EFFECTS OF FOOD LIMITATION ON THE POPULATION DYNAMICS OF HYDRA

by

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ABSTRACT

EFFECTS OF FOOD LIMITATION ON THE
POPULATION DYNAMICS OF HYDRA

George B. Mateja
Master of Science
Youngstown State University, 1984

Field studies were undertaken in Meander Creek Reservoir in 1979 and 1981 to determine if the decline in the late spring hydra population was food limited. Hydra condition and density reductions on submerged slides occured in conjunction with a decline in food availability and an increase in water temperature. As a result of high water temperatures and limited food availability, the energy available for growth (G) declined to zero in 1979 and below zero in 1981. The virtual disappearance of hydra from the trap slides coincided with the prolonged reduction in G. Other hypothesized limiting factors were not observed to affect the hydra condition or density.

During the fall of 1979 the reestablishment of the hydra population occurred in conjunction with an increase in the availability of food and a decrease in the water temperature. As the season progressed the hydra condition increased in conjunction with an increase in the availability of food and the energy available for growth. Since the decline and virtual disappearance occurred when the hydra population underwent a prolonged energy deficit, it was concluded that the late spring decline was due to food limitation.

Twenty-three crustacean species and two genera of rotifers were identified in the Meander Creek Reservoir zooplankton. The spring zooplankton densities and biomass values peaked by late May, then declined while the 1979 fall zooplankton biomass tended to remain constant at values comparable to the late May populations. Ingestion of the zooplankton was not selective and hydra fed exclusively on the zooplankton identified in the vertical tows.

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Finally, I wish to extend my sincere thanks to the Mahoning Valley Sanitary District, Mr. John Tucker, Chief Engineer, for providing the facilities and access to the Meander Creek Reservoir.

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SYMBOL	DEFINATION
GA	GROWTH AXIS
H	HYDRA
kJ/kJ·day	Kilojoules of Zooplankton per Kilojoule of *Hydra* per Day

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INTRODUCTION

Populations of temperate lake hydras undergo marked annual fluctuations. Bryden (1952) and Batha (1974) observed populations undergoing a monocyclic fluctuation while Moen (1951), Carrick (1956), Reeder (1979), and Schroeder and Callaghan (1982) reported populations with bicyclic fluctuations. Populations undergoing monocyclic fluctuations have a density peak occurring during the summer, while the bicyclic population fluctuation has two annual peaks, one occurring during early spring to early summer and the other during the late fall. Hydras collected from the Meander Creek Reservoir have a bicyclic population fluctuation (Schroeder and Callaghan, 1982). The spring density maximum occurs by late May/early June, after which the population undergoes a precipitous decline. Hydra reappear by mid September and attain peak densities by mid November.

The decline in the population densities of *Hydra* has been associated with high temperatures (Welsh and Loomis, 1924), low temperatures (Batha, 1974), insufficient food (Batha, 1974; Schroeder and Callaghan, 1982), predation and parasitism (Griffing, 1965; Lomnicki and Slodkin, 1966), competition for supports (Miller, 1936; Batha, 1974), rapid sinking in convergences (Batha, 1974), and depression (Reisa, 1973). The range of dissolved oxygen, pH, and water pressure conditions observed in most temperate lake basins have not been documented to be deleterious to *Hydra* (Welsh and Loomis, 1924; Miller, 1936; Bryden, 1952; Loomis, 1954; Batha, 1974), except for anoxic conditions (Welsh and Loomis, 1924).

Although an apparent correlation exists between the high epilimnetic temperatures and the precipitous summer decline of the hydra population, high water temperatures alone have not been demonstrated as a direct cause of the decline. Schroeder and Callaghan (1981) determined the upper lethal temperatures of the hydras H. oligactis and H. pseudologactis. H. oligactis reared at constant temperatures ranging from 5°C to 21°C had an upper lethal temperature (ULT) range of 26°C to 30°C. The ULT range for H. pseudologactis ranged from 31°C to 34°C (rearing temperature range: 5°C to 27°C). Hydra collected from Meander Creek Reservoir at 20°C had an ULT of 27°C. The ULT in every case exceeded the maximum water temperature observed when the hydra population declined. Consequently, high temperature cannot be considered as a direct cause of the population crash.

Increasing temperatures may indirectly contribute to the population decline by increasing the basic maintenance costs and reducing the food conversion efficiencies. Schroeder and Callaghan (1982) documented an increase in the hydra's basic maintanence costs ranging from 0.02 to 0.10 kJ/kJ, within a temperature range of 10°C to 25°C. They also observed H. pseudologactis to undergo a 61 percent reduction of its assimilation efficiency and a 51 percent reduction of its gross growth efficiency with increasing temperature over the same temperature range. Therefore, the hydras must substantially increase their rate of ingestion in order to meet the increased maintenance costs. Hydra populations must ingest about 0.04 kJ of zooplankton per kJ of Hydra per day (kJ/kJ·day) at 10°C, and about 0.20 kJ/kJ·day (recalculated from Schroeder and Callaghan, 1982) at 20°C. If the population is unable to meet the increased maintenance costs associated with high temperatures, the population size will decrease.

The observations of Welsh and Loomis (1924), Carrick (1936), Bryden (1952), Reeder (1979), Cuker and Mozley (1981), and Schroeder and Callaghan (1981, 1982) suggest that the spring population reductions are caused by the limitation of food. In temperate lakes, eg. Sanctuary Lake, Pennsylvania (Cummins et al., 1969) and Pine Lake, Ohio (Reeder, 1979), the seasonal succession of the zooplankton populations is bicyclic, with a large density maximum appearing in early May, followed by a substantial decline through July and a small peak in autumn (Cummins et al., 1969; Wetzel, 1975; Reeder, 1979). Temperatures steadily increase during the spring and summer through August. Hydras are unlikely to be food limited during the spring because of their low maintenance costs and the abundant and increasing zooplankton populations. However, higher summer water temperatures, reduced zooplankton population densities and increased temperature dependant hydra maintenance costs would enhance the possibility of hydra starvation. If the hydra population is limited by food, the precipitous declines reported by Welsh and Loomis (1924), Reeder (1979), and Schroeder and Callaghan (1982) should correspond with the onset of an energy budget deficit.

To determine if the spring hydra population decline was due to starvation the energy available for growth was compared to the hydra condition and population density. Reductions in the hydra condition and population density should have occured in conjunction with a reduction in the ingestion rate, the energy available for growth, and the prey density. The seasonal feeding selectivity of <u>Hydra</u> was also studied.

METHODS AND MATERIALS

Study Site

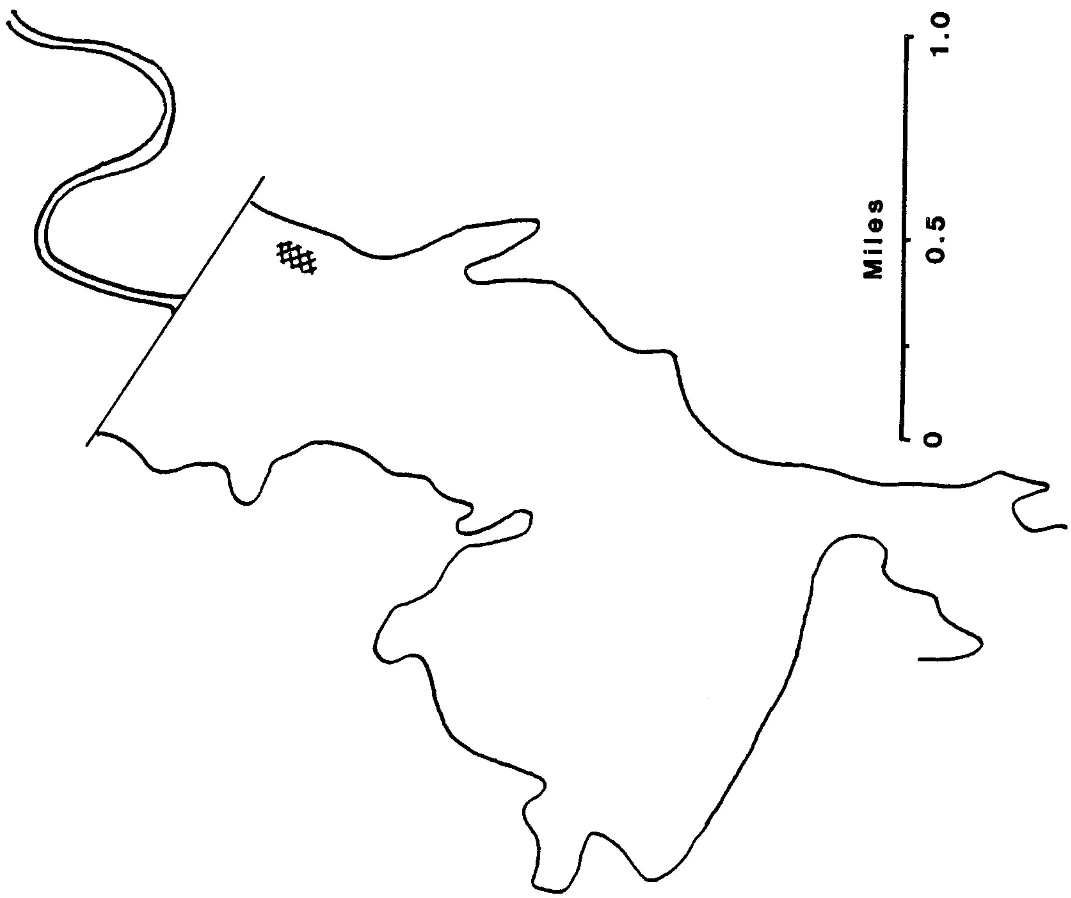
Meander Creek Reservoir is located in Trumbull Co., Ohio, nine miles west of the Youngstown Municipal Airport and one-eighth mile west of the junction of McDonald Avenue and Route 46 in Mineral Ridge, Ohio. Meander Reservoir is a domestic water supply with a capacity of 10.5 billion gallons and covers 2,000 acres. The reservoir and the surrounding 4,000 acres of forested lands is set aside as a state wildlife refuge. The watershed contains eighteen streams (Figure 1) that drain the surrounding farmlands and developing urban areas (Cubbison, unpublished).

Zooplankton Procedures

The zooplankton were sampled every six hours during the spring (collection hours: 22:00, 04:00, 10:00, 16:00) and every twelve hours during the fall (collection hours: 22:00, 10:00). A 100μ plankton bucket was used throughout the entire study on a Wisconsin type plankton net (diameter: 0.97 m; mesh size: 64μ). A 64μ bucket was also used in the program during the fall of 1979 and the spring of 1981. Each zooplankton sample sample was obtained from a single vertical tow during the spring of 1979 and triplicate tows during the fall of 1979 and spring of 1981.

In order to prevent the zooplankton from ballooning (i.e. severe carapace distortion), each collection was preserved in a sucrose-club soda-formalin solution. The freshly collected zooplankton were transferred from the plankton bucket to a polyethylene storage bottle. To every

Fig. 1.--Map of Meander Creek Reservoir. Crosshatched area represents the zone where the hydra traps were located.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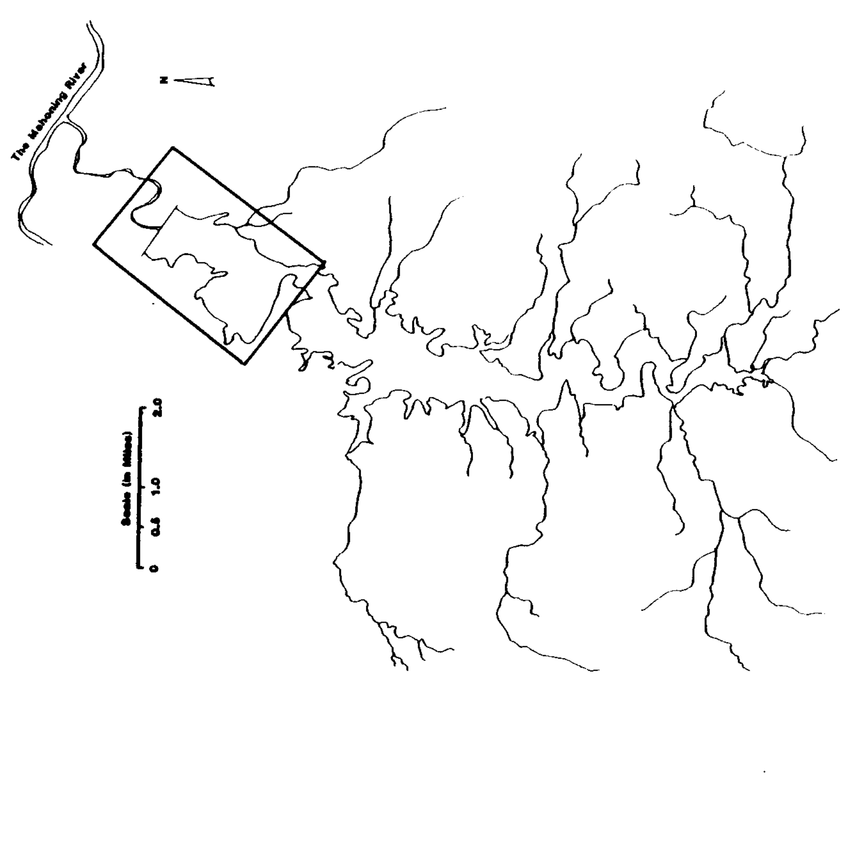

The Mahoning River
N
Scale (in Miles)
0 0.5 1.0 2.0

100 ml of sample, 10 ml of club soda was added and allowed to stand for 10 minutes, then 10 ml of a 40 percent sucrose solution was added. The addition of 10 ml of absolute formaldehyde was the final step of this preservation process (Haney and Hall, 1973; Gannon and Gannon, 1975).

Upon arrival in the laboratory the preserved plankton sample was stirred and strained through a no. 102 nitex net and washed into a 10 ml beaker. The filtered preservative was used to wash the origional container and was restrained to collect any remaining zooplankton. The concentrated sample was then transferred into shell vials containing a solution of 10 percent sucrose and 4 percent formaldehyde, and stored until analyzed.

Subsamples of the zooplankton were taken using the procedure developed by McCallum (1979). The sample, in the shell vials, was transferred to a 250 ml round bottomed flask. The volume of the sample was adjusted to either 250 ml, for the 100µ bucket tows, or to 150 ml, for the 64µ bucket tows. The samples were mixed by gently blowing through a pipette for 5 seconds while the tip was held beneath the liquid's surface. A 5 ml sample was then immediately drawn up and transferred to a 10 ml beaker. All the zooplankton in this subsample were identified and counted.

The process of identification and measurement of the zooplankton was performed under either the low (4x) or medium (10x) power of an American Optical binocular microscope. The identification of the zooplankton species was based on the keys of Brooks (1957), Pennak (1953, 1978), and Ward and Whipple (1959). The identification process was also aided by the use of the keys of Czaika and Roberts (1968), for the Diaptomidae, Deevy and Deevy (1971), for the genus Eubosmina, Roberts (1970) for the genus *Ergasilis*, and Torke (1974) for the Crustacea.

The measurement of the zooplankton was facilitated by using a calibrated ocular micrometer. The total length was taken for all of the zooplankton (Fig. 2), and the standard length was also measured for the Daphnidae. The total length represents the distance from the anterior-most portion to the posterior-most portion of the zooplankton, excluding the caudal rami of the copepods and the entire spine of the daphnids. The daphnid's standard length was taken from the leading edge of the eye to the base of the spine. The total length data was used to estimate the zooplankton biomass via a length weight regression (Table 1; Boucherle et al., unpublished; Dumont et al., 1975). Dry weights used for the biomass calculation of the rotifers *Keratella spp.* ($3.14 \times 10^{-4} \mu g$) and *Polyarthra spp.* ($3.76 \times 10^{-3} \mu g$) are from Dumont et al. (1975).

Hydra Collections

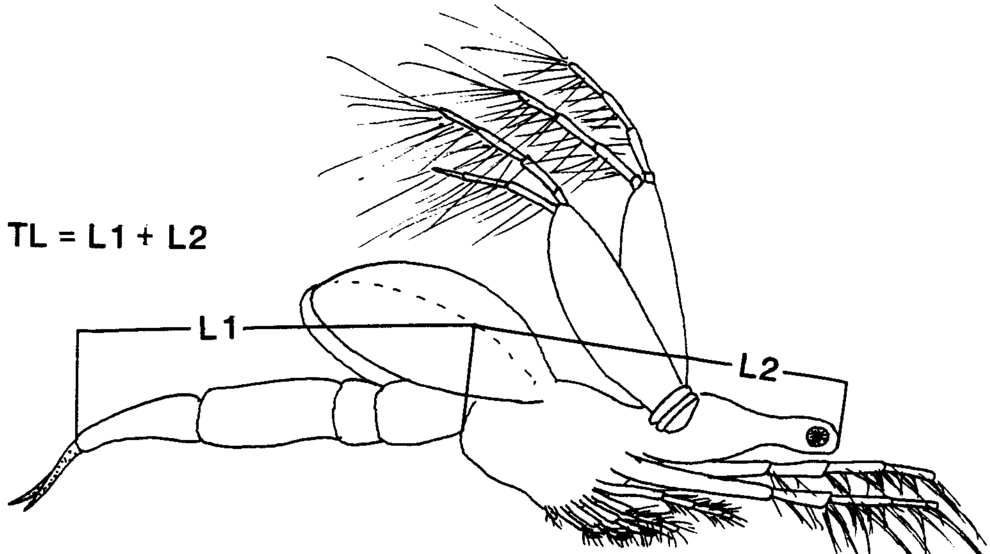
The hydra traps were patterned after Schwoerbel (1970) and Reeder (1979). Four glass microscope slides (25mm by 75mm) were inserted into horizontal slots in a single holed no. 8 rubber stopper at right angles to each other. These were suspended at one meter intervals on an anchored clothes line (plastic coated steel core) beginning at the surface (5cm, designated as 0m) and extending to the base of the trap (4.05m, designated as 4.0m). A styrofoam float was attached to the line at the surface of the water and a marker was attached to a 0.5m trailing line. As the reservoir depth decreased in the fall, the traps were shortened, at the base, in order to preserve the established spacing below the water's surface.

Table 1. The length-weight regression (log W = a + blog L) of the crustacean zooplankton. Length is expressed as either μ or mm, while weight is expressed as μg.

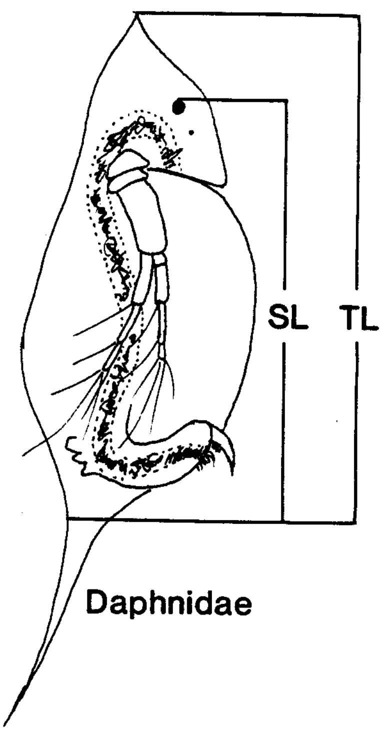
Taxa	a	b
Daphnia galeata mendota [1,4]	-3.8182	1.5644
Daphnia retrocurva [1,4]	-7.4641	2.6807
Daphnia ambigua [2,4]	6.29×10^{-7}	2.29
Daphnia parvula [2,4]	1.50×10^{-8}	2.84
Daphnia longiremus [2,4]	1.50×10^{-8}	2.84
Daphnia dubia [2,4]	1.50×10^{-8}	2.84
Daphnia pulex [2,4]	2.40×10^{-8}	2.77
Ceriodaphnia lacustris [2,4]	1.70×10^{-6}	2.66
Bosmina longirostris [1,4]	-5.4384	2.2291
Eubosmina coregoni [1,4]	-5.6706	2.3371
Chydorous sphaericus [2,3]	89.43	3.93
Kurzia latissima [2,4]	29.65	3.48
Alona guttata [2,4]	1.70×10^{-4}	1.39
Diaphanosoma leucthenbergianium [2,4]	-2.4317	1.0456
Leptodora kindtii [1,4]	-5.4257	1.8730
Sida crystallina [1,4]	-3.8182	1.5644
Camptocercus rectirostris [2,4]	15.92	3.84
Cyclops bicuspitus thomasi [1,4]	-5.0504	1.9347
Cyclops vernalis [1,4]	-6.8192	2.5563
Mesocyclops edax [1,4]	-7.8592	2.8945
Cyclops nauplii [1,4]	-4.4902	1.6349
Cyclops copepodite [1,4]	-5.0504	1.9347
Diaptimus nauplii [1,4]	-4.4902	1.6349
Diaptimus copepodite [1,4]	-4.4482	1.7034
Diaptimus sicilis [2,4]	7.90×10^{-7}	2.33
Diaptimus siciloides [1,4]	-10.7797	3.8498
Ergasilis megaceros [2,4]	4.90×10^{-8}	2.75

1. Boucherle et al., unpublished.
2. Dumont et al., 1975.
3. length, in mm
4. length, in μ

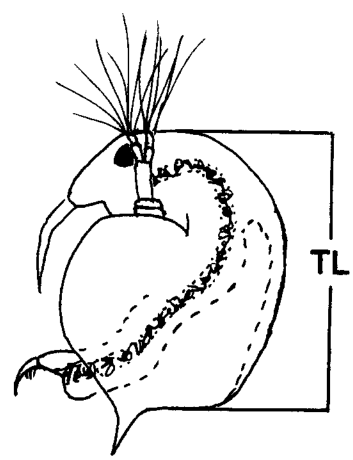
Fig. 2.--Diagram of the Copepod and Cladoceran measurements (redrawn from Boucherle et al., unpublished). L denotes length, SL denotes standard length, and TL denotes total length.



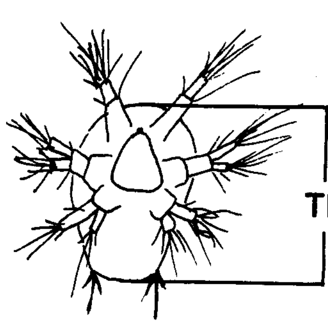
Leptodoridae



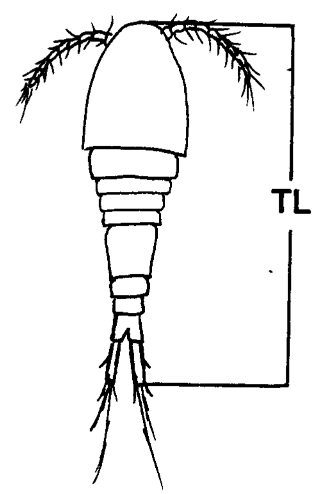
Daphnidae



Bosminidae



Nauplius



Copepodidae

Gut Analysis

Each combined hydra sample was placed into a 50 ml beaker and was gently mixed by blowing through a pipette. Three to seven hydra were transferred with an eyedropper to a seperate 10 ml beaker. A single hydra was transferred from the subsample onto a depression slide; the number of growth axes were recorded at this time.

Dissection of the hydra was facilitated with the aid of an A. O. dissection microscope. Each hydra was gently held at the basin with a scalpel while the region including the mouth and tentacles was detached from the rest of the body. The ingested material was exposed by making a second cut along the main axis of the body. The zooplankton tests were gently scraped from the dissected gut wall and seperated. Length measurements were taken and the zooplankton were identified to species, whenever possible.

Temperature

Temperature was taken during each collection with a Model FT3 Hydrographic Thermometer (Applied Research, Austin). The temperatures were recorded in the air, at the water's surface, and at each successive trap depth.

Depth

The water depth was measured at the beginning of each collection period using a sounding chain.

Transparency

A Secchi disc (diameter: 20 cm) was used to measure the water transparency of the reservoir. The line attached to the disc was marked in 10 cm intervals. Readings were obtained by lowering the disc to the depth at which it disappeared from view, then lowered it an additional half meter and slowly raised it until it reappeared. The average of the depths at disappearence and reappearence is the reported Secchi depth (in cm). These measurements were taken at 10:00 hours from the shade at the boat's lee side.

Data Analysis

Most of the statistical computations were conducted with the aid of an Amdahl 370 series computer at Youngstown State University. One-way Analysis (SPSS program; Nie et al., 1975) was used to test for the significance of the differences in the daily variations of the zooplankton population densities and of the hydra gut contents. Differences amoung means were determined by the Scheffe's multiple range tests (SPSS program; Nie et al., 1975).

Selectivity

The linear index of selectivity proposed by Strauss (1979) was used to determine whether *Hydra* fed selectively in Meander Creek Reservoir during the period of time covered by this investigation. The index of selectivity is calculated by $L = r - p$, where: r = the percent of zooplankton species found in the ration and p = the percentage of zooplankton species found in the plankton. The estimated sample variance (s^2) of the population (L) is $s^2(L) = r_i(1-r_i)/n_r + p_i(1-p_i)/n_p$. The Student's t-statistics are used for the evaluation and statistical comparisons (the degrees of freedom, ν, being $n_r + n_p - 2$)

RESULTS

Transparency

During the spring of 1979, the Secchi disc readings increased from 160 cm on April 28 to a maximum of 235 cm on May 17, then decreased to 120 cm by June 1 (mean depth: 170.8 cm ± 58.56 SD; Fig. 3). The spring 1981 transparency readings remained at a value below 170 cm until May 2, then sharply increased throughout the rest of the season to a level of 290 cm by June 12 (Fig. 3). The fall 1979 transparency readings fluctuated about the mean value of 129 cm (SD = 12.5) throughout the season (Fig. 3).

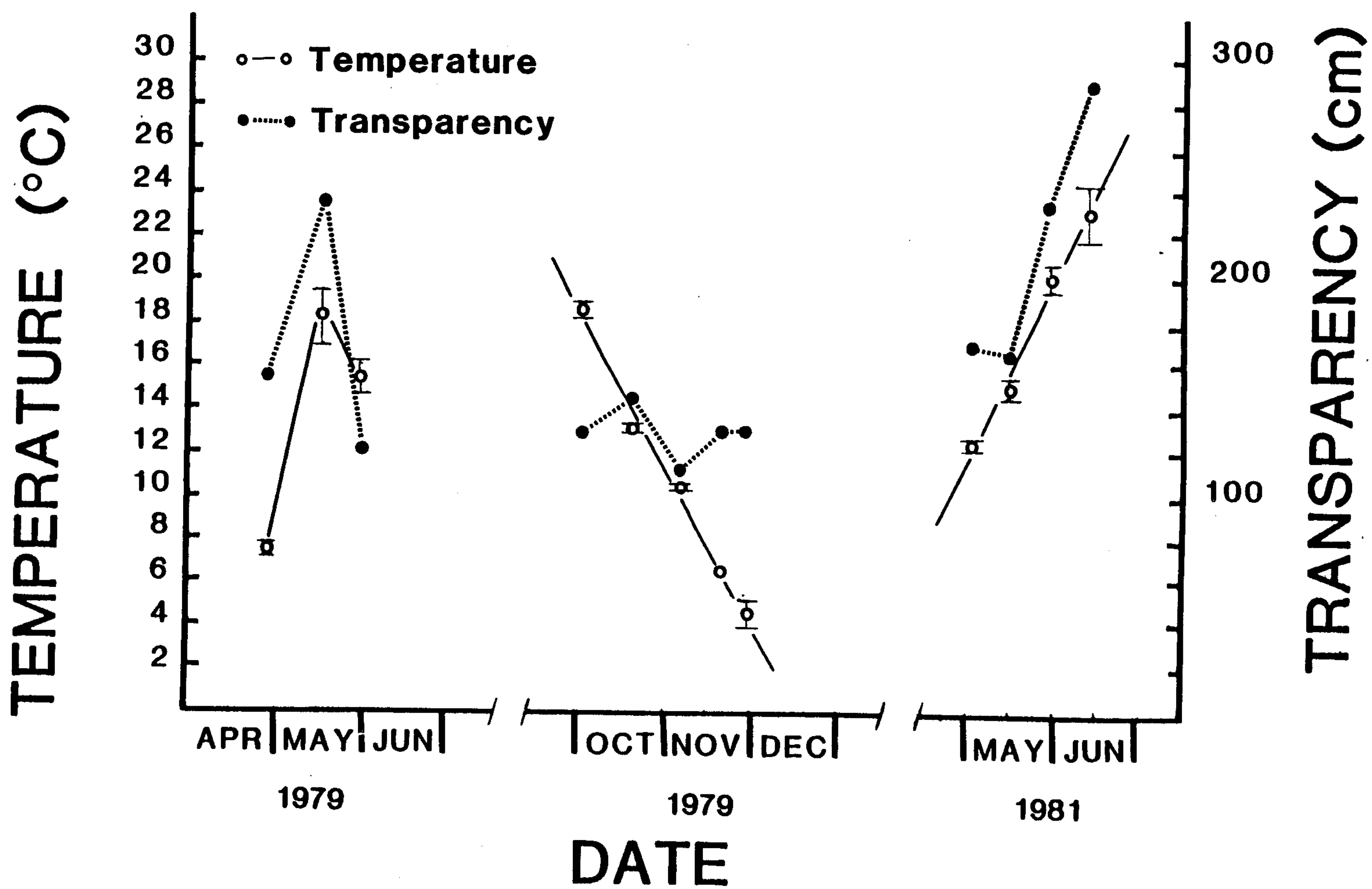
Zooplankton Composition

Twenty-three species of crustacean zooplankton and two genera of rotifers were collected in the plankton tows. The collection included seventeen species of Cladocera and six species of Copepoda. Sixteen of nineteen species identified in the central basin of Lake Erie are common with the Meander Creek Reservoir zooplankton (Palatas, 1972; Watson, 1974). Eleven, out of twelve, species identified by Cummins et al. (1969) are also present in the Meander Creek Reservoir (Table 2). Nine, out of twelve, species identified in Pine Lake (Reeder, 1979) are common with the zooplankton of Meander Creek Reservoir.

Joulerific Value of Zooplankton

The joulerific values of aquatic invertebrates, especially those of the zooplankton, undergo significant seasonal changes (Wissing and Hasler, 1968, 1971; Schindler et al., 1971). The zooplankton joulerific data used in this study were obtained from the Meander Creek Reservoir

Fig. 3.--Mean water column temperatures and Secchi transparency values with time. Solid line represents temperature, while broken line represents Secchi disc readings. Bars denote standard error.



Temperature
Transparency
TEMPERATURE (°C)
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
TRANSPARENCY (cm)
300
200
100
APR
MAY
JUN
1979
OCT
NOV
DEC
1979
MAY
JUN
1981
DATE

Table 2. Zooplankton species identified from the Meander Creek Reservoir, Lake Erie (A and B), Sanctuary Lake (C), and Pine Lake (D). An astrisk (*) indicates a reported occurance.

Meander Creek Reservoir	Regional Sites			
	A[1]	B[2]	C[3]	D[4]
Daphnia galeata mendota Birge	*	*	*	*
Daphnia retrocurva Forbes	*	*	*	*
Daphnia ambigua Scourfield	*	*		*
Daphnia parvula Fordyce	*	*		*
Daphnia longiremus Sars	*			
Daphnia dubia Herrick				
Daphnia pulex Leydig			*	
Ceriodaphnia lacustris Birge	*	*		*
Bosmina longirostris (O.F.M.)	*	*		*
Eubosmina coregoni (Baird)	*	*	*	*
Chydorous sphaericus (O.F.M.)	*	*	*	*
Kurzia latissima (Kurz)				
Alona guttata Sars				
Diaphanosoma leucthenbergianium Fischer	*	*		*
Leptodora kindtii (Focke)	*	*	*	*
Camptocercus rectirostris Schödler				
Sida crystallina (O.F.M.)				
Cyclops bicuspitus thomasi Forbes	*	*		*
Cyclops vernalis Fischer	*	*	*	
Mesocyclops edax Forbes		*		
Diaptomus sicilis Forbes		*		
Diaptomus siciloides Lillij	*	*	*	
Ergasilis megaceros Wilson				
Keratella spp.		*	*	
Polyarthra spp.			*	

1) Central Basin - Lake Erie; Palatas, 1972.
2) Central Basin - Lake Erie; Watson, 1974.
3) Sanctuary Lake - Crawford Co., Pennsylvania; Cummins et al., 1969.
4) Pine Lake - Mahoning Co., Ohio; Reeder, 1979.

studies of Schroeder (unpublished), and Schroeder and Callaghan (1982). The Meander Creek Reservoir zooplankton joulerific content declined, during the spring, from 21.2 kJ/g (April 15) to 20.4 kJ/g (June 15). After the mid June minima, the energy content of the zooplankton increased, through mid September, to 22.8 kJ/g (Fig. 4). The estimates for the energy content of zooplankton from Meander Creek Reservoir (Schroeder, unpublished; Schroeder and Callaghan, 1982) were similar to those for the Lake Mendota collections (Wissing and Hasler, 1968, 1971) and for the Canadian Shield lake collections, obtained in Ontario (Schindler et al., 1971).

Interpolation of the energy content of the ingested zooplankton was based on a least squares regression equation of energy content (in kJ/g with time, in days from January 1). The estimate of $Y = 22.33 - 0.01X$ ($r = -1.0$) describes the curve from April 17 to June 19. The period of time extending from June 20 up to and including October 8 is described by the estimate $Y = 16.92 = 0.02X$ ($r = 0.93$).

Weight Relationship of Hydra with Temperature

The investigations of Callaghan (1978) and Reeder (1979) determined that hydra weight is inversely related to the ambient water temperature (Fig. 5). Linear regression equations estimated the temperature/weight relationship to be $Y = 96 - 2.9X$ ($r = -0.99$) for laboratory reared hydra (Callaghan, 1978) and $Y = 39.59 - 0.75X$ ($r = -0.48$) for hydra collected from Pine Lake (Reeder, 1979). The regression estimate of the Pine Lake hydra (Reeder, 1979) was used to determine the energy based ingestion rate of hydra.

Fig. 4.--Changes in the joulerific content of the zooplankton from the Meander Creek Reservoir with time (in days from January 1). Data from Schroeder (unpublished), and Schroeder and Callaghan (1982).

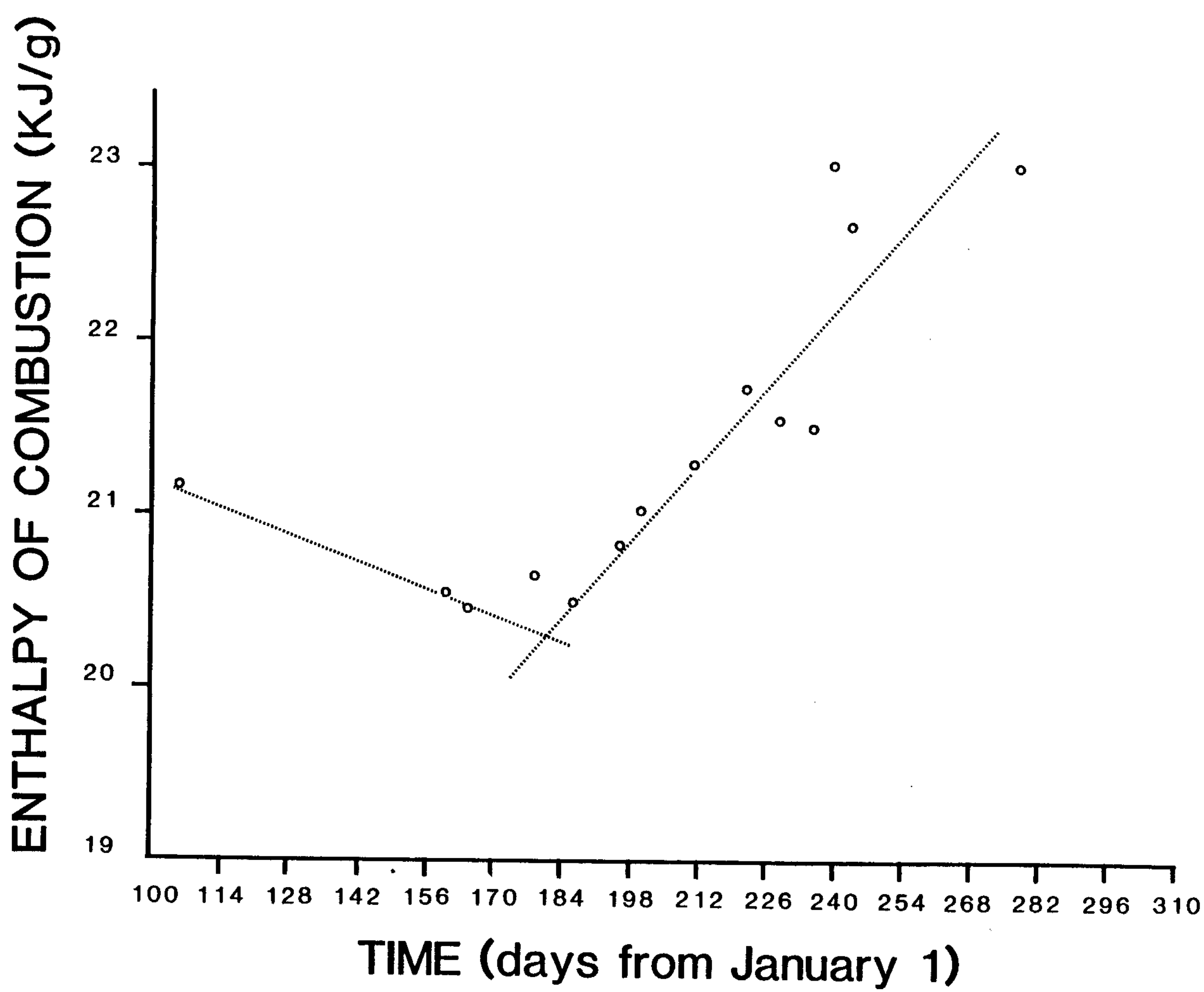
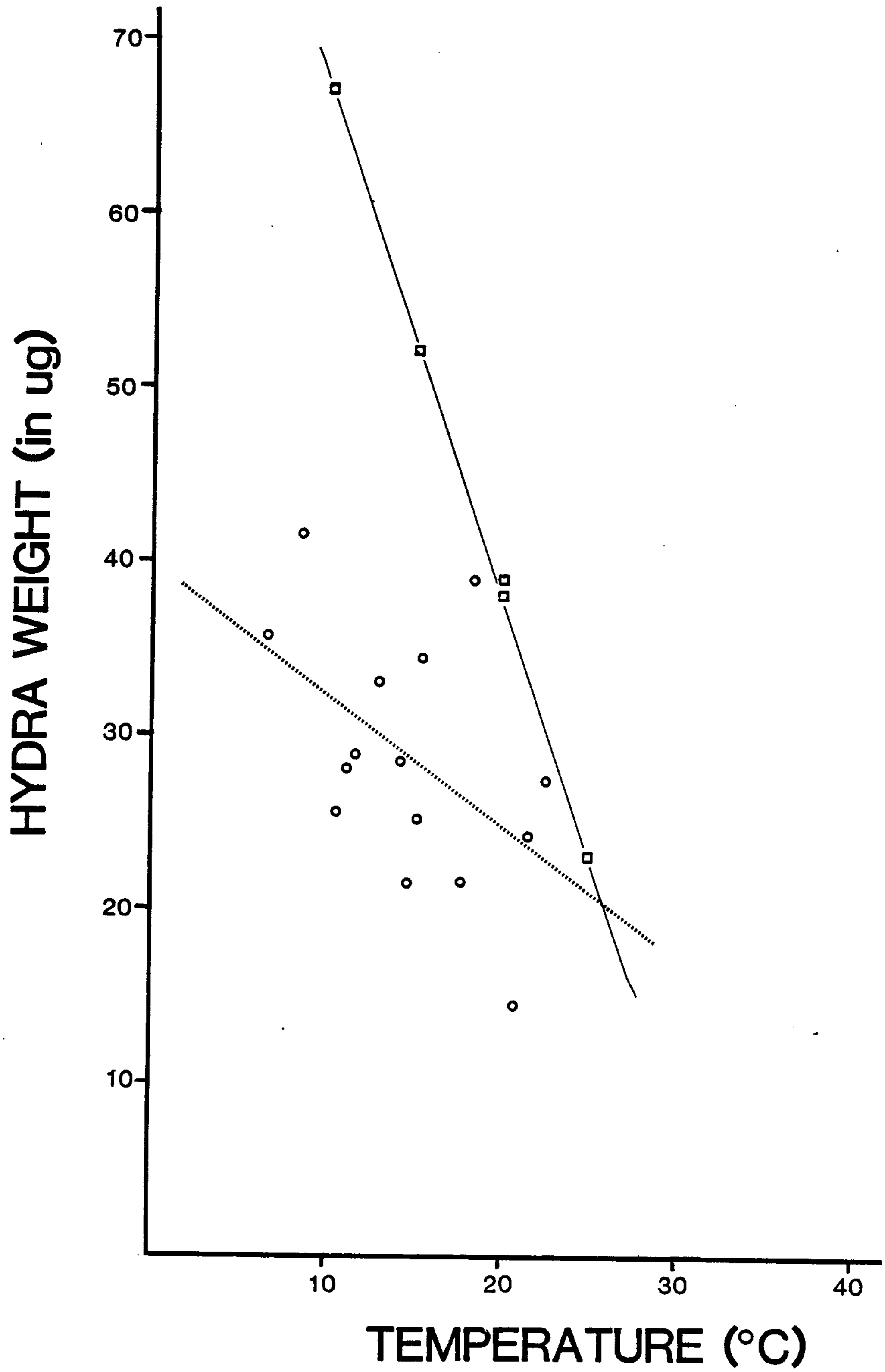

ENTHALPY OF COMBUSTION (KJ/g)
23
22
21
20
19
100 114 128 142 156 170 184 198 212 226 240 254 268 282 296 310
TIME (days from January 1)

Fig. 5.--Temperature induced changes of the weight of *Hydra*. Solid line is the least squares regression line of the data from Callaghan (1978). Broken line is the least squares regression line of the data from Reeder (1979).


70
60
50
40
30
20
10
HYDRA WEIGHT (in ug)
10
20
30
40
TEMPERATURE (°C)

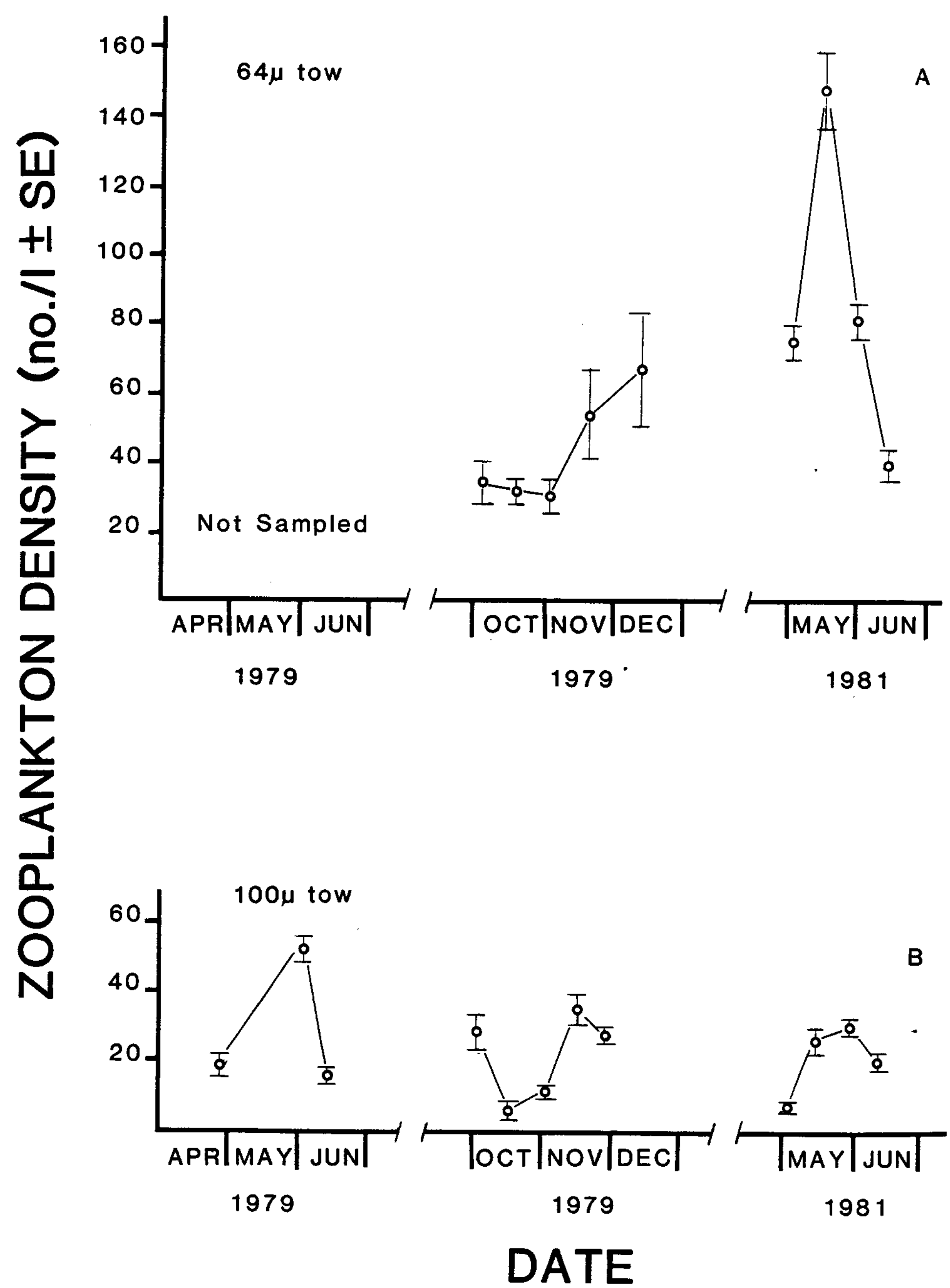
Seasonal Zooplankton Availability

Zooplankton population densities were bicyclic(Fig. 6) with peaks appearing during mid to late May and late November. Maximum densities obtained with the 100μ bucket tow (Fig. 6B) occured on May 15 of 1979 ($\bar{x}$ = 51.9, SE = 3.8, /ℓ) and on May 30 of 1981 ($\bar{x}$ = 30.6, SE = 3.2, /ℓ). Following this peak the 100μ bucket tow densities (Fig. 6B) declined to a mean of 16.1 /ℓ (SE = 2.09) on June 1, 1979 and to 20.0 /ℓ (SE = 2.7) by June 12 of 1981. The densities of the zooplankton sampled with the 64μ bucket tow (Fig. 6A) peaked at 148 /ℓ (SE = 12) on May 15, 1981 then plummeted to a mean value of 39.9 /ℓ (SE = 2.7) by June 12.

During the fall of 1979, the zooplankton density equaled or exceeded the spring zooplankton density. The 64μ bucket tow (Fig. 6A) density remained at a mean value of 32.4 /ℓ (SE = 1.2) through November 2. Following the November 2 collection, the density sharply increased until November 30 when it reached a mean density of 68.1 /ℓ (SE = 16.3). The 100μ bucket tow density (Fig. 6B) increased during the fall from October 20 ($\bar{x}$ = 5.0 /ℓ, SE = 1.4) through November 30 ($\bar{x}$ = 27.7 /ℓ, SE = 2.1). The seasonal distribution of the zooplankton densities is similar to those reported by Reeder (1979) for Pine Lake.

The vertical tow biomass estimates (Appendix D) documented a bicyclic fluctuation typical of other temperate basins. By May 15, 1979 the biomass estimates attained a maximum of 186 mg/m^3 (SE = 42.2). During the spring of 1981, the biomass maximum was observed on May 30 at 157 mg/m^3 (SE = 63.8) for the 100μ bucket tow, and 237 mg/m^3 (SE = 67.5) for the 64μ bucket tow. The zooplankton biomass remained at concentrations of less than 150 mg/m^3 (SE = 54.8), during the fall, for the 100μ bucket tows.

Fig. 6.--Seasonal distribution of the zooplankton, expressed as mean numbers per liter (no./l). Bars denote standard error.


ZOOPLANKTON DENSITY (no./l ± SE)
160
140
120
100
80
60
40
20
64μ tow
Not Sampled
A
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
60
40
20
100μ tow
B
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
DATE

Utilization of the 100μ zooplankton bucket failed to sample much of the zooplankton. During the spring of 1981 only 28 percent of the zooplankton population sampled with the 64μ plankton bucket was collected with the 100μ bucket tows (Appendix D). During the fall of 1979, the 100μ plankton bucket tow collections were found to contain only 48 percent of the total zooplankton biomass collected with the 64μ zooplankton bucket. The difference in the biomass estimates is attributed to the difference in the plankton buckets' mesh size. Similar population estimation differences have been reported by Saville (1956), and Edmonson and Winberg (1971).

The zooplankton community was predominantly composed of cladocerans during the spring and copepods during the fall. During the spring of 1979 (100μ bucket tow) the percentage of Daphnia comprising the total zooplankton population density increased from 25 percent, on May 28, to 81 percent by June 1. The spring 1981 population (100μ bucket tow) increased from 36 percent, on May 2, to 81 percent by June 12. The percentage of daphnids, collected with the 64μ bucket tow, increased from 11 percent, on May 2, to 52 percent by June 12.

Seven species of Daphnia were identified in the Meander Creek Reservoir. Daphnia galeata mendota, D. retrocurva, and D. ambigua each consistantly contributed greater than two percent to the total population density. The combined remaining species, D. parvula, D. longispina, D. dubia, and D. pulex contributed less than one percent to the total spring zooplankton population density. The dominant daphnid during the spring, D. g. mendota, attained a maximum density of 29.7 /ℓ (SE = 2.3) on May 15 and declined to 9.1 /ℓ (SE = 0.9) by June 1, during 1979 (Fig. 7A). During the spring of 1981, D. g. mendota attained a maximum density of 19.8/ℓ (SE = 2.5) on May 30 (Fig. 7A and 7B).

The percentage of the zooplankton consisting of daphnids, collected during the fall with the 100μ bucket tow remained constant (below 37 percent). However, the daphnid population sampled with the 64μ bucket tow increased from 17 percent of the total zooplankton population on October 20 to 72 percent by November 30. Daphnid densities remained low during the fall. Except for the December 30 collection, the samples did not exceed 10/ℓ. The dominant daphnid during the fall was *D. retrocurva* (Fig. 7A and 7B).

The bosminids contributed less than 4 percent to the zooplankton (100μ bucket tow) during the spring of 1979. During the spring of 1981, the bosminid percentage of the zooplankton declined from 23 percent on May 15 to 1.7 percent by June 12 using the 64μ bucket, while the percentage of the zooplankton collected with the 100μ bucket tow declined from 13 percent on May 2 to 1.1 percent by June 12. During the fall of 1979 the bosminid percentage increased from 3 percent on October 4 to 23 percent on November 17 (64μ bucket tow). By November 30 the bosminids declined to 12 percent of the zooplankton population.

Bosmina longirostris is the dominant species of bosminids during spring. The maximum density observed for *B. longirostris* was 0.5/ℓ (SE = 0.2) on May 17, 1979 and 2.4/ℓ (SE = 1.0) on May 15, 1981, for the 100μ bucket tows (Fig. 7C). The *B. longirostris* population sampled with the 64μ bucket tow reached a minimum density of 30.8/ℓ (SE = 2.9) on May 15 (Fig. 7D). *Eubosmina coregoni* shared a similar population density during the spring (Fig. 7C and 7D).

E. coregoni became the dominant bosminid during the fall. The

E. coregoni population density was about 1.0/ℓ through November 3 with a maximum density of 12/ℓ (SE = 2.9) Fig. 7D) on November 17.

The percentage of adult copepods that comprised the zooplankton declined during the spring of 1979 (100μ bucket tow) from 71 percent, on May 28, to 15 percent by June 1. The copepods sampled during the spring of 1981 declined from 44 percent on May 2 to 15 percent by June 12, for the 100μ bucket tow, and from 26 percent on May 28 to 16 percent by June 12, for the 64μ bucket tow. The fall copepod densities remained high during 1979. The percentage of copepods composing the fall zooplankton increased from 44 percent on October 5 to 68 percent by November 3, then declined, by November 30, to 25 percent (64μ bucket tow).

The Meander Creek Reservoir copepods include the cyclopoids Cyclops bicuspitus thomasi, C. vernalis, and Mesocyclops edax, and the calanoids Diaptomus sicilis and D. siciloides. Of the copepods, C. b. thomasi is the dominant copepod during the spring. The densities of C. b. thomasi decreased from 8.0/ℓ (SE = 1.0) on April 28 to 0.4/ℓ (SE = 0.1) by June 1 of 1979 (Fig. 7E). During the spring of 1981, population densities declined from a high of 15.2/ℓ (SE = 2.1) on May 2 to 0.5/ℓ (SE = 0.1) by June 12 (Fig. 7F). M. edax maintained relatively constant densities of less than 5.0/ℓ throughout the spring (Fig. 7E and 7F).

During the fall of 1979, M. edax was the dominant cyclopoid through October 20 at densities of less than 5.0/ℓ (Fig. 7F). The density of C. b. thomasi remained low through October 20, then sharply increased to about 7.0/ℓ (SE = 2.9) by November 30 (Fig. 7E).

The adult calanoids attained their spring peak densities by mid to late May and declined throughout June. D. sicilis, the dominant calanoid, never exceeded a density of 4.0/ℓ, while D. siciloides never exceeded 2.0/ℓ (Fig. 7G and 7H).

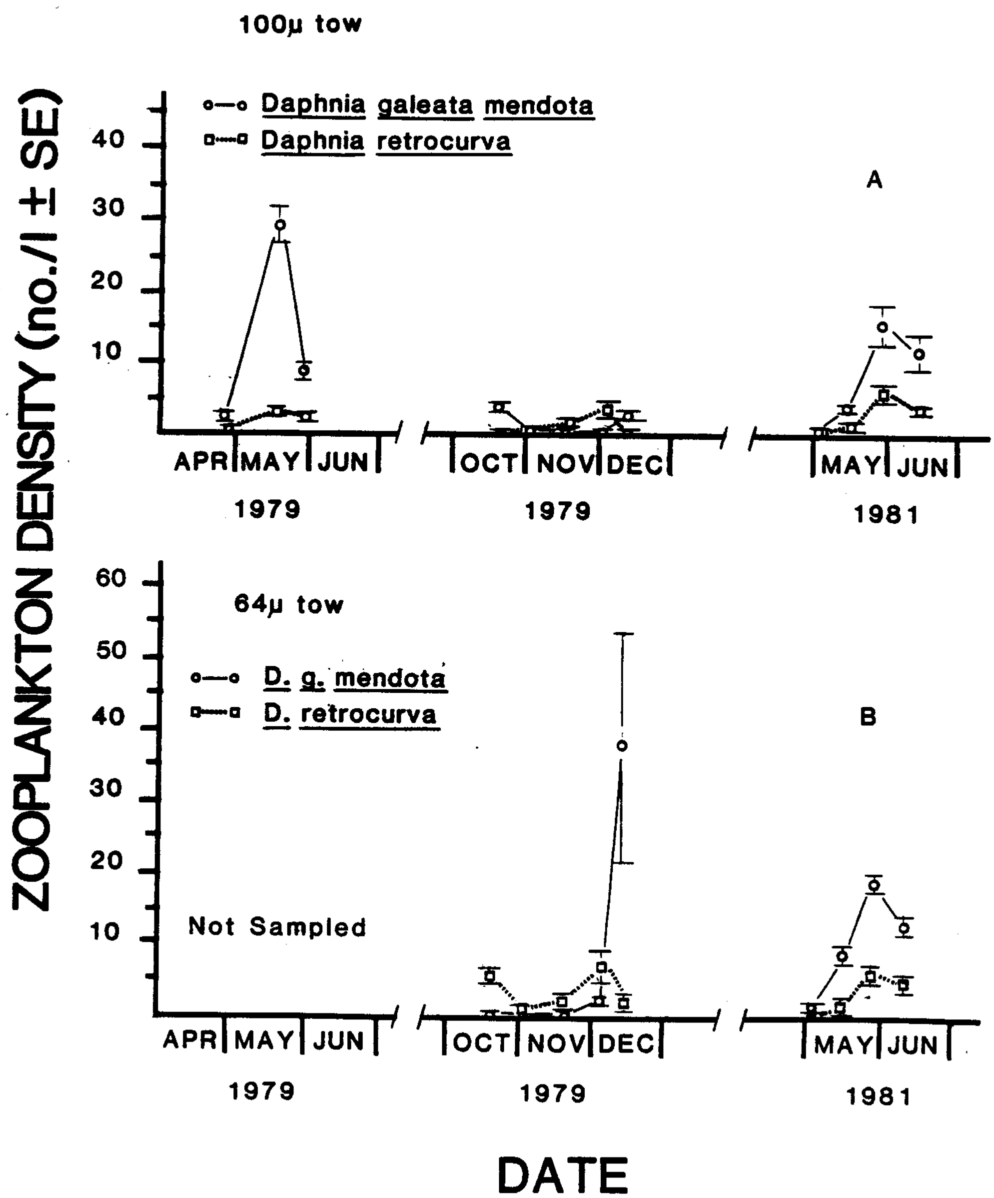
The fall populations of D. siciloides remained below 4.0/ℓ through November 3, then increased to a maximum of 6.3/ℓ (SE = 1.5) by November 17 (Fig. 7H). The population density of D. sicilis increased from 2.0/ℓ (SE = 0.5), on October 20 to 8.0/ℓ (SE = 0.3) by November 30 for the 100μ bucket tows (Fig. 7G). Conversely, for the 64μ bucket tows, the densities of D. sicilis declined from 9.2/ℓ (SE = 2.3), on October 5, to 6.9/ℓ (SE = 0.7) by November 30 (Fig. 7H).

The percentage of the zooplankton composed of the nauplii and copepodite copepods, collected with the 100μ bucket tow, decreased during the spring of 1979 from 4 percent on April 28 to 2 percent by June 1. During the spring of 1981 the nauplii and copepodites sampled with the 100μ bucket tow declined from 8 percent, on May 2, to 3 percent by June 12, while those sampled with the 64μ bucket tow declined from 42 percent, on May 2, to 30 percent by June 12, of the zooplankton population.

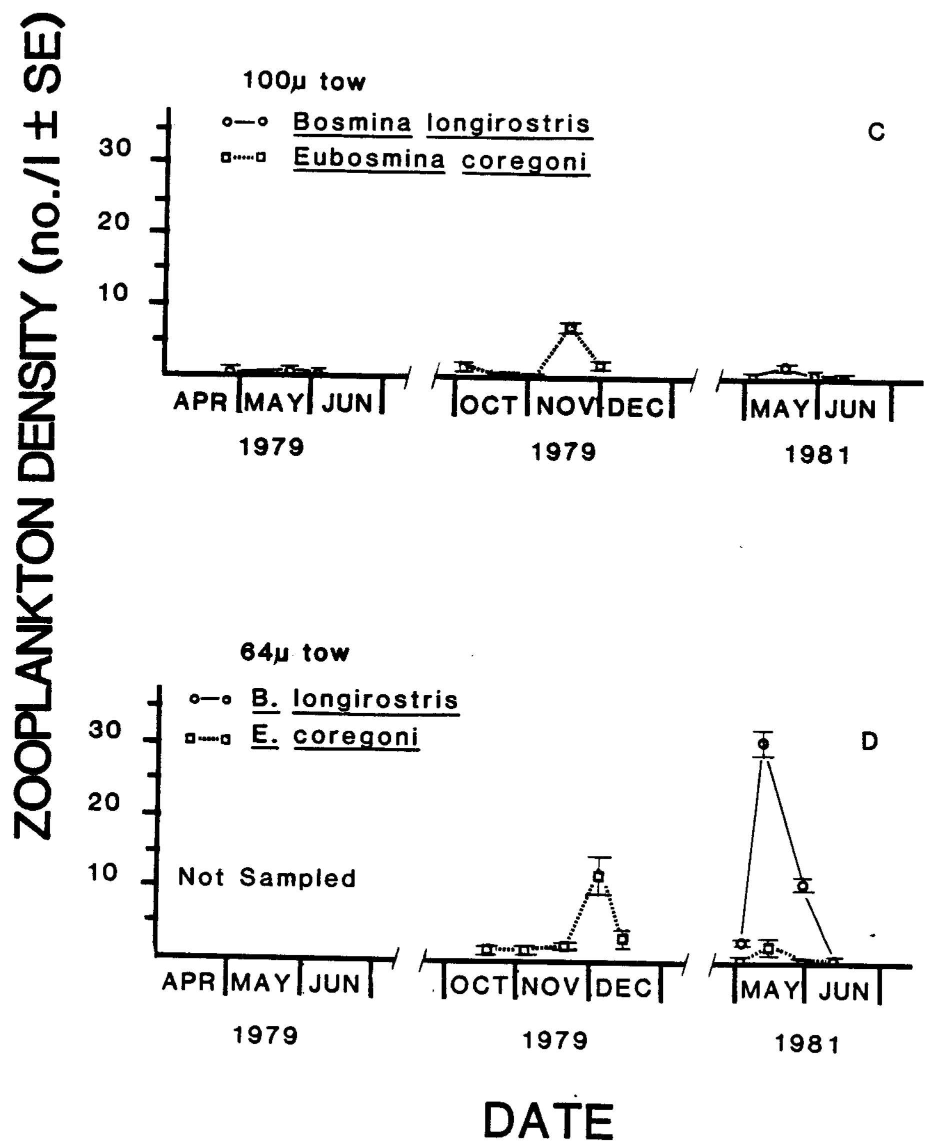
The nauplii and copepodite density declined similarly to the adult copepoid densities. The nauplii density in the 64μ tow (Fig. 7J), during the spring of 1981, declined from 7.0/ℓ (SE = 0.7), on May 2, to 1.9/ℓ (SE = 0.6) by June 12. The fall nauplii population declined from 3.0/ℓ (SE = 1.2), on October 5, to 0.8/ℓ (SE = 0.3) by November 30 (Fig. 7J). During the spring of 1981 the copepodites declined from 17.9/ℓ (SE = 1.1), on May 2, to 2.0/ℓ (SE = 0.3) by June 12 (Fig. 7J). The fall 1979 copepodite population declined from 3.9/ℓ (SE = 1.7), on October 5, to 1.4/ℓ (SE = 0.6) by November 30 (Fig. 7J).

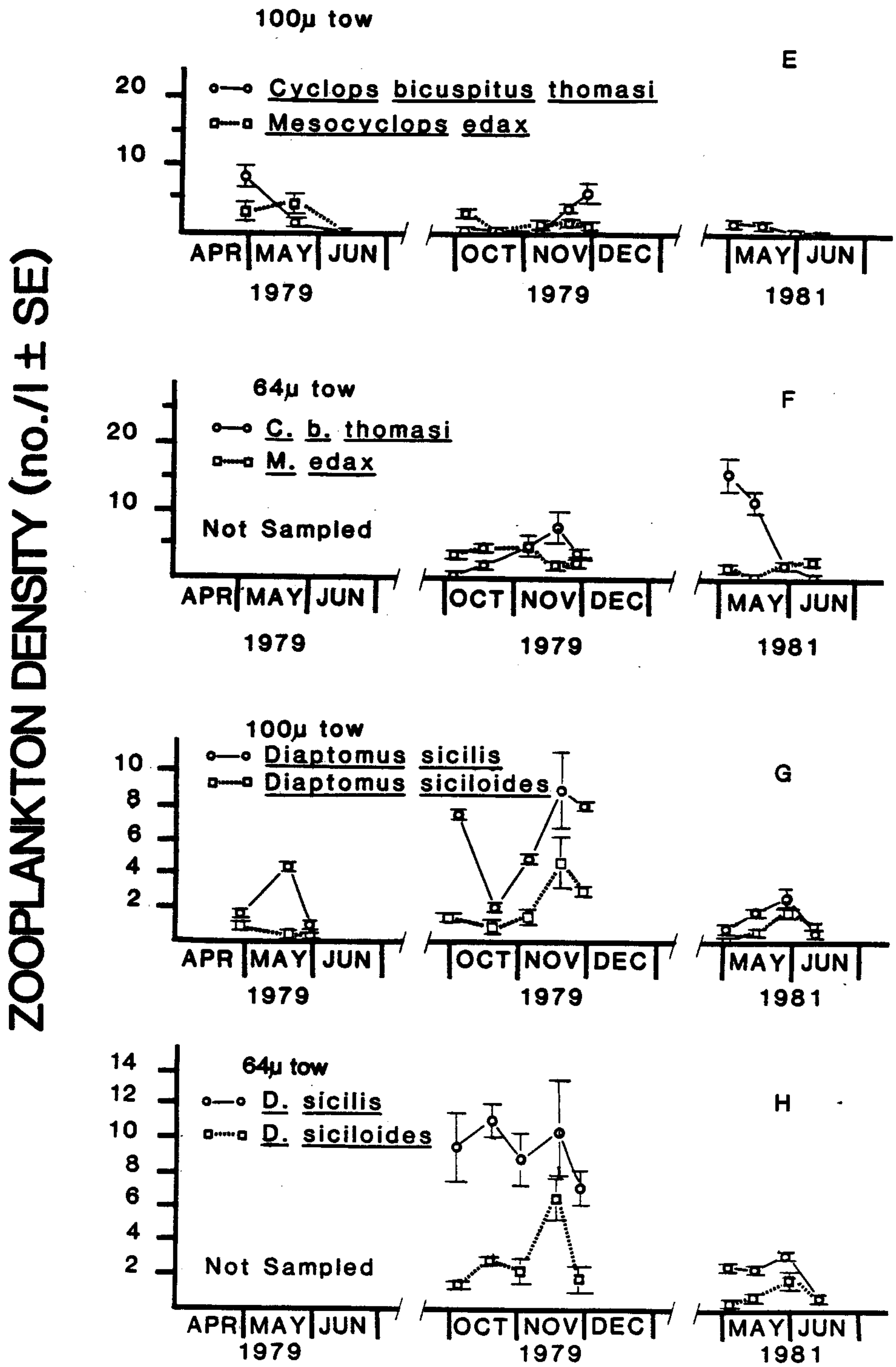
The rotifers were not observed to substantially contribute to the zooplankton population during the spring and fall of 1979. The

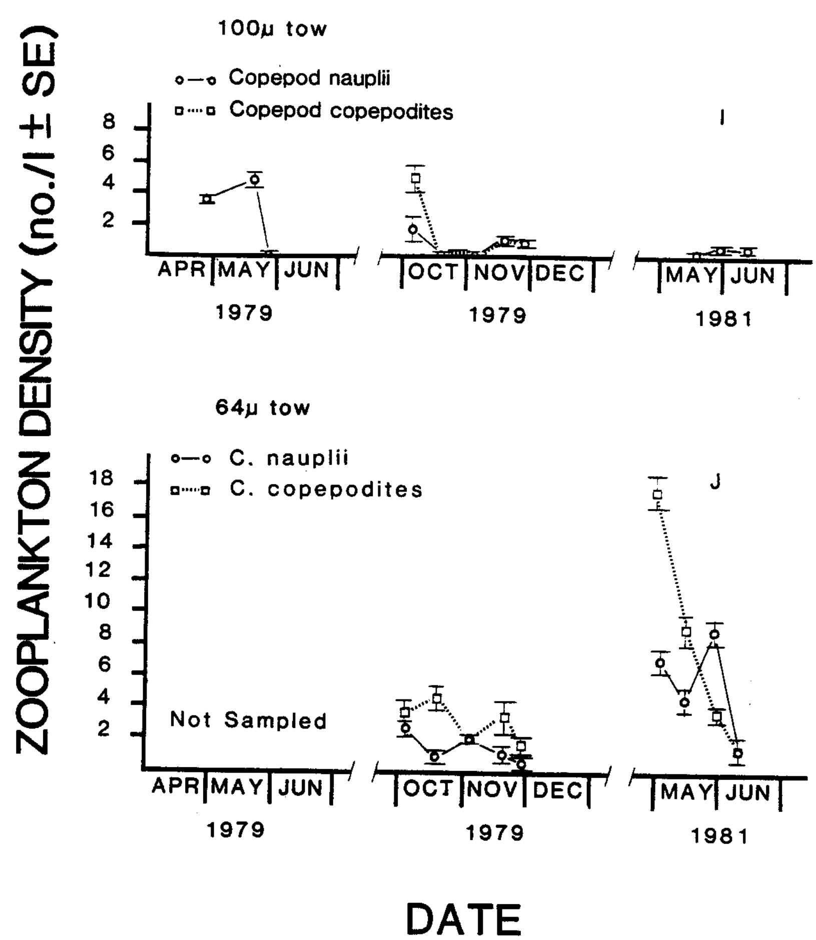
Fig. 7.--Seasonal distribution of the zooplankton species, expressed in numbers per liter (no./l). Bars denote standard error.



100µ tow
Daphnia galeata mendota
Daphnia retrocurva
A
40
30
20
10
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
64µ tow
D. g. mendota
D. retrocurva
B
60
50
40
30
20
10
Not Sampled
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
ZOOPLANKTON DENSITY (no./l ± SE)
DATE


ZOOPLANKTON DENSITY (no./l ± SE)
100μ tow
Bosmina longirostris
Eubosmina coregoni
C
30
20
10
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
64μ tow
B. longirostris
E. coregoni
D
30
20
10
Not Sampled
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
DATE


ZOOPLANKTON DENSITY (no./l ± SE)
100μ tow
E
Cyclops bicuspitus thomasi
Mesocyclops edax
20
10
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
64μ tow
F
C. b. thomasi
M. edax
20
10
Not Sampled
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
100μ tow
G
Diaptomus sicilis
Diaptomus siciloides
10
8
6
4
2
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981
64μ tow
H
D. sicilis
D. siciloides
14
12
10
8
6
4
2
Not Sampled
APR MAY JUN
1979
OCT NOV DEC
1979
MAY JUN
1981


ZOOPLANKTON DENSITY (no./l ± SE)
100μ tow
Copepod nauplii
Copepod copepodites
I
8
6
4
2
APR
MAY
JUN
1979
OCT
NOV
DEC
1979
MAY
JUN
1981
64μ tow
C. nauplii
C. copepodites
J
18
16
14
12
10
8
6
4
2
Not Sampled
APR
MAY
JUN
1979
OCT
NOV
DEC
1979
MAY
JUN
1981
DATE

maximum percentage of rotifers appearing in the zooplankton during the spring and fall of 1979 was 0.7 (November 3). However, both the 100μ and 64μ vertical tows, during the spring of 1981, sampled substantial rotifer populations. The rotifer population sampled with the 100μ bucket tow had a maximum of 38 percent, on May 15, which declined to 0.3 percent, by June 12, of the total number of zooplankton. The rotifer population sampled with the 64μ vertical tow had a maximum of 42 percent, on May 15, that declined to 0.9 percent by June 12. The maximum density observed on May 15, 1981, for the 100μ vertical tow was 10.2/ℓ and for the 64μ vertical tow was 62.0/ℓ. Although the rotifers substantially contributed to the zooplankton density, the rotifer contribution to the zooplankton biomass was insignificant (Appendix D).

Planktonic Hydra

Although not reported in the zooplankton density data, planktonic hydra were collected in the vertical tows during the spring collections of 1979 and 1981 (Table 3). Planktonic hydra have occasionally been collected in other studies (Welsh and Loomis, 1924; Miller, 1936; Batha, 1974). Hydra may become planktonic either by direct dislodgement by wind generated currents, wave action, scraping (Miller, 1936; Batha, 1974) or by the secretion of a gas bubble beneath the basal disc and floating away through the water column (Łomnicki and Slobodkin, 1966). The accidental removal of the *Hydra* from the *Myriophyllum* was not a factor since the sampling site was located well outside the nearest *Myriophyllum* bed. The dredging up of the *Hydra* from the sediments was also prevented by not allowing the plankton net to be dragged along the bottom. The collected material did not have any extraneous material in-

Table 3. Hydra collected in the Meander Creek Reservoir vertical tows. Mean expressed in numbers per liter. SE denotes standard error. N denotes the number of vertical tows using both the 64μ and the 100μ plankton buckets.

Date	N	$\bar{x}$	SE
04/28/79	12	0.02	0.02
05/17/79	12	0	0
06/01/79	12	0.03	0.02
10/05/79	12	0	0
10/20/79	12	0	0
11/03/79	12	0	0
11/17/79	12	0	0
11/30/79	12	0	0
05/02/81	24	0.18	0.06
05/15/81	24	0	0
05/30/81	24	0.01	<0.01
06/12/81	24	0	0

dicating either contamination from the sediments or from the *Myriophyllum*.

Zooplankton Densities with Time of Day per Collection Date

Variation within the daily collections was found to be significant (One-way Analysis of Variance; Nie et al., 1975) at $P < 0.05$ during both the spring and fall collections (Table 4). The spring collections had no obvious pattern of time dependent densities. The fall collections, on the other hand, tended to have a maximum at 10:00 hours. The zooplankton density variations are most likely due to inherent patchiness caused by Langmuir currents (Langmuir, 1938; Stavn, 1971; George and Edwards, 1973), zooplankton patch and net size (Weibe and Holland, 1968; Weibe, 1971), species density of zooplankton (Weibe, 1971), reproductive assemblages of zooplankton (Brandl and Fernando, 1970), reactions to light (Hutchinson, 1967), and shoreline avoidance (Wetzel, 1975).

Feeding Electivity

The T-test results of the Strauss feeding selectivity index are found in Appendix G. During the spring of 1979 and 1981 the hydras did not consistently feed selectively. However, during the fall of 1979 the hydras consistently fed upon the zooplankton *D. sicilis* and *C. b. thomasi* ($P < 0.05$; Appendix G). *C. b. thomasi* had an electivity index of 18, while *D. sicilis* had an index of -21.

Seasonal Ingestion of Zooplankton by Hydra

Ingestion, during the spring of 1979 and 1981, declined as the season progressed (Fig. 8A; Appendix E). The ingestion rate during 1979 decreased steadily from 0.90/growth axis (GA) (SE = 0.04) on April 28 to 0.55/GA (SE = 0.02) by June 1. During the spring of 1981, ingestion decreased from 1.17/GA (SE = 0.04) on May 2 to 0.30/GA

Table 4. One-way Analysis of Variance and Scheffe's Multiple Range test results--64μ tow. B represents between groups variation (i.e. time of collection). W denotes within groups variation (i.e. replication). T denotes total variation. (†) signifies that the Scheffe's test is not applicable since there are less than three groups. Significance at 95% (*) and 99% (**).

Date	Source	df	Mean Square	F	Homogeneous Subsets
10/05/79	B	1	186208.80	182.08**	2 > 4†
	W	4	1022.67		
	T	5			
10/20/79	B	1	486.00	0.89	2 = 4†
	W	4	574.33		
	T	5			
11/03/79	B	1	45213.94	223.90**	4 > 2†
	W	4	202.90		
	T	5			
11/17/79	B	1	204241.50	266.52**	2 > 4†
	W	4	766.33		
	T	5			
11/30/79	B	1	349450.50	347.65**	2 > 4†
	W	4	1005.17		
	T	5			
05/02/81	B	3	39368.07	14.34**	3 = 4 = 2 > 1
	W	9	2746.18		
	T	12			
05/15/81	B	3	82501.69	3.63	3 = 1 = 2 = 4
	W	8	22708.74		
	T	11			
05/30/81	B	3	26944.17	12.53**	2 = 3 = 1 > 4
	W	8	2151.42		
	T	11			
06/12/81	B	3	5853.98	3.36	3 = 4 = 1 = 2
	W	8	1737.08		
	T	11			

Table 4 (Continued). One-way Analysis of Variance and Scheffe's Multiple Range test results--100μ tow.

Date	Source	df	Mean Square	F	Homogeneous Subsets
04/28/79	B	3	34347.16	17.01^{**}	3 > 1 = 4 = 2
	W	8	2019.83		
	T	11			
05/17/79	B	3	98463.53	69.50^{**}	1 > 2 = 3 = 4
	W	8	1416.67		
	T	11			
06/01/79	B	3	30405.53	141.59^{**}	4 > 3 = 2 = 1
	W	8	214.75		
	T	11			
10/05/79	B	1	114816.56	173.00^{**}	$2 > 4^{\dagger}$
	W	4	663.67		
	T	5			
10/20/79	B	1	2948.16	170.90^{**}	$4 > 2^{\dagger}$
	W	4	17.33		
	T	5			
11/03/79	B	1	130.67	1.01	$4 = 2^{\dagger}$
	W	4	118.67		
	T	5			
11/17/79	B	1	17712.60	16.43^{*}	$2 = 4^{\dagger}$
	W	4	4311.33		
	T	5			
11/30/79	B	1	6016.65	40.56^{**}	$2 > 4^{\dagger}$
	W	4	148.33		
	T	5			
05/02/81	B	3	2154.01	3.16	3 = 2 = 4 = 1
	W	9	680.75		
	T	12			
05/15/81	B	3	1878.24	2.60	2 = 1 = 3 = 4
	W	8	722.40		
	T	11			
05/30/81	B	3	43722.68	54.81^{**}	3 = 2 = 1 > 4
	W	8	828.00		
	T	11			
06/12/81	B	3	25328.84	12.53^{**}	3 = 4 > 4 = 2 = 1
	W	8	2020.25		
	T	11			

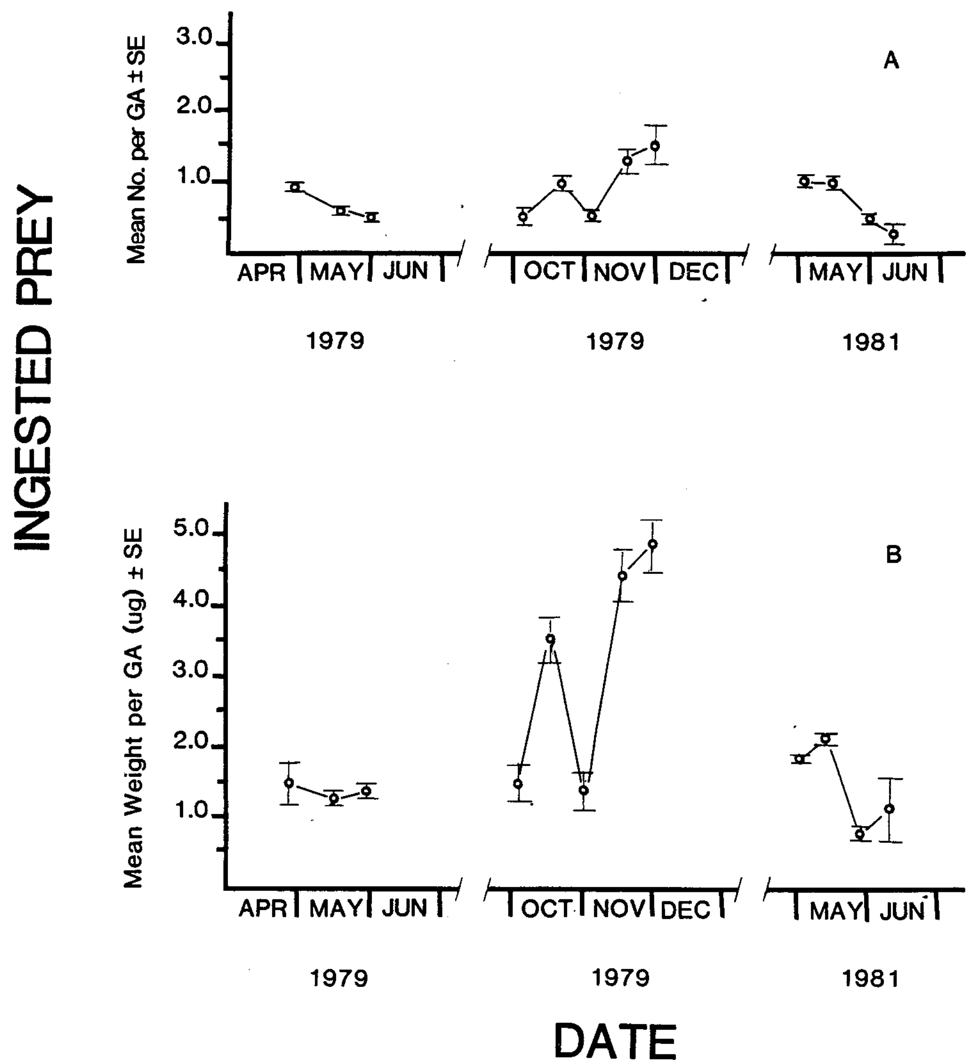
(SE = 0.03) by June 12.

The ingestion of zooplankton tended to increase throughout the fall (Fig. 8). Ingestion increased from 0.59/GA (SE = 0.07), on October 5 to 1.66/GA (SE = 0.15) by November 30. The low value on November 3 (0.62/GA, SE = 0.05) is considered to be abnormally low and not indicative of the general seasonal trend.

The patterns of ingestion based on biomass (Fig. 8B) and energy (Fig. 8C) were similar to the pattern based on the number of zooplankton ingested per GA (Fig. 8A). The variability of the data tends to be greater for the weight and energy based rates, but the seasonal trends were similar to those based upon numbers. The percentage of hydras containing ingested zooplankton is indicative of the feeding rates. The percentage of hydra containing prey decreased from over 60 to 40 percent during the spring of 1979, and from 70 to 20 percent during the spring of 1981 (Fig. 9). Conversely, during the fall of 1979, the percentage of hydras containing prey increased from about 50 to 80 percent of the total population (Fig. 9).

Ingestion of Daphnia galeata mendota, by hydra, attained a maximum of 0.10/GA (SE = 0.01) by May 17, then declined to 0.09/GA (SE = 0.01) by June 1, during the spring of 1979 (Fig. 10A). Ingestion of Daphnia retrocurva during the spring of 1979 reached a maximum by May 17 at 0.10/GA (SE = 0.01) and declined to 0.06/GA (SE = 0.01) by June 1 (Fig. 10A). During the spring of 1981, hydra ingested 0.27/GA (SE = 0.02) of D. g. mendota on May 15, which decreased to 0.11/GA (SE = 0.08) by June 12 (Fig. 10A). Ingestion of D. retrocurva peaked at 0.21/GA (SE = 0.02) on May 15, the declined to 0.09/GA (SE = 0.05) by June 12, during 1981 (Fig. 10A).

Fig. 8.--Seasonal ingestion of zooplankton by Hydra; expressed as a) mean numbers per growth axis(/GA), b) mean weight of prey per growth axis, c) ingested energy (kJ) of zooplankton per kJ of hydra. Bars denote standard error.


INGESTED PREY
Mean No. per GA ± SE
3.0
2.0
1.0
A
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
Mean Weight per GA (ug) ± SE
5.0
4.0
3.0
2.0
1.0
B
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
DATE

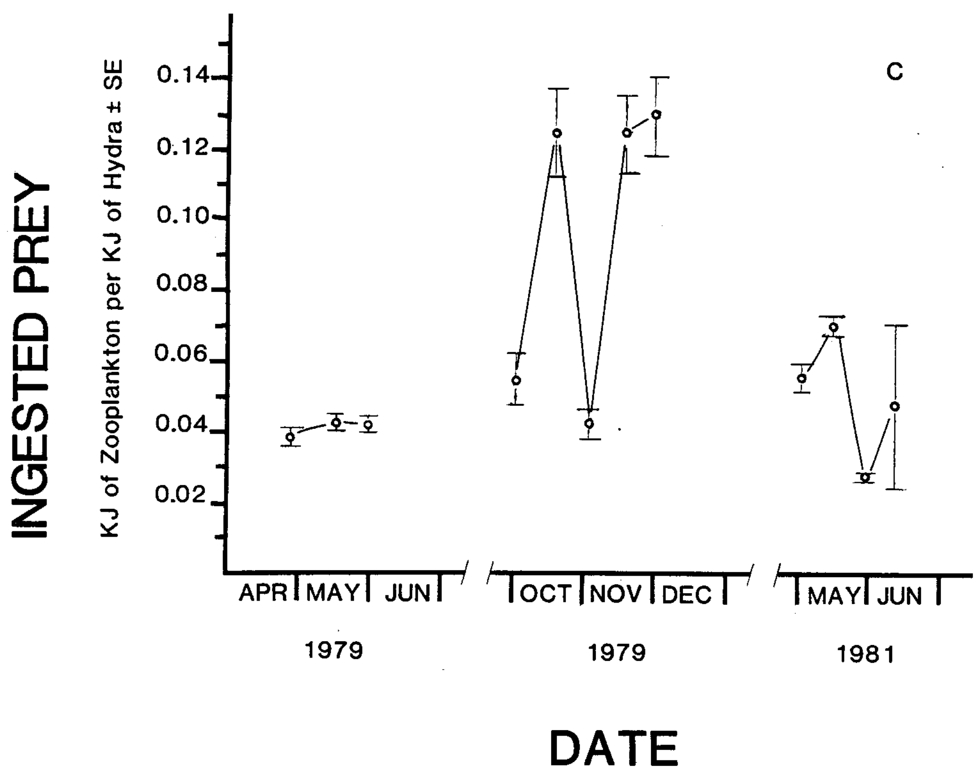
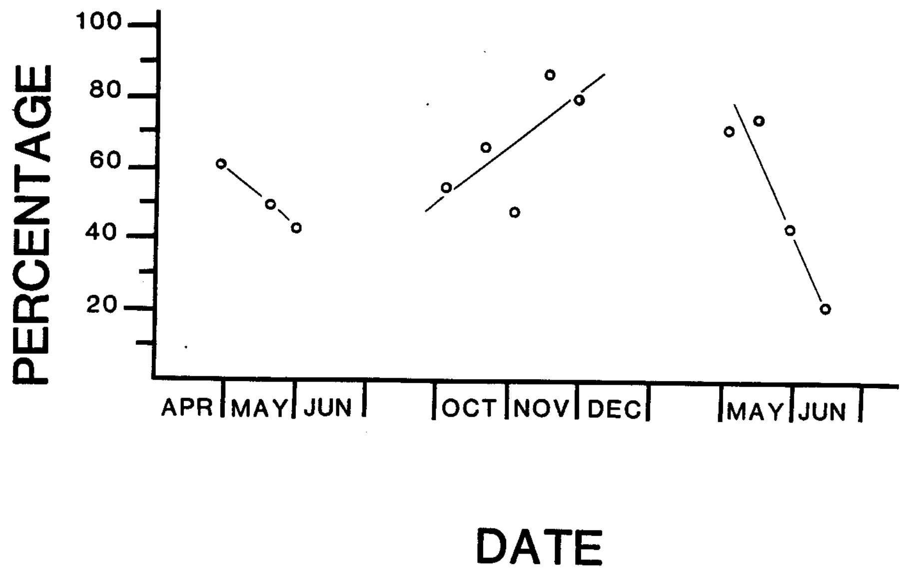

INGESTED PREY
KJ of Zooplankton per KJ of Hydra ± SE
0.14
0.12
0.10
0.08
0.06
0.04
0.02
C
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
DATE

Fig. 9.--The total percentage of *Hydra* containing ingested prey.



PERCENTAGE
100
80
60
40
20
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
DATE

Ingestion of D. retrocurva was greater than the ingestion of D. g. mendota through the November 5, 1979 collection (Fig. 10A). On November 17, the ingestion of D. g. mendota peaked at 0.24/GA (SE = 0.04), while the ingestion of D. retrocurva peaked at 0.23/GA (SE = 0.04). The ingestion rate declined on November 30.

The ingestion rates of B. longirostris reached their maximum on May 30 of 1979 and May 15 of 1981, then declined through the month of June (Fig. 10B). The maximum ingestion of B. longirostris was 0.08/GA (SE = 0.01) during 1979 and 0.28/GA (SE = 0.02) during 1981. Ingestion of Eubosmina coregoni was 0.01/GA (SE = 0.002) on May 17, 1979 and 0.02/GA (SE = 0.004) on May 2, of 1981.

Hydra maintained a relatively constant ingestion rate of E. coregoni below 0.04/GA during the fall of 1979 (Fig. 10B). The ingestion rate of B. longirostris also remained constant from October 5 (0.03/GA, SE = 0.01) to November 30 (0.03/GA, SE = 0.01 (Fig. 10B). Ingestion of B. longirostris was 0.07/GA (SE = 0.02) on November 17, which was not reflected in either the 64μ or 100μ vertical tow density estimates.

Ingestion of the copepod Cyclops bicuspitus thomasi sharply declined during the spring of 1979 from 0.17/GA (SE = 0.01) on April 28 to 0.11/GA (SE = 0.01) by June 1 (Fig. 10D). During the spring of 1981 the ingestion of C. b. thomasi decreased from 0.25/GA (SE = 0.02) to 0.04/GA (SE = 0.04) for the collection period of May 2 through June 12. Mesocyclops edax and Cyclops vernalis both declined in a similar manner through the spring, but their maxima did not exceed 0.02/GA (Fig. 10D).

During the fall of 1979, ingestion of C. b. thomasi increased from 0.10/GA (SE = 0.03) on October 5 to 0.67/GA (SE = 0.08) by

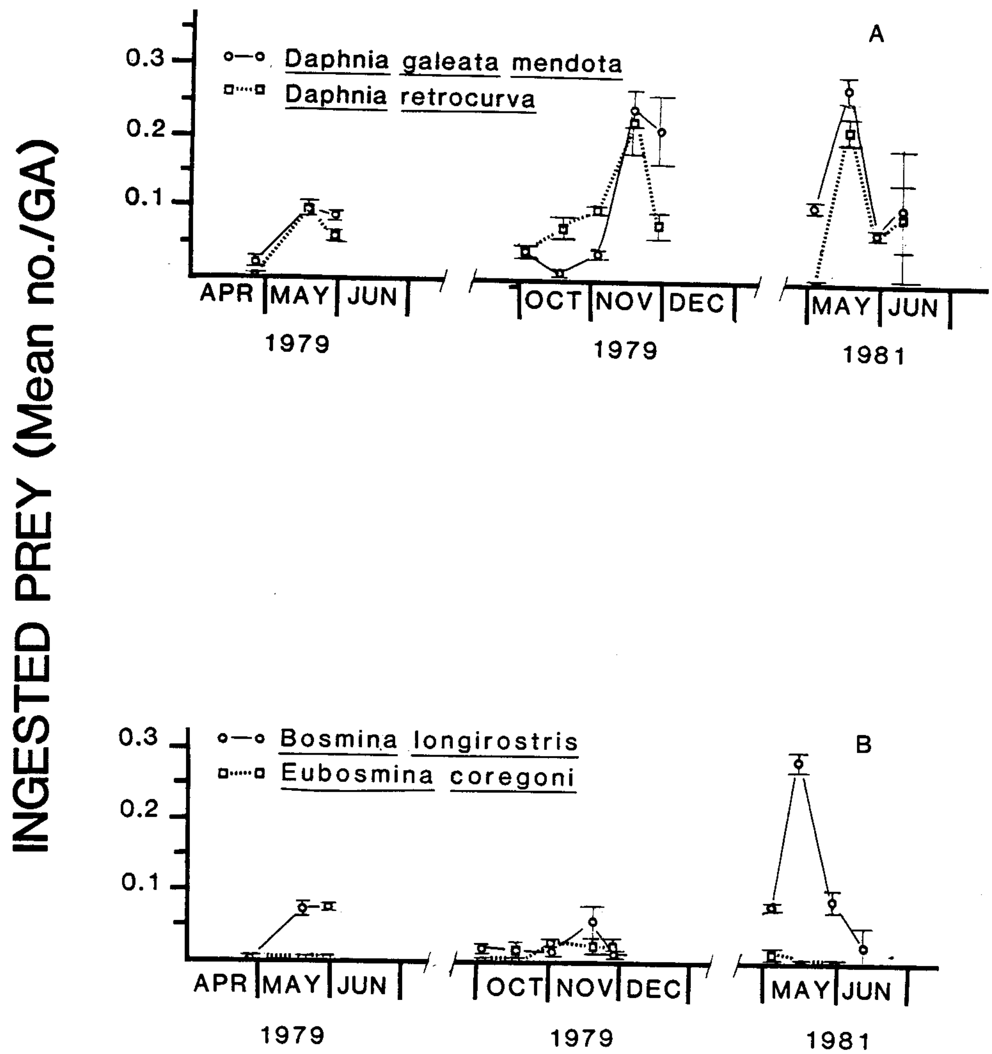
November 30 (Fig. 10D). The maximum ingestion of M. edax was 0.21/GA (SE = 0.04) on October 20, which declined to 0.03/GA (SE = 0.02) by November 30 of 1979 (Fig. 10D).

Ingestion of the diaptomids, D. sicilis and D. siciloides, during the spring of 1979 and 1981 was less than 2 percent of the total ingested zooplankton. During the fall of 1979 the diaptomids contributed only 1 to 6 percent of the total zooplankton ingestion. D. sicilis (Fig. 10C) remained constant from October 5 (0.03/GA, SE = 0.01) to November 17 (0.02/GA, SE = 0.01), and increased to 0.05/GA (SE = 0.02) by November 30. Ingestion of D. siciloides (Fig. 10C) remained constant from October 20 through November 30 (0.06/GA, SE = 0.01). The ingestion of the diaptomids did not closely correspond with the density estimates for either the 64μ or 100μ vertical tows (Fig. 10C vs. Figs. 7G & 7H).

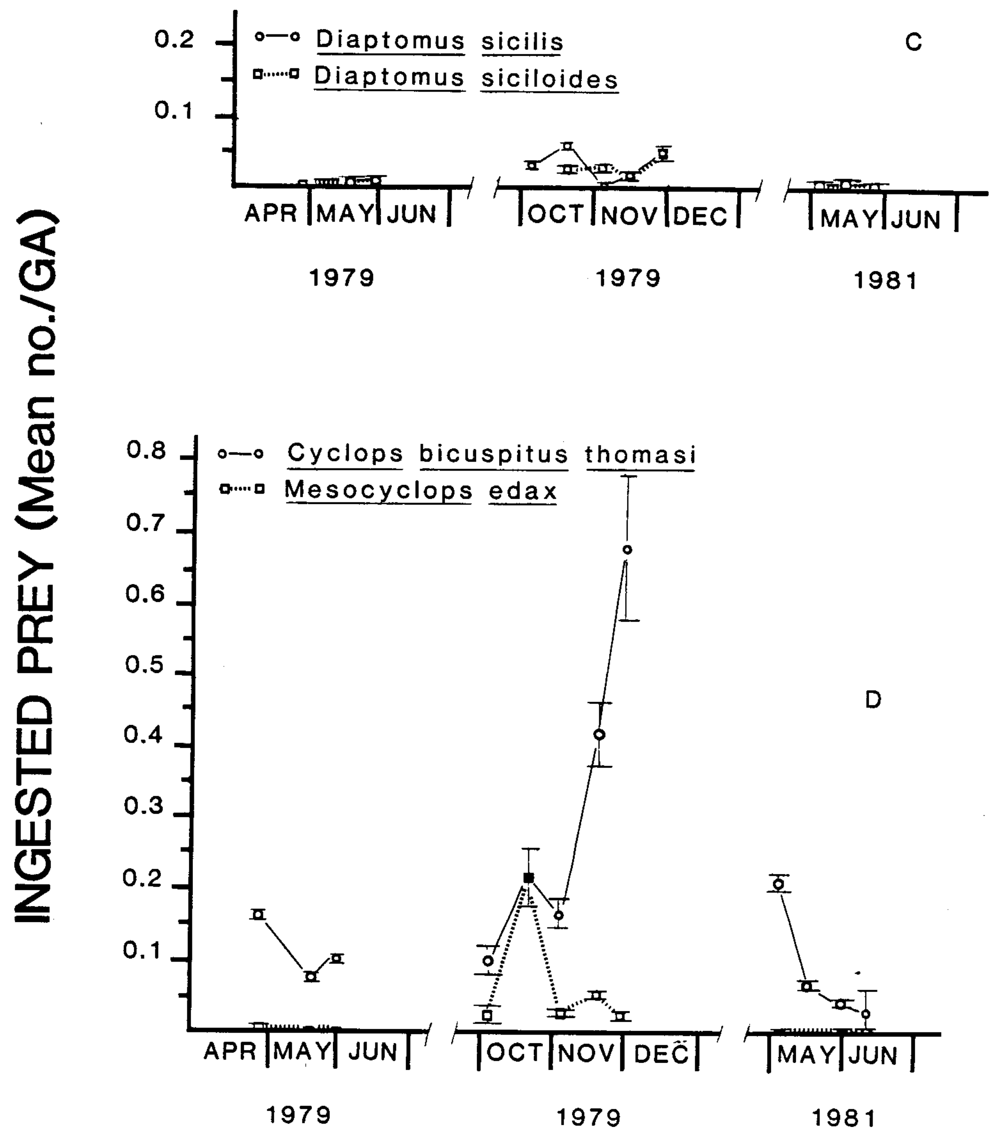
Ingestion of the copepod nauplii (Fig. 10E) during the spring of 1979 steadily decreased from 0.21/GA (SE = 0.02) on April 28 to 0.03/GA (SE = 0.003) by June 1. During the spring of 1981, ingestion of the nauplii decreased from 0.25/GA (SE = 0.02) on May 2 to 0.10/GA (SE = 0.01) by May 30, then to zero by June 12. Ingestion of the copepod copepodites (Fig. 10E) during the spring of 1979 declined from 0.11/GA (SE = 0.01) on May 28 to 0.05/GA (SE = 0.01) by June 1. During the spring of 1981, the ingestion of the copepodites declined from 0.35/GA (SE = 0.02) on May 2 to 0.08/GA (SE = 0.01) on May 30, then to zero by June 12.

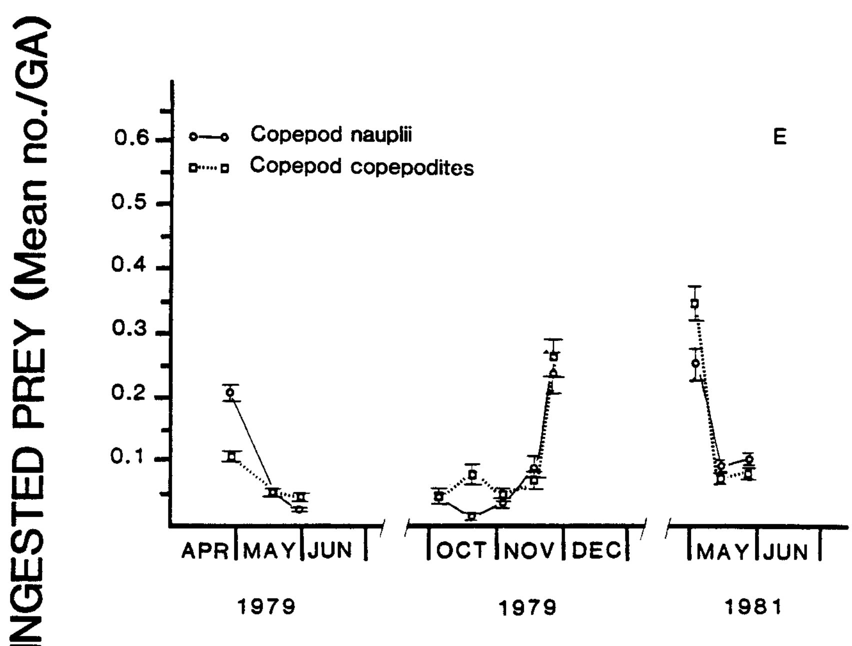
During the fall of 1979 (Fig. 10E), ingestion of the nauplii was less than 0.05/GA (SE = 0.02) through November 3, then increased to 0.24/GA (SE = 0.05) by November 30. Ingestion of the copepodites remained at levels below 0.08/GA (SE = 0.02) through November 17, then increased to

Fig. 10.--Mean number of the zooplankton species ingested by *Hydra*. Bars denote standard error.



INGESTED PREY (Mean no./GA)
A
Daphnia galeata mendota
Daphnia retrocurva
0.3
0.2
0.1
APR
MAY
JUN
1979
OCT
NOV
DEC
1979
MAY
JUN
1981
B
Bosmina longirostris
Eubosmina coregoni
0.3
0.2
0.1
APR
MAY
JUN
1979
OCT
NOV
DEC
1979
MAY
JUN
1981


INGESTED PREY (Mean no./GA)
0.2
0.1
Diaptomus sicilis
Diaptomus siciloides
C
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Cyclops bicuspitus thomasi
Mesocyclops edax
D
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981


INGESTED PREY (Mean no./GA)
0.6
0.5
0.4
0.3
0.2
0.1
Copepod nauplii
Copepod copepodites
E
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981

0.26/GA (SE = 0.04) by November 30.

Ingestion of the rotifers during the spring of 1979 decreased from 0.25/GA (SE = 0.02) on April 28 to 0.05/GA (SE = 0.01) by June 1. During the spring of 1981 however, the hydra ingested less than 0.02 /GA (SE = 0.01) throughout the season. During the fall of 1979 ingestion of the rotifers remained below 0.06/GA (SE = 0.01).

Ingestion of Zooplankton with Time of Day per Collection Date

Ingestion rates of zooplankton with time of day were consistantly significant (One-way Analysis of Variance; Nie et al., 1975) at $P < 0.05$ during the spring of 1979 and 1981, but not during the fall of 1979 (Table 5). The greatest period of feeding tended to be during the evening at 22:00 or 04:00 hours (Scheffe's Multiple Range Test; Nie et al., 1975; Table 5).

Condition and Density Indices of Hydra in Meander Creek Reservoir

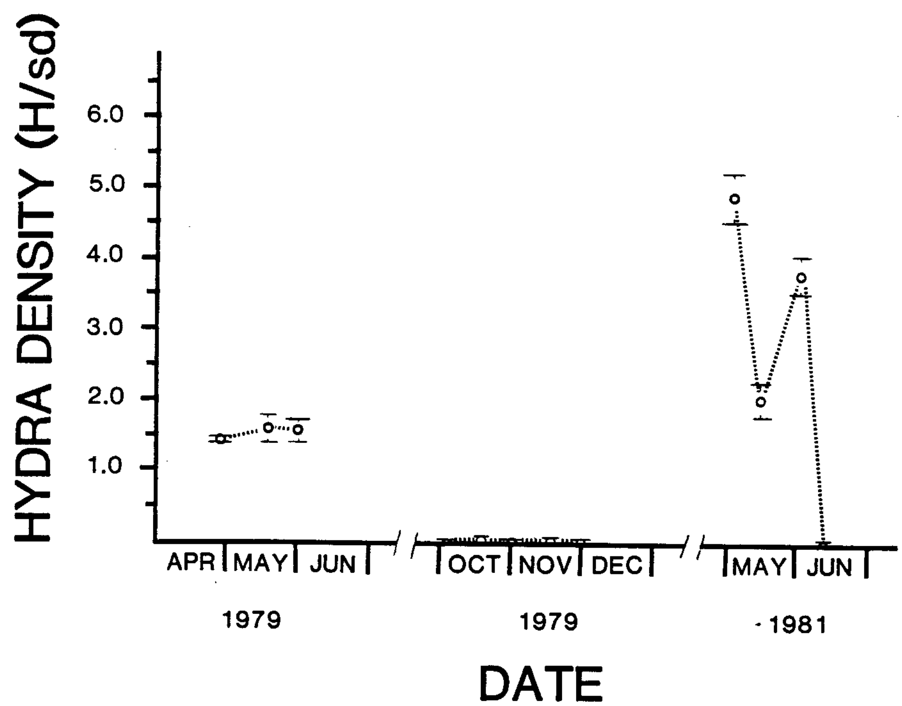
The density of hydra is expressed as either the number of hydra basal-discs per slide divided by the number of days in the lake (BDI), or the number of growth axes per slides per day (GAI). Both the BDI (Fig. 11) and the GAI (Fig. 12) are bicyclic. The spring population attained a high density, while the fall population remained at a low constant density.

The BDI (Fig. 11) attained a maximum of 1.62 H/slide·day (SE = 0.17), but sampling was discontinued before the expected decline. The 1981 hydra population attained its maximum density on May 30 at 3.81 H/sd (SE = 0.23), then declined rapidly to 0.01 H/sd (SE = 0.004) by June 12, 1981. The BDI for the fall population did not increase as sharply as for the spring population. The fall population increased from

Table 5. One-way Analysis of Variance and Scheffe's Multiple Range test of the number of zooplankton ingested with the time of day. B represents between groups variation (i.e. time of collection). W denotes within groups variation (i.e. replications). T denotes total variation. (†) denotes that the Scheffe's test is not applicable since there are less than three groups. Significance at 95% (*) and 99% (**).

Date	Source	df	Mean Square	F	Homogeneous Subsets
04/28/79	B	3	15.55	3.69*	1 = 3 > 4 = 2
	W	1092	4.21		
	T	1095			
05/17/79	B	3	307.98	75.92**	4 = 1 > 3 = 2
	W	1689	4.06		
	T	1692			
06/01/79	B	3	107.23	55.74**	1 > 4 > 2 > 3
	W	2096	1.93		
	T	2099			
10/05/79	B	1	3.26	1.24	4 = 2†
	W	347	2.63		
	T	348			
10/20/79	B	1	7.64	2.03	4 = 2†
	W	219	3.76		
	T	220			
11/03/79	B	1	64.87	33.58**	2 > 4†
	W	347	1.93		
	T	348			
11/17/79	B	1	9.93	1.97	2 = 4†
	W	126	5.04		
	T	127			
11/30/79	B	1	39.36	9.38**	4 > 2†
	W	158	4.20		
	T	159			
05/02/81	B	3	278.49	62.65**	4 > 1 = 3 > 3 = 2
	W	926	4.44		
	T	929			
05/15/81	B	3	228.98	47.30**	1 > 3 = 2 > 2 = 4
	W	849	4.84		
	T	852			
05/30/81	B	3	112.30	68.36**	1 = 2 > 4 = 3
	W	956	1.64		
	T	959			
06/12/81	B	3	0.23	0.31	1 = 3 = 4 = 2
	W	23	0.75		
	T	26			

Fig. 11.--Seasonal change of mean Hydra density, expressed as hydra basal-discs per slide divided by the number of days in the water (H/sd). Bars denote standard error.



HYDRA DENSITY (H/sd)
6.0
5.0
4.0
3.0
2.0
1.0
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
DATE

Fig. 12.--Changes of *Hydra* density with time, expressed as growth axes per slide divided by the number of days in the water (GA/sd). Bars denote standard error.

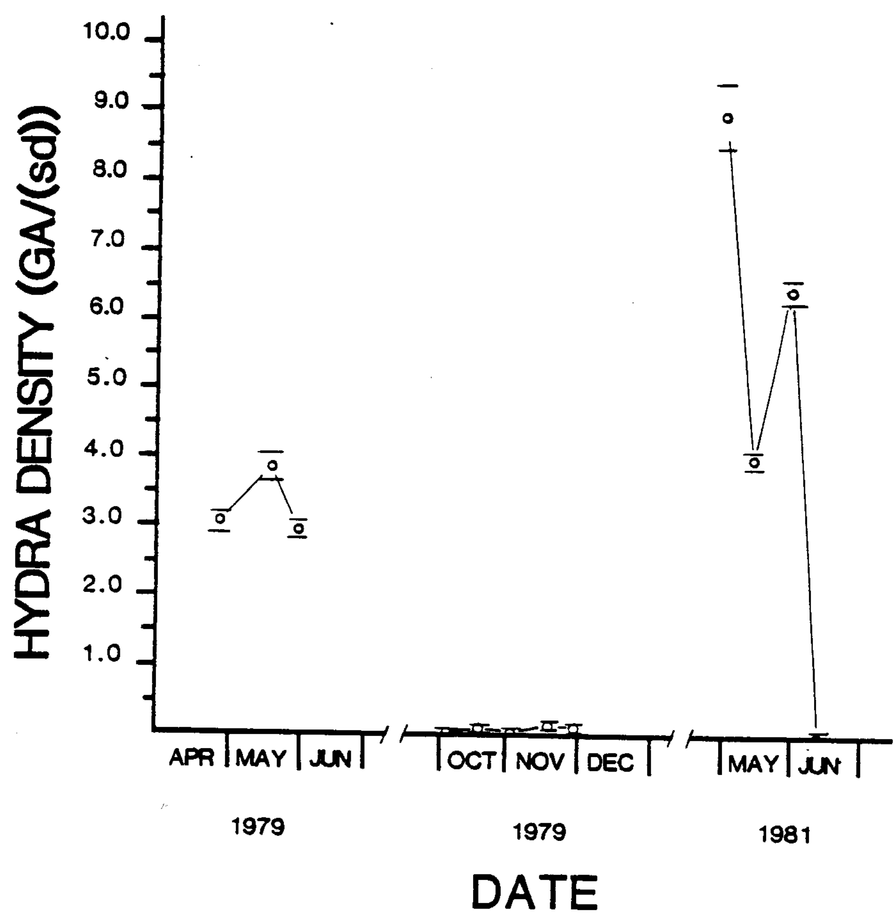
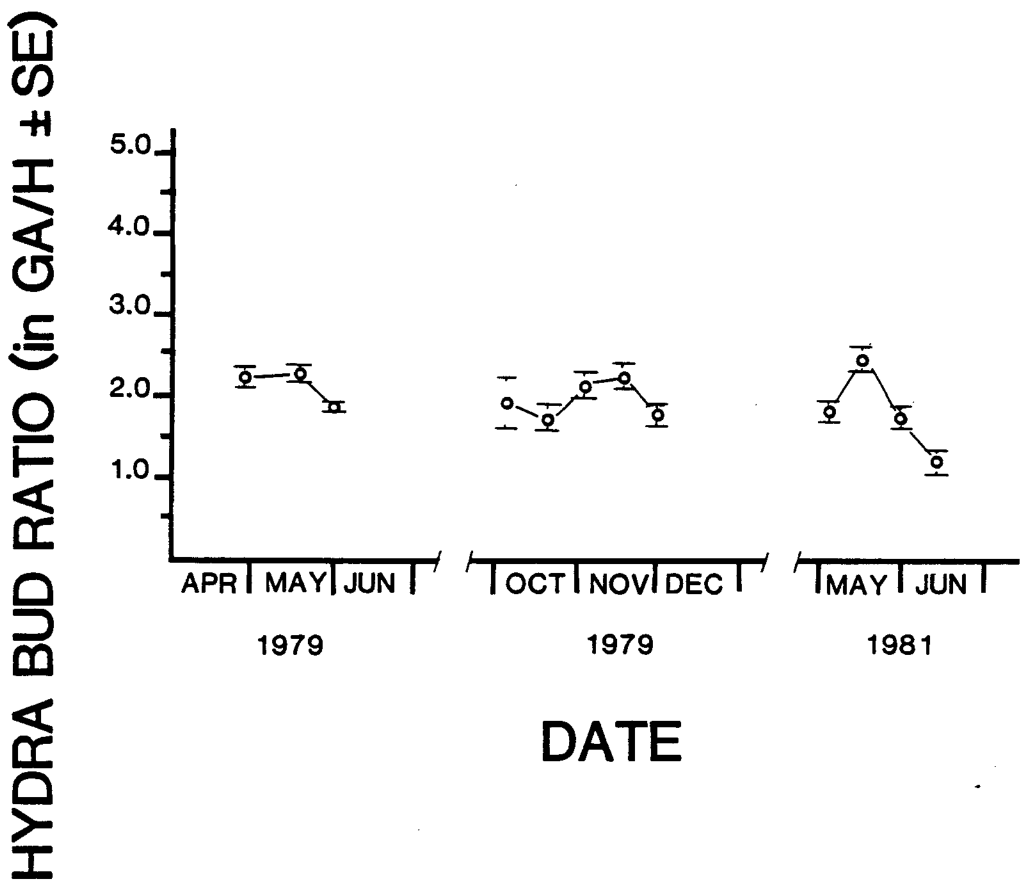

HYDRA DENSITY (GA/(sd))
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
DATE

Fig. 13.--Seasonal change of the hydra bud ratio, expressed as the number of growth axes per basal-disc (GA/H). Bars denote standard error.


HYDRA BUD RATIO (in GA/H ± SE)
5.0
4.0
3.0
2.0
1.0
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
DATE

0.01 H/sd (SE = 0.01) on October 5 to a mean level of 0.15 H/sd (SE = 0.02) from October 20 through November 30 of 1979.

The GAI curve (Fig. 12) is similar to that of the BDI curve (Fig. 11). The spring hydra population attained a maximum GAI density of 3.94 GA/sd (SE = 0.28) on May 17 and declined to 2.98 GA/sd (SE = 0.53) by June 1 of 1979. During the spring of 1981 the GAI declined throughout the season from 8.89 GA/sd (SE = 0.51) on May 2 to 0.01 GA/sd (SE = 0.03) by June 12. During the fall of 1979, the GAI increased from 0.07 GA/sd (SE = 0.02) on October 5 to a mean density of 0.30 H/sd (SE = 0.03) from October 20 through November 30.

The hydra bud ratio (HBR), the number of growth axes per number of basal-discs (Fig. 13), is an index of the hydra population condition, and is dependant upon the availability of food and the ambient water temperature (Bryden, 1952; Schroeder and Callaghan, 1982). Hydra collected during the spring attained an HBR maximum of 2.3 GA/H (SE = 0.06) on May 17, 1979 and 2.47 GA/H (SE = 0.13) on May 15, 1981. The HBR then rapidly declined to a value of 1.80 GA/H (SE = 0.03) by June 1, 1979 and 1.26 GA/H (SE = 0.11) by June 12, 1981. During the fall of 1979, the HBR increased to a maximum of 2.23 GA/H (SE = 0.11) on November 17, then declined to 1.80 GA/H (SE = 0.07) by November 30. The range of the HBR during both seasons is similar to those reported by Reeder (1979) for the hydra collected from Pine Lake.

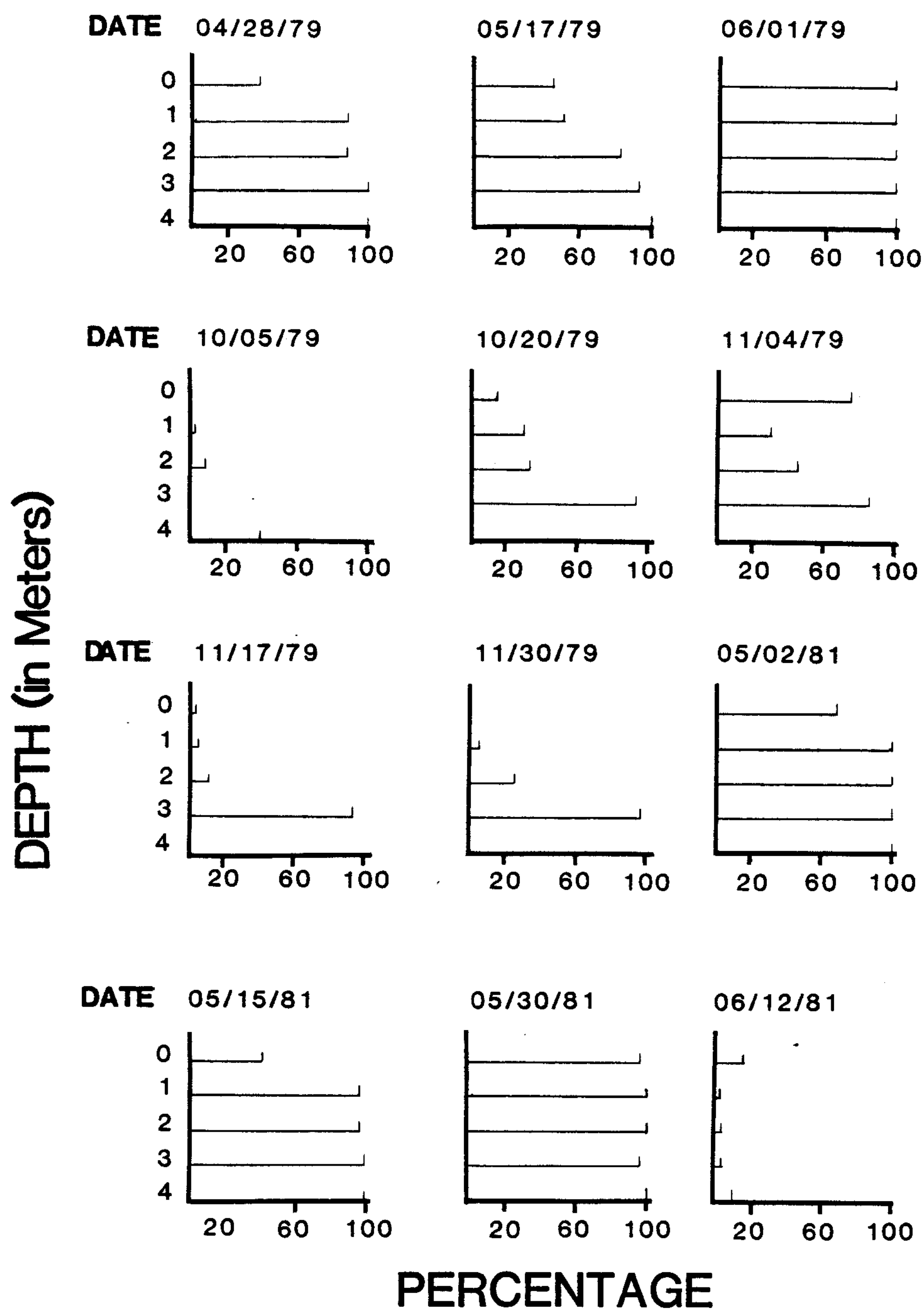
Dynamics of Slide Colonization

Three methods are used to describe the colonization of the trap sets. The first, the percentage of slides colonized by the hydra (Table 6), is an indicator of the planktonic hydra density (Reeder, 1979). The second,

Table 6.--Changes of <u>Hydra</u> density with time. Density is expressed as the mean number of growth axes per slide per day (GA/s·day). Standard error (SE) is used to measure the variance. SN is the number of slides collected. D is the number of days that the slides remained in the water until collection.

Date	Density	SN	D
04/28/79	3.11 ± 0.25	277	14
05/17/79	3.94 ± 0.12	236	20
06/01/79	2.99 ± 0.12	229	14
10/05/79	0.07 ± 0.02	223	14
10/20/79	0.31 ± 0.05	168	14
11/03/79	0.25 ± 0.03	176	14
11/17/79	0.37 ± 0.06	190	14
11/30/79	0.27 ± 0.04	184	14
05/02/81	8.89 ± 0.51	234	28
05/15/81	3.92 ± 0.23	238	14
05/30/81	6.40 ± 0.29	240	14
06/12/81	0.01 ± 0.004	238	14

Fig. 14.--Percentage of slides colonized by *Hydra*.


DATE
04/28/79
05/17/79
06/01/79
10/05/79
10/20/79
11/04/79
11/17/79
11/30/79
05/02/81
05/15/81
05/30/81
06/12/81
0
1
2
3
4
20
60
100
DEPTH (in Meters)
PERCENTAGE

the mean number of growth axes collected per slide per day (Table 7; Fig 15), is a measure of the abundance of the growth axes per depth (Reeder, 1979). Finally, a product moment formula was used to locate the depth of the greatest concentration of hydra (Fig. 16). This formula scores the percentage of growth axes according to the formula in Appendix C (Reeder, 1979).

The hydras remained planktonic throughout the spring (Fig. 14). During the early spring, hydra predominently colonized the lower traps, but by June 1, 1979 and May 30, 1981 the entire trap set was colonized. Following the May 30, 1981 colonization maximum, colonization of the slides declined below twenty percent within two weeks (by June 12; Fig. 14).

Colonization during the fall was primarily restricted to slides within one meter of the bottom (Fig. 14). During the collections of October 20 through November 30, 1979, the hydra colonized at least 80 percent of the lowest traps, while only 20 percent of the slides within 0m to 2m were consistantly colonized (Fig. 14).

The density of growth axes per slide increased with increasing trap depths (Fig. 15). During the spring of 1979, the percentage of the total GA numbers increased from about 1 percent (at 0m) to 56 percent (at 4m) on April 28. As the season progressed, the distribution of the growth axes density attained a greater degree of parity on the traps, and by June 1 the GA density ranges from about 11 percent (at 0m) to 28 percent (at 3m and 4m) (Fig. 15). Collections obtained during the spring of 1981, from May 2 through May 30 had a GA percentage range of 5 to 32 percent as the collections depth increased from 0m to 4m. By the final collection on June 12, 1981 the GA density was greatest in the

Table 7--The mean number of hydra growth axes (GA) collected per slide per day (GA/slide·day). Standard error (SE) is used as the measure of variance. The % GA is the percentage of the GA of the total population on the slides.

Date	Depth	GA/sd	% GA
04/28/79	0m	0.17 ± 0.05	1.03
	1m	1.02 ± 0.22	6.16
	2m	2.30 ± 0.62	13.89
	3m	3.85 ± 0.37	23.25
	4m	9.21 ± 0.55	55.62
	Total	16.56	
	Mean	3.31 ± 1.60	
05/17/79	0m	0.90 ± 0.22	4.62
	1m	2.04 ± 0.43	10.48
	2m	3.15 ± 0.51	16.19
	3m	4.24 ± 0.54	21.79
	4m	9.12 ± 0.57	46.87
	Total	19.46	
	Mean	3.89 ± 1.42	
06/01/79	0m	1.66 ± 0.17	11.11
	1m	2.15 ± 0.17	14.42
	2m	2.66 ± 0.20	17.84
	3m	4.36 ± 0.27	29.24
	4m	4.09 ± 0.30	27.43
	Total	14.91	
	Mean	2.98 ± 0.53	

Table 7. (Continued)

Date	Depth	GA/sd			% GA
10/05/79	0m	0.0		---	0.00
	1m	0.01	±	0.01	2.94
	2m	0.03	±	0.01	8.82
	3m	0.00	±	0.00	0.00
	4m	0.30	±	0.09	88.24
	Total	0.34			
	Mean	0.08	±	0.06	
10/20/79	0m	0.04	±	0.02	3.25
	1m	0.12	±	0.05	9.76
	2m	0.10	±	0.11	8.13
	3m	0.97	±	0.12	78.86
	Total	1.23			
	Mean	0.31	±	0.22	
11/03/79	0m	0.01	±	0.01	1.03
	1m	0.07	±	0.02	7.22
	2m	0.25	±	0.06	25.77
	3m	0.63	±	0.10	64.95
	Total	0.97			
	Mean	0.24	±	0.14	
11/17/79	0m	0.04	±	0.03	2.60
	1m	0.02	±	0.01	1.30
	2m	0.03	±	0.01	1.95
	3m	1.45	±	0.16	94.16
	Total	1.54			
	Mean	0.39	±	0.36	
11/30/79	0m	0.0		---	0.00
	1m	0.03	±	0.01	2.75
	2m	0.05	±	0.02	4.59
	3m	1.01	±	0.01	92.66
	Total	1.09			
	Mean	0.27	±	0.25	

Table 7. (Continued)

Date	Depth	GA/sd	% GA
05/02/81	0m	1.40 ± 0.41	1.59
	1m	14.68 ± 1.29	16.69
	2m	26.72 ± 1.64	30.38
	3m	34.19 ± 2.01	38.87
	4m	10.96 ± 1.57	12.46
	Total	87.59	
	Mean	17.59 ± 5.80	
05/15/81	0m	0.41 ± 0.15	2.06
	1m	2.44 ± 0.34	12.24
	2m	4.86 ± 0.38	24.37
	3m	6.96 ± 0.58	34.90
	4m	5.27 ± 0.37	26.43
	Total	19.94	
	Mean	3.99 ± 1.15	
05/30/81	0m	1.68 ± 0.25	5.09
	1m	5.98 ± 0.59	18.12
	2m	9.37 ± 0.52	28.39
	3m	10.47 ± 0.62	31.73
	4m	5.50 ± 0.45	16.67
	Total	33.00	
	Mean	6.60 ± 1.56	
06/12/81	0m	0.03 ± 0.01	37.50
	1m	0.03 ± 0.03	37.50
	2m	0.01 ± 0.00	12.50
	3m	0.00 ± 0.00	0.00
	4m	0.01 ± 0.01	12.50
	Total	0.08	
	Mean	0.02 ± 0.01	

Fig. 15.--The percentage of the total number of growth axes, of the *Hydra*, observed per slide per day.

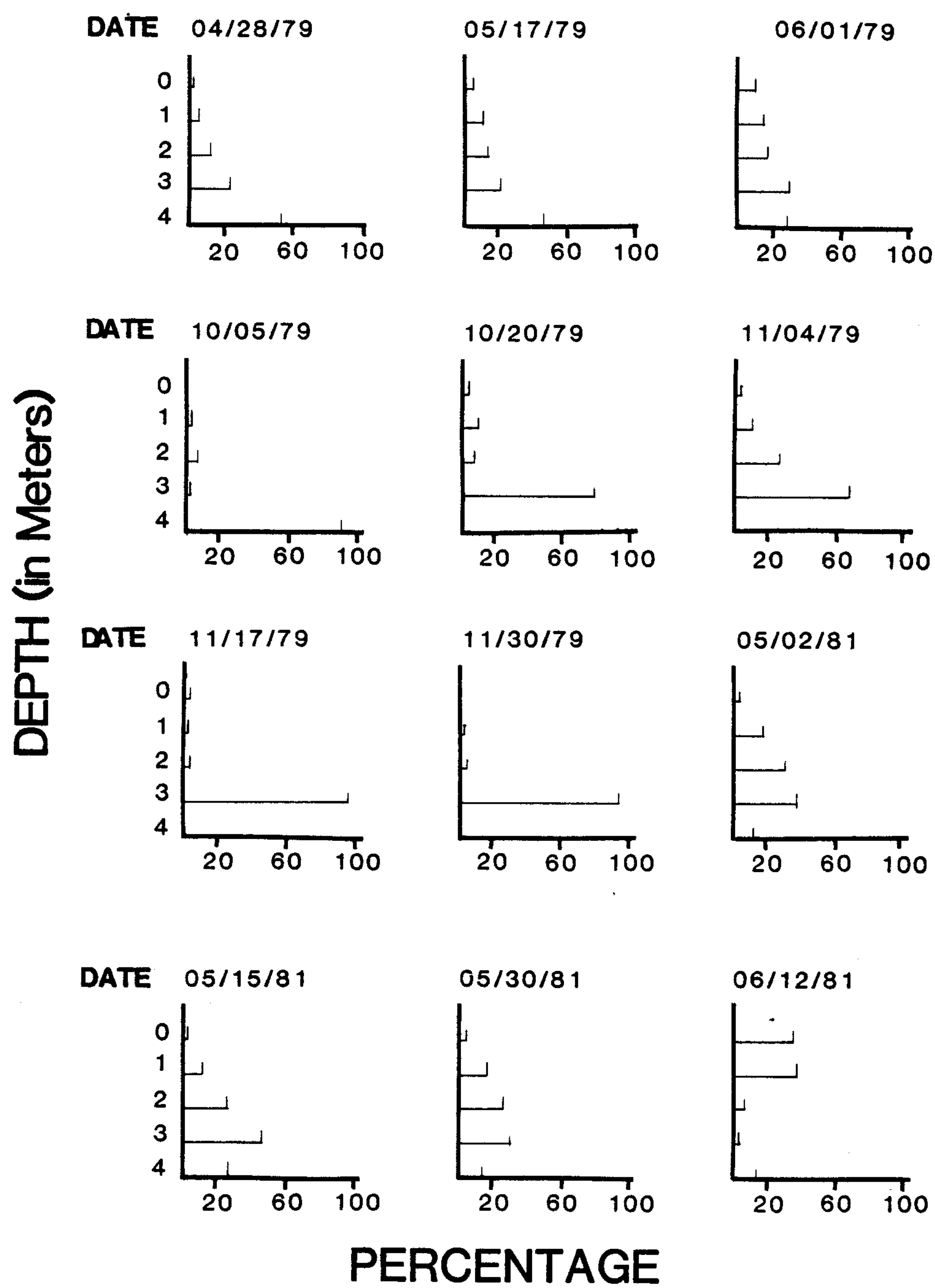
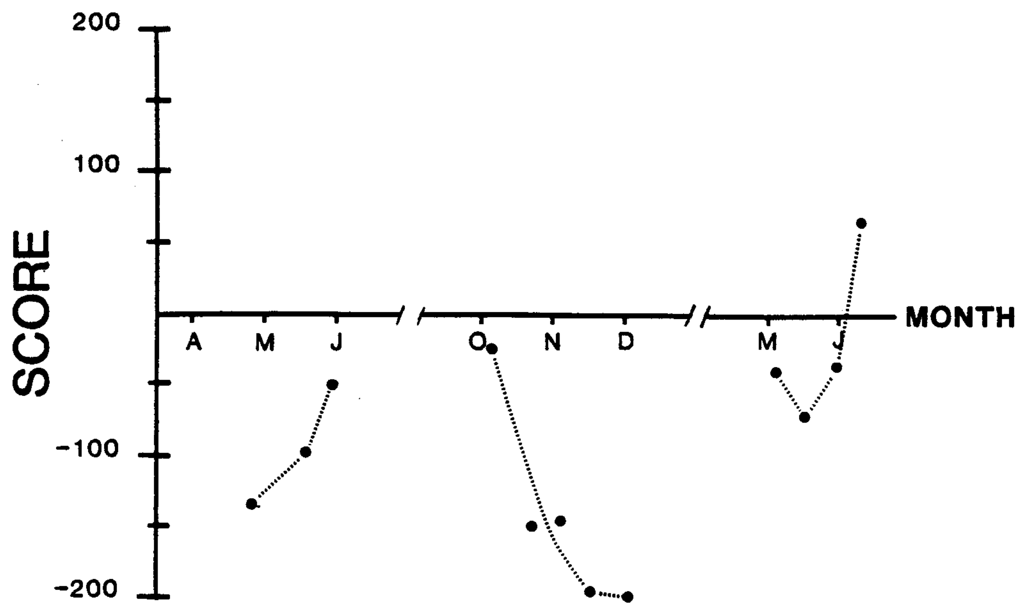

DATE
04/28/79
05/17/79
06/01/79
10/05/79
10/20/79
11/04/79
11/17/79
11/30/79
05/02/81
05/15/81
05/30/81
06/12/81
0
1
2
3
4
20 60 100
DEPTH (in Meters)
PERCENTAGE

Fig. 16.--The distribution of *Hydra* in the water column as determined by the Product Moment Formula.


200
100
-100
-200
SCORE
A
M
J
O
N
D
M
J
MONTH

upper portion of the water column. Approximately 70 percent of the GA were found on the 0m and 1m traps (Fig. 15). During the fall of 1979 the density of GA was greatest near the bottom (Fig. 15). The traps at the mud-water interface contained 80 percent of the total GA density.

The hydra's distribution in the water column, as determined by the product moment formula, increased with the progression of the spring season (Fig. 16). The scores of the 1979 hydra population increased from -126 on April 28 to -47 by June 1. The scores of the 1981 hydra population initially decreased from -44 on May 2 to -71 on May 15, then increased to 73 by June 12. Conversely the fall hydra product moment scores steadily decreased from -18 on October 5 to -184 on November 17, and finally to -187 by November 30.

Hydra Energy Budgets

The energy budget of hydra is represented as $I = G + R + E$ where I = ingestion, G = growth, R = respiration and E = egestion. Whenever G equals zero, the cost of maintenance, estimated as R, is directly related to the minimal rate of ingestion. Hydra at 20°C have a minimal ingestion rate of 0.2 kJ/kJ (Schroeder, 1969; Schroeder and Callaghan, 1982). Changes in R, caused by temperature changes ($Q_{10} = 3.0$; Schroeder and Callaghan, 1982), results in the regression estimate $\log R = 0.049T - 1.696$ for a temperature range of 10°C to 25°C.

Changes in the ambient water temperature not only affects R, but also the assimilation efficiency ($(I - E)/I$) of hydra. The assimilation efficiency of H. pseudologactis is reduced from 80 percent at 10°C to 45 percent at 25°C (Schroeder and Callaghan, 1982). Compensation for temperature affects on assimilation efficiency and respiration are described in the regression equation $\log R = 0.66T - 2.0$ (Fig. 17).

Fig. 17--Ingested energy (kJ of zooplankton per kJ of Hydra) vs. temperature. ○ represents the energy ingested during the spring of 1979. ● represents the energy ingested during the fall of 1979. □ represents the energy ingested during the spring of 1981. Standard error is used as the measure of the variance.

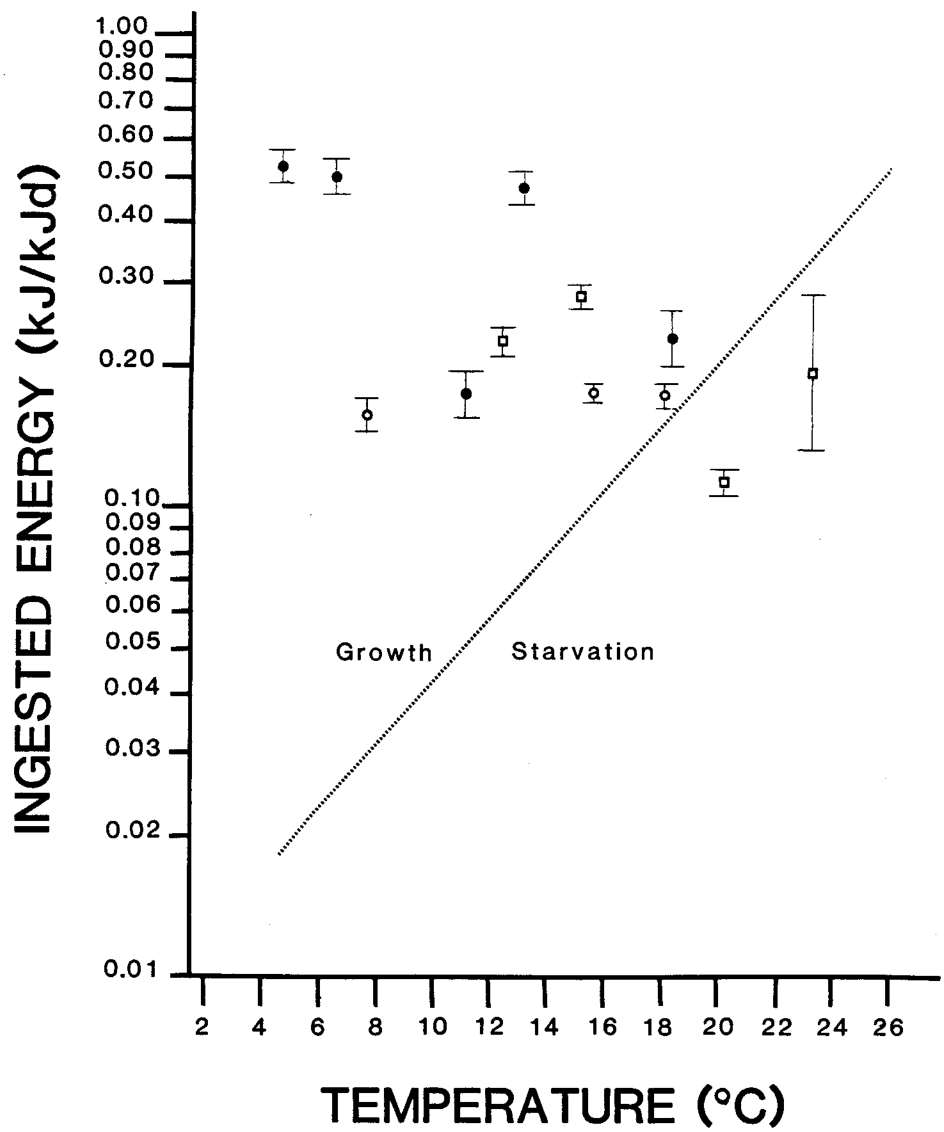

INGESTED ENERGY (kJ/kJd)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
Growth
Starvation
2
4
6
8
10
12
14
16
18
20
22
24
26
TEMPERATURE (°C)

Table 8. Hydra gut analysis results including the basic cost of maintenance of hydra, and the remaining energy for growth. N is the number of growth axes analyzed. T°C is the mean daily temperature. Standard deviation (SD) is used as the measure of variance. T is the mean of the combined depth data.

Date	Depth (m)	N	T°C	Ingestion: Biomass (µg/GA·day ± SD)	Ingestion: Energy (kJ/kJ·day ± SD)	Maintenance Cost (kJ/kJ·day)	Energy Available for Growth (kJ/kJ·day)
04/28/79	0	92	8.13	7.88 ± 13.60	0.182 ± 0.314	0.034	0.15
	1	221	7.88	5.68 ± 10.00	0.153 ± 0.269	0.033	0.12
	2	248	7.44	4.60 ± 11.36	0.123 ± 0.304	0.031	0.09
	3	296	7.38	5.52 ± 12.52	0.148 ± 0.336	0.031	0.12
	4	239	7.25	6.80 ± 12.00	0.183 ± 0.333	0.030	0.15
	T	1096	7.62	5.84 ± 11.76	0.156 ± 0.314	0.032	0.12
05/17/79	0	240	20.75	5.52 ± 10.21	0.192 ± 0.355	0.234	-0.04
	1	343	20.75	8.32 ± 14.89	0.289 ± 0.517	0.234	0.05
	2	316	20.94	6.08 ± 12.24	0.210 ± 0.423	0.240	-0.03
	3	437	20.50	2.80 ± 6.74	0.097 ± 0.233	0.225	-0.13
	4	357	12.94	3.28 ± 7.65	0.113 ± 0.263	0.071	0.04
	T	1693	18.06	5.00 ± 10.80	0.173 ± 0.324	0.156	0.02
06/01/79	0	412	16.88	5.52 ± 5.08	0.178 ± 0.164	0.130	0.05
	1	385	16.63	6.60 ± 13.52	0.211 ± 0.432	0.125	0.09
	2	443	16.38	5.16 ± 11.48	0.165 ± 0.367	0.121	0.04
	3	433	15.13	5.12 ± 11.20	0.163 ± 0.357	0.100	0.06
	4	426	14.25	4.48 ± 10.08	0.143 ± 0.322	0.087	0.06
	T	2100	15.55	5.36 ± 11.88	0.171 ± 0.379	0.106	0.06

Table 8. (Continued)

Date	Depth (m)	N	T°C	Ingestion: Biomass (μg/GA·day ± SD)		Ingestion: Energy (kJ/kJ·day ± SD)		Maintenance Cost (kJ/kJ·day)	Energy Available for Growth (kJ/kJ·day)
10/05/79	0	0	18.75	--	--	---	---	0.173	---
	1	1	18.63	8.16	--	0.314	---	0.170	0.14
	2	8	18.50	5.36	8.28	0.205	0.317	0.166	0.04
	3	1	18.38	19.16	--	0.731	---	0.163	0.57
	4	105	17.50	5.88	8.18	0.224	0.334	0.143	0.08
	T	115	18.35	5.96	8.14	0.228	0.311	0.163	0.07
10/20/79	0	15	13.38	9.70	24.82	0.321	0.821	0.076	0.25
	1	32	13.25	13.92	35.69	0.320	1.170	0.075	0.25
	2	68	13.00	8.72	13.71	0.287	0.451	0.072	0.22
	3	106	13.00	18.36	21.11	0.606	0.697	0.072	0.53
	T	221	13.16	14.16	22.54	0.467	0.743	0.074	0.40
11/03/79	0	4	10.50	8.24	11.36	0.254	0.350	0.049	0.21
	1	182	10.63	5.72	11.86	0.177	0.367	0.050	0.13
	2	120	10.63	4.36	8.61	0.135	0.267	0.050	0.09
	3	43	10.63	8.12	11.18	0.251	0.346	0.050	0.20
	T	349	10.60	5.60	10.78	0.173	0.333	0.050	0.12
11/17/79	0	4	6.50	4.52	9.06	0.127	0.254	0.027	0.10
	1	11	6.50	10.68	6.92	0.300	0.194	0.027	0.27
	2	13	6.50	12.52	12.08	0.352	0.340	0.027	0.33
	3	99	6.50	19.88	19.64	0.588	0.551	0.027	0.53
	T	127	6.50	17.84	18.32	0.501	0.516	0.027	0.47
11/30/79	0	0	2.75	--	--	---	---	0.015	--
	1	23	5.13	17.28	15.64	0.466	0.421	0.022	0.44
	2	29	5.38	12.72	11.84	0.343	0.319	0.023	0.32
	3	108	5.50	21.81	29.89	0.585	0.802	0.023	0.56
	T	160	4.69	19.51	25.93	0.524	0.696	0.020	0.50

Table 8. (Continued)

Date	Depth (m)	N	T^oC	Ingestion: Biomass (µg/GA·day ± SD)	Ingestion: Energy (kJ/kJ·day ± SD)	Maintenance Cost (kJ/kJ·day)	Energy Available for Growth (kJ/kJ·day)
05/02/81	0	164	12.44	6.72 ± 9.60	0.202 ± 0.289	0.066	0.14
	1	192	12.69	9.72 ± 13.78	0.299 ± 0.423	0.069	0.22
	2	192	12.56	7.44 ± 11.38	0.223 ± 0.341	0.067	0.16
	3	192	12.13	8.32 ± 12.34	0.249 ± 0.369	0.063	0.19
	4	190	12.06	5.60 ± 9.00	0.168 ± 0.270	0.063	0.11
	T	930	12.38	7.60 ± 11.47	0.228 ± 0.344	0.066	0.16
05/15/81	0	86	14.94	7.36 ± 8.73	0.236 ± 0.280	0.097	0.14
	1	192	15.25	10.00 ± 13.16	0.320 ± 0.421	0.102	0.22
	2	192	15.31	10.92 ± 15.52	0.349 ± 0.496	0.102	0.25
	3	192	15.31	8.52 ± 14.20	0.273 ± 0.455	0.102	0.17
	4	191	15.19	6.00 ± 10.68	0.192 ± 0.342	0.101	0.09
	T	853	15.20	8.72 ± 13.20	0.279 ± 0.422	0.101	0.18
05/30/81	0	192	21.50	2.92 ± 4.92	0.106 ± 0.179	0.262	-0.16
	1	192	21.31	2.52 ± 5.52	0.091 ± 0.199	0.255	-0.16
	2	192	21.13	3.40 ± 6.00	0.125 ± 0.221	0.248	-0.12
	3	192	20.38	3.68 ± 7.28	0.136 ± 0.269	0.221	-0.09
	4	192	18.56	2.88 ± 5.44	0.106 ± 0.200	0.168	-0.06
	T	960	20.11	3.08 ± 5.88	0.113 ± 0.216	0.212	-0.10
06/12/81	0	15	24.19	5.26 ± 9.29	0.212 ± 0.376	0.395	-0.18
	1	1	23.94	0.0 ± --	0.0 ± --	0.380	-0.38
	2	3	23.56	16.84 ± 29.16	0.679 ± 1.176	0.359	0.32
	3	2	23.06	0.0 ± --	0.0 ± --	0.333	-0.33
	4	6	21.50	0.0 ± --	0.0 ± --	0.262	-0.26
	T	27	23.25	4.77 ± 11.69	0.193 ± 0.473	0.342	-0.15

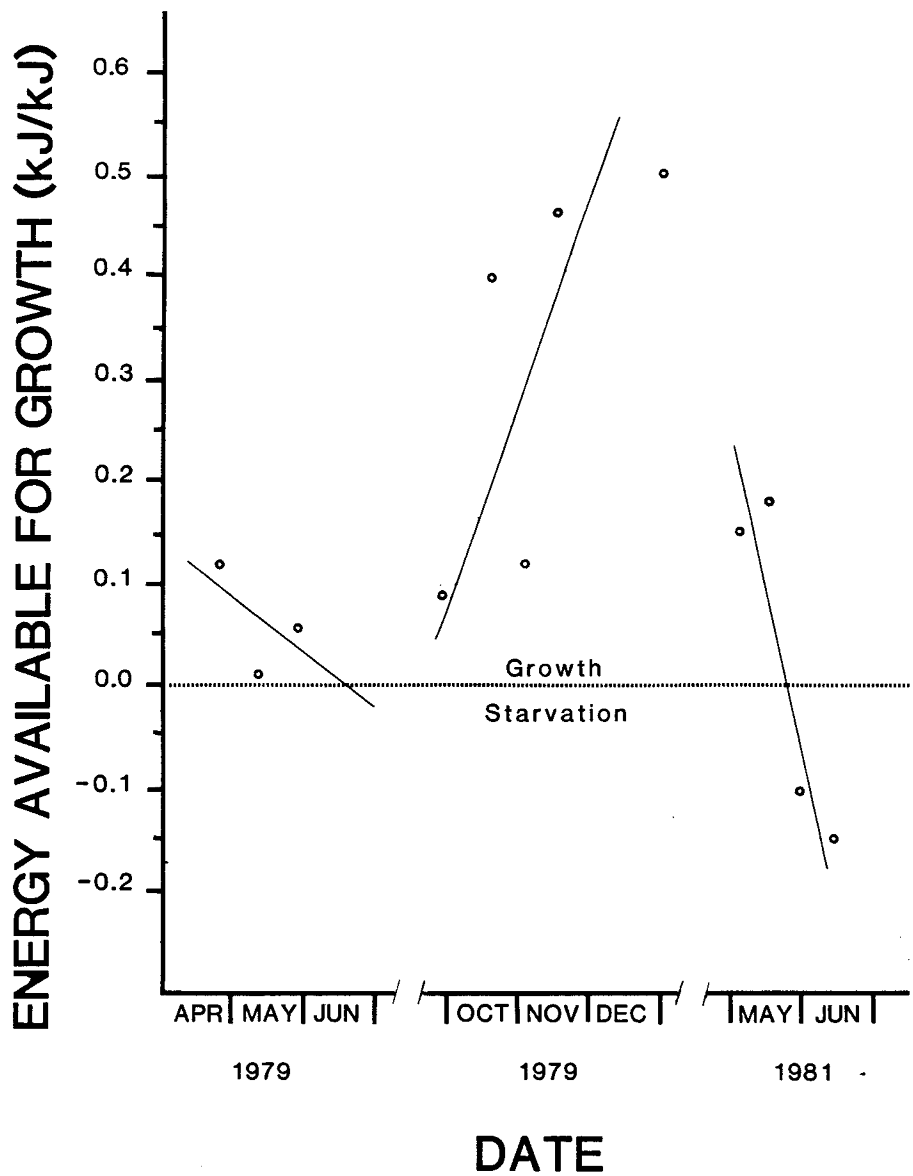
Ingestion during the spring of 1979 tended to remain constant at a value of 0.173 kJ/kJ·day (SD = 0.324). Since an increase in water temperature results in an increase in the cost of maintenance and a decrease in the assimilation efficiency, the increasing water temperatures caused a reduction in G from 0.12 kJ/kJ·day on April 28 to 0.06 kJ/kJ·day by June 1 of 1979 (Table 8). The regression equation y = 0.33 - 0.002x (r = -0.65) describes the decline of G during the spring of 1979 (Fig. 18). Ingestion during the spring of 1981, however, increased through May 15 to 0.279 kJ/kJ·day (SD = 0.422) then declined to 0.193 kJ/kJ·day (SD = 0.473) by June 12 (Table 8). G underwent a similar increase to 0.18 kJ/kJ by May 15, but plummeted to -0.15 kJ/kJ by June 12 (Table 8). The decline in G is described by the regression equation y = 1.29 - 0.009x (r = -0.92) for the spring of 1981 (Fig. 18).

During the fall of 1979 ingestion increased as the season proressed. Ingestion increased from 0.228 kJ/kJ·day (SD = 0.311) on October 5 to 0.524 kJ/kJ·day (SD = 0.696) by November 30 (Fig. 17; Table 8). G similarily increased from 0.07 kJ/kJ·day on October 5 to 0.50 kJ/kJ·day by November 30 as the temperatures declined from 18.35^{o} to 4.70^{o} C, respectively (Table 8). The increase in G is described by the regression equation y = 0.475 - 77.78 (r = 0.66) during the fall of 1979 (Fig. 18).

Predation

Predation of the hydra on the traps was not high. The planarian *Microstonum sp.*, appearing only during the late spring, was the only predator infesting the hydra traps. Infestation of the traps did not exceed two percent except for those collected on June 12, 1981, when *Microstonum sp.* infested about ten percent of the traps (see Appendix F).

Fig. 18--Energy available for growth (G) through time.



ENERGY AVAILABLE FOR GROWTH (kJ/kJ)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
Growth
Starvation
APR
MAY
JUN
OCT
NOV
DEC
MAY
JUN
1979
1979
1981
DATE

DISCUSSION

The Meander Creek Reservoir has a zooplankton community structure similar to that of other lake systems. Siegfried and Kopache (1984) collected 15 cladocerans and six copepods from Big Bear Lake, Southern California; Schindler and Novén (1971) collected 7 cladocerans and 2 copepods from Lake 122 and 11 cladocerans and 6 copepods from Lake 132, Experimental Lake Area in Northwestern Ontario; Reeder (1979) found 11 cladocerans and 2 copepods in Pine Lake, Ohio; Watson (1974) reported 7 cladocerans and 13 copepods from Lake Erie. The daphnids were the dominant cladocerans with Daphnia galeata mendota being dominant during the cold-water period of spring and late fall, while D. retrocurva was dominant during the warm-water period of summer and early fall. A similar successional pattern is reported at Base Line Lake (Hall, 1964) and Sanctuary Lake (Cummins et al., 1968). The cyclopoids were the dominant copepods of Meander Creek Reservoir. Cyclops bicuspitus thomasi was the dominant copepod during the cold-water months, while Mesocyclops edax was dominant during the warm-water months. The remaining species found in the Meander Creek Reservoir are common and widespread throughout the United States (Pennak, 1953, 1978; Hutchinson, 1967).

Feeding selectivity of hydra on C. b. thomasi and D. sicilis is attributed to the uneven distribution of the hydra and the zooplankton in the water column. During the fall 80 percent of the hydras were found to inhabit the 3m traps. The zooplankton, however, are not limited to a particular depth, and clump at particular depths depending upon the season and time of day (Hutchinson, 1967; Carter, 1969; George and

Edwards, 1973). Sampling the zooplankton with the vertical tow integrates the zooplankton vertical distribution and may substantially under- or overestimate the zooplankton density available to the hydras (O'Brien and Vinyard, 1974). Hydras feeding from high or low density zooplankton communities would display an apparent feeding electivity. Consequently, since the hydras were primarily found at 3m the feeding electivity is considered to be an artifact of the sampling design.

The virtual disappearance of hydra during the summer in the Meander Creek Reservoir is likely to be caused by starvation. The summer hydra density decline occurs when the water temperature exceeds 20^{o}C, much like the Douglas Lake populations studied by Welsh and Loomis (1924) and Miller (1936), and the Pine Lake populations studied by Reeder (1979). Temperature, however, is not a direct cause of the late spring decline because the ambient water temperatures did not exceed the upper lethal temperature of hydra (Schroeder and Callaghan, 1981). The hydra population decline is caused, however, by the reduction of the zooplankton density and the indirect effects of temperature (i.e. the increase in the cost of maintenance and the decline in the assimilation efficiency) (Schroeder and Callaghan, 1982).

The principal food of the Meander Creek Reservoir hydra are zooplankton. The theoretical estimates of the minimum density of zooplankton required for hydra to meet their basic maintenance cost at 15^{o}C is 15/ℓ, while at 20^{o}C 100/ℓ is required (Schroeder & Callaghan, 1982). By the end of May 1981, the mean water temperature was above 20^{o}C and the zooplankton density was below the required minimum density. Reductions of the zooplankton density resulted in a concomitant reduction in the ingestion of zooplankton. As the zooplankton density declined the percentage of the total hydras containing food declined to 40 percent during the spring of 1979, and to 20 percent during the spring of 1981. The reduction of the ingestion rate, in conjunction with the increased maintenance cost and reduced assimilation efficiency, reduced the energy available for growth (G) to zero.

The condition of the hydras was also supportive of the food limitation hypothesis. Reductions in the hydra bud ratio (HBR), preceded by reductions in the food availability and G, were also similar to the HBR reductions reported by Carrick (1956), and Cuker and Mozley (1982). The HBR of the Lake Erie hydra declined when only 18 percent of the population contained food (Carrick, 1956). Hydra canadensis from Toolik Lake (Alaska) underwent a 69 percent reduction (i.e. from 1.80 to 1.25 GA/H) in the HBR as the water temperature increased from $15^{o}C$ to $20^{o}C$, and as the percentage of fed hydras declined from 70 to 20 percent (Cuker and Mozley, 1982). The death related disappearance of the Meander Creek Reservoir hydra, in 1981, within 18 days after G equalled zero is also consistent with other reported findings. The extinction of a laboratory hydra population due to starvation was noted by Beringer (Kanev, 1954) to occur within 12 to 14 weeks. However, Welsh and Loomis (1924) observed a population die after four weeks at temperatures similar to those found in the Meander Creek Reservoir.

The disappearence of hydra from the littoral and epilimnetic zones has been attributed to predation (Griffing, 1965; Cuker and Mozley, 1982) and emigration (Łomnicki and Slobodkin, 1966; Miller, 1936; Young, 1945; Batha, 1974). Neither predation nor parasitism appeared to be an important factor in the decline of the Meander Creek Reservoir hydra population. The Meander Creek Reservoir hydra are preyed upon by the planarian Microstomum lineare, the cladoceran Achistropus spp., and the mollusk

Limnea sp. (Schroeder and Callaghan, 1982). The planarian was the only predator observed on the slides during the study. Infestation of the slides by Microstomum sp. was only observed during the spring of 1981 in numbers not considered to be detrimental to the hydra population. Previous investigations at Pine Lake (Reeder, 1979) and Meander Creek Reservoir (Schroeder and Callaghan, 1982) also reported planarian densities to increase during the late spring.

The amoeboid parasite Hydramoeba hydroxena is the only protozoan commonly associated with the Meander Creek Reservoir hydra known to kill hydra (Reynolds and Looper, 1925). H. hydroxena is not reported to attain exceptionally high densities on hydras during the spring. Densities of less than 2 per hydra have been reported and are not considered to be the primary cause of the Meander Creek Reservoir hydra population decline (Schroeder and Callaghan, 1982). Although the collection methods prevented direct observation of H. hydroxena during this study, the collected hydras did not display any signs of significant ameboid parasitism.

Migration caused by starvation is not considered to affect the results of this investigation. Locating the traps along the openwater edge of the Myriophyllum bed allowed planktonic hydra to immigrate into the trap zone, while the minimum two week trapping period allowed for sufficient trap colonization. Wind speed and direction during the investigation (National Weather Service Data, Youngstown) assured a movement of planktonic hydra through the area. Therefore, colonization of the traps was considered to be continual throughout the study.

Competition for substrate attachment (Miller, 1936; Carrick, 1956; Young, 1945) was not a factor in the reduction of the hydra populations during this study. Except for those of May 2, 1981, slides were free of any excessive accumulations of periphyton. Plumatella sp. colonies were noted on the slides but were not large enough to affect the hydra populations. Water mite eggs were common on the slides but had minimal impact upon the hydra densities. The periphyton community that was established prior to the May 2, 1981 collection was extensive since the traps had not been collected for four weeks. Dense mats of organisms were observed within the upper three meters of the traps. Unlike the observations of Miller (1936), Carrick (1956) and Young (1945), neither the densities nor the condition of the hydras were affected by the luxurient growth of the periphyton.

If food is the primary limiting factor, the reestablishment of the hydra population should correspond with an increase in G. During the fall, reduced water temperatures and increased zooplankton density resulted in an increase in G. Consequently, hydra condition (HBR) and hydra density on the traps concomitantly increased as well.

The late spring decline of the hydra population has been demonstrated to be caused by starvation. Hydra ingest enough food during the early spring to provide energy for growth. As the ambient water temperature increase, the reductions of the zooplankton density, increase of the cost of maintenance, and the decrease of the assimilation efficiency causes hydra starvation. Periods of prolonged energy deficits during late May through June resulted in the virtual disappearance of the hydra population. During the fall of 1979 this process was reversed. Other suspected factors including the direct effects of temperature, predation, parasitism, the competition for supports, and floating from unfavorable environments were not implicated as the primary cause of the late spring hydra population decline.

APPENDIX A

Mean Water Temperatures and Depths, and Wind Velocities

Water temperatures recorded per collection, in degrees Celsius, from Meander Reservoir. Standard deviation (SD) measures the varience.
Spring 1979

Date	Depth	Time 22:00	04:00	10:00	16:00	Mean	SD
04/28	Air	15.00	6.25	5.00	6.00		
	0m	9.00	7.75	7.75	8.00	8.13	0.60
	1m	8.75	7.50	7.75	7.75	7.88	0.60
	2m	7.25	7.25	7.50	7.75	7.44	0.24
	3m	7.25	7.25	7.25	7.25	7.38	0.25
	4m	7.00	7.25	7.25	7.50	7.25	0.20
	Mean	7.85	7.40	7.45	7.75	7.62	0.51
	SD	0.95	0.22	0.21	0.18		
05/17	Air	10.00	13.75	14.50	12.00		
	0m	20.50	20.00	23.00	19.50	20.75	1.55
	1m	20.25	19.75	23.00	20.00	2..75	1.51
	2m	20.00	19.50	23.00	21.25	20.94	1.56
	3m	20.00	19.50	23.00	19.50	20.50	1.68
	4m	13.00	12.75	13.75	12.25	12.94	0.63
	4.5m	12.75	12.50	12.75	12.00	12.50	0.35
	Mean	18.75	18.30	21.25	18.50	18.06	4.04
	SD	3.78	3.65	5.04	4.15		
06/01	Air	16.50	17.00	19.75	20.50		
	0m	15.25	14.25	17.25	20.75	16.88	2.87
	1m	14.75	14.50	17.00	20.25	16.63	2.67
	2m	14.00	14.00	16.75	20.75	16.38	3.19
	3m	12.25	12.00	16.50	19.75	15.13	3.71
	4m	11.75	11.50	14.00	19.75	14.25	3.84
	4.5m	11.25	11.50	13.75	19.50	14.00	3.84
	Mean	13.21	12.96	15.88	20.13	15.55	3.21
	SD	1.68	1.44	1.97	0.54		

Water Temperature Data -- Fall 1979 (Continued).

Date	Depth	22:00	04:00	10:00	16:00	Mean	SD
10/05	Air	16.25		18.00			
	0M	18.50		19.00		18.75	0.35
	1M	18.25		19.00		18.63	0.53
	2M	18.25		18.75		18.50	0.35
	3M	18.00		18.75		18.38	0.53
	4M	17.25		17.75		17.50	0.35
	Mean	18.05		18.65		18.35	0.57
	SD	0.48		0.52			
10/20	Air	19.75		17.25			
	0M	13.75		13.00		13.38	0.53
	1M	13.50		13.00		13.25	0.35
	2M	13.00		13.00		13.00	0.00
	3M	13.00		13.00		13.00	0.00
	Mean	13.31		13.00		13.16	0.30
	SD	0.40		0.00			
11/04	Air	7.00		7.00			
	0M	10.50		10.50		10.50	0.00
	2M	10.75		10.50		10.63	0.18
	2.0M	10.75		10.50		10.63	0.18
	2.66M	10.75		10.50		10.63	0.18
	Mean	10.69		10.50		10.60	0.09
	SD	0.13		0.00			
11/17	Air	2.00		9.00			
	0M	6.50		6.50		6.50	0.00
	1M	6.50		6.50		6.50	0.00
	2M	6.50		6.50		6.50	0.00
	2.5M	6.50		6.50		6.50	0.00
	Mean	6.50		6.50		6.50	0.00
	SD	0.00		0.00			
11/30	Air	0.50		0.00			
	0M	0.50		5.00		2.75	3.18
	1M	5.25		5.00		5.13	0.18
	2M	5.50		5.25		5.38	0.18
	3M	5.50		5.50		5.50	0.00
	Mean	4.19		5.19		4.69	1.70
	SD	2.46		0.24			

Water Temperature Data-- Spring 1981 (Continued)

Date	Depth	Time 22:00	04:00	10:00	16:00	Mean	SD
05/02	Air	8.00	5.00	12.50	13.00		
	0M	12.00	11.75	13.00	13.00	12.44	0.66
	1M	12.25	12.50	13.00	13.00	12.69	0.38
	2M	12.00	12.50	13.00	12.75	12.56	0.43
	3M	11.50	12.50	12.75	11.75	12.13	0.60
	4M	11.50	12.50	12.50	11.75	12.06	0.52
	Mean	11.85	12.35	12.85	12.45	12.38	0.53
	SD	0.34	0.34	0.22	0.65		
05/15	Air	11.00	9.00	13.00	18.00		
	0M	15.00	14.50	14.50	15.75	14.94	0.59
	1M	15.25	15.00	15.00	15.75	15.25	0.35
	2M	15.50	15.00	15.00	15.75	15.31	0.38
	3M	15.25	15.00	15.00	15.75	15.31	0.38
	4M	15.25	15.00	15.00	15.50	15.19	0.24
	Mean	15.25	14.90	14.90	15.70	15.20	0.38
	SD	0.17	0.24	0.22	0.11		
05/30	Air	18.00	18.00	21.25	20.50		
	0M	21.50	22.00	21.25	21.25	21.25	0.35
	1M	21.50	21.25	21.25	21.25	21.31	0.13
	2M	21.50	21.25	20.75	21.00	21.13	0.32
	3M	19.50	21.50	21.50	20.75	20.38	0.60
	4M	16.50	16.75	20.50	20.50	18.56	2.24
	Mean	19.42	19.67	20.79	20.54	20.65	1.47
	SD	2.57	2.50	0.40	1.04		
06/12	Air	20.00	21.00	25.50	25.00		
	0M	23.50	23.50	24.00	25.75	24.19	1.07
	1M	23.50	22.50	24.00	25.75	23.94	1.36
	2M	22.50	22.50	23.25	25.75	23.56	1.53
	3M	22.50	22.00	22.75	25.00	23.06	1.33
	4M	21.00	21.00	21.50	23.50	21.50	1.00
	Mean	22.60	22.30	23.10	25.19	23.29	1.46
	SD	1.02	0.91	1.04	0.98		

Wind conditions recorded at the Youngstown Municipal Airport (National Weather Service data). Wind direction (D) is in degrees from true North. Wind velocity (V) is expressed in cm/sec. NA indicates that the data was not available.

Date		22:00	04:00	10:00	16:00
04/28/79	D	80	120	230	230
	V	257.2	411.5	514.4	617.3
05/17/79	D	20	70	120	120
	V	257.2	308.6	411.5	617.3
06/01/79	D	110	100	350	340
	V	265.8	308.6	154.3	411.5
10/05/79	D	270		160	
	V	668.7		514.4	
10/20/79	D	180		210	
	V	514.4		668.7	
11/03/79	D	260		280	
	V	257.2		411.5	
11/17/79	D	230		240	
	V	565.8		411.5	
11/30/79	D	200		230	
	V	514.4		308.6	
05/02/81	D	350	340	360	360
	V	411.5	360.1	720.2	514.4
05/15/81	D	270	NA	310	350
	V	463.0	NA	720.2	720.2
05/30/81	D	320	320	350	300
	V	NA	NA	720.2	720.2
06/12/81	D	NA	NA	130	220
	V	NA	NA	411.5	205.8

Mean depth per sampling period, in meters. Standard deviation (SD) is used to measure variance.

Date		Depth	SD
04/28/79		4.00	0
05/17/79		4.50	0
06/01/79		4.50	0
	Mean	4.33	0.25
10/05/79		4.00	0
10/20/79		3.00	0
11/03/79		2.63	0.18
11/17/79		2.50	0
11/30/79		3.0	0
	Mean	2.99	0.57
05/02/81		4.44	0.13
05/15/81		4.19	0.13
05/30/81		4.25	0
06/12/81		4.00	0
	Mean	4.19	0.19

APPENDIX B

Hydra Trap Data from the Meander Reservoir

APPENDIX B

Collections from Meander Creek Reservoir in number of growth axes per hydra (GA/H). 0 indicates that no hydra appeared on the slides. X indicates that the slide was lost. † represents the sum total for slides 1 through 3. Depth is in meters.

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
		04/28/79			22:00	
1	1	0	64/24	47/16	106/51	105/48
	2	0	35/10	36/23	92/38	106/67
	3	0	56/23	27/11	161/23	120/63
	4	8/3	95/34	38/14	57/20	109/57
2	1	0	0	14/5	44/19	145/83
	2	0	22/9	39/12	66/30	154/85
	3	1/1	0	90/30	27/14	169/76
	4	0	3/3	16/7	43/22	172/83
3	1	2/2	42/12	16/7	66/31	*
	2	1/1	4/3	8/7	44/26	310/158†
	3	3/2	7/4	35/17	23/13	*
	4	0	25/6	10/7	35/19	110/51
					04:00	
1	1	0	X	42/16	66/26	152/79
	2	0	X	86/37	121/53	123/60
	3	0	X	0	111/38	91/43
	4	0	X	26/11	104/46	141/75
2	1	0	4/4	16/11	32/14	99/61
	2	0	4/3	15/9	32/20	34/19
	3	0	4/2	6/2	19/9	88/54
	4	X	6/3	X	38/19	138/87
3	1	0	0	31/16	31/17	86/51
	2	2/1	7/3	1/1	41/24	190/125
	3	2/1	10/6	16/10	31/17	146/90
	4	X	0	0	6/6	108/71
					10:00	
1	1	0	14/6	43/12	58/20	173/91
	2	0	10/3	47/11	41/17	161/91
	3	25/7	17/5	18/7	32/14	231/112
	4	5/3	0	12/4	71/22	X
2	1	0	1/1	27/13	67/33	184/121
	2	0	71/31	30/9	33/19	121/75

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
	3	1/1	11/9	40/17	63/29	199/105
	4	0	2/2	48/23	91/27	124/77
3	1	0	0	8/4	97/35	74/41
	2	0	12/3	29/9	17/8	162/66
	3	0	12/6	0	59/21	196/98
	4	0	7/3	26/11	75/41	83/35
					16:00	
1	1	10/3	10/4	16/9	68/25	193/97
	2	6/2	9/3	0	32/12	183/87
	3	9/2	4/2	18/10	24/12	152/61
	4	0	6/2	8/4	16/12	87/50
2	1	15/2	5/3	57/36	141/34	110/63
	2	13/3	9/4	86/21	54/15	201/102
	3	4/2	10/4	24/9	60/18	X
	4	6/2	5/2	8/1	53/20	X
3	1	0	5/4	1/1	4/1	27/21
	2	0	5/3	7/3	1/1	36/21
	3	0	5/1	0	31/7	77/36
	4	0	11/3	0	1/1	110/71
		05/17/79			22:00	
1	1	28/12	0	49/18	12/6	126/55
	2	51/18	0	0	11/4	148/75
	3	35/15	0	0	5/3	114/49
	4	16/6	13/5	69/27	0	313/125
2	1	0	21/7	0	54/17	222/120
	2	0	0	0	243/85	177/90
	3	0	33/13	25/10	310/134	228/123
	4	0	0	89/41	136/51	193/109
3	1	34/15	95/55	234/110	156/68	218/120
	2	110/43	0	82/38	167/67	198/111
	3	3/1	68/27	23/10	184/76	77/47
	4	40/16	43/20	27/16	176/73	125/81
					4:00	
1	1	0	15/5	5/2	24/10	199/83
	2	0	0	94/31	22/7	310/120

APPENDIX B (continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
	3	X	0	56/17	0	293/114
	4	X	22/9	11/3	26/12	181/80
2	1	0	161/81	9/2	142/56	118/78
	2	0	64/31	233/111	175/89	157/89
	3	9/3	19/7	107/45	40/19	206/109
	4	X	95/35	71/33	25/13	296/214
3	1	11/7	0	43/15	86/39	282/133
	2	23/10	0	3/1	106/35	294/151
	3	0	0	48/15	64/20	212/113
	4	42/17	0	0	28/12	281/158
					10:00	
1	1	0	143/82	37/18	91/50	42/17
	2	0	86/49	83/42	79/44	144/73
	3	0	6/4	22/9	78/35	50/29
	4	0	178/104	156/83	70/31	42/17
2	1	0	0	117/44	0	156/91
	2	18/6	0	0	27/12	152/84
	3	125/50	0	17/7	1/1	149/75
	4	0	143/64	98/44	16/6	126/64
3	1	0	0	2/1	227/97	137/60
	2	0	0	46/16	36/17	233/130
	3	37/18	0	178/84	89/38	302/159
	4	0	111/59	36/16	25/11	303/167
					16:00	
1	1	0	173/72	151/68	110/48	229/113
	2	0	202/108	256/119	132/69	274/124
	3	0	23/13	119/48	227/93	232/124
	4	28/11	0	24/11	182/65	141/65
2	1	0	60/30	14/6	79/39	78/47
	2	0	44/20	24/13	24/10	141/74
	3	18/9	0	109/50	83/42	84/54
	4	1/1	98/51	218/118	107/42	42/25
3	1	102/45	0	25/9	44/17	249/117
	2	40/17	0	13/4	52/20	76/44
	3	0	0	0	25/12	193/85
	4	40/17	X	0	79/32	215/102

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
		06/01/79			22:00	
1	1	26/16	5/5	31/17	74/44	71/44
	2	7/3	39/23	11/8	61/36	68/44
	3	17/11	21/11	54/27	85/38	57/35
	4	12/7	49/25	29/13	64/28	54/24
2	1	25/13	27/13	66/30	52/30	91/45
	2	30/14	27/12	42/24	102/55	94/47
	3	13/9	21/11	51/24	59/35	103/53
	4	23/13	38/15	11/5	X	X
3	1	32/15	55/21	45/19	55/32	57/26
	2	16/6	35/18	37/17	65/35	95/55
	3	35/17	17/12	30/17	78/45	76/41
	4	2/2	39/21	63/32	82/46	72/45
					4:00	
1	1	20/11	33/14	14/8	41/19	59/36
	2	7/5	35/18	25/14	63/28	76/44
	3	36/16	19/10	37/20	52/31	78/47
	4	X	18/10	36/21	47/27	55/28
2	1	13/7	50/22	X	74/42	95/48
	2	17/8	21/11	X	52/29	84/54
	3	30/14	29/13	34/19	75/43	57/29
	4	12/7	11/7	50/33	82/44	70/44
3	1	62/29	52/24	28/19	54/31	97/49
	2	16/7	26/13	17/11	47/23	111/61
	3	X	70/30	60/31	80/40	101/58
	4	X	31/18	51/28	55/28	99/55
					10:00	
1	1	30/20	16/11	15/9	63/31	48/27
	2	14/10	10/8	17/8	9/5	43/24
	3	12/7	25/11	45/20	70/37	26/18
	4	28/18	32/22	27/20	64/30	34/21
2	1	5/3	8/5	15/10	26/16	55/33
	2	14/9	15/9	7/5	10/5	46/25
	3	8/5	6/4	29/13	51/26	46/28
	4	18/11	5/3	1/1	74/46	24/15

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
3	1	2/2	36/13	45/26	10/6	9/6
	2	29/15	62/34	33/15	6/3	10/4
	3	18/13	42/22	69/39	X	23/13
	4	24/16	9/4	27/18	67/37	23/11
					16:00	
1	1	49/25	23/13	22/14	82/45	41/21
	2	31/21	43/30	43/23	63/36	82/47
	3	45/25	29/20	66/35	76/39	57/32
	4	8/6	45/28	82/41	93/52	47/28
2	1	82/49	16/10	40/24	120/65	45/27
	2	3/1	40/25	36/17	40/26	61/34
	3	41/24	19/13	17/10	68/38	49/28
	4	11/6	57/31	47/23	104/47	42/28
3	1	36/22	48/26	37/23	X	17/9
	2	33/20	12/8	X	76/47	7/6
	3	46/22	56/24	67/42	4/3	18/11
	4	32/20	X	64/42	69/43	18/13
		10/05/79			22:00	
1	1	X	0	0	0	25/13
	2	X	0	0	0	0
	3	X	0	0	0	38/27
	4	X	X	0	0	26/16
2	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	2/1
3	1	0	0	6/3	1/1	0
	2	0	3/1	0	0	2/1
	3	0	0	0	0	0
	4	0	0	4/3	0	0
4	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
5	1	0	0	0	0	0
	2	0	0	0	0	0

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
5	3	0	X	0	0	3/1
	4	0	X	0	0	7/4
6	1	0	0	2/1	0	0
	2	0	0	0	0	2/2
	3	0	0	0	0	0
	4	0	0	0	0	3/1
					10:00	
1	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	X	0	0
2	1	0	0	0	0	29/12
	2	0	0	4/2	0	16/7
	3	0	0	0	0	0
	4	0	X	0	0	0
3	1	X	0	0	0	0
	2	X	0	0	0	0
	3	X	0	0	0	1/1
	4	X	0	0	X	0
4	1	0	0	0	0	3/2
	2	0	0	0	0	10/5
	3	0	0	0	0	22/8
	4	0	0	X	0	0
5	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	X
	4	0	0	0	X	4/1
6	1	0	0	0	0	0
	2	0	0	0	0	1/1
	3	0	0	0	0	1/1
	4	0	0	0	0	0
		10/20/79			22:00	
1	1	X	X	X	X	
	2	X	X	X	X	
	3	X	X	X	X	
	4	X	X	X	X	

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0
2	1	0	1/1	4/1	16/9
	2	0	0	0	26/15
	3	0	3/1	0	6/3
	4	0	1/1	0	4/4
3	1	0	0	2/1	29/15
	2	0	1/1	6/3	31/18
	3	2/1	0	0	13/9
	4	X	0	0	X
4	1	0	0	3/3	3/2
	2	0	11/5	8/5	28/17
	3	0	1/1	0	27/10
	4	2/2	0	0	12/5
5	1	0	0	0	5/2
	2	0	0	0	22/12
	3	4/2	0	0	10/6
	4	0	0	0	9/6
6	1	0	18/9	3/3	27/15
	2	7/3	23/12	0	10/8
	3	0	6/4	4/3	1/1
	4	X	0	3/3	12/9
				10:00	
1	1	0	0	0	4/2
	2	0	0	0	4/2
	3	0	0	0	15/8
	4	X	X	0	0
2	1	1/1	0	0	15/11
	2	0	0	1/1	14/9
	3	8/6	1/1	2/1	0
	4	X	1/1	1/1	25/18
3	1	0	0	0	12/24
	2	0	0	0	11/6
	3	0	0	0	23/13
	4	0	0	0	11/8
4	1	0	0	0	2/2
	2	0	0	0	14/11
	3	0	0	0	5/4
	4	X	0	X	1/1

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0
5	1	0	0	9/4	5/4
	2	0	0	0	6/5
	3	0	0	0	14/8
	4	0	0	0	0
6	1	0	0	0	42/23
	2	0	0	0	36/19
	3	0	0	10/3	8/7
	4	0	6/2	1/1	26/12
		11/03/79			22:00
1	1	0	12/2	10/5	3/1
	2	0	7/4	6/3	10/9
	3	0	0	18/8	7/7
	4	0	0	17/10	6/5
2	1	0	1/1	4/1	11/5
	2	0	0	0	3/1
	3	0	0	0	0
	4	0	0	0	3/1
3	1	0	0	0	15/7
	2	0	0	6/3	6/3
	3	0	0	0	0
	4	0	0	0	8/4
4	1	0	0	8/4	3/1
	2	3/1	0	1/1	0
	3	0	0	1/1	4/2
	4	X	1/1	0	13/7
5	1	0	0	0	0
	2	1/1	0	0	0
	3	0	1/1	0	3/3
	4	2/2	0	X	0
6	1	0	3/1	0	19/9
	2	0	0	0	37/25
	3	0	0	0	16/8
	4	0	0	0	33/12
					10:00
1	1	X	0	0	10/5
	2	X	0	0	1/1

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0
1	3	X	0	0	24/12
	4	X	0	0	X
2	1	0	3/1	10/6	16/8
	2	0	0	18/11	15/10
	3	0	3/1	0	29/14
	4	0	6/2	6/4	30/17
3	1	0	0	1/1	0
	2	0	2/1	1/1	1/1
	3	0	0	0	6/2
	4	X	1/1	1/1	0
4	1	0	1/1	5/3	7/6
	2	X	4/3	12/6	3/2
	3	X	0	12/5	4/3
	4	X	X	8/5	X
5	1	0	0	0	19/9
	2	X	0	0	7/4
	3	X	0	0	5/3
	4	X	0	6/3	1/1
6	1	0	0	2/2	7/5
	2	0	3/1	10/6	2/2
	3	0	0	0	20/11
	4	0	0	0	1/1
		11/17/79			22;00
1	1	0	5/1	0	3/1
	2	0	0	0	9/3
	3	0	0	0	16/5
	4	0	5/1	5/2	18/7
2	1	0	0	6/3	52/20
	2	0	0	0	27/12
	3	0	0	3/1	13/8
	4	0	0	0	30/14
3	1	4/2	0	0	8/2
	2	0	0	0	28/12
	3	0	0	1/1	44/20
	4	0	0	0	39/19

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0
		11/30/79			22:00
1	1	0	0	0	20/7
	2	0	0	6/4	12/6
	3	0	0	4/3	11/6
	4	0	0	0	14/8
2	1	0	0	0	26/17
	2	0	0	0	9/6
	3	0	0	0	2/2
	4	0	0	0	9/7
3	1	0	0	3/2	10/4
	2	0	0	2/1	40/16
	3	0	1/1	0	3/3
	4	0	2/1	0	12/6
4	1	0	0	0	11/4
	2	0	0	0	4/4
	3	0	0	0	12/8
	4	0	0	0	15/5
5	1	0	1/1	0	12/5
	2	0	0	0	4/4
	3	0	0	3/1	13/4
	4	0	6/2	4/3	12/4
6	1	0	0	0	21/11
	2	0	0	3/2	6/6
	3	0	0	0	10/7
	4	0	0	0	4/2
		11/31/79			10:00
1	1	0	0	0	9/3
	2	X	0	1/1	14/10
	3	0	0	0	6/4
	4	0	X	2/1	16/6
2	1	0	0	0	10/8
	2	0	0	0	8/3
	3	0	0	0	10/5
	4	0	0	0	17/8
3	1	0	0	0	10/8
	2	0	0	0	26/16

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0
4	1	0	0	0	51/26
	2	0	0	0	10/5
	3	0	6/2	2/1	33/16
	4	0	0	0	33/12
5	1	0	0	0	8/6
	2	0	0	0	11/5
	3	0	0	0	0
	4	0	0	0	X
6	1	0	0	0	14/6
	2	0	0	0	47/17
	3	0	0	0	3/2
	4	0	0	0	31/13
		11/18/79			10:00
1	1	0	0	X	6/3
	2	0	0	0	4/2
	3	0	0	0	4/4
	4	0	0	0	16/8
2	1	0	0	0	0
	2	0	0	0	5/2
	3	0	0	0	1/1
	4	0	0	0	8/2
3	1	0	0	0	31/16
	2	0	0	0	24/14
	3	0	0	0	32/16
	4	0	0	0	59/30
4	1	1/1	0	0	11/4
	2	0	0	0	9/3
	3	0	0	0	28/13
	4	0	0	0	20/8
5	1	0	0	0	21/7
	2	0	0	0	0
	3	0	0	0	41/15
	4	0	0	0	22/8
6	1	0	0	0	14/4
	2	0	0	0	21/8
	3	0	0	0	23/12
	4	0	0	0	28/12

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
3	3	0	0	X	9/3	
	4	0	0	X	12/10	
4	1	0	0	0	32/11	
	2	0	3/1	0	15/7	
	3	0	0	0	8/4	
	4	0	1/1	2/2	25/9	
5	1	0	0	3/2	17/9	
	2	X	0	0	10/5	
	3	X	0	1/1	37/17	
	4	X	0	0	0	
6	1	0	0	0	16/10	
	2	0	3/2	0	27/13	
	3	0	0	0	16/7	
	4	X	0	0	37/19	
		05/01/81			22:00	
1	1	0	145/59	420/152	705/289	455/261
	2	2/1	158/65	771/225	557/210	439/277
	3	0	220/85	198/85	457/172	250/187
	4	0	73/54	454/176	542/205	X
2	1	3/1	89/41	695/275	996/469	344/236
	2	0	442/224	623/290	759/386	327/246
	3	3/2	558/248	631/280	803/360	374/265
	4	0	436/216	157/69	733/327	245/150
3	1	16/5	387/203	530/274	868/475	X
	2	8/4	366/185	600/312	753/389	71/53
	3	6/3	372/181	599/306	832/416	63/20
	4	7/5	258/131	466/236	624/317	68/57
					04:00	
1	1	21/8	224/121	285/154	366/215	90/67
	2	25/12	314/167	280/130	289/167	102/88
	3	2/2	228/130	328/211	447/259	89/71
	4	38/18	119/59	342/193	369/215	74/61
2	1	0	176/74	406/180	422/197	171/135
	2	3/1	166/84	445/223	595/310	109/83
	3	2/1	72/30	424/190	616/290	118/90
	4	0	43/24	101/50	X	185/139

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
3	1	0	52/18	126/41	395/135	584/345
	2	X	19/10	107/38	461/169	414/335
	3	X	46/17	95/35	127/56	547/410
	4	X	33/13	73/25	326/129	641/462
					10:00	
1	1	0	243/135	399/251	146/101	26/22
	2	8/5	435/265	402/250	336/217	38/35
	3	11/5	293/166	314/196	333/220	50/42
	4	5/3	301/190	433/253	312/201	58/56
2	1	114/44	181/97	294/166	215/135	17/17
	2	20/7	278/148	260/169	238/141	38/27
	3	40/17	208/97	301/169	333/217	27/20
	4	4/2	166/75	344/212	334/202	25/21
3	1	0	3/3	212/182	582/369	73/66
	2	0	121/62	277/144	395/255	61/58
	3	0	68/22	395/221	433/296	76/68
	4	0	134/73	378/205	439/266	116/91
					16:00	
1	1	15/5	227/117	289/149	565/299	102/93
	2	17/8	244/137	400/211	440/265	82/67
	3	44/19	312/187	501/288	539/323	88/82
	4	8/5	220/112	524/301	615/377	70/66
2	1	2/2	171/77	414/278	390/275	51/45
	2	0	181/97	501/289	277/190	60/54
	3	17/6	127/63	329/214	317/198	47/46
	4	19/9	132/87	394/244	354/236	49/37
3	1	138/64	78/40	453/291	436/291	31/28
	2	48/20	228/121	324/207	454/295	38/31
	3	46/21	272/156	446/302	427/294	51/39
	4	190/83	249/152	214/120	544/332	22/18

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
		05/15/81			22:00	
1	1	0	14/2	60/18	139/61	66/43
	2	9/2	60/28	75/29	70/31	75/42
	3	3/2	18/7	107/43	28/14	57/30
	4	0	17/8	30/13	5/4	74/39
2	1	0	8/2	64/25	39/14	106/67
	2	0	11/7	34/14	79/37	78/46
	3	3/1	97/32	23/8	58/20	47/32
	4	0	35/12	28/10	107/42	68/42
3	1	0	21/8	106/46	133/45	71/43
	2	0	58/25	94/28	208/81	114/74
	3	3/1	1/1	52/20	62/27	68/36
	4	0	78/22	92/41	124/49	118/74
		05/16/81			04:00	
1	1	0	38/15	68/30	158/65	46/30
	2	0	3/3	124/43	124/48	137/76
	3	0	15/6	9/5	153/64	128/66
	4	0	103/30	62/22	154/63	83/54
2	1	0	21/9	123/45	140/60	88/52
	2	11/2	46/16	59/24	121/46	79/51
	3	0	36/12	92/29	132/49	115/65
	4	0	7/3	34/12	114/44	105/57
3	1	23/8	19/9	10/6	59/20	114/57
	2	3/2	22/8	62/20	135/45	42/28
	3	0	26/9	14/6	61/24	95/53
	4	8/3	7/3	31/14	75/32	72/45
					10:00	
1	1	0	10/3	44/18	95/48	174/98
	2	0	34/11	131/54	12/7	129/78
	3	2/1	62/21	63/19	112/49	63/32
	4	0	36/18	39/12	67/37	78/39
2	1	12/5	182/76	121/62	164/88	87/62
	2	18/4	56/21	33/13	117/63	29/18
	3	10/3	9/2	48/17	164/77	112/87
	4	93/26	65/22	74/32	107/49	39/20

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
3	1	0	15/5	70/32	11/6	33/18
	2	0	10/4	12/5	9/6	24/16
	3	0	7/3	51/20	12/7	66/29
	4	0	9/3	43/16	86/40	19/11
					16:00	
1	1	11/4	13/7	112/46	173/76	63/45
	2	38/14	59/26	54/21	134/54	98/66
	3	0	43/17	147/57	114/53	X
	4	0	52/24	62/34	133/69	X
2	1	0	44/15	123/51	106/40	47/30
	2	4/2	10/4	109/44	159/73	28/20
	3	17/5	39/14	75/31	242/131	46/32
	4	4/1	7/5	98/48	78/41	64/39
3	1	2/2	13/3	60/16	25/13	33/15
	2	0	35/10	35/14	37/13	38/16
	3	0	0	0	6/3	32/13
	4	2/1	69/20	24/7	38/12	45/29
		05/29/81			22:00	
1	1	8/3	78/41	75/51	136/95	100/84
	2	5/4	153/84	54/46	151/107	34/32
	3	6/6	189/108	110/50	193/132	73/66
	4	10/4	83/55	113/71	120/76	62/52
2	1	18/8	83/49	121/80	113/75	86/74
	2	16/10	78/37	99/58	92/71	85/83
	3	17/7	68/34	185/112	200/131	88/87
	4	29/19	119/73	130/74	116/83	49/43
3	1	0	36/22	56/27	156/96	150/112
	2	3/2	40/21	101/58	219/140	69/57
	3	9/8	124/58	146/76	216/138	54/46
	4	9/5	66/26	89/50	182/107	52/45
		05/30/81			04:00	
1	1	4/4	77/36	47/26	143/71	19/16
	2	11/5	100/44	147/78	210/105	98/59
	3	22/8	101/46	92/44	126/75	142/100
	4	19/9	13/4	59/28	191/104	66/47

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
2	1	2/2	198/89	77/40	65/36	43/43
	2	3/2	44/20	129/62	91/64	7/7
	3	51/26	62/28	202/101	95/63	26/26
	4	9/7	47/24	186/40	40/26	37/27
3	1	38/16	30/16	137/57	205/170	43/32
	2	18/9	135/66	268/132	150/80	119/94
	3	22/11	198/86	131/66	142/78	168/102
	4	17/8	17/11	156/70	0	94/76
					10:00	
1	1	33/17	40/17	62/26	180/82	441/214
	2	4/2	52/23	40/16	110/59	65/59
	3	14/8	13/6	137/61	63/31	27/18
	4	48/26	51/20	36/15	298/145	173/122
2	1	43/18	88/49	102/59	91/64	42/34
	2	10/5	63/33	11/6	67/47	32/25
	3	20/11	107/51	78/44	121/81	53/44
	4	4/2	170/79	176/114	69/56	56/46
3	1	6/3	91/44	155/69	257/124	152/109
	2	34/18	257/122	222/117	159/90	49/35
	3	19/13	43/18	141/61	205/86	35/30
	4	10/5	43/18	144/69	140/86	80/64
					16:00	
1	1	15/6	42/16	77/28	186/111	75/61
	2	37/15	24/9	144/57	229/123	74/67
	3	8/4	47/20	100/38	147/74	120/96
	4	10/5	34/14	181/71	188/99	98/82
2	1	102/61	158/95	142/90	125/97	61/57
	2	88/49	194/127	112/67	134/91	50/44
	3	49/25	13/8	112/80	111/76	59/57
	4	101/49	101/58	173/115	79/54	76/58
3	1	42/19	81/42	139/76	185/127	111/75
	2	33/16	46/25	146/83	238/155	78/63
	3	10/5	74/44	83/60	191/135	85/72
	4	42/22	55/25	104/67	106/64	75/55

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
		06/12/81			22:00	
1	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
2	1	2/2	1/1	0	0	0
	2	0	0	0	0	0
	3	2/1	0	0	0	0
	4	0	0	0	0	0
3	1	1/1	0	2/2	0	0
	2	0	0	0	0	0
	3	0	0	0	0	2/2
	4	0	0	0	0	1/1
		06/13/81			04:00	
1	1	0	0	0	0	0
	2	7/6	0	0	0	0
	3	X	0	1/1	0	0
	4	X	0	0	0	0
2	1	0	0	0	0	0
	2	0	0	0	0	0
	3	2/1	0	0	0	0
	4	0	0	0	2/1	1/1
3	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
					10:00	
1	1	0	0	1/1	0	0
	2	0	0	0	0	0
	3	1/1	0	0	0	0
	4	0	0	0	0	0
2	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0

APPENDIX B (Continued)

Trap no.	Slide no.	Depth 0	1.0	2.0	3.0	4.0
3	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	1/1	0
	4	0	0	0	0	0
					16:00	
1	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
2	1	2/1	0	0	0	0
	2	0	0	0	0	0
	3	1/1	0	0	0	0
	4	0	0	0	0	0
3	1	0	0	0	0	0
	2	0	0	0	0	3/1
	3	0	0	0	0	1/1
	4	0	0	0	0	0

APPENDIX C

Product Moment Formula

The product moment formula scores the percentage of the total number of growth axes at each level (Table 7) according to the formula:

$$\text{Score} = \%\ \text{GA} \cdot \text{F},$$

where F is 2 at 0m, 1 at 1m, 0 at 2m, -1 at 3m, and -2 at 4m whenever the total water column depth equalled 4m. The F values were readjusted to the values of 2 at 0m, 1 at 1m, 0 at 1.5m, -1 at 2m, and -2 at 3m when the water column depth equalled 3m. The subsequent table is a summary of the results.

	Depth					
Date	0m	1m	2m	3m	4m	Score
04/28/79	2.10	6.17	0.0	-23.23	-111.32	-126.28
05/17/79	8.72	10.48	0.0	-21.81	-93.78	-96.38
06/01/79	22.48	14.34	0.0	-29.32	-54.86	-47.36
10/05/79	0.0	1.52	0.0	-0.61	-18.48	-17.57
10/20/79	7.16	9.82	-7.72	-157.72		-148.44
11/03/79	2.48	7.36	-25.70	-131.30		-147.26
11/17/79	5.06	1.56	-1.69	-188.46		-183.53
11/30/79	0.0	2.39	-4.87	-185.50		-187.39
05/02/81	3.58	16.68	0.0	-38.87	-24.92	-43.52
05/15/81	4.12	12.24	0.0	-34.92	-52.86	-71.42
05/30/81	10.18	18.11	0.0	-31.72	-33.33	-36.36
06/12/81	69.14	38.27	0.0	-4.94	-29.62	72.85

APPENDIX D

Biomass of Zooplankton Collected by 100μ and 64μ Vertical Tows.

Mean biomass ($\mu g/m^3$) of the Meander Creek Reservoir zooplankton collected by vertical tow. Standard deviation (SD) is the measure of variance. Plankton bucket mesh size is 100μ.

Taxa	Date 04/28/79	05/17/79	06/01/79
D. g. mendota	19.19 ± 9.06	121.64 ± 41.97	49.77 ± 23.61
D. retrocurva	1.11 ± 0.44	8.47 ± 4.31	10.53 ± 8.39
D. ambigua	0.14 ± 0.20	2.42 ± 3.04	0.69 ± 0.50
D. parvula	0.83 ± 0.50	0.34 ± 0.41	0.0
D. longiremus	0.04 ± 0.10	0.0	0.0
D. dubia	0.02 ± 0.10	0.05 ± 0.12	0.0
D. pulex	0.0	0.0	0.0
C. lacustris	0.0	0.09 ± 0.11	0.0
B. longirostris	1.13 ± 0.90	1.13 ± 1.44	0.45 ± 0.49
E. coregoni	0.91 ± 0.93	0.61 ± 0.34	0.36 ± 0.43
C. sphaericus	0.0	0.02 ± 0.03	0.0
K. latissima	0.23 ± 0.54	0.03 ± 0.01	>0.00 ± 0.01
A. guttata	0.32 ± 1.11	0.0	0.0
D. leuchtenbergianium	0.03 ± 0.11	0.06 ± 0.06	0.05 ± 0.13
L. kindtii	0.0	0.07 ± 0.14	0.0
S. crystallina	0.0	0.0	0.0
C. rectirostris	0.0	0.0	0.0
C. b. thomasi	45.50 ± 23.26	2.48 ± 2.19	1.18 ± 1.23
C. vernalis	0.87 ± 1.05	0.31 ± 0.54	0.16 ± 0.34
M. edax	27.28 ± 34.94	10.93 ± 8.51	2.83 ± 2.15
C. nauplii	0.02 ± 0.03	0.07 ± 0.09	0.01 ± 0.13
C. copepodites	0.89 ± 0.31	1.96 ± 1.67	0.16 ± 0.25
D. nauplii	0.04 ± 0.06	0.03 ± 0.06	0.03 ± 0.07
D. copepodites	0.0	0.0	0.0
D. sicilis	18.38 ± 16.14	24.99 ± 10.63	7.68 ± 5.01
D. siciloides	8.21 ± 4.83	4.27 ± 3.57	4.99 ± 4.47
E. megaceros	0.0	0.0	0.0
Keratella spp.	0.0	0.0	0.0
Polyarthra spp.	0.0	0.0	0.0
Total	125.89 ± 66.40	186.08 ± 42.44	81.25 ± 41.04

Mean zooplankton biomass ($\mu g/m^3 \pm$ SD) - 100µ tow. (Continued)

Taxa	Date 10/05/79	10/20/79	11/03/79
D. g. mendota	1.93 ± 1.39	0.42 ± 0.34	0.09 ± 0.22
D. retrocurva	15.80 ± 3.78	1.87 ± 1.25	2.30 ± 2.07
D. ambigua	0.0	0.0	0.0
D. parvula	0.0	0.0	0.0
D. longiremus	0.0	0.0	0.0
D. dubia	0.0	0.0	0.0
D. pulex	0.0	0.0	0.0
C. lacustris	0.0	0.0	0.0
B. longirostris	0.03 ± 0.07	0.0	0.09 ± 0.11
E. coregoni	1.05 ± 0.88	20.85 ± 50.66	0.52 ± 0.43
C. sphaericus	0.0	0.0	0.0
K. latissima	0.08 ± 0.13	0.0	0.0
A. guttata	0.0	0.0	0.0
D. leuchtenbergianium	11.42 ± 8.43	1.35 ± 1.29	0.69 ± 0.91
L. kindtii	0.07 ± 0.18	0.0	0.0
S. crystallina	0.0	0.0	0.0
C. rectirostris	0.0	0.0	0.0
C. b. thomasi	1.73 ± 0.38	0.45 ± 0.71	1.74 ± 0.84
C. vernalis	1.58 ± 1.13	0.88 ± 0.83	1.16 ± 1.13
M. edax	16.38 ± 12.72	1.47 ± 1.53	4.35 ± 3.23
C. nauplii	0.33 ± 0.36	0.02 ± 0.02	0.05 ± 0.04
C. copepodites	6.12 ± 7.61	0.19 ± 0.18	0.28 ± 0.37
D. nauplii	0.03 ± 0.04	0.0	0.0
D. copepodites	0.0	0.0	0.0
D. sicilis	56.81 ± 30.58	17.90 ± 12.01	35.95 ± 8.78
D. siciloides	15.21 ± 6.80	4.75 ± 3.77	11.71 ± 6.75
E. megaceros	0.0	0.0	0.0
Keratella spp.	0.0	0.0	0.0
Polyarthra spp.	0.0	0.0	0.0
Total	128.01 ± 52.88	150.28 ± 54.77	58.93 ± 17.02

Mean zooplankton biomass ($\mu g/m^3 \pm SD$) - 100μ tow. (Continued)

Taxa	Date 11/17/79	11/30/79
D. g. mendota	9.20 ± 7.71	20.32 ± 7.39
D. retrocurva	13.10 ± 6.79	2.91 ± 1.59
D. ambigua	0.05 ± 0.11	0.0
D. parvula	0.0	0.0
D. longiremus	0.0	0.0
D. dubia	0.0	0.0
D. pulex	0.0	0.0
C. lacustris	0.0	0.88 ± 1.03
B. longirostris	0.63 ± 0.18	1.92 ± 1.05
E. coregoni	10.81 ± 4.33	0.17 ± 0.41
C. sphaericus	0.0	0.26 ± 0.65
K. latissima	0.0	0.0
A. guttata	0.02 ± 0.05	0.27 ± 0.30
D. leuchtenbergianium	1.04 ± 1.06	0.0
L. kindtii	0.0	0.0
S. crystallina	0.0	0.0
C. rectirostris	0.0	0.0
C. b. thomasi	17.31 ± 7.02	16.62 ± 9.27
C. vernalis	0.65 ± 0.83	3.18 ± 2.26
M. edax	4.45 ± 1.94	2.25 ± 1.58
C. nauplii	0.22 ± 0.18	0.17 ± 0.17
C. copepodites	1.85 ± 1.12	0.85 ± 0.82
D. nauplii	0.0	0.0
D. copepodites	0.0	0.0
D. sicilis	52.17 ± 32.06	54.46 ± 13.85
D. siciloides	33.44 ± 29.18	21.28 ± 5.17
E. megaceros	0.0	0.0
Keratella spp.	0.0	0.0
Polyarthra spp.	0.0	0.0
Total	144.94 ± 79.53	126.27 ± 25.39

Mean zooplankton biomass ($\mu g/m^3 \pm SD$) - 100μ tow. (Continued)

Taxa	Date 05/02/81	05/15/81	05/30/81
D. g. mendota	7.68 ± 4.65	27.66 ± 15.80	79.63 ± 37.47
D. retrocurva	0.38 ± 0.50	4.41 ± 3.58	14.20 ± 9.13
D. ambigua	0.82 ± 0.95	3.61 ± 1.84	1.30 ± 0.77
D. parvula	1.21 ± 1.14	0.32 ± 0.40	0.10 ± 0.16
D. longiremus	0.0	0.0	0.0
D. dubia	0.0	0.0	0.0
D. pulex	0.0	0.0	0.0
C. lacustris	0.04 ± 0.14	0.05 ± 0.18	0.07 ± 0.16
B. longirostris	1.98 ± 1.60	3.20 ± 3.10	1.06 ± 0.72
E. coregoni	0.53 ± 0.52	0.45 ± 0.61	0.32 ± 0.45
C. sphaericus	0.01 ± 0.03	0.08 ± 0.23	0.03 ± 0.05
K. latissima	0.0	0.0	0.0
A. guttata	0.0	0.02 ± 0.05	0.0
D. leuchtenbergianium	0.0	0.06 ± 0.14	0.16 ± 0.24
L. kindtii	0.0	0.0	0.0
S. crystallina	0.0	0.0	0.0
C. rectirostris	0.0	0.0	0.0
C. b. thomasi	6.58 ± 3.44	2.76 ± 3.82	0.60 ± 0.60
C. vernalis	0.64 ± 1.21	3.55 ± 2.56	0.59 ± 0.58
M. edax	7.92 ± 3.69	2.64 ± 1.77	3.57 ± 4.47
C. nauplii	0.02 ± 0.06	0.10 ± 0.29	0.06 ± 0.06
C. copepodites	0.23 ± 0.18	0.48 ± 1.02	0.30 ± 0.26
D. nauplii	0.01 ± 0.02	0.02 ± 0.03	0.04 ± 0.05
D. copepodites	0.40 ± 0.36	0.43 ± 0.47	1.43 ± 1.02
D. sicilis	7.12 ± 4.16	18.99 ± 8.32	21.10 ± 10.90
D. siciloides	3.65 ± 1.68	8.65 ± 6.10	26.04 ± 10.10
E. megaceros	0.0	0.0	0.0
Keratella spp.	>0.00 ± 0.01	0.50 ± 0.68	>0.00 ± >0.00
Polyarthra spp.	0.0	0.0	0.0
Total	39.41 ± 14.51	78.43 ± 22.73	156.83 ± 63.79

Mean zooplankton biomass (μg/m^3 ± SD) - 100μ tow. (Continued)

Taxa	Date 06/12/81
D. g. mendota	74.70 ± 43.22
D. retrocurva	10.39 ± 8.16
D. ambigua	0.11 ± 0.17
D. parvula	0.0
D. longiremus	0.0
D. dubia	0.0
D. pulex	0.0
C. lacustris	0.03 ± 0.09
B. longirostris	0.09 ± 0.10
E. coregoni	0.26 ± 0.22
C. sphaericus	0.0
K. latissima	0.0
A. guttata	0.02 ± 0.05
D. leuchtenbergianium	0.33 ± 0.43
L. kindtii	0.77 ± 2.33
S. crystallina	0.0
C. rectirostris	0.0
C. b. thomasi	0.70 ± 1.28
C. vernalis	3.56 ± 4.10
M. edax	8.63 ± 5.83
C. nauplii	0.01 ± 0.01
C. copepodites	0.07 ± 0.13
D. nauplii	0.01 ± 0.01
D. copepodites	0.93 ± 1.20
D. sicilis	4.87 ± 1.99
D. siciloides	8.22 ± 6.35
E. megaceros	0.0
Keratella spp.	0.0
Polyarthra spp.	0.0
Total	114.34 ± 52.07

Mean zooplankton biomass ($\mu g/m^3 \pm SD$) - 64μ tow. (Continued)

Taxa	Date 10/05/79	10/20/79	11/03/79
D. g. mendota	2.79 ± 1.92	1.73 ± 1.01	1.05 ± 1.27
D. retrocurva	14.25 ± 6.33	3.21 ± 2.33	3.77 ± 3.18
D. ambigua	0.0	0.0	0.0
D. parvula	0.0	0.0	0.0
D. longiremus	0.0	0.0	0.0
D. dubia	0.04 ± 0.09	0.0	0.0
D. pulex	0.0	0.0	0.0
C. lacustris	0.12 ± 0.29	0.0	0.0
B. longirostris	0.03 ± 0.07	0.18 ± 0.22	0.59 ± 0.41
E. coregoni	1.13 ± 0.91	16.09 ± 35.66	1.77 ± 1.20
C. sphaericus	0.0	0.0	0.0
K. latissima	0.0	0.0	0.04 ± 0.10
A. guttata	0.0	0.17 ± 0.19	0.0
D. leuchtenbergianium	17.26 ± 11.85	6.35 ± 2.37	1.58 ± 1.37
L. kindtii	0.22 ± 0.36	0.01 ± 0.24	0.0
S. crystallina	0.0	0.0	0.0
C. rectirostris	0.0	0.0	0.0
C. b. thomasi	1.68 ± 1.33	8.12 ± 2.78	13.80 ± 5.88
C. vernalis	1.75 ± 1.63	0.0	2.46 ± 2.22
M. edax	10.81 ± 10.54	12.00 ± 4.04	13.73 ± 10.58
C. nauplii	1.23 ± 1.52	0.33 ± 0.19	0.62 ± 0.27
C. copepodites	4.37 ± 4.82	5.00 ± 0.96	2.39 ± 1.17
D. nauplii	0.04 ± 0.03	0.0	0.0
D. copepodites	0.0	0.0	0.0
D. sicilis	56.18 ± 36.84	75.02 ± 22.93	68.85 ± 17.81
D. siciloides	18.76 ± 13.01	18.84 ± 11.56	10.25 ± 9.57
E. megaceros	0.15 ± 0.25	0.0	0.0
Keratella spp.	0.0	0.0	0.0
Polyarthra spp.	0.0	0.0	0.0
Total	130.92 ± 57.77	136.25 ± 27.67	120.31 ± 42.62

Mean zooplankton biomass ($\mu g/m^3 \pm SD$) - 64μ tow. (Continued)

Taxa	Date 11/17/79	Date 11/30/79
D. g. mendota	22.61 ± 16.55	273.55 ± 291.95
D. retrocurva	19.37 ± 9.03	9.60 ± 9.95
D. ambigua	0.09 ± 0.14	0.33 ± 0.50
D. parvula	0.0	0.15 ± 0.25
D. longiremus	0.0	0.0
D. dubia	0.0	0.20 ± 0.49
D. pulex	0.0	0.0
C. lacustris	0.0	0.0
B. longirostris	0.96 ± 1.12	5.19 ± 6.33
E. coregoni	13.39 ± 8.45	3.38 ± 1.92
C. sphaericus	0.0	0.0
K. latissima	0.11 ± 0.27	0.0
A. guttata	0.0	0.08 ± 0.19
D. leuchtenbergianium	0.74 ± 0.52	0.0
L. kindtii	0.0	0.58 ± 1.43
S. crystallina	0.0	0.0
C. rectirostris	0.0	0.0
C. b. thomasi	125.54 ± 23.94	11.99 ± 12.37
C. vernalis	1.02 ± 0.90	2.39 ± 1.63
M. edax	5.76 ± 2.39	10.87 ± 9.94
C. nauplii	0.31 ± 0.34	0.30 ± 0.44
C. copepodites	3.75 ± 3.87	2.08 ± 1.13
D. nauplii	0.0	0.0
D. copepodites	0.0	0.0
D. sicilis	86.19 ± 59.44	0.98 ± 16.76
S. siciloides	59.43 ± 45.50	11.95 ± 6.37
E. megaceros	0.0	0.0
Keratella spp.	0.0	0.0
Polyarthra spp.	0.0	0.0
Total	237.41 ± 158.65	389.92 ± 307.83

Mean zooplankton biomass ($\mu g/m^3 \pm SD$) - 64μ tow. (Continued)

Taxa	Date 05/02/81	05/15/81	05/30/81
D. g. mendota	10.67 ± 6.96	40.36 ± 14.54	98.35 ± 42.70
D. retrocurva	4.62 ± 5.44	4.94 ± 3.71	15.80 ± 12.78
D. ambigua	0.67 ± 0.67	5.03 ± 2.04	1.26 ± 0.63
D. parvula	0.64 ± 0.62	0.38 ± 0.41	0.52 ± 0.74
D. longiremus	0.0	0.0	0.0
D. dubia	0.0	0.03 ± 0.06	0.0
D. pulex	0.0	0.0	0.0
C. lacustris	0.0	0.08 ± 0.23	0.77 ± 0.35
B. longirostris	5.26 ± 4.43	29.40 ± 10.09	11.17 ± 5.39
E. coregoni	0.61 ± 0.66	2.27 ± 2.25	0.60 ± 0.65
C. sphaericus	0.27 ± 0.37	0.99 ± 0.60	0.59 ± 0.21
K. latissima	0.10 ± 0.24	0.0	0.0
A. guttata	0.86 ± 3.12	0.07 ± 0.13	0.04 ± 0.09
D. leuchtenbergianium	0.0	0.0	0.23 ± 0.33
L. kindtii	0.0	0.0	0.0
S. crystallina	0.0	0.0	0.0
C. rectirostris	0.0	0.0	0.0
C. b. thomasi	33.62 ± 14.97	23.16 ± 8.71	5.89 ± 1.10
C. vernalis	0.28 ± 0.31	5.02 ± 3.07	1.43 ± 0.96
M. edax	11.57 ± 11.36	0.85 ± 0.58	4.70 ± 3.86
C. nauplii	0.31 ± 0.47	0.94 ± 0.49	1.54 ± 0.52
C. copepodites	17.04 ± 6.63	0.63 ± 2.45	4.06 ± 1.75
D. nauplii	0.74 ± 0.25	0.42 ± 0.15	0.67 ± 0.27
D. copepodites	6.96 ± 2.64	3.06 ± 1.31	15.13 ± 3.82
D. sicilis	14.89 ± 6.86	14.81 ± 10.51	29.46 ± 14.74
D. siciloides	2.46 ± 2.52	0.83 ± 0.45	25.79 ± 15.33
E. megaceros	0.0	0.0	0.0
Keratella spp.	0.57 ± 0.60	6.43 ± 4.70	0.05 ± 0.02
Polyarthra spp.	0.0	0.0	0.0
Total	113.96 ± 38.96	156.11 ± 48.62	217.47 ± 67.53

Mean zooplankton biomass ($\mu g/m^3 \pm SD$) - 64μ tow. (Continued)

Taxa	Date 06/12/81
D. g. mendota	72.49 ± 22.87
D. retrocurva	13.69 10.30
D. ambigua	0.13 ± 0.25
D. parvula	0.0
D. longiremus	0.0
D. dubia	0.0
D. pulex	0.0
C. lacustris	0.10 ± 0.07
B. longirostris	0.16 ± 0.27
E. coregoni	0.72 ± 0.48
C. sphaericus	0.29 ± 0.59
K. latissima	0.0
A. guttata	0.05 ± 0.09
D. leuchtenbergianium	0.94 ± 0.99
L. kindtii	0.72 ± 0.89
C. rectirostris	0.0
S. crystallina	0.0
C. b. thomasi	1.28 ± 0.86
C. vernalis	4.00 ± 2.51
M. edax	1.44 ± 1.12
C. nauplii	0.41 ± 0.44
C. copepodites	2.01 ± 1.09
D. nauplii	0.25 ± 0.18
D. copepodites	13.04 ± 4.20
D. sicilis	6.43 ± 6.43
D. siciloides	6.35 ± 6.20
E. megaceros	0.0
Keratella spp.	0.0
Polyarthra spp.	>0.00 ± >0.00
Total	151.84 ± 43.18

APPENDIX E

Mean Ingested Zooplankton Biomass

Mean ingested biomass (μg/GA), per collection, of the Meander Creek Reservoir zooplankton. Standard deviation (SD) is the measure of variance.

Taxa	Date 04/28/79	05/17/79	06/01/79
D. g. mendota	0.43 ± 0.83	0.45 ± 1.62	0.51 ± 1.92
D. retrocurva	0.01 ± 0.10	0.19 ± 0.71	0.17 ± 0.75
D. ambigua	>0.00 ± 0.08	0.04 ± 0.25	0.03 ± 0.21
D. parvula	0.0	>0.00 ± 0.05	0.01 ± 0.10
D. longiremus	>0.00 ± 0.03	0.0	0.0
D. dubia	0.0	0.01 ± 0.13	0.01 ± 0.17
D. pulex	0.01 ± 0.15	>0.00 ± 0.02	>0.00 ± 0.04
C. lacustris	>0.0	>0.00 ± 0.07	>0.00 ± 0.01
B. longirostris	0.04 ± 0.78	0.09 ± 0.48	0.09 ± 0.39
E. coregoni	0.01 ± 0.12	0.01 ± 0.10	0.02 ± 0.11
C. sphaericus	0.0	>0.00 ± 0.03	>0.00 ± 0.01
K. latissima	0.0	>0.00 ± 0.13	>0.00 ± 0.16
A. guttata	0.0	>0.00 ± 0.03	>0.00 ± 0.01
D. leuchtenbergianium	0.0	0.0	0.0
L. kindtii	0.0	0.0	>0.00 ± 0.01
S. crystallina	0.0	>0.00 ± 0.03	>0.00 ± 0.04
C. rectirostris	0.0	>0.00 ± 0.05	0.0
C. b. thomasi	0.76 ± 1.91	0.25 ± 0.83	0.27 ± 0.94
C. vernalis	0.08 ± 0.94	0.03 ± 0.29	0.01 ± 0.21
M. edax	0.16 ± 1.26	0.06 ± 0.84	0.01 ± 0.24
C. nauplii	0.04 ± 0.13	0.01 ± 0.05	>0.00 ± 0.03
C. copepodites	0.10 ± 0.35	0.06 ± 0.27	0.06 ± 0.27
D. nauplii	>0.00 ± 0.02	>0.00 ± 0.01	>0.00 ± 0.02
D. copepodites	>0.00 ± 0.01	0.0	>0.00 ± 0.04
D. sicilis	0.01 ± 0.95	0.02 ± 0.28	0.08 ± 0.75
D. siciloides	0.09 ± 0.79	0.03 ± 0.38	0.06 ± 0.69
E. megaceros	0.0	0.0	>0.00 ± 0.08
Keratella spp.	0.0	>0.00 ± >0.00	>0.00 ± >0.00
Polyarthra spp.	>0.00 ± >0.00	>0.00 ± >0.00	>0.00 ± >0.00
Total	1.46 ± 2.94	1.27 ± 2.74	1.33 ± 2.96

Mean ingested zooplankton biomass (μg/GA ± SD) (Continued).

Taxa	Date 10/05/79	10/20/79	11/03/79
D. g. mendota	0.19 ± 0.71	0.10 ± 0.60	0.11 ± 0.57
D. retrocurva	0.09 ± 0.38	0.28 ± 1.47	0.15 ± 0.59
D. ambigua	0.0	0.0	0.0
D. parvula	0.0	0.0	>0.00 ± 0.03
D. longiremus	0.0	0.0	0.0
D. dubia	0.0	0.0	0.0
D. pulex	0.0	0.0	0.0
C. lacustris	>0.00 ± 0.02	0.0	0.0
B. longirostris	0.05 ± 0.24	0.02 ± 0.17	0.03 ± 0.17
E. coregoni	0.02 ± 0.09	0.02 ± 0.11	0.05 ± 0.24
C. sphaericus	0.0	0.0	>0.00 ± 0.06
K. latissima	0.0	0.0	>0.00 ± 0.07
A. guttata	0.0	0.0	0.0
D. leuchtenbergianium	0.14 ± 0.51	0.22 ± 1.10	0.01 ± 0.10
L. kindtii	0.0	0.0	0.0
S. crystallina	0.0	0.06 ± 0.57	0.0
C. rectirostris	0.0	0.02 ± 0.21	0.01 ± 0.14
C. b. thomasi	0.30 ± 0.84	0.71 ± 1.65	0.57 ± 1.50
C. vernalis	0.13 ± 0.63	0.20 ± 0.80	0.08 ± 0.78
M. edax	0.10 ± 0.55	0.86 ± 2.37	0.08 ± 0.48
C. nauplii	0.01 ± 0.05	>0.00 ± 0.02	0.01 ± 0.05
C. copepodites	0.05 ± 0.18	0.02 ± 0.32	0.06 ± 0.29
D. nauplii	>0.00 ± 0.01	0.0	0.0
D. copepodites	0.0	0.47 ± 0.69	0.0
D. sicilis	0.18 ± 0.74	0.29 ± 1.58	0.06 ± 0.48
D. siciloides	0.0	0.30 ± 1.41	0.18 ± 1.18
E. megaceros	0.24 ± 0.76	0.34 ± 1.07	0.03 ± 0.02
Keratella spp.	0.0	0.0	>0.00 ± >0.00
Polyarthra spp.	>0.00 ± >0.00	>0.00 ± 0.04	>0.00 ± >0.00
Total	1.49 ± 2.03	3.55 ± 5.64	1.43 ± 2.70

Mean ingested zooplankton biomass (μg/GA ± SD) (Continued).

Taxa	Date 11/17/79	11/30/79
D. g. mendota	1.36 ± 2.77	0.99 ± 2.50
D. retrocurva	0.73 ± 1.83	0.31 ± 1.21
D. ambigua	0.0	0.0
D. parvula	0.0	0.0
D. longiremus	0.0	0.0
D. dubia	0.01 ± 0.07	0.0
D. pulex	0.0	0.0
C. lacustris	0.0	0.0
B. longirostris	0.11 ± 0.44	0.01 ± 0.08
E. coregoni	0.03 ± 0.14	0.02 ± 0.12
C. sphaericus	0.0	0.0
K. latissima	>0.00 ± >0.00	0.0
A. guttata	0.0	0.0
D. leuchtenbergianium	0.06 ± 0.41	0.05 ± 0.41
L. kindtii	0.0	0.0
S. crystallina	0.0	0.0
C. rectirostris	0.0	0.0
C. b. thomasi	1.43 ± 2.26	2.36 ± 3.79
C. vernalis	0.01 ± 0.10	0.0
M. edax	0.15 ± 0.40	0.06 ± 0.49
C. nauplii	0.04 ± 0.31	0.06 ± 0.20
C. copepodites	0.08 ± 0.26	0.29 ± 0.62
D. nauplii	0.0	>0.00 ± 0.02
D. copepodites	0.02 ± 0.17	0.0
D. sicilis	0.24 ± 1.15	0.27 ± 1.48
D. siciloides	0.15 ± 0.71	0.40 ± 1.73
E. megaceros	0.07 ± 0.49	0.02 ± 0.20
Keratella spp.	>0.00 ± >0.00	0.0
Polyarthra spp.	>0.00 ± >0.00	>0.00 ± >0.00
Total	4.49 ± 4.56	4.85 ± 6.52

Mean ingested zooplankton biomass (μg/GA ± SD) (Continued).

Taxa	Date 05/02/81	05/15/81	05/30/81
D. g. mendota	0.42 ± 1.34	1.11 ± 2.38	0.27 ± 0.97
D. retrocurva	0.01 ± 0.19	0.37 ± 0.96	0.11 ± 0.45
D. ambigua	0.0	0.03 ± 0.21	0.01 ± 0.09
D. parvula	0.02 ± 0.20	>0.00 ± 0.08	0.0
D. longiremus	0.0	0.0	>0.00 ± >0.00
D. dubia	0.0	0.0	>0.00 ± 0.01
D. pulex	0.0	0.0	0.0
C. lacustris	>0.00 ± 0.01	>0.00 ± 0.06	>0.00 ± 0.01
B. longirostris	0.11 ± 0.54	0.31 ± 0.94	0.09 ± 0.40
E. coregoni	0.04 ± 0.31	0.01 ± 0.07	0.01 ± 0.09
C. sphaericus	0.01 ± 0.12	>0.00 ± 0.04	0.0
K. latissima	>0.00 ± 0.10	>0.00 ± >0.00	>0.00 ± 0.01
A. guttata	>0.00 ± 0.02	0.0	0.0
D. leuchtenbergianium	>0.00 ± 0.01	0.0	0.0
L. kindtii	0.0	0.0	0.0
S. crystallina	0.0	0.0	0.0
C. rectirostris	0.0	0.0	0.0
C. b. thomasi	0.67 ± 1.51	0.18 ± 0.71	0.12 ± 0.47
C. vernalis	0.01 ± 0.27	>0.00 ± 0.08	>0.00 ± 0.05
M. edax	0.14 ± 1.27	>0.00 ± >0.00	0.04 ± 0.45
C. nauplii	0.05 ± 0.10	0.02 ± 0.06	0.02 ± 0.07
C. copepodites	0.33 ± 0.66	0.08 ± 0.28	0.08 ± 0.80
D. nauplii	>0.00 ± 0.01	>0.00 ± 0.02	>0.00 ± 0.01
D. copepodites	0.01 ± 0.11	>0.00 ± 0.07	0.01 ± 0.06
D. sicilis	0.04 ± 0.59	0.0	0.09 ± 0.34
D. siciloides	0.05 ± 0.68	0.05 ± 0.71	0.01 ± 0.18
E. megaceros	0.0	0.0	0.0
Keratella spp.	>0.00 ± >0.00	>0.00 ± >0.00	0.0
Polyarthra spp.	>0.00 ± >0.00	>0.00 ± >0.00	>0.00 ± >0.00
Total	1.90 ± 2.90	2.17 ± 3.30	0.73 ± 1.52

Mean ingested zooplankton biomass (μg/GA ± SD) (Continued).

Taxa	Date 06/12/81
D. g. mendota	0.58 ± 2.14
D. retrocurva	0.42 ± 1.44
D. ambigua	0.0
D. parvula	0.0
D. longiremus	0.0
D. dubia	0.0
D. pulex	0.0
C. lacustris	0.0
B. longirostris	0.03 ± 0.16
E. coregoni	0.0
C. sphaericus	0.0
K. latissima	0.0
A. guttata	0.0
D. leuchtenbergianium	0.0
L. kindtii	0.08 ± 0.40
S. crystallina	0.0
C. rectirostris	0.0
C. b. thomasi	0.09 ± 0.45
C. vernalis	0.0
M. edax	0.0
C. nauplii	0.0
C. copepodites	0.0
D. nauplii	0.0
D. copepodites	0.0
D. sicilis	0.0
D. siciloides	0.0
E. megaceros	0.0
Keratella spp.	0.0
Polyarthra spp.	0.0
Total	1.19 ± 2.92

APPENDIX F

Number of Microstonum sp. Collected from Trap Sets at Meander Reservoir

Number of <u>Microstomum</u> <u>sp</u>. collected from the Meander Creek Reservoir hydra traps. T is the time of the trap collection. TS represents the trap set that the planarian was collected from. D is the depth where the infested slide was located. GA/H is the total number of hydra remaining on the slide. NP represents the number of <u>Microstomum</u> collected from the slides.

Date	T	TS	D	GA/H	NP
05/15/81	16:00	3	3m	38/12	1
05/30/81	22:00	3	0m	9/5	1
			1m	66/26	1
			4m	150/112	1
	10:00	3	4m	49/35	1
	16:00	3	4m	78/36	1
06/12/81	22:00	1	4m	0	1
		2	4m	0	1
				0	1
				0	4
		3	0m	0	1
			4m	1/1	1
	10:00	1	2m	0	1
			3m	0	1
			4m	0	1
		3	1m	0	1
			4m	0	1
	16:00	2	4m	0	1
		3	4m	0	2
				1/1	5

APPENDIX G

Selectivity in Hydra

Strauss electivity index coefficients - 100μ tow, Spring 1979. * indicates that the probability cannot be determined due to small sample size.

Taxa	$\bar{x}$	s^2	t	P	no.
D. g. mendota	-0.31	-0.05	5.82	<0.01	6
D. retrocurva	>0.00	0.31	0.00	<0.50	6
D. ambigua	-0.09	0.04	-2.39	>0.05	6
D. parvula	-0.32	0.01	-32.00	<0.001	4
D. longiremus	0	0	0	*	2
D. dubia	-0.01	0.01	-1.00	>0.20	4
D. pulex	0.09	>0.00	0.0	>0.50	4
C. lacustris	0.09	>0.00	0.0	>0.50	3
B. longirostris	0.09	0.09	1.01	>0.20	6
E. coregoni	0.01	0.03	0.32	>0.50	6
C. sphaericus	0	0	0	*	2
K. latissuma	>0.00	>0.00	0.00	>0.50	5
A. guttata	>0.00	>0.00	0.00	>0.50	3
D. leuchtenbergianium	>0.00	>0.00	0.00	>0.5	3
L. kindtii	0	0	0	*	2
C. rectirostris	0	0	0	*	2
S. crystallina	0	0	0	*	1
C. b. thomasi	2.02	2.17	0.12	>0.50	6
C. vernalis	>0.00	0.01	0.00	>0.05	6
M. edax	-0.08	0.08	-0.97	>0.50	6
C. naupli	0.12	0.08	1.51	>0.20	6
C. copepodite	0.07	0.09	0.75	>0.20	6
D. naupli	>0.00	>0.00	0.00	>0.05	6
D. copepodite	0	0	0	*	2
D. sicilis	-0.07	0.07	-1.00	>0.20	6
D. siciloides	-0.02	0.04	-0.69	>0.50	6
E. megaceros	0	0	0	*	0
Keratella sp.	0.01	0.01	1.0	*	2
Polyarthra sp.	0.20	0.08	2.47	>0.20	3

Electivity coefficients - 100μ tow, Fall 1979. (Continued)

Taxa	$\bar{x}$	s^2	t	P	no.
D. g. mendota	0.06	0.08	0.67	>0.50	10
D. retrocurva	-0.01	0.10	-0.10	>0.50	10
D. ambigua	0.08	0		*	1
D. parvula	0 [illegible]	0		*	1
D. longiremus	0	0		*	0
D. dubia	>0.00	0		*	1
D. pulex	0	0		*	0
C. lacustris	>0.00	0		*	1
B. longirostris	0.02	0.04	0.40	>0.50	10
E. coregoni	0.03	0.08	0.40	>0.50	10
C. sphaericus	0	0		*	2
K. lattissima	0	0		>0.50	4
A. guttata	0	0		*	1
D. leuchtenbergianium	-0.01	0.06	0.13	>0.50	10
L. kindtii	0	0		*	1
C. rectirostris	>0.00	0		*	1
S. crystallina	>0.00	0.01	0.40	*	2
C. b. thomasi	0.19	-0.05	-3.80	<0.01	10
C. vernalis	0.01	0.05	0.16	>0.50	9
M. edax	0.01	0.09	0.16	>0.50	10
C. naupli	0.04	0.07	0.54	>0.50	10
C. copepodite	0.04	0.09	0.40	>0.50	10
D. naupli	>0.00	0.01	0.20	>0.50	3
D. copepodite	0.01	0.01	1.00	*	2
D. sicilis	0.30	0.00	-101.30	<0.001	10
D. siciloides	-0.09	0.08	-1.18	>0.02	9
E. megaceros	0.05	0.04	1.30	>0.20	5
Keratella sp.	>0.00	0.01	0.33	*	2
Polyarthra sp.	0.04	0.03	1.27	>0.20	5

Electivity coefficients - 100μ tow, Spring 1981.

Taxa	$\bar{x}$	s^2	t	P	no.
D. g. mendota	0.06	0.08	0.67	>0.50	10
D. retrocurva	-0.01	0.10	-0.10	>0.50	10
D. ambigua	0	0		*	1
D. longiremus	0	0		*	1
D. dubia	0	0			0
D. pulex	0	0		*	1
C. lacustris	0	0		*	1
B. longirostris	0.02	0.04	0.40	>0.50	10
E. coregoni	0.03	0.08	0.40	>0.50	10
C. sphaericus	0	0		*	2
K. latissima	0	0			4
A. guttata	0	0		*	2
D. leuchtenbergianium	0.01	0.06	0.13	>0.50	10
L. kindtii	0	0		*	1
C. rectirostris	0	0		*	1
S. crystallina	0	0		*	2
C. b. thomasi	0.19	-0.05	-3.8	<0.01	10
C. vernalis	0.01	0.05	0.16	>0.50	9
M. edax	0.01	0.09	0.16	>0.50	10
C. nauplii	0.04	0.07	0.54	>0.50	10
C. copepodites	0.04	0.09	0.40	>0.50	10
D. nauplii	>0.00	0.01	0.20	>0.50	3
D. copepodites	0	0		*	2
D. sicilis	0.30	>0.00	-101.30	<0.001	10
S. siciloides	-0.09	0.01	-1.18	>0.02	9
E. megaceros	0.05	0.04	1.30	>0.20	5
Keratella sp.	>0.00	0.01	0.33	*	2
Polyarthra sp.	0.04	0.03	1.27	>0.20	5

Electivity coefficients - 64μ tow, Fall 1979.

Taxa	$\bar{x}$	s^2	t	P	no.
D. g. mendota	-0.03	0.10	-0.27	>0.50	10
D. retrocurva	0.01	0.10	0.10	>0.50	10
D. ambigua	0	0		*	2
D. parvula	0	0		*	2
D. longiremus	0	0		*	0
D. dubia	0	0		*	2
D. pulex	0	0		*	0
C. lacustris	0	0		*	2
B. longirostris	0.01	0.05	0.31	>0.50	10
E. coregoni	-0.03	0.09	-0.33	>0.50	10
C. sphaericus	0	0		*	2
K. latissima	>0.00	>0.00	1.10	>0.50	4
A. guttata	0	0		*	2
D. leuchtenbergianium	-0.01	0.07	-0.21	>0.50	10
L. kindtii	0	0		*	2
C. rectirostris	0	0		*	1
S. crystallina	0	0		*	2
C. b. thomasi	0.18	-0.04	-4.07	<0.01	10
C. vernalis	0.01	0.05	0.32	>0.50	9
M. edax	-0.02	0.10	-0.19	>0.50	10
C. nauplii	0.03	0.08	0.38	>0.50	10
C. copepodites	0.01	0.10	0.12	>0.50	10
D. nauplii	>0.00	0.01	0.17	>0.50	3
D. copepodites	0	0		*	2
D. sicilis	-0.21	0.02	-11.44	<0.001	10
D. siciloides	-0.04	0.07	-0.49	>0.50	9
E. megaceros	0.05	0.04	1.33	>0.20	6
Keratella sp.	0	0		*	2
Polyarthra sp.	0.04	0.04	1.00	>0.20	7

Electivity coefficients - 64μ tow, Spring 1981.

Taxa	$\bar{x}$	s^2	t	P	no.
D. g. mendota	0.03	0.09	0.34	>0.50	8
D. retrocurva	0.11	0.10	1.10	>0.20	8
D. ambigua	-0.01	0.02	-0.23	>0.05	6
D. parvula	0	0.01	0	>0.50	5
D. longiremus	0	0		*	1
D. dubia	0	0		*	2
D. pulex	0	0			0
C. lacustris	0	>0.00	0	>0.50	7
B. longirostris	0.05	0.12	0.45	>0.50	8
E. coregoni	>0.00	0.03	0.11	>0.50	7
C. sphaericus	-0.02	0.03	0.50	>0.50	6
K. latissima	0	>0.00	0	>0.50	4
A. guttata	0	>0.00	0	>0.50	5
D. leuchtenbergianium	<-0.00	0.01	-0.60	>0.50	3
L. kindtii	0	0		*	2
C. rectirostris	0	0			0
S. crystallina	0	0			0
C. b. thomasi	0.05	0.12	0.41	>0.50	8
C. vernalis	-0.01	0.01	-1.00	>0.30	7
M. edax	-0.02	0.04	-0.59	>0.50	7
C. nauplii	0.06	0.13	0.44	>0.50	7
C. copepodites	0.06	0.14	0.44	>0.50	7
D. nauplii	-0.02	0.02	-1.05	>0.30	7
D. copepodites	-0.10	0.06	-1.59	>0.10	7
D. sicilis	-0.63	0.03	-0.81	>0.40	7
D. siciloides	-0.01	0.02	-0.50	>0.50	7
E. megaceros	0	0			0
Keratella sp.	-0.17	0.07	-2.85	>0.20	6
Polyarthra sp.	0.01	0.02	0.81	>0.40	6

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