Biospectra : ISSN: 0973-7057, Vol. 17(1), March, 2022, pp. 107-110
An International Biannual Refereed Journal of Life Sciences
22(AS).
Animal Science

ISSN : 0973-7057

Int. Database Index: 616 www.mjl.clarivate.com

Change in the fundamental niche of *Mesocyclops* species by the action of *Brachionus* species at Ranchi Lake

Nivedita Moon Moon* & Nayni Saxena
University Department of Zoology, Ranchi University, Ranchi, Jharkhand, India

Received : 02nd February, 2022 ; Revised : 04th March, 2022

Abstract- Changes in the niche structure of a cultural eutrophic lake at Ranchi were studied in relation to the population structure of three zooplankters *Mesocyclops leuckartii, Brachionus qudridentatus and Brachionus angularis*. Twenty two parameters were used to define the broad environmental framework of the lake. These parameters create an n-dimensional hypervolume within which the plankton selects the optimum combination of variables that creates its fundamental niche. The fundamental niche of *Mesocyclops* is defined by three parameters: food resource, temperature, and alkalinity. However, the same food resource is used by other zooplankton and thus compresses the fundamental niche to a realized niche. The parameters defining the fundamental niche are in turn are controlled by a variety of other subsystems. The result showed that the *Brachionus* species caused a change in the fundamental niche of *Mesocyclops* species.

Key words: Hypervolume, temperature, alkalinity, niche, correlation

INTRODUCTION

Rotifers of the Subclass Monogononta (Phylum Rotifera) are common metazoans in the plankton of freshwater environment.[1,2] Although small (usually 50–500 µm), they often are extremely abundant and important in the transfer of energy from algae, microbes, and detritus to higher trophic levels in community food webs.[3]

Rotifer life cycles often include several types of females and eggs.[4] Females sequentially produce single eggs throughout their reproductive life. Most rotifers are oviparous for instance in *Brachionus* eggs are attached to the mother until they hatch[5] and are released into the environment, or deposited onto a substratum.

An early, long – held view of the rotifer life cycle was a seasonal progression of events in which resting eggs hatch, populations develop via female parthenogenesis as long as environmental conditions are favourable, and then bisexual reproduction with resting-egg production occurs when conditions turn unfavourable at the end of the growing season.

The objective of the present study was to identify the changes in the niche structure of *Mesocyclops* species which shrinks its fundamental niche to a realised niche by the action of another species *Brachionus* at Ranchi Lake, Ranchi.

MATERIALS & METHODS

Plankton samples were collected once each month and used for species identification and counting on a Sedgwick rafter cell at 10x magnification. Twenty two parameters were used to define the broad environmental framework of the lake.[6] An n-dimensional hyper volume is created by these parameters. The plankton selects the

*Corresponding author :
Phone : 9771644535
E-mail : nivedita.moon@gmail.com

optimum combination of variables among these which create its fundamental niche. The estimation of chlorophyll was done by using spectrophotometer at 630nm, 645nm and 665nm.[7] The measurement of water temperature, salinity, conductivity and alaklinity[8] was done every month.

RESULTS & DISCUSSION

Results are presented in Table 1 and Figures 1 to 9. Figure 1 (a) and 1 (b) depict the *Brachionus* species with attached eggs. Bisexual reproduction is clearly evident in *Brachionus* species (Figure 2).

At Ranchi Lake three zooplankters were in abundance that is *Mesocyclops leuckartii, Brachionus qudridentatus and Brachionus angularis* (Figure 3). Organisms are primarily dependent on their food source. *Mesocyclops* is omnivorous feeding on algae, insect larvae and dead organic matter.[9,10] However, their primary dependence is on available algae.

Figure 4 represents changes in the phytoplankton population with respect to food availability at Ranchi Lake during the study. Another aspect which affects the plankton is competition from *Brachionus* which in the present case is *Brachionus angularis*. Populations of *Brachionus angularis* were quite common in Ranchi lake and had a fundamental niche defined by a temperature of 15-25ºC; a salinity of 9-40 (parts per thousand %); conductivity of 5mS cm^{-1} and food resource. The average life span of *Brachionus* species is 8-10 days and produces two eggs at a time. The maximum individuals were found in October at a temperature of 24.7°C and minimum in March at a temperature of 26.4°C (Figure 4).

The basic energy source of the zooplankton is the phytoplankton population specifically the various species of algae. The phytoplankton population at Ranchi Lake showed two peaks, one in the month of April – May, and the other in the month of August – September (Figure 5), it exhibited fluctuations with nutrient availability as the nutrients were released through decomposition of organic matter (Figure 6).

The phytoplankton population reached its peak in April-May and decreased rapidly in June due to unfavorable environmental conditions. It was estimated by chlorophyll method. The phytoplankton population was calculated from the concentration of chlorophyll and a significant negative correlation (r = -0.98) was noted between the organic matter and the phytoplankton population (Figure 7).

Brachionus competes for food resource to a certain extent but it has an alternative food source in the form of dead particulate organic matter. However, *Mesocyclops* can change its food preference from, algae to predation on living zooplankton, including *Brachionus* and dead organic matter.

One of the competitors of *Mesocyclops* with respect to food resource is *Brachionus*. A significant negative correlation (r = - 0.82) was noted between the population of *Mesocyclops* and *Brachionus* (Figure 8). *Brachionus* species shrinks the fundamental niche of *Mesocyclops* species to a realized niche (Figure 9).

$\Delta \log$ Mesocyclops = - 0.5481Δ log Brachionus – 0.0278 (r = - 0.82)

Brachionus uses the same food resource as *Mesocyclops* and competes with the latter for food. This competition shrinks the fundamental niche of *Mesocyclops* species to a realized niche (Figure 9 & 10).

Table 1: The parameters and their range

Parameters	Range
Temperature	15 – 25 °C
Salinity	9 – 40 ‰
Conductivity	5 mS cm^{-1}
Alkalinity	200 – 250 mgL^{-1}
Chlorophyll	12.55 μgL^{-1}

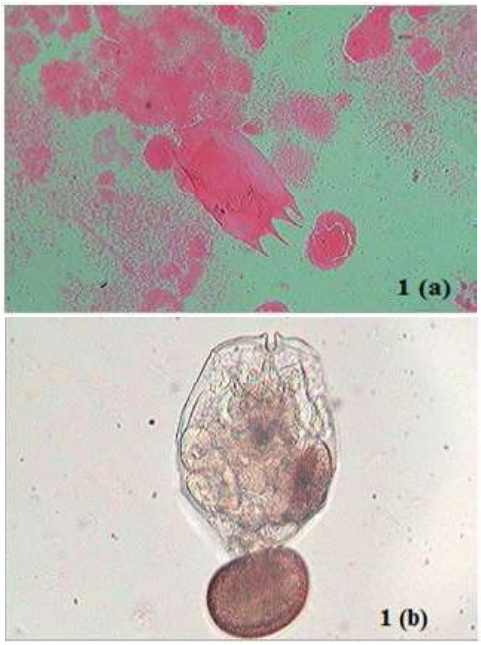

Fig 1: Eggs are attached to the female of *Brachionus angularis*

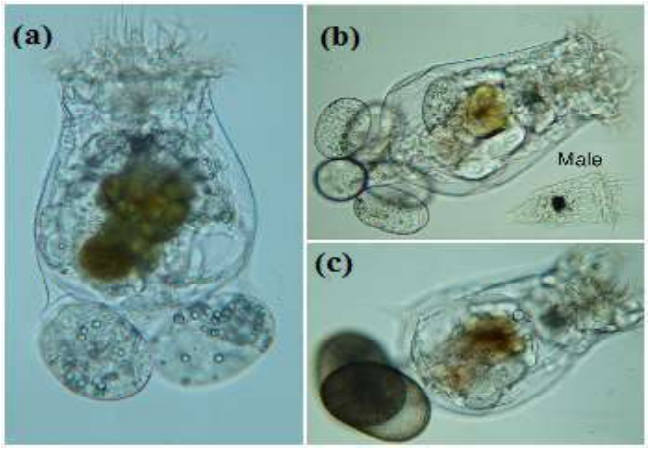

Fig. 2: Life-cycle stages of *Brachionus calyciflorus*. (a) Female carrying two diploid eggs developing parthenogenetically into females. (b) Female carrying five haploid eggs developing parthenogenetically into haploid males, and one hatched male. (c) Fertilised female carrying two encysted diapausing embryos or resting eggs.

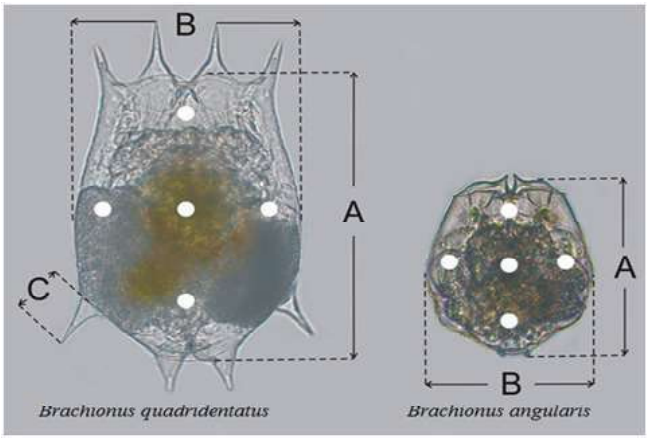

Fig. 3: Biometric characters of *Brachionus* species (A) body length; (B) body width; (C) length of posterolateral spine

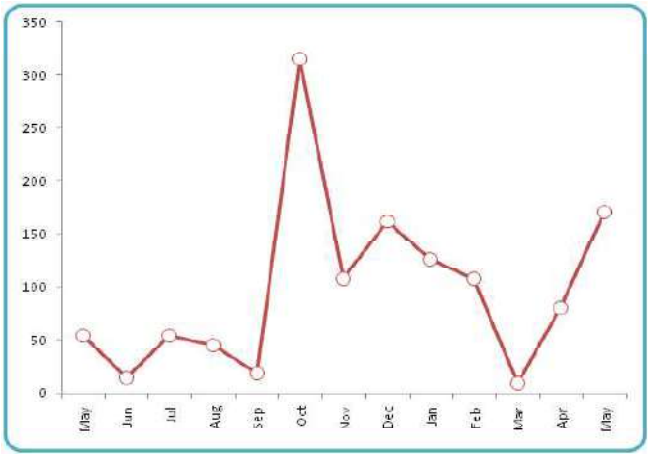

Fig. 4: The abundance of zooplankton population with respect to the temperature at Ranchi Lake

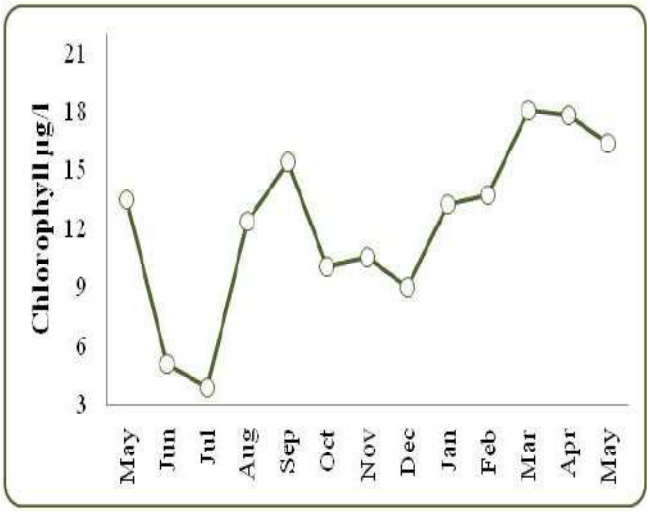

Fig. 5: The abundance of phytoplankton population with respect to the food availability at Ranchi Lake

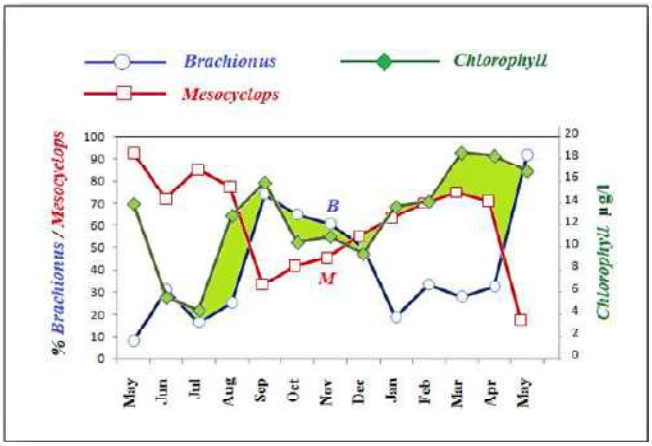

Fig. 6: The fluctuations of *Mesocyclops* and *Brachionus* at Ranchi lake

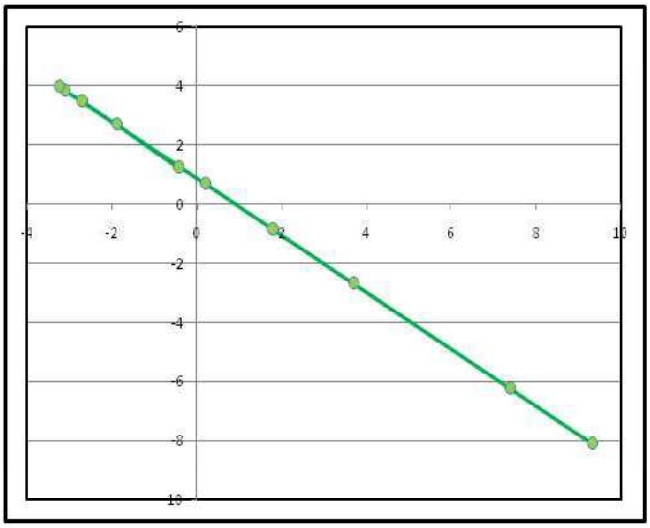

Fig. 7: showing a negative correlation between chlorophyll and dead organic matter

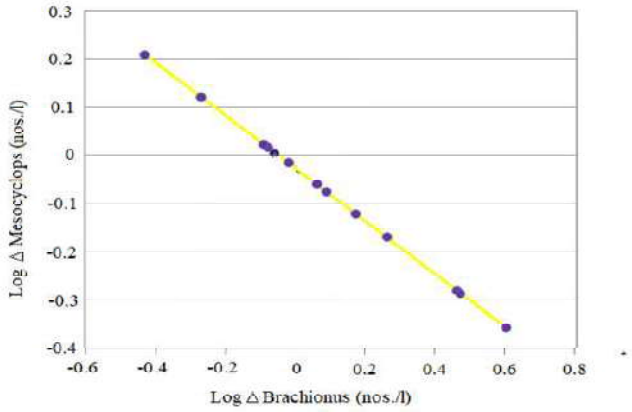

Fig. 8: Double logarithmic plot showing the negative correlation between *Mesocyclops* and *Brachionus*

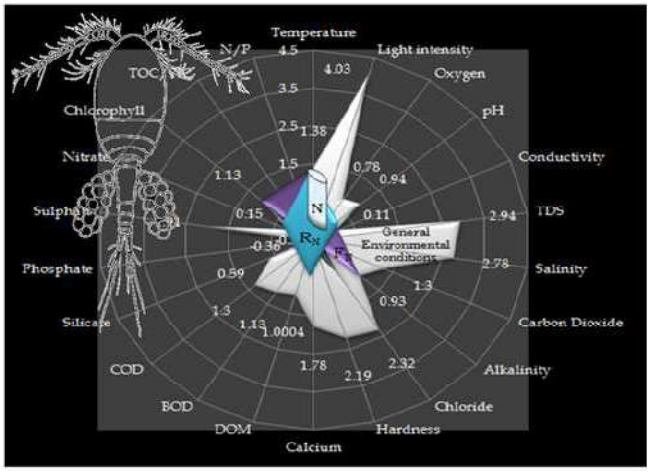

Fig. 9 The general environmental conditions; fundamental niche (FN); Realized niche (RN) and the *Mesocyclops* population (N)

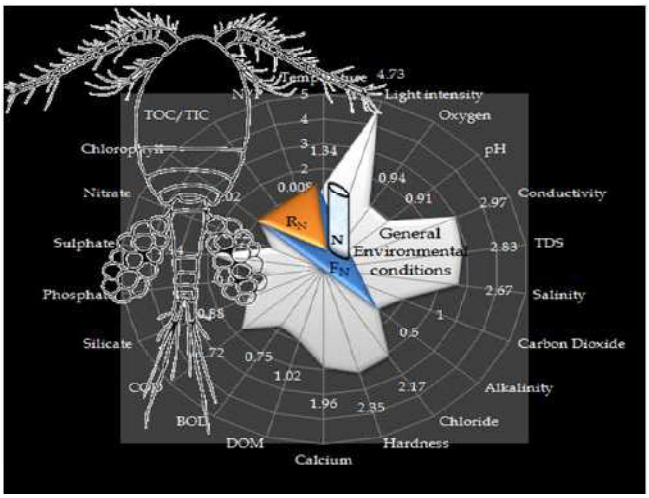

Fig. 10: The general environmental conditions; fundamental niche (FN); Realized niche (RN) and the Mesocyclops population (N) in the month of November

ACKNOWLEDGEMENT

I express my gratitude to my mentor and supervisor, Late Professor Biswarup Mukherjee, for his guidance and support during the period of my work.

REFERENCES

1. **Wallace, R. L., & Snell, T. W. 2010.** Rotifera. In Ecology and classification of North American freshwater invertebrates. 173-235. Academic Press.
2. **Wallace, R. L., Snell, T. W., & Smith, H. A. 2015.** Phylum rotifera. In Thorp and Covich's freshwater invertebrates. 225-271. Academic Press.
3. **Porter, K.G., Paerl, H., Hodson, R., Pace, M., Priscu, J., Riemann, B., Scavia, D. and Stockner, J., 1988.** Microbial interactions in lake food webs. In Complex interactions in lake communities. 209-227. Springer, New York, NY.
4. **Gilbert, J. J., & Schröder, T. 2004.** Rotifers from diapausing, fertilized eggs: unique features and emergence. *Limnology and Oceanography*, **49(4 part 2):** 1341-1354.
5. **Marcial, H. S., & Hagiwara, A. 2007.** Effect of diazinon on life stages and resting egg hatchability of rotifer *Brachionus plicatilis*. *Hydrobiologia*, **593(1):** 219-225.
6. **Nivedita Moon Moon. 2021.** The fundamental niche of *Mesocyclops* species within the broad aquatic environmental framework at Ranchi Lake. *Biospectra*, **16(2):** 145-150.
7. **Sartory, D. P., & Grobbelaar, J. U. 1984.** Extraction of chlorophyll a from freshwater phytoplankton for spectrophotometric analysis. *Hydrobiologia*, **114(3):** 177-187.
8. **APHA. 2006.** Standard methods for the examination of water and wastewater, 21st Edn. APHA, AWWA, WPCF, Washington, DC, USA.
9. **Hansen, A. M., & Santer, B. 1995.** The influence of food resources on the development, survival and reproduction of the two cyclopoid copepods: *Cyclops vicinus* and *Mesocyclops leuckarti*. *Journal of Plankton Research*, **17(3):** 631-646.
10. **Gophen, M. 1977.** Food and feeding habits of *Mesocyclops leuckarti* (Claus) in Lake Kinneret (Israel). *Freshwater Biology,* **7(6):**513-518.

***