Pak J. Bot. 33 (special issue) 2001

ECOLOGICAL STUDY OF ALGAL FLORA OF KUNHAR RIVER OF PAKISTAN

M. K. LEGHARI *S. BUSHRA WAHEED AND **M. Y. LEGHARI

Pakistan Museum of Natural History, Islamabad

Abstract

First time ecological study of Algal Flora of Kunhar River was carried out during January 1998 to July 1998. A total of 100 species belonging to 62 genera of 6 Algal groups. Cyanophyceae (21 species 21% belonging to 14 genera), Chlorophyceae (24 species 24% belonging to 20 genera), Bacillariophyceae (48 species 48% belonging to 21 genera), Xanthophyceae (2 species 2% belonging to 2 genera), Chrysophyceae (2 species 2% belonging 2 genera), Euglenophyceae (3 species 3% belonging to 3 genera) and 38 physico-chemical parameters were recorded.

INTRODUCTION

Qualitative and quantitative determinations of Algal Flora are essential for determining the aquatic productivity, as they are the chief source of food for aquatic animals including fishes. The first information on the Algal Flora from state of Jammu & Kashmir by Disckie (1882); Later Misra (1937) few species of Zygnemaceae from Srinagar now occupied by India, Khan (1957) culture of rice field algae, Faridi (1971) freshwater algae of Pakistan brief reference of algae of Kashmir, Hassan and Alisa (1986) some freshwater algae. Leghari, *et al.*, (2000) Limnological Study of Hot Spring, Azad Kashmir. Algae is an important group of cryptogams. These are the primary producers of energy in the energy cycle of this wild, fixing energy by the process of photosynthesis. The algal flora is widely distributed and is an important component of various ecosystems like marine, fresh water rivers, ponds and streams etc. It is the basic food for aquatic fauna and fish. Like other algal flora it is an important indicator of pollution (Patrick, 1966) and bloom in the water bodies receiving animal, poultry and house hold waste. The present studies were undertaken to isolate and identify the diatoms. The diatoms are a vast group of algae having diverse economic importance. These are present through out the year and resist the adverse environmental conditions due to hard silica shell. Diatoms serve the purpose of indicator of oil reserves in the sediments in which they are found in fossilized forms. Many important oil reserve discoveries have been made by OGDC by study of these diatoms. Other industrial uses include the use of diatoms as abrasive material in the tooth pastes. IN advanced countries these are used in the preparation of some solutions to clean the walls, sound and fire proofing materials and polish for the heavy metals. Diatoms have been isolated in the fish and other fauna guts and is a source of fish food. The people as oil, which is very rich in vitamins A & D and increases the users resistance against winter cold, then use fish oil. The fishermen also coat their boats once a year with this oil to protect them from the insect/ fungus attacks and other factors.

*Department of Pharmacy, University of Sindh, Jamshoro.
**Department of Environment, WAPDA, Lahore.

The present work will give the result of Algal flora of Kunhar River, where different physico-chemical properties and other parameters have been taken into consideration to study the Algal flora it is in interesting to note that about 70% of the diatoms isolated from these studies were recorded from the gut content of the fish caught from these waters.

Kunhar River originates from Lulusar Lake below Babusar Top. It crosses Bata Kundi, Naran, Kaghan, Kawai, Balakot, Ghari Habibullah and ultimately joins the River Jhelum at Rara. The water of the river is rich in algal flora due to which several fish species like *Triplophysa kashmirensis, Crossocheihis latius, Schizothorax plagiostomuss, Schizopyge esocinus, Racoma labiatus, Schistura nalbanti, S. alepidota, Triplophysa kashmirensis* are commonly found. Algal samples have been collected from Ghari Habibullah from the hillside area on the way to Muzaffarabad. The latitude of the area is 34^0.24' north, longitude 73^0.25' east and the altitude of the locality is 812 meters. As regards the precipitation, the area receives rainfall both in monsoon and in winter with snow fall and cold winds. The vegetation is mostly of moist temperate type. Gelutinous Mosses of Nostoc and tufts of Cladophora were also abundant in this habitat.

If a river would act as a plug flow reactor water parcels are transported down ward with tranverse mixing plankton imported by wind or birds or other chances sources may well grow in this water parcel. At the end of the river course only more or less dispersed clouds of plankton would be observeable. In unimpounded rivers a lot of zones may act like mixed reactors, too, old branches, basins, pools, dead zones at the back of tree, groynes, or stones etc. in some dead zones the mean retention time of water may be long enough to allow establishing of stable plankton population.

Materials and methods

Algal Flora were collected monthly from January, 1998 to July, 1998 between 11 a.m. to 3 p.m with the help of using phytoplankton net of 5-10 μm mesh. Filamentous algae collected with the help of forsap, blue green algae collected with slide cover, diatoms collected with tooth brush, algae which can see easily with naked eye picking with hands like *Chara, Cladophora, Spirogyra* etc. from the different zones of the river like mixed reactors, too old branches, basins, pools, dead zones at the back of tree groynes, stones etc. in some dead zones mean retention time of water long enough to allow establishing of stable Algal population. Geology: The surrounding area of the Kunhar River is a characterized by rugged mountains and deep canyons terraces formed by the Kunhar River. Erosion usually takes place during the monsoon season by rains. Rocks of different types are eroded such that granite gneiss, quartzite, biotite, phylite schist, chlorite schist, Dolorites, Sandstones and carbonaceous rocks of different ages. Bedrock of Kunhar River is under lied by the glacial layer, which consists of high calcium and magnesium content.

Water samples were collected every time using water sampler (Nansen bottle) for studying physico-chemical features using standard methods (APHA, 1985) and for identification of Algal Flora. Samples were preserved in 4% formalin solution (Mason, 1967). The species composition was determined by utremohal method (Lund, 1958). The micro algae (Ultra nannoplankton) were not counted. Algal

Flora identification and counts were done using inverted electric microscope (PZO poland 10x40) and identified with the help of available literature (Tilden, 1910; Husted, 1930; Majeed, 1935; Smith, 1950; Desikachary, 1959; Prescott, 1962; Siddiqi & Faridi, 1964; Patrick, 1966; Philpose, 1967; Tiffany & Briton, 1971; Vinyard, 1979; Akiyama & Yamagishi, 1981).

Result and discussion

According to the result ecological study of Algal flora of Kunhar River shown in Table 2 out of 100 species belonging to 62 genera of 6 Algal groups, Cyanophyceae (21 species 21% belonging to 14 genera), Chlorophyceae (24 species 24% belonging to 20 genera), Bacillariophyceae (48 species 48% belonging to 21 genera), Xanthophyceae (2 species 2% belonging to 2 genera), Chrysophyceae (2 species 2% belonging 2 genera), Euglenophyceae (3 species 3% belonging to 3 genera) and 38 physico-chemical parameters were recorded.

Physical and chemical parameters in Table 1 show the effect of temperature. High air temperature (8-23° C) change the climate, directly affecting glacier, snow, water form and water surface temperature (3.7-12.2°C). High temperature of water surface helps in dissolving the organic and inorganic matter. pH (7.5-7.8) show that the water is alkaline, pH increase is due to high concentration of dissolved organic and inorganic matter, temperature and algal flora, etc. T.D.S. (74-236 PPM) showing the concentration of total dissolved solids of the river is quite productive aquatic life. T.S.S. (35-433 Mg/L) shows the ratio of total suspended solids in water, high T.S.S. value show that high concentration of non living particulates originate as catchment, derived silts, clay, mud, organic matter, etc. are present in the water. This high value is due to rain and flood so flood episodes are the major disturbance in river affecting composition and biomass of the plankton/algae. The high turbidity (1.4-4) value shows that water is too much turbid. High concentration of abiogenic turbidity, whether disturbance or not, water colum mixing as such or in combination with in organic turbidity cause concomitant changes in the light field over time. Consequently, vertical mixing and suspended solids significantly affect phytoplankton photosynthesis and productivity in aquatic environment. Conductivity (11.6-33 M.ohmsx^{10}) shows the current ions for production means water is enough for productivity. Salinity (0.01 - 0.02%) and Orthophosphate (0.02-0.2 µg/L) were low. The result show that low salinity, orthophosphate, low temperature (4°C) provide chances for the presence of species of class Chrosophyceae, Dinophyceae, but species of Dinophyceae could not find due to fast river flow (200-1762.5 M^3/S). High Humidity (49-58%) value shows that Fungus, Bacteria, Cyanobacteria, Aerial algae etc. could be present as humidity directly affects light and temperature. Light transparency was 1-4 ft. At one ft. the water is too much turbid which affect the light limit as a result phytoplankton photosynthesis and therefore restrict biomass development. Dissolved oxygen (11.2-12.9 Mg/L) was in sufficient quantity of D.O. for production of aquatic life like fish, fauna etc. but this high concentration of D.O. was due to low temperature and fast flowing as in table-1 (200-1762.5 M^3/S). Carbon dioxide CO_2 (20-30 PPM) was in sufficient quantity for the growth of phytoplankton/algal flora as increase in CO_2 causes increased algal flora; blue green algae making blooms, and green algae making mats. Higher value of CO_2 shows availability of rock carbonaceous in river Kunhar. Higher Nitrate (0.7-3.5 µg/L) value in summer season increased chlorophyll-a

distribution and alternate high value in cold/winter season low chlorophyll-a were observed which means that both nitrate and temperature play significant role in chlorophyll distribution. Phosphate (0.08-0.27 µg/L) plays significant role to control the algal growth. Total hardness (80-100 PPM) concentration show that sufficient quantity of blue green algae was available in this water. Increase in Calcium hardness (45-60 PPM) increases the production of green algae. Increase in the concentration of Magnesium hardness (35-40 PPM) results in the production of blooms of Cyanophyceae. Higher wave (2-15 inch) reading was due to fast flow of water. Taste, ordour, and colour of the water of Kunhar River showed that it was tasteless, ordourless, and colour in winter season was gray but in summer and in monsoon season it was colourless, mixed with sand, mud, etc.

Observations

Time factor is involved in river.
Continuous turbulence, unidirectional flow and more periodic changes of turbidity in river ecosystem.
The above factors affecting on the growth of the algae/plankton.

Conclusion

From the Table-1 that the water quality of Kunhar River seems good.
Cold temperature indicates for abundance growth of diatoms and green algae.
Total hardness, magnisium hardness indicates for growth of blue green algae.
Fish are commonly found due to rich of Algal flora.
pH indicate that water is alkaline.

Table-1: Showing physico-chemical properties of Kunhar River.

		Min	Max
1	Soil temperature °C	4	11
2.	Air temperature °C	8	23
3.	Water surface temperature °C	3.7	12.2
4.	Water bottom temperature °C	3.8	11
5.	pH	7.5	7.8
6.	Turbidity in NTU Range on 1000	1.4	4
7	T.D.S (ppm)	74	236
8.	T.S.S. mg/L	35	433
9.	Conductivity (m.Ohms x^{10})	11.6	33
10.	Salinity (NaCl%)	0.01	0.02
11.	Humidity (%)	49	58
12.	Light transparency by		
	Secchi disc (feet)	2	4
13.	Dissolved oxygen (mg/l)	11.2	12.9
14.	Saturation(%)	89	102
15.	CO_2 (ppm)	20	30
16.	Ammonia Nitrogen (NH_3 N_2 ppm)	0.02	0.05
17.	Nitrate □g/L.	0.7	3.5
18.	Density (30°C g/v)	1.002	1.004
19.	Water colour (Numbers)	Colourless Sandy	
20.	Orthophosphate (ug/1)	0.02	0.2
21.	Phosphate (ug/l)	0.08	0.27
22.	Total Hardness ($CaCO^3$ ppm)	80	100

23.	Ca++ Hardness (ppm)	45	60
24	Mg Hardness (ppm)	35	40
25.	$CaCl_2$ Hardness (ppm)	49.95	66.6
26	Mg Cl_2 (ppm)	33.3	38
27	Grain Per Gallon (Gpg)	4.64	5.8
28.	Refractiv index (30oC)	1.33	1.332
29	Wave (inch)	2	15
30.	Taste	Tastless	Tastless
31	Odour	Odourless	
32.	Wind	Cold fast	
		East	West
33.	Day	Cludy	Clear
34.	Weather	Fogy	Dry Clear
35.	Water	Shallow	Deep
		near bank	at centre
36.	Soil	Sandy	Rocky
37	Zone	Moist	Temperate
38.	Flows m^3/S	200	1762.5

Table-2: The Occurrence of Algal Flora during January 1998 to July, 1998 in Kunhar River.

Class: Cyanophyceae

1. *Anabaena variabilis* Kuetz.
2. *Aphanocapsa elachista* W & West
3. *Aphanothece castagnei* (Breb.)Raben.
4. *A. microscopica* Naegeli
5. *A. nidulans* Richter
6. *Calothrix parietana* (Naeg.) Thuret
7. *Chroococcus minor* (Kuetz) Naegeli
8. *C. turgidus* (Kuetz.) Naeg.
9. *Gloeocapsa montana* Kuetz
10. *Gloeothece lacustris* Chod.
11. *Lyngbya heronymusii* Lemm.
12. *L. martensiana* Meneghine
13. *Merismopedia glucum* (Ehr) Naegeli.
14. *M. punctata* Meyen
15. *Microcystis flos-aquae* Kirch.
16. *Nostoc commune* Vaucher.
17. *Oscillatoria formosa* Bory
18. *O. princeps* Vaucher
19. *O. tenuis* Agardh
20. *Spirulina subsalsa* Oersted
21. *Synechocystis aquatilis* Sauv.

Class: Chlorophyceae

22. *Actinastrum hantzschii* var. *elongatum* Smith
23. *Ankistrodesmus falcatus* (Corda) Ralfs

24. *Chara schweinitzii* Braun
25. *Chlorella vulgaris* Beyerinck
26. *Cladophora glomerata* Kuetz.
27. *Closterium ralfsii* var. *hybridium* Rabenk.
28. *Cosmarium contractum* Kirchner
29. *Crucigenia irregularis* Wille
30. *Cylindrocapsa geminella* Wolle
31. *Geminella minor* Heering
32. *Oedogonium angustum* Tiffany
33. *Oocystis borgei* Snow
34. *O. elliptica* W. West
35. *Palmella miniata* Naegeli
36. *Protococcus viridis* Agardh
37. *Scenedesmus bijuga* (Turp.) Lagerheim
38. *Spirogyra rectangularis* Transeau.
39. *Tetraedron muticum* (A. Braun) Hansgirg
40. *Trochiscia granulata* (Reinsch) Hansgirg
41. *T. obtusa* (Reinsch) Hansgirg
42. *Ulothrix subtilissima* Raben
43. *U. variabillis* Kuetz.
44. *U. zonata* Kuetz.
45. *Zygnema cylindricum* Transeau.

Class: Bacillariophyceae

46. *Achnanthes affinis* Kuetz.
47. *A. exilis* Kuetz.
48. *A. lanceolata* (Breb.) Grunow
49. *A. minutissima* (Kuetz.) Cleve
50. *A. microcephala* (Kuetz.) Cleve.
51. *Amphora delicatissima* Krab.
52. *A. ovalis* Kuetz.
53. *A. perpusilla* Grunow
54. *Amphipleura pellucida* Kuetz.
55. *Anomoeoneis sphaerophora* Kuetz.
56. *Cocconeis placentula* Ehrenberg
57. *Cyclotella glomerata* Bachmann
58. *Cymbella amphicephalla* Naegeli
59. *C. laevis* Naegeli
60. *C. cymbiformis* (Kuetz.) Breb.
61. *C. naviculiformis* Averswald
62. *C. turgida* Gregory
63. *C. ventricosa* Kuetz.
64. *Diatoma elongatum* Agardh
66. *D. vulgare* Bory
66. *Epithemia argus* Kuetz.

67. *Fragilaria construens* Grunow
68. *F. pinnata* Ehren.
69 *F. virescens* Ralfs.
70 *Gomphonema ghosea* n. sp
71. *G. olivaceum* var. *calcarea* Pascher
72. *Gyrosigma scalproides* (Rabh.) Cl.
73. *Mastogloia smithii* Thureites
74. *Melosira granulata* (Ehr.) Ralfs.
75. *Navicula anglica* Ralfs.
76. *N. cryptocephala* var. *intermedia* Grun.
77. *N. lanceolata* Grun.
78. *N. protracta* (Grunow) Cleve
79. *N. radiosa* Kuetz.
80. *N. radiosa* Kuetz. var. *tenella* Grun.
81. *Neidium dumium* (Ehr.) Pfitzer
82. *N. iridis* Cleve
83. *N. productum* Cleve
84. *Nitzschia vermicularis* Hantzsch.
85. *N. palea* Smith
86. *Pinnularia borealis* (Kuetz.) Rab.
87. *P. gibba* (van Heurck) Boyer
88. *Rhopaldia gibba* (Kuetz.) Mueller.
89. *Synedra acus* Kuetz.
90. *S. affinis* (Kuetz.) Pascher.
91. *S. ulna* (Nitzsch) Ehr.
92. *S. ulna* var. *amphirhynchus* (Ehr.) Grun.
93. *Tabellaria fenestrata* Kuetz.

Class: Chrysophyceae

94. *Dinobryon divergens* Imhof.
95. *Mallomonas caudata* Iwanoff.

Class: Xanthophyceae

96. *Botryococcus braunii* Kuetz.
97. *Vaucheria sessilis* De candolle

Class; Euglenophyceae

98. *Euglena acus* Ehr.
99. *Phacus orbicularis* Huebner
100. *Trachelomonas haxangulata* (Swir.) Play.

Acknowledgement

I am very grateful to Dr. Shahzad A. Mufti, Director General, P.M.N.H. and Mrs. Bushra Waheed, Incharge, Kohala Hydroelectric power project (NORCONSULT) 1998 for giving me a chance to work in the above mentioned project. The finance of this research was supported by NORCONSULT.

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