Aquatic Biodiversity of Rana Pratap Sagar Lake

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ABSTRACT

Aquatic biodiversity has enormous economic and aesthetic value and is largely responsible for maintaining & supporting overall aquatic environmental health. Humans have long depended on aquatic resources for food, medicines and materials as well as for recreational and commercial purposes such as fishing and tourism. Aquatic organisms also rely upon the great diversity of aquatic habitats and resources for food materials and breeding ground. The aquatic biodiversity of a water body gets significantly affected by several factors such as contamination due to anthropogenic wastes from industry or other human activities including sewage disposal into the reservoirs. This paper presents the study details collected over three years on planktonic biodiversity, productivity and fisheries aspects of RPS reservoir. It includes identification of aquatic species, evaluation of Ponderal index and thermal tolerance study in respect of RPS fishes. Attempts are also made to estimate the harvesting age of commercial fishes of RPS lake. The data analysis on fish catch at the study reservoir shows a gradual increase of about three folds in the total fish landing during last three decades.

Keywords: Biodiversity, Anthropogenic waste, Thermal tolerance, Ponderal index, Harvesting age, Rana Pratap Sagar Lake, Nuclear Power Plant

INTRODUCTION

Aquatic biodiversity may be defined as the variety of species and their abundance in the aquatic ecosystem. The aquatic ecosystem provides home to several aquatic life species including phytoplanktons, zooplanktons, fishes and other abiotic entities like sediment, weeds etc., the interaction among all these biotic species and abiotic matter forms an aquatic ecosystem. Besides several other factors, the temperature has many fold effects on biodiversity as it implies to growth of an organism, distribution of animals, physiological processes like oxygen consumption, reproduction, rate of embryonic development and behavioral changes in organisms. It also affects the biochemical, metabolic and physiological activities of fishes. The growth rate, reproduction and enzyme activity increases with increase in temperature up to a certain limit, beyond that it creates adverse effect on the organisms. The critical temperature range is that over which a significant disturbance in the normal behaviour of the fishes may occur i.e. sign of stress.

Rana Pratap Sagar is one of the largest reservoirs of Rajasthan. On its eastern bank there exists Rawatbhata Site, comprising of multi-nuclear facilities. There are four PHWR units of Rajasthan Atomic Power Station (RAPS) which are in operations, two are under construction and another two are under advanced stage of planning. In addition to nuclear power plants the Site also houses a Heavy Water Plant and other allied facilities such as cobalt facility and waste management facilities.

RAPS draws water from RPS lake through a 300 m long conduit pipe located at lake bottom about 20 m below the surface. Duly treated low level radioactive liquid effluents from RAPS facilities are injected to the warmed condenser outlet and then allowed to discharge to RPS in a controlled manner. The warm water is likely to remain at the surface and get mixed with lake water and cooled due to dilutions, evaporation from the lake surface and wind currents.

The heat release to the RPS lake through condenser outlet may effect the microbiological & water quality parameters, planktonic biodiversity, fish productivity etc. and thus it is imperative to conduct the thermal ecological studies pertaining to this reservoir. Thermal ecological studies were carried out at Rana Pratap Sagar lake during 2002–2005 under DAE-BRNS project. The study included monitoring of several water quality parameters, biological & bacterial parameters and data on thermal stratification in respect of RPS reservoir. It also involved identification of aquatic species, evaluation of Ponderal index and thermal tolerance of RPS fishes.

MATERIALS & METHODS

During the study five off-shore locations as shown in fig.1, were chosen at RPS lake for sampling namely...
one as Control which was located at about 5 km upstream, near Intake jetty of RAPS, Discharge area of RAPS, Dam side which was located about 6 km downstream and the last one is Sentab which was about 9 km down stream away from the discharge area of RAPS. In addition to off-shore sampling locations, samples were also collected from another five locations on the downstream and three locations on the upstream side of RAPS discharge point along the RPS shore.

The RPS fishes were collected from landing centers and identified. The length and weight data of fishes were used to calculate the Pondral index, which indicate general well being of the fishes. Thermal tolerance and oxygen consumption of common fishes were also studied. Attempts were also made to estimate the harvesting age of commercial fishes of RPS lake.

RESULTS AND DISCUSSIONS

The temperature profile data from surface water as well as sub surface water at 2 meter interval were collected to study the thermal stratification at various sampling locations. The data gathered indicated that there was no uniform pattern of thermal stratification in the reservoir. Further, the stratification was poor and totally lacking in the periods of winter and monsoon. The RPS water appears to be homogeneous as revealed from the parallel studies carried out on depth wise tritium measurements (Verma et. al, 2005). As evident from the thermal profile study that the RPS water mass frequently undergoes mixing, which is a desirable feature for augmenting aquatic productivity at different trophic levels.

The physico-chemical data collected on monthly basis during the study period were subjected to statistical analysis. The probabilistic & possibilstic approaches have been applied to evaluate ecological risk. The study revealed that there is no adverse effect on RPS water quality owing to the warmed effluents from RAPS (Verma, et.al. 2007). Furthermore, it showed that RPS water is nearly homogeneous and showed weak thermocline and chemocline patterns. Based on monitoring data, the reservoir could be assigned as mild eutrophic status (Verma, et. al, 2005).

Macro invertebrates:

A total of 38 species of micro invertebrates have been recorded from RPS during the course of study. The Mollusca, Diptera, Hemiptere, Colepetera, Odonata, Isopod, Zygoptera, Crutacea, and Oligochaeta constitutes the main groups of the micro invertebrates. The average density of benthos varied between 462 (summer) to 4288 N/m2 (monsoon). The frequency and concentration of macro invertebrates varied from sampling location to location. Using average density of benthos, the Odum’s diversity index worked out to be 7.88.

Macrophytes:

A total of 19 species of macrophytes have been recorded. The prominent macrophytes are Potamogeton spp, Hydriila, Vallisneria and Najans minor. Macrophytes were noticed to grow luxuriantly.
even at the depth of 6 to 8 meters. The average biomass ranged between 0.473 to 4.171 kg/m² during the study period. The Odum’s diversity index for macrophytes was found to be 594.6.

**Plankton and Biodiversity:**

The biodiversity of planktonic organisms in RPS has been observed fairly well. About 82 phytoplankters and 63 zooplankters have been observed and identified. The average density of plankton ranged between 0.11 to 1677.77 Nos./l. The diversity indices for plankton were estimated in terms of Odum’s index and Menhinick’s index. They are found to be 165.26 and 3.68 respectively for phytoplankton whereas 276.4 and 4.17 for zooplankton respectively.

**Primary Productivity:**

The GPP manifested by surface water of RPS during the study period indicated seasonal average value 0.362, 0.449 and 0.285 gC/m³/hr for winter, summer and monsoon respectively. The higher GPP average was seen for the Intake location as compared to other locations whereas the minimum was seen at dam side location. The chlorophyll ‘a’ showed an overall average value of 0.031 and 0.042 mg/m³ in monsoon and winter respectively. Location wise, the highest chlorophyll ‘a’ value was exhibited at Dam side.

**Fish and Fisheries:**

A total of 39 fish species have been identified from RPS. Out of these, 18 species are of commercial values and regularly harvested from RPS and collected at landing stations. The length weight data in respect of 16 common fishes were used to calculate the Pondral Index, the indicator for general well being of these fishes. The Podral Index varied from 0.93 to 7.5 which indicate the satisfactory growth status of this water body. The principal major carp species have shown appreciably high values of Pondral index especially for *Catla catla*, *Labeo rohita*, *Tor khudree* and *Labeo calbasu* fishes.

The harvestable sizes of five commercially important fishes of RPS were estimated from their scale rings measurements. A typical imagery of *Catla catla* scale is shown in fig.2. It is estimated to harvest *Cirrhinus mrigla* & *L Calbasu*, *Catla catla* & *L rohita*, & *Tor khudree* respectively at the age of 3, 4 and 5 years respectively. Moreover, it is interesting to observe that during the last 30 years the fish catch has shown consistent increase which can be co-related to heat inputs (Juyal and Chaudhary, 2003).

Thermal tolerance and oxygen consumption studies on *Rasbora sp.* acclimated to temperatures viz. 200C, 280C and 360C respectively were conducted using critical thermal methodology. The temperature tolerance polygon of *Rasbora sp.* is calculated as 449.120C2. It is observed that the temperature tolerance of the fishes changed with the change in acclimation temperature. The oxygen consumption rates increased in fishes acclimated to 280C. However, the rates decreased at 360C. The decrease in oxygen consumption rates may be due to the damage caused to the gill structures at high temperature.

**CONCLUSIONS**

The biodiversity of fishes were found to be fairly good in RPS reservoir as it habitats about 39 species of the fishes. The fishes enjoy a healthy environment which is evident from the Pondral index values as well as general morphology. The consistent increase in fish catch during last thirty years can also be closely related with impact of warmed waters released from RAPS into the reservoir without any adverse impact on fisheries. This indicates the balanced environmental status of RPS reservoir.

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