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Physico-Chemical and Biological Characteristics of Awang Khujairok River, Manipur, India

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Abstract

An attempt was made to study the physico-chemical and biological characteristics of Awang Khujairok river, Manipur. Well mark seasonal variations were recorded in respect of physico-chemical characteristics. The collection included 11 species of fishes (belonging to 9 genera and 6 families), 3 species of snails (belonging to 3 genera and 3 families) and 9 species of macrophytes (belonging to 9 genera and 6 families). The river is considered eutrophic as it has rich concentration of nutrients, fecal coliform bacteria and aquatic flora and fauna, which can thrive well in different environmental conditions. The river water is not suitable for human consumption.

Key words : Awang Khujairok river, Physico-chemical features, Biodiversity, Eutrophic.

Freshwaters are inhabited by a remarkable variety of species from most taxonomic groups evolved on earth, but they are also a scene of human opportunities, requirements and conflicts (1). Today, the river water, which plays an important role in agriculture and domestic purposes receive untreated sewage, domestic waste, industrial and agricultural effluents containing substances varying from simple nutrients to highly toxic substances. Nutrient input to these water courses has increased dramatically during the last 150 years and it has intensified over the last decades. As a results many rivers are highly eutrophic and brought considerable changes in the species composition of flora and fauna. Studies on water quality and ecology of the rivers in India have been done by various workers (2—6). In Manipur, there are numerous rivers and streams, of which many are feeding important lakes of the state. The lake ecosystem is a system that is intimately coupled with the land surrounding it in its drainage area and chemical components transported to the lake by ground water or running surface waters of streams and rivers (7). There are some reports on the trophic status and biodiversity of lakes of the state. However, information about the rivers and streams which are associated with these important lakes are scanty (8). In the present study an attempt was made to study the water quality status and aquatic biodiversity of Awang Khujairok river. The river originates from the western catchment of Loktak lake and fall into the lake near Yangoi Karong in Bishenpur District of the state.

Methods

Surface water samples were collected from the down stream of Awang Khujairok river near Oinam (latitude : $24^0 41' 5''$ N; longitude : $93^0 47' 51''$E) on quarterly basis (September/post-monsoon, December/winter, March/pre-monsoon and June/monsoon) during 2000 and 2002. For each season, five replicates of water samples were collected and their physico-chemical and microbiological parameters were analyzed following standard methods (9, 10). The average of five samples for each parameters studied was considered as one reading. The water temperature, pH, dissolved oxygen (DO) and free CO_2 were determined in the field and other parameters were analyzed in the laboratory within 48 hours. Water temperature was measured using a mercury thermometer and pH by digital pH meter. DO was estimated by the azide modifica-

Table 1. Physico-chemical characteristics of Awang Khujairok river studied during September 2000–June 2002. All the values are in mg/liter, except temperature and pH.

Parameters	Range Min	Max	Mean	SD
1 Water temperature (C)	16.8	28.5	23.15	4.25
2 pH	6.4	8.2	7.14	0.62
3 Dissolved oxygen	5.1	8.9	6.74	1.29
4 Free CO_2	5.0	12.9	9.12	2.69
4 Total dissolved solids	80.0	198	124.00	35.42
5 Chloride	8.2	16.1	12.35	2.64
6 Calcium	3.6	15.5	10.28	3.91
7 Magnesium	3.8	6.2	4.66	0.82
8 Sodium	12.0	19.0	15.75	2.37
9 Potassium	1.0	3.0	1.75	0.70
10 Nitrite-nitrogen	0.008	0.025	0.018	0.01
11 Nitrate-nitrogen	0.184	0.675	0.38	0.20
12 Total nitrogen	1.857	2.376	2.05	0.22
13 Inorganic phosphorus	0.035	0.098	0.07	0.02
14 Organic phosphorus	0.169	0.324	0.25	0.05
15 Total phosphorus (TPP)	0.231	0.411	0.324	0.06

tion of Winkler's method. Total dissolved solid (TDS) was determined as the residue left after evaporation of filtered sample. Free CO_2, chloride, calcium and magnesium were derermined by titration methods. Sodium and potassium were estimated by flame photometer. Nitrite and nitrate were recorded calorimetrically. The total nitrogen was estimated by micro-Kjeldahl distillation method. Phosphorus was determined calorimetrically by stannous chloride method. Organic phosphorus was calculated as the difference between the total phosphorus and inorganic phosphorus. Coliform counts were made using membrane filter (MF) technique.

Fishes were identified following Jayaram (11) and Talwar and Jhingran (12). Snails were identified following Rao (13). Aquatic Macrophytes and planktons were identified following Adoni et al. (14) and by comparing with the preserved herbaria and photographs available in the Loktak Development Authority, Manipur.

Results and Discussion

Physico-chemical Characteristics

The results of physico-chemical characteristics of the Khujairok river are summarized in Table 1. Surface water temperature fluctuates from 16.8 to 28.5 C with an average value of 23.15 C. The pH, dissolved

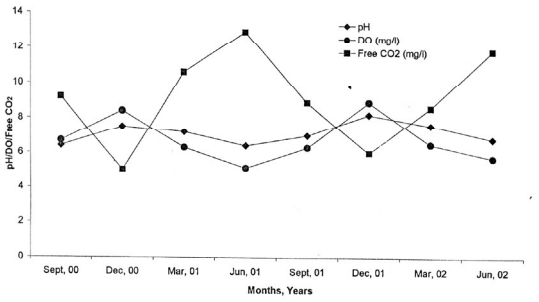

Figure 1. Seasonal variations in pH, dissolved oxygen (DO) and free CO_2 concentrations in Awang Khujairok river, Manipur studied during September 2000—June 2002.

oxygen (DO) and free CO_2 concentrations showed marked seasonal fluctuations (Fig. 1). The lower value of pH was observed during monsoon and post-monsoon periods. The average value of pH was slightly alkaline. The pH value is within the tolerance limit of Indian standard (15). Highest value of DO was observed during December and lowest during June. It was negatively correlated with free carbon dioxide (r= -0.94677). The free CO_2 concentration was usually high during the present study with an average value of 9.12 mg/liter. Its concentration was highest during June and lowest during December. The river water is not suitable for fish culture as average value of free CO_2 exceeds the tolerance limit of Indian standard.

The total dissolved solid varied from 80.0 to 198.0 mg/liter with an average value of 124.0 mg/liter. The concentration of potassium was highest during the pre-monsoon period and declines during the monsoon and post-monsoon periods (Fig. 2). The calcium content was usually low and may be categorized as calcium poor water. Concentrations of sodium, chloride, and magnesium occurred within the tolerance limit of Indian standard.

The nitrite-nitrogen concentration ranged from 0.008—0.025 mg/liter with an average value of 0.018 mg/liter. Presence of nitrite-nitrogen in the present study suggests the contamination of water. The nitrate-nitrogen concentration was highest during March and lowest during the September. The phosphorus content was comparatively higher during the pre-monsoon period (Fig. 2). The average concentration of inorganic phosphorus was found to be higher than the standard permissible limit recommended by

Table 2. List of fishes, snails, macrophytes and planktons of Awang Khujarirok river.

Fishes	Snails	Macrophytes	Planktons
Family : Cyprinidae			
1. *Cyprinus carpio* (Linnaeus)	Family : Viviparidae	Family : Poaceae	Phytoplanktons
2. *Puntius sophore* (Ham.)	1. *Angulyagra oxytropis* (Benson)	1. *Echinochloa stagnina* Retz.	1. *Diatoma* sp.
3. *Ampblypharyngodon mola* (Ham.)		2. *Phragmites karka*	2. *Euglena* sp.
4. *Esomus danricus* (Ham.)		3. *Erianthus procerus* (Roxb.) Raizada	4. *Navicula* sp.
	Family : Pilidae		5. *Nitzschia* sp.
Family : Cobitidae	2. *Pila* sp.	4. *Capillipedium* sp.	6. *Phacus* sp.
5. *Lepidocephalus guntea* (Ham.)			7. *Spirogyra* sp.
	Family : Unionidae	Family : Polygonaceae	
	3. *Lamellidens* sp.	5. *Polygonum barbatum* Linn.	
Family : Heteropneustidae			Zooplanktons
6. *Heteropneustes fossilis* (Bloch.)		Family : Cyperaceae	1. *Cyclops* sp.
		6. *Cyperus* sp.	2. *Daphinia* sp.
Family : Gobiidae			3. *Vorticella* sp.
7. *Glossogobius giuris* (Ham.)		Family : Amaranthaceae	
		5. *Alternanthera pheloxeroides* (Mart.) Grised	
Family : Belontiidae		Family : Pontederiaceae	
8. *Colisa fasciatus* (Schn.)		6. *Eichhornia crassipes* (Mart.) Solms.	
Family : Channidae		Family : Hydrocharitaceae	
9. *Channa orientalis* (Schn.)		9. *Hydrilla* sp.	
10. *Chana marulius* (Ham.)			
11. *Channa punctatus* (Bloch.)			

USEPA (16) for any tributary discharging to a lake. The concentration of nutrients were higher in winter (December) and pre-monsoon (March), decreasing in the monsoon season and lowest in post-monsoon (September). This may be attributed to the reason that during winter and pre-monsoon period the river water is more or less stagnant with less water volume, thereby increasing the nutrient concentration. Moreover, the river receives nutrients from the surrounding agricultural filds, fertile soils from the catchment hills, domestic waste from the human settlements and deposition of animal waste.

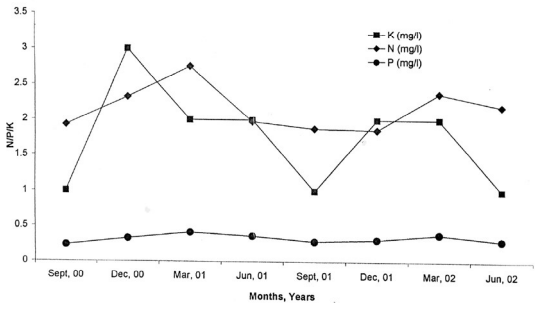

Figure 2. Seasonal variations in nitrogen (N), phosphorus (P) and potassium (K) concentrations in Awang Khujairok river, Manipur studied during September 2000—June 2002.

Microbiological Characteristics

Microbial analysis in terms of most probable number (MPN) of total coliform bacteria and fecal coliform/100 ml ranged from 24 to 96 and 8 to 28 respectively. The concentration was highest during the monsoon and lowest during post monsoon. The present findings indicate contamination of microorganisms in the river water. According to BIS (17), drinking water should not contain any coliform bacteria in 100 ml of samples. It indicates that the water at the down stream of the river is not suitable for drinking purposes without treatment.

Aquatic Bio-Diversity

List of fishes, snails, macrophytes and planktons were collected and identified (Table 2). The collection included 11 species of fishes (belonging to 9 genera and families), 3 species of snails (belonging to 3 genera and 3 families) and 9 species of macrophytes (belonging to 9 genera and 6 families). Most of the fish

species collected were widely distributed forms, which can thrive well in the polluted waters.

In the present study 6 genera of phytoplanktons and 3 genera of zooplanktons were identified. All the genera of algae observed were included in the sixty most pollution tolerant genera listed by Palmer (18). It suggested the contamination in the river water.

Thus the down stream of the Khujairok river is eutrophic as it has high concentration of nutrients, free CO_2 and coliform organisms. Occurrence of flora and fauna which can thrive well in the polluted environment further confirmed eutrophic nature of the river. Proper conservation measures should be taken up to save the river from further process of eutrophication.

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