Bull. Iraq nat. Hist. Mus.

(1990) 8 (3) : 95-117

AQUATIC INVERTEBRATE FAUNA OF AN UPLAND RESERVOIR SYSTEM, CO—WICKLOW, IRELAND

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ABSTRACT

Littoral and benthic invertebrates from Roundwood Reservoir System were sampled. Oligochaetes and molluscs were the dominant organisms in the littoral and benthic areas. Trichopterans and chironomids were the most abundant insect groups. Scuba diving samples reinforced that view. Other groups of macroinvertebrates were poorly represented.

Vertical and horizontal hauls of zooplankton revealed that there were twelve species of zooplankton present. *Daphnia hyalina* Leydig and *Bosmina coregoni* Baird were the two dominant species.

INTRODUCTION

In recent years catches of brown trout, *Salmo trutta* L., taken on rod and line in the Roundwood System Co - Wicklow, have shown a marked decline, which caused anxiety among anglers who have fished these waters for fifty years. The system is composed of two man - made impoundments known locally as the North and South lakes. They are subjected annually to marked water level fluctuation which lead to a deterimental affects on aquatic plants and animals (Hynes, 1961; Grimas 1962, 1964, 1965 a, b, c; Hunt and Jones 1972, Kaster and Jacobi 1978, *inter alia*) in most cases the littoral fauna suffer the inshore habitats and causes many problems for the aquatic organisms. Some species can adapt to the changes and survive but many are unable to adjust and perish. Over period of the time physical changes in the nature of substratum may also occur which inturn affect the macrovegetation. New species may dominate the faunal communities.

The present paper reports part of an extensive study which has been carried out in an attempt to explain the poor catches (Dauod, 1985).

One of the major drawbacks with the current investigation was the almost complete lack of scientific data prior to 1982. It is not possible to say how much damage has been caused to the flora and fauna by the fluctuating water levels, nor is it possible to surmise whether or not community structures have altered.

MATERIALS AND METHODS

The Study Area

The Roundwood Reservoir System is composed of two reservoirs which lie approrximately 200 m above sea level. These are known as the North and South lakes and their location is indicated in Fig. (1). The South lake, which is larger of the two (surface area : 165.52 he), was constructed in 1866. Increased demand led to the construction if the North lake (surface area : 122.62 ha) which came into operation in 1922. The physical parameters of each are listed in Table (1). Water level fluctuations for the period June 1982 to December 1984 are given in Fig (2).

The geology of the area is Middle Cambrian Rock underlying a granite based boulder clay Fig (3). The annual average precipitation for the 1951—1980 period was 1.216 mm (Figures supplied by Metereological Service). December shows the highest average rainfall at 148 mm. while the lowest values occur in June at 63mm.

Five species of fish occur in the system, brown trout, *Salmo trutta* L., minnow, *phoxinus phoxinus* (L.), three-spined stickleback, *Gasterosteus aculeatus* L., stoneloach, *Nemacheilus berbatula* (L.) and eel *Anguilla anguilla* (L.).

The dominant aquatic macrophytes in both lakes were *Elecharis palustris* R. and S., *Ranunculus flammula* L., *Polygonum amphibium* L., *Littorella uniflora* Asch., *Mentha aquatica* L., *Hydrocotyle vulgaris* L., *Utricularis intermedia* Hayne and *Ranunculus* sp.

Analysis of Invertebrates Populations

Table (1) Physical parameters of the North and South lakes, Roundwood, Co. Wicklow

Parameter	North Lake	South Lake
Maximum Volume (m^3)	5,632,494	11,283,172
Maximum Depth (m)	13,41	18,59
Maximum Length (km)	2,82	2,42
Maximum Width (km)	0,40	0,80
Area (hectares)	122,62	165,52
Tropic Status	Oligotrophic	Oligotrophic
PH	6.4—7.6	6.4—7.6
Conductivity (mhos)	69 —114	69 —114
Height a. s. L. (m)	226,77	213,36

Littoral samples were collected from September 1982 to September 1985. In the North lake low water levels made it impossible to take littoral smaples during September 1984. A surber sampler (0.0625 m^2) was used to collect these samples from five stations in the North lake and four in the South lake. A range of station types was selected to cover the different types of habitat available. Four replicate samples were takenat at each. The range included (i) macrophytic vegetation, (ii) a mixture of sand, gravel and stone substrate, (iii) mud aid (iv) stones only. All material was preserved in 5% formalin in the field.

Benthic macroinvertebrates were also sampled on the same period using an Eckmann grab (0.02 m^2). Four stations were selected; (i) in the deepest sector of each reservoir, (ii) close to the dam walls, (iii) approximately at the centre of the widest transect and (iv) in the shallow inshore bays. Six replicates were taken at each station.

Scuba diving was made to investigate the distribution of the dominant species of macroinvertebrates in the littoral and sub-littoral regions of the North lake.

Finally, samples of zooplankton were collected at four stations in each reservoir using plankton nets (mesh- 0.515 mm). Vertical and horizontal hauls were taken during June and September 1983 and 1984.

RESULTS

(A.) Littoral and Benthic Samples

In the present study, an attempt was made to describe the fauna of the Roundwood Reservoir (North and South lakes) and to indicate the relative importance of the component taxa. The littoral fauna of the South lake was richer than the North lake. Molluscs, oligochaetes and chironomid larvae were the most abundant groups in both lakes. In the case of the benthic fauna, the North lake samples showed the greatest diversity.

A total of 35 littoral species were recorded for each lake and 34 species were common to both lakes. On the other hand a total of 35 (North lake) and 30 (South lake) benthic species were recorded. A list of species is presented in Table (2).

(a.) Tricladida

Few specimens of *Polycelis nigra* (MÜller) were recorded from the litttoral samples in the South lake during September 1982 and 1983.

b.) Mollusca

This group was dominant in both littoral and benthic samples. Eight species were recorded from lakes, *Potamopyrgus jenkinsi* Smith, *Lymnaea peregra* MÜller and *Sparium corneum* L. were the most abundant species, particularly in the benthic area. *Lymnaea peregra* occurred irregularly in the benthic zone. These four species represented about 80% of the molluscs.

(c.) Oligochaeta

Oligochaetes were another abundant group of macroinvertebrates in the littoral and benthic areas of both lakes. Seven species of oligochaetes were found. Two species belonging to the family lumbriculidae, *Lumbriculus variegatus* (Müll) and *Stylodrillus heringianus* Clap. were dominant particularly in the littoral area. Immature tubificidae were also abundant, especially in the littoral samples.

(d.) Hirudinea

This group included two species, *Glossiphonia complanata* (L.) and *Helobdella stagnalis* (L.). Both of them were rarly taken in either lake.

(e.) Isopoda

Asellus meridianus Racovitza was rare and the only Isopod species recorded from Roundwood. It was found sporadically in the littoral and benthic areas of the South lake. It was only present in the littoral area of the North lake.

(f.) Amphipoda

Gemmarus duebeni Lilj was common in the littoral samples of the South lake but appeared to be scarer in the North lake.

(g.) Ephemeroptera

Six species of ephemeropteran nymphs were recorded from the North lake and four species from the South lake. *Caenis* spp. were ne dominant species. *Baetis rhodani* Pict and *Leptophlebia vespertina* L. were rarely recorded in the North lake.

(h.) Trichoptera

This is probably the most abundant insect group available at Roundwood. Ten species of larvae were recorded at both lakes, most of which were littoral species. *Limnephilus vittatus* Fbr. was the dominant species. Since the main emergence period for *L. vittatus* is June most of them were on the wing when the sampling programme was carried out. *Mystacides* spp. were recorded from both lakes after the emergence of the *L. vittatus* especially in the South lake. The latter species occurred irregulary in the benthic samples.

L. vittatus and *L. lunatus* were the only trichopteran pupae recorded from the littoral samples.

(i.) Chaoboridae

Chaoberus sp. wes recorded in reasonable numbers in the deepest sector of each lake.

(j.) Chironomidae

Chironomid larvae represented one of the most important groups in the fauna of both lakes. More species were. recorded from benthic areas of both lakes. The most abundant species were *Procladius* sp., *Orthocladius* sp., *Endochironomus* sp., and *Microtendipes* sp.

The most abundant adult insect species belonged to the Coleoptera *Galerucella nymphaeae* (L.) which was found in relatively good numbers on *Polygonum amphibium* L. Two Hemipteran species *Corixa lateraits* ,Leachi *and Notonecta glauca* Linn. were also common-

(B.) Scuba Diving

The cinnamon Sedge *Limnephilus vittatus* Fbr. was the most abundant food oranism found in the guts of the brown trout, minnow and three-spined stickleback at Roundwood Rservoir. In addition, *Potamoppyrgus jenkinsi* Smith and *Endochironomus* sp. larvae were also dominant in the gut of the above fish species. The distribution of these species was examined by Scuba diving through the littoral and sub-littoral regions of the North lake. The data reveal that *L. vittatus* was present in large numbers only at the mud interface. It was totally absent from the weed. High numbers occurred at depth 6—7 m (10—20 per m^2) but they were absent from 9m. onwards. The numbers tapered off with depth. Low numbers of *L. vittatus* occured on the gravel and stones (2—10 Per m) but the numbers of *P. Jenkini* were quite high (> 50 Per m^2). Similar results were obtained from the littoral samples where over 70% of mollusce were *P. Jenkinsi* & *S. corneum* *L. vittatus* accounted for more than 80% of the trichopteran larvae and *ndochironomus* sp. and *Orthocladius* sp. made up over 70% of the littoral chironomids.

(C.) Zooplankton

Qualitative analysis of the zooplankton samples reveal that twelve species of zooplankton were recorded from the lakes. These are listed in Table (3). All twelve species were found in the North lake, but only eight species occurred in the South lake.

The most abundant species in the community were *Daphnia hyalina* Leydig and *Bosmina coregoni* Baird. They made up 52% and 21% respectively of the plankton present. Copepods were less important but the most abundant specis was *Diaptomus grailis* Sars which represented 9,95%.

DISCUSSION

The present study on the invertebrates fauna in the Roundwood Reservoir System is a part of an extensive study which has been undertaken to examine the reasons which lead to a marked decline in the number of brown trout present.

The system is subject to the severe water level fluctuations which occur annually in both reservoirs. These fluctuations adversely affect the productivity of invertebrates. Much has been written on this topic. Rawson (1958), Grimas (1961), Hynes (1961), Fillion (1967) Hunt and Jones (1972) and Miller and Paetz (1972) have commented on major changes in the community structure of the littoral and benthic fauna resulting from such fluctuations. The severity of the damage depends on the morphology of the lake basin. Small changes in water level may sometimes uncover large stretches of the littoral zone.

This in turn causes extensive damage to the macrophytes thus reducing the amount of available habitat for the aquatic organisms. Many species, such as *Gammarus* and *Asellus* become rare or disappear, while there is ai increase in the relative abundance of some chironomid larvae, oligochaetes and nematodes (Hynes 1961, Grimas 1965c and Hunt and Jones 1972). The fauna of the Roundwood System conformed to the pattern expected when such fluctuations occur. *Gammarus, Asellus,* flaworms and some types of chironomid larvae rare, while populations of some trichoptera, especially *L. vittatus,* molluscs, oligochaetes and other chironomids larvae flourished.

During 1983 and 1984 most stretches of the inshore areas of the Roundwood lakes were uncovered causing widespread damage to the already poor, oligotrophic fauna.

Related factors, including Physio-chemical and biological interaction, food availability, the presence or absence of predators and competitors also affect different groups or species. The paucity of flatworms and leeches in Roundwood reservoirs for example, may be largely attributed to the low calcium concentrations coupled with the humic environment (Mann, 1955; Reynoldson, 1958 a, b; Tucker, 1958; Reynoldson and Davies, 1970 a, b). Sutcliffe (1967) suggests that *Gammarus duebeni* is unable to colonise the Wicklow area encompassing Roundwood reservoirs owing to the low sodium content.

Ephemeropteran eggs and nymphs are vulnerable to predation by carnivores, omnivores and even herbivores (Macan, 1965, 1970 and Macan and Maudsley, 1968, 1969). Presumably because many of these predators (e. g. triclads, *Aseluus* and *Gammarus* are either absent or scarce in both reservcirs, several specis of mayfly have successfully colonised them.

Differences in the species composition of many groups must be due to their mode of colonisation. The distribution of water mites and leech (*Theromyzon tessulatum* (Müllar)) for instance is largely dependent on their methods of dispersal (Macan, 1974 and McCarthy, 1975). In Roundwood reservoirs a similar argoment applies to the leeches (*Glossiphonia complanata* (L) and *Helobdella stagnalis* (L.)).

Summarising a reserch carried out on European lakes, Macan (1974) suggests that insects are more abundant than non - insects in unproductive water. On tht other hand the reverse holds true in mort productive ones (O'Connor, 1975 and O'Connor and Bracken, 1978). The present invtstigation supports that assertion.

ACKNOWLEDGMENTS

The authors are indebted to Dr. J. P. O'Connor, National Museum of Ireland, for confirming many of our identifications. We would also like to thank most sincerely, Mr. R. Ridgeon ,Chairman of the Wicklow Anglers, whose enthusiasm, co-operation and assistance made our task so much easier. Special word of thanks to Dr. M. A. Al-Adhami who read the manuscript.

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Aquatic invertebrate fauna in Roundwood Reservoir

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اللافقريات المائية في خزان رووندوود (Roundwood Rescrvoir) في منطقة وكلو (Co. Wicklow)

جي · جي · بريكن و حسين عبدالمنعم داود

قسم الحيوان ، جامعة دبلن

قسم الحيوان ـ جامعة دبلن
قسم علوم الحياة ـ كلية التربية
(ابن الهيثم) ـ بغداد

أ

تعتبر الدراسة الحالية محاولة للتعرف على اللافقريات المائية في خزان روندوود (Roundwood Reservoir) وهي جزء من دراسة موسعة كان الغرض منها التعرف على الاسباب التي ادت الى نقصان واضح في اعداد اسماك التراوت (*Salmo trutta* L.) في الخزان والانهار او الجداول المغذية ·

تضمنت الدراسة ما يلي :

١ ـ اخذ عينات من قيعان المناطق الضحلة والعميقة من البحيرة الاصطناعية في راوندوود ، وتمثلت الاحياء السائدة في كلا المنطقتين الضحلة والعميقة بقليلة الاهلاب (Oligochaeta) والنواعم (Mollusca) ومثلث شعرية الاجنحة (Trichoptera) وثنائية الاجنحة (Diptera) مجاميع الحشرات السائدة في كلا البحيرتين الشمالية والجنوبية ، واكدت العينات التى اخذت عن طريق الغوص هذه النتيجة · وكانت المجاميع الاخرى من اللافقريات قليلة ·

٢ ـ فحص عينات للهائمات الحيوانية جمعت افقيا وعموديا وقد اشار الفحص الى وجود اثني عشر نوعا من الهائمات الحيوانية · وكانت براغيث الماء *Bosmina corigoni* Baird *Daphnia hyalina* Leydig الانواع السائدة ·

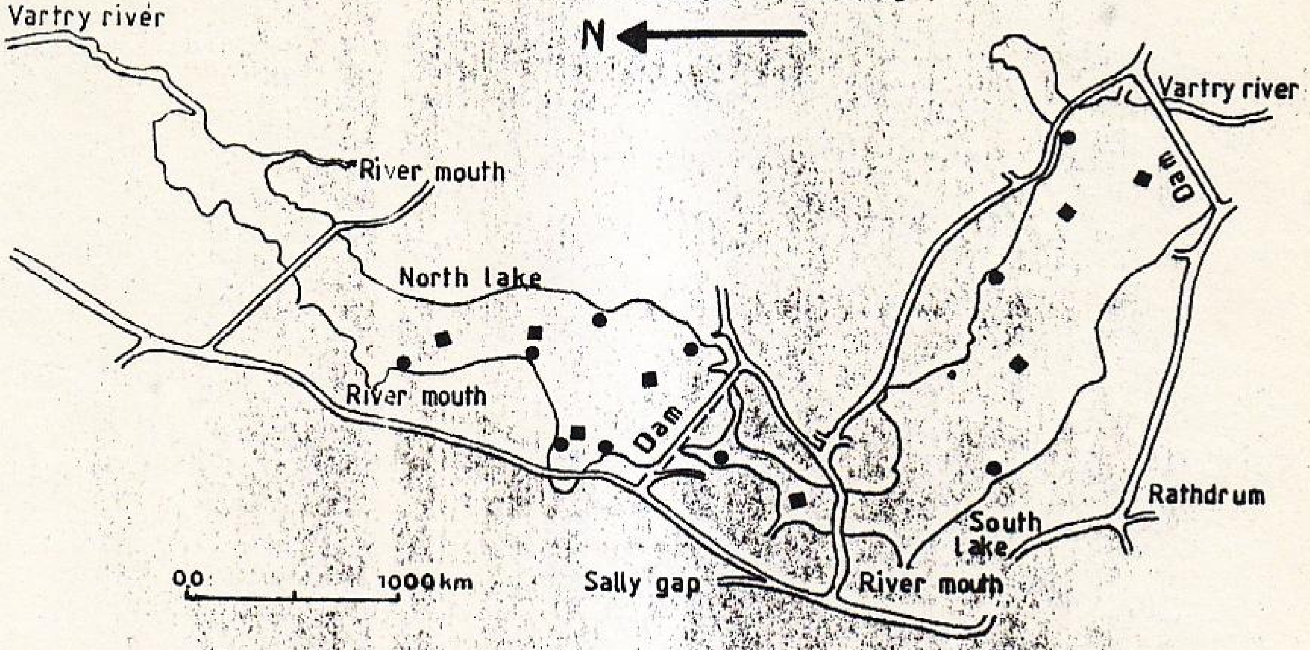

Figure 1. Roundwood Reservoir showing sampling stations
■ Benthic and Planktonic sampling sites
● Littoral sampling sites

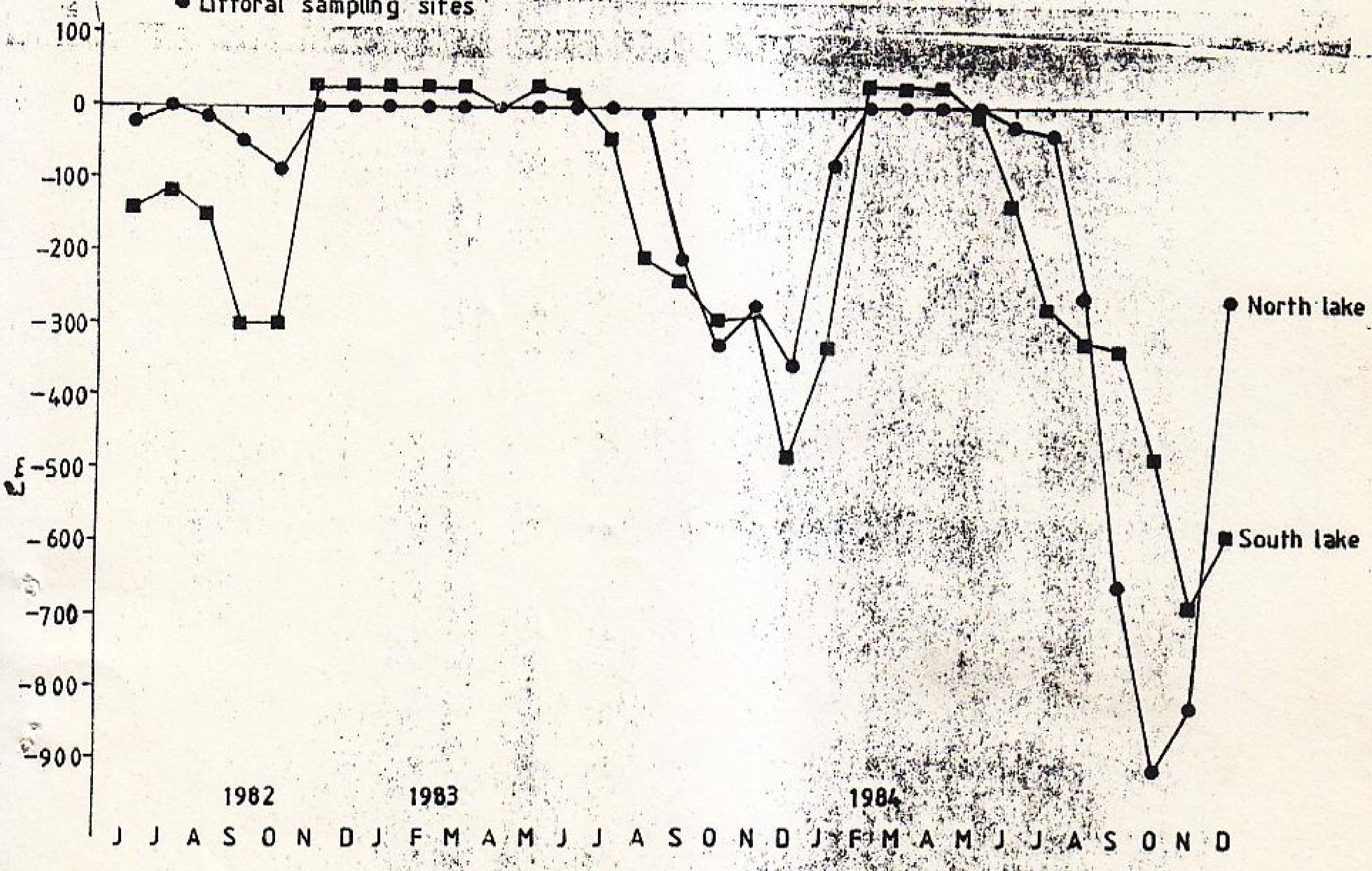

Figure 2. Water level fluctuations for the period June 1982 to December 1984

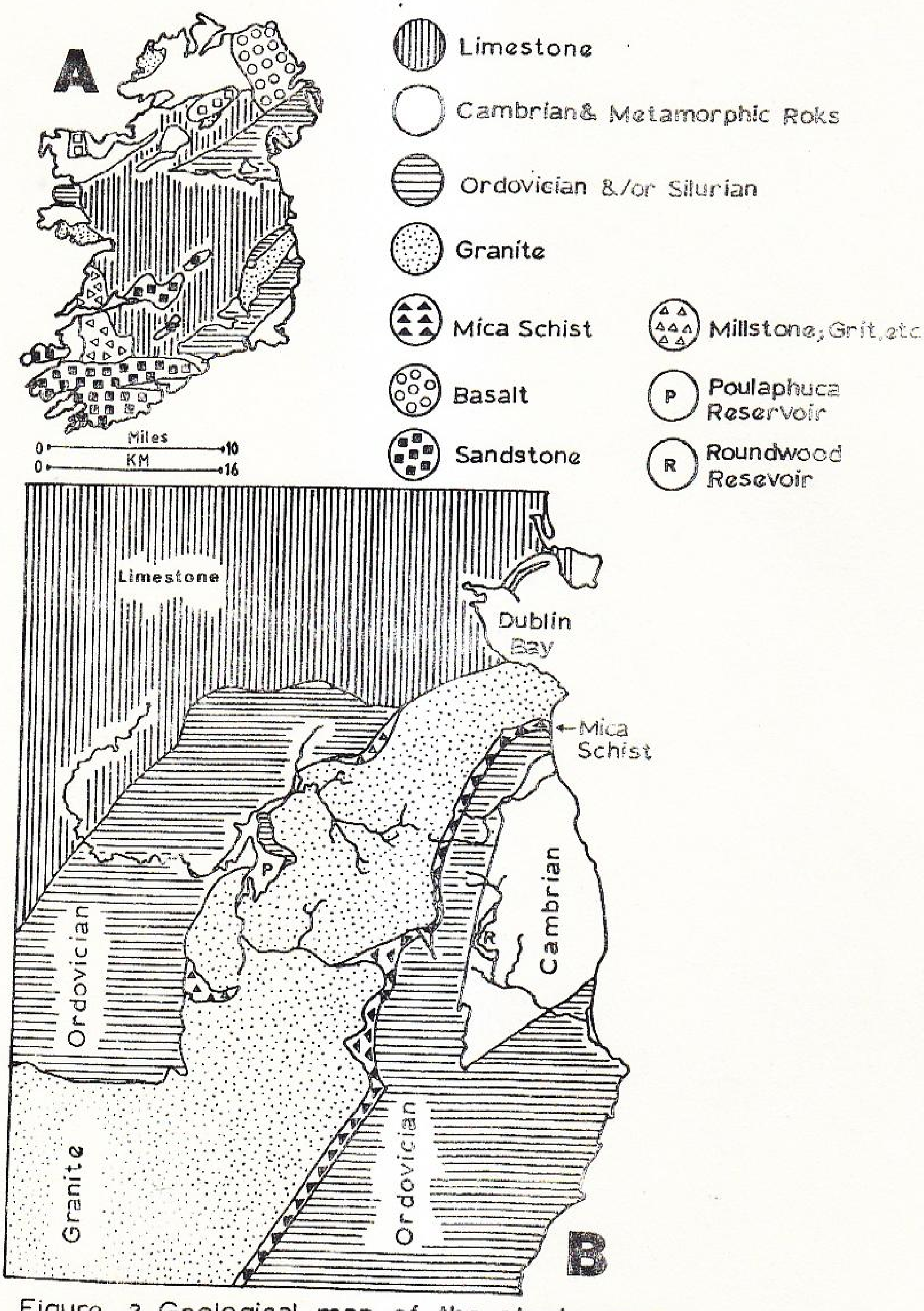

Figure 3. Geological map of the study area

Table 2 Mean Number and (Percentage) Per (m²) of the macro invertebrates fauna of the North and South Lakes, Roundwood Reservoir

Littoral Samples – North Lake

Faunal list	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept.* 1984
Tricladida:					
Polycelis nigra (Müller)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-
Mollusca:					
Potamopyrgus jenkinsi Smith	24.0 (5.6)	60.8 (18.5)	74.4 (17.3)	37.0 (1.0)	-
Bithynia leachi Shepp.	2.4 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-
B. tentaculata L.	6.4 (1.5)	0.0 (0.0)	3.2 (0.7)	7.0 (1.9)	-
Physa fontinalis L.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-
Lymnaea peregra Müller	37.6 (8.7)	20.0 (6.1)	36.0 (8.4)	34.0 (9.5)	-
Ancylus fluviatilis Mull.	0.0 (0.0)	0.8 (0.2)	0.0 (0.0)	0.0 (0.0)	-
Sphaerium corneum L.	4.8 (1.1)	6.4 (1.95)	28.0 (6.5)	9.0 (2.5)	-
Pisidium sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	9.0 (2.5)	-
Oligochaeta:					
Limnodrilus hoffmeisteri Clap.	0.0 (0.0)	0.8 (0.2)	0.3 (0.3)	6.0 (1.6)	-
Aulodrilus pluriseta (Pig.)	1.6 (0.4)	0.8 (0.2)	2.4 (0.6)	7.0 (1.9)	-
Lumbriculus variegatus (Mull.)	154.4 (35.8)	66.4 (20.3)	84.8 (19.8)	69.25 (19.3)	-
Stylodrilus heringianus Clap.	26.4 (6.1)	20.0 (6.1)	22.4 (5.2)	27.0 (7.5)	-
Eiseniella tetraedra (Savigny)	1.6 (0.4)	4.0 (1.2)	3.2 (0.7)	6.0 (1.6)	-
Immature Tubificidae	17.6 (4.9)	9.6 (2.9)	16.8 (3.9)	9.0 (2.5)	-
Enchytraeidae	3.2 (0.7)	0.0 (0.0)	1.5 (0.3)	0.0 (0.0)	-

Littoral Samples – South Lake

Faunal list	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984
Tricladida:					
Polycelis nigra (Müller)	24 (2.25)	0.0 (0.0)	17.0 (3.5)	0.0 (0.0)	0.0 (0.0)
Mollusca:					
Potamopyrgus jenkinsi Smith	581.0 (54.6)	108.0 (25.1)	165.0 (34.0)	18.0 (4.9)	46.0 (12.4)
Bithynia leachi Shepp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
B. tentaculata L.	94.0 (8.8)	5.0 (1.1)	11.0 (2.2)	2.0 (0.5)	11.0 (2.9)
Physa fontinalis L.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Lymnaea peregra Müller	0.0 (0.0)	15.0 (3.5)	31.0 (6.4)	29.0 (8.0)	31.0 (8.4)
Ancylus fluviatilis Mull.	12.0 (1.1)	0.0 (0.0)	7.0 (1.4)	0.0 (0.0)	7.0 (1.9)
Sphaerium corneum L.	25.0 (2.4)	9.0 (2.1)	3.0 (0.6)	13.0 (3.6)	6.0 (1.6)
Pisidium sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	8.0 (2.2)	3.0 (0.8)
Oligochaeta:					
Limnodrilus hoffmeisteri Clap.	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	2.0 (0.5)	0.0 (0.0)
Aulodrilus pluriseta (Pig.)	1.0 (0.1)	3.0 (0.7)	4.0 (0.8)	5.0 (1.3)	0.0 (0.0)
Lumbriculus variegatus (Mull.)	63.0 (5.9)	33.0 (7.5)	55.0 (11.3)	35.0 (9.5)	57.0 (15.3)
Stylodrilus heringianus Clap.	3.0 (0.8)	7.0 (1.6)	7.0 (1.4)	7.0 (1.9)	10.0 (2.7)
Eiseniella tetraedra (Savigny)	4.0 (0.4)	5.0 (1.1)	8.0 (1.6)	4.0 (1.1)	11.0 (2.3)
Immature Tubificidae	4.0 (0.4)	6.0 (1.4)	15.0 (3.1)	7.0 (1.9)	14.0 (3.8)
Enchytraeidae	0.0 (0.0)	0.0 (0.0)	1.6 (0.2)	0.0 (0.0)	0.0 (0.0)

Benthic Samples – North Lake

Faunal list	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984
Tricladida:					
Polycelis nigra (Müller)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Mollusca:					
Potamopyrgus jenkinsi Smith	59.0 (6.0)	77.7 (4.3)	61.0 (4.9)	62.7 (3.8)	271.3 (18.0)
Bithynia leachi Shepp.	3.7 (0.4)	3.7 (0.2)	0.0 (0.0)	1.83 (1.1)	0.0 (0.0)
B. tentaculata L.	11.0 (1.1)	33.0 (1.8)	22.0 (1.7)	33.0 (2.0)	29.3 (1.94)
Physa fontinalis L.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Lymnaea peregra Müller	40.3 (4.1)	51.3 (2.9)	9.2 (0.7)	0.0 (0.0)	0.0 (0.0)
Ancylus fluviatilis Mull.	0.0 (0.0)	12.8 (0.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Sphaerium corneum L.	257.9 (26.3)	836.2 (46.6)	862.9 (53.4)	691.2 (41.8)	462.0 (30.7)
Pisidium sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	67.83 (4.1)	0.0 (0.0)
Oligochaeta:					
Limnodrilus hoffmeisteri Clap.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Aulodrilus pluriseta (Pig.)	1.5 (0.2)	0.8 (0.04)	2.4 (0.2)	7.0 (0.4)	0.0 (0.0)
Lumbriculus variegatus (Mull.)	291.5 (29.7)	113.6 (6.3)	119.2 (9.6)	234.7 (14.2)	139.3 (9.3)
Stylodrilus heringianus Clap.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	9.2 (0.5)	0.0 (0.0)
Eiseniella tetraedra (Savigny)	0.0 (0.0)	0.0 (0.0)	1.8 (0.1)	0.0 (0.0)	0.0 (0.0)
Immature Tubificidae	3.7 (0.4)	20.2 (1.1)	22.3 (1.8)	29.33 (1.7)	36.7 (2.4)
Enchytraeidae	3.2 (0.3)	0.0 (0.0)	1.6 (0.1)	0.0 (0.0)	0.0 (0.0)

Benthic Samples – South Lake

Faunal list	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984
Tricladida:					
Polycelis nigra (Müller)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Mollusca:					
Potamopyrgus jenkinsi Smith	34.83 (8.1)	198.0 (19.6)	308.0 (14.9)	298.0 (22.3)	421.7 (6.2)
Bithynia leachi Shepp.	0.0 (0.0)	0.0 (0.0)	9.2 (0.4)	0.0 (0.0)	0.0 (0.0)
B. tentaculata L.	0.0 (0.0)	1.83 (0.2)	29.3 (1.4)	0.0 (0.0)	33.0 (2.1)
Physa fontinalis L.	0.0 (0.0)	0.0 (0.0)	38.5 (1.9)	0.0 (0.0)	0.0 (0.0)
Lymnaea peregra Müller	0.0 (0.0)	23.83 (2.4)	38.5 (1.9)	0.0 (0.0)	12.8 (0.8)
Ancylus fluviatilis Mull.	0.0 (0.0)	0.0 (0.0)	12.8 (0.6)	0.0 (0.0)	0.0 (0.0)
Sphaerium corneum L.	122.7 (28.54)	324.0 (32.2)	1131.2 (54.7)	436.5 (32.6)	273.0 (17.0)
Pisidium sp.	0.0 (0.0)	9.2 (0.9)	0.0 (0.0)	33.0 (2.5)	33.0 (2.1)
Oligochaeta:					
Limnodrilus hoffmeisteri Clap.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Aulodrilus pluriseta (Pig.)	1.0 (0.23)	3.0 (0.3)	4.0 (0.2)	5.0 (0.4)	0.0 (0.0)
Lumbriculus variegatus (Mull.)	44.0 (10.23)	97.2 (9.6)	108.2 (5.2)	165.0 (12.3)	174.2 (10.8)
Stylodrilus heringianus Clap.	1.83 (0.42)	1.83 (1.8)	1.83 (0.1)	12.8 (0.9)	22.0 (1.4)
Eiseniella tetraedra (Savigny)	0.0 (0.0)	0.0 (0.0)	3.7 (0.2)	1.8 (0.1)	3.7 (0.2)
Immature Tubificidae	11.0 (2.56)	22.0 (2.2)	38.5 (1.9)	12.8 (0.9)	22.0 (1.4)
Enchytraeidae	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Table 2 (contd.)

Faunal list	Littoral Samples										Benthic Samples									
	North Lake					South Lake					North Lake					South Lake				
	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept.* 1984	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984	Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984
Hirudinea																				
Glossiphonia complanata (L.)	1.0 (0.2)	0.0 (0.0)	2.4 (0.6)	0.0 (0.0)	-	3.0 (0.3)	0.0 (0.0)	4.0 (0.8)	0.0 (0.0)	6.0 (1.6)	1.8 (0.2)	3.7 (0.2)	1.8 (0.1)	1.8 (0.1)	0.0 (0.0)	0.0 (0.0)	3.7 (0.4)	7.5 (0.4)	14.7 (1.1)	25.7 (1.6)
Helobdella stagnalis (L.)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	4.0 (1.1)	0.0 (0.0)	3.7 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.7 (0.86)	9.2 (0.9)	9.2 (0.4)	0.0 (0.0)	3.7 (0.2)
Isopoda:																				
Asellus meridianus Racovitza	2.4 (0.5)	2.4 (0.7)	4.0 (0.9)	9.0 (2.5)	-	3.0 (0.3)	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	5.5 (0.5)	11.0 (0.5)	0.0 (0.0)	0.0 (0.0)
Amphipoda:																				
Gammarus duebeni Lilj	3.2 (0.7)	4.0 (1.2)	4.8 (1.1)	12.0 (3.3)	-	189.0 (17.8)	14.0 (3.2)	45.0 (9.2)	14.0 (3.8)	49.0 (13.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Ephemeroptera:																				
Baetis rhodani Pict.	0.0 0.0	1.6 0.5	0.8 0.2	4.0 1.1	- -	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Centroptilum luteolum Muller	0.0 (0.0)	0.8 (0.2)	0.0 (0.0)	1.0 (0.2)	-	0.0 (0.0)	4.0 (0.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Leptophlebia vespertina L.	1.0 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Caenis horaria L.	32.0 (7.4)	1.6 (0.5)	8.8 (2.05)	7.0 (1.9)	-	0.0 (0.0)	0.0 (0.0)	10.0 (2.0)	0.0 (0.0)	8.0 (2.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Caenis moesta Bengtss	23.2 (5.3)	0.8 (0.2)	0.8 (0.2)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	6.0 (1.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Caenis sp.	6.4 (1.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	4.0 (0.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Trichoptera:																				
Rhyacophila dorsalis Curtis	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	6.0 (1.4)	0.0 (0.0)	10.0 (2.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Polycentropus flavomaculatus Pictet	1.6 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	3.0 (0.3)	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.9 (0.1)	1.8 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Limnephilus lunatus Curtis	0.0 (0.0)	16.0 (5.0)	0.0 (0.0)	9.0 (2.5)	-	0.0 (0.0)	5.0 (1.2)	0.0 (0.0)	4.0 (1.1)	0.0 (0.0)	0.0 (0.0)	1.8 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	11.0 (1.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
L. marmoratus Curtis	0.0 (0.0)	8.0 (2.0)	0.0 (0.0)	2.0 (0.5)	-	0.0 (0.0)	8.0 (1.9)	0.0 (0.0)	3.0 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
L. rhombicus L.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	2.0 (0.5)	-	0.0 (0.0)	2.0 (0.5)	0.0 (0.0)	3.0 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
L. vittatus Fbr.	0.0 (0.0)	88.9 (27.1)	0.0 (0.0)	13.0 (3.6)	-	0.0 (0.0)	13.0 (3.0)	0.0 (0.0)	15.0 (4.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Grammotaulius atomarius Fbr.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.0 (0.3)	-	0.0 (0.0)	3.0 (0.7)	0.0 (0.0)	6.0 (1.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Table 2 (contd.)

Faunal list	Littoral Samples: North Lake Sept. 1982	June 1983	Sept. 1983	June 1984	Sept.* 1984	Littoral Samples: South Lake Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984	Benthic Samples: North Lake Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984	Benthic Samples: South Lake Sept. 1982	June 1983	Sept. 1983	June 1984	Sept. 1984
Mystacides azurea L.	0.0 (0.0)	0.0 (0.0)	8.0 (2.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	6.0 (1.2)	0.0 (0.0)	16.0 (4.3)	5.5 (0.6)	5.5 (0.3)	9.2 (0.7)	23.8 (1.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	11.0 (0.8)	67.8 (4.2
M. longicornis L.	0.0 (0.0)	0.0 (0.0)	4.8 (1.1)	0.0 (0.0)	-	3.2 (0.3)	0.0 (0.0)	10.0 (2.0)	4.0 (1.1)	9.6 (2.6)	3.7 (0.4)	0.0 (0.0)	22.0 (1.8)	0.0 (0.0)	29.3 (1.9)	11.0 (2.56)	0.0 (0.0)	14.7 (0.7)	0.0 (0.0)	25.7 (1.6)
Sericostoma personatum Spence	0.0 (0.0)	0.8 (0.2)	0.0 (0.0)	1.0 (0.2)	-	0.0 (0.0)	3.0 (0.7)	0.0 (0.0)	4.0 (1.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Chaoboridae:																				
Chaoborus sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	34.8 (3.5)	100.8 (5.6)	0.0 (0.0)	89.83 (5.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	18.3 (0.9)	86.2 (6.4)	127.3 (7.9)
Chironomidae:																				
Macropelopia sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	4.0 (0.9)	0.0 (0.0)	2.0 (0.5)	0.0 (0.0)	0.0 (0.0)	9.2 (0.5)	0.0 (0.0)	31.2 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	7.3 (0.3)	0.0 (0.0)	0.0 (0.0)
Procladius sp.	0.0 (0.0)	15.2 (4.6)	0.0 (0.0)	35.0 (9.8)	-	0.0 (0.0)	74.0 (17.2)	2.0 (0.4)	13.0 (3.6)	3.0 (0.8)	44 (4.5)	100.8 (5.6)	108.1 (8.7)	62.3 (3.8)	98.0 (5.9)	82.5 (19.19)	93.5 (9.3)	113.7 (5.5)	61.0 (4.5)	84.3 (5.3)
Tanypus sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	5.5 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Trissopelopia sp.	0.0 (0.0)	0.8 (0.2)	10.4 (2.4)	0.0 (0.0)	-	0.0 (0.0)	16.0 (3.7)	3.0 (0.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	34.8 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	7.3 (0.3)	0.0 (0.0)	(0.0) (0.0)
Prodiamesa sp.	0.0 (0.0)	0.0 (0.0)	4.8 (1.1)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	3.0 (0.8)	0.0 (0.0)	9.2 (0.5)	3.7 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	7.3 (0.3)	0.0 (0.0)	0.0 (0.0)
Brillia sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.83 (0.1)	0.0 (0.0)	1.83 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Cricotopus sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	11.0 (0.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Orthocladius sp.	37.3 (8.6)	20.8 (6.3)	40.0 (9.3)	30.0 (8.4)	-	2.0 (0.2)	32.0 (7.4)	38.0 (7.8)	44.0 (12.12)	38.0 (10.2)	60.5 (6.2)	113.7 (6.3)	55.0 (4.4)	78.8 (4.8)	176.0 (1.2)	49.5 (11.515)	123.2 (12.2)	86.2 (4.2)	71.5 (5.3)	130.2 (8.1)
Chironomus sp.	0.0 (0.0)	0.0 (0.0)	0.8 (0.2)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	9.2 (0.5)	0.0 (0.0)	31.2 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	11.0 (0.8)	25.7 (1.6)
Endochironomus sp.	38.0 (8.3)	6.4 (1.3)	60.0 (14.0)	9.2 (2.5)	-	3.0 (0.3)	41.0 (9.5)	32.0 (6.6)	41.0 (11.2)	32.0 (8.6)	40.3 (4.1)	93.5 (5.2)	60.5 (4.9)	71.5 (4.3)	80.7 (5.4)	18.3 (4.25)	58.7 (5.8)	40.3 (1.9)	67.8 (5.1)	62.3 (3.9)
Microtendipes sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	60.5 (6.2)	113.7 (6.3)	55.0 (4.4)	78.8 (4.8)	176.0 (11.7)	49.5 (11.51)	0.0 (0.0)	1.83 (0.09)	18.3 (1.4)	0.0 (0.0)
Polypedilum sp.	1.9 (0.2)	0.0 (0.0)	2.4 (0.6)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.7 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	5.5 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Psectrocladius sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.83 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Tanytarsus sp.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	1.0 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	5.5 (0.3)	0.0 (0.0)	1.93 (0.1)	0.0 (0.0)	0.0 (0.0)	5.5 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

* Because of low water levels it was impossible to take littoral samples in the North lake during September 1984

Table 3 Percentage of the zooplanktons of the North and South Lakes, Roundwood Reservoir

Taxa	North Lake				South Lake			
	June 1983	Sept. 1983	June 1984	Sept. 1984	June 1983	Sept. 1983	June 1984	Sept. 1984
Cladocera								
Acroperus angustatus Sars	-	1.111	-	-	1.562	1.699	1.079	1.020
Alona quadrangularis (O.F. Müller)	-	0.555	-	-	-	-	-	-
Alona affinis (Leydig)	0.611	-	2.033	-	2.343	1.416	1.079	2.040
Alona guttata Sars	-	1.111	2.033	2.203	-	-	-	-
Alona intermedia Sars	0.917	0.555	-	1.377	-	-	-	-
Alonella nana (Baird)	-	-	1.016	-	-	-	-	-
Chydorus sphaericus (O.F. Müller)	2.446	6.111	4.067	4.958	3.906	5.099	5.755	6.122
Bosmina coregoni Baird	25.688	17.222	18.305	20.936	22.656	22.096	23.741	20.918
Daphnia hyalina Leydig	51.987	58.333	58.983	53.994	45.312	50.424	43.984	47.959
Copepoda								
Diaptomus gracilis Sars	11.009	6.666	8.813	10.468	10.937	9.065	12.230	10.714
Cyclops vicinus Uljanin	4.892	4.444	2.711	3.856	10.937	5.099	8.633	7.142
Cyclops minutus (Claus)	2.446	3.888	2.033	2.203	2.343	2.832	3.597	4.081