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THE CHLOROPHYLL-A CONTENT, SPECIES COMPOSITION AND POPULATION STRUCTURE OF PHYTOPLANKTON IN RANDENIGALA RESRVOIR IN SRI LANKA

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Abstract

Preliminary investigations of phytoplankton composition their population densities, chlorophyll - a, content and seasonal fluctuation of the phytoplakton were carried out in Randenigala reservoir.

Vertical and horizontal sampling was performed at different locations, in three major stations and in eight sub stations at monthly intervals from May to December 1992.

The phytoplankton groups in the reservoir belong to Chlorophyceae, Cyanophyceae and Bacillariophyceae.

The most abundant taxonamic group in the reservoir was Chlorophyceae and the ***Straurastrum limneticum*** was the most prominent species.

When the vertical distribution was concerned, the highest phytoplankton density was observed in the surface epilimnetic waters upto about 10m depth and it declined with increasing depth.

Fluctuation of seasonal phytoplankton densities and production of phytoplankton pulses of ***Cosmarium*** species and ***straurastrum*** species were observed during May to June and September to October 1992.

The highest chlorophyll - a content was recorded in May and it remained at a low level bellow 0.1 µg/l through out the investiga tion period. During some occasions there was no clear-cut inverse relationship between chlorophyll a content and transparancy values of the reservoir.

The species diversity, high transparancy values and low nutrient conditions of Randenigala reservoir indicates that its trophic nature is perhaps far from eutrophic status.

Key words Phytoplankton, Chlorophyll-a content, Lake trophy, Population strcuture.

1. Introduction

Sri Lanka is rich in its inland water resources and reservoirs. The multitude of Sri Lankan reservoir system consist of ancient reservoirs which have been rehabilitated as new reservoirs.

Several studies on Limnology, of Sri Lankan ancient reservoirs have been repoted (Schiemer 1983, Amarasinghe et al 1983, Daniel et al 1988, Silva and Davies 1986). Intensed investigations have been carriedout on Limnological aspects of newly built upland hydropower reservoirs (Piyasiri 1990, 1991 a 1991 b and 1992). De Silva (1992) has studied some aspects of limnology and fisheries of newly constructed up conuntry reservoirs.

Randenigala (7^0 8^1 - 7^0 14^1 N and 80^0 - 48^1 - 80^0 49^1 E) reservoir was constructed by damming of river Mahaweli under the Accelerated Mahaweli Project in 1982. The two major purposes of the reservoir are hydroelectric power generation and irrigation.

The morphometric features of the reservoir could be summarized as 23.5km^2 surface area (A), 860 million cubic metres (mcm) volume V) at full supply level, 74km shore line, 36.6m mean depth (Z=V/A), 1.6km maximum length and 1.2km maximum width.

Limnological investigations have been conducted (Piyasiri 1990, 1991 a, 1991 b, 1992) since 1987 to understand the trophic nature of the reservoir. Present paper deals with preliminary investigation of composition of phytoplankton, its population density, related chlorophyll-a values and seasonal fluctuation of the phytoplankton in the reservoir. This work was carried out from May to December 1992.

Running title: Phytoplamkton in Randenigala Resevoir

The study area

Randenigala reservoir is located in the wet zone of Sri Lanka (Fig. 1.) The river Mahaweli is the major source of water in the reservoir. In addition the reservoir is fed by five tributaries namely Mee Oya, Unagolla Kanda

Oya, Kehel ella and Medagama Oya. Catchment area of the reservoir is fully covered by the forest preventing soil erosion at the land water ectone.

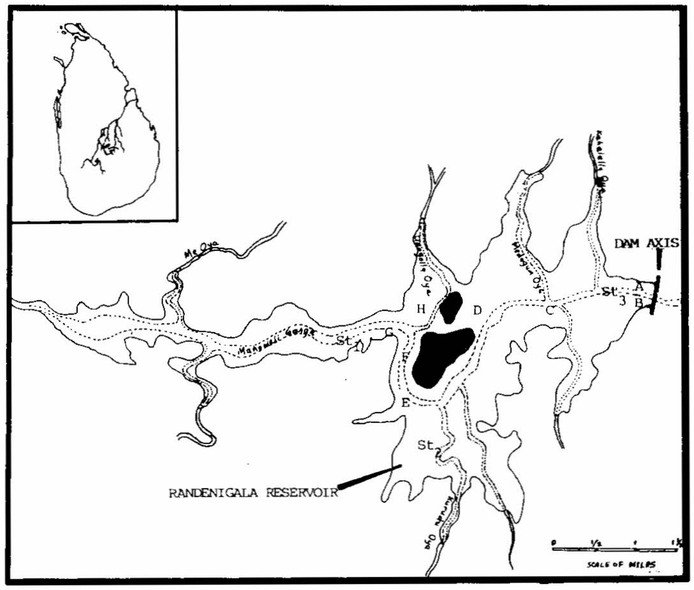


Fig 1. The main identification characteristics of the Randenigala reservoir and the locations of the sampling. St1 - St2 - St3 are the three major sampling stations and A - H are the sub stations.

2. Material and methods

Sampling was performed at different locations, in three major stations (St1, St2, St3) and in eight sub stations (A-H) as illustrated in Fig. 1.

Plankton samples were collected using a closing type plankton net (mesh size of the net was 50 μ and the diameter was 30.5cm) by filtering each water column at 10m intervals from bottom to the top by using integrated depth meter attached to the boat. Investigation for horizontial distribution pattern of plankton was done by filtering water for period of one minute over the surface horizontially thorugh the net as the boat was moving over the water. Same procedure was used to collect water samples to obtain physical and chemical properties of water by using RUTTNER sampler.

Water transparancy was measured at each sampling stations by means of a secchi disc (25cm diameter). These values were recorded within the time period between 10am - 2pm. Water temperature, conductivity and pH were measured using a thermometer, conductivity meter (Jenway 3070) and a pH meter (Jenway 3070) respectively.

Ammonia, Nitrate, Nitrite and Orthophosphate were measured using lovibond test kits which enabled immediate analysis of the samples in the field.

For chlorophyll - a analysis, water samples were collected with a RUTTNER sampler at surface and 10m depths. 100ml of water sample was filtered through glass fibre filters (Whatman G. F. C.) using a hand filter unit. Then the filter paper containing the residue was transferred into glass tubes containing acetone. Tubes were covered by Aluminium foils to avoid light penetration and stored in ice bucket and transported to the laboratory for analysis of chlorophyll-a concentration using a standard spectrophotometric method (Golterman 1970)

Plankton samples collected were fixed in 5% formalin (Lincolin and Sheals 1971) and further analysis was done in the laboratory under microscope using a Sedwick-Rafter cell. Plankton samples were enumerated by pipeting out sub samples from each sample bottle through appropriate dilution series depending on the density of phytoplankton.

Results were expressed as,

No of colonies/m^3 for Microcystis etc (The Microcystis colonies consisted approximetly 950-1100 cells, mean 1025 cells)

No of cells/m^3 for filamentous algae etc (The filamentous algae were counted as a unit and one unit consisted of 7-13 individual cells, and it was taken as one unit for enumeration).

3. Results

Composition and abundance

The phyoplankton in the reservoir consists mainly of green and blue green algae. The reservoir consists algae belonging to Chlorophyceae, Cyanophyceae, and Bacillariophyceae. (Table 1)

Table 1. Phytoplankton species collected from Randenigala reservoir

Chlorophyceae

Pediastrum reticulatum	***Straurastrum brasilience***
Pediastrum gracillium	***S. limneticum***
P. duplex	***S. tophopekaligense***
P. simplex	***S. angulum***
Zygneme sp.	***S. penticerim***
Cosmarium contract	***S. leptocladum***
C. deticulatum	***S. brevispinum***
Aphanocapsa delicertissima	***Gloeocasa arenaria***
Polcystis aeraginosa	

Cyanophyceae	*Bacillariphyceae*
Merismopeda elegans	*Melosira granulate*
Chroococcus dispersus	*Melosira sp.*
Anabaena sp.	
Lyngbia sp.	
Microcystis incerta	
Microcystis aeruginosa	

The Most abundant taxonamic phytoplankton group in the reservoir was Cyanophyceae and the ***Straurastrum*** species representing large numbers. ***Straurastrum limneticum*** was the prominent species and ***Chroococcus dispersus*** was found in lowest numbers through out the investigation.

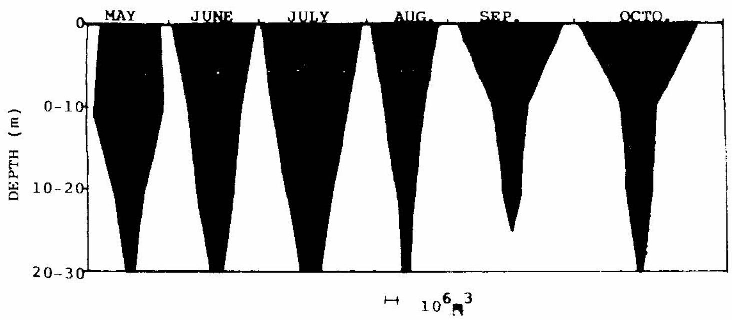


Fig 2a Vertical distrinbution pattern of **Straurastrum** sp.

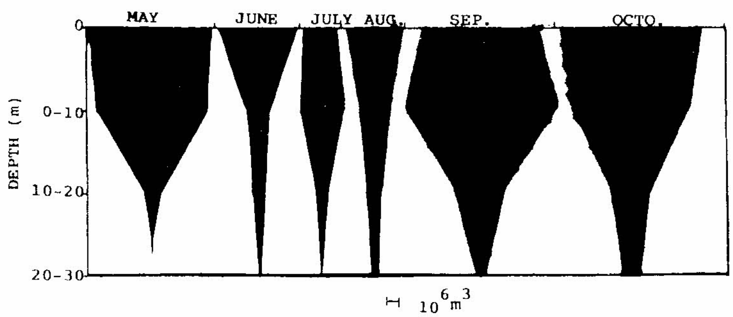


Fig 2b. Vertical distribuion pattern of **Cosmarium** sp

When vertical distribution patterns of phytoplankton were concerned, as illustrate in Figs. 2 a and 2 b, the highest phytoplankton density was observed in the surface epilimnetic waters upto about 10 m depth. The number of the phytoplanktonic algae declined with increasing depth.

Seasonal fluctuation

Fig. 3a, 3b, 3c, 3d, and 3e illustate the seasonal fluctuation of different pyhtoplankton species in the reservoir.

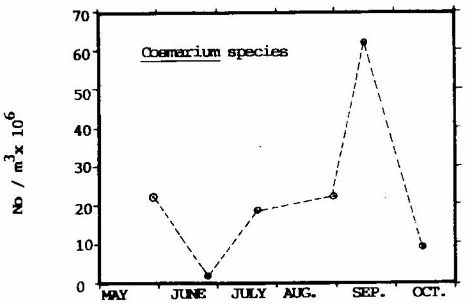


Fig 3a Seasonal fluctuations of Cosmarium species in Randenigala reservoir.

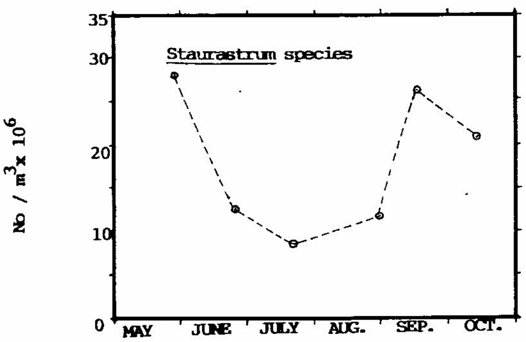


Fig 3b. Seasonal fulctuation of Staurastrum species in Randenigala reservoir.

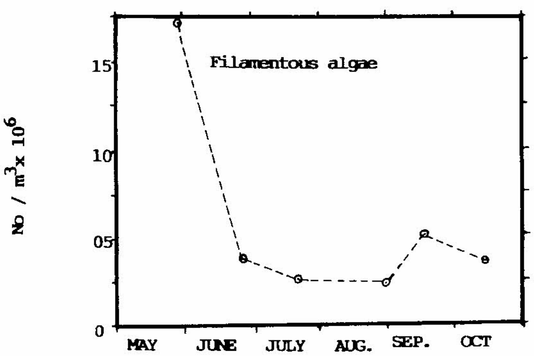


Fig 3c. Seasonal fluctuation of filamentous algae in Randenigala resevoir.

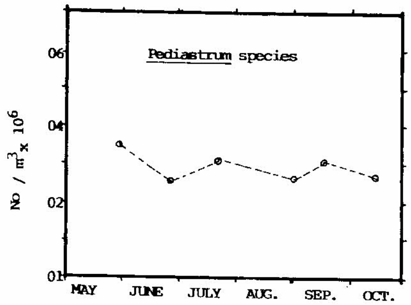


Fig 3d. Seasonal fulctuation of Pediastrum species in Randenigala reservoir.

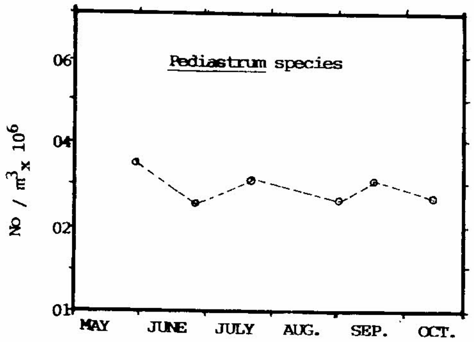


Fig 3e. Seasonal fulctuation of Microcystis species in Randenigala reservoir.

There was striking increse in ***Cosmarium*** population from Aug. to Oct. 1992. Reaching a density of $62x10^6$- number of cells/m^3

The abundance of ***Straurastrum*** species also was high but density remained below $30x10^6$ number of cells/m^3. The ***Pediastrum*** species mostly remained at low densities, bellow $27x10^5$ number of cells/m^3.

The abundance of filamentous algae was high and density remained below $16x10^7$ number of cells/m^3. The ***Microcystis*** algae also dominated the phytoplankton community and density remained below $20x10^8$ number of cells/m^3.

The seasonal fluctuation in chlorophyll-a content as shown in Fig. 4 also reflects relationship to the population densities of different algal types. The highest chlorophyll-a content was recorded in May during which ***Straurastrum*** and ***Cosmarium*** algae population were high in the epilimnetic region from surface to 10m depth of the reservoir.

During September and October months also there was a considerable increase in chlorophyll-a content. It may be due to the high numbers of ***Cosmarium*** and ***Straurastrum*** population in the reservoir during this period.

When compared to other Sri Lankan reservoires (Costa 1994), the chlorophyll-a concentration in Randenigala reservoir was low (<o.1 mg/m^3) throughout the investigation period perhaps indicating low nutrient levels in the reservoir (Fig. 4)

The Secchi disk transparancies (Table 11) indicate that the reservoir may have not yet reached eutrophic condition as the transparancy values were generally high compared to the other Mahaweli reservoirs (Piyasiri 1991 a, 1991 b and 1992).

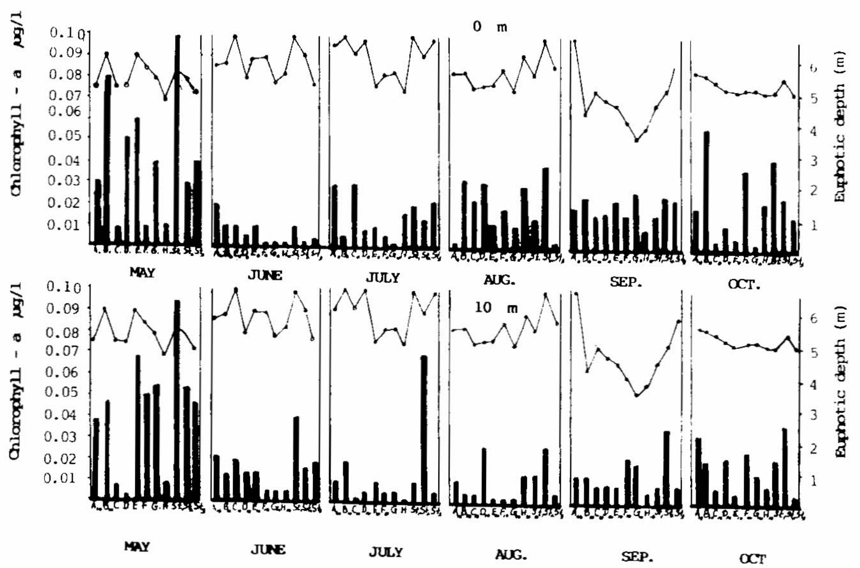


Fig 4. The chlorophyll - a content at the surface and the ten meter depth of Randenigala reservoir at major and sub stations (A-H). The black bars indicates the chlorophyll - a content. The line above the black bars indicates the euphotic depth.

Table 11: Frequency Percentage of secchi depth and euphotic limits of kotmale, victoria and Randeniga reservoirs

Reservoir	Frequency percentage of Secchi depth (m)	Euphotic limit (m)
Kotmale	2.10 - 2.3- m	5.10 m
Victoria	1.21 - 1.61 m	5.00 m
Randenigala	2.51 - 3.01 m	6. 25 m

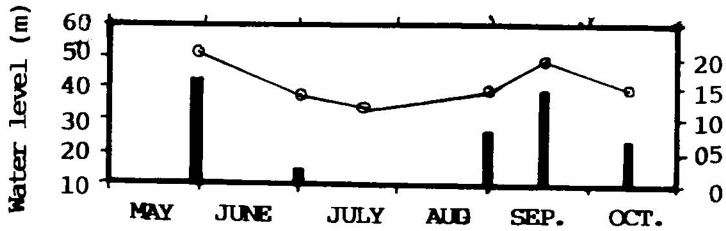
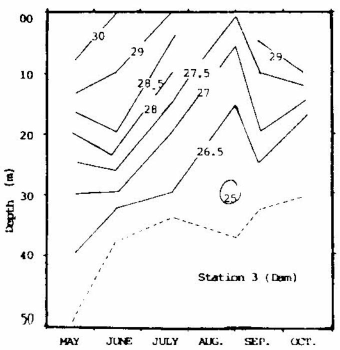


Fig 5. Seasonal water level and rainfall fluctuation in Randenigala reservoir.

Randenigala reservoir was often subjected to water level fluctuations (Figs 5) due to hydro power generations.

Temperature of Randenigala reservoir was always above 4^{0}C from the surface to the bottom indicating an Oligomictic nature according to Hutchinson and Loffler (1956). Fig. 6 illustrate the time depth diagrams of isotherm in St3 (Closer to the dam) of Randenigala reservoir. Epilimnetic waters of the reservoir changed between 28^{0} C - 30^{0} C. Below 20 m where hypolimnion was developed, temperatures were btween 26.5^{0} C and 25.5^{0} C. Thermal fluctuation at major stations were recorded between 30^{0} C to 25^{0} C.

Fig 6. Isotherm in St 3 (closer to the dam) of Randenigala reservoir. The broken line indicates water level fluctuation in the reservoir during the study period.



Oxygen isopleths of Randenigala reservoir indicate a close relation to the thermal stratification. There is a marked decline in dissolved oxygen indicating a :Clinograde Oxygen profile:. The upper epilimenitic water layers have shown high oxygen concentrations of 4.8 mg/l at the surface and low values as 0.2 mg/l at the deep layers below 35 m depth (Fig. 7).

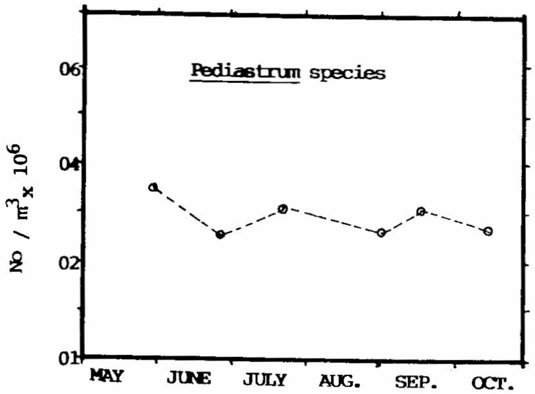


Fig 7. Oxygen isopleths in St 3 (closer to the dam) of Randenigala reservoir. The broken line indicates water level fluctuation in the reservoir during the study period.

4. Discussion

The dominant algal groups in the low land lakes of Sri Lanka are either blue green and green algae (Fritsh, 1907, Crow, 1923) or blue green and diatoms (Apstein, 1907). According to Fritish (1907), the most abundant taxonamic groups were the blue green and green algae in reservoirs of lower latitudes in Sri Lanka. Similar situation has been observed in Randenigala reservoir during present investigation. Results obtained in Randenigala indicate typically tropical condition having low numbers of Cyanophyceae species than the Chlorophyceae.

In Randenigala reservoir the highest phytoplakton density has been observed in the epilimnetic region where dissolved oxygen concentration is high. Similar situations have been observed at Victoria and Kotmale (Piyasiri 1991 a, 1991 b and 1992) and in Parakrama Samudra reservoir (Fernando 1984). It is well known that phytoplakton density is high in euphotic zone of the lakes and reservoirs (Welch 1952).

A clear relationship between seasonal fluctuation of phytoplankton and rain fall has been observed in Randenigala reservoir (Fig. 7). Soon after rain the highest density of phytoplankton were recorded as peaks (Fig. 3a. 3b, 3d and 3e). This is due to high growth of phytoplankton community which is accelerated by allochthonous input into the reservoir from the catchmant area during rainy season.

The phytoplankton community of Randenigala is dominated by Chlorophyceae.. Bloom forming Cyanophyceae algae such as ***Microcystis*** species are also existing in high numbers. However its existence has not yet created a problem towards lake trophy.

There was no clearcut inverse relationship between chlorophyll -a content and the transparancy values of the reservoir. The phytoplankton community also has not yet caused marked effect on water trasparancy perhaps due to oligotrophy of the reservoir, compared to Parakrama Samudura reservoir (Bauer 1983). Randenigala Reservoir may therefore be far from eutrophic situation during the investigation period.

According to the species composition, chlorophyll -a content, transparency values and other pyhsical and chemical factors other than dissolved oxygen concentration, Randenigala reservoir has not yet reached the eutrophic nature. However the threat of deoxygenation in hypolimnetic region is an indication of its sensitivity towards eutrophy.

5. Acknowledgement

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