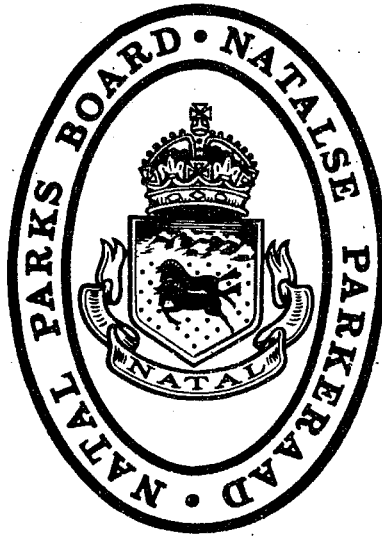


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Author GRINDLEY J R

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ZOOPLANKTON OF ST. LUCIA

J.R. Grindley

University of Cape Town

INTRODUCTION

Studies of the zooplankton of St. Lucia have been carried out as part of a wider programme of research on the plankton of South African estuaries. This work has been funded largely by the South African National Committee for Oceanographic Research. Samples of plankton have been studied from 75 estuaries around the coast of southern Africa from Angola to Mozambique. Some of these estuaries have been sampled only once while others have been studied more intensively. St. Lucia is one of the estuary systems that has been selected for more intensive study. Work has been carried out over a long period to get a picture of seasonal and long-term changes and to get results of a quantitative nature. The aim of this research has been to make a contribution to the understanding of the overall ecology of the St. Lucia system and in particular the ecological responses of the system to major environmental fluctuations.

METHODS

Plankton has been sampled at a series of stations throughout the St. Lucia estuary system. All sampling was done at night (except for some early samples collected by others). A variety of different kinds of nets and samples have been employed. During the most intensive investigations 5 samples were taken at each station as follows: A quantitative zooplankton sample with a 36cm diameter zooplankton net, a quantitative zooplankton sample with a Clarke-Bumpus plankton sampler, a quantitative phytoplankton sample with a water bottle sample and a water sample for chemical analysis if required. The species composition and abundance of the plankton in the samples was analysed on the basis of sub-samples in the laboratory. The period covered by samples studied is now nearly 30 years. The earliest samples available were collected in 1948. Samples are available from 1948, 1949, 1951, 1954, 1955, 1956, 1957, 1964, 1965, 1967, 1969, 1970, 1972, 1973 and 1974. A series of samples is thus available which

covers a number of major and significant environmental changes including the opening and closing of the mouth and great salinity fluctuations.

To supplement the information provided by field studies and to explain as far as possible these findings various laboratory studies have also been carried out. These have included studies of vertical migration behaviour, salinity and temperature tolerance, feeding and reproduction.

I am grateful to a number of people for assistance with plankton sampling. Their willingness to work at all hours of the night under difficult conditions went well beyond the normal calls of duty. Samples were collected for me in the 1950's by Mr. R.S. Crass. Later more intensive sampling has been carried out with the help of Mr. R. Murray, Mr.G.Forrest, Mr. J. Breytenbach, Mr. N. van Niekerk and Mr. F. Joubert of the Natal Parks Board and Mr. H.F.B. Champion, Mr.E.A. Fearnhead, Dr.J.H. Wallace and Mr. R.P. van der Elst of the Oceanographic Research Institute.

Accounts of the environmental changes which occurred and of the changes made by man during the sampling period have been presented elsewhere.

RESULTS

Communities

Several different zooplankton communities appear in the St. Lucia System. There is a stenohaline marine component including for example species of Corycaeus which may penetrate with the tides into the mouth area. A euryhaline marine component including species of Paracalanus may penetrate somewhat further. Most of the system however, is dominated by a typical estuarine plankton. A fourth community of fresh water species such as species of Diaptomus and Cyclops (sensu lato) occurs in the mouths of the rivers and may penetrate the lakes during periods of low salinity.

The true estuarine plankton is dominated by the copepods Pseudodiaptomus charteri Grindley and Acartiella natalensis Connel and Grindley. Other copepods include Oithona and Halicyclops species. The most abundant Mysids are Mesopodopsis africana and Gastrosaccus brevifissura. In addition there are species of Isopoda, Amphipoda, Ostracoda, Cumacea, Tanaidacea and the larvae of many groups of invertebrata. Small numbers of fish eggs and fish larvae appear in some samples.

Salinity tolerance

Tolerance to a wide range of salinities is important for the plankton of estuaries and particularly for the plankton of the St. Lucia system. The wide range of salinities from which plankton samples have been taken indicates that this estuarine plankton community is indeed well adapted to a very variable environment. To get a clearer idea of the range of tolerance survival experiments were carried out in the laboratory with a few dominant species. Pseudodiaptomus charteri was found to survive in salinities from less than 5‰ to more than 60‰. Survival was best in salinities near 35‰ although they are not found in the sea. The fact that they tend to dominate hypo- and hyper-saline parts of estuaries indicates that factors other than salinity preference influence their distribution. Probably they cannot compete with the wide range of species occurring in the sea water but in higher and lower salinities where there is little competition they flourish. Experiments with the mysid Gastrosaccus brevifissura were carried out to determine the interaction of salinity and temperature on survival in this species. The results will be published separately (Wooldridge and Grindley)

Valuable observations of salinity tolerance were possible during the period of exceptionally high salinity in 1970. At that time there was a gradient of salinity from about 40^o/oo south of Charters Creek to over 100^o/oo in the extreme north. On the night of the 15th March 1970 a series of samples was taken from Lister Point in False Bay where the salinity was 78,5^o/oo to south of Charters Creek where the salinity was 40^o/oo. By examining the reproductive condition of the various species in the samples obtained it was possible to determine not only the range of salinities inhabited by various species but also the range of salinity in which breeding continued to take place.

Most of the estuarine plankton species were found to tolerate salinities of above 40^o/oo and many showed evidence of breeding activity. The species that were found to survive in salinities above 60^o/oo included Pseudodiaptomus charteri (few above 70^o/oo, breeding to 60^o/oo), Acartia natalensis (few above 70^o/oo, abundant to above 60^o/oo), Halicyclops sp. (some above 70^o/oo, breeding to above 60^o/oo), Mesopodopsis africana (few above 60^o/oo, breeding above 50^o/oo), Grandidierella bonieri (rare above 60^o/oo, breeding to 60^o/oo). Gastropod larvae, fish eggs and fish larvae (indet.) survived in salinities above 60^o/oo. A few species including another species of Halicyclops, two species of Harpacticoids, juveniles of the fish Hyporhamphus improvisus and larvae of chironomid insects survived in salinities between 70^o/oo and 80^o/oo. The Halicyclops and one of the Harpacticoids were ovigerous at salinities above 70^o/oo. Details of these observations will be published separately.

Red water

During July and August 1969, red water appeared in the northern lakes of the St. Lucia estuary system. It was caused by proliferation of Noctiluca scintillans. Some dead fish washed up at that time and may have been killed by the red water. Salinities ranged from 42-48^o/oo during

this period. It is suggested that a period of hypersaline conditions earlier in the year which caused widespread mortality of fauna was a significant factor in the development of the red water. In addition as a result of the widespread mortality of their normal predators a plague of chironomid midges appeared and later myriads of spiders appeared catching them. In the Lister Point area the spiders webs became so dense that plants and branches of trees were completely smothered and killed. Details of these observations have been published (Grindley and Heydorn, 1970).

Plankton fluctuations

During the periods of excessively high salinity in the period 1969-1971 most of the plankton disappeared in some of the northern parts of the St. Lucia system and only the few species referred to in the section on salinity tolerance survived. Apart from this, approximately the same community of estuarine plankton species occurred throughout the St. Lucia system except near the mouth. Considering the wide range of salinity conditions during the 29 year period and the occasional closing of the mouth it is remarkable that the plankton composition remained so stable. Various seasonal and longer term changes in total biomass and relative abundance of different species have been observed but the pattern of variation is complex. Details of the changes observed and the associated environmental conditions will be published separately. Some preliminary observations of abundance in terms of biomass are perhaps of interest. For the 1967 series the mean biomass was:

Ash-free dry biomass 19mg/m³

Live biomass 108mg/m³

For the 1969 series in the Charters Creek area the mean biomass was:

Ash-free dry biomass 37mg/m³

Live biomass 201mg/m³

This would indicate a total live biomass of zooplankton for the whole St. Lucia lake system of the order of 40 000kg. This would appear to be about an order of magnitude less than the biomass of phytoplankton calculated from the cell volume figures presented by Mrs. Johnson (assuming a phytoplankton cell density of 1,0 or neutral buoyancy).

Trophic relationships

The trophic relationships of the zooplankton of the St. Lucia system are not yet clear. Some species such as Pseudodiaptomus charteri appear to depend primarily on nannoplanktonic flagellates but diatoms are also consumed and bacteria may be involved. The mysids are apparently involved in the detritus cycle. Nutrient and other environmental factors influencing the phytoplankton and nannoplankton must have secondary effects on the zooplankton but these relationships are not yet clear. The zooplankton must serve as a food source for a variety of invertebrates and fish but few details have yet been determined. Stomach contents of juvenile mullet (Mugil spp) have been found to include remains of Pseudodiaptomus charteri, Acartiella natalensis and Mesopodopsis africana and gut contents of Penaeus indicus have included remains of Pseudodiaptomus charteri. Because the vertical migration behaviour of these estuarine plankton species takes them on to the bottom they may be taken by bottom feeders as well as by filter feeders.

CONCLUSION

- (1) The zooplankton of the St. Lucia system is typical estuarine plankton as found in other Natal estuaries. The dominant species throughout the system, except in the mouth, are true estuarine species that are not found in the sea or in rivers.

- (2) The species composition of the zooplankton is similar throughout the system, except in the mouth.
- (3) The species composition of the zooplankton has not changed significantly during the past 29 years despite the great environmental fluctuations that have taken place.
- (4) It is suggested that the ecological fluctuation in the St. Lucia system which have been observed in higher plants and animals must be looked for as direct salinity effects on those organisms rather than indirect effects in the lower trophic levels.

REFERENCE

GRINDLEY, J.R. and HEYDORN, A.E.F., 1970. Red water and associated phenomena in St. Lucia. S. Afr. J. Sci., 66(7): 210-213.