

LIMNOLOGY OF TWO TEMPORARY PONDS IN THE JAFFNA PENINSULA, SRI LANKA

N. SELVARAJAH & VANAJA RAJARATNAM¹

(Department of Zoology, University of Jaffna, Jaffna, Sri Lanka.)

Vingnanam — Journal of Science 5: 7 — 13 (1990)

ABSTRACT : A limnological study was made of two temporary ponds namely Ariyakulam and Regal ponds in the Jaffna peninsula of Sri Lanka. This part experiences north-east monsoonal rains around December and this period is referred to as the 'rainy season'.

Of the two ponds, Ariyakulam pond dries up completely during the dry season and the other Regal pond does not dry up, since it is supplied by drainage water throughout the year. The study commenced with initial filling of the ponds and concluded when the ponds were dry or nearly so.

During the period of the study almost all the observed organisms, the phytoplankton such as members of chlorophyceae and zooplankton including crustacea and protozoa were found in both ponds, while considerable differences were observed in the two ponds regarding the chemical factors such as nitrogen, oxygen, salinity and pH which were higher in Regal Pond probably due to the accumulation of drainage water in this pond.

Introduction

Edible fresh water fish are an asset and a potential source for supplementing the protein shortage in our country. The successful inland management depends basically upon limnological aspects of water bodies.

In recent years the cultivation of fresh water fishes for food has been spreading throughout the country. Most work on limnology has been carried out in various water bodies of this peninsula to analyse the abundance of certain zooplankton (Fernando and Mendis 1962; Selvarajah and Costa 1979; Fernando 1980).

This study is mainly concerned with the abundance of zooplankton which especially play an important role in the food chain in ponds. The local species of fish, which are zooplankton feeders, are *Catla* and *Aristichthys nobilis* (big-head carp).

Zooplankton fulfil a vital role in the transfer of energy through the food chains since they are the intermediate step between the phytoplankton and most fishes.

¹ Present address : Chundikuli Girls College, Jaffna.

The Study Area

The two ponds selected for this study were Ariyakulam ($80^{\circ} 01' 05''$ E, $9^{\circ} 40' 00''$ N) and Regal, ($80^{\circ} 00' 30''$ E, $9^{\circ} 39' 45''$ N) both situated within the Jaffna municipality. Ariyakulam is located about one mile northeast to Regal pond. The area and maximum depths of these two ponds are 0.524 hectares and 2.94 meters for Ariyakulam and 0.920 hectares and 1.72 meters for Regal pond.

These two ponds receive water during the north-east monsoon extending up to February. In addition to this they are supplied with drainage water throughout the year. Particularly the drains that reach the Regal pond collect water from the adjacent hospital and motor service station.

During the end of the dry season (that is about August) Ariyakulam dries completely, but sometimes intermonsoonal rains provide certain amount of water. The Regal pond, since it collects the drainage from the town, does not dry up and has sufficient water to tide over the dry season.

Considering the boundary areas, Ariyakulam is surrounded by large trees *Terminalia arjuna*, *Thespesia populnea*, *Delonix elata* and *Ficus religiosa* and some bushes especially of *Calotropis*. The wide spreading branches of these were found to cover a considerable area of the pond, except its middle region, while the Regal pond is almost exposed, with only 2 or 3 large trees. A small area of the pond which is near the clock-tower situated close by is mostly covered with grass.

Materials and Methods

The study commenced with the initial filling of the ponds (October 1980) and was planned to conclude with the termination of the dry season (August 1981). From each pond, weekly plankton samples were taken at about 10.30 a.m. and 40 samples were obtained throughout the study period from each pond.

Physical parameters

Temperature and light are the main physical parameters that determine the distribution of pond water organisms. Temperature was measured using a thermometer which was placed at a point about one foot below the surface. The transparency of the water was observed using a sachchi disc.

Samples to determine water chemistry

To determine the oxygen content, water samples were taken monthly at about 30 - 40 cm below the surface. They were collected in 125 ml dark stoppered bottles which were filled until they overflowed once. To

determine the amount of oxygen, unmodified Winkler method was used. For this, oxygen of the samples was fixed in the field by the addition of manganous sulphate and potassium iodate solutions. The resultant precipitate was dissolved in concentrated sulphuric acid and titrated with sodium thiosulphate solution.

Since the pH is known to change in an isolated container of water it was measured in the field using pH paper and immediately upon arrival in the laboratory a more exact reading was taken using a Beckman pH meter.

Water samples for the determination of salinity and nitrogen content were obtained in one litre plastic bottles and analysed within four hours. Salinity was determined by titrimetry. Total nitrogen content was determined by Kjeldhal method converting nitrogen into ammonia.

Collection of plankton samples

Quantitative plankton sampling was performed on each pond at every observation period by pouring a measured volume of water through a plankton net of 64 μ mesh and concentrating to final volume. By prior trials, a 10 litre sample concentrated to 40 ml was found to be suitable. Water was poured through the net so that the filtered water was poured back into the pond. The samples were immediately preserved in 5% formalin.

Qualitative and quantitative analysis of plankton

Among the algal population the blue-green alga *Microcystis* species was not counted because of its high density. For quantitative purpose all other species of algae were considered collectively as "algae". Identifications of organisms was carried out mostly to the generic level.

One millilitre of the sample was withdrawn with a pipette, after thoroughly mixing to homogenize the concentrate, and transferred to a Sedgewick - Rafter counting cell and covered by a coverslip. Three counting techniques were used (Tribbey 1965). For larger organisms counts were made of the entire number within the counting cell under low magnification. Smaller and sparse forms were counted by traversing the width of the cell and counting all the types encountered. For very common smaller forms the number in one field was recorded. This was repeated for 5 fields and the average of these five counts was taken.

Bottom samples were first analysed for microfauna. Then they were dissolved in water and the resultant solution was examined under the microscope for microorganisms. Significance of correlation between biotic and abiotic factors was determined by the large sample approximation test for significance of correlation. The number of samples used was 40 (hence > 30).

Results and Discussion

The bottom of both ponds were found to be muddy, but that of the Regal pond was found to be much softer in nature than that of Ariyakulam.

The abiotic factors of the two ponds are given in figures 1 — 3.

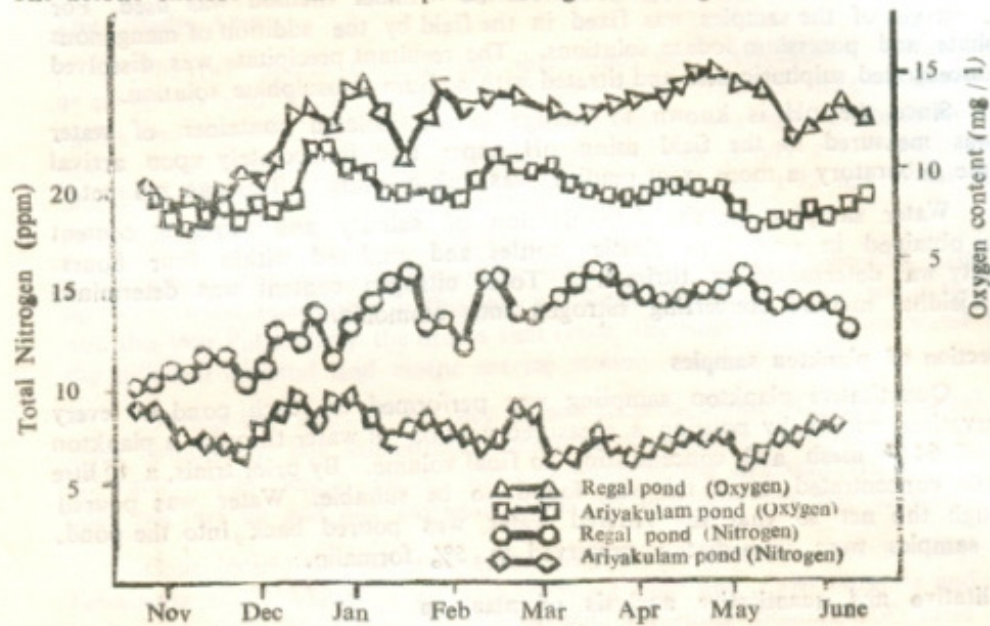


Fig. 1. Nitrogen and oxygen content in Ariyakulam and Regal Ponds.

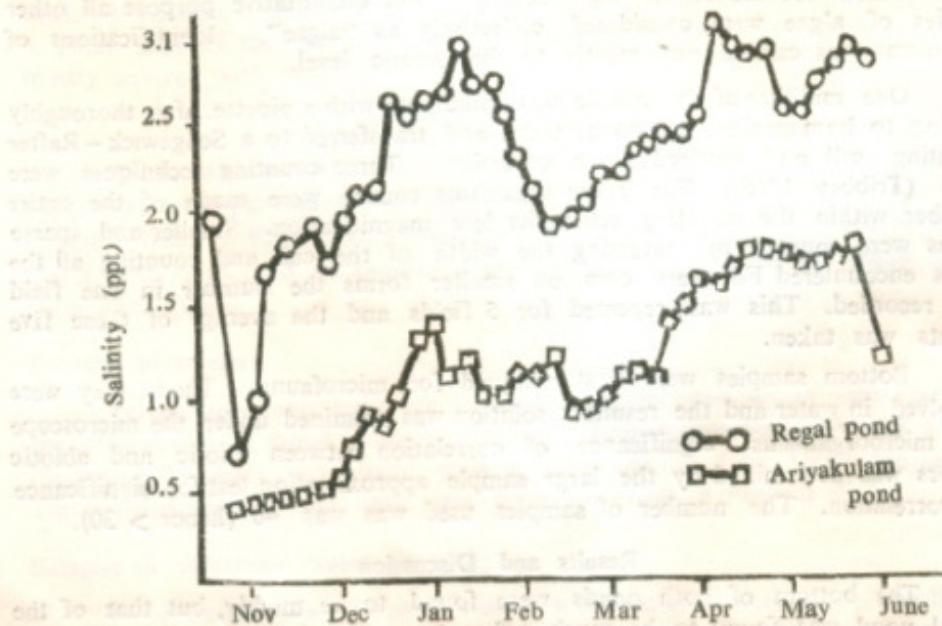


Fig. 2. Salinity in Ariyakulam and Regal Ponds.

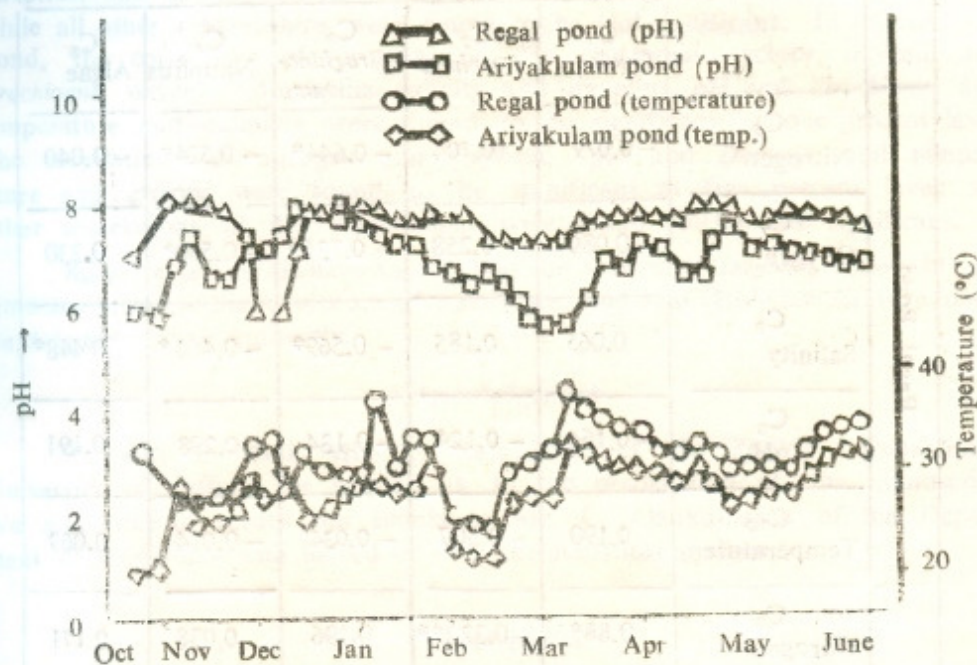


Fig. 3. pH and temperature in Ariyakulam and Regal Ponds.

The phytoplankton common to both ponds were species of *Chlamydomonas*, *Ulothrix*, *Pediastrum*, *Spirogyra*, *Volvox*, *Clsterium*, *Navicula*, *Asterionella*, *Scenedesmus* and *Microcystis*. The zooplankton common to both ponds were species of *Daphnia*, cyclops, *Brachionus*, *Vorticella*, *Epistylis*, *Philodina*, *Euglena*, *Paramecium* and nauplius larvae.

Ariyakulam pond had *Nelumbium* and fish fingerlings, birds - Heron, tadpoles and mosquito larvae, while Regal Pond had shrimps and *Pistia*. Correlation matrix between biotic and abiotic factors in Regal and Ariyakulam ponds is given in Table 1.

It was found from this study, that both Ariyakulam and Regal ponds possess similar types of algae and mesofauna, but the larger organisms showed variation in types in these two ponds.

Table 1

Correlation matrix between biotic and abiotic factors in Regal and Ariyakulam ponds

		C ₁ Cyclops	C ₂ <i>Daphnia</i>	C ₃ <i>Brachionus</i>	C ₄ Nauplius	C ₅ Algae
Regal Pond	C ₆ Nitrogen	-0.079	0.104	-0.644*	-0.524*	-0.040
	C ₇ Oxygen	-0.089	0.258	-0.736*	-0.560*	0.230
	C ₈ Salinity	0.065	0.185	-0.569*	-0.461*	0.448*
	C ₉ pH	-0.166	-0.124	-0.134	-0.298	0.191
	C ₁₀ Temperature	0.190	-0.307	-0.034	-0.014	0.069
Ariyakulam Pond	C ₆ Nitrogen	0.88*	-0.322**	0.196	0.038	0.171
	C ₇ Oxygen	0.148	-0.188	0.473*	-0.526*	0.031
	C ₈ Salinity	0.282	0.073	0.052	-0.744*	-0.092
	C ₉ pH	0.274	-0.321**	0.468*	-0.241	0.281
	C ₁₀ Temperature	0.375**	-0.040	-0.001	-0.422*	0.101

* Significant at 1% level.

** Significant at 5% level.

In the correlation matrix of the Regal pond the relationship between nitrogen and the rotifer *Brachionus*, nitrogen and the crustacean larva nauplius, oxygen and *Brachionus*, oxygen and nauplius, salinity and *Brachionus*, salinity and nauplius, and salinity and algae were found to be significant at one percent level while all other relationships were found to be not significant. In Ariyakulam pond, the correlation of nitrogen and the crustacean cyclops, oxygen and *Brachionus*, oxygen and nauplius, salinity and nauplius, pH and *Brachionus* and temperature and nauplius were found to be significant at one percent level. The correlation of nitrogen and *Daphnia*, pH and *Daphnia*, and temperature and cyclops were found to be significant at five percent level. All other correlations of the Ariyakulam were found to be not significant.

Burgis *et al.* (1973) have shown that the species of *Daphnia* found in the Limnetic region in the tropics are of small size and that high temperature limits *Daphnia* directly or indirectly.

Acknowledgements

We wish to thank Miss C. Rajendram of the Zoology Department, University of Jaffna, for helping us in the preparation of the manuscript. We also wish to record our thanks to Mr. C. Elankumaran of the Department of Economics who helped us with the statistical analysis.

References

- Burgis, M. J., Darlington, J.P.E.C., Dunn, I. G., Grant, G. G., Gwaha, J. J. and McGowan, L.M. (1973) The biomass and distribution of organisms in Lake George, Uganda. *Proceedings of Royal Society London* (B) 184: 271 - 298.
- Fernando, C. H. and Mendis, A. H. (1962) Guide to the fresh water fauna of Ceylon. *Bulletin of Fisheries Research Station, Sri Lanka* 12, 11-29.
- Fernando, C. H. (1980) *The fresh water zooplankton of Sri Lanka with a discussion of tropical fresh water zooplankton composition*. Sawers, London.
- Selvarajah, N. and Costa, H. H. (1979) Distribution of Anostraca and Conchostraca (crustacea) in the Jaffna peninsula. *Bulletin of Fisheries Research Station, Sri Lanka* 29, 79-87.
- Tribbey, B.A. (1965) *A field and laboratory study of ecological succession in temporary ponds*. Ph.D. thesis, University of Texas, U.S.A.

Received for publication August 1989