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Influence of physico-chemical characteristics of water in seasonal abundance of insects of Kapla Beel, Assam, India

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Abstract

During the entire study period total 46 species of insects were recorded from the Kapla Beel. Among these, the order Coleoptera comprised of greatest number with 20 species belongs to 5 families. Diptera with 3 genera belongs to two families, Hemiptera recorded with 13 species belongs to 7 families, Odonata with 8 species belongs to 3 families and Ephemeroptera with 2 genera belongs to 1 family. The study revealed that aquatic insects abundance show positive correlation with pH, Conductivity, Dissolved Oxygen, BOD, Total Alkalinity, calcium, Magnesium and water Hardness and negatively correlated with Water Temperature, Turbidity, COD, Sulphate and Free CO_2 during the year 2010-2011 and the pattern was almost same in 2011-2012 except Calcium. The study on the abundance of insects showed that they were abundant mostly during post monsoon season as compared to other two seasons.

Keywords: Aquatic insects, physico-chemical characteristics, abundance, Kapla Beel.

Introduction

In freshwater ecosystems aquatic insects are among the most important components biota. In energy flow pathways aquatic insects play a vital role as they are the chief components of aquatic ecosystem[1]. They keep proper functioning of fresh water ecosystem[2]. Aquatic forms of life and various physico-chemical parameters of water showed a relationship between them. Aquatic insects diversity fluctuate with the fluctuations of water quality[3-5].

The physico-chemical characteristics of water plays very important role in occurrence, distribution and abundance of insects in wetlands[6,7]. Water temperature in an aquatic ecosystem have great influence on aquatic mode of life as every species have a optimum temperature for their normal life. According to Sweeney[8] various aspects of nature, temperature and photoperiod are the most vital environmental factors that influence the life style of aquatic insects. All these parameters affect the distribution and relative abundance of aquatic insects[9].

Materials and methods

The study area: The Kapla Beel is located in Barpeta District of Assam. The geographical position of the Kapla Beel is 26°15′–26°30′ N latitude and 91°0′–91°15′ E longitude (Figure-1) It covers an area of 91 hectares at full storage level but at dead storage level the area is reduced to approximately 55 hectares. The average depth of the Beel is 4-6 m which varies according to season. The study were conducted from May, 2010 to April,2012 and sampling was done in three seasons *viz.* pre monsoon (March-May), monsoon (June-October), and post monsoon (November- February) seasons of a year. Sample were collected from five zones of the Beel namely North zone, South zone, Central zone, East Zone and West Zone. Division of Beel into five zones done on the basis of occurrence of density macrophytes species and presence of insects (Figure-2).

Collection of insects specimen in the Beel:. Sampling of aquatic insects were done on an area of about $10m^2$ in the above mentioned five zones. Insects from water surface collected by using pond net of mesh size of 500 µm, diameter of 30 cm and depth of 15 cm. Insect from substratum collected using "all out search method". For collection of benthic insect community, the bottom mud scraper with tow-line was used[10]. Small sieve and hand operated 'D' framed sweep net were used to collect insects from vegetated zones[11]. The net were dragged around the vegetation for one minute[12]. Terrestrial adult forms of aquatic insects were collected by insect net by sweeping the net through the vegetation. After sampling specimen were washed and collected from the vegetation and transferred it to fresh 70% alcohol. The collected specimens were changed with fresh 70% alcohol after 24 hours.

Identification of Insects specimens: Identification were done using simple and compound microscope and followed the standard keys of Bal and Basu[13,14], Biswas and Mukhopadyaya[15], Biswas *et a,*[16,17], Winterbourn[18], Pillai[19], Epler[20], Bouchard[21], Needham and Needham[22], Andrew *et al.*[23].

Analysis of water samples: The water samples from above mentioned five different zones of the Beel were collected

following the standard methods of APHA[24] and Trivedy and Goel[25].

Statistical analysis: Statistical analysis were done by using MS Excel 2007 and PAST version 3.12 software. Dominant status of insects was determined by following Engelmann's scale[26].

Results and discussion

This study recorded of 46 species of insects from the Kapla Beel (Table-1). All together 5 orders of Insects viz. Coleoptera, Diptera, Hemiptera, Odonata, and Ephemeroptera recorded from the Beel. Among these, Coleoptera were recorded in greatest number with 20 species consisting of 5 families. Diptera with 3 genera consisting of two families Hemiptera recorded with 13 species consisting of 7 families, Odonata with 8 species consisting of 3 families and Ephemeroptera with 2 genera consisting of 1 family. The order Coleoptera composed of 44%, Diptera composed of 7%, Hemiptera composed of 29% Odonata composed of 16% and Ephemeroptera composed of 4% each of the total recorded aquatic insects species.

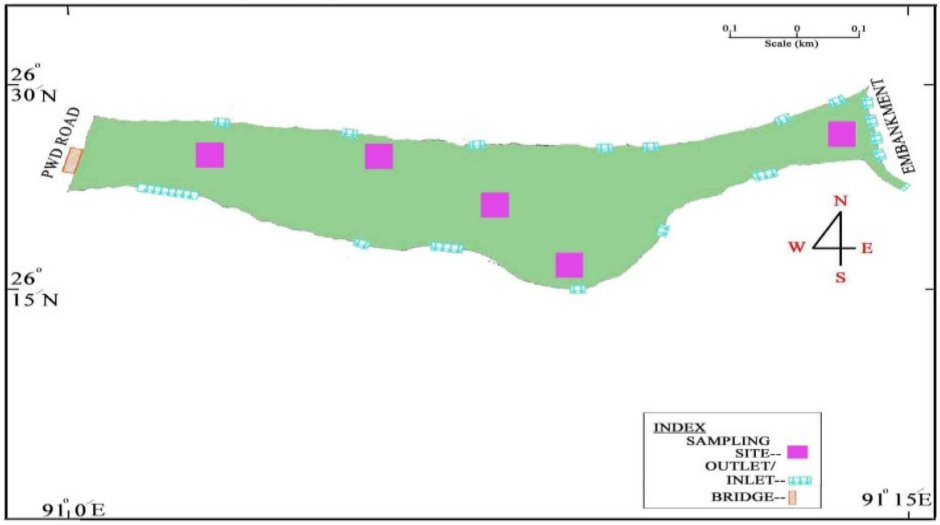

Figure-1: Location map of Kapla Beel.

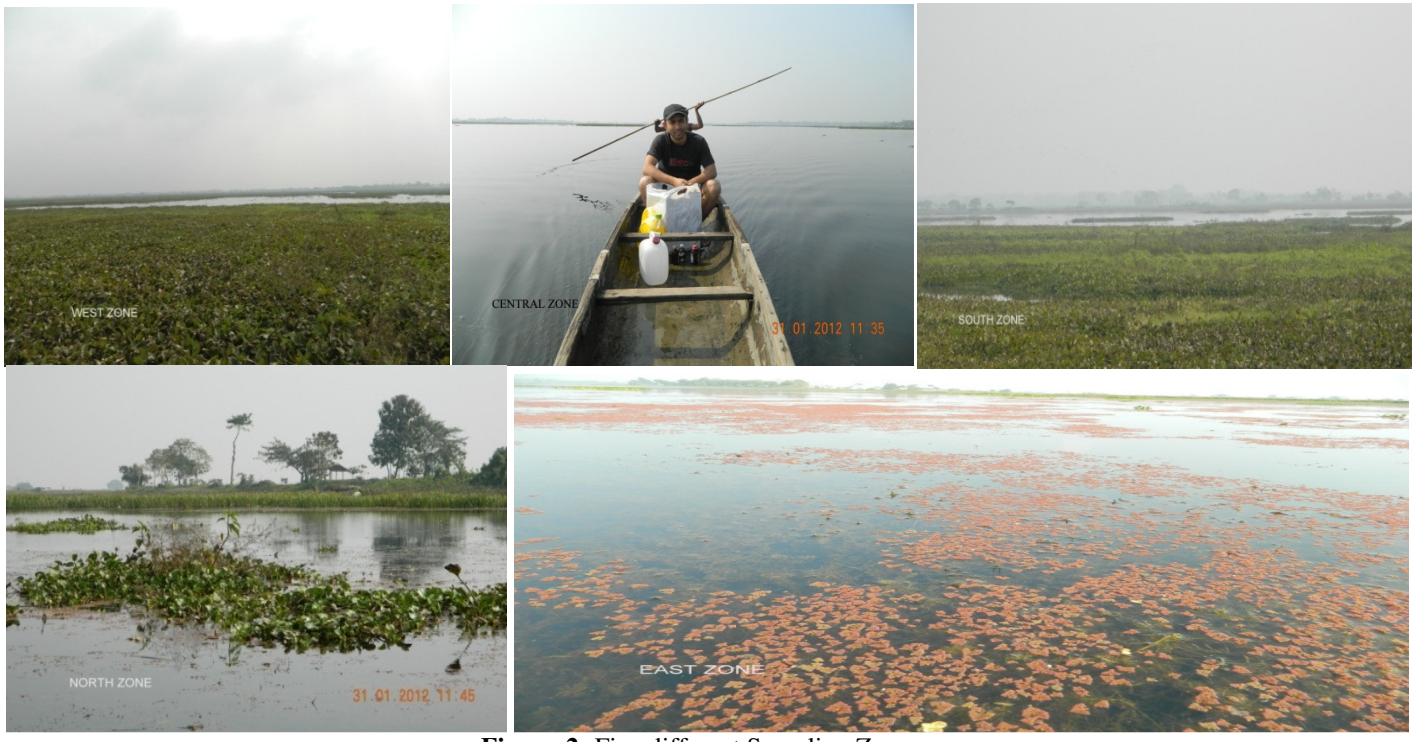

Figure-2: Five different Sampling Zones.

Table-1: Insects Species of Kapla Beel.

Order	Family	Species
Coleoptera	Carabidae	*Chlaenius sp.*
		Casnoidea sp.
	Dyticsidae	*Hydrovatus sp*
		Hydatics fabricii fabricii Machley
		Laccophilus anticatus anticatus Sharp
		Laccophilus inefficiens Walker
		Laccophilus elegans Sharp
		Clypeodytes sp.
		Cybister tripunctatus asiaticus Sharp
	Gyrinidae	*Dineutus (Spinosodineutus) unidenttatus* Aube
	Hydrophilidae	*Cercyon sp.*
		Hydrophilus olivaceus Fab
		Sternolophus rufipes Fab
		Amphiops sp.
		Helochares sp.
		Enochrus esuriens Walker
		Laccobius sp.
	Noteridae	*Hydrcanthus sp.*
		Neohydrocoptus subvittulus Mots
		Canthydrus laetabilis Walker
Diptera	Culicidae	*Culex sp.*
		Anophles sp.
	Chironomidae	*Chironomous sp.*
Hemiptera	Gerridae	*Gerris gracilicornis* Horvath
		Neogeris parvulus Stal
	Belostomatidae	*Lethocerus indicus* Lepeleiter and Serville
		Diplonychus rusticus Fabricius
		Diplonychus annulatus Fabricius
	Nepidae	*Laccotrephes ruber* Linnaeus
		Ranatra filiformes Fabricius
	Corixidae	*Micronecta scuttellaris scuttellaris* Stal
		Micronecta punctata Horvarth
	Hydrometridae	*Hydrmetra vittata* Stal
		Hydrometra butleri Hungerford and Evans
	Pleidae	*Plea liturata* Fiebr
	Notonectidae	*Anisop sp.*
Odonata	Libellulidae	*Orthetrum sp*
		Orthetrum sabina sabina Drury
	Aeshnidae	*Anax guttatus* Burmeister
	Coenagrionidae	*Ischnura senegelensis Rumber*
		Ischnura aurora aurora Brauer
		Ceriagrion olivaceum Laidlaw
		Onychargia atrocyana selys
		Agriocnemis pygmaea Rumber
Ephemeroptera	Baetidae	*Baetis sp.*
		Cloeon sp.

Among the order Coleoptera, Dytiscidae and Hydrophilidae family recorded highest with 35% while Notoridae, Carabidae and Gyrinidae recorded 15%, 10% and 5% respectively.Two Families of Diptera, Chiornomidae and Culicidae recorded from the Beel which comprised of 33% and 67% respectively. Order Hemiptera recorded with 7 families out of which Belostmatide was highest with 23% followed by Nepidae, Corixidae and Hydrometridae each of which consist of 15% respectively while Pleidae and Notonectidae consist of 8% each.

Among the three families of Odonata recorded from the Kapla Beel, Coagrionidae consist of 72% and Libellulidae and Aeshnidae 14% respectively. Only one family of Order Ephemeroptera recorded from the Beel during the study period.

The Physicochemical characteristics of Kapla Beel was analysed for two years from May of 2010 to April of 2012. The result of the physicochemical characteristics is presented in the Table-2. The study revealed that aquatic insects abundance show positive correlation (Table-3) with pH, Conductivity, Dissolved Oxygen, BOD, Total Alkalinity, calcium, Magnesium and water Hardness and negatively correlated with Water Temperature, Turbidity, COD, Sulphate and Free CO_2 during the year 2010-2011 and the pattern was almost same in 2011-2012 except Calcium (Table-4).

Table-2: Physicochemical characteristics of water of Kapla Beel.

Year		2010-2011						2011-2012					
		Season											
		PM		MON		PSM		PM		MON		PSM	
Temperature (oC)		28.80		29.60		25.00		28.60		30.20		24.20	
	±	0.67	±	1.34	±	0.71	±	0.55	±	0.45	±	0.45	
pH		7.12		7.08		7.34		7.06		7.08		7.30	
	±	0.15	±	0.22	±	0.15	±	0.17	±	0.11	±	0.14	
Turbidity (NTU)		8.20		10.80		6.90		9.60		11.60		9.80	
	±	2.28	±	3.49	±	4.93	±	3.58	±	4.16	±	5.63	
Conductivity (Microhms/cm)		143.00		128.00		149.00		147.00		157.00		181.00	
	±	5.70	±	5.70	±	7.42	±	9.75	±	10.95	±	7.42	
Dissolved oxygen (mgl^{-1})		7.80		5.40		10.40		8.80		5.70		9.80	
	±	0.84	±	0.55	±	1.14	±	1.10	±	0.45	±	1.64	
BOD		6.90		4.50		7.00		6.80		3.80		6.20	
	±	1.71	±	1.22	±	1.41	±	0.45	±	0.84	±	1.48	
Chemical Oxygen Demand		41.20		40.60		29.80		43.40		41.20		34.91	
	±	3.90	±	6.43	±	3.03	±	4.72	±	3.35	±	3.41	
Total alkalinity (mgl^{-1})		67.00		30.60		63.20		68.40		29.80		65.20	
	±	2.12	±	1.95	±	2.39	±	1.67	±	1.10	±	2.78	
Sulphate (mgl^{-1})		3.00		2.52		1.84		3.54		2.08		2.00	
	±	0.00	±	0.58	±	0.29	±	0.09	±	0.55	±	0.00	
Calcium (mgl^{-1})		34.80		37.00		40.60		33.80		37.00		36.80	
	±	5.85	±	10.79	±	10.31	±	5.22	±	12.98	±	11.10	
Magnesium (mgl^{-1})		24.00		28.00		29.80		27.20		30.80		32.00	
	±	6.25	±	10.05	±	7.36	±	7.56	±	6.57	±	6.63	
Hardness (mgl^{-1})		60.00		50.60		64.60		55.00		52.20		68.80	
	±	6.40	±	12.26	±	11.95	±	15.36	±	17.23	±	17.06	
Free carbon dioxide (mgl^{-1})		6.04		7.38		3.80		6.12		7.14		4.22	
	±	0.52	±	0.93	±	0.76	±	0.74	±	0.88	±	0.39	

PM-Premonsoon, MON-Monsoon, PSM-Postmonsoon.

Table-3: Correlation coefficient Matrix(Pearson) of physico chemical character of water during the period of 2010 -2011.

	TMP	pH	TBD	CNDT	DO	BOD	COD	TA	SUL	CAL	MAG	HARD	FCO2	ABD
TMP		0.01	0.35	0.38	0.21	0.54	0.13	0.62	0.37	0.35	0.57	0.35	0.14	0.21
pH	-1.00		0.36	0.40	0.23	0.55	0.12	0.64	0.36	0.34	0.56	0.37	0.15	0.22
TBD	0.85	-0.84		0.03	0.14	0.19	0.48	0.27	0.72	0.70	0.92	0.00	0.21	0.14
CNDT	-0.82	0.81	-1.00		0.17	0.16	0.52	0.24	0.76	0.73	0.96	0.03	0.25	0.18
DO	-0.94	0.94	-0.98	0.96		0.33	0.35	0.41	0.59	0.56	0.79	0.14	0.08	0.01
BOD	-0.66	0.65	-0.96	0.97	0.87		0.67	0.08	0.91	0.89	0.89	0.19	0.40	0.33
COD	0.98	-0.98	0.72	-0.69	-0.85	-0.49		0.76	0.24	0.22	0.44	0.49	0.27	0.34
TA	-0.56	0.54	-0.91	0.93	0.80	0.99	-0.37		1.00	0.97	0.80	0.27	0.49	0.42
SUL	0.83	-0.84	0.42	-0.37	-0.60	-0.13	0.93	0.00		0.02	0.20	0.73	0.51	0.58
CAL	-0.85	0.86	-0.45	0.41	0.63	0.17	-0.94	0.04	-1.00		0.23	0.70	0.49	0.56
MAG	-0.62	0.64	-0.12	0.07	0.33	-0.18	-0.77	-0.31	-0.95	0.94		0.93	0.71	0.78
HARD	-0.85	0.84	-1.00	1.00	0.98	0.96	-0.72	0.91	-0.41	0.45	0.11		0.22	0.15
FCO2	0.98	-0.97	0.94	-0.93	-0.99	-0.81	0.91	-0.72	0.69	-0.72	-0.44	-0.94		0.07
ABD	-0.95	0.94	-0.97	0.96	1.00	0.87	-0.86	0.79	-0.61	0.64	0.34	0.97	-0.99	

Table-4: Correlation coefficient Matrix(Pearson) of physico chemical character of water during the period of 2011 -2012

	TMP	pH	TBD	CNDT	DO	BOD	COD	TA	SUL	CAL	MAG	HARD	FCO2	ABD
TMP		0.21	0.56	0.35	0.35	0.62	0.33	0.55	0.80	0.87	0.68	0.07	0.06	0.21
pH	-0.94		0.77	0.14	0.56	0.84	0.11	0.76	0.59	0.65	0.46	0.15	0.27	0.43
TBD	0.64	-0.35		0.91	0.21	0.06	0.89	0.01	0.64	0.57	0.76	0.62	0.50	0.35
CNDT	-0.85	0.98	-0.14		0.70	0.97	0.02	0.90	0.45	0.52	0.33	0.29	0.41	0.56
DO	-0.85	0.63	-0.95	0.45		0.27	0.68	0.20	0.85	0.78	0.97	0.42	0.29	0.14
BOD	-0.56	0.26	-1.00	0.04	0.91		0.95	0.07	0.58	0.51	0.70	0.69	0.56	0.41
COD	0.87	-0.98	0.18	-1.00	-0.49	-0.08		0.87	0.48	0.54	0.35	0.26	0.38	0.54
TA	-0.65	0.37	-1.00	0.16	0.95	0.99	-0.20		0.65	0.58	0.77	0.61	0.49	0.34
SUL	0.30	-0.60	-0.54	-0.76	0.24	0.62	0.73	0.52		0.06	0.13	0.74	0.86	0.99
CAL	-0.21	0.52	0.62	0.69	-0.34	-0.70	-0.66	-0.61	-0.99		0.19	0.80	0.93	0.92
MAG	-0.48	0.75	0.36	0.87	-0.04	-0.45	-0.85	-0.35	-0.98	0.96		0.61	0.74	0.89
HARD	-0.99	0.97	-0.56	0.90	0.79	0.47	-0.92	0.57	-0.40	0.30	0.57		0.12	0.28
FCO2	1.00	-0.91	0.71	-0.80	-0.90	-0.63	0.82	-0.72	0.22	-0.12	-0.40	-0.98		0.15
ABD	-0.95	0.78	-0.86	0.63	0.98	0.80	-0.66	0.86	0.02	-0.12	0.17	0.91	-0.97	

TMP: Temperature; TBD: Turbidity; CNDT: Conductivity; DO: Dissolved Oxygen; BOD: Biochemical Oxygen Demend; COD: Chemical Oxygen Demand; TA: Total Alkalinity; SUL: Sulphate; CAL: Calcium; MAG: Magnesium; HARD: Hardness; FCO2: Free Carbon Dioxide; ABD: Abundance.

Discussion: During the study period it was noticed that abundance of insects were highest during the Post monsoon season as compared to other two seasons. This was may be due to favourable condition of physico chemical characteristics of water, sufficient amount of food and suitable shelter. This was in agreement with the findings of Mukherji *et al*.[27], who noted that Odonata, Coleoptera and Diptera were more abundant during post monsoon season in some urban wetlands of Calcutta. They didn't observed seasonal fluctuation of Hemiptera, though present study noticed such seasonal fluctuation. The findings of Takhelmayum and Gupta[28] also supported the seasonal fluctuation of aquatic insects noticed in the present study. They noted highest number of aquatic insects during post monsoon season in Loktak Lake of Manipur. Presence of highest number of aquatic insects during Post Monsoon in the Kapla Beel in this study also supported the findings of Sharma and Agrawal[29], in their work on aquatic insects diversity of Surha Tal of District of Ballia (U.P.) of India. In a similar study Tara *et al*.[30] observed maximum number of Coleoptera during the post monsoon season in Gharana wetland of Jhammu of India which was in agreement with the present investigation.

The present study on seasonal abundance of insects in the Kapla Beel also in agreement with the findings of Singh and Borana[31]. They found similar pattern of abundance of aquatic insects in which Coleoptera, Diptera and Hemiptera are mostly abundant during post monsoon season in Lower Lake of Bhopal. It was found that Hemipteran population were maximum during the post monsoon season in the Kapla Beel which established a close relationship with the findings of Das and Gupta[32]. They recorded maximum numbers of Hemiptera during the post monsoon season in temple pond of a Cachar district of Assam. A similar trend of increasing abundance of aquatic insects during the post monsoon also observed by Sarma and Baruah[33], which supported the findings of present study. Moreover, Barman and Gupta[34] also recorded highest number of aquatic insects during post monsoon season in Bakuamari stream of Chakrasila Wildlife Sanctuary of Assam.

Decline in the abundance of aquatic insects in the monsoon period may be due to water dynamics of the Beel caused by inflow of rain and flood water into Beel. Water dynamics affects the insects stability disturbing their habitat, growth and proliferation, in spite of nutrient input into the Beel along with the water flow. This supported the findings of Sarma and Baruah[34] in their study on wetlands in Guwahati city.

The study recorded reduction in the insect abundance in the pre monsoon period in the Beel area. The reduction was attributed to lack of inflow of nutrient as the water level of catchment area considerably reduced and utilization of existing nutrients of the Beel by already developed insects population. More over water quality parameters like DO, BOD, COD etc. exhibited alteration in comparison to post monsoon period , all these led to reduction in insects abundance. This observation was in close proximity with the findings of Das and Gupta[35] in their study on fresh water wetland ecosystem of North east India.

The present study revealed that aquatic insects abundance show positive correlation with pH, Conductivity, Dissolved Oxygen, BOD, Total Alkalinity, Calcium, Magnesium and water Hardness and negatively correlated with Water Temperature, Turbidity, COD, Sulphate and Free CO_2 during the year 2010-2011. While in 2011-2012 the pattern was almost same with 2010-2011 except Calcium. Study of Singh and Borana[31] also found significant correlation of total insect abundance with conductivity, pH and dissolved oxygen. The observation of present study was also in agreement with the findings of Ganai[36] and Yadav *et al*[37], who worked on insects of freshwater ecosystem and established co-relation of insects with some water quality parameters.

Wahizatul *et al*[38], also established a positive correlation of pH with aquatic insects diversity and abundance of different species of aquatic insect in relation to water quality in Hulu Terengganu wetland. Gupta and Narzary[39] showed that Dissolved Oxygen and FreeCO_2 have strong influence in the aquatic insects abundance as noticed in the present study. Contrary to present findings, the study of Devi[40] revealed that water temperature has an impact in the abundance of aquatic insects as it affects respiratory rate and metabolism. On the other hand the study of Oku *et al.*[41], on insects of wetland revealed that Diptera, Hemiptera and Coleoptera were affected by acidification to a small degree whereas Plecoptera, Ephemenoptera and Odonata are sensitive and prefer clean alkaline water in nature. Harun *et al.*[42], found that Culicidae family of Diptera showed notable dependence on Dissloved Oxygen where as other families such as Coenagrionidae, Libellulidae Dysticidae and Corixidae and can bear fluctuation of Dissolved Oxygen concentrations. They also observed high tolerance to BOD by the families of Corixidae and Pleidae. The present study was in agreement with the study of Barman and Gupta[35] who observed significant positive correlation with insect diversity and abundance with pH, EC, DO in Bakuamari Stream of Chakrasila Wildlife Sanctuary of Assam.

Conclusion

The present study clearly showed that water quality of Kapla Beel is good and unpolluted. Different water chemistry parameters such as Temperature, Conductivity, pH, DO, BOD, COD, TA, calcium, Turbidity, Magnesium, Hardness Sulphate and Free CO_2 were analysed during the study period and most of the parameters were influence on abundance of insects. It was found that the parameters were under permissible level prescribed by BIS which indicate that the Beel is not subjected to pollution. The Beel ecosystem is self sustainable and can be useful for deriving economic gain in terms of fishing and cultivation by the neighbouring human population.

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