IJASRM
International Journal of Advanced Scientific Research and Management, Vol. 2 Issue 12, Dec 2017.
www.ijasrm.com
ISSN 2455-6378

Diversity of Aquatic Insects and Physico-Chemical Parameters of Kelageri Lake, Dharwad (Karnataka)

Pavan Yargal[1], Vaibhav Ugare[2], Soumya R. Patil[3], Dheeraj K. Veeranagoudar[4] and Pulikeshi M. Biradar[5]*

[1-5] Department of Zoology, Karnatak University,
Dharwad (Karnataka) India

Abstract

Abstract:- The present work deals with the diversity of aquatic insects and physico-chemical parameters of Kelageri Lake, Dharwad, Karnataka, India. It is one of the biggest lakes in Dharwad district, which used to facilitate drinking water and irrigation needs of Dharwad and was also known for its range of floral and faunal diversity. The aquatic entomo-fauna and physico-chemical parameters were studied using standard protocols. Aquatic insects belonging to eleven species under nine families and one spider family were collected during the present study. The taxonomic groups (order) encountered were Hemiptera, Coleoptera, Odonata, Acarina, Araneae (spider). The order Hemiptera was the most abundant and prominent having more number of species (04), while order Coleoptera was represented by three species and least number (01) of species were observed in the order Odonata, Acarina, Araneae. The highest numbers of individual species were observed during the month of January and June and lowest in March and April months. The water insects act as a bio-indicator to monitor the water body pollution. The analysis of physico-chemical parameters revealed that the values are in the acceptable range that denotes the water body is in good condition. There has to be routine monitoring of aquatic insects and physico-chemical parameters to facilitate the conservation and management of any water body.

Key words:- *Aquatic insects, Diversity, Kelageri lake, Physico-chemical parameters.*

1. Introduction:

Aquatic insects are a group of arthropods that need water bodies either to live or to complete their life cycle [1], [2]. Though they are small in size, they play a major role in the aquatic food chain as they serve various purposes such as, food for fish and other invertebrates, they also predate on smaller insects and few are detritus feeders and help in decomposition process. Some of the aquatic insects also play a role of vectors by transmitting pathogenic micro organisms to both humans and animals [3]. Among all insects, minor fractions of about 3-5% are aquatic in habitat and initial life cycle of about 3% insects is initiated as aquatic larvae before emerging as winged terrestrial forms [4]. Some fresh water insects have specific requirements regarding their nutrients, water quality, substrate and vegetation. The impact of humans on fresh water bodies were assessed by the use of aquatic insects as an indicator species [5].

Most of the stream ecosystems are becoming increasingly polluted by domestic sewage, agricultural runoff, urban wastes and industrial effluents [6]. Physical and chemical parameters will reflect the condition of the water body at the time of sampling, but biological monitoring such as studying the floral and faunal diversity gives us an overall condition of the water body including the past condition and we can even predict the future status of it if no preventive measures are taken up. Hence, use of aquatic insects as a bio-indicator to estimate the past, present and future condition of the water body is one of the good method as it provides the degree of environmental impact and its potential effects on other living organisms [7]. Most importantly, the aquatic insects are very good indicators of water quality since they have various environmental disturbance tolerance levels [2]. Some are very

IJASRM
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vulnerable and sensitive to pollution, while others can live and proliferate in disturbed and extremely polluted waters [8], [9]. Many methods have been developed to analyze impairments to water quality. Among these, physical parameters (such as stream bank erosion, turbidity, sedimentation, siltation, flow patterns, water temperature, riparian cover and debris) and chemical parameters (such as dissolved oxygen, biochemical oxygen demand, pH, alkalinity, hardness, nutrients, metals and organic compounds) analysis have been investigated to assess the quality of water [10], [11]. To plan and execute any sustainable developmental works, there has to be updated data of the flora and fauna along with the physico-chemical properties of that particular water body for an effective conclusion. When we compare the water bodies in the forest with that of the water bodies surrounded by urban areas, there will be frequent change in the quality and composition of those water bodies surrounded by human habitation. Hence, there has to be frequent survey of those water bodies. Since, Kelageri lake is one such water body that is located or surrounded by human habitation, there has to be frequent survey works to monitor the present status of it, and the results can be used to plan for an appropriate corrective measures. Hence, the present study was undertaken to survey the water insect diversity and water quality parameters of Kelageri lake.

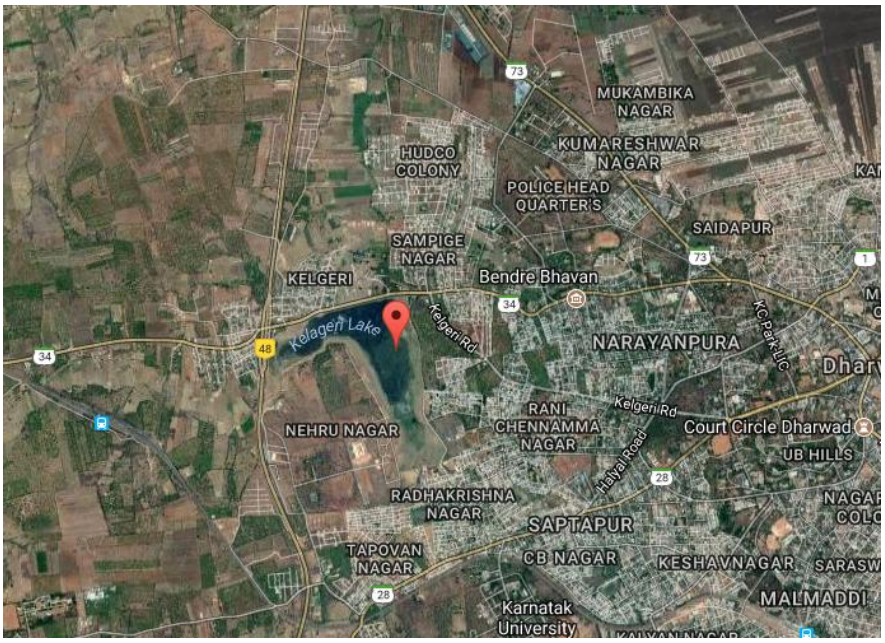
2. Materials and methods:

2.1 Study area:

Kelageri lake is one of the biggest lake in Dharwad district situated between the latitudinal parallels of 15°02' and 15°51' N and longitudes of 73°43' and 75°35' E. (Figure 1), which was built with a catchment area of around 6.36 sq. miles under the guidance of Sir M. Vishwesharaya during 1911 to meet the drinking and irrigation needs of Dharwad.

2.2 Sampling: The sampling was done twice in a month and all the surveys were carried out early in the morning between 7 to 9 am on a regular basis for six months. A stretch of approximately 10m was chosen for collection of samples at different edges of the lake. Every time, three replicate samples were collected at each spot, considering all types of representative micro-habitats of the entire pond. The water samples (in sterilized bottles) along with the collected aquatic insects were brought to the laboratory for physico-chemical analysis and identification of aquatic insects. For screening of aquatic insects the collected samples were placed in a white tray and were handpicked for preservation. Later, aquatic insects were identified using specified taxonomic keys [12], [13]. At the study site, temperature and pH were measured, while rest of the parameters such as, Total Alkalinity, Total Hardness, Dissolved oxygen, Free CO_2, Chloride, Biological Oxygen Demand, Sulphate and Phosphate were analyzed in the laboratory by using standard methods [6], [14].

Figure 1: Google image of the Kelageri lake



3. RESULTS:

IJASRM
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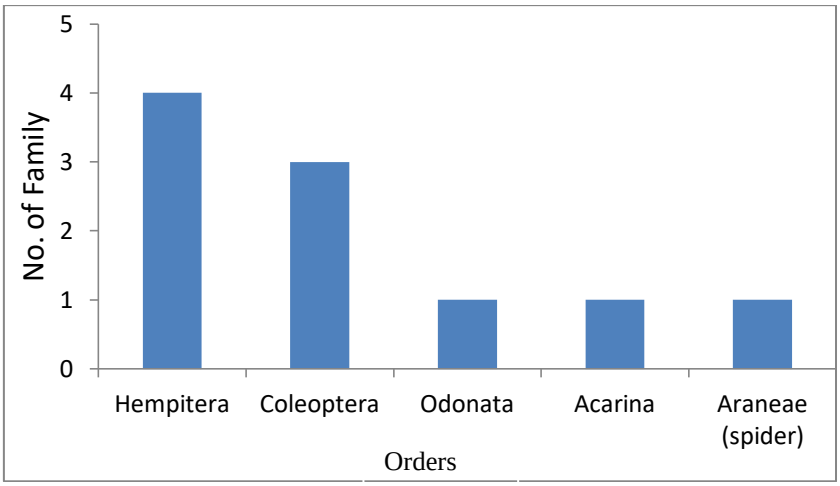
www.ijasrm.com
ISSN 2455-6378

3.1 Aquatic insect composition: Individuals belonging to ten families were spotted during the sampling period. The main taxonomic groups encountered were Hemiptera with the individuals representing four families and belonging to five species observed at different lake habitats (Table 1). Likewise, three species were observed in order Coleoptera and all of them were encountered from submerged habitat, while order Odonata was represented by one species that was collected form surface habitat, order Acarina also has one representation that was collected from submerged habitat, interestingly individuals belonging to one spider species under order Arneae were collected from the surface habitat. Number of individuals and their distribution observed on monthly bases is represented in Table 1 along with their order, family and habitat in which they were found. The number of families found in different orders is represented in Graph 1, while the total numbers of individuals under different species are represented in Graph 2.

Table 1: Aquatic insect distribution and their habitat in Kelageri lake during the study period

Sl. No.	Name of the species	Order	Family	Number of individuals found with respect of different species						Habitat
				Jan	Feb	Mar	Apr	May	Jun	
1	*Ranatra linearis*	Hemiptera	Nepidae	3	1	0	0	1	3	Beneath
2	*Nepa cineria*	Hemiptera	Nepidae	2	2	5	6	2	4	On weeds
3	*Notonecta glauca*	Hemiptera	Notonectidae	5	*3*	1	2	5	6	Submerged
4	*Gerris lacustris*	Hemiptera	Gerridae	14	11	7	2	4	9	Surface
5	*Lethocerus americanus*	Hemiptera	Belostomatidae	1	0	0	2	0	2	On weeds
6	*Gyrinus natator*	Coleoptera	Gyrinidae	4	5	2	2	1	4	Submerged
7	*Cybister fimbriolatus*	Coleoptera	Dytiscidae	2	1	1	0	3	6	Submerged
8	*Enochrus testaceus*	Coleoptera	Hydrophilidae	2	2	1	2	4	4	Submerged
9	*Eschnura elegans*	Odonata	Coenagrionidae	4	2	2	0	3	14	Surface
10	*Hydrachna species*	Acarina	Hydrachenellae	8	5	3	4	7	12	Submerged
11	*Pisaura mirabilis*	Araneae (spider)	Pisauridae	18	22	12	14	19	17	Surface

Graph 1: Number of water insect families recorded under each order during the study period



Graph 2: Total number of individuals of different species recorded from Kelageri Lake.

IJASRM
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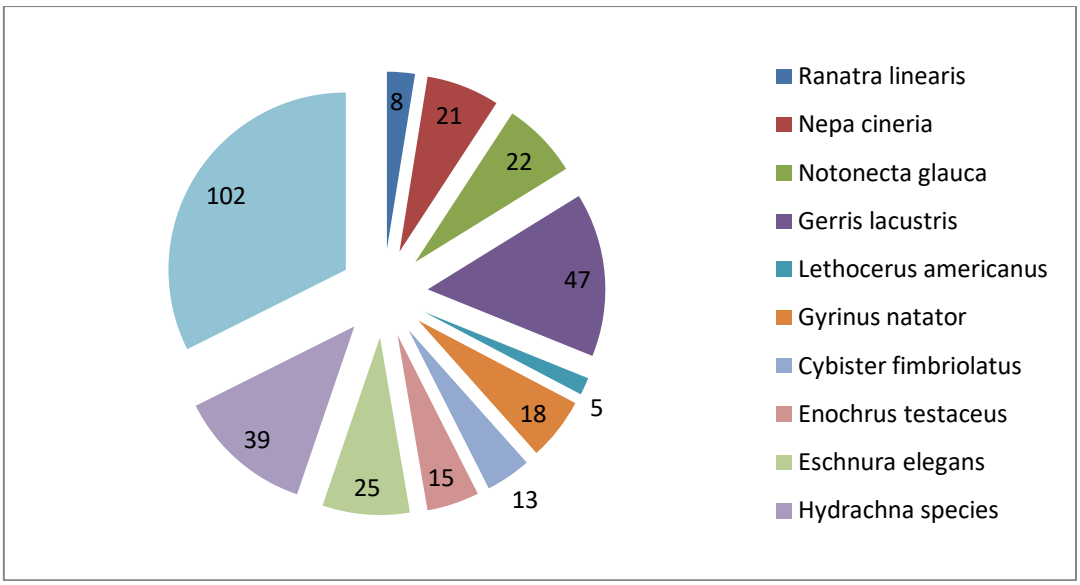
ISSN 2455-6378



3.2 Physico-chemical Parameters:

Different water quality parameters were also recorded and are represented in the Table 2. The data revealed that, the temperature remained almost constant with a mean of 24.40 ^{0}C, the pH ranged between 7.30 to 8.10, while Dissolved Oxygen (DO) was maximum (4.30 mg/L) during June and least during April (3.20 mg/L) and the average Biological Oxygen Demand (BOD) was 0.26 mg/L. Maximum free CO_2 and hardness of water were observed in the month of January, there was no much variation in the values of chloride and sulphate. However, there was much variation in the value of Phosphate, when the monthly data were seen, it varied between 21.0 mg/L (March) to 53.20 mg/L (May) with an average of 36.90 mg/L
.

Table 2: Month wise representation of physico-chemical parameters of water sample

Sl. No.	Physico-chemical parameters	Values						
		Jan	Feb	Mar	Apr	May	Jun	Mean
1	Temperature (^{o}C)	24.60	24.40	24.90	25.30	24.30	23.20	24.40
2	pH	7.70	7.60	7.30	7.50	8.10	7.60	7.60
3	Dissolved Oxygen (mg/L)	3.76	3.76	3.92	3.20	3.30	4.30	3.76
4	BOD (mg/L)	0.20	0.26	0.26	0.30	0.36	0.29	0.26
5	Free CO_2 (mg/L)	18.00	16.20	16.10	15.60	16.10	16.30	16.20
6	Chloride (mg/L)	78.10	79.20	79.90	77.90	78.30	82.20	79.20
7	Sulphate (mg/L)	21.00	20.76	20.20	22.00	21.30	19.80	20.84
8	Phosphate (mg/L)	33.00	36.90	21.00	42.00	53.20	49.20	36.90
9	Hardness (mg/L)	192.0	184.5	183.0	188.0	186.0	179.0	184.5

4. Discussion:

When a water body is considered, we need to view from different angles as there will be multiple components that act to influence on it and also various organisms depend on the water quality. Hence, an attempt was made to survey the diversity of water insects along with the physico-chemical parameters of Kelageri lake. Earlier reports have mentioned that the diversity of water insects depends of the physico-chemical properties of the water body [9]. In the present study also we could find low insect diversity compared to the size of the lake, probably this may be due to the quantity and quality of water during our investigations. The collected insects occupy different habitats in the lake like few are adapted for submerged habitats, while some are found on surface of water body, we could also find very few species that depend on the weeds present in the water body. Water insects also try to utilize different habitats within the water body, when the water quantity and quality diminishes. Impairment of habitat and water quality can lead to reduction in the diversity of aquatic macro-invertebrates and

maximize the utilization of the available resources [9]. The physico-chemical parameters of Kelageri lake had Low pH, dissolved oxygen (DO) and high chloride, sulphate and phosphate concentrations that can be attributed to reduced water quality and quantity. The parameters like dissolved oxygen, sulphate and phosphate have direct impact on the growth of biotic communities including insects. However, the other physico-chemical parameters such as hardness, CO_2, temperature etc. have a direct as well as an indirect effect on the biological diversity [15]. The analysis of physico-chemical parameters are useful in determining the effect on water quality and its pollution, but changes in trophic conditions of water body will also reflect the biological community structure including species pattern, distribution and diversity [16]. Temperature is the most common physical parameter of the water body as it influences both chemical and biological characteristics of water and is one of the major factor in determining the distribution of Hydropsychidae, where most of the species exhibit higher densities in warmer waters [17]. However, in the present study, temperature ranged narrowly (2.1ºC) and hence, the water insects were found throughout the water body instead of colonizing at a particular place. Even pH affects the dissolved oxygen, photosynthesis of aquatic organisms (phytoplankton) [18]. In this present study, lake have optimum pH ranging from 7.3 to 8.1 which is suitable for the aquatic organisms. The concentration of dissolved oxygen (DO) and Biological Oxygen Demand (BOD) are the most important parameters to indicate water quality (purity) and to determine the distribution of various aquatic insect groups [7].

Sulphate is widely distributed in nature and may be present in natural waters at concentrations ranging from a few to several hundred mg/L due to anthropogenic activities. It may come from mining and drainage wastes. Alkalinity values of 20-200 mg/L are common in fresh water ecosystems and alkalinity below 10 mg/L indicates poorly buffered water bodies. In the present study, biological indices represent the quality of water in the lake, and reveals that it is slightly affected by anthropogenic activities and may led to decrease in water flora and faunal diversity. The distribution of aquatic insect communities provides useful bio-indicators for the bio-monitoring approach in order to provide a complete spectrum of information for appropriate management of fresh water lake. The present study results revealed that the existence of diverse aquatic fauna in lake. Hence, the lake can be a suitable model for studying biodiversity, distribution and effect of physico-chemical parameters on different group of flora and fauna.

Acknowledgements:

The authors thank the authorities of Karnatak University, Dharwad for providing necessary facilities to carry out this work in the Department of Zoology, KUD. PMB thanks UGC-SAP for the financial assistance. DKV acknowledges, CSIR, New Delhi for the Associateship.

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