relatively small standard deviation values.

The algal samples of the Sengwa River mouth contained large amounts of organic detritus making quantitative assessment of the standing crop difficult. This material was the result of the abundant floating aquatic macrophytes.

Table 16: Seasonal phytoplankton standing crop of the Sengwa River mouth (cells x 10^6/l).

Station	Sampling Period					Mean, S.E.
	Aug.	Oct.	Dec.	Feb.	Apr.	
1	-	-	0,55	-	-	-
2	-	-	0,49	-	-	-
3	0,50	-	1,24	0,23	-	0,66 ± 0,52
4	0,37	0,49	0,97	0,26	0,78	0,57 ± 0,29
5	0,25	0,59	0,96	0,28	1,39	0,69 ± 0,48
6	0,56	0,53	0,56	0,36	1,10	0,62 ± 0,28
7	0,53	0,75	0,46	0,55		0,57 ± 0,12

5.2.2.1.4 Mujery Offshore Area

The phytoplankton standing crop for the Mujery offshore transects is illustrated in Table 17. The total cell counts for the two transects for five sampling periods showed good correlation ($r = 0,7494$). The standing crops of the two transects were most similar in August ($r = 0,6694$) and October ($r = 0,9652$), and showed a weak correlation in April ($r = 0,4256$). There was relatively small standard deviation values.

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Table 16: Seasonal phytoplankton standing crop of the Sengwa River mouth. (cells x 10^6/l).

Station	Sampling Period					Mean, S.E.
	Aug.	Oct.	Dec.	Feb.	Apr.	
1	-	-	0,55	-	-	-
2	-	-	0,49	-	-	-
3	0,50	-	1,24	0,23	-	0,66 ± 0,52
4	0,37	0,49	0,97	0,26	0,78	0,57 ± 0,29
5	0,25	0,59	0,96	0,28	1,39	0,69 ± 0,48
6	0,56	0,53	0,56	0,36	1,10	0,62 ± 0,28
7	0,53	0,75	0,46	0,55		0,57 ± 0,12

5.2.2.1.4 Mujery Offshore Area

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Probably the most important factors contributing to the reduced algal densities in December and February wre the high water temperatures, high light penetration into the water, and the low nutrient levels present.

Table 17: Seasonal phytoplankton standing crop for the Mujery transects (cells x 10^6/l).

	Station	Sampling Period					Mean, S.E.
		Aug.	Oct.	Dec.	Feb.	Apr.	
Transect 1	1	0,37	1,54	0,35	0,45	4,76	1,49 ± 1,89
	2	0,92	0,84	0,78	0,34	0,88	0,75 ± 2,36
	3	0,40	4,38	0,37	0,29	0,78	1,24 ± 1,76
	4	1,00	4,78	0,58	1,79	0,46	1,72 ± 1,79
Transect 2	5	0,34	0,62	1,19	0,43	0,85	0,69 ± 0,34
	6	0,34	0,41	0,75	0,36	0,95	0,56 ± 0,27
	7	0,31	2,41	0,31	0,26	0,59	0,78 ± 0,92
	8	0,94	3,64	0,45	0,26	0,61	1,18 ± 1,40

Generally the phytoplankton densities remained below 1,0 x 10^6 cells/l, except on a few occasions when algal maxima were recorded at the shoreward stations or the open water stations. In August both transects showed low algal densities. The phytoplankton densities in October showed a decrease from stations 1 and 5 to stations 2 and 6 respectively, and then an increase to stations 4 and 8. The plankton maxima at stations 3 and 4, and stations 7 and 8 were the result of increases in <u>Phormidium</u> sp. This organism was extremely difficult to count accurately, because of the indistinct cell walls between cells. The count values for these stations are therefore an underestimation of the actual density of this organism.

The December samples were generally quite low, with the highest values being recorded from the shore stations. The slightly high algal density at station 5 was due to *Phormidium* sp.; this can be attributed to nutrient release when the lake level rose and flooded the fringing vegetation (McLachlan 1971). The size of the algal population showed little change from December to February. A slight decrease in standing crop from the shore to the open water stations for February was noted, with the exception of the increase in algal density at station 4, which was caused by *Anabaena* sp. A similar algal standing crop decrease from shore to open water stations was recorded in April. This pattern was not as clear in the transect 1 as in transect 2. The only phytoplankton maximum recorded during this period was at station 1 when the pennate diatoms dominated the standing crop.

The algal population density of transect 1 exhibited larger seasonal fluctuations than transect 2, and was less stable. The standard deviation for station 8 was lower than those for transect 1, but greater than the other transect 2 stations. The environ=mental stresses on the algal populations of the uncleared areas was greater than on the cleared area. This can be expected as the habitat was more diverse, due to the presence of the dead trees.

5.2.2.2 Vertical Variation

The seasonal depth distribution of the phytoplankton standing crop for the Mwenda Basin is presented in Table 18. The highest phytoplankton densities were recorded during August when the water was thermally unstratified, and in April when the thermocline was at its strongest.

Table 18: Vertical distribution of phytoplankton standing crop for the Mwenda Basin (cells x 10^6/l). High winds in October prevented water samples being taken at depth.

Sample Depth (m)	Sampling Period					Mean, S.E.
	Aug.	Oct.	Dec.	Feb.	Apr.	
0	2,62		0,85	0,91	1,96	1,58 ± 0,86
5	1,88		0,43	1,00	1,42	1,18 ± 0,62
10	2,46		1,05	0,37	1,42	1,32 ± 0,87
15	2,86		0,67	0,24	1,45	1,31 ± 1,15
20	-		0,44	0,18	2,34	0,99 ± 1,18
25	-		0,35	0,24	2,39	0,99 ± 1,21
30	-		0,55	0,17	1,25	0,66 ± 0,55
35	-		-	-	0,58	-

These algal maxima, which probably remain high throughout the cool period of the year, indicate that temperatures of ± 28,0° C adversely affect the algal population. The algal densities > 1,4 x 10^6 cells/l were generally associated with photosynthetic pigment values of approximately 1,5 µg Pt/1. These algal populations were composed mainly of diatoms and green algae.

In December the phytoplankton density had decreased although the maximum photosynthetic pigment values were recorded between 7 m and 22 m depth. This was due to the algal population being completely dominated by Scenedesmus bijuga (> 35,0% of the population in all December samples).

By February the algal density had decreased still further, with maximum values being recorded in the surface waters (0 m to 5 m depth), due to a dominance of Anabaena sp. Surface water temperatures ranged between 28,0 and 29,0° C. The population was dominated in the deeper waters by the diatoms.

By April there was an increase in the algal density which coincided with the cooling of the lake waters. The algal population decreased from the surface to 5 m, and then remained constant to 15 m ($\pm$ 1,40 x 10^6 cells/1). A plankton maximum was recorded from $\pm$ 20 m to $\pm$ 25 m depth which was due to increased numbers of the diatom Melosira granulata, and Tetraedriella sp. This coincided with decreased water temperatures above the thermocline. The algal density then decreased at the thermocline and decreased still further below it. The majority of the algae below the thermocline were probably organisms that had sedimented from the epilimnion to the hypolimnion. Most of the organisms (mostly Melosira granulata) were in a state of senescence with some chloroplast deterioration observed.

5.2.3 Generic Diversity

Two general characteristics of Lake Kariba phytoplankton are the great variety of species present (Appendix 18) and the relative abundance of the Cyanophyceae. The first feature is illustrated by a qualitative account based on net samples (Thomasson 1965). This account gives an incorrect picture of the actual population composition, by excluding non-desmid phytoplankters. The present study has included all photosynthetically active cells, and classified them into five major groupings (Chlorophyta, Pyrrhophyta, Chrysophyta, Bacillariophyceae and Cyanophyta). The taxonomic identification for counting was taken to the generic level due to the algal diversity, and the ecological unimportance of many of the taxa. Note: the percentages quoted in brackets are the percentage of that taxon in the whole population of the sample.

5.2.3.1 Horizontal Variation

5.2.3.1.1 Mwenda River

The waters of the Mwenda River maintain a very poor algal standing crop. This, and the high suspended silt load of the water, made the quantification of the algal population impossible. The samples were therefore scanned and an occurrence table compiled (Table 19). The plankton could be counted on two occasions only,

Table 19: The algal occurrence data for the Mwenda River. The numbers (1, 2, 3 and 4) in each column are the sampling stations.

Algal Taxa	Sampling Date				
	Aug.	Oct.	Dec.	Feb.	Apr.
Chlorophyta					
Eudorina	2	4	2		
Ulothrix	1				
Pediastrum	2	4	2 4		
Coelastrum			2 4		
Schroederia	1 2 3 4	1 2 3 4	1 2 3 4		1 2 3 4
Kirschneriella	4				
Tetraëdron	2 3 4	4	2 3 4		1
Scenedesmus	1 2 3 4	4	2 3 4		2
Crucigina		4	4		
Mougeotia	1				
Spirogyra	1 3				
Closterium			4		
Gonatozygon	1 4		4		
Xanthidium	1				
Cosmarium					4
Euastrum			4		
Staurastrum	1 4	4	2		
Euglenophyta					
Euglena			4		2 3
Phacus			4		2 3
Pyrrhophyta					
Gymnodinium					2 4
Peridinium	1 2	4			1 2 3 4
Chrysophyta					
Tetraedriella	3		4		
Bacillariophyceae					
Centric diatoms	3 4	3 4	2 3 4		1 3
Pennate diatoms	1 2 3 4	1 2 3 4	1 2 3 4		1 2 3 4
Cyanophyta					
Merismopedia		4	4		
Microcystis	3 4		2 3 4		
Phormidium	3 4		2 4		1 2 3 4
Anabaena	1 4		2 3 4		
Number of genera present	11 7 9 11	2 2 3 11	2 12 7 18	0 0 0 0	6 8 7 6

when algal blooms developed at station 2 (Weir Pool - Bowmaker's map, 1969). The first algal bloom was recorded in August, totally dominated by Schroederia sp. (89,8 x 10^{6} cells/l), and the second in December when the population was dominated by Pediastrum clathratum and P. simplex (mostly 16-celled organisms, 66,7% of the population), together with the centric diatoms (17,9% of the population - mostly Melosira granulata), Microcystis sp. (occasional lumps) and Phormidium sp. (8,7%).

The diversity of phytoplankton generally showed an increase from station 1 to station 3, then a marked increase to station 4, where the most diverse population was recorded in December. The water in February, when the river was in flood, contained no identifiable plankters at any of the sampling stations.

The most frequently occurring taxa present in the Mwenda River were Schroederia sp. and the pennate diatoms (mostly Gomphonema parvulum) which were recorded at all the sampling stations. The next most frequent genera were Tetraëdron, Scenedesmus, centric diatoms (dominated by Melosira), and Phormidium.

5.2.3.1.2 Mwenda River Mouth

The phytoplankton population of the Mwenda River mouth is presented in Figure 28. The generic diversity index (d) (Appendix 14), photosynthetic pigments (Pt), and total algal cell counts (Tc) have been included for comparison.

The algal population cor.,osition of the Mwenda River mouth showed both seasonal and spatial variation during the period of investigation. In August the population at station 1 was co-dominated by Chlorophyta (Scenedesmus 11,7%), pennate diatoms (28,2%) and Cyanophyceae (Anabaena 28,2%). At station 2 the Cyanophyceae were absent and the Chlorophyceae dominated the population. The blue-green algae were again present at station 3, with the rest of the river mouth having a similar population composition as station 3. By October the diatoms had dis= appeared from the samples, except at stations 6 and 7. This could have been caused by increas= ing water temperatures and light penetration into the water, which either eliminated the diatoms, or caused them to be absent in the surface waters. The riverine stations were dominated by Scenedesmus (± 50,0%), with Peridinium (± 25,0%) as the sub-dominant organism. The Anabaena population increased from station 4 (10,2%) to

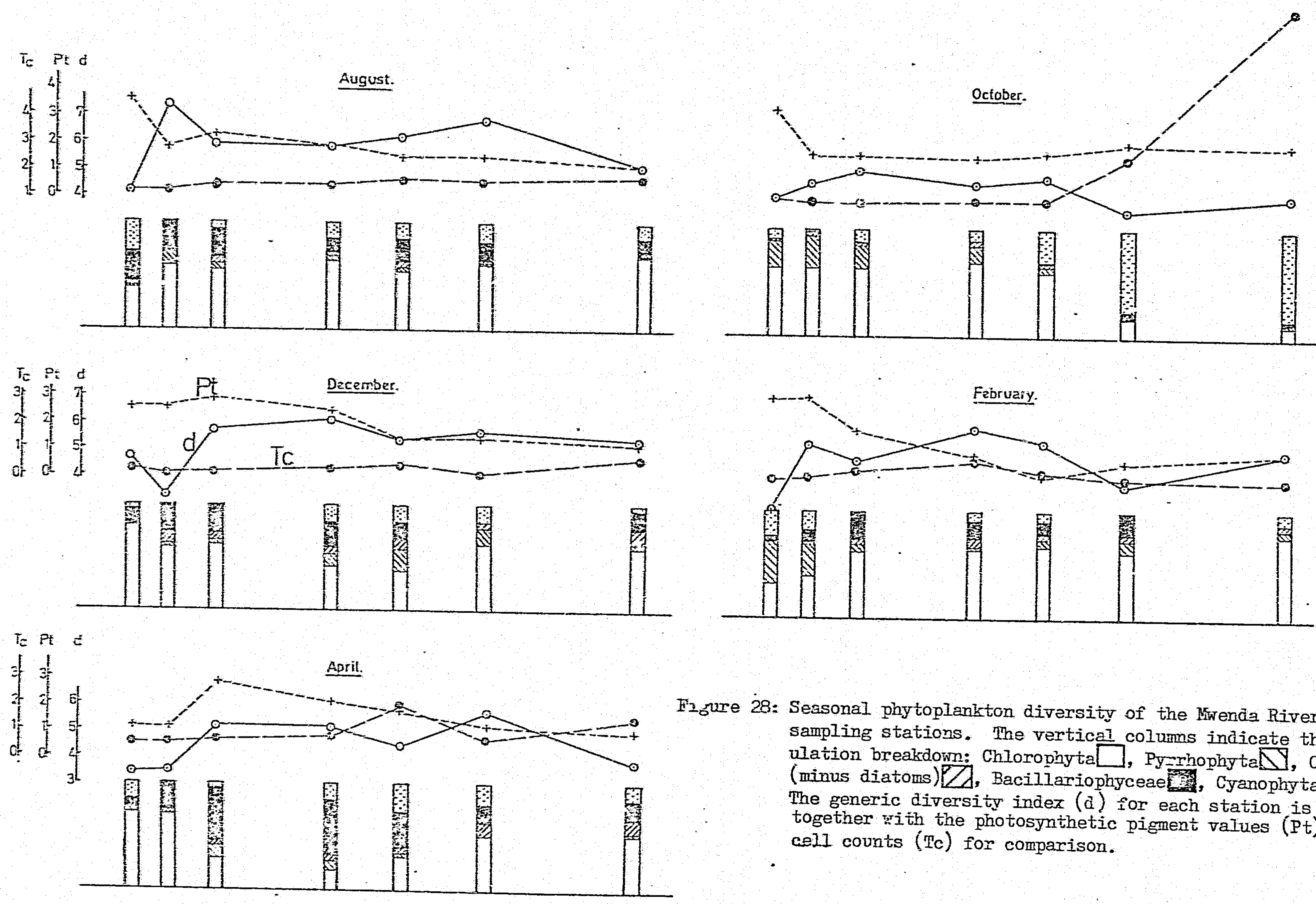


Figure 28: Seasonal phytoplankton diversity of the Mwenda River mouth routine sampling stations. The vertical columns indicate the algal population breakdown: Chlorophyta, Pyrrhophyta, Chrysophyta (minus diatoms), Bacillariophyceae, Cyanophyta. The generic diversity index (d) for each station is indicated, together with the photosynthetic pigment values (Pt) and total cell counts (Tc) for comparison.

station 5 (28,4%), to stations 6 and 7 (± 77,0%). This situation could be due to the incidence of very windy weather in October 1971, which caused considerable vertical mixing throughout the water profile, resulting in nutrients being released from the bottom sediments, brought into the photic zone, and then rapidly utilized by Anabaena. These Anabaena-dominated populations produced significantly higher total cell counts than the other stations with approximately the same photo= synthetic pigment values. The generic diversity index dropped, also due to the Anabaena domination.

By December the population had more or less re-established to that present in August. Station 1 was dominated by Scenedesmus (30,5%), with the diatoms contributing 14,4%. Samples from stations 2 and 3 showed similar population compositions, with the more open water stations being generically richer. No diatoms were recorded from station 6.

The highest Pyrrhophyte populations were recorded from stations 1 and 2 in February (Peridinium sp. 41,3% and 30,0% respectively). This can be attributed to the Mwenda River being in flood and imposing a considerable stress on this aquatic ecosystem (see 6.0 below). The rest of the Mwenda River mouth was dominated by *Scenedesmus* ($\pm$ 30,0%). In April *Schroederia* sp. dominated stations 1 and 2 (25,6% and 28,3% respectively). The diatom population increased from station 1 to station 4 (13,3% to 51,7%), and then decreased to station 7 with a corresponding increase in *Scenedesmus* sp. (5,5% to 24,4%).

Generally the generic diversity of the Mwenda River transect increased from station 1 to station 4, and then decreased to station 7 (Figure 29). The maximum seasonal flux in algal diversity occurred at stations 2, 6 and the Mwenda Basin (0 m). This indicates the zones of the highest algal population variations and generic richness.

5.2.3.1.3 Sengwa River Mouth

The composition of the phytoplankton population of this area is illustrated in Figure 30, together with the generic diversity index (d), photosynthetic pigments (Pt), and total cell counts (Tc). The horizontal extent of the "sudd" mat has also been included.

The phytoplankton population in August was dominated by the Chlorophyta (> 55,0%) at all

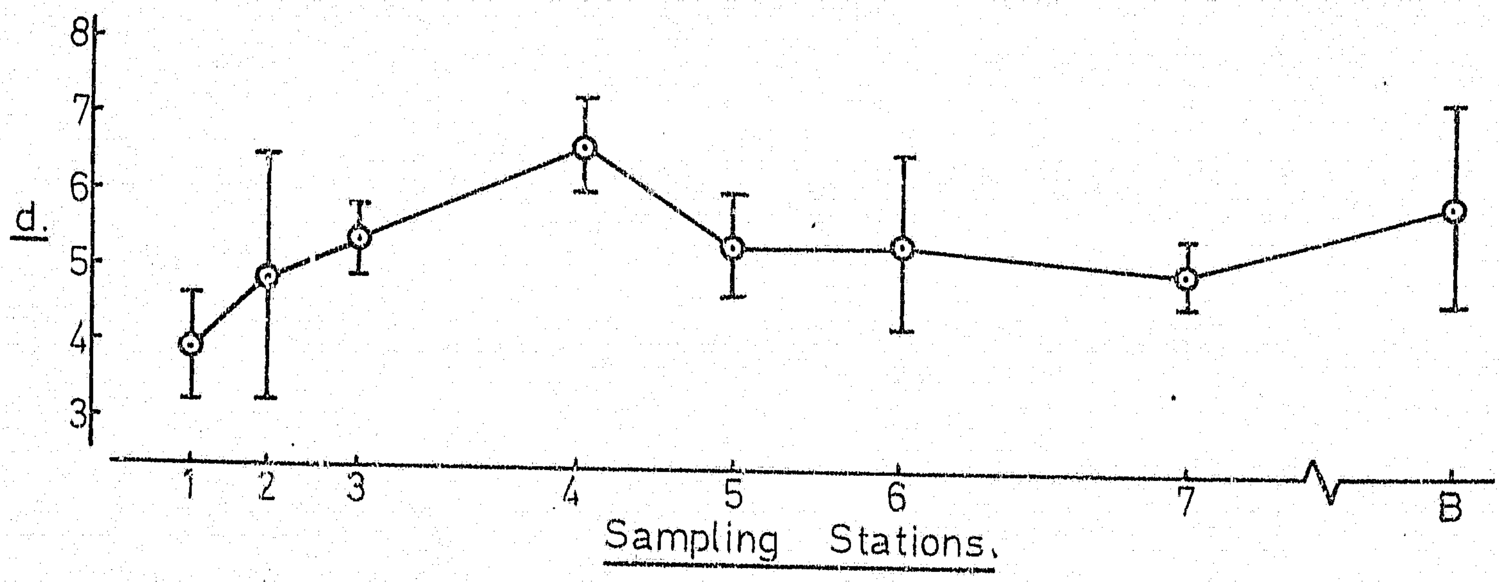
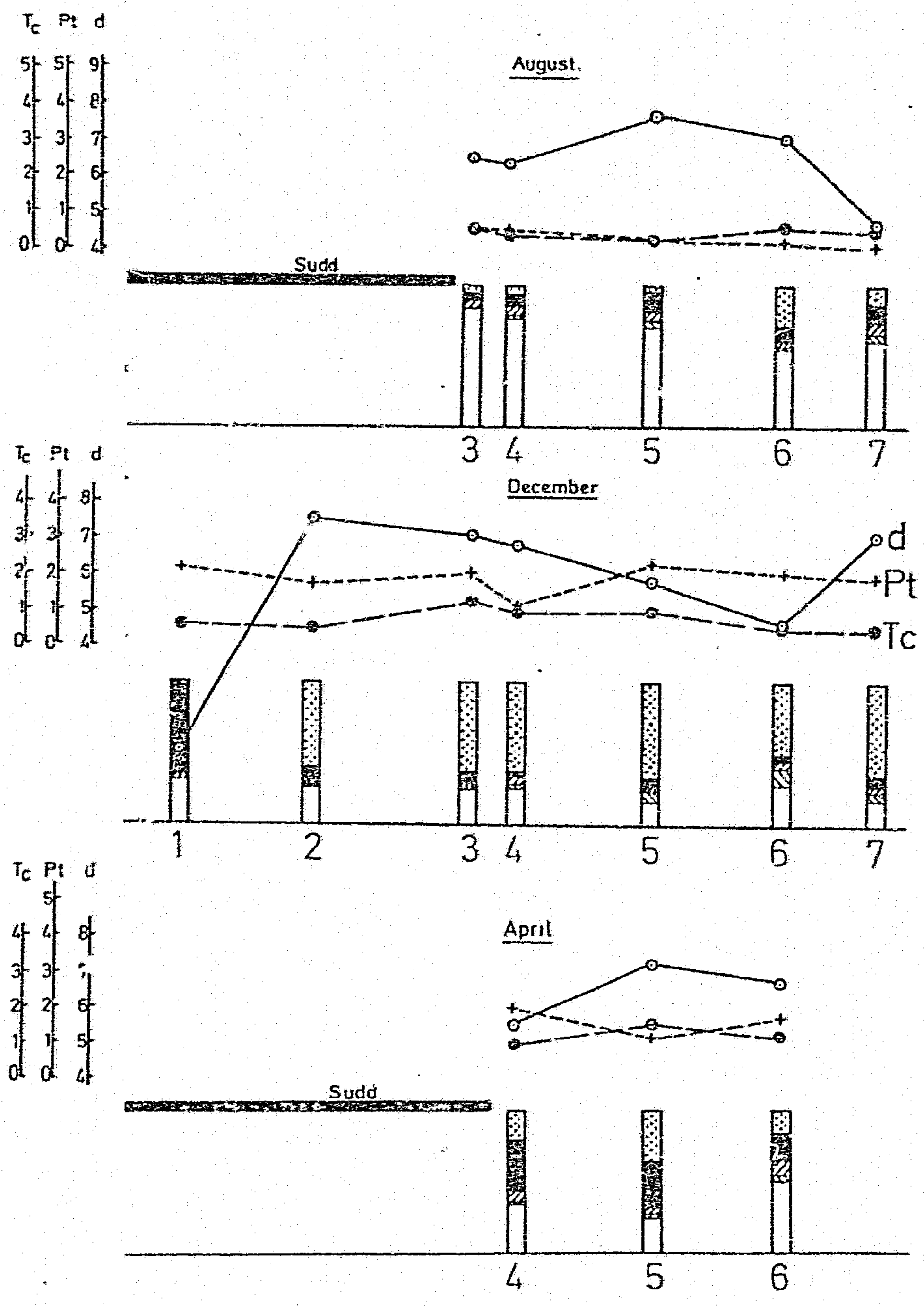


Figure 29: Mean generic diversity indices for the Mwenda River mouth, and the Mwenda Basin surface (B). Vertical lines are the standard deviations of the mean.



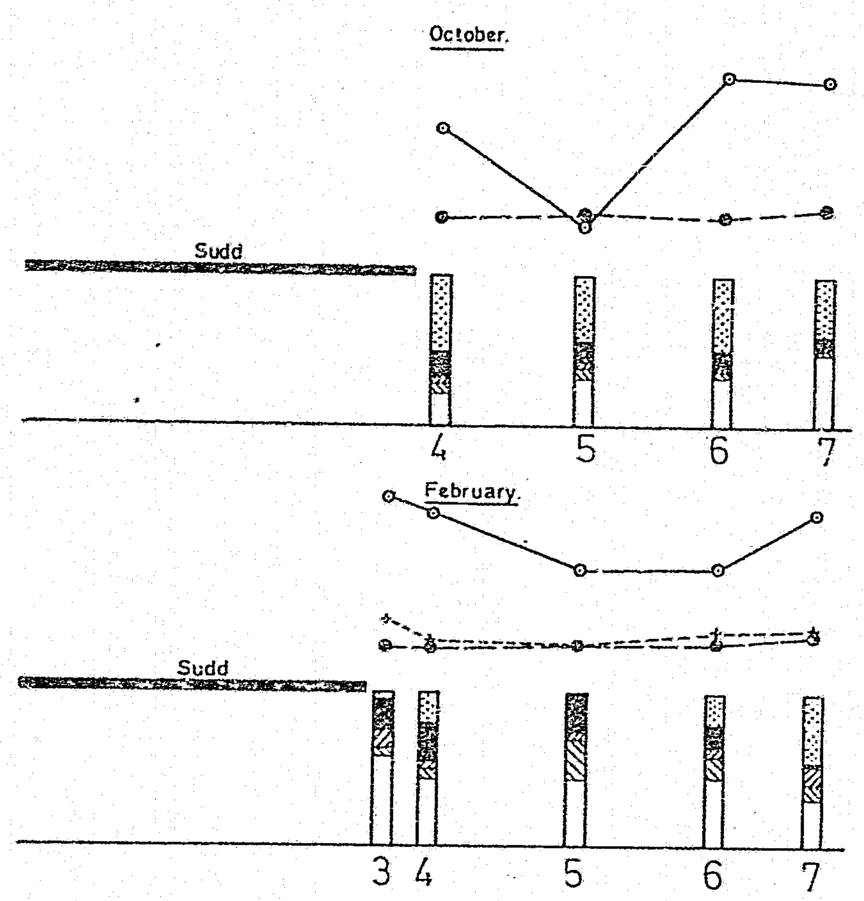


Figure 30: Seasonal phytoplankton diversity of the Sengwa River mouth. The vertical columns indicate the algal population breakdown: Chlorophyta, Pyrrophyta, Chrysophyta(minus diatoms), Bacillariophyceae, Cyanophyta. The generic diversity index (d) for each station is indicated, together with the photosynthetic pigment values(Pt) and total cell counts(Tc) for comparison. The horizontal black line indicates the extent of the "sudd" mat. Figures below the columns are the sampling stations.

stations, with Scenedesmus being the dominant organism ($>$ 35,5%). At station 6 Anabaena occurred as a sub-dominant, contributing 25,5% of the population. By October the Anabaena population had increased sufficiently to dominate the phytoplankton. At stations 4, 5 and 6 the population was dominated by Anabaena ($>$ 43,0%) with Scenedesmus as the sub-dominant (between 12,0% and 17,0%). At station 7 the population was co-dominated by the blue-green and green algae (Anabaena 40,2% and Scenedesmus 26,5%). This increase in the blue-green algae in October can be attributed to the increased surface water temperatures and light penetration into the water. The algal population in December was completely dominated by Anabaena ($>$ 50,0%), except for station 1, which comprised mainly centric diatoms (Melosira 65,6%), and Schroederia (32,2%). Tetraedriella and a few pennate diatoms were recorded from this station, hence the low generic diversity index ($\bar{d}$ = 1,12). The phyto= plankton population composition at station 1 was probably the result of a high suspended silt load in the water, and the low level of plant nutrients. The presence of blue-green algae was less significant in February. Station 3 was dominated by Scenedesmus (31,9%), while station 4 was co-dominated by centric diatoms (19,3%), *Anabaena* (17,8%) and *Coelastrum* (17,8%). At station 5 the population was dominated by *Peridinium* (27,9%), and at station 6 by *Anabaena* (21,9%), *Scenedesmus* (14,6%) and *Peridinium* (14,0%). The Sengwa Bay sample (station 7) still consisted mainly of *Anabaena* (42,7%).

In April the algal population at station 4 consisted predominantly of diatoms (35,1%), *Anabaena* (16,4%) and *Tetraëdron* (14,[illegible]); station 5 was dominated by *Anabaena* (36,4%), and station 6 by *Scenedesmus* (28,4%). No sample was available from station 7, due to extremely rough weather on the open lake.

The mean generic richness for the Sengwa River mouth is illustrated in Figure 31. The values for stations 1 and 2 have no standard deviations calculated because only one sample was counted. There was a general decrease in species richness from the more riverine stations (2 and 3 - disregarding station 1) to station 5, and thereafter a slight increase. The stability of the population appears to decrease from station 3 to station 7, which suggests that the phytoplankton population was more diverse toward the open lake than in the sheltered riverine areas. The *Salvinia* mat also had an effect on the

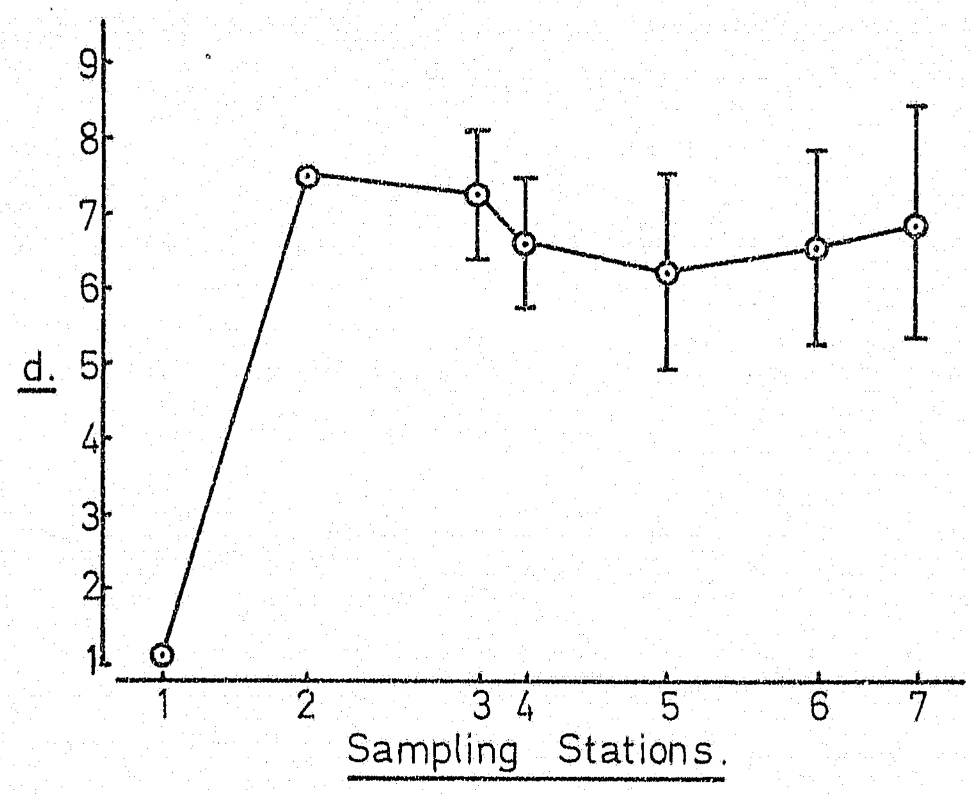


Figure 31: The mean generic diversity index values for the Sengwa River mouth. The vertical lines are the standard deviation of the mean - stations 1 and 2 were only sampled once.

euplankton population, the exact nature of which is not completely understood.

5.2.3.1.4 Mujery Offshore Area

The seasonal variation in algal population composition for the two Mujery offshore transects is illustrated in Figure 32. For convenience transect 1 will be discussed separately from transect 2 and then a comparison drawn between the two.

The phytoplankton population of transect 1 showed a reciprocal relationship between the Chlorophyta (mainly Scenedesmus) and Cyanophyta (Anabaena) in August. In October the algal population along the transect was completely dominated by the Cyanophyta (> 55,4% Anabaena for stations 1, 2 and 3, and 78,7% Phormidium sp. for station 4). The blue-green algae-dominated populations were manifested by higher photosynthetic pigment values and total cell counts from station 1 to station 4, except at station 2 where the pennate diatoms contributed 26,2% of the population.

In December a recripocal relationship between the diatoms and blue-green algae was evident. The pennate diatom population decreased from station

1 (42,4%) to station 4 (14,7%), while the blue-greens increased from 5,7% at station 1 to 50,9% at station 4 (Phormidium 27,6% and Anabaena 23,3%). The green algae also contributed significantly, dominating the population at stations 2 and 3. The blue-green domination at station 4 caused a marked reduction in the generic diversity index.

In February the algal population was dominated by the Chlorophyta with station 2 being dominated by Peridinium (33,1%) and station 4 co-dominated by the green algae (Mougeotia 16,9%) and the blue-green algae (Anabaena 33,3%). Again this increase in blue-green algae caused a drop in the generic diversity index and an increase in the total cell count, with little change in the photosynthetic pigment value. The population composition in April was very similar to that of the December sample. A decrease in the diatoms was evident from station 1 to station 4, with an increase in the Chlorophyta from station 1 to station 3; the latter group then decreased, with the Pyrrhophyta and Chrysophyta increasing slightly. The Cyanophyta did not contribute significantly to the plankton. The sharp drop in algal density from station 1 to station 2 resulted in the characteristic decrease in photosynthetic pigment values and the diversity index, except for the slight increase in Anabaena at stations 3 and 4.

The phytoplankton population fluctuations of transect 2 stations showed a close similarity to the transect 1 area. A reciprocal relation= ship was present between the Chlorophyta (mainly Scenedesmus) and the Cyanophyta (mainly Anabaena) in August. The algal density was fairly constant at this time along the transect, except that the diversity index increased markedly at station 2 due to a number of desmid genera being present (Closterium, Arthrodesmus, Micrasterias, Staurodesmus and Spondylosium), contributing to $>$ 1,0% of the total population.

In October the percentage of blue-green algae increased from station 5 to station 8 with a corresponding reduction in the green algae. At station 5 the population was dominated by Scenedesmus (21,5%) with Peridinium (15,9%) and the pennate diatoms as sub-dominants. From station 6 to station 8 the percentages of Pyrrhophyta, Chrysophyta and Bacillariophyceae remained fairly constant. The Scenedesmus population decreased from 61,5% at station 5 to 14,7% at station 8. The blue-green population

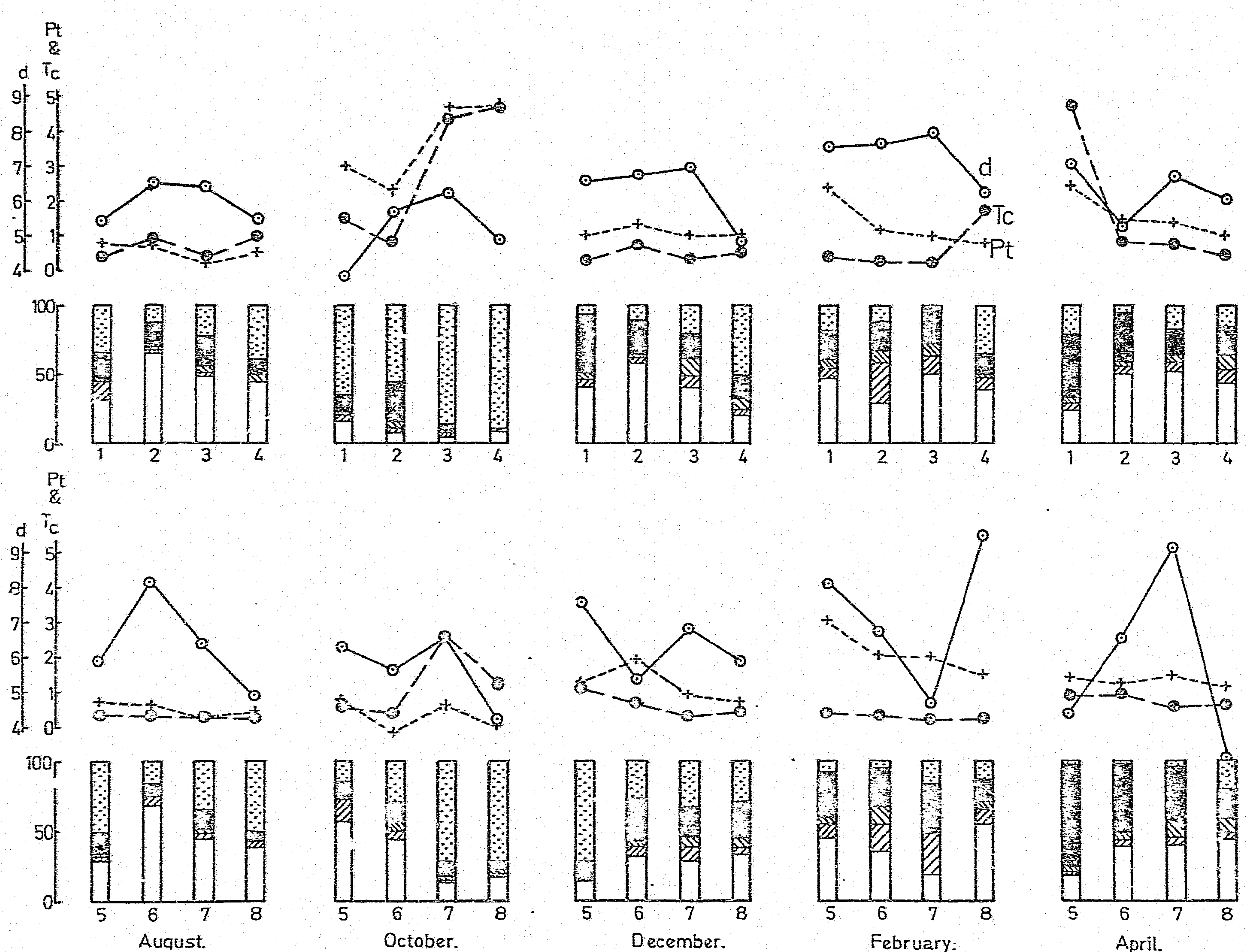


Figure 32: Seasonal phytoplankton diversity of the Mujery offshore transects. The vertical columns indicate the algal population breakdown: Chlorophyta, Pyrrhophyta, Chrysophyta (minus diatoms), Bacillariophyceae, Cyanophyta. Generic diversity (d), photosynthetic pigments (Pt) and total cell counts (Tc) are included for comparison.

increased from 14,7% at station 5 to 70,5% at station 8 (stations 5 and 7 were dominated by Anabaena, station 6 co-dominated by Anabaena and Phormidium, and station 8 by Phormidium, similar to transect 1). The Anabaena population at station 7 caused an increase in the diversity index, photosynthetic pigments and total cell counts; the Phormidium population at station 8 caused a decrease in the above three parameters.

By December the Cyanophyta completely dominated the algae at station 5 (Phormidium 51,8%), and at stations 6, 7 and 8 the phytoplankton was co-dominated by Chlorophyta, pennate diatoms and blue-greens (approximately 3?%, 24% and 29% respectively). In February the phytoplankton population at station 5 was composed mainly of Chlorophyta (46,6%) and Bacillariophyceae (pennate diatoms 27,6%). At station 6 the green algae and diatoms were less significant because the Pyrrhophyta and Chrysophyta populations had increased, and the population at station 7 was co-dominated by Peridinium (28,3%), pennate diatoms (32,1%) and Anabaena (16,0%). Station 8 was dominated by the Chlorophyta with no single genus dominant. There was a low generic diversity at station 7 because only a few genera were recorded from each group.

In April the percentage of the Bacillariophyceae decreased from 71,1% (57,0% pennate diatoms) at station 5 to 21,0% at station 8. The percentage of Chlorophyta increased from station 5 (21,5%) to station 6 (40,6%) to station 8 (46,1%), with Scenedesmus contributing 6,6% at station 5 and 22,6% at station 8. The high generic diversity index at station 7 was the result of a rich desmid population (Arthrodesmus, Xanthidium, Euastrum and Spondylosium).

Generally the generic diversity showed a slight increase from the shoreward stations (1 and 5) to stations 3 and 7, thereafter decreasing to the open water in transect 1 (as seen population stability increased from the shore to the open water in the uncleared area (as seen from the decreasing standard deviations in Figure 33).

Transect 1 showed a similar increase in stability from the shore to station 6, then the stability decreased due on the one hand to algal populations of many rare organisms (e.g. desmids) that contributed minimally to the algal density, and on the other to populations con=

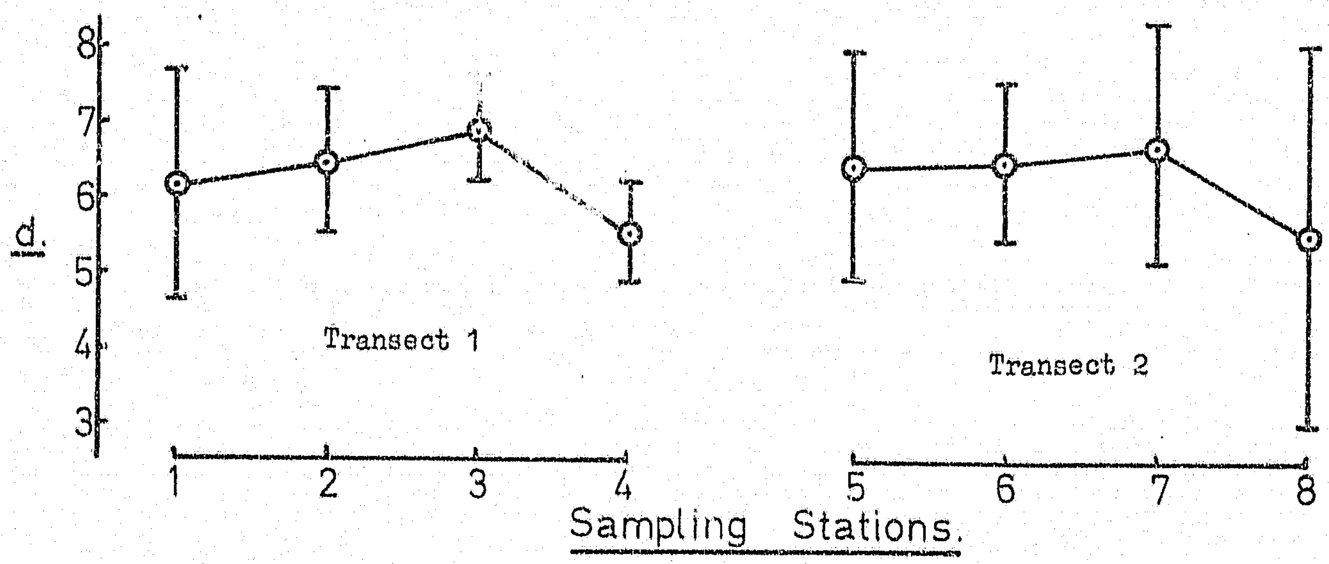


Figure 33: Mean seasonal generic diversity index values for the two Mujery transects. The vertical lines are the standard deviations.

taining only a few genera dominating the phyto= plankton (e.g. the Anabaena-pennate diatom-Peridinium association at station 7 in February, where only 10 genera were recorded in the population in relation to more than 15 in the other samples for the same period).

5.2.3.2 Vertical Variation

The vertical distribution of phytoplankton showed con= siderable variation in time and space in the Mwenda Basin (Figure 34). The Chlorophyta dominated the population at the surface in August (Scenedesmus 45,1%). At 5 m depth the diatoms increased from 20,0% to 48,5% (Melosira 26,7%, pennate diatoms 21,9%), and at 10 m the blue-green algae had increased to co-dominate the phytoplankton with the Chlorophyta (Anabaena 24,5% and Scenedesmus 30,9%). A similar population composition was present at 15 m depth. At this time the photosynthetic pigments showed a reciprocal relationship with total cell counts, which can be attributed to the flux in the diatom and blue-green algal populations.

Extremely bad weather conditions on the lake in October prevented the collection of any samples in the Mwenda Basin.

The vertical distribution of the phytoplankton population in December showed only very slight changes from the surface to 30 m depth, Scenedesmus being dominant

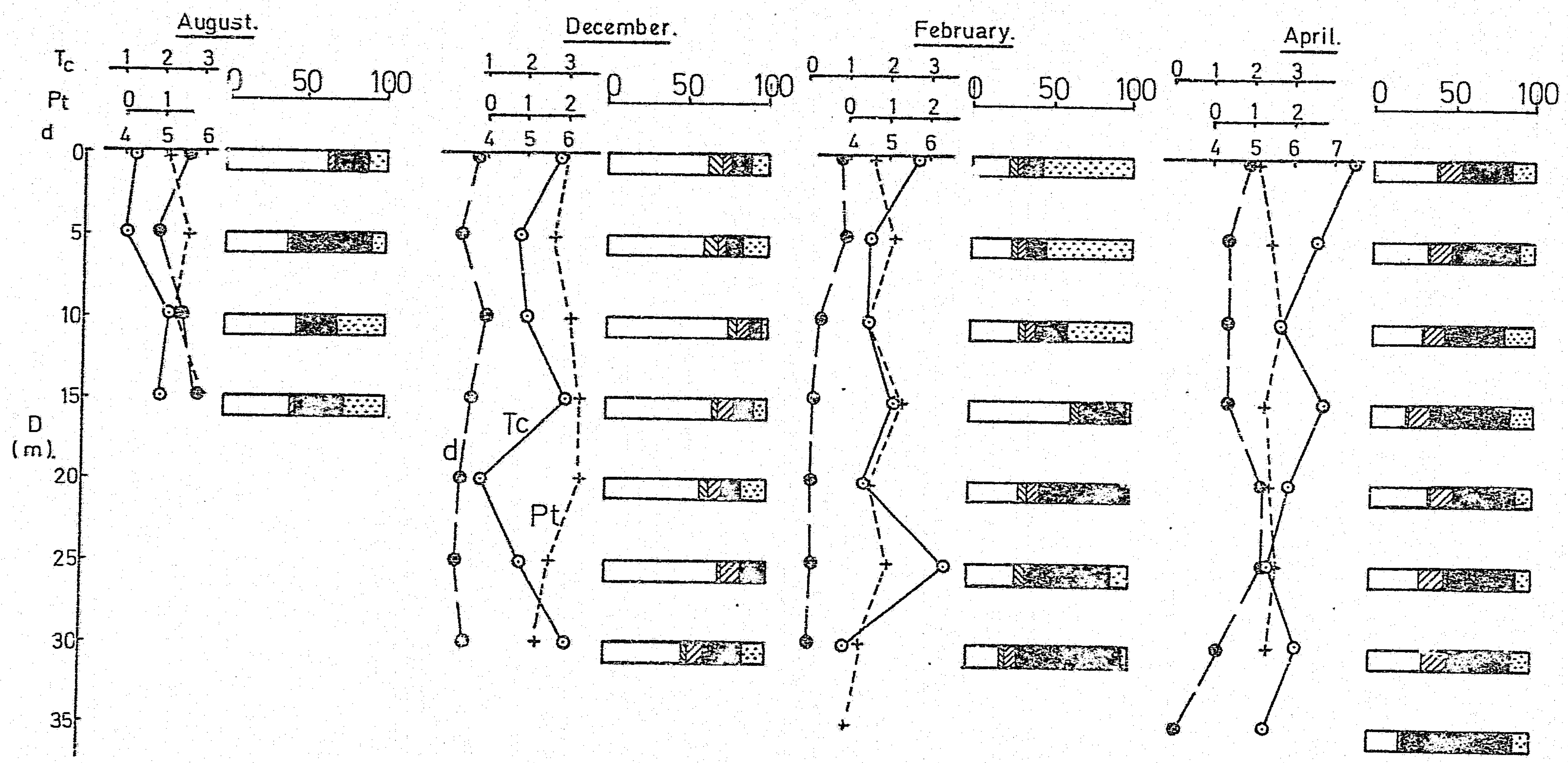


Figure 34: The vertical distribution of the phytoplankton diversity for the Mwenda Basin for four sampling periods. The horizontal columns indicate the algal population breakdown: Chlorophyta, Pyrrhophyta, Chrysophyta (minus diatoms), Bacillariophyceae, Cyanophyta. Generic div[illegible]ity (d), photosynthetic pigments (Pt) and total cell counts (Tc) are included for [illegible]parison.

(> 40,0% except at 30 m where the pennate diatoms increased from $\pm$ 10,0% to 22,4%). The Pyrrhophyta and Chrysophyta were present in all the samples but never contributed more than 10% to the phytoplankton population. The total cell counts and photosynthetic pigments showed a close relationship with depth, and each remained fairly constant with depth.

In February the surface waters (0 m to 5 m layer) were completely dominated by the Cyanophyta (<u>Anabaena</u> 53,0%). The 10 m sample was also dominated by <u>Anabaena</u> (40,5%) with sub-dominants of <u>Schroederia</u> (15,1%) and pennate diatoms (17,6%). Below this 10 m level the blue-green algae were almost completely absent, with the transitional zone at 15 m where the population was dominated by the Chlorophyta (<u>Scenedesmus</u> 24,6% and <u>Coelastrum</u> 13,4%). From 15 m to 30 m the phytoplankton was dominated by the diatoms (25,0% to [illegible] respectively). The algal density and photosynthetic pigment fluctuations with depth were fairly constant.

The phytoplankton in April also showed very small fluctuations through the water profile. In the surface 5 m of the water column the algal population was co-dominated by the Chlorophyta and Bacillariophyceae. With depth, the diatoms became more important in the population until they were completely dominant at 35 m. <u>Melosira</u> was the only taxon which contributed significantly to the algal

(> 40,0% except at 30 m where the pennate diatoms increased from ± 10,0% to [illegible],4%). The Pyrrhophyta and Chrysophyta were present in all the samples but never contributed more than 10% to the phytoplankton population. The total cell counts and photosynthetic pigments showed a close relationship with depth, and each remained fairly constant with depth.

In February the surface waters (0 m to 5 m layer) were completely dominated by the Cyanophyta (Anabaena 53,0%). The 10 m sample was also dominated by Anabaena (40,5%) with sub-dominants of Schroederia (15,1%) and pennate diatoms (17,6%). Below this 10 m level the blue-green algae were almost completely absent, with the transitional zone at 15 m where the population was dominated by the Chlorophyta (Scenedesmus 24,6% and Coelastrum 13,4%). From 15 m to 30 m the phytoplankton was dominated by the diatoms (25,0% to 64,0% respectively). The algal density and photosynthetic pigment fluctuations with depth were fairly constant.

The phytoplankton in April also showed very small fluctuations through the water profile. In the surface 5 m of the water column the algal population was co-dominated by the Chlorophyta and Bacillariophyceae. With depth, the diatoms became more important in the population until they were completely dominant at 35 m. Melosira was the only taxon which contributed significantly to the algal population at this time. The algal density showed a maximum between 20 m and 25 m, and decreased markedly to the deeper waters. The photosynthetic pigments showed almost no change from 0 m to 30 m.

A plot of the mean generic diversity indices of the Mwenda Basin (Figure 35) shows that the algal diversity was greatest in the top 5 m, at 15 m and below 20 m depth of the water profile.

5.2.4 Diatom Populations

The diatoms contributed sognificantly to the total phytoplankton population of Lake Kariba, therefore selected samples were sent to Dr. F.R. Schoeman for detailed taxonomic classification (see Appendix 18).

The main aim of this detailed diatom analysis was to furnish information on the planktonic diatom flora of Lake Kariba in general, and to see what periphytic species colonized the submerged Salvinia leaves, as well as the periphyton from the Mwenda River. The results are presented in Table 20.

These samples were selected from three different habitat types:

a) net hauls of euplankton
b) microfiltered samples of the euplankton, and
c) periphytic diatoms attached to Nitella sp. and Salvinia leaves.

These samples were collected between May and July 1972. The

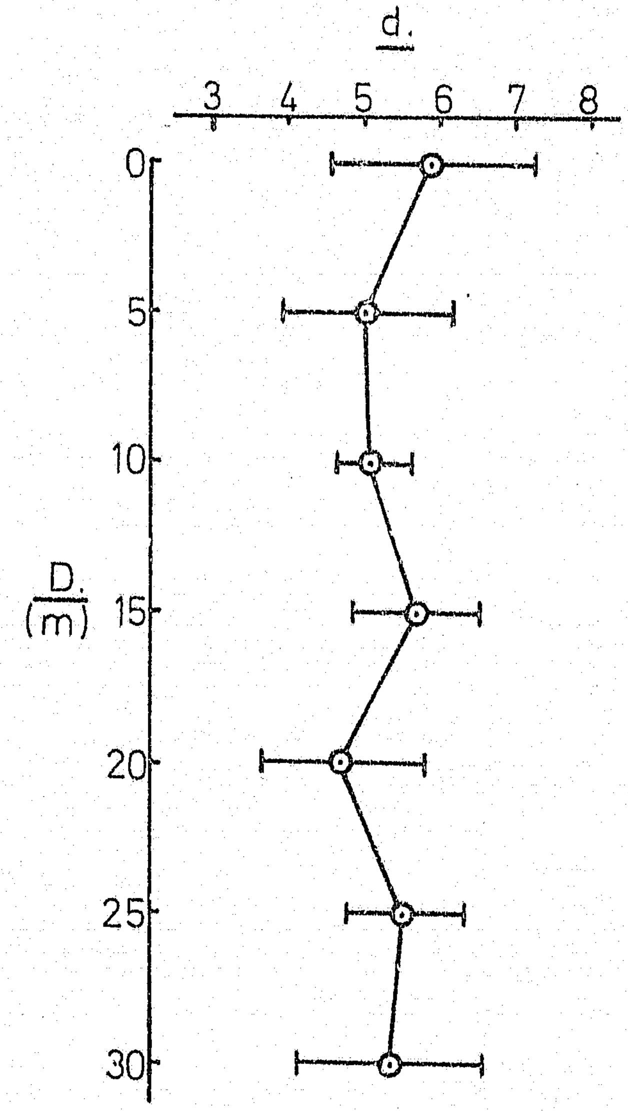


Figure 35: Mean generic diversity index depth profile for the Mwenda Basin. The horizontal lines are the standard deviations.

Table 20: List of diatom species occurrences from selected samples from Lake Kariba. Sampling sites are as follows:

Net
- Sample 127 - Mwenda River mouth, net haul, June 1972
- Sample 173 - Mujery area, net haul, May 1972
- Sample 166 - Sengwa River mouth, net haul, July 1972
- Sample 131 - Mlibizi River mouth, net haul, June 1972

Periphyton
- Sample 123 - Mwenda River, periphyton on Nitella sp., June 1972
- Sample 87 - Mwenda River mouth, periphyton on Salvinia submerged leaves, May 1972
- Sample 91 - Mwenda River mouth, periphyton on Salvinia submerged leaves, May 1972
- Sample 170 - Sengwa River mouth, periphyton on Salvinia submerged leaves, July 1972
- Sample 146 - Binga Basin, periphyton on Salvinia submerged leaves, June 1972

Filtered
- Sample J51 - Mujery area, filtered sample, April 1972.

	Sample Number									
	127	173	166	131	123	87	91	170	146	J51
CENTRIC DIATOMS										
Attheya sp.										x
Cyclotella kützingiana		x								
C. pseudostelligera	x	x							x	
C. sp.		x								
Melosira distans									x	
M. granulata	xxx	xxx	xxx	xxx					x	
M. granulata var. angustissima	xxx	xxx	xxx	xxx					x	x
PENNATE DIATOMS										
Achnanthes lanceolata			x		x	x				x
A. minutissima			x		x	x				x
Anomoeoneis exilis						x				
Caloneis clevei									x	
Cymbella grossestriata										x
C. kolbei										x
C. microcephala										x
C. turgida		x						x		
C. ventricosa										x
Epithemia sorex		x								
Eunotia flexuosa								x		
E. lunaris						x		xxx	x	
E. pectinalis									x	
Fragillaria pinnata										xx
F. vaucheriae										xxxx
Gomphonema brasiliense										x
G. gracile								x	x	x
G. parvulum					xxxx	x	x		x	x
G. sp.									x	

continued...

Table 20 (continued): List of diatom species occurrences from selected samples from Lake Kariba.

	Sample Number									
	127	173	166	131	123	87	91	170	146	J51
Gyrosigma kützingii						x				x
Navicula angusta										x
N. cryptocephalia					x					x
N. exiguiformis										x
N. halophila										x
N. pupula										x
N. rostellata					x					x
N. seminulum										x
N. submolesta					x					x
N. tenella										x
N. tridentula										x
N. vitabunda										x
N. zanonii										xx
Neidium affine					x					
Nitzschia acicularis										xx
N. amphibia		x								x
N. confinis										x
N. epiphyticoides										x
N. gracilis										xx
N. intermedia										x
N. kützingiana										x
N. palea						x				x
N. perpusilla		x						x		
N. subsala										x
Pinnularia interrupta										x
P. interrupta fo. minutissima										x
P. mesolepta										x
Rhizosolenia eriensis										x
Rhopalodia gibba		x						x		
Stauroneis merrimacensis										x
Surirella tenera										x
Synedra acus	x	x				xx	x			
S. acus var. radians										x
S. amphicephala								x		
S. rumpens	x						xxxx	xxx	xxxx	
S. ulna	x	x				xxx		xx	x	xx
S. ulna var. danica	x	x	x			xxx				
Number of species	7	13	5	2	7	10	3	9	12	43
Number of genera present	3	7	3	1	3	7	2	6	6	14

xxxx – Dominant
xxx – Co-dominant
xx – Sub-dominant
x – Present

limitation of this species list is appreciated, in view of the few samples studied.

Net haul samples were dominated by Melosira; this was often the case in the filtered and counted lake samples. The dominance by this genus was due to two main factors. Firstly, the samples were collected shortly after the post turnover algal bloom had developed and, secondly, because this genus is a filamentous centric diatom and was caught up by the net. A few incidental species were also recorded, but many more were lost through the relatively large pores of the net.

The periphyton attached to Nitella sampled from the Mwenda River was completely dominated by Gomphonema parvulum with a few incidental species being recorded.

The major element of the diatom flora attached to the submerged leaves of Salvinia in the lower reaches of the lake (Mlibizi area) was the genus Synedra (Synedra rumpens, S. ulna, S. ulna var. danica). In the Sengwa River mouth Eunotia lunaris occurred as a co-dominant with Synedra rumpens. The dominant elements of the periphyton were also present in the euplankton, but occurred rarely. The reverse can sometimes be true, when planktonic forms are caught up in the periphyton.

The true complexity of the euplanktonic Bacillariophyceae was evident from sample J51, which contained 14 genera and 43 species. The dominance of this sample is not a true reflection of the lake limitation of this species list .s appreciated, in view of the few samples studied.

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The true complexity of the euplanktonic Bacillariophyceae was evident from sample J51, which contained 14 genera and 43 species. The dominance of this sample is not a true reflection of the lake as a whole, as tremendous population fluxes occurred. As was the case with many of the lake samples counted, the diatom populations were generally dominated by one or two species, with several sub-dominants and a large number of rare species present. This was equally true for the Desmidiaceae, although rarely did one species dominate the population.

These results will serve as a tentative list of diatom species present in Lake Kariba, and it is hoped that it will be supplemented in the near future.

5.2.5 Generic Frequency

The frequency with which the algal genera occurred in the plankton samples was determined according to Raunkiaer's law of frequencies, and the typical J-shaped curve plotted as seen in Figure 36 (Appendix 15) (Raunkiaer 1934, as shown in Kershaw 1964). The five percentage frequency classes used were 1 = 0 - 20, 2 = 21 - 40, 3 = 41 - 60, 4 = 61 - 80, and 5 = 81 - 100. The number of genera present in each class falls from class 1 to class 4. This is expected as there are many more rare genera than common ones, but the increase in the fifth class is unexpected and, as Greg-Smith (1964) states, 'It has played a notorious part in some attempts at definition of plant associations'. According to Kershaw,

> The increase in class 5 reflects the theoretical infinite range of density and contrasts with the more strictly defined limits of classes 1, 2, 3 and 4. The fifth class has a possible density range greatly exceeding that occurring in the remainder of the frequency classes 1 - 4. Accordingly, many more species fall into this class, despite the general tendency for 'common' species to be relatively few in number in a community.

CLASS 1

Pandorina (13,1%)
Sphaerocystis (8,3%)
Gloeocystis (6,2%)
Elakatothrix (1,4%)
Ulothrix (5,5%)
Oedogonium (2,8%)
Golenkina (7,6%)
Characium (0,7%)
Sorastrum (0,7%)
Treubaria 3,4%)
Nephrocytium (20,0%)
Lagerheimia (5,2%)
Ankistrodesmus (17,2%)
Closteriopsis (4,1%)
Selenastrum (2,8%)
Pectodictyon (1,4%)
Mougeotia (18,6%)
Spiro· ra (2,1%)
Closterium (9,6%)
Spirotaenia (0,7%)
Arthrodesmus (7,6%)
Xanthidium (14,5%)
Micrasterias (4,1%)
Spondylosium (20,7%)
Sphaerozosma (4,1%)
Euglena (11,0%)
Phacus (4,1%)
Gymnodinium (2,1%)
Glenodinium (2,8%)
Centritractus (4,1%)

CLASS 2

Pediastrum (31,7%)
Franceia (33,8%)
Kirschneriella (22,8%)
Crucigenia (26,9%)
Euastrum (35,2%)
Microcystis (30,3%)
Phormidium (31,0%)
Spirulina (23,4%)

CLASS 3

Eudorina (41,4%)
Coelastrum (60,7%)
Oocystis (57,2%)
Gonatozygon (61,4%)
Cosmarium (51,0%)
Merismopedia (50,3%)

CLASS 4

Staurastrum (80,7%)
Centric diatoms (73,1%)

CLASS 5

Schroederia (95,2%)
Tetraëdron (84,8%)
Scenedesmus (88,2%)
Peridinium (90,0%)
Tetraedriella (84,8%)
Pennate diatoms (93,1%)
Anabaena (84,1%)

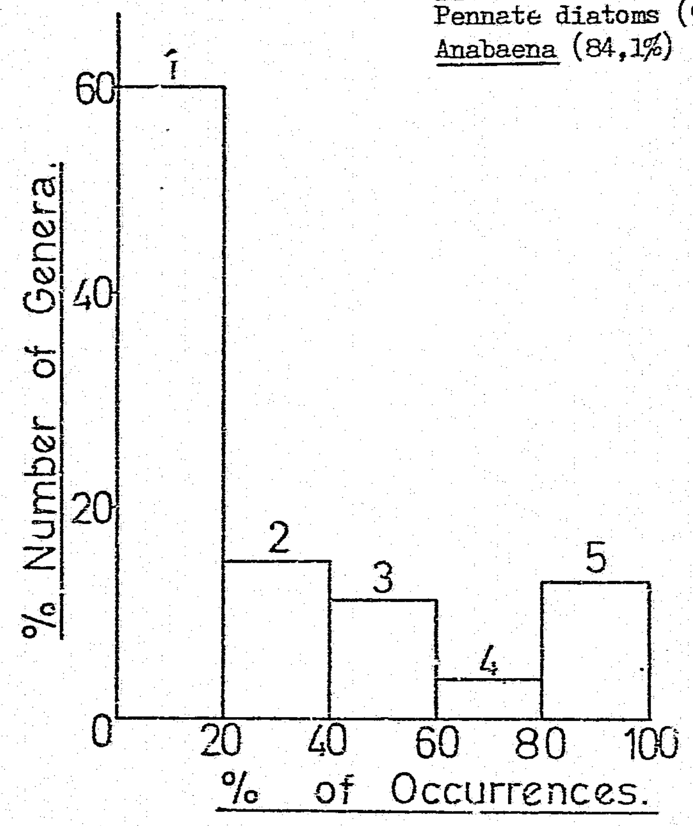

Figure 36: The relationship between frequency class and the number of genera falling within each of the classes.

This percentage frequency analysis was thus used to separate out the important algal genera of the sampling areas.

These genera are commonly encountered in the lake samples, but are not necessarily the most dense in the individual samples (e.g. Staurastrum occurred in 80,9% of all samples but never contributed more than 10% of the plankton density. This was one genus which was represented by a large number of species). On the other hand, Scenedesmus and Schroederia occurred in 88,2% and 95,2% of the samples respectively, and dominated the plankton density in many cases.

The genera occurring in classes 1, 2 and 3 were of little ecological significance to the biomass as a whole, and only the genera in classes 4 and 5 were significant. The most important taxa were Schroederia, Scenedesmus, pennate diatoms, Anabaena and the centric diatoms. The genera Tetraëdron, Peridinium, Tetraedriella and Staurastrum occurred frequently but did not contribute significantly to the phytoplankton standing crop. Generally, the rest of the genera were more of taxonomic significance than of ecological importance.

5.2.6 Post Turnover Algal Bloom

The annual phytoplankton bloom in Lake Kariba has been described by Mitchell (1970) as the "Microcystis bloom". A series of net haul samples from the Mlibizi River mouth to the Mwenda Basin indicated that the bloom was composed of:

Microcystis Melosira Anabaena Pediastrum	abundant
Synedra Staurastrum Peridinium Eudorina	frequent
Gonatozygon Ceratium Desmidium Volvox Euastrum Sphaerozosma	rare

Due to the large variation in the population between samples, the recorded genera were arranged into the above order. Generally, but not in all cases, the population was dominated by the Cyanophyta and the Bacillariophyceae, with the Chlorophyta being less import= ant, but being represented by many taxa.

Mitchell (1970) has indicated that the thermal stratification of Lake Kariba begins breaking down in the shallowest part of the old Zambezi River bed, i.e. near the point of inflow of the Zambezi River into the lake. Thermal destratification does not occur in the whole lake at the same time, but proceeds towards the dam wall. This is because the thermocline, when at its strongest, slopes down towards the dam wall where it is generally at its deepest.

Once the process of lake turnover begins, plant nutrients are brought from the hypolimnion into the euphotic zone, and rapidly utilized by the algae, producing the typical annual bloom. This sudden increase in phytomass begins appearing approximately two weeks after turnover at any point (Pers. obs.). The bloom develops to the point where shading causes the gas-vacuolated blue-green algae to float to the surface to form a scum, which is typical of a eutrophic water body. Once the algae have utilized the available nutrients and the population starts senescing, toxic compounds are released into the water which cause gastric problems in the humans inhabiting the lake shore. The origin of this toxin is probably due to Microcystis and Anabaena, as these effects are similar to those experienced by the inhabitants of the catchment area of the Hartbeespoort Dam (Toerien 1974).

The bloom appears to last for about a month and then rapidly disappears (Pers. obs.). The time periods invloved in the formation and disappearance of the bloom algae vary greatly from place to place, so a detailed study will be required ascertain the dynamics in time and space of this annual event.

6 RIVER FLOODING

Today most natural waters contain solid matter of some sort in suspension, sometimes at very high concentrations, e.g. eroding flood waters. Considerable quantities of such solid matter are derived either from natural processes of erosion, or by man's activity on the land. Some waters, according to Brown (1960) can contain up to several hundred grams per litre of suspended solid material. There is little doubt that such conditions can have a destructive effect on the primary producers and subsequent fish production. Alabaster (1972) has indicated that this suspended matter can produce direct harmful effects on the normal maintenance of fish and their eggs and larvae. Abnormalities have also been noticed in fish behaviour, breeding, feeding and movement patterns. The direct effects of suspended silt on the invertebrate fauna in South African streams have been detrimental to both species composition and population dynamics (Chutter 1969). Chutter (1969) has further shown that some animals are particularly sensitive to silt abrasion. Many algal taxa with unthickened walls e.g. unicellular green flagellates and non-flagellates, are also subject to cell destruction by silt abrasion. The indirect effect of this particulate matter on freshwater fauna is a reduction in food supply either due to decreased productivity of algae, caused by light attenuation, or decreased zooplankton production. The algal production throughout the water profile will decrease with depth - productivity closer to the surface where light conditions still remain favourable, remains high.

The suspended solids of geological origin of the Mwenda River are essentially inert and unlikely to affect the dissolved oxygen concentration, as they contain only small amounts of oxidizable organic material. Consequently they affect the primary production due to light penetration into the water body and also the selective scattering of this light. Surface biomass (photosynthetic pigment) is, however, increased due to the nutrients brought into the lake by the flood waters.

6.1 PHYSICAL-CHEMICAL EFFECTS

The flow characteristics of the flood waters entering the lake depend on the density of these inflowing waters in comparison with that of the waters of the lake. The density of the flood waters is largely controlled by temperature and silt load. The temperature and dissolved oxygen depth profile diagrams for stations 1, 3 and 6 are presented in Figure 37.

The initial spate entered the lake at approximately 24,5^{o} C, initially undercutting the warm lake water. The flood waters were then warmed by the land, and flowed along the surface and mixed with the lake water, displacing the existing waters (station 1) downstream. At the point of inflow the river water reduced its flow rate due to friction with the lake water, thus allowing a large proportion of the silt load to sediment out; this also acted in reducing the water density.

During the flood period (16th to 23rd February) the river water flowed along the original river bed, displacing existing bottom waters (oxygen deficient) downstream, but for a short distance only. The rive ater then flowed along a comparable density level and merged with the lake water, resulting in interflow (Bowmaker 1968). From data recorded at station 6 it is unlikely that this particular flood maintained flow along the old river bed much beyond station 3. The low oxygen values recorded in the bottom waters at station 6 indicate a displacement of dense deoxygenated bottom water from upstream and not the original flood waters (Figure 37). The poor oxygen conditions were also due to bottom waters moving over the sediment surface and resuspending the biogenic sediment which effectively created a high biological oxygen demand. No hydrogen sulphide was recorded in these deoxygenated waters (smell test). The temperature, dissolved oxygen and light penetration character= istics of the lake water mass soon re-established after the flood occurred with the exception of station 1. This is probably the effect of local climatic conditions on the shallow (3,5 m) water body as the local atmospheric circulation again stabilized, and the land temperature rose.

The horizontal extent of surface-suspended silt is shown in Figure 38. This indicates that the flood waters only influenced the phytomass (as a result of light attenuation) up to station 4 and not beyond. The reduction in light penetration was delayed at station 1 at the onset of floods while the cold dense spate undercut the lake water. At stations 3 and 6 the increased turbidity was more apparent on the 17th February, being the effect of suspended solid material and increased productivity at station 3, and increased productivity only at station 6. The pre= cipitation of solid particles into the lake waters will probably have a significant effect on the light penetration, the effect of which is difficult to quantify (Grove 1972).

The scattering of light by the suspended silt material of the flood waters in contrast to open lake waters can be seen in Figure 39. The penetration of all wavelengths of the visible spectrum is markedly influenced by the silt load, showing decreasing attenuation from short to long wavelength radiation. The wavelengths of light utilized by the primary producers are significantly affected, as can be seen from the photosynthetic pigment data in Figure 40.

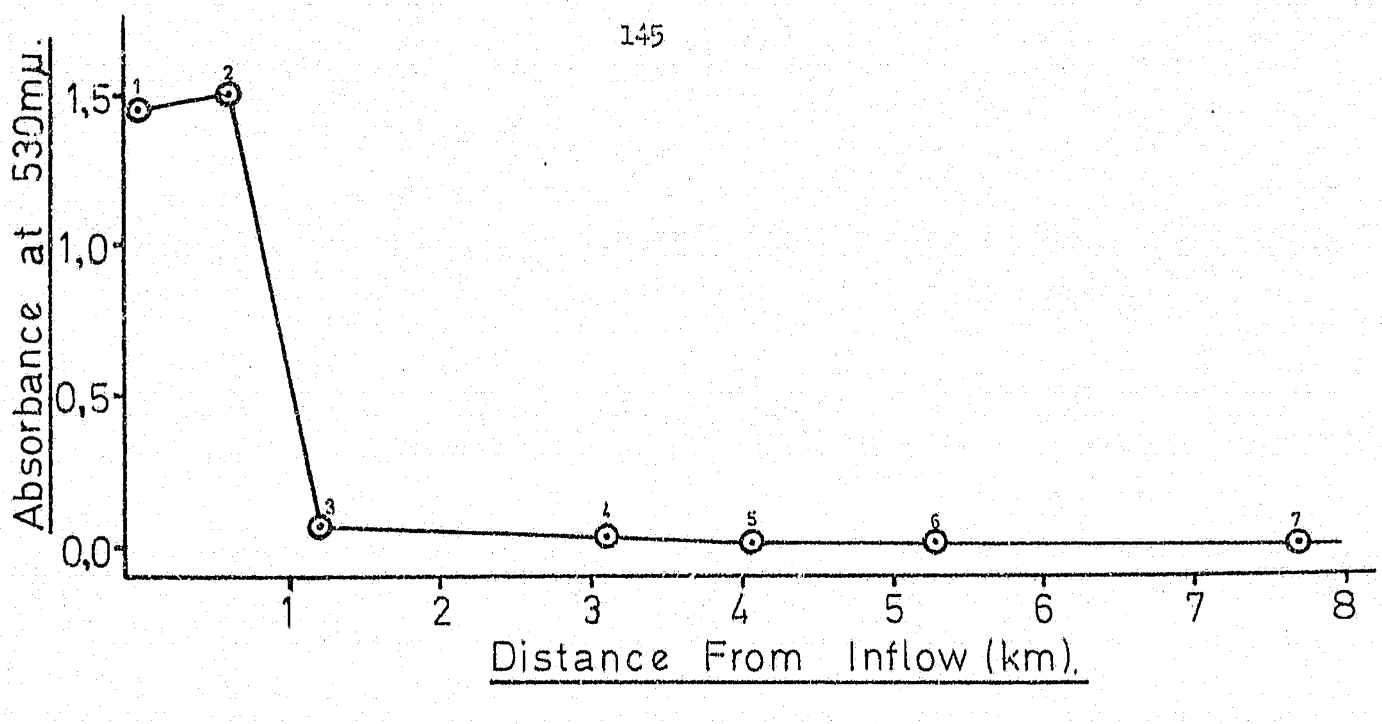

Figure 38: The distribution of suspended silt in the surface waters of the Mwenda River mouth after flooding. The sampling stations are noted above each point.

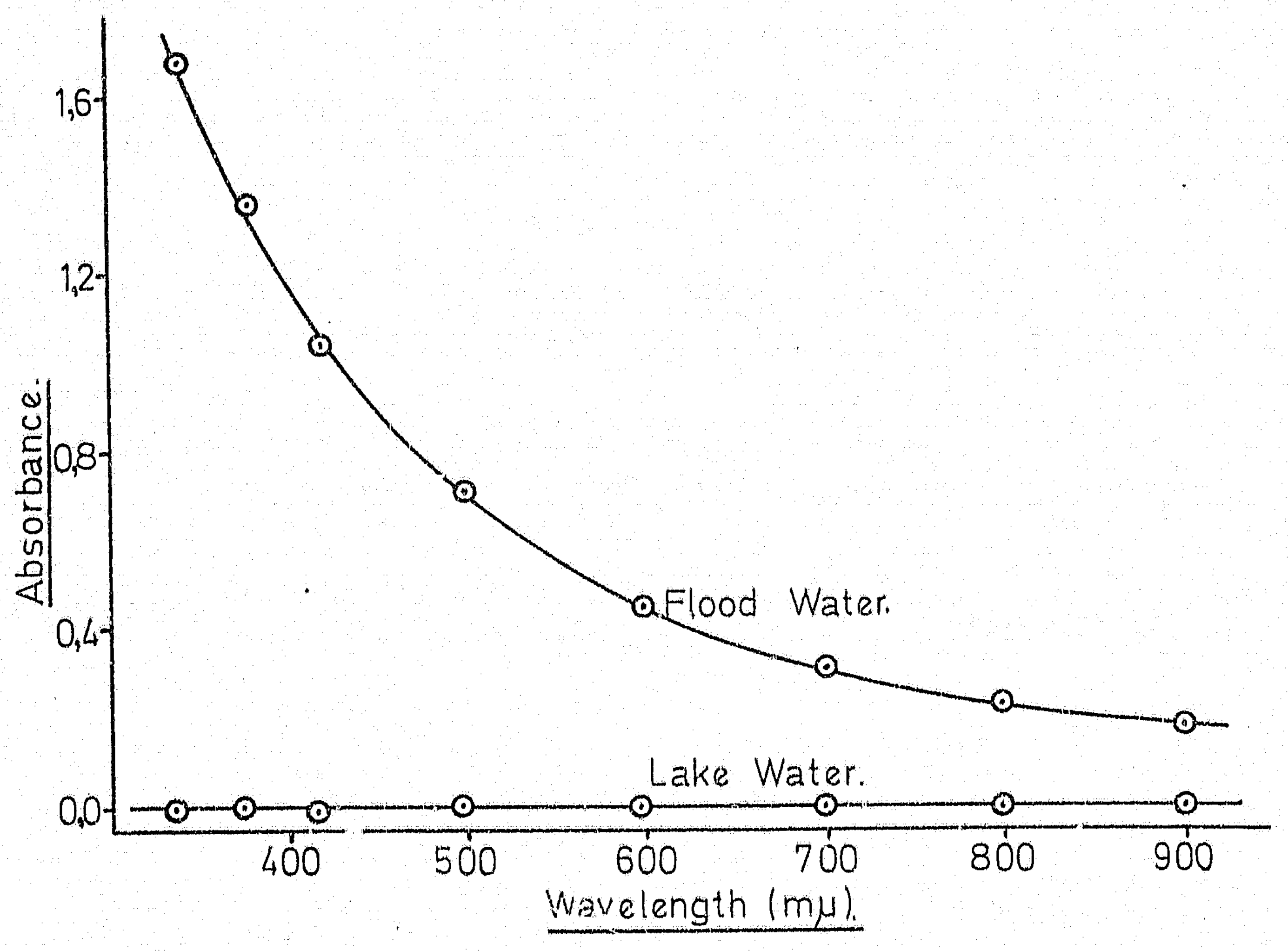

Figure 39: The effect of suspended silt load on the penetration of different wavelengths of light through the flood waters of the Mwenda River.

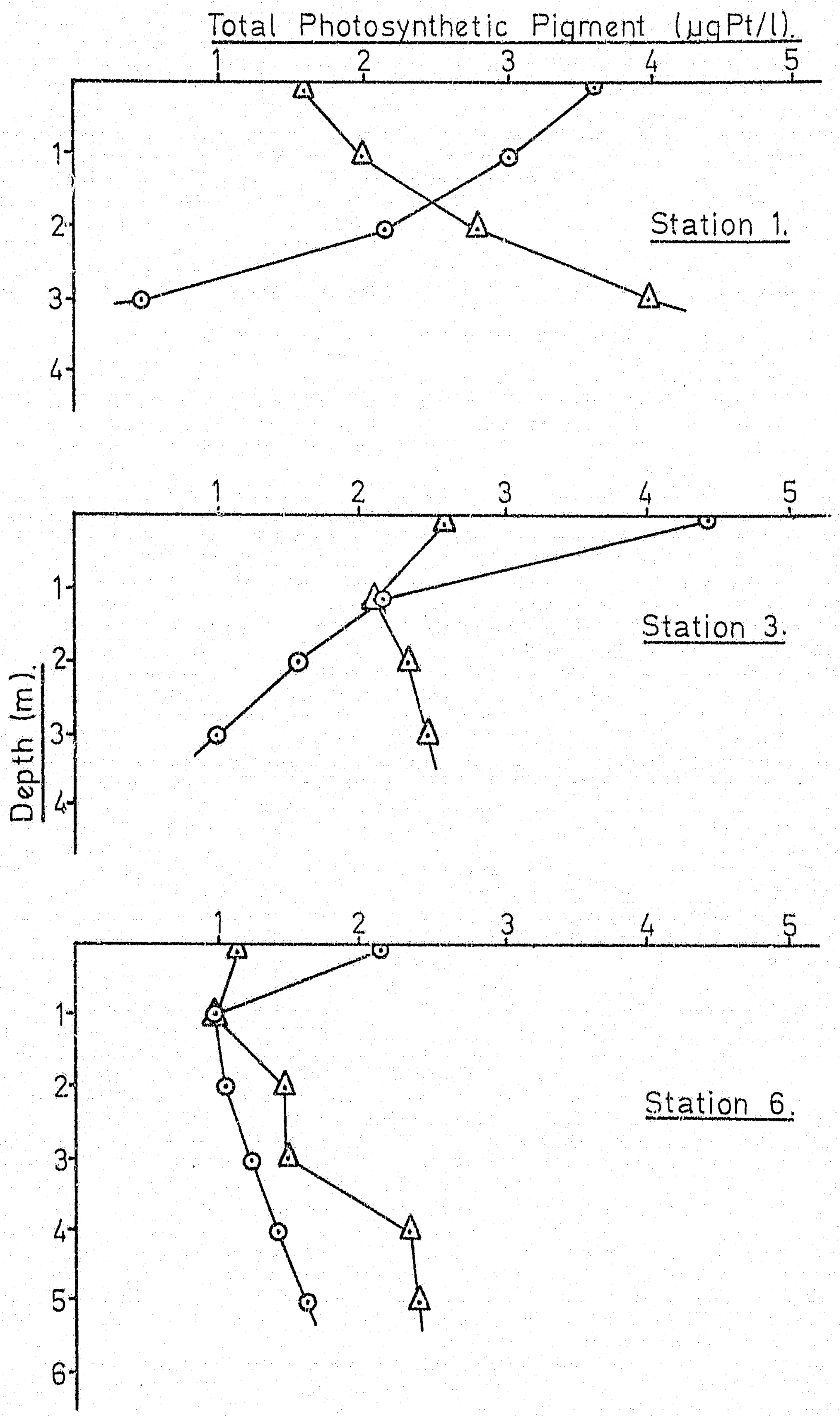

Figure 40: The variation of total photosynthetic pigment (μg Pt/l) with depth for three stations in the Mwenda River mouth during the flood in February 1972. (14.2.72 sample =–△– and 17.2.72 sample =–⊙–)

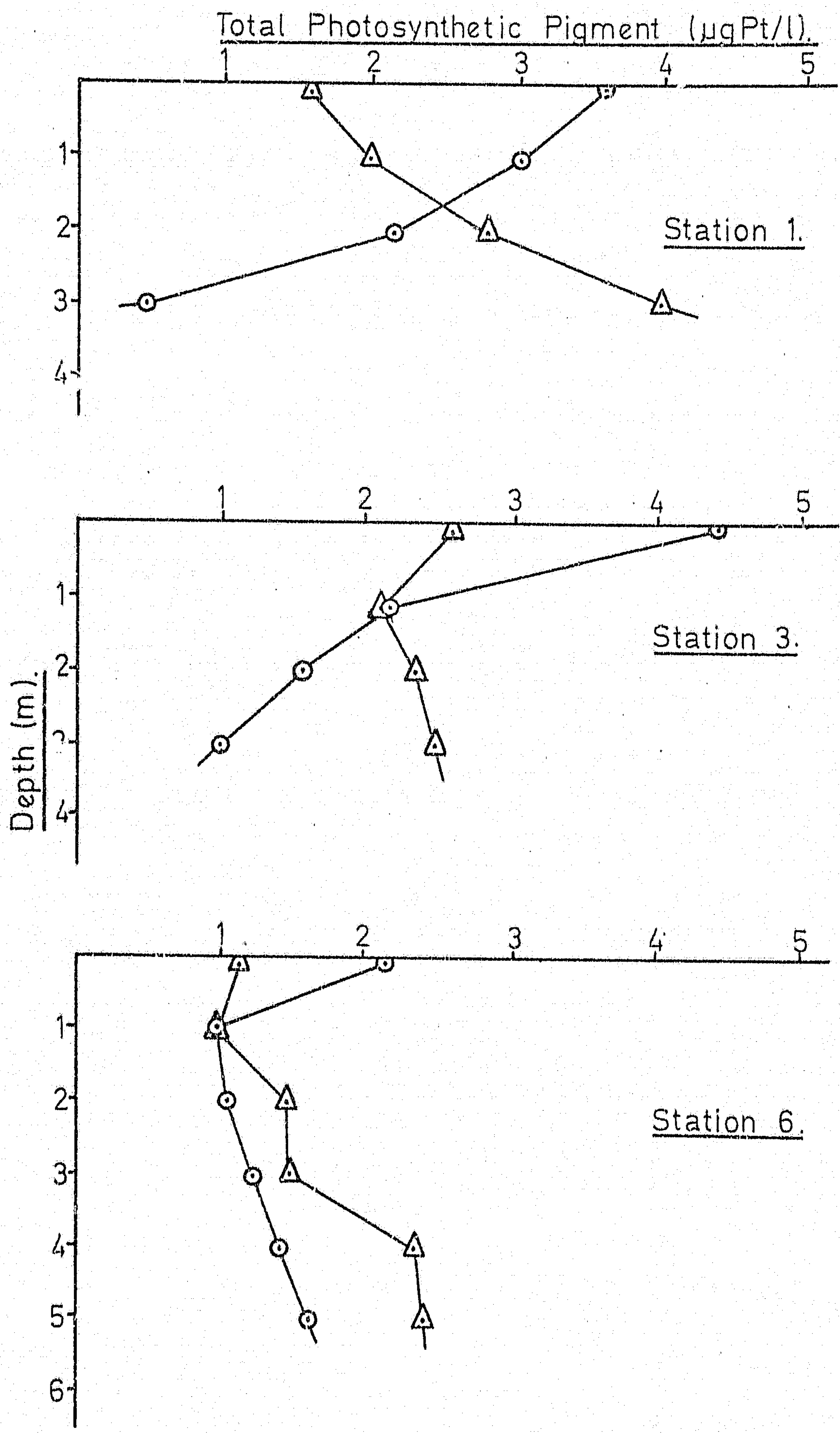

Figure 40: The variation of total photosynthetic pigment (µg Pt/l) with depth for three stations in the Mwenda River mouth during the flood in February 1972. (14.2.72 sample —△— and 17.2.72 sample —⊙—)

The water transparency (see Figure 38) decreased with the introduction of the flood waters. The phytomass data indicates that the water transparency was decreased (depth of visibility decreased) not only by the silt load at stations 1 and 3, but also by an increase in the surface phytoplankton (Figure 40). The decreased water transparency caused a marked reduction in subsurface production at stations 1 and 3, but not so at station 6. Here productivity decreased from the surface to 1 m, thereafter increasing in the characteristic manner with depth. Prior to flooding, station 3 showed a decrease in production from the surface to 1 m, thereafter increasing with depth as in station 6. Therefore station 3 occurs in the transition zone between the waters influenced by water flooding and the open bay water (Figure 38).

6.2 PHYTOPLANKTON

The phytoplankton of the Mwenda River mouth is hitherto unknown except for a brief study on Lake Kariba by Thomasson in 1965. The relative number of phytoplankton species increases from station 1 to 6. The main primary producers at station 1 were *Palmella* sp., *Eudorina elegans* and the diatoms *Synedra ulna* and *Melosira granulata*. Station 3 exhibited dominant genera such as *Volvox areus*, *Melosira granulata* and *Spirogyra* sp. with frequent occurrence of *Staurastrum* spp., *Cosmarium* spp. and *Peridinium* sp. The species diversity of the desmids was high, but their contribution to the population was small - many species were recognized but the total number of cells/1 was low.

Spirogyra is not a true planktonic alga, but occurred as a free-floating organism when the flood waters scoured the benthic colonies from the rocks upstream. The filaments were broken into short lengths of a few cells when recorded in the lake. These benthos were unable to survive the lake conditions, for they disappeared from the phytoplankton shortly after the river subsided. The diatom Gomphonema parvulum occurred periphytically on Nitella sp. which grows on the sand slopes of the pools upstream. The flood waters also carried large numbers of these organisms into the lake. The algae recorded at stations 1 and 3 were subject to severe silt abrasion. The diatom Melosira granulata was often broken into two separate valves; desmids showed silt abrasion on the cell walls and the two semicells were often broken apart. The dinoflagellates showed very indistinct cell wall plates. The Volvocaceae were rarely recorded as complete colonies, but rather as small fragments of the whole. Daughter colonies of Volvox areus were seldom recorded. At station 6 no generic dominance was apparent as the community exhibited a mature structure, according to Margalef's (1968) classification. The genera present here were the diatoms Synedra sp. and Melosira sp. and the desmids Staurastrum sp. and Cosmarium sp.

The phytoplankton samples studied contained large amounts of silt and dead organic matter which originated from flood erosion and the breakup of fringing Salvinia mats. The flood waters contributed very little to this dead organic matter load which probably plays an important role in the nutrient budget of the lake.

7 GENERAL DISCUSSION

Lake Kariba may be described as a typical warm monomictic reservoir (Coche 1968), the physical limnology of which is essentially controlled by the inflowing rivers and the local climatic conditions, e.g. air temperature, rainfall and wind.

During the 1971 - 1972 period of this study the temperature of the Mwenda River showed a pattern similar to that of the local air temperature, as did the other areas investigated. The Salvinia which covered station 1 had a large influence on the temperature pattern of this pool when the river was not in flood. The light penetration into the water was markedly reduced and therefore the algal population was impoverished. The water chemistry of this pool was distinct from the other three sampled pools.

The overall physical limnology of the two drowned river mouths studied was similar, and essentially dependent on the local climatic pattern. The more riverine areas were generally warmer than the open water. The drowned river mouths did not stratify as did the main lake, but Bowmaker (1973) indicates localized stratification which was not evident in 1971 - 1972. From the profile temperatures plotted (Figures 10 and 13) the Salvinia and "sudd" mat present in the Sengwa River mouth did not have any great effect on the mid-stream waters, as wind action shifts this vegetation around, and the heat budget of the waters is maintained. Closer to the shoreline this floating vegetation did lower water temperatures and affect the water chemistry (Mitchell 1970). The oxygen tension and pH of the water was lowered and O_2, PO_4 and NO_3 increased. The mechanisms involved are complex, but this marginal niche could be the driving force behind the maintenance of these 'weed' mats on waters poor in nutrients. Bowmaker (1973) has described this zone as being the only area that approached biological richness in Lake Kariba.

Thermal destratification occurs in Lake Kariba annually between March and July. Homothermy in the Mwenda Basin established itself at about 22° C. The metalimnion occurred between 30 m and 32 m with a temperature gradient of 2° C/m and, when fully developed, was 2 m deep. The depth and intensity of the thermocline was largely dependent on local climatic conditions.

The light penetration into the Mwenda River waters was extremely poor (always < 0,1 m), which, when caused by suspended silt, reduced algal growth greatly. The two algal blooms recorded also resulted in poor light conditions in the pool.

The light climate of the two river mouths was similar, with the lowest penetration at the riverine stations, improving with increased distance from the point of river inflow into the lake to the open water. In comparison to other reservoirs in Southern Africa (e.g. Midmar Dam), light penetration into Lake Kariba is extremely good, and sufficient light is available for algal growth, providing other factors are favourable. At the coastal zone at Mujery the light penetration increased from the shore to the open water as well. In all the areas investigated (except Mwenda River) availability of nutrients was more likely to limit algal growth than the light climate.

The dissolved oxygen regimes of the two river mouth areas showed essentially the same pattern, except that the bottom waters of the Sengwa River showed greater oxygen depletion than those of the Mwenda River. This was the result of a high oxygen demand created by organic detrital decomposers. The surface waters of both areas remained approximately at saturation throughout the year. The degree of oxygen depletion in the bottom waters and the oxycline formation were influenced by the temperature pattern. In the cold months, oxygen stratification is fairly weak, and as water temperatures increased so the bottom waters became more depleted of oxygen because of increased activity of the benthic decomposers. The greatest differences between surface and bottom oxygen saturations occurred in February towards the end of the hot season. As the water temperatures cooled, vertical mixing replenished some oxygen to the bottom waters. The degree of oxygen depletion in the bottom waters also depended on water depth. The dissolved oxygen concentration decreased with increasing distance from the point of river inflow to the open water.

In the case of the Mwenda area the river mouth oxygen stratification corresponded to the main lake oxypleths. In August the water was uniformly oxygenated, and as the surface water temperature increased the oxygen stratification began setting in and intensified between 20 m and 30 m, until a true oxycline was present just prior to turnover. This oxycline was between 30 m and 32 m, coinciding exactly with the thermocline. The entire river mouth area was almost iso=oxygenated, with some oxygen-deficient water in the riverine area. As the warmer weather approached, oxygen was replenished throughout the profile, and then, as temperatures increased, oxygen depletion again occurred in the bottom waters.

The shallow water offshore areas at Mujery showed an inverse relationship between temperature and dissolved oxygen, similar to that of the bottom waters of the river mouths. The entire profile remained at about saturation throughout the year. This inverse relationship could be due to a high oxygen demand by the decomposers, as much organic detritus was present in the algal samples during the summer, and when the lake level dropped, the nutrient input into the lake was reduced. When the lake level again began to rise in March, plant nutrients were released from the newly inundated shoreline and stimulated growth (both algae and macrophytes).

Coche (1968) has described Lake Kariba as a mesotrophic reservoir on the grounds of nutrient status and the presence of hydrogen sulphide in the bottom waters. This is however no longer the case for, although the nutrient status of the water has not changed significantly since Coche's report, hydrogen sulphide is no longer a regular feature of the deep hypolimnetic waters. It therefore appears that Lake Kariba is tending more toward oligotrophy.

The nutrient status of the open lake is very low, although the areas which are fed by rivers or terrestrial runoff show higher nutrient concentrations, and thus higher biological production.

The algal standing crop (as measured by photosynthetic pigments) in the Mwenda River increased as the air temperatures increased, reaching a maximum in December. River flooding in February removed all pool algae from the river into the lake - populations again re-established themselves by April.

The riverine areas of the river mouths maintained higher surface algal standing crops than the open water. This was due to higher water temperatures and the inflow of plant nutrients into the lake by river flooding. This nutrient material was often not easily measurable; it was bound onto the terrogenic detritus which then sedimented out. When this material was available, it was rapidly consumed by the plants, and therefore not detected.

This pattern was not as clear in the Sengwa River mouth due to the presence of floating macrophyte vegetation. Generally the phytomass was lower than in the Mwenda River mouth.

The standing crop increased only slightly from the shoreward stations to the open water at Mujery. The high values (Pt) recorded in October were due to a dense population of Cyanophyta (Anabaena and Phormidium) mostly in the open water stations. This sudden increase in the blue-green algal population can only be explained by the increase in water temperatures, causing a rapid increase in algal growth. Once the available nutrients had been depleted the population died. There was a good correlation between the standing crops along the two transects, so the presence of dead trees did not significantly affect the algal standing crop.

Depth distribution of the algal standing crop e Mwenda Basin showed little variation throughout the year. By June thermal destratification had occurred, but the post turnover algal bloom had not yet appeared. It had, however, appeared further up the lake towards Mlibizi.

Only two high algal populations were quantified, both of which were from the Mwenda River. Fairly high blue-green algal cell counts were recorded from the open water stations at Mujery in October. The rest of the areas studied maintained poor population densities.

The algal density depth distribution at the Mwenda Basin showed a mean decrease with depth for the four sampling periods. Generally the highest standing crop was recorded in the surface waters. The algal population recorded at 35 m in April was dominated by the diatoms (mainly Melosira) - cells that had sedimented through the water profile. As this sample produced no photosynthetic pigments it can be assumed that the cells were dead - but it is not a simple matter to decide whether preserved algal cells were alive prior to preservation.

Diversity of the algal population in the Mwenda River was poor due to the silt-laden waters and the fact that the algal population is flushed out during the rainy season.

The algae of the Mwenda River mouth were dominated by the Chlorophyta or Bacillariophyceae. In October the lakeward stations were dominated by the blue-green algae (Anabaena) which occurred fairly commonly, and once the post turnover algal bloom had disappeared. This could possibly be triggered by fairly sharp rises in water temperature.

The generic diversity index increased from station 1 to station 4 then dropped and levelled off to the open water station; it then increased to the deep water station. All stations in the Mwenda River mouth showed a mean diversity index indicative of a mature population. The variation of algal diversity at the different stations was due to environmental factors acting on the system. The high generic richness at station 4 could be partly due to the many dead trees adjacent to the old river channel, making available additional niches for phytoplankton.

The algal population composition of the Sengwa River was similar to that of the Mwenda River mouth except that the blue-green algae were dominant from October through to December (Anabaena). This could be due to more plant nutrients being made available by the detrital decomposers (undetectable because as this material becomes available the algae utilize it immediately) in the warmer months of the year. The maintenance of this blue-green population coincided with an intensification of the oxycline, which suggests increased oxygen demand by the decomposers.

The generic diversity index curve (Figure 31) shows that the most riverine area (station 1) had a poor algal population diversity, possibly due to the effect of silt-laden river water entering the lake, but that little variation existed in the remainder of the Sengwa River mouth (again a typical tropical ecosystem).

Interesting features of the algal population at Mujery were the large number of desmid species, and the complete dominance of the population by the blue-green algae and diatoms. The Pyrrhophyta and Chrysophyta were more numerous here than in any of the other areas studied.

Vertical distribution of the algal population in the Mwenda Basin showed almost complete homogeneity in August, December and February, dominated either by the Chlorophyta or diatoms. In February the surface waters were dominated by blue-green algae (Anabaena) and the bottom waters by the diatoms (Melosira). Unfortunately no data are available for October, which would give some indication of the horizontal and vertical extent of the blue-green population recorded from the other areas. The generic diversity index shows only a slight decrease with depth, with the highest flux in algal richness in the surface waters (0 m to 5 m) and below 20 m depth.

The diatom population of Lake Kariba was characterized by a large number of rare organisms and only a few species which were significant in the phytoplankton. The list of diatom species presented in Table 20 is only a preliminary indication of the rich flora. The ecology of this group of organisms should be given more attention as they contribute significantly to the phytoplankton.

The most frequently occurring genera recorded from the lake samples were classified according to Raunkiaer's Law of Frequencies. Classes 4 and 5 contained the genera which were also the most dense in the population, i.e. the ecologically important organisms. Taxonomically important organisms fall into classes 1, 2 and 3. The Bacillariophyceae were both ecologically and taxonomically important.

The post turnover algal bloom was similar to blooms occurring in typically eutrophic waters (i.e. blue-green gas-vacuolated algae which form surface scums). The population structure was different, however, because of the presence of more than one dominant genus and many frequently occurring genera. The lake system after thermal destratification was typically a tropical high production/low nutrient ecosystem. The triggering mechanism for the bloom formation was unlikely to be the physical environment but rather availability of nutrient material. The algae utilized this material almost immediately it was available, for no increase could be recorded. Once the bloom died, the organisms sedimented to the bottom where decomposition took place, but the nutrients were not released until turnover the following year. More detailed research is required to elucidate the effect of turnover on the algal population, and the internal nutrient loading from the sediments, which results in this post turnover algal bloom.

The phytoplankton populations of the selected areas of Lake Kariba were most productive in a) the Mwenda River prior to flooding

b) sheltered riverine stations of the drowned river mouths

c) the shoreward stations at Mujery

d) the open lake after turnover (post turnover algal bloom).

The algal population is supplied with nutrients from runoff, nutrient release from drowned animal dung and grass, decomposition of organic material, river flooding into the lake, and nutrient release from bottom sediments. These areas are all along the lake margin (except the Mwenda River) where established mats of Salvinia occur and which is, as Bowmaker (1973) has stated, 'the only zone approaching biological richness'.

The effects of river flooding on the ecosystem have been indicated in 6.0 above. Once the silt-laden waters have reached their specific density level they mix in with the lake water. The suspended silt eventually sediments out, thus re-establishing the light climate in the water. The riverine stations do however remain slightly murky throughout the year. The algal populations are affected for a short period only after the flood and then re-established.

A further factor controlling the algal populations could be the effects of grazing by zooplankton. Many of the algae discussed occur as large cells or colonies unlikely to be ingested by most zooplankters. The latter were also insufficiently numerous to have any effect on the algal population, for they were rarely seen during the phytoplankton counts.

In investigating a diverse and low density algal population such as occurred in Lake Kariba during 1971 - 1972, there was a significant correlation between the total cell count and total algal occurrences, but not so between these two parameters, generic diversity and the photosynthetic pigments (Table 21).

Kobayasi (1961) obtained a significant linear correlation between cell numbers and chlorophyll content in natural populations. However, Stein (1973) has indicated that such a relationship does not always hold. In this survey,

Table 21: Correlation coefficients relating photosynthetic pigments to total cell counts (A), total algal occurrences (B) and generic diversity (C), and total cell counts and total algal occurrences (D) for the lake sampling areas for 1971 - 1972.

Sampling Area	Correlations A	B	C	D
Mwenda River Mouth	-0,1082	-0,1814	-0,2353	0,8297
Sengwa	0,4801	0,3263	-0,3689	0,8024
Mwenda Basin	0,1808	0,2023	0,0546	0,9849
Mujery	0,5536	0,4009	-0,1336	0,8815

a weak linear correlation occurred between photosynthetic pigments and total algal cell numbers at Sengwa and Mujery. It is thus clear, as seen from Table 21, that these relationships need not be very strong for a mature tropical ecosystem, in which the organisms are in a state of delicate balance with the environment.

The areas investigated showed that a very delicate nutrient balance exists in the lake which is largely controlled by the local climatic regime. Nutrient availability is a major factor controlling the phytoplankton population, therefore the sources of these nutrients and input rates to the system should be quantified. This will entail a detailed study of the Mwenda River flooding through an annual cycle, characterizing the nutrients into available and unavailable forms. The rate of release of nutrients from the sediments to the overlying water and subsequent utilization by the phytoplankton requires investigation. The open lake algal population shows very slight change both seasonally and with depth except for the annual post-turnover algal bloom, which is probably the most significant plankton occurrance throughout the year, this needs further investigation. Permanent stations need to be established to study the phytoplankton over a long period. A thorough algal taxonomic survey also needs to be initiated to gain a more complete picture of the lake system.

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9 APPENDIXES

APPENDIX 1

Climatic data for the Nuffield Kariba Research Station for the period 1971/1972

Month		Air Temperature (°C)			Rain fall (mm)
		Maximum	Mean	Minimum	
	J	21,5	18,5	15,4	-
	A	20,4	17,7	15,0	-
	S	28,0	24,4	20,7	-
1971	O	34,4	29,5	24,5	6,1
	N	33,5	29,4	25,3	60,4
	D	32,6	28,0	23,4	130,8
	J	31,2	26,8	22,4	267,0
	F	32,4	27,3	22,2	162,8
	M	31,6	28,8	22,1	111,2
1972	A	32,0	26,7	21,4	36,5
	M	30,2	24,3	18,4	-
	J	29,5	22,4	15,3	-
	J	26,7	21,2	15,7	3,0
	A	28,6	22,7	16,7	-

APPENDIX 2

The monthly maximum, minimum and mean lake levels recorded at the dam wall, in metres above mean sea level (Ministry of Water Development).

Month		Mean	Maximum	Minimum
1971	J	483,78	484,22	483,40
	F	484,30	484,39	484,19
	M	484,06	484,39	483,79
	A	483,69	483,79	483,60
	M	483,96	484,17	483,67
	J	484,33	484,44	484,19
	J	484,42	484,46	484,35
	A	484,26	484,36	484,13
	S	483,99	484,13	483,84
	O	483,65	483,82	483,44
	N	483,34	483,44	483,26
	D	483,17	483,26	483,11
1972	J	483,27	483,76	483,05
	F	484,35	484,57	483,82
	M	483,62	484,09	483,35
	A	483,80	484,03	483,53
	M	484,31	484,57	484,04
	J	484,78	484,89	484,60
	J	484,91	484,95	484,84
	A	484,74	484,91	484,61
	S	484,49	484,63	484,34
	O	484,18	484,34	483,98
	N	483,80	483,98	483,63
	D	483,45	483,63	483,29

APPENDIX 3

The mean temperatures for the seven routine sampling stations in the Mwenda River mouth. The figures in brackets ( ) indicate the range of the mean.

Sampling station	Sampling Periods					No. of readings
	3.8.71	15.10.71	13.12.71	7.2.72	18.4.72	
1	23,3(22,8-24,5)	27,3(26,9-27,4)	30,2(29,7-30,6)	31,1(28,6-33,4)	27,4(27,3-27,6)	4
2	22,9(22,6-23,6)	27,2(26,6-28,0)	29,4(27,3-30,6)	30,5(28,1-34,5)	27,3(27,1-27,7)	7
3	23,2(23,0-23,6)	26,8(26,5-27,0)	28,9(27,8-29,9)	29,4(27,9-30,6)	27,6(27,4-27,8)	10
4	23,0(22,7-23,7)	26,5(26,4-26,5)	28,6(27,7-29,5)	28,7(27,9-30,4)	27,4(27,2-27,6)	12
5	23,0(22,8-23,1)	27,3(26,2-26,4)	28,6(27,8-29,4)	28,6(27,8-30,0)	27,5(27,2-27,7)	13
6	22,8(22,5-23,0)	26,5(25,4-26,8)	28,1(27,4-28,4)	28,2(27,1-29,7)	27,4(27,3-27,7)	18
7	22,8(22,6-22,9)	26,5(25,6-26,7)	28,3(27,8-28,7)	28,1(24,6-29,4)	27,5(27,2-27,9)	15
Mean	23,0	26,9	28,9	29,3	27,4	
Maximum Fluctuation	22,5-24,5	25,4-28,0	27,3-30,6	24,6-34,5	27,1-27,9	

APPENDIX 4

Temperature (°C) and dissolved oxygen (% saturation) data from the depth profiles of the routine sampling stations of the Mujery coastline.

Sampling Station		Sampling Period: 9. 8.71		20.10.71		13.12.71		16. 2.72		21. 4.72		8. 7.72	
		Temp.	D.O.	Temp.	D.O.	Temp.	D.O.	Temp.	D.O.	Temp.	D.O.	Temp.	D.O.
Transect 1	1	23,2	113	28,1	122	30,2	90	32,0	48	27,[illegible]	102	22,8	-
	2	23,3	118	27,9	106	29,4	92	29,6	70	27,1	97	23,2	-
	3	23,3	113	27,2	109	28,7	101	29,2	85	26,9	100	23,0	-
	4	23,2	105	26,6	109	28,9	103	28,5	86	27,3	101	23,0	-
Mean S.E.		23,3 ± 0,1	112 ± 5,4	27,5 ± 0,7	111 ± 7,1	29,3 ± 0,7	97 ± 6,4	29,9 ± 1,5	72 ±17,4	27,1 ± 0,2	101 ± 2,1	23,0 ± 0,1	-
Transect 2	5	24,6	132	28,7	167	30,5	111	28,1	65	26,1	110	21,8	-
	6	24,4	142	28,0	168	30,2	91	29,5	75	26,4	108	22,4	-
	7	24,0	132	28,0	124	30,2	107	29,5	67	26,4	102	22,5	-
	8	23,4	104	26,8	108	29,8	104	28,9	91	26,9	67	23,8	-
Mean S.E.		24,1 ± 0,5	127 ±16,3	27,9 ± 0,8	142 ±30,4	30,0 ± 0,3	103 ± 8,6	29,0 ± 0,6	75 ±11,8	26,5 ± 0,3	104 ±20,1	23,0 ± 0,8	-

APPENDIX 5

Water quality of the Mwenda River mouth.

Chemical Parameter	Station	Sampling Period: August	October	December	February	April	June
ectrical Conductivity (mS/m at 25°C)	1	7,0	7,1	7,2	6,2	7,3	7,4
	2	6,9	7,0	7,1	6,1	7,2	7,4
	3	7,0	7,0	7,0	6,8	7,0	7,4
	4	6,8	7,0	7,0	6,9	6,9	7,2
	5	6,9	7,0	6,9	6,8	6,8	7,2
	6	6,8	7,0	6,9	6,8	6,9	7,2
	7	6,8	7,0	7,1	6,8	6,9	7,5
Total Alkalinity (meq $CaCO_3$/l)	1	0,85	0,80	0,71	0,66	0,83	0,80
	2	0,73	0,76	0,73	0,65	0,79	0,79
	3	0,74	0,80	0,72	0,68	0,78	0,80
	4	0,76	0,80	0,72	0,74	0,77	0,79
	5	0,79	0,80	0,69	0,75	0,77	0,79
	6	0,75	0,80	0,71	0,75	0,77	0,80
	7	0,73	0,80	0,68	0,75	0,76	0,81
Calcium (mg Ca/l)	1	4,28	8,62	15,16	7,68	8,04	8,48
	2	4,24	8,54	14,40	10,08	8,28	8,36
	3	2,14	7,86	14,36	9,88	7,96	7,80
	4	4,26	8,64	15,18	10,48	7,92	8,24
	5	2,90	7,98	14,88	10,84	7,92	8,40
	6	2,10	8,12	15,34	10,92	8,08	8,72
	7	2,36	8,04	15,00	10,24	8,08	8,44
Magnesium (mg Mg/l)	1	0,47	0,34	0,08	0,15	0,16	0,17
	2	0,40	0,21	0,12	0,14	0,34	0,20
	3	0,54	0,30	0,07	0,13	0,13	0,12
	4	0,49	0,21	0,21	0,13	0,50	0,13
	5	0,45	0,52	0,21	0,13	0,07	0,14
	6	0,45	0,36	0,26	0,13	0,11	0,18
	7	0,50	0,37	0,14	0,13	0,12	0,19
Ortho-phosphate (µg PO_4/l)	1	< 10	< 10	< 10	47	13	< 10
	2	< 10	< 10	< 10	53	< 10	< 10
	3	< 10	< 10	< 10	17	12	< 10
	4	< 10	< 10	< 10	22	< 10	< 10
	5	< 10	< 10	< 10	12	11	< 10
	6	< 10	< 10	< 10	14	< 10	< 10
	7	< 10	< 10	< 10	< 10	< 10	< 10
Nitrite (µg NO_2/l)	1	< 10	< 10	40	< 10	100	29
	2	< 10	< 10	40	< 10	100	36
	3	< 10	< 10	30	< 10	64	31
	4	< 10	< 10	20	< 10	42	26
	5	< 10	< 10	30	< 10	34	28
	6	< 10	< 10	30	< 10	34	38
	7	< 10	< 10	20	< 10	32	36

APPENDIX 6

Water quality of the Mwenda Basin deep water station.

Poor weather conditions in August made deep sampling impossible. Magnesium and nitrite analyses were only made after the August sampling trip and in October inconsistent spectrophotometer results were obtained as a result of the high relative humidity.

Chemical Parameter	Depth (m)	Sampling Date Aug	Dec	Feb	Apr	Jun
Electrical Conductivity (mS/m at 25°C)	0	6,7	7,1	6,8	7,1	7,1
	5	6,8	7,1	6,8	7,2	7,4
	10	6,8	7,0	6,8	7,1	7,2
	15	6,8	7,1	6,8	7,1	7,2
	20	-	7,0	6,8	7,1	7,2
	25	-	7,0	6,8	7,1	7,2
	30	-	6,7	6,8	6,8	7,2
Total Alkalinity (meq $CaCO_3$/l)	0	0,70	0,72	0,76	0,76	0,78
	5	0,70	0,73	0,74	0,80	0,77
	10	0,70	0,73	0,73	0,78	0,78
	15	0,70	0,73	0,73	0,79	0,77
	20	-	0,72	0,72	0,79	0,77
	25	-	0,71	0,73	0,75	0,78
	30	-	0,74	0,71	0,79	0,79
Calcium (mg Ca/l)	0	9,04	8,44	8,88	8,32	8,28
	5	9,56	8,28	8,48	8,39	8,64
	10	8,64	8,60	8,80	8,28	8,60
	15	9,00	8,32	8,28	8,48	8,48
	20	-	8,88	7,52	8,08	8,80
	25	-	8,54	8,40	8,48	8,88
	30	-	8,44	7,92	8,00	8,80
Magnesium (mg Mg/l)	0	-	0,14	0,18	0,26	0,17
	5	-	0,12	0,16	0,21	0,17
	10	-	0,15	0,22	0,09	0,11
	15	-	0,12	0,22	0,11	0,16
	20	-	0,14	0,21	0,14	0,19
	25	-	0,14	0,19	0,26	0,15
	30	-	0,14	0,19	0,16	0,18
Ortho-phosphate (µg PO_4/l)	0	11	< 10	< 10	< 10	< 10
	5	19	< 10	< 10	< 10	< 10
	10	14	< 10	< 10	< 10	< 10
	15	25	< 10	< 10	< 10	< 10
	20	-	< 10	< 10	< 10	< 10
	25	-	< 10	< 10	< 10	< 10
	30	-	< 10	< 10	< 10	< 10
Nitrite (µg NO_2/l)	0	-	< 10	< 10	30	20
	5	-	< 10	< 10	30	40
	10	-	< 10	< 10	30	30
	15	-	< 10	10	20	30
	20	-	< 10	40	70	30
	25	-	< 10	40	50	40
	30	-	< 10	40	50	30

APPENDIX 7

Water chemistry for the Sengwa River mouth.

Stations 1, 2 and 3 were visited only twice, due to the river mouth being congested by floating "sudd". The spectrophotometer became faulty in October 1971, thus no calcium or magnesium data are presented.

Chemical Parameter	Station	Sampling Period Aug	Oct	Dec	Feb	Apr	Jun
Electrical Conductivity (mS/cm at $25^{\circ}C$)	1	–	–	9,1	–	–	9,1
	2	–	–	7,3	–	–	8,7
	3	6,9	–	7,2	7,3	–	8,3
	4	6,9	7,2	7,2	7,2	9,0	8,[illegible]
	5	6,9	7,1	7,2	7,2	8,9	8,1
	6	7,1	7,2	7,1	7,2	8,8	7,8
	7	6,9	7,1	7,1	7,2	7,6	–
Total Alkalinity (meq/l)	1	–	–	0,83	–	–	1,03
	2	–	–	0,77	–	–	0,95
	3	0,80	–	0,75	0,80	–	0,92
	4	0,80	0,72	0,74	0,78	0,98	0,91
	5	1,00	0,80	0,72	0,80	0,99	0,92
	6	0,60	0,80	0,73	0,77	0,92	0,83
	7	0,80	0,80	0,72	0,77	0,84	–
Calcium (mg Ca/l)	1	–	–	20,00	–	–	11,24
	2	–	–	16,40	–	–	10,24
	3	7,92	–	16,72	8,72	–	9,84
	4	7,60	–	16,72	8,48	10,88	9,88
	5	7,68	–	17,88	8,84	11,12	9,68
	6	7,92	–	18,08	8,84	10,44	10,28
	7	7,76	–	17,80	10,08	9,12	–
Magnesium (ma Mg/l)	1	–	–	0,12	–	–	0,27
	2	–	–	0,13	–	–	0,20
	3	0,62	–	0,14	0,15	–	0,24
	4	0,52	–	0,15	0,15	0,42	0,20
	5	0,53	–	0,16	0,15	0,14	0,00
	6	0,38	–	0,16	0,15	0,25	0,16
	7	0,37	–	0,11	0,15	0,27	–
Ortho-phosphate ($\mu g\ PO_4/l$)	1	–	–	10,0	–	–	10,0
	2	–	–	10,0	–	–	20,3
	3	48,1	–	10,0	10,0	–	10,0
	4	62,0	24,8	10,0	10,0	10,0	20,3
	5	84,6	87,3	10,0	10,0	10,0	14,7
	6	104,1	102,0	10,0	14,4	10,0	23,5
	7	86,5	115,6	10,0	10,0	10,0	–
Nitrite ($mg\ NO_2/l$)	1	–	–	0,01	–	–	0,01
	2	–	–	0,01	–	–	0,01
	3	–	–	0,01	0,01	–	0,01
	4	–	0,03	0,01	0,01	0,01	0,01
	5	–	0,03	0,02	0,01	0,01	0,01
	6	–	0,04	0,01	0,01	0,01	0,01
	7	–	0,04	0,01	0,01	0,01	–

APPENDIX 8

Total photosynthetic pigment values (μg Pt/l) for the Mwenda River (Methanol extraction).

Station	Sampling Date					
	Aug.	Oct.	Dec.	Feb.	Apr.	Jun.
1	0,59	0,81	2,25	0,00	1,80	0,59
2	11,52	15,52	152,79	0,00	3,60	2,67
3	7,24	4,98	12,35	0,00	2,24	2,74
4	8,24	4,17	40,45	0,00	1,80	3,63

APPENDIX 9

Surface total photosynthetic pigment data (μg Pt/l) for the seven routine sampling stations in the Mwenda River mouth.

Station	Sampling Dates						Mean S.E.
	3. 8.71	15.10.71	3.12.71	7. 2.72	18. 4.72	26. 6.72	
1	3,60	3,42	2,75	3,11	1,12	1,18	2,53 ± 1,11
2	1,80	1,75	2,70	3,23	1,12	1,33	1,98 ± 0,82
3	2,25	1,78	3,01	1,91	2,82	1,41	2,19 ± 0,62
4	2,20	1,63	2,52	1,01	2,10	1,71	1,86 ± 0,53
5	1,48	1,82	1,48	0,28	1,75	1,26	1,34 ± 0,56
6	1,45	2,26	1,59	0,84	1,18	1,85	1,52 ± 0,50
7	1,18	2,19	1,30	1,24	1,01	1,10	1,33 ± 0,43

APPENDIX 10

Photosynthetic pigment depth profiles for the Mwenda Basin routine sampling station.

No data are available for October 1971.

Sampling Depth (m)	Sampling Dates 22. 8.71	6.12.71	19. 2.72	24. 4.72	30. 6.72
0	1,15	1,85	0,67	0,79	1,11
5	1,64	1,78	1,18	0,90	1,48
10	1,38	2,14	0,51	1,18	1,71
15	1,82	2,36	1,35	1,57	1,33
20	-	2,36	0,56	1,74	1,41
25	-	1,63	1,07	1,23	1,63
30	-	1,30	0,39	1,18	1,48
35	-	-	-	0,00*	-

* Sample analysed from below the thermocline contained no H_2S (smell test).

APPENDIX 11

Total photosynthetic pigment data (µg Pt/l) for the offshore transects in the Mujery area, together with the coefficients of linear correlation between the two transects. The overall correlation co-efficient for all sampling stations for the annual cycle is 0,8799.

Sampling Station		Sampling Dates 9. 8.71	20.10.71	13.12.71	16. 2.72	21. 4.72	8. 7.72
Transect 1	1	0,76	3,03	1,01	2,42	2,48	0,89
	2	0,76	2,32	1,35	1,24	1,35	0,59
	3	0,26	4,72	1,07	1,07	1,46	0,89
	4	0,51	4,72	1,01	0,84	1,01	0,59
Transect 2	5	0,72	4,78	1,24	3,04	1,46	0,22
	6	0,62	3,88	1,91	2,08	1,24	0,52
	7	0,25	4,61	0,95	2,08	1,46	0,67
	8	0,42	4,05	0,73	1,57	1,18	0,52
Correlation coefficient		0,9705	0,2024	0,8937	0,9774	0,7470	-0,2294

APPENDIX 12

Replicate algal count data of sample M17 for the six counting chambers, with the mean count and standard deviation for each chamber and count number.

Total algal cell count (cells/l x 10^6)

Chamber	Count Number 1	2	3	4	5	Mean, S.E.
1	0,966	1,021	1,062	0,877	0,867	0,958 ± 0,076
2	0,934	0,981	0,993	0,932	0,906	0,949 ± 0,032
3	0,956	0,853	0,981	0,930	0,922	0,928 ± 0,041
4	0,928	0,958	1,029	0,908	1,007	0,966 ± 0,045
5	0,847	0,946	0,942	0,863	0,965	0,892 ± 0,041
6	0,936	0,958	0,972	1,005	0,869	0,948 ± 0,043
Mean S.E.	0,928 ± 0,041	0,953 ± 0,055	0,996 ± 0,041	0,919 ± 0,050	0,906 ± 0,084	0,940 ± 0,0556

Algal occurrence count (cells/l x 10^6)

Chamber	Count Number 1	2	3	4	5	Mean, S.E.
1	0,468	0,541	0,527	0,468	0,470	0,495 ± 0,034
2	0,429	0,474	0,513	0,506	0,460	0,476 ± 0,028
3	0,492	0,454	0,480	0,500	0,462	0,478 ± 0,014
4	0,480	0,517	0,509	0,450	0,476	0,486 ± 0,024
5	0,448	0,535	0,476	0,470	0,454	0,477 ± 0,033
6	0,484	0,511	0,508	0,504	0,460	0,493 ± 0,020
Mean S.E.	0,467 ± 0,022	0,505 ± 0,033	0,502 ± 0,020	0,483 ± 0,022	0,463 ± 0,000	0,484 ± 0,026

APPENDIX 13

Coefficients of linear correlation between total cell count and total algal occurrences (number of organisms) for all the plankton samples collected at different times of the year.

Sampling Area	Sampling Period.				
	August	October	December	February	April
Mwenda River Mouth	0,9454	0,9982	0,9961	0,9947	0,9711
Mwenda Basin	0,7746	-	0,9929	0,9939	0,9928
Mujery	0,9117	0,8449	0,6701	0,9853	0,9955
Sengwa River Mouth	0,8700	0,3970	0,6409	0,7233	0,9605

APPENDIX 14

Seasonal variation of generic diversity indices for all stations of the routine sampling areas.

No data are available for the Mwenda River stations, and for the Mwenda Basin in October 1971.

Area	Station	Sampling Period Aug	Oct	Dec	Feb	Apr	Mean, S.E.
Mwenda River Mouth	1	4,15	4,11	4,85	3,02	3,40	3,91 ± 0,71
	2	7,35	4,70	3,39	5,41	3,42	4,85 ± 1,64
	3	[illegible]	5,15	5,82	4,85	5,11	5,37 ± 0,47
	4	5,83	4,70	6,19	6,05	5,10	6,65 ± 0,64
	5	6,20	4,94	5,41	5,62	4,40	5,31 ± 0,68
	6	6,84	3,71	5,72	4,91	5,69	5,37 ± 1,15
	7	5,11	4,26	5,42	5,20	4,79	4,96 ± 0,45
Mwenda Basin	1	4,29	-	5,93	5,75	7,58	5,89 ± 1,34
	2	4,09	-	4,87	4,57	6,68	5,05 ± 1,13
	3	5,14	-	5,04	4,54	5,75	5,12 ± 0,49
	4	4,96	-	6,00	5,15	6,81	5,73 ± 0,85
	5	-	-	3,91	4,45	5,99	4,78 ± 1,08
	6	-	-	4,90	6,46	5,45	5,60 ± 0,79
	7	-	-	6,07	3,99	6,17	5,41 ± 1,25
	8	-	-	-	-	5,44	-
Mujery	1	5,43	3,86	6,58	7,67	7,17	6,16 ± 1,53
	2	6,66	5,73	6,86	7,75	5,34	6,47 ± 0,95
	3	6,43	6,29	7,04	8,07	6,79	6,92 ± 0,70
	4	5,54	4,95	4,91	6,32	6,16	5,58 ± 0,66
	5	5,91	[illegible]	7,75	8,13	4,38	6,48 ± 1,51
	6	8,17	5,67	5,40	6,74	6,56	6,51 ± 1,08
	7	6,48	[illegible]	6,85	4,70	9,17	6,77 ± 1,59
	8	[illegible]	[illegible]	5,90	9,56	2,92	5,51 ± 2,50
Sengwa River Mouth	1	-	-	1,12	-	-	1,12
	2	-	-	7,49	-	-	7,49
	3	6,48	-	7,09	8,17	-	7,25 ± 0,85
	4	6,33	6,79	6,77	7,75	5,38	6,60 ± [illegible]
	5	7,63	4,28	5,80	6,28	7,06	6,21 ± 1,29
	6	7,09	8,17	4,66	6,32	6,50	6,55 ± 1,28
	7	4,64	8,07	7,04	7,72	-	[illegible] ± 1,54

APPENDIX 15

List of algal genera counted, and generic frequency data for all the sampling areas.

Total number of samples was 145, and the total number of algal genera was 55. Genera are arranged into five % frequency classes (Kershaw 1964). Sampling areas are as follows: MR - Mwenda River, MRM - Mwenda River mouth, B - Mwenda Basin, S - Sengwa River mouth, J - Mujery [redacted] (1-4) and [redacted] (5-8) transects.

	Sampling Areas						No. of occurr -ences	% freq.	Frequency class
	MR	MRM	B	J 1-4	J 5-8	S			
Chlorophyta									
Pandorina		4	1	5	5	4	19	13,1	1
Eudorina	3	13	10	11	8	15	60	41,4	3
Sphaerocystis		4	5				9	6,2	1
Gloeocystis		1		3	1	7	12	8,3	1
Elakatothrix						2	2	1,4	1
Ulothrix	1			2	5		8	5,5	1
Oedogonium				1	3		4	2,8	1
Golenkina		4	3	2		2	11	7,6	1
Characium				1			1	0,7	1
Pediastrum	4	12	13	7	7	3	46	31,7	2
Sorastrum						1	1	0,7	1
Coelastrum	2	2[illegible]	20	11	13	13	88	60,7	3
Treubaria		[illegible]	4				5	3,4	1
Oocystis		19	15	15	15	19	83	57,2	3
Nephrocytium			1	6	7	15	29	[illegible]0,0	1
Lagerheimia		2	3	1		3	9	6,2	1
Franceia		9	20	5	2	13	49	33,8	2
Ankistrodesmus				12	13		25	17,2	1
Schroederia	15	35	26	20	18	24	138	95,2	5
Closteriopsis				3		3	6	4,1	1
Selenastrum		2	1			1	4	2,8	1
Kirschneriella		7	8	7	8	3	33	22,8	2
Tetraëdron	8	33	24	19	19	20	123	84,8	5
Scenedesmus	9	35	26	19	17	22	130	88,2	5
Crucigina	1	13	13	2	3	7	39	26,9	2
Pectodictyon		1		1			2	1,4	1
Mougeotia	1	1		9	6	10	27	18,6	1
Spirogyra	2	1					3	2,1	1
Closterium	1	3	1	3	3	3	14	9,6	1
Gonatozygon	3	21	18	16	16	15	89	61,4	3
Spirotaenia				1			1	0,7	1
Arthrodesmus			2	3	6		11	7,6	1
Xanthidium	1	1	2	6	10	1	21	14,5	1
Cosmarium	1	17	4	16	17	19	74	51,0	3
Euastrum	1	9	8	9	10	14	51	33,2	2
Micrasterias		1		4	1		6	4,1	1
Staurodesmus				1	4	2	7	4,8	1
Staurastrum	4	30	20	20	20	23	117	80,7	4
Spondylosium		2		8	5	15	30	20,7	1
Sphaerozosma				4	2		6	4,1	1

continued...

APPENDIX 15 continued. List of algal genera counted, and generic frequency data for all the sampling areas.

	Sampling Areas						No. of occurr -ences	% freq.	Fre- quency class
	MR	MRM	B	J 1-4	J 5-8	S			
Euglenophyta									
Euglena	3			6	7		16	11,0	1
Phacus	3			2		1	6	4,1	1
Pyrrhophyta									
Gymnodinium	2		1				3	2,1	1
Glenodinium	1	1				2	4	2,8	1
Peridinium	8	35	24	20	20	23	130	90,0	5
Chrysophyta									
Tetraedriella	2	33	26	20	18	24	123	84,8	5
Centritractus				3	3		6	4,1	1
Bacillariophyceae									
Centric diatoms	9	27	23	14	12	21	106	73,1	4
Pennate diatoms	15	33	26	19	19	23	135	93,1	5
Cyanophyta									
Merismopedia	2	19	16	7	14	15	73	50,3	3
Microcystis	5	7	3	14	9	6	44	30,3	2
Phormidium	8	5	4	13	8	7	45	31,0	2
Spirulina		7	6	7	5	9	34	23,4	2
Anabaena	5	33	24	20	18	22	122	84,1	5
Genera present	28	39	34	46	39	39			
Total genera	55	55	55	55	55	55			
Number of samples	20	35	26	20	20	24			

APPENDIX 16

Depth profiles of total photosynthetic pigments (μg Pt/l) for stations 1, 3 and 6 on 14. 2.72 (prior to river flooding) and 17. 2.72 (after flooding).

Sampling depth (m)	Sampling stations					
	14. 2.72			17. 2.72		
	1	3	6	1	3	6
0	1,57	2,59	1,12	3.60	4,38	2,13
1	2,02	2,07	1,01	3,03	2,13	1,00
2	2,81	2,33	1,46	2,24	1,57	1,08
3	-	2,47	1,52	0,48	1,01	1,29
4	-	1,47	2,36	-	-	1,45
5	-	-	2,42	-	-	1,55

APPENDIX 17

The effect of the Mwenda River flash flood on the water transparency of stations 1, 3 and 6 in the Mwenda River mouth.

Sampling station	Sampling Dates						
	7.2.72	14.2.72	Flood 16.2.72	17.2.72	21.2.72	23.2.72	26.2.72
1	0,3	0,3		0,2	0,2	0,2	0,4
3	1,1	1,1		0,2	0,2	0,3	0,6
6	4,9	5,0		4,0	4,2	4,7	4,8

APPENDIX 18

Notes on the algal taxa

Due to the taxonomic complexity of the algae of Lake Kariba, the organisms were classified to the generic level; where possible, certain algae were identified to the specific level, and selected samples were submitted for specialized taxonomic treatment (diatom identification). All the samples were preserved with Lugol's iodine, which on one hand aided the microscopic of many taxa which had distinct chloroplasts, and on the other hand hindered identification of the Pyrrhophyta where live material was required.

The algae were classified according to the scheme of Prescott (1962). Additional texts used were Claassen (1961), Fritsch (1935), Prescott (1970), Round (1973), Taft and Taft (1971), Thomasson (1957, 1960 and 1965), and West and West (1904 - 1923).

Complete sets of all algal samples collected are housed in:-

a) Botany Department,
University of the Witwatersrand,
Jan Smuts Ave.,
Johannesburg

and b) National Institute for Water Research,
Council for Scientific and Industrial Research,
P O Box 395,
Pretoria.

The notes which follow outline the general ecological distribution in time and space of the respective taxa, together with any special peculiarities.

PANDORINA Bory 1824

Occurred rarely at all sampling areas except the Mwenda River.

EUDORINA Ehrenberg 1832

Recorded from all sampling areas, occurring fairly frequently in the Mwenda and Sengwa River mouths.

VOLVOX Linnaeus 1758

Recorded from net samples from the riverine stations of the Mwenda River mouth, and rarely in the post-turnover algal bloom.

PALMELLA Lyngbye 1819

Recorded only once from the riverine stations of the Mwenda River mouth in a net sample. Present for a short period only in February.

SPHAEROCYSTIS Chodat 1897

Recorded from the Mwenda and Sengwa River mouths and the Mujery area, in February and April. The genus occurred very rarely, generally comprising $< 5,0\%$ of the population.

GLOEOCYSTIS Naegeli 1849

Occurred very rarely in the Mwenda River mouth in August; in the Mwenda Basin it was found near the surface in August, and below 20 m in February.

ELAKATOTHRIX Wille 1898

Recorded very rarely from the Sengwa River mouth in April only.

ULOTHRIX Kützing 1833

Recorded very rarely, once from the Mwenda River at station 1 (Bowmaker 1969), and from the Mujery area from December to February.

OEDOGONIUM Link 1820

Recorded rarely from the Mujery area only from October to December. No fruiting material was recorded.

GOLENKINA Chodat 1894

This organism occurred very rarely in all areas except the Mwenda River. Generally recorded in the cool dry period and absent during the rains. Characteristic of oligotrophic waters (Prescott 1969).

CHARACIUM A. Braun 1849

Very rare in the phytoplankton. Recorded from station 1 at Mujery in August only. A benthic or periphytic alga, detached by wave action.

PEDIASTRUM Meyen 1829

Recorded from all the sampling areas. Absent from the phytoplankton of the Mwenda River in February and April (mainly due to river flooding), and the Mwenda and Sengwa River mouths once the waters began cooling. This genus was generally present throughout the year at Mujery and the Mwenda Basin. Generally comprised $>$ 5,0% of the phytoplankton, except in December, when it contributed 29% of the Mujery population (station 2) and was abundant at station 2 in the Mwenda River. This genus was also conspicuous in the post turnover algal bloom. Main species present:

<u>Pediastrum clathratum</u> (Schroter) Lemm.

P. simplex (Meyen) Lemm.

P. duplex Meyen

P. tetras (Ehrenberg) Ralfs

P. boryanum (Turp.) Meneghini.

SORASTRUM Kützing 1845

A rare alga in Lake Kariba; only one specimen recorded from the Sengwa River. The organism recorded resembled very closely Sorastrum americanum var. undulatum G.M. Smith, reported by Prescott in 1962.

COELASTRUM Naegeli 1849

Recorded from all sampling areas, occurring fairly frequently in the samples except those from the Mwenda River. Main species noted were:

Coelastrum proboscidum Bohlin

C. reticulum (Dang.) Senn.

C. microporum Naegeli.

TREUBARIA Bernard 1908

Very rare organism, recorded from the Mwenda River mouth and the Mwenda Basin in the cool dry period of the year. This taxon is characteristic of an oligotrophic lake (Prescott 1969).

OOCYSTIS Naegeli 1855

Widely distributed throughout the samples, although not recorded from the Mwenda River. Colonies two- to four-celled only. This genus is characteristic of oligotrophic lakes (Prescott 1969).

<u>NEPHROCYTIUM   Naegeli 1849</u>

Generally a rare genus, but recorded fairly frequently in the Sengwa River mouth samples throughout the year.

<u>LAGERHEIMIA   Chodat 1895</u>

A rare geuns in the areas sampled except the Mwenda River. Generally occurred in the cool dry period of the year.

<u>FRANCEIA   Lemmermann 1898</u>

Occurred generally in the sampling areas except the Mwenda River. Never contributed more than 5,0% of the population. Cells always recorded solitary and free-floating.

<u>ANKISTRODESMUS   Corda 1838</u>

Recorded from the Mujery offshore transects only, throughout the year. This genus was often fairly rare in the samples. The organisms recorded resembled <u>Ankistrodesmus falcatus</u> (Corda) Ralfs.

<u>SCHROEDERIA   Lemmermann 1898</u>

These organisms are free-floating unicellular or circular, fusiform or straight, tapering at the poles. They occur in all the sampling areas, being recorded from most samples. The genus generally contributes > 10% of the population; in August it dominated the Mwenda River phytoplankton, and in December and April comprised ± 25% of the riverine algae in the Mwenda River mouth (stations 1, 2, 3 and 4).

CLOSTERIOPSIS Lemmermann 1898

A rare genus, recorded from Mujery in October and December, and the Sengwa River mouth in February.

SELENASTRUM Reinsch 1867

A rare genus recorded from the Mwenda and Sengwa River mouths, and the Mwenda Basin. Selenastrum is characteristic of oligotrophic waters, and is strictly a euplankter.

KIRSCHNERIELLA Schmidle 1893

Those recorded were arcuate to irregularly curved cylinders with broadly rounded ends. Cells generally did not lie with their convex faces opposed. Colonies consist of 4 or 8 irregularly dispersed cells lying within the gelatinous matrix. Recorded from the plankton of all the sampling areas except the Mwenda River.

TETRAËDRON Kützing 1845

Cells solitary and free-floating. Genus is widely distributed and repre= sented by many species. These organisms occur at all the sampling areas throughout the year and generally constitute ... % of the phytoplankton population. Accurate identification of the species of this genus is difficult as Tetraëdron-like stages occur in the life-cycles of Pediastrum, Hydrodictyon and Oocystis. The species of this genus can only be established if reproduction by autospores is known to take place.

SCENEDESMUS Meyen 1829

Recorded from the plankton of all the sampled areas. Singularly the most numerous organism in Lake Kariba, frequently completely dominating the phytoplank[illegible] [illegible]pulation. The coenobia of 2 and 4 cells only were recorded in the lake s[illegible]ples. This genus is mostly represented by Scenedesmus bijuga (Turp.) Lagerheim; other species recorded are:

S. dimorphus (Turp.) Kützing

S. quadricauda (Turp.) de Brébisson

S. bijuga var. alternans (Reinsch) Hansgirg

S. opoliensis P. Richter.

CRUCIGINA Morren 1830

Recorded from all the areas, but most numerous in the Mwenda River mouth and Mwenda Basin.

PECTODICTYON Taft 1945

Rare genus recorded from the areas close to the shore in the Mwenda River mouth and Mujery uncleared areas in August to October. Taft (1945) describes only one species of this genus from the United States (see Smith 1950).

MOUGEOTIA C.A. Agardh 1824

Occurs occasionally in all the shoreward areas, being most frequent in the Sengwa River mouth. Recorded throughout the year. This genus was identified from vegetative filaments only, as no reproductive structures were recorded (see Smith 1950). The filaments of Mougeotia may be confused with the smooth-walled filaments of Gonatozygon. In both cases the cell length is many times greater than the width.

SPIROGYRA Link 1820

Occurs as a benthic organism lining the bottoms of small rocky pools in the Mwenda River. This alga fruits in late spring (October to December) before the rains flush the river out. Recorded from the plankton at stations 1, 2 and 3 in the Mwenda River mouth. These are fragments of the benthic colonies from the Mwenda River, and soon disappear from the phyto= plankton.

CLOSTERIUM Nitzsch 1817

Occurs rarely at all the sampling areas. Described by Smith (1950) as a genus frequently encountered in inland waters.

GONATOZYGON de Bary 1856

Frequently encountered at all sampling areas throughout the year - pop= ulation reached a peak towards the end of the hot rainy period. It occurred most frequently at Mujery (contributed 37,7% of the total population at station 5 in April 1972) and the Sengwa River mouth. Many species were noted, and the narrow, smooth-walled taxa occurred in short chains. In the lake samples these taxa were very similar to Mougeotia and Gonatonema Wittrock 1878 (see West and Fritsch 1927). Occasionally large spinescent individuals occurred. The slight dilation in the vicinity of the truncate apices of the filamentous species was often indistinct.

SPIROTAENIA de Brébisson 1848

This genus was recorded only once from station 5 at Mujery in April.

ARTHRODESMUS Ehrenberg 1838

Recorded rarely from the lake plankton at the Mwenda Basin (15 m depth only) and Mujery areas only. This genus was only recorded during the rainy season.

XANTHIDIUM Ehrenberg 1834

Recorded from all the sampling areas, occurring most frequently at Mujery in the hot dry season (August to November). Main species was:

Xanthidium subtrilobium var. africanum (Schmidle) Grönblad and Scott.

COSMARIUM Corda 1834

Recorded from all the sampling areas, being fairly frequent in the Mwenda and Sengwa River mouths and at Mujery, and occurring rarely in the Mwenda River and the Mwenda Basin. Generally contributed $> 5,0\%$ to the total algal populations. A large number of species represented this genus (see Thomasson 1965).

EUASTRUM Ehrenberg 1832

This genus occurred at all the sampling areas throughout the year, being very rare in the Mwenda River. Many species represented this genus, the most frequent being:

Euastrum denticulatum var. rectangulare West and West

E. bidentatum Naegeli.

MICRASTERIAS Agardh 1827

Very rarely recorded from the Mwenda River mouth and Mujery throughout the year. The species recorded were:

Micrasterias radiata Hass

M. radians Turner

M. amboeiensis (Grönblad and Scott) Thom.

M. truncata (Corda) Breb.

STAURASTRUM Meyen 1829

Recorded very frequently at all the sampling areas throughout the year, generally contributing > 5,0% of the total population. This genus was represented by a large number of species, each occurring rarely.

SPONDYLOSIUM de Brébisson 1844

Recorded from the Sengwa River mouth and the Mujery area, and rarely from the Mwenda River mouth. It was absent in the Mwenda River and the Mwenda Basin. Most frequent in the rainy season (November to April). The plants occur sparingly in samples rich in desmids (Smith 1950).

SPHAEROZOSMA Corda 1835

A rare genus recorded from the Mujery area in the cool season and in the post-turnover algal bloom. This filamentous desmid is associated with samples ric'. in desmids (Smith 1950).

PHACUS Dujardin 1841

A very rare genus in the lake samples, recorded from the Mwenda River, Sengwa River mouth and the Mujery area. These plants do not have the same preference for stagnant water as does Euglena, and seldom occur abundantly (Smith 1950).

EUGLENA Ehrenberg 1838

A rarely recorded taxon from the Mwenda River during the dry season when the river is not flowing, and from the . .reward stations along the Mujery coast.

GYMNODINIUM (Stein) Kofoid and Swezy 1921

Recorded very rarely from the Mwenda River system.

GLENODINIUM (Ehrenb.) S... ...03

A very rare genus, recorded from the Mwenda River and the Mwenda and Sengwa River mouths.

PERIDINIUM Ehrenberg 1832

A very common genus in the phytoplankton of Lake Kariba. Present in all the lake samples from all areas throughout the year. Less abundant in the silt-laden Mwenda River waters. Generally comprised less than 10% of the population, being most abundant in the Mwenda and Sengwa River mouths (up to 41%).

CERATIUM Schrank 1793

A very rare genus, recorded from net samples of the post-turnover bloom. Only species recorded was C. hirudinella O.F.N.. Begg (1967) recorded this species as being common in net samples, though rare in the Mlibizi basin. Probably less abundant at present than before. Thomasson (1965) also re= corded Ceratium sp. from the net plankton in Lake Kariba.

TETRAEDRIELLA Pascher 1930

A frequently occurring plant from all the areas except the Mwenda Basin throughout the year. The density of this plant was generally below 10% of the algal population. There were probably only two species representing this genus.

CENTRITRACTUS Lemmermann 1900

A very rare genus recorded from the Mujery area in February only.

CENTRIC DIATOMS

The plants representing this group of genera occurred in all the sampling areas throughout the year. Only three genera were recorded from the limited number of samples submitted for identification, namely Melosira, Attheya and Cyclotella. The first often dominated the population, while Attheya was a very rare and delicate diatom which has not been recorded from Southern Africa to date. The species recorded were:

Attheya sp.

Cyclotella kützingiana Thawaites

C. pseudostelligera Hustedt

C. sp.

Melosira distans (Ehrenberg) Kützing

M. granulata (Ehrenberg) Ralfs

M. granulata var. angustissima O. Müller

PENNATE DIATOMS

This group of plants was represented at all the sampling areas throughout the year. From the limited number of samples that were submitted for a systematic study, eighteen genera and fifty-six species have so far been identified. Many of these plants were extremely rare in the samples. The periphytic populations (attached to the submerged leaves of Salvinia molesta D.S. Mitchell) were generally dominated by Eunotia lunarus, Synedra rumpens, S. ulna and S. ulna var. danica. Gomphonema parvulum was very abundant, attached to Nitella sp. growing on the mud banks of the Mwenda River pools.

Achnanthes lanceolata (Brébisson) Grunow

A. minutissima Kützing

Anomoeoneis exilis (Kützing) Cleve

Caloneis clevei (Lagerstedt) Cleve

Cymbella grossestriata O. Müller

C. kolbei Hustedt

C. microcephala Grunow

C. turgida Gregory

C. ventricosa Agardh

Epithemia sorex Kützing

Eunotia flexuosa (Brébisson) Kützing

E. lunarus (Ehrenberg) Grunow

E. pectinalis (Kützing) Rabenhorst

Fragillaria pinnata Ehrenberg

F. vaucheriae (Kützing) Boye Petersen

Gomphonema brasiliense Grunow

G. gracile Ehrenberg

G. parvulum (Kützing) Grunow

G. sp.

Gyrosigma kützingii (Grunow) Cleve

Navicula angusta Grunow

N. cryptocephala Kützing

N. exiguiformis Hustedt

N. halophila (Grunow) Cleve

N. pupula Kützing

N. rostellata Kützing

N. seminulum Grunow

N. submolesta Hustedt amend. Archibald

N. tenella Brébisson

N. tridentula Krsske

N. vitabunda Hustedt

N. zanonii Hustedt

[illegible]dium affine (Ehrenberg) Cleve

Nitzschia acicularis (Kützing) W. Smith

N. amphibia Grunow

N. confinis Hustedt

N. epiphyticoides Hustedt

N. gracilis Hantzsch

N. intermedia Hanyzsch

N. kützingiana Hilse

N. palea (Kützing) W. Smith

N. perpusilla Rabenhorst

N. subsala Cholnocky

Pinnularia interrupta W. Smith

P. interrupta fo. minutissima Hustedt

P. mesolepta (Ehrenberg) W. Smith

Rhizosolenia eriensis H.L. Smith

Rhopalodia gibba (Ehrenberg) O. Müller

Stauroneis merrimacensis (Grunow) Woodhead et Tweed

Surirella tenera Gregory

Synedra acus Kützing

S. acus var. radians Hustedt

S. amphicephala Kützing

S. rumpens Kützing

S. ulna (Nitzsch) Ehrenberg

S. ulna var. danica Grunow.

MERISMOPEDIA Meyen 1839

Recorded fairly frequently from all the sampling areas, except in the Mwenda River where it occurred rarely. Not abundant in the samples ($<$ 5,0% of population).

MICROCYSTIS Kützing 1833

Present at all the sampling areas, being most frequent in the Mujery area, due to very local eutrophication by nutrient release from dung and decaying grass. The density of these organisms was generally low, except in the post-turn= over algal bloom when a large population was recorded.

PHORMIDIUM Kützing 1843

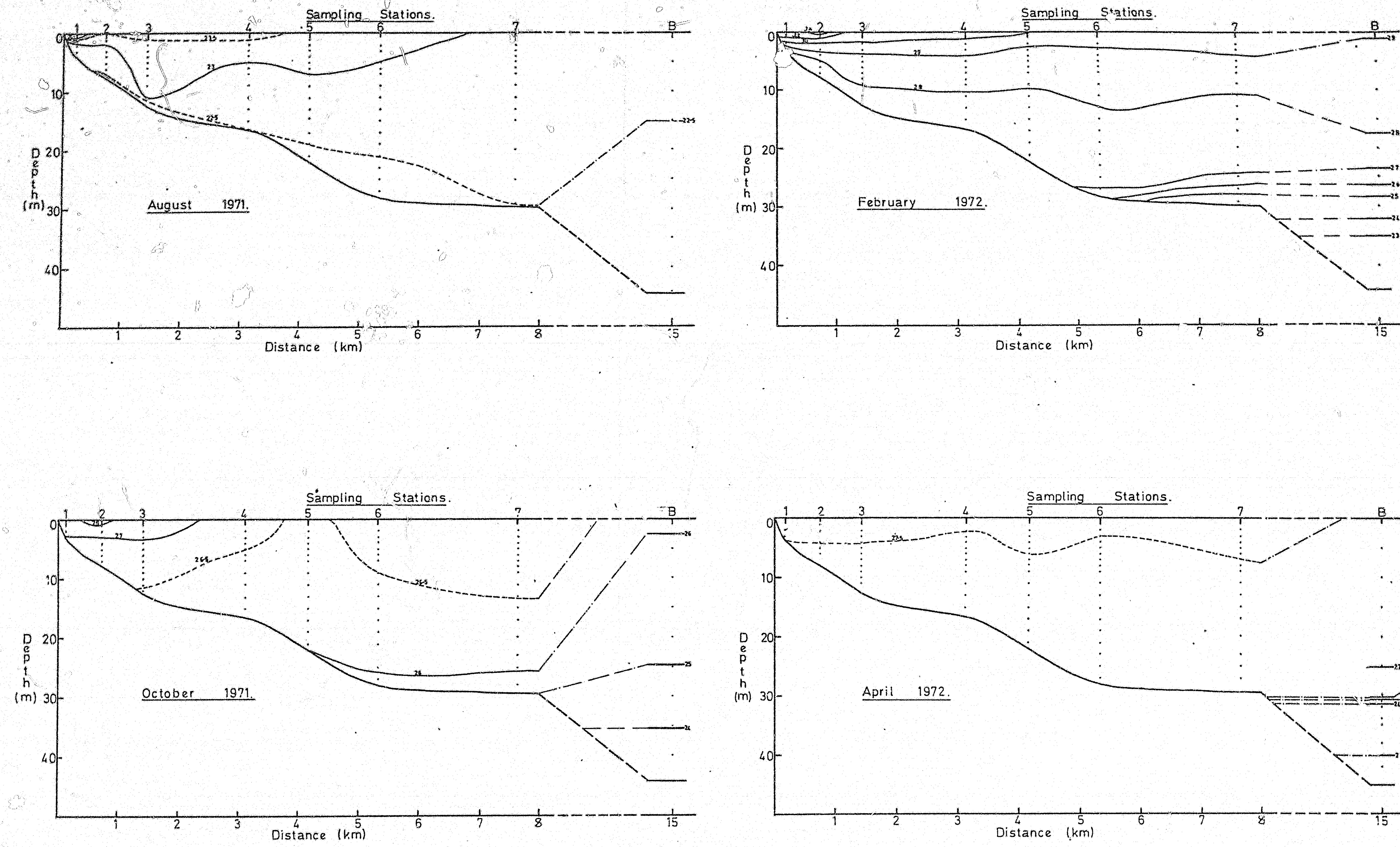
Recorded from all the sampling areas throughout the year, being most frequent at Mujery. This genus often completely dominated the phytoplankton. An accurate quantification of the population of Phormidium was occasionally difficult due to indistinct cell wall formation between cells of a filament.

SPIRULINA Turpin 1827

Occurred frequently in all the lake areas. Indistinct in the phytoplankton, never contributing more than 5,0% of the algae.

ANABAENA Bory 1822

Recorded frequently from all samples throughout the year. This genus contributed significantly to the phytoplankton, often dominating the population. Present in the post-turnover algal bloom. Generally these organisms dominated the lake phytoplankton in October, which coincided with the warming of the lake waters.



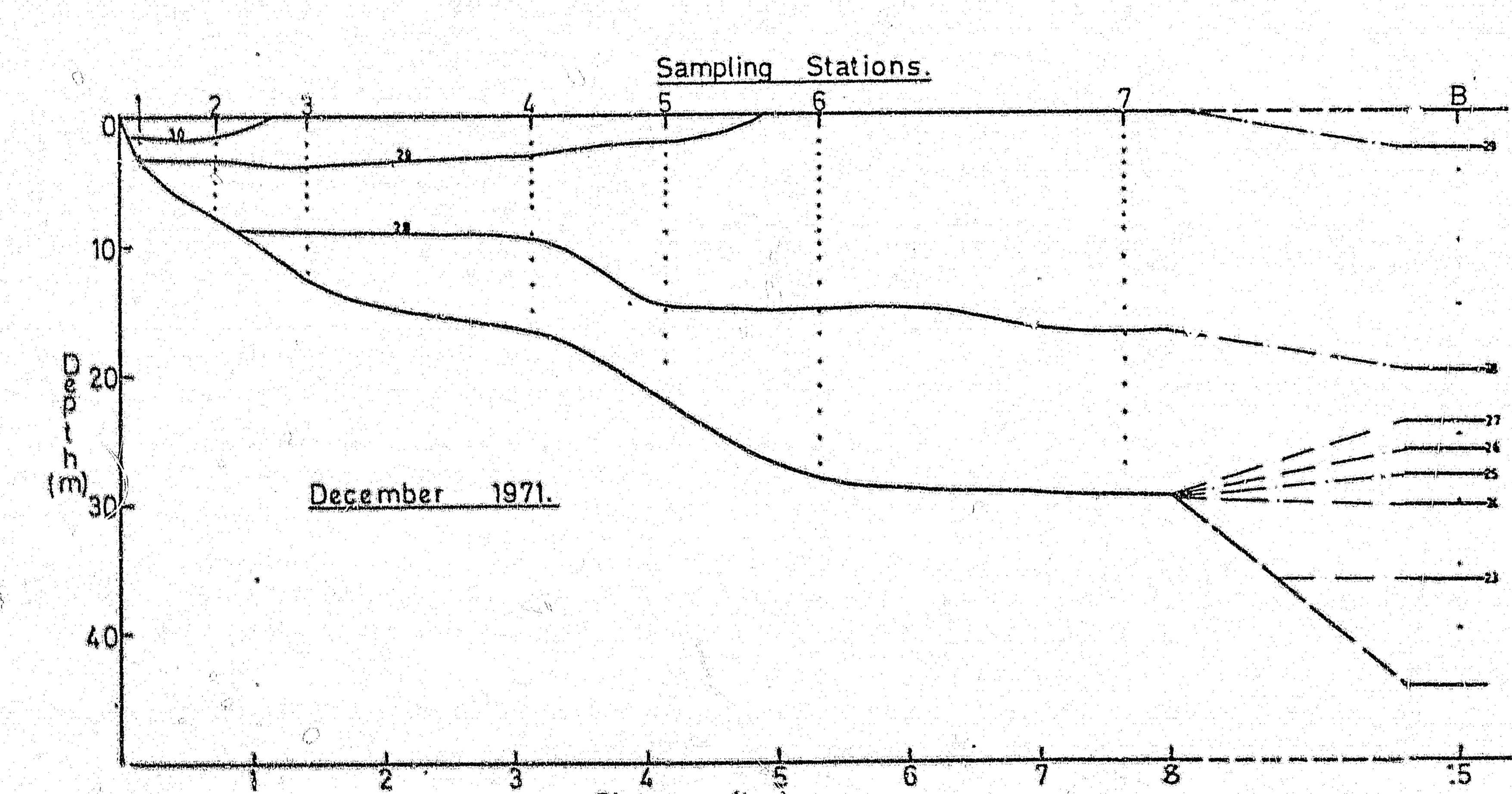
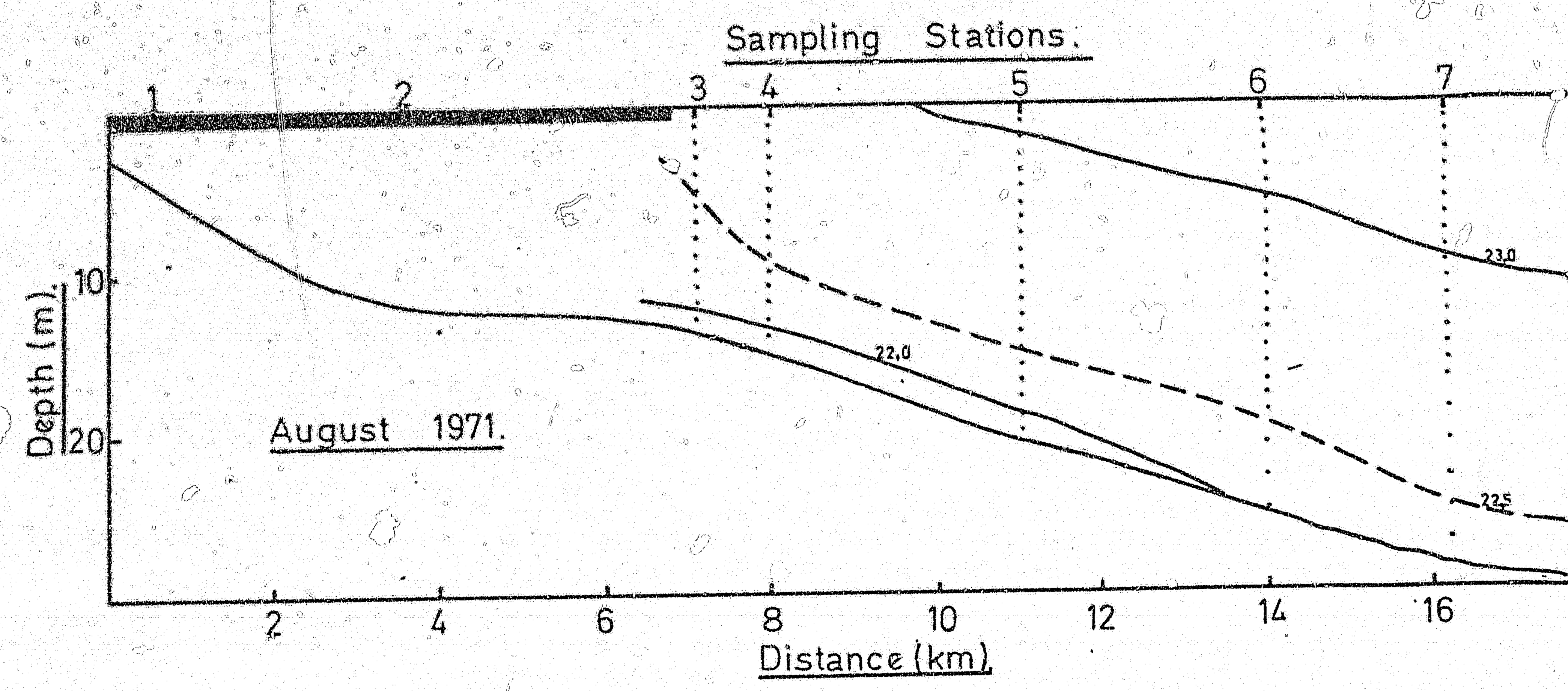
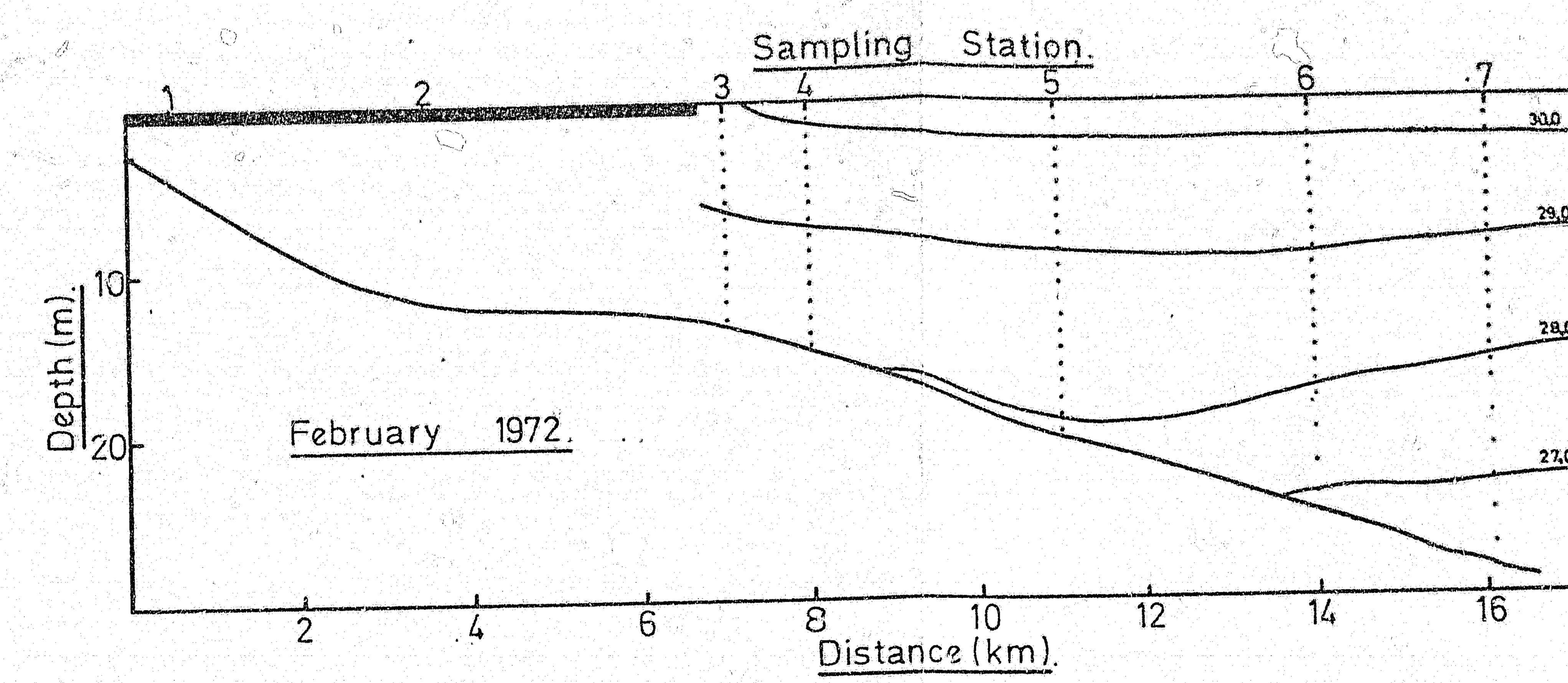
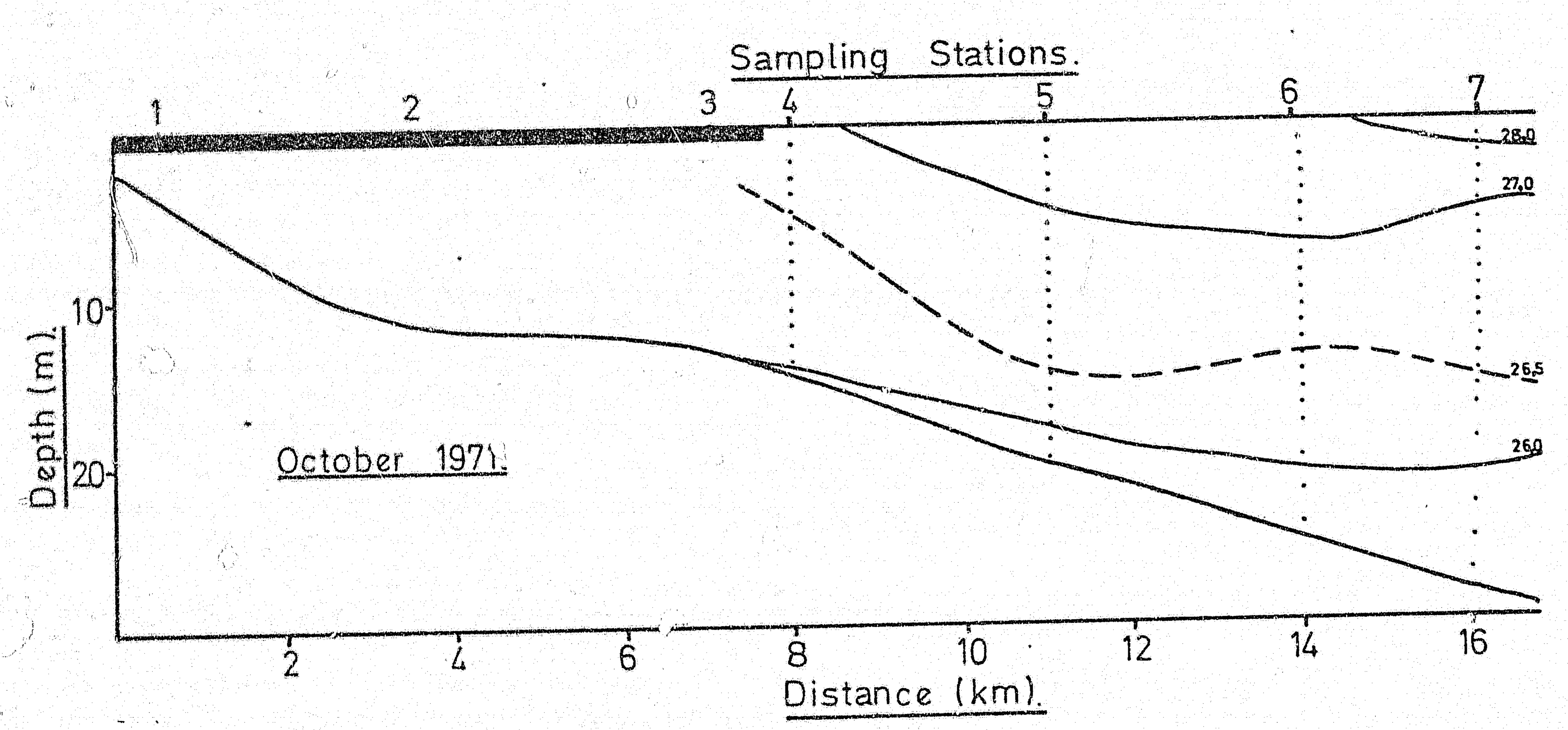
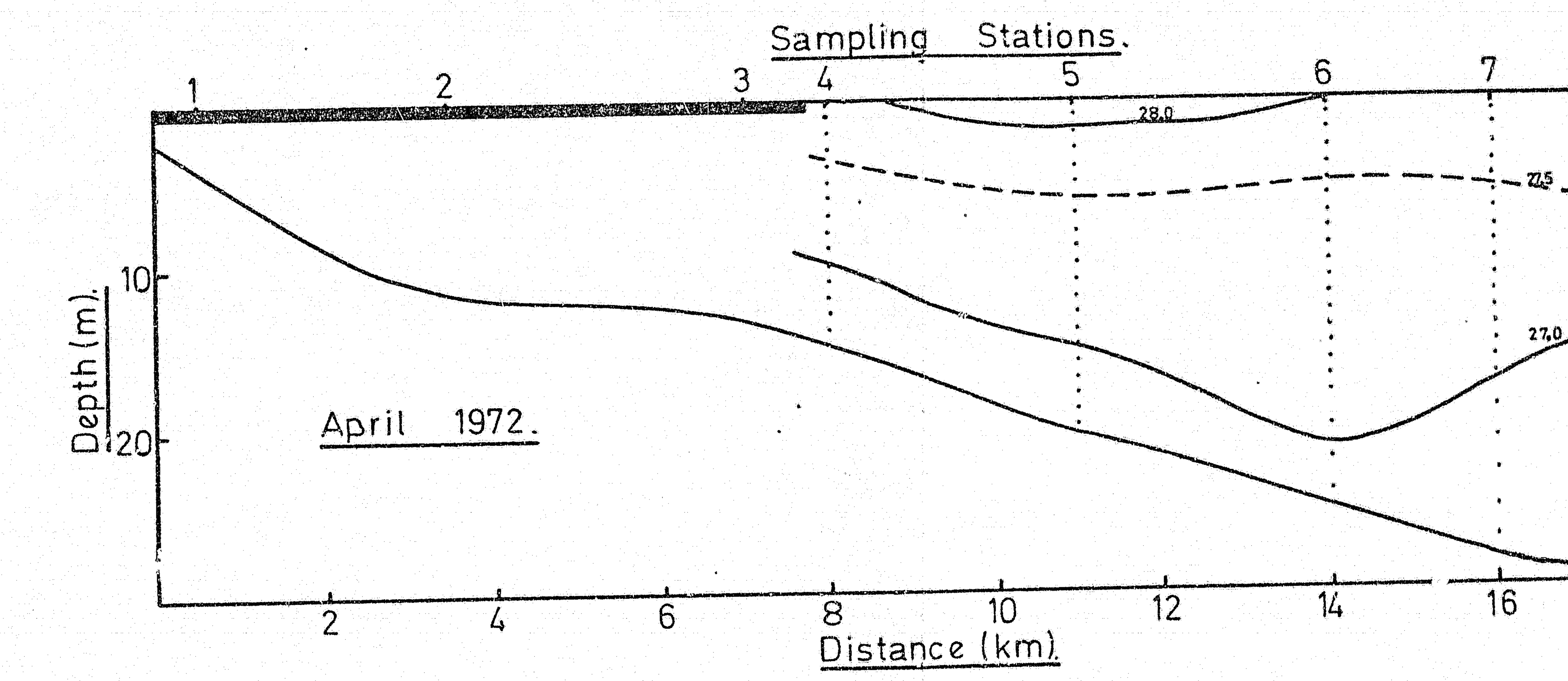


Figure 10: Isotherm diagrams for the Mwenda River mouth for August, October and December 1971, and February and April 1972. The Mwenda Basin deep water station has been included to indicate the thermal effect of the open water on that in the drowned river mouths.









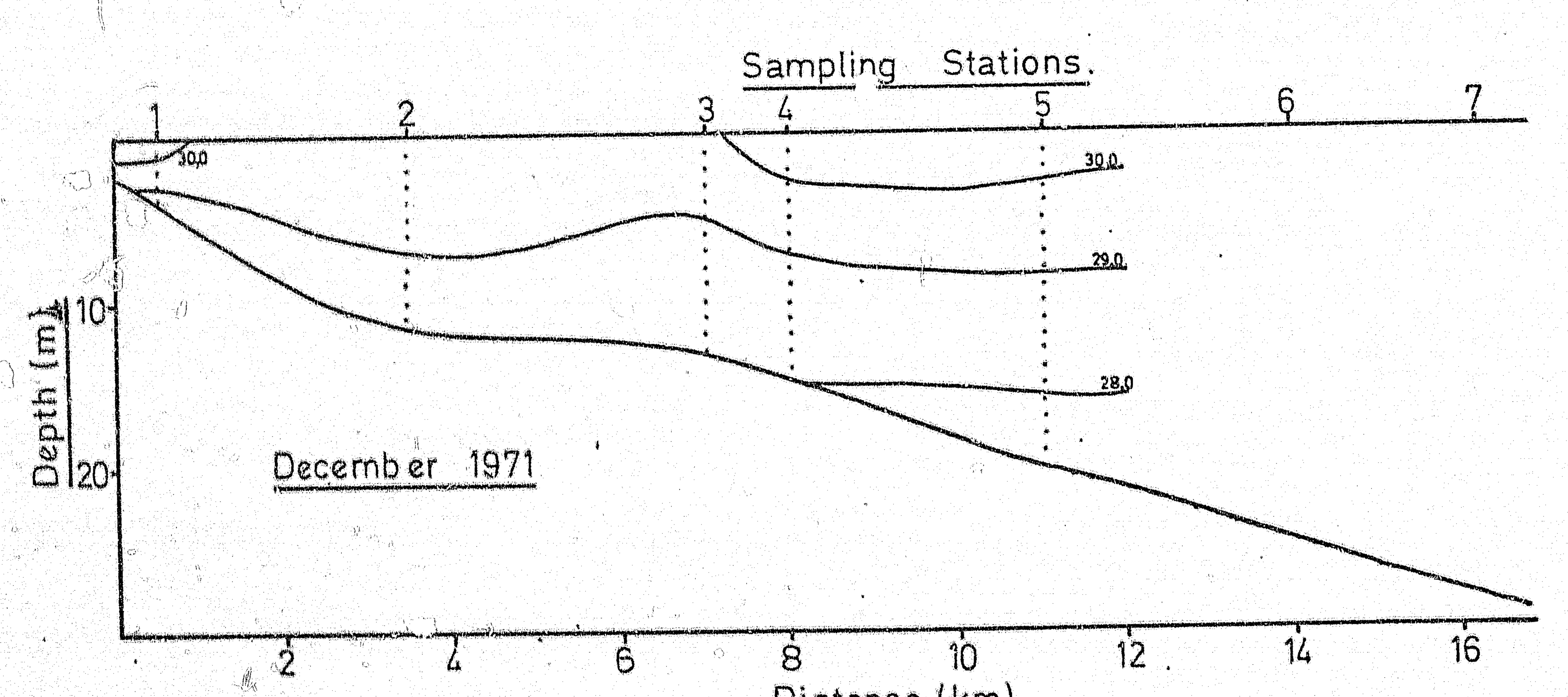
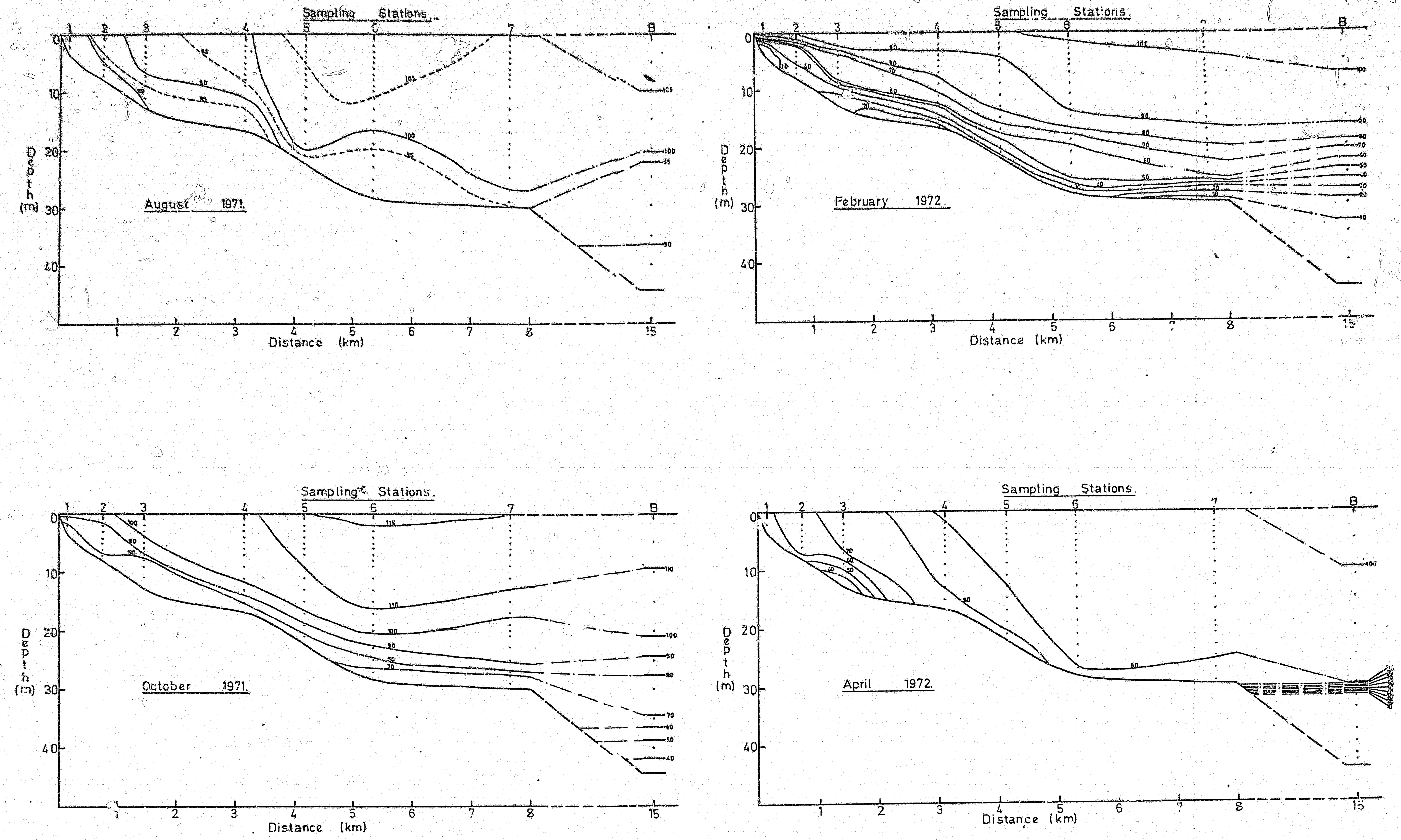


Figure 13: Isotherm diagrams for the Sengwa River mouth for August, October and December 1971, and February and April 1972. Horizontal dark lines indicate the extent of the floating "sudd" mat.



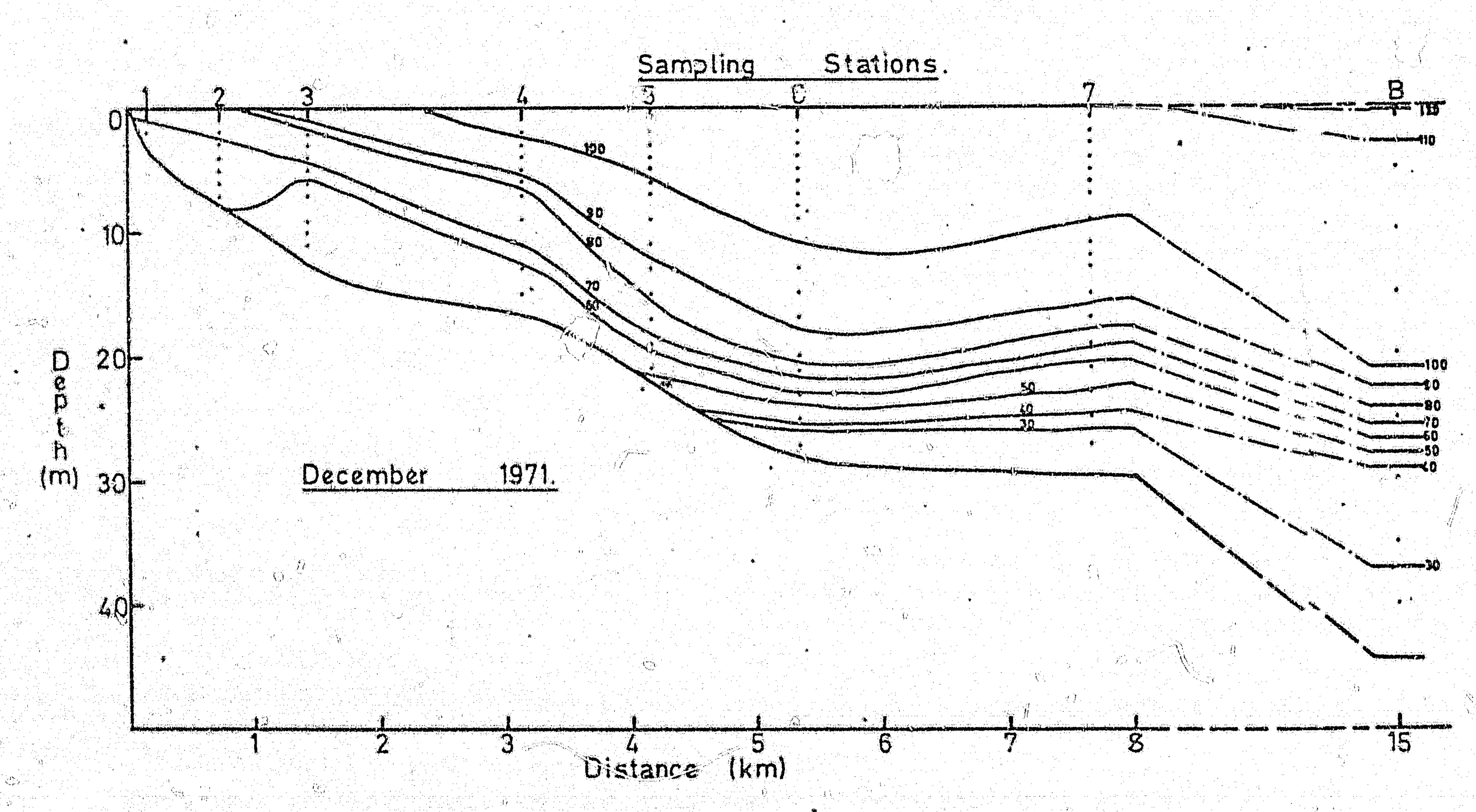


Figure 17: The dissolved oxygen (% saturation) isopleth diagrams for the Mwenda River mouth for the 1971-1972 sampling period. The Mwenda Basin deep water station has been included to indicate the relationship between the lake oxycline and the oxygen conditions in the river mouth.