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ASSESSMENTOF WATER QUALITY AND FISH GROWTH IN MICRO-WATER SHEDS OF BANSWARA DISTRICT IN SOUTHERN RAJASTHAN

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ABSTRACT

Present study has been conducted to investigate the status of water quality and fish growth performance in selected micro-water sheds of Banswara district (Rajasthan). The mean values of water quality parameters fluctuated between, 26.35 – 32.95°C(Water temperature), 7.7 – 9.5(pH), 6.5 – 9.64 mg/l(DO), 0 – 0.1 ppt (Salinity), 0.0 - 15 mg/l(Free CO_2), 119.05-290.5 mg/l(TDS), 248 – 598 ms/Cm(Conductivity), 0.131 – 0.230 mg/l(Nitrate-nitrogen), 0.05 – 0.12 mg/l(Orthophosphate) and0 – 1.845 mg/l(Ammonia). These values of different water quality parameters indicated that the selected micro-water sheds were congenial and moderately productive from the fisheries point of view. The net weight gain of catla, rohu and mrigla varied between 855 to 1167.1gm, 699.66 to 908.12gm and 451.46 to 749.51gm respectively in different micro-water sheds. Whereas, the specific growth rate of catla, rohu and mrigla were 2.04-2.19, 2.02- 2.14, and 1.89-2.10 % respectively. Since, no feed and fertilizers were used to fish culture, in micro water sheds, therefore the observed growth can be considered satisfactory. Hence the input (feed, manuring, and fertilization) is recommended for higher returns.

KEYWORDS: Fish Growth, Water Quality, Micro-Water Sheds, Productivity, Physico-Chemical

INTRODUCTION

Water is one of the most important vital resources for the living beings to survive and a number of physic-chemical properties that help the molecule to act as the best suitable medium for the life activities. Hence water is called "Elixir of life". Indeed it is a part of life itself since; the protoplasm of most of the living cell contains about 80 % of water. Most of the biochemical reactions that occur in the metabolism and growth of living cells involve water.

Water quality refers to all physical, chemical and biological characteristics of water and plays an important role in the growth and survival of aquatic organisms. Relationship between water quality and aquatic productivity is a pre-requisite for obtaining optimum growth and production.

The water used for aquaculture would not give the desired production unless the prevailing water quality parameters are optimum for the organism under culture. Study of the physico-chemical parameters of an aquatic ecosystem is basic for understanding its biological productivity. Although each factor plays its individual role but it is the synergistic effect of various parameters which determines the composition and productivity of the flora and fauna. Conducive range of

these factors is essential for obtaining optimum fish production. Among physico-chemical factors influencing the aquatic productivity; temperature, pH, total alkalinity, dissolved gases like oxygen and carbon dioxide and dissolved inorganic nutrients like nitrate and phosphorus are considered to be important. Physico-chemical features such as temperature, transparency, pH, alkalinity, free carbon dioxide, dissolved oxygen, electrical conductivity, nitrate-nitrogen, orthophosphate etc. of any water body grossly determine the trophic status of that water body. These parameters influence the primary productivity (phytoplankton) and in turn the growth of the fish. In Rajasthan and especially in Banswara district (Rajasthan), a sizable number of micro- watersheds have been constructed primarily for the purpose of rain water harvesting and for increasing irrigation facilities. Though, these water resources were initially created for irrigation/water harvesting purpose, but now these aquatic resources are serving multipurpose, i.e. domestic, irrigation, fisheries *etc*. Due to the increasing interest of local masses in fish culture, micro- watersheds are the first choice as these resources are easily available with local tribes of this region.

The present study aim was to conduct the assessment of water quality parameters in selected micro-watersheds in Southern Rajasthan and their co-relation with fish growth

MATERIALS AND METHODS

The present study was carried out during January 2016 to June 2016 with a view to investigate the dynamics of selected abiotic factors in selected micro-water sheds of Banswara (Rajasthan)**,** and its relation with fish growth.

Study Area

The proposed study was conducted on selected micro-water sheds of Southern Rajasthan mainly Banswara. Geographical location and area of the selected micro-water sheds is presented in Table.1

Table 1: List of Selected Water Bodies and their Geographical Location

Water Shed Name	Area(ha)	Longitude	Attitude	MSL
Parahera	4	23°34.549'N	74°13.217'E	161
khajuriya	4	23°36.523'N	74°11.328'E	149
Panchal	12	23°19.952'N	74°12.803'E	200
Sonariya	20	23°14.765'N	74°27.877'E	332
Gorcha	8	23°40.494'N	74°29.307'E	264
Kaligati	8	23°43.483'N	74°36.548'E	304

Collection & Analysis of Water Sample

To monitor the status of water quality (physico-chemical) in selected micro-watersheds, water samples were collected during January 2016 to June 2016 at an interval of 45 days. The surface water sample was collected using wide mouth sterile transparent plastic bucket. The water samples were secured in one litre plastic bottles with air tight cap. A total of 12 physico-chemical parameters *viz*. temperature, pH, DO, TDS, conductivity, hardness, free carbon-dioxide, alkalinity, salinity, nitrate-nitrogen, orthophosphate and ammonium-nitrogen were analyzed following standard methods of APHA (1989).

Fish Growth Studies

The selected water bodies were stocked with IMC fingerling @ 2500 Nos/ha in the ratio of 3:4:3 of Catla, Rohu and Mrigala. The initial respective size of catla, rohu and mrigal fingerling was 7.2 $\pm$0.05 C.m. /6.19 $\pm$0.01g, 8.00$\pm$0.03

C.m./5.32±0.02g and 6.9±0.09 C.m./4.85±0.02g. On the basis of initial size of seed stocked and size (length and weight) of harvested/sampled fish growth rate performance was estimated as below.

Net Weight Gain

NWG (gm) = Final weight – Initial weight x 100/ Initial weight

Net Length Gain

NLG (cm) = Final length – Initial length x 100/ Initial length

Specific Growth Rate (SGR)

Specific Growth Rate = Ln (Final weight) – Ln (initial weight) × 100/ Day of culture period

RESULTS

The results pertaining to water quality and fish growth are presented in tables 2 and 3. The water temperature varied between a minimum of 25.6°C at Gorcha and maximum of 32.8°C in Parahada (Table 2). The average being lowest (26.35°C) in Gorcha and highest (32.95°C) in Khajuriya. In general, the water of all the micro-water sheds remained alkaline throughout the study period. The pH value of water varied between a minimum of 7.6 in Sonariya and a maximum of 9.9 in Kalighati (Table 2). Further, the values of total alkalinity in micro-water sheds ranged between 94 and 180 mg/l with lowest in Panchal and highest in Khajuriya (Table 2). The lowest average value of total alkalinity (102 mg/l) was found in Panchal, while the highest (162 mg/l) being in Khajuriya (Table 2).

In the present study, the maximum (9.85 mg/l) concentration of dissolved oxygen (DO) was observed in Parahada, while the minimum (5.67 mg/l) was noticed in Kalighati (Table 2). The mean concentration of DO was lowest (6.50 mg/l) in Kalighati and highest (9.64 mg/l) in Panchal. The free carbon-dioxide fluctuated from 10 mg/l to 16 mg/l with minimum in Gorcha and maximum in Kalighati. Further, the average value of free CO_2 was also found to be highest in Kalighati (15 mg/l) and lowest in Gorcha (11 mg/l).

The electrical conductivity of micro-water sheds recorded in the present study, ranged between 240 and 618 mS/cm with a minimum in Kalighati and a maximum in Khajuriya (Table2). The average conductivity was also recorded to be lowest and highest in Kalighati and Pagara respectively (Table 2). In general, salinity values in micro-water sheds were between 0.0 and 0.2 ppt with lowest in Kalighati and highest in Panchal, khajuriya, Gorcha and Parahada (Table.2). Similarly, the average values of salinity were also found to be lowest and highest in these waters.

Total hardness in micro-water sheds fluctuated between 108 and 200 mg/l with lowest in Sonariya and highest in Parahada. Similarly, the average values of total hardness were also found to be lowest and highest in Sonariya and highest in Parahada (Table 2). Further, the values of TDS in micro-water sheds fluctuated between a minimum of 115.2 mg/l and a maximum of 300 mg/l in Kalighati and Panchal respectively. The average value of TDS was recorded to be lowest and highest in Sonariya and Parahera (Table 2).

The higher concentration of ammonia is an indication of toxicity in natural water. In the present study, the concentration of ammonia ranged from 0.0 to 3.63 mg/l with mean values of 0.0 to 1.845 mg/l. The highest ammonia content was noticed in Gorcha (Table 2). The concentration of nitrate-nitrogen in micro-water sheds have been depicted in

(Table 2). The respective highest (0.608 mg/l) and lowest (0.087 mg/l) values of nitrate-nitrogen were observed in Panchal and Khajuriya. The respective highest (0.23) and lowest (0.131) mean values were noticed in Parahada and Gorcha.

The orthophosphate concentration in micro-water sheds varied between 0.02 mg/l to 0.2 mg/l. Both the lowest and highest values were noticed in Kalighati. However, the average being lowest 0.05 mg/l in Panchal but the highest was seen in Kalighati (Table 2).

The results of fish growth parameters (Net weight gain, net length gain and specific growth rate) from selected micro-watersheds are presented in Table 3. The net weight gain of Catla, Rohu and Mrigala varied between 855 to 1167.1gm, 699.66 to 908.12gm and 451.46 to 749.51gm respectively with minimum in Khajuriya (Catla & Rohu) and Kalighati (Mrigala) and maximum in Sonaliya (Catla and Rohu)) and Panchal (Mrigala). The highest of 32.31 (Catla), 23.50cm (Rohu) and 24.33cm (Mrigala) and lowest of 20.99cm (Catla), 15.28cm (Rohu) and 11.97cm (Mrigala) net length gains were observed in Sonaliya (Catla and rohu) and Kalighati. The respective highest (2.19 %, 2.14 %, and 2.10 %) and lowest (2.04 %, 2.02 %, and 1.89%) specific growth rate of Catla, Rohu and Mrigala were noticed in Sonariya, Valota and Parahada and Kalighati, Gorcha and Khajuriya and Kalighati respectively.

DISCUSSIONS

To understand the dynamics of limno-chemical parameters in micro-water sheds of Banswara, a study was conducted during January to June 2016. As such the data obtained are summarized in Table 2 and 3. Temperature is the degree of hotness or coldness in the body of a living organism either in water or on land. As fish is a cold blooded animal, its body temperature changes according to that of the environment, affecting its metabolism and physiology. This ultimately affecting the growth rate. In the present study, the water temperature ranged between 25.6°C to 32.8°C in different micro-watersheds. These values resulted around the optimal water temperatures (28 - 30 ^{o}C) within which maximal growth rate, efficient food conversion, best condition of fish, resistance to disease and tolerance of toxins (metabolites and pollutants) are enhanced. Similar range of water temperature is reported by Bhatnagar and Devi (2013).

pH is an important factors of freshwater bodies deciding fish health as well as the productivity of water. In the present study, the pH values ranged from 7.6 to 9.9 in different micro-watersheds. This range found out of the limit prescribed by WHO (1993). The high values of pH must be attributed the highly saline soil. The moderate to slightly alkaline pH has been considered as most suitable for fish culture while pH above 9 is unsuitable (Ellis, *et al*. 1948, Swingle, 1967, Jhingran, 1977).

Dissolved oxygen (DO)is the most critical water quality variable in aquatic ecosystem. It is of prime importance both as regulator of metabolic of plants and animal communities and as an indicator of water condition. In the present study dissolved oxygen concentration ranged from 5.67 mg/l to 9.85 mg/l. Similar value of DO were also observed by Adeyemi (2011). As per Dwivedi and Pandey (2002), the main sources of free CO_2 are mainly decomposition of organic matter and respiration of plants and animal. In the present study, free CO_2 ranged from 10-16 mg/l. Similar results from Rajasthan water were also reported by Gupta and Sharma (1994), Ujjainia, *et al*. (2007) and Balai (2007). The presence of CO_2 in micro-watersheds (Gorcha and Kalighati) can be attributed to the fluish of nutrients and organic matter rich community sewage**.**

Electrical conductivity (EC) in natural waters is the normalized measure of the water's ability to conduct electric current. The source of EC may be an abundance of dissolved salts due to poor irrigation management, minerals from rain water runoff, or other discharges. In the study period, electrical conductivity reported to be in the range of 240µS/cm is found to be in (Kalighati) and 618 µS/cm in (khajuriya). Sreenivasan, (1969), Bajpai and Tamot, (1999), were opined that waterbodies receiving domestic sewage have higher values of electrical conductivity.

Alkalinity is water's ability to resist changes in pH and is a measure of the total concentration of bases in pond water including carbonates, bicarbonates, hydroxides, phosphates and borates. These bases react with and neutralize acids, buffering changes in pH. In the **present** study, total alkalinity observed from 94 to 180 mg/l (Table 2). Similar value of total alkalinity was also observed by Koli and Ranga (2011). The values of alkalinity recorded in different micro-water sheds were always above 60 mg/l, thus this water could be considered as productive from fish culture point of view.

The hardness indicates level of carbonates and bicarbonates in the water. The total hardness in water is relatively high due to the presence of Ca^{+2}, Mg^{+2}, CI^{-} and $S0_4^{-2}$ ions. The hardness value of all the selected micro-water sheds ranged from 64 to 200 mg/l. According to Jhingran (1988), the most suitable hardness value for fish is 108-200 ppm and does not require additional liming. This proves that the water of selected micro-watersheds is most suitable for the growth and production of fish.

Salinity is the total concentration of electrically charged ions in water. It is the major environmental factor restricting the distribution of freshwater and marine taxa. In the present study, the salinity ranged from 0 ppt to 0.2 ppt, which is within permissible levels. This proves that the water of selected micro-water sheds is most suitable for the growth. Total dissolved solids (TDS) contain different kinds of nutrients and have been proved to be a very useful parameter in determining the productivity of the aquatic system. A sudden rise in the content of TDS can often indicate pollution by extraneous sources (Aboo and Mandal, 1967). The TDS content in the current study showed a minimum of 115.2 mg/l in Kalighati and maximum of 300 mg/l in Ladsore. A maximum value of 500 mg/l of TDS is permissible for a diverse fish population. TDS concentration below 200 mg/l promoted even healthier spawning conditions. Hence, it can be concluded that selected micro-watersheds provide intermediate condition for fish production.

Nitrates are a form of nitrogen and a vital nutrient for growth, reproduction, and the survival of organisms. Nitrate generally occurs in the trace quantities which is essential for many photosynthetic autotrophs. In the present study, the value of nitrate nitrogen varied from 0.087 mg/l to 0.608 mg/l. Santhosh and Singh (2007) described the favourable range of 0.1 mg/ l to 4.0 mg/l in fish culture water. Based on the recommended values about nitrate content in selected micro-water sheds is considered moderately favorable for fish growth

Phosphorus is generally recognised as a key nutrient in the fertility of a water body. Almost all of the phosphorus (P) present in water is in the form of phosphate (PO_4^{-3}) and it is an essential plant nutrient. In the present study, the orthophosphate concentration in micro-water sheds observed between 0.02 to 0.2 mg/l. Banerjea (1967) opined that phosphate below 0.05mg/l results in poor production and should be considered as undesirable. According to Stone and Thomforde (2004), the phosphate level of 0.06 mg/l is desirable for fish culture. Bhatnagar, *et al*. (2004) suggested 0.05 - 0.07mg/L as optimum level

Ammonia is the by-product of protein metabolism excreted by fish and bacterial decomposition of organic matter such as wasted food, feces, dead planktons, sewage, etc. The unionized form of ammonia (NH_3) is extremely toxic while

the ionized form (NH_4^+) is not toxic and both the forms are grouped together as "total ammonia" (Bhatnagar and Devi, 2013). Maximum limit of ammonia concentration for aquatic organisms is 0.1 mg/l (Santhosh and Singh, 2007). In the present study, ammonia content fluctuated between 0.0 to 3.63 mg/l. Similar results were also observed by Bhatnagar and Singh (2010), Stone and Thomforde (2004) from natural waters. Higher concentration of ammonia (> 0.1) causes sub lethal effects like reduced growth, and poor feed conversion.

The physico-chemical quality of water affects fish growth. Generally growth is an integrated physiological response encompassing external (food quality and quantity), temperature, water quality and internal physiological status (stress, health and reproductive). In the present study, the growth in terms of weight, length and SGR of IMC in selected micro-water sheds varied between 451.46 -1167.1 gm, 11.97 cm-32.31 and 1.89-2.19 % respectively. Significantly higher growth rate of IMCs in selected micro-water sheds might be due to favourable physico-chemical parameters. Ujjania (2003) has also reported similar results from the water bodies of Southern Rajasthan.

CONCLUSIONS

Based on the results of the physico-chemical and biological parameters, it is evident that all the selected micro-water sheds are suitable for fish culture except Kalighati very high level of pH is unfavorable for fish growth in this water body, which need to be corrected with the use of chemicals and more suitably by the use of organic fertilizer. But, there should be a constant monitoring of the physical and chemical parameters in water of all selected micro-water sheds in the future for better growth of fish.

Table 2: Range and Mean Value of Water Quality Parameters in Selected Micro-Water Sheds of Banswara District

Waterbodies	Parahera	Khajuriya	Panchal	Sonariya	Gorcha	Kalighati
Temperature (°C)	31.1-32.8 (31.95)	32.833.1 (32.95)	28.4-30.5 (29.45)	31.5-31.9 (31.7)	25.6-27.1 (26.35)	29.4-41.1 (30.25)
pH	8.2-8.39 (8.25)	8.5-8.5 (8.5)	8.3-8.4 (8.35)	7.6-7.8 (7.7)	8.9-9.5 (9.2)	9.1-9.9 (9.65)
DO (mg/l)	9.43-9.85 (9.64)	7.46-8.99 (8.46)	6.47-7.66 (7.06)	8.41-8.5 (8.45)	6.73-7.46 (7.09)	5.67-7.34 (6.50)
Free CO_2 (mg/l)	0-0 (0)	0-0- (0)	0-0 (0)	0-0 (0)	10-12 (11)	14-16 (15)
Conductivity(µS/cm)	333-613 (473)	578-618 (598)	271-284 (277.5)	280-289 (284.5)	393-472 (432.5)	240-256 (248)
Alkalinity (mg/l)	130-150 (140)	144-180 (162)	94-110 (102)	110-120 (115)	124-128 (126)	116-126 (121)
Hardness (mg/l)	188-200 (194)	164-172 (168)	100-122 (111)	116-130 (123)	120-134 (127)	108-120 (114)
Salinity (ppt)	0.2-0.1 (0.15)	0.2-0.1 (0.15)	0.1-0.2 (0.15)	0.1-0.1 (0.1)	0.1-0.2 (0.15)	0-0 (0)
TDS (mg/l)	281-300 (290.5)	129.9-136.5 (132.2)	129-136.5 (133.2)	13.7-139.2 (136.95)	189.7-228 (208.85)	115.2- 112.9 (119.05)
NO_3-N (mg/l)	0.229-0.232 (0.23)	0.087-0.22 (0.154)	0.127-0.608 (0.3675)	0.112-0.189 (0.150)	0.125-0.137 (0.131)	0.107-0.301 (0.204)
HPO_4^{-3}(mg/l)	0.06-0.08 (0.07)	0.05-0.08 (0.070)	0.2-0.08 (0.05)	0.05-0.06 (0.055)	0.05-0.16 (0.105)	0.02-0.22 (0.12)
NH_3 (mg/l)	0-0.04 (0.02)	0.-0 (0)	0-0 (0)	0.06-3.63 (1.845)	0.02-0.04 (0.03)	0-0 (0)

Table 3: Growth Summary of Carps (Catla, Rohu and Mrigala) in Selected Micro-Water Sheds of Banswara District (NWG= Net Weight Gain, NLG= Net Length Gain and SGR= Specific Growth)

Waterbodies	Species	Weight (gm)			Length (cm)			SGR (%)
		Initial	Final	NWG	Initial	Final	NLG	
Parahada	Catla	6.19±0.01	957.14	950.95	7.2±0.05	32.23	25.03	2.10
	Rohu	5.34±0.02	835.58	830.24	8.0±0.03	28.81	20.81	2.11
	Mrigal	4.85±0.01	749.51	744.66	6.9±0.09	31.23	24.33	2.10
Khajuriya	Catla	6.19±0.01	861.90	855.71	7.2±0.05	29.02	21.82	2.06
	Rohu	5.34±0.02	675.00	669.66	8.0±0.03	23.28	15.28	2.02
	Mrigal	4.85±0.01	462.14	457.29	6.9±0.09	19.26	12.36	1.90
Panchal	Catla	6.19±0.01	941.90	935.71	7.2±0.05	31.71	24.51	2.09
	Rohu	5.34±0.02	724.04	718.70	8.0±0.03	24.97	16.97	2.05
	Mrigal	4.85±0.01	642.72	637.87	6.9±0.09	26.78	19.88	2.04
Sonariya	Catla	6.19±0.01	1173.33	1167.1	7.2±0.05	39.51	32.31	2.19
	Rohu	5.34±0.02	913.46	908.12	8.0±0.03	31.50	23.50	2.14
	Mrigal	4.85±0.01	638.83	633.98	6.9±0.09	26.62	19.72	2.03
Gorcha	Catla	6.19±0.01	920.95	914.76	7.2±0.05	31.01	23.81	2.08
	Rohu	5.34±0.02	680.77	675.43	8.0±0.03	23.47	15.47	2.02
	Mrigal	4.85±0.01	536.89	532.04	6.9±0.09	22.37	15.47	1.96
Kalighati	Catla	6.19±0.01	837.14	830.95	7.2±0.05	28.19	20.99	2.04
	Rohu	5.34±0.02	733.65	728.31	8.0±0.03	25.30	17.30	2.05
	Mrigal	4.85±0.01	451.46	446.61	6.9±0.09	18.81	11.91	1.89

REFERENCES

1. APHA (American Public Health Association, American water work association and water pollution control Federation, 1989). Standard Methods for Examination of water and wastewater. 17th edition. Washington, *D.C.* pp 1193.
2. Bajpai, A. and Tamot, P. (1999). Nutrient status of upper lake, Bhopal. In: Advances in Environmental Biopollution. A.P.H. Publishing Corporation, New Delhi. pp 179-187.
3. Balai, V.K. (2007). Current fish and planktonic biodiversity in the Jaisamand reservoir Udaipur, (Rajasthan) Ph.D. (Limnology) Thesis, Maharana Pratap University of Agriculture and Technology, Udaipur. pp 25-30.
4. Banerjea, S.M. (1967). Water quality and soil condition of fish ponds in states of India in relation to fish production. *Indian Journal of Fisheries*. 14: 115-144.
5. Barbieri, R., Maria, S.R.I., Floriman, J.A., M.F.C., Janet, W.R. and PAUL, T. (1989). Plankton, primary product and some physico-chemical factors of two lakes from marannense (Brazil). *Review Bios. Biol*. 49: 390-398.
6. Baumgartner, G., Nakatani, K., Luiz Carlos Gomes, L. C., Vanderlei, P. and Makrakis, M. C. (2008). Fish larvae from the upper Paraná River: Do abiotic factors affect larval density? Neotropical Ichthyology. 6(4): 551-558.
7. Bhatnagar, A., Jana, S. N., Garg, S. K., Patra, B. C., Singh, G. and Barman, U. K. (2004). Water quality management in aquaculture. In: Course Manual of summer school on development of sustainable aquaculture technology in fresh and saline waters, CCS Haryana Agricultural, Hisar (India). pp 203- 210.
8. Bhatnagar, A. and singh, G. (2010). Culture fisheries in village ponds: a multi-location study in Haryana, India.

Agriculture and Biology Journal of North America. 1(5): 961-968.

9. Bhatnagar, A. and Devi, P. (2013). Water quality guidelines for the management of pond fish culture. Department of Zoology, Kurukshetra University, Kurukshetra, India. *International Journal of Environmental Science*. 3(6): 1980-1994.
10. Bolatito, I.N. (2005). Limnology and plankton abundance in relation to fish production in Oyan Lake, south western Nigeria. A PhD thesis. pp 237.
11. Chaurasia, M. and Pandey, G.C. (2007). Study of physico-chemical characteristics of some water ponds of Ajodhya, Faizabad. *Indian Journal of Environmental Protection* (IJEP). 27 (11): 1019-1023.
12. Chouhan, C.S. and Sharma, K.C. (2007). Limno-Biotic status of religious Lake Budha Pushkar near Ajmer, Rajasthan. Proceedings of DAE-BRNS National Symposium on Limnology. Udaipur (Rajasthan), Feb, 19-21. 227-230.
13. Das, A.K. (2000). Limno-chemistry of some Andhra Pradesh Reservoirs. *Journal of the Inland fisheries of India*. 32: 37- 44.
14. Deacon, N. and Hecht, T. (1996). The effect of temperature and photoperiod on the growth of juvenile spotted grunter pomadasys commersonnii (Pisces: Haemulidae). *South African Journal of Marine Science*. 17(1): 55-60.
15. Dwivedi, B.K., and Pandey, G.C. (2002). Physico-Chemical Factors and Algal Diversity of Two Ponds, (Girija and Maqubara Pond), Faizabad. *Pollution Research*. 21:361-370.
16. Djukic, N., Maletin, S., Pujin, V., Ivanc, A. and Milajonovic, B. (1994). Ecological assessment of water quality of Tisze by physico-chemical and biological parameters. *Tisca (Szeged)*. 28: 37-40.
17. Ellis, M.M., Westfall, B.A., and Ellis, M.D. (1948). Determination of water quality. Fish and Wild Life Service. Research ReportNo. 9. pp 122.
18. Ellis, M.M., Westfall, B.A., and Ellis, M.D. (1949). Determination of water quality. Fish and Wild Life Services, United State Department of the Interior, Report No. 10. pp122.
19. Gupta, R. (1991). Some aspects of hydrobiology of Daya Dam, Tehsil Sarada, Udaipur (Rajasthan). M.Sc. (Ag.) thesis submitted to Rajasthan Agricultural University, Bikaner.pp 127.
20. Gupta, M.C. and Sharma, L.L. (1994). Seasonal variations in selected limno-chemical parameters of Amarchand reservoir, Southern Rajasthan. *Pollution Research*. 13: 217-226.
21. Gupta, S.K. and Gupta, P.C. (2006). General and Applied Technology (Fish and Fisheries*)* S. Chand and Company, New Delhi. pp 1130.
22. Meena, S., Sharma, R., Sharma, V., and Sharma, M.S. (2007). Tropic status of the lake Pichhola in relation to physico-chemical characteristics of its water. *Proceedings of DAE-BRNS National Symposium on Limnology*, Udaipur (Rajasthan), February 19-21. pp 244-248.
23. Offem, B. O., Ayotunde, E. O., Ikpi, G. U., Ochang, S. N. and Ada, F. B. (2011). Influence of Seasons on Water

Quality, Abundance of Fish and Plankton Species of Ikwori Lake, *South-Eastern Nigeria. Fisheries and Aquaculture Journal*. 2011: 1-18

24. Patil, A.A. (2014). Limnological and correlation studies of Birnal water body of Sangli, Maharashtra. *International Research Journal of Environment Sciences*. 3(4): 43-49.
25. Ujjania, N.C. (2003). Comparative performance of Indian major carps (*Catla catla, Labeo rohita and Cirrhinus mrigala*) in Southern Rajasthan. Ph.D. thesis submitted to Central Institute of Fisheries Education, ICAR, Mumbai.pp 145.
26. Ujjania, N.C., Sharma, L.L., Kohli, M.P.S. and Jain, A.K. (2007). Physico-chemical properties and productivity of different water bodies from Southern Rajasthan (India). Proceedings of DAE-BRNS National Symposium on Limnology, Udaipur (Rajasthan). 19-21 Feb. pp 193-197.
27. WHO (1993). Guideline values for contaminants in water: Guidelines for Drinking-Water Quality-Recommendations 2nd Edition Vol.-1. WHO, Geneva. pp 208.