INVESTIGATIONS INTO THE BENTHIC MACRO-INVERTEBRATE FAUNA OF THE MIDDLE LETABA IMPOUNDMENT, GAZANKULU

by

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SUMMARY

A seasonal investigation was made into the physical and chemical conditions as well as the occurrence and densities of the benthic macro-invertebrate fauna of the Middle Letaba Dam, Gazankulu. The study lasted from winter 1987 to summer 1989.

The physical and chemical conditions of the water of the dam suggest an unpolluted largely oligotrophic ecosystem with some slight organic enrichment of the water which may lead to occasional algal and phytoplankton blooms.

Seasonal tendencies in the standing crop of the benthic macro-invertebrate organisms for the different localities were compared. Based on both numbers and biomass of these organisms an index was drafted which reflected the most productive seasons and areas in the dam.

Dietary habits of both the small and large fish species which occurred in the dam at the time of the survey were correlated with the presence and relative abundance of the benthic macro-invertebrate organisms.

Based on the findings of the survey the Middle Letaba Dam can be classified as being in a primary developmental phase where the bio-geochemical cycles and the biotic communities, which existed at the time of the survey, have not yet reached a stabilizing phase.

It is recommended that further studies be undertaken on the population dynamics and trophic interrelationships of the microflora and microfauna of the dam. Attention should also be given to the possible sources of pollution in areas upstream from the dam. The larval and adult stages of the aquatic insects should be correlated and where possible new species should be described. It is also recommended that bio-energetic studies be made on certain components of the fauna and flora of the dam especially in those cases where certain organisms constitute important items in the diet of the various fish species.

OPSOMMING

Seisoenale ondersoeke is uitgevoer in verband met fisiese en chemiese toestande sowel as die voorkoms en digthede van die bentiese makro-invertebraatfauna van die Middel Letabadam, Gazankulu. Hierdie ondersoek het geduur vanaf die winter van 1987 tot en met die somer van 1989.

Die fisies-chemiese toestande van die water van die dam dui op hoofsaaklik onbesoedelde oligotrofiese toestande. Matige organies-verrykte toestande kom soms voor in die water van die dam wat aanleiding mag gee tot periodieke alg- en fitoplankton opbloei.

Seisoenstendense en die staande oes van die bentiese makro-invertebraat organismes is vergelyk vir die verskillende lokaliteite. Gebaseer op beide getalle en biomassa van hierdie organismes is 'n indeks daargestel wat die mees produktiewe gebiede in die dam sowel as vir die seisoene weerspieël.

Die voedingsgewoontes van beide die klein- en grootvis spesies in die dam is gekorreleer met die aanwesigheid en relatiewe volopheid van die bentiese makro-invertebraat organismes in die dam.

Gebaseer op die bevindinge van die ondersoek kan die Middel Letabadam geklasifiseer word as in 'n primêre ontwikkelingsfase waar die biogeochemiese siklusse en die biotiese gemeenskappe wat voorgekom het in die dam tydens die ondersoek nog nie 'n gestabiliseerde fase bereik het nie.

Daar word voorgestel dat verdere ondersoeke uitgevoer word na die bevolkingsdinamika en trofiese verwantskappe van die mikroflora en mikrofauna van die dam. Aandag sal ook gegee moet word aan die moontlike bronne van besoedeling in die opvangsgebied van die dam. Die larwaal- en volwasse stadia van die akwatiese insekte behoort gekorreleer te word en waar moontlik moet nuwe spesies beskryf word. Dit word ook voorgestel dat die bioenergetika van bepaalde komponente van die flora en fauna van die dam uitgevoer word. Dit geld hoofsaaklik in daardie gevalle waar sekere organismes belangrike voedselitems vorm in die dieet van die verskillende vissoorte wat daar voorkom.

CONTENTS

CHAPTER 1

PAGE

1. INTRODUCTION

1.1 Introduction and literature survey

There are several factors which necessitate the large scale construction of impoundments in rivers in southern Africa. One major reason is the uneven and concentrated summer percipitation over most parts of South Africa. Much of this rainwater is usually lost through surface run-off with the water being carried to the sea by rivers within a period of days.

As a result of the increasing demand for water for domestic, agricultural and industrial use as well as the need to cater for stock farming practices in the North-Eastern Transvaal, numerous reservoirs were constructed in this region (Mitchell and Marshall, 1974;Davies, Hall and Jackson, 1975). As the future demand for water grows, even more impoundments will have to be constructed. In the North-Eastern Transvaal alone several large impoundments are currently either being planned or are in the process of construction.

Gazankulu, a North-Eastern Transvaal territory in the Republic of South Africa (Figure 1.1), where the present study was undertaken, regularly experiences similar climatic and rainfall conditions as described above. The need for the impoundment of rivers in this particular region to retain run-off water for domestic and agricultural use, is therefore of paramount importance.

Gazankulu is situated in the north-eastern lowveld of the Transvaal between the latitudes 22°30' and 25° South, and the longitudes 30° and 31°30' East (Figure 1.1). It occupies approximately 752 000 hectares of land. The landscape of this region consists of three separate geographical areas namely a highveld plateau, a lower lying plateau, and western and eastern plains regions. Within these areas the topography changes from flowing landscapes, valleys and ravines to plains on which small koppies and granite hills are scattered (BENBO, 1976).

These geographical areas are divided into regions for grazing (412 698 ha), arable purposes (82 159 ha), nature conservation (73 400 ha), dryland cultivation of crops (61 873 ha), irrigation (20 186 ha) and forestry (150 ha) (BENBO, 1976).

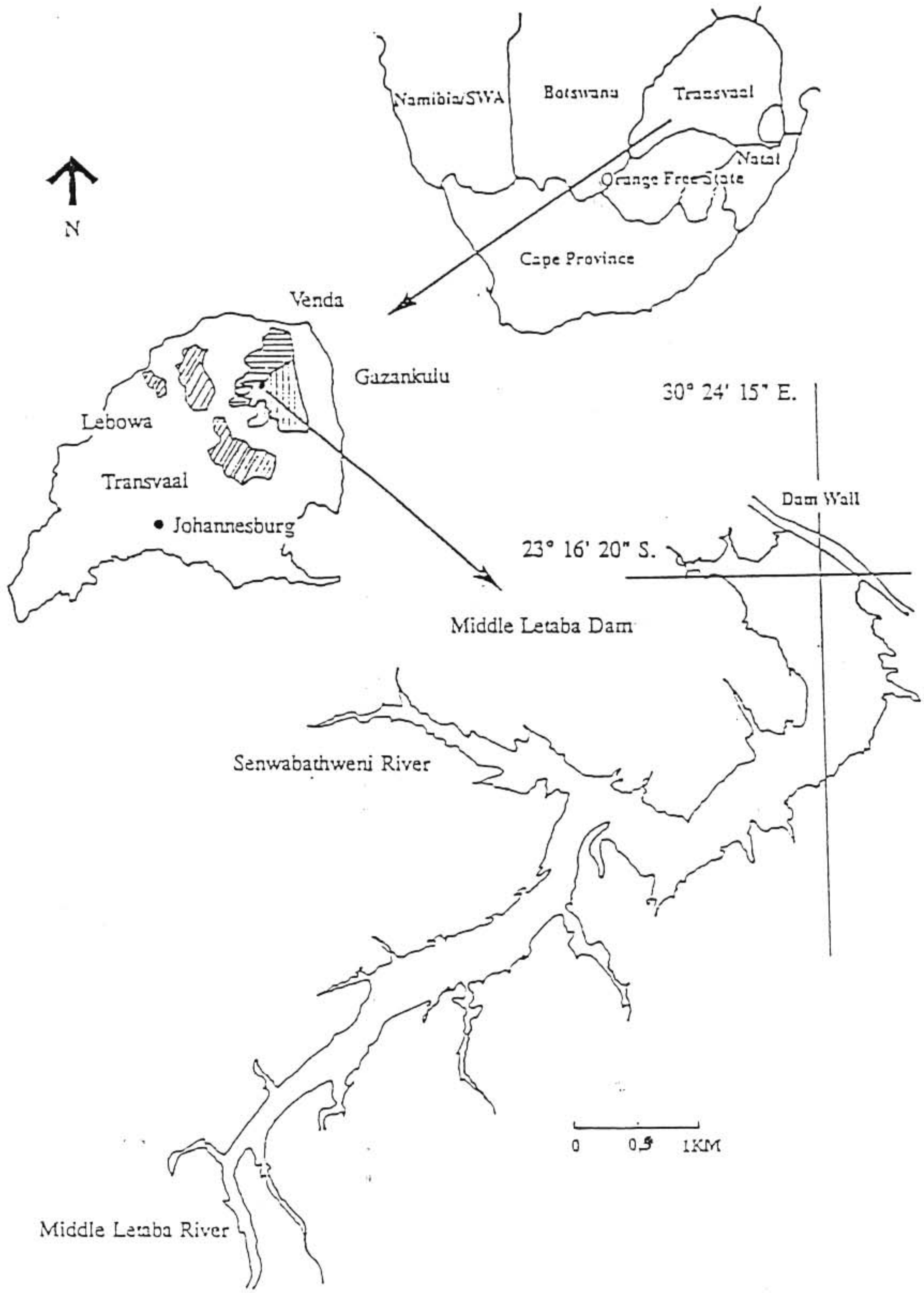

Figure 1.1 Geographical location of the Middle Letaba Dam

Table 1.1 : Climatological data for various physiographical regions of Gazankulu

Physiographical region and district	Altitude (m)	Rainfall (mm)		Summer evaporation (mm)	Temperature °C			
		Annual mean	Summer (Sept - March) mean		January max.	January min.	July max.	July min.
Western plateau (Giyani)	650-1100	650-780	700-950	700-720	27	16	22	7
Giyani belt (Malamulele & Giyani)	450- 900	440-480	550-600	710-750	30	18	25	4
Letsitele Belt (Ritavi)	600-1000	550-660	700-880	700-750	30	17	23	4
Eastern Soutpansberg (Malamulele)	450-700	440-700	550-900	700-730	32	17	25	4
Granite Lowveld region (Malamulele, Giyani, Mhala)	400-700	380-640	480-800	700-790	32	17	24	4

There are two climatic periods which can be distinguished annually namely a very hot, humid summer followed by a dry, cool, frost-free winter. The annual mean rainfall of Gazankulu fluctuates between 380 and 780 mm (Table 1.1). Of this, up to 2 000 mm rain per year is measured on the plateau area. The rain falls mainly in the form of scattered thunder showers in summer. It is therefore important that as much as possible of the water should be retained, especially during the dry non-rainy seasons, and this is achieved by the construction of a number of impoundments (Table 1.2), including the recently established Middle Letaba Dam.

The Middle Letaba Dam is situated at the latitude 23°16'20" South and the longitude 30°24'15" East in the Gazankulu Territory (Figure 1.1). The dam is fed by two river systems, the Senwabathweni river with a catchment area of 757 km^2 with an annual rainfall of 775 mm, and the Middle Letaba River with a catchment area of 1 042 km^2 and an annual rainfall of 708 mm. The most important tributaries of the Middle Letaba and the Senwabathweni Rivers include the Koedoes and Brandboontjies Rivers. (Figure 1.2); Department of Works, Gazankulu Government Service, 1975; Mouton, 1980).

The construction of the Middle Letaba Dam, with its associated more than 60 km irrigation canals commenced in August 1977. The canal system connects the Middle Letaba and the Hudson Ntsanwisi Dams (Figure 1.2) with each other and supplies water to an estimated 5 600 ha of agricultural land. The annual irrigation rate is 900 mm.

The closure of the dam wall was completed in September, 1984.
Development of irrigation schemes is at present being undertaken by the Gazankulu Department of Agriculture and private enterprise. An extensive water purification plant has been built below the dam to supply household water to the capital of Giyani as well as to other settlements in the Giyani District. Although there are more than 200 dams in Gazankulu (Table 1.2), the Middle Letaba Impoundment forms the major component of the so-called **Little Letaba Water Scheme** which is the most comprehensive hydrological network in the Gazankulu Territory. When full, its water covers an area of 1 943 ha with a maximum water depth of 34 m (Department of Works, Gazankulu Government Service, 1975; Mouton, 1980).

Table 1.2 : Reservoirs and water usage in Gazankulu

District	Name of Reservoir	River source	Capacity at full water level (Mm)	Important usage
Malamulele	Shingwidzi	Shingwidzi	1,3 Mm	D+C
Giyani	Hudson	Nsami Ntsanwisi	24,0 Mm	D+C+I
"	Middle Letaba	Middle Letaba & Senwabathweni	194,3 Mm	D+C+I
Mhala	Orinoco	Orinoco and Mutlumuvi	1,8 Mm	D+C+I
"	Edinburg	Sephiri, Nwandla and Muhari	3,2 Mm	D+C+I
Malamulele	Mophophe 1	Madzimu (Levuvhu)	75,0 ha	D+C
"	Maluleke 3	Mphongolo	67,5 ha	D+C
"	Ntlhaveni 17	Mphongolo	31,0 ha	D+C+I
"	Boltman A	Mphongolo	12,5 ha	D+C
"	Natorp 51	Mphongolo	12,0 ha	D+C
"	Hlangani	Mphongolo	10,0 ha	D+C
"	Kelder	Phugwane	9,8 ha	D+C
"	Nghomunghomu	Phugwane	7,8 ha	D+C
"	Phaphazela	Levuvhu	6,9 ha	D+C
"	Frankmanne	Shingwidzi	5,8 ha	D+C
"	Alten 24	Shingwidzi	4,8 ha	D+C
"	Kluster	Mphongolo	4,8 ha	D+C
"	Malamula	Nsami	4,5 ha	D+C
"	Alten 25	Shingwidzi	4,0 ha	D+C
"	Mukhomi	Nsami	3,9 ha	D+C
"	Nthlaveni 18	Phugwane	3,5 ha	D+C
"	Natorp 53	Singwidzi	3,4 ha	D+C
"	Nthlaveni 19	Phugwane	3,4 ha	D+C
"	Maphophe 2	Levuvhu	3,1 ha	D+C
"	Nkuri	Klein Letaba	3,8 ha	D+C
"	Nthlaveni 16	Mphongolo	3,0 ha	D+C
"	Johnston	Mphongolo	2,5 ha	D+C
"	Makulake 13	Phungwane	2,4 ha	D+C
Giyani	Gandlanani	Molototsi	13,8 ha	D+C
"	Mageva	Molototsi	12,5 ha	D+C
"	Jakkals	Molototsi	12,0 ha	C
"	Xikukwani	Nsami	8,0 ha	D+C
"	Maphata	Molototsi	6,8 ha	D+C
"	Dzumeri	Molototsi	6,5 ha	D+C
"	Mayephu	Molototsi	5,4 ha	D+C
"	Mbambeni	Molototsi	4,7 ha	D+C
"	Mahlathi	Nsami	4,0 ha	D+C

D = Domestic use
C = Cattle watering
I = Irrigation

Table 1.2 : Continued ...

District	Name of Reservoir	River source	Capacity at full water level (Mm)	Important usage
Giyani	Shimange	Molototsi	4,3 ha	D+C
"	Daniel	Molototsi	4,5 ha	D+C
"	Basani	Molototsi	3,2 ha	D+C
Ritavi	Rigorigo	Thabina	23,0 ha	D+C+I
"	Kloof	Thabina	8,6 ha	D+C+I
"	Burgersdorp	Thabina	7,2 ha	D+C+I
"	Shilovolve	Shilovolve (Groot Letaba)	17,5 ha	D+C
"	Nkwambako	Shilovolve	1,5 ha	C
Mhala	Agincourt (Sabie)	Magoso	12,4 ha	D+C
"	Ludlow	Sand	7,5 ha	D+C
"	Arthurstone	Sand	5,1 ha	D+C
"	Calcutta	Ngwenyameni (Sabie)	4,5 ha	D+C
"	Clare	Khokhovela (Sand)	4,7 ha	D+C
"	Sjikwidi	Khokhovela	4,2 ha	D+C
"	Nkwinyamahe	Musuhli (Sabie)	3,9 ha	D+C
"	Gottenburg	Musuhli	3,8 ha	D+C
"	Ronaldsy	Saringwa	3,6 ha	D+C
"	Zitsutswani	Sand	3,0 ha	D+C
"	Allandale	Sand	2,8 ha	D+C
"	Ireghla	Saringwa	1,4 ha	D+C
"	Zanthia	Matsabana (Sabie)	1,7 ha	D+C
"	Huntington 2	Sand	1,1 ha	D+C
"	Saville	Manyeleti	1,3 ha	D+C
"	Huntington	Sand	1,0 ha	C

D = Domestic use
C = Cattle watering
I = Irrigation

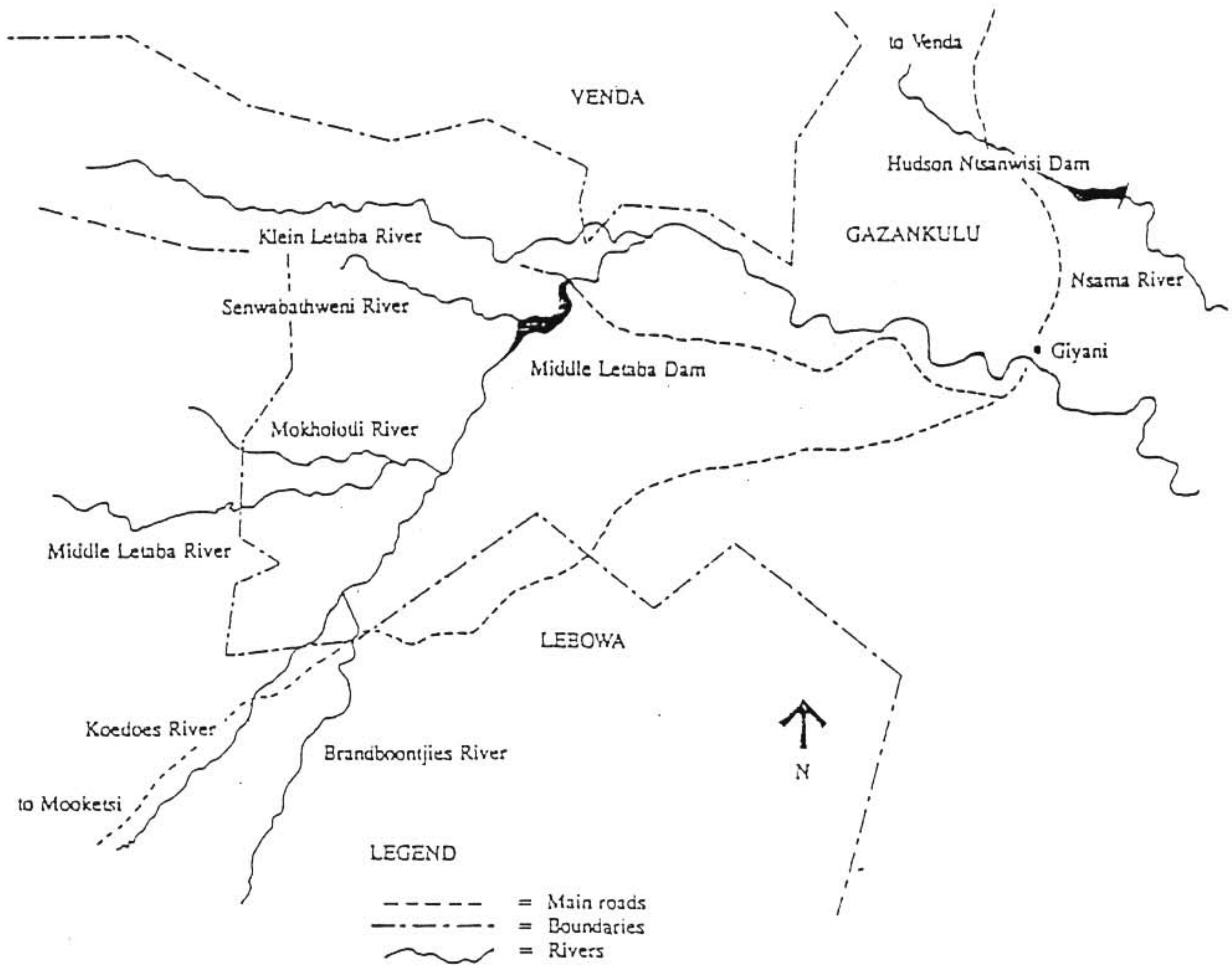

Figure 1.2 Little Letaba Drainage system - hydrologic artery of the Giyani District of Gazankulu

In a newly constructed impoundment like the Middle Letaba Dam, there are important physical changes which take place following the closure of the dam wall. The aquatic environment is then transformed from a predominantly lotic to an exclusively lentic environment. These developments are in turn accompanied by important changes in the structure and composition of the macro-invertebrates as well as in the fish fauna. The fish population of a new impoundment constitute an extremely important economic asset and initially consist of those species already present in the river at the site of the dam (Davies, et al., 1975). To sustain the various growing fish populations, the benthic macro-invertebrate fauna as well as the zooplankton must likewise develop significantly in such an impoundment.

The environmental approach to fish biology becomes even more important in the event of a newly constructed man-made impoundment like the Middle Letaba Dam. During the ageing process of a man-made impoundment three primary phases are recognized (Bowmaker, 1975). The first phase is usually characterized by the sharp increase in the biomass of the fauna and flora. This is known as the high productive phase. The newly created impoundment will be colonized by river fishes. Some of these species will adapt themselves to the new conditions, while others may disappear from the community. After the impoundment has stabilized, species from elsewhere in the river system may gain access to it and the number of species which favour lacustrine conditions will increase.

As the impoundment level rises it floods the surrounding land. The submerged decaying vegetation then liberates an abundance of nutrients which in turn leads to a significant increase in the primary and secondary production levels in the impoundment. This so-called nutrient pulse may also emanate from various other sources eg., the incorporation of allochthonous detritus, mineral loads as well as nutrients originating from animal waste material and soil (Odum, 1971; Bruton and Jackson, 1983). The fishes which can take direct advantage of this productivity and which can spawn successfully under such local conditions usually increase significantly in numbers (Lowe-McConnel, 1987).

Because of their value as food for fish, a study of the zoobenthos of lakes and impoundments is extremely important in any investigation aimed at establishing ecological interrelationships conducive to tertiary production levels. This component is amongst the commonest and most widespread of the freshwater fauna.

The benthic organisms often occur in large numbers and constitute an important link in the food web of water bodies. Many are microphagous in their feeding habits utilizing either phytoplankton, submerged macrophytes, bacteria or other nutrient sources as their food.

In turn, they are widely eaten by many aquatic carnivores and constitute an important component in the diets of omnivorous and carnivorous fish. Fundamentally they transform fine organic matter into food for larger carnivores (Borutzky, 1939; Ricker, 1952; Hayne and Ball, 1956; MacDonald, 1956; Jonasson, 1978; Benson, Fitzpatrick and Pearson, 1980; Moore, 1980; Hart, Allanson and Selkirk, 1983).

Numerous studies on the distribution and abundance of benthic invertebrate populations in relation to various physical and chemical environmental factors such as temperature, dissolved oxygen concentration, pH, depth, water type, substratum characteristics, etc., have been conducted in standing water bodies. Literature reviews on this subject were compiled by, amongst others, Heuschele (1969); Iovino and Miner (1970); McLachlan and Cantrell (1976); Mothersil, Freitag and Barnes (1980); Vodopick (1980); and Cowell and Vodopick (1981).

Thus, it is important to relate the distribution and abundance of benthic macro-invertebrates to lake type (trophic level), physico-chemical characteristics as well as life cycles and growth patterns of the major taxa (Cowell and Vodopick, 1981).

A feature of the development of benthic communities in newly constructed impoundments is the rapid colonization by Chironomidae (Morduchai-Boltovski, 1961; Sokolova, 1963; Paterson and Fernando, 1970; McLachlan, 1975; McLachlan and McLachlan, 1976). The development of a sediment layer and the substrate particle size seem to be necessary prerequisites for the colonization of new impoundments by certain chironomid species (McLachlan and Cantrell, 1976).

The above concise, and rather incomplete, literature review clearly shows that detailed studies of the ecological parameters influencing the biology and productivity of benthic organisms need to be included in any comprehensive ecological survey of the biological interrelationships in standing water bodies. However, due to the lack of manpower, infrastructure and time, this is not always possible.

Manpower limitations and time constraints may also be the major reason why South African limnologists have, in the past, sadly neglected this important aspect of inland water biology. No attempts at the integrated synthesis of the benthic productivity, environmental conditions and aquatic vertebrate production could be traced in the southern African literature.

Another aspect of the South African limnological scene is that studies on the plankton have received much more attention than investigations on bottom dwelling organisms. Furthermore, although the hydrobiology of various South African river systems, including the occurrence and biological aspects of benthic organisms, has been studied during the latter half of the century (Harrison, 1958 a and b; Harrison and Elsworth, 1958; Allanson, 1961; Chutter, 1963, 1968, 1970, 1972, 1975, 1984; Harrison, Keller and Lombard, 1963; Hughes, 1964 a and b; Schoonbee, 1964; De Kock, 1966; Matthew, 1968; Roode, 1971; Coetzer, 1978; Dassonville, 1981; Masihleho, 1981; Mokgalong, 1981), less attention was devoted to benthic diversity and production in man-made water masses and inland lakes.

To date the only detailed investigations on the benthos of standing water bodies are the studies of Schuurman (1932); Roode (1967); Boltt (1969 a and b, 1975 a, b and c); Mulder (1969); Mulder, Kruger and Van Eeden (1970); Van Loggerenberg (1972) and Jooste (1977). The effects of domestic, agricultural and industrial pollution on the benthic fauna of South African waters were also investigated by, amongst others, Allanson (1961); Allanson and Gieskes (1961); Booyse (1971); Vermaak (1972); Kilger (1974); Potgieter (1974); Viljoen (1974); Wessels (1974); Batchelor (1977); Van der Merwe (1988, 1990) and De Wet (1990).

The present study forms part of a multi-disciplinary research project on the post-impoundment ecology of the Middle Letaba Dam which included the following aspects:

1. Water quality conditions

2. Aquatic macrophyte diversity and species occurrence

3. Aspects of the primary and secondary trophic conditions as represented by the phytoplankton, zooplankton and macro-invertebrate fauna

4. Biological aspects and population dynamics of the fish fauna

5. Seasonal diversity and population size of the diving and wading waterbirds

6. Helminth parasites of the fish population and of selected piscivorous birds.

The specific aims and objectives of this study can be summarized as follows:

1. Seasonal evaluation of the physical and chemical conditions of the Middle Letaba Dam during the period Winter 1987 - Summer 1989

2. Qualitative and quantitative assessment of macro-invertebrate fauna of selected localities in the littoral zones of the Middle Letaba Impoundment

3. Seasonal investigation of the benthic fauna including the relative importance of the benthic macro-invertebrates in terms of biomass in the dam

4. Seasonal tendencies of the benthic macro-invertebrate standing crop

5. Compilation of a provisional index of benthic macro-invertebrate production

6. Correlation of macro-invertebrate fauna with the dietary habits of different fish species in the impoundment.

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CHAPTER 2

PAGE

2. MATERIALS AND METHODS

2.1 Approach: Seasonal surveys

In the temperate to subtropical South African lowveld, seasonal changes are difficult to distinguish and are usually not clearly defined. Seasons were therefore arbitrarily selected depending on the months in which sampling took place: Winter being June, July and August, Spring in September, October and November with Summer in December, January and February. Autumn occurs in March, April and May. Sampling of the benthic macro-invertebrate fauna commenced during the winter of 1987 and was continued for a period of seven successive seasons with the survey ending during the summer of 1989.

2.2 Selection and description of sampling localities

Sampling localities (Figure 2.1 and Figure 2.2) were selected to represent as much as possible of the environmental conditions prevailing in the dam. Considered in the selection of sampling localities were the habitat types. These vary in depth, type of bottom substrate (sandy, muddy, gravel, rocky and/or with silt), vegetation type and shoreline characteristics. For correlation of research results, the sampling localities were chosen in the proximity of some of the sampling sites selected for the collection of the various fish species. However, the collection of samples of the plankton, benthic macro-invertebrate fauna as well as the investigation on the physico-chemical conditions of the water regime, were all done at the same localities. Vegetation types (Table 2.1) were specified according to the following classification by Venter, (1991).
All localities were individually marked using floats anchored to the bottom of the lake.

Table 2.1: The identification system of aquatic vegetation types present in the Middle Letaba Dam

a) Emergent aquatic	(EA)	-	Plants growing permanently in the water with stems and leaves emerging above the water level
b) Submerged aquatic	(SA)	-	Plants growing and rooted completely below the water surface
c) Partial aquatic	(PA)	-	Rooted plants growing on mud or sand banks but occurring for a portion of the time in the water
d) Mud plant	(MP)	-	Rooted plants which occur on moist sand or mud banks but never in the water itself for any length of time
e) Floating aquatic	(FA)	-	Non-rooted plants, floating on the surface of the water
f) Rooted floating aquatic	(RFA)	-	Rooted plants with the leaves floating on the water surface

Initially eleven benthic faunal sampling localities were selected to represent the various habitat types in the littoral (8 localities) and limnetic (3 localities) zones of the impoundment (Figure 2.1). As the dam subsequently filled beyond the original river zone, four additional localities were added to cover the newly submerged littoral areas in the dam (Figure 2.2).

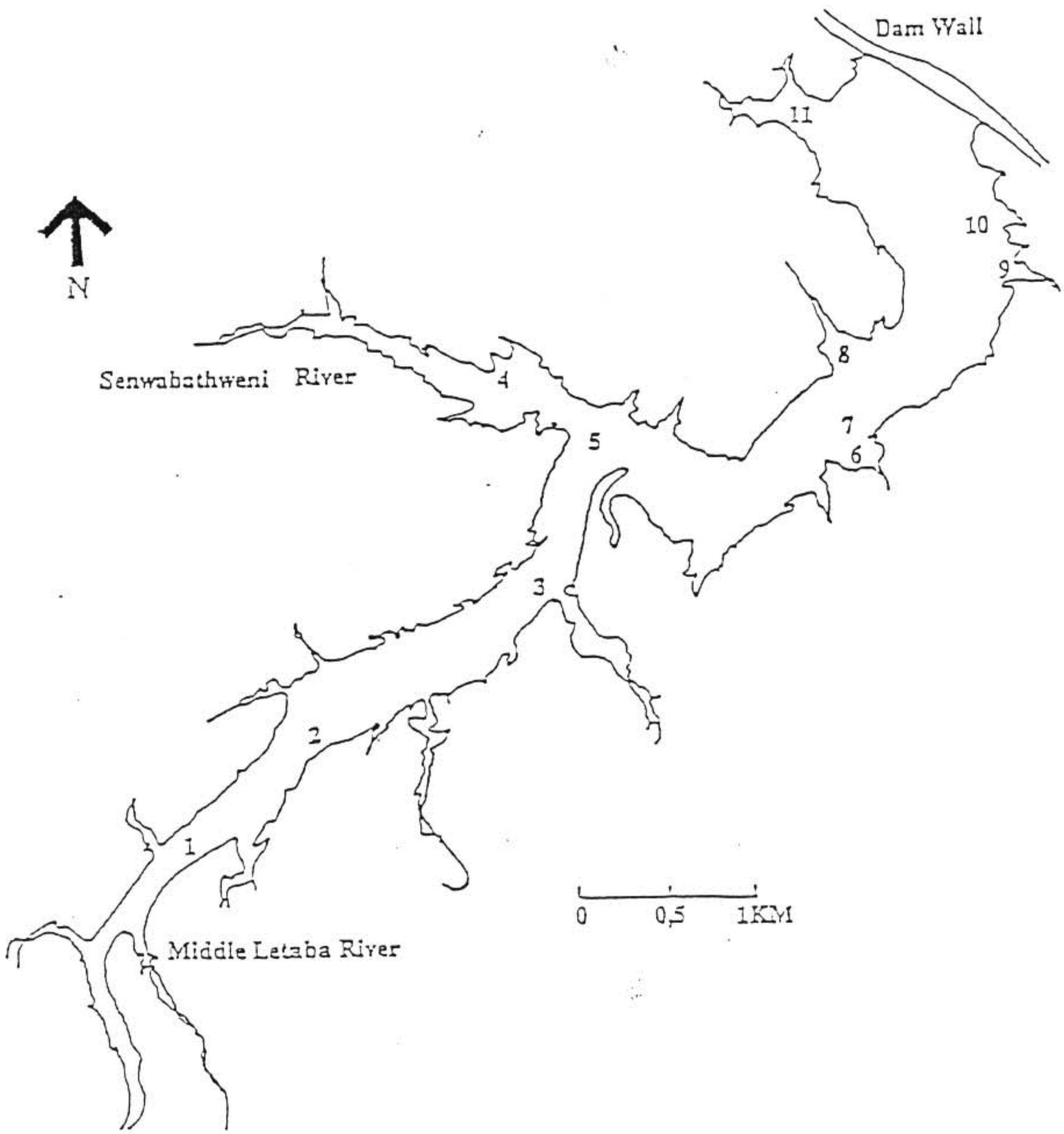

Figure 2.1 **The eleven major sampling localities for the seasonal surveys of the benthic macro-invertebrate fauna in the Middle Letaba Dam during the period June 1987 (Winter) to January 1989 (Summer)**

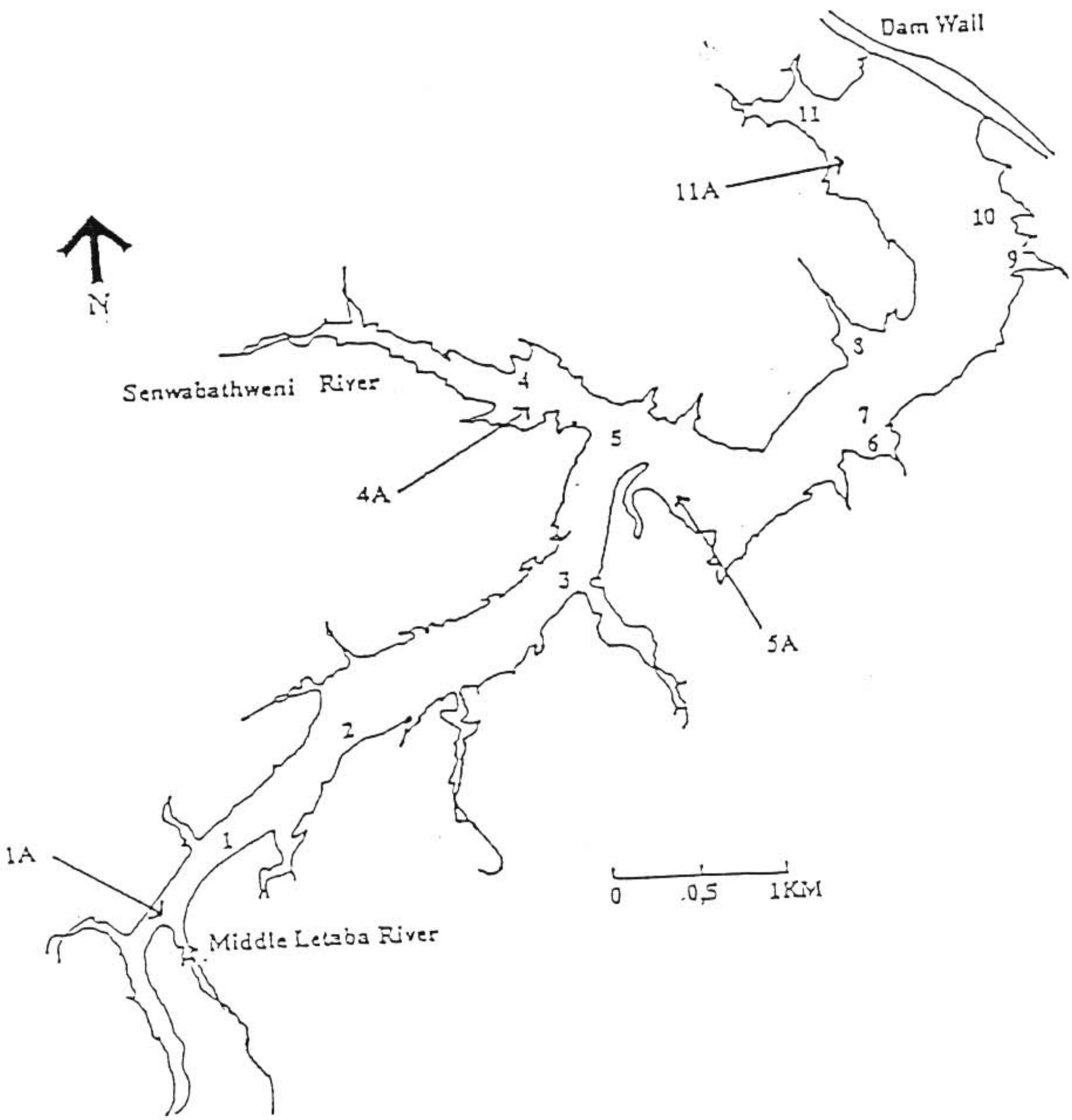

Figure 2.2 New additional benthic fauna sampling localities (1A - 11A) in the newly submerged littoral areas of the Middle Letaba Dam

Locality 1 was situated at a point where the Middle Letaba River enters the dam (Figure 2.2). This locality had an average depth of 4 - 5 m with the bottom substrate consisting mainly of a sandy to muddy texture with rich loads of organic material present. The aquatic vegetation at this locality consisted mainly of *Phragmitis mauritianus* Kunth (EA), *Leersia hexandra* Swarts (MP/EA), *Panicum subalbidum* Kunth (MP/EA), and *Najas pectinata* (Parl.) Magnus (SA).

Locality 1A, like Locality 1, was also at the main inflow area of the dam (Figure 2.2). It is situated at the Middle Letaba River zone which, at the beginning of the investigation, was still dry. The water level at this point was approximately 3m deep with a bottom substrate of sand and mud rich in organic matter. The aquatic vegetation consisted of *P. mauritianus, L. hexandra* and *N. pectinata*. Sampling for the zoobenthos at this site commenced during the autumn of 1988.

Locality 2 was situated in the littoral zone on the eastern shore of the dam (Figure 2.2). At this point the dam was approximately 2m deep with a muddy substrate. The aquatic flora present included *Nymphaea lotus* L. (RFA), *P. mauritianus, N. pectinata*, and *Ultricularia inflexa* Forssk. (SA).

Locality 3 was situated in a bay in the littoral zone on the eastern embankment of the dam (Figure 2.2) where the substrate forms a muddy bottom. The depth in this area was approximately 13m. The aquatic vegetation consisted mainly of *N. pectinata, U. inflexa* and *Potamogeton crispus* L. (SA).

Locality 4 was located at the second major inflow area of the dam, in the Senwabathweni River (Figure 2.2). The area was 6 - 7m deep and forms a rocky substrate with patches of sand. The water plants present were *N. pectinata, Potamogeton schweinfurthii* A.W. Benn. (RFA), *L. hexandra, Panicum subalbidum, U. inflexa* and *Marsilea macrocarpa* Presl (PA).

Locality 4A was also situated on the Senwabathweni inlet and represents a flooded area (Figure 2.2). The bottom substrate consisted of mud with an abundance of organic material. At this point, the dam was about 2m deep. The following aquatic flora occurred at the site: *N. pectinata, P. schweinfurthii, L. hexandra, Panicum subalbidum, U. inflexa* and *M. macrocarpa*. Sampling at this site began during the Spring of 1987.

Locality 5 was established at the confluence of the Middle Letaba and the Senwabathweni Rivers (Figure 2.2). The water level was 13 - 14m deep with the bottom substrate consisting largely of soft mud. The aquatic flora at this site included *N. pectinata, P. schweinfurthii, L. hexandra, Panicum subalbidum, U. inflexa* and *Ludwigia stolonifera* (Guill. & Perr.) Raven (MP).

Locality 5A was situated in the littoral region on the south-eastern shore of the dam (Figure 2.2). Water depth at this site measured approximately 4m. The bottom substrate consisted of mud mixed with gravel and small stones. The water plants present included *N. pectinata, U. inflexa* and *P. schweinfurthii*. Sampling of the zoobenthos commenced during Spring of 1987.

Locality 6 was selected at the south-eastern shore of the dam (Figure 2.2). It was 7 - 8m deep with a bottom substrate consisting largely of mud with loose stones and patches of sand. The aquatic vegetation at this site included *N. pectinata, P. crispus* and *Cynodon dactylon* (L.) Pers. (MP/EA).

Locality 7 was situated not far from locality 6, but occurred towards the open area of the dam in the original river bed (Figure 2.2). The depth at this point was about 15m with a muddy bottom substrate. The aquatic flora consisted of *N. pectinata, P. crispus* and *C. dactylon*.

Locality 8 was situated on the north-western shore of the dam (Figure 2.2). It was 4 - 5m deep with soft muddy substrate. The flora in this locality consisted of the aquatic macrophytes *N. pectinata, Potamogeton octandrus* Poir. (RFA) *P. crispus, P. schweinfurthii, Panicum subalbidum* and *L. hexandra*.

Locality 9 was established on the eastern shore of the dam in a narrow ravine and was approximately 6 - 8m deep. It had a muddy bottom with loose stones and pebbles. The plants found at this locality were *N. pectinata, P. crispus, P. schweinfurthii* and *U. inflexa*.

Locality 10 was situated in the open dam area in the original river bed and had a depth which varied from 20 - 23m during the survey. This was the deepest benthic faunal sampling station selected and had a bottom substrate consisting mainly of soft mud.

Locality 11 was selected on the north-western shore of the dam. It was 6 - 7m deep and had a bottom substrate consisting of sand and mud with loose stones. The aquatic flora present consisted of *N. pectinata, Potamogeton pusillus* L. (SA), *P. crispus, P. octandrus, L. stolonifera* and *U. inflexa.*

Locality 11A was located in a shallow area of 2 - 3m deep and was flooded during the filling of the dam. It was situated on the north-western shore of the dam. This locality had a sandy bottom with gravel. The plants found included *N. pectinata, P. octandrus, P. crispus, P. pusillus, L. stolonifera* and *U. inflexa.* Sampling of the benthic fauna commenced during the Spring of 1987.

All the sampling localities as mentioned earlier, were clearly marked with anchored floats.

2.3 Collection and processing of samples

The seasonal samples were all collected within a five metre radius from each float. During surveys, three substrate samples were collected at each locality using a Petersen mudgrab with a bite of 350 cm^2. Samples were individually transferred to labelled plastic bags and transported to the field laboratory. On arrival samples were gently stirred in 20 l containers in tap water. Organic matter and organisms were separated from the inorganic material by rinsing them into a handnet of 250 openings /cm^2 mesh size. This process was repeated for at least five times per sample until all the organic matter (including organisms) was visibly removed from the sand or gravel particles that remained in the container. Organisms and organic material were then washed from the handnet into properly labelled glass containers for immediate analysis under a stereo-microscope.

2.4 Identification and sorting of benthic macro-invertebrate organisms

Identification of the benthic macro-invertebrates were done with the aid of a Wild M5A stereomicroscope using a number of standard references including Hutchinson (1929), Barnard (1932), Crass (1947), Chu (1949), Pennak (1953), Mellanby (1956), Usinger (1956), Ward and Wipple (1959), Van Eeden (1960), Scott (1963 a and b), Noble and Schaefer (1967 a and b) and McCafferty (1981).

The number of benthic macro-invertebrate organisms present in quantitative samples from a lake bottom may be large. The labour involved in sorting and counting the organisms is a tedious and time consuming task but can be significantly reduced if a satisfactory method of subsampling is employed (Hickley, 1975).

Several techniques have been described for subdividing aquatic macro-invertebrate samples in order to conserve time during sorting (Gibbons, 1933; Ladell, 1936; Beak, 1938; Lyman, 1943; Wiborg, 1951; Kott, 1953; McEwen, Johnson and Folson (1954) ; Caverness and Jensen, 1955; Birkett, 1957; Anderson, 1959; Motoda, 1959; Allanson and Kerrich, 1961; Bayless, 1961; Cushing, 1961; Hynes, 1961; Lauff, Cummins, Eriksen and Parker 1961; Gerking, 1962; Whitehouse and Lewis, 1966; Cross and Minns, 1969; Waters, 1969; Starling, 1971; Pauly, 1973; and Hickley, 1975). However, these methods have their own shortcomings. A major problem in finding a suitable procedure for the subsampling of benthic macro-invertebrates is that they do not remain in suspension with the planktonic organisms whilst some frequently clump together, getting tangled up by hooks or claws to each other or to the plant material (Hickley, 1975). Sorting samples by hand remains the most widely used method of separation with several techniques existing. Williams (1974) compared techniques of hand-sorting benthic macro-invertebrate organisms from organic and inorganic detritus in terms of accuracy and efficient use of time.

The American Public Health Association (A.P.H.A, 1965) recommends that samples be hand-picked in a white enamel dish before preservation. However, if a large number of samples is involved, this is generally modified to allow sorting after preservation in formalin or alcohol. Preservation usually results in bleaching of organisms and workers have generally countered this effect by using a black sorting dish to provide a contrasting background to the usually light coloured organisms (Williams, 1974). The value of stains as an aid in sorting macrobenthos was demonstrated by Williams (1974).

Several workers sorted and counted the benthic organisms after preservation (Harrison and Elsworth, 1958; Allanson, 1961; Roode, 1967; Mulder, 1969; Kilger, 1974; Potgieter, 1974; Viljoen, 1974 and Chutter, 1984).

In this project the organisms were sorted live by hand-picking, counting and converting these to numbers /m^2 substrate area using the results of all three sets of samples collected at each station. The advantage of sorting them live is the ease with which they are recognized by their characteristic movements. In their studies, Berg (1938); Jooste (1977); Masihleho (1981) and Mokgalong (1981) sorted and counted the benthic macro-invertebrate organisms live. Identified and sorted taxa/groups of organisms were then preserved and stored in 80% alcohol in properly labelled specimen bottles for subsequent laboratory processing and analyses. Harrison and Elsworth (1958); Seaman, Scott, Walmsley, Van der Waal and Toerien (1978) and Chutter (1984) preferred 10% formalin for the preservation of the organisms.

2.5 Laboratory analysis of benthic macro-invertebrate organisms

In the laboratory the alcohol of each sample was decanted and the already identified and counted organisms transferred to weighing boats of known mass which was then dried for a period of 24 hours in a drying oven (Labotec model 380) at a constant temperature of (60 $\pm$ 1°C). Abdel-Malek and Ishak (1980) also obtained dry weight of benthic samples through drying in an oven at 60°C. In order to obtain sufficient material for dry mass determinations, the same taxa/groups from all localities collected during the same season were combined. From the results obtained, calculations were made of individual and total dry mass of the taxa or groups of organisms/locality/season.

Values were expressed as dry mass in milligrams /m^2 of the substrate. In some instances (e.g. Nematoda) the numbers and mass of organisms did not allow for reliable assessment of dry mass values.

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CHAPTER 3

PAGE

3.1 Introduction

Many research workers have analysed river and lake waters in the hope of finding water quality parameters with which faunistic data might be correlated, and almost all have been disappointed (Macan and Worthington, 1951). Production studies on newly-made impoundments have assumed considerable importance. Nielson (1967) suggested and outlined such studies, whilst Dussart, Lagler, Larkin, Scudder, Szesztay and White (1972) emphasized the importance of such surveys in formulating management programmes. A sound limnological background on South African impoundments is undoubtedly a prerequisite for the efficient management and usage of water.

Hydrological, chemical, physical and biological characteristics of each impoundment and its inflowing waters must be considered in relation to developments within the catchment area. It can be stated that in most South African impoundments the limnological characteristics vary considerably as a consequence of the unstable seasonal hydrology (Water Research Commission Report, 1980). Considerable variations in water quality can be brought about by fluctuation in lake levels due to the influx and outflow of water from the lake (Marshall and Falconer, 1973). McKendrick and Williams (1968) have shown a relationship between total rainfall and water quality. Immature aquatic stages of insects, as well as other aquatic animals, have been used for many years as indicators of water quality (Kolkwitz and Marsson, 1908, 1909; Fair and Whipple, 1948; Liebmann, 1951; Gaufin and Tarzwell, 1952, 1956; Hynes, 1960; Jacobson, 1978).

It is well known that certain nutrients act as limiting factors for primary production in lakes (Vollenweider, 1968; Schindler, Kling, Schmidt, Prokopowich, Frost, Reid and Capel, 1973). In recent years research has shown that the level of productivity of a body of water is governed by the regeneration of nutrients and not necessarily by the concentration of nutrients present (Jacobson, 1978).

Efforts to learn how the nutrient cycling of lakes expresses itself in the production and maintenance of populations, have involved a variety of approaches, from theoretical models to empirical correlation analysis. According to Edmondson and Lehman (1981) the empirical approach usually is based on data from many lakes with a variety of nutrient budgets. Evaluation of such relations is complicated by the fact that lakes may vary in many additional features affecting the way they utilize their nutrients, such as relative depth, proportion of littoral zone, water influx, climate and the relationship as well as concentrations of major ions present in the water. In the theoretical approach, a set of equations or other computational devices are established to predict a dependent variable. When the values of such independent variables are altered, they usually correspond to events which occur in practice. The theoretical approach appears to be more dynamic, but is complicated since the quantitative relations must be established empirically among certain formally defined processes (Edmondson and Lehman, 1981).

It was found logical to determine for this part of the project, empirical data to express the physical and chemical conditions of the water regime in the Middle Letaba Dam, and to identify those nutrients which may be critical in the production potential of the lake itself.

3.2 Materials and methods

Monthly records of rainfall as well as of evaporation were obtained from the Weather Bureau Station near the dam. The various physical and chemical parameters were determined from the eleven selected localities in the dam (Figure 3.1).

The physical parameters were monitored /station /survey during the 1987 to 1989 sampling period. Day and night readings were conducted at all sampling localities. Day measurements were taken from 11h00 to 13h00 whilst night readings were taken from 22h00 to 01h00.

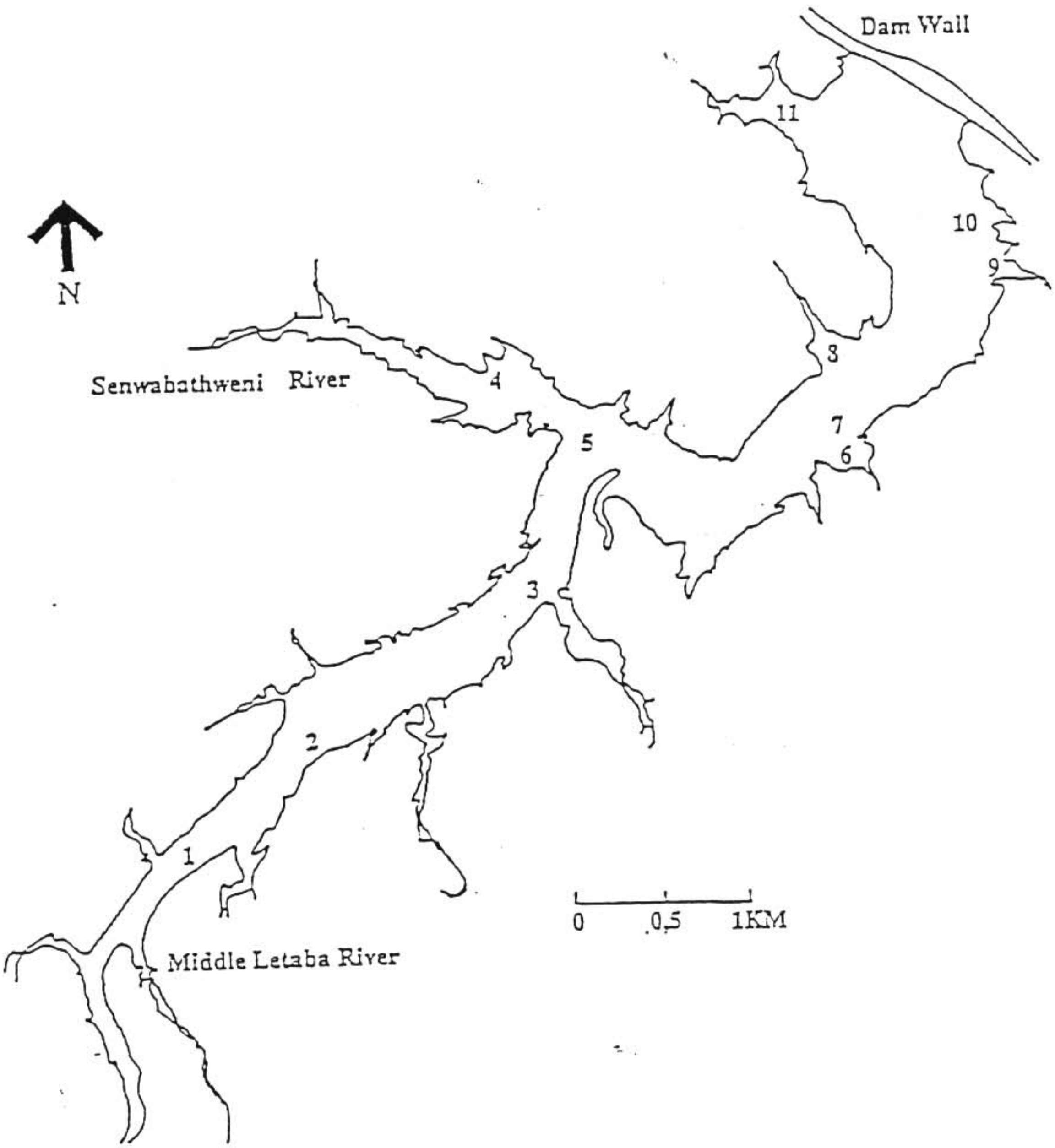

Figure 3.1 **Eleven sampling localities selected for the determination of various physical and chemical parameters in the Middle Letaba Dam**

A mercury thermometer (°C) as well as an oxygen thermister probe of an Y.S.I. model 54A oxygen and temperature meter were used for determining both the surface and bottom temperatures (°C) as well as the surface and bottom oxygen content (mg l^{-1} O_2) of the water, respectively. The pH of the water was determined by using a Zeiss pH 1602 meter. Conductivity (μScm^{-1}) was determined at approximately 1m depth with the use of a Chemtrix type 700 meter. Water transparency (cm) was determined during the day using a Secchi disk. The Secchi disk is a much simpler but reliable instrument for providing a measure of the clarity of water. It consists of a black and white disc of 30cm diameter. The disk is lowered vertically into the water to a point at which it becomes invisible to the naked eye. A Secchi disk is accurate enough to provide comparisons between different types of waters. The Secchi disk technique was originally developed by Angelo Secchi in 1866 and is still in use today. According to Preisendorfer (1986) it is one of the few traditional instruments still in use by modern science. The Secchi disk procedure is valued by many aquatic biologists as a useful and informal visual index of the trophic activity of a lake (Preisendorfer, 1986). Depth of water was measured using a calibrated rope marked at 25 cm intervals attached to a Petersen mudgrab.

Water samples were collected seasonally at various sampling localities in pre-cleaned, specially prepared containers. The physical and chemical conditions of the water were determined by the Water Quality Division of the National Institute for Water Research (NIWR) of the South African Council for Scientific and Industrial Research (CSIR) using an auto-analyser. Analyses of the following chemical parameters were made:

Sodium (Na)	Silicon (Si)
Potassium (K)	Sulphate (SO_4)
Calcium (Ca)	Chloride (Cl)
Magnesium (Mg)	Calcium Carbonate ($CaCO_3$) as a measure of alkalinity and hardness.

In addition dissolved Salts, Kjeldahl-Nitrogen, Ammonia-Nitrogen, Nitrite-Nitrogen, Nitrate-Nitrogen, Total phosphate, Ortho-Phosphate, Boron (B) and Fluoride (F) were also determined. Localities 5 and 10 were specifically selected for the determinations of the following heavy metals:

Arsenic (As)	Manganese (Mn)
Copper (Cu)	Nickel (Ni)
Mercury (Hg)	Zinc (Zn)
Lead (Pb)	Iron (Fe)

3.3 Results

3.3.1 Rainfall and evaporation

According to statistics for 1987-1988, the Middle Letaba Dam area averaged a monthly precipitation of 34 mm with peaks during the summer months (197 mm during December 1987 and 133 mm during February 1988). Minimum values occurred in winter (4 mm in May 1987 and 8 mm in May 1988) (Figure 3.2). The evaporation rate followed a similar pattern, with peak values found during the warmer summer periods (Figure 3.2).

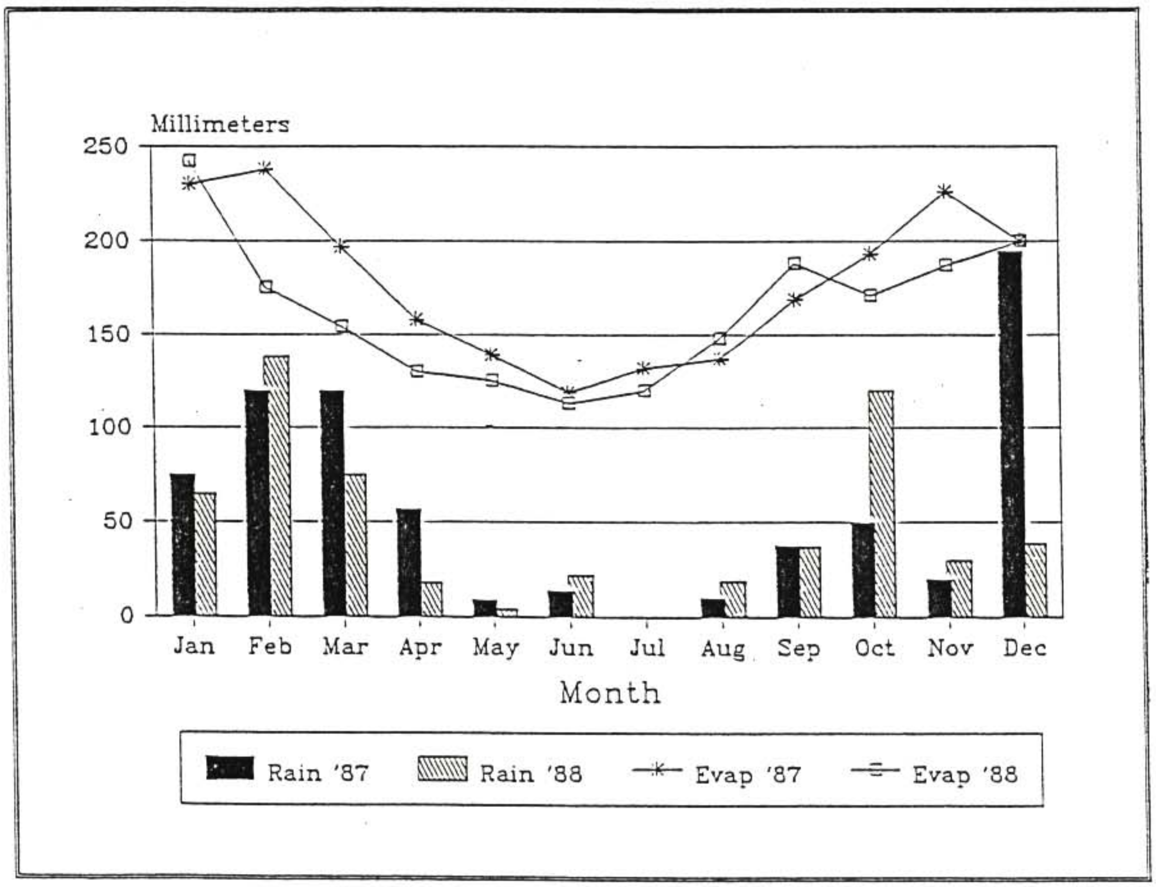

Figure 3.2 Average monthly precipitation (mm)and evaporation (mm) during the 1987-1988 period of investigation at the Middle Letaba Dam.

3.3.2 Physical conditions of the water

The mean values of surface and bottom water temperatures from 11 sampling localities, during successive seasons in the Middle Letaba Dam are shown in Table 3.1

Table 3.1 Mean values of surface and bottom water temperatures from 11 sampling localities, during successive seasons in the Middle Letaba Dam

Season	Surface Temp. °C Day	Surface Temp. °C Night	Bottom Temp. °C Day	Bottom Temp. °C Night
Winter 87	16,8	15,7	16,3	14,8
Spring 87	21,7	21,5	20,5	20,8
Summer 88	26,9	26,8	25,2	24,6
Autumn 88	25,8	25,4	24,1	23,4
Winter 88	17,6	17,0	15,5	15,3
Spring 88	22,2	20,4	20,6	17,7
Summer 89	26,5	24,3	21,8	21,2

The highest individual water temperature recorded was 28,2 °C in summer while the minimum winter water temperature was 14,0 °C. Surface water was always warmer than bottom water throughout the survey, but with minor differences (Figure 3.3.). The differences between maximum and minimum water temperatures for all seasons during the survey did not exceed 10 °C. This resulted in the dam not showing any marked temperature stratification. This can be ascribed to the relative shallowness of the dam during the survey period which allowed for thorough mixing of the entire water column.

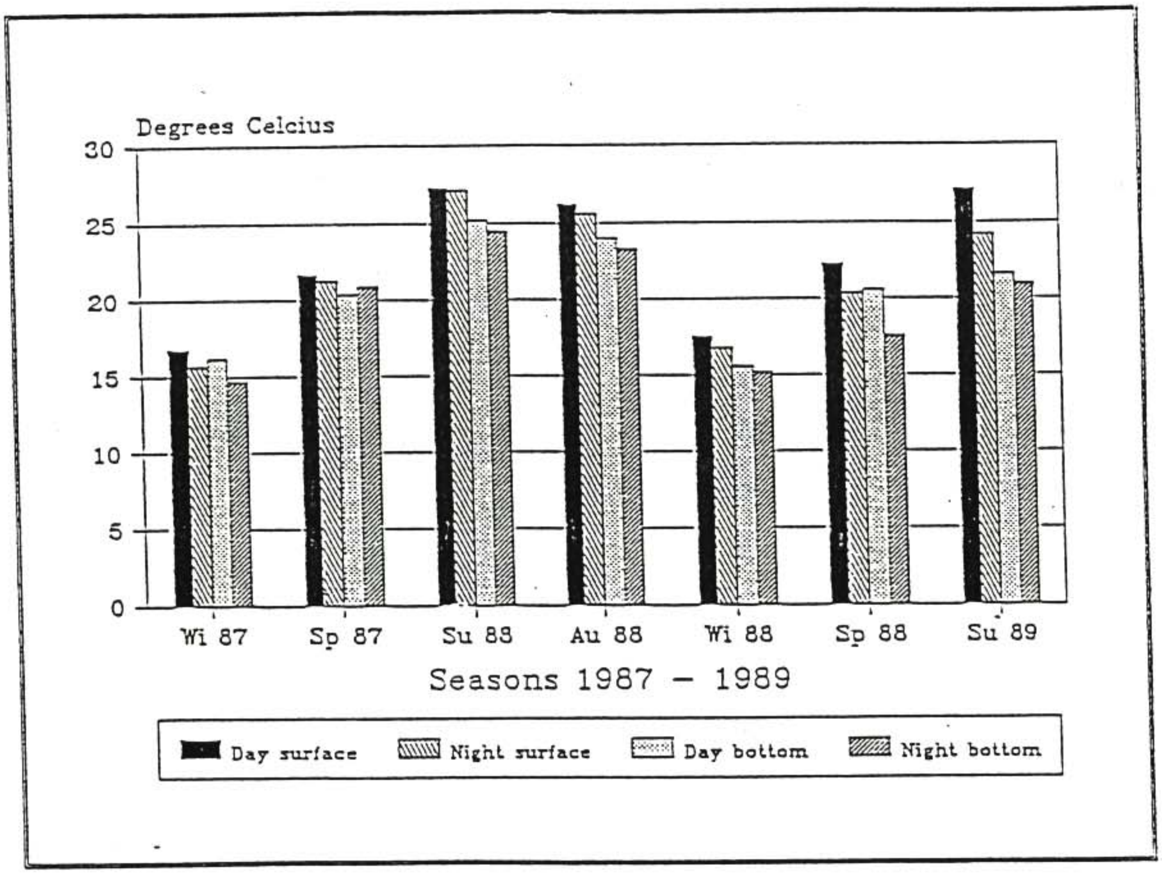

Figure 3.3 **Average day (11h00 - 13h00) and night (22h00 -01h00) water temperature profiles during various seasons of the 1987-1989 period of investigation in the Middle Letaba Dam**

The oxygen in the surface water layers of the dam (Table 3.2; Figure 3.4) was always higher (albeit not much) during the day than during the night - partly due to the reduction of photosynthetic activity during the night, althought respiration remains relatively constant throughout the 24 hour day-night cycle. The contrasting mean day and night oxygen values obtained near the bottom of the dam were substantially lower than those found for the surface waters (Table 3.2; Figure 3.4). The exception was autumn 1988, when comparatively little variation in the values for oxygen between the surface and the bottom of the dam were recorded. This can be attributed to the heavy summer rains and the influx of water into the dam, resulting in virtually a complete mixing of the entire water column at the time of the survey.

In general, the tendency towards a higher oxygen concentration during the dry seasons of the year can largely be attributed to the increasing transparency of the water column (Figure 3.7) and, consequently, higher diurnal photosynthetic activity of phytoplankton and aquatic macrophytes, which occurred in the surface layer of the littoral regions in the water column .

Table 3.2: Mean values of surface and bottom oxygen content (ppm.) in water from 11 sampling localities, during successive seasons

Season	Surface Oxygen (ppm.)		Bottom Oxygen (ppm.)	
	Day	Night	Day	Night
Winter 87	9,2	7,8	8,3	7,2
Spring 87	8,6	8,6	6,8	7,5
Summer 88	6,7	7,2	4,7	5,2
Autumn 88	4,7	4,7	4,8	4,8
Winter 88	7,5	7,8	4,9	5,6
Spring 89	6,7	6,7	2,6	3,2
Summer 89	6,8	5,9	3,1	2,7

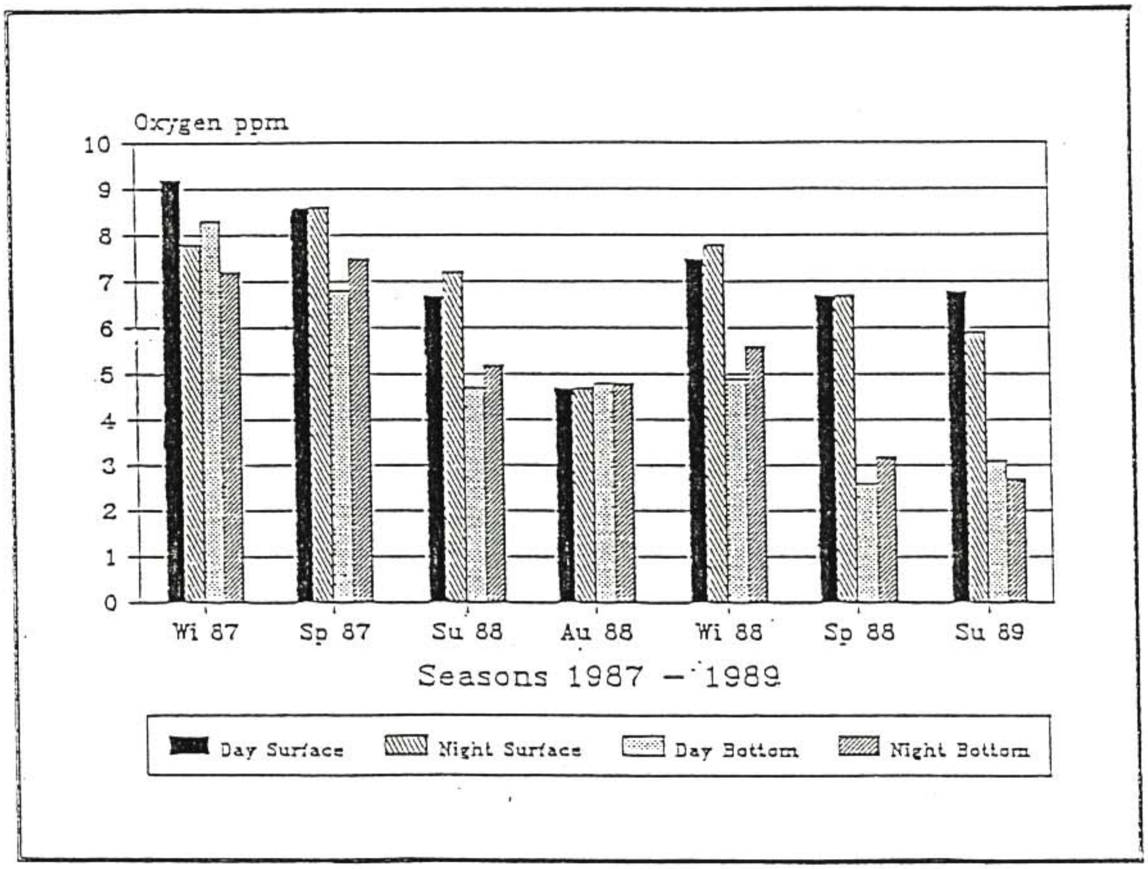

Figure 3.4 **Average day (11h00 - 13h00) and night (22h00 - 01h00) oxygen concentration obtained from the water surface and near the bottom of the dam during the various seasons of the 1987 - 1989 period of investigation in the Middle Letaba Dam**

The pH values of the impoundment were relatively constant throughout the 1987 - 1989 sampling period, with average seasonal values ranging from 6,7 to 8,3 (Table 3.3; Figure 3.5). As can be seen from Figure 3.5, dry season pH values were usually the highest. This coincided with increased water transparency and, as mentioned earlier, higher photosynthetic activities of the phytoplankton and aquatic macrophytes. At night the pH values were usually lower than during the day, because respiratory processes release carbon dioxide into the water resulting in a pH decrease, whereas photosynthetic activity, which decreases the carbon dioxide content during the day, ceases at night. Values for pH during the period of survey were usually above seven. This confirms the fact that the river water reaching the Middle Letaba Dam already contained sufficient amounts of mineral solutes, allowing for well buffered water, with adequate quantities of carbonate and bicarbonate ions.

Table 3.3 pH ranges of the water during the day and night from 11 sampling stations throughout the survey period in the Middle Letaba Dam

Season	Day	Night
Winter 87	7,0 - 7,6	7,3 - 7,7
Spring 87	7,1 - 7,5	7,1 - 7,4
Summer 88	6,8 - 6,9	6,8 - 7,1
Autumn 88	6,7 - 6,9	6,7 - 7,1
Winter 88	7,9 - 8,3	7,9 - 8,3
Spring 88	7,0 - 7,3	6,9 - 7,4
Summer 89	7,4 - 8,3	8,2 - 8,3

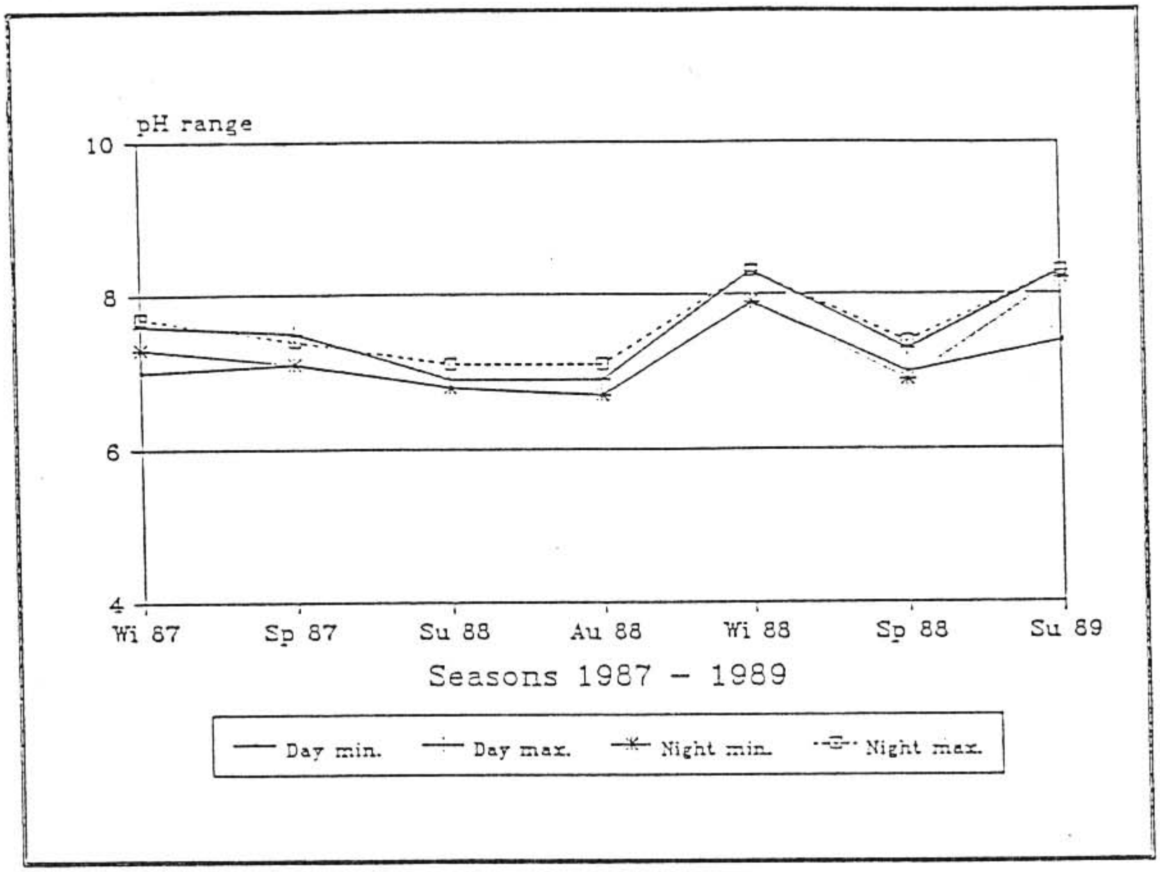

Figure 3.5 pH ranges of the water during the day and night from 11 sampling stations throughout the survey period in the Middle Letaba Dam

The water transparency was high with visibility being more than one metre throughout the sampling period, except during January and April 1988 (Table 3.4; Figure 3.6). The latter can be explained by the fact that the catchment area had 197 mm of rain during December 1987, resulting in both river systems flowing strongly and pushing muddy water into the impoundment, thereby decreasing the water transparency during the summer of 1988. A further 133 mm of rain fell during February 1988, resulting in similar conditions during the autumn of 1988.

Table 3.4 Mean Secchi disk transparency (m) during various seasons of the investigation period in the Middle Letaba Dam

Season	meter
Winter 87	1,4
Spring 87	1,3
Summer 88	0,6
Autumn 88	0,7
Winter 88	1,2
Spring 88	1,3
Summer 89	1,6

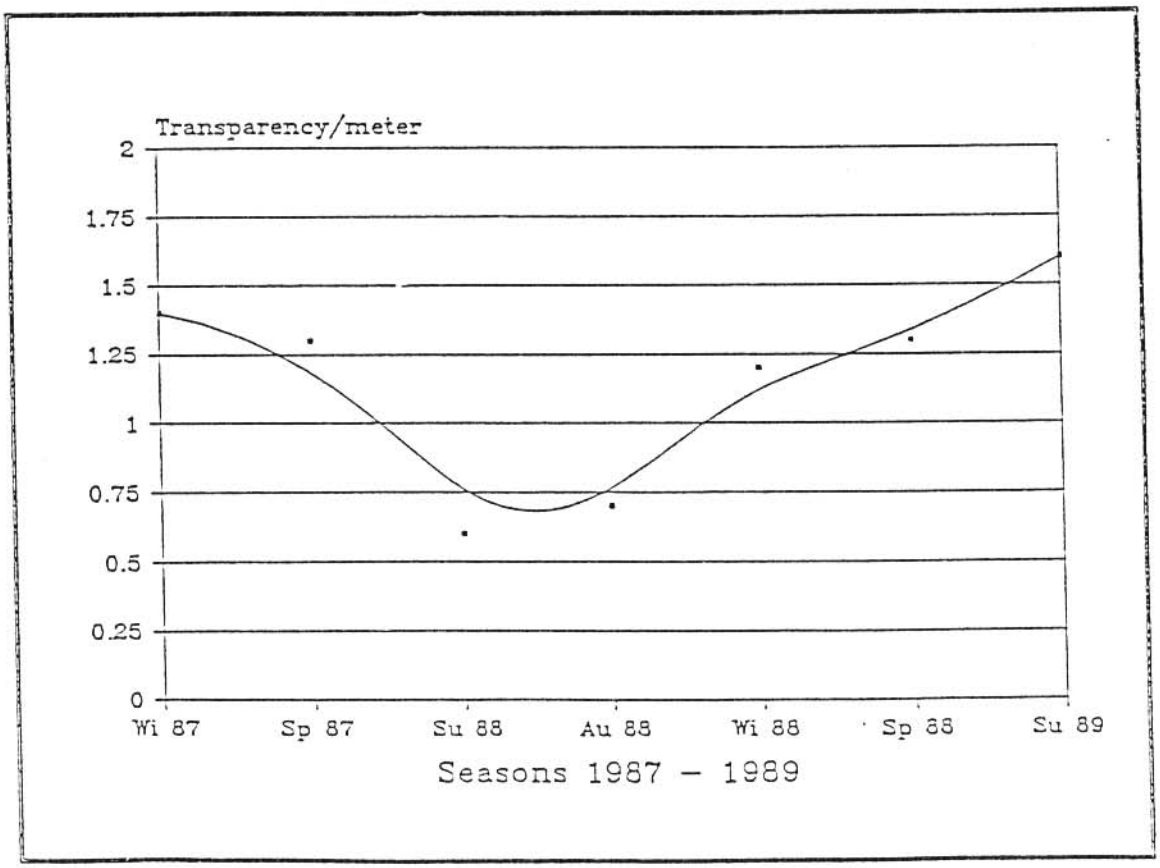

Figure 3.6 Mean Secchi disk transparency (m) during various seasons of the investigation period in the Middle Letaba Dam

Conductivity is a measure of the ability of a body of water to convey an electrical current. Conductivities measured in the Middle Letaba Dam are represented in Table 3.5 and Figure 3.7. The conductivity of the lake water had a wide range, from 156,7 μScm^{-1} during the winter of 1988 survey to 433,7 μScm^{-1} during the summer of 1988. Because of rains and influx of water into the dam during the late autumn of 1987, conductivity values in the dam were low during winter 1987 and spring of the same year with mean values being below 200 μScm^{-1}. Because of the December rains in 1987, there was a build-up of dissolved minerals in the dam, resulting in increases in conductivity exceeding 400 μScm^{-1} during the summer (Figure 3.7). With more rain which fell during February 1988 and the resulting influx of water into the dam, the conductivity declined rapidly towards winter, with conductivity values being the lowest over the entire study period during this season. With the increasing influx of water during spring 1988 and summer 1989, conductivity values began to stabilize between 160 and 190 μScm^{-1}.

Table 3.5 **Mean values of conductivity from 11 sampling localities for various seasons during the survey period in the Middle Letaba Dam**

Season	Day (μScm^{-1})	Night (μScm^{-1})
Winter 87	181,4	194,5
Spring 87	192,6	196,1
Summer 88	433,7	379,0
Autumn 88	317,3	280,0
Winter 88	162,5	156,7
Spring 88	168,3	167,8
Summer 89	186,5	188,0

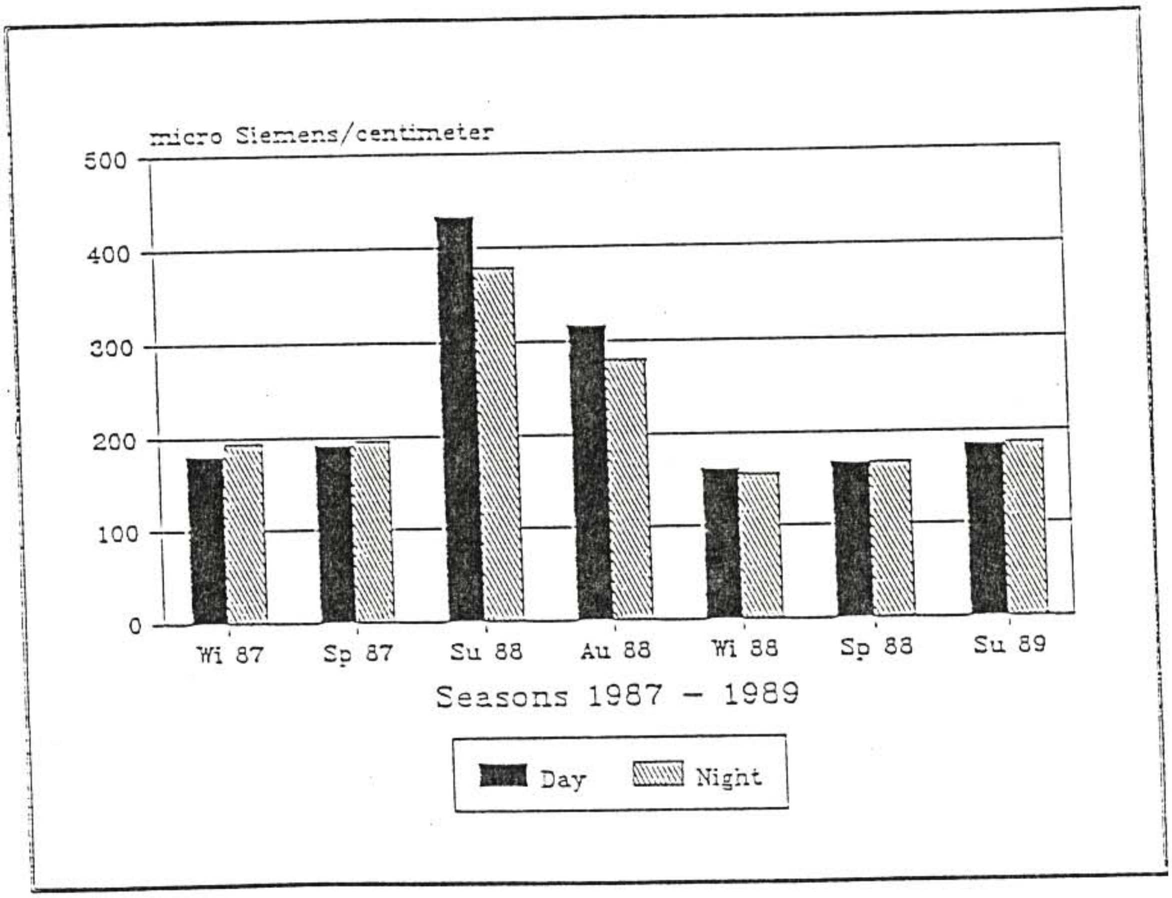

Figure 3.7 Mean values of conductivity (μS/cm) from 11 sampling localities for various seasons during the survey period in the Middle Letaba Dam.

3.3.3 Chemical conditions of the water

Table 3.6 shows the mean values of some chemical parameters of the water during the survey period in the Middle Letaba Dam. Histograms for selected chemical parameters pertinent to the water of the Middle Letaba Dam are also shown in Figures 3.8 to 3.23.

Ammonia as well as nitrite and nitrate were present in low concentrations. The highest values for ammonia occurred during the winter months, when concentrations exceeded 80 $\mu g\ l^{-1}$ and during autumn 1988, when a value of 76,91 $\mu g\ l^{-1}$ was obtained (Table 3.6; Figure 3.8). Lower ammonia values recorded coincided with the rainy seasons. A similar situation was experienced with nitrite and nitrate values, which also had a maximum value during the winter of 1988 (240,36 $\mu g\ l^{-1}$)(Table 3.6; Figure 3.9). The mean values for Kjeldahl-nitrogen, which includes ammonia and organic nitrogen, exceeded 150 $\mu g\ l^{-1}$ during all seasons and showed a gradual increase in values with time during successive sampling periods, with a maximum exceeding 220 $\mu g\ l^{-1}$ during the winter of 1988 (220,45 $\mu g\ l^{-1}$) and the summer 1989 (259,83 $\mu g\ l^{-1}$) surveys (Table 3.6; Figure 3.10).

Mean values for ortho-phosphate were generally low, with maximum concentrations found during autumn 1988 (44,91 $\mu g\ l^{-1}$) and winter 1988 (33,36 $\mu g\ l^{-1}$)(Table 3.6; Figure 3.11). Even so, concentrations of this nutrient must be considered to be comparatively low, as no form of eutrophic conditions resulting in the formation of algal blooms prevailed during much of the study period.

Table 3.6 Mean values of chemical parameters of water samples from 11 sampling stations during successive seasons from 1987 - 1989. Metal analyses were conducted only at Stations 5 and 10 (Figure 3.1)

Parameter	Unit of measure	Winter 87	Spring 87	Summer 88	Autumn 88	Winter 88	Summer 89
Ammonia	$\mu g\ l^{-1}$	80,91	46,91	54,64	76,91	84,27	31,16
Nitrate + Nitrite	$\mu g\ l^{-1}$	65,45	61,09	22,82	91,00	240,36	62,66
Kjeldahl-Nitrogen	$\mu g\ l^{-1}$	151,82	207,18	174,91	181,43	220,45	259,83
Ortho-Phosphate	$\mu g\ l^{-1}$	-	12,55	25,00	44,91	33,36	16,66
Alkalinity	$mg\ l^{-1}$	71,36	83,82	77,09	53,18	62,18	77,00
Na	$mg\ l^{-1}$	6,91	6,91	9,14	9,45	9,58	9,83
K	$mg\ l^{-1}$	3,91	3,36	4,09	3,09	4,00	3,50
Ca	$mg\ l^{-1}$	14,73	14,09	13,73	9,64	10,36	14,66
Mg	$mg\ l^{-1}$	6,19	7,18	6,64	5,91	5,64	6,61
Si	$mg\ l^{-1}$	5,03	5,01	5,65	9,33	9,43	6,68
So4	$mg\ l^{-1}$	7,82	4,00	5,36	11,18	9,00	6,50
Cl	$mg\ l^{-1}$	5,82	5,82	5,55	8,00	7,27	7,38
B	$\mu g\ l^{-1}$	75,91	-	-	158,09	143,73	121,16
Fluoride	$\mu g\ l^{-1}$	260,82	-	-	166,55	156,25	180,83
As	$\mu g\ l^{-1}$	<5	<5	<5	<5	<5	<5
Cu	$\mu g\ l^{-1}$	<25	<25	<25	27,50	28,00	<25
Hg	$\mu g\ l^{-1}$	12,5	<1	<1	<1	<1	<1
Pb	$\mu g\ l^{-1}$	<50	<50	<50	<50	<50	<50
Mn	$\mu g\ l^{-1}$	48,5	36,50	67,50	29,50	38,50	94,00
Ni	$\mu g\ l^{-1}$	<25	<25	<25	<25	32,50	<25
Zn	$\mu g\ l^{-1}$	91,50	<25	87,00	<25	61,00	<25
Fe	$\mu g\ l^{-1}$	154,00	92,00	1794,00	250,00	1126,00	316,50

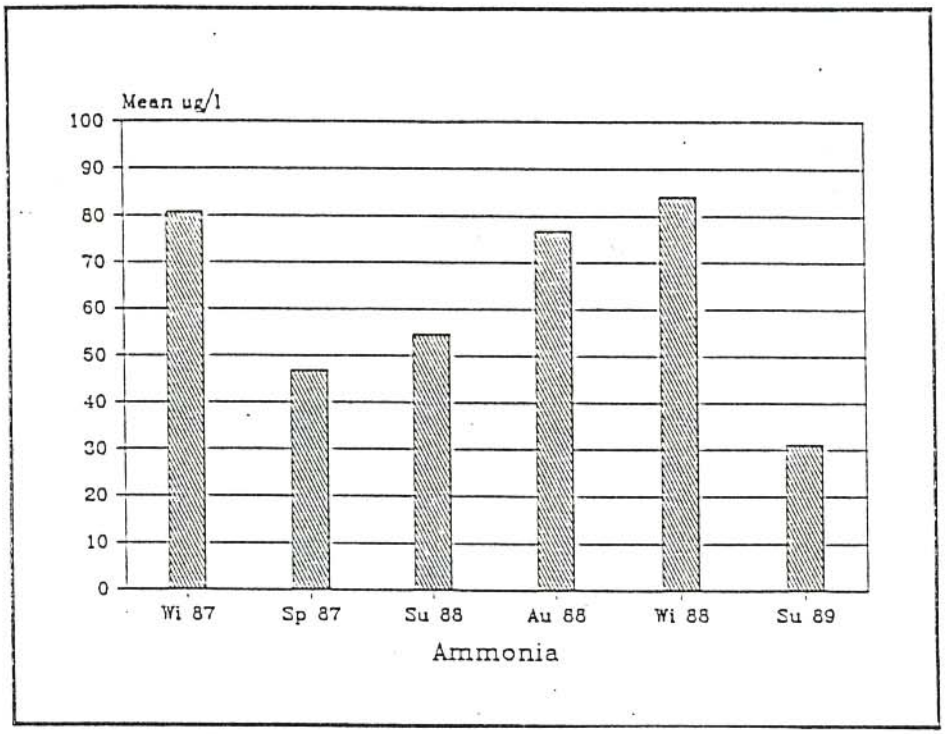

Figure 3.8 Mean values of Ammonia $\mu g/l$ from 11 sampling localities and for the various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam.

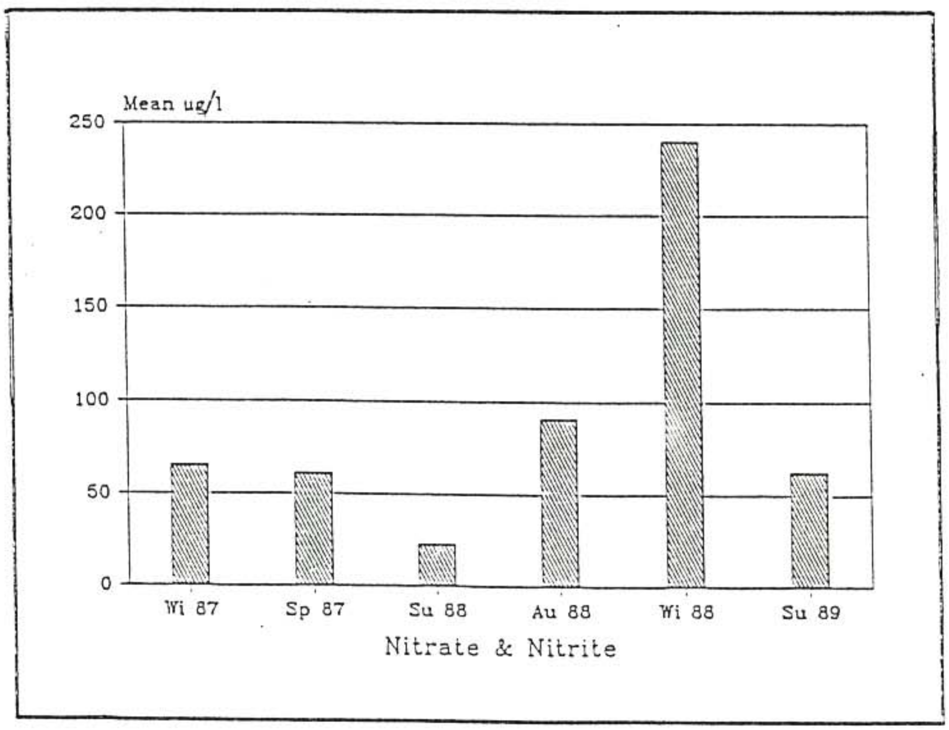

Figure 3.9 Mean values of Nitrate & Nitrite $\mu g/l$ from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam.

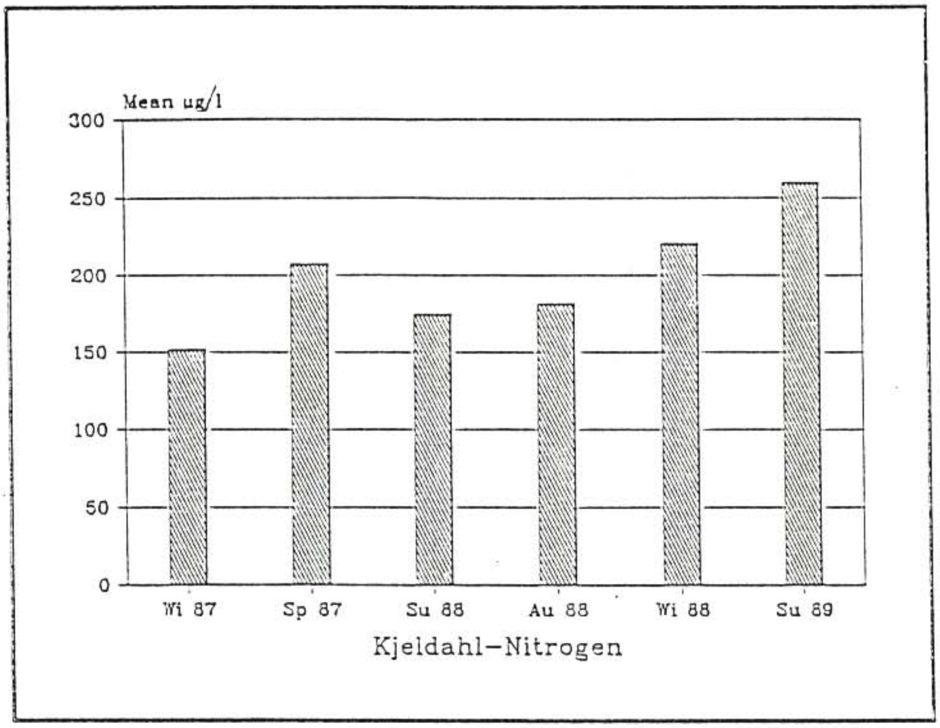

Figure 3.10 Mean values of Kjeldahl-Nitrogen ($\mu g/l$) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam.

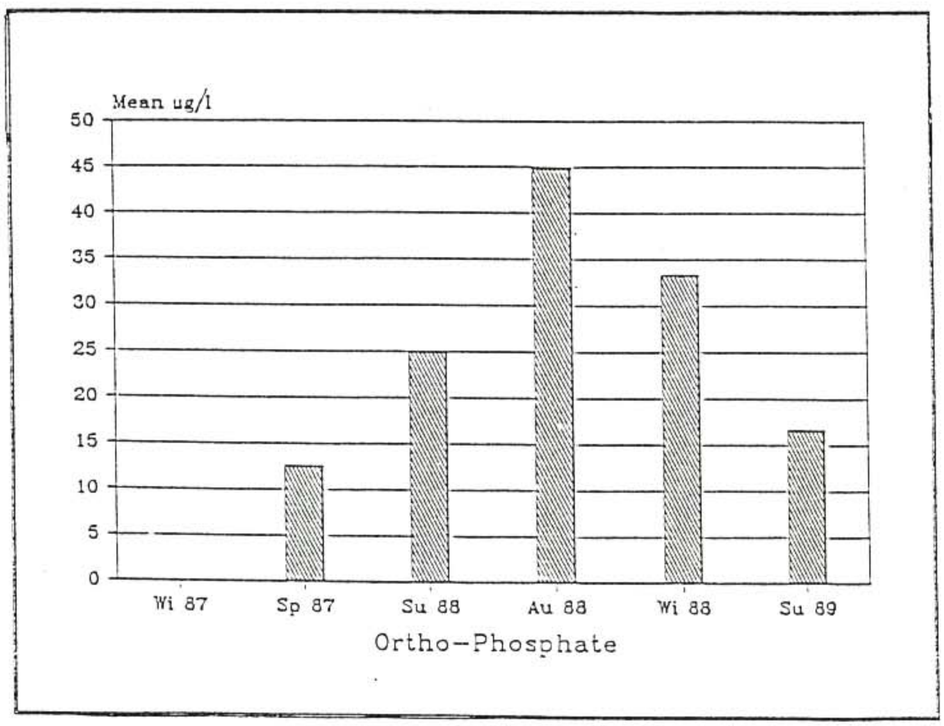

Figure 3.11 Mean values of Ortho-Phosphate ($\mu g/l$) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam.

Little fluctuation occurred in total alkalinity during the various seasons of 1987 - 1989 (Table 3.6; Figure 3.12), with mean values ranging from 53,18 mg l^{-1} (autumn 1988) to 83,82 mg l^{-1} (spring 1987), providing a range of approximately 30 mg l^{-1}. Boyd (1979) defines hardness as the total concentration of alkaline earth ions usually including only calcium and magnesium ions, expressed as mg l^{-1} equivalent $CaCO_3$, and it is closely related to alkalinity. Although no determinations were made for total hardness during these specific investigations, analyses for hardness done at the laboratories of the University of the North during a preliminary survey of 1985 -1986, revealed values ranging between 40 and 85 mg l^{-1}, with an average of 66,7 mg l^{-1}. Stickney (1979) states that values of total hardness between 20 and 150 mg l^{-1} are favourable for the growth and survival of freshwater organisms.

There is usually a close correlation between Sodium and Chloride ions in river waters. This was also found to exist in the water column of the Middle Letaba Dam during the different seasons of the year, with the exception of summer 1988, when the mean concentration of Chloride was 5,55 mg l^{-1} (Table 3.6). There was a general but slight increase in the concentration of this ion towards the latter part of the investigation (Figure 3.19). Sodium ions also showed a similar tendency, with values exceeding 9 mg l^{-1} during the 1988 - 1989 sampling periods. (Table 3.6;Figure 3.13)

Concentrations of Potassium were on average more than 50 percent lower than those for Sodium (Figure 3.14) while a similar relationship was found to exist for the ratio of Calcium and Magnesium (Table 3.6; Figure 3.15 - 3.16). Mean values for Silica remained below 10 mg l^{-1}, with maximum values recorded during the autumn and winter periods of 1988 (Figure 3.17). Mean values for Sulphate were generally low, exceeding 10 mg l^{-1} only during autumn 1988 (11,18 mg l^{-1}) (Figure 3.18).

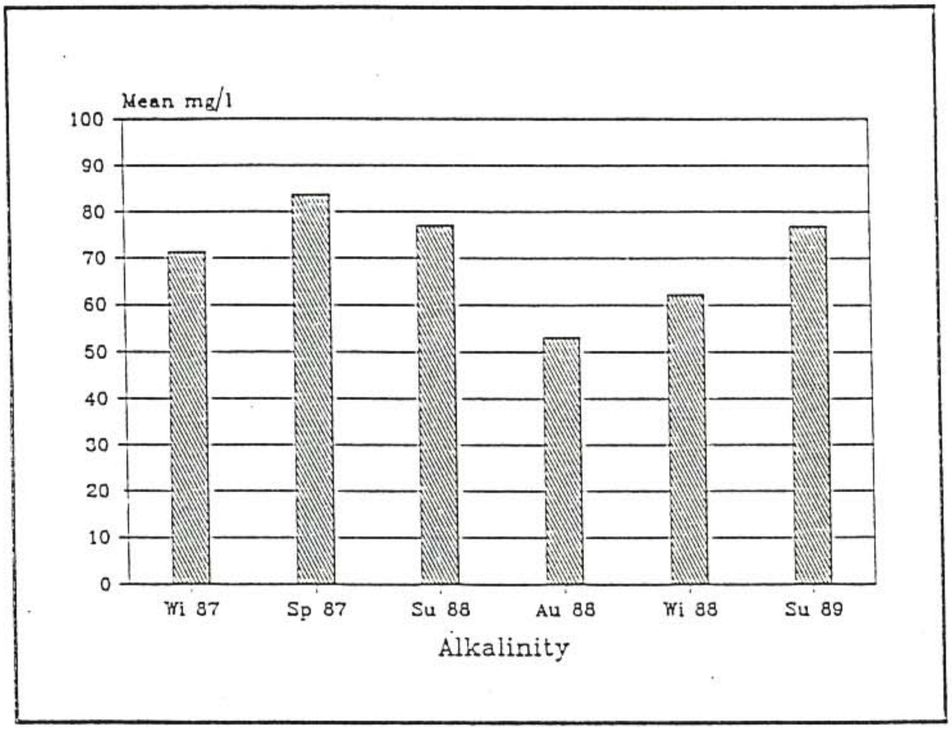

Figure 3.12 Mean values of Alkalinity (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

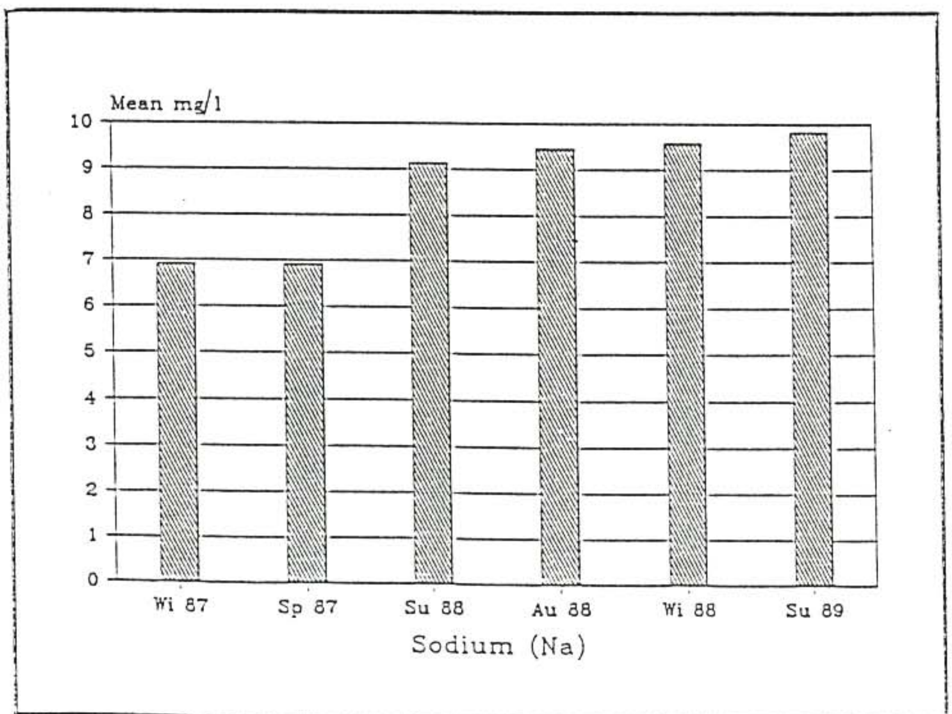

Figure 3.13 Mean values of Sodium (Na) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

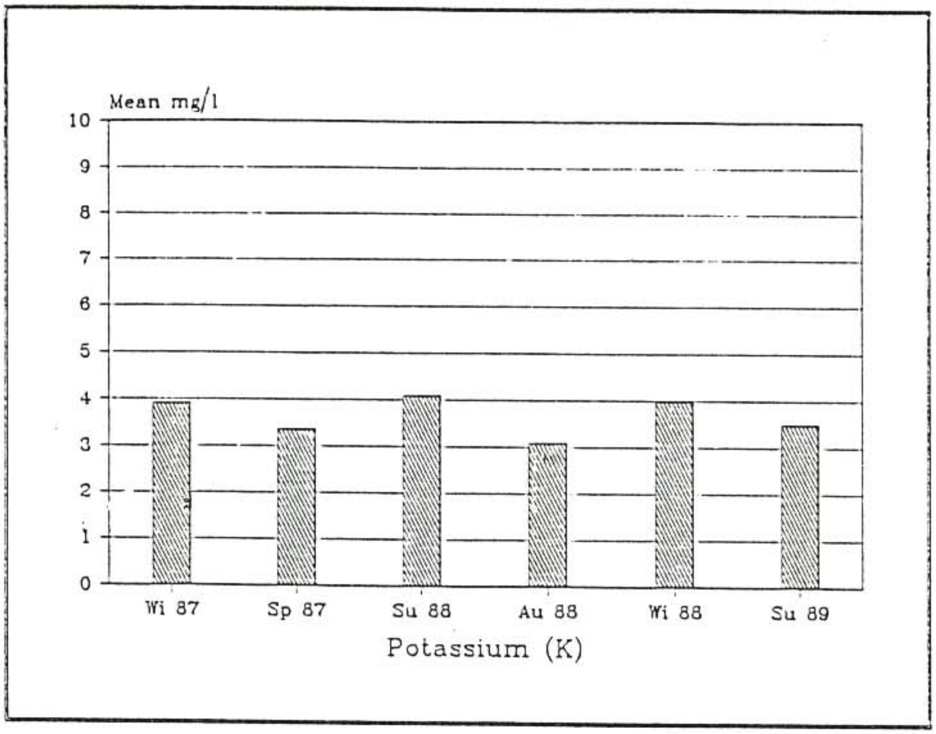

Figure 3.14 **Mean values of Potassium (K) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam**

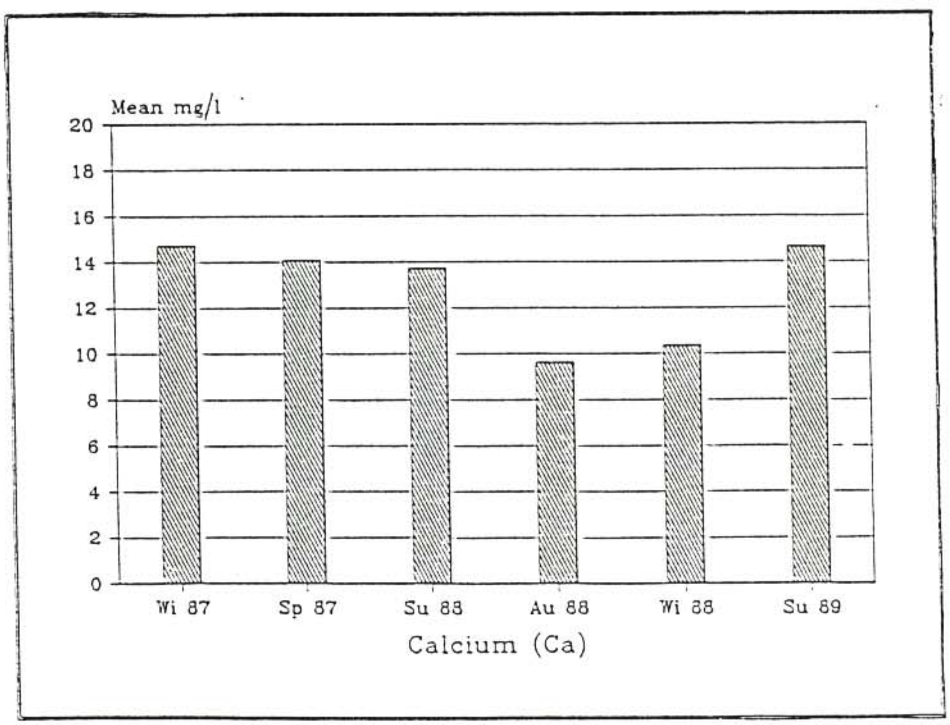

Figure 3.15 **Mean values of Calcium (Ca) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam**

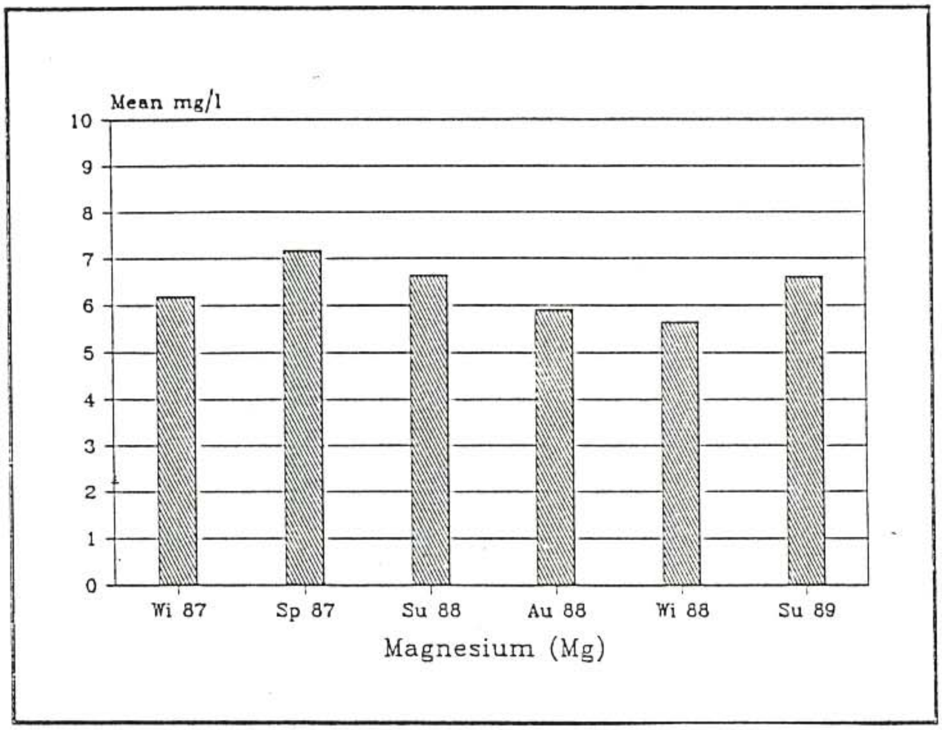

Figure 3.16 **Mean values of Magnesium (Mg) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam**

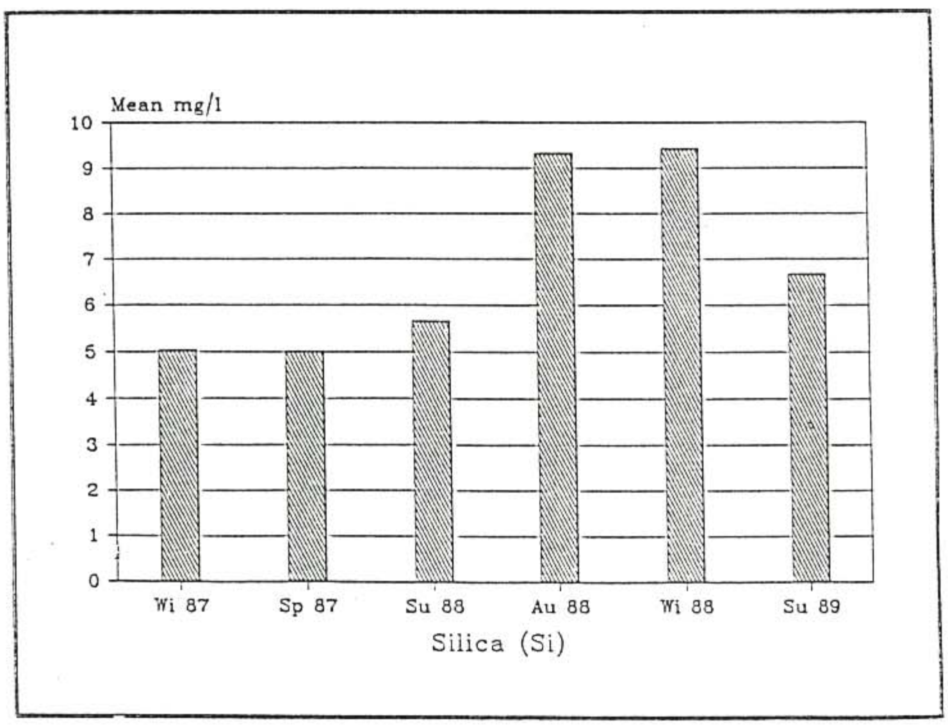

Figure 3.17 **Mean values of Silica (Si) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam**

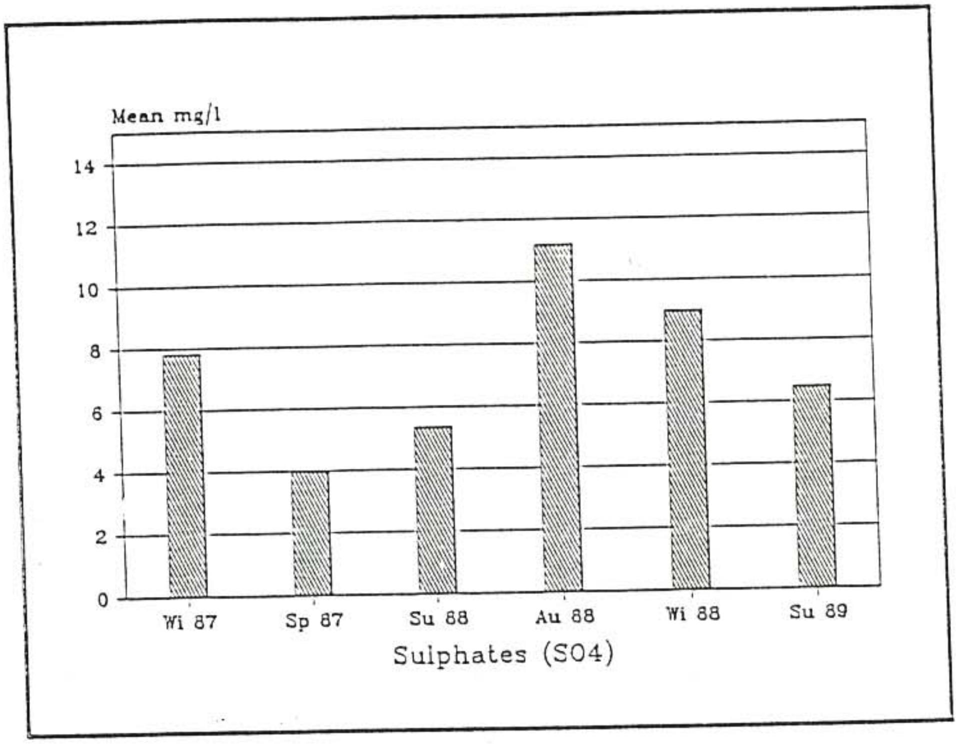

Figure 3.18 Mean values of Sulphates (SO4) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

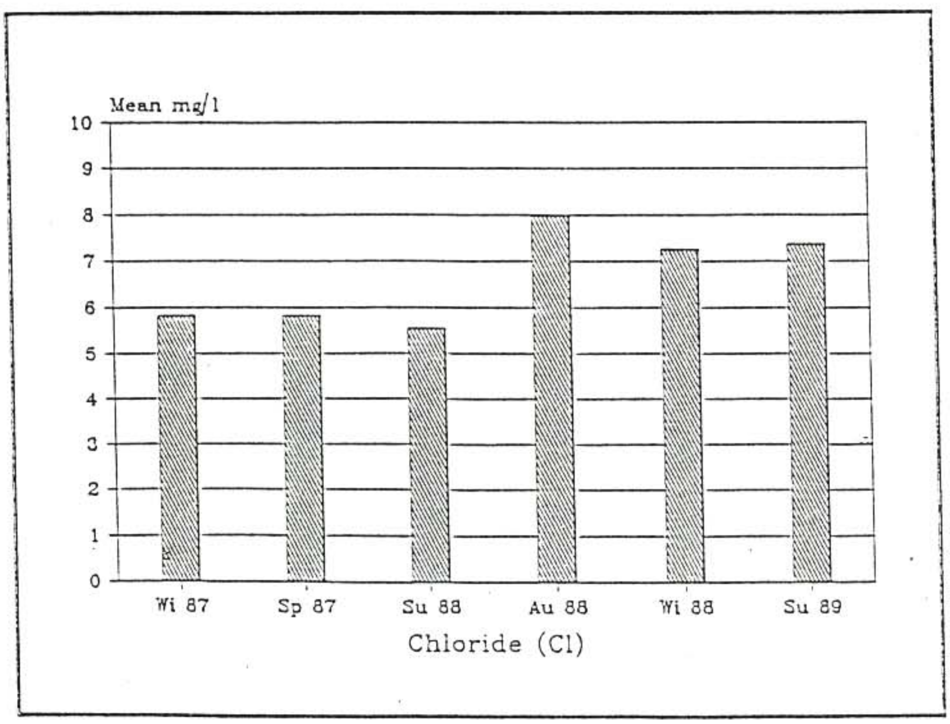

Figure 3.19 Mean values of Chloride (Cl) (mg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

Values obtained for Arsenic, Lead and Nickel were all below concentrations capable of being actively determined by the auto-analyser used in the laboratories of the CSIR (Table 3.6). Copper also occurred in low quantities, except for the autumn and winter seasons of 1988 when mean values fluctuated around 28 $\mu g\ l^{-1}$. Only during a single survey, (winter 1987), was a measurable value of Mercury, (12,5 $\mu g\ l^{-1}$) recorded in the dam. During all subsequent seasons from 1987 to 1989 concentrations of this metal remained below 1 $\mu g\ l^{-1}$ and could, therefore, not be accurately determined (Table 3.6).

Boron registered a minimum of 75,91 $\mu g\ l^{-1}$ during winter of 1987 and a maximum of 158,09 $\mu g\ l^{-1}$ in autumn 1988 (Table 3.6; Figure 3.20). Fluoride registered the highest mean value during winter 1987 (260,82 $\mu g\ l^{-1}$) and from autumn 1988 to summer 1989 the mean values were lower and provided a range of approximately 14 $\mu g\ l^{-1}$(Table 3.6; Figure 3.21).

Manganese and Iron occurred in measurable concentrations during some of the seasons, with values for Manganese exceeding 90 $\mu g\ l^{-1}$ during the summer survey of 1989 (Table 3.6; Figure 3.22). In the case of Iron, mean concentrations exceeding 1 mg l^{-1} occurred on two occassions, namely during the summer and winter surveys of 1988 (Table 3.6; Figure 3.23). Values of Zinc were relatively high during winter 1987 (91,5 $\mu g\ l^{-1}$), summer 1988 (87 $\mu g\ l^{-1}$) and winter 1988 (61 $\mu g\ l^{-1}$). During the remainder of the seasons, concentrations for Zinc, being less than 25 $\mu g\ l^{-1}$, could not be determined accurately (Table 3.6).

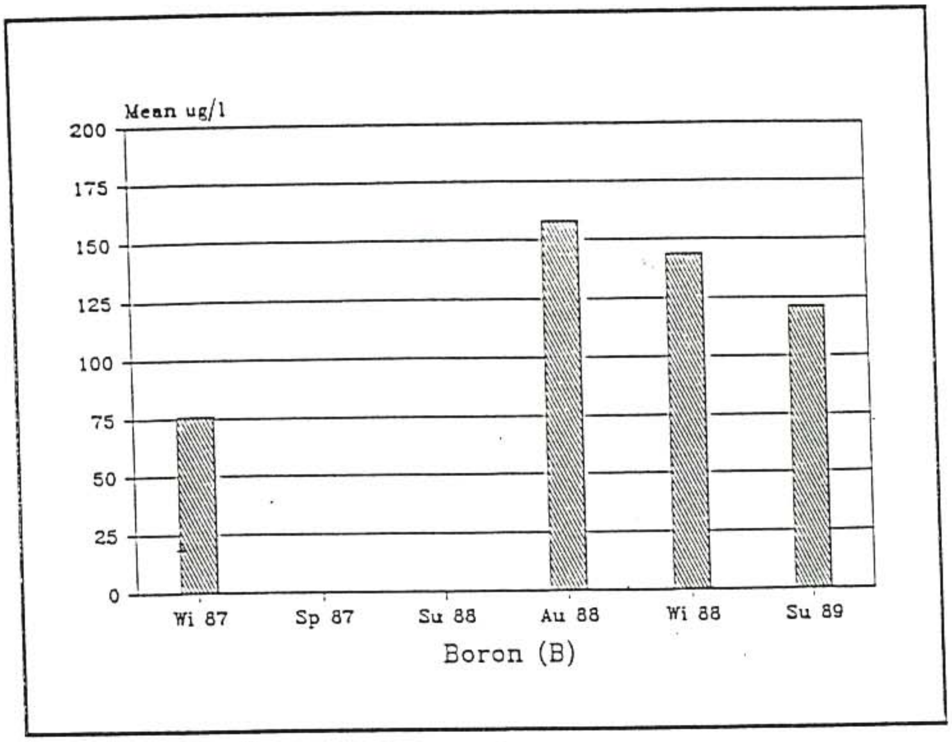

Figure 3.20 Mean values of Boron (B) (μg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

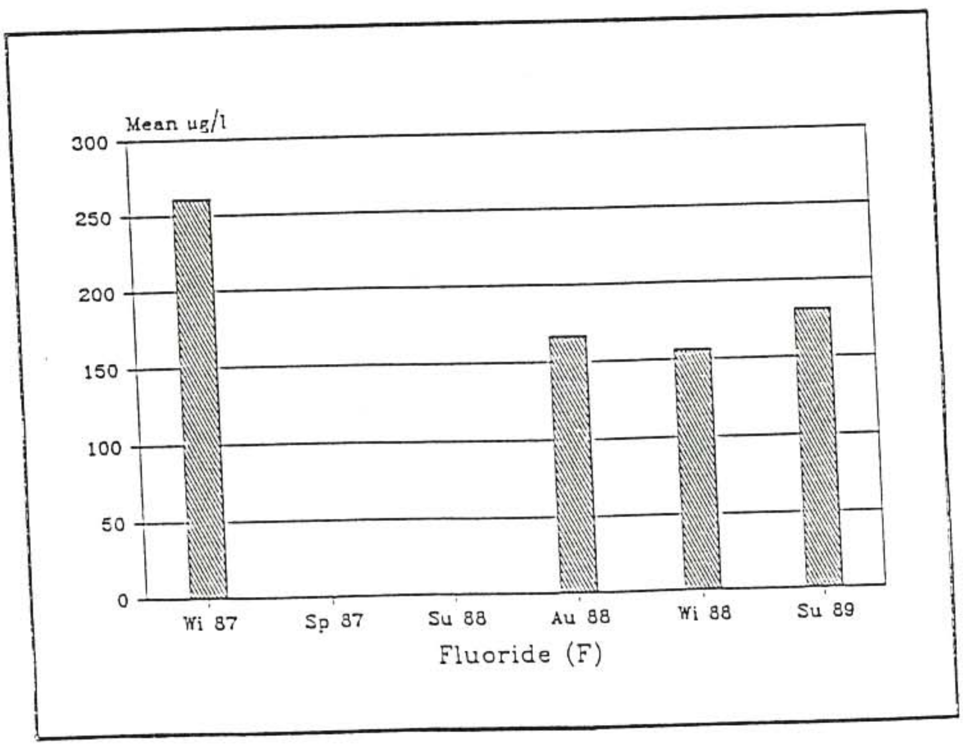

Figure 3.21 Mean values of Fluoride (F) (μg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

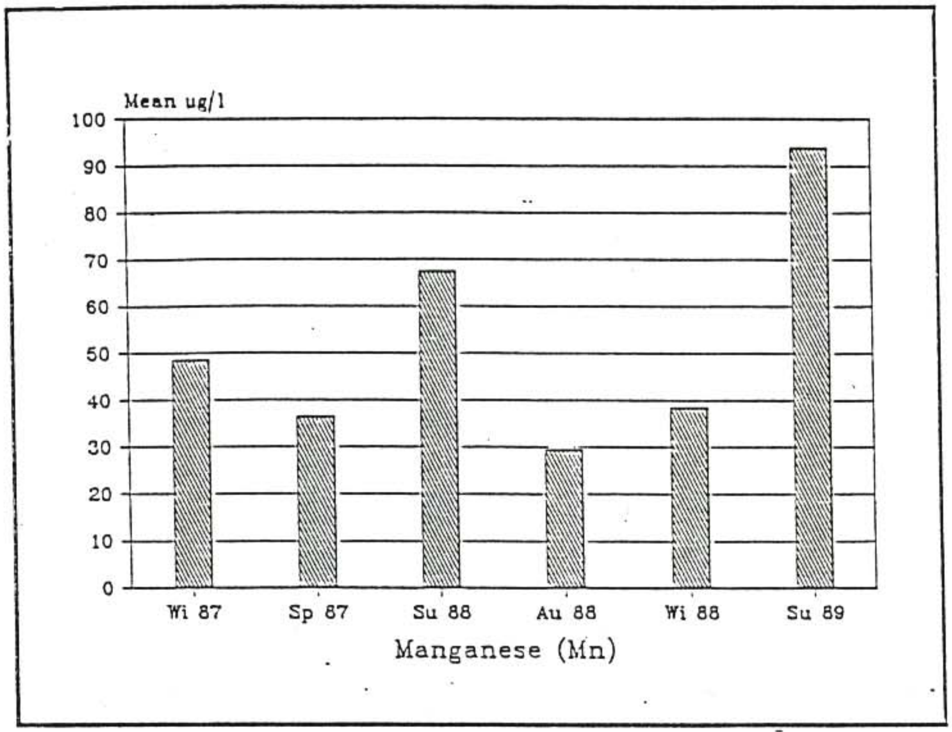

Figure 3.22 Mean values of Manganese (Mn) (μg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

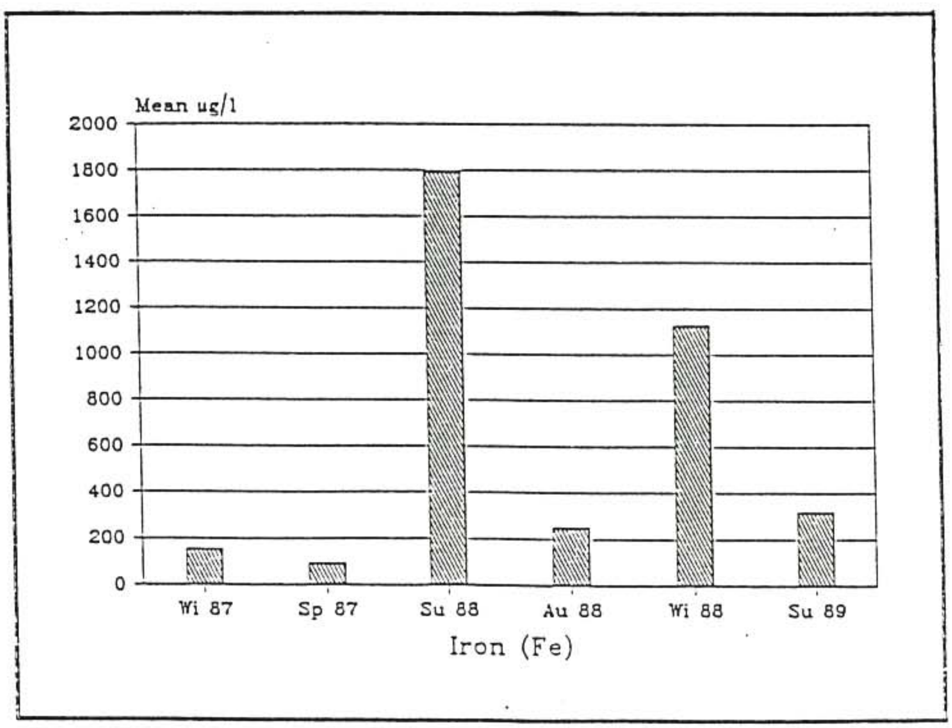

Figure 3.23 Mean values of Iron (Fe) (μg/l) from 11 sampling localities for various seasons during the survey period (Winter 1987 to Summer 1989) in the Middle Letaba Dam

3.4 Discussion

Temperature is an important physical variable in the metabolism of organisms and the functioning of lake ecosystems (Wetzel, 1975). It is of value to predict the temperature variation in a lake, and more particularly, the temperature of the surface layers (epilimnion) where primary production predominates (Van Schalkwyk and Walmsley, 1984). The annual variation in lake surface water temperature usually follows a simple sinusoidal pattern which is considerably modified by latitude (Talling, 1969). Straskraba (1980) quantified this annual pattern by an empirical equation which appeared to have good predictive qualities for global application. However, Straskraba (1980) stressed that there was some uncertainty in the application of his model in the Southern Hemisphere. Factors such as summer flooding, altitude, impoundment morphometry and water transparency were identified as being important in influencing the seasonal temperature variation for many (18) South African impoundments (Van Schalkwyk and Walmsley, 1984). The thermal cycle which is typical of Transvaal impoundments, is that during winter isothermal conditions are encountered whilst in early summer, thermal layering is prominent (Butty, Walmsley and Alexander, 1980). This, however, was not the case with the Middle Letaba Dam.

The amount of oxygen dissolved in water has been cited as perhaps the single most important environmental factor for the survival, growth and reproduction of aquatic animals. An absence of oxygen in water precludes the survival of virtually all animals. The atmosphere and photosynthesis by aquatic plants and algae are the main sources of dissolved oxygen (NIWR report, 1985).

Extremes of pH are usually indicative of industrial waste sources. pH is modified by temperature and the ratio of dissolved gases in the water. It is also dependent upon the type and amount of cations (especially Ca, Mg, Na and K) (Berry, 1977). Pollution which effects a change in any one of these variables may also alter pH levels.

Significant changes in pH from normal levels can produce several adverse effects on aquatic life. Non-lethal limits are even narrower for many fish food organisms such as plankton and benthic macro-invertebrates (Berry, 1977). In the Middle Letaba Dam the pH levels reflect slightly alkaline conditions (Table 3.3; Figure 3.5) with little indication of pollution. Alkaline waters are favourable to biological processes in general and to fish production in particular. An alkaline pH usually indicates high concentrations of calcium, but the alkalinity may be influenced by other substances such as magnesium. An acid pH usually indicates a low concentration of these substances (Macan and Worthington, 1951).

Water transparency is a variable which plays a major role in dictating the impact of a nutrient load on the trophic status of any impoundment (Water Research Commission Report, 1980). Van Schalkwyk and Walmsley (1984) suggested that water transparency is important in influencing seasonal temperature variation in South African impoundments. It can be stated that most South African impoundments have a low water transparency and that limnological characteristics may vary considerably as a consequence of the unstable seasonal hydrology (Water Research Commission Report, 1980). In the Middle Letaba Dam water transparency readings were reasonably high with most exceeding 1m (Table 3.4; Figure 3.6).

Electrical conductivity has always been used by limnologists as a valuable tool to estimate the degree of mineralization of waters and as a guide for studying its global variations in rivers and lakes. The amounts of dissolved ionizable salts in freshwater are generally considered to be related to their potential biological productivity. Conductivity measurements have also been widely taken to provide the basis for the estimation of fish production. Conductivity can be used as an index of the inorganic ion status of lake waters (NIWR report, 1985).

In freshwaters, ammonia generally results from the aerobic decomposition of nitrogenous organic matter (Soltero, 1969; Barica, 1974) or it may be a direct product of the decomposition of algae and plant material which were alive in the previous productive season (Fogg, 1966; Lean and Nalewajko, 1975). Since ammonia is usually present in natural waters in very small concentrations, its presence in water in levels exceeding 0,1 mg l^{-1} usually indicates organic pollution (Berry, 1977). In the Middle Letaba Dam, like in many unpolluted lakes, there were low concentrations of ammonia as values never exceeded 0,1 mg l^{-1} (Figure 3.8). High levels of ammonia are extremely toxic to fish. Ammonia occupies an important position in the nitrogen cycle. Bacterial action converts ammonia to nitrites and then to nitrates. Nitrogen, in this form is used for protein synthesis by macrophytes and phytoplankton. High levels of nitrite and nitrate promote eutrophication of a water body (Berry, 1977). Nitrates and nitrites, like ammonia, were also present in relatively low concentrations in the Middle Letaba Dam.

Like nitrates, phosphorus is an essential plant nutrient necessary for the growth of aquatic vegetation. Phosphorus is a major nutrient regulating algal growth in lakes (Vollenweider, 1968; Thomas, 1969). Phosphates in large quantities can also stimulate algal blooms and contribute to the eutrophication of a water body (Berry, 1977). The supply of natural levels of phosphorus to water bodies depends to a large extent on leaching from soil and rock sediments, suspended inorganic particles and from the decomposition processes of plants and animals (Berry, 1977; Avnimelech, 1983). Lee (1969) pointed out that knowledge is particularly lacking on the role of the lake sediments in maintaining phosphate levels in water. It is not known whether the sediments act as a sink in which many nutrients are not available for exchange (Hayes, 1964; Schindler, Armstrong, Holmgren and Brunskill, 1971), or whether the sediments act as a buffer in which phosphate concentrations in the overlying water are controlled by sediment-water exchange reactions (Ohle, 1964, 1968; Serruya and Berman, 1970; Burns, 1972; Tessenow, 1972; Golterman, 1973).

Fuller (1949) demonstrated that phosphates are seldom toxic to fish and other aquatic life whilst Brinley (1943) stated that it may even be beneficial to fish production by increasing algal and zoo-benthos populations. Phosphorus occurs in different forms in natural waters, varying from simple orthophosphate to complex organic phosphorus compounds arising from algal metabolites. Shorter methods of total phosphorus analysis have been developed in order to convert all the different types of phosphorus into a state suitable for measurement (Harwood, Van Steenderen and Kühn, 1969b). The usual chemical state chosen is orthophosphate (soluble reactive phosphorus),since its analysis is simple (Harwood, *et. al.*, 1969a).

The total alkalinity is closely related to the pH and is produced by the molecules or ions of weak acids which are not fully dissociated (Berry, 1977). Contributing to the total alkalinity are the carbonates, bicarbonates, hydroxides, and to a lesser extent the silicates, phosphates, borates as well as the cations (especially Ca, Mg, Na and K) and certain organic anions (Berry, 1977). In the Middle Letaba Dam, the total alkalinity and its various individual constituents, occurred in low concentrations and resulted in extremely soft waters.

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CHAPTER 4

PAGE

THE BENTHIC MACRO-INVERTEBRATE ORGANISMS IN THE MIDDLE LETABA DAM

The ecological importance of the benthic component of the aquatic fauna of standing water bodies was elaborated on in Chapter 1. In this chapter specific attention is given to the occurrence, numbers and biomass of member groups of this taxon in the Middle Letaba Dam over the various seasons of the survey.

4.1 List of organisms

The following groups/taxa of benthic organisms were represented in the substrate samples:

Phylum Nematoda
Phylum Nematomorpha
Phylum Bryozoa
Phylum Annelida

Tubificidae

Limnodrilus sp.
Branchiura sowerbyi
Unidentified species

Naididae

Chaetogaster sp.
Aulophorus sp.
Dero sp.
Pristina sp.
Unidentified species

Lumbricidae

Hirudinea

Phylum Arthropoda

Cladocera

Daphnia sp.
Ceriodaphnia sp.
Ilyocryptus sp.

Ostracoda

Copepoda
Calanoida
Cyclopoida

Hydracarina

Insecta
Ephemeroptera
Caenis sp.
Povilla adusta

Baetidae

Odonata

Anisoptera

Hemiptera

Trepobates
Notonecta sp.
Corixa sp.

Trichoptera
Orthotrichia sp.

Coleoptera

Dytiscidae
Berosus sp.
Unidentified

Diptera

Chaoborinae
Chaoborus sp.
Chironomidae
Chironomus sp.
Pentaneura sp.
Rheotanytarsus sp.
Unidentified
Ceratopogonidae
Palpomyia sp.

Phylum Mollusca

Gastropoda
Ferrissia sp.
Bulinus sp.
Unidentified sp.

4.2 Results on the benthic macro-invertebrate fauna of the Middle Letaba Dam

Tables 4.1 - 4.7 and Figures 4.1 - 4.10 represent an analysis over seven successive seasons of the numerical contribution as well as dry biomass values of the major groups of benthic organisms expressed as values /m^2 substrate. From the results of seven successive seasonal surveys incorporating 11 - 15 sampling localities representative of the different physical habitats of Middle Letaba Impoundment, the following information is recorded:

4.2.1 Occurrence of macro-invertebrate organisms in the various regions of the impoundment

- Nematoda

Occurrence of nematodes showed no specific preference for any particular locality, substrate or region of the dam. They were present during all seasons (Tables 4.1 - 4.7) Nematoda were best represented during spring of 1987 when they occurred at six of the eleven sampling localities.

- Nematomorpha

This group was recorded once at sampling locality 3 during the summer of 1989 when only one specimen was found (Table 4.7). This is not surprising as the Nematomorpha usually prefer riverine habitats.

- Annelida

Annelida was represented by no less than six different genera. Of these the tubificid *Branchiura sowerbyi* occurred in large numbers at localities where the sediments were rich in organic material e.g. localities 1 - 4, in the inflow areas of the impoundment.

- Hydracarina

This group occurred at most localities during all seasons but was generally represented in small numbers.

- Crustacea

The Crustacea was mainly represented by the calanoid and cyclopoid Copepoda. They occurred in higher densities in the open water sections of the dam (sampling localities 6 - 11).

- Ephemeroptera

As a group this insect order was poorly represented both in numbers and variety. Specimens of *Povilla adusta, Caenis* sp. and members of the Baetidae were recorded.

- Trichoptera

The Trichoptera was poorly represented in numbers. Only members of the genus *Orthotrichia* were recorded.

- Coleoptera

The Coleoptera was recorded once during autumn of 1988 at sampling locality 1 where it was represented by a low incidence of *Berosus* sp.

- Diptera

Numerically the Diptera constituted the most important group of benthic macro-invertebrates in Middle Letaba Impoundment. The genus *Chaoborus* was encountered in large numbers at virtually all localities during the entire survey period (Tables 4.1 - 4.7). The genus *Chironomus* occurred at localities where detrital material was in abundance.

- Mollusca

This phylum was represented by *Ferrissia* sp. and *Bulinus* spp. Gastropoda was present in isolated spots at localities 4, 4A, 5, 5A, 6, 8 and 11 (Fig. 2.2). These stations are located in the shallow vegetated areas of the impoundment.

4.2.2 The relative importance of various benthic organisms in terms of numbers and biomass

In assessing the importance of a specific organism/group of benthic organisms in terms of their value as a potential energy source for fish, the following considerations were taken into account:

- Numerical density per given area of substrate;
- Biomass contribution/area of substrate;
- Utilization potential by fish and the
- extent to which an organism is preferred as a food item.

Figures 4.3 - 4.10 represent a summary of the numerical (nm^{-2}) as well as dry biomass (mg m^{-2}) standing crop values of the major macro-invertebrate groups for the different seasons of the investigation.

From Figures 4.1 - 4.2 the following deductions concerning the numerical contributions of the major benthic organisms can be made:

- Throughout the survey period the Arthropoda, as a group, was the major contributor towards the total density of organisms/m^2 substrate (Figure 4.1). The Diptera which was mainly represented by the genera *Chaoborus* and *Chironomus* comprised 83,4% of the total numbers of Arthropoda (Tables 4.1 - 4.7).

- The second most important numerical contributors were the Annelida which were significantly lower in incidence than the Arthropoda (Figure 4.1). This group varied in density between 353,04 organisms/m^2(Spring 1987: Table 4.2) and 108,3 organisms/m^2(Spring 1988: Table 4.6).

- Although not represented in Figure 4.1, the gastropod group featured prominently in respect of their biomass contribution during autumn of 1988 (Figure 4.6 and Table 4.4). For this reason their numerical contribution is also considered here. They were completely absent from the samples during winter of 1987 (Table 4.1), but were present during all subsequent seasons with a maximum numerical contribution of 35,6 organisms/m^2 substrate in autumn of 1988 (Table 4.4).

- Density figures for the major zoobenthos groups did not show any consistent seasonal tendencies. However, a major peak was evident during winter of 1988 with two lesser peaks during winter and spring of 1987 (Figure 4.1 and Tables 4.5, 4.1 and 4.2 respectively.

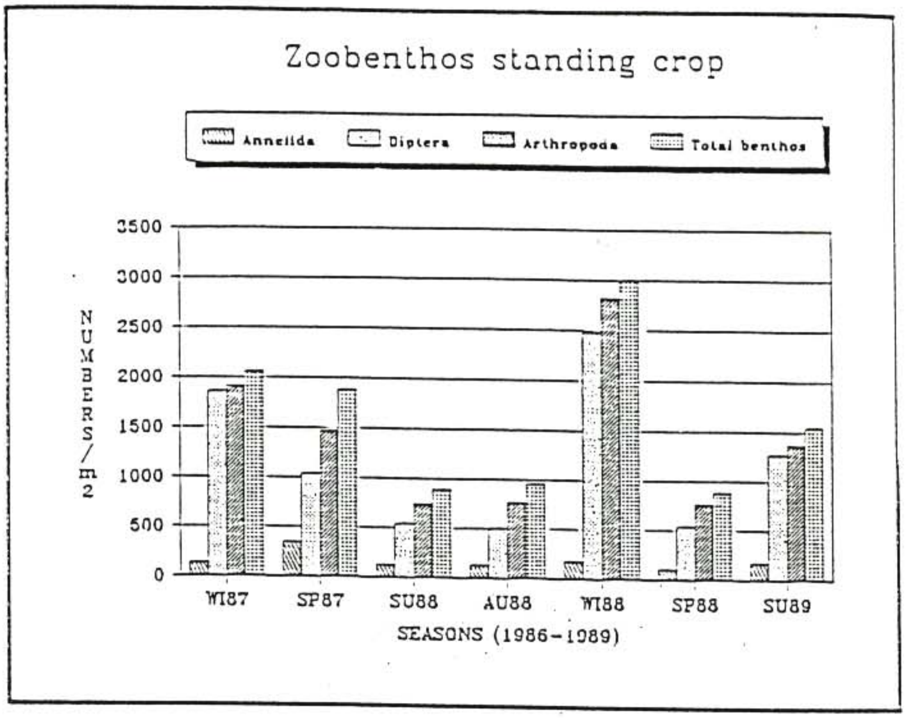

Figure 4.1 Numerical contribution (m² of substrate) of the major macro-invertebrate taxa during the different seasons towards the zoobenthos standing crop at Middle Letaba Dam during the 1987-1989 period of investigation

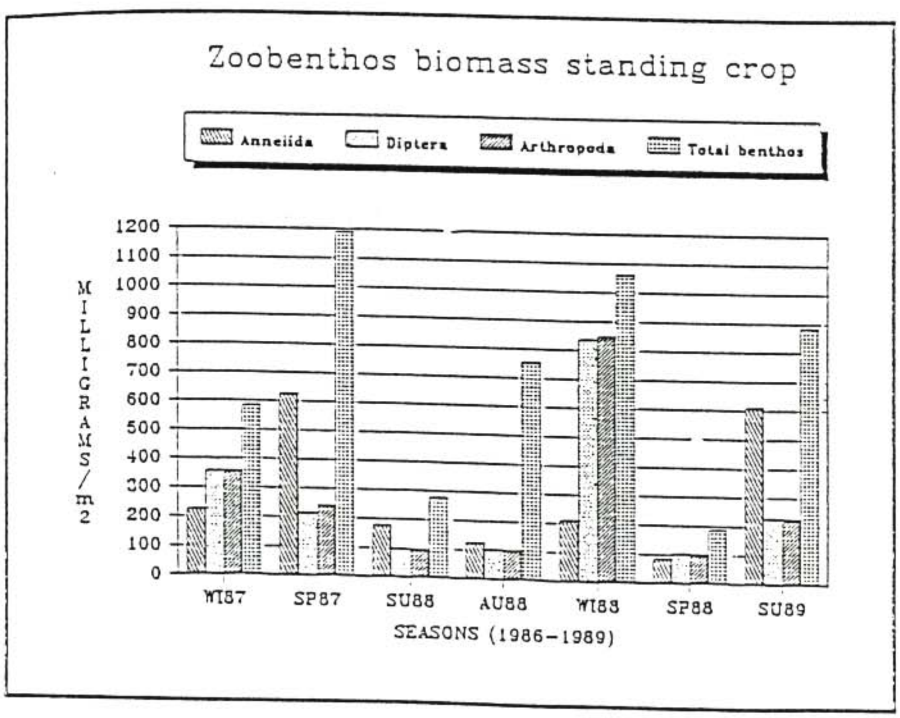

Figure 4.2 Biomass contribution (mg m^{-2} of substrate) of the major macro-invertebrate taxa during the different seasons towards the zoobenthos standing crop at Middle Letaba Dam during the 1987-1989 period of investigation

- The relative biomass contribution of the major macro-invertebrate taxa for the various seasons (Figure 4.2) emphasize the importance of the larger organisme in this group despite their comparatively low numbers. In this regard it is interesting to note that the Annelida registered the major contribution towards total macro-invertebrate biomass during spring 1987 and summer 1989 (Figure 4.2).

The seasonal standing crop (numbers as well as dry biomass/m^2) for all seven seasons of the investigation is represented in Figures 4.5 to 4.10. The following observations need to be pointed out:

- In terms of both numbers and biomass the sampling stations located in the inflow areas of the two major rivers (Figure 2.2) were generally found to be the most productive (Figures 4.3 - 4.10). This was particularly evident during the initial phases of the investigation which coincided with the onset of the post-impoundment biological development of the dam. Organisms which contributed significantly towards this high standing crop included chironomids, *Chaoborus* and the Annelida (Table 4.1 and Figures 4.5 and 4.6).

- The most productive season of the zoobenthos in terms of biomass and numbers was found to be the winter of 1988 (Figure 4.7). This was followed by the spring of 1987 (Figure 4.4).

- Although it was anticipated, there was, generally speaking, no sequential build-up in the standing crop of benthic macro-invertebrates during the initial post-impoundment phase in the biological development of the Middle Letaba Impoundment. This is largely ascribed to prevailing drought conditions in the catchment areas of the impoundment resulting in a much slower built-up of the water level and the resultant newly inundated areas of the dam basin.

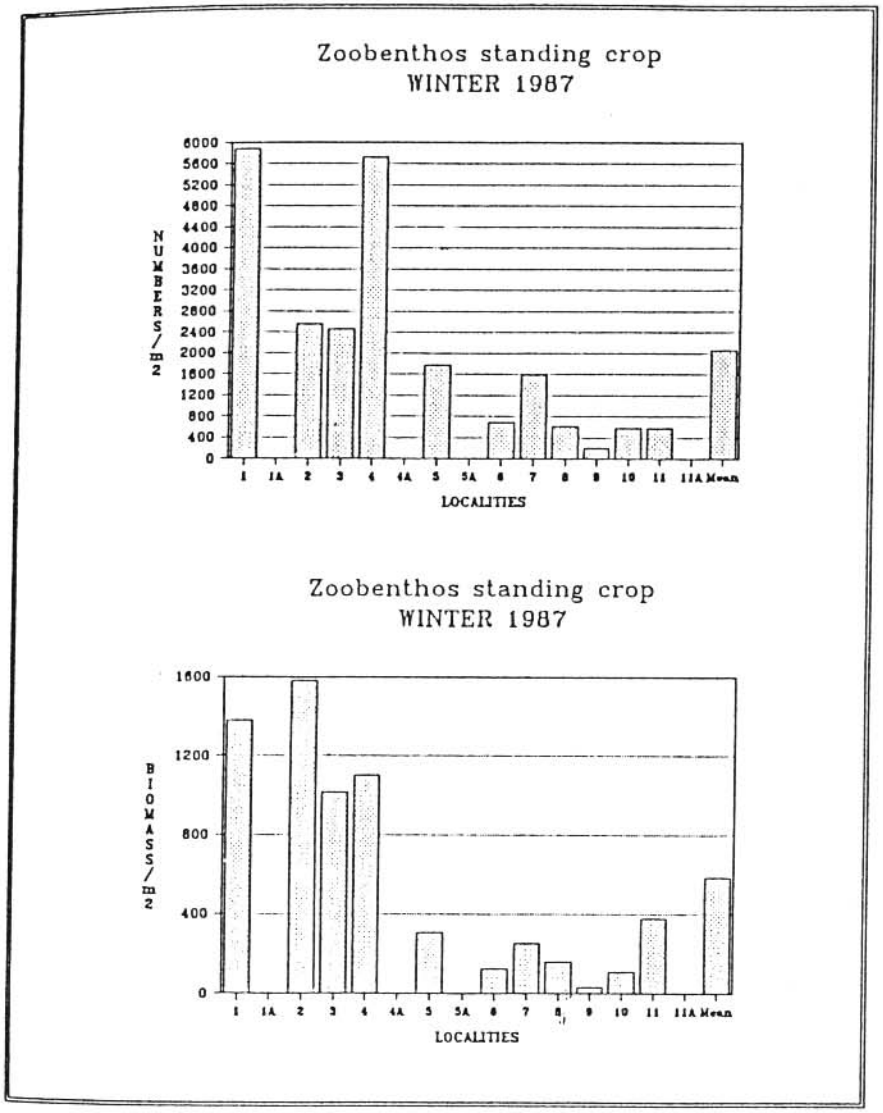

Figure 4.3 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Winter 1987. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

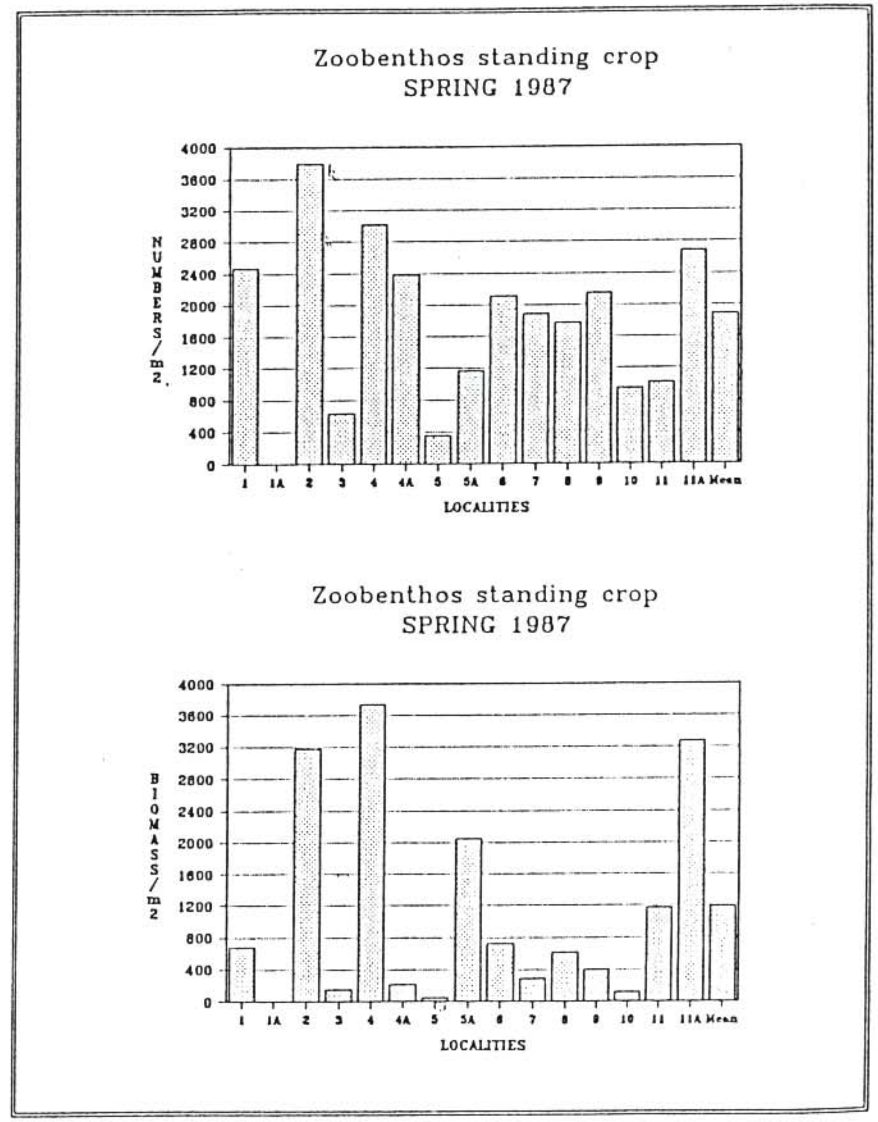

Figure 4.4. Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Spring 1987. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

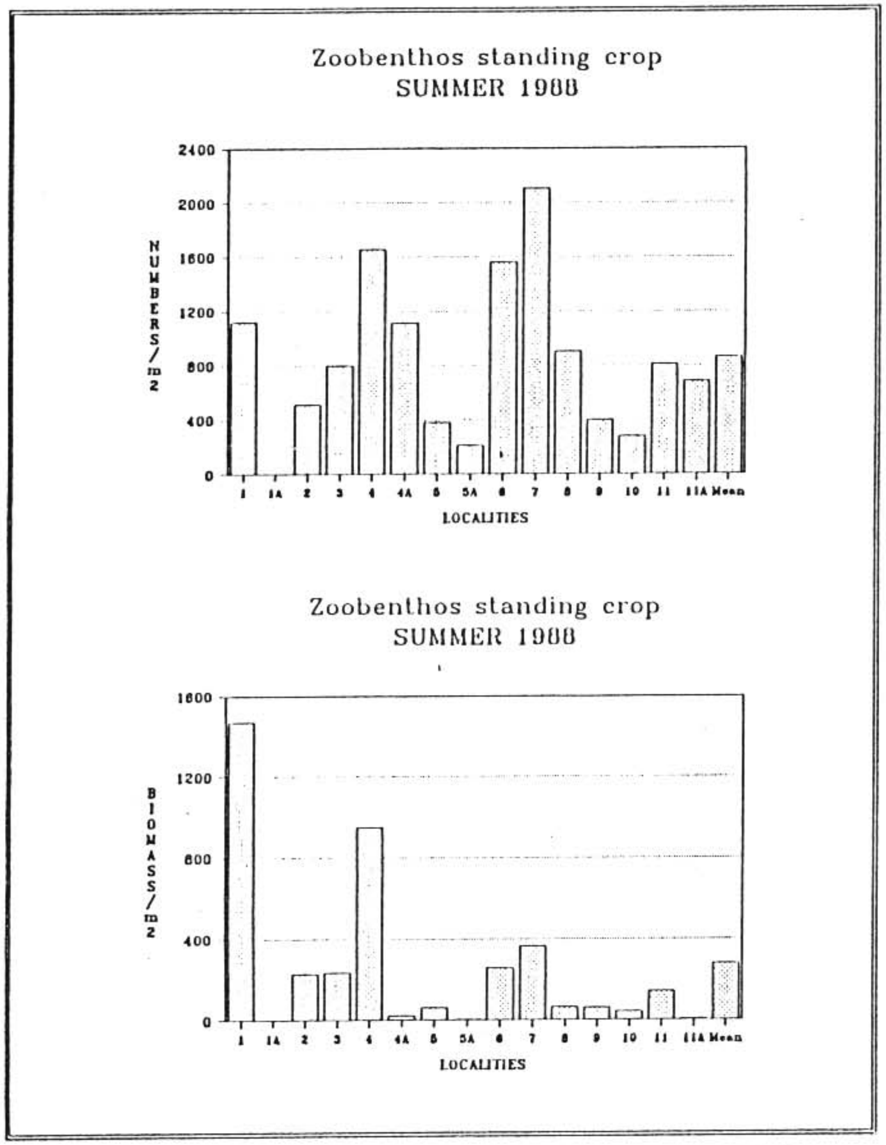

Figure 4.5 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Summer 1988. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

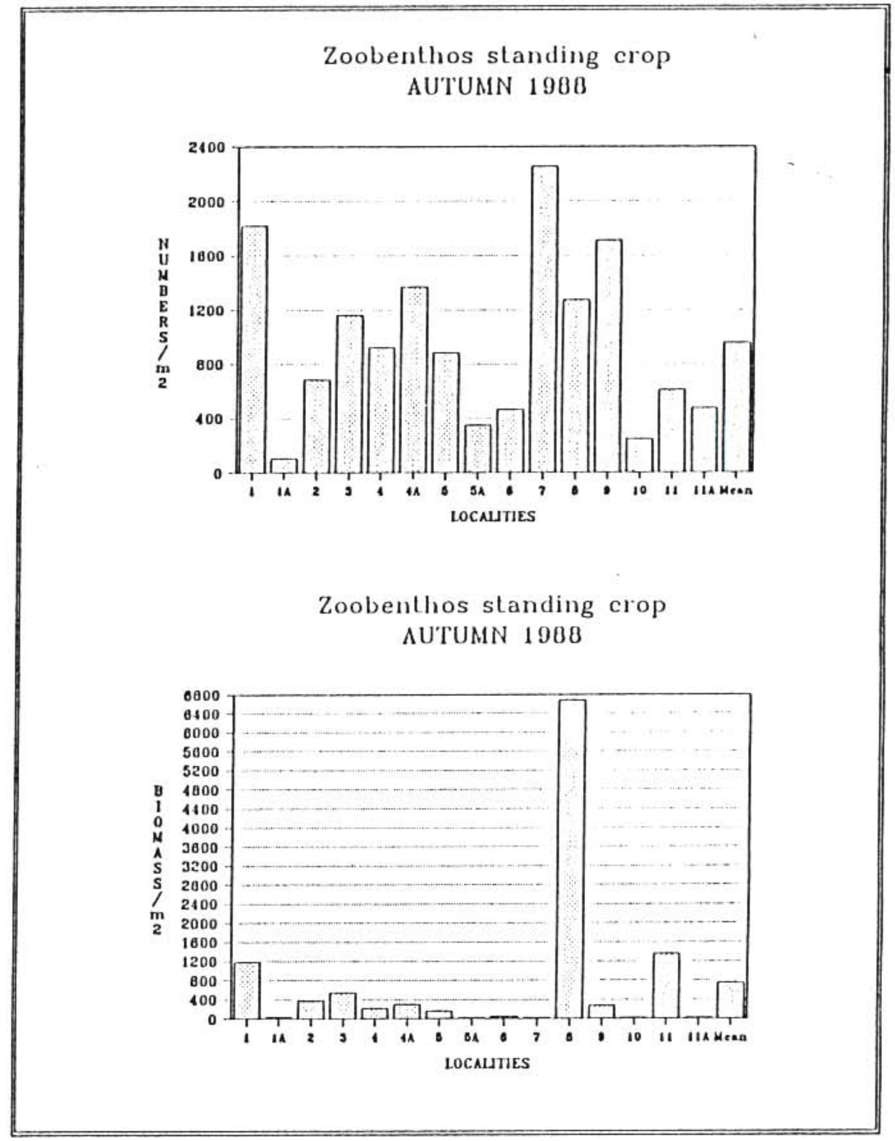

Figure 4.6 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Autumn 1988. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

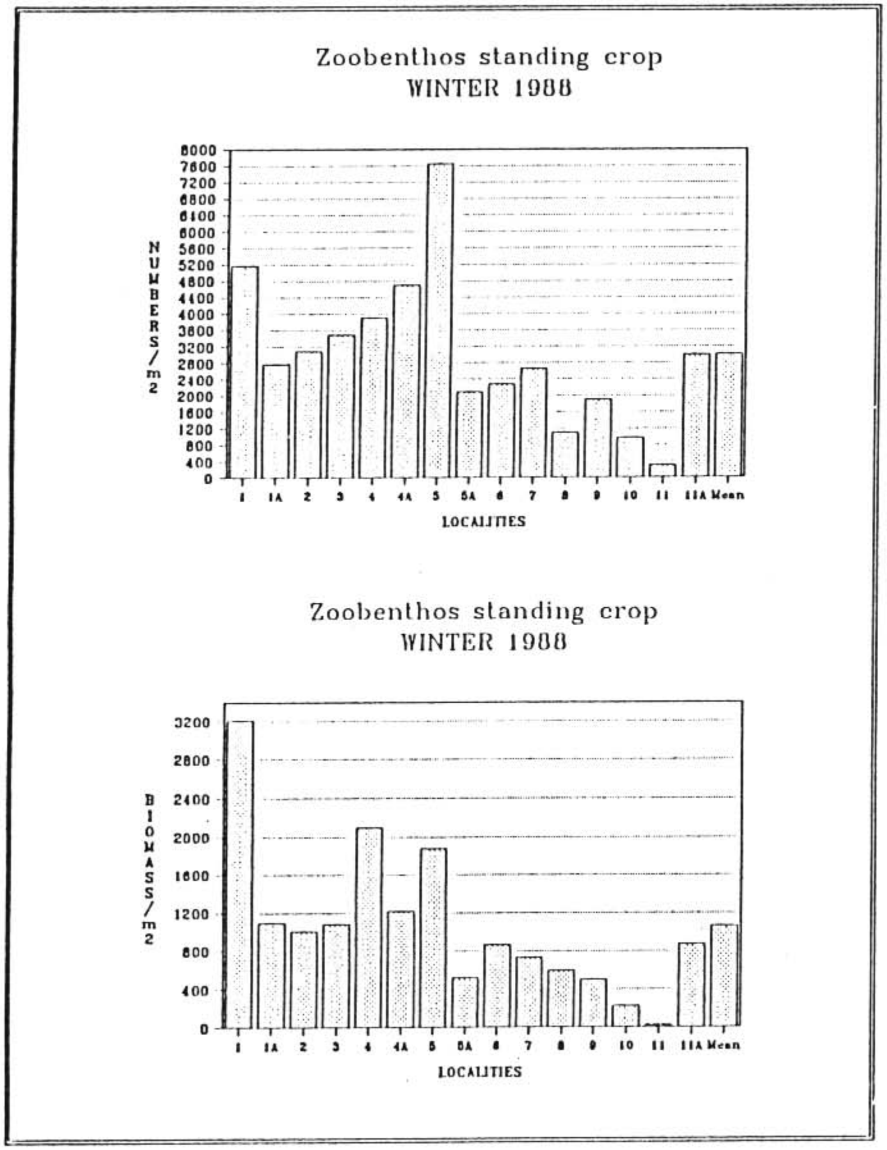

Figure 4.7 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Winter 1988. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

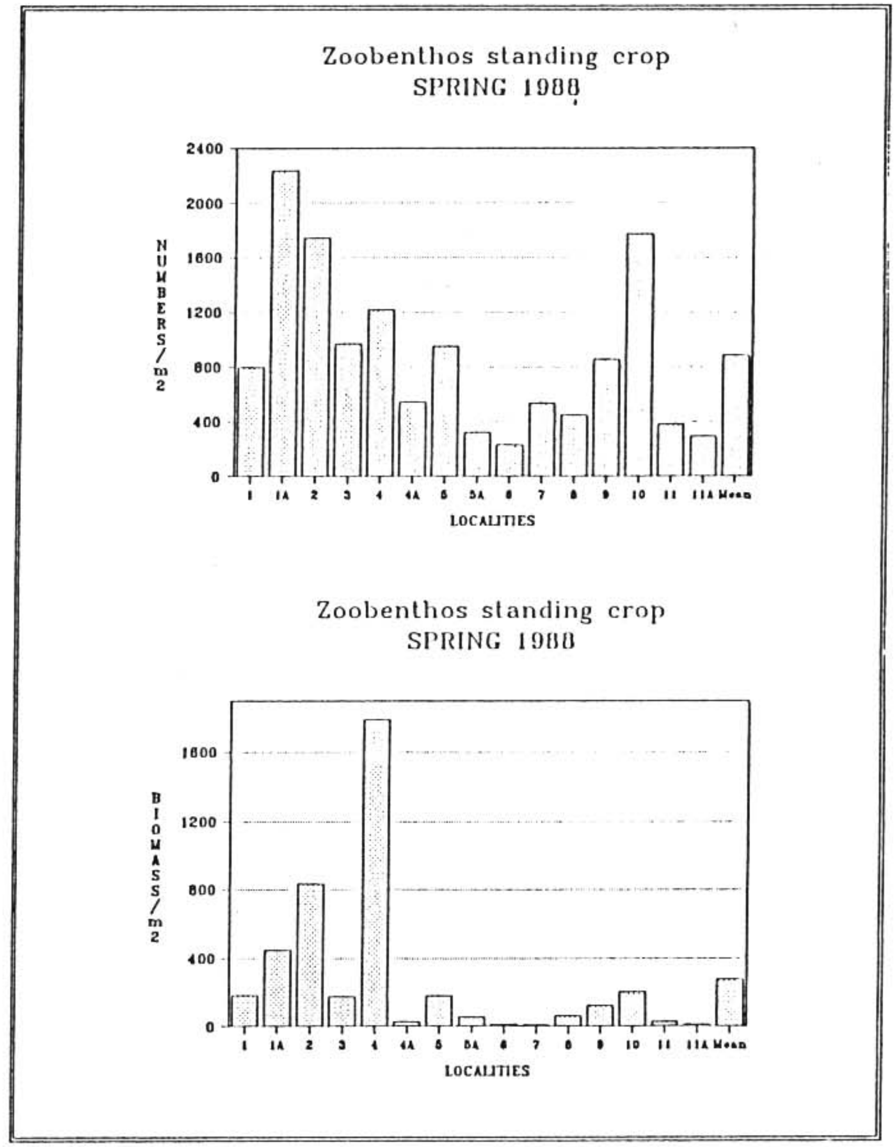

Figure 4.8 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Spring 1988. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

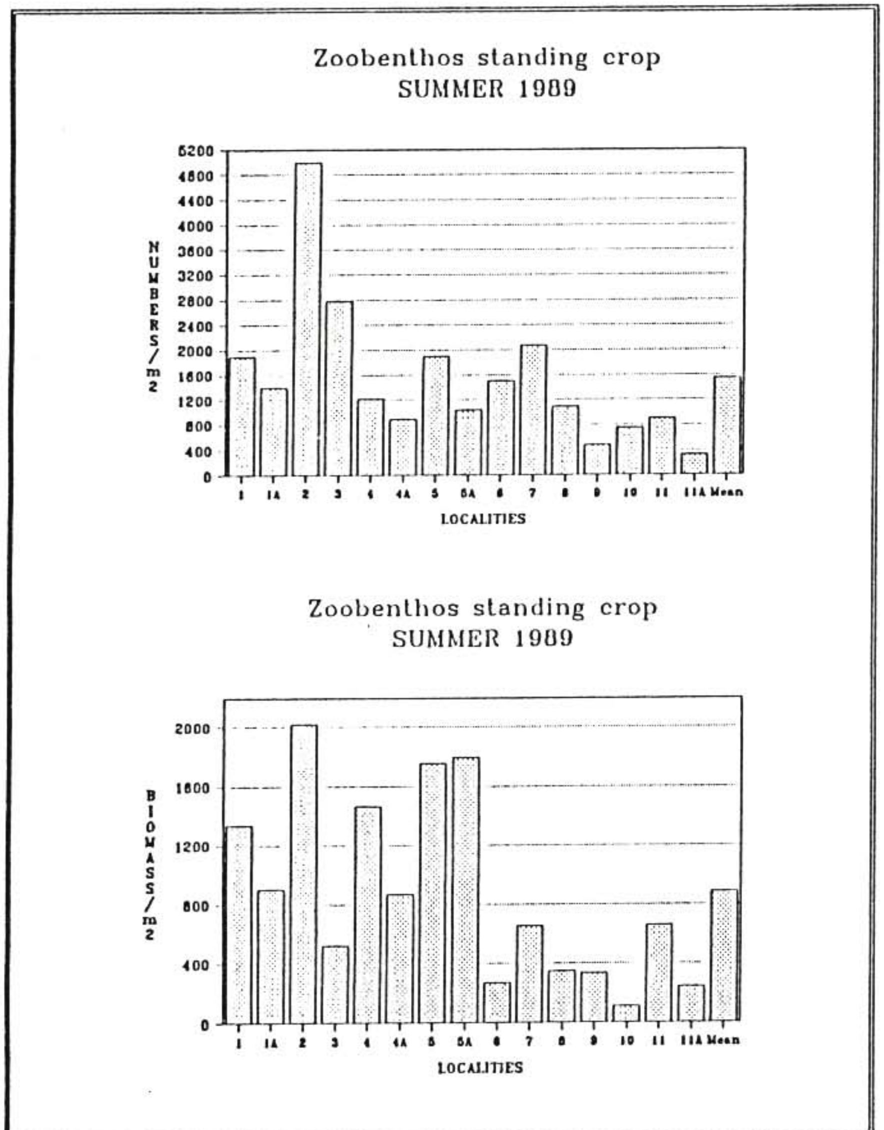

Figure 4.9 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam during Summer 1989. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

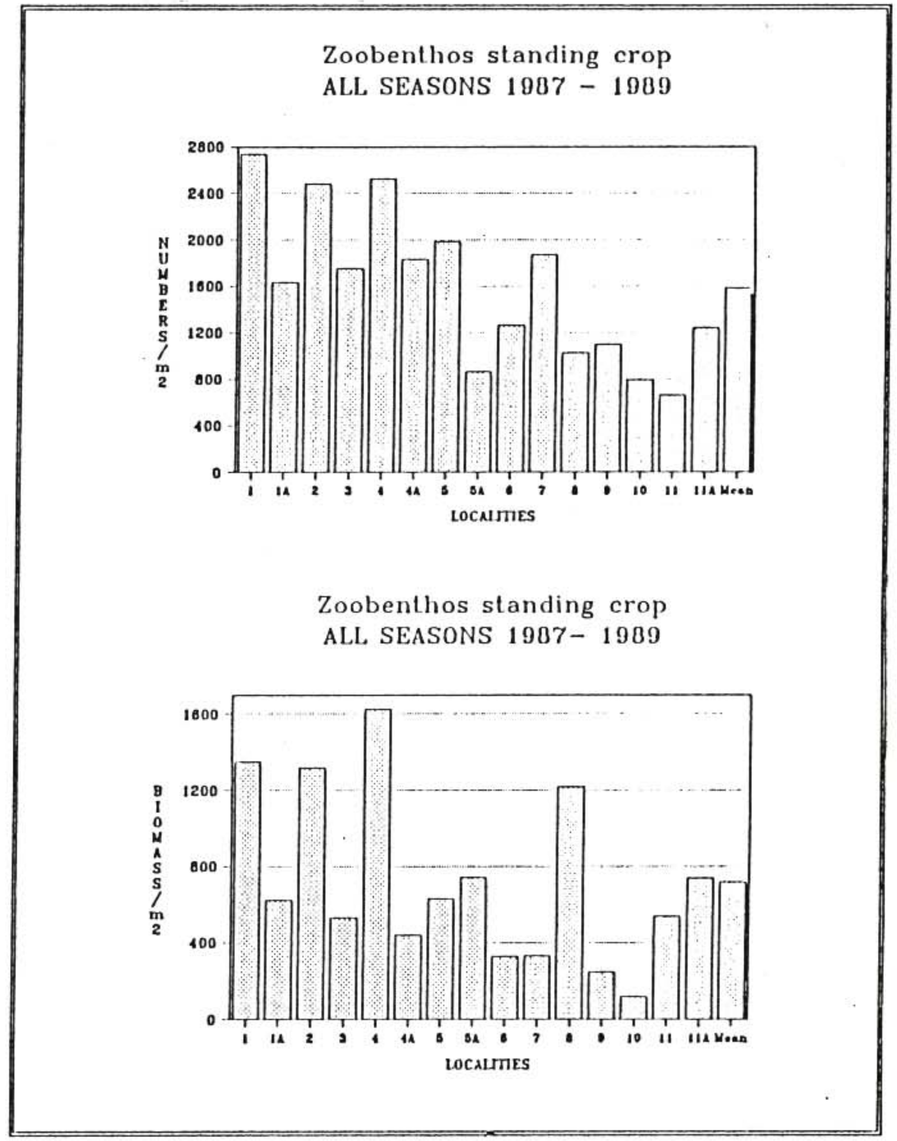

Figure 4.10 Analysis of zoobenthos standing crop at the various sampling localities of Middle Letaba Dam for all seasons 1987 - 1989. Values expressed as numbers and dry biomass (mg m^{-2}) substrate

- The relative contributions of the benthic macro-invertebrates in numbers and biomass of the different areas of the impoundment (represented at 15 sampling localities and over the entire period of investigation), is indicated in Figures 4.3 - 4.10.

From these data a provisional index of benthic macro-invertebrate production was compiled (Tables 4.1 - 4.7).

In the index based on numbers, four categories can be distinguished. The index on biomass was likewise subdivided into four categories (Tables 4.1 - 4.7).

Using the mean values for all seven seasonal surveys, both with regard to numbers and biomass/m^2 substrate as basis, it was possible to subdivide the different localities in order of descending zoobenthos standing crop. Localities 1,2 and 4 are classified as the most productive in terms of numbers whilst 1,2,4 and 8 occupied the highest position in terms of biomass. This is not surprising as Stations 1,2 and 4 are located in the inflow areas of the dam (Figure 2.2) where silt deposition was most pronounced. Station 8, situated on the western shore, in a shallow, highly vegetated littoral zone of the dam, occupied this position solely as a result of a comparatively heavy densities of the gastropod *Bulinus tropicus*.

The bottom end of both categories were occupied by localities 5A, 10 and 11 (numbers) and 9 and 10 (biomass). Localities 9 and 11 (Figure 2.2) are located in hard rocky substrate areas that were excavated for filling material during the construction phase of the dam wall, whilst Locality 10 represented the deepest station in the impoundment (in excess of 23m in depth). Station 5A represented a newly inundated area with a hard gravel bottom substrate.

The present ecological survey of the benthic macro-invertebrate fauna proved to be of considerable value to the researchers involved in the dietary studies of the fish fauna of Middle Letaba Impoundment.
A more detailed discussion of this aspect is considered in Chapter 5.

Table 4.1 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Winter 1987

LOCATION		STATION 1.				STATION 2.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	19.0	(0.7)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	666.6	(26.0)	1079.9	(67.1)
	Unidentified spp.	57.1	(1.0)	39.4	(2.9)	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	85.7	(1.5)	24.9	(1.8)	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	47.6	(1.9)	186.7	(11.6)
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	142.9	(2.4)	64.3	(4.7)	714.2	(27.9)	1266.6	(78.7)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	9.5	(0.2)	0.4	(0.1)	28.6	(1.1)	1.1	(0.1)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	428.6	(7.3)	72.9	(5.3)	1523.7	(59.5)	259.0	(16.1)
Chironomidae	*Chironomus* sp.	5161.7	(87.8)	1238.8	(89.8)	-	-	-	-
	Unident. spp.	-	-	-	-	276.2	(10.8)	52.5	(3.26)
Ceratopogonidae	*Palpomyia* sp.	133.3	(2.3)	4.0	(0.3)	-	-	-	-
	SUBTOTAL	5723.5	(97.4)	1315.7	(95.3)	1799.9	(70.3)	311.5	(19.4)
	SUBTOTAL (Insecta)	5723.5	(97.4)	1315.7	(95.3)	1799.9	(70.3)	311.5	(19.4)
	TOTAL (Arthropoda)	5733.1	(97.6)	1316.0	(95.3)	1828.5	(71.4)	312.6	(19.4)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	5875.9	100%	1380.3	100%	2561.8	100%	1609.5	100%

TAXON	SPECIES	STATION 3. n	(%)	DRY MASS (μg)	(%)	STATION 4. n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	95.2	(1.7)	154.3	(14.0)
	Unidentified spp.	19.1	(0.9)	13.1	(1.3)	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		38.1	(1.8)	149.3	(14.7)	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	57.2	(2.7)	162.1	(16.0)	95.2	(1.7)	154.3	(14.0)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	9.5	(0.4)	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	9.5	(0.4)	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	19.0	(0.9)	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	114.3	(4.3)	4.6	(0.5)	209.5	(3.7)	8.4	(0.8)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1714.2	(79.6)	291.4	(28.7)	4771.2	(83.4)	811.1	(73.5)
Chironomidae	*Chironomus* sp.	9.5	(0.4)	2.3	(0.2)	133.1	(2.3)	32.0	(2.9)
	Unident. spp.	238.1	(11.1)	45.2	(4.5)	514.3	(9.0)	97.7	(8.9)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1961.8	(91.1)	338.9	(33.4)	5418.6	(94.7)	940.8	(85.3)
	SUBTOTAL (Insecta)	1961.8	(91.1)	338.9	(33.4)	5418.6	(94.7)	940.8	(85.3)
	TOTAL (Arthropoda)	2095.1	(97.3)	343.5	(33.8)	5628.1	(98.3)	949.2	(86.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	2466.5	100%	1015.1	100%	5723.3	100%	1103.5	100%

TAXON	SPECIES	STATION 5. n	(%)	DRY MASS (μg)	(%)	STATION 6. n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	9.5	(1.4)	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	9.5	(1.4)	-	-
ARACHNIDA	Unident. watermites	38.1	(2.2)	1.5	(0.5)	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	9.5	(0.5)	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	9.5	(0.5)	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1495.2	(84.4)	254.2	(83.1)	400.0	(58.3)	68.0	(54.9)
Chironomidae	*Chironomus* sp.	133.3	(7.5)	32.0	(10.5)	66.7	(9.7)	16.0	(12.9)
	Unident. spp.	95.2	(5.4)	18.1	(5.9)	209.5	(30.6)	39.8	(32.1)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1723.7	(97.3)	304.3	(99.5)	676.2	(98.6)	123.8	(100.0)
	SUBTOTAL (Insecta)	1733.2	(97.8)	304.3	(99.5)	676.2	(98.6)	123.8	(100.0)
	TOTAL (Arthropoda)	1771.3	(100)	305.8	(100)	685.7	(100)	123.8	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1771.3	100%	305.8	100%	685.7	100%	123.8	100%

TAXON	SPECIES	STATION 7. n	(%)	DRY MASS (µg)	(%)	STATION 8. n	(%)	DRY MASS (µg)	(%)
	LOCATION								
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	19.1	(3.1)	30.9	(19.4)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	19.1	(3.1)	30.9	(19.4)
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		47.6	(3.0)	-	-	-	-	-	-
Copepoda	Calanoida	95.2	(6.0)	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	142.8	(9.0)	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	19.1		(1.2)		0.8	(0.3)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1057.1	(66.5)	179.7	(71.6)	142.9	(23.4)	24.3	(15.3)
Chironomidae	*Chironomus* sp.	-	-	-	-	380.9	(62.5)	91.4	(57.4)
	Unident. spp.	371.4	(23.4)	70.6	(28.1)	66.7	(10.9)	12.7	(8.0)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1428.5	(89.8)	250.3	(99.7)	590.5	(96.9)	128.4	(80.6)
	SUBTOTAL (Insecta)	1428.5	(89.8)	250.3	(99.7)	590.5	(96.9)	128.4	(80.6)
	TOTAL (Arthropoda)	1590.4	(100)	251.1	(100)	590.5	(96.9)	128.4	(80.6)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1590.4	100%	251.1	100%	609.6	100%	159.3	100%

TAXON	SPECIES	STATION 9. n	(%)	DRY MASS (µg)	(%)	STATION 10. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	47.6	(22.7)	1.9	(5.9)	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	19.1	(9.1)	3.2	(10.0)	447.6	(77.1)	76.1	(70.4)
Chironomidae	*Chironomus* sp.	-	-	-	-	133.3	(23.9)	32.0	(29.6)
	Unident. spp.	142.9	(68.2)	27.1	(84.2)	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	161.9	(77.3)	30.3	(94.1)	580.9	(100.0)	108.1	(100.0)
	SUBTOTAL (Insecta)	161.9	(77.3)	30.3	(94.1)	580.9	(100.0)	108.1	(100.0)
	TOTAL (Arthropoda)	209.6	(100.0)	32.2	(100.0)	580.9	(100.0)	108.1	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	209.6	100%	32.2	100%	580.9	100%	108.1	100%

TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)
	LOCATION	STATION 11.			
NEMATODA		-	-	-	-
ANNELIDA					
Tubificidae	*Limnodrilus* sp.	-	-	-	-
	Branchiura sowerbyi	190.5	(32.8)	308.6	(81.6)
	Unidentified spp.	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-
	Aulophorus sp.	-	-	-	-
	Dero sp.	-	-	-	-
	Pristina sp.	-	-	-	-
	Unidentified spp.	-	-	-	-
Lumbricidae		-	-	-	-
Hirudinea		-	-	-	-
	TOTAL (Annelida)	190.5	(32.8)	308.6	(81.6)
ARTHROPODA					
CRUSTACEA					
Cladocera	*Daphnia* sp.	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-
	Iliocryptus sp.	-	-	-	-
Ostracoda		-	-	-	-
Copepoda	Calanoida	-	-	-	-
	Cyclopoida	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-
ARACHNIDA	Unident. watermites	9.5	(1.6)	0.4	(0.1)
INSECTA					
Ephemeroptera	*Caenis* sp.	-	-	-	-
	Povilla adusta	-	-	-	-
Baetidae		-	-	-	-
	SUBTOTAL	-	-	-	-
Odonata					
Anisoptera		-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-
	Notonecta sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-
Coleoptera		-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Diptera	*Chaoborus* sp.	238.1	(41.0)	40.5	(10.7)
Chironomidae	*Chironomus* sp.	28.6	(4.9)	6.9	(1.8)
	Unident. spp.	114.3	(19.7)	21.7	(5.7)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-
	SUBTOTAL	380.9	(65.6)	69.0	(18.3)
	SUBTOTAL (Insecta)	380.9	(65.6)	69.0	(18.3)
	TOTAL (Arthropoda)	390.5	(67.2)	69.5	(18.4)
GASTROPODA	*Ferrissia* sp.	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-
	GRAND TOTAL	581.0	100%	378.1	100%

Table 4.2 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Spring 1987

LOCATION		STATION 1.				STATION 2.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		219.0	(8.9)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	66.7	(2.7)	124.7	(19.3)	561.9	(14.8)	1050.7	(33.1)
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	9.5	(0.4)	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		85.7	(3.5)	130.3	(20.2)	1171.4	(30.9)	1780.5	(56.1)
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	161.9	(6.6)	255.0	(39.5)	1733.3	(45.7)	2831.2	(89.2)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	9.5	(0.4)	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	9.5	(0.4)	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	180.9	(7.3)	9.1	(1.4)	28.6	(0.8)	1.4	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	76.2	(3.1)	6.1	(0.9)	19.1	(0.5)	1.5	-
	SUBTOTAL	76.2	(3.1)	6.1	(0.9)	19.1	(0.5)	1.5	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	866.6	(35.1)	147.3	(22.8)	2009.4	(53.0)	341.6	(10.8)
Chironomidae	*Chironomus* sp.	57.1	(2.3)	13.7	(2.1)	-	-	-	-
	Unident. spp.	895.2	(36.3)	214.9	(33.0)	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1818.9	(73.7)	375.9	(58.2)	2009.4	(53.0)	341.6	(10.8)
	SUBTOTAL (Insecta)	1895.1	(76.8)	382.0	(59.1)	2028.5	(53.5)	343.1	(10.8)
	TOTAL (Arthropoda)	2085.5	(84.6)	391.0	(60.5)	2057.0	(54.3)	344.5	(10.8)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	2466.4	100%	646.1	100%	3790.3	100%	3175.7	100%

TAXON	LOCATION / SPECIES	STATION 3. n	(%)	DRY MASS (µg)	(%)	STATION 4. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	9.5	(1.5)	21.0	(13.7)	123.8	(4.1)	273.6	(7.3)
	Unidentified spp.	-	-	-	-	1704.7	(56.5)	3187.8	(85.3)
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		19.1		(3.0)	29.0	(18.9)	76.2	(2.5)	115.8 (3.1)
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	28.6		(4.5)	50.0	(32.6)	1904.7	(63.1)	3577.2 (95.7)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	257.1	(8.5)	12.9	(0.3)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	580.9	(92.4)	98.8	(64.4)	847.6	(28.1)	144.1	(3.9)
Chironomidae	*Chironomus* sp.	19.1	(3.0)	4.6	(3.0)	-	-	-	-
	Unident. spp.	-	-	-	-	9.5	(0.3)	2.3	(0.1)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	600.0	(95.5)	103.4	(67.4)	857.1	(28.4)	146.4	(3.9)
	SUBTOTAL (Insecta)	600.0	(95.5)	103.4	(67.4)	857.1	(28.4)	146.4	(3.9)
	TOTAL (Arthropoda)	600.0	(95.5)	103.4	(67.4)	1114.2	(36.9)	159.3	(4.3)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	628.6	100%	153.4	100%	3018.9	100%	3736.5	100%

TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
	LOCATION	STATION 4a.				STATION 5.			
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	38.1	(10.8)	3.1	(5.7)
Copepoda	Calanoida	-	-	-	-	9.5	(2.7)	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	47.6	(13.5)	3.1	(5.7)
ARACHNIDA	Unident. watermites	1876.1	(78.8)	93.8	(43.6)	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	9.5	(2.7)	0.8	(1.5)
	SUBTOTAL	-	-	-	-	9.5	(2.7)	0.8	(1.5)
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	-	-	-	-	295.2	(83.8)	50.2	(92.8)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	504.7	(21.2)	121.1	(56.4)	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	504.7	(21.2)	121.1	(56.4)	295.2	(83.8)	50.2	(92.8)
	SUBTOTAL (Insecta)	504.7	(21.2)	121.1	(56.4)	304.7	(86.5)	51.0	(94.4)
	TOTAL (Arthropoda)	2380.8	(100)	214.9	(100)	352.3	(100)	54.1	(100)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	2380.8	100%	214.9	100%	352.3	100%	54.1	100%

TAXON	SPECIES	STATION 5a. n	(%)	DRY MASS (µg)	(%)	STATION 6. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	104.8	(5.0)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	57.1	(2.7)	106.9	(15.1)
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	9.5	(0.4)	14.5	(2.0)
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	66.6	(3.2)	121.4	(17.1)
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		219.0	(18.8)	17.5	(0.9)	104.8	(5.0)	8.4	(1.2)
Copepoda	Calanoida	-	-	-	-	9.5	(0.4)	-	-
	Cyclopoida	19.1	-	-	-	38.1	(1.8)	-	-
	SUBTOTAL (Crustacea)	238.1	(20.5)	17.5	(0.9)	152.4	(7.2)	8.4	(1.2)
ARACHNIDA	Unident. watermites	38.1	(3.3)	1.9	(0.1)	28.6	(1.4)	1.4	(0.2)
INSECTA									
Ephemeroptera	*Caenis* sp.	123.8	(10.7)	35.9	(1.8)	-	-	-	-
	Povilla adusta	-	-	-	-	9.5	(0.4)	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	123.8	(10.7)	35.9	(1.8)	9.5	(0.4)	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	9.5	(0.4)	0.8	(0.1)
	SUBTOTAL	-	-	-	-	9.5	(0.4)	0.8	(0.1)
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	38.1	(3.3)	-	-	85.7	(4.1)	14.6	(2.1)
Chironomidae	*Chironomus* sp.	-	-	-	-	180.9	(8.6)	43.4	(6.1)
	Unident. spp.	619.0	(53.3)	148.6	(7.3)	1466.6	(69.4)	352.0	(49.6)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	657.1	(56.6)	148.6	(7.3)	1733.2	(82.0)	410.0	(57.8)
	SUBTOTAL (Insecta)	780.9	(67.2)	184.5	(9.0)	1752.2	(82.9)	410.8	(57.9)
	TOTAL (Arthropoda)	1057.1	(91.0)	203.9	(10.0)	1933.2	(91.4)	420.6	(59.3)
GASTROPODA	*Bulinus* sp.	104.8	(9.0)	1841.7	(90.0)	9.5	(0.4)	167.4	(23.6)
	TOTAL (Gastropoda)	104.8	(9.0)	1841.7	(90.0)	9.5	(0.4)	167.4	(23.6)
	GRAND TOTAL	1161.9	100%	2045.6	100%	2114.1	100%	726.0	100%

	LOCATION	STATION 7.				STATION 8.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		9.52		(0.5)	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	164.3	(9.2)	307.2	(49.9)
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	21.4	(1.2)	32.6	(5.3)
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	185.7	(10.4)	339.8	(55.2)
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	7.1	(0.4)	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		66.7	(3.5)	5.3	(1.9)	271.4	(15.3)	21.7	(3.5)
Copepoda	Calanoida	9.5	(0.5)	-	-	7.1	(0.4)	-	-
	Cyclopoida	152.4	(8.1)	-	-	192.9	(10.8)	-	-
	SUBTOTAL (Crustacea)	228.6	(12.1)	5.3	(1.9)	478.5	(26.9)	21.7	(3.5)
ARACHNIDA	Unident. watermites	-	-	-	-	28.6	(1.6)	1.4	(0.2)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	19.1	(1.0)	1.5	(0.5)	21.4	(1.2)	1.7	(0.3)
	SUBTOTAL	19.1	(1.0)	1.5	(0.5)	21.4	(1.2)	1.7	(0.3)
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	7.1	(0.4)	-	-
	SUBTOTAL	-	-	-	-	7.1	(0.4)	-	-
Diptera	*Chaoborus* sp.	1619.0	(85.9)	275.2	(96.8)	35.7	(2.0)	6.1	(1.0)
Chironomidae	*Chironomus* sp.	-	-	-	-	678.5	(38.2)	162.9	(26.4)
	Unident. spp.	9.5	(0.5)	2.3	(0.8)	342.8	(19.3)	82.3	(13.4)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1628.5	(86.4)	277.5	(97.6)	1057.0	(59.4)	251.3	(40.8)
	SUBTOTAL (Insecta)	1647.6	(87.4)	279.0	(98.1)	1085.5	(61.0)	253.0	(41.1)
	TOTAL (Arthropoda)	1876.2	(99.5)	284.3	(99.1)	1592.6	(89.6)	276.1	(44.8)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1885.7	100%	284.3	100%	1778.3	100%	615.9	100%

TAXON	SPECIES	STATION 9. n	(%)	DRY MASS (µg)	(%)	STATION 10. n	(%)	DRY MASS (µg)	(%)
NEMATODA		200.0	(9.3)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	71.4	(3.3)	133.6	(36.3)	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	71.4	(3.3)	133.6	(36.3)	-	-	-	-
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	14.3	(0.7)	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		678.5	(31.6)	54.3	(14.7)	304.8	(32.0)	24.4	(19.7)
Copepoda	Calanoida	21.4	(1.0)	-	-	38.1	(4.0)	-	-
	Cyclopoida	321.4	(15.0)	-	-	38.1	(4.0)	-	-
	SUBTOTAL (Crustacea)	1035.7	(48.2)	54.3	(14.7)	381.0	(40.0)	24.4	(19.7)
ARACHNIDA	Unident. watermites	50.0	(2.3)	2.5	(0.7)	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	57.1	(2.7)	4.6	(1.2)	19.1	(2.0)	1.5	(1.2)
	SUBTOTAL	57.1	(2.7)	4.6	(1.2)	19.1	(2.0)	1.5	(1.2)
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	42.9	(2.0)	7.3	(2.0)	495.2	(52.0)	84.2	(68.0)
Chironomidae	*Chironomus* sp.	21.4	(1.0)	5.1	(1.4)	-	-	-	-
	Unident. spp.	671.4	(31.2)	161.1	(43.7)	57.1	(6.0)	13.7	(11.1)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	735.7	(34.2)	173.5	(47.1)	552.3	(58.0)	97.9	(79.1)
	SUBTOTAL (Insecta)	792.8	(36.9)	178.1	(48.3)	571.4	(60.0)	99.4	(80.3)
	TOTAL (Arthropoda)	1878.4	(87.4)	234.9	(63.7)	952.4	(100)	123.8	(100)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	2149.8	100%	368.5	100%	952.4	100%	123.8	100%

TAXON	SPECIES	STATION 11. n	(%)	DRY MASS (µg)	(%)	STATION 11a. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	7.1	(0.3)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	590.5	(57.9)	1104.1	(94.2)	200.0	(7.4)	374.0	(11.4)
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	590.5	(57.9)	1104.1	(94.2)	200.0	(7.4)	374.0	(11.4)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		19.1	(1.9)	1.5	(0.1)	250.0	(9.3)	20.0	(0.6)
Copepoda	Calanoida	9.5	(0.9)	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	85.7	(3.2)	-	-
	SUBTOTAL (Crustacea)	28.6	(2.8)	1.5	(0.1)	335.7	(12.5)	20.0	(0.6)
ARACHNIDA	Unident. watermites	66.7	(6.5)	3.3	(0.3)	164.3	(6.1)	8.2	(0.3)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	35.7	(1.3)	10.4	(0.3)
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	35.7	(1.3)	10.4	(0.3)
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	7.1	(0.3)	40.7	(1.2)
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	7.1	(0.3)	40.7	(1.2)
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	238.1	(23.4)	40.5	(3.5)	-	-	-	-
Chironomidae	*Chironomus* sp.	19.1	(1.9)	4.6	(0.4)	7.1	(0.3)	1.7	(0.1)
	Unident. spp.	76.2	(7.5)	18.3	(1.6)	1792.8	(66.8)	430.3	(13.2)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	333.4	(32.7)	63.4	(5.4)	1799.9	(67.0)	432.0	(13.2)
	SUBTOTAL (Insecta)	333.4	(32.7)	63.4	(5.4)	1842.7	(68.6)	483.1	(14.8)
	TOTAL (Arthropoda)	428.7	(42.1)	68.2	(5.8)	2342.7	(87.2)	511.3	(15.6)
GASTROPODA	Unident. sp.	-	-	-	-	135.7	(5.1)	2385.8	(72.9)
	TOTAL (Gastropoda)	-	-	-	-	135.7	(5.1)	2385.8	(72.9)
	GRAND TOTAL	1019.2	100%	1172.3	100%	2685.5	100%	3271.1	100%

Table 4.3 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Summer 1988

	LOCATION	STATION 1.				STATION 2.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	885.7	(78.8)	1425.9	(97.1)	95.2	(18.5)	153.3	(67.5)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	885.6	(78.8)	1425.9	(97.1)	95.2	(18.5)	153.3	(67.5)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	9.5	(1.8)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	238.1	(21.2)	42.9	(2.9)	409.5	(79.6)	73.7	(32.5)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	238.1	(21.2)	42.9	(2.9)	409.5	(79.6)	73.7	(32.5)
	SUBTOTAL (Insecta)	238.1	(21.2)	42.9	(2.9)	409.5	(79.6)	73.7	(32.5)
	TOTAL (Arthropoda)	238.1	(21.2)	42.9	(2.9)	409.5	(79.6)	73.7	(32.5)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1123.8	100%	1468.8	100%	514.2	100%	227.0	100%

TAXON	LOCATION / SPECIES	STATION 3. n	(%)	DRY MASS (µg)	(%)	STATION 4. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	66.7	(8.3)	107.3	(46.2)	466.6	(28.1)	751.3	(79.1)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	66.7	(8.3)	107.3	(46.2)	466.6	(28.1)	751.3	(79.1)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	9.5	(0.6)	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	38.1	(2.3)	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	47.6	(2.9)	-	-
ARACHNIDA	Unident. watermites	38.1	(4.8)	-	-	38.1	(2.3)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata									
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	695.2	(86.9)	125.1	(53.8)	1104.7	(66.7)	198.9	(20.9)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	695.2	(86.9)	125.1	(53.8)	1104.7	(66.7)	198.9	(20.9)
	SUBTOTAL (Insecta)	695.2	(86.9)	125.1	(53.8)	1104.7	(66.7)	198.9	(20.9)
	TOTAL (Arthropoda)	733.3	(91.7)	125.1	(53.8)	1190.4	(71.8)	198.9	(20.9)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	800.0	100%	232.4	100%	1657.1	100%	950.2	100%

LOCATION		STATION 4a.				STATION 5.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		114.3	(10.3)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		28.6	(2.6)	-	-	9.5	(2.5)	-	-
Copepoda	Calanoida	800.0	(71.8)	-	-	57.1	(15.0)	-	-
	Cyclopoida	162.0	(14.5)	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	990.6	(88.9)	-	-	66.6	(17.5)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	19.1	(5.0)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Corixa sp.	9.5	(0.9)	-	-	-	-	-	-
	SUBTOTAL	9.5	(0.9)	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	-	-	-	-	285.7	(75.0)	51.4	(83.0)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	285.7	(75.0)	51.4	(83.0)
	SUBTOTAL (Insecta)	9.5	(0.9)	-	-	285.7	(75.0)	51.4	(83.0)
	TOTAL (Arthropoda)	1000.0	(89.7)	-	-	371.4	(97.5)	51.4	(83.0)
GASTROPODA	*Bulinus* sp.	-	-	-	-	9.5	(2.5)	10.5	(17.0)
	TOTAL (Gastropoda)	-	-	-	-	9.5	(2.5)	10.5	(17.0)
	GRAND TOTAL	1114.4	100%	-	-	380.9	100%	61.9	100%

	LOCATION	STATION 5a.				STATION 6.			
				DRY MASS				DRY MASS	
TAXON	SPECIES	n	(%)	(µg)	(%)	n	(%)	(µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	9.5	(4.5)	-	-	-	-	-	-
	Cyclopoida	161.9	(77.3)	-	-	95.2	(6.1)	-	-
	SUBTOTAL (Crustacea)	171.4	(81.9)	-	-	95.2	(6.1)	-	-
ARACHNIDA	Unident. watermites	9.5	(4.5)	-	-	38.1	(2.4)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	9.5	(4.5)	1.7	(43.6)	1428.5	(91.5)	257.1	(100)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	9.5	(4.5)	2.2	(56.4)	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	9.5	(4.5)	-	-	-	-	-	-
	SUBTOTAL	28.5	(13.6)	3.9	(100)	1428.5	(91.5)	257.1	(100)
	SUBTOTAL (Insecta)	28.5	(13.6)	3.9	(100)	1428.5	(91.5)	257.1	(100)
	TOTAL (Arthropoda)	209.4	(100)	3.9	(100)	1561.8	(100)	257.1	(100)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	209.4	100%	3.9	100%	1561.8	100%	257.1	100%

LOCATION		STATION 7.				STATION 8.			
TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)	n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	66.7	(7.4)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	9.5	(1.0)	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	28.6	(3.2)	-	-
	Pristina sp.	-	-	-	-	181.0	(20.0)	25.3	(49.6)
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	219.1	(24.2)	25.3	(49.6)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	66.7	(7.4)	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		57.1	(2.7)	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	247.6	(27.4)	-	-
	Cyclopoida	28.6	(1.4)	-	-	152.4	(16.8)	-	-
	SUBTOTAL (Crustacea)	85.7	(4.1)	-	-	466.7	(51.6)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	2019.0	(95.9)	363.4	(100)	142.9	(15.8)	25.7	(50.4)
Chironomidae	*Pentaneura* sp.	-	-	-	-	9.5	(1.0)	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	2019.0	(95.9)	363.4	(100)	152.4	(16.8)	25.7	(50.4)
	SUBTOTAL (Insecta)	2019.0	(95.9)	363.4	(100)	152.4	(16.8)	25.7	(50.4)
	TOTAL (Arthropoda)	2104.7	(100)	363.4	(100)	619.1	(68.4)	25.7	(50.9)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	2104.7	100%	363.4	100%	904.9	100%	51.0	100%

TAXON	LOCATION SPECIES	STATION 9. n	(%)	DRY MASS (μg)	(%)	STATION 10. n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	9.5	(2.4)	15.3	(24.7)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	76.2	(19.0)	10.7	(17.3)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	85.7	(21.4)	26.0	(41.9)	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		57.1	(14.3)	-	-	9.5	(3.4)	-	-
Copepoda	Calanoida	38.1	(9.5)	-	-	19.1	(6.9)	-	-
	Cyclopoida	19.1	(4.8)	-	-	19.1	(6.9)	-	-
	SUBTOTAL (Crustacea)	114.3	(28.6)	-	-	47.7	(17.3)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata									
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera		-	-	-	-	-	-	-	-
	Trepobates sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	200.0	(50.0)	36.0	(58.1)	228.6	(82.7)	41.1	(100)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	200.0	(50.0)	36.0	(58.1)	228.6	(82.7)	41.1	(100)
	SUBTOTAL (Insecta)	200.0	(50.0)	36.0	(58.1)	228.6	(82.7)	41.1	(100)
	TOTAL (Arthropoda)	314.3	(78.6)	36.0	(58.1)	276.3	(100)	41.1	(100)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	400.0	100%	62.0	100%	276.3	100%	41.1	100%

	LOCATION	STATION 11.				STATION 11a.			
				DRY MASS				DRY MASS	
TAXON	SPECIES	n	(%)	(µg)	(%)	n	(%)	(µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	28.6	(4.2)	4.0	(47.6)
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	28.6	(4.2)	4.0	(47.6)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	28.6	(4.2)	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		19.1	(2.4)	-	-	9.5	(1.4)	-	-
Copepoda	Calanoida	-	-	-	-	590.5	(86.1)	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	19.1	(2.4)	-	-	628.6	(91.7)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	9.5	(1.4)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	790.4	(97.6)	142.3	(100)	-	-	-	-
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	19.1	(2.8)	4.4	(52.4)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	790.4	(97.6)	142.3	(100)	19.1	(2.8)	4.4	(52.4)
	SUBTOTAL (Insecta)	790.4	(97.6)	142.3	(100)	19.1	(2.8)	4.4	(52.4)
	TOTAL (Arthropoda)	809.5	(100)	142.3	(100)	657.2	(95.8)	4.4	(52.4)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	809.5	100%	142.3	100%	685.8	100%	8.4	100%

Table 4.4 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Autumn 1988

	LOCATION	STATION 1.				STATION 1a.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		9.5	(0.5)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	1019.0	(56.0)	1059.8	(90.0)	28.6	(27.3)	29.7	(65.0)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	1019.0	(56.0)	1059.8	(90.0)	28.6	(27.3)	29.7	(65.0)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	19.1	(1.1)	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	114.3	(6.3)	-	-	-	-	-	-
	Cyclopoida	95.2	(5.2)	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	228.6	(12.6)	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata									
Anisoptera		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	9.5	(0.5)	1.4	(0.1)	-	-	-	-
	SUBTOTAL	9.5	(0.5)	1.4	(0.1)	-	-	-	-
Diptera	*Chaoborus* sp.	552.4	(30.4)	116.0	(9.9)	76.2	(72.7)	16.0	(35.0)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	552.4	(30.4)	116.0	(9.9)	76.2	(72.7)	16.0	(35.0)
	SUBTOTAL (Insecta)	561.9	(30.9)	117.4	(10.0)	76.2	(72.7)	16.0	(35.0)
	TOTAL (Arthropoda)	790.4	(43.5)	117.4	(10.0)	76.2	(72.7)	16.0	(35.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1819.0	100%	1177.2	100%	104.8	100%	45.7	100%

	LOCATION	STATION 2.				STATION 3.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
BRYOZOA		-	-	-	-	9.5	(0.8)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	276.2	(40.3)	287.2	(77.0)	380.9	(32.8)	396.2	(72.8)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	276.2	(40.3)	287.2	(77.0)	380.9	(32.8)	396.2	(72.8)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	9.5	(0.8)	-	-
	Cyclopoida	-	-	-	-	57.1	(4.9)	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	66.6	(5.7)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	409.5	(59.7)	86.0	(23.0)	704.7	(60.7)	148.0	(27.2)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	409.5	(59.7)	86.0	(23.0)	704.7	(60.7)	148.0	(27.2)
	SUBTOTAL (Insecta)	409.5	(59.7)	86.0	(23.0)	704.7	(60.7)	148.0	(27.2)
	TOTAL (Arthropoda)	409.5	(59.7)	86.0	(23.0)	771.3	(66.4)	148.0	(27.2)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	685.7	100%	373.2	100%	1161.7	100%	544.2	100%

TAXON	SPECIES	STATION 4. n	(%)	DRY MASS (µg)	(%)	STATION 4a. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	57.1	(4.2)	-	-
BRYOZOA		-	-	-	-	9.5	(0.7)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	28.6	(3.1)	29.7	(13.8)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	9.5	(0.7)	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	95.2	(6.9)	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	28.6	(3.1)	29.7	(13.8)	104.8	(7.6)	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	28.6	(2.1)	-	-
	Macrothrix sp.	-	-	-	-	38.1	(2.8)	-	-
	Iliocryptus sp.	-	-	-	-	66.7	(4.9)	-	-
Ostracoda		9.5	(1.0)	-	-	9.5	(0.7)	-	-
Copepoda	Calanoida	-	-	-	-	76.2	(5.6)	-	-
	Cyclopoida	-	-	-	-	66.7	(4.9)	-	-
	SUBTOTAL (Crustacea)	9.5	(1.0)	-	-	285.8	(20.8)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	885.7	(95.9)	186.0	(86.2)	9.5	(0.7)	2.0	(0.7)
Chironomidae	*Chironomus* sp.	-	-	-	-	304.8	(22.2)	73.1	(24.5)
	Unident. spp.	-	-	-	-	590.5	(43.1)	82.7	(27.7)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	885.7	(95.9)	186.0	(86.2)	904.8	(66.0)	157.8	(52.9)
	SUBTOTAL (Insecta)	885.7	(95.9)	186.0	(86.2)	904.8	(66.0)	157.8	(52.9)
	TOTAL (Arthropoda)	895.2	(96.9)	186.0	(86.2)	1190.6	(86.8)	157.8	(52.9)
GASTROPODA	*Bulinus* sp.	-	-	-	-	9.5	(0.7)	140.5	(47.1)
	TOTAL (Gastropoda)	-	-	-	-	9.5	(0.7)	140.5	(47.1)
	GRAND TOTAL	923.8	100%	215.7	100%	1371.4	100%	298.3	100%

TAXON	LOCATION / SPECIES	STATION 5. n	(%)	DRY MASS (µg)	(%)	STATION 5a. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	9.5	(2.7)	-	-
Ostracoda		47.6	(5.4)	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	28.6	(8.1)	-	-
	Cyclopoida	9.5	(1.1)	-	-	123.8	(35.1)	-	-
	SUBTOTAL (Crustacea)	57.1	(6.4)	-	-	161.9	(45.9)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		9.5	(1.1)	1.4	(0.8)	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	9.5	(1.1)	1.4	(0.8)	-	-	-	-
Diptera	*Chaoborus* sp.	819.0	(92.5)	172.0	(99.2)	19.1	(5.4)	4.0	(11.3)
Chironomidae	*Chironomus* sp.	-	-	-	-	85.7	(24.3)	20.6	(58.4)
	Unident. spp.	-	-	-	-	76.2	(21.6)	10.7	(30.3)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	9.5	(2.7)	-	-
	SUBTOTAL	819.0	(92.5)	172.0	(99.2)	190.5	(54.1)	35.2	(100.0)
	SUBTOTAL (Insecta)	828.5	(93.6)	173.4	(100.0)	190.5	(54.1)	35.2	(100.0)
	TOTAL (Arthropoda)	885.6	(100)	173.4	(100.0)	352.4	(100.0)	35.2	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	885.6	100%	173.4	100%	352.4	100%	35.2	100%

LOCATION		STATION 6.				STATION 7.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	19.1	(4.1)	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		9.5	(2.0)	-	-	28.6	(1.3)	-	-
Copepoda	Calanoida	-	-	-	-	514.3	(22.8)	-	-
	Cyclopoida	161.9	(34.7)	-	-	1495.2	(66.2)	-	-
	SUBTOTAL (Crustacea)	190.5	(40.8)	-	-	2038.1	(90.3)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	47.6	(2.1)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	276.2	(59.2)	58.0	(100.0)	171.4	(7.6)	36.0	(100.0)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	276.2	(59.2)	58.0	(100.0)	171.4	(7.6)	36.0	(100.0)
	SUBTOTAL (Insecta)	276.2	(59.2)	58.0	(100.0)	171.4	(7.6)	36.0	(100.0)
	TOTAL (Arthropoda)	466.7	(100.0)	58.0	(100.0)	2257.1	(100.0)	36.0	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	466.7	100%	58.0	100%	2257.1	100%	36.0	100%

LOCATION		STATION 8.				STATION 9.			
				DRY MASS				DRY MASS	
TAXON	SPECIES	n	(%)	(µg)	(%)	n	(%)	(µg)	(%)
NEMATODA		9.5	(0.7)	-	-	66.7	(3.9)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	76.2	(6.0)	79.2	(1.2)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	114.3	(9.0)	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		9.5	(0.7)	9.5	(0.1)	-	-	-	-
	TOTAL (Annelida)	200.0	(15.7)	88.7	(1.3)	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	9.5	(0.6)	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	9.5	(0.6)	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	238.1	(13.9)	-	-
	Cyclopoida	57.1	(4.5)	-	-	95.2	(5.6)	-	-
	SUBTOTAL (Crustacea)	57.1	(4.5)	-	-	352.3	(20.6)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	571.4	(44.8)	120.0	(1.8)	1295.2	(75.6)	272.0	(100.0)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	571.4	(44.8)	120.0	(1.8)	1295.2	(75.6)	272.0	(100.0)
	SUBTOTAL (Insecta)	571.4	(44.8)	120.0	(1.8)	1295.2	(75.6)	272.0	(100.0)
	TOTAL (Arthropoda)	628.5	(49.3)	120.0	(1.8)	1647.5	(96.1)	272.0	(100.0)
GASTROPODA	*Bulinus* sp.	438.1	(34.3)	6465.9	(96.9)	-	-	-	-
	TOTAL (Gastropoda)	438.1	(34.3)	6465.9	(96.9)	-	-	-	-
	GRAND TOTAL	1276.1	100%	6674.6	100%	1714.2	100%	272.0	100%

	LOCATION	STATION 10.				STATION 11.			
				DRY MASS				DRY MASS	
TAXON	SPECIES	n	(%)	(µg)	(%)	n	(%)	(µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	9.5	(3.8)	-	-	9.5	(1.6)	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	28.6	(11.6)	-	-	-	-	-	-
	Cyclopoida	47.6	(19.2)	-	-	76.2	(12.5)	-	-
	SUBTOTAL (Crustacea)	85.7	(34.6)	-	-	85.7	(14.1)	-	-
ARACHNIDA	Unident. watermites	38.1	(15.4)	-	-	9.5	(1.6)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	123.8	(50.0)	26.0	(100.0)	428.6	(70.3)	90.0	(6.6)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	123.8	(50.0)	26.0	(100.0)	428.6	(70.3)	90.0	(6.6)
	SUBTOTAL (Insecta)	123.8	(50.0)	26.0	(100.0)	428.6	(70.3)	90.0	(6.6)
	TOTAL (Arthropoda)	247.6	(100.0)	26.0	(100.0)	523.8	(85.9)	90.0	(6.6)
GASTROPODA	*Bulinus* sp.	-	-	-	-	85.7	(14.1)	1265.1	(93.4)
	TOTAL (Gastropoda)	-	-	-	-	85.7	(14.1)	1265.1	(93.4)
	GRAND TOTAL	247.6	100%	26.0	100%	609.5	100%	1355.1	100%

TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)
	LOCATION	STATION 11a.			
NEMATODA		-	-	-	-
ANNELIDA					
Tubificidae	*Limnodrilus* sp.	-	-	-	-
	Branchiura sowerbyi	-	-	-	-
	Unidentified spp.	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-
	Aulophorus sp.	-	-	-	-
	Dero sp.	-	-	-	-
	Pristina sp.	-	-	-	-
	Unidentified spp.	-	-	-	-
Lumbricidae		-	-	-	-
Hirudinea		-	-	-	-
	TOTAL (Annelida)	-	-	-	-
ARTHROPODA					
CRUSTACEA					
Cladocera	*Daphnia* sp.	19.1	(4.0)	-	-
	Ceriodaphnia sp.	-	-	-	-
	Iliocryptus sp.	47.6	(10.0)	-	-
Ostracoda		-	-	-	-
Copepoda	Calanoida	123.8	(26.0)	-	-
	Cyclopoida	66.7	(14.0)	-	-
	SUBTOTAL (Crustacea)	257.2	(54.0)	-	-
ARACHNIDA	Unident. watermites	38.1	(8.0)	-	-
INSECTA					
Ephemeroptera	*Caenis* sp.	-	-	-	-
	Povilla adusta	-	-	-	-
Baetidae					
	SUBTOTAL	-	-	-	-
Odonata		-	-	-	-
Anisoptera		-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-
	Notonecta sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-
Coleoptera		-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Diptera	*Chaoborus* sp.	19.1	(4.0)	4.0	(15.0)
Chironomidae	*Chironomus* sp.	-	-	-	-
	Unident. spp.	161.9	(34.0)	22.7	(85.0)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-
	SUBTOTAL	181.0	(38.0)	26.7	(100.0)
	SUBTOTAL (Insecta)	181.0	(38.0)	26.7	(100.0)
	TOTAL (Arthropoda)	476.3	(100.0)	26.7	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-
	GRAND TOTAL	476.2	100%	26.7	100%

Table 4.5 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Winter 1988

	LOCATION	STATION 1.				STATION 2.			
TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)	n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	1428.5	(27.7)	1875.1	(58.1)	47.6	(1.7)	5.4	(0.5)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	1428.5	(27.7)	1875.1	(58.1)	47.6	(1.7)	5.4	(0.5)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		47.6	(0.9)	-	-	-	-	-	-
Copepoda	Calanoida	142.9	(2.8)	-	-	-	-	-	-
	Cyclopoida	47.6	(0.9)	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	238.1	(4.6)	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	9.5	(0.2)	0.6	-	9.5	(0.3)	0.6	(0.1)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1609.4	(31.2)	354.1	(11.0)	438.1	(15.8)	96.4	(8.8)
Chironomidae	*Chironomus* sp.	1371.4	(26.6)	795.4	(24.6)	457.1	(16.4)	265.1	(24.1)
	Unident. spp.	504.7	(9.8)	201.9	(6.3)	1828.5	(65.8)	731.4	(66.6)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	3485.5	(67.5)	1351.4	(41.9)	2723.7	(97.9)	1092.9	(99.5)
	SUBTOTAL (Insecta)	3485.5	(67.5)	1351.4	(41.9)	2723.7	(97.9)	1092.9	(99.5)
	TOTAL (Arthropoda)	3733.1	(72.3)	1352.0	(41.9)	2733.2	(98.3)	1093.5	(99.5)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	5161.6	100%	3209.0	100%	2780.8	100%	1098.9	100%

	LOCATION	STATION 2.				STATION 3.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	257.1	(8.2)	334.3	(33.0)	28.6	(0.8)	37.1	(3.4)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	257.1	(8.2)	334.3	(33.0)	28.6	(0.8)	37.1	(3.4)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	19.1	(0.6)	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		28.6	(0.9)	-	-	66.7	(1.9)	-	-
Copepoda	Calanoida	9.5	(0.3)	-	-	-	-	-	-
	Cyclopoida	39.1	(1.3)	-	-	38.1	(1.1)	-	-
	SUBTOTAL (Crustacea)	96.3	(3.1)	-	-	104.8	(3.0)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	2447.5	(78.3)	538.5	(53.2)	2019.0	(57.9)	444.2	(41.0)
Chironomidae	*Chironomus* sp.	144.3	(4.6)	66.3	(6.6)	380.9	(10.9)	220.9	(20.4)
	Unident. spp.	181.0	(5.8)	72.4	(7.2)	952.3	(27.3)	380.9	(35.2)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	2772.8	(88.7)	677.2	(67.0)	3352.2	(96.2)	1046.0	(96.6)
	SUBTOTAL (Insecta)	2772.8	(88.7)	677.2	(67.0)	3352.2	(96.2)	1046.0	(96.6)
	TOTAL (Arthropoda)	2869.7	(91.8)	677.2	(67.0)	3457.0	(99.2)	1046.0	(96.6)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	3126.8	100%	1011.5	100%	3485.6	100%	1083.1	100%

	LOCATION	STATION 4.				STATION 4a.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	314.3	(8.0)	408.6	(19.5)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	314.3	(8.0)	408.6	(19.5)	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	9.5	(0.2)	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		38.1	(1.0)	-	-	-	-	-	-
Copepoda	Calanoida	38.1	(1.0)	-	-	219.0	(4.7)	-	-
	Cyclopoida	-	-	-	-	495.2	(10.5)	-	-
	SUBTOTAL (Crustacea)	85.7	(2.2)	-	-	714.2	(15.2)	-	-
ARACHNIDA	Unident. watermites	19.1	(0.5)	1.1	(0.1)	1057.1	(22.5)	63.4	(5.2)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	533.3	(13.7)	117.3	(5.6)	47.6	(1.0)	10.5	(0.9)
Chironomidae	*Chironomus* sp.	2161.8	(55.4)	1253.8	(59.8)	-	-	-	-
	Unident. spp.	790.4	(20.2)	316.2	(15.1)	2857.0	(60.9)	1142.8	(93.7)
Ceratopogonidae	*Palpomyia* sp.					19.1	(0.4)	2.9	(0.2)
	SUBTOTAL	3485.5	(89.3)	1687.3	(80.5)	2923.7	(62.3)	1156.2	(94.8)
	SUBTOTAL (Insecta)	3485.5	(89.3)	1687.3	(80.5)	2923.7	(62.3)	1156.2	(94.8)
	TOTAL (Arthropoda)	3590.3	(92.0)	1688.5	(80.5)	4695.0	(100.0)	1219.6	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	3904.6	100%	2097.0	100%	4695.0	100%	1219.6	100%

TAXON	SPECIES	STATION 5. n	(%)	DRY MASS (µg)	(%)	STATION 5a. n	(%)	DRY MASS (µg)	(%)
	LOCATION	STATION 5.				STATION 5a.			
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	47.6	(0.6)	61.9	(3.3)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	19.1	(0.3)	8.2	(0.4)	35.7	(1.7)	36.9	(7.1)
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	66.7	(0.9)	70.1	(3.7)	35.7	(1.7)	36.9	(7.1)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	47.6	(2.3)	-	-
Ostracoda		200.0	(2.6)	-	-	-	-	-	-
Copepoda	Calanoida	123.8	(1.6)	-	-	276.2	(13.2)	-	-
	Cyclopoida	114.3	(1.5)	-	-	428.6	(20.5)	-	-
	SUBTOTAL (Crustacea)	438.1	(5.7)	-	-	752.4	(36.0)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	47.6	(2.3)	2.9	(0.6)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	9.5	(0.5)	7.9	(1.5)
	SUBTOTAL	-	-	-	-	9.5	(0.5)	7.9	(1.5)
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	6285.4	(82.3)	1382.8	(73.7)	133.3	(6.4)	29.3	(5.6)
Chironomidae	*Chironomus* sp.	466.6	(6.1)	270.7	(14.4)	-	-	-	-
	Unident. spp.	380.9	(5.0)	153.4	(8.2)	1114.2	(53.2)	445.7	(85.3)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	7132.9	(93.4)	1806.9	(96.3)	1247.5	(59.6)	475.0	(90.9)
	SUBTOTAL (Insecta)	7132.9	(93.4)	1806.9	(96.3)	1257.0	(60.1)	482.9	(92.4)
	TOTAL (Arthropoda)	7571.0	(99.1)	1806.9	(96.3)	2057.0	(98.3)	485.8	(92.9)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	7637.7	100%	1877.0	100%	2092.7	100%	522.7	100%

	LOCATION	STATION 6.				STATION 7.			
				DRY MASS				DRY MASS	
TAXON	SPECIES	n	(%)	(μg)	(%)	n	(%)	(μg)	(%)
NEMATODA		9.5	(0.4)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	28.6	(1.1)	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	19.1	(0.7)	-	-
Copepoda	Calanoida	47.6	(2.1)	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	47.6	(2.1)	-	-	47.7	(1.8)	-	-
ARACHNIDA	Unident. watermites	9.5	(0.4)	0.6	(0.1)	9.5	(0.4)	0.6	(0.1)
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		9.5	(0.4)	7.9	(0.9)	-	-	-	-
	SUBTOTAL	9.5	(0.4)	7.9	(0.9)	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	19.1	(0.8)	6.7	(0.8)	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	19.1	(0.8)	6.7	(0.8)	-	-	-	-
Diptera	*Chaoborus* sp.	371.4	(16.3)	81.7	(9.4)	2047.5	(76.8)	450.5	(61.6)
Chironomidae	*Chironomus* sp.	247.6	(10.8)	143.6	(16.6)	352.4	(13.2)	204.4	(27.9)
	Pentaneura sp.	9.5	(0.4)	-	-	19.1	(0.7)	-	-
	Unident. spp.	1561.8	(68.3)	624.7	(72.2)	190.5	(7.1)	76.2	(10.4)
	SUBTOTAL	2190.3	(95.8)	850.0	(98.2)	2609.5	(97.9)	731.1	(99.9)
	SUBTOTAL (Insecta)	2218.9	(97.1)	864.6	(99.9)	2609.5	(97.9)	731.1	(99.9)
	TOTAL (Arthropoda)	2276.0	(99.6)	865.2	(100.0)	2666.7	(100.0)	731.7	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	2285.5	100%	865.2	100%	2666.7	100%	731.7	100%

TAXON	SPECIES	STATION 8. n	STATION 8. (%)	STATION 8. DRY MASS (µg)	STATION 8. (%)	STATION 9. n	STATION 9. (%)	STATION 9. DRY MASS (µg)	STATION 9. (%)
BRYOZOA		9.5	(0.9)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	257.1	(23.3)	334.3	(56.1)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	9.5	(0.9)	-	-	19.1	(1.0)	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	266.6	(24.1)	334.3	(56.1)	19.1	(1.0)	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	9.5	(0.5)	-	-
	Macrothrix sp.	-	-	-	-	19.1	(1.0)	-	-
Ostracoda		-	-	-	-	9.5	(0.5)	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	76.2	(6.9)	-	-	19.1	(1.0)	-	-
	SUBTOTAL (Crustacea)	76.2	(6.9)	-	-	57.2	(3.0)	-	-
ARACHNIDA	Unident. watermites	19.1	(1.7)	1.1	(0.2)	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	9.5	(0.9)	3.3	(0.6)	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	9.5	(0.9)	3.3	(0.6)	-	-	-	-
Diptera	*Chaoborus* sp.	276.2	(25.0)	60.8	(10.2)	1371.4	(72.0)	301.7	(59.9)
Chironomidae	*Chironomus* sp.	47.6	(4.3)	27.6	(4.6)	104.8	(5.5)	60.8	(12.1)
	Unident. spp.	390.5	(35.3)	156.2	(26.2)	352.4	(18.5)	141.0	(28.0)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	714.3	(64.7)	244.6	(41.1)	1828.6	(96.0)	503.5	(100.0)
	SUBTOTAL (Insecta)	723.8	(65.5)	247.9	(41.6)	1828.6	(96.0)	503.5	(100.0)
	TOTAL (Arthropoda)	819.1	(74.1)	249.0	(41.8)	1885.8	(99.0)	503.5	(100.0)
GASTROPODA	*Ferrissia* sp.	9.5	(0.9)	12.4	(2.1)	-	-	-	-
	TOTAL (Gastropoda)	9.5	(0.9)	12.4	(2.1)	-	-	-	-
	GRAND TOTAL	1104.7	100%	595.7	100%	1904.9	100%	503.5	100%

	LOCATION	STATION 10.				STATION 11.			
TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)	n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	9.5	(3.1)	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	9.5	(3.1)	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	9.5	(1.0)	-	-	85.7	(28.1)	-	-
	Macrothrix sp.	-	-	-	-	9.5	(3.1)	-	-
Ostracoda		47.6	(4.9)	-	-	38.1	(12.5)	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	95.2	(31.2)	-	-
	SUBTOTAL (Crustacea)	57.1	(5.8)	-	-	228.5	(75.0)	-	-
ARACHNIDA	Unident. watermites	9.5	(1.0)	0.6	(0.3)	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	780.9	(79.6)	171.8	(76.1)	-	-	-	-
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	133.3	(13.6)	53.3	(23.6)	66.7	(21.9)	26.7	(100.0)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	914.2	(93.2)	225.1	(99.8)	66.7	(21.9)	26.7	(100.0)
	SUBTOTAL (Insecta)	914.2	(93.2)	225.1	(99.8)	66.7	(21.9)	26.7	(100.0)
	TOTAL (Arthropoda)	980.8	(100.0)	225.7	(100.0)	295.2	(96.9)	26.7	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	980.8	100%	225.7	100%	304.7	100%	26.7	100%

TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)
	LOCATION	STATION 11a.			
NEMATODA		-	-	-	-
ANNELIDA					
Tubificidae	*Limnodrilus* sp.	-	-	-	-
	Branchiura sowerbyi	-	-	-	-
	Unidentified spp.	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-
	Aulophorus sp.	-	-	-	-
	Dero sp.	-	-	-	-
	Pristina sp.	228.6	(7.6)	98.3	(11.2)
	Unidentified spp.	-	-	-	-
Lumbricidae		-	-	-	-
Hirudinea		-	-	-	-
	TOTAL (Annelida)	228.6	(7.6)	98.3	(11.2)
ARTHROPODA					
CRUSTACEA					
Cladocera	*Daphnia* sp.	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-
	Iliocryptus sp.	19.1	(0.6)	-	-
Ostracoda		28.6	(1.0)	-	-
Copepoda	Calanoida	38.1	(1.3)	-	-
	Cyclopoida	390.5	(13.1)	-	-
	SUBTOTAL (Crustacea)	476.3	(15.9)	-	-
ARACHNIDA	Unident. watermites	380.9	(12.7)	22.9	(2.6)
INSECTA					
Ephemeroptera	*Caenis* sp.	-	-	-	-
	Povilla adusta	-	-	-	-
Baetidae		104.8	(3.5)	87.0	(9.9)
	SUBTOTAL	104.8	(3.5)	87.0	(9.9)
Odonata		-	-	-	-
Anisoptera		-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-
	Notonecta sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-
Coleoptera		-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Diptera	*Chaoborus* sp.	57.1	(1.9)	12.6	(1.4)
Chironomidae	*Chironomus* sp.	-	-	-	-
	Unident. spp.	1580.9	(52.9)	632.4	(72.1)
Ceratopogonidae	*Palpomyia* sp.	161.9	(5.4)	24.3	(2.8)
	SUBTOTAL	1799.9	(60.2)	669.3	(76.3)
	SUBTOTAL (Insecta)	1904.7	(63.7)	756.3	(86.2)
	TOTAL (Arthropoda)	2761.9	(92.4)	779.2	(88.8)
GASTROPODA	*Ferrissia* sp.	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-
-	GRAND TOTAL	2990.5	100%	877.5	100%

Table 4.6 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Spring 1988

TAXON	LOCATION / SPECIES	STATION 1. n	(%)	DRY MASS (µg)	(%)	STATION 2. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	57.1	(7.1)	58.9	(32.0)	-	-	-	-
	Unidentified spp.	19.1	(2.4)	5.0	(2.7)	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	76.2	(9.5)	63.8	(34.7)	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	19.1	(2.4)	-	-	-	-	-	-
	Cyclopoida	66.7	(8.3)	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	85.8	(10.7)	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	28.6	(3.6)	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	600.0	(75.0)	120.0	(65.3)	2238.0	(100.0)	447.6	(100.0)
Chironomidae	*Pentaneura* sp.	9.5	(1.2)	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	609.5	(76.2)	120.0	(65.3)	2238.0	(100.0)	447.6	(100.0)
	SUBTOTAL (Insecta)	609.5	(76.2)	120.0	(65.3)	2238.0	(100.0)	447.6	(100.0)
	TOTAL (Arthropoda)	723.9	(90.5)	120.0	(65.3)	2238.0	(100.0)	447.6	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	800.1	100%	183.9	100%	2238.0	100%	447.6	100%

TAXON	SPECIES	STATION 2. n	(%)	DRY MASS (µg)	(%)	STATION 3. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	9.5	(1.0)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	619.0	(35.5)	637.6	(76.5)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	619.0	(35.5)	637.6	(76.5)	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	9.5	(0.5)	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		9.5	(0.5)	-	-	38.1	(3.9)	-	-
Copepoda	Calanoida	38.1	(2.2)	-	-	38.1	(3.9)	-	-
	Cyclopoida	85.7	(4.9)	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	142.8	(8.2)	-	-	76.2	(7.8)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	980.9	(56.3)	196.2	(23.5)	857.1	(88.2)	171.4	(98.4)
Chironomidae	*Chironomus* sp.	-	-	-	-	19.1	(2.0)	1.9	(1.1)
	Unident. spp.	-	-	-	-	9.5	(1.0)	0.8	(0.5)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	980.9	(56.3)	196.2	(23.5)	885.7	(91.2)	174.1	(100.0)
	SUBTOTAL (Insecta)	980.9	(56.3)	196.2	(23.5)	885.7	(91.2)	174.1	(100.0)
	TOTAL (Arthropoda)	1123.7	(64.5)	196.2	(23.5)	961.9	(99.0)	174.1	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1742.7	100%	833.8	100%	971.4	100%	174.1	100%

	LOCATION	STATION 4.				STATION 4a.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	371.4	(30.5)	382.6	(21.4)	19.1	(3.5)	19.6	(72.9)
	Unidentified spp.	83.7	(6.9)	22.3	(1.2)	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	9.5	(1.7)	1.0	(3.7)
	Annelid cocoons	19.1	(1.6)	-	-	-	-	-	-
	TOTAL (Annelida)	474.2	(39.0)	404.9	(22.6)	28.6	(5.3)	20.6	(76.6)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	9.5	(0.8)	-	-	-	-	-	
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		9.5	(0.8)	-	-	19.1	(3.5)	-	-
Copepoda	Calanoida	-	-	-	-	57.1	(10.5)	-	-
	Cyclopoida	9.5	(0.8)	-	-	190.5	(35.1)	-	-
	SUBTOTAL (Crustacea)	28.5	(2.3)	-	-	266.7	(49.1)	-	-
ARACHNIDA	Unident. watermites	95.2	(7.8)	-	-	171.4	(31.6)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-				
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae						9.5	(1.7)	1.0	(3.7)
	SUBTOTAL	-	-	-	-	9.5	(1.7)	1.0	(3.7)
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	133.3	(11.0)	26.7	(1.5)	-	-	-	-
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	419.0	(34.4)	33.5	(1.9)	66.7	(12.3)	5.3	(19.7)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	552.3	(45.4)	60.2	(3.4)	66.7	(12.3)	5.3	(19.7)
	SUBTOTAL (Insecta)	552.3	(45.4)	60.2	(3.4)	76.2	(14.0)	6.3	(23.4)
	TOTAL (Arthropoda)	676.2	(55.6)	60.2	(3.4)	514.3	(94.7)	6.3	(23.4)
GASTROPODA	Unident. spp.	66.7	(5.5)	1323.2	(74.0)	-	-	-	-
	TOTAL (Gastropoda)	66.7	(5.5)	1323.2	(74.0)	-	-	-	-
	GRAND TOTAL	1216.9	100%	1788.3	100%	542.9	100%	26.9	100%

	LOCATION	STATION 5.				STATION 5a.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		47.6	(5.0)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	28.6	(3.0)	29.4	(16.4)	38.1	(11.8)	39.2	(71.0)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	247.6	(26.0)	32.2	(18.0)	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	276.2	(29.0)	61.6	(34.5)	38.1	(11.8)	39.2	(71.0)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		38.1	(4.0)	-	-	66.7	(20.6)	-	-
Copepoda	Calanoida	-	-	-	-	19.1	(5.9)	-	-
	Cyclopoida	-	-	-	-	47.6	(14.7)	-	-
	SUBTOTAL (Crustacea)	38.1	(4.0)	-	-	133.4	(41.2)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	38.1	(11.8)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	580.9	(61.0)	116.2	(65.0)	57.1	(17.6)	11.4	(20.7)
Chironomidae	*Chironomus* sp.	9.5	(1.0)	1.0	(0.6)	-	-	-	-
	Unident. spp.	-	-	-	-	57.1	(17.6)	4.6	(8.3)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	590.4	(62.0)	117.2	(65.5)	114.2	(35.3)	16.0	(29.0)
	SUBTOTAL (Insecta)	590.4	(62.0)	117.2	(65.5)	114.2	(35.3)	16.0	(29.0)
	TOTAL (Arthropoda)	628.5	(66.0)	117.2	(65.5)	285.7	(88.2)	16.0	(29.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	952.3	100%	178.8	100%	323.8	100%	55.2	100%

TAXON	SPECIES	STATION 6. n	(%)	DRY MASS (μg)	(%)	STATION 7. n	(%)	DRY MASS (μg)	(%)
	LOCATION								
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-						
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		9.5	(4.2)	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	9.5	(4.2)	-	-	-	-	-	-
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		9.5	(4.2)	-	-	-	-	-	-
Copepoda	Calanoida	9.5	(4.2)	-	-	114.3	(21.4)	-	-
	Cyclopoida	114.3	(50.0)	-	-	361.9	(67.8)	-	-
	SUBTOTAL (Crustacea)	133.3	(58.3)	-	-	476.2	(89.3)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	19.1	(3.6)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	57.1	(25.0)	11.4	(88.4)	38.1	(7.1)	7.6	(100.0)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	19.1	(8.4)	1.5	(11.6)	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	9.5	(4.2)	-	-	-	-	-	-
	SUBTOTAL	85.7	(37.5)	12.9	(100.0)	38.1	(7.1)	7.6	(100.0)
	SUBTOTAL (Insecta)	85.7	(37.5)	12.9	(100.0)	38.1	(7.1)	7.6	(100.0)
	TOTAL (Arthropoda)	219.0	(95.8)	12.9	(100.0)	533.4	(100.0)	7.6	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	228.5	100%	12.9	100%	533.4	100%	7.6	100%

TAXON	SPECIES	STATION 8. n	(%)	DRY MASS (µg)	(%)	STATION 9. n	(%)	DRY MASS (µg)	(%)
NEMATODA		9.5	(2.1)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	38.1	(8.5)	39.2	(63.4)	-	-	-	-
	Unidentified spp.	-	-	-	-	19.1	(2.3)	5.0	(4.1)
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	19.1	(2.3)	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	9.5	(2.1)	1.2	(1.9)	9.5	(1.1)	1.2	(1.0)
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	47.6	(10.6)	40.4	(65.4)	47.7	(5.6)	6.2	(5.0)
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		66.7	(14.9)	-	-	123.8	(14.6)	-	-
Copepoda	Calanoida	85.7	(19.1)	-	-	-	-	-	-
	Cyclopoida	104.8	(23.4)	-	-	66.7	(7.9)	-	-
	SUBTOTAL (Crustacea)	257.2	(57.5)	-	-	109.5	(22.5)	-	-
ARACHNIDA	Unident. watermites	9.5	(2.1)	-	-	9.5	(1.1)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	95.2	(21.3)	19.1	(30.9)	571.4	(67.4)	114.3	(92.9)
Chironomidae	*Chironomus* sp.	-	-	-		9.5	(1.1)	1.0	(0.8)
	Unident. spp.	28.6	(6.4)	2.3	(3.7)	19.1	(2.3)	1.5	(1.2)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	123.8	(27.7)	21.4	(34.6)	600.0	(70.8)	116.8	(95.0)
	SUBTOTAL (Insecta)	123.8	(27.7)	21.4	(34.5)	600.0	(70.8)	116.8	(95.0)
	TOTAL (Arthropoda)	390.5	(87.2)	21.4	(34.6)	800.0	(94.4)	116.8	(95.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	447.6	100%	61.8	100%	847.7	100%	123.0	100%

	LOCATION	STATION 10.				STATION 11.			
TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)	n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	9.5	(2.5)	1.0	(3.4)
	TOTAL (Annelida)	-	-	-	-	9.5	(2.5)	1.0	(3.4)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	180.9	(47.5)	-	-
Copepoda	Calanoida	209.5	(11.8)	-	-	-	-	-	-
	Cyclopoida	514.3	(29.0)	-	-	38.1	(10.0)	-	-
	SUBTOTAL (Crustacea)	723.8	(40.9)	-	-	219.0	(57.5)	-	-
ARACHNIDA	Unident. watermites	9.5	(0.5)	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1000.0	(56.5)	200.0	(98.5)	133.3	(35.0)	26.7	(91.4)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	38.1	(2.2)	3.1	(1.5)	19.1	(5.0)	1.5	(5.1)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1038.1	(58.6)	203.1	(100.0)	152.4	(40.0)	28.2	(96.6)
	SUBTOTAL (Insecta)	1038.1	(58.6)	203.1	(100.0)	152.4	(40.0)	28.2	(96.6)
	TOTAL (Arthropoda)	1771.4	(100.0)	203.1	(100.0)	371.4	(97.5)	28.2	(96.6)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1771.4	100%	203.1	100%	380.9	100%	29.1	100%

	LOCATION	STATION 11a.			
				DRY MASS	
TAXON	SPECIES	n	(%)	(μg)	(%)
NEMATODA		-	-	-	-
ANNELIDA					
Tubificidae	*Limnodrilus* sp.	-	-	-	-
	Branchiura sowerbyi	-	-	-	-
	Unidentified spp.	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-
	Aulophorus sp.	-	-	-	-
	Dero sp.	-	-	-	-
	Pristina sp.	-	-	-	-
	Unidentified spp.	-	-	-	-
Lumbricidae		-	-	-	-
Hirudinea		-	-	-	-
	TOTAL (Annelida)	-	-	-	-
ARTHROPODA					
CRUSTACEA					
Cladocera	*Daphnia* sp.	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-
	Iliocryptus sp.	-	-	-	-
Ostracoda		38.1	(12.9)	-	-
Copepoda	Calanoida	9.5	(3.2)	-	-
	Cyclopoida	38.1	(12.9)	-	-
	SUBTOTAL (Crustacea)	85.7	(29.0)	-	-
ARACHNIDA	Unident. watermites	142.9	(48.4)	-	-
INSECTA					
Ephemeroptera	*Caenis* sp.	-	-	-	-
	Povilla adusta	-	-	-	-
Baetidae					
	SUBTOTAL	-	-	-	-
Odonata		-	-	-	-
Anisoptera		-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-
	Notonecta sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-
Coleoptera		-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Diptera	*Chaoborus* sp.	57.1	(19.3)	11.4	(93.4)
Chironomidae	*Chironomus* sp.	-	-	-	-
	Unident. spp.	9.5	(3.2)	0.8	(6.6)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-
	SUBTOTAL	66.6	(22.6)	12.2	(100.0)
	SUBTOTAL (Insecta)	66.6	(22.6)	12.2	(100.0)
	TOTAL (Arthropoda)	295.2	(100.0)	12.2	(100.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-
	GRAND TOTAL	295.2	100%	12.2	100%

Table 4.7 Seasonal zoobenthos (numbers and biomass) of Middle Letaba Dam: Summer 1989

	LOCATION	STATION 1.				STATION 2.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	200.0	(10.6)	690.0	(51.5)	200.0	(14.3)	690.0	(76.4)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	200.0	(10.6)	690.0	(51.5)	200.0	(14.3)	690.0	(76.4)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	19.1	(1.4)	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	19.1	(1.4)	-	-
ARACHNIDA	Unident. watermites	19.1	(1.0)	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1666.6	(87.9)	300.0	(22.4)	390.5	(27.9)	70.3	(7.8)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	790.4	(56.5)	142.3	(15.8)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1666.6	(87.9)	300.0	(22.4)	1180.9	(84.4)	212.6	(23.6)
	SUBTOTAL (Insecta)	1666.6	(87.9)	300.0	(22.4)	1180.9	(84.4)	212.6	(23.6)
	TOTAL (Arthropoda)	1685.7	(88.9)	300.0	(22.4)	1200.0	(85.7)	212.6	(23.6)
GASTROPODA	Unident. sp.	9.5	(0.5)	349.4	(26.1)	-	-	-	-
	TOTAL (Gastropoda)	9.5	(0.5)	349.4	(26.1)	-	-	-	-
	GRAND TOTAL	1895.2	100%	1339.4	100%	1400.0	100%	902.6	100%

LOCATION		STATION 2.				STATION 3.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATOMORPHA		-	-	-	-	9.5	(0.3)	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	238.1	(4.8)	821.4	(40.7)	9.5	(0.3)	32.8	(6.3)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	238.1	(4.8)	821.4	(40.7)	9.5	(0.3)	32.8	(6.3)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	19.1	(0.7)	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	19.1	(0.7)	-	-
ARACHNIDA	Unident. watermites	38.1	(0.8)	-	-	9.5	(0.3)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	4704.5	(94.3)	846.8	(42.0)	2723.7	(98.3)	490.3	(93.7)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	4704.5	(94.3)	846.8	(42.0)	2723.7	(98.3)	490.3	(93.7)
	SUBTOTAL (Insecta)	4704.5	(94.3)	846.8	(42.0)	2723.7	(98.3)	490.3	(93.7)
	TOTAL (Arthropoda)	4742.6	(95.0)	846.8	(42.0)	2752.2	(99.3)	490.3	(93.7)
GASTROPODA	Unident. sp.	9.5	(0.2)	349.4	(17.3)	-	-	-	-
	TOTAL (Gastropoda)	9.5	(0.2)	349.4	(17.3)	-	-	-	-
	GRAND TOTAL	4990.2	100%	2017.6	100%	2771.3	100%	523.1	100%

TAXON	SPECIES (LOCATION)	STATION 4. n	(%)	DRY MASS (µg)	(%)	STATION 4a. n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	400.0	(33.1)	1379.9	(94.0)	238.1	(26.6)	821.4	(94.6)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	400.0	(33.1)	1379.9	(94.0)	238.1	(26.6)	821.4	(94.6)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	9.5	(0.8)	-	-	38.1	(4.3)	-	-
	Cyclopoida	266.7	(22.1)	-	-	95.2	(10.6)	-	-
	SUBTOTAL (Crustacea)	276.2	(22.8)	-	-	133.3	(14.9)	-	-
ARACHNIDA	Unident. watermites	47.6	(3.9)	-	-	257.1	(28.7)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	9.5	(1.1)	1.0	(0.1)
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	9.5	(1.1)	1.0	(0.1)
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	476.2	(39.4)	85.7	(5.8)	209.5	(23.4)	37.7	(4.3)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	9.5	(0.8)	1.7	(0.1)	47.6	(5.3)	8.6	(1.0)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	485.7	(40.2)	87.4	(6.0)	257.1	(28.7)	46.3	(5.3)
	SUBTOTAL (Insecta)	485.7	(40.2)	87.4	(6.0)	266.6	(29.8)	47.3	(5.4)
	TOTAL (Arthropoda)	809.5	(66.9)	87.4	(6.0)	657.0	(73.4)	47.3	(5.4)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1209.5	100%	1467.3	100%	895.1	100%	868.7	100%

LOCATION		STATION 5.				STATION 5a.			
TAXON	SPECIES	n	(%)	DRY MASS (µg)	(%)	n	(%)	DRY MASS (µg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	447.6	(23.6)	1544.2	(88.1)	504.7	(48.6)	1741.4	(97.1)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	447.6	(23.6)	1544.2	(88.1)	504.7	(48.6)	1741.4	(97.1)
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	38.1	(2.0)	-	-	85.7	(8.3)	-	-
	Cyclopoida	123.8	(6.5)	-	-	142.9	(13.8)	-	-
	SUBTOTAL (Crustacea)	161.9	(8.5)	-	-	228.6	(22.0)	-	-
ARACHNIDA	Unident. watermites	123.8	(6.5)	-	-	19.1	(1.8)	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1152.3	(60.8)	207.4	(11.8)	152.4	(14.7)	27.4	(1.5)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	9.5	(0.5)	1.7	(0.1)	133.3	(12.8)	24.0	(1.3)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1161.8	(61.3)	209.1	(11.9)	285.7	(27.5)	51.4	(2.9)
	SUBTOTAL (Insecta)	1161.8	(61.3)	209.1	(11.9)	285.7	(27.5)	51.4	(2.9)
	TOTAL (Arthropoda)	1447.5	(76.4)	209.1	(11.9)	533.4	(51.4)	51.4	(2.9)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1895.1	100%	1753.3	100%	1038.1	100%	1792.8	100%

TAXON	SPECIES	STATION 6. n	(%)	DRY MASS (μg)	(%)	STATION 7. n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	85.7	(4.1)	295.7	(45.2)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	85.7	(4.1)	295.7	(45.2)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	1504.7	(100.0)	270.8	(100.0)	1990.4	(95.9)	358.3	(54.8)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1504.7	(100.0)	270.8	(100.0)	1990.4	(95.9)	358.3	(54.8)
	SUBTOTAL (Insecta)	1504.7	(100.0)	270.8	(100.0)	1990.4	(95.9)	358.3	(54.8)
	TOTAL (Arthropoda)	1504.7	(100.0)	270.8	(100.0)	1990.4	(95.9)	358.3	(54.8)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1504.7	100%	270.8	100%	2076.1	100%	654.0	100%

	LOCATION	STATION 8.				STATION 9.			
TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)	n	(%)	DRY MASS (μg)	(%)
NEMATODA		-	-	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	47.6	(4.4)	164.3	(47.1)	76.2	(16.0)	262.9	(78.5)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	47.6	(4.4)	164.3	(47.1)	76.2	(16.0)	262.9	(78.5)
ARTHROPODA									
CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		-	-	-	-	-	-	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-	-	-	-	-
ARACHNIDA	Unident. watermites	9.5	(0.9)	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	9.5	(0.9)	1.0	(0.3)	-	-	-	-
Baetidae		-	-	-	-	-	-	-	-
	SUBTOTAL	9.5	(0.9)	1.0	(0.3)	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	885.7	(81.6)	159.4	(45.7)	400.0	(84.0)	72.0	(21.5)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	133.3	(12.3)	24.0	(6.9)	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	1019.0	(93.9)	183.4	(52.6)	400.0	(84.0)	72.0	(21.5)
	SUBTOTAL (Insecta)	1028.5	(94.7)	184.4	(52.9)	400.0	(84.0)	72.0	(21.5)
	TOTAL (Arthropoda)	1038.0	(95.6)	184.4	(52.9)	400.0	(84.0)	72.0	(21.5)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	1085.6	100%	348.7	100%	476.2	100%	334.9	100%

TAXON	LOCATION SPECIES	STATION 10. n	(%)	DRY MASS (μg)	(%)	STATION 11. n	(%)	DRY MASS (μg)	(%)
NEMATODA		9.5	(1.3)	-	-	-	-	-	-
ANNELIDA									
Tubificidae	*Limnodrilus* sp.	-	-	-	-	-	-	-	-
	Branchiura sowerbyi	-	-	-	-	152.4	(16.8)	525.7	(79.9)
	Unidentified spp.	-	-	-	-	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-	-	-	-	-
	Aulophorus sp.	-	-	-	-	-	-	-	-
	Dero sp.	-	-	-	-	-	-	-	-
	Pristina sp.	-	-	-	-	-	-	-	-
	Unidentified spp.	-	-	-	-	-	-	-	-
Lumbricidae		-	-	-	-	-	-	-	-
Hirudinea		-	-	-	-	-	-	-	-
	TOTAL (Annelida)	-	-	-	-	152.4	(16.8)	525.7	(79.9)
ARTHROPODA CRUSTACEA									
Cladocera	*Daphnia* sp.	-	-	-	-	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-	-	-	-	-
	Iliocryptus sp.	-	-	-	-	-	-	-	-
Ostracoda		114.3	(15.2)	-	-	19.1	(2.1)	-	-
Copepoda	Calanoida	-	-	-	-	-	-	-	-
	Cyclopoida	-	-	-	-	-	-	-	-
	SUBTOTAL (Crustacea)	114.3	(15.2)	-	-	19.1	(2.1)	-	-
ARACHNIDA	Unident. watermites	-	-	-	-	-	-	-	-
INSECTA									
Ephemeroptera	*Caenis* sp.	-	-	-	-	-	-	-	-
	Povilla adusta	-	-	-	-	-	-	-	-
Baetidae									
	SUBTOTAL	-	-	-	-	-	-	-	-
Odonata		-	-	-	-	-	-	-	-
Anisoptera		-	-	-	-	-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-	-	-	-	-
	Notonecta sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-	-	-	-	-
Coleoptera		-	-	-	-	-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	-	-	-	-	-	-	-	-
Diptera	*Chaoborus* sp.	628.5	(83.5)	113.1	(100.0)	733.3	(81.0)	132.0	(20.1)
Chironomidae	*Chironomus* sp.	-	-	-	-	-	-	-	-
	Unident. spp.	-	-	-	-	-	-	-	-
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-	-	-	-	-
	SUBTOTAL	628.5	(83.5)	113.1	(100.0)	733.3	(81.0)	132.0	(20.1)
	SUBTOTAL (Insecta)	628.5	(83.5)	113.1	(100.0)	733.3	(81.0)	132.0	(20.1)
	TOTAL (Arthropoda)	742.8	(98.7)	113.1	(100.0)	752.4	(83.2)	132.0	(20.1)
GASTROPODA	*Ferrissia* sp.	-	-	-	-	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-	-	-	-	-
	GRAND TOTAL	752.3	100%	113.1	100%	904.8	100%	657.7	100%

TAXON	SPECIES	n	(%)	DRY MASS (μg)	(%)
LOCATION		STATION 11a.			
NEMATODA		-	-	-	-
ANNELIDA					
Tubificidae	*Limnodrilus* sp.	-	-	-	-
	Branchiura sowerbyi	57.1	(17.7)	197.1	(81.0)
	Unidentified spp.	-	-	-	-
Naididae	*Chaetogaster* sp.	-	-	-	-
	Aulophorus sp.	-	-	-	-
	Dero sp.	-	-	-	-
	Pristina sp.	-	-	-	-
	Unidentified spp.	-	-	-	-
Lumbricidae		-	-	-	-
Hirudinea		-	-	-	-
	TOTAL (Annelida)	57.1	(17.7)	197.1	(81.0)
ARTHROPODA CRUSTACEA					
Cladocera	*Daphnia* sp.	-	-	-	-
	Ceriodaphnia sp.	-	-	-	-
	Iliocryptus sp.	-	-	-	-
Ostracoda		-	-	-	-
Copepoda	Calanoida	-	-	-	-
	Cyclopoida	-	-	-	-
	SUBTOTAL (Crustacea)	-	-	-	-
ARACHNIDA	Unident. watermites	9.5	(2.9)	-	-
INSECTA					
Ephemeroptera	*Caenis* sp.	-	-	-	-
	Povilla adusta	-	-	-	-
Baetidae					
	SUBTOTAL	-	-	-	-
Odonata		-	-	-	-
Anisoptera		-	-	-	-
Hemiptera	*Trepobates* sp.	-	-	-	-
	Notonecta sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Trichoptera	*Orthotrichia* sp.	-	-	-	-
Coleoptera		-	-	-	-
Dytiscidae	*Berosus* sp.	-	-	-	-
	SUBTOTAL	-	-	-	-
Diptera	*Chaoborus* sp.	152.4	(47.1)	27.4	(11.3)
Chironomidae	*Chironomus* sp.	-	-	-	-
	Unident. spp.	104.8	(32.4)	18.9	(7.8)
Ceratopogonidae	*Palpomyia* sp.	-	-	-	-
	SUBTOTAL	257.2	(79.4)	46.3	(19.0)
	SUBTOTAL (Insecta)	257.2	(79.4)	46.3	(19.0)
	TOTAL (Arthropoda)	266.7	(82.4)	46.3	(19.0)
GASTROPODA	*Ferrissia* sp.	-	-	-	-
	TOTAL (Gastropoda)	-	-	-	-
	GRAND TOTAL	323.8	100%	243.4	100%

CHAPTER 5

PAGE

THE UTILIZATION OF THE BENTHIC MACRO-INVERTEBRATE FAUNA AS FOOD BY FISH SPECIES IN THE MIDDLE LETABA IMPOUNDMENT

5.1 Introduction

Little attention was given to the benthic macro-invertebrate fauna of inland lakes and impoundments in past limnological studies in South Africa. This is especially so when it comes to a correlation between macro-invertebrate occurrence, densities and fish dietary habits. Roode (1967) conducted a survey of the benthic macro-invertebrate fauna of Baberspan in the Western Transvaal concurrently with a fish ecological study by Göldner (1967). Mulder (1969) investigated the benthic fauna of Loskop Dam, Eastern Transvaal. This particular study coincided with an ecological survey of the fish fauna which included dietary analysis (Göldner, 1969; Göldner, Schoonbee and Vermeulen, 1972).

In recent years comprehensive studies were undertaken on the limnology and fisheries potential of Lake Le Roux (Allanson and Jackson, 1983) and on the Renosterkop Dam, Eastern Transvaal (Heath, Jarvis, Zohary, Robarts, Sephton, Pais Madeira, Combrink, Herbst and Swanepoel, 1989). In both the latter investigations little attention was given to the importance of the benthic macro-invertebrate fauna as a potential nutrient source for fish. In fact, Allanson and Jackson (1983) stated that the zoobenthos appeared to be a relatively minor forage component for fish in Lake Le Roux compared to the zooplankton. Heath, *et al.*, (1989) also came to a similar conclusion by stating that the benthic faunal community of Renosterkop Dam is less important as fish food than the macro-invertebrates inhabiting the macrophyte beds.

During the present study on the dietary habits of the larger as well as smaller fish species in the Middle Letaba Impoundment it is conclusively demonstrated that the benthic macro-invertebrates do form an important component of the dietary budget of a number of fish species.

5.2 Utilization of macro-invertebrates as food by the larger fish species

The diet of *Oreochromis mossambicus* and other closely related tilapia species have been researched in their natural habitats (Le Roux, 1956; Harbot, 1975; Bowen, 1976, 1979; Spataru, 1978; Fagade, 1982, El Safi, Haridi and Rabaa, 1985; De Moor, Wilkinson and Herbst, 1986). This is also the case with *Clarias gariepinus* (Corbet, 1961; Groenewald, 1964a; Schoonbee, 1969; Van der Waal, 1972, 1976; Bruton, 1977; Willoughby and Tweddle, 1978; Clay, 1981; Hyslop, 1987; Spataru, Viveen and Gophen, 1987). However, little is known about the natural diets of *Labeo ruddi, Labeo molybdinus, Labeo cylindricus* and *Barbus marequensis*. Although the basic diet of *O. mossambicus* (herbivore) and that of *C. gariepinus* (omnivore with carnivorous tendencies) is well documented in the literature, it was still considered necessary to investigate their feeding ecology as the two pioneer fish species in the Middle Letaba Dam. Attention was also given to the feeding ecology of various *Labeo* species and of *B. marequensis*. The details of food habits, seasonal variations in dietary items and changes in their feeding habits were dealt with.

The investigations were done during each season of 1988. A total of 288 *O. mossambicus*, 155 *C. gariepinus* and 136 *L. ruddi* were examined during the period of investigation. The nets were emptied at two-hourly intervals over a period of 24 hours, and the collected fish were transported back to the field laboratory. At the field laboratory the fish were divided into five centimeter length groups. The selected specimens were weighed, their total lengths recorded, and then cut open ventrally, from the cloaca, past the pectoral fins. The entire gut was then removed from the oesophagus to the cloaca, and gut length recorded. The stomach was then separated from the rest of the gut, and the mass of the stomach and its contents was determined to the nearest 0,01g on an electronic microbalance.

The stomach was then stripped of its contents, and the empty mass of the stomach was determined. The intestine and rectum were also stripped of their contents. The stomach, intestine and rectum contents were preserved separately in 10 percent formalin for later analysis. The various sections of the gut contents were inspected microscopically, using a Wild stereo-microscope, and the dietary items were identified using Jahn and Jahn (1949), Smith (1950), Pennack (1953), Usinger (1956), Edmondson (1959) and Scholtz and Holm (1985). Gut contents of individual fish were subsampled using a selectivity petri dish grid and were analysed using the frequency of occurrence method, where the number of stomachs in which each food item occurred was expressed as a percentage of the total number of stomachs examined (Hynes, 1950; Okach and Dadzie, 1988), and the numerical method as described by Hyslop (1980).

5.2.1 *Oreochromis mossambicus*

The following macro-invertebrate organisms formed part of the dietary items:

Class :	Crustacea
Order :	Cladocera
	Daphnia sp.
Order :	Cyclopoida
Order :	Calanoida

Small amounts of *Daphnia* sp., Cyclopoida and Calanoida were present in the gut contents of all length groups of *O. mossambicus* specimens examined throughout the sampling period, their percentage values, however, being insignificant when compared to other dietary items.

Items which formed the bulk of the diet of *O. mossambicus* included detritus, sand, vascular plants, filamentous algae, phytoplankton and Rotifera (zooplankton). When the diets of the various size ranges of *O. mossambicus* recorded in the literature from different water bodies are compared, it is clear that this fish species is able to consume a great variety of food items, dictated to by their availability and abundance under different environmental conditions.

5.2.2 *Clarias gariepinus*

Groenewald (1964a) and Mulder (1971) considered *C. gariepinus* to be a predator whilst researchers such as Schoonbee (1969), Van der Waal (1972;1976) and Bruton (1977) view this fish as omnivorous with opportunistic feeding habits. The views held in the present study support those of the latter researchers. The following formed the dietary items: detritus, vascular plants, Arthropoda, Mollusca and fish. Of the various arthropod members which formed part of the benthic macro-invertebrate fauna of the Middle Letaba Impoundment, the following occurred in the diet of *C. gariepinus*:

Class :	Crustacea
Order :	Cladocera
	Daphnia sp
Order :	Cyclopoida
Order :	Calanoida
Class :	Insecta
Order :	Odonata
Order :	Ephemeroptera
	Povilla adusta
Order :	Hemiptera
	Notonectidae
Order :	Diptera
	Chaoborus sp
	Chironomid larvae

Arthropoda, in general constituted an important dietary item of most of the length groups (Figure 5.1)

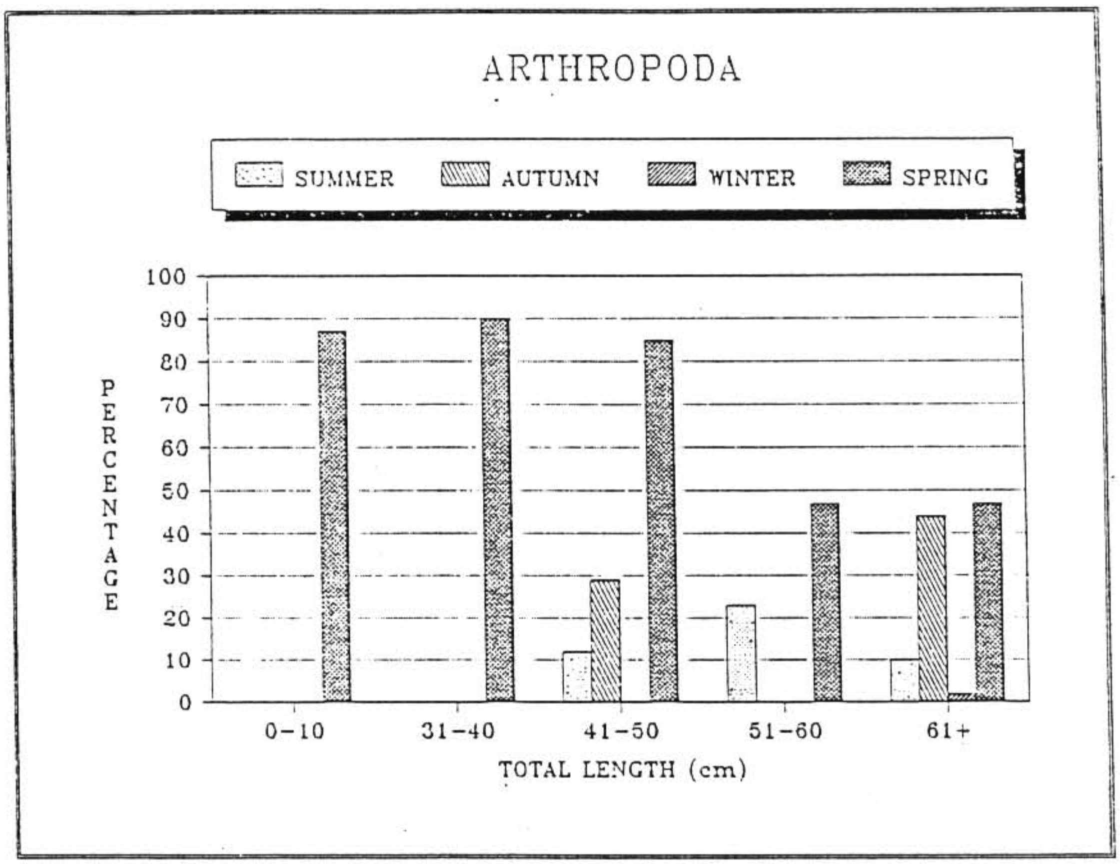

Figure 5.1 Percentage of the various Arthropoda species consumed by a size range of C. *gariepinus* during each of the four seasons of 1988 in the Middle Letaba Dam

Arthropoda was abundant during spring in all the length groups while the percentage frequency was also prominent during summer in the diet of fish in the 41 - 61±cm total length (TL) groups. In other length groups the Arthropoda were also recorded among food items in autumn.

The most common insect order in the gut contents of all the length groups of *C. gariepinus* was the Odonata (Figure 5.2). However, in the sampling of the zoobenthos members of this order appeared only once in Spring 1987 and at very low numbers. For observations on their dietary habits, fish were sampled only from station 8 (Figure 2.2). The Ephemeroptera which mainly consisted of *Povilla adusta* (98 percent) were also encountered. The Diptera consisting mainly of *Chaoborus* sp. and chironomid larvae, were also present (Figure 5.2).

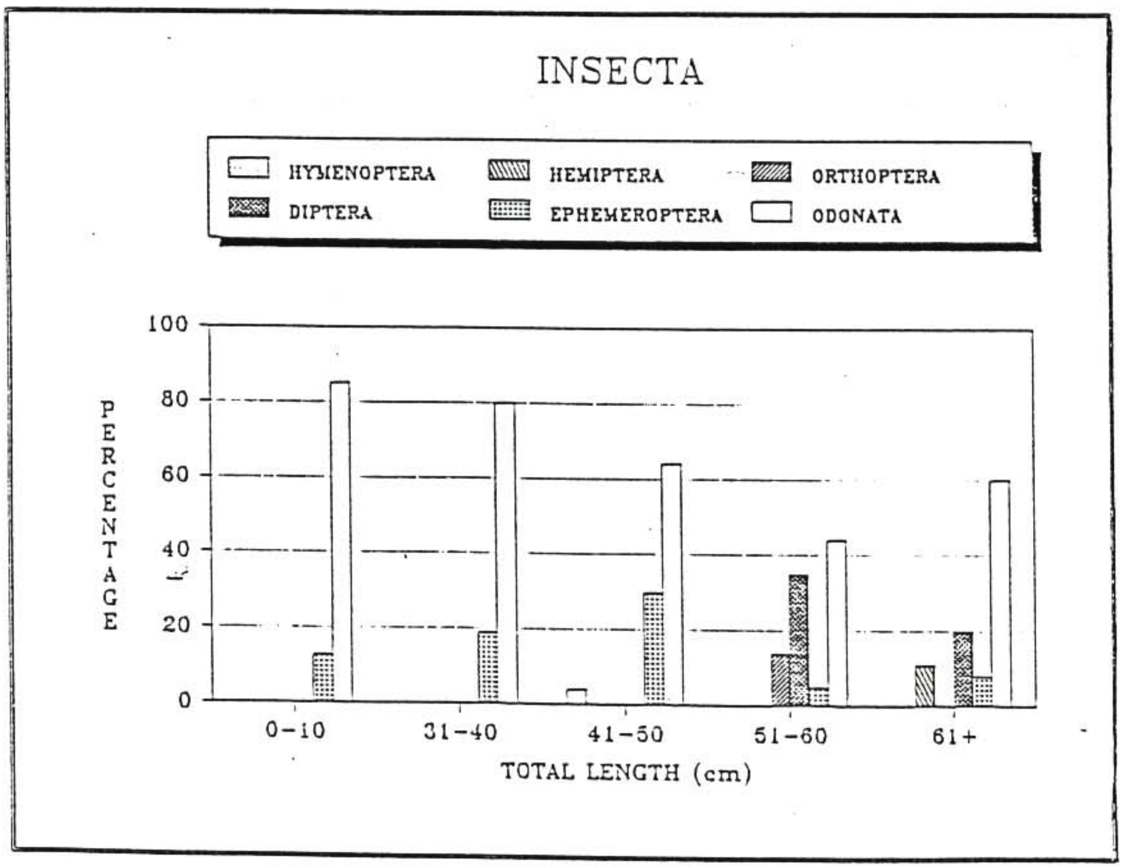

Figure 5.2 Percentage of specific insect orders preyed upon by a size range of *C. gariepinus* during each of the four seasons of 1988 in the Middle Letaba Dam

The molluscan genus *Bulinus* sp. occurred only in small numbers in the gut contents in the 31 - 40cm TL length group of *C. gariepinus* specimens during spring 1988 (Figure 5.3)

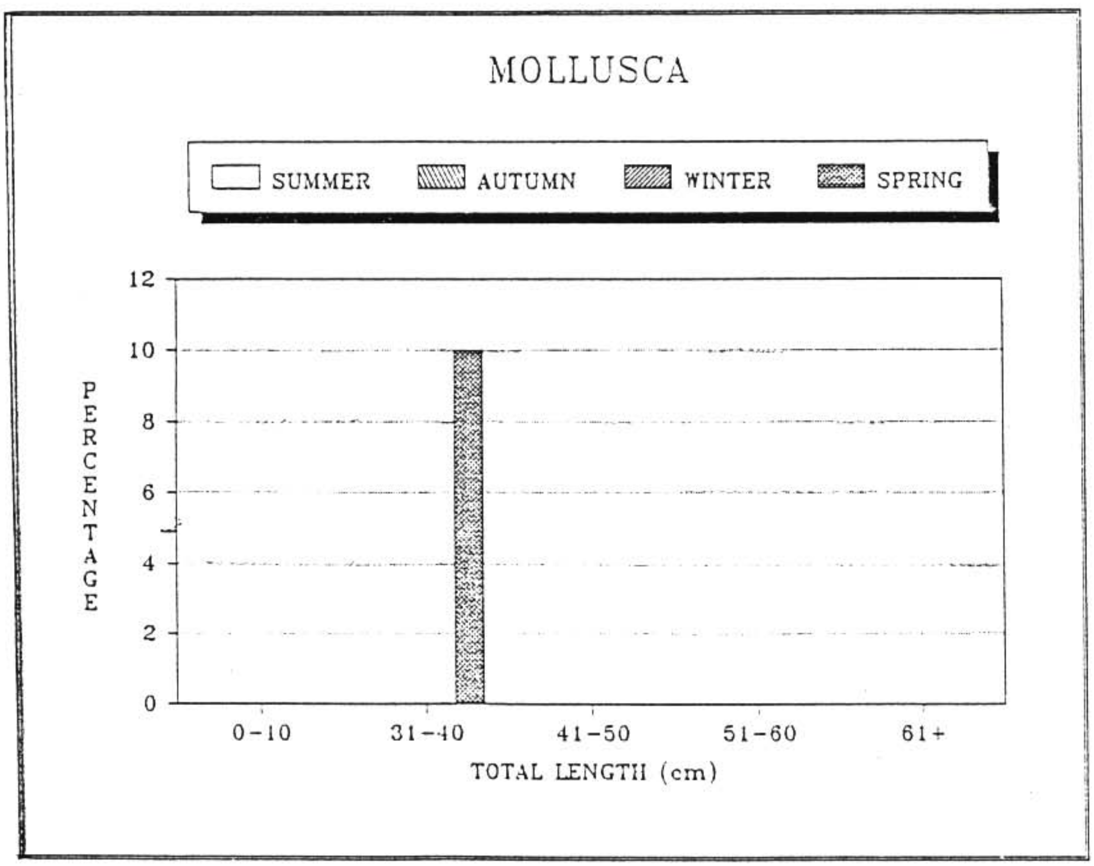

Figure 5.3 Percentage of Mollusca consumed by a size range of *C.gariepinus* during each of the four seasons of 1988 in the Middle Letaba Dam

The various dietary items in the stomachs of 20 *C. gariepinus* specimens caught near the bottom of the dam are illustrated in Figure 5.4. Seventy percent of the diet of *C. gariepinus* consisted of benthic-dwelling organisms present in the muddy substrate of the dam, of which *Chaoborus* sp. made up 63 percent, chironomid larvae (two percent) while Ephemeroptera represented five percent of the total sample. It appears that *C. gariepinus* specimens caught near the bottom of the dam fed selectively on *Chaoborus* sp. larvae, removing the larvae from the substrate, as large amounts of sand and small stones were also present in their stomachs.

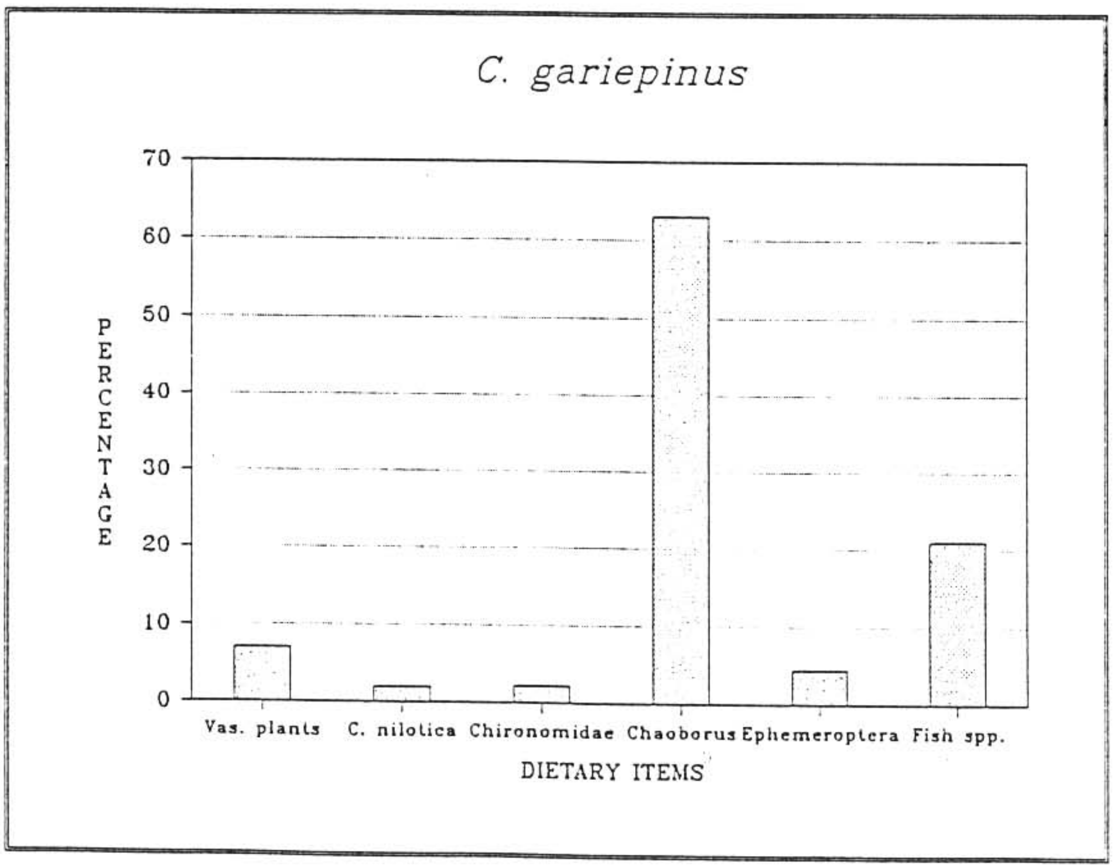

Figure 5.4 Percentage of various dietary items consumed by a size range of *C. gariepinus* caught at the bottom of the dam during each of the four seasons of 1988 in the Middle Letaba Dam

5.2.3 *Labeo ruddi*

The diet of *L. ruddi* included detritus, sand, vascular plants, filamentous algae, phytoplankton, Rotifera (zooplankton) and Crustacea (Cladocera). Cladocera (*Daphnia* sp.) was exclusively consumed during the summer season by specimens in the 21 - 25cm TL length group and constituted less than five percent of the total diet.

5.2.4 *Barbus marequensis*

In analysing the food items present in the guts of a size range of *B. marequensis* specimens, completely different dietary patterns were observed (Figure 5.5).

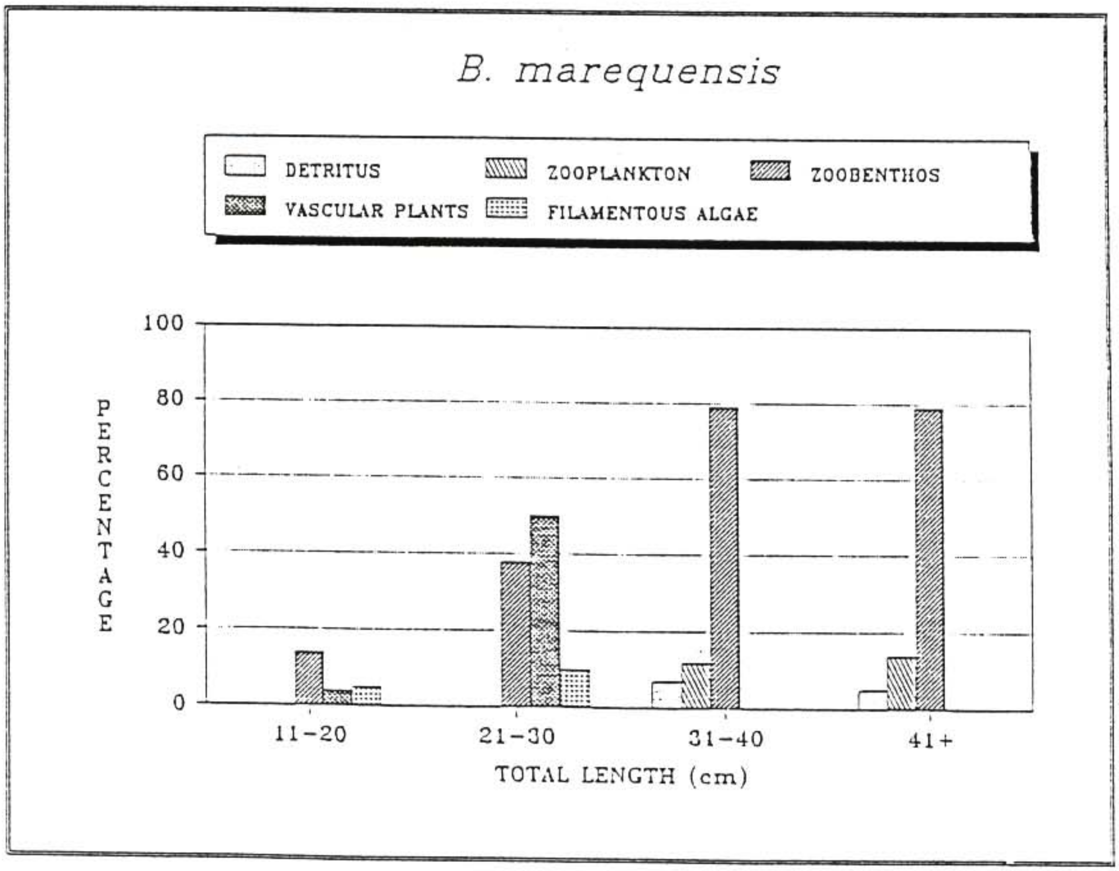

Figure 5.5 **Percentage of principle dietary items consumed by a size range of *B marequensis* combined for all seasons during 1988 in the Middle Letaba Dam**

In the smaller, 11 - 20cm TL length group of *B. marequensis*, small amounts of zoobenthos (15 percent), which consisted of *Chaoborus* sp., Chironomidae, Odonata and Ephemeroptera (*Povilla adusta*) were found in their guts. In the 21 - 30 cm TL length group the zoobenthos made up 38 percent of the total gut content. In the 31 - 41 cm TL group the zoobenthos formed the dominant dietary item (79 percent) of the total gut content. Cladocera (*Daphnia* sp.), Cyclopoida and Calanoida, which usually form part of zooplankton, but is also found (though in lesser numbers) in the bottom substrate were also present in the larger, 31 - 41^{+} cm TL length groups.

5.3 Utilization of macro-invertebrates as food by the smaller fish species

During the study, the population of small fish in the dam consisted of six species namely:

Barbus trimaculatus

Barbus paludinosus

Barbus unitaeniatus

Barbus bifrenatus

Barbus toppini

Pseudocrenilabrus philander

Four sampling localities were selected (Figure 5.6).

For correlation of research results, the sites were selected to be in the proximity, or to overlap, with some of the sampling stations selected for the benthic macro-invertebrate sampling.

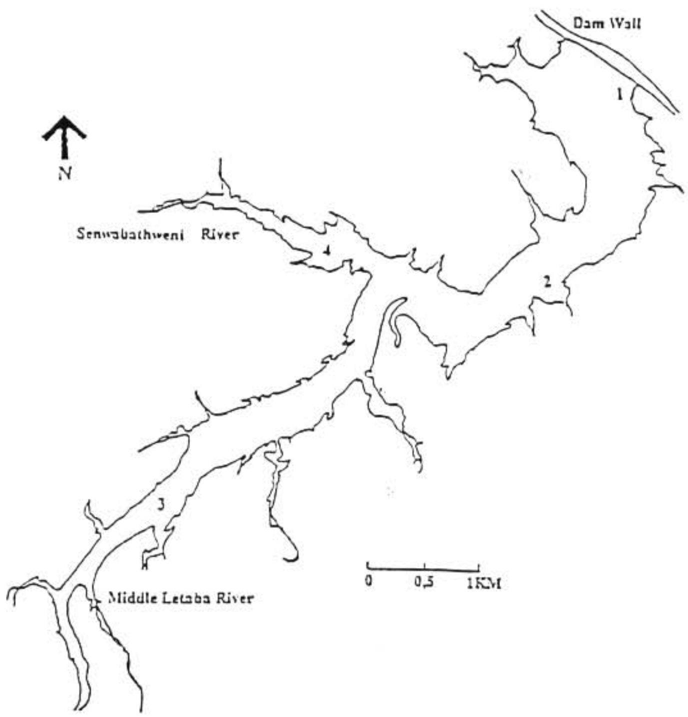

Figure 5.6 Location of the four sampling stations used for the small fish survey in the Middle Letaba Dam.

Very few researchers have until now attempted detailed analysis of stomach contents of small South African fish species. Only Gaigher (1975) and Cambray (1983) made in depth analyses of the gut contents of *Barbus trevelyani* (40 stomachs) and *B. anoplus* (526 stomachs) respectively, while Kleynhans (1984) reported in detail on the gut contents of several endangered Transvaal fish species. Polling, Schoonbee and Saayman (1992a, 1992b) reported on the diet and feeding habits of *Barbus paludinosus, B. unitaeniatus, B. bifrenatus* and *B. toppini*. Other researchers like Groenewald (1957), Crass (1964), Jubb (1967), Bell-Cross (1974) and Pienaar (1978) provided information on the feeding habits of some South African freshwater fish species, including the smaller Cyprinidae.

None of the five *Barbus* spp. under investigation possesses a true stomach, but only a dilated portion of the anterior gut. *P. philander* contains a gastric caecum.

An overview of all food items taken by the different species at the various localities during a period of one year is illustrated in Figure 5.7. In general Copepoda and the various other aquatic macro-invertebrate fauna constituted the bulk of the food items taken by all the fish, whilst plant material contributed more than 17% of the total food intake.

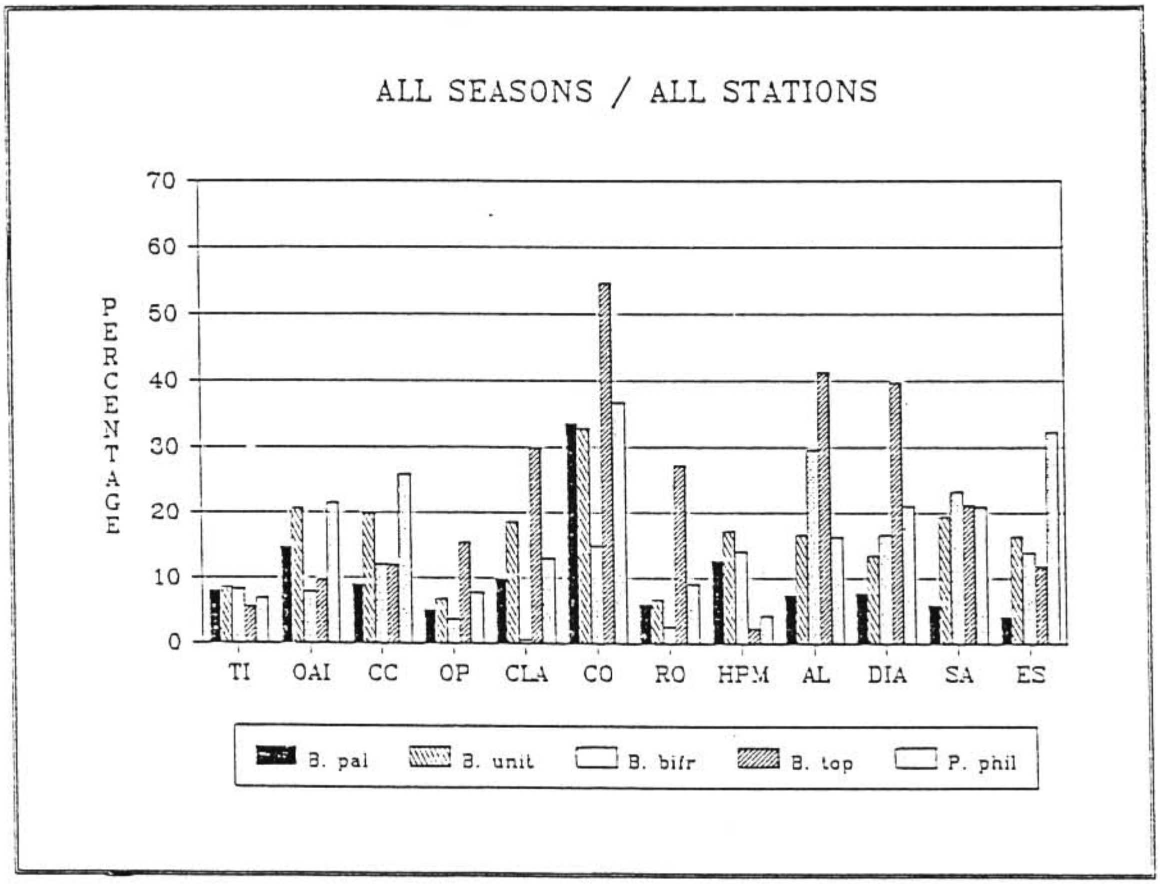

Figure 5.7 Total feeding of all species at all stations during the survey period 1988 - 1989. (See appendix A on page 169 for abbreviations)

5.3.1 *Barbus trimaculatus*

Very few stomachs of this species could be examined as the catches of this species were poor. The few stomachs examined indicated utilization of the benthos, larger planktonic organisms and terrestrial insects (Table 5.1).

Table 5.1 Incidence of a variety of food items taken by *B. trimaculatus* in the Middle Letaba Dam. Number of stomachs examined: 13

Food item	*Incidence*
Hydracarina	*3*
Keratella	*1*
Peridinium	*1*
Copepoda	*2*
Calanoid Copepoda	*1*
Cladocera	*1*
Chironomidae (larvae)	*1*
Chaoborus *(adults)*	*3*
Bryozoa statoblasts	*1*
Orthoptera	*1*
Trichoptera	*1*
Terrestrial insects	*7 (1xScarabidae 4xDiptera 2xColeoptera)*
Potamon *spp.*	*1*
Freshwater snails	*1*

5.3.2 Barbus paludinosus

This species displays a marked preference for Copepoda, which occurred in 27% of all the stomachs (63) analyzed during this survey (Figure 5.8)(Polling, *et al*, 1992b).

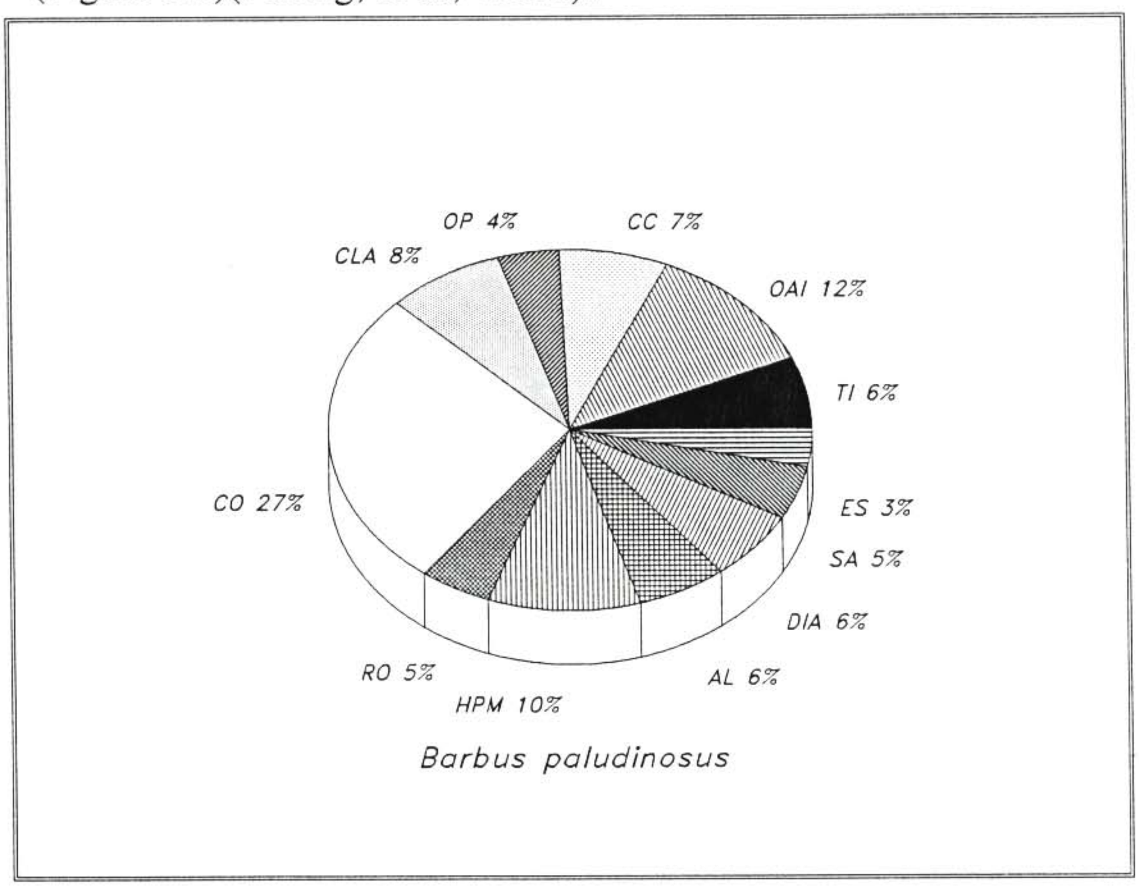

Figure 5.8 Total food composition of *B. paludinosus* for the survey period 1988 - 1989. (See appendix A on page 169 for abbreviations)

5.3.3 *Barbus unitaeniatus*

Barbus unitaeniatus appears to prefer the more bulky food items like chironomid larvae and adults, *Chaoborus* sp. larvae and adults, aquatic insects like Ephemeroptera and Trichoptera, and terrestrial insects such as small Coleoptera and Formicidae (Figure 5.9; Table 5.2). (Polling, *et al.*, 1992b). These food items constitute approximately 25% of the total food intake.

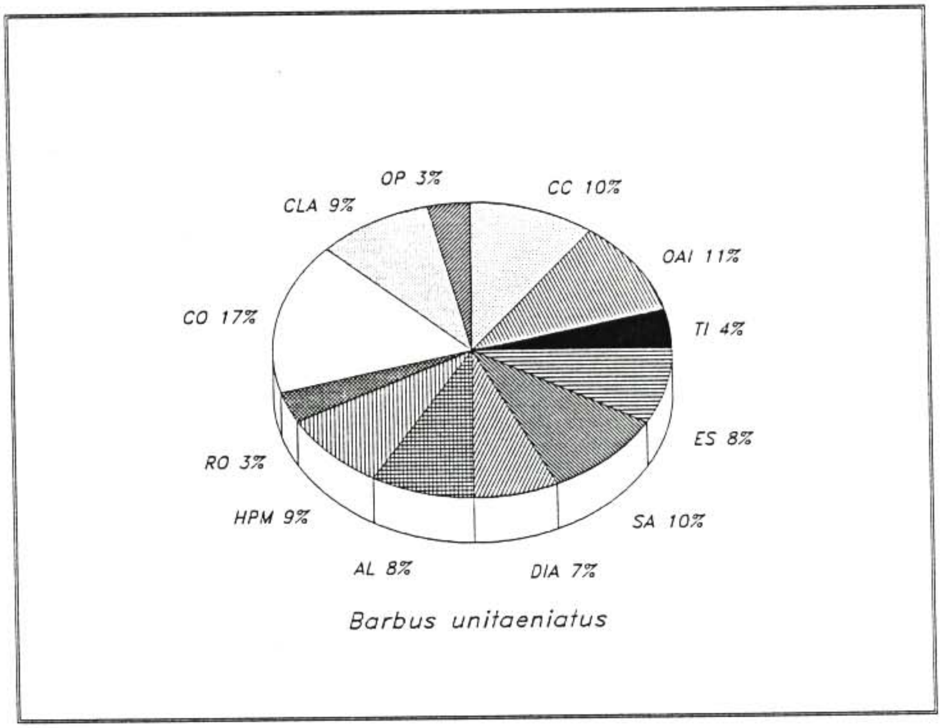

Figure 5.9 Total feeding pattern for *B. unitaeniatus* for the survey period 1988 - 1989 in the Middle Letaba Dam. (See appendix A on page 169 for abbreviations)

Table 5.2 *Barbus unitaeniatus* : distribution of food items per stomach. Number of stomachs examined: 108

Food item		No. of stomachs	
Empty	20	Plant Seeds	
Sand	28	Asteracae	7
Diatoms	22	Eragrostis	10
Higher plant material	23 → → → → →	Panicum	7
Rotifera	4	Portalucae	7
Copepoda	46	*Urochloa* sp	2
Ostracoda	7	*Utracularia*	2
Cladocera	23		
Chironomids and *Chaoborus* larvae and adults	29		
Other aquatic insects	21	Formicidae	5
Terrestrial insects	10 → → → → →	Orthoptera	5

5.3.4 *Barbus bifrenatus*

This fish utilizes the entire spectrum of available food items, but it utilizes more plant material than any of the other small cyprinids in the impoundment (Figure 5.10). Copepoda, *Chaoborus*, chironomid larvae and other aquatic insects also occurred in their stomachs (Figure 5.10)(Polling, *et al.*, 1992a).

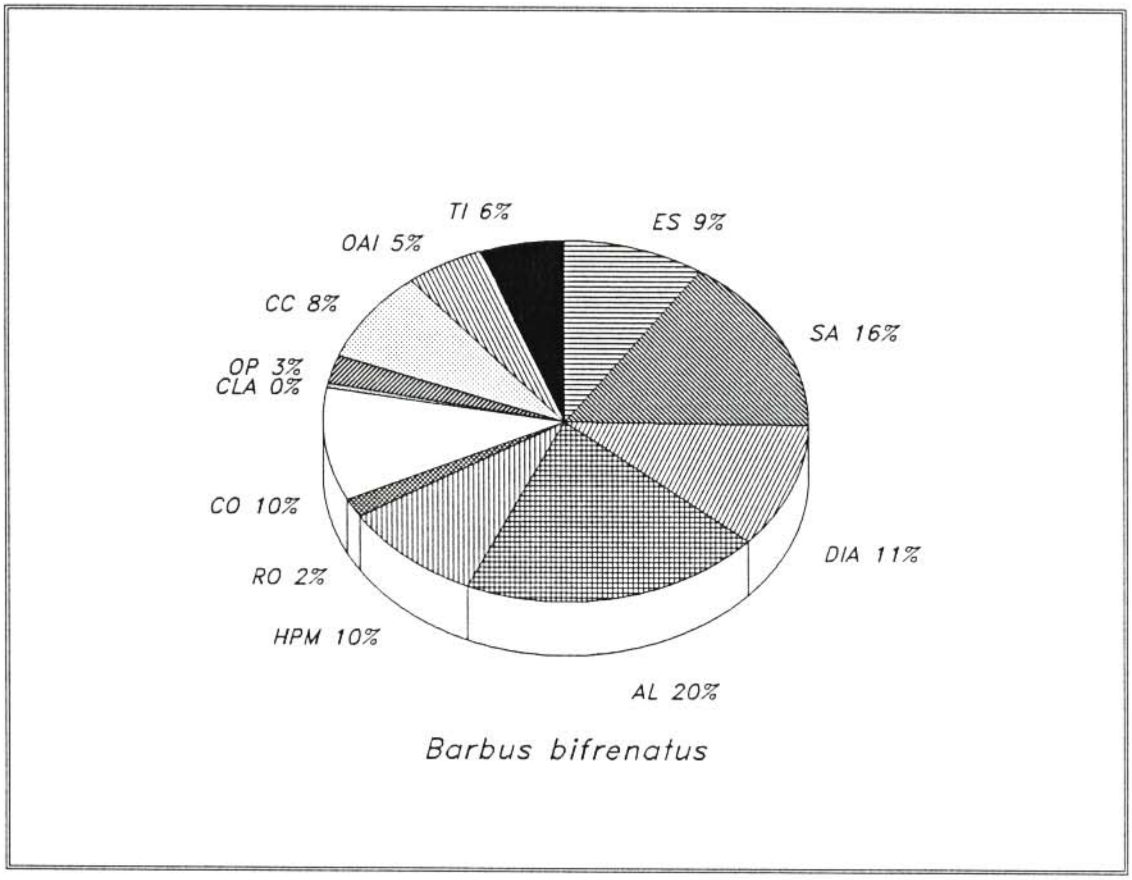

Figure 5.10 Food items taken by *B. bifrenatus* during the survey period 1988 - 1989. (See appendix A on page 169 for abreviations)

5.3.5 *Barbus toppini*

As a very small species, it utilizes mainly smaller groups of benthic fauna like Copepoda and Cladocera which formed 31% of the items encountered (Figure 5.11). The ratio between the smaller Copepoda and the larger calanoid Copepoda is 78,5% to 21,5% (Polling, *et al.*, 1992a).

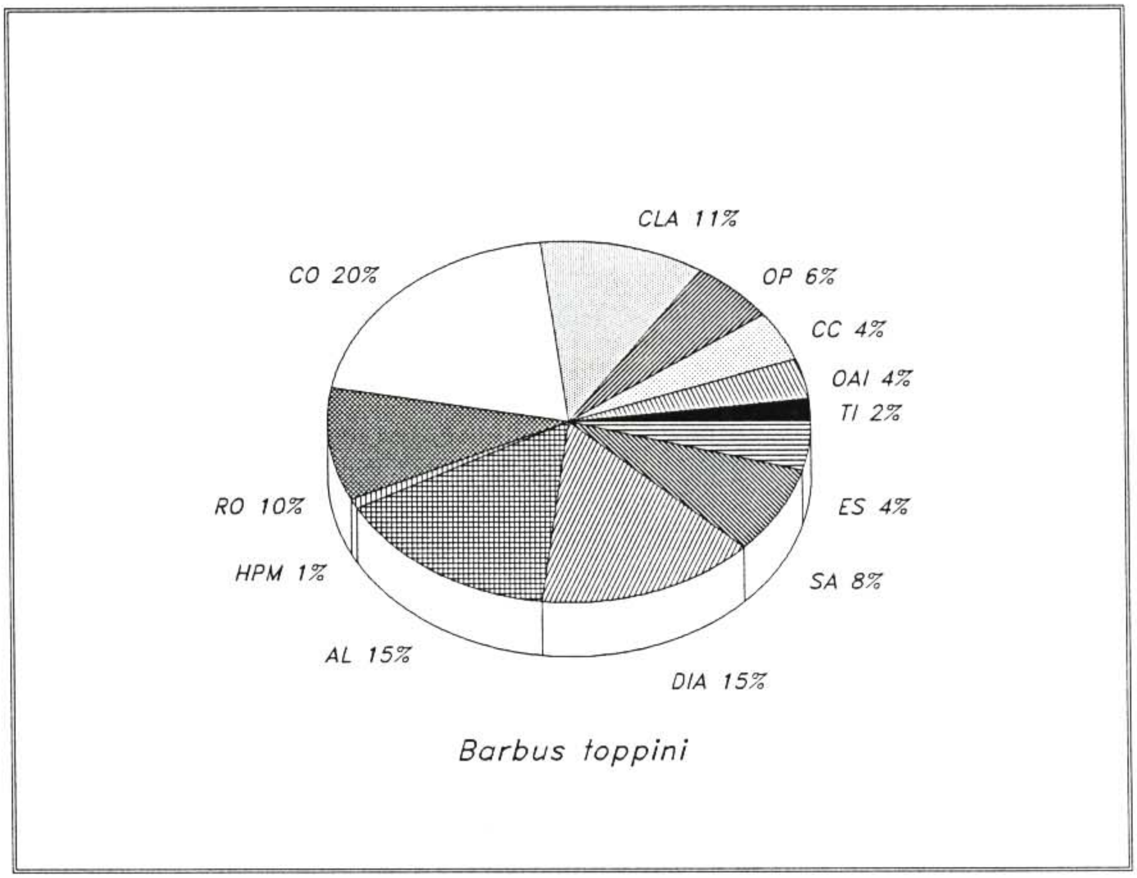

Figure 5.11 Feeding pattern for *B. toppini* over the survey period 1988 - 1989. (See appendix A on page 169 for abbreviations)

5.3.6 *Pseudocrenilabrus philander*

Copepoda, *Chaoborus*, chironomid larvae, Cladocera and other aquatic insects were found as part of the dietary items of this species (Figure 5.12). Copepoda constituted 17% of the diet whilst *Chaoborus* and chironomid larvae made up 12% of the diet of *P. philander* (Figure 5.12).

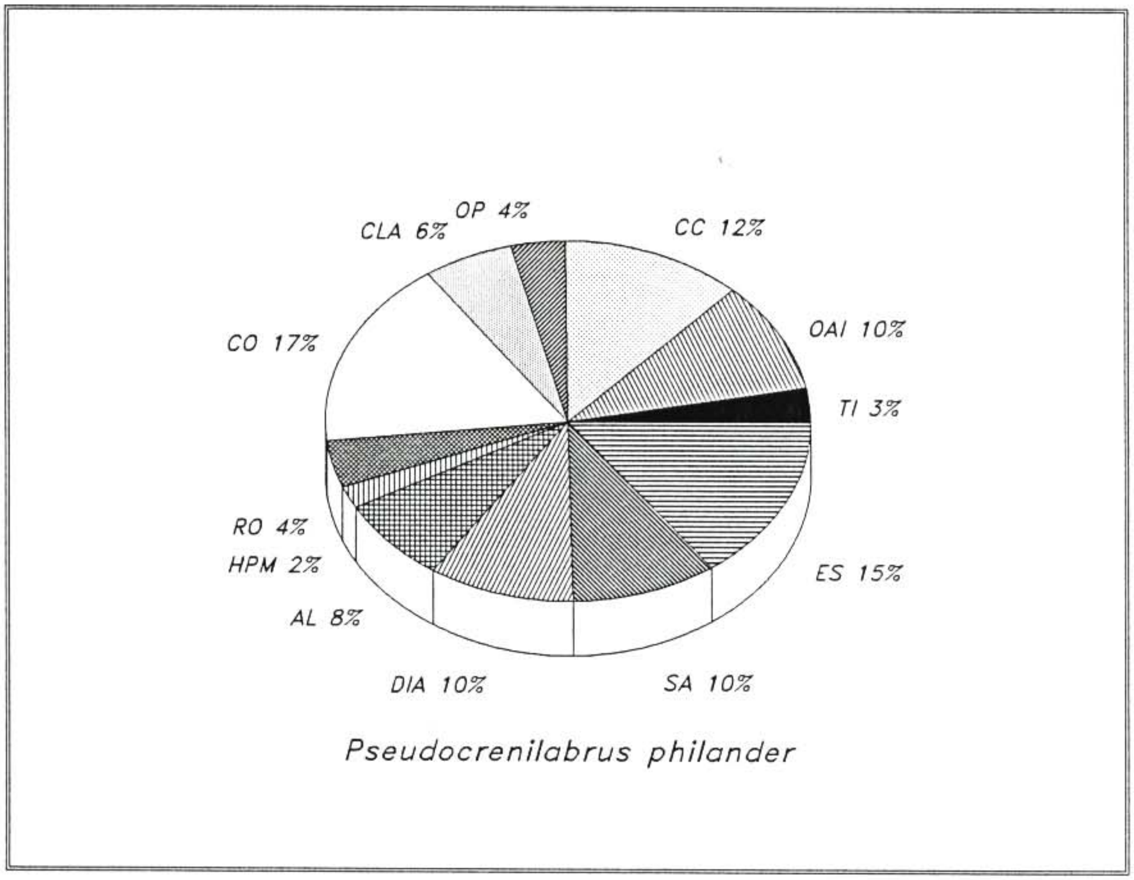

Figure 5.12 Feeding of *P. philander* during the survey period 1988 - 1989. (See appendix A on page 169 for abbreviations).

In conclusion it can be stated that the study on Middle Letaba Impoundment has demonstrated that the benthic macro-invertebrate fauna form an important integral part of dietary items of most of the fish species in the dam.

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CHAPTER 6

PAGE

GENERAL DISCUSSION, FUTURE RESEARCH AND RECOMMENDATIONS

6.1 General discussion

From the data on the physical, chemical and biological conditions of the Middle Letaba Dam, the lake can be classified as being in a primary development phase, where the biogeochemical cycles and the biotic communities have not yet reached a stabilizing stage. In fact, it has as yet not even completed the first phase of Bowmaker's (1975) three developmental stages in the evolution of a newly constructed man-made lake (see Chapter 1).

Unfortunately, the survey period was characterized by a well below normal rainfall pattern in the catchment area of the dam so that the lake did not fill beyond the 30% mark of its full level capacity. This implied that vast areas of the lake basin covered with grass and shrubs have not yet been submerged at all. Should this occur one would expect a considerable increase in productivity at all trophic levels and in particular at the levels affecting the densities and biomass of the benthic macro-invertebrate fauna of the lake.

The data on the physical and chemical conditions of the water of the dam provided an overall impression of an unpolluted largely oligotrophic ecosystem. Values for ammonia, nitrate, nitrite and phosphate suggest some slight organic enrichment of the water which may induce occasional algal and phytoplankton blooms. However, the levels of these nutrients at the time of the survey were in all cases not high enough to create eutrophic conditions. The Middle Letaba Dam catchment area at present includes large vegetable and subtropical fruit farms with intensive fertilization and pest control programmes. For this and other reasons the water of the impoundment would in future be expected to become considerably more enriched and possibly polluted.

The submerged and emerged aquatic macrophytes contributed much towards the primary energy source of the food web in water bodies such as the Middle Letaba Dam and play a vital role in habitat diversification as well as shelter, breeding and feeding areas for aquatic fauna and water birds. These plants play an important role in trapping and sieving both dissolved and particulate matter entering the dam from land sources (Howard-Williams and Allanson, 1978).

Because of the already mentioned presence of nutrient loads in the water of the dam the growth of *Najas pectinata* is currently increasing in density, covering large portions of the littoral zone of the impoundment. Should this tendency continue this aquatic weed may pose a severe problem to anglers and any future recreational activities such as boating, yachting, etc.

At present there is a remarkable species diversity of the benthic macro-invertebrate fauna in the dam. The Arthropoda as a group constituted the major portion of the total density of organisms/m^2 substrate throughout the survey period. In terms of biomass, however, the Annelida comprised the major component of the benthic macro-invertebrate fauna of the dam. This emphasizes the importance of the size of certain benthic macroinvertebrates in the total energy budget of this component in the dam ecosystem.

In the past comparatively little attention was given to the macro-invertebrate fauna in lakes and rivers in southern Africa as potential food for benthic feeding fish species. During the present survey Van Senus (1989) and Polling, Schoonbee and Saayman (1992a, 1992b) clearly demonstrated the considerable importance of these organisms in the diet of most of the larger and smaller fish species inhabiting the Middle Letaba Dam. The integration of the data on the fish feeding habits by the fish researchers on the one hand and the present study on the other provided valuable information not only on the actual food preferences of these fish, but also the specific localities where much of the feeding of the fish took place.

6.2 Future research and recommendations

The population dynamics and trophic interrelationships of the micro-flora and fauna and their contribution towards tertiary productivity have received relatively little attention in ecological studies of southern African man-made lakes. This is in sharp contrast to the investigations on the ecology of the fish fauna of these water bodies. Against the background of all the research data that has been collected on the Middle Letaba Dam during 1987 - 1989, but in particular with reference to the present project, certain aspects of the work need to be expanded upon should further research be continued there :

- As much of the research was done prior to the complete filling of the dam, investigations should continue on the primary and secondary productivity of this water body once sufficient rain has fallen in the catchment area to fill the entire basin of the impoundment. Coinciding with this, further studies should be done on the fish population numbers and densities in view of their future cropping potential.

- It can be expected that organic loads and pesticide concentrations will increase because of agricultural activities in the catchment area of the dam. Specific attention should therefore be given in future research programmes to combat these particular problems at their source. Uncontrolled access to the dam and its surrounding area should be restricted to prevent domestic pollution, degradation of vegetation in the area, minimize bilharzia and protect waterbird habitat and breeding localities as well as fish breeding grounds.

- Although a large number of the benthic macro-invertebrates could be identified to the genus level, the available information on the taxonomy of these organisms did not allow the identification of most to the species level. It is extremely important that the larval, pupal and adult stages of these organisms be correlated and the species be identified. In the case of new, undescribed species, expertise should be sought locally or abroad to describe these new organisms. This particularly applies to the aquatic insects present in the dam.

- One important shortcoming of the present study was the total lack of information on the emergence of the adult stages of the different aquatic insects during the different seasons of the year as well as at the various localities of the impoundment. This type of investigation would be sufficient for postgraduate projects and would also be of benefit to the studies on the taxonomy of the aquatic insects present at the Middle Letaba Impoundment.

- Since the studies on the feeding habits of the fish in the Middle Letaba Dam revealed the importance of the macro-invertebrate fauna in their diet, it is recommended that laboratory investigations be made on the value of certain benthic fauna as food for the growth and survival of the larval and juvenile stages of these fish species. This can be accompanied by bio-energetic studies including a detailed analysis of the nutritional value of specific macro-invertebrates.

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APPENDIX A

List of abbreviations used in figures

ES	=	Empty stomach
SA	=	Sand
DIA	=	Diatoms
AL	=	Algae
HPM	=	Higher plant material
RO	=	Rotifera
CO	=	Copepoda
CLA	=	Cladocera
OP	=	Other planktonic organisms
CC	=	Chaoborid and chironomid larvae
OAI	=	Other aquatic insects
TI	=	Terrestrial insects