BIODIVERSITY O.F LAKE VICTORIA:

ITS CONSERVATION AND SUSTAINABLE USE

[THE UGANDAN VERSION]

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CHAPTER 8

THE DIVERSITY AND ABUNDANCE OF ZOOPLANKTON IN THE LAKE VICTORIA AND KYOGA BASINS AND THEIR RELATIONSHIP TO FISH PRODUCTION

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INTRODUCTION

Biological diversity of an ecosystem is considered a reliable measure of the state of health of the ecosystem. In Uganda's large lakes, the Victoria and Kyoga, the past three decades have been characterized by profound changes in fish species composition following the introduction of the piscivorous Nile perch (Oguto-Ohwayo 1990). Over 300 haplochromine cichlid species comprising a wide range of trophic groups were lost along with a host of non-cichlid fishes which occupied virtually all available ecological niches and in the lakes (Witte 1992). A second major ecological event has been the gradual nutrient enrichment of the water bodies (eutrophication) from diffuse and point sources, while at the same time pollutants have also gained entrance into the water systems in pace with indusfrial development and human population increases in the lake basins. Eutrophication and pollution have drastically altered the physical and- chemical character of the water medium in which different fauna and thrive. In Lake Victoria these alterations have resulted in changes of algal species composition from pristine community dominated by chlorophytes and diatoms *(Melosira* etc) to one composed largely of blue-green algae or Cyanobacteria *(Microcystis, Anabaena, Planktolyngbya* etc) (Mugidde 1993, Hecky 1993).

Algae constitute the base of the biological production pyramid, and provides the sole source of nutrition to some fish species such as the tilapines, some haplochromines and most invertebrate organisms. Changes in algal species composition may, to some degree, have caused food limitation to some phytophagous macro- and micro-invertebrates. Such changes, if accompanied by alterations in size structure of available algal food particles, may result in new 'competitive interactions which can lead to decline in species diversity, or at least changes in relative abundance of organisms depending on algae for nutrition (Mwebaza-Ndawula 1994) i.e. most copepods, cladocerans and rotifers). The chemical environment, particularly with respect to parameters like pH, dissolved oxygen (DO), conductivity, suspended organic and inorganic particles a'great extent influence species diversity due to differences in tolerance ranges of different organisms to changing environmental conditions. In addition, size selective predation by fish, a common feature in predator- prey relationships may also greatly reduce or eliminate certain preferred

categories of prey species thereby altering both species composition and size structure of prey communities (Brooks and Dodson 1965).

Although zooplankton community studies have been conducted in Ugandan water bodies since the dawn of the twentieth century (Daday 1907, Delachaux 1917, Worthington 1931, Rzoska 1957, Green 1967, 1971,1976, Akiyama et al. 1976, Kateyo 1983, Mavuti and Litterick 1991, Mwebaza-Ndawula 1994, 1998, Kizito 1995, Branstrator et al. (996), no .single study has dealt specifically with aspects of diversity and in relation to the potential influence of the various environmental parameters to species richness or rarity.

The lakes surveyed in the study (see Materials and Methods section) were presumed to be at varying stages of water fertility (lake trophy) resulting from different levels of anthropogenic and other perturbations around them. The overall aim of the study was to investigate the diversity of zooplankton communities under widely differing limno-ecological conditions prevailing in the various water bodies surveyed. This paper presents, faunistic lists of zooplantkton encountered in field samples, estimates of areal and relative abundance of the various invertebrates and compares diversity of species between different ecological zones within lakes (Le. inshore and offshore waters) and between the different water bodies investigated.

STUDY AREAS

Field surveys were carried out in various water bodies within the Lake Victoria and Kyoga basins which included the Kooki lakes namely Mburo and Kachera in the Mburo National Park, Lake Wamala, Kayanja and Kayugi satellite lakes, Lake Nabugabo, lakes Victoria and Kyoga, the Victoria Nile, the Kyoga minor lakes namely Nawampasa, Nakuwa, Gigati, Nyaguo, Agu, Bisina, Kawi arid Lemwa, (Fig.I).

MATERIALS AND **METHODS**

In each lake two samples were taken; one from a shallow inshore area and another from an offshore point 20-50metres away from the shoreline. Zooplankton was sampled using plankton nets of 0.25m mouth opening and 50 and 100um mesh sizes. At each sampling point, the net was lowered with a rope up to Im above the bottom and hauled to the water surface. Four replicate hauls were combined to make a composite sample. In shallow areas «l.Om) with emergent vegetation, a tube sampler of 6.4 cm diameter was used to draw a volume of. water after which the water sample was filtered through a 50um mesh net. Four replicate tube samples were combined to make a composite sample. The samples were preserved in 4% sugar-formalin.

In the laboratory each sample was sufficiently diluted, agitated and sub-sampled with a calibrated bulb pipette. Each sub-sample (2 and 5ml) was placed on a counting chamber and examined under an inverted microscope at x40magnification. Taxonomic identification was done using available identification keys and each species was counted. A real density of zooplankton and percentage relative abundance was calculated from the count data.

[n most of the water bodies which generally small lakes, samples were taken at the edge (inshore) and in the middle of the lake (offshore). [n Lake Nabugabo an additional sample was taken from the River Juma mouth. At each of the two stations sampled in Lake Victoria (Kikondo and Kiryowa), samples were taken from the shoreline or edge and at 5 and 20m from the edge along a transect. A similar sampling approach was followed at the various points sampled along the River Nile.

RESULTS

Zooplankton composition and relative abundance at inshore and offshore sites in different lakes

Lake Wamala

Data taken during January and May 1998 at Ziggwa and Bagwe showed rotifer as the dominant taxon (> 70%) at inshore and offshore sites in both sampling stations (Table 1). At Ziggwa "edge" a rare copepod genus *Eucyclops* (6.5%) represented the taxon Copepoda as did *M micrura* (0.8%) for cladocerans. At Ziggwa "centre" *T negleclus* was the only copepod species found and in very small proportions (1.1%). Two species of cladocerans (C *comula* and *M micrura)* occurred in small proportions at Ziggwa centre. *Keratella tropica* contributed the highest numerical proportion at both "edge" and "centre" (72.4% and 83.6% respectively).

At Bbagwe sampling station *similar* trends in species composition abundance and diversity as at Ziggwa were found except for a small proportion of a predaceous copepod genus, *Mesocyclops* spp. was recovered in the sample from the "centre" in addition to *T neglectus.* Similarly, the small-bodied cladoceran, *Bosmina longirostris* (2.5%) occurred Bbagwe "edge". No major difference in rotifer composition was found between the "edge and "centre" sites at Bbagwe station. Dominant rotifer species included *K. tropica (27.5%), Trichocerca* spp (26.5%), *B. caudatus* (19.7%) and *Polyarthra* spp (13.1 %).

Nabugabo satellite lakes

Lake Kayanja

A single sample from the "centre" site presence of one species of Copepoda *T negleclus,* which was also numerically the most dominant species (75%) (Table 2). Cladocerans were completely unrepresented while rotifers were represented by 8 species albeit in rather small proportions « I0% each).

Lake Kayugi

Samples from both the "edge" and center had representatives from copepoda, Cladocera and Rotifera (Table 2). The latter was numerically most dominant group at both inshore and offshore sites (80% and 81.3% respectively). Rotifera comprised 6 species at both

sites compared to I copepod *(T neglectus)* and 1 cladoceran *(M micrura)* species. Prominent rotiferan species included *Trichocerca* spp.(40-42%) and *B. falcatus (30-*39%). Differences in species composition and species diversity were minimal between inshore and offshore sites.

Lake Nabugabo

The sample from]uma River mouth contained no adult (identifiable) copepods but had C. *cornuta* and *M micrura* representing Cladocera while to species represented Rotifera (Table 2). The latter was numeically the dominant group (96.9%) in which key species were *Trichocerca* spp (23.7%), *F. longiseta* and *Lecane* spp (15.5), *B. caudatus* (13.4) and *K. tropica (10.3%).*

Rotifers were still the dominant (> 70%) and diverse group (7 species) at the "edge" and "centre" sites. Copepods were represented by *T neglectus* which contributed 10>4% at the offshore site and 0.8% at the "edge". Among Cladocera, *B. longorostris* and *M micrura.* were present in small proportions « 1%) at the "edge" while the latter species achieved 13% numerical abundance at the "centre" site. The most dominant rotifers were *K. tropica* (42.7%), *B. caudatus* (27-55%) and *Trichocerca* spp (14-17%).

Lake Victoria

Rotifers were numerically the most dominant (> 50%) as well as the most diverse group in samples from both sampling sites (Table 3). The highest diversity of II species .was recorded in a sample taken 5m from edge at Kikondo, with rotifers contributing 8 species. The lowest number of species was 2 recorded in a sample from the edge at Kiryowa. A general increasing abundance of organisms from the edge towards offshore waters was observed for copepods and rotifers. The commonest species recovered in nearly all samples were *T. negelectus* (Copepoda: Cyclopoida) and *Polyarthra vulgaris* (Rotifera). A rare copepod taxon, Harpacticoida was recoded in a sample from Kikondo edge.
Cladocerans were poorly represented in all samples. Although *Diaphanosoma excisum* and *Moina micrura* were recovered at 20 metres from the edge at Kiryowa and Kikondo respectively, cladocerans were completely missing in samples from the edge at Kiryowa and 5m away from the edge at Kikondo and Kiryowa.

Victoria Nile River

Samples taken at Bujagali (downstream of Bujagali falls), Kalungi, Kasato and Kyankole (Victoria Nile mouth to Lake Kyoga) showed occurrence of copepods, cladocerans and rotifers in varying numerical proportions relative to site and distance from the edge of the river course (Table 4). At Bujagali, 5m from the edge copepods were represented by largely *Tropocyclops tenellus* (41.7%) and a small proportion of *T. confinnis (4.6%);* cladocerans were absent while six species of rotifers were found. *Brachionus forficula* .showed the highest rotifer abundance (16.7%). Copepods and rotifers occurred nearly in equal proportions (46.3% and 53.7% respectively). At 20m from the edge, a more diverse

community of copepods (66.3) consIstIng of *T tene/lus, T confinnis, Thermocyclops incisus, T emini* and *Thermodiaptomus galeboides* was encountered. Cladocera was still not represented while a rather impoverished community ofrotifers (33.7%) comprising *B. caudatus, K. tropica* and *K. cochlearls* was found. A total of 8 species was found at each of the two sites.

Further downstream at Kalungi, the sample from the "edge" was very poor, consisting of only three rotifer species *(Asplanchna* sp., *Filinia opoliensis* and *Trichocerca* sp.) (Table 4 contd) The sample taken 5m from the edge contained one copepod species, T. neglectus, one cladoceran, *M micrura* and five rotifer species dominated by *Asplanchna* sp. Copepods (70.6%) comprising *T neglectus, T tene/lus* and *T confinnis* numerically dominated a third sample taken 20m from the edge. Cladoceran presence was relatively high (11.8%) with *Chydorus* sp. and *M micrura* contributing equal proportions. The rotifer community was still impoverished, with only three species found *Asplanchna* sp., *B. falcatus* and *K. tropica,* each in small proportions (5.9%). Altogether 3,7 and 8 species were identified in samples from the edge, 5m and 20m from the edge respectively. Nearly similar trends of generally impoverished zooplankton communities were observed further downstream at Kasaatu, particularly at the edge and 5m from the edge.

At Kyankole river mouth area, a transitIOn between riverine and lake conditions all samples taken from the edge, 5 and 20m from the edge showed relatively high species diversity (9-13 species) among the three broad taxonomic groups (Table 4 contd). Copepods, which contributed 38.5% of the numerical abundance at 20m from the edge, contained the rare genus, Eucyclops sp. (21.2%). Rotifers were numerically superior (51-93%) at all three sites and the dominant species were *K. trapica, Polyarthra* spp, *B. caudatus* and *Asplachna* sp.

Lake Kyoga

Lake Kyoga was represented by a single sample from Iyingo "centre" (Table 5). A total of 10 species were recorded, with 6 from rotifers, 2 from Cladocera and 2 from copepods. Copepods and rotifers were co-abundant at Iyingo (ca. 45%).

Kyoga satellite lakes

Nawampasa

Rotifers were the 'numerically the most abundant (> 60%) as well as the most diverse taxon, contributing 9 out of the 15 species recorded in this lake (Table 6). Copepods were represented by four species of which *T neglectus* and *T confinnis* constituted the bulk. A rare genus *Eucyclops* sp. was also recovered but all the samples lacked the large-bodies calanoid copepods. Mainly *Moina micrura* and few *Ceriodaphnia cornuta* represented cladocerans. Of the 12 rotiferan species, the bulk was contributed by *Ascomopha, Keratella tropica, Brachionus caudatus* and *Tricocerca* spp. No major difference in species composition between inshore and offshore sites was evident.

Lake Nakuwa

This lake was represented by one sample from the "centre" in which a total of 12 species were encountered (Table 5). The bulk of the species diversity came from Rotifera which accounted for 9 species, besides being numerically the most dominant taxon (>70%). Three genera, *B. caudatus, K. tropica* and *Polyarthra* spp. contributed most to the rotiferan component in the lake. The small (4.9%) c1adoceran component contained a rare large-bodied daphnid, *Daphnia lumholtzi* (0.2%), while copepods were represented by a single species, *T. neglectus.*

Lake Gigati

Samples from the edge and centre of the Lake showed fair of the three broad taxonomic groups: Copepoda, Cladocera and Rotifera (Table 6). The latter was by far the most diverse group containing! lout of a total of 15 species encountered. Most rotiferan species were found both inshore and offshore except *F. opoliensis* recovered only in inshore sample. Cladocerans were poorly represented in terms of species diversity (2 species) and relative abundance «3%) at both sites. Rotifers were numerically dominant inshore (51.6%) while copepods dominated in the offshore (centre) sample (80.2%). Dominant copepods were *T. neglectus* and *T. confinnis* while *B. caudatus* and *K. tropica* dominated among rotiferan species.

Lake Nyaguo

From this lake, a single sample from the "centre" site contained representatives of copepods, c1adocerans and rotifers (Table 5). The latter was the dominant group in terms of species diversity contributing 9 out of a total of 13 species, but was superceded in abundance .by copepods 80.4% compared to 19.6% for rotifers. Dominant copepods species were *T. confinnis* (59.8%) and *T. neglectus* (20.1 %). A dearth of Cladocera was evident as only *D. excisum* (0.3%) found in the entire sample.

Lake Agu

Samples from both inshore and offshore contained representatives of copepods, Cladocera and rotifers (Table 6). Rotifers were superior both numerically (77.2% and 76.3% inshore and offshore respectively) and in terms of species diversity (13 species out of a total of 18). Generally the same rotifer species were found at both sites and *B. caudatus, F. longiseta* and *K. tropica* constituted the dominant taxa. Copepods were poorly represented inshore where only *T. confinnis* was found and in low proportions (1.4%). Similarly, poor copepod abundance (5.9%) was found offshore. On the other hand c1adocerans. were relatively well represented numerically (17-21 %) though only by three species, *Moina micrura* (16-17%), *D. excisum* (4.7%) and a rare species *Macrothrix laticornis* (0.7%).

Lake Kawi

A single sample collected from the "edge" site showed absence of adult (identifiable) copepod species and c1adocerans. Rotifers were represented by 7 species of *which B. caudalus, F. long/seta* and *Trichocerca* spp. were the dominant taxa 57.1%, 10.7% and 10.7% respectively) (Table 5).

Lake Lemwa

A single sample from the "centre" site contained one copepod species *(T. negleetus* 6.3%), no c1adocerans and 8 species of rotifers (93.7%) (Table 5). Dominant rotiferan species included *F longisera* (27.8%), *B. ClJudatus* and *F. opoliens/s* (19.6%) and *B. angularis (12.9%)*.

Comparison of zooplankton species distribution between different lakes

Two categories of species were distinguishable on the basis of either wide *or* restricted distribution in the lakes surveyed (Table 6). The cyclopoid copepod, *T negleetus* was found in all lakes except lakes Kawi and Nakuwa where adult specimens used in taxonomic identification could not be found in the samples. The most widely distributed c1adoceran was *Moina mierura* which occurred in 10 out of 14 lakes. Among the rotifers three species namely, *Brachionus eaudatus, Keratel/a tropica* and *Triehoeerea* spp occurred in all the lake surveyed. The rare looplankters included *Eucyclops* sp. which occurred only in lakes Wamala, Nawampasa and Nakuwa; *Daphnia* sp., *Chydorus* sp. and the Harpacticoid copepod found only in the Victoria Nile; *Maerothrix latieonis* found only in Lake Agu; *B parulus* found only in Nabugabo, and *Euclanis* sp.found only in Lake Victoria.

Discussion

The highest number of zooplankton species (24) was recorded in the Victoria Nile samples (Table 4) is probably related to the diverse physical-chemical conditions prevailing in different habitat types i.e. fast-current mid-stream areas compared to relatively quiescent bays and river edge with macrophyte growth etc. Such varieties of environmental conditions provide equally wide niche opportunuties for a wider range of zooplankton species than probably less varied lacustrine conditions. High species diversity in some Kyoga satelite lakes like Agu, and Nawarnpasa (Table6) may indicate a relatively good quality of these lakes' environment. Both eutrophication and pollution of lakes tends to reduce faunal diversity as a result of different of species' tolerance to environmental stress. As an example, Lake Agu is a very clear lake with a Secchi reading as high as the lake depth itself (personal observations), indicating oligotrophic conditions. Its high zooplankton species diversity may to a .great extent be explained by the apparent pristine state of the lake. In contrast, the Nabugabo satellite lakes of Kayugi and Kayanja (Table 2) which are acidic, with pH < 6, (personal observations), a presumably stressful condition, supported relatively *low* species diversity (8-9 species); as were many other lakes that appeared to be tending towards eutrophic conditions (Tables 1-4). Other

environmental parameters likely to adversely impact faunal diversity are conductivity, and dissolved oxygen both of which can be markedly altered with the onset of eutrophic conditions.

Cladocerans, observed to be very rare and least abundant in most water bodies (Tables 1-5), are known to be very vulnerable to predation. This is largely due to their relatively large size, conspicuous eyes and their mode of movement, the sum total of which makes them an anractive prey and easy target for capture by fish predators. This may partly explain the dearth of these organisms in all the water bodies surveyed and the absence of the largest and therefore more vulnerable daphnids in most lakes. On the other hand, the small but numerous rotifers appear to be naturally protected from excessive predation owing to their diminutive size which offers low calorific value as prey besides being not easily visible to the predators. This attribute, probably together with high tolerance of environmental stress conditions may explain their numerical superiority in virtually all the lakes surveyed.

Medium. - to - large-sized copepods rank second to rotifers in numerical abundance, but. on account of their larger size presumably support much higher biomass and calorific values. The large-bodied calanoid copepods are endowed with a rather high escape response from fish predators compared to cyclopoids (Lazzaro 1987) although they were relatively rare in most lakes. Due to their size and relatively high abundance in most water bodies, copepods probably constitute the most targeted prey species by fish predators as has been observed in Lake Victoria (Mwebaza - Ndawula 1998). In the laner environment, they appear to exhibit high resilience to fish predation probably as a result of some reproductive strategies and availability of ample quality food to support both their growth and production.

Themocyclops neglec(us along with some rotifers such as *Brachionus cauda(us, Kera(ela (ropica* and *Trichocerca* spp are evidently the most widespread zooplankton species while Cladocera are generally rare, apart from *Moina micrura.* These distribution and abundance trends are probably related to both intensity of fish predation and limitation by environmental factors, which may include food quality and quantity in the different lake systems. Some of the rare species like the cladoceran *M la(icornis* and harpacticoid copepods are known to be largely benthic and were therefore outside the sampling range of pelagic zooplankton. Tentatively however, some rare species like *Ellcyclops* sp. and daphnids may have the potential to be used as environmental indicators as practiced in some temperate countries.

[n order to promote conservation of zooplankton diversity and *lor* to restore lost species richness in the water bodies, there is need to avert excessive nutrient loading into rivers and lakes. This involves control of deforestation, cultivation in fringing swamp zones and macrophyte harvesting, regulation/control atmospheric pollution through sensitising people on the dangers of unnecessary vegetation burning and industrial emissions, enforcement of pre-treatment of industrial and sewage effluents, encouraging and promoting sanitation, and observance of hygiene and safe waste disposal in the lake basin. The sum total of these participatory actions, will hopefully minimise excessive

nutrient loading (eutrophication) into water bodies, a feature so rampant in most Ugandan lakes. The resulting changes in water quality, algal production and succession has direct and indirect effects on the largely phytophagous zooplankton community and other organisms like fish that depend on secondary producers as a source of nutrition.

REFERENCES

Akiyama, T. A.A. Kajumulo and S. Olsen 1977. Seasonal vanatlon of plankton and physicochemical condition in Mwanza·Gulf, Lake Victoria. Bull. Freshw. Fish. Res. Lab. 27 (2): 49-61.

Branstrator D.K., L.M. Ndawula, and J.T. Lehman 1996. Zooplankton dynamics in Lake Victoria. In: I.C. Johnson and E. Odata (eds), Limnology , Climatography and Palaeolimnology of the East African lakes. Gordon and Breach.

Brooks, J.L. and S.1. Dodson 1965. Predation,body size and composition of zooplankton. Science 150:28-35.

Daday, E. 1907. Planktoniere aus dem Victoria Nyanza. Sammelaubeute vo A. Bogert *1904-1905. Zool.1.* (Syst.) 25: 245-262.

Delachaux, T. 1917. Cladoceres de la region du lac Victoria Nyanza. Rev. suisse Zool. 25: 77-92.

Green, J. 1967. The distribution and variation of Daphnia lumholtzi (Crustacea: Cladocera) in relation to fish predation in Lake Albert, East Africa. J. Zool. Lond.151: 181-197.

Green, J. 1971. Associations of Cladocera in the zooplankton of the lake sources of the white Nile. J. Zool. Soc. Lond. 165: 373-414.

Hecky, R. 1993. The eutrophication of Lake Victoria. Verh. Internat.Verein. Limnol. 25: 39-48.

Kateyo, E. 1982. Population studies of zooplankton in Kisubi Bay, Lake Victoria. M.Sc. Thesis, Makerere University.

Lazzaro, X.1987. A review of planktivorous fishes. Their evolution, feeding, behaviour, selectivities and impacts. Hydrobiologia 146: 97-167.

Mavuti K.M. and M.R. Litterick 1991. Composition, distribution and ecological role of zooplankton community in Lake Victoria, Kenya waters. Verh. 1nternal.Verein. Limnol. 24: 1117-1122.

Mugidde, R.1933. The increase in phytoplankton primary productivity and biomass in Lake Victoria (Uganda). Verh. Internal. Verein. Limnol. 25: 846-849.

Mwebaza-Ndawula, L. 1994. Changes in relative abundance of zooplankton in northern Lake Victoria. Hydrobiologia 272:259-264.

Mwebaza-Ndawula, L. 1998. Distribution and abundance of zooplankton and Rastrineobola argentea (Pisces: Cyprinidae) and their trophic interactions in northern Lake Victoria, Wast Africa. Ph.D. Thesis, University of Vienna, Austria. 162pp.

Ogutu-Ohwayo, R. 1990. Changes in the prey ingested and the variations in the Nile perch and other fish stocks in Lake Kyoga and the nothern wates of Lake Victoria (Uganda). J. Fish Bio1.3 7:55-63.

Rzoska, J. 1957. Notes on the crustacean plankton of Lake Victoria. Proc. Linn. Soc. Lond. 168:116-125.

Witte, F., T. Goldschmidt, W. Ligtvoet, M.P.J. van Oijen and J.H. Wanink 1992. Species extinction abd concomitant ecological changes in Lake Victoria. Netherlands J. Zoo1. 4223: 214-232.

Worthington, E.B. 1931. Vertical movements of freshwater macrop1ankton. [nt.Rev. ges. Hydrobio1. Hydrogr. 25: 393-436.

Table1. Percentage composition of zooplankton taxa at different sites on lake Wamala, Jan. and May 1998.

Sampling stations:	Ziggwa		Bbagwe	
Habitats:	edge	centre	edge	centre
Taxa:				
Copepoda				
Mesocyc/op spp.				0.2
Eucyc/ops spp.	6.5			
T. neg/ectus		11	25.0	1.7
Sub-total	**6.5**	**1.1**	**25.0**	**1.9**
Cladocera				
c.comuta		1.2		
B. longirostris			2.5	
Moina micrura	0.8	1.8		1.2
Sub-total	**0.8**	**3.0**	**2.5**	**1.2**
Rotifera				
Ascomopha sp.	0.8	3.5	25.0	
Asp/anchna spp.	9.2	1.5	2.5	
B. angu/aris			7.5	0.5
B. ca/yciflorus	1.2	0.4		
B. caudatus	1.4	2.6	12.5	19.7
F. opo/iensis				6.1
K. coch/earis				1.0
*K. tropic*a	72.4	83.6		27.5
Lecane spp.			10.0	2.4
Po/yarthraspp.		1.3	7.5	13.1
Trichocerca spp.	7.6	3.0	7.5	26.5
Sub-total	**92.6**	**96.0**	**72.5**	**96.8**
Total	**100**	**100**	**100**	**100**
No. of species	8	**10**	9	**11**

Table 2. Percentage composition of zooplankton taxa at different sites on Nabugabo and satellite lakes

Lakes:	Kayanja	Kayugi	Kayugi	Nabugabo Juma R.	Nabugabo Lubira	Nabugabo
Habitats:	Centre	Centre	edge	mouth	edge	Centre
Taxa:						
Copepoda						
T. negleclus	75	9.9	6.5		0.8	10.4
Sub- total	75	9.9	6.5		0.8	10.4
Cladocera						
B.longirostris					0.2	
C.comuta				1		
Moina micrura		4.1	12.1	2.1	0.5	13
Sub-total		4.1	12.1	3.1	0.6	13
Rotifera						
Asplanchna spp.	0.9	1.1	0.9	1		
B. *angularis*	0.9					
B. *caudalus*	6.9	0.3	3.7	13.4	27.2	54.8
B. *falcalus*	3.4	39.4	30.8	3.1	3.1	1.7
B. *palulus*				1		
F. longiseta	0.9		0.9	15.5	8.3	0.8
F. opoliensis		3.3		5.2		1.6
K. cochlearis	1.7				0.3	0.2
K. lropica	1.7		2.8	10.3	42.7	
Lecane spp.				15.5		
Polyarlhra spp.		17		8.2	2.8	0.1
Trichocerca spp.	8.6	40.2	42.1	23.7	14.3	17.3
Sub-total	25	86	81.3	96.9	98.6	76.6
Grand total *("!o)*	100	100	100	100	100	100
Total no. of specie ,-	9	8	8	12	10	9

Table 3. Percentage composition of zooplankton taxa at different sites on Lake Victoria, April 1998.

Sampling stations:	Kikondo			Kiryowa		
Habitats:	edge	5m from edge	20m from edge	edge	5m from edge	20m from edge
Taxa:						
Copepods						
T. emini		6.3				
T neglectus	8.3	22.9	21.5	25.0	50.0	13.3
T galeboides			1.1			
T confinis	8.3	15.6			33.3	
Sub-total	**16.7**	**44.8**	**22.6**	**25.0**	**83.3**	**13.3**
Harpaticoida	25.0					
Cladocerans						
O. *excisum*						3.3
Moina mierura			8.6			
Sub-total			**8.6**			**3.3**
Rotifers						
Ascomopha sp.		3.1				
Asplanchna spp.	25.0	10.4		75.0		3.3
B. *angularis*						6.7
B. *ealyeiflorus*						3.3
B. *eaudatus*		12.5	8.6			23.3
Euelanis sp.		8.3				
F. opoliensis		2.1				
K. eochlearis		2.1	17.2			
K. tropiea	16.7					
Lecane bulla	16.7					
Polyarthra spp.		8.3	21.5		16.7	36.7
Trichocerca spp.		8.3	21.5			10.0
Sub-total	**58.3**	**55.2**	**68.8**	**75.0**	**16.7**	**83.3**
No. of species	6	**11**	7	2	3	8
Total	**100**	**100**	**100**	**100**	**100**	**100**

Table 4. Percentage composition of zooplankton taxa at different sites along the River Nile, June 1999.

Sampling stations:	Bujagali			Kalungi	
Habitats:	5m from edge	20m from edge	edge	5m from edge	20m from edge
Taxa:					
Cyclopoida					
Tneglectus				2.9	41.2
Temini		8.4			
Tincisus		1.2			
T confinnis	4.6	8.4			235
Ttenellus	41.7	37.3			5.9
Calanoida					
T galeboides		10.8			
Sub-total	46.3	66.3	0.0	2.9	70.6
Cladocera					
Chydorus sp.					5.9
Moina micrura				14.7	5.9
Sub-total	0.0	0.0	0.0	14.7	11.8
Rotifera					
Asplanchna spp.	9.3		33.3	44.1	5.9
B. *angularis*				5.9	
B. *calyciflorus*				11.8	
B. *caudatus*	9.3	8.4		17.6	
B. *falcatus*				2.9	5.9
B. *forficula*	16.7				
F. *opoliensis*			33.3		
K. cochlearis	4.6	3.6			
K. tropica	9.3	21.7			5.9
T cylindrica	4.6				
Trichocerca spp.			33.3		
Sub-total	53.7	33.7	100.0	82.4	17.6
Grand Total *("!o)*	100	100	100	100	100
No. of species	8	8	3	7	8

Table 4.(contd.) Percentage composition of zooplankton taxa at different sites along the River Nile, June 1999.

Sampling stations:	Kasato			Kyankole		
Habitats:	edge	5m from edge	20m from edge	edge	5m from edge	20m from edge
Taxa:						
Cyclopoida						
Eucyc/ops spp.						21.2
Tneg/ectus		5.6	6.5	1.4	1.1	5.8
Temini			4.3	0.7	1.1	1.9
Tincisus					1.1	1.9
Tconfinnis	36.4		4.3			3.8
Ttenellus			4.3	1.4		3.8
Sub-total	**36.4**	**5.6**	**19.6**	**3.4**	**3.3**	**38.5**
Harpaticoida			2.2			
Cladocera						
Daphnia sp.	9.1					
D.excisum				0.7		7.7
D.lumho/tzi					1.1	
Moina micrura			8.7	2.7	3.3	1.9
Sub-total	**9.1**	**0.0**	**10.9**	**3.4**	**4.4**	**9.6**
Rotifera						
Asp/anchna spp.				185	14.4	
8.angu/aris				2.1		
8. ca/ycif/orus	36.4	63.9	8.7	6.8	8.9	
8. caudatus	18.2		8.7	12.3	22.2	7.7
8. fa/catus		11.1	13.0	2.7		7.7
K. tropica			39.1	17.8	46.7	28.8
Po/yarthra spp.		19.4		28.1		7.7
Tcy/indrica				4.8		
Sub-total	**54.5**	**94.4**	**69.6**	**93.2**	**92.2**	**51.9**
Grand total (%j	**100**	**100**	**100**	**100**	**100**	**100**
NO.of specjes	4	4	**10**	**13**	9	**12**

Table 5. Percentage composition of zooplankton taxa in different satellite lakes of Kyoga, June 1999

Lakes:	Kawi	Iyingo	Lemwa	Nyaguo	Nakua
Habitats:	Edge	Centre	Centre	Centre	Centre
Taxa:					
Copepods					
T neglectus		32.2	6.3	20.1	24.6
Mesocyclops spp.				0.5	
Tgaleboides		8.2			
Tconfinnis				59.8	
Sub- total		**40.4**	**6.3**	**80.4**	**24.6**
Cladocera					
D.excisum				0.3	
D. *(umholtzi*		1.3			0.2
Moina micrura		10.1			4.7
Sub-total		**11.4**		**0.3**	**4.9**
Rotifera					
Ascomopha sp.			0.4		
Asplanchna spp.	3.6	2.2			
B. angu(aris			12.9	0.8	5.9
B. ca(ycif(orus	7.1			0.8	5.9
B. caudatus	57.1	3.8	196	5.2	11.2
B. fa(catus				2.7	6.8
F. (ongiseta	10.7	7.6	27.8		
F. opo(iensis	7.1		19.6		0.7
K. coch(earis		0.6			
K. tropica	3.6	33.4	8.2	4.3	12.2
Lecane bu({a				0.8	
Lecane spp.			0.4	2.4	0.7
Polyarthra spp				1.4	25.8
Trichocerca spp	10.7	0.6	4.7	1.1	1.4
Sub-total	**100.0**	**48.3**	**93.7**	**19.6**	**70.5**
Grand total	**100**	**100**	**100**	**100**	**100**
No. of species	7	**10**	9	**13**	**12**

Table 6. Percentage composition of zooplankton taxa in different satellite lakes of Kyoga, June 1999.

Lakes:	Agu		Gigati		Nawampasa	
Habitats:	Centre	Edge	Centre	Edge	Centre	Edge
Taxa:						
Copepods						
Eucyc/ops spp.						3
T neg/ectus		1.3	46.2	20.1	13	4
Mesocyclops spp.				1.6		
Tga/eboides						
T confinnis	1.4	4.6		59.6	6	
Ttenellus					1	
Sub- total	**1.4**	**5.9**	**46.2**	**80,2**	**20**	7
Cladocera						
C.comuta					2	
D.excisum	4.7			0.3		
D.lumho/tzi						
M./aticornis		0.7				
Moina micrura	16.7	17.1	2.2		14	8
Sub-total	**21.4**	**17.8**	**2.2**	**0.3**	**16**	8
Rotifera						
Ascomopha sp.						
Asp/anchna spp.		0.7				35
B.angu/aris	0.9		4.3	0.8	3	
B. ca/yciflorus			0.4	0.8	8	8
B. caudatus	13.0	4.6	14.3	5.1	13	5
B. fa/catus	0.9	5.9	6.1	2.7	9	
B. patu/us					0	
F. /ongiseta	24.7	2.0			1	3
F. opo/iensis	2.3	3.9	3.6		5	
K. coch/earls		2.0				
K. tropica	28.8	52.0	19.4	4.3	22	5
Lecane bulla				0.8		
Lecane spp.	1.9	0.7	0.7	2.4		
Po/yarthra spp.		3.3	2.5	1.4	1	
Tcy/indrica	1.4					
Trichocerca spp.	3.3	1.3	0.4	1.1	4	28
Sub-total	77.2	76.3	51.6	19.5	64	85
Grand total	100	100	100	100	100	100
No. of species	**12**	**14**	**11**	**13**	**15**	9