ijlpr 2020; doi 10.22376/ijpbs/lpr.2020.10.2.L 26-30

International Journal of Lifescience and Pharma Research

Research Article

Environmental Science for better human health

Study On Nutrient Levels and Entomological Indicator of Biological Integrity In Fish Culture Ponds of Bhadra Reservoir Project, Karnataka, India

Dr.S.Thirumala[1], Prof.B.Rajappa[2] and Dr.B.R.Kiran[3]

[1] *Department of Environmental Science, Govt. First Grade College & P G Centre, Davangere-577004 Karnataka, India.*

[2] *Department of Chemistry, Rwandan Defence College, Kigali Rwandan, East Africa.*

[3]*Research & Teaching Assistant in Environmental Science, DDE, Kuvempu University, Shankarghatta-577451, Karnataka*

Abstract: The supplement levels and organic uprightness of five fish culture ponds were contemplated utilizing water insects and the water quality investigation of the fish ponds as markers from January to December 2011.A sum of 203 insects were recorded with 04 orders and 07 families. There was huge contrast in the plenitude of pond skaters, dragon/damsel fly and whirligig beetles for the five fish ponds (P=0.05). There was no critical distinction in the bounty of water insects and dytiscid beetle (P<0.05). The mean estimations of the physico-chemical parameters of the five fish ponds indicated no noteworthy degree of distinction. The least noteworthy distinction of the bounty of insects demonstrated that ponds 1, 2 and 3 were not favorable for the amphibian bugs inspected. Pond 5 indicated the pinnacle portrayal of all insects inspected. The Carl Pearson connection coefficient demonstrated a solid connection between the quantity of individual of dragon/damsel fly, dytiscid and whirligig beetles and the magnesium focus and Chemical Oxygen demand of the ponds. The pond skater and water bug were adversely associated with the nitrogen substance and temperature of the water bodies. In view of these discoveries the fish culture ponds were considered as decently contaminated biological systems whose contamination load came about predominantly from dumping of poultry/dairy animals' compost excrement and fish food.

Keywords: Aquatic insects, fish ponds, nutrient levels, correlation coefficient.

***Corresponding Author**

Dr.B.R.Kiran , Research & Teaching Assistant in Environmental Science, DDE, Kuvempu University, Shankarghatta-577451, Karnataka

Recieved On **02 December 2019**
Revised On **24 December 2019**
Accepted On **20 January 2020**
Published On **04 April 2020**

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Dr.S.Thirumala, Prof.B.Rajappa and Dr.B.R.Kiran , Study On Nutrient Levels and Entomological Indicator of Biological Integrity In Fish Culture Ponds of Bhadra Reservoir Project, Karnataka,India.(2020).Int. J. Life Sci. Pharma Res.10(2), L 26-30 http://dx.doi.org/10.22376/ijpbs/lpr.2020.10.2.L 26-30

1. INTRODUCTION

The aquatic insects are hardly a fraction of about 4% of the total insect population. They have evolved from the terrestrial forms by subsequently taking to the aquatic mode of existence. The aquatic insects form a major item of food for several fishes. Many of them being carnivores, prey upon fish seed. A number of aquatic insects and their larval forms compete with fishes for food, especially, the molluscs. Aquatic insects serve as indicators of several ecological characteristics, the nature of pollution and its extent in the water bodies. The total number of species belonging to families of aquatic insects is about 11200. Of them, 8520 species belonging to 145 families have so far been recorded from the Indian region. Pollution of freshwater is also caused by thermal input and the input of biodegradable materials, and persistent organic chemicals. These inputs have direct toxic effect on both sediment and sediment biota and for persistent chemicals linkages between biota in above sediment and region may exacerbate and prolong the pollution[1]. Habitat fragmentation and deterioration of water quality constitute increasing threat to biodiversity [2]. The biological integrity of a fresh water ecosystem has been defined as a balanced, integrated adaptive community of organism having a species composition, diversity and functional organization comparable to that of the natural habitat of the region[3]. Pollution effects such as eutrophication due to excess input of nutrient (nitrogen and or phosphorus) from point and non-point sources. Eutrophication has significant impacts on pelagic above sediment and this eventually lead to increase, in dissolved oxygen depletion[1]. Freshwater biota are exposed to a range of natural disturbances varying in strength frequencies, predictability, duration and spatial scale, such disturbances can deplete the biota, disrupt ecological process and redistribute resources[4,18]. Human activities are now a major force affecting the freshwater ecosystem for the earth [5,6] . In many situations, the freshwater are exposed to a variety of anthropogenic disturbances acting simultaneously[7]. Entomological indicators (use of insect) is widely used as biological indicator because they constitute a wide range of sensitivity to pollution and are relatively easy to sample and identify [8]. Insect composition and abundance in water vary spatially due to several factors among which the most important are the physico-chemical parameters of the water[9]. For instance their diversity is high in shallower and more productive littoral zones of the water, while in other zones the diversity decreases due to the presence of silt / organic mud deposit and the associated reduced condition result from oxygen depletion by biodegradation of organic matter. Consequently, only a few specialized species appear and often reach very high population [10]. The main objective of the present study is to establish the impact of waste dump, pollution source, on the biological integrity and nutrient levels using the insect community and water quality as indicator, along the course of the study fish ponds.

Two specific goals are identified to meet the overall objective of the investigation.

i. To collect and identify the insect fauna from different fish ponds.
ii. To analyze the water samples for some of the physico-chemical parameters to enumerate the biological enumeration and nutrient levels of the fish ponds.

2. MATERIALS AND METHODS

2.1 Study Area

Fish culture ponds are located in B.R. Project region of Bhadra fish farm, Karnataka. They are situated at 13° 42′ N latitude and 75° 38′ E longitude. This fish farm is the second largest one in the Karnataka state. Area of the ponds vary from 300 to 1500 m^2. The depth of the water bodies is about 2-3m and the main source of water to these ponds is from Bhadra left bank channel. Fish farmers add poultry manure and cow dung manure to ponds for zooplankton production (fish food) besides supplementary food (Ricebran, groundnut oil cake, fishmeal).

2.2 Collection of samples

Insect specimens were collected at the surface of the fish ponds using the insect net. Samples were also collected from sediment using the kick sampling technique, observed insects were counted at the different sites while representative samples were collected to be preserved in 70% alcohol for transfer to be identified. The collection and counts were made at the ponds 1, 2, 3, 4, and 5 twice between the period of 9 A.M. and 11 Noon during the day.

2.3 Physico-Chemical profile of water

Water samples were collected from different ponds of Bhadra fish farm in triplicate using bottles which were properly labelled for identification. The water samples were taken to the laboratory for physico-chemical analysis. The determination of temperature and pH value was done using the digital pH meter The pH meter was calibrated using a buffer standard solution after which the probe was inserted into the water samples and the reading taken. Chemical characteristics of water like magnesium, chloride, nitrogen, phosphate, chemical oxygen demand (COD), biochemical oxygen demand (BOD), dissolved oxygen (DO) were analyzed as per standard methods [11].

3. STATISTICAL ANALYSIS

Carl Pearson's correlation analysis was employed to study the relationship between different variables. The variables identified for the study have been detailed. In the present study, correlation matrix was worked out to find out the correlation between different physico-chemical parameters and insects.

4. RESULTS AND DISCUSSION

Aquatic insect samples collected represent seven families, which is depicted in Table 1. Damsel fly and Dragon fly larvae were found in all the five ponds. Pond 5 also have a representative of all sampled insect specimen. The pond skater and Whirligig beetle recorded the highest population. In the present study, the aquatic insects recorded were in the order as follows. Pond skater > Whirligig beetle >Dysticid beetle > Water spider > Dragonfly\Damsel fly. Dragonfly\damsel fly showed the least representation of all the insects. Table 2 shows the mean physico-chemical characteristics of fish ponds. Water temperature ranged from a minimum of 30°c in pond 5 to a maximum of 31.3°c at pond 2. The pH value was deviated from 6.5 (pond 5) to

7.02 (pond 2). Magnesium content was highest at pond 2 with 1.68 mg/L. There is a gradual increase in phosphate level from pond 1 to pond 4. Phosphate content was maximum (4.80 mg/1) at pond 4. The nitrogen concentration fluctuated from 0.02 (pond 3) to 0.062 mg/1 (pond 2) respectively. Peak nitrogen content was recorded at pond 2 and minimum in pond 4 (47.35 mg/1). Pond 2 and Pond 5 showed a narrow range in the COD i.e. 68.32 to 68.00 mg/l. Pond 4 have the lowest mean value of COD. The mean BOD and dissolved oxygen showed a gradual and continuous decrease from pond 1 to pond 5. In the current investigation, pH and temperature showed no marked difference in the values. Aquatic insects were primarily terrestrial forms which have subsequently taken to the aquatic existence by means of varied respiratory adaptations. Basically, their respiratory system comprises of a network of tracheal tubes that open to the exterior by means of spiracles or stigmata. The insects store air under the wings or at any other part modified for this purpose and utilize it when under water. The body in *Notonectids* is covered with small microscopic layer of hairs filled with air that forms an air film around the body and prevents it from becoming wet. The air film around the body is in contact with the open spiracle. The aquatic insects which breathe dissolved oxygen possess closed spiracles. The internal wall of the rectum in the naiads of dragon flies has developed rich vascularisation and is thrown into folds which act like the gill lamellae. Exchange of DO from water and CO_2 from the body is brought about through the tracheal gills. In the aquatic larval forms, exchange of gases may be brought about through the surface of the skin also. The aquatic insects have either the biting and chewing or piercing and sucking type of mouth parts. The former help in feeding on solid food materials while the latter, on liquid food such as blood of other animals or sap from the plants. All aquatic insects possess well developed hind legs beset with hairs that help in swimming. Evidently these legs are used as paddles or oars.

The total number of taxa represented in the present water bodies is low compared to higher numbers recorded for related tropical water bodies[12,13]. The absence of caddis fly , stone fly and may fly larvaes are indicative of high water quality. Slingsby and Cook [15]; Feminella and Flynn [8], opined that the water body is a stressed ecosystem and the water is of poor quality. This is further showed by the peak population of pond skater (*Gerris* species) in pond 3 and 5. The presence of at least a representative of all insect sample at pond 5 showed that this pond records the least level of anthropogenic activity like dumping of poultry / cow dung manure. The presence of dragon fly/ damsel fly at all the ponds may be due to the fact that they are flight insects. The absence of some of the aquatic insects at the other pond could be attributed to dropping of poultry and cow dung waste and release of nutrient into the fishpond. The dissolved oxygen observed are relatively lower than that given by the BIS [16] standard at the observed temperature except that was observed at pond 3 and this may be due to the presence of paddle aerator which maintains the temperature at this pond and this in effect keeps the DO at a higher level relative to the other four ponds where the water bodies are exposed to direct sunlight. Banjo *et al*[13] reported water quality standard of 20 mg/1 and 10 mg/1 for BOD and DO respectively the maximum value recorded for the present water bodies indicates that the water of the ponds is moderately polluted. The presence of dragon fly / damsel fly, pond skater and whirligig beetle showed that only pond 5 is relatively favourable for all the insects and vegetation among the ponds as reported by Newburg [14]. The significant fluctuation in Mg, P, N_2, Cl, COD, DO and BOD for the different ponds may be attributed to the dumping of animal waste (Cow dung and poultry manure). The significant difference observed in the pattern of fluctuation for the damselfly / dragon fly, pond skater and whirligig beetle for the different ponds may be attributed to the ability of these group of insects to tolerate pollution condition of the habitat as reported by Slingby and Cook [15] and Banjo et al.[13]. The correlation-coefficient of the number of individuals of damsel fly / dragon fly with magnesium level and COD and the correlation of the dysticid beetle and the whirligig beetle to this parameter suggest that some of its physico-chemical parameters can influence the abundance and distribution of aquatic insects as noted by Ogbogu and Hassan [17].The pond skaters are negatively correlated with the temperature and the nitrogen content and this suggests that the abundance of these species may be caused by the difference in the temperature. Similar findings also observed by Boulton and Lakes [19,20] and Banjo et al.[13] The correlation coefficient indicates a strong relationship between the magnesium concentration, COD and the number of dragon fly/ damselfly. The dytiscid beetle and the whirligig beetle show strong correlation to the magnesium and COD level of the fish ponds. The pond skater negatively correlated to the nitrogen content and water temperature of the study ponds. The water spider was negatively correlated with the water temperature (Table 3).

4.1 Advantages of using Aquatic insects bio assessments.

Advantages of using entamofauna as a bio assessment tool are listed as follows:

- Aquatic insects are good indicators of localized environmental conditions. Because they have limited migration patterns or a sessile mode of life, they are particularly well suited for assessing list specific impacts.
- Sensitive species respond quickly to environmental stress while the overall community responds more slowly.
- An experienced entomologist can easily detect a degraded condition with an examination of the aquatic insect assemblage.
- Aquatic insect assemblages are made of species that constitute a broad range of trophic levels and pollution tolerance, thus providing strong and graded information for interpreting cumulative effects.
- Sampling of entomofauna is relatively easy and has minimal detrimental effect on the resident biota.
- They also play an important role in the food chain of fish ponds. Many state water quality agencies have more expertise with invertebrates than fish

Therefore, most state water quality agencies that routinely perform biosurveys focus on aquatic insects.

Table 1 Identification of Insect specimens sampled at different fish ponds of Bhadra fish farm, Karnataka

Water bodies	Insect	Class	Order	Family	Scientific name
Pond 1	Dragon fly Damsel fly Water spider	Insecta Insecta Insecta	Odonata Odonata Araneae	Platycnemidae Platycnemidae Platycnemidae	*Microleonsp* *Validussp*
Pond 2	Pond skater Dragon fly Dystiscid beetle	Insecta Insecta Insecta	Hemiptera Odonata Coleoptera	Gerridae Notonectoidae Pentaluridae Dystiscidae	*Gerrissp* *Notenectaglauca* *Gynacathassp* *Dytiscusmaginalis*
Pond 3	Damsel fly Pond skater Water spider	InsectaInsecta Insecta	Odonata Hemiptera Araneae	Platycnemidae Gerridae Notonectoidae	*Microleon sp.* *Validus sp.* *Gerris sp.*
Pond 4	Dragon fly Pond skater	Insecta Insecta	Odonata Hemiptera	Pentaluridae Gerridae Notonectoidae	*Gynacatha sp.* *Gerris sp.* *Notonectaglauca*
Pond 5	Dragon fly Damsel fly Pond skater Dysticid beetle	Insecta Insecta Insecta Insecta	OdonataOdonata Hemiptera Coleoptera	Pentalridae Platycnemidae Gerridae Notonectoidae Dystiscidae	*Gynacatha sp.* *Microleon sp.* *Validus sp.* *Gerris sp.* *Notonectaglauca*

Table 2 Physico-chemical profile of the five ponds on Bhadra fish farm, Karnataka

Ponds	pH	Temp.	Mg	PO_4	N_2	Cl	COD	BOD	DO
1	7.01	31.25	1.44	1.21	0.031	70.00	52.35	38.09	4.01
2	7.02	31.3	1.68	2.59	0.062	81.00	68.32	32.34	5.68
3	6.60	30.30	0.97	2.76	0.020	56.8	49.60	29.30	7.33
4	6.53	30.34	0.93	4.80	0.035	47.35	48.68	28.0	4.35
5	6.54	30.0	1.63	3.089	0.021	56.80	68.00	24.0	4.68

All the parameters are in mg/l except pH and temperature (°C)

Table 3 Correlation coefficient between the water quality and the insect specimens.

Type of Insects	pH	Temp.	Mg	PO_4	N_2	Cl	COD	BOD	DO
Dragon fly/ damsel fly	0.70	0.51	0.003	0.66	0.44	0.35	0.006	0.61	0.27
Pond skater	0.14	-0.45	0.75	0.45	-0.05	0.16	0.71	0.36	0.30
Dysticid beetle	0.44	0.27	0.02	0.70	0.30	0.82	0.006	0.80	0.79
Whirligig beetle	0.362	0.62	0.005	0.67	0.25	0.88	0.02	0.75	0.70
Water spider	0.90	-0.08	0.97	0.31	0.33	0.80	0.81	0.38	0.51

$P < 0.05$ level

5. CONCLUSION

The present investigation revealed that the fish ponds have lower number of insect taxa and the major source of stress to the ecosystem identified is addition of poultry / cow dung manure and fish food. There is a significant level of interaction and influence of the biological integrity of the lentic habitat and its nutrient strength on the aquatic insect population and this influence is related strongly to the tolerance capacity of the different insect population. Based on the present research findings it is necessary to introduce catfish before stocking the fish seeds and brooders in the ponds to control the population of aquatic insects as they compete with fish for nutrition which in turn decreases the fish production. Many roles performed by aquatic insects in water bodys and the importance of their conservation. These aquatic insects have served as valuable indicators of degradation of water body, and as increasing demands are placed on our water resources, their value in assessments of their impacts is necessary. Aquatic insects are excellent overall indicators of both recent and long term environmental conditions. Thus when environmental changes occur, the species must endure the disturbance, adapt quickly, or die and be replaced by more tolerant species. These changes often result in an overabundance of a few tolerant species, and the communities become destabilized or unbalanced.

6. AUTHORS CONTRIBUTION STATEMENT

Authors are grateful to Government First Grade College, Davangere, Kuvempu University, Shankaraghatta and Bhadra Fish seed farm, B.R. Project-577115 for providing research facilities. All authors collected and entered the research data and discussed the methodology and results and contributed to the final manuscript.

7. CONFLICT OF INTEREST

Conflict of interest declared none.

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