular basis to confirm to suitability. The types of analysis could vary from simple field testing for a single analyze to laboratory based multi component instrumental analysis.

The analytical process involves sampling and sample storage since changes in composition of water do not stop once the sampling has been taken. Protection has to be taken to make sure that the water success the laboratory has the same composition as when the sampling was completed.

Though the terms “acidity” “alkalinity” and “neutrality” are in common use they refer to complex chemical situations. Acidity indicates the total available acids as well as the concentration of hydrogen ions. Water is said to be alkaline when concentration of hydroxyl (OH$^-$) ions exceed that of the hydrogen (H$^+$) ions. Chemically pure water is neutral having equal amounts of hydrogen and hydroxyl ions.

In acid waters, productivity is low because, acidity not only inhibits nitrogen fixation; it also prevents the recirculation of nutrients by reducing the rate of decomposition. Alkaline waters are generally known to show high biological productivity. The presence of calcium carbonate improves aeration permeability indirectly by increasing the particle size of the soil due
to the flocculation of colloidal humus gel. Moreover, the ability of these colloids to interact with neutral salts results in the reduced production of hydrogen. This inhibition of hydrogen liberation brings about favorable conditions for rapid bacterial decomposition of the organic matters accumulates at the bottom. Nutrients thus get released into the system favoring production of plant materials.

The acidity of the most of the natural waters, domestic sewage and industrial waters results from strong mineral acids such as HCl and weak acids such as carbonic acid and acetic acid, and to oxidizable ions of aluminum and manganese. In natural unpolluted waters, the acidity is mainly contributed by dissolved carbon dioxide, through the acids produced by the reaction of carbon dioxide with water. In industrial waste waters, mineral acidity is frequently encountered. Acidity may influence the equilibrium and reaction rates of chemical and biological processes. Acidity is one of the important parameter considered during the treatment of water and wastewater. Neutralization, lime soda water softening and CO₂ removal by aeration are some of the important treatment processes where acidity measurements are used. Abbasi, (1998)

Chlorides occur practically in all waters and waste waters and are often a major inorganic constituent. In natural waters, chloride results from the leaching of chloride containing rocks and soils with which the water comes in contact. In coastal regions salt water intrusion may contribute to the chloride content of inland waters.

Discharge of agricultural, industrial and domestic wastewaters could also be a source of chlorides in natural waters. Water softener also adds to the chloride content of the water. Human excreta contain about 6 gms. chloride per person per day. Chlorides may impart salty taste to water, depending on the cation constituents. Some waters containing 280 mg/l may have typically salty taste, if the main cation is sodium, whereas in some other waters this taste may be absent even when chloride content is as high as 1000 mg/l if the predominant cations are calcium and magnesium. High calcium content may harm metallic pipes and structures. High chloride content in irrigation water may be harmful to many plant species. Abbasi, (1998).

There is an intricate link between the physical and chemical parameters and living communities in water. For example, temperature and DO determines to a very large extent the type and number of organisms in water, but at the same time mere presence or absence of living
organisms would indicate the healthy\^\textsuperscript{a} unhealthy state of affairs, respectively. Aquatic organisms range in size and complexity from the smallest single celled microorganism to large fishes, mammals and amphibians. A body of water hosting large number of species with well-balanced number of individuals is considered to be healthy system. When water gets polluted, the organisms sensitive to that type of pollution begin to die or migrate and the dominance of species and populations shift towards tolerant organisms. Thus, based on their known tolerance for a given pollutant, certain organisms can be used as indicators of presence of pollutants. Abbasi, (1998)

Lakes, ponds and tanks are standing water ecosystems and their ecology differs from those of running water ecosystems of the fresh waters. However, in some respect common features are also manifest. Littoral zone near the shore, rooted plants and in limnetic zone plankton also develops in lakes depending upon the depth to which sunlight can penetrate. A profundal zone of deep waters with heterotrophs is equally developed. Unlike the case in rivers, in lakes the plankton shows a characteristic uneven distribution vertically. Also, zooplanktons are predominant over the phytoplankton. Crustaceans are the most important among the zooplankton. It may be noted that plankton of lakes comprises "true plankton" produce locally in the standing water of the surface to the depth sunlight can penetrate, and also differ from "drift planktons" of the streams. Shrivastava, (1988)

The macrophytes are well known to antagonize the planktonic population of the lake, either by the shade effect due to the surface area coverage or by high growth rate, resulting in nutrient deficiency.

Fresh water is one of the great importances, it is again subdivided into lentic habitat and lotic habitat. Lentic habitat ecosystem means standing water ecosystem or stagnant water ecosystem whereas lotic water ecosystem means running water or floating water ecosystem. Lentic water ecosystem such as ponds and reservoir, whereas lotic water ecosystems such as stream, rivers and tributaries.

It has been known form the Vedic time that nature and human being forms an flora, and fauna, which are interconnected and interdependent to each other. Water is one of the most essential substances available on earth. Water is needed for existence of life. It is essential and most abundant inorganic bimolecular in protoplasm of the living organism, it might be said that
all life is aquatic. The water is principle external medium for an aquatic habitat. All living organism are composed of cell that contain at least about 65 to 75 percent of water. Organism can exist, where there are accesses to adequate supplies of water. Water is essential for life.

Freshwater has been of great importance to human being and other organisms of the environment for sustenance of life, and maintaining the balance of nature hence water it eh life blood of the earth.” The most important role since ecology determines the habitability and abundance of flora and fauna in different section though the defilement of water and deterioration of aquatic system is as old civilization however escalating industrialization, urbanization and developmental and agricultural activities have brought irreversible changes to such system unplanned and excessive exploitation and mounting anthropogenic influences in and around aquatic ecosystem have resulted in pollution problems. The demands for water have increased with the increased in human activites, and therefore several of the important concepts in ecology have been developed from studies of the aquatic ecosystem and organisms. Water is one of the most precious gift of nature without which no life could survive on the earth all life on earth be contingent on water man uses water for many purposes, industrial process, drinking, irrigation, fisheries, transportation and waste disposal, rapid industrialization, urbanization and other anthropogenic activities are responsible for contamination of water bodies. The contamination occurs due to hazard and unplanned discharge of industrial waste and effluents, extensive use of fertilizer and discharge of domestic sewage etc. About 80% water pollution occurs due to domestic waste according to WHO. (1992)

The fresh water habitats have their own physical, chemical and biological characteristics which are molded by local condition and physiographic. Mukherjee (1997). According to the river for the purpose of irrigation, flood control, navigation, generation of power etc. These water sheets by virtue of their sheer magnitude, constitute an important fishery resources and contribute significantly to the in land fish production of India and provide a means of live hood to many local fisherman. Raman and Sreeamulu, (1994). Fresh water constitutes only about three percent of the total water present on the earth. The abundance of interaction of number of physical, chemical and biological processes.