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Studies on Physico-Chemical Characteristics, Fish and Fishery Resource Potential and Diversity of Macrophytes of Moirang River, Manipur

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ABSTRACT: Moirang river is one of the most important river which drains into the Loktak lake. Physico-chemical parameters like temperature, pH, DO, CO_2, BOD, COD, hardness, chlorides, calcium, sodium, potassium, nitrates and phosphates were analysed during January 2010 to December 2010 and indicates high value of BOD and COD, nitrates and phosphate in downstream area of the Moirang river. Fishery resource potential of this river includes 42 fish species under 30 genera, 15 families and 6 orders. Some of the fish species are having high fishery potential. There are 20 species, 16 genera representing 10 families of macrophytes in the river.

Keywords : Physico-chemical parameter, Moirang river, upstream, downstream, biodiversity.

INTRODUCTION

Aquatic ecosystems are affected by several anthropogenic activities that significantly deplete the biodiversity. In the future, the loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than terrestrial ecosystem (Sala *et al.*, 2000). Stream water run-off and discharge of sewage into rivers are two common ways that various nutrients enter the aquatic ecosystems resulting in the pollution of those ecosystem (Sudhira and Kumar, 2000; Adeyemo, 2003). Rivers are the most important freshwater resource for human being. Assessments of river water quality have been done by various workers in India (Sharma and Agrawal, 1999; Baruah and Baruah, 2003; Kumar, 2003; Kulshrestha and Sharma, 2006). In Manipur there are numerous rivers and streams which are directly or indirectly feeding the important lakes of the state and many of them enhancing the process of eutrophication and pollution in the lake ecosystem as they discharge huge amounts of nutrients and polluted water (Tombi Singh and Shyamananda Singh, 1994). However, there are few reports on the status of riverine ecosystem of the state (Kosygin and Dhamendra, 2005; Rajeshwari Devi, *et al.*, 2005; Dhamendra and Kosygin, 2005; Kosygin *et al.*, 2009).

Moirang river is one of the important river which discharge into the Loktak lake. It arises from the Thanging hill and passes through a long distance and also passing through Moirang town, then falls into the Loktak lake. While passing through agricultural fields and Moirang town it losses its purity by collecting all the agricultural waste from the surrounding agricultural field, domestic sewages and solid waste from Moirang town. In the present study an attempt has been made to evaluate the water quality, fish and fishery resource potential and macrophyte diversity in Moirang river.

MATERIAL AND METHODS

Surface water samples were collected on monthly basis during the study period from January 2010 to December 2010. For each month five replicates of water sample were collected from two sampling station, upstream and downstream. Physico-chemical analysis were analysed following the standard method of APHA *et al.*, 1989, Trivedi and Goyal, 1986. The average of the five sample was taken for each parameters studied was considered as one reading. The water temperature, pH, DO and free CO_2 were determined in the field and other parameter were analysed in the laboratory within 48 hrs. Water temperature was measured using mercury thermometer and pH by digital pH meter. DO was determined by Winker's method. Free CO_2, Chloride, Calcium and Magnesium were determined by titration method. Sodium and Potassium were estimated by Flam Photometer. Nitrate was obtained calorimetrically. Inorganic Phosphorous was calculated calorimetrically. Fishes were identified following Jayaram (1981), Talwal and Jhingran (1991) and Vishwanath (2002). Aquatic macrophytes were identified following Adoni *et al.*, (1985) and Mishra (1968).

RESULT AND DISCUSSION

The value of Physico- Chemical parameters of water is presented in the Table 1 for upstream and Table 2 for downstream. The graphic presentation is presented in fig 1. In the downstream, the temperature varies from 18.5 to 26 and the highest value is observed during the month of July. Likewise, the highest temperature of the upstream is also observed during the month of July. In downstream, the value of transparency varies from 0.108m to 0.152m whereas in upstream it varies from 0.150m to 0.169m. The pH of the upstream and downstream ranges between 6.8 to 7.5 which indicates the neutral condition of the water. Free CO_2 is highest during the month of August with a value of 7.4mg/L in downstream whereas in upstream it is highest during the month of July with a value of 17.25 mg/L. The high value is due to the stagnation of water in the streams. The DO value ranges from 1.8 mg/L to 3mg/L in downstream whereas in the upstream it ranges from 4.2 mg/L to 7 mg/L. The higher value of DO in the upstream is due to minimum interference of the water body by the human activities and high current. The lower DO in the downstream implies that the river were more polluted at downstream. When compared BOD value in both upstream and downstream, it was observed that BOD value is higher in the downstream than in the upstream. The highest BOD value is observed during the month of June with a value varies from 9 mg/L to 12 mg/L with high value observed during the month of December. In upstream, it lies between 8 mg/L to 11.61 mg/L. The value of hardness is maximum during the month of January and minimum during the month of September in downstream. In upstream, the value of hardness lies between 68 mg/L to 85 mg/L with maximum in October and minimum in May. The maximum limit of total hardness for drinking water is 300mg/L (WHO, 1984). The hardness of river lies within the prescribed standard. The value of chloride lies between 18 mg/L to 24.6mg/L in downstream whereas in upstream it lies between 20mg/L to 25mg/L. The maximum limit for chloride for drinking water is 250mg/L (USEPA-standard). The value of chloride of the river water lies within the limit.

Table 1: Monthly variation in physico-chemical characteristics of downstream of the Moirang River, year (2010).

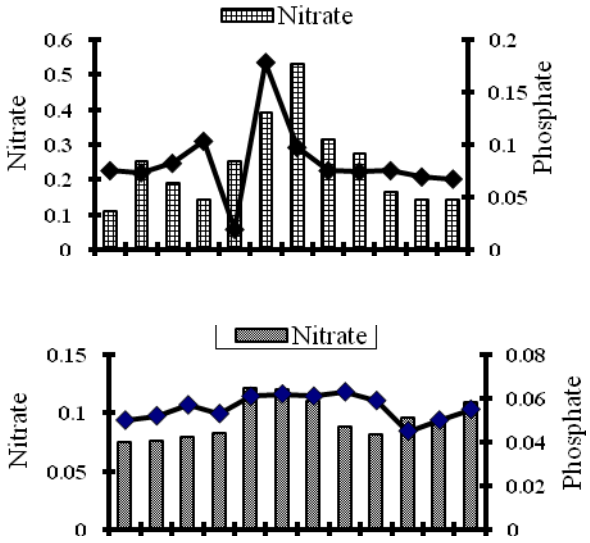
Water Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sd
Temperature (ºC)	18.5	21	23.5	24	25.3	25.4	26	25.5	24	21	20	19	22.7667	2.7161
pH	7	7.2	6.9	7	7.5	7.2	7.3	7.1	7	6.9	6.7	6.8	0.1309	0.0342
Free CO_2	6.1	6.2	3	3.5	6.2	6.2	7	7.4	7	6.2	6.4	5.1	7.05	0.2236
DO	2.8	2.9	3	2.5	3	2.8	2.85	2.5	2.2	2.9	1.9	1.8	5.8583	0.3521
BOD	6.9	7.8	7.5	8.5	9.3	9.5	9.5	7.8	6.9	9.5	6.4	5.8	2.5958	0.4213
COD	9	9	9.5	11.5	11.6	12	10.5	10.6	10.7	9.5	10.71	12	7.95	1.3077
Hardness	43	33	36	41	42	42	33	36	32	41	40	42	10.5508	1.0985
Chlorides	24	23	23.8	22	24.5	24.6	20.8	20.3	19	19	20.5	21	38.4167	4.1222
Calcium	10.5	10.4	9.7	9	9.1	10.1	9.2	9.5	9.3	10.5	8.5	8.7	21.875	2.0592
Sodium	5	4.5	4.5	4	4	5.1	4	5.5	4	2.2	2.1	3.2	9.5417	0.5986
Potassium	2.1	2.5	2.3	2.6	2.3	3.1	3.1	3.4	2.9	2.2	3.3	3.2	4.0083	1.0638
Nitrate	0.110	0.253	0.191	0.143	0.254	0.391	0.53	0.315	0.273	0.163	0.141	0.141	2.75	0.4681
Phosphate	0.075	0.073	0.082	0.103	0.019	0.178	0.097	0.075	0.074	0.075	0.069	0.068	0.219	0.0847

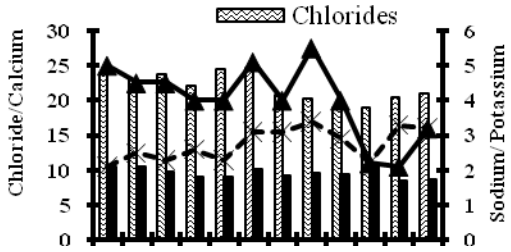
Notes: All values are in mg/l except water temp transparency and pH.

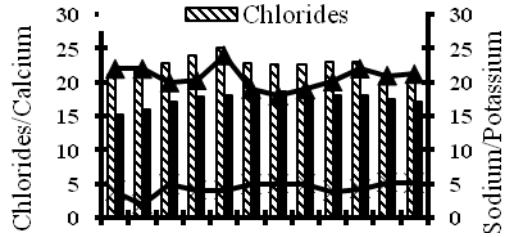
Table 2: Monthly variation in physico-chemical characteristics of upstream of the Moirang River, year (2010).

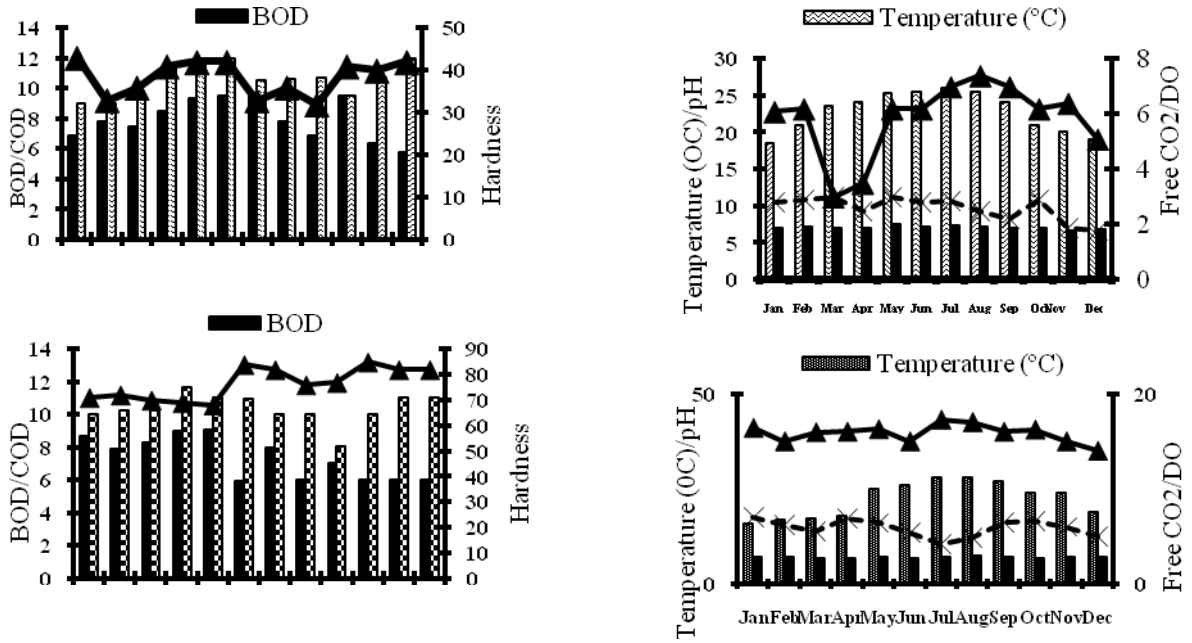
Note : All the parameters are in mg/L except water temp. transparency and pH.

Water Parameter	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	Standard Deviation
Temperature (ºC)	16	17	17.25	18	25	26	28	28	27	24	24	19	22.4375	4.6345
Transparency (m)	0.165	0.162	0.162	0.15	0.156	0.154	0.16	0.167	0.169	0.159	0.158	0.157	0.1599	0.0055
pH	7.1	7	6.9	6.8	7	6.7	7.2	7.3	7	6.8	7	7.2	7	0.1809
Free CO_2	16.4	15	15.94	16	16.25	15	17.25	17	16	16.21	15	14	15.8375	0.9301
DO	7	6.2	5.5	6.9	6.4	5.4	4.2	4.9	6.5	6.6	6	5	5.8833	0.8799
BOD	8.7	7.92	8.3	9.02	9.04	5.93	7.94	6.06	7	6.04	6.05	6	7.3333	0.8799
COD	10	10.23	10.24	11.61	11.01	10.9	9.98	9.97	8	10	11.02	11	10.33	0.9179
Hardness	71	72	70	69	68	84	82	76	77	85	82	82	76.5	6.3317
Chlorides	21	22	22.76	24	25	22.72	22.65	22.68	23	23	20	20	22.4008	1.4787
Calcium	15.1	16	17	17.9	18	18.24	18.61	17.91	18	18	17.5	17.06	17.4433	1.0123
Sodium	22	22	20	20.3	24	19	18	18.91	20.1	22.03	21	21.24	20.715	1.6736
Potassium	4	2.02	5	4.09	4.08	5.01	5.02	5.03	4	4.25	5.25	5.2	4.4125	0.9085
Nitrate	0.075	0.076	0.079	0.082	0.121	0.12	0.11	0.088	0.081	0.096	0.092	0.109	0.0941	0.0169
Phosphate	0.05	0.052	0.057	0.053	0.061	0.062	0.061	0.063	0.059	0.045	0.05	0.055	0.0557	0.0057









Upstream ***Downstream***

Fig 1. Seasonal variation of Physico-chemical parameters of Moirang rivers during 2010.

The maximum value of calcium in the downstream is 10.5 mg/L and in the upstream is 18.61mg/L. The higher value of calcium is due to the high calcium content discharged into the water bodies. The value of sodium is highest during the month of August with a value of 5.5 mg/L and minimum with a value of 2.1 mg/L during the month of November in the downstream.

Table 3: Fish diversity and fishery potential of Moirang river.

No	*Order*	*Family*	*Type*	*Local Name*	*Fishery potential*
1	Osteoglossiformes	Notopteridae	*Notopterus notopterus (Hom-Buch)*	Kandala	M
2	Cypriniformes	Cyprinidae	*Hypopthalmichthys molitrix* (Valenciennes)	Silver carp	H
3			*Barillius bendelisis* (Hora)	Ngawa	M
4			*Esomus danricus* (Hamilton-Buchanan)	Ngasang	L
5			*Catla catla* (Hamilton-Buchanan)	Bou	H
6			*Amblyphanyngodon mola* (Hamilton-Buchanan)	Mukanga	L
7			*Ctenophanyngodon idellus* (Valenciennes)	Grass carp	H
8			*Cirrhinus mrigalal* (Hamilton-Buchanan)	Mirgal	H
9			*Devario acuticephala (Hora)*	Nunga	L
10			*Cyprinus carpio* (Linnaeus)	Puklaobi	H
11			*Labeo rohita* (Hamilton-Buchanan)	Rohu	H
12			*Labeo gonius (Ham-Buch)*	Kuri	M
3			*Puntius chola* (Hamilton-Buchanan)	Phabounga	L
14			*P.manipurensis (Menon,Rema and Vishwanath)*	Phabounga	L
15			*Puntius javanicus Bleeker*	Phabounga	L

16			*P. sophore (Ham-Buch)*	Phabounga	L
17			*P.atar Linthoi and Vishwanath*	Phabounga	L
18			*Gara lissorhynchus (Mcclelland)*	Ngamu sengum	L
19		Balitoridae	*Acanthocobites botia (Ham-Buch)*	Ngakhoibinap	L
20			*Schistura manipurensis (Chaudhuri)*	Ngatup	L
21			*S.kangchupkhulensis (Hora)*	Ngatup	L
22		Cobitidae	*Synchrosus berdmorei*	Sareng	L
23			*Acanthopthalmus pangia (Ham-Buch)*	Nganap	L
24			*Lepidocephalichthys berdmorei*	Nganap	L
25			*L.guntia (Ham-Buch)*	Nganap	L
26			*L.errata(Hora)*	Nganap	L
27	Siluriformes	Bagridae	*Mystus bleekeri (Day)*	Ngasep	M
28		Clariidae	*Clarias batrachus(Linnaeus)*	Ngakra	H
29		Heteropneustidae	*Heteropneustes fossilis (Bloch)*	Ngachik	M
30	Cyprinidontiformes	Aplocheilidae	*Aplocheilus panchax (Ham-Buch)*	Lanmeithanbi	L
31	Synbranchiformes	Synbranchidae	*Monopterus albus (Zuew)*	Ngaprum	H
32		Mastacembelidae	*Mastacembelus armatus (Lacepede)*	Ngarin	H
33	Perciformes	Chandidae	*Chanda nama Ham-Buch*	Ngamhai	H
34		Cichlidae	*Oreochromis mossambica (Piters)*	Tunghanbi	M
35		Gobiidae	*Glossigobius giuris*	Nailon Ngamu	M
36		Anabantidae	*Anabas testudineus (Bloch)*	Ukabi	M
37		Belontidae	*Trichogaster fasciatus (Schneider)*	Ngapemma	L
38			*T.labiosus (Schneider)*	Nga Samjet	L
39			*T.sota (Ham-Buch)*	pheeten	L
40	Perciformes	Channidae	*Chana striatus (Bloch)*	Ngamu porong	M
41			*Channa gachua (Hamilton Buchanan)*	Meitei Ngamu	M
42			*Chana punctatus (Bloch)*	Ngamu Bogra	M

Notes: H denoted high, M denotes medium and L denotes low.

Table 4: Macrophytes found in Moirang river.

Macrophytes	*Local name*	*Family*
1. *Brachiaria mutica* (Forssk) Stapf	Paragrass	Poaceae
2. *Echinochloa stagnina* Retz	Hoop	Poaceae
3. *Erianthus procerus* (Roxb.)Raizada	Singnang	Poaceae
4. *Zizania latifolia* (Turcz)Hand Mazz	Esing kangbong	Poaceae
5. *Polygonum barbatum* Linn.	Yelang	Polygonaceae
6. *Polygonum chinense* Linn.	Lihar/Angom yensil	Polygonaceae
7. *Argyreia nervosa*(Burm f)Boj	Uritujombi/Phum uri	Convolvulaceae
8. *Ipomea aquatic* Forsk	Kolammi	Convolvulaceae
8. *Alternanthera pheloxeroides*(Mart)Grised	Kabonapi	Amaranthaceae
10. *Eicchornia crassipes*(Mart)Solms	Kabokang	Pontederiaceae
11. *Colocasia esculenta*(Linn)Schott.	Lampal	Araceae
12. *Pistia stratiotes* Linn.	Kangjao	Araceae
13. *Hydrilla verticillate*(L.F.)Royle	Charang	Hydrocharitaceae
14. *Hydrilla sp*	Charang	Hydrocharitaceae
15. *Salvinia natans* Hoffim	Kangkup	Salviniaceae
16. *Lemna sp*	Kangmacha	Lemnaceae
17. *Cynodon dictylon (Linn.)Pers*	Tingthou	Poaceae
18. *Colocasia sp. (black leaf)*	Pankhok	Araceae
19. *Hydrocotyle javanica Thumb*	Lai peruk	Apiaceae
20. *Paspalum sp.*	Lampak napi	Poaceae

In upstream the value of sodium is highest during the month of October with 22.10 mg/L and minimum during the month of July with a value of 18 mg/L. The value of potassium is higher in the upstream than in the downstream. In downstream, the value of nitrate ranges from 0.110mg/L to 0.391 mg/L whereas in upstream it lies between 0.075 mg/L to 0.120 mg/L. The high concentration was probably partially a result of runoff, from agricultural field including fertilizers. High nitrate level are not good for aquatic life (Johnson *et al.*, 2000). The phosphate contents lies between the value of 0.073 mg/L to 0.103 mg/L in the downstream and in upstream, it lies between the value of 0.045 mg/L to 0.063mg/L. According to Raste *et al.*,(1989), increase in Nitrogen and phosphorous one or other of which tends to limit productivity will lead to eutrophication. Eutrophication could also lead to unpleasant taste and odour of the water when the algae die and decompose thus deteriorating the water quality and heavy infestation of weeds.

An assessment of the Fish and Fishery resource potential of Moirang river is shown in the Table 3. During the investigation the diversity of the fishes includes 42 species under 30 genera, 15 families and 6 orders. Moirang river shows high biodiversity of fishes. Some of the fishes are having high fishery potentials as shown in the table.

The macrophytes of Moirang river includes 20 species under 16 genera representing 10 families is shown in the Table 4. The macrophytes are more abundant in the downstream than the upstream.

From the above investigation and discussion, it is found that the downstream of Moirang river is polluted as it has high value of CO_2, Nitrate, Phosphate and high BOD. Most of the flora and fauna were widely distributed forms which can thrive well in river water. Proper conservation measures are needed in the Moirang river for future sustenance.

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