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Monitoring of Water Pollution of Selected Freshwater Sites of Kollam District, using the Aquatic Insects as Bio Indicators

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Abstract: ***Aquatic ecosystems perform many important environmental functions like recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitats for life. A stress on an aquatic ecosystem can be a result of physical, chemical or biological alterations of the environment. Aquatic insects of inland wetlands comprised some well known groups like mayflies, dragonflies, and caddis flies. Aquatic bio monitoring can represent the overall health and status of the environment; detect different environmental trends and how different environmental trends and how different stressors will affect of different environmental activity will have on the overall health of the environment. In the present study three diverse sites from Kollam district, Kerala were selected. They were Canal near Kattil mekkathil temple (site I), post retting site near kadavoor (sie II) and Ashatamudi, Link Road (site III). The main physical parameters were estimation of Carbon dioxide and Oxygen. Heavy metals under study were zinc, lead, iron, copper and nickel. Beyond these insect species were also collected. In an over view heavy metal was higher in the site-3. The dissolved oxygen concentration was lower in site-3 and carbon dioxide concentration was found higher. Main insects were collected from the three sites include Dobsonfly larvae, Water striders skate, Mayfly larva, Stonefly larva and Snipe fly larvae, Midge, True fly larvae, Drone flies, Red taild maggots, Snails and Left handed snail, Aquatic worm, Leech. Small red damselfly, Ceriagrion tenellum, Water striders skate, Freshwater mussels, Cranefly. As a conclusion, it is noted that the site I is slightly or less polluted, site II is moderated polluted and site III is highly polluted. Site III needed urgent strategies for pollution control.***

Keywords: aquatic pollution, bio monitoring, insects, freshwater hydrology, dissolved oxygen carbon dioxide, heavy metal

1. Introduction

An aquatic ecosystem is a diverse community comprised of biotic communities that are structured by biological interactions and abiotic environmental factors. There are many factors, which disturbs the balance of the ecosystem. Many of them are anthropogenic. Common chemical stresses on freshwater ecosystem health include acidification, eutrophication, copper, and pesticide contamination. Water pollution affects the entire biosphere of plants and organisms living in these water bodies, as well as organisms and plants that might be exposed to the water. In almost all cases the effects is damaging not only to individual species and populations, but also to natural biological communities. Bio monitoring is a valuable assessment tool that is receiving increased use in water quality monitoring programs (Harikumar *et.al*, 2014).Current bio monitoring techniques focus mainly on community structure or biochemical oxygen demand. Responses are measured by behavioural changes, altered rates of growth, reproduction or mortality. Macro invertebrates are most often used in these modals because of well-known taxonomy, ease of collection, sensitivity to a range of stressors and their overall value to the ecosystem.

Aquatic insects of inland wetlands comprised some well-known groups like mayflies (Ephemeroptera), dragonflies (Odonata) and caddisflies (Trichoptera) (Nair G.A, *et al*, 2015).Living aquatic insects represent 12 insect orders like mayflies (Ephemeroptera), dragonflies and damselflies (Odonata), stoneflies (Plecoptera), alderflies (Megaloptera), lacewings (Neuroptera) and wasps (Hymenoptera) (Barman B, *et al*, 2015).Bio indicators can tell us about the cumulative effects of different pollutants in the ecosystem and about how long a problem may have been present, which physical and chemical testing cannot.

Aquatic insects are among the most prolific animals on earth. They are found associated with water for most part of their life cycle, any change in their number and composition in the population at a given time and space may indicate a change in the water quality. This class has many potential representatives that can be used as environmental bioindicators, among which are from the Coleoptera, Diptera, Lepidoptera, Hymenoptera. Water insects or aquatic beetles are biological indicator. These bio indicators organisms deliver information on alterations in the environment or the quantity of environmental pollutant by changing in one of the following ways; physiology, chemically or behaviourally. Aquatic insects are preferred indicator for measuring water quality because. Bashti.H and Ostovan.H.2014 studied the biotic index of streams in North West of Shiraz region. A total of 11 families were collected and identified in four habitat codes of streams and biological parameters were calculated for the streams. Insects can be used to monitor the accumulation and contamination of heavy metals (*i.e.*, Cd, Cr, Cu, Ni, and Zn) in soil, air, and water (Azam *et. al.*, 2015).In the present study we monitored the water quality parameters of selected freshwater bodies, by checking the insect population profiling there.

2. Materials and Methods

In the present study three diverse sites from Kollam district, Kerala were selected. They were Canal near Kattil mekkathil temple (site I), post retting site near kadavoor (sie II) and Ashatamudi, Link Road (site III). The main physical parameters were estimation of Carbon dioxide and Oxygen. Heavy metals under study were zinc, lead, iron, copper and nickel. Beyond these insect species were also collected.

Site I Canal near Kattil Mekkathil template
The Kaattil Mekkathil Temple at Ponmana near Chavara has the Arabian Sea on one side and the TS Canal on the other. Thousands of devotees from all over the country come to the temple to tie the sacred bells given to them from the temple to the tree. The canal is selected for the sample collection for site I. It is running water without any stagnation. Not sighted any pollution or eutrophication.

Site II kadavoor shap mukku.
Kadavoor is a small Village in Anchalummood Block in Kollam District of Kerala State, India. It comes under Thrikkadavoor Panchayath. It belongs to South Kerala Division. It is located 3 KM towards North from District head quarters Kollam. It is near to Arabian Sea. There is a chance of humidity in the weather. The selected site is near kadavoor and is a post-retting site. Noted with moderate level of pollution.

Site III Ashatamudi, Link Road
The Asramam Link Road is an important four-lane city road in Kollam in the Indian state of Kerala. The road starts from Kappalandimukku near Polayathode in the east and currently ends at KSRTC. It is highly polluted with oil waste from the boats and KSRTC stand, So Ashtamudi is severely polluted.

The water samples were checked for quantitative estimation of dissolved oxygen (Winkler Method) and carbon dioxide (Leeds.A.R., 1891).The water samples were analysed for heavy metals like Zinc, Lead, Iron, Copper and Nickel (Ahmed, M., 2003). The macro invertebrates were collected and identified using (Moulton II *et.al.*, 2000).All data were statistically analysed and ANOVA test was conducted to compare significant differences among treatments using the SPS software and differences were considered significant when $p<0.05$.

3. Result

Estimation of heavy metals in drinking water is a pollution index. From the estimation it is clear that the amount copper (0.1mg/l) is higher in site-3 (link road, kollam) (figure.1 and 2). While other two sites have the values 0.07mg/l (site-2 kadavoor, kollam), 0.06mg/l (site-1 chavara, kollam). The content of iron in water is same in site-3 and site-2 (2.6mg/l) and it is lower in site-1 (1.2mg/l) (figure.1 and 3). The amount of zinc is not detected in three sites (figure.1 and 4). In the case of lead, is higher in site-3 (0.5mg/l). The other two sites have the values 0.4mg/l (site-2) and 0.2mg/l (site-1) (figure 1 and 5).The amount of nickel is same in both site-2 and site-3 (0.6mg/l) and it is lower in site-1 (0.4mg/l) (figure 1 and 6).From the above estimation, the amount of heavy metals are higher in site-3 compared to other two sites. So, site-3 is highly polluted area.

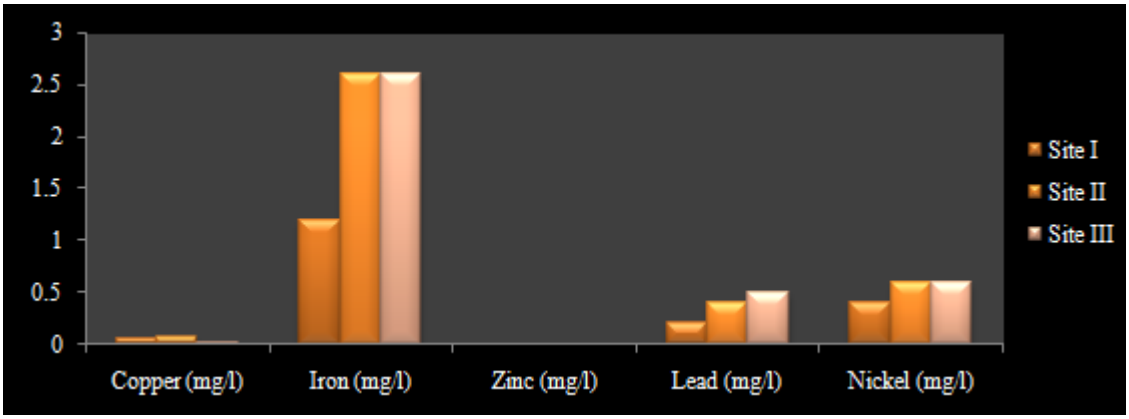

Figure 1: Concentrations of Heavy metals in selected sites

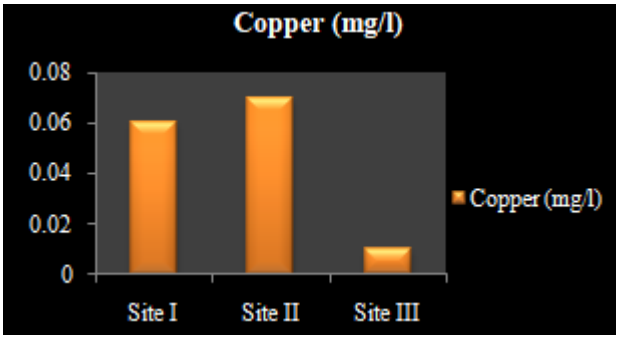

Figure 2: Concentrations of Copper in selected sites

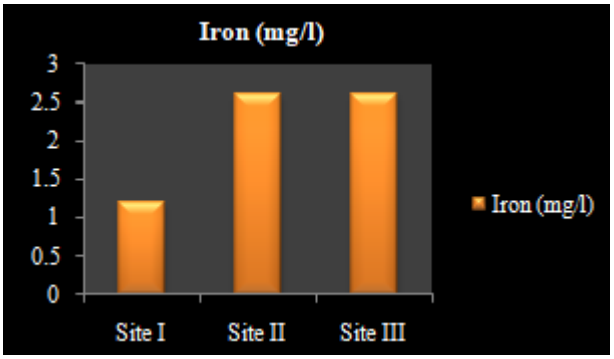

Figure 3: Concentrations of Iron in selected sites

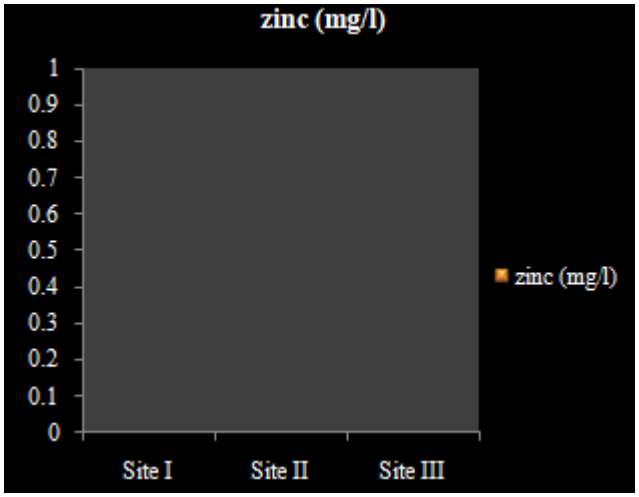

Figure 4: Concentrations of Zinc in selected sites

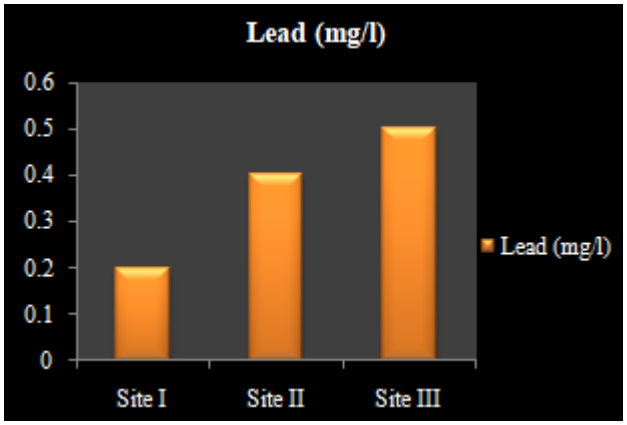

Figure 5: Concentrations of Lead in selected sites

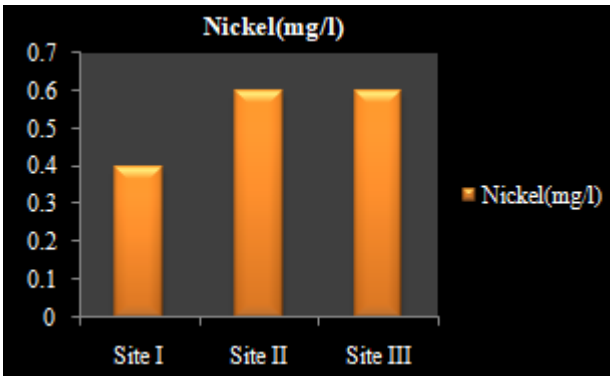

Figure 6: Concentrations of Nickel in selected sites

The oxygen content of water sample in site-3 (0.84ppm) is comparatively lower than other two sites (site-1 4ppm, site-2 1.68ppm).From this estimation of dissolved oxygen, we can concluded that the site-3 is highly polluted, because of the lower content of oxygen. Site -2 is moderately polluted and site-1 is slightly polluted (Figure.7.)

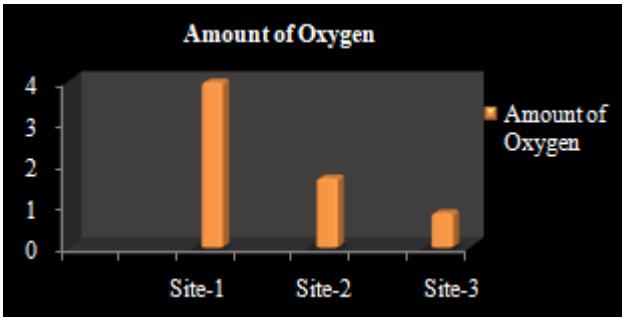

Figure 7: Dissolved oxygen in selected sites

The amount of CO_2 is grater in site-3 (4.2ppm), 1.44ppm in site-2 and 1.36ppm in site-1. Thus we can conclude that the amount of CO_2in site-3 is higher than that of the other two sides. So, site-3 is highly polluted (figure.8).

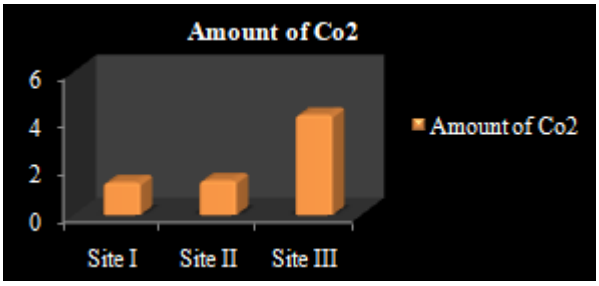

Figure 8: Dissolved carbon dioxide in selected sites.

Insects found in the site I includes dobsonfly larvae, Water striders skate, Mayfly larva, Stonefly larva and Snipe fly larvae. All the spies were inhibiting in the freshwater without any pollution of less polluted water. Water striders skate is a good indicator of pure water. In the case of mayfly and stone fly also their life cycle requires pollution free water. Site III is Ashatamudi is highly polluted site and the main invertebrates found were Midge, true fly larvae, Drone flies, red tailed maggots, Snails, Left handed snail, Aquatic worm, Leech. Site II is kadavoor the water is collected from the post retting processing site of coconut husk. Here the main invertebrates found were Peanaus indicus, Small red damselfly, *Ceriagrion tenellum*, Water striders skate, Freshwater mussels, Crane fly (Table.1).

Table 3.2: Showing major Macro invertebrates in the selected sites.

Site I	Site II	Site III
dobsonfly larva Water striders skate Mayfly larva Stonefly larva	Peanaus indicus Small red damselfly Water striders skate Freshwater mussels. Cranefly	Midge, true flies larvae. Drone flies, red tailed maggots Snails. Left handed snail. Aquatic worm Leech

4. Discussion

There are numerous works dealing with the correlation between macro invertebrates' diversity and water quality (Rashid and Ashok, 2014). These organisms can be benthic, inhabiting substrates like sediments, debris, or logs, or pelagic, swimming freely in the water column. Benthic

macrofauna is a good indicator of the variability of environmental conditions. Heavy metals are dangerous because they tend to bio accumulate.Dissolved oxygen in the most indicator of the health of a water body and its capacity to support a balanced aquatic ecosystem of plants and animals. Waste water containing organic pollutants depletes the dissolved oxygen and may lead to death of marine organisms. Carbon Dioxide is present in water in the form of a dissolved gas. Surface waters normally contain less than 10 ppm free carbon dioxide, while some ground waters may easily exceed that concentration.Some macro invertebrates regarded as the indicator of the water quality; as highly polluted, moderately polluted and slightly or less polluted. Stone fly larvae found in cold water with high level of dissolved oxygen. Dobsonfly larvae is one of the species found in the Site I, indicated as pollution free or less polluted site. Donso can be found in pure water. Like that snipe fly larvae is a clear indicator of pollution free water as they only dwell in bottom of very clean water. In the first site noted with the presence of snipe, fly larvae. Mayflies are found in cool standing water as well as in headwater streams. They require moderate amount of dissolved oxygen in the water and prefer clean water but sometimes they can also survive in low amount of dissolved oxygen also. In some case crustacean found in the less polluted or pure water with huge amount of dissolved oxygen. Here in site II, *Peneaus indicus* detected and also noted the presence of few freshwater molluscs. In the site II , cranefly larvae was found indicated the presence of pollution as in moderate level. As the pollution in the water increases the turbidity of water also increases. The turbidity in the water thus results in the disturbance of life cycles of macro invertebrates. Because of the increase in sedimentation, the attaching macro invertebrates will be replaced by silt-tolerant Oligochaetes, Chironomids etc. Midges feeds on aquatic plants and can be found in any water type including salt water. Molluscans like *Snails (Gastropoda)* Snails with gills are sensitive to less amount of dissolved oxygen and are sensitive to pollution. Leeches are pollution tolerant except some of their species. They feed on insects, dead organic matter and other small invertebrates. Leeches lives in shallow water, and cannot tolerate acidic water (Natesan *et. al.,* 2017). Alakananda *et. al*., 2011 investigated the water quality for 11 urban wetlands in a tropical region (Bangalore, India) using bio indicators..A correlation of biological oxygen demand, chemical oxygen demand and electric conductivity with trophic diatom index (TDI) was significant than with biotic index (BI). Sharma and Chowdhary., 2011 assessed the benthic macro invertebrate assemblages at sub-tropical River of Jamu, River Tawi, corresponding to different catchment land uses, were assessed in 2008 to 2009 as indicators of water quality.

In the present investigation site III is highly polluted and indicated with high level of heavy metal like copper, iron, nickel and lead. Site II is moderately polluted noted by the presence of heavy metals. Singh *et. al.,* 2017 conducted a systematic analysis of sediment contamination by heavy metals of the River Ghaghara flowing through the Uttar Pradesh and Bihar in Indian Territory. Positive correlation between Zn, Co, Cu, Cr, and Ni indicated a natural origin of these elements in the river sediment.

In the present study less dissolved oxygen was noted in site-3 and is highly polluted. Site -2 is moderately polluted and site-1 is slightly polluted. In the case of CO_2 the amount of CO_2in site-3 is higher than that of the other two sides. So, site-3 is highly polluted. On a work by Kshirsagar and Gunale (2011) deals with the seasonal variations in physico-chemical parameters of river Mula at Pune city. Gangwar *et.al.,* 2013 an attempt has been made to study Water Quality Index (W QI) and pollution or changes in the quality of water. Water quality index (W QI) is a useful tool for quick estimation of quality of any water resource.

5. Conclusion

In the present study three sites were selected as canal of kattil mekkathil temple, kadavoor and ashatamudi link road. The sites are selected due to their ecological impacts in the present days. The sites were checked for dissolved oxygen carbon dioxide and heavy metal concentrations. The second phase of the study was to assess the macro invertebrate diversity and correlated with the hydrology of the site. As a conclusion, it is noted that the site I is slightly or less polluted, site II is moderated polluted and site III is highly polluted. Site III needed urgent strategies for pollution control.

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