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Water Quality parameters in relation to Insect composition in Fish Ponds at Bhadra Fish Farm, Karnataka

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Abstract

Fish ponds at Bhadra fish seed farm in Shivamogga district was studied for insect composition and Physico-chemical parameters in two fish ponds, for a period from April to September 2018. A total of 19 species of aquatic insects belonging to 04 orders were recorded. Among orders, Hemiptera consists of 11 species followed by Coleoptera with 04 species and Odonata and Diptera each with 02 species respectively. Human fishing activities and dumping of cowdung/poultry manure to the fish ponds water creates threat to the biota by altering the water quality. Different parameters studied were Water temperature, pH, al;kalinity, hardness, DO, Free CO_2 and BOD. The results obtained from the current study indicated that the water pH of fish ponds were alkaline in nature and remaining contents were in moderate concentrations. One-way ANOVA and Tukey HSD test were calculated to know the significant difference between the water quality parameters.

Ponds are the lentic water bodies of numerous landscapes and often contribute to the regional freshwater biological diversity[2,5,22,26]. Water is the natural resources in the globe for living creatures. Water can be found in lentic and lotic habitats. Such water may be polluted by discharging domestic waste, industrial effluents, agricultural wastes from surface-runoff and erosion. They may pollute the water bodies and become unfit for human consumption and adversely affects the natural surroundings[17].

Insects are most common in shallow water because of their familiarity with the aquatic life cycle. As the main group in the pond fauna. they form an important part of the biota of the marine community. I just said. Insects are popular for pond farming as they form an important on the natural diet of fish and serve as a reliable indicator of the natural characteristics of the water. But at the same time. its increase in stocks. especially in

prevalenne. it hurts a lot. See. as usual. they act as competitors for young fish to be eaten and the older ones among them cause great death and especially the newly hatched chicks. As aquatic insects and their immature phases play a direct or indirect role in the survival and growth of young fish in day care centers. in-depth knowledge about these insects and their management should be considered important in the culture of paid fish[9].

Aquatic insects form an important group of organisms in the freshwater system. They are known to play a very important role in the processing and cycling of nutrients, as they are part of several specialist feeding groups such as filter feeders, deposit, collectors, scrapers, shredders and predators[10]. while their importance as biomonitors or indicators of clean water pollution have also been widely demonstrated[13,25].

The diversity and conservation approaches are widely promoted and provide challenges and opportunities to understand the impact of anthropogenic activities and environmental degradation on natural communities[20,24]. India as a major center for biodiversity offers a unique richness of biodiversity due to its habitat and accounts for about 7% of the world's biodiversity. Biodiversity combined with floral diversity provides excellent habitats for biodiversity. Although the diversity of insects in India is closely linked to the global ecosystem, the diversity of aquatic animals and water bugs is astonishing.

The objectives of the current study include the study of the insect species diversity and classification of aquatic insects in Fish Ponds at the Bhadra fish seed farm in Shivamogga Province of Karnataka.

Study area :

The current fish seed farm is located at 13º 41 'N latitude and 75º 38' E longitude. The ponds of the Bhadra fish farm are fully earthen (Figure 1) and some of them are earthen with side rock revitted. The area of these ponds ranged from 600-1000 m^2. The fish farm is situated in Bhadravathi taluk of the Shivamogga region of Karnataka (Figure 2) for fish seed production and brood stock management.

Aquatic insects were captured in volume and quality using a 1 m wide kick-net[3] with a measuring mass of 1mm. One person holds the net while the other takes a formal sample of 1 m^2. The stones or boulders in the ponds were picked up and the insects were washed away by the net. The samples were then carefully taken from the net and stored immediately in 5% formaldehyde. These samples were transferred to the laboratory for further processing. All samples from one of the ponds of different samples were filtered and identified with the help of a field guide[18,23]. Physico-chemical limitations of water were recorded during collection[1]. One way ANOVA and Tukey HSD tests for water quality parameters is carried out by using the software of www.socscistatistics.com.

Table 1 shows the physico-chemical properties of the fish ponds at Bhadra fish seed farm. Water temperature ranged 22 to 29

Figure 1: Fish ponds at Bhadra fish farm used for water & insect sampling

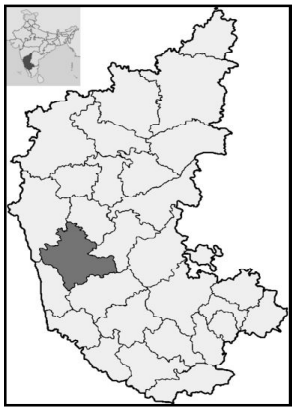

Figure 2: Location of the study area

degree centigrade (Figure 3). While, the pH of the ponds were naturally alkaline. Dissolved oxygen levels vary from 4.70- 6.4 mg/l with CO_2 content between 4.4 and 16.4 mg/l respectively. The total alkalinity varied from 90 to 140 mg/l. However, hardness values vary from 86 to 155.5 mg/l. BOD levels ranged from 0.60 to 2.2 mg/l. The water boundaries were within the normal range of fish production at Bhadra fish farm.

Table-1. Average Physico-chemical characteristics of Fish ponds (Pooled) water during 2018

Months	Water temperature (°C)	pH	DO	Free CO_2	Total alkalinity	Hardness	BOD
April	28	7.4	4.70	16.4	90.0	86	1.50
May	29	7.5	4.85	8.8	130.0	98.4	2.2
June	24	7.5	6.2	8.6	110.0	116.0	0.60
July	23	8.1	6.4	5.6	140.0	155.5	0.80
August	22	7.6	5.8	4.4	90.0	112	1.10
September	23.5	7.9	6.10	6.4	98.2	88	0.60

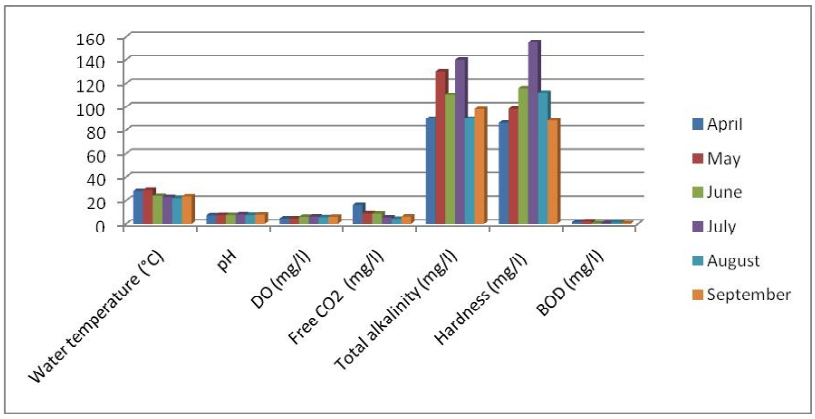

Figure 3: Average water quality characteristics of Fish ponds (Pooled) water during 2018

A total of 19 species of aquatic insects were recorded with 04 orders. Among 4 orders, odonata and Diptera having 02 species each. Hemiptera is dominant with 11 species followed by Coleoptera with 4 species. Factors such as light, temperature, food, water, habitat, pond size and depth pattern have a major influence on a variety of insects.

Temperature is the most obvious factor affecting the seasonal cycle and the abundance of insects in the aquatic ecosystem[6]. The alkalinity and hardness of the arc are closely related. Water with high alkalinity, hardness, chloride and phosphates are found to be highly productive and support rich plants and animals. Mairs[11] and Moyle[15] have also noted similar incidents**.**

Ranatrids have shown an attraction to underwater vegetation such as *Hydrilla* and lay their eggs in their shoots (Sarkar and Krishnamoorthi, 1979). *Ranatra elongata* and *Laccotrephes maculatus* have been found attached to *Hydrilla* plants. Chironomus worms were found in tubes attached to rocks and on the side walls of ponds. In addition, mosquito and Chironomous larvae were collected. Thus, it can be concluded that these fish ponds are moderately polluted.

Hydrophilus olivaceous was found in *Hydrilla* plants. *Anisops* species were found to eat mosquito larvae. In the meantime, Dragon fly larvae and Damsel flies were found attached to plant roots, rocks and the side walls of the lake[24].

Odonata insects were flourished when macrophytic growth was luxuriant. Similarly, Hynes[7] and Perry[19] have noticed that odonata insects are distributed in rich growth macrophytes. Similar condition was observed in these ponds.

Water bugs exhibits distinct diversity in their structural modifications, behaviour and physiological adaptation such as predation. Presently there is a great threat to these phenomena due to human interference in fresh

water bodies and loss of heterogencity in species richness of flora and fauna. These bugs may be considered beneficial because they often feed on dipteran larvae.

The Hemiptera, Odonata, Coleoptera and Ephemeroptera are the bio- indicators and they act as bio- control agents. Similar explanation were reported by Majumder *et al*.,[12] from fresh water lake of Tripura having 23 genera, 15 families and 4 orders and they opined that Hemiptera and Odonata orders were dominant. However, Choudhary and Gupta[4] have studied the insect fauna of Deepor beel in Assam and they reported 31 species belonging to 18 families of 5 orders and noticed that Hemiptrea was the dominant order with 17 species and 8 families. Mirgane Amol Prabhakar and Kumbhar Arvind Choodamani (2018) paper deals with aquatic insect diversity of Katphal Lake Tal. Sangola, Dist. Solapur, India. They reported a total of 20 species of aquatic insects belonging to 20 genera and 15 families distributed over 5 orders; Hemiptera was dominant order with 7 species and Ephemeroptera least with 2 species. Nagaraja and Thirumala[16] have recorded 11 species of aquatic insects belonging to 04 orders and 07 families in Bathi lake of Davangere. Among orders, Hemiptera consists of 08 species followed by Trochoptera, Ephemeroptera and Araneae with 01 species each.

Most of these insects are found in lentic ,lotic and limnetic habitats. Regarding trophic category, the order of preference is predators are dominant followed by grazers and collectors.

Table-2. Diversity of Aquatic insects in Fish ponds at Bhadra fish seed farm, Karnataka

Order	Pond 1	Pond 2
Odonata	*Dragon fly larvae*	*Damsel fly larvae*
	Damsel fly larvae	-
Hemiptera	*Laccotrephes maculates*	*Laccotrephes maculates*
	Ranatra elongata	*Ranatra elongata*
	Anisops sp.	*Ranatra filiformis*
	Plea sp.	*Hydrometra vittata*
	Corixa sp.	*Notonecta glauca*
	Micronecta sp.	
	Lethocerus indicus	
	Gerris sp.	
Coleoptera	*Hydaticus leucozonicus*	*Hydaticus leucozonicus*
	H. fabrici	*H. fabricii*
	Hydrophilus olivaceous	*Dinetutes indicus*
Diptera	*Chironomus* sp	*Chironomus* sp
	Mosquitoe larvae	-

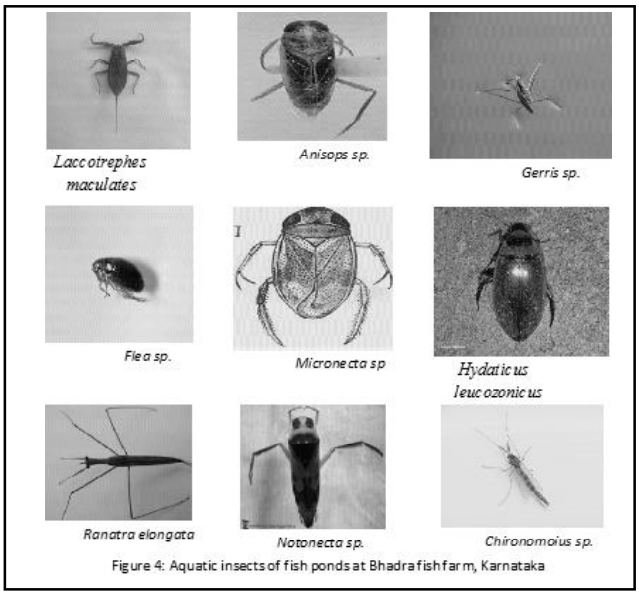

Figure 4: Aquatic insects of fish ponds at Bhadra fish farm, Karnataka

One-Way ANOVA and Tukey HSD Data

Table-3. One-Way ANOVA for water quality parameters of fish ponds at Bhadra fish seed farm

	WT (T1)	pH (T2)	DO (T3)	Free CO_2 (T4)	BOD (T5)	Total
N	6	6	6	6	6	30
$\sum X$	149.5	46	34.05	50.2	6.8	286.55
Mean	24.9167	7.6667	5.675	8.3667	1.1333	9.552
$\sum X^2$	3766.25	353.04	195.8625	512.04	9.66	4836.8525
Std.Dev.	2.8708	0.2733	0.7251	4.2903	0.625	8.5093

Source	***SS***	***df***	***MS***	
Between-parameterss	1961.6253	4	490.4063	$F = 88.71503$
Within-parameters	138.1971	25	5.5279	
Total	2099.8224	29		

The f-ratio value is 88.71503. The p-value is < .00001. The result is significant at $p < .05$.

Post Hoc Tukey HSD (beta)

The Tukey's HSD (significant difference) procedure facilitates pairwise comparisons within ANOVA data. The F statistic (above) tells whether there is an overall difference between your sample means. Tukey's HSD test allows to determine between which of the various pairs of means- if any of them - there is a significant difference.

Table -4. Tukey HSD values for water quality parameters of fish ponds at Bhadra fish seed farm

Pairwise Comparisons		$HSD_{.05} = 3.9866$ $HSD_{.01} = 4.9374$	$Q_{.05} = 4.1534$ $Q_{.01} = 5.1439$
T_1:T_2	$M_1 = 24.92$ $M_2 = 7.67$	17.25	Q = 17.97 (p = .00000)
T_1:T_3	$M_1 = 24.92$ $M_3 = 5.67$	19.24	Q = 20.05 (p = .00000)
T_1:T_4	$M_1 = 24.92$ $M_4 = 8.37$	16.55	Q = 17.24 (p = .00000)
T_1:T_5	$M_1 = 24.92$ $M_5 = 1.13$	23.78	Q = 24.78 (p = .00000)
T_2:T_3	$M_2 = 7.67$ $M_3 = 5.67$	1.99	Q = 2.08 (p = .59206)
T_2:T_4	$M_2 = 7.67$ $M_4 = 8.37$	0.70	Q = 0.73 (p = .98498)
T_2:T_5	$M_2 = 7.67$ $M_5 = 1.13$	6.53	Q = 6.81 (p = .00053)
T_3:T_4	$M_3 = 5.67$ $M_4 = 8.37$	2.69	Q = 2.80 (p = .30290)
T_3:T_5	$M_3 = 5.67$ $M_5 = 1.13$	4.54	Q = 4.73 (p = .01993)
T_4:T_5	$M_4 = 8.37$ $M_5 = 1.13$	7.23	Q = 7.54 (p = .00014)

Few physico-chemical parameters in the studied fish ponds showed temporal and spatial variations throughout the study. These ponds are receives maximum organic load by using cowdung and poultry manure for zooplankton production. These zooplankton act as food for the small and brooder fishes. Ponds play a fundamental role in the management of aqua-diversity at the neighborhood level apart from other water bodies. Hence, a study was carried out on the aquatic insects of two fish ponds at Bhadra fish farm.

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