ASSESSMENT OF BIOTIC COMPONENTS WITH SPECIAL REFERENCE TO FISH POPULATION OF LENTIC ECOSYSTEM

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By

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INTRODUCTION:

Fresh water is a renewable and vulnerable resource on the earth having a great role in sustenance of life of all living organisms of the environment and maintaining the balance of nature. In various activities like aquaculture, agriculture, hydropower, fisheries and industries, the water resources are being used by human being on the large scale.

Fresh water ecosystems are of two general types: Lotic (running water) and lentic (still or stagnant water). Lentic ecosystem (such as ponds, lakes, wetlands, bogs, marshes, swamps) is one of the most productive ecosystems with respect to aquatic plants and animals in the biosphere and plays a significant role for sustainment.

A pond can be defined as an earthen depression filled with water, either natural or artificial that is smaller than a lake. Ponds can majorly classify on the basis of formation and availability of water. On the basis of formation ponds have two types: Natural pond and artificial pond.

Natural pond: A natural pond is created by nature and helps to balance ecosystem. The real benefit of this kind of pond is that it requires virtually no maintenance.

Artificial pond: Artificial pond is also known as manmade pond. It generally refers to bodies of water that are built and or are maintained by humans rather than Nature. It has great importance in aquaculture and fishery.On the basis of availability of water ponds are of two types: Temporary pond and Permanent pond.

Temporary pond or Seasonal pond: It is usually rain fed water bodies found in different geographical locations. It may dry out periodically or drought in year and example of inland wetland ecosystem.

Permanent pond or Perennial pond: This kind of ponds holds water all year round, providing permanent habitat for a range of wild life as well as a many occasional or periodic visitors.

Ponds can make impact a large on the big environmental issue that us all climate change, flooding and pollution. All this, as well as being fantastic for wildlife. In agriculture, treatment ponds may reduce nutrients released downstream from the pond. They may also provide irrigation reservoirs at terms of drought.

Urban ponds are generally described as water body of a smaller, manmade or developed naturally. It also subjected to a different set of stressors dumping sewage, running of effluents through industrial waste and various anthropogenic activities.

The quality of water is described by its physical, chemical, and microbial characteristics and affects directly or indirectly by physico-chemical parameters. Water quality and its parameters are very essential for current information about the concentration of various solutes; it provides the basis for judging the suitability of water for its designated uses and to improve existing conditions. The study of physico-chemical parameters could help in understanding the structure, function and metabolic events in a particular aquatic ecosystem. These parameters change widely due to many factors like source of water, type of pollution, seasonal fluctuations.

The physical properties such as solubility of gases and solids, transparency, temperature, density, the chemical factor such as salinity, pH, hardness, phosphates, nitrates, BOD, COD etc and biological parameters such as plankton, benthos, productivity directly or indirectly affects the pond water quality, productivity, survival and distribution of flora and fauna (Jhingran, 1985; Odum, 1984).Such physical, chemical and biological parameters state the hydrobiology of a pond and influenced by surrounding environmental condition. These parameter also affects the density, abundance, growth and population of fishes.

Fish population majorly estimated through the morphology, morphometry and condition factor of fishes of specific region or study area. The morphology and morphometry of fishes exists size, structure and growth of fish population. The

condition factor indicates the condition (good or poor) or well being of fishes in population.

AIMS AND OBJECTIVES:

To exploit fresh water lentic ecosystem with their best capacities, it is essential to have knowledge of their structural status and fishery potential etc. Present study emphasizes on the condition, hydrobiology and environmental status of lentic ecosystem and their effects on fishes. The investigation was carried out to study about physicochemical and environmental components with fishery potential of ponds through monthly variation. The main aim of this research work is to establish the relation between the environmental conditions and its impact on fish population. The work was planned to address the main objectives.

1) Assessment of physico-chemical status of the lentic ecosystem.
2) Understand the biology of fish population.
3) Establish interrelation between environmental conditions and fish population.

This project was designed to assume that there is interrelation between environmental conditions and fish population of lentic ecosystem. For establishment of interrelation between environmental conditions and fish population, the fishes length-weight, and condition were analyzed with water and soil quality parameters and other surroundings of lentic ecosystem.

The selection of the criteria of the study sites were depended on availability of fish and water throughout the study period.

STUDY SITES AND AREA:

For the present study following ponds were selected as the study sites:

1. Dhobi talav
2. Majam talav
3. Danteshwar pond
4. Sama pond

Dhobi talav is perennial and natural urban pond situated near Swami Taioon Ram temple Warasiya Vadodara, there was no slum area and was not disturbed by anthropogenic activities. Majam Talav, Danteshwar Talav and Sama talav are also perennial, natural urban ponds but they were surrounded by the slum area and puccha houses and very much disturbed by anthropogenic activities.

In this research work two such ponds i.e. Dhobi talav and Majam talav were majorly investigated for the period of two year. For some period work also has been carried out for Danteshwar pond and Sama pond.

MATERIALS AND METHODS:

Parametric analysis

Such analyses are essential for assessment of hydro-biological status, environmental condition, quality of water and soil and the structure of an ecosystem. A healthy aquatic ecosystem is dependent on the maintenance of physico-chemical properties of water and its biological diversity. Water quality plays an important role in aquaculture because its imbalances can cause stress, poor growth and mortality of culture species (Boyd, and Tucker, 1998). To assess the environmental condition and hydro-biological status of study sites, physico-chemical analysis of water and soil samples was carried out throughout the study period for research work.

Water analysis

For assessment of physico-chemical status of water, the study sites were studied monthly. Water samples were collected from various sites at random from the ponds in the morning time between 7 to 8 am in plastic bottles. Water temperature was recorded by standard centigrade thermometer on site. For the estimation of dissolved oxygen, water samples were collected separately in 300 ml BOD bottles and oxygen was fixed by using Winkler's reagent at the time of sampling on field. pH was recorded by standard pH meter. All other remaining parameters were analyzed immediately on return to the laboratory by titrometric methods. The physico-chemical parameters for water quality

were assessed using standard methods (APHA, 1998), details for the same in presented in (Table 2.1).

Table – 2.1: Methods for various water quality parameters

Sr. No.	Parameter	Method	Instrument
1	pH	Electrometric method	pH meter
2	Temperature	Laboratory or Field method	Mercury Thermometer
3	Acidity	Titrimatric Method	Titration assembly
4	Alkalinity	Titrimatric	Titration assembly
5	Chloride	Argentometric Method (Titrimetric method)	Titration assembly
6	Total Hardness (TH)	Titrimetric Method	Titration assembly
7	Total Solids (TS)	Filtration method	Oven, Beaker
8	Dissolved Oxygen (DO)	Winkler's method - Azide modification method	BOD bottle, Titration assembly
9	Total Phosphorus	Ammonium Molybdate method.	Spectrophotometer
10	Nitrate	Cadmium reduction method.	Spectrophotometer

Soil quality analysis:

Monthly collection of soil samples up to the depth of 15 cm was done for the study the soil quality parameters. The soil samples were collected using scoop and were kept in thick quality polythene bags. The samples were dried in laboratory oven. The dried soil was grinded using mortar and pestle and then sieved through 2 mm mesh sized sieve and used for further analysis. The soil

quality parameters such as pH; Phosphate-P and Nitrate-N were analyzed during the investigation of the study sites by using Standard methods.

Fish population analysis

Fish population majorly estimated through the morphology, morphometric and condition factor of fishes. Morphology and morphometric of fishes exists size, structure and growth while the condition factor indicates the condition (good or poor) or well being of fishes in population.

Morphological and morphometric analysis:

Morphologic and morphometric analysis has been done by taking length and weight relationship of fishes. For such analysis the fishes {Tilapia (*Oreochromis mossaimbicus*)} were collected from the study sites.The following measurements and observations were recorded for each sample. i. Total length in centimeters. ii. Standard length in centimeters. Length was measured with the help of thread and scale (in cm). iii. Total weight in grams. Weight was measured with help of an electronic weighing balance to the nearest 0.01 (in gm). After taking measurements the fishes were released in natural water bodies.

The relationship between the length (L) and weight (W) of fish was expressed by equation **W=a Lb, (Le cren, 1951)**

Where W= weight of fish in gram, L=total length (TL) of fish in cm. a=Constant (intercept), b = The length exponent (slope)

When expressed in Logarithm: Log W=Log a + b LogL i.e. y = A+Bx**,** where Y = Log W, B = n (regression coefficient) and X =Log L. The "a" and "b" values were obtained from a linear regression of the length and weight of fish.

The correlation (r^2) that is the degree of association between the length and weight was computed from the linear regression analysis: **$R = r^2$**

Condition Factor analysis:

The condition factor (K) of the experimental fish was estimated by using Fulton's condition factor: K= W/L3 x 100 (**Fulton, 1904**).

Where K= condition factor, W= weight of fish (g), L= length of fish (cm).

All the observations were tabulated to various relevant statistical analyses to draw inference.

RESULTS AND DISCUSSION:

A comparative study of the water parameters of the study sites reveled that some water parameters were high in concentration at Majam Talav. Danteshwartalav water parameter was within the permissible limit by WHO. Dhobi Talav was having higher concentration of total solids comparatively to other sites. Phosphate and nitrate were noticed as a growth indicator on the all study sites. These parameters were having good range for growth of fishes.

Soil parameter exhibited that its alkaline nature is suitable for growth of fauna and flora of the study sites Majam talav and Dhobi talav. Whereas Phosphate and nitrate concentration were differ at both the sites which affect fish population size and growth respectively.

After the study of fish population length weight relationship of all the study sites, it has been seen that fishes were having different range of length and weight. The water and soil quality parameters reflect the abundance and sustainment of fishes. The fish length weight data revealed that fishes were in good conditions and exhibited negative allometric growth at the all study sites except Majam talav where the b (length exponent) the b value is near to three which indicate isometric growth.

A comparative study of Majam Talav and Dhobi talav revealed that that the range of total length and weight of fishes of Majam talav were high. Fishes were better in condition and abundance of fishes was also good. The data also indicate that the biomass of the fishes of the Majam talav was higher than the Dhobi Talav.

Most of all the parameters were maximum in summer and minimum in monsoon and winter exhibited seasonal fluctuations through which growth of fishes were affected seasonally. Finally it can be assumed that environmental conditions of the study sites create interrelation between the fish population and aquatic ecosystem. Evaluation of the relationship between environmental

conditions and existing fish population of lentic ecosystem is beneficial for pisciculture practice.

After the experiments and observations, it has been found that water quality parameters such as temperature were suitable for the aquatic medium of the study sites. pH exhibited alkaline nature of water which was suitable for aquatic fauna such special fish growth. The acidity, alkalinity, total hardness, and total solids were indicated that they create a productive column for abundance of fish population. Dissolve oxygen was with good concentration for productivity for aquatic environment and fish growth. Chloride concentrations were also suitable for growth and abundance of fishes at the investigated sites.

CONCLUSION:

The fresh water ecosystems are the good sources of rearing fish culture and aquaculture. They provides habitat to aquatic flora and fauna, but now a days due to urbanization, increasing population and industrialization such ecosystem have disturbed at their tropic level which affects the sustainment of aquatic life so it is necessary to monitoring lentic ecosystem such as ponds and lakes time to time so that the flora and fauna of aquatic ecosystem will stay with its environmental condition. The environmental condition exhibits by physiochemical and biological parameters of water and soil of an aquatic ecosystem. This environmental condition also governs the biota and tropic status of aquatic ecosystem.

In the present investigation after the analysis of physico-chemical properties of water and soil revealed that such properties creates the environmental conditions for aquatic medium and affect the flora and fauna of ecosystem. It has been noticed that some water quality parameter such as pH, DO, Chloride, temperature and hardness of water were suitable for the growth of fishes. Therefore a trend found by the fish population of the study sites.

Nitrate and Phosphate marked as a growth indicator of fishes in the investigation. The average of Nitrate and Phosphate of soil and water of Majam Talav was higher than Dhobi Talav, thus the fishes of Majam Talav

was heavier in weight and good growth and shows better condition. Due to higher concentration of Total solids of water the density and growth of fishes were low at Dhobi Talav.

Most of all the parameters were maximum in summer and minimum in monsoon and winter exhibited seasonal fluctuations through which growth of fishes were affected seasonally. Finally it can be assumed that environmental conditions of the study sites create interrelation between the fish population and aquatic ecosystem.

BIBLIOGRAPHY

Abdullah Harun, Chowdhury and Abdullah A Mamun 2006. Physico-chemical conditions and plankton population of two fish ponds in Khulna. Univ. J. Zool. Rajshahi Univ. Vol. 25, pp. 41-44 ISSN 1023-6104.

Adoni, A.D. 1975. Studies on microbiology of Sagar Lake, Ph. D. Thesis, Sagar University, Sagar, India. APHA, 1998. Standard methods for examination of water and waste (20th ed.) American Public health Association. Washington D.C.

Ameen, M., Begum, Z.N.T., Ali, S., Rahman, M.M. & Roy, T.K. 1986. A comparative limnological study of two fish ponds Raipur. Dhaka Uni. Stud. E 1 (1):25-34.

Anene, A., 2005. Condition factors of four cichlid species of a man-made lake in Imo state, Southeast, Nigeria. Turk. J. Fish. Aquat. Sci., 5: 43-47.

APHA 1998. Standard methods for examination of water and waste water (20ed.) American Public Health Association. Washington D.C.

APHA. 2004. Standard Methods for the Examination of Water and Waste Water. 20th Ed. American Public Health Association, Washington D. C.

Arthington A.H. and D.A. Milton. 1986. Reproductive biology, growth and age composition of the introduced *Oreochromis mossambicus*Cichlidae) in two reservoirs, Brisbane, Australia. Environmental Biology of Fishes 16:257-266.

Bagenal T. B. and Tesch F. W. 1978. Age and growth. In: T.B. Bagenal, (ed) Methods for assessment of fish production in freshwater, 3rd edition. Blackwell Scientific Publication, Oxford, UK. 101–136.

Bakare, O., 1970. Bottom Deposits as Food of Inland Fresh Water Fish. In: Kainji, A Nigerian man-made lake. S.A. Visser, (Ed.)., Kanji Lake Studies Vol. 1.Ecology Published for the Nigerian Institute.

Basavaraja, J. Narayana, et, al ; 2014. Fish diversity and abundance in relation to water quality of Anjanapura reservoir, Karnataka, India. International Journal of Current Microbiology and Applied Sciences. ISSN: 2319-7706, Vol.3 No.3,pp.747-757.

Bhatt M., Yazdani T., Narian K., Yunus M., and Shukla R. 2009. Water quality status of some urban ponds of Lucknow, Uttarpradesh. Journal of Wetlands Ecology.vol-2, pp 67-73.

Bhuiyan, N.I.M.A.S, Nahar, Q. & Islam, M.N. 1997.Physico-chemical condition in relation to meteorogical condition of a fish pond in Rajshahi. Univ. j. zool.Rajshahi Univ.16:85-88.

Boschung, H.T., and R.L Mayden. 2004. Mozambique Tilapia: *Oreochromis mossambicus* (Peters). Pp 620. In: Fishes of Alabama. Smithsonian Books. Washington D.C. 960 p.

Bowen S.H. 1979. A nutritional constraint in detritivory by fishes: The stunted population of *Sarotherodon mossambicus* in Lake Sibaya, South Africa. Ecological Monographs 49:17-31.

Boyd, C. E. and C. S. Tucker. 1982. Pond Aquaculture Water Quality Management. Kluwer Academic Publishers, Boston, Massachusett.

Boyd, C.E and Tucker, C.S. 1998. Pond aquaculture water quality management. Kluwer Academic Publishers, London.

Brown W. H. 1961. First Record Of The African Mouthbreeder *Tilapia mossambica* Peters In Texas. Texas Journal of Science 13:352-354.

Bruton M.N., and B.R. Allanson. 1974. The growth of *Tilapia mossambica* Peters (Pisces: Cichlidae) in Lake Sibaya, South Africa. Journal of Fish Biology 6:701-715.

Chowdhury, A.N., Begum, S. & Sultana, S. 1989.Occurrence of seasonal variation of zooplankton in fishpond in relation to some physico- chemical factors. Bangladesh j. zool.17(2):101-106.

Das A. K. 2000. Limmnochemistry of some Andhra Pradesh reservoirs. J. Inland. Fish Soc. India, 32:37-44.

Das SK, Chand BK. 2003. Limnology and biodiversity of Ichthyo fauna in a pond of Southern Orissa, India, Journal of Ecotoxicology and Environmental monitoring. 13(2): 97-102.

De Silva S.S., Perera M.K., and P. Maitipe. 1984. The composition, nutritional status and digestibility of the diets of *Sarotherodon mossambicus* from nine man-made lakes in Sri Lanka. Environmental Biology of Fishes 11:205-219.

Dial R.S. and S.C. Wainright. 1983. New distributional records for non-native fishes in Florida. Florida Scientist 46:8-15.

Fagade, S.O., 1979. Observation of the biology of two species of Tilapia from the Lagos lagoon Nigeria. Bull. Inst. Fond Afr. Nore (Ser. A), 41: 627-658.

Fakruzzaman, M., Chowdhury, A.H., Naz, S. & Zaman, M.2001. Zooplankton of some fishponds in Barind Tract inrelation to its physico-chemical variables.Univ. j. zool.

Forse, R., Pauly, D. (Eds.) (2011). FishBase. World Wide Web electronic publication. URL: www.fishbase.org http//:www.fishbase.org [version 08/ 2011]

Fulton, T. W., The rate of growth of fishes. 22nd Annual Report of the Fishery Board of Scotland (3), 141-241 (1904).

Gupta M.V. and B.O. Acosta. 2004. A review of global tilapia farming practices. World Fish Center P.O. Box 500 GPO, 10670, Penang, Malaysia.

Harshey, D.K., Patil, G. and Singh, D.F. 1982. Limnological studies on a tropical fresh water fish tank of Jabalpur, India. Geobios New Reports 1 (2) : 98-102.

Hecky R.E., and Kilham P. 1988. Nutrient limitation of Phytoplankton in fresh water and marine environments: a review of recent evidence on the effects of enrichments Limnology and Oceanography 33: 796-832.

Hodgkiss I.J., and H.S.H. Man. 1978. Reproductive biology of *Sarotherodon mossambicus* (Cichlidae) In Plover Cove Reservoir, Hong Kong. Environmental Biology of Fish 3:287-292.

Hubbs C., Lucier T., Garrett G.P., Edwards R.J., Dean S.M., Marsh E., and D. Belk. 1978. Survival and abundance of introduced fishes near San Antonio, Texas. Texas Journal of Science 30:369-376.

IAAB, Hyderabad publication 31-82.

ICAR 2011. Hand book of fisheries and aquaculture. ICAR Publication New Delhi.

Jain SM, Sharma M and Thakur R 1996.Seasonal variation in physico – chemical parameters of Halali reservoir of Vidisha District, India. Journal of Ecobiologia. 8 (3) 181 – 188.

Jana, B.B.1973. Seasonal periodicity of plankton in a fresh water pond in West Bengal, India. Int. Rev. Ges. Hydrobiol. 58:127-143.

Jhingran**,** V.**G.**1985**.** Fish and Fisheries of India. Hindustan Publishing Corporation (India), Delhi.

Keri AlhadiIghwela, Aziz Bin Ahmed and A.B. Abol-Munafi (2011). Condition Factor as an Indicator of Growth and Feeding Intensity of Nile Tilapia Fingerlings (Oreochromis niloticus) Feed on Different Levels of Maltose. American-Eurasian J. Agric.& Environ. Sci., 11(4): 559-563, ISSN 1818-6769.

King, R.P. (1996). Length –Weight relationship of Nigeria fresh water fishes. Naga ICLARM Quarterly. 19 (4): 53-58.

Kodarkar MS 1995. Conservation of lakes. Indian Association of Aquatic Biologists

Korai, A.L., Sahato, G.A. Lashari, K.H., S.N. 2008. Biodiversity in Relation to Physicochemical Properties of Keenjhar Lake, Thatta Disteric, Sindh, Pakistan. Turkish Journal Of Fisheries and Aquatic Sciences 8:259-268.

Kumar N. and Sharma R. C. 2000. Water Quality of river Krishna (Part-2 Biological Characteristics of 7 bioindicators) J. Nature Conservator, 14(2): 273-297.

Landau, M. 1992. Introduction to Aquaculture. John Wiely and Sons, Inc. New York.

Le Cren, E. D., 1951. The length weight relationship and seasonal cycle in gonad weight and condition of Perch (Perca fluviatilis), J. Anim. Eco., 21, 210-219.

Lee D.S., Gilbert C.R., Hocutt C.H., Jenkins R.E., McAllister D.E., and J.R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History, Raleigh, NC. 854 p.

Lett, P. F., and W. G. Doubleday. 1976. The influence of fluctuations in recruitment on fisheries management strategy. International Commission for the Northwest Atlantic Fisheries Selected Papers 1:171–193.

Mallasen M, Barros HP, Traficante DP, Camargo ALS. 2012. Influence of net cage tilapia culture on the water quality of the Nova Avanhandava reservoir, Sao Paulo state, Brazil. Acta Scientiarum Biological Sciences. 34(3):289-296.

Manimegalai M.1, Karthikeyeni S 2 et al. 2010. Morphometric Analysis – A Tool to Identify the Different Variants in Fish Species E. Maculatus. Research article ISSN 0976-4402. 481.

Mauro Jose Cavalcanti, Leandro RabelloMonterio and Paulo Roberto Duarte Lopes 1999. Landmark- based Morphometric Analysis in selected species of Serranid Fishes (Perciformes:Teleostei). Zoological studies 38 (3): 287-294.

Mc Laughlin and Brindle R. L. 2001. A laboratory-scale investigation into the use of powdered iron for in situ: Removal of phosphorus form treated sewage effluent with constructed wetlands. Water Quality. Res. J. Canada. 36(4):759-779.

Mc Rae, B. J., and J. S. Diana. 2005. Factors influencing density of age-0 brown trout and brook trout in the Au Sable River, Michigan. Transactions of the American Fisheries Society 134:132–140.

Mishra, P.C., Dash, M.c., Choudhary, K and Das, R.C. 1988. Pollution studied in river Ib:Microbial analysis of water and sediments Book. "Ecology and Pollu. Of rivers" (Ed.Trivedi, R.K.). Ashish Pub. House, New Delhi, I:293-302.

Morey, G., Moranta, J., Massuti, E., Grau, A., Linde, M., Rivera, F. and Morales-Nin, B.2003.Weigth-length relationships of littoral to lower slope fishes from the western Mediterranean. Fisheries Res., 62:89-96.

Murta, G. 2002. "Morphological variation of horse mackerel (*Trachuvus trachurus*) in the Iberian and North African Atlantic: implications for stock identification," J. Mar. Sci., vol. 57, 1240-1248.

Mustapha M. K. 2008. Assessment of water quality of Oyun Reservoir, Offa, Nigeria, and Using2 selected Physic-chemical Parameters. Turkish Journal of Fisheries and Aquatic Sciences8:309-319.

Naz, S. 1992. Studies on Physico-chemical Conditions and Plankton of Fish ponds in Rajshahi. Unpubl. M.Sc. thesis, Dept. of Botany. Rajshahi University. 167 pp.

Odem, E.P. 1971. Fundamentals of ecological. 3rd Ed. W.B. Saunserp Company Philadelphia, 578 pp.

Odum, E.P. 1984. Fundamentals of Ecology. 3rd Ed. W.B. Saunders Company Toronto.

Oni, S.K., J.Y. Olayemi and J.D. Adegboye, 1983. Comparative physiology of three ecologically distinct fresh water fishes, *Alestes nurse* (Ruppell), *Synodontisschall*(Bloch), *S. schneider* and *Tilapia zilli* (Gervais). J. Fish Biol., 22: 105-109.

Parikh, Ankita N. 2011. "Assessment of Urban Ponds with special Reference to Anthropogenic Activities". Ph. D. Thesis, The Maharaja Sayajirao University of Baroda, Vadodara.

Pathak Neelam B. Parikh Ankita N. and Mankodi Pradeep C. 2013. Morphometric Analysis of Fish Population from two Different Ponds of Vadodara City, Gujarat, India. Research Journal of Animal, Veterinary and Fishery Sciences, Vol. **1(6),** 6-9: ISSN 2320 – 6535.

Pervin, M.R. and M.G. Mortuza, 2008. Notes on length-weight relationship and condition factor of fresh water fish, *Labeoboga*(Hamilton) (Cpriniformes:Cyprinidae). Univ. J. Zool. Rajshahi Univ. 27: 97-98.

Radha, and Seenayya, G.2004. Influence of Physico-vhemical Parameters on the distribution of heterophic bacteria in a highly populated and Europhicated freshwater lake. Asian Ir. Of Microbiol. Biotech. Env. Sc. Vol.6, No.(3), 373-377.

Rath, R.1993. Fresh water Aquaculture. Scientific Publishers, Jodhpur.

Richards, L.A.1954. Diagnosis and improvement of saline and alkali soils. Hand book No.60, Oxford and IBH publication company, Calcutta-16.

Seenayya, G. 1971. Ecological studies in the Plankton of certain fresh water ponds of Hyderabad, India. II, Phytoplankton-I. Hydrobiol. 37: 35-88.

Shafland P.L. and J.M. Pestrak. 1982. Lower lethal temperatures for fourteen non-native fishes in Florida. Environmental Biology of Fishes 7:139-156.

Shastri, Y .and Pandse, D.C. 2001. Hidrobiological study of Dahikhuta reservoir J. Environment Biol. 22:67-70.

Singh M. 1965. Phytoplankton periodicity in small lake near Delhi (I) Seasonal fluctuations of the physic-chemical characteristics of the water. Phykos. 4:61-68.

Soni R. N and Bhatt S. A. 2008. Periodical Ecological Study of an urban pond

Stergiou, K.I. and D.K. Moutopoulos, 2001. A review of length-weight relationships of fishes from Greekmarine waters. Naga, ICLARM Quart, 24(1-2): 23-39.

Swaranlatha, N. and Rao, A.N., 1998. Ecological studies of Banjara Lake with reference to water pollution J. Environment Biol. 19:179-186.

Trewevas E. 1983. Tilapiine Fishes Of The Genera *Sarotherodon,Oreochromis* And *Danakilia*. British Museum Of Natural History, Publication Number 878.Comstock Publishing Associates. Ithaca, New York. 583 p.

Tripathi, A.K. and Pandey. S. N. 1989. Studies of algae of populated ponds of Kanpur II. Qualitative, quantitative and periodical occurrence of the blue green algae of Chandori pond. Res. J Pl. Environ. 5(1): 89-93.

Unni K. S. 1985. Comparative limnology of several reservoirs of central India. Int. Review of Hydriobiol. 70(6):845-856.

Vivekananda, E. 2005. Stock assessment of tropical marine fishes, Indian Council of Agricultural Research, New Delhi, India, 115.

Weatherley , A. H., 1972. Growth and ecology of fish populations. Academic Press., London, 293p.

Welcome, R.L., 1979. Fisheries Ecology of Flood Plain Rivers. Longman Press, London, pp: 317.

Wells, J. V., and M. E. Richmond. 1995. Populations, metapopulations, and species populations: what are they and who should care? Wildlife Society Bulletin 23:458–462.

Wetch, P.S.1952. Limnology. Mc. Graw. Hill Book. Co., New York. 538pp.

Wetzel, R.G.!983. Limnology. Second edition Saunders college Publishing, USA. 767 PP.

Yadav, Y.S., Singh, R. K., Choudhary, M. and Kolekar, V.(1987). Limnology and productivity in Dighalibeel (Assam). Trop. Ecol. 28: 137-146.

Yazdandoost, M.Y. and Katdare, M.S.2000. Water quality index of major rivers in Pune. J. Industrial Pollution Control, 16: 231-238.