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Eco-biological status of Chotiari reservoir (Distt. Sanghar) Sindh, Pakistan

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Abstract:

Studies on some important limnological parameters, plankton productivity and fishery status of Chotiari reservoir was carried out during 2006-07. The hydrological parameters such as; Temperature air and water (30.5-38°C and. 26.5-33°C), Secchi depth transparency (25-60'), pH (6.1-8.5), conductivity (504-570µS/cm^2), TDS (252-363mg/l), chlorides (25.8-59.9 mg/l), salinity (0.24-0.3) alkalinity (92.5-312.5mg/l), hardness (110-379.2mg/l) and dissolved oxygen (4.8-7.6mg/l). These parameters were found within the suitable ranges for fish culture.

33 fish species were recorded which belonged to order Cypriniformes, Siluriformes, Clupeiformes and Channiformes. 10 species of zooplankton were recorded. 2 species of rotifers *Keratella tropica* and *Monostyla bulla,* and 3 species of genus *Bosmina* were commonly found. The copepods did not show any markable pattern. 80 species of phytoplankton (algae) were recorded, out of these Green algae (Chlorophyta), Euglenophyta, blue-green algae (Cyanophyta) and diatoms (Bacillariophyta).

The most prominent feature of Chotiari area is the presence of aquatic plants, the *Typha* and *Phragmites species* were observed in dominant form. Total 15 species of macrophytes were recorded. Submerged plants *Hydrilla* sp. *Potamogeton* sp. *Ceratophyllum* sp. were found on the bottom.

Keywords: Limnological parameters, Natural productivity, Chotiari reservoir

1. Introduction

The Chotiari reservoir is located 20 km north east from Sanghar city, at 69´.4 E longitudes and 26´.1" N latitudes. It covers an area of about 86 km^2. The reservoir is built up on small lakes comprising, Gawari, Tajar, Phulel, Seri and Sao Naro. This complex of lakes also receives water from Nara canal through Ajoeo and Ranto escapes during the flood season. Baker lake is now out of the complex and Chotiari reservoir would provide the water to Khipro subdivision of Sanghar District and Umer Kot areas.

The purpose of the construction of this reservoir is to supply the water to Thar desert, because on the eastern side the reservoir extends into finger like projections into Thar Desert **Fig.1** The reservoir having depth from 15' to 30 ' with sandy and silty bottom which provides a suitable surface for the growth of algae and aquatic plant species. In winter during November to April water of the reservoir is supplied to Nara canal for irrigation and drinking purposes in the command area.

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Before construction of the Chotiari reservoir, some limnological and biological work on the Bakar lakes complex was carried out by Leghari *et al.* (1997), Jafri (1997) and Leghari *et al.* (1999a, and 1999b). The present report examines water quality and natural productivity of Chotiari reservoir after its construction.

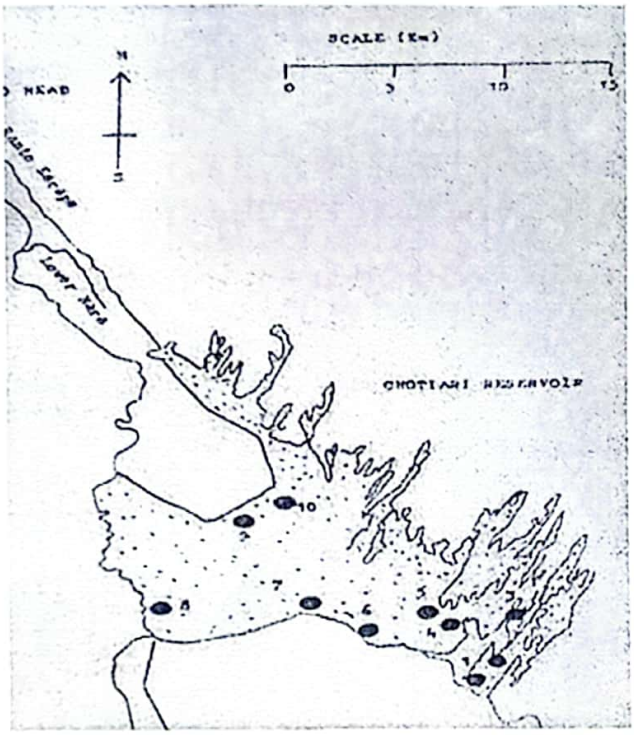


Fig.1 Map showing sampling stations in Chotiari reservoir

2. Materials and Methods

Four sampling sites were selected at the reservoir (Fig.1) for the collection samples of water, plankton and algae quarterly from November 2006 to August 2007. Physico-chemical parameters temperature, conductivity, total dissolved solids (TDS) and salinity were measured with WTW 320 conductivity meter; pH was measured with Orion 420 A pH meter, dissolved oxygen was recorded with Oxi. WTW 315i meter and transparency of water was measured with the help of Secchi disc. Total alkalinity hardness and chlorides were analyzed according to the recommended methods of APHA (1992).

Plankton were collected with plankton net No. 25 (mesh size 55µ) and preserved in 4% formalin solution. The detailed analysis was carried out in the laboratory. The photography of the species was done at a magnification ×100 and ×400 with DCM 35 (350 pixels USB 0.1) digital camera under the binocular microscope (Swift M.3300D).

3. Results and Discussion

Chotiari reservoir includes a number of lakes which are interconnected where life history of particular flora can be found. Some marshy erect plants *Ipomea aquatica*, *Phragmites communis*, *Typha domogensis* and *Typha elephantina* were observed to flourish on moist soil swampy ground along the margin of water. Some rooted submerged plants *Hydrilla verticillata*, *Najaz minor*, *Potamogeton natans* and *P. pectinatus* were present in the mat formation. The assessment of the water quality parameters of Chotiari reservoir was carried out on seasonal basis. The ranges of air and water temperature were within 30.5-38°C and 26.5-33°C and 31.8-33°C Tabs.1-4 and dissolved oxygen ranged between 4.8-7.6mg/l. Similar variation in temperature of water, air and dissolved oxygen was observed by Nazneen (1980) and Jahangir *et al.*, (2000) in Keenjhar Lake. Secchi depth transparency was between 25-60 inches indicating presence of phytoplankton communities in water. The pH, alkalinity and hardness ($CaCO_3$) values were 6.1-8.5; 92.5-312.5mg/l and 110-279mg/l respectively. The results indicated that the lake water is slightly alkaline in nature. Electrical conductivity (EC), total dissolved solids (TDS) and salinity were observed within 504-570µS/cm^2, TDS 252-363mg/l and 0.24-0.3ppt respectively (**Tab.1-3**). It is the indication of being a freshwater body, because the EC and TDS were observed within the acceptable limits as recommended by WHO as EC 0.75mS/cm and TDS 500mg/l for water, which is used for domestic consumption.

The phytoplankton population belonged to 4 groups of algae, Cyanophyta, Chlorophyta, Euglenophyta and Bacillariophyta. In general, blue green algae were observed as a dominant group over other kinds of algae. Thirty six species of phytoplankton were identified. These include filamentous, colonial as well as unicellular forms (**Tab. 4**).

Ten species of zooplankton were recorded among these three species *Brachionus caudatus, Keratella tropica* and *Monostyla bulla* belonged to Rotifera; *Mesocyclops leuckerti* and *Heliodiaptomus* sp. to Copepoda. Five species comprising *Bosimina coregoni, Bosmina fatalis, Bosmina longirostris, Ceriodaphnia reticulate* and *Diaphanosoma sarsi* were recorded. In over all population of the zooplankton, the rotifer's group was consistent. In copepod group, only two species were identified. Cladocerans were found dominant quantitatively and qualitatively (**Tab.5**). Three species of molluscs *Tricula cristella, Gyraulus convexiusculus* and *Lymnaea auricularia* were recorded (**Tab.6**).

During the present study 33 fish species were recorded (**Tab.7**). These were belonging to order Cypriniformes followed by Siluriformes Channiformes and Clupeiformes observed rare throughout the study period. Leghari *et al.,* (1999) reported 29 species of fish from Chotiari lakes. Jafari *et al.,* (1999) reported fish diversity of Manchhar lake.

The mechanism of seasonal changes in phytoplankton can be based upon physical, chemical and biological environmental factors of any water body (Mahar *et al.,* 2004). The distribution of phytoplankton in the lake is regulated mainly by temperature, light, nutrients, toxicants, parasitism, grazing and inter-specific competition (Harris, 1986). The present position of the reservoir is meso-eutrophic due to the extra growth of plankton and also luxurious growth of higher aquatic plants. 15 species of aquatic plants were recorded from various sampling stations of the reservoir (**Tab.8**). These included free floating, emergent and submerged. Due to the presence of plants the reservoir is a good source for fish culture. The bottom and soil are purely sandy and silty it may create the problem of water logging for the surrounding crop lands. At present the primary production in reservoir is higher for the proper utilization, it therefore need to introduce the seed of phytophagous fish species to consume the primary productivity. Phytoplankton and macrophytes in the reservoir were very rich and indicate the suitability of the environmental conditions for the growth of fish and fisheries. These weeds have covered a large area of the reservoir in the form of marsh.

The Chotiari reservoir is characterized by continuous slow flowing water and flushing out of salts. The eco-biological status of the reservoir was found to be productive in planktonic community and fisheries. The process of eutrophication is at its prelimnary stage due to luxurious growth of phytoplankton filamentous green algae vascular aquatic plants and high population with good growth rate of cyprinidae fishes in the reservoir.

Table 1: Physico-chemical parameters of Chotiari Reservoir during November 2006

S. NO.	PARAMETERS	1	2	3	MEAN
1.	Time	11.45	12.30	12.50	--
2.	Temperature of Air (°C)	30.5	32	32	31
3.	Temperature of Water (°C)	26.5	27	28	27
4.	Secchi depth (inches)	46	54	52	50.6
5.	pH	8.41	7.56	8.56	8.17
6.	Conductivity (µS/ Cm)	568	566	567	567
7.	Total alkalinity ($CaCo_3$ mg/ L)	141	183	166	163.3
8.	Salinity (ppt)	0.25	0.27	0.29	0.27
9.	Chloride (mg/ L)	59.9	59.2	59.2	59.4
10.	Hardness ($CaCo_3$ mg/ L)	145	138	140	141
11.	Dissolved oxygen (mg/ L)	7.34	6.7	7.6	7.21
12.	TDS (mg/ L)	363	362	362.8	362.6

1. Ganwari lake area in reservoir
2. Tajar lake centre area in reservoir
3. Out let structure regulator

Table 2: Physico-chemical parameters of Chotiari Reservoir during April 2007

S. NO.	PARAMETERS	1	2	3	MEAN
1	Time	11.45	12	12.5	--
2	Temperature of (Air °C)	35	36	36	35.6
3	Temperature of (Water °C)	31.2	32.2	31.8	31.7
4	Secchi Depth (inches)	36	60	60	52
5	pH	7.83	7.89	7.96	7.89
6	Conductivity (µS/ cm)	520	504	509	511
7	Total alkalinity ($CaCo_3$ mg/ L)	155	165	143.33	154.4
8	Salinity (ppt)	0.300	0.254	0.240	0.264
9	Chloride (mg/ L)	59.9	58.3	58.1	58.7
10	Hardness ($CaCo_3$ mg/ L)	120	110	130	120
11	Dissolved oxygen (mg/ L)	7.2	7.8	7.4	74.6
12	TDS (mg/L)	332.8	322.5	325.8	327

1. Ganwari lake area in reservoir
2. Tajar lake centre area in reservoir
3. Out let structure regulator

Table 3: Physico-chemical parameters of Chotiari Reservoir during August 2007

S. NO.	PARAMETERS	1	2	3	MEAN
1	Time	10:38	11:17	12:07	--
2	Temperature of (Air °C)	34	37	38	36
3	Temperature of (Water °C)	30	32	33	31
4	Secchi Depth (inches)	26	28	25	26.3
5	pH	6.4	6.1	6.2	6.3
6	Conductivity (µS/ cm)	570	531	532	544
7	Total alkalinity ($CaCo_3$ mg/ L)	92.5	225	312.5	210
8	Salinity (ppt)	0.3	0.3	0.3	0.3
9	Chloride (mg/ L)	35.1	25.8	30.2	30.3
10	Hardness ($CaCo_3$ mg/ L)	37.92	32.5	23.3	31.24
11	Dissolved oxygen (mg/ L)	5.7	5.62	4.8	5.37
12	TDS (mg/L)	277	252	253	261

1. Ganwari lake area in reservoir
2. Tajar lake centre area in reservoir
3. Out let structure regulator

Table 4: Phytoplankton (algae) recorded from Chotiari reservoir.

Months	Nov	Apr	Aug
Phylum: Cyanophyta			
Class: Chroocophyceae			
Order: Chroococcales			
Family: Chroococcaceae			
Chroococcus tenax	-	+	-
Chroococcus disperses	+	-	+
C. limneticus	+	+	-
C. minutus	+	+	-
C. minor	+	+	+
Cylindrospermum staganale	+	-	-
Gloeocapsa magma	+	-	+
Gomphosphaeria aponina	+	-	-

Merismopedia glauca	+	+	+
M. punctata	+	+	+
M. tenuissima	-	-	+
M. elegan	+	+	-
M. cenvoluta	-	-	+
Microcystis aeruginosa	-	+	+
M. robusta	+	-	-
Xenococcus kerneri	-	+	+
Class: Nostocophyceae			
Order: Nostocales			
Family: Nostocaceae			
Anabaena variabilis	+	-	+
A. limnetica	+	+	+
A. subcylindrice	-	+	-
Nostoc commune	-	-	+
N. microscopicuas	+	-	+
Family: Oscillatoriaceae			
Oscillatoria amphibia	-	+	+
O. formosa	+	+	+
O. jasorvensis	-	+	-
O. limosa	+	+	-
O. princeps	+	-	-
O. tenuis	-	+	-
O. splendida	-	+	+
Spirulina princeps	+	+	-
Lyngbya bergei	-	+	+
L. martensiana	+	-	+
L.limnetica	+	+	+
L. major	+	+	+
Phylum:Chlorophyta			
Class: Chlorophyceae			
Order: Chlorococcales			
Family: Oocystaceae			
Oocystis borgei	-	+	+
O. elliptica	+	-	+
O. pusilla	+	-	+
O. crassa	+	+	+
Sphaerocystis schroeteri	+	+	-
Family: Scenedesmaceae			
Ankistrodesmus faloatus var. acicularis	+	+	+
Family: Hydrodictyaceae			
Pediastrum duplex var.clathratum	+	+	+
P. duplex var. rotumdatum	-	-	+
P. tetras	+	+	+
P. duplex	-	+	+
P. duplex var. gracilimum	-	+	+
P. simplex	-	+	+
Spirogyra subsalsa	+	+	+
S. fluviatilis	-	+	-
S. fuellebornei	+	-	+
S. micropunctata	-	+	+
S. gratiana	+	-	-
Order:Zygnematales			
Cosmarium blyttii	+	+	-
C. deprassum	+	-	-
C. graminatum	-	-	-

	+	-	+
Ankistrodesmus convolutes	-	+	+
A. falcatus	+	-	-
Tetraedron minimum	-	+	+
Scenedesmus alundans	+	+	+
S. aliundaus var. lengicanda	-	+	+
S. arcuatus	+	+	+
S. bijuga	+	+	+
S. dimorphus	+	+	+
S. quadricauda	+	+	+
S. armatus			
Phylum: Euglenophyta			
Class: Euglenophyceae			
Order: Euglenales			
Family: Euglenaceae			
Euglena acus	+	-	+
E. deses	+	-	+
E. spirogyra	+	-	-
Phacus curvicauda	+	+	-
P. caudatus	-	+	-
P. orbicularis	-	+	+
P. pleuronectes	-	+	-
P. acuminatus	+	+	+
Lepocinclis longistriata	-	+	+
L. fusiformis	-	+	-
L. ovum	-	+	-
Phylum: Bacillariophyta			
Class: Bacillariophyceae			
Order: Centrals			
Family: Coscinoiscoideae			
Cymbella affinis	+	-	+
C. gracilis	+	-	-
Fragilaria capucina	+	-	+
Gomphonema parvulum var. subelliptica	+	-	+
Gyrosigma kutzingii	-	+	-
Navicula anglica	+	-	-
Nitzschia palea	+	-	+

(- absence + presence)

Table.5. Zooplankton recorded from Chotiari reservoir.

Months	Nov	Apr	Aug
Phylum: Rotifera			
Class: Monogonota			
Order: Ploima			
Family: Brachionidae			
Brachionus caudatus	0	0	22
Keratella tropica	37	2	56
Monostyla bulla	6	4	3
Phylum: Arthropoda			
Class: Crustacea			
Order: Copepoda			
Suborder: Cyclopoida			
Mesocyclops leuckarti	0	69	0
Cyclops nupli	34	0	26

Suborder: Calanoida			
Family: Diaptomidae			
Heliodiaptomus sp.	3	4	6
Suborder: Cladocera			
Family: Bosminidae			
Bosmina coregoni	6	56	9
B. fatalis	2	1	7
B. longirostris	13	48	7
Family: Daphnidae			
Ceriodaphnia reticulata	4	0	17
Diaphanosoma sarsi	0	24	3

Table 6. Quantitative analysis of molluscs (collected from 1 sq. m) recorded from Chotiari reservoir

Months	Nov	Apr	Aug
Phylum: Mollusca			
Class: Gastropoda			
Subclass: Pulmonata			
Order: Basommatophora			
Gilla sp.	8	0	11
Gyrulus convixiusculus	4-	0	0
Lymnea auricularia	2	0	0
Pleurocerca sp.	24	32	16
Tricula cristella	0	0	2
Torquies sp.	12	19	30
Viviparus sp.	13	25	17

Table 7. Fish species recorded from Chotiari reservoir.

Order: Cypriniformes
Family: Cyprinidae
Catla catla
Labeo rohita
L. gonius
Osteobrma catio
Puntius sophore
P. ticto
P. sarana
Chela labuca
Cirrhinus reba
C. mrigala
Order: Siluriformes
Family: Bagridae
Aorichthy aor
Rita rita
Mystus tengara
Family: Sisoridae
Mystus bleekri
Gagata Cenia
Family:Siluridae
Wallago attu
Ompok bimaculatus
Clupisoma garua
Ailia coila
Order: Clupeiformes
Family: Clupeidae

Gadusia chapra
Family: Notopteridae
Notopterus notopterus
Order:Channiformes
Family: Channidae
Channa morulia
Channa striata
Order: Beloniformes
Family:Xenentodontidae
Xenentodon cancila
Order: Cyprinodontifomes
Family: Aplocheilidae
Aplochelus panchax
Order: Perciformes
Family: Gobidae
Glossogobius giuris
Family: Cichlidae
Oreochromis mossambicus
O. nilotica
Family: Mugilidae
Sicamugil cascasia
Family: Chandidae
Chanda ranga
Family: Osphronenidae
Colisa faciata
Family:Mastacembilidae
Mastacembelus armatus

Table.8. Macrophytes recorded from Chotiari reservoir

Stations	Ganwari lake	Tajar lake	Out let structure.
Azolla pinnata	+	-	+
Ceratophyllum demersum	+	-	+
Hydrilla verticillata	+	-	+
Ipomoea aquatica	+	-	+
Lemna minor	+	-	+
Myriophyllum tuberculatum	+	-	+
M. vendicum	-	+	-
Nymphaea lotus	-	+	-
Najas	-	+	-
Phragmite (communis) vallatoria	-	+	-
Potamogeton pectinatus	-	+	-
Salvinia nataus	-	+	-
Typha elephantine	-	+	-
T. domingensis	-	+	-
Utricularia flexuosa	-	+	-

(- absence + presence)

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