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DIVERSITY AND DENSITY OF MACROINVERTEBRATES IN VEMBAKOTTAI WATER RESERVOIR, VIRUDHUNAGAR DISTRICT, TAMILNADU

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Abstract

Water is a basic need of all living organisms on the earth. Most of the water on this planet is stored in oceans and ice caps, which is difficult to recover for our diverse needs. Most of our demand for water is fulfilled by rain water, which gets deposited in surface as ground water resources. More than 73% of the earth's surface is covered by water to an average depth of 3,8m. In India, there are several large reservoirs exist besides large natural lakes and innumerable small tanks and ponds. Reservoirs are made by constructing dams across the rivers to serve a variety of purposes like industrial process, irrigation, navigation, domestic water supply, fish culture and recreation (Mankor., 2011).

Keywords: Agriculture, navigation, recreation, ecosystem, revolution

Freshwater resources need special care and attention to make it available sustainably for the present and future generations. Water is vital for agriculture, industries and almost all the other human activities. Ensuring uninterrupted freshwater supply is the greatest challenge the water managers of the world have to face in the coming decades

Freshwater resources - both surface and subsurface - need to be wisely conserved and cautiously managed for the benefit of the present and future generations. With varying degrees of success, mankind have corrected, to some extent, the imbalance by storing water in reservoirs and also channeling the stored water to the needy areas. However, water pollution from industry, agriculture and urban centres still makes the situation complex as the quality and quantity of freshwater resources are critically affected by these activities

Each water source should be monitored with utmost care and precision for laying down strategies for the effective conversation and management of the water resources. The water related issues are critical in the small catchment rivers of developing economic with high incidence of human stress

India is rich in its aquatic resources, both fresh and marine and high great variations in environmental conditions. A wide range of habitats are observed. Limnology plays an important role in decision making processes for problems like dam construction, pollution control, fish and agnaculture practies. Due to increased demands for reliable supply of electric power, irrigation and drinking water, the number of new reservoirs is

increasing dramatically especially in India. The available estimates made by rarious aqencies regarding resvervoir Grea in the country area conflicting and wide off the maric

Dams are the most important water resources. Unfortunately, the dams are polluted by indiscriminate disposal of sewage, industrial wastes and human activities. Freshwater resources need special care and attention to make it available sustainably for the present and future generations. In the recent years environmental monitoring through regular assessment of water quality has become a crucial factor in the exploitation or conservation of aquatic resources. Water quality regulates biotic diversity and biomass, energy and material cycles, tropical levels and rate of succession. This, in turn, helps in planning exploitation, antipollution or conservation strategies. The environmental monitoring through water quality assessment should be a continuous process and regularly undertaken for a variety of purposes like testing suitability of water for agricultural, industrial, aquaculture, recreational and domestic purposes.

A number of chemical substances may be present in water. If these substances are present in high level, the health is affected. To indicate the permissible limit of water quality parameters guideline values have been prescribed by Bureau of Indian Standards. Sometimes the water works structures, distribution pipe lines and storage structures may also be affected. Other problems are also caused due to poor quality of water. Some health problems like fluorosis, blue baby disease, *etc*. are associated with water quality chemical parameters. The human body contains about 70 % water. All body mechanisms in animals and plants depend on water as the media. Some of the salts naturally present in water serve as nutrients and are essential for the functional and growth of body.

The Physical and chemical characteristics of water are important parameters as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of aquatic organisms. The water bodies, rivers, lakes and dams are continuously subject to dynamics state of change with respect to the geological age and geochemical characteristics. This is demonstrated by continuous circulation transformation and accumulation of energy and matter through the medium of living thing and their activities. The dynamic balance in the aquatic ecosystem is upset by human activities, resulting in pollution which is manifested dramatically as fish kill, offensive taste, odour, colour and unchecked aquatic needs. The availability of good quality water is an indispensable feature for preventing disease and improving quantity of life. (Oluduro and Aderiye, 2007)

The quality of water may be described according to their physico-chemical and micro-biological characteristics. For effective maintenance of water quality through appropriate control measures, continuous monitoring of a large number of quality parameters is essential. However, it is very difficult and laborious task for regular

monitoring of all the parameters even if adequate manpower and laboratory facilities are available. Therefore, in recent years an alternative approach based on statistical correlation, has been used to develop mathematical relationships for comparison of physico-chemical parameters (Jena *et.al.,* 2013).

Reservoirs are biologically very potential and rich in flora and fauna. The marshy places forms natural habitat for feeding, breeding and nesting grounds

Biological diversity means the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity with in species between species and of ecosystems. It provides the basis for life on earth the fundamental, social, ethical, cultural and economic values of these resources have been recognized in region and literature from the earliest days recorded history. The zooplankton play a role of converting phytoplankton in to food, suitable for fish and aquatic animals and acquired importance in fishery research. The zooplankton indicating the presence or absence of certain species of fishes or in determining the population densities. Freshwater zooplankton is an important component in aquatic ecosystem, whose main function is to act as a primary and secondary link in the food chain.

Aquatic ecosystem provides a home to many species including phytoplankton, zooplankton, aquatic plants, insects, molluscans *etc*. They are organized at many levels from smallest building blocks of life to complete ecosystems, encompassing communities, populations, species and genetic levels. All aquatic ecosystems around the globe are generally colonied by the representatives of Phylum Arthropoda and Mollusca. Benthic invertebrates occupy the bottom of water body. The functional role of benthic communities in the trophic dynamics of river distribution of benthic organisms over a period of time provide index of the ecosystem. In recent years, there is a greater emphasis world over for better understanding of benthic environment. Molluscan are of great significance because they form the food of fishes and their productivity play an important link in the food chain. Benthic organisms are detritus and form an important link in the food chain. On account of their ability to convert low quality and low energy detritus into better quality food for higher organisms in the food web with the unfolding of important of benthos in food chain, benthic productivity has been correlated with fish resources. Molluscan communities are good indicators of localized conditions, species of birds living in the world today, with a tremendous diversity of life style. Besides this, birds are valuable for many aspects i.e. sensitive indicator of pollution and also play great role in pest control. Tropical regions have a rich store of birds diversity. Birds community investigations in nature and man-made habitats are so far poor in many South Indian regions. The most important environmental

use is that birds serve as ecological indicator. They are capable of supplying information on adverse changes in the features of any ecosystem.

Freshwater molluscs, snails and bivalves have been used frequently as bioindicator organisms. With increasing needs for research on contaminant effects in freshwater ecosystem, this kind of bio monitoring is likely to develop further in the future. Molluscs can be used effectively for studies of both organic and inorganic contaminants. Bio-monitoring studies with freshwater molluscs have covered a wide diversity of species, metals, and environments. The principal generalization that can be drown from this research is that bioaccumulation and toxicity are extremely situation dependent, hence, it is difficult to extrapolate, results from any particular study to other situations where the biological species or environmental conditions are different Even within one species, individual characteristics such as size, life stage, sex, and genotype can have significant effects on responses to contaminants.

The bioavailability of the metal is highly variable and depends on p^H, presence of organic ligands, water hardness, and numerous other controlling factors. Despite this variability, past studies provide some general principles that can facilitate planning of research with freshwater snails and bivalves as metal bio-indicators. These principles may also be useful in understanding and managing freshwater ecosystems. Freshwater mussels inhabit permanent lakes, pond, rivers, canals and streams throughout the world except in the Polar Regions. They require a constant source of cool, clean water. They prefer water with a substantial mineral content, using $CaCo_3$ to build their shells.

Ever increasing demands for water exceeding its availability due to population explosion, industrial revolution *etc.*, have led to several other problems. Besides drinking, water is also used for fresh and aquaculture, irrigation, hydropower generation *etc*. In spite of multifarious uses unfortunately the water bodies are being used as receptacles for sewage and industrial wastes. Water the **"elixir of life"** is becoming more and more unfit and dearer to mankind due to unwise use, neglect and mismanagement. Proper management and enforcement of environmental laws alone can save us from the awful situation.

The quality of impounded water is subjected to major physical, chemical and biological changes due to the influx substances from the catchment area with which the water comes in contact with rocks, soils and vegetation during run-off. The reservoir water is generally composed of surface run off and ground water and the relative amount of these two components are constantly changing owing chiefly to change in the rates of precipitation and evaporation. The dissolved and suspended solids and contained in the reservoir water are derived from all materials with which the water comes in contract including the atmosphere vegetation soil and rocks. A significant variation of water quality

in the reservoir can be expected due to the nature of input of water from these sources of contamination seasonally. This will have a profound impact on the treatment processes of the water.

Small reservoirs occupy a unique position in the limnology and offer immense scope for enhanced fish production by adopting extensive aquaculture techniques. Since the quality of water affects aquatic lives in many ways and hence it must be good quality for health survival of organisms. Water quality can have a great influence on the ability of growth of aquatic plants and animals in a stream, pond or lake.

The quality of water described as the physical, chemical and microbial characteristics. But, if some correlations were possible among these parameters, then significant ones would be fairly useful to indicate by the quality water. Water quality and other ecological changes are generally unfavorable whenever a freely flowing stream and its riparian zones are committed to permanent inundation in the form of reservoir.

Water bodies all contain both organic and inorganic dissolved solids. The inorganic solids consist of anions like carbonates, chlorides, sulphate, nitrate *etc*. the concentration of cations like magnesium, sodium, potassium and anions like chloride undergo minor fluctuation within a freshwater body. The ionic composition of water has an important role play in the metabolism of various aquatic organisms and it is the index of productivity. The concentration of calcium, inorganic carbon and sulphate are influenced by microbial metabolism. The direct relationship between calcium content is an indication of eutropic water. To benefit from the algae in lakes, ponds, dam reservoirs and rivers it is necessary to study the taxonomy of freshwater system. Algae, the source of oxygen in aquatic system are the main autochthonous primary producers and are used in determining water pollution levels.

The study area for the present study is Vembakkottai water reservoir that is situated near at Sivakasi, Virudhunagar District, TamilNadu. It is situated 14 km away from near town Sivakasi. It is recently constructed water reservoir (1986) across Vaippar River.

With this background, my present study entitled “diversity and density of macroinvertebrates in vembakottai water reservoir” studies in Virudhunagar District, Tamilnadu with reference to seasons”

Methodology

Study Area

The reservoir selected for the study of water quality parameters micro and macroinvertebrates diversity is located at Vembakottai, Virudhunagar district. It was constructed in 1986 for the purpose of supplying drinking water to Sivakasi and its surroundings. The depth is bout 7.0m. Total length is about 3400m. Total capacity of water

is about 398.70 million cubic feet. The number of sluices in the reservoir is two. Fish rearing and harvesting are also being carried out in this reservoir during rainy season. About 6275 tons of food production is being done every year. It irrigates the fields surrounding of Vembakottai. The reservoir has been constructed across the Vaippor river. It is located at 14 km south of Sivakasi ($9^0$33'N, Latitude and $77^0$77'E, Longitude)

Table 1: Showing Morphometric and Hydrological Characteristics of Vembakottai Reservoir

S. No.	Parameters	Vembakottai reservoir
1.	Year of construction	1986
2.	Water capacity (Mm^3)	3.987
3.	Maximum depth (m)	7.0
4.	Length of Dam (m)	3400
5.	Water catchment area (Acre)	136.51
6.	Number of sluices	2
7.	Velocity m^3/s	5849.0
8.	Irrigation area (Acre)	8100

Table 2: Showing Water Supplying Area of two Main Sluices of Vembakottai Reservoir

S. No.	Left Sluice	Right Sluice
1.	Vembakottai	Panaiyadipatti
2.	Vijayakarisalkulam	Panduvarpatti
3.	Salvarpatti	Soorankudi
4.	Sankarnatham	Othaiyar
5.	Padanthal	Kottaipatti

Period of study

The investigation was carried out in Vembakottai reservoir for a period of 24 months from July'2012 to June'2014. To make a survey about macroinvertebrates such as insects and molluscs and their relative abundance had been done during the time of this investigation.

Field Sampling

Surface water sample was collected from reservoir using clean one litre polypropylene container for the estimation of water quality parameters once in a fortnight at early hours of the day (7.00 a.m.). The collected water samples were immediately brought to the laboratory and analyzed. All recorded data were segregated into four categories on the following basis.,

1. Premonsoon period (July to September)

2. Mansoon period (October to December)
3. Early Post monsoon period (January to March)
4. Late Post monsoon period (April to June)

Survey of Macroinverbrates

Benthic macroinvertebnrates especially arthropods (insects) and molluscs were collected and number of individuals per square meter area was counted during the period of investigation. The macroinvertebrates were identified using standard keys of Mani (1982), Madhyastha (1998), IAAB (1998) and Sivaramakrishnan.*et.al.*,(1998) Borror (1970). Density and Relative abundance of insects and other invertebrates were computed using the following formulae.

$$\text{Density} = \frac{\text{Total number of individuals of the species}}{\text{Total number of quadrates sampled}}$$

$$\text{Abundance (\%)} = \frac{\text{Total number of individuals of the species}}{\text{Total number of quadrates sampled}} \times 100$$

Results

Diversity of Macroinvertebrates

Seasonal variation of Macroinvertebrates of the vembakottai reservoir have been presented. In the class Insecta such as *Gyrinus americanus, Peltodytes edentylus, Noctonecta undulate, Geris graciliornis, Laccotrephes Griseus, Ranatra filiformis, Geris Marginatus, Chironomus sp., Macromia sp., Isoperla sp., Ischnura sp., Heptagenia sp.* were identified. In Phylum Mollusca, *Thiara scabra, Thiara tuberculata, Pila globosa, Cremnoconctus conicus, Cyclophorus indicus, Pauldomus stomatodon, Lymnea luteola, Gabbia stenothyrodies, Lamellidens marginalis, Ariophanta laevipes, Planorbis exustus, Testacela sp.* were observed.

Density of Macroinvertebrates

During 2012-2013 *Geris graciliornis* (8.2/ml), was found to be more density in Macroivertebrates fauna followed by *Heptagenia sp* (6.4/ml), *Gyrinus americanus* (6.2/ml), *Lymnea luteola* (1.8/ml), *Gabbia stenothyrodies,* (1.6/ml), *Geris Marginatus* (4.2/ml), *Macromia sp. Laccotrephes Griseus* (4.1/ml), (3.8/ml), *Noctonecta undulate* (3.4/ml), *Chironomus sp.* (3.4/ml), *Planorbis exustus,* (3.2/ml), *Ariophanta laevipes,* (2.8/ml), *Cremnoconctus conicu* (2.6/ml), *Lamellidens marginalis* (2.6/ml), *Pauldomus stomatodon* (2.2/ml), *Thiara tuberculata* (5.2/ml), *Peltodytes edentylus* (2.2/ml), *Cyclophorus indicus*

(2.1/ml), *Ranatra filiformis* (2.0/ml), *Isoperla sp.* (2.0/ml), *Ischnura sp.* (2.0/ml) *Thiara scabra,* (6.0/ml) *Pila globosa* (2.0/ml) and *Testacela sp.* (2.0/ml).

During 2013-2014 *Geris graciliornis* (8.4/ml), was found to be more density in aquatic insects fauna followed by *Heptagenia sp* (6.8/ml), *Gyrinus americanus* (6.0/ml), *Chironomus sp.* (5.0/ml), *Geris Marginatus* (4.8/ml), *Laccotrephes Griseus* (4.2/ml), *Macromia sp* (3.4/ml), *Noctonecta undulate* (3.0/ml),), *Isoperla sp.* (2.4/ml), *Ranatra filiformis* (2.4/ml) *Ischnura sp.* (2.2/ml) and *Peltodytes edentylus* (2.0/ml). *Lymnea luteola* (2.6/ml) was found to be more density in Phylum Mollusca, followed by *Gabbia stenothyrodies,* (2.4/ml), *Lamellidens marginalis* (4.8/ml), *Thiara scabra* (6.2/ml), *Ariophanta laevipes,* (3.2/ml), *Thiara tuberculata* (6.0/ml), *Planorbis exustus,* (3.0/ml), *Pila globosa* (2.2/ml), *Cyclophorus indicus* (2.2/ml), *Cremnoconctus conicu* (2.0/ml), *Pauldomus stomatodon* (2.0/ml) and *Testacela sp.* (1.8/ml).

Relative Abundance of Macroinvertebrates

During 2012-2013 *Geris graciliornis* (10.13%), was found to be more density in aquatic insects fauna followed by *Heptagenia sp* (7.90%), *Gyrinus americanus* (7.65/ml), *Geris Marginatus* (5.20%), *Laccotrephes Griseus* (5.06%), *Macromia sp* (4.63%), *Noctonecta undulate* (4.02%), *Chironomus sp.* (4.20%), *Peltodytes edentylus* (2.71%). *Ranatra filiformis* (2.50%), *Isoperla sp.* (2.46%) and *Ischnura sp.* (2.46/ml). *Lymnea luteola* (2.22%) was found to be more density in Phylum Mollusca, *Gabbia stenothyrodies,* (1.97%), *Planorbis exustus,* (2.71%), *Ariophanta laevipes,* (3.45%), *Lamellidens marginalis* (3.20%), *Cremnoconctus conicu* (3.20/ml), *Thiara tuberculata* (7.41%), *Pauldomus stomatodon* (2.71%), *Cyclophorus indicus* (2.60%), *Thiara scabra* (6.42%), *Testacela sp.* (2.505) and *Pila globosa* (2.46%).

During 2013-2014 *Geris graciliornis* (9.43%), was found to be more density in aquatic insects fauna followed by *Heptagenia sp* (7.64%), *Gyrinus americanus* (6.74%), *Chironomus sp.* (5.60%), *Geris Marginatus* (5.40%), *Laccotrephes Griseus* (4.70%), *Macromia sp* (3.82/ml), *Noctonecta undulate* (3.37/ml), *Isoperla sp.* (2.70%), *Ranatra filiformis* (2.70%), *Ischnura sp.* (2.47%) and *Peltodytes edentylus* (2.24%), *Lymnea luteola* (2.92%), was found to be more density in Phylum Mollusca, *Gabbia stenothyrodies,* (2.70%), *Lamellidens marginalis* (5.40%), *Ariophanta laevipes,* (3.60%), *Thiara scabra* (7.00%), *Planorbis exustus,* (3.37%), *Thiara tuberculata* (6.74%), *Cyclophorus indicus* (2.50%), *Pila globosa* (2.47%), *Cremnoconctus conicu* (2.24%), *Pauldomus stomatodon* (2.24%), *Testacela sp.* (2.0%).

Table 3: The Density of Macroinvertebrates (aquatic insect fauna and molluscan fauna) of Vembakottai reservoir 2012 – 2014

S. No.	Taxa	Year 2012-2013	Year 2013-2014
	Aquatic insect fauna		
1.	*Gyrinus americanus*	6.2	6.0
2.	*Peltodytes edentylus*	2.2	2.0
3.	*Noctonecta undulata*	3.4	3.0
4.	*Geris graciliornis*	8.2	8.4
5.	*Laccotrephes Griseus*	4.1	4.2
6.	*Ranatra filiformis*	2.0	2.4
7.	*Geris Marginatus*	4.2	4.8
8.	*Chironomus sp.*	3.4	5.0
9.	*Macromia sp.*	3.8	3.4
10.	*Isoperla sp.*	2.0	2.4
11.	*Ischnura sp.*	2.0	2.2
12.	*Heptagenia sp.*	6.4	6.8
	Molluscan fauna		
13.	*Thiara scabra*	6.0	6.2
14.	*Thiara tuberculata*	5.2	6.0
15.	*Pila globosa*	2.0	2.2
16.	*Cremnoconctus conicus*	2.6	2.0
17.	*Cyclophorus indicus*	2.1	2.2
18.	*Pauldomus stomatodon*	2.2	2.0
19.	*Lymnea luteola*	1.8	2.6
20.	*Gabbia stenothyrodies*	1.6	2.4
21.	*Lamellidens marginalis*	2.6	4.8
22.	*Ariophanta laevipes*	2.8	3.2
23.	*Planorbis exustus*	2.2	3.0
24.	*Testacela sp.*	2.0	1.8

Table 4: Relative abundance of Macroinvertebrates (aquatic insect fauna and molluscan fauna) of Vembakottai reservoir 2012 – 2014

S.No.	Taxa	Year 2012-2013	Year 2013-2014
	Aquatic insect fauna		
1.	*Gyrinus americanus*	7.65	6.74
2.	*Peltodytes edentylus*	2.71	2.24
3.	*Noctonecta undulate*	4.20	3.37
4.	*Geris graciliornis*	10.13	9.43
5.	*Laccotrephes Griseus*	5.06	4.70
6.	*Ranatra filiformis*	2.50	2.70
7.	*Geris Marginatus*	5.20	5.40
8.	*Chironomus sp.*	4.20	5.60
9.	*Macromia sp.*	4.63	3.82
10.	*Isoperla sp.*	2.46	2.70
11.	*Ischnura sp.*	2.46	2.47
12.	*Heptagenia sp.*	7.90	7.64
	Molluscan fauna		
13.	*Thiara scabra*	7.41	7.00
14.	*Thiara tuberculata*	6.42	6.74
15.	*Pila globosa*	2.46	2.47
16.	*Cremnoconctus conicus*	3.20	2.24
17.	*Cyclophorus indicus*	2.60	2.50
18.	*Pauldomus stomatodon*	2.71	2.24
19.	*Lymnea luteola*	2.22	2.92
20.	*Gabbia stenothyrodies*	1.97	2.70
21.	*Lamellidens marginalis*	3.20	5.40
22.	*Ariophanta laevipes*	3.45	3.60
23.	*Planorbis exustus*	2.71	3.37
24.	*Testacela sp.*	2.50	2.00

Discusion

Macroinvertebrates Diversity

In the present investigation, the spatial distribution, of macro invertebrates with reference to aquatic msecta and Mollusca for sampling station in vembakottai reservoir were assessed for observing species density, and relative abundance. The maximum density in *Geris graciliornis* was noticed in 2012 to 2014 in Mollusca, the maximum density in *Thiara species* were recorded in 2012 to 2014.

The insects are the dominant group of animal kingdom on the earth today, the insects have 'solved' in many ways the various problem of food supply, protection against enemies, adaptation to specific environmental conditions. Many aquatic insect species have

more or less tolerance power against to extremes of Physic – Chemical parameter such as pH, alkalinity, dissolved oxygen temperature and have bread tolerance for environmental perturbation or polluted environments three fore, these are also named as bio-indicator of water quality. It is very essential to form late a sound public policy for water quality impartment in the present study was made to assess the diversity and relative abundance of aquatic insects in order to measure the status of water quality in Vembakkottai reservoir – diversity of aquatic insect in Vembakottai water reservoir, A total of 12 genera of aquatic insects were observed from the study area between July 2012 to June 2014 in class insect six orders such as Hemiptera Coeloptera, Diptera, odonata, Plecekpka and Ephemeroptera, Thus the study revealed that Hemipteran aquatic insects are predominant than others. Effective predator at varied aquatic organism their role in nature may be beneficial, They are control the larva of dipteran species. Such aquatic insect were effective tools of water quality parameter insense of bio indicator, These result indicate the very low level of water polluted Khan and Ghos 2002) in Vembakottai reservoir. The occurrence of thiara species related to unpolluted nature of Aquatic ecosystem (Rajan 2008).

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