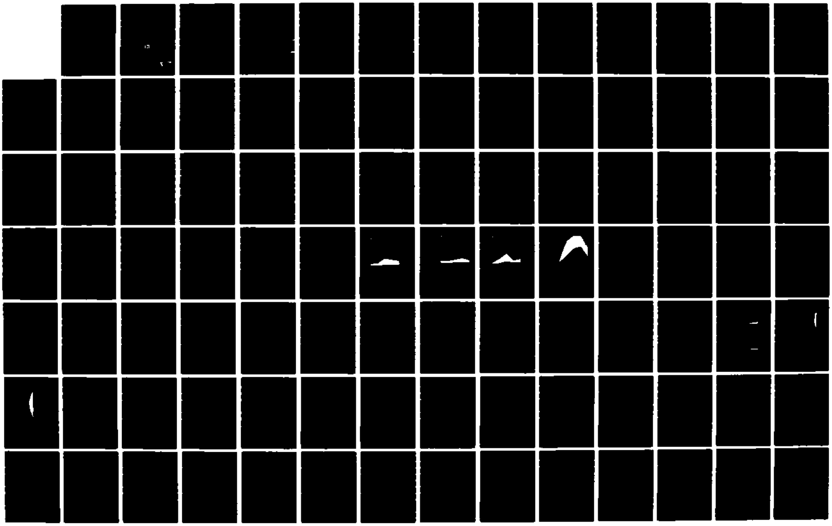
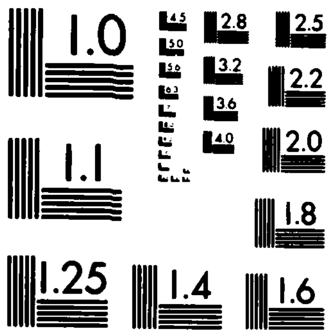
AD-A149 945 FISHERIES AND LIMNOLOGICAL STUDIES ON WESTPPOINT RESERVOIR ALABAMA-GEORGI..(U) AUBURN UNIV ALA DEPT OF FISHERIES AND ALLIED AQUACULTURES W D DAVIES ET AL. 1/2

UNCLASSIFIED DEC 84 COESAM/PDEE-84/010 DACW01-78-C-0082 F/G 8/8 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

COESAM/PDEE - 84/010

FISHERIES AND LIMNOLOGICAL STUDIES ON WEST POINT RESERVOIR, ALABAMA-GEORGIA

DECEMBER 1984

FINAL REPORT

PREPARED FOR
U.S. ARMY ENGINEER DISTRICT, MOBILE
MOBILE, ALABAMA
36628

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Fisheries and Limnological Studies on West Point Reservoir, Alabama-Georgia	5. TYPE OF REPORT & PERIOD COVERED Final Report October 1980-September 1981
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) D. R. Bayne, W. D. Davies, S. P. Malvestuto, J. M. Lawrence, and W. L. Shelton	8. CONTRACT OR GRANT NUMBER(s) DACW01-78-C-0082
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Fisheries and Cooperative Fishery Research Unit, Auburn University, Alabama 36849	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS --
11. CONTROLLING OFFICE NAME AND ADDRESS Mobile District, U. S. Army Corps of Engineers SAMPD-EE, P. O. Box 2288, Mobile, Alabama 366628	12. REPORT DATE December 1984
	13. NUMBER OF PAGES 157
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) --	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE --

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release: Distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Unlimited

18. SUPPLEMENTARY NOTES

--

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fisheries
Limnology
West Point Lake/Reservoir

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

West Point Reservoir on the Chattahoochee River was impounded by a ~~Corps of~~ Engineers dam located 3.2 miles north of West Point, GA. Fishery and limnological studies ~~funded by the Corps~~ began in Feb~~ruary~~ 1976 to (a) document changes in the physical, chemical, and biological characteristics of West Point Lake over a period of years with emphasis on detection of those factors contributing to the expected decline in sport fishing success; and (b) implement and evaluate fishery management practices aimed at improving the catch per unit of effort of sport fisherman. Limnological data collected between ~~October 1980~~

DD FORM 1473 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

and September 1981 indicate that mean phytoplankton standing crops were higher this year than 1979 - 1980. The higher standing crops resulted from increases in all three major algae divisions; Chrysophyta, Chlorophyta and cyanophyta. The increase in phytoplankton density should have a positive effect on the fishery since many of the fishes are plankton feeders. As for 1979 - 1980, mean total organic carbon levels varied little throughout the lake. The annual mean of 7.79 mg/l for the current year was higher than that reported for the previous four years. The mean of the quarterly samples of zooplankton was lower than any previous year which continued an apparent trend toward an overall decrease in zooplankton density in the lake. Low lake levels during the year reduced available habitat for alligatorweed and smartweed such that they remained inconsequential in the reservoir. The length - frequency distribution for important prey species reflect a condition where adults occupy a significant portion of total standing stock. Harvest estimates on important sport fishes such as bass and sunfish show a decline from last year's values which were the highest recorded since impoundment. Both largemouth bass and sunfish harvest declined, while harvest of black crappie continued to show a steady increase. Harvest regulations on largemouth bass appear to have the most promise in redirecting the dynamics of the fish populations into a more productive mode. A 16-inch minimum size limit on bass harvest has been proposed.

FINAL REPORT

Fisheries and Limnological Studies on
West Point Lake
Alabama-Georgia
(Contract No. DACW01-78-C-0082-P00005)
Modification No. 5
October 1980-September 1981
Phase V

Submitted to

Mobile District
Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

A-1 23

FINAL REPORT

Fisheries and Limnological Studies on West Point Lake Alabama-Georgia

(Contract No. DACW01-78-C-0082-P00005)
Modification No. 5
October 1980-September 1981
Phase V

Submitted to

Mobile District
Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Fisheries
W. D. Davies
W. L. Shelton
S. P. Malvestuto

Limnological
D. R. Bayne
J. M. Lawrence

Department of Fisheries and
Cooperative Fishery Research Unit
Auburn University, Alabama 36849

PREFACE

This report presents the results of the fisheries and limnological studies on West Point Lake, Alabama-Georgia, from October 1980 through September 1981 with some unreported data covering previous report periods. The investigation was conducted under Contract No. DACW01-78-C-0082 to the Department of Fisheries and Allied Aquacultures, Auburn University, Alabama from the U.S. Army Corps of Engineers, Mobile District.

Personnel of the Alabama Department of Conservation and Natural Resources, Georgia Department of Natural Resources, U.S. Fish and Wildlife Service are acknowledged for their aid and cooperation in various facets of the study and their agencies as cooperators on the project.

The report was written by W. D. Davies, W. L. Shelton and S. P. Malvestuto (fisheries), D. R. Bayne (limnology) and J. M. Lawrence (water chemistry). The following individuals are acknowledged for their assistance in the study: B. Ciliax, W. Seesock, R. Ott, A. Sonski, S. Miranda, M. Hudgins, K. Collins, P. Pearson, C. Webber, L. Cotter, R. Stiefvater and H. Lazauski.

Suggested citation: Bayne, D. R., W. D. Davies, S. P. Malvestuto, J. M. Lawrence, and W. L. Shelton. 1983. Fisheries and limnological studies on West Point Lake, Alabama-Georgia. Draft Final Report. U.S. Army Corps of Engineers, Mobile District, Mobile, AL. 157 pp.

EXECUTIVE SUMMARY

1. This report presents the results of the fisheries and limnological studies conducted on West Point Lake from October 1980 through September 1981. Overall study objectives continue to be: 1) documenting changes in the physical, chemical and biological characteristics of West Point Lake with emphasis on detection of those factors contributing to the expected decline in sport fishing success, and 2) implementing and evaluating fishery management practices aimed at improving the catch per effort (CPE) of sport fishermen.

2. Limnological data collected during the study period of 1 October 1980 through 30 September 1981 consisted of the following variables: phyto- and zooplankton abundance and taxonomic composition; primary productivity; carbon analyses including total organic carbon, suspended organic matter and total carbon; chlorophyll measurements as an estimate of phytoplankton biomass; aquatic macrophyte abundance and distribution; and benthic macroinvertebrate abundance and taxonomic composition. Sampling design included temporal and spatial sampling to provide information representative of the entire lake during each season.

3. Fishery studies involved sampling reservoir fish populations and the creel. A roving creel survey was designed to provide precise and unbiased estimates of catch, effort and catch per unit of effort. Fish population sampling included electrofishing, toxicants, and netting. These sample data provided estimates of fish population size, age structure and relative rates of recruitment into the fishery.

4. Estimated mean phytoplankton densities varied from a low of 773 organisms/ml at mainstream station A in the headwaters of the lake to a high of 3,754 organisms/ml at station C in the middle reaches of the lake. Phytoplankton density was lowest in November (1,211 organisms/ml) and highest in August (6,775 organisms/ml). Mean chlorophyll a concentrations ranged from a low of 3.0 mg/m^3 at station A in September to a high of 27.5 mg/m^3 at station B in August. Mean phytoplankton standing crops were higher this year than 1979-80. The higher standing crops resulted from increases in all three major algal divisions: Chrysophyta, Chlorophyta and Cyanophyta. This increase in phytoplankton density should have a positive effect on the fishery in West Point Lake because of the plankton feeders found in the lake.

5. Numerical dominance varied considerably between yellow-green algae (Chrysophyta), green algae (Chlorophyta) and blue-green algae (Cyanophyta). Yellow-green and green algae were both dominant at all stations except for G where a blue-green bloom occurred in August.

6. Species dominance exhibited greater variability this year than 1979-80. Pennate diatoms (e.g. *Asterionella* spp.) occupied prominent positions in the dominance hierarchy, however they were not as important

in the rankings as during the previous year. Centric diatoms included Cyclotella spp., Melosira granulata and M. varians. Green algae included the coccoids Ankistrodesmus convolutus and Scenedesmus quadricauda and the flagellate Chlamydomonas spp. Usually blue-green algal communities are dominated by Oscillatoria angustissima in West Point Lake. However, this year a different alga, Spirulina laxa, dominated samples at several stations during the summer. There have been no significant shifts in dominant algal forms during the 1st six years.

7. Quarterly estimates of primary productivity in West Point Lake ranged from a low of 277.7 mg C/m^2/day in the spring to a high of 734.6 mg C/m^2/day in the summer. Annual mean estimates of productivity were 503.9 mg C/m^2/day, the lowest value measured to date. This was the second consecutive year that primary productivity measurements declined.

8. Based on measurements of the organic matter content of lake waters, allochthonous organic loading of reservoir headwaters was common. Analyses of particulate organic matter (POM) from previous years' research have revealed the same trends. However, mean total organic carbon (TOC) measurements varied little throughout the lake. Highest TOC measurements have often reflected the highest phytoplankton densities. However, TOC concentrations were highest in March and May while phytoplankton density was highest in August. The annual mean TOC of 7.79 mg/l for the current year was higher than that reported for the previous four years.

9. Zooplankton abundance averaged from a low of 12 organisms/l at station A to a high of 229 organisms/l at station B. Pronounced seasonal variations were observed in the lake ranging from highs of 265 and 115 organisms/l during May and January, respectively, to lows of 21 and 59 organisms/l in November and August, respectively. The spatial and temporal differences noted in zooplankton density throughout the lake were again due to fluctuations in the number of rotifers collected in the samples. Based on density, rotifers were the most important component of the zooplankton community, followed in order by copepods and cladocera. The mean of the quarterly samples was lower than any previous year. This continued an apparent trend toward an overall decrease in zooplankton density in the lake. Three species of rotifers numerically dominated most samples: Polyarthra vulgaris, Synchaeta pectinata and Brachionus caudatus. An unidentified species of cyclopoid copepod was dominant at two stations but clacoerans were not part of the dominance hierarchy on any date.

10. Low lake levels during the year reduced available habitat for alligatorweed (Alternanthera philoxeroides) and smartweed (Polygonum spp.). These populations remained inconsequential in the reservoir.

11. Benthic macroinvertebrate standing crops collected by dredge (grab) samples in the littoral areas of the lake contained a total of 65

identifiable taxa. Forty-five of these taxa were members of one insect family, Chironomidae. Aquatic earthworms (Oligochaetes) and midge larvae (Chironomidae) usually dominated collections on most dates. A total of 52 taxa were identified from the Hester-Dendy multiple plate samplers used in the littoral areas of the lake. Thirty-two of these taxa were members of the Chironomidae. Cladocerans (water fleas) and chironomids dominated collections on most dates. Throughout the lake dredge samples varied much less than plate collections. Average species diversity of macroinvertebrate collections from West Point Lake indicate it should be classified as mesotrophic. Since plate samplers are a less variable substrate than the natural lake bottom, species diversity of the benthic fauna from plate collections was lower than that from dredge samples.

12. The length-frequency distribution for important prey species (i.e., gizzard shad, bluegill and threadfin shad) reflect a condition where adults occupy a significant portion of total standing stock. Few young of year are spawned each year resulting in a shortage of prey for young of year largemouth bass. In those years, however, following a threadfin shad dieoff, relatively large numbers of young are produced resulting in good growth of predators that readily feed on threadfin (i.e., black crappie, hybrid striped bass).

13. Average standing stock of fishes as measured by large cove rotenone sampling was 982.7 kg/ha. The coefficient of variation associated with this estimate (130.2%) reflects considerable variation between the four coves sampled.

14. On the average largemouth bass are reading 20 cm during their first year of life; after completing their 2nd, 3rd, 4th and 5th year of life they read 26, 32, 40 and 46 cm, respectively. As a result largemouth bass protected from harvest with a 16-inch minimum size limit would have completed their fourth year of life, while achieving a size during their third year where they would be effective predators on adult gizzard shad.

15. Hybrid striped bass feed prmarily on threadfin shad; even large individuals rarely were observed feeding on gizzard shad. Subsequent stocking of the hybrid is planned and this fish will become an increasingly important component of the creel.

16. Significant correlations of environmental factors with electrofishing success demonstrated that certain factors (e.g., air temperature, lake level, Secchi disc visibility, light intensity, wind speed) may be useful in predicting the distribution of fish in a reservoir.

17. Dynamics of young of the year largemouth bass in 1981 were compared to the growth and mortality of the 1977-1980 year classes. Mortality (Z) and growth (G) ranged from 0.185 (1979) to 0.224 (1978) and 0.072 (1981) to 0.287 (1977), respectively. The largest number of

young of year (peak abundance) occurred in 1981; during 1981, however, fish were dying at a rapid rate and were growing slowly.

18. Harvest estimates show a decline from last year's (Sept. 1979-Aug. 1980) values which were the highest recorded since impoundment. Both largemouth bass and sunfish harvest declined, while harvest of black crappie continued to show a steady increase (28 kg/ha). Expressing total harvest of the three species groups on a per unit of effort basis gives approximately 0.3 kg/h.

19. Of the management recommendations discussed (i.e., stocking, water level manipulation, harvest restrictions), harvest regulations on largemouth bass appear to have the most promise in redirecting the dynamics of the fish populations into a more productive mode. A 16-inch minimum size limit on bass harvest has been proposed.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

CONVERSION FACTORS, U.S. TO METRIC (SI) UNITS OF MEASUREMENT

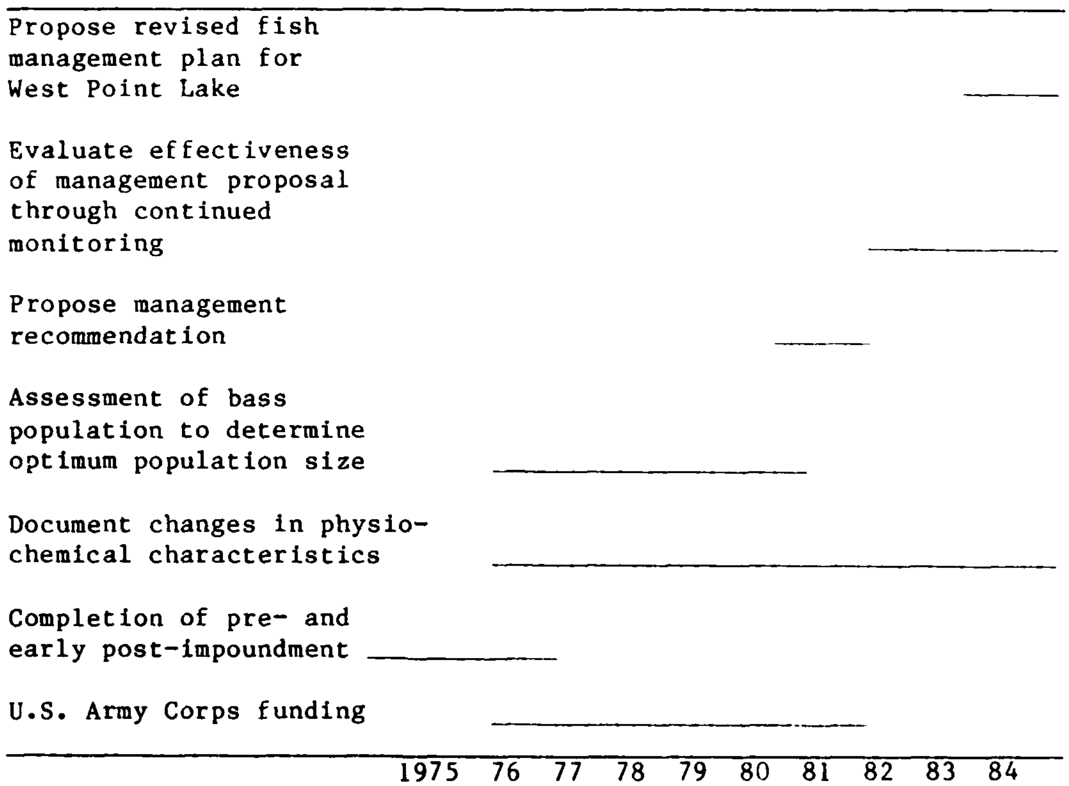
U.S. customary units of measurement used in this paper can be converted to metric (SI) units as follows:

Multiply	By	To obtain
inches	25.4	millimeters
feet	0.3048	meters
miles	1.609344	kilometers
square miles	2.58999	square kilometers
acres	0.40468	hectares
acres	0.0040468	square kilometers
pounds	453.5923	grams
pounds per acre	1.120851	kilograms per hectare
number per acre	2.47	number per hectare

INTRODUCTION

1. The present report covers the period October 1980 through September 1981 (Phase V). Complete discussions of the physiochemical and biological relationships for West Point Lake are presented in Davies et al. (1979), Bayne et al. (1980), Shelton et al. (1981) and Lawrence et al. (in review) which are job completion reports for Phases I through IV respectively. The overall study objectives as previously stated are: 1) documenting changes in the physical, chemical and biological characteristics of West Point Lake with emphasis on detection of those factors contributing to the expected decline in sport fishing success, and 2) implementing and evaluating fishery management practices aimed at improving the catch per effort of sport fishermen.

2. The following schedule illustrates past activities and the expected sequence of planned events:



3. While objective one is essentially structured to provide a base line reference for evaluating long term changes, objective two addresses

the dynamic state of the fishery in terms of developing and evaluating management strategy and input. Some management practices may not be appropriate for West Point Lake; thus meeting objective two may involve some "deadends" as well as some progress.

4. This report evaluates management considerations proposed from previous studies and specifically outlines recommendations for the future. These recommendations, if followed, will require evaluation. During the 1980-81 study period, overall study objectives were met in addition to evaluating sampling efficiency in terms of cost effectiveness and precision. Our conclusions are discussed in this report and should be carefully considered in future planning.

METHODS AND DESIGN

Limnological Studies

Plankton

5. The objective of this phase of the study was to identify and quantify the plankton community at each sample station in the lake. Data collected from the various depths sampled at each location were averaged to obtain station means. In addition, the numerically dominant plankters were determined from composite samples of all depths at that location. Plankton samples were collected quarterly using a submersible plastic water pump and hose apparatus. The locations and depths sampled appear in Table 1 and Figures 1 and 2. Discrete depths were sampled at each station to adequately characterize the plankton community at that location in the lake. The vertical migrations typical of plankton necessitated this approach (Weber 1973).

Phytoplankton

6. The phytoplankton sample at each station and depth consisted of 500 ml of water measured into a flat-bottom, one liter Nalgene bottle containing a merthiolate preservative (Weber 1973). These samples were transported to the laboratory, allowed to settle at least 24 hours and concentrated by siphoning off most of the water.

7. Enumeration was accomplished in a Sedgwick-Rafter counting cell using a one milliliter aliquot taken from the well mixed concentrate. Both field and strip counts were used depending on the concentration of phytoplankton (APHA 1980). However, only one type of count was used for all depths at a particular station. Phytoplankters were counted and reported by taxonomic group. The groups included:

Chrysophyta	Chlorophyta	Cyanophyta	Others
Diatoms	Green algae	Blue-green algae	Others
centric	coccoids	coccoids	pigmented
pennate	filamentous	filamentous	flagellates
	flagellates		

When filamentous fragments were encountered they were counted as whole organisms if complete cells were present. The counts for each depth at a particular station were averaged to obtain the station means.

8. In addition to enumeration, those phytoplankters that were numerically dominant in composite samples from each station were identified to species where possible. Taxonomic references used were Smith (1950), Cocke (1967), Prescott (1970), Weber (1971) and Whitford and Schumacher (1973).

Table 1

Description of sample stations in West Point Lake for plankton and water samples, 1980-81.

Station	Location	Depths (m) for plankton sampling
A	Chattahoochee River, Franklin, GA	0[1], 2
B	GA Hwy 219 Bridge	0, 2, 4
C	GA Hwy 701 Bridge	0, 2, 4
D	300 m above West Point Dam	0, 2, 4, 8
E	300 m below West Point Dam	0
F	Wehadkee Cr. above AL Hwy 701 Bridge	0, 2 ,4
G	Yellowjacket Cr. above Wares Road Bridge	0, 2, 4

[1] 0 m is between water surface and 0.1 m depth.

Zooplankton

9. The zooplankton community was sampled at each station and depth by pumping at least 40 liters of water through an 80 micron mesh Wisconsin style plankton net. Organisms were concentrated by washing them from the plankton bucket into 100 ml Nalgene bottles and preserving in 5% formalin.

10. Zooplankters were enumerated and identified in a Sedgwick-Rafter counting cell. A one milliliter aliquot of each well-mixed sample was used for analysis. To provide a statistically valid count at least 100 organisms were counted from each sample. The counts for each depth at a particular station were averaged to obtain station means. Additionally, the two numerically dominant zooplankters were identified plus the three dominant taxa within each major group (rotifers, copepods, cladocerans) were identified for each station. Where feasible zooplankters were identified to genus and species. Taxonomic references used were Ahlstrom (1940), Hauer (1953), Edmondson (1959), Sudzuki (1964), Pourriot (1965), Ruttner-Kolisko (1974) and Pennak (1978).

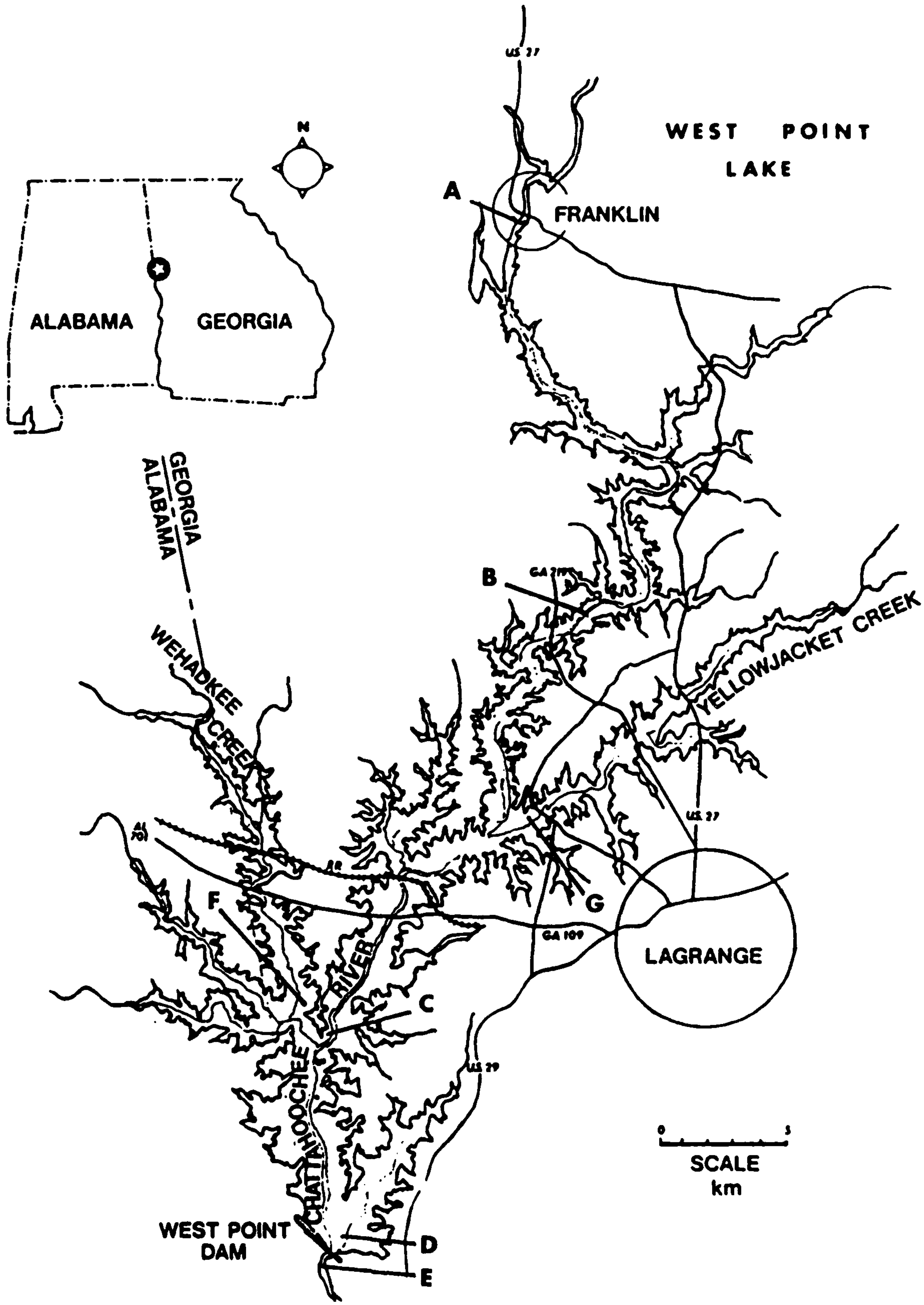


Figure 1. Map of West Point Lake with locations of limnological sampling stations.

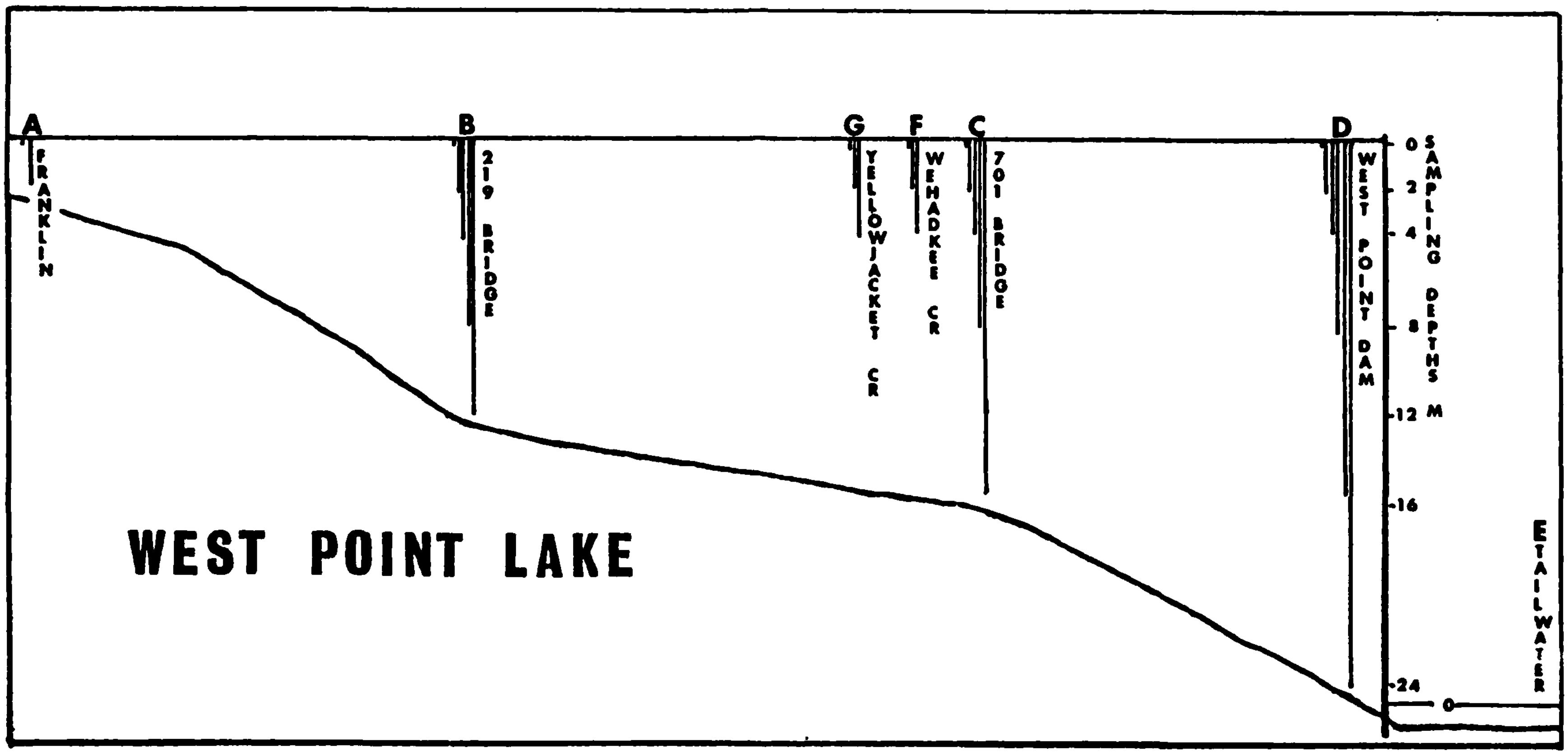


Figure 2. Sampling depth profile of each station in West Point Lake.

11. Diversity ($\bar{d}$) and equitability (e) of zooplankton communities at each station were calculated (excluding immature copepods) as recommended by Weber (1973). Annual means for zooplankton density, number of taxa, taxa diversity and equitability for the five sampling years (1976-77, 1977-78, 1978-79, 1979-80, 1980-81) were tested for significant differences (alpha = 0.05) using the student's t test (Steel and Torrie 1960).

Chlorophyll

12. Water samples for chlorophyll analysis were collected on eight dates (Table 3). The stations and depths sampled were the same as those for plankton (Figure 1 and 2). Water samples were pumped into 2 liter Nalgene containers, cooled and returned to the laboratory where the suspended matter was filtered onto 0.45 micron pore size millipore filters. The trichromatic method used to measure and calculate chlorophylls a, b and c followed Standard Methods (APHA 1980). Chlorophyll values were calculated on a volume basis (mg/m^3) and an areal basis (mg/m^2). Chlorophyll quantities expressed on an areal basis were useful in comparing one area of the lake with another. This was particularly true in a reservoir like West Point Lake since flow patterns result in a photic zone with a highly variable depth. The method used to calculate chlorophyll values on an areal basis at each station consisted of the computations shown in Table 2.

Table 2

Chlorophyll calculations on an areal basis.

Depths Sampled (m)	Chlorophyll (mg/m^3)	Computations
0	C_1	
1	C_2	$(C_1+C_2)/2$ x Depth Interval = X C_1-C_2
2	C_3	$(C_2+C_3)/2$ x Depth Interval = X C_2-C_3
4	C_4	$(C_3+C_4)/2$ x Depth Interval = X C_3-C_4
8	C_5	$(C_4+C_5)/2$ x Depth Interval = X C_4-C_5
		ΣC_x = mg chlorophyll/m^2

Chlorophyll values calculated on a volume basis (mg/m^3) at each station were averages of all depths sampled at that location.

Table 3

Dates, stations and depths from which water samples were collected from West Point Lake between 1 October 1980 and 30 September 1981.

Date	Station and depth (m) sampled						
	A	B	C	D	E	F	G
4 Nov 80[1]	0[2],2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
10 Dec 80	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
27 Jan 81[1]	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
25 Mar 81	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
13 May 81[1]	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
11 June 81	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
4 Aug 81[1]	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4
3 Sep 81	0,2	0,2,4,8,12	0,2,4,8,16	0,2,4,8,16,24	0	0,2,4	0,2,4

[1]Dates on which plankton samples collected.

[2]0 = depth between water surface and 0.1 m depth.

Primary Productivity

13. The carbon-14 method of estimating primary productivity was used (APHA 1980). Duplicate light and dark bottles were incubated for three hours at each of three depths within the photic zone at six locations within the reservoir (Figure 3). The lower limit of the photic zone was defined by multiplying the Secchi disc visibility by a factor of four (Taylor 1971a). Bottles were incubated at the lower limit of the photic zone, midway between the lower limit and the surface and just below the surface. The study was repeated for three consecutive days in December 1980 and March, June and September, 1981.

14. Productivity was calculated and reported as mg C/m^3/day. Mean productivity values for the three days were extrapolated to quarterly estimates based on total solar radiation measured during the quarter (Appendix Table 1). This was accomplished by multiplying the mean productivity for three days by the total solar radiation (Langleys) measured during the quarter (Appendix Table 1) and dividing by the average daily radiation measured during the three day sample (Taylor 1971a). The quotient was then divided by the number of days in the quarter. The Duncan's Multiple Range Test (Steel and Torrie 1960) was used to detect differences in seasonal and station means (alpha = 0.05).

Organic Matter and Carbon

15. Organic Content of Suspended Matter. Water samples were collected on the eight dates shown in Table 3. At each depth water samples were collected with a submersible plastic water pump and hose apparatus, stored in two liter Nalgene plastic containers, cooled and returned to the laboratory at Auburn University, Auburn, Alabama. Estimates of total suspended matter content of each water sample were made by filtering a 500 ml sample through a Gelman A-E glass fiber filter. The filter plus residue was dried to a constant weight at 105°C for the estimate of total suspended matter. The filter plus residue was then ashed for 20 minutes in a muffle furnace at 550°C. The loss in weight following ashing was the estimate of organic content of the sample. Analytical procedures used for measuring total suspended matter and the fixed residue (organic matter) were those in Standard Methods (APHA 1980).

16. Total Carbon (TC). Total carbon was measured on the water samples collected during 1980-81 (Table 3). Analytical techniques included use of a total carbon analyzer (the combustion infrared method) following procedures in Standard Methods (APHA 1980).

17. Total Organic Carbon (TOC). Total organic carbon was measured on the water samples collected during 1980-81 (Table 3). Analytical

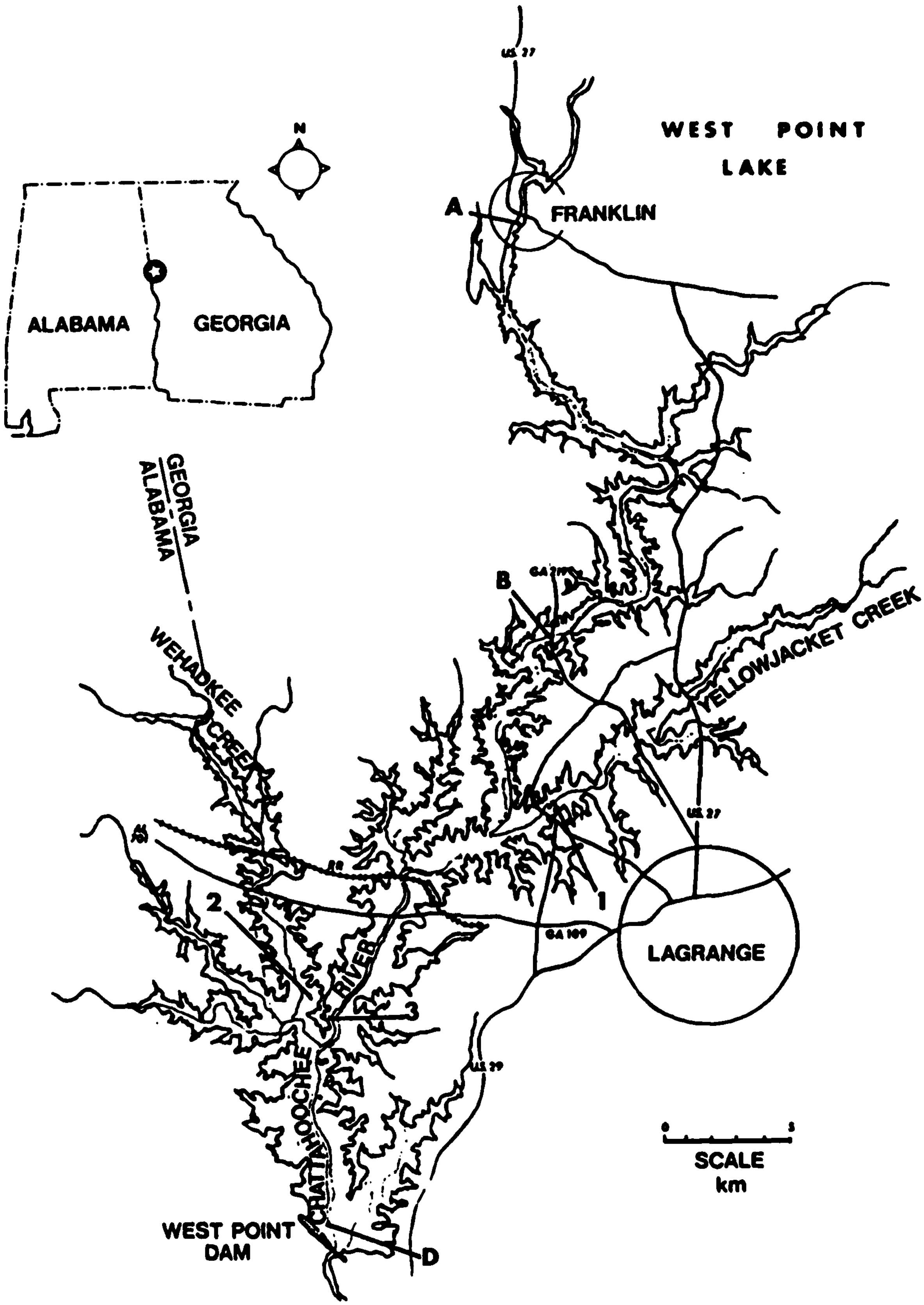


Figure 3. Primary productivity sample stations.

procedures used included use of a total carbon analyzer (the combustion infrared method) following techniques in Standard Methods (APHA 1980).

Aquatic Macrophytes

18. The distribution and estimated abundance of aquatic macrophytes were determined by visual observation of shoreline and shallow water areas during the growing season of 1980-81.

Benthic Macroinvertebrates

19. The benthic macroinvertebrate fauna in West Point Lake was sampled with bottom grabs (dredge samples) and artificial substrates (Hester-Dendy multiple plate samplers). Dates for collecting the bottom samples and setting the artificial substrates were the same.

Season	Grab Samples	Pickup of Artificial Substrates
Fall	27 August 1980	24 September 1980
Winter	5 December 1980	27 January 1981
Spring	20 March 1981	28 April 1981
Summer	8 June 1981	4 August 1981

20. Grab samples were collected with a Ponar dredge (23 x 23 cm) at 12 stations in the littoral zone of the lake (Figure 4). Sampling was confined to the contour interval where the water level was 0.3-0.9 meters deep. Duplicate samples were collected at each station and each sample was analyzed separately. Bottom materials were washed through a U.S. Standard No. 30 sieve (pore size 0.59 mm), preserved in 5-10% formalin and returned to the laboratory (Weber 1973). Samples were placed in a saturated salt solution to float organisms free from the sediment and debris. The organisms were transferred back into 5% formalin containing rose bengal, a stain selective for tissues. The stain facilitated sorting and removal of the invertebrates from the remaining debris. Various levels of taxonomic identification are required to classify aquatic invertebrates to general functional groups. Therefore, macroinvertebrates were counted and identified to the lowest taxon practical which was usually the generic level for aquatic insects. Several of the invertebrate groups (e.g., annelids, nematodes) were identified only to phylum and/or class levels. Taxonomic references used were Usinger (1956), Edmondson (1959), Mason (1973), Parrish (1975), Beck (1976), Edmunds et al. (1976), Wiggins (1977) and Merritt and Cummins (1978).

21. Macroinvertebrate communities in the lake were also collected using 1000 cm^3 Hester-Dendy multiple plate samplers (Hester and Dendy 1962). The plate samplers were suspended in the water column the

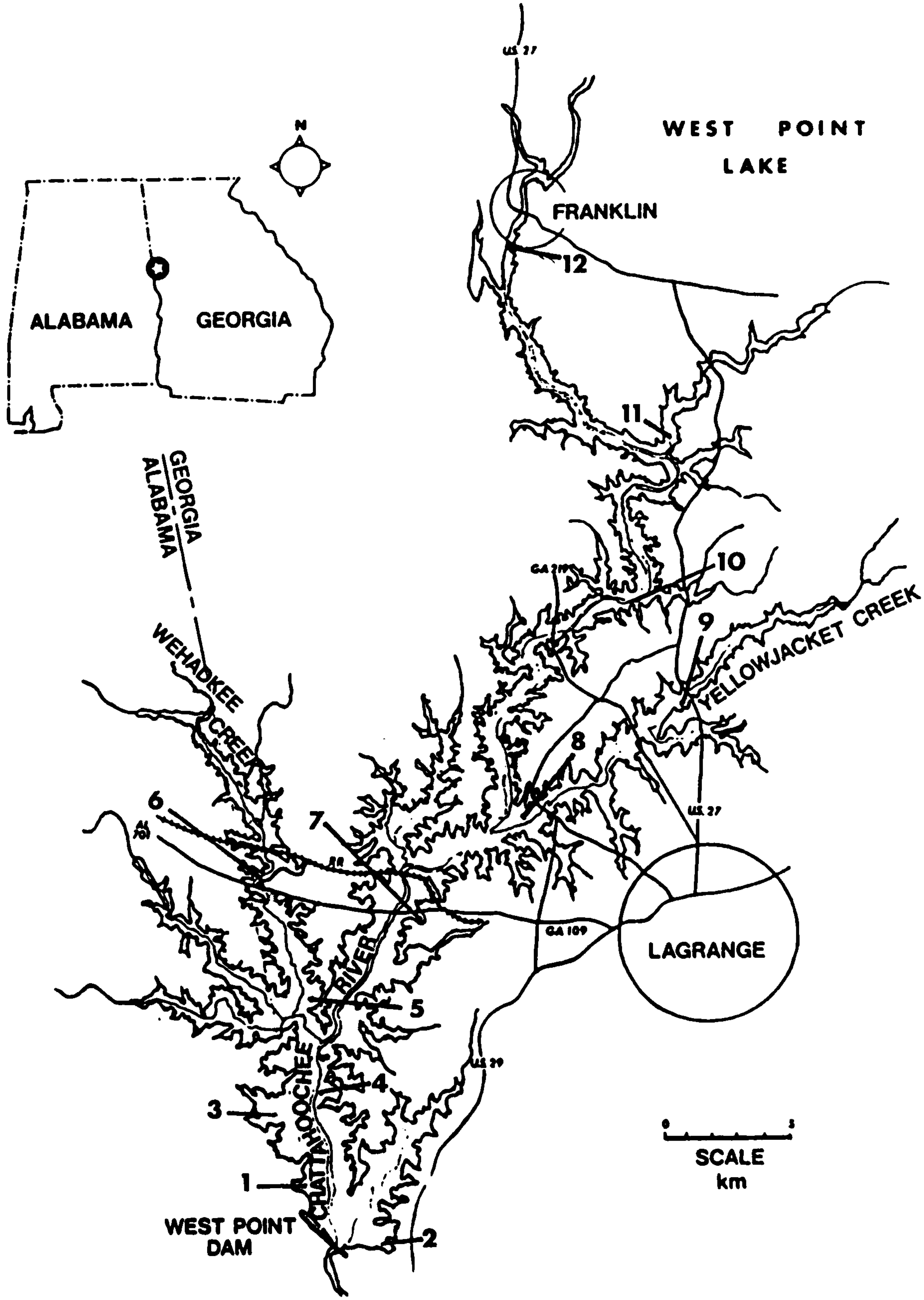


Figure 4. Benthic macroinvertebrate sample stations for dredge and plate samples.

day grab samples were collected. Four plate samplers were placed at each of eleven stations (see Figure 4 for location of each station). The samplers were suspended from floats with two samplers per float; one sampler was approximately two feet below the surface of the water while the other was approximately two feet above the bottom. Floats were anchored by a brick attached to the string holding the samplers.

22. Plate samplers were left in the water for approximately four weeks. After this colonization period, samplers were retrieved and returned to the laboratory. Invertebrates were carefully removed from each sampler by scraping the plates, sieved through a U.S. Standard No. 30 sieve, and preserved in 70% alcohol containing rose bengal to stain the organisms. Samples were enumerated and identified to the lowest taxon practical with the same references used in processing the dredge samples. Species diversity ($\bar{d}$) and equitability (e) of all macroinvertebrate collections were calculated as in the zooplankton analysis.

Fishery Studies

23. The objective during the 1980-81 period was to continue to monitor changes in the size structure of the fish populations and characteristics of the fishery while addressing the problems (i.e., bias, precision) associated with the sampling process.

24. As discussed in Shelton et al. (1981) routine sampling consisted of cove and shoreline rotenone sampling, electrofishing and creel survey. In addition gill and trap netting in the fall provided crappie and hybrid striped bass for study.

Cove Rotenone Sampling

25. Studies of fish populations in 0.5- to 1-ha coves were made with rotenone. The general methods of sampling described by Chance (1958) and Hall (1974) were followed. The entrance to the cove was blocked with a 0.9 cm mesh net. The volume of each cove was calculated on the basis of a plane-table map of the outline and mean depth readings. Emulsified rotenone (5%) was uniformly dispersed within the cove by first pumping through a weighted hose and then spraying the shallow areas. Potassium permanganate was used to control rotenone drift from the cove. Distressed fish were collected until no more surfaced. The fish were sorted, measured to total length by 2.5 cm-groups (inch groups) and weighed. The following morning fish were again picked up and measured. Two coves have been sampled each summer during the months of July-August ("reference coves"). Two other coves were selected at random from the reservoir; the selection was accomplished by randomly choosing a shoreline area (from a grid superimposed on a map of the lake) and then selecting an appropriate sized cove that could realistically be "blocked-off".

26. Traditionally, fishery biologists have measured fish into length classes according to inch groups. Despite an effort by the scientific community to transition from the English to the metric system, fishery workers have not accepted this philosophy when sampling with rotenone. Perhaps because of voluminous data collected in the past were in inch groups, there has been reluctance to change. More practically, if centimeter-groups are the selected interval, over two times the number of groups must be processed as compared to processing with inch-groups. Centimeter grouping, however, might yield more information (especially with smaller species) on predator-prey relationships, and length frequency distributions. Overlapping histograms of inch and centimeter groups were used to summarize these comparisons for several species.

Marginal Rotenone Sampling

27. Fishes in the littoral areas of West Point Lake were collected by surrounding a 0.015-ha area with a net (30.5 x 2.7 m, with 0.5 cm mesh) equipped with a float and lead line, and applying the fish toxicant, rotenone, to the area surrounded. One end of the net was anchored on shore and a semi-circle was formed by feeding the net off the bow of the boat. The lead line was immediately examined by probing to be certain that it was on the bottom. Enough emulsified rotenone (5%) was applied to provide a 1-ppm concentration within the sample area. The material was poured through a weighted hose, or distributed at the surface in shallow water. The amount of rotenone used was small; therefore no potassium permanganate was used. Fish were collected as they surfaced. Then the net was pulled directly onto the shore and fish in the net were removed. Small fish were preserved in 10% formalin and larger fish were held on ice in plastic bags. Fish were measured to the nearest millimeter (total length) and weighed to the nearest gram.

28. Sampling sites were chosen at random from the Yellowjacket Creek arm, Wehadkee Creek arm and the mainstream portion of the reservoir between these arms. A grid system with 0.65-km (0.25-square mile) section was used to select specific sites. Each section was assigned a number (from 1 to 500). Open-water sections were eliminated and one within each large area was chosen by using a table of random numbers. The shoreline segment was visually divided into six portions and the selection was determined by toss of a die. At least eight samples per trip were made each week. Sampling began in May and continued through August 1981.

Largemouth Bass Food Habits

29. Only stomachs from largemouth bass, black crappie and hybrid striped bass collected by electrofishing, seining, gill and trap netting were examined for food items. A boat-mounted 110-volt A.C. generator with a pulsator unit that provided variable D.C. was used to electrofish

nearshore areas. Fish were placed on ice to minimize regurgitation and later measured to the nearest millimeter total length and weighed to the nearest gram. Because of the importance of fish as prey, only the piscivorous habits (number and size of prey fish) were recorded.

Electrofishing Sampling

30. Large impoundments contain a wide range of habitats from which fish populations can be sampled. Collection sites that contain representative segments of the population must be selected to precisely and accurately estimate some characteristics of the population. Bayne et al. (1980) determined that there was no benefit (increased precision) from repeated sampling of "reference sites." Therefore strictly random sampling was employed during 1980-1981 (Phase V).

31. The reservoir was divided into three major zones of about equal area (3,500 ha) for sampling. Zone I was the southernmost portion of the reservoir nearest to the dam; zone II consisted of the middle portion of the reservoir which included a major arm receiving effluent from a city with 26,000 inhabitants; zone III was essentially confined to the former flood plain of the river (Figure 5).

32. Selection of the random sampling sites was achieved by superimposing a grid (0.65 km^2) on a reservoir map. Grids adjacent to the shoreline were numbered and given equal probability of selection for sampling. One grid area from each major zone was selected each sampling day.

33. The year, October, 1980-September, 1981, was blocked into three seasons: October-December, February-April, and June-August. Twice monthly (6 times each season) electrofishing trips were conducted. Each trip consisted of four 45-minute sampling periods. The three shocking locations were picked at random as described above. A single night location was selected randomly from the day areas by simply selecting one where each had an equal probability of being chosen. The exact location of the nighttime sample was marked by placing a flashing light on shore at the beginning of the randomly chosen daytime location. A coin toss decided whether the daytime samples were taken to the right or left of the marker. Nighttime shocking began at the marker approximately 3-4 hours after nightfall and continued for 45 minutes in the opposite direction along the section of shoreline adjacent to the day shocking area.

34. The equipment used for electrofishing consisted of a Polarcraft 16-foot aluminum boat with a livewell and safety guardrail surrounding the bow. The boat was powered by a 35-horsepower Johnson outboard motor with remote throttle and steering. Twin boom-mounted positive electrodes extended from the bow and two negative electrodes were attached directly to the bow on either side. A Homelite 110 to 220-volt alternating current generator supplied electrical current; the

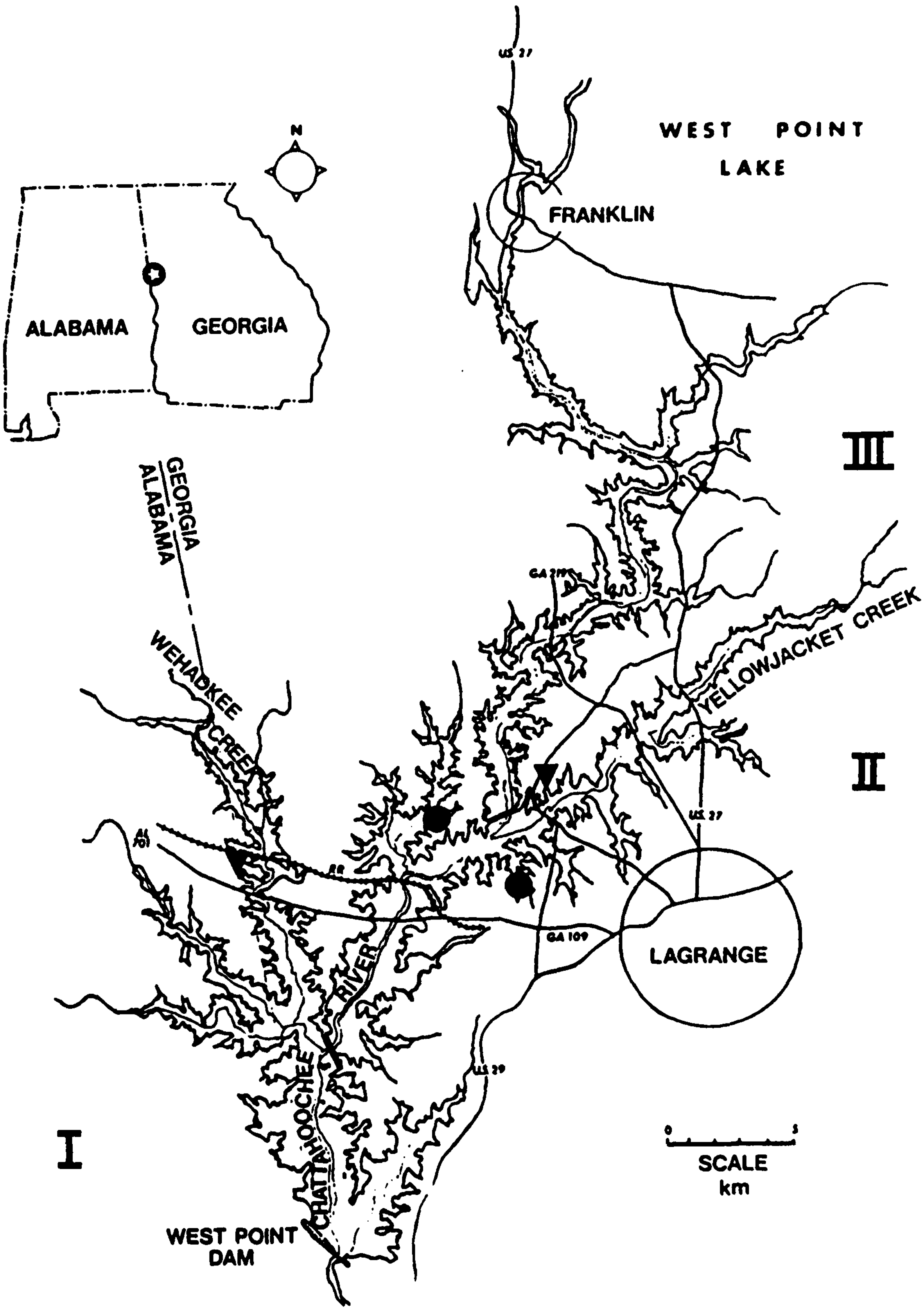


Figure 5. West Point Lake, Alabama-Georgia, showing cove rotenone sampling sites (▼, control; ●, random) and major sampling zones (I, II, III).

alternating current was transformed to one-half pulsed direct current with a Coffelt variable voltage pulsator (model VVP-2C).

35. Before each sample, the environmental factors of water temperature, wind velocity and direction, light intensity, Secchi disc visibility, and conductivity were measured and quantity of shoreline structure was evaluated. Bass were counted and measured then immediately returned to the water; all other species were collected. The bass were grouped as being less than 20 cm, between 20 and 30 cm, between 30 and 38 cm, or greater than 38 cm in total length.

Other Gears

36. Several sampling gears were used to provide hybrid bass for the study. Because of the limnetic habits of the fish, gill netting provided most of the specimens. Littoral sampling techniques, such as night electrofishing and shoreline rotenone sampling, provided small age 0+ to 1+ fish. Some age 0+ fish were collected in cove rotenone samples; trap nets and angling were also used to supplement gill net collection.

37. Gill nets were of monofilament construction consisting of five 25-foot panels of 2 to 6 inch-stretch mesh. Gill nets were set where hybrids were suspected of occurring based on the recommendations of local fishing guides. At any one time, two nets were set (one parallel to the shoreline and one perpendicular to the shoreline) for periods of 2 to 24 hours according to water temperature; efforts were made to remove the fish from the nets while they were still alive.

38. Data were analyzed using the Statistical Analysis System (Council and Helwig 1979) and correlation analyses were performed on several aspects of the age, growth, and food habit data. For age and growth, total fish length was regressed against scale radius, and a slope and intercept were established for use in back calculating the lengths at annuli formation. For example, 305 hybrid striped bass from 80 to 501 mm in total length provided values for back calculating the lengths used to compare growth at two stocking rates. The scale radius body length relationship used was LENGTH = 56.3912 + 12.1794(RADIUS). Mouthpart size (from inside to inside surface of the cleithrum) was measured and substituted into an equation (Lawrence 1958) to calculate the maximum possible size of prey that could be eaten. Using actual stomach data, prey total length was regressed against hybrid mouthpart size and against hybrid total length to establish the actual predator-prey size relationship. Log transformations were used to provide a better fit to linear plots. Data from summer cove sampling were compiled to provide prey availability information for the two years under consideration.

Roving Creel Survey

39. Thirty-seven boat access points (Figure 5) were in use during the period of study. Because of the large number of access points in the reservoir, we felt that the number of interviews which could be obtained at any one access point during a sampling period usually would be too few for our purposes. Therefore the roving creel survey, where fishermen are actively contacted, was a necessity.

40. The application of nonuniform probability sampling to the roving creel survey has been outlined by Malvestuto et al. (1978). The following is a summary of the basic features of this approach:

(a) The entire period for which the fishery is to be surveyed is divided into time blocks. The amount of fishing expected to take place within these blocks should be similar.

(b) Each time block is divided into sampling units (the time periods during which sampling will take place on the lake) such that all of the fishing time within a block is contained within the sampling units and the units do not overlap.

(c) Sampling probabilities proportional to the amount of fishing expected are assigned to the sampling units. The sum of the probabilities assigned to the sampling units within any given block equals 1.0.

41. Our survey was divided into time blocks of 1 month and the blocks divided into sampling units of 4 hours. Any given day contained three sampling units spanning a 12-hour (hr) fishing period. These units were designated the A.M., Noon, and P.M. sampling periods, ranging from 0600 to 1000 hr, 1000 to 1400 hr, and 1400 to 1800 hr, respectively (all times were moved ahead 1 hr during daylight savings time).

42. Fishing patterns for West Point Lake have shown a marked difference between fishing pressure on weekdays and weekends; these two time categories thus were classified as separate strata. Three units were worked monthly within each stratum except for the winter period (November-January). During the winter period when fishing pressure decreased, a total of six sampling units (three in each stratum) were assigned.

43. A particular sampling unit was chosen by first randomly choosing a day, where all days within a month were given equal probability of being chosen, and then, within the chosen day, randomly choosing one based on the amount of fishing expected to occur during that period. Expected fishing was estimated from fishermen counts made on the lake during the A.M., Noon, and P.M. sampling periods. The sampling probabilities for these three periods summed to 1.0. Sampling periods were chosen independently for each stratum each month.

44. The large size of the reservoir required its division into six sections, one section being sampled during a sampling period. Since there are no vantage points, counts were made by making a circuit, by boat, of the section being sampled. The section sampled was chosen with probability proportional to the amount of fishing expected in that section (Shelton *et al*. 1981).

45. Sampling on the lake in 1980 was conducted by choosing at random (by coin toss) the direction (right or left) in which the creel clerk circled the lake section. Groups of fishermen interviewed were chosen so that one complete circuit was made during the time allotted to interviews. During each interview, the number and lengths of all fish caught were recorded by species. Lengths were later converted to weights using weight-length tables for Alabama fishes (Swingle 1972). The length of a fishing trip at the time of the interview (incompleted trip length) was an estimate based on the fisherman's memory as to what time he began fishing. Using this sampling scheme where months are stratified into weekdays and weekends the data may be expanded as discussed by Malvestuto *et al*. (1978).

46. The creel survey design, in terms of its ability to detect changes in catch per effort (CPE) of largemouth bass, is quite adequate for our purposes. The evaluation provided a basis by which our design was modified so that the precision of the survey was maintained while sampling effort was substantially reduced.

47. The primary justification for reduced sampling is that sample size appears to have no effect on the precision of the survey, at least within the range of 5 to 10 sample days per month. Summer sampling was reduced from 10 to 6 days per month during Phases II and III without significantly impairing the precision of the estimates (Malvestuto *et al*. 1978). During 1980-1981 (Phase V) this sampling regime was continued.

48. The precision of the survey during the winter is, in general, 2 to 3 times lower than in the summer. This is seemingly due to the irregular fishing effort and catch during the winter as dictated by the vagaries of the weather. To substantially increase winter sampling in order to increase the precision of winter estimates would not be efficient because only about 10% of the annual total harvest is expected to occur during this part of the year. It is obvious, however, that we must sample during the winter to obtain an estimate of winter harvest despite the fact that the precision of this estimate will be low.

49. Malvestuto *et al*. (1978) suggest a modified survey design based on a minimum of 45 sample days per year rather than the 90 days used previously (Davies *et al*. 1979). Initially however, it was reduced to 60 days per year. Because we are primarily interested in obtaining estimates of harvest, it was logical to allocate our seasonal sampling effort proportional to harvest; that is, 10%, or 6 days, would be sampled during the winter (November-January) and the remaining 54 sample

days would be allocated to the summer season (February-October). The winter fishing pattern begins in November and continues through March, but due to the advent of the early crappie fishery, February and March are included within the more intensely sampled summer period.

50. The low precision of the survey during the winter suggests that it is not profitable to obtain monthly estimates during this part of the year. As a result the 6 sample days (3 weekdays and 3 weekend days) were randomly chosen from all days within the 3 month period. It is probably desirable to maintain monthly estimates during the summer so that changes in the species composition of the harvest during this 9-month period can be accurately documented. In such a case, 6 sample days (3 weekdays and 3 weekend days) would be randomly chosen each month.

51. This modified creel survey program will provide unbiased annual estimates of harvest while maintaining the relatively high precision {Coefficient of Variation (C.V.) at approximately 30%} of the survey during the summer fishing season. At the same time, annual creel survey effort was reduced by 33%.

Sampling Schedule

52. The following schedule illustrates the timing of routine sampling outlined in the scope of work:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Electro-fishing	X[1]	X	X	X	X	X	X	X	X	X	X	X
Rotenone												
Cove							X[2]	X				
Marginal					X[3]	X	X	X				
Netting												
Gill								X	X	X	X	X
Trap								X	X	X	X	X

[1] Thirty-six days/year.
[2] Four cove rotenone samples/year.
[3] Eight samples per weekly trip.

RESULTS AND DISCUSSION

Limnological Results

Plankton

Phytoplankton

53. Phytoplankton Abundance. Data on phytoplankton density at the mainstream stations are presented in Figures 6-9. Phytoplankton density in the two major arms of the reservoir, Yellowjacket and Wehadkee Creeks, appear in Table 4. Chlorophyll a, b and c concentrations expressed on a volume basis are also included in Figures 6-9 and Table 4. Annual mean phytoplankton densities for each station appear in Table 5. Mean phytoplankton density for the lake on each date appears in Table 6.

54. At mainstream stations, phytoplankton density for the year ranged from highs of 3,754 and 3,267 organisms/ml at stations C and D, respectively, to a low of 773 organisms/ml at station A (Table 5). Density in Yellowjacket Creek (G) averaged 3,601 organisms/ml while density in Wehadkee Creek averaged 2,588 organisms/ml (Table 5).

55. Seasonally, phytoplankton density in the lake was much higher during summer than other seasons. Values ranged from 6,775 organisms/ml in August to a low of 1,211 organisms/ml in November (Table 6).

56. Group Dominance. Numerical dominance varied considerably between the three main groups of phytoplankton. Means were dominated by yellow-green algae (Chrysophyta) at stations A, B, D and E while green algae (Chlorophyta) were dominant at station C and in Wehadkee Creek (F). Blue-green algae (Cyanophyta) dominated samples from Yellowjacket Creek (G) because of a blue-green "bloom" during August (Tables 4 and 5).

57. Winter samples were dominated by yellow-green algae while Fall and Spring samples were dominated by green algae. Blue-greens dominated the summer samples but there was little difference between the three main groups of algae for this period (Table 6).

58. Species Dominance. Dominant phytoplankters were ranked by algal division and are presented in Table 7. Pennate diatoms were not routinely identified to genus because of time limitations. The most commonly encountered pennate diatom that could be identified without special preparation was *Asterionella* spp. Pennate diatoms occupied prominent positions in the dominance hierarchy, however, they were not as important in the rankings as during the previous year when pennates were either first or second in dominance at most stations on most dates (Lawrence *et al.* 1982).

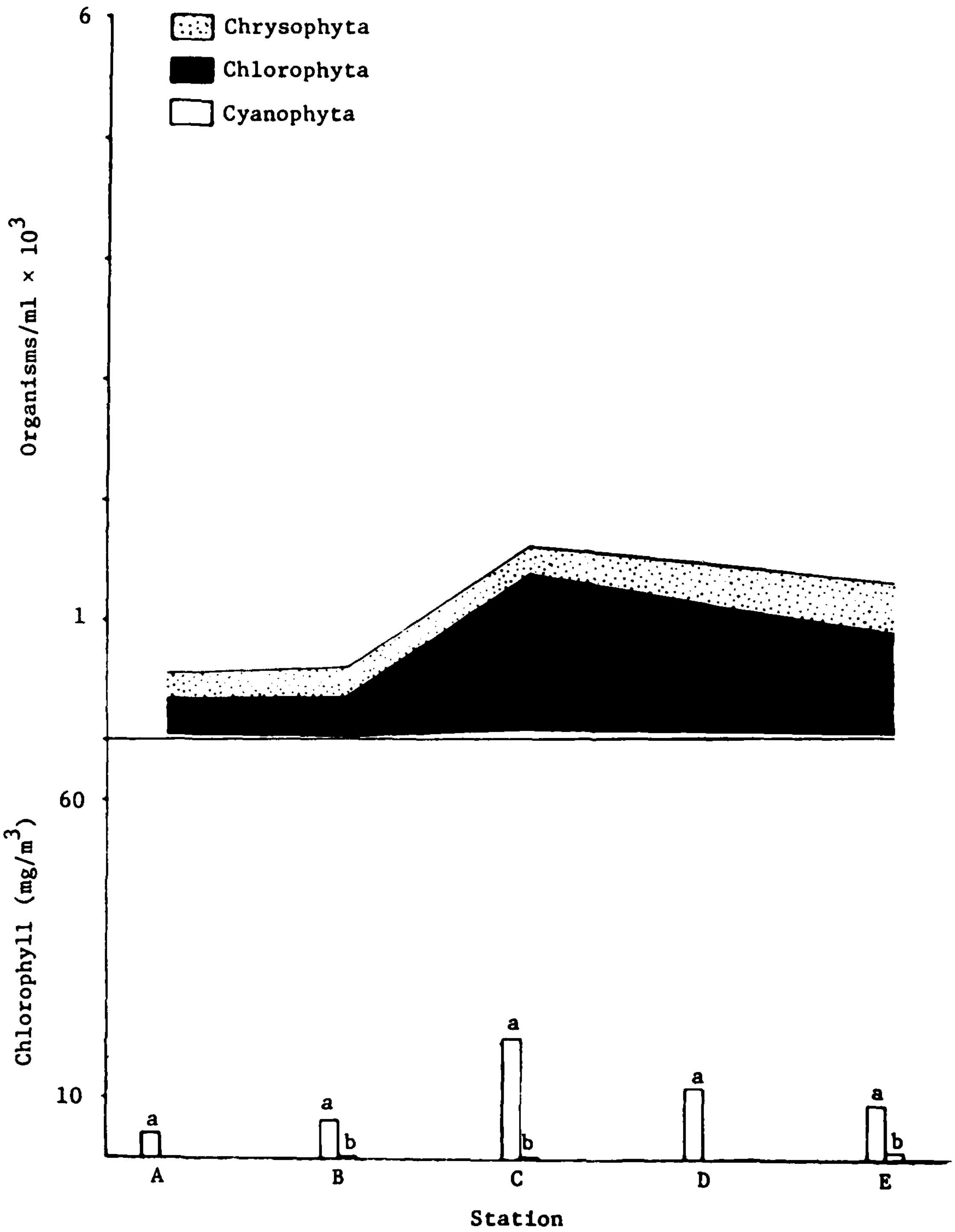


Figure 6. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentration (mg/m^3) at mainstream sampling stations on West Point Lake 4 November 1980. Values represent means of all samples taken at all depths.

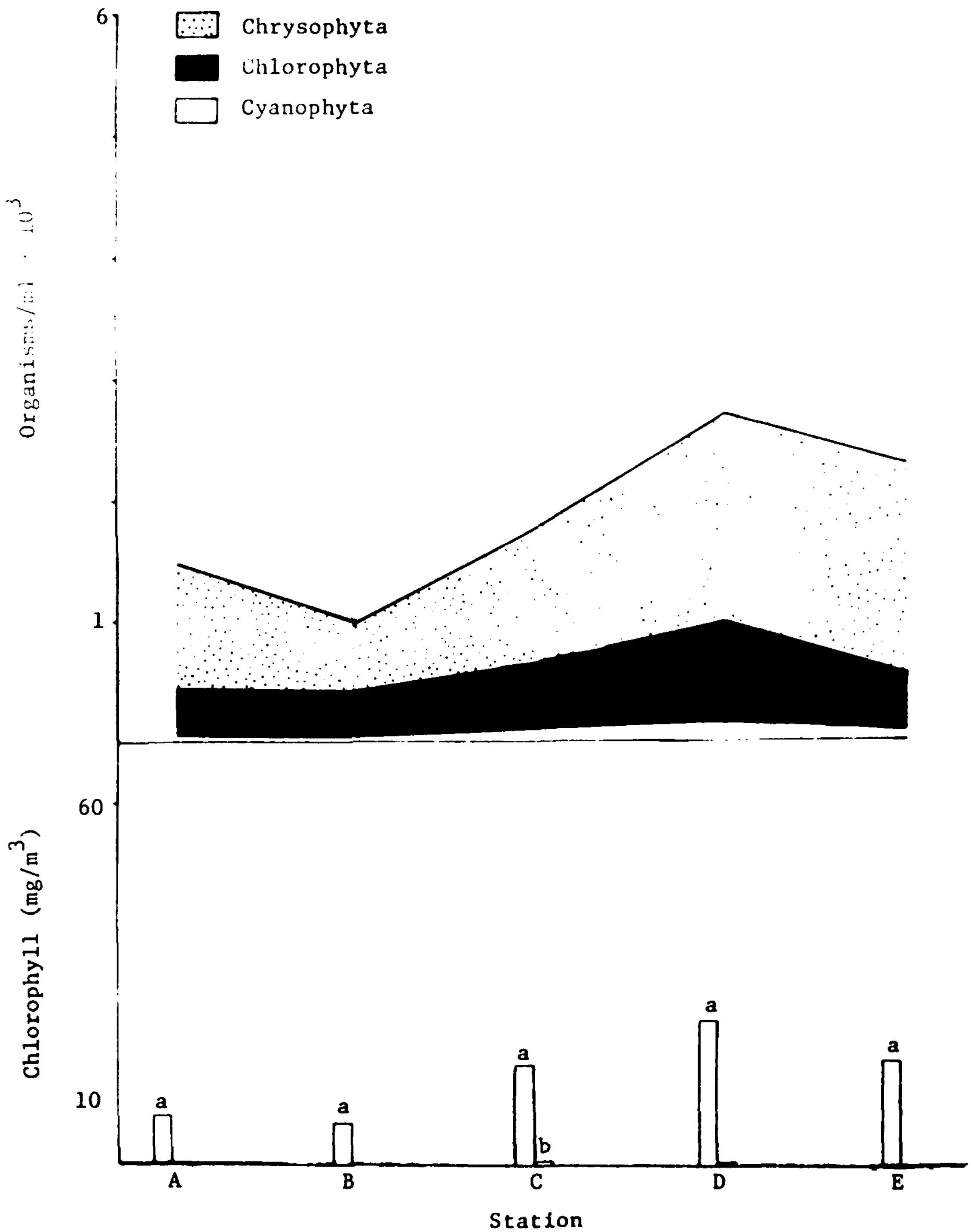


Figure 7. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentration (mg/m^3) at mainstream sampling stations on West Point Lake 27 January 1981. Values represent means of all samples taken at all depths.

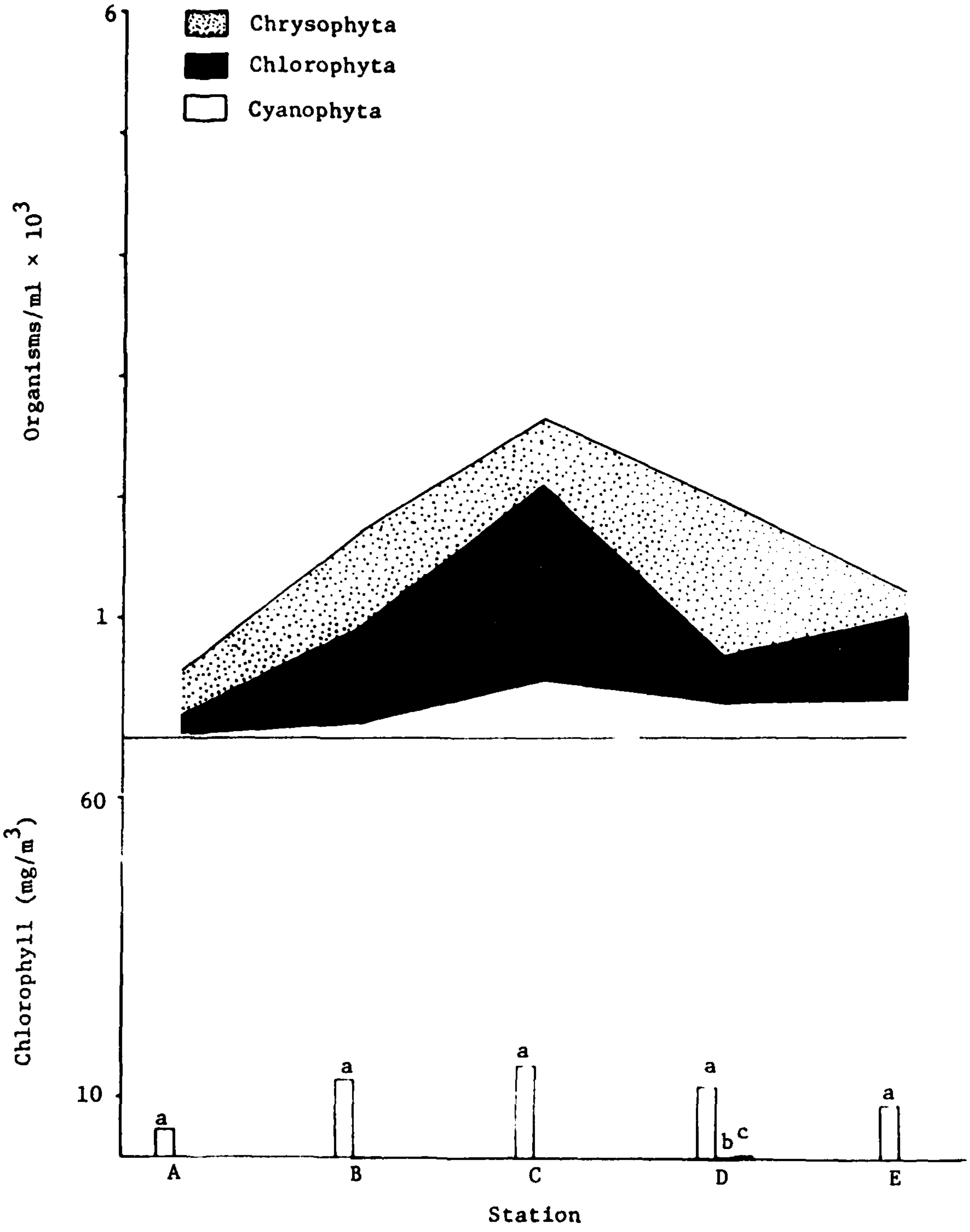


Figure 8. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentration (mg/m^3) at mainstream sampling stations on West Point Lake 13 May 1981. Values represent means of all samples taken at all depths.

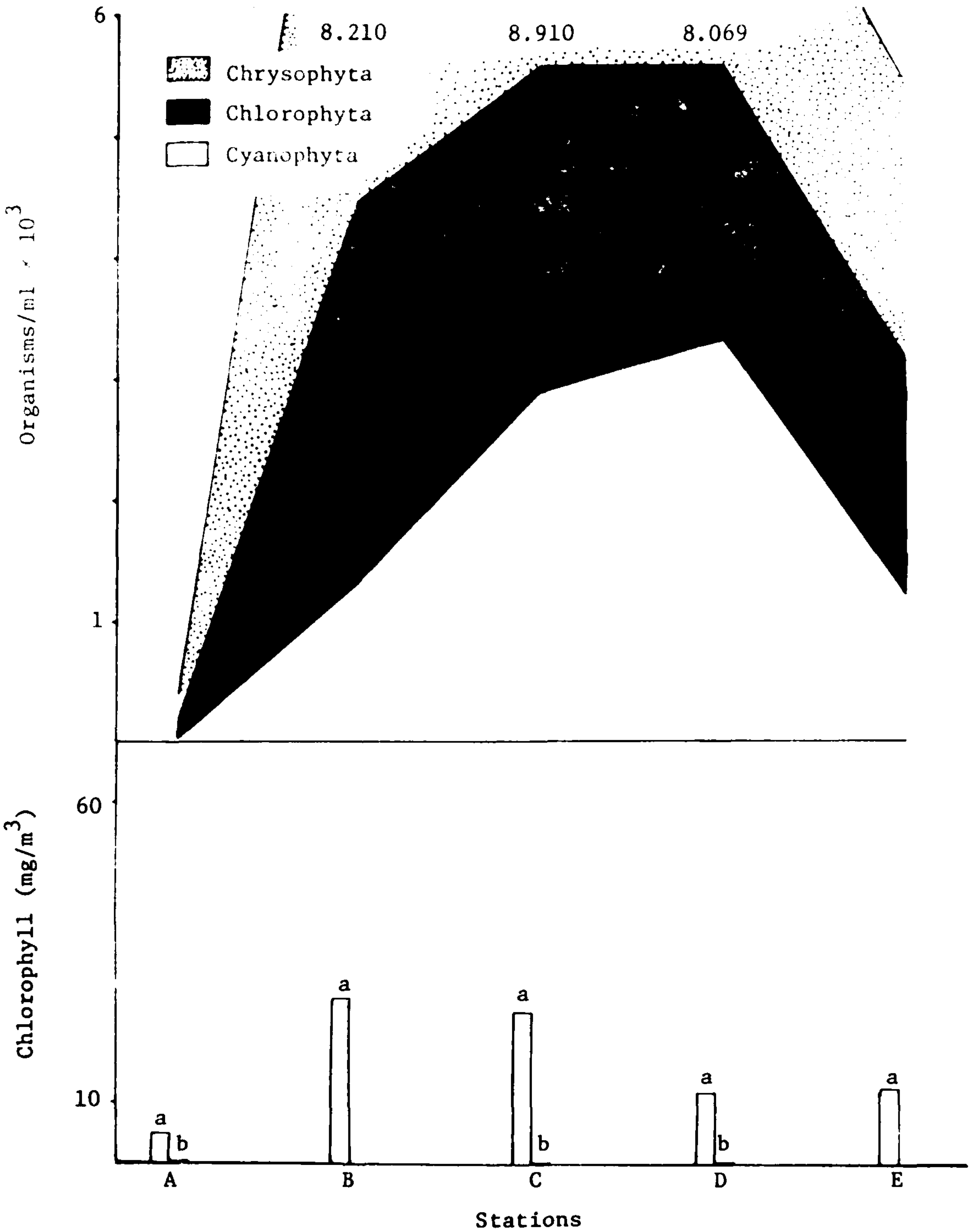


Figure 9. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentration (mg/m^3) at mainstream sampling stations on West Point Lake August 1981. Values represent means of all samples taken at all depths.

Table 4

Mean number of phytoplankters (organisms/ml) chlorophyll concentrations (mg/m^3) in Yellc and Wehadkee Creeks on all sampling date 1980-81. Values represent means of al samples taken at all depths.

	1980	1981		
	Nov	Jan	May	Aug
	YELLOWJACKET CREEK (Station G)			
	organisms/ml			
ALGAL DIVISION				
Chrysophyta	170	913	1,258	793
Chlorophyta	691	883	1,624	1,341
Cyanophyta	31	43	1,165	5,235
Others	32	96	37	92
Total	924	1,935	4,084	7,461
	mg/m^3			
CHLOROPHYLL (mg/m^3)				
Chlorophyll a	14.63	16.45	15.48	13.17
Chlorophyll b	0.10	0.00	0.00	0.00
Chlorophyll c	0.00	0.00	0.00	0.00
	WEHADKEE CREEK (Station F)			
	organisms/ml			
ALGAL DIVISION				
Chrysophyta	419	822	585	1,909
Chlorophyta	1,199	476	1,078	1,644
Cyanophyta	42	28	222	1,638
Others	103	87	7	93
Total	1,763	1,413	1,892	5,284
	mg/m^3			
CHLOROPHYLL (mg/m^3)				
Chlorophyll a	10.26	8.32	12.71	12.45
Chlorophyll b	0.00	0.48	0.55	0.01
Chlorophyll c	0.00	0.00	2.88	0.00

Table 5

Mean phytoplankton numbers (organisms/ml) for each station on all sampling dates during 1980-81.

Algal Division	Stations						
	A	B	C	D	E	F	G
	organisms/ml						
Chrysophyta	456	1,341	1,306	1,194	1,153	934	783
Chlorophyta	253	1,161	1,532	1,106	987	1,099	1,135
Cyanophyta	40	376	879	947	407	483	1,619
Others	24	60	37	20	22	72	64
Total	773	2,938	3,754	3,267	2,569	2,588	3,601

Table 6

Mean phytoplankton numbers (organisms/ml) for West Point Lake on each sampling date during 1980-81.

Algal Division	1980	1981		
	Nov	Jan	May	Aug
	organisms/ml			
Chrysophyta	283	1,087	575	2,251
Chlorophyta	847	607	944	1,959
Cyanophyta	43	75	394	2,505
Others	38	54	31	60
Total	1,211	1,823	1,944	6,775

Table 7

Dominance ranking of phytoplankters identified from samples taken at each sampling station during 1980-81 sampling year.

Organism	4 November 1980							27 January 1981							13 May 1981							4 August 1981						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
CHRYSOPHYTA																												
Pennate diatoms	1	1	3	2	1	1	2	1	1	2	4	5	1	3	1	3	5	3	3	1	5	1	4	5	1	1	2	
Melosira granulata	4	3			4		4								5			8	4	5	6		5					
M. varians			3				5				4	2	5	2				8		5								
Cyclotella sp.				4	5			3		1	1	1	2	1	4	1	1		4	2	2	3	1	2		4		3
Chrysococcus sp.																							8					5
Dinobryon sp.		4													5													
Pseudotetraedron neglectum																												
Ophiocytium sp.																												
Asterionella sp.										4		6					7	6										
Tabellaria sp.																		8		3							7	
CHLOROPHYTA																												
Elakatothrix sp.																			6									
Ankistrodesmus sp.																												
A. convolutus		3	2	3	2	2	1			4	3	3	3	4		2	2	2	1	3	1							
A. falcatus						4	6						5															
A. nanoselene			4												5	4		7	5		5							
Scenedesmus sp.																												
S. quadricauda	3		5	1	3	3	3	2					5		3	5	6	7		6	6	4	3	3	6		5	4
S. acuminatus							6								5									8				
S. armatus																					6						7	
S. abundans								2	2							6					6			8				
S. denticulatus		3	5	3	3	4	5								5									6		4		
S. bijuga							5	4												5								
Pandorina charkowiensis																												
P. morum																												
Dictyosphaerium sp.		4									7	5		4									8					
Eudorina elegans																												
Actinastrum sp.																							7					
Closterium sp.			5	4			6																					
Golenkinia sp.										6	2	6		3	4	6	3						7	8		6	6	
Cosmarium sp.		4				5	5									6	7	8				4		8	3	3	4	5
Arthrodesmus sp.																												
Sphaerocystis sp.																			6									
Kirchneriella sp.																												
Chlamydomonas sp.	2	2	1	3		4	3		3	3	5	5		4	2	3	4	4	5	4	4	4	8	7		5	5	3
Crucigenia sp.			5			4	3									4							8					
Pediastrum sp.					5	5	5										7	8	6									
Schroederia sp.		1		4					3		6	6							6				6	8				
Staurastrum sp.				4			5					6										4		8			6	5
Unid. green flagellate																												
Coelastrum sp.	4									6								5	6		3							5
Tetrastrum sp.			5				6																					
Micratinium sp.										6				4							6							
Oocystis sp.	4		4						3			6						7	6		5							
Euastrum sp.						5																						
Tetraedron sp.				3	5		6				7																	
Nephrocytium sp.																6	4		6									

Table 7, continued

Organism	4 November 1980							27 January 1981							13 May 1981							4 August 1981						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
CYANOPHYTA																												
Anabaena sp.																												
Gomphosphaeria sp.																		8		5				6		5		5
Merismopedia sp.																				6			2	5		6		
Oscillatoria angustissima	2				5			4	3							5	1	1	2	2	2		7	4		6	5	
Chroococcus sp.	3				5			4				4			5	5	7	6			6	4						
Microcystis sp.																												
Cylindrospermum sp.																												
Lyngbya sp.																									2			2
Rhaphidiopsis sp.	4	4						4							5										4		3	5
Aphanotheca sp.										5																		
Spirulina laxa																								1	5	2	1	1
EUGLENOPHYTA																												
Trachelomonas sp.						4								5			7				6	3					7	4
Phacus sp.							6							5														
Euglena sp.		4			5	5									3	6												
Unid. pigmented flagellate																						2						
PYRRHOPHYTA																												
Gymnodinium sp.										6			5															
Peridinium sp.		4														6		6										
Glenodinium sp.					4	3						6	4															
Unid. dinoflagellate																												

59. Other phytoplankters commonly encountered were the centric diatoms Cyclotella spp., Melosira granulata and M. varians, the green coccoids Ankistrodesmus convolutus and Scenedesmus quadricauda and the green flagellate Chlamydomonas spp. Usually blue-green algal communities are dominated by Oscillatoria angustissima in West Point Lake. However, this year a different alga, Spirulina laxa, dominated samples at several stations during the summer (Table 7).

Chlorophyll

60. Chlorophyll values measured on a volume basis (mg/m^3) generally exhibited the same pattern as phytoplankton density at mainstream stations (Figures 6-9). Mean chlorophyll a concentrations at each station and date appear in Table 8. Mean chlorophyll a concentrations ranged from a low of 3.0 mg/m^3 at station A in September to a high of 27.5 mg/m3 at station B in August (Table 8). The yearly mean chlorophyll a concentrations for the lake the past five years were: 13.1, 9.5, 9.8, 10.3 and 13.3 for 1976-77, 1977-78, 1978-79, 1979-80 and 1980-81, respectively.

Table 8

Chlorophyll a concentrations at sample stations in West Point Lake. Values are means of all depths measured at that station.

Year	Month	Station A	B	C	D	E	F	G
		Chlorophyll a (mg/m^3)						
1980	Nov	4.2	6.4	20.2	11.8	8.9	10.3	14.6
	Dec	6.2	5.6	17.1	6.7	3.5	11.7	12.8
1981	Jan	8.1	6.9	16.5	23.9	17.2	8.3	16.5
	Mar	5.4	13.2	12.5	15.3	15.3	5.6	15.9
	May	4.7	13.0	15.5	12.0	8.9	12.7	15.5
	Jun	4.6	20.6	18.3	6.8	5.8	10.8	25.3
	Aug	5.0	27.5	25.2	12.1	12.6	12.5	13.2
	Sept	3.0	16.5	22.3	15.2	15.3	13.0	19.4

61. Values converted to an areal basis (mg/m^2) and referred to as chlorophyll standing crops appear in Tables 9, 10 and 11. Chlorophyll a standing crop was measured from a low of 3.5 mg/m^2 at station E in December to a high of 185.8 mg/m2 at station D in January (Table 9). The highest chlorophyll b standing crop was 10.4 mg/m2 measured at station G in June. Highest chlorophyll c standing crop was 19.8 mg/m^2 measured at station D in March. Annual mean chlorophyll a standing crops ranged from lows of 8.0 and 10.9 mg/m^2

Table 9

Chlorophyll a, b and c standing crops (mg/m^2) measured at each station and date during 1980-81. Values represent means of all depths measured at that station.

	Station	A			B			C			D			[illegible]			F			G		
		Chlorophyll (mg/m^2)																				
Year	Month	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
1980	Nov	4.2	0.0	0.0	25.9	0.5	0.0	86.6	0.3	0.0	84.7	0.0	0.0	8.9	1.0	0.0	41.0	0.0	0.0	56.3	0.3	0.0
	Dec	6.2	0.1	0.3	22.5	0.0	4.7	70.4	1.9	0.0	14.5	1.1	0.0	3.5	0.0	0.0	43.2	0.4	1.8	53.0	0.0	0.1
1981	Jan	8.1	0.0	0.0	28.6	0.0	0.2	67.3	2.7	0.0	185.8	3.3	0.0	17.2	0.0	0.0	32.6	2.9	0.0	32.9	0.0	0.0
	Mar	10.8	3.7	0.0	52.8	8.2	16.3	51.8	7.3	12.9	122.6	4.5	19.8	15.3	3.5	6.5	23.6	0.6	1.2	67.6	6.7	0.0
	May	9.3	0.0	0.0	51.9	0.0	0.0	63.6	0.0	0.0	105.2	0.9	3.7	8.9	0.7	0.0	53.9	1.6	8.6	68.9	0.0	0.0
	Jun	9.1	1.5	5.1	77.8	0.4	1.8	79.0	0.0	0.0	50.7	1.6	13.3	5.8	0.0	0.0	42.8	2.0	7.4	108.8	10.4	0.0
	Aug	10.0	0.6	0.0	102.7	0.0	0.0	97.3	0.7	0.0	98.2	2.2	0.0	12.6	0.0	0.0	46.6	0.0	0.0	56.8	0.0	0.0
	Sep	6.0	0.0	0.0	60.1	0.0	0.0	88.7	0.0	0.0	117.7	0.0	0.0	15.3	0.0	0.0	56.4	0.0	0.0	83.7	0.0	0.0

Table 10

Mean chlorophyll standing crops (mg/m^2) at each station for all sampling dates. Values represent means of all depths measured at that station.

Chlorophyll	Station						
	A	B	C	D	E	F	G
				mg/m^2			
a	8.0	52.8	75.6	97.4	10.9	42.5	66.0
b	0.7	1.1	1.6	1.7	0.7	0.9	2.2
c	0.7	2.9	1.6	4.6	0.8	2.4	0.0

Table 11

Mean chlorophyll standing crops (mg/m^2) on each sampling date for all stations. Values represent means of all depths measured at that station.

Chlorophyll	1980		1981					
	Nov	Dec	Jan	Mar	May	Jun	Aug	Sep
				mg/m^2				
a	43.9	30.5	53.2	49.2	51.7	53.4	60.6	61.1
b	0.3	0.5	1.3	4.9	0.5	2.3	0.5	0.0
c	0.0	1.0	0.0	8.1	1.8	3.9	0.0	0.0

at station A and E, respectively, to a high of 97.4 mg/m^2 at station D (Table 10). Station A is located in the headwaters of the lake, station E in the tailwaters and station D is the lowermost station within the reservoir. On three of four dates, chlorophyll a standing crop was higher in Yellowjacket Creek than in Wehadkee Creek (Table 11).

Primary Productivity

62. Mean net primary productivity by station and date is presented in Table 12. Seasonal and annual mean estimates of net primary productivity for the current year and the previous four years appear in Table 13. The mean net primary productivity, chlorophyll a standing crop, and turbidity for each station and date are plotted together in Figure 10.

63. The lotic headwaters of the reservoir at station A exhibited the lowest primary productivity averaging for the year 48.9 mg C/m^2/day (Table 12). The more lentic areas of the reservoir had much higher productivity values averaging from a low of 448.6 mg C/m^2/day at station F to a high of 635.5 mg C/m^2/day at station C (Table 12). March estimates of primary productivity were lower at most stations because of higher turbidity in the photic zone (Figure 10).

64. The seasonal estimates for the lake ranged from a low of 277.7 mg C/m^2/day in the spring to a high of 734.6 mg C/m^2/day in the summer. The annual mean estimate of 503.9 mg C/m^2/day was the lowest estimate measured during the five years primary productivity has been investigated in West Point Lake (Table 13).

Organic Matter and Carbon

65. Organic Content of Suspended Matter. The dry weight of particulate suspended matter filtered from water samples collected at each station is presented in Table 14. The organic fraction (Particulate Organic Matter) of these samples appears in Table 15. The pattern of distribution of particulate organic matter (POM) and total organic carbon (TOC) measured at mainstream stations on selected dates is presented in Figure 11.

66. Particulate organic matter at mainstream stations differed little from the headwaters to the tailwaters of the reservoir (Table 15). Two exceptions to this statement were noted in May and September when POM at station A had means more than double measurements at all other stations (Table 15).

67. Total suspended matter values ranged from a low of 2.5 mg/l at station E in May to a high of 79.2 mg/l at station A in September. On most dates, total suspended matter measurements were higher in the upper

Table 12

Mean primary productivity by station and date for West Point Lake during 1980-81.

Station	Date				Annual
	Dec	Mar	Jun	Sept	Mean
			mg C/m^2/day		
A	56.7	49.5	65.9	23.5	48.9
B	267.2	161.8	968.7	758.8	539.1
G	659.4	225.1	1255.5	348.9	622.2
C	781.3	359.8	847.2	553.5	635.5
F	474.9	278.7	344.6	696.2	448.6
D	333.8	537.5	648.1	627.4	536.7

Table 13

Seasonal and annual mean estimates (mg C/m^2/day) of primary productivity measured in West Point Lake from 1976-1981.

	Season				
Year	December Winter	March Spring	June Summer	September Fall	Annual Mean
1976-77	472.0	267.0	700.0	1316.0	689.0
1977-78	70.0	279.0	1161.0	1465.0	744.0
1978-79	66.9	78.9	1611.8	1068.9	706.6
1979-80	79.3	116.5	881.1	1160.6	559.4
1980-81	432.7	277.7	734.6	570.4	503.9

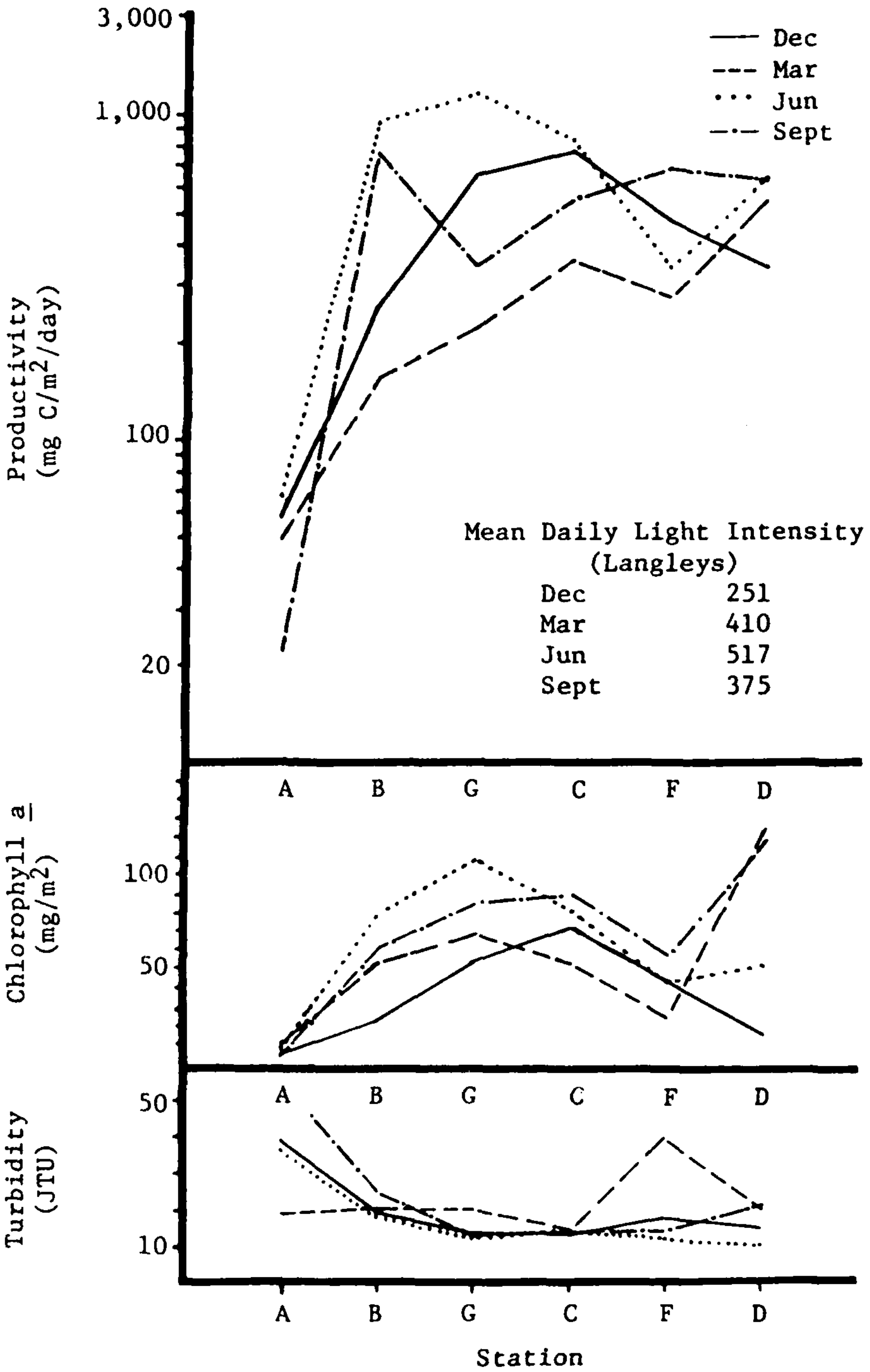


Figure 10. Net primary productivity (mg C/m^2/day), chlorophyll a standing crop (mg/m^2), turbidity (JTU) and mean daily light intensity (Langleys) for quarterly samples during 1980-81 on West Point Lake. The light intensity values are the average daily light intensity for that quarter in which sampling occurred.

Table 14

Total suspended matter (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1980-81.

Station	Depth (m)		4 Nov 80	10 Dec 80	27 Jan 81	25 Mar 81	13 May 81	11 Jun 81	4 Aug 81	3 Sept 81
						mg/l				
A	0		8.8	35.6	9.7	3.8	29.9	28.9	32.3	68.8
	2		8.7	39.8	11.0	14.7	61.0	33.0	33.1	79.2
		$\overline{X}$	8.8	37.7	10.4	9.3	45.5	31.0	32.7	74.0
B	0		11.9	10.8	6.7	10.1	2.8	6.8	7.4	9.2
	2		11.9	8.5	6.8	10.1	5.4	7.8	7.5	12.6
	4		11.5	10.6	7.2	10.7	5.5	8.5	8.8	14.9
	8		18.3	15.6	6.5	11.0	11.9	7.6	12.7	12.3
	12		--*	16.2	8.3	15.5	12.7	23.6	--	21.1
		$\overline{X}$	13.4	12.3	7.1	11.5	7.7	10.9	9.1	14.0
C	0		5.6	5.2	4.8	5.1	4.0	3.9	4.6	5.1
	2		5.8	5.1	5.0	5.5	5.1	4.9	4.1	3.6
	4		5.8	5.3	4.7	5.8	5.2	5.9	3.9	5.8
	8		5.0	4.6	4.0	6.9	5.8	5.9	3.8	6.2
	16		7.5	--	7.1	26.1	12.9	16.2	53.6	15.3
		$\overline{X}$	5.9	5.1	5.1	9.9	6.6	7.4	14.0	7.2
D	0		3.8	6.0	5.2	8.7	3.0	2.5	4.5	3.7
	2		3.7	6.3	5.8	8.2	2.5	2.8	3.7	4.0
	4		3.3	7.1	4.6	8.5	2.8	3.0	3.8	5.7
	8		4.7	5.5	8.0	8.8	3.0	2.4	3.9	38.2
	16		12.7	5.2	5.2	8.2	2.4	6.9	11.5	8.0
	24		18.1	--	4.1	9.0	2.6	8.2	14.9	11.7
		$\overline{X}$	7.7	6.0	5.5	8.6	2.7	4.3	7.1	11.9
E	0		5.5	4.3	6.3	8.3	2.5	3.2	7.6	6.3
F	0		7.3	7.6	8.0	14.3	3.5	3.5	4.3	7.1
	2		8.0	8.1	10.1	18.2	5.0	4.5	4.5	7.2
	4		10.5	9.9	9.9	19.2	4.2	4.5	5.3	8.1
		$\overline{X}$	8.6	8.5	9.3	17.2	4.2	4.2	4.7	7.5
G	0		6.4	5.4	5.5	8.2	2.9	5.4	3.8	4.7
	2		5.7	4.4	6.3	9.0	5.1	5.1	5.3	4.9
	4		4.5	5.5	5.8	9.0	3.6	4.1	4.1	2.8
		$\overline{X}$	5.5	5.1	5.9	8.7	3.9	4.9	4.4	4.1

*Dash (--) indicates no data for that date and depth.

Table 15

Suspended matter organic content (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1980-81.

Station	Depth (m)	4 Nov 80	10 Dec 80	27 Jan 81	25 Mar 81	13 May 81	11 Jun 81	4 Aug 81	3 Sept 81
					mg/l				
A	0	2.42	6.02	3.86	1.28	6.40	6.06	5.90	10.70
	2	2.36	5.42	4.30	3.40	11.30	6.40	6.00	12.80
	$\overline{X}$	2.39	5.72	4.08	2.34	8.85	6.23	5.95	11.75
B	0	3.02	2.20	3.10	2.66	2.86	4.86	5.80	4.82
	2	2.50	1.92	3.08	2.90	3.08	3.96	3.74	3.88
	4	3.06	2.60	3.00	3.00	2.78	3.50	3.64	4.08
	8	4.46	2.80	3.08	2.34	3.92	3.40	4.02	4.10
	12	--*	2.74	--	3.14	4.30	6.12	--	5.60
	$\overline{X}$	3.26	2.45	3.07	2.81	3.39	4.37	4.30	4.50
C	0	2.76	2.18	3.10	1.90	2.78	4.00	3.98	4.48
	2	2.86	2.66	2.94	2.50	3.16	4.50	3.22	4.06
	4	2.46	2.48	3.02	2.18	3.38	3.88	3.66	4.20
	8	1.82	2.10	3.48	2.30	2.74	2.74	3.02	3.00
	16	2.08	--	3.20	5.40	3.90	5.18	13.42	3.78
	$\overline{X}$	2.40	2.36	3.15	2.86	3.19	4.06	5.46	3.90
D	0	2.50	2.00	3.18	3.00	2.30	2.50	3.72	4.02
	2	2.58	2.06	3.80	2.80	3.18	2.62	3.72	3.82
	4	1.60	2.08	3.84	2.84	2.34	2.84	3.22	3.04
	8	1.80	1.84	3.82	2.62	1.98	2.28	3.24	8.50
	16	3.16	1.92	2.34	2.62	1.38	3.50	4.20	6.18
	24	4.70	--	2.92	2.40	1.50	3.96	5.40	5.98
	$\overline{X}$	2.72	1.98	3.32	2.71	2.11	2.95	3.92	5.26
E	0	2.08	1.68	3.52	2.70	2.10	2.70	3.80	2.88
F	0	2.80	3.06	3.32	3.58	2.48	3.14	3.70	4.70
	2	2.64	2.70	3.20	3.36	2.62	3.28	3.60	4.60
	4	2.90	2.88	2.82	3.22	2.28	3.28	3.26	4.22
	$\overline{X}$	2.78	2.88	3.11	3.39	2.46	3.23	3.52	4.51
G	0	3.40	2.66	3.10	2.60	2.54	4.02	3.42	4.58
	2	2.26	2.00	3.30	3.02	3.14	3.88	4.32	4.52
	4	1.72	1.88	3.62	2.80	2.60	3.40	3.26	2.42
	$\overline{X}$	2.46	2.18	3.34	2.81	2.76	3.77	3.67	3.84

*Dash (--) indicates no data for that date and depth.

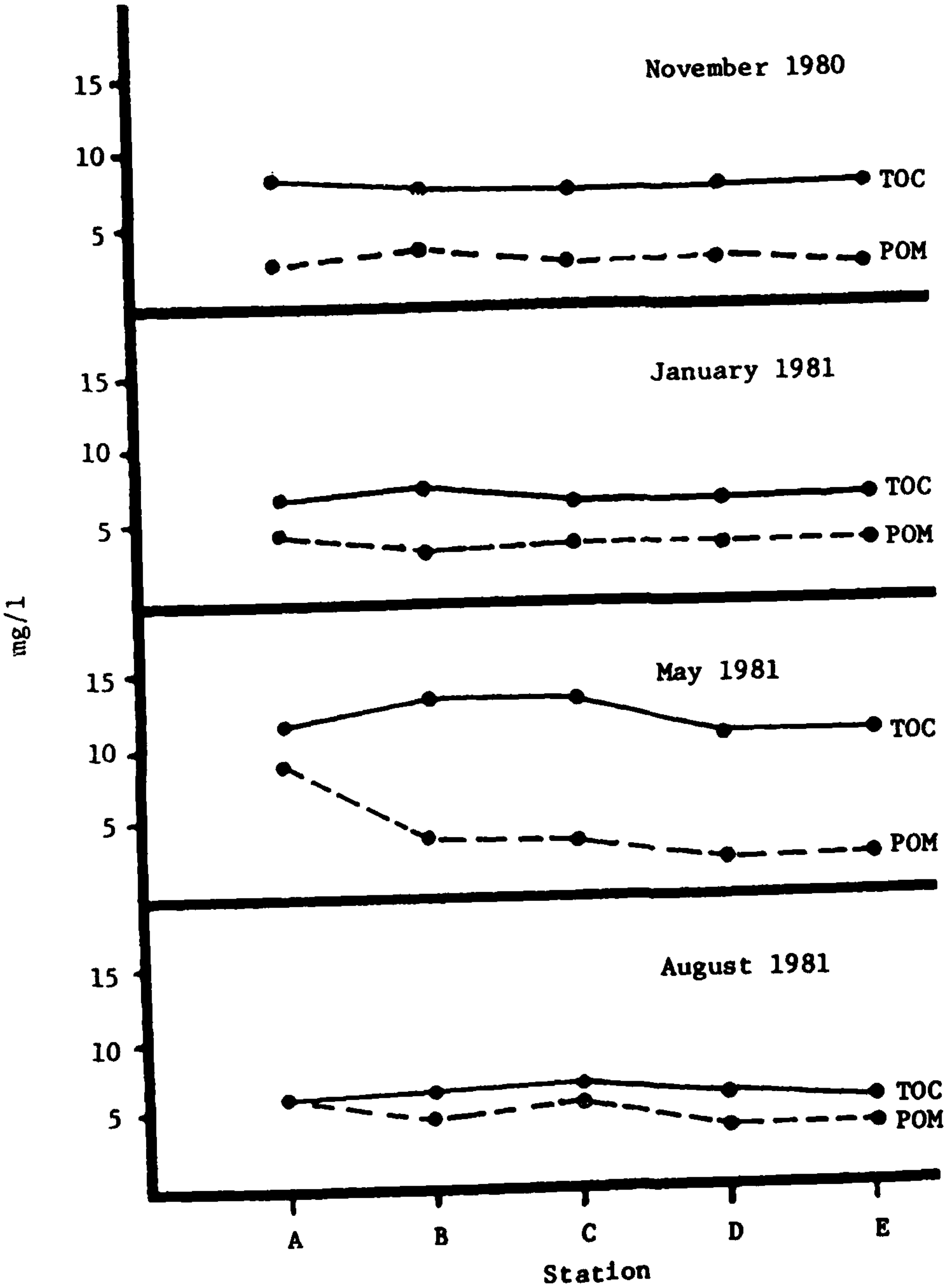


Figure 11. Particulate organic matter (POM) and total organic carbon (TOC) content of waters on the mainstream of West Point Lake in November 1980, January 1981, May 1981 and August 1981.

reaches of the reservoir at stations A and B. Moving down the reservoir toward the dam the total suspended matter in the water column decreased. March samples differed somewhat from the typical pattern at station F in Wehadkee Creek (Table 14).

68. Total Carbon (TC). The total carbon content of water samples collected from each station and depth appears in Table 16. Mean values at a particular station ranged from a low of 7.9 mg/l in Wehadkee Creek (station F) to a high of 17.8 mg/l at station B.

69. Total Organic Carbon (TOC). Total organic carbon measurements from each station are presented in Table 17. The relationship of TOC to POM for selected dates appears in Figure 11. Mean TOC values ranged from a low of 4.8 mg/l at station E in June to a high of 15.1 mg/l at station G in May. TOC values were highest at all stations during March and May (Table 17).

Zooplankton

70. Zooplankton Abundance. The mean zooplankton density collected on each date at mainstream stations appears in Figures 12-14. Zooplankton density measured in Yellowjacket and Wehadkee Creeks appears in Table 18. Annual means for each station are presented in Table 19 while mean density for the lake on each date appears in Table 20. Appendix Table 5 includes mean density by station and date for 1980-81.

71. Zooplankton density for the year averaged from 12 organisms/l at station A to 229 organisms/l at station B. Density was higher at station B than any other location (Table 19). A zooplankton density of 842 organisms/l was collected during May at station B (Figure 13). Station E, F and G had similar numbers of zooplankton on all dates (Appendix Table 5).

72. Zooplankton abundance exhibited pronounced seasonal variations. Mean density ranged from highs of 265 and 115 organisms/l during May and January, respectively, to lows of 21 and 59 organisms/l in November and August, respectively (Table 20).

73. Group Dominance. Rotifers numerically dominated zooplankton samples in the lake at all sites except station F in Wehadkee Creek (Table 19). Copepods dominated zooplankton collections on three of four dates in Wehadkee Creek and two of four dates in Yellowjacket Creek (Table 18). Averages from each date for the lake also contained more copepods than rotifers on two of four dates (Table 20). Few cladocera were collected at any station during the year (Table 19). Based on density, rotifers were the most important component of the zooplankton community, followed in order by copepods and cladocera.

74. Species Dominance. The dominant genera and/or species collected at each station during the year are presented in Tables 21 and

Table 16

Total carbon concentration (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1980-81.

Station	Depth (m)	4 Nov 80	10 Dec 80	27 Jan 81	25 Mar 81	13 May 81	11 Jun 81	4 Aug 81	3 Sept 81
					mg/l				
A	0	10.9	10.9	9.7	13.6	15.3	10.2	9.3	10.1
	2	11.6	10.7	10.1	13.4	15.3	10.0	8.3	10.4
	$\bar{X}$	11.3	10.8	9.9	13.5	15.3	10.1	8.8	10.3
B	0	11.3	10.2	11.2	13.3	15.4	9.2	9.2	10.4
	2	10.9	9.8	9.9	12.9	15.3	9.1	9.0	8.9
	4	10.4	9.9	12.4	13.6	15.2	9.4	8.9	9.4
	8	11.3	10.2	10.3	12.4	18.5	10.0	9.7	8.9
	12	--*	9.5	10.1	12.8	24.6	11.4	--	8.0
	$\bar{X}$	11.0	9.9	10.8	13.0	17.8	9.8	9.2	9.1
C	0	10.1	9.5	9.3	12.5	17.0	8.3	9.6	9.5
	2	10.1	9.2	9.3	11.8	15.7	8.7	9.6	9.1
	4	9.8	9.9	9.2	11.4	13.8	8.8	9.3	10.0
	8	9.7	9.1	9.3	12.3	13.7	9.4	9.4	8.6
	16	10.0	--	9.7	12.5	17.5	10.2	16.5	8.1
	$\bar{X}$	9.9	9.4	9.4	12.1	15.5	9.1	10.9	9.1
D	0	10.1	7.9	9.0	11.6	11.6	7.7	10.0	9.5
	2	9.8	8.5	9.0	11.4	12.6	7.6	9.3	9.1
	4	10.0	8.3	9.0	11.0	12.2	7.5	9.0	8.3
	8	10.0	9.0	9.2	11.1	12.5	7.3	9.2	11.2
	16	10.5	8.7	9.0	10.3	14.2	10.7	12.3	23.6
	24	10.2	--	--	11.3	14.8	11.0	14.3	16.6
	$\bar{X}$	10.1	8.5	9.0	11.1	13.0	8.6	10.7	13.1
E	0	10.0	10.8	9.3	10.9	13.3	8.1	9.6	9.4
F	0	10.6	9.7	8.1	10.0	13.6	7.8	9.0	10.5
	2	10.4	9.3	8.2	9.9	13.5	7.6	8.6	10.5
	4	11.1	9.2	7.8	10.2	13.9	8.4	8.8	10.3
	$\bar{X}$	10.7	9.4	8.0	10.0	13.7	7.9	8.8	10.4
G	0	11.8	10.0	10.7	11.2	18.2	8.4	9.9	10.4
	2	10.9	9.0	10.1	11.9	18.2	8.7	10.3	11.0
	4	11.0	9.0	10.3	24.2	15.8	7.8	10.5	9.4
	$\bar{X}$	11.2	9.3	10.4	15.8	17.4	8.3	10.2	10.3

*Dash (--) indicates no data for that date and depth.

Table 17

Total organic carbon concentration (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1980-81.

Station	Depth (m)	4 Nov 80	10 Dec 80	27 Jan 81	25 Mar 81	13 May 81	11 Jun 81	4 Aug 81	3 Sept 81
					mg/l				
A	0	7.7	7.3	6.6	10.1	11.4	7.6	6.3	7.7
	2	8.6	7.2	6.9	10.4	11.2	7.5	5.6	8.0
	$\bar{X}$	8.2	7.3	6.8	10.3	11.3	7.6	6.0	7.9
B	0	8.0	6.7	8.0	10.4	11.8	7.4	7.3	8.3
	2	7.6	6.4	6.6	10.0	11.5	6.5	5.6	5.9
	4	7.1	6.4	9.4	10.8	11.2	5.9	5.6	6.1
	8	7.8	6.9	7.0	9.6	13.7	5.5	6.4	4.8
	12	--*	5.7	7.0	9.9	17.4	6.3	--	4.0
	$\bar{X}$	7.6	6.4	7.6	10.1	13.1	6.3	6.2	5.8
C	0	7.9	6.9	6.6	10.0	14.4	6.1	7.3	7.4
	2	7.7	6.7	6.4	9.2	12.9	6.7	6.8	7.1
	4	7.1	7.3	6.6	8.7	11.4	6.7	6.0	7.8
	8	7.0	6.5	6.4	9.5	10.8	5.1	5.6	4.9
	16	6.7	--	6.7	9.2	12.6	4.5	7.0	3.9
	$\bar{X}$	7.3	6.9	6.5	9.3	12.4	5.8	6.5	6.2
D	0	8.3	5.3	6.5	9.4	9.6	5.5	7.3	7.3
	2	7.3	5.9	6.6	9.5	10.8	5.5	6.6	6.3
	4	7.3	5.6	6.8	9.2	10.1	4.9	6.2	4.7
	8	7.4	5.4	6.7	8.9	10.1	3.4	5.7	6.5
	16	7.7	6.1	6.3	8.1	10.5	4.9	4.9	18.5
	24	6.8	--	--	9.2	11.1	5.2	4.8	7.1
	$\bar{X}$	7.5	5.7	6.6	9.1	10.4	4.9	5.9	8.4
E	0	7.8	8.1	6.9	8.9	10.7	4.8	5.4	6.9
F	0	7.8	7.0	5.8	8.2	11.4	6.0	6.2	8.1
	2	7.5	6.8	5.8	8.0	11.4	5.8	5.6	7.3
	4	7.9	6.5	5.4	8.1	11.7	6.5	5.4	6.0
	$\bar{X}$	7.7	6.8	5.7	8.1	11.5	6.1	5.7	7.1
G	0	9.1	7.2	8.4	9.3	16.0	6.4	7.1	8.2
	2	8.2	6.1	6.7	10.0	16.0	6.8	7.9	8.3
	4	7.5	5.7	7.5	22.0	13.2	5.6	6.9	6.1
	$\bar{X}$	8.3	6.3	7.5	13.8	15.1	6.3	7.3	7.5

*Dash (--) indicates no data for that date and depth.

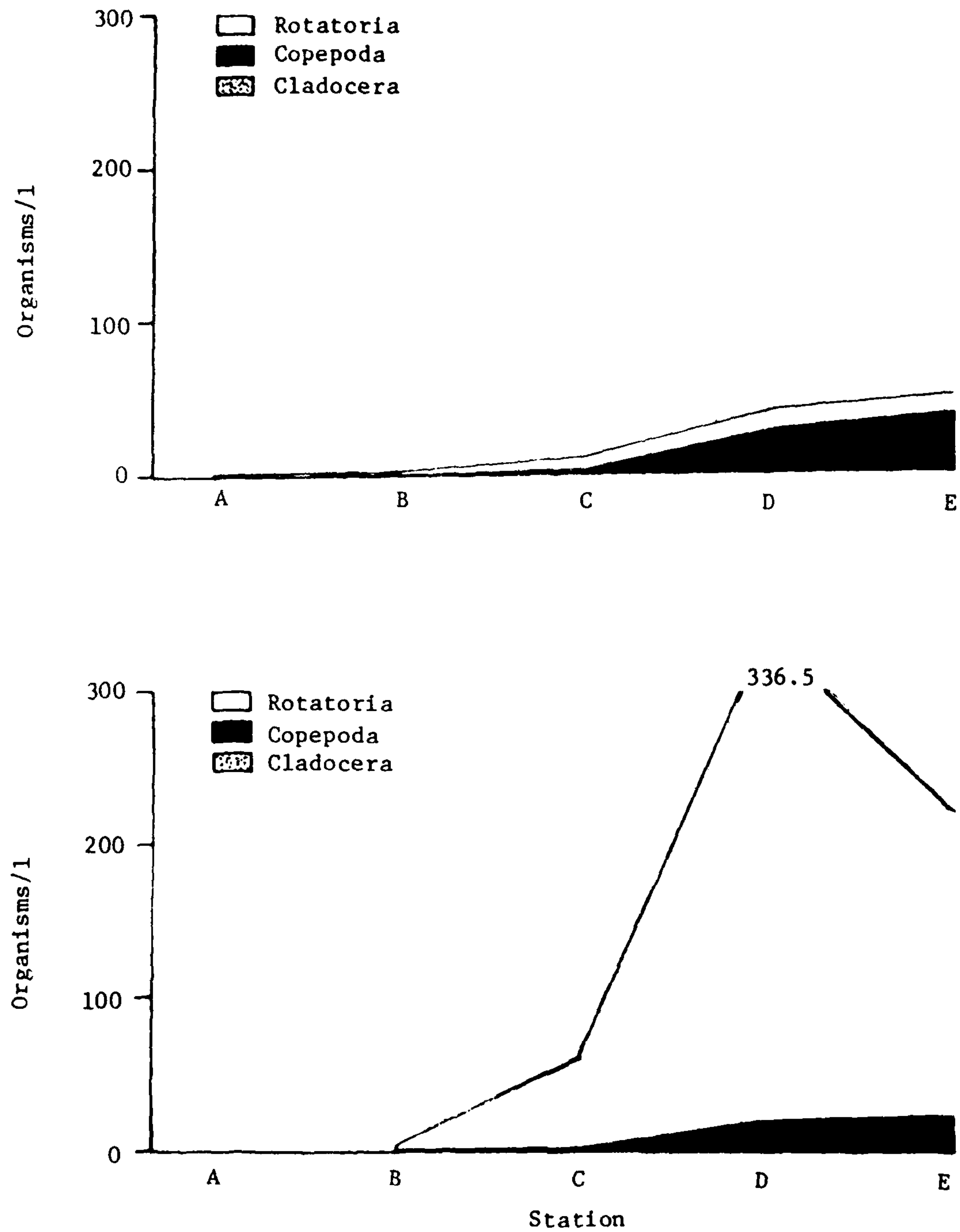


Figure 12. Zooplankton standing crop at mainstream sampling stations on West Point Lake on 4 November 1980 (upper) and 27 January 1981 (lower). Values represent means of all samples taken at all depths.

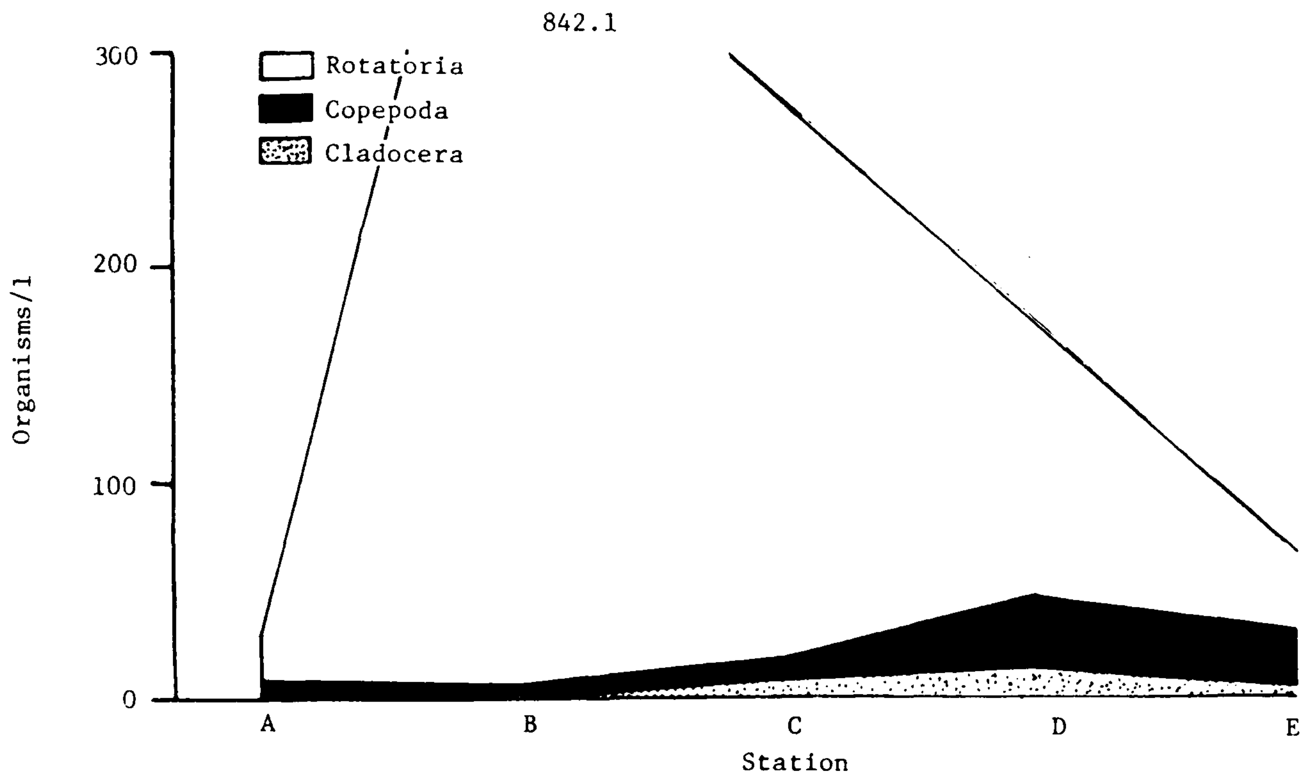


Figure 13. Zooplankton standing crop at mainstream sampling stations on West Point Lake on 13 May 1981. Values represent means of all samples taken at all depths.

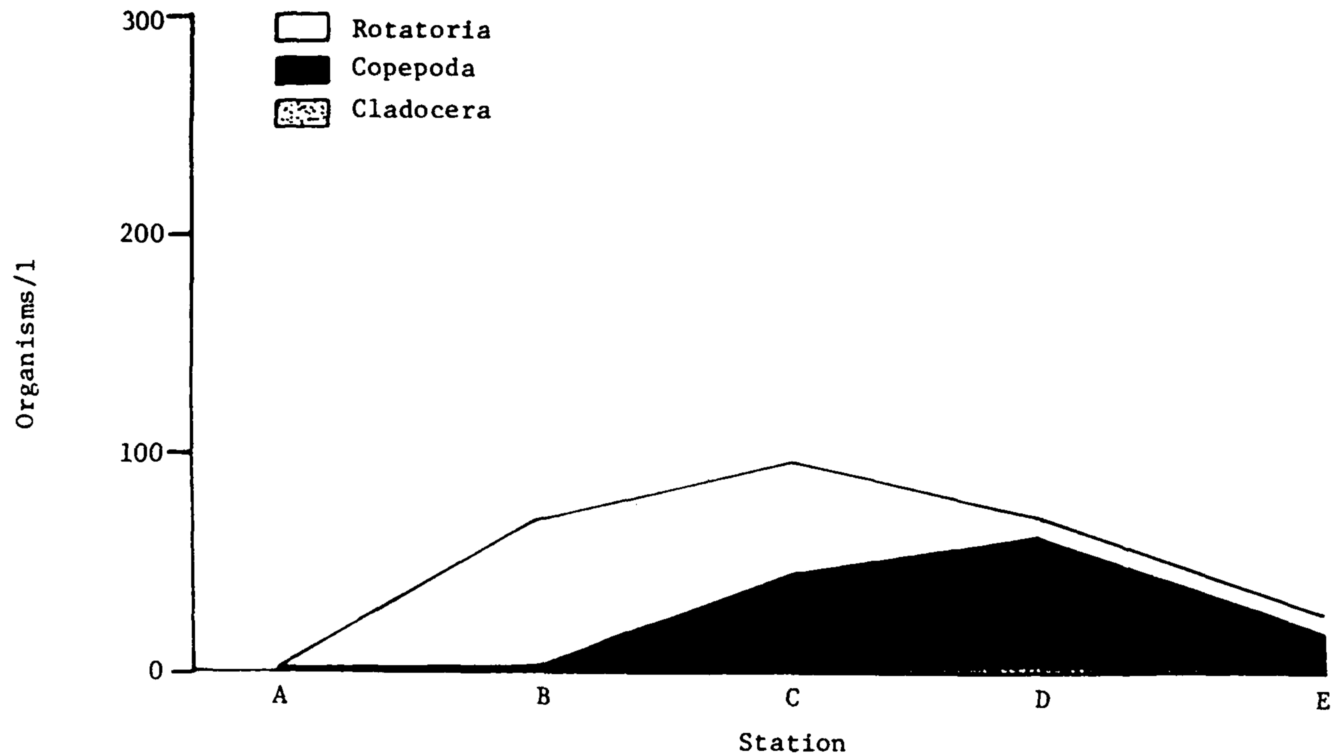


Figure 14. Zooplankton standing crop at mainstream sampling stations on West Point Lake on 4 August 1981. Values represent means of all samples taken at all depths.

Table 18

Mean number of zooplankters (organisms/l) found in Yellowjacket and Wehadkee Creeks on all sampling dates during 1980-81.

Organism	1980 Nov	1981 Jan	1981 May	1981 Aug
	YELLOWJACKET CREEK (Station G)			
	organisms/l			
Rotatoria	3	30	198	36
Copepoda	7	6	20	55
Cladocera	0	0	18	0
Total	10	36	236	91
	WEHADKEE CREEK (Station F)			
	organisms/l			
Rotatoria	10	12	55	24
Copepoda	17	8	148	29
Cladocera	2	3	18	1
Total	29	23	221	54

Table 19

Mean number of zooplankters (organisms/l) for each station on all sampling dates during 1980-81.

Organism	Stations A	B	C	D	E	F	G
				organisms/l			
Rotatoria	8	226	94	115	63	25	67
Copepoda[1]	3	3	16	36	27	51	22
Cladocera	1	0	3	5	2	6	5
Total	12	229	113	156	92	82	94

[1]Numbers include immature copepods.

Table 20

Mean number of zooplankters (organisms/l) from all stations for each date during 1980-81.

Organism	1980 Nov	1981 Jan	May	Aug
		organisms/l		
Rotatoria	6	103	218	28
Copepoda[1]	14	11	37	30
Cladocera	1	1	10	1
Total	21	115	265	59

[1]Numbers include immature copepods.

Table 21

Dominance ranking of zooplankters found on each sampling date during the 1980-81 sampling year. Numbers indicate the two dominant species of zooplankters.

Organism	4 Nov 1980							27 Jan 1981*							13 May 1981							4 Aug 1981						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
ROTATORIA																												
Hexarthra intermedia																							2	2				
Conochilus unicornis			2															2	1	2								
Keratella cochlearis				1											1						1							
Syncheata pectinata		2	1				2		1	1	1	1		1														
Trichocerca cylindrica																									2	2	1	
T. porcellus																											2	
Collotheca sp.																												
Ploesoma truncatum																										1		
Polyarthra vulgaris		1		2	1	1	1				2	2	2	2			2	1			2							
Brachionus angularis																												1
B. caudatus																1	1						1	1				2
B. urceolaris																												
Kellicottia bostoniensis																												
Conochiloides coenobasis																												
C. dossuarius																												
Philodina sp.																												
Rotaria sp.																												
Bdelloid rotifer	2	2							2	2												2						
Asplanchna priodonta						2							1						2									
Dipeuchlanis propatula	1																											
Keratella quadrata															2	2												
COPEPODA																												
Cyclops sp.																												
Cyclopoid copepod					2															1		1			1			
CLADOCERA																												
Bosmina longirostris																												

*Zooplankton was not sampled at station A on this date.

22. Table 21 includes the two taxa numerically dominant at each station from all major taxonomic groups. Table 22 includes the three taxa within each major group (Rotatoria, Copepoda, Cladocera) that were numerically dominant at each station.

75. When immature copepods (nauplii) are excluded, several species of rotifers dominated zooplankton collections at most stations on each date. A species of cyclopoid copepod shared dominance with the rotifers on three dates at four stations (Table 21).

76. The rotifer, Polyarthra vulgaris, was numerically dominant at four stations in November, while Synchaeta pectinata dominated at five stations in January. May and August samples were dominated by the rotifer, Brachionus caudatus, at two stations and a species of cyclopoid copepod, also dominant at two stations (Table 21). Cladocerans were not part of the dominance hierarchy on any date.

77. The dominance hierarchy within each major group included the following taxa that usually dominated most collections (Table 22):

Rotatoria	Asplanchna priodonta
	Brachionus angularis
	Brachionus caudatus
	Conochilus unicornis
	Keratella cochlearis
	Ploesoma sp.
	Polyarthra vulgaris
	Synchaeta pectinata
	Trichocerca cylindrica
	Bdelloid rotifer
Copepoda	Nauplii (immature copepods)
	Cyclops sp.
	Cyclopoid copepod
Cladocera	Bosmina longirostris
	Daphnia sp.
	Diaphanosoma leuchtenbergianum
	Holopedium amazonicum

78. Diversity and Equitability. Species diversity and equitability of zooplankton collections are presented in Table 23. The density, number of taxa, diversity and equitability of zooplankton samples from 1976-81 are compared in Table 24 (Davies et al. 1979; Bayne et al. 1980; Shelton et al. 1981 and Lawrence et al. 1982). During 1980-81 there was a significant ($P < 0.05$) decrease in number of taxa and increase in equitability compared with the previous year. Zooplankton density and diversity were not significantly different ($P > 0.05$) from the 1979-80 data.

Table 22

Dominance ranking of zooplankters found on each sampling date during 1980-81 sampling year. Number indicates ranking within each major group.

Organism	4 Nov 1980							27 Jan 1981*							13 May 1981							4 Aug 1981						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
ROTATORIA																												
Hexarthra sp.																							2	2				3
H. intermedia																												
Conochilus unicornis			2	3	2		3											2	1	1				3				
C. hippocrepis																												
Keratella sp.																												
K. serrulata																												
K. earlinae																												
K. cochlearis			3	1	2	3	3			3		3		3	1		3	3		2	1							
K. quadrata															2	2					3							
Proales sp.																												
Synchaeta sp.		3			3																		3					
S. pectinata			1				2		1	1	1	1	3	1														
Trichocerca sp.																												
T. cylindrica																						3			1	2	1	
T. porcellus	3																		3						3	3	2	
Trichotria tetractis																												
Cyrtonia tuba																												
Collotheca sp.																												
Ploesoma sp.																									2	1		
P. truncatum																												
Polyarthra sp.																												
P. vulgaris		1		2	1	1	1		3		2	2	2	2			2	1		3	2						3	
Brachionus sp.																3												
B. angularis															3													1
B. calyciflorus																												
B. caudatus																1	1						1	1				2
B. urceolaris																												
Kellicottia bostoniensis																												
Asplanchna sp.																												
A. priodonta						2							1						2									
Conochiloides sp.																												
C. coenobasis																												
C. dossuarius																												
Lecane sp.																						2						
Cephalodella sp.																												
Dipeuchlanis propatula	1																											
Monostyla sp.	3																					3						
Platyias sp.																						3						
Philodina sp.																												
Bdelloid rotifer	2	2							2	2	3											1						
Unidentified rotifer																												

Table 22, continued

Organism	4 Nov 1980							27 Jan 1981*							13 May 1981							4 Aug 1981						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
COPEPODA																												
Immature (Nauplii)	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diaptomus sp.																												
Cyclops sp.															2	1	2	3	2	2								
Cyclopoid copepod	**1/2/3	2/3	2/3	2/3	2	2/3	3		2/3	2	2	2	2	2	3			2	2	3	2	1/2	2		2/3	2	2/3	
Calanoid copepod											3		3				3		2		2							
Harpacticoid copepod							2																					2
Unidentified copepod																												
CLADOCERA																												
Bosmina longirostris	1	1	1	1	1	1	2		1		1		1		1		1	1	1	1	1	1	1		1	1	1	1
Daphnia sp.				2			3						2		2					3								
D. pulex																												
D. parvula																												
Eurycercus lamellatus																												
Chydorus sphaericus									2																			
Bosminopsis deitersi																					2					2		
Ceriodaphnia sp.																												
C. pulchella																												
C. lacustris						3									3										2			
Alona sp.																												
A. affinis																												
A. costala													3															
A. guttata																												
A. quadrangularis																												
A. rectangula			3																									
Pseudosida bidentata																												
Ilyocryptus sp.						2																2						
I. acutifrons																												
I. sordidus																												
I. spinifer																												
Holopedium amazonicum							1												2									
Alonella sp.																												
A. acutirostris									3																			
Sida crystalline																												
Moina sp.																								2				
M. micrura																												
Diaphanosoma sp.																												
D. brachyurum		2	2																									
D. leuchtenbergianum																	2	2		2	3		2	1		2		
Scapholeberis sp.																												
S. kingii																												
Dadaya macrops																												
Leydigia quadrangularis													3															
Pleuroxus denticulatus																	3											
Kurzia latissima																												
Camptocercus rectirostris																												
Immature cladoceran																												
Unidentified cladoceran																												

*Zooplankton was not sampled at station A on this date.

**Slash (/) indicates shared dominance between two or more species of that genus.

Table 23

Number of zooplankters (excluding immature copepods), number of taxa, diversity (d), and equitability (e) of zooplankton communities by station and date in West Point Lake during 1980-81.

Station	Month		Organisms/l	Taxa	d	e
A	Nov		2.3	12	2.94	0.90
	Jan		--	--	--	--
	May		24.2	23	3.51	0.72
	Aug		1.5	12	3.37	1.25
		$\overline{X}$	9.3	16	3.27	0.96
B	Nov		2.3	20	4.26	1.36
	Jan		5.5	29	4.46	1.20
	May		838.0	13	2.45	0.58
	Aug		67.8	18	1.43	0.19
		$\overline{X}$	228.4	20	3.15	0.83
C	Nov		9.6	19	2.98	0.58
	Jan		60.1	10	2.08	0.50
	May		270.7	20	3.15	0.65
	Aug		50.9	14	2.11	0.48
		$\overline{X}$	97.8	16	2.58	0.55
D	Nov		12.1	16	2.89	0.64
	Jan		318.0	13	2.16	0.38
	May		161.9	18	3.08	0.67
	Aug		28.0	23	3.18	0.57
		$\overline{X}$	130.0	18	2.83	0.57
E	Nov		13.8	11	3.10	1.09
	Jan		199.2	9	1.67	0.44
	May		45.7	14	3.06	0.86
	Aug		11.6	15	3.19	0.87
		$\overline{X}$	67.6	12	2.76	0.82
F	Nov		14.9	20	3.48	0.80
	Jan		18.1	17	2.79	0.57
	May		90.3	16	2.99	0.69
	Aug		26.1	15	2.77	0.63
		$\overline{X}$	37.4	17	3.01	0.67
G	Nov		3.3	19	3.69	1.00
	Jan		30.1	11	2.21	0.59
	May		220.5	20	3.34	0.73
	Aug		35.8	11	2.43	0.66
		$\overline{X}$	72.4	15	2.92	0.75

Table 24

Annual means of number of zooplankters[1], number of taxa, diversity (d) and equitability (e) of zooplankton communities for all five sampling years on West Point Lake[2].

	Sampling year				
	1976-77	1977-78	1978-79	1979-80	1980-81
Org/l	214.8±307.3 AB	227.3±262.5 A	95.2±111.5 B	157.9±204.4 AB	94.9±172.6 B
Taxa	13.7± 7.0 A	16.1± 6.4 A	23.9± 5.8 B	22.8± 5.0 B	16.2± 4.7 A
d	2.14± 0.59 A	2.67± 0.40 B	2.62± 0.67 B	2.78± 0.5 B	2.92± 0.7 B
e	0.61± 0.33 A	0.65± 0.24 A	0.41± 0.20 B	0.46± 0.2 B	0.73± 0.3 A

[1]Zooplankton densities do not include immature copepods.
[2]Means subtended by like letters are not significantly different ($p > 0.05$). Those subtended by unlike letters are significantly different ($p < 0.05$).

Aquatic Macrophytes

79. Low lake levels during the year reduced available habitat for alligatorweed (*Alternanthera philoxeroides*) and smartweed (*Polygonum* spp.). These populations remained inconsequential in the reservoir.

80. During September (1981) there was an unusual occurrence in the upper reaches of the reservoir. There were numerous fragments of at least four different plant species floating in the reservoir. These fragments had apparently entered the water upriver from Franklin, Georgia. The plant species included *Egeria densa* (egeria), *Najas quadalupensis* (southern naiad), *Myriophyllum* sp. (milfoil), and *Potamogeton diversifolius* (waterthread pondweed).

Benthic Macroinvertebrates

Dredge (Grab) Samples

81. A total of 65 taxa were identified from dredge samples in the littoral areas of West Point Lake. Forty-five of these taxa were

members of one insect group, the Family Chironomidae of the Order Diptera. Ten groups of benthic invertebrates dominated dredge samples again this year as they have since bottom sampling began in 1977 (Table 25). Aquatic earthworms (Oligochaeta) and midge larvae (Chironomids) typically comprised the highest percentage of macroinvertebrates each year, together making up more than 70% of most samples. Two families of oligochaetes were identified, Naididae and Tubificidae. Of those oligochaetes collected, most were tubificids. Other invertebrates that together comprised from one to thirty-six percent of the dredge collections, depending on the season and year, were aquatic nematodes (Nematoda), copepods (Copepoda), mayflies (Ephemeroptera), caddisflies (Trichoptera), phantom midges (Chaoborinae), biting midges (Ceratopogonidae), and mollusks (Gastropoda and Pelecypoda) (Table 25).

82. The chironomid fauna identified from dredge samples consisted of several engulfers, predators on rotifers, microcrustacea, or other chironomids. Examples of these predatory genera were Coelotanypus, Procladius, Cryptochironomus and Parachironomus (Table 26). Remaining chironomid genera were either collectors (gatherers or filterers) or shredders (herbivores feeding on filamentous algae). The dominant herbivores in dredge samples were usually Tanytarsus, Glyptotendipes and Chironomus (Table 26).

83. Mean values for density, number of taxa, species diversity and equitability by station and date for dredge samples appear in Table 27. Considerable variability occurred in these samples between stations, seasons and years for each variable. Seasonal density for the 1980-81 year varied from a low of 22 organisms/0.09 m^2 at station 10 during the spring to a high of 548 organisms/0.09 m^2 at station 9 during the summer (Table 27). Data on macroinvertebrate density for each dredge sample by station and date appear in Appendix Tables 6-9.

Artificial Substrate (Plate) Samples

84. A total of 52 taxa were identified from the Hester-Dendy multiple plate samplers used in the littoral areas of West Point Lake.

85. Thirty-two of these taxa were members of the Family Chironomidae. Data on macroinvertebrate density for each station and date collected from the plate samplers are presented in Appendix Tables 9-12. Five groups of macroinvertebrates numerically dominated the benthos from plate samples. These groups included: Nematoda, Oligochaeta, Cladocera, Trichoptera and Chironomidae (Table 28). Of these groups cladocerans and chironomids dominated collections on most dates. Two families of oligochaetes were identified as in the dredge samples, Naididae and Tubificidae. However, Naididae comprised most of the oligochaetes identified.

86. The chironomid fauna identified from plate samples was dominated by genera that were collectors and/or shredders. These genera

Table 25

Percent composition of the ten numerically dominant macroinvertebrate groups collected from dredge samples in West Point Lake between 1977 and 1981.

Taxon	Winter	Spring				Summer				Fall				Winter			
	1977	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981
Nematoda	0.3	T[1]	0.8	4.6	3.3	0.2	2.4	5.1	11.4	0.5	0.9	1.9	-[2]	0.4	0.3	1.5	-[2]
Oligochaeta	25.8	60.6	37.8	71.8	28.4	56.4	39.4	44.6	29.1	63.5	80.3	75.0	-	46.2	40.8	47.8	-
Cladocera	1.8	0.6	0.4	0.5	1.1	0.6	2.4	2.5	3.4	0.2	0.3	0.3	-	1.5	3.4	1.1	-
Copepoda	14.8	11.8	1.8	0.6	9.6	8.3	5.4	2.3	6.3	4.5	0.2	0.8	-	10.3	7.7	3.8	-
Ephemeroptera	3.0	T	0.4	0.6	0.8	0.6	T	1.2	0.1	0.5	2.8	1.6	-	0.8	1.7	1.0	-
Trichoptera	4.0	0.2	0.8	0.6	T	0.6	1.4	0.4	0.7	0.2	0.1	0.4	-	0.2	0.8	0.1	-
Chironomidae	47.6	22.6	41.2	16.2	43.9	15.9	49.4	41.4	46.8	17.6	13.3	10.9	-	35.5	23.6	26.5	-
Chaoborinae	0.5	3.2	8.2	0.1	0.2	16.8	T	0.1	0.7	12.1	T	1.9	-	1.1	1.3	0.6	-
Ceratopogonidae	0.2	0.3	4.5	2.4	5.2	0.4	T	1.1	0.3	0.4	0.8	1.3	-	2.0	2.8	0.9	-
Pelecypoda	0.1	T	0.0	1.4	5.5	T	T	0.4	0.5	0.4	0.5	5.4	-	1.7	15.5	16.1	-

[1]T denotes trace (<0.1).

[2]Samples collected but not yet processed.

Table 26

Percent composition of the nine dominant genera of the family Chironomidae collected from dredge samples from 1977 through 1981.

Taxon	Winter	Spring				Summer				Fall				Winter			
	1977	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981
Chironomus	7.3	11.5	20.9	2.8	4.8	2.8	5.2	2.2	0.5	1.9	0.0	0.0	-[1]	47.3	15.5	37.1	-[1]
Cladotanytarsus	0.0	0.0	0.0	9.1	31.1	0.0	5.5	6.7	2.4	0.0	0.3	11.0	-	0.0	2.1	0.0	-
Coelotanypus	0.0	0.0	14.0	0.0	3.7	0.0	0.2	0.0	0.0	0.0	0.3	6.9	-	18.6	5.3	4.4	-
Cryptochironomus	19.2	11.5	0.0	12.2	14.6	15.4	12.7	11.7	14.6	24.0	52.7	15.7	-	10.4	16.9	25.3	-
Glyptotendipes	42.2	12.1	9.4	2.3	4.7	20.5	19.1	3.6	8.5	21.9	19.0	3.9	-	9.0	1.2	4.7	-
Parachironomus	0.0	0.0	0.0	0.0	0.0	0.0	2.9	12.1	0.0	0.0	2.0	2.8	-	0.0	29.7	3.6	-
Polypedilum	0.0	0.0	2.7	37.0	4.1	0.0	6.4	5.9	16.6	0.0	4.2	0.5	-	1.6	4.4	1.2	-
Procladius	14.6	19.0	29.5	3.5	7.9	20.9	11.4	2.9	17.4	4.1	2.8	22.4	-	3.1	11.8	1.6	-
Tanytarsus	6.4	12.8	10.1	24.0	16.3	16.7	25.8	37.6	7.9	11.6	7.9	10.8	-	0.0	7.2	7.0	-

[1] Fall and winter samples have been collected but not yet processed.

Table 27

Mean density, number of taxa, diversity ($\bar{d}$) and equitability (e) of macroinvertebrates collected from dredge samples for each sampling period between 1978 and 1981.

Station	Season	Organisms/0.09 m²				Number of Taxa				Species Diversity				Equitability			
		1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981	1978	1979	1980	1981
1	Fall	57	82	81	-[1]	9	16	11	-	2.59	2.96	1.69	-	0.96	0.69	0.36	-
	Winter	113	377	324	-	10	10	18	-	2.32	2.54	2.96	-	0.70	0.80	0.61	-
	Spring	97	233	50	92	15	13	10	22	3.33	3.32	2.44	3.94	0.99	1.08	0.70	1.00
	Summer	238	214	326	78	10	18	15	20	1.32	3.27	2.60	2.68	0.30	0.78	0.53	0.45
	$\bar{X}$	126	227	195	85	11	14	14	21	2.39	3.02	2.42	3.31	0.74	0.84	0.55	0.73
2	Fall	143	48	88	-	8	11	9	-	1.61	2.53	1.63	-	0.60	0.91	0.44	-
	Winter	147	353	184	-	8	20	16	-	1.99	3.23	1.76	-	0.62	0.70	0.33	-
	Spring	313	180	35	70	13	12	13	14	2.59	2.45	3.16	2.56	0.75	0.58	1.00	0.57
	Summer	229	211	251	97	10	22	24	16	1.86	3.30	3.89	3.48	0.68	0.64	0.92	1.00
	$\bar{X}$	208	198	140	84	10	16	16	15	2.01	2.88	2.61	3.02	0.66	0.71	0.67	0.79
3	Fall	225	320	104	-	9	8	8	-	2.11	1.96	0.86	-	0.73	0.62	0.25	-
	Winter	163	423	194	-	10	20	14	-	2.94	3.17	2.33	-	1.10	0.65	0.50	-
	Spring	252	252	583	165	11	16	17	17	2.17	3.61	1.83	3.37	0.62	1.13	0.29	0.88
	Summer	212	202	311	170	12	19	25	24	2.61	3.47	3.09	3.81	0.77	0.84	0.48	0.83
	$\bar{X}$	213	299	298	168	11	16	16	21	2.46	3.05	2.03	3.59	0.81	0.81	0.38	0.86
4	Fall	811	94	221	-	10	9	11	-	1.57	1.92	1.48	-	0.35	0.51	0.36	-
	Winter	238	287	62	-	11	19	8	-	2.98	2.86	1.43	-	1.00	0.53	0.38	-
	Spring	322	202	55	28	12	12	8	12	2.42	2.97	1.32	3.11	0.64	0.92	0.38	1.00
	Summer	137	187	87	212	10	18	17	22	1.98	3.48	3.16	2.91	0.55	0.89	0.76	0.45
	$\bar{X}$	377	193	106	120	11	15	11	17	2.24	2.81	1.85	3.01	0.64	0.71	0.47	0.73
5	Fall	207	85	150	-	9	12	12	-	1.72	2.12	1.25	-	0.60	0.50	0.25	-
	Winter	89	676	121	-	9	16	12	-	2.13	2.09	2.47	-	0.67	0.38	0.67	-
	Spring	392	284	102	82	13	13	17	14	2.00	3.13	2.72	0.56	0.50	0.92	0.53	0.14
	Summer	198	168	581	323	9	19	19	24	1.47	3.28	2.62	3.32	0.37	0.78	0.42	0.58
	$\bar{X}$	219	303	239	203	10	15	15	19	[illegible]	2.66	2.27	1.94	0.54	0.65	0.47	0.36
6	Fall	183	113	153	-	6	6	9	-	2.10	1.65	1.01	-	0.74	0.67	0.25	-
	Winter	366	316	251	-	12	22	14	-	2.26	3.20	2.29	-	0.50	0.59	0.43	-
	Spring	509	138	68	60	16	11	15	17	2.65	2.60	2.94	[illegible]	0.54	0.73	0.73	1.00
	Summer	294	208	201	60	9	17	16	19	1.56	2.77	2.77	3.42	0.48	0.59	0.56	0.79
	$\bar{X}$	338	194	168	60	11	14	13	18	2.14	2.56	2.25	3.49	0.57	0.65	0.49	0.90

Table 27, continued

Station	Season	Organisms/0.09 m^2 1978	1979	1980	1981	Number of Taxa 1978	1979	1980	1981	Species Diversity 1978	1979	1980	1981	Equitability 1978	1979	1980	1981
7	Fall	262	215	185	-	6	8	5	-	1.11	1.34	0.43	-	0.41	0.38	0.20	-
	Winter	133	646	130	-	11	19	6	-	2.30	3.59	1.65	-	0.64	0.89	0.67	-
	Spring	257	415	551	44	18	8	12	16	2.74	0.95	1.79	3.65	0.56	0.25	0.33	1.12
	Summer	183	295	254	183	9	17	20	21	1.87	2.53	2.33	3.31	0.51	0.47	0.35	0.67
	$\bar{X}$	209	393	280	164	11	13	11	19	2.01	2.10	1.55	3.48	0.53	0.50	0.39	0.90
8	Fall	269	259	149	-	5	11	14	-	1.21	2.31	2.02	-	0.40	0.64	0.36	-
	Winter	378	257	231	-	10	17	15	-	2.47	3.21	2.69	-	0.80	0.76	0.60	-
	Spring	368	170	416	99	16	9	11	14	2.83	2.57	1.70	2.65	0.88	0.89	0.36	0.64
	Summer	182	732	338	314	10	18	21	21	2.34	3.06	3.35	3.72	0.73	0.67	0.67	0.90
	$\bar{X}$	299	355	284	207	10	14	15	18	2.21	2.79	2.43	3.19	0.70	0.74	0.50	0.77
9	Fall	357	505	163	-	9	7	11	-	1.93	1.36	1.32	-	0.59	0.43	0.27	-
	Winter	460	406	79	-	9	21	9	-	1.77	2.34	1.20	-	0.44	0.33	0.22	-
	Spring	476	875	81	66	15	11	11	14	2.59	2.50	1.92	2.69	0.59	0.73	0.45	0.64
	Summer	84	357	548	330	10	16	21	27	2.55	3.48	2.99	3.81	0.87	1.00	0.52	0.74
	$\bar{X}$	345	536	218	198	11	14	13	21	2.21	2.42	1.86	3.25	0.62	0.62	0.37	0.69
10	Fall	265	287	99	-	9	9	18	-	1.18	0.62	2.56	-	0.23	0.22	0.44	-
	Winter	112	254	100	-	2	19	4	-	0.34	3.39	1.23	-	0.50	0.79	0.75	-
	Spring	465	154	136	22	10	4	7	11	1.10	1.40	0.71	2.80	0.27	0.75	0.29	0.92
	Summer	294	500	163	181	10	14	15	18	1.52	2.73	2.84	3.28	0.51	0.64	0.67	0.78
	$\bar{X}$	284	299	125	102	8	12	11	15	1.04	[illegible]	[illegible]	3.04	.38	0.60	0.54	0.85
11	Fall	159	389	129	-	9	10	9	-	1.75	0.83	2.20	-	0.47	0.20	0.67	-
	Winter	115	270	94	-	6	10	13	-	1.68	2.51	2.34	-	0.67	0.80	0.54	-
	Spring	229	426	139	75	8	9	16	25	1.56	1.98	2.40	3.90	0.55	0.56	0.44	0.58
	Summer	479	779	263	217	7	10	20	26	1.65	1.73	3.13	3.58	0.60	0.40	0.60	0.87
	$\bar{X}$	246	466	156	146	8	10	15	23	1.66	1.76	2.52	3.74	[illegible]	0.49	0.56	0.87
12	Fall	127	153	137	-	3	6	3	-	[illegible]	1.02	0.07	-	.38	0.33	0.33	-
	Winter	33	356	39	-	4	2	10	-	1.69	3.44	2.48	-	1.0	1.00	0.80	-
	Spring	253	25	81	53	6	2	6	11	0.79	1.63	0.78	1.55	0.34	1.00	1.00	0.45
	Summer	90	134	165	101	4	3	9	9	0.75	0.62	1.65	0.87	0.43	0.67	0.44	0.22
	$\bar{X}$	136	167	106	77	4	3	7	10	0.92	0.68	1.25	1.35	[illegible]	0.75	0.64	0.34

[1] Samples collected but not yet processed from fall and winter, 1981.

Table 28

Percent composition of the major groups of organisms collected from plate samples from 1979 through 1981.

	Spring			Summer			Fall			Winter		
	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
Nematoda	6.7	0.2	T[1]	0.2	0.1	0.2	T	0.5	-[2]	1.6	T	T
Oligochaeta	0.0	13.9	0.7	7.2	0.7	T	T	0.8	-	19.0	1.5	6.7
Cladocera	71.2	3.5	88.8	0.3	50.4	0.3	84.3	80.0	-	56.0	95.7	82.3
Copepoda	0.0	0.2	0.0	T	T	T	0.0	T	-	0.0	T	T
Ephemeroptera	0.0	0.2	0.0	0.0	T	0.3	T	T	-	0.2	0.0	0.0
Trichoptera	0.6	0.9	T	5.3	22.2	17.9	2.2	2.3	-	0.0	T	0.2
Chironomidae	21.5	79.9	10.4	85.4	25.8	79.3	13.4	16.2	-	22.0	2.5	9.6
Ceratopogonidae	0.0	0.1	T	0.0	0.0	0.2	0.0	0.0	-	0.0	0.0	0.0
Gastropoda	0.0	0.1	T	0.7	0.0	T	0.0	T	-	0.0	0.0	0.2

[1] T denotes trace (<0.1).

[2] Samples collected but not yet processed.

feed either by gathering, filtering, shredding, or a combination of these methods. Most sampling periods were dominated by two genera: Glyptotendipes and Dicrotendipes. However, at certain times Psectrocladius, Cricotopus and Rheotanytansus were collected in large numbers. The only predator collected was Ablabesmyia (Table 29).

87. Mean values for density, number of taxa, species diversity and equitability by station and date for plate samples appear in Table 30. No data was collected from four stations (3, 5, 7 and 10) during the spring of 1981 due to loss of plate samplers. However, mean density at the other seven stations throughout the lake was higher during the spring, 1981 than the other sampling periods (Table 30). Seasonal density for the 1980-81 year ranged from a low of 6 organisms/0.09 m^2 at station 3 during the winter to a high of 7,048 organisms/0.09 m^2 at station 8 during the spring. Data on macroinvertebrate density for each plate sample by station and date appear in Appendix Tables 10-13.

88. A comparison of macroinvertebrate density at selected stations in West Point Lake appears in Figure 15. Average density during the year varied from about 100 to 2,600 organisms/0.09 m^2 in plate collections throughout the lake. Dredge collections ranged between 100 and 200 organisms/0.09 m^2 and were less variable than plate collections. The benthic macroinvertebrate communities in West Point Lake varied considerably between seasons. In general though, the same groups of organisms dominated samples each season (Table 31).

Macroinvertebrate Diversity and Equitability

89. Fall dredge collections during 1980-81 had lower average diversity values than any other season (Table 28). These values ranged from a low of 0.07 at station 12 to a high of 2.56 at station 10. Species diversity at station 12 in the headwaters of the reservoir was low because of the large number of oligochaetes in the sample and only three different taxa were identified. However, the equitability value calculated for the fall sample at station 12 was 0.33, which is not indicative of environmental stress. Generally in West Point Lake, values for density, number of taxa and diversity of dredge samples at station 12 average lower than other locations.

90. Winter and spring plate collections in 1980-81 had lower average diversity values than any other season (Table 31). These values ranged from a low of 0.08 at station 6 to a high of 1.66 at station 8. Species diversity at station 6 in Wehadkee Creek was low because of the large number of cladocerans in the sample even though 17 different taxa were identified.

91. Data on species diversity and number of taxa for selected stations in the reservoir are presented in Figure 16. These data illustrate the more variable nature of plate collections compared with the dredge samples.

Table 29

Percent composition of the major genera of the family Chironomidae collected from plate samples from 1979 through 1981.

Taxon	Spring			Summer			Fall			Winter		
	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
Ablabesmyia	1.8	6.5	0.3	4.1	10.7	8.3	0.6	1.8	-[1]	0.0	0.8	0.0
Cricotopus	0.2	0.0	1.5	0.2	0.0	0.0	0.5	0.1	-	57.5	2.6	44.9
Dicrotendipes	51.9	2.5	23.6	16.7	42.9	13.9	42.6	34.6	-	5.5	6.1	3.4
Glyptotendipes	31.6	45.2	66.7	59.2	34.3	70.2	49.4	58.0	-	4.0	21.2	29.3
Psectrocladius	0.5	37.0	T[2]	1.1	2.3	0.2	0.7	T	-	4.2	48.0	11.3
Rheotanytarsus	2.7	0.0	T	0.0	0.0	0.0	0.2	0.0	-	14.4	5.1	0.0

[1] Samples collected but not yet processed.

[2] T denotes trace (<0.1).

Table 30

Mean density, number of taxa, diversity ($\bar{d}$) and equitability (*e*) of macroinvertebrates collected on plate samplers for each sampling period during 1979 through 1981.

Station	Season	Organisms/0.09 m^2			Number of Taxa			Species Diversity			Equitability		
		1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
1	Fall	890	162	-[1]	18	16	-	2.22	2.65	-	0.33	0.56	-
	Winter	183	175	25	3	10	8	1.48	0.25	1.60	1.08	0.10	0.50
	Spring	1036	14	396	5	11	8	0.87	2.28	1.33	0.61	0.64	0.38
	Summer	233	306	142	11	15	17	2.04	2.16	1.70	0.50	0.40	0.24
2	Fall	822	357	-	11	18	-	1.51	2.75	-	0.36	0.50	-
	Winter	82	90	57	2	2	10	0.80	0.15	0.77	1.17	0.50	0.20
	Spring	1951	12	1394	5	10	11	0.64	1.96	0.96	0.43	0.50	0.18
	Summer	98	441	13	8	13	10	2.04	1.47	2.68	0.75	0.23	0.90
3	Fall	266	180	-	7	15	-	1.44	2.46	-	0.43	0.53	-
	Winter	151	128	6	3	4	4	1.31	0.10	0.82	1.00	0.25	0.50
	Spring	374	-[2]	-	4	-	-	0.78	-	-	0.71	-	-
	Summer	93	263	78	10	14	14	2.44	2.30	1.80	0.79	0.50	0.38
4	Fall	298	233	-	9	16	-	2.04	2.47	-	0.56	0.50	-
	Winter	257	162	23	3	5	7	0.84	0.19	1.17	0.94	0.20	0.43
	Spring	2329	18	834	8	9	8	1.04	1.88	1.56	0.33	0.56	0.50
	Summer	194	175	269	8	9	15	2.06	1.49	1.56	0.78	0.33	0.27
5	Fall	1258	341	-	7	10	-	0.83	2.05	-	0.29	0.50	-
	Winter	90	103	45	2	5	9	0.61	0.15	0.81	0.83	0.20	0.22
	Spring	1828	-	-	4	-	-	0.34	-	-	0.25	-	-
	Summer	85	116	112	10	10	15	2.41	1.17	2.11	0.75	0.30	0.40

Table 30, continued

Station	Season	Organisms/0.09 m^2			Number of Taxa			Species Diversity			Equitability		
		1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
6	Fall	1895	4609	-	10	16	-	0.39	0.49	-	0.10	0.12	-
	Winter	1526	418	208	3	8	10	0.34	0.21	0.61	0.50	0.13	0.20
	Spring	2960	58	5077	2	16	17	0.31	2.73	0.08	0.61	0.56	0.06
	Summer	204	115	186	6	14	26	2.17	2.48	1.72	1.25	0.57	0.15
7	Fall	220	-	-	12	-	-	2.02	-	-	0.42	-	-
	Winter	194	127	-	2	2	-	0.53	0.24	-	0.88	0.50	-
	Spring	452	35	-	4	8	-	0.71	2.28	-	0.67	0.87	-
	Summer	334	209	206	6	11	17	1.96	1.28	2.74	0.84	0.27	0.53
8	Fall	2518	-	-	10	-	-	0.39	-	-	0.10	-	-
	Winter	149	187	19	2	6	8	0.77	0.12	1.66	1.00	0.17	0.50
	Spring	2224	58	7048	8	8	11	1.50	1.39	0.53	0.50	0.37	0.16
	Summer	981	607	742	7	7	14	1.62	1.92	0.85	0.61	0.29	0.14
9	Fall	1994	5199	-	9	20	-	0.41	0.93	-	0.22	0.10	-
	Winter	900	113	29	2	10	5	0.69	0.50	0.61	1.11	0.20	0.40
	Spring	4936	60	1001	8	11	11	1.59	2.07	1.33	0.55	0.55	0.27
	Summer	698	128	196	8	20	18	1.53	2.99	2.55	0.54	0.55	0.44
10	Fall	173	87	-	14	10	-	0.77	2.77	-	0.14	0.90	-
	Winter	699	34	19	6	8	6	1.98	2.00	1.48	0.88	0.63	0.68
	Spring	386	34	-	4	10	-	1.34	2.12	-	0.67	0.60	-
	Summer	955	368	212	8	12	12	1.76	2.32	2.35	0.65	0.58	0.58
11	Fall	-	-	-	-	-	-	-	-	-	-	-	-
	Winter	168	16	-	3	6	-	1.29	1.71	-	1.14	0.67	-
	Spring	74	11	323	3	5	13	0.99	1.68	1.49	1.00	0.80	0.31
	Summer	-	657	261	-	15	12	-	1.09	2.07	-	0.13	0.50

[1] Samples collected but not yet processed from fall, 1981.
[2] Missing data.

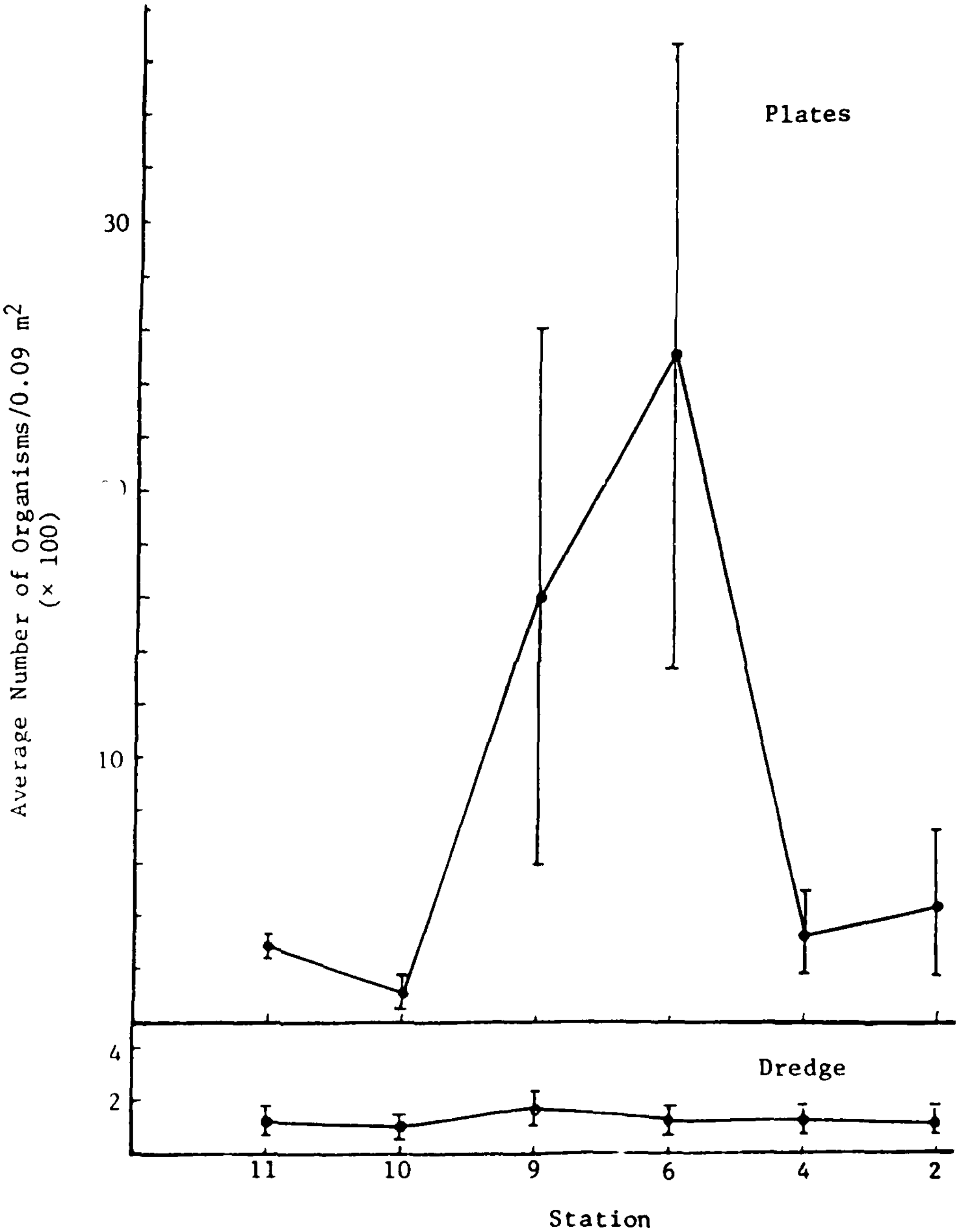


Figure 15. Average density (organisms/0.09 m^2) for plate and dredge samples at selected stations in West Point Lake during 1980-81. Vertical bars are the standard errors.

Table 31

Percent composition of the benthic macroinvertebrates that dominated dredge and plate sample collections the last three years in West Point Lake.

	Spring			Summer			Fall			Winter		
	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
	Percent Composition											
Dredge Samples												
Oligochaeta	37.8	71.8	28.4	39.4	44.6	29.1	80.3	75.0	--*	40.8	47.8	--
Copepoda	1.8	0.6	9.6	5.4	2.3	6.3	0.2	0.8	--	7.7	3.8	--
Chironomidae	41.2	16.2	43.9	46.3	41.4	46.8	13.3	10.9	--	23.6	26.5	--
Others	19.2	11.4	18.1	8.9	11.7	17.8	6.2	13.3	--	27.9	22.7	--
Plate Samples												
Cladocera	71.2	3.5	88.8	0.3	50.4	0.3	84.3	80.0	--	56.0	95.7	--
Chironomidae	21.5	79.9	10.4	85.4	25.8	79.3	13.4	16.2	--	22.0	2.5	--
Others	7.3	16.6	0.8	14.3	23.8	20.4	2.3	3.8	--	22.0	1.8	--

*Samples collected but not yet processed; to be included in later report.

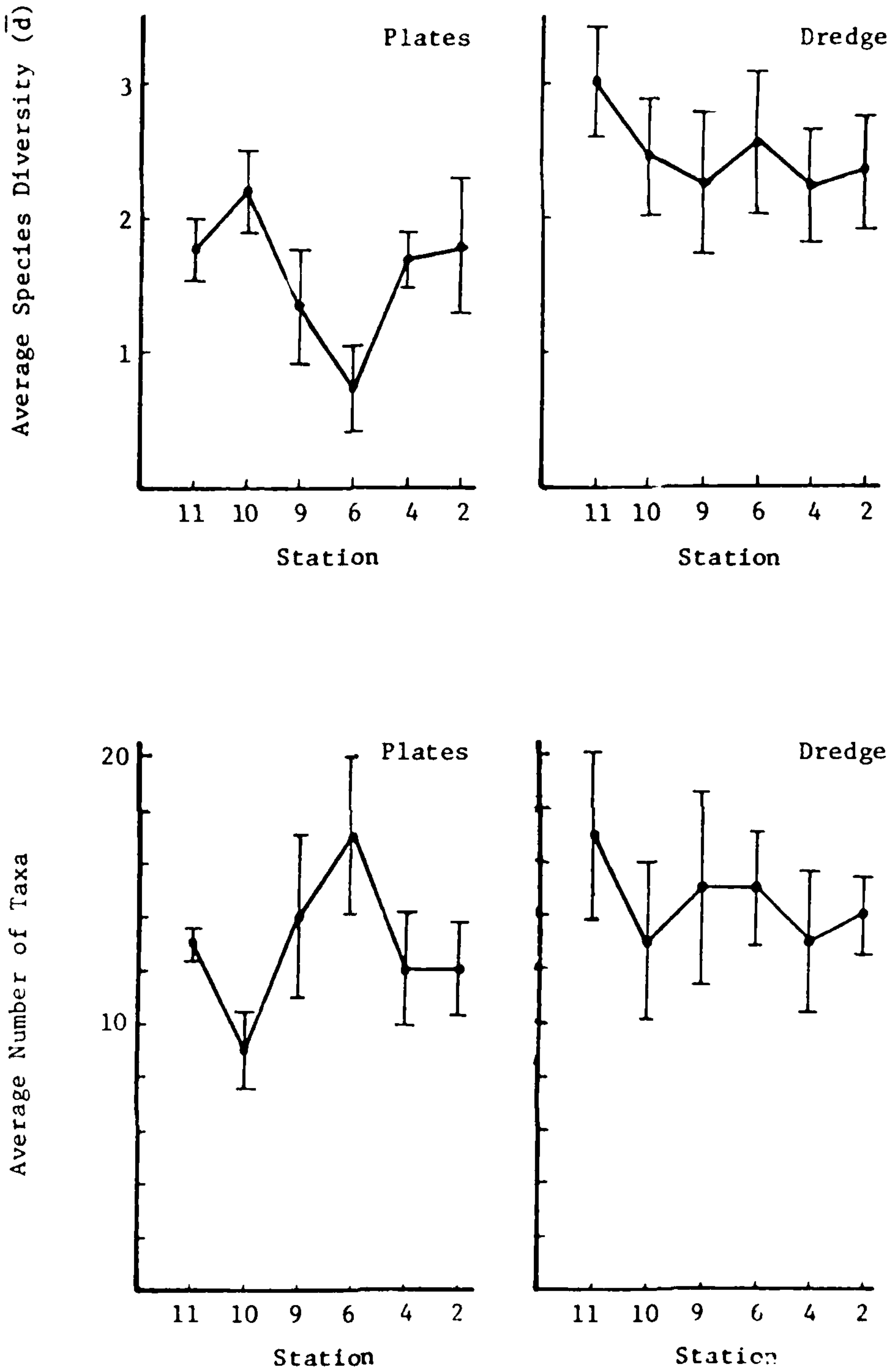


Figure 16. Average species diversity ($\bar{d}$) and number of taxa for plate and dredge samples at selected stations in West Point Lake during 1980-81. Vertical bars are the standard errors.

Limnological Discussion

Plankton

Phytoplankton/Chlorophyll Relationships

92. Phytoplankton standing crops were higher during the current sample year than the previous year. The 1980-81 mean was 2,938 organisms/ml compared to 1,585 organisms/ml in 1979-80. The current annual mean density more closely approximated means from 1976-77 (3,272 organisms/ml), 1977-78 (2,222 organisms/ml), and 1978-79 (2,268 organisms/ml) (Davies et al. 1979, Bayne et al. 1980 and Shelton et al. 1981).

93. Winter and summer standing crops were more than three times greater this year than 1979-80 (Table 6). This difference resulted from increases in all three major algal divisions: Chrysophyta, Chlorophyta and Cyanophyta. This increase in phytoplankton density should have a positive effect on the fishery because of the typical plankton feeders in West Point Lake.

94. Phytoplankton biomass measured by chlorophyll a concentrations were also higher this year than 1979-80 values. The annual mean of 13.3 mg/m^3 was the highest measured during the last five years.

95. The upper, lotic reaches of the reservoir at station A had the lowest phytoplankton density while the more lentic reaches at stations B, C, D, F and G had much higher standing crops of phytoplankton (Table 5). The lentic areas of West Point Lake (stations B, C, D, F and G) typically had lower turbidity in the photic zone on dates plankton was sampled (Appendix Table 3). As expected, chlorophyll measurements in lentic areas of the lake averaged higher than values at station A (Tables 8, 9 and 10). Chlorophyll a concentrations exhibited a significant positive correlation with phytoplankton density ($r = 0.45$; $p < 0.0001$) and a negative correlation with turbidity ($r = -0.35$; $p < 0.0001$).

96. Environmental factors that seem to contribute to phytoplankton blooms in West Point Lake continue to be high water temperatures, reduced water flow through the reservoir, low turbidities in the photic zone and higher solar radiation (Shelton et al. 1981). Flow of water through the lake during 1980-81 was less than any previous year (Davies et al. 1979, Bayne et al. 1980, Shelton et al. 1981, Lawrence et al. 1982). Physical variables measured during August were conducive to high phytoplankton densities: water temperatures averaged 28 to 30oC throughout the photic zone, flow through of water was low (2,685 cfs), turbidity averaged less than eight JTU's in the photic zone and solar radiation was high at 12,207 Langleys (Appendix Table 1).

Primary Productivity

97. Seasonal estimates of primary productivity differed from the previous year especially in June and September (Table 13). Productivity in September (570.4 mg C/m^2/day) was less than half of values measured the previous year (1,160.6 mg C/m2/day). Productivity estimates the last five years continue to exhibit the same seasonal trends: 1) lower values during the winter and spring when water temperatures are cooler and turbidity higher in the photic zone; 2) higher values during the summer and fall when water temperatures are warmer and turbidity lower in the photic zone.

98. Measurements of primary productivity were significantly different ($p < 0.05$) between mainstream stations A, B, C and D. The lotic headwaters of the reservoir at station A had the lowest primary productivity while the middle reaches of the reservoir at station C had the highest productivity. Production estimates measured in Wehadkee and Yellowjacket Creeks also differed significantly ($p < 0.05$) for the year (Table 12 and Figure 11).

99. Primary productivity again exhibited a significant negative correlation with turbidity measurements in the photic zone ($r = -0.50$; $p < 0.05$). This correlation was expected since increased clay turbidity usually reduces standing crops of phytoplankton thus reducing primary productivity. Measurements of chlorophyll a standing crops were positively correlated ($r = 0.69$; $p < 0.01$) with productivity. It is interesting to note, however, that chlorophyll a standing crops were higher in August and September instead of June when productivity was highest.

100. Although phytoplankton density was greatest during August, primary productivity was highest in June. Since physical conditions in the lake were similar in June and August, except for solar radiation which reached an annual high of 16,776 Langleys in June, the community structure of phytoplankton populations in June may have been composed of more efficient photosynthesizers than in August. The higher average light intensity may also have contributed significantly to the higher June productivity. There was no simple connection between phytoplankton photosynthesis and phytoplankton biomass. Other researchers have found similar results and concluded that undetermined variables, such as the physiological state of the alga (e.g. = internal concentrations of elements such as nitrogen and phosphorous are probably critical), must have had considerable effects (Fogg 1975).

101. Estimated annual mean productivity for the reservoir (503.9 mg C/m^2/day) declined for the fourth consecutive year (Table 13). The decrease was not statistically significant ($p > 0.05$), but it continued a trend toward decreasing primary productivity with aging of the reservoir.

Organic Matter and Carbon

102. As in previous years (Davies et al. 1979, Bayne et al. 1980, Shelton et al. 1981, Lawrence et al. 1982), mean values for total suspended matter and particulate organic matter (POM) were usually higher in the upper reaches of the reservoir (Tables 14 and 15 and Figure 12). This was expected because of allochthonous input from the Chattahoochee River. A comparison of the two major arms of the lake, Wehadkee and Yellowjacket Creeks, showed differences with respect to the amount of suspended matter in the water. Values for total suspended matter averaged higher in Wehadkee Creek, but total organic carbon (TOC) values averaged higher in Yellowjacket Creek.

103. The TOC of reservoir waters at station A differed little from the TOC of waters released downstream from the dam at station E (Table 16). This continues to indicate the significant contribution the plankton community makes to the organic carbon load in the lake. However, TOC values were not correlated with variables like phytoplankton density and chlorophyll a concentrations. Also, TOC was negatively correlated with primary productivity ($r = -0.45$; $p < 0.05$). These data seem to indicate that changes in organic carbon in the reservoir were derived allochthonously within the catchment basin. This statement is also supported by the fact that TOC measurements were higher in the spring during heavy runoff periods than any other season (Table 16). The annual mean TOC of 7.79 mg/l for the current year was higher than that reported by Lawrence et al. (1982) for the previous four years.

104. Mean daily inflow and outflow through West Point Lake during all months except February, was lower than any previous year of the lake's impoundment. Water levels fluctuated less and there were no rapid variations in lake elevation. Littoral areas were exposed that normally would not be, even during winter drawdown. This may have resulted in more stirring of bottom muds (sediments still containing a sizable silt + organic detritus load) due to wave action. This type of action would be expected to raise TOC values in the lake.

Zooplankton

105. Zooplankton Abundance. Usually major changes in zooplankton standing crops in West Point Lake are due to shifts in the number of rotifers collected (Davies et al. 1979, Bayne et al. 1980, Shelton et al. 1981, Lawrence et al. 1982). The spatial and temporal differences in zooplankton density between stations this year were again due mainly to fluctuations in the number of rotifers collected in the samples (Tables 19 and 20). The factors that produce these fluctuations in rotifer abundance are difficult to detect on the basis of four quarterly samples.

106. Simple linear correlation analysis of zooplankton density in the reservoir with phytoplankton abundance, chlorophyll a standing crops (another measure of phytoplankton abundance), and turbidity (both biogenic and abiogenic) have resulted in significant correlations in past years (Davies et al. 1979, Bayne et al. 1980, Shelton et al. 1981, Lawrence et al. 1982). However, during 1980-81 there was no significant correlaion between zooplankton density and these three variables ($p > 0.05$). The lack of a significant correlation between zooplankton and phytoplankton density has occurred previously but this was the first year there has not been a significant negative (inverse) correlation between zooplankton density and turbidity. This was probably due to the lack of seasonal variation in abiogenic turbidity normally found in West Point Lake. Variations in abiogenic turbidity were minimized during 1980-81 because of drought conditions that limited sediment laden runoff waters entering the lake. Except for station A, photic zone turbidities remained consistently low throughout the year (Appendix Table 3).

107. The mean of the four quarterly samples was lower than any previous year (Table 24). This continued an apparent trend toward an overall decrease in zooplankton density in the lake. If the decrease in density is real and not a product of the limited sampling program, then it may reflect a response of the zooplankton community to changes in environmental variables (e.g., food availability or grazing pressure) typical in an aging reservoir.

108. Zooplankton Dominance. Limnetic zooplankton communities in West Point Lake were again dominated by rotifers (Table 20). Copepods and cladocerans were the other two important groups. Several species of rotifers were numerically dominant depending on the location and date. Typical examples of these rotifers include *Synchaeta* sp., *Polyarthra vulgaris*, and *Brachionus caudatus*. Immature nauplii dominated copepod populations on every date. Cladocerans were dominated on most dates by *Bosmina longirostris* (Table 21).

109. Zooplankton Diversity and Equitability. Even though statistically significant differences existed in the number of taxa, species diversity, and equitability of the quarterly zooplankton samples collected during the last five years, no clear trend was observed with respect to these populations (Table 24). Aside from an increase in the mean number of taxa and lower equitabilities, counting 300 organisms/sample as procedure dictated in 1978-79 and 1979-80 provided no important additional information beyond that gained from counting 100 organisms/sample.

Benthic Macroinvertebrates

Community Structure

110. The benthic macroinvertebrate fauna of the reservoir was dominated by aquatic earthworms (Oligochaeta), water fleas (Cladocera)

and midges (Chironomidae). Other groups that comprised from 1 to 28% of the macroinvertebrate community, depending on the season and type of sample, were nematodes (Nematoda), copepods (Copepoda), mayflies (Ephemeroptera), caddisflies (Trichoptera), phantom midges (Chaoboridae), biting midges (Ceratopogonidae), and mollusks (Gastropoda and Pelecypoda).

111. As expected, community structure of the macroinvertebrate fauna varied somewhat between the bottom (dredge) samples and the plate samples since the two methods sample different habitats. On most dates bottom samples were dominated by oligochaetes and chironomids while plate samples were dominated by cladocerans and chironomids.

112. Dredge and plate samples were collected in littoral (shoreline) and sublittoral zones of the lake. However in a reservoir like West Point, shoreline areas have little, if any, aquatic vegetation because of significant water level fluctuations. Therefore, the demarcation between littoral, sublittoral and deeper profundal zones is not as sharp.

113. The benthic fauna in profundal zones of lakes is usually dominated by two groups of invertebrates, chironomids and oligochaetes (Wetzel 1975). These two macroinvertebrate groups dominated dredge samples taken from the littoral areas in West Point Lake. The percentage composition of the benthic fauna that chironomids and oligochaetes comprised in the lake was similar to data presented by Wetzel (1975) for eutrophic lakes.

114. Another difference in macroinvertebrate collections was the percentage composition of the two oligochaete families from dredge and plate samples. Dredge samples consisted mostly of tubificids while plate samples contained mostly naidids (Appendix Tables 5-12). Wetzel (1975) pointed out that oligochaete species are separated within the bottom sediments. Naidid oligochaetes concentrate at the sediment-water interface, seldom deeper than 2 to 4 cm below the surface. Tubificid oligochaetes are most dense between 2 to 4 cm of sediment depth. This might explain why the oligochaetes on plate samplers were mainly naidids since they would be more likely to swim up into the water column where the samplers were suspended.

115. A notable feature of cladoceran zooplankton is their daily vertical migrations over large distances (Wetzel 1975). Also, plate samplers provide a protective surface from fish predation. The migrations plus protectin may explain the large number of cladocera collected on the plates. Another interesting feature of the plate collections was the ratio of cladocerans to chironomids. When one of these groups comprised more than 50% of the sample, the other group made up 25% or less (Table 31).

Trophic Relationships

116. The feeding relationships discussed here center on the principal invertebrate groups collected: oligochaetes, chironomids, and cladocerans. Understanding the food habits of these invertebrates also provides insight into the trophic status of the lake.

117. The majority of aquatic oligochaetes feed by ingesting substrate material, the organic component being digested as it passes through the gut. Under some circumstances the food may consist largely of filamentous algae, diatoms, or miscellaneous plant and animal detritus (Pennak 1978).

118. Cladocera filter food particles from the water by the use of their highly setose thoracic legs. Chief food items are algae, protozoa, organic detritus and bacteria (Pennak 1978). These types of food items comprised the periphytic community on the plate samplers so it was not surprising that cladocerans were so numerous in most of these collections.

119. Trophic relationships of the chironomid fauna from dredge samples were more diverse than those from plate samples. Approximately half of the genera from the dredge samples were engulfers, predators on rotifers, microcrustacea or other chironomids. Merritt and Cummins (1978) classify the following genera (common in dredge samples) as predators: Coelotanypus, Procladius, Cryptochironomus and Parachironomus. Remaining chironomid genera were either collectors (gatherers or filterers) or shredders (herbivores feeding on filamentous algae). The dominant herbivores comprising the chironomid fauna in dredge samples were Tanytarsus, Glyptotendipes and Chironomus (Table 26).

120. Plate samples were dominated by chironomid genera that were collectors and/or shredders. These genera feed either by gathering, filtering, shredding, or a combination of these methods (Merritt and Cummins 1978). Two genera domminated on most dates: Glyptotendipes and Dicrotendipes. However, on selected dates Psectrocladius, Cricotopus and Rheotanytarsus comprised the largest percentage of the chironomid fauna. The only predator collected was Ablabesmyia (Table 29).

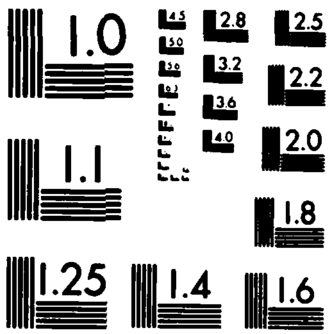
Macroinvertebrate Density

121. Dredge samples varied much less than plate collections throughout the lake (Figure 16). Differences in density from dredge samples was due mostly to variations in the number of oligochaetes collected. Plate sampler collections varied mainly because of occasional dense accumulations of cladocerans on the plates. This was especially true in both Wehadkee and Yellowjacket Creek (Figure 16).

AD-A149 945 FISHERIES AND LIMNOLOGICAL STUDIES ON WESTPPOINT RESERVOIR ALABAMA-GEORGI..(U) AUBURN UNIV ALA DEPT OF FISHERIES AND ALLIED AQUACULTURES W D DAVIES ET AL. DEC 84 COESAM/PDEE-84/010 DACW01-78-C-0082 F/G 8/8 2/2

UNCLASSIFIED NL

END



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Species Diversity

122. Another measure of the trophic status of the lake was based on species diversity and equitability values of benthic invertebrate communities. The lake was classified as oligotrophic, mesotrophic or eutrophic instead of clean, intermediate and mildly polluted, or highly enriched. Patrick (1970) and Ransom and Dorris (1972) utilized a similar classification since clean waters are typically characterized by large numbers of benthic species with few individuals per species (also typical of oligotrophic waters). High diversity and equitability would be expected from benthic collections in oligotrophic lakes. Lakes between the extremes of heavy pollution (eutrophic conditions) and clean water (oligotrophic conditions) often have intermediate diversity values. Low diversity values usually characterize benthic collections from heavily stressed waters.

123. Average species diversity of macroinvertebrate collections from West Point Lake indicate it should be classified as mesotrophic. Most of the mean diversity values were between one and three (Tables 27 and 30). Since the plate samplers are a less variable substrate than the natural lake bottom, species diversity of the benthic fauna from plate collections was lower than that from dredge samples (Figure 17). The average number of taxa collected from plate or dredge samples varied little between stations (Figure 17).

Fisheries Results and Discussion

Large Cove Sampling

124. Fish populations in coves on West Point Lake were sampled in April, June and August (4 coves each period) and provided an estimate of bias in determining standing stocks of important predator-prey species. Sampling during the April and June periods was funded by cooperating agencies (i.e., Alabama and Georgia Departments of Conservation and Natural Resources and Department of Fisheries and Allied Aquacultures, Auburn University) and will not be reported here. Table 32 summarizes standing stock estimates for the sampling period 1975-1981 and relates the results from repeatedly sampling the same coves (reference) to those chosen at random. The C.V.'s for "reference" compared to "random" sites are not different implying that there may not be a benefit (increased precision) from repeatedly sampling the same site.

125. Those fish recovered from the August sampling period (Table 33) represent 23 species. Of these, the largemouth bass, black crappie, bluegill, threadfin and gizzard shad will be discussed below.

Table 32

Standing stock estimates (kg/ha) for West Point Lake, Alabama-Georgia. Estimates are based on four large cove rotenone samples (0.5-1.7 ha) taken each year during July-August.

	Cove samples (group)						
Year	Reference (I)	Random (II)	Random (III)	Reference (IV)	Means	C.V. (%)	Total area (ha)
1975	282.1	762.3	325.5	189.5	389.8	65.2	2.84
1976	264.9	785.2	253.7	150.4	363.5	78.6	2.93
1977	356.0	2,854.5	317.4	209.7	934.4	137.1	1.92
1978	284.4	236.1	386.6	232.6	284.9	25.2	3.87
1979	865.6	1,079.9	314.6	125.6	596.4	75.4	2.67
1980	233.9	616.5	252.8	177.1	320.1	62.5	2.64
1981	271.9	2,899.7	400.0	359.0	982.7	130.2	2.23
Means	365.5	1,319.2	321.5	206.3	553.1		
C.V. (%)	64.7	82.9	17.9	36.9			

Table 33

Species presence in West Point Lake from large cove rotenone sampling, August 1981.

Species	August
Brown bullhead	X
Bluegill	X
Black crappie	X
Brook silversides	X
Bowfin	X
Channel catfish	-
Creek chubsucker	X
Chain pickerel	-
Common carp	-
Flier	X
Goldfish	-
Gizzard shad	-
Green sunfish	X
Golden shiner	X
Hybrid striped bass	X
Gambusia sp.	X
Largemouth bass	X
Undescribed redhorse	X
Notropis sp.	-
Redbreast sunfish	X
Redear sunfish	X
Snail bullhead	X
Spotted bass	X
Spotted sucker	-
Spotted sunfish	X
Swamp darter	-
Threadfin shad	X
White catfish	X
Warmouth	X
Yellow bullhead	X
Yellow perch	X
TOTAL	23

Gizzard Shad

126. The length frequency (inch versus cm grouping) distribution for gizzard shad from large cove rotenone sampling in August (Figure 17) shows three modes, representing the three age groups present. Note that inch grouping only demonstrates two, the first being young of the year, and the second consisting of 2+ and older fish.

127. Gizzard shad continue to represent a significant proportion of total standing stock (49.8%) in the August samples. Shad are obviously "stockpiling" as the total contribution of predators by weight to total standing stock in the system is relatively small. Shad will continue to dominate the dynamics of other fish populations (i.e., slow growth, low levels of recruitment) until their number (biomass) is reduced.

Bluegill

128. Bluegill biomass (7.4% of total standing stock) in West Point Lake is in effect limited by competition by gizzard shad (Davies et al. 1982. Growth of bluegill into the harvestable size range is slow and as a result spawning is limited to the extent that only a relatively few young of the year are produced in June.

129. Figure 18 illustrates the length frequency of bluegill (inch versus cm grouping) from the August cove sample. The modal length (cm grouping) at 4 cm represents those fish spawned in June while the mode at approximately 8 cm represents last year's fish. Relatively few fish of harvestable size ($\geq$ 15 cm) were present in the sample; those that were appeared to be in poor condition and of an age greater than 4+.

Threadfin Shad

130. Threadfin shad collected from large cove rotenone sampling represented 32% of the total standing stock. Compared to previous years this represents a significant recovery. The relatively mild winter permitted a large number of adults to survive and spawn (represented as the second modal group (cm) in Figure 19.

131. Shad are important to many species as prey. Black crappie and the hybrid striped bass select for young of year threadfin shad. These important sport species should show improved growth given the relative abundance of prey during 1981.

Black Crappie

132. Relatively few crappie were collected from cove sampling in 1981 (<1% of the total standing stock). Gill and trap netting in the

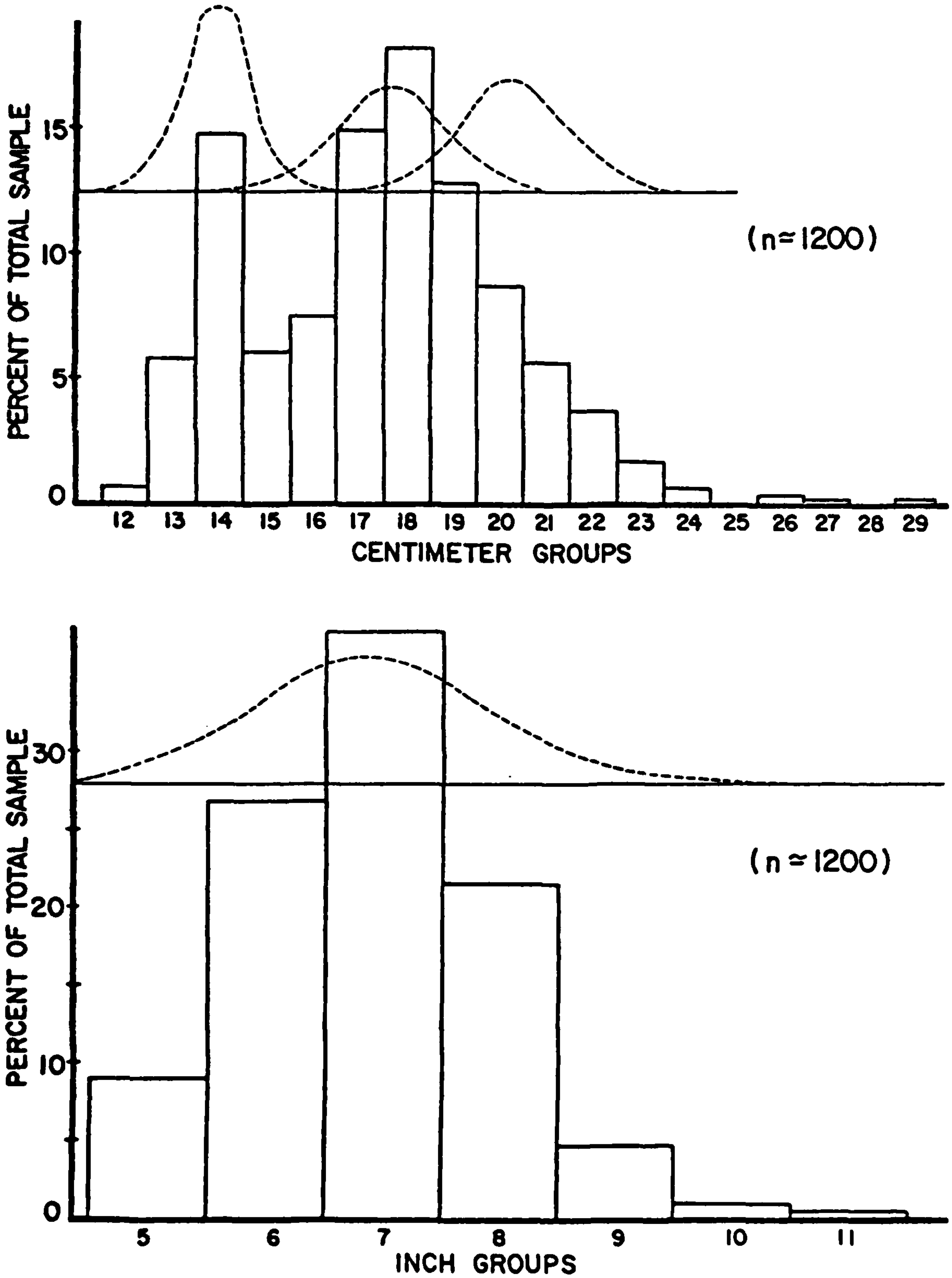


Figure 17. Gizzard shad centimeter and inch group length frequency distributions from West Point Lake in August 1981, and the age class curves estimated by computer.

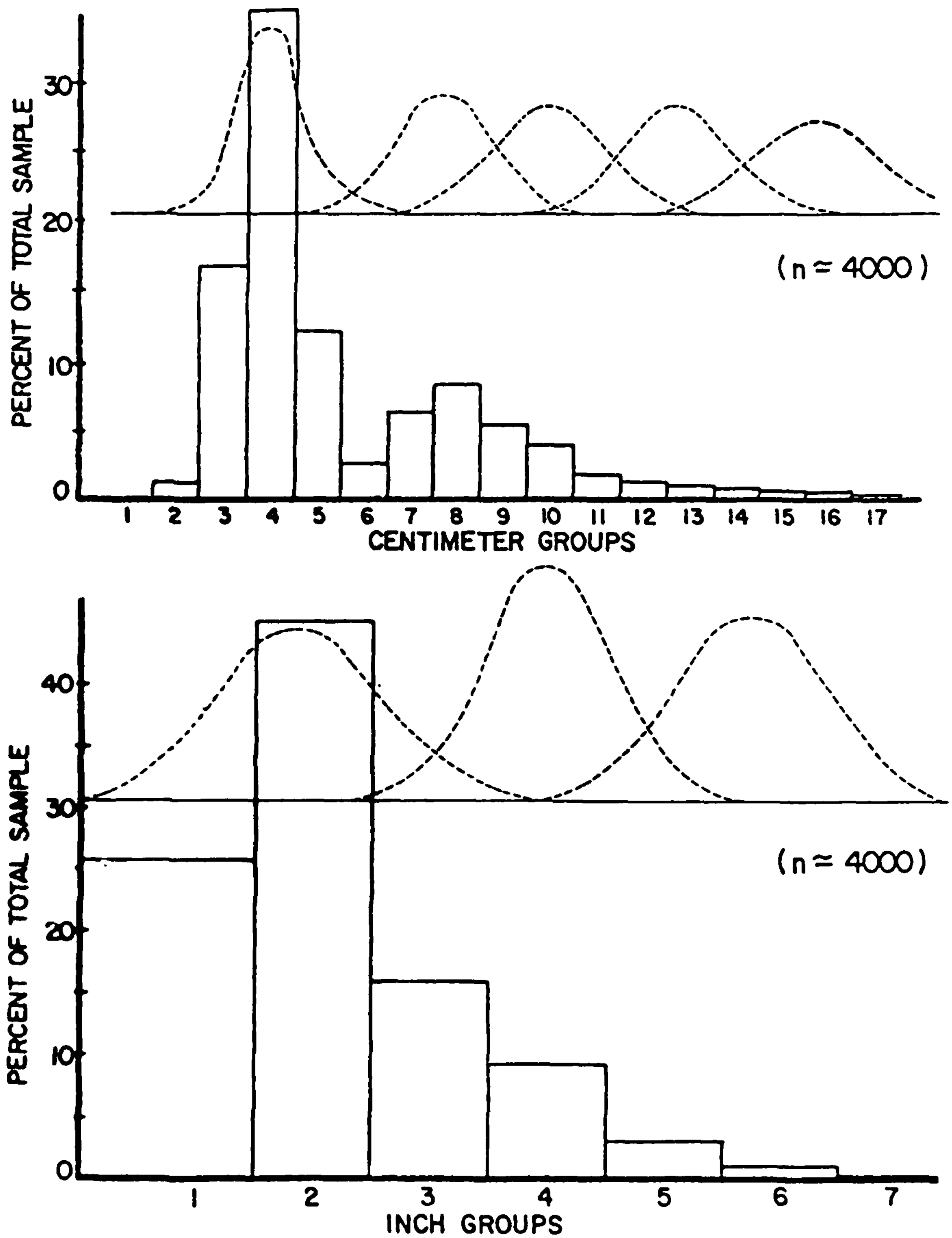


Figure 18. Length frequency distribution of bluegill centimeter and inch groups from West Point Lake in August 1981, and the age class curves estimated by computer.

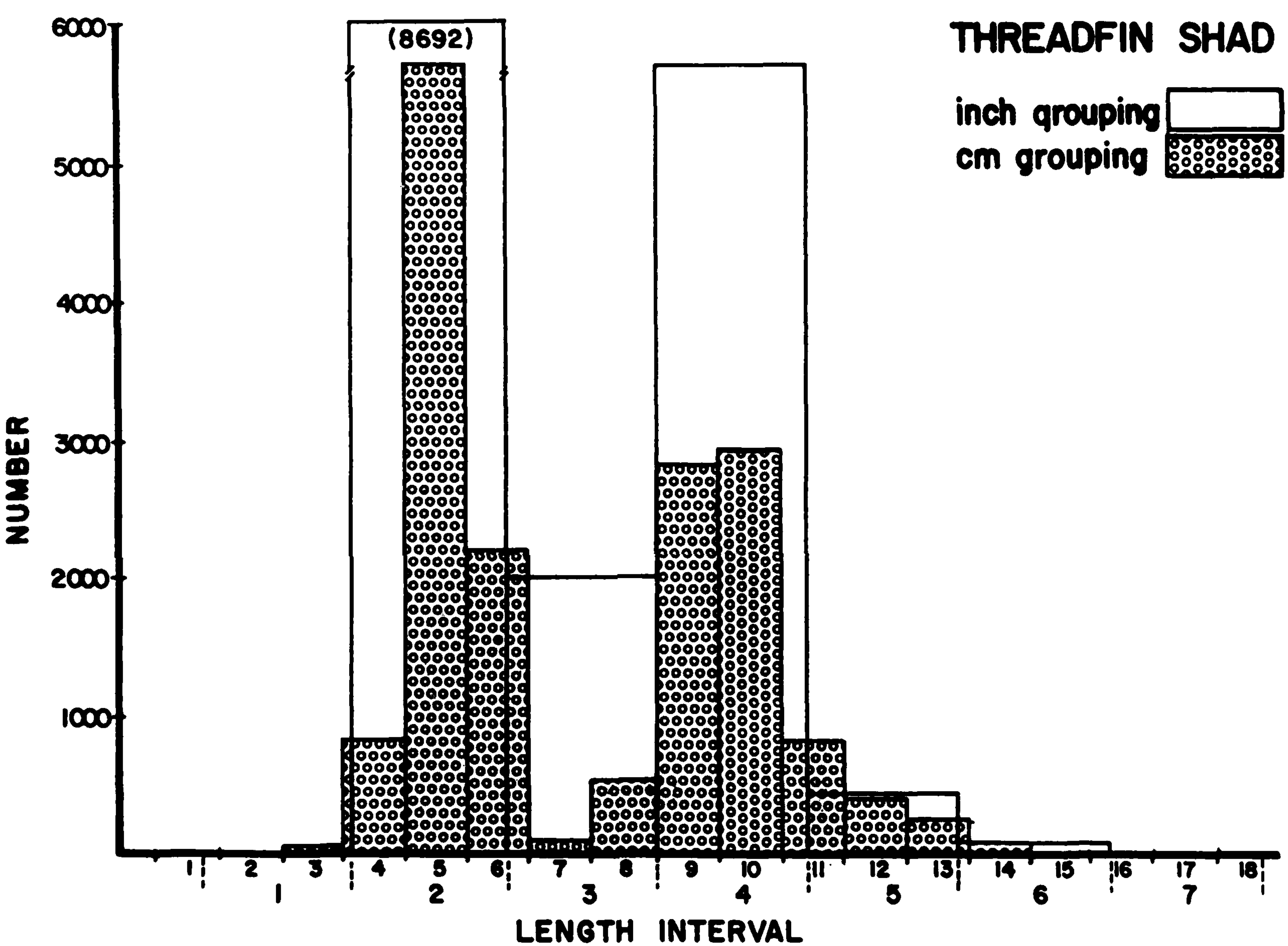


Figure 19. Length frequency distributions of threadfin shad (centimeter versus inch groupings) from West Point Lake, August 1981.

fall, however, produced large numbers (1,543) of adult crappie. These fish had a modal length of 25 cm and were in relatively good condition; many fish had recently fed on young of year threadfin shad.

133. The black crappie population appears to be in equilibrium with the fishery in that large numbers were caught (see Harvest section) and recruitment appears to be constant. Growth in previous years has been slow; however, given a series of mild winters with adequate threadfin shad survival, growth and recruitment into the fishery should improve.

Largemouth Bass

134. Relatively few adult fish were collected during the August large cove rotenone sampling. Only 1.1% of total standing stock consisted of largemouth bass in August compared to 2.2 and 7.9%, respectively, during the summer and spring periods (Davies and Shelton 1983). Obviously seasonal distributional patterns inflict serious bias into the fall and summer periods. As a result the dynamics of the adult largemouth bass population are better described from electrofishing, while young of year growth and survival are depicted from the littoral rotenone sampling (see appropriate sections). Figure 20 relates centimeter and length frequency histograms versus expected lengths at age from scale readings. Note that the proposed 16-inch minimum size restriction on harvest would protect bass until their 5th (age 4+) year of life.

Striped Bass x White Bass Hybrid

135. The Georgia Department of Natural Resources began stocking hybrid striped bass into West Point Lake in 1978; both fingerlings and fry were stocked (Figure 21).

136. Although preliminary analysis of cove sampling data suggested that the 1978 year class had a better growth rate than the 1979 year class (Shelton et al. 1981), analysis by back-calculation of length at annulus formation showed that fish from the 1979 stocking rate of 150 mixed fingerlings and fry per hectare grew significantly better than fish stocked in 1978 at a rate of 84 mixed fingerlings and fry per hectare. The mean length at annulus one for the 1978 year class was 242 mm (mean weight = 0.17 kg) compared to 290 mm (mean weight = 0.31 kg) for the 1979 year class. Stocking rates and growth rates were within the ranges reported in other southeastern and southwestern reservoirs (Bishop 1968, Ware 1975, Williams 1971). It is possible that the better growth observed for the 1979 year class can be correlated with a higher standing stock of threadfin shad 89 mm or less in length. Cove sampling (4 coves) in the summer of 1978 showed a mean value of 303 threadfin shad per hectare while in the summer of 1979 there were 1,880 per

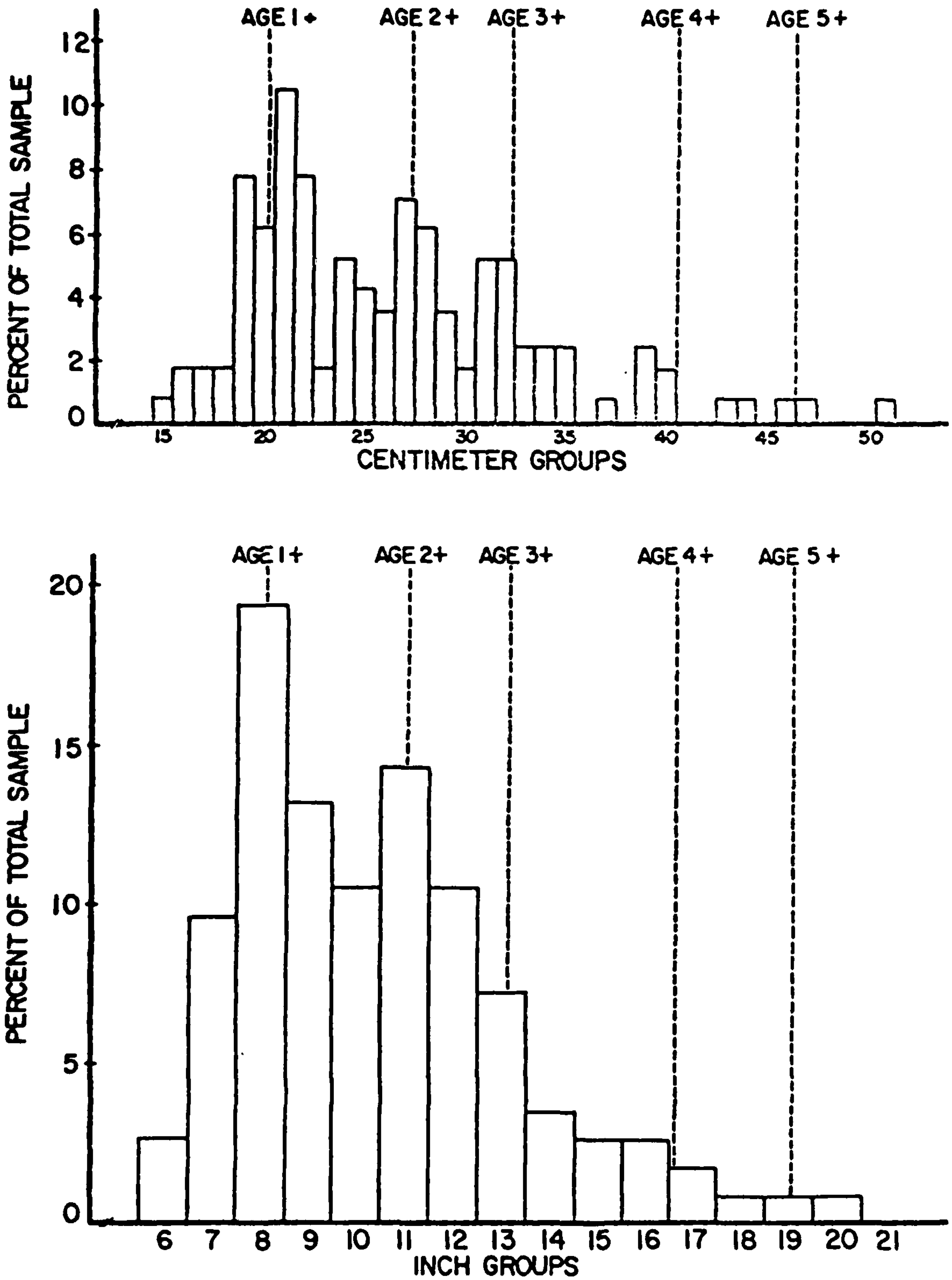


Figure 20. Centimeter and inch group length frequency histograms versus expected lengths at age from scale readings for West Point Lake largemouth bass, August 1981.

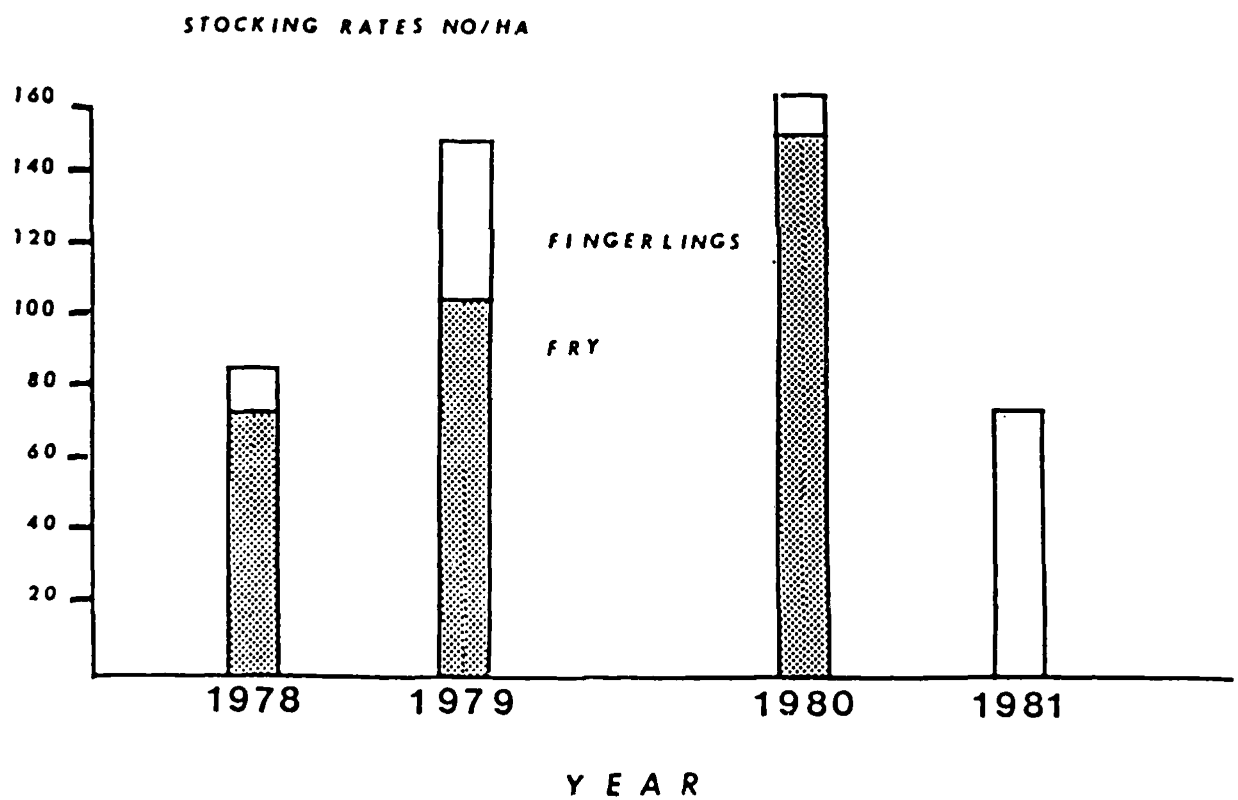


Figure 21. Stocking rates (no/ha) for hybrid striped bass (1978-1981), West Point Lake.

hectare. It is reasoned that the greater abundance of threadfin shad in 1979 contributed to the greater growth of the hybrid in that season.

137. Stomach analysis showed a preponderance of threadfin shad in the diet. For hybrids over 150 mm, approximately 83% of the food items identifiable by species were threadfin shad; approximately 10% were gizzard shad, and the remaining 7% were yellow perch, bluegill, and fingerling largemouth bass (Figure 22). Mean length of fish prey found in these hybrid stomachs was 65 mm. Small hybrids in the 100 to 150 mm length range fed on centrarchids 15 to 20 mm in length; stomachs of hybrids less than 100 mm were found to contain only insect larvae (Table 34).

Table 34

Items found in the stomachs of 30[1] hybrid bass 80-150 mm.

Food Item	Total # of Each Item (all stomachs)	% of Food Item
Insect larvae	24	92.3
Bluegill	1	3.8
Other	1	3.8

[1] Fourteen of the 30 stomachs were found to be empty.

138. Regression of prey length on hybrid length (Figure 23) from stomach data showed essentially no ($r^2 = 0.09$) relationship. When the maximum hypothetical prey size that hybrids can swallow was compared with actual lengths of prey consumed, it was apparent that the hybrids were not utilizing prey items in accordance with this relationship, but were instead feeding upon individuals of approximately 65 mm regardless of their ability to swallow larger-sized fish. Cove rotenone samples taken over the two years of the study (8 coves) showed an average of 5,594 gizzard shad per hectare at an average length of 156 mm indicating that ample numbers of larger-sized prey were available. Hybrid mouthpart size was correlated with total hybrid length ($r^2 = 0.86$), thus the regression of prey length on hybrid mouthpart size did not show any greater association than the regression of prey length on hybrid length.

139. It is speculated that there is very little size selection involved when a school of hybrids feeds on a school of forage fish, regardless of the size range of individual members in the hybrid school. Schooling and subsequent herding behavior of the hybrid bass on forage fish may make the hybrids more efficient predators than if selectively capturing individual prey items. A few hybrids in the 350 mm and above length range had eaten gizzard shad of 100 to 150 mm in length, but this

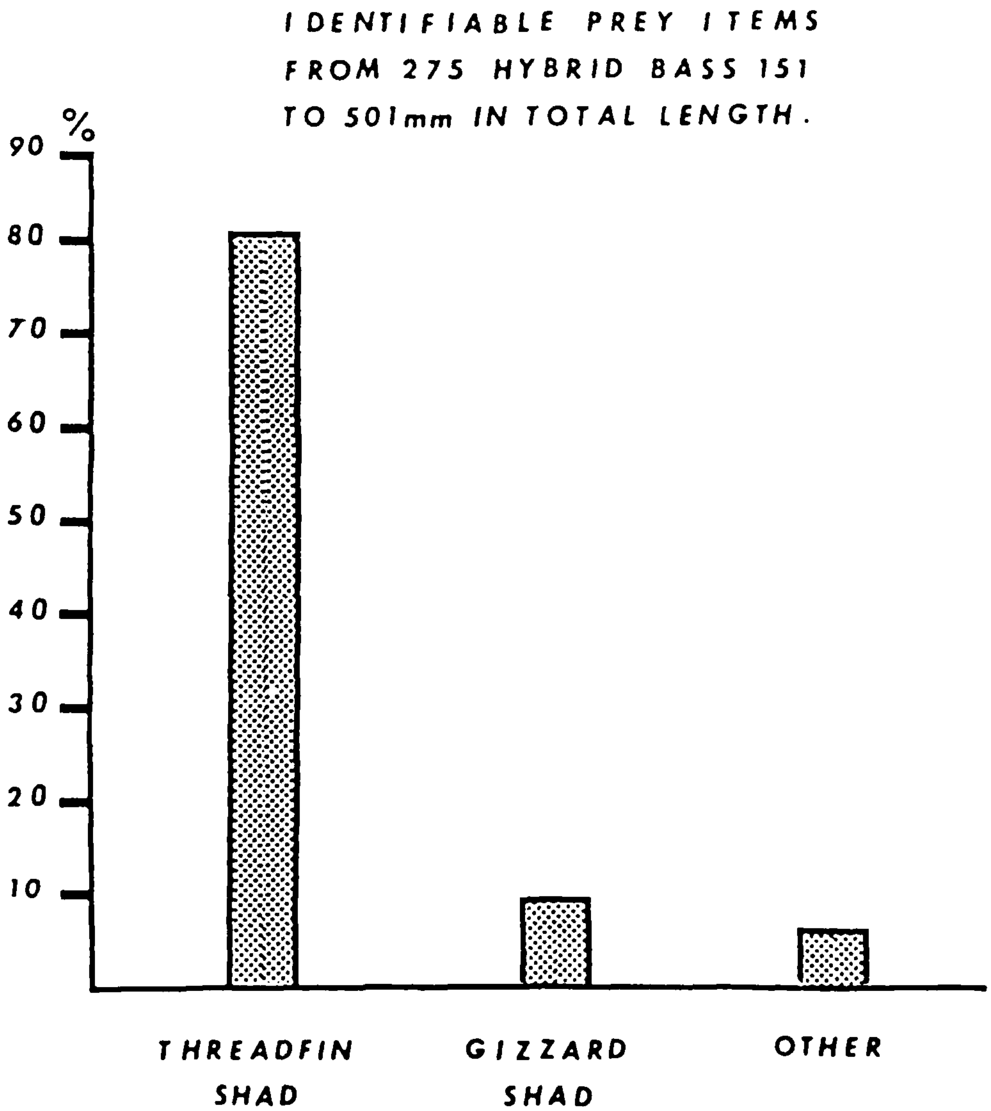


Figure 22. Relative frequency of prey items found in the stomach of hybrid striped bass, West Point Lake, 1981.

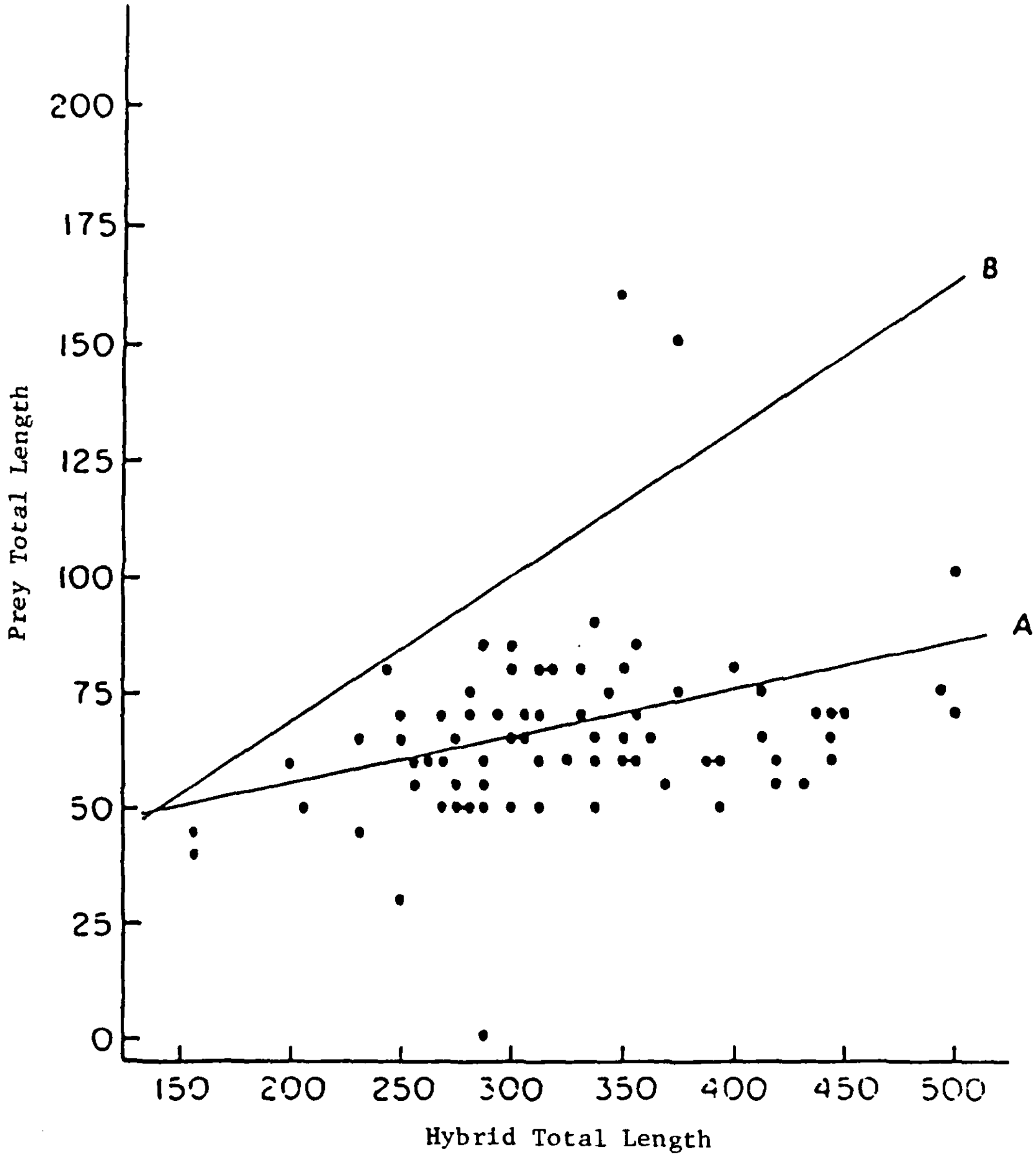


Figure 23. Regressions of (A) actual (measured) prey as a function of hybrid striped bass length, and (B) maximum hypothetical prey size that hybrids can swallow, West Point Lake, August 1981.

occurrence was rare compared to hybrids of the same size that were feeding on smaller threadfin shad. Hybrids may feed to a greater extent on threadfin shad because of the pelagic habits of both species and the predatory efficiency of hybrid schooling behavior. It is possible that in the future, when hybrids in West Point Lake reach larger sizes, they may begin to feed more on the gizzard shad as a group, but given their size range during this study, hybrids were not exerting significant predatory pressure on the gizzard shad.

140. A stocking rate as high as 45 fingerlings and 105 fry per hectare does allow growth of hybrid bass similar to that reported in other southeastern reservoirs, assuming adequate threadfin shad abundance. It might be advantageous to lower stocking rates after a very severe winter if threadfin shad populations are adversely affected. In this respect, it might be possible to develop guidelines for hybrid stocking rates based on indices of threadfin shad abundance. A fishery has developed for the hybrid striped bass at West Point Lake with some anglers fishing exclusively for this fish, but at their present size, there is no evidence to suggest that hybrids in the size range represented in this study are providing any beneficial effect in utilizing gizzard shad in the 150 mm and greater size range.

The Effects of Environmental Factors on Electrofishing Success

141. Environmental variables have been correlated with sport and commercial fish harvests (Jenkins 1968). Malvestuto *et al.* (1979) incorporated environmental variables to predict the precision of creel survey estimates of fishing effort. There have been no published studies that correlate electrofishing success with environmental variables, or determine the relative importance of environmental variables as they affect catch rate using electrofishing equipment. An assessment of the effects of environmental factors will help our understanding of electrofishing selection for a particular size and species of fish.

142. Multiple regression equations were selected for only one length group of largemouth bass, stock-size (≥20 cm). The equations relating to the length group, substock-size, were not selected because the R2 values obtained for the models were very low, or the relationships between the variables could not be logically explained. Multiple regression equations were established for the stock-size (≥7.6 cm) and substock-size (<7.6 cm) length groups of bluegill for each season.

143. Simple correlation matrices, one for each season, giving the r-values and associated significance for the environmental variables are given in Table 35; dates of sampling and lake sections corresponding to sample areas are also given. All multiple regression equations and their respective R^2 values for both species are given in Table 36;

Table 35

Simple correlations between environmental variables within seasonal classifications measured in association with electrofishing samples on West Point Reservoir. (DT = date, LS = lake section, AT = air temperature, LL = lake level, SV = secchi disc visibility, LI = light intensity, WS = wind speed).

	DT	LS	AT	WT	LL	SV	LI	WS
				Fall				
DT	1.00							
LS	.08	1.00						
AT	-.90*	.07	1.00					
WT	-.96*	-.02	.95*	1.00				
LL	-.96*	-.05	.91*	.94*	1.00			
SV	-.42	-.69*	.25	.40	.39	1.00		
LI	-.64*	-.04	.66*	.70*	.70*	.34	1.00	
WS	-.42	-.31	.40	.30	.33	.21	.37	1.00
				Spring				
DT	1.00							
LS	.12	1.00						
AT	.53*	.22	1.00					
WT	.91*	.12	.66*	1.00				
LL	.98*	.09	.49	.88*	1.00			
SV	-.00	-.30	.48	.03	.05	1.00		
LI	.13	.46	.29	.20	.14	-.21	1.00	
WS	.08	-.31	-.36	.17	-.20	-.17	-.17	1.00
				Summer				
DT	1.00							
LS	-.11	1.00						
AT	.73*	-.07	1.00					
WT	.30	-.31	-.20	1.00				
LL	-.86*	.10	.65*	-.25	1.00			
SV	.06	-.83*	.17	.61*	.02	1.00		
LI	.18	-.45	.30	-.06	-.40	.21	1.00	
WS	-.23	.04	-.34	-.61*	-.00	-.29	.06	1.00

*Indicates significance (alpha = 0.10).

Table 36

Selected multiple regression models for largemouth bass and bluegill sunfish showing the association between the number of fish captured in a 45-minute electrofishing sample on West Point Reservoir and selected environmental factors. All variables in each equation are signficant at alpha = 0.10. (SV = secchi disc visibility, WS = wind speed, AT = air temperature, LI = light intensity, LL = lake level.)

Season	Size	Multiple Regression Equation	R^2
		Largemouth Bass	
Fall	Stock	No = 22.495-0.102(SV)-0.392(WS)	0.831
Spring	Stock	No = 20.675-0.546(AT)-0.369(WS)	0.448
Summer	Stock	No = 15.866-0.419(AT)-0.0192(SV)+0.0000596(LI)	0.728
		Bluegill Sunfish	
Fall	Substock	No = -3475.904+5.615(LL)-0.000622(LI)-0.276(SV)	0.714
Fall	Stock	No = -55.215+7.225(AT)	0.452
Spring	Substock	No = -1555.009-1.594(WS)-0.415(SV)+2.542(LL)	0.612
Spring	Stock	No = -8775.064-7.995(WS)+14.210(LL)-1.149(SV)	0.765
Summer	Substock	No = 84.833-2.375(AT)	0.377
Summer	Stock	No = -3017.247+4.778(LL)+2.258(WS)	0.522

standard slopes (B') for each variable in each equation are given in Table 37.

144. To understand the relationships between the environmental variables in each season, a correlation matrix was used. Although a certain variable appears in an equation it may be strongly correlated with another variable which logically affects fish abundance. In addition to the predictive value of the equations, it is important to note the magnitude of the importance between the independent variables in each model (standard B' values in Table 37), and the direction (positive or negative) of the relationship with the dependent variable. All the independent variables in each model are listed in order of decreasing importance in Tables 36 and 37.

145. The model for stock-size largemouth bass in the fall showed that secchi disc visibility (SV) and wind speed (WS) both had negative relationships with the number of bass caught indicating that more bass were caught where the secchi disc and wind speed readings were lower. During that season, from Table 35, there was a significant negative correlation between secchi disc visibility and lake section (r = -0.69); secchi disc readings were usually lower in the uppermost section of the lake. An analysis of variance with a Duncan's multiple range test (Council and Helwig 1979) showed that the uppermost lake section had a statistically lower secchi disc reading (SV = 60.0 cm) than the lowermost section (SV = 132.8 cm). Mean catches of bass were statistically higher in the two upper sections of the reservoir (No. = 10 and 12 bass/sample in lake sections II and III, respectively) than in the lower section (No. = 3.0). Secchi disc visibility was substantially more important than wind speed in accounting for the variability between catches; B'-values were 0.73 and 0.41, respectively, for SV and WS.

146. The springtime model for largemouth bass was based on the negative relationships of air temperature and wind speed on catch rate. The air temperature relationship was due to changes in air temperature within the season as indicated by the significant negative correlation between air temperature and date in Table 35. Smaller numbers of bass were caught when warmer air temperatures were recorded; that is, as the season progressed. Wind speed influenced changes in catch rates in a similar manner as hypothesized for the fall. The variable, air temperature, was only slightly more important than wind speed according to the B'-values of Table 37.

147. A model with three variables was selected for the summer season to describe the environmental effects of catch rate of stock-size bass. The R^2-value of 0.73 indicated that 73% of the variability in catch rate between samples could be accounted for by changes in the magnitudes of air temperature, secchi disc visibility and light intensity. There was not a large difference between the importance of each variable, but air temperature was the most important and had a B'-value of 0.612; light intensity had the lowest value of 0.477. The effect of air temperature on catch rate was similar in the summer to

Table 37

Significant environmental variables and associated standard slopes from multiple regression equations found in Table 36 (SV = secchi disc visibility, WS = wind speed, AT = air temperature, LI = light intensity, LL = lake level.)

Season	Size	Environmental Variable	Standard Slope
		Largemouth Bass	
Fall	Stock	SV	-0.732
		WS	-0.411
Spring	Stock	AT	-0.648
		WS	-0.515
Summer	Stock	AT	-0.612
		SV	-0.546
		LI	0.477
		Bluegill Sunfish	
Fall	Substock	LL	1.130
		LI	-0.702
		SV	-0.494
	Stock	AT	0.670
Spring	Substock	WS	-0.602
		SV	-0.587
		LL	0.407
	Stock	WS	-0.765
		LL	0.576
		SV	-0.411
Summer	Substock	AT	-0.614
	Stock	LL	0.583
		WS	0.427

that found in the spring; larger catches of bass were obtained when the air temperature was lower, during the early part of the season. The correlation between date and air temperature was significant (r = .73). Although secchi disc visibility was a significant variable in the model, we could not determine the exact reasons for the relationship with catch rate. Duncan's multiple range tests showed that there was a significant difference between secchi disc visibility between all lake sections (I, II, and III), but there were no differences between catch rates associated with the lake sections. However, secchi disc was significantly correlated with catch rate and explained a meaningful portion of variability in catches. Increases in sunlight positively affected the catch of bass in electrofishing samples; the variable has predictive qualities within the equation, but we cannot determine why it has a positive relationship during the summer months. High light intensities were generally found to exist with extremely high air and water temperatures which normally cause bass to be found in deeper water. An increase in light intensity may allow shocked fish to be seen more clearly and thus captured.

148. The equation selected to estimate the number of substock-size bluegill in the fall contains three environmental variables: lake level, light intensity, and secchi disc visibility. The variable, lake level, was the most important factor affecting the catches of bluegill (B' = 1.13); while light intensity (B' = 0.702) and secchi disc visibility (B' = -0.494) were less important. Significant negative correlations existed between lake level and dates of sampling in the fall (r = -0.96). Lake level decreased as the season progressed and the catch rate of bluegill likewise decreased. Lake level was significantly correlated (+) with air temperature and water temperature; bluegill moved to warmer, deep water areas (off-shore) as temperature near the shore decreased and the season progressed. Apparently, lake level was a better predictor of electrofishing success than air or water temperature. Additionally, decreases in lake level may force bluegill to deeper water because shoreline habitat is lost. The negative relationship with light intensity and bluegill catch rate suggests larger catches of small bluegill with lower light intensities. There were significant correlations (+) between light intensity and air temperature, water temperature, and lake level, and a negative correlation with date (Table 35). A few samples during the later part of the season produced enough substock-sized bluegill to allow light to become significant in the equation. The negative relationship between catch rate of substock-size bluegill and secchi disc visibility may be due to geographic variation in productivity. Mean catch rates were not significantly different between lake sections, but the mean for lake section III (34) was about three times greater than the mean for lake section II (11). About 71.4% (R^2-value) of the variation in bluegill catch rate was attributed to the three variables in the model.

149. For stock-size bluegill captured in the fall, the equation contained only one independent variable with an R^2 value of 0.452.

Although this value is low, air temperature as a single variable was obviously important. The positive sign indicated that higher catch rates were associated with higher air temperatures.

150. In the spring, both length groups, substock- and stock-size, were responding to the same environmental variables: wind speed, secchi disc visibility and lake level. The variables probably affect all sizes of bluegill alike so they are discussed collectively. Wind speed was the most important variable, with standard B-values of -0.602 and -0.765 for substock- and stock-size fish, respectively. The effects of reduced visibility of shocked fish with higher wind speeds may be less critical for larger fish, such as large bass or carp, than for small centrarchids. Secchi disc visibility was more important in affecting the catches of substock-size bluegill than stock-size fish; lake level was more important for stock-size bluegill. A high significant positive correlation (r = 0.98) existed with dates of sampling and lake level, as well as with dates of sampling and water temperature (r = 0.91). Water temperature increased as lake level increased and this was conducive to rehabitation of shoreline areas by bluegill during the spring. Changes in primary productivity between samples may account for the changes in secchi disc visibility; more productive areas contained higher numbers of bluegill. The R^2-values for the models were 0.612 and 0.765 for substock-size and stock-size bluegill, respectively.

151. Air temperature was the only significant environmental variable in the equation for substock-size bluegill in the summer. The relationship with air temperature and catch rate is negative; that is, larger catches of substock-size bluegill were caught when cooler air temperatures were measured. Air temperature and dates of sampling were correlated (r = 0.73); as the summer season progressed, less bluegill were captured in electrofishing samples due to high air (and water) temperatures. Only 37.7% of the total variation in catch rate of substock-size bluegill between daytime samples is explained by changes in air temperature.

152. In the multiple regression equation for stock-size bluegill in the summer, the environmental variables of lake level and windspeed were found to explain a significant amount of variation in catch rate between electrofishing samples. The B'-value (0.583) for lake level was slightly higher than the B'-value (0.427) for wind speed and both lake level and wind speed were positively correlated with catch rate. The positive sign associated with wind speed is opposite of all previous relationships between wind speed and catch rate of bass or bluegill. An increase in wind speed may cause evaporative cooling, or be associated with rain storms, which bring cooler runoff water into littoral areas. There was a significant negative correlation (r = -0.61) between wind speed and water temperature lending credence to the above hypothesis. Increasing lake levels would provide new aquatic habitat for bluegill. About 52% of the total variability in catch rate was attributed to the two variables in the equation.

153. The predictive qualities of the model for stock-size largemouth bass were assessed using data collected from electrofishing samples taken during October-December, 1980. This model was chosen because of its high R2 value of 83%. Environmental data other than those used to formulate the models were only available from the fall season, 1980. Secchi disc visibility and wind speed measurements were placed into the equation: No. = 22.495 - 0.102(SV) - 0.392(WS), and a predicted number of bass was calculated for each sample. The results for the comparison between the predicted and actual number of bass captured are given in Table 38.

Table 38

Predicted and actual numbers of largemouth bass > 8.9 centimeters captured in each 45-minute electrofishing sample during the fall season 1980, on West Point Lake.

Sample	Actual Number	Predicted Number	Absolute Difference
1	6	7	1
2	7	12	5
3	11	17	6
4	6	3	3
5	8	13	5
6	12	16	4
7	0	12	12
8	6	15	9
9	4	16	12
10	2	11	9
11	10	11	1
12	14	12	2
13	4	8	4
14	2	11	9
15	4	6	2
16	11	10	1
17	13	7	6
Mean	7.10	11.00	5.40

154. To determine the utility of the model, the bias associated with predicted versus actual numbers of bass captured was calculated as No. predicted - No. actual. The ratio, No. predicted/No. actual (11/7), indicated a positive bias of 1.57 when all seventeen samples were included in the analysis, i.e., the equation overestimated the actual numbers by about 57%. It is evident that samples 7, 8 and 9 had large absolute differences and were possibly aberrant since they were all collected on the same day. If these samples are eliminated, bias becomes about 1.25. A minimum correction factor can be applied by multiplying the predicted values by 0.80.

155. Indications are that the equations can be used to predict the abundance of fish if certain environmental variables are measured. It will be necessary to test the remaining models to determine if appreciable bias exists in the slopes associated with the environmental variables. An accurate assessment will occur if several years of data can be combined to produce multiple regression equations; the present equations are an initial indication of which easily obtainable environmental factors hold promise in a predictive sense, and additionally, are logical in a descriptive sense given our understanding of the biological system. This study quantifies relations of fish samples by electrofishing to the environment in West Point Lake. General application of the models given here to other large southeastern reservoirs must be done with caution. It will be necessary to conduct similar studies on environmentally different water bodies in order to fully understand the effect of the environment on electrofishing success. Presently, very little of the environmental data which is usually collected in conjunction with routine reservoir sampling has been quantified with reference to sampling efficiency. Developing relationships or, more exactly, equations, describing fish abundance as a function of the environment for particular sampling gears, is an approach which may lead to more cost effective sampling programs for the future. This in turn will permit management programs to be realistically evaluated.

Dynamics of Young of Year Largemouth Bass

156. Largemouth bass spawning occurs in the southeastern U.S. in late April and early May, but YOY bass are not usually collected with littoral rotenone sampling until the second week of May (Timmons et al. 1980a) and these are most often schools of fry. Thus during the early post-spawning period, estimates of young bass are highly variable because of the grouped distribution of schooling fry. More uniform distribution of bass in the littoral zone occurs after these schools disperse and consequently more precise estimates of young bass are obtained after this period; in 1981, sampling was not started until June and included a total of 102 littoral rotenone samples.

157. Water level was brought above summer pool the first week of May, inundating terrestrial vegetation in the flood pool. In 1981, water level was maintained approximately 12 cm above summer pool over the principal spawning season of mid-April through mid-June. Peak water level in late May was 194.11 meters (m), 0.57 m above summer pool. However, the water level fell below summer pool during the second week in July; it dropped continuously through the summer and was 190.7 m, 2.8 m below summer pool, by the last collection period in late August. Water level for 1981 was below summer pool four weeks earlier than in 1980 and during the last week in August averaged 1 m lower than the previous year. Peak of YOY abundance occurred in the second week of June. Mean density at peak abundance was 3,632 YOY/ha (Figure 24); the highest YOY population in the past 5 years (Table 39). The number of

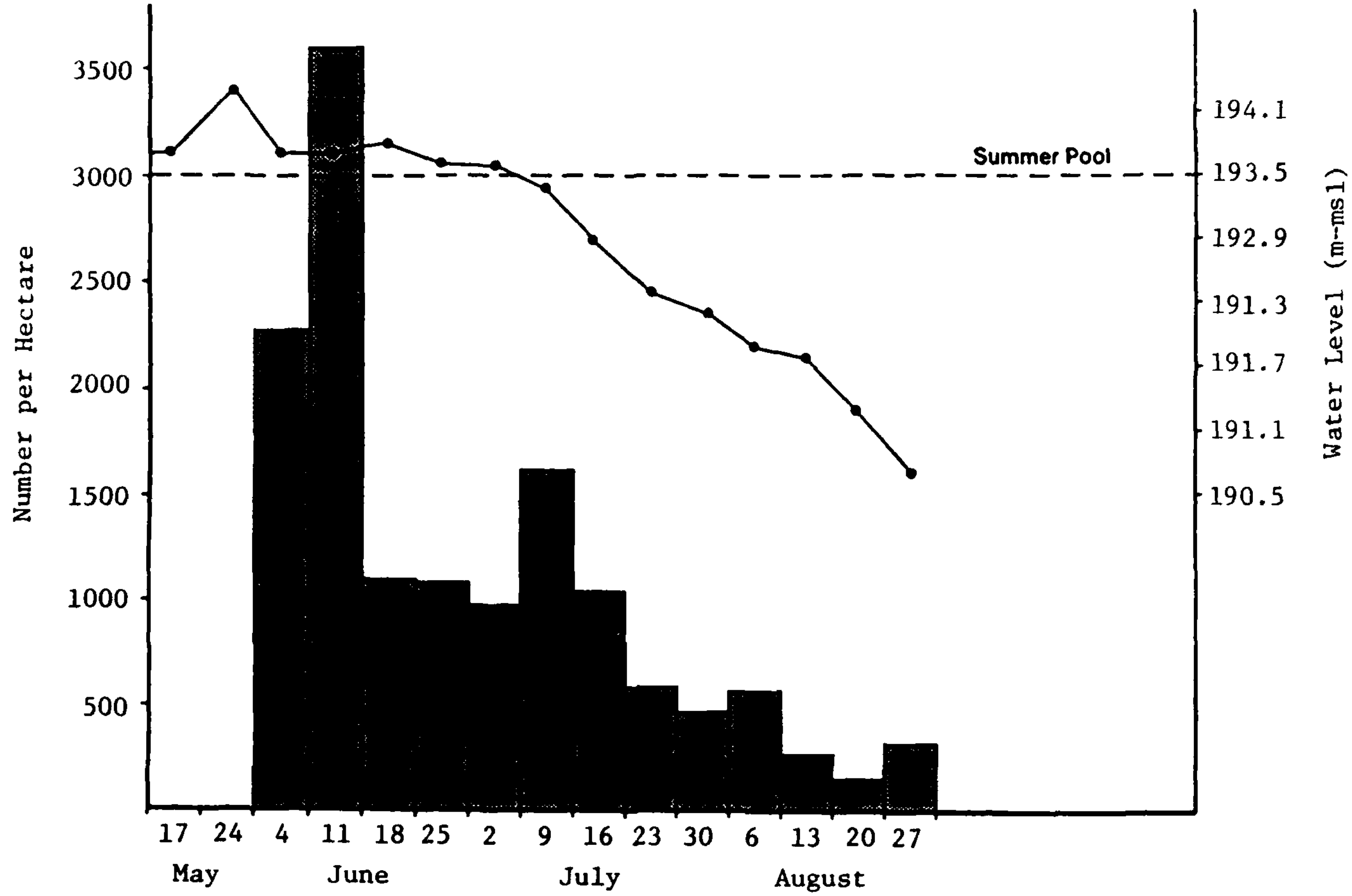


Figure 24. Relationship between water level and mean number of young-of-the-year largemouth bass collected by marginal rotenone sampling (1981), West Point Lake, Alabama-Georgia.

young bass declined throughout the summer and by the last week of August, mean density had decreased to 304 YOY/ha; the mean number for the month of August was 317/ha (Table 39). In 1980, peak abundance of YOY was [illegible] about 1,200 YOY/ha with about 300 YOY/ha surviving in August. Relative abundance in August was similar between the two years due to a greater mortality in the population in 1981. The weekly rate of instantaneous mortality (Z) was calculated from the week of peak abundance to the last week of August. The computed Z (0.219) was the highest of the 5-year period (Table 39). Conditions for survival were diminished because water level was below summer pool earlier than previous years, except for 1977. During years when the reservoir level is kept above summer pool through May and early June, survival of YOY bass is enhanced due to increased protection afforded by the flooded vegetation.

Table 39

Some statistics pertaining to water levels and the biology of the 1977-1981 year classes of largemouth bass in West Point Lake.

	Year				
	1977	1978	1979	1980	1981
Ha-day of flooding (spawning season)*	2935	21804	28912	13242	11085
Ha-day of flooding (post-spawning)*	0	7277	16663	16306	2617
Density at peak abundance (no/ha)	586	1915	2883	1174	3632
Average density in August (no/ha)	142	174	584	311	317
Average weight (g) of YOY in August	7.76	6.00	2.25	3.27	5.90
YOY biomass in August (kg/ha)	1.10	1.04	1.31	1.02	2.02
Z (Ricker 1975)	0.218	0.224	0.185	0.135	0.219
G (Ricker 1975)	0.287	0.224	0.138	0.202	0.072
No. of YOY/ha > 90 mm in August	54.3	48.1	21.0	23.6	19.0

*Definition in text.

158. To examine the effects of water level upon a new year class of bass, the year was divided into two seasons, spawning and post-spawning. The period from mid-April to mid-June comprised the

spawning season (Timmons et al. 1980a), and the period from mid-June to the end of the sampling season comprised the post-spawning season.

159. Flooding was quantified in terms of hectare-days; a hectare-day of flooding was defined in terms of acres by Aggus and Elliott (1975) as an acre of the flood pool inundated for one day. Hectare-days are therefore the metric equivalent. Miranda (1981) found that YOY bass peak abundance was significantly and positively influenced by the number of hectare-days of flooding recorded during the spawning season ($r = 0.98$, $p < 0.05$). But with the inclusion of the 1981 data, the same linear regression resulted in a non-significant relationship ($r = 0.478$, alpha = 0.41) indicating other factors might influence the spawning success.

160. The amount of exposed littoral zone below summer pool was examined as an influential factor in YOY bass abundance. The period considered began when the water level dropped below summer pool and extended through the month of September; the significance of this pertained to the colonization of terrestrial vegetation on the exposed littoral zone which when inundated the next spring would have the same effect as flooding above summer pool.

161. The effect on peak abundance over all five years of littoral rotenone sampling was explained by this variable providing an r of 0.724 (alpha = 0.166), thus underlining the importance of cover during the spawning season on spawning success whether derived from a previous year of exposing a part of the littoral zone or from flooding above normal levels. Even though spawning success and early survival were apparently enhanced by cover during the spawning season, peak abundance alone was not highly correlated with density of YOY bass in August.

162. Density in August was best explained by the number of total hectare-days of flooding as compared to flooding only during the spawning season. The following equation describes the relationship ($r = 0.761$, alpha = 0.135):

Density in August = 109.48 + 0.008 total ha-days of flooding.

163. The monthly length-frequency distributions of the 1980 and 1981 year classes of bass were examined. The June length frequency of the year classes revealed a slightly skewed distribution toward the larger size classes; this skewed distribution became more pronounced in July and August. The length of YOY bass in June ranged from 25 to 69 mm while in August the bass ranged from 29 to 198 mm.

164. The length frequencies for 1980/1981 are very similar (Figure 25) primarily because the majority of fish were growing at similar rates. But the difference appears to be in the number of more rapidly growing bass within the YOY population. This can be judged by looking at the number of YOY bass greater than 90 mm in August (Table 39). The abundant 1981 year class suffered a high rate of mortality and still had

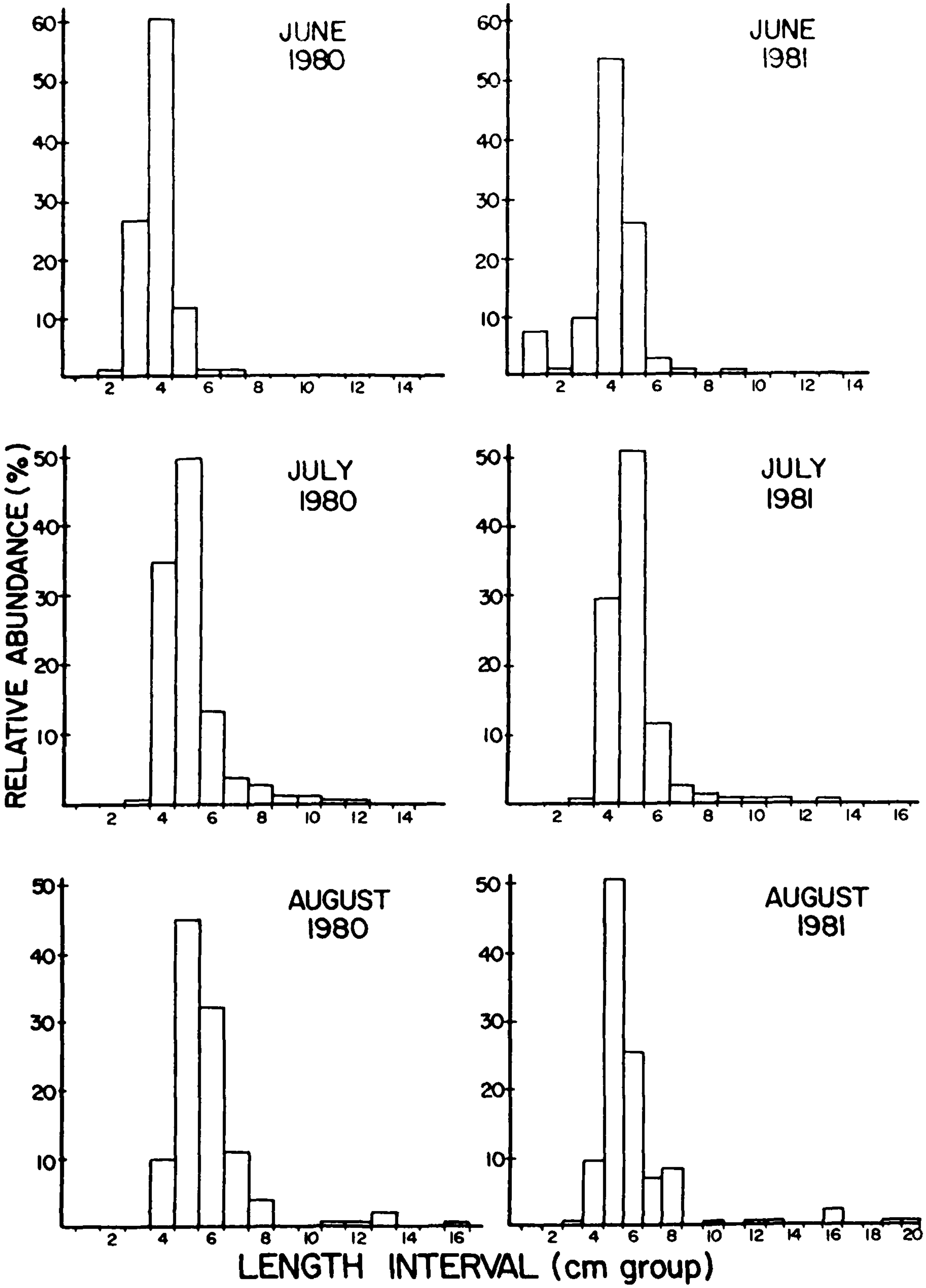


Figure 25. Young-of-the-year largemouth bass length frequencies for 1980-81, June through August, West Point Lake.

an abundance of YOY bass in August. Thus, throughout the growing season, there was a large population to be supported and growth was affected judging from the calculated instantaneous rate of growth (G) which was the lowest in the past 5 years (Table 39).

165. Over the past 5 years there has been an inverse relationship between the number of YOY bass at peak abundance and the number of YOY bass greater than 90 mm at the end of August. Growth and mortality are related to prey availability. The primary food of YOY bass in West Point Lake is bluegill (Miranda 1981). In 1981, the greatest number of YOY bluegill occurred in the third week of June (2,364 YOY/ha); the average length of YOY bass the third week of June was 47 mm. Stomach analysis of West Point YOY bass revealed larval fishes as small as 25 mm but indicated that bass 25 to 49 mm long usually fed on copepods, cladocera, insects, and larval fishes, while bass between 50 and 74 mm fed chiefly on fish (Davies et al. 1979). Therefore, based on the size of YOY bass in late June, the presence of adequate numbers of larval fishes was critical to proper growth and development. Following bluegill peak abundance in the third week of June, their density dropped significantly to 180 YOY/ha. From the fourth week of June to the third week of August the weekly average of YOY was only 418/ha. Only during the fourth week of August did YOY bluegill abundance significantly increase (1,706 YOY/ha). Through June and most of August, translucent bluegill fry were rarely observed, indicating that spawning during these months was minimal. Consequently, during this interim period between bluegill peaks, prey was limited to the young bass.

166. This situation was hypothesized to result in increased intraspecific competition among YOY bass with a subsequent reduction in growth rate among the majority of the bass. By the fourth week in August, the average length of YOY bass was 73.2 mm and the average length of YOY bluegill was 46mm; therefore, the average YOY bluegill was too large to be available as prey for the average size YOY bass. Only those more rapidly growing bass would have been able to utilize the majority of YOY bluegill.

167. Large numbers of YOY brook silversides (1,170/ha) were in the August littoral samples but Timmons et al. (1980b) determined that young bass fed little on brook silverside during the summer. Additionally, large numbers of YOY threadfin shad were present in August (11,128/ha) but the average length of this species the fourth week in August was 61 mm, thus placing this potential food item out of reach for the average YOY bass. Young-of-year shad are, however, a predominant food item for YOY bass longer than 175 mm (Davies et al. 1979).

168. Differential growth of YOY bass has been reported from West Point Lake (Shelton et al. 1979, Timmons et al. 1980b). This phenomenon has been attributed to a shortage of available prey for the small bass. A bimodal length-frequency distribution usually results by fall in each new year class of bass with the upper mode consisting of YOY bass that were able to change to a piscivorous diet earlier than the majority of

the year class. This early transition enables them to maintain a competitive growth rate with YOY bluegill and to continue to feed on these young bluegill throughout the summer.

169. To further support the above hypothesis, growth in weight of YOY bass was examined. Average weight of YOY bass increased from 2.3 g in early June to 12.1 g in late August. The instantaneous rate of growth (G) of young bass, for the period June to August, was 0.072, as compared to the 1980 calculated G of 0.202 (Table 39). As a result of high bass density in 1981 and limited mid-summer bluegill reproduction, growth rate for YOY bass was the lowest recorded.

170. Growth rate (G) of YOY bass was found to be inversely correlated with density at peak abundance (r = -0.949, alpha = 0.014) inferring that competition for food was the major factor. The equation describing the relationship is:

$$G = 0.3135 + (-0.000063) \text{ density at peak abundance.}$$

171. First winter mortality is probably greater for smaller than for larger individuals (Aggus and Elliott 1975). Thus, rather than manage the water level to produce excessive numbers of YOY bass, it would be more meaningful to manage for the greatest number of adequate size YOY bass. The YOY biomass over the past 5 years has been fairly consistent which suggests a carrying capacity for the lake (Table 39); thus if growth is to be managed, fewer YOY bass produced during spawning should increase individual growth and consequently increase their chances for survival and recruitment. Miranda (1981) concluded that the YOY bass greater than 90 mm in August are probably more able to keep up with the simultaneous growth of its prey (principally YOY bluegill), therefore representing the best prospect regarding recruitment into the fishery the following year.

Harvest

172. Estimates of angler harvest of largemouth bass, black crappie and sunfish (bluegill, redear, redbreast, green and warmouth sunfishes), plus bank and boat fishing effort are given in Table 40 for the current study period (Sept. 1980-Aug. 1981). These estimates show a decline in harvest and effort from last year's (Sept. 1979-Aug. 1980) values which were the highest recorded since impoundment. Effort declined to levels indicative of pre-1979 years with bank fishing effort at about 400,000 h (40 h/ha) and boat fishing effort at 600,000 h (60 h/ha). Harvest of certain species, however, declined more markedly relative to previous years. For example, largemouth bass harvest has averaged about 60 metric tons per year from 1976-1979; the estimate for the current period was near 30 metric tons, or a 50% decrease, and may reflect an actual decrease in bass production as implied in the conceptual model discussed in Shelton et al. (1981). Sunfish harvest has been declining since impoundment and only about 5 metric tons (0.5 kg/ha) were harvested this

year. Black crappie harvest, on the other hand, has been increasing since impoundment and that trend continued with crappie harvest reaching a new high of near 300 metric tons or 28 kg/ha. Expressing total harvest of the three species groups on a per unit of effort basis gives about 0.3 kg/h which is equivalent to that measured over the past two years. It might be noted that catfish harvest has previously been considered to be a minor component of the lake's fishery, but it did climb to about 20 metric tons during the current study period, roughly 4 times the harvest of sunfish and 60% of the harvest of largemouth bass.

Table 40

Roving creel survey harvest and effort estimates for West Point Lake, Alabama-Georgia, September 1980-August 1981.

	Weight of species harvested (kg)			Effort (fisherman-hours)	
	Largemouth bass	Black crappie	Bream	Bank	Boat
Sept	6,221	18	49	6,642	29,004
Oct	1,815	2,248	419	5,118	18,645
Nov-Jan	2,691	2,035	0	5,229	30,676
Feb	65	2,000	0	7,648	2,348
Mar	2,521	268,856	387	116,788	158,460
Apr	2,411	16,429	429	164,358	202,691
May	6,056	599	3,790	48,583	74,620
Jun	2,051	1,580	157	28,437	31,477
Jul	1,315	154	150	17,066	35,320
Aug	6,984	1,790	15	26,589	47,241
Total	32,130	295,709	5,396	426,458	630,482

CONCLUSIONS

Stocking

173. Stocking fishes is probably one of the most abused management efforts. Supplemental stocking frequently has little positive impact on the fish community and cannot be recommended unless reproductive requirements are not met. However, introductory stocking is more often successful. An introduction may be based on stocking a species not previously found in the drainage or on its absence from the particular water body.

174. In West Point Lake, stocking has involved two fishes (threadfin shad; hybrid striped bass). The threadfin shad is recognized as a valuable prey species; the apparent absence in the preimpoundment watershed suggested the desirability of attempting to establish a population. This task was a coordinated effort between personnel of the Georgia Department of Natural Resources and the Department of Fisheries at Auburn University.

175. In 1973, adult threadfin shad were stocked into two watershed ponds that were to be inundated after the impoundment of West Point. The shad were collected from two sources, the Chattahoochee River near Columbus, Georgia and the Coosa River in Alabama. Both pond populations expanded prior to the impoundment of West Point, providing a relatively large brood stock base for the lake. Establishment of the reservoir population has been successful, with a few minor setbacks caused by winter kills.

176. We requested of the Alabama and Georgia Departments of Conservation that no predator stocking be done in the initial period of impoundment so that the largemouth bass biology could be more precisely characterized. Following this period and with the knowledge that the threadfin shad population had developed, the second fish stocking program was started. The hybrid of the striped bass (female) and white bass (male) was produced by the Georgia Department of Natural Resources and initially stocked in 1978. Annual stocking has occurred through 1981. The population of hybrids was successfully established with the 1978 stocking and the outlook for this fishery is excellent. Since the hybrid is produced artificially, the population must be maintained with continued stocking, which will be accomplished by the Georgia DNR in accordance with prey abundance and hybrid population replacement needs.

177. Stocking of additional species is not anticipated although consideration has been given to alternative prey species. We have recognized a prey-limited condition that affects YOY largemouth bass but an appropriate forage species has not been identified. We have conducted several years of investigations in Auburn experimental ponds on the tidewater silverside, Menidia beryllina (formally the Mississippi silverside, M. audens). The silverside appears to compete with bluegill

and young bass for food, thus its value as a forage fish might be ameliorated by this diet overlap; consequently, we do not recommend its introduction into West Point.

Water Level Manipulation

178. Various environmental factors have been recognized as having an effect on reproductive success. Water level is influential in determining year-class strength of largemouth bass early in the season; high water enhances reproductive success and continued high water during the growing season also generally increases survival. Beginning in 1977, a series of studies was begun in West Point to characterize the relationship of water level management and largemouth bass year-class strength.

179. We have seen that bass reproduction can be enhanced through water level manipulation but that abundant young-of-year bass may not result in a higher than usual recruitment. Apparently limitation of appropriate-size prey for the greater numbers of bass intensifies competition for food which results in slower average growth. The slower growth affects the transition to a fish diet which further affects growth of much of the population. Year-class strength has been assumed to correlate with recruitment but in fact there seems to be an indirect relationship in that increased numbers seem to result in slow growth which may reduce survival and thus recruitment. These latter comments are not completely substantiated, as relating actual recruitment to numbers of YOY largemouth bass needs further investigation. But at this time, we cannot recommend using high water level as a mechanism for increasing recruitment into the fishery of West Point.

180. The factors involved in the prey-limited situation observed for YOY largemouth bass in West Point Lake may be a function of the reproductive capacity of the major prey species. Young bluegill are the most important prey for YOY largemouth bass during the transition from an invertebrate diet. The rate of growth of bass in relation to the timing of bluegill reproduction and growth rate are important factors in this relationship. If bluegill continued to reproduce throughout the summer as they do in fertilized small impoundments, then the growth of largemouth bass would be less critical since young bluegill would be available at any time. The difference in reproductive potential of bluegill in West Point Lake compared to a well-managed small impoundment may be related to the normal operations of large mainstream impoundments. Annual drawdown affects the benthic community which is the major food source of bluegill; thus, if their level of nutrition is limited, then their reproductive capability may be restricted. If this condition is the correct explanation for the observed phenomenon, then there appears little that can be done to rectify the situation and we must consider largemouth bass in terms of a prey-limited system. Some improvement in the bluegill populaton would be expected if, as suggested in an earlier report (Lawrence et al. 1982), lake water level was

maintained as close to 635 ft msl as possible through the month of October. This would allow the fish access to invertebrate organisms that during the summer recolonize the annually exposed littoral areas. The drawdown of the lake in early September as normally practiced eliminates valuable feeding areas for a considerable portion of the fish growing season.

181. Food availability is not a problem for larger-size largemouth bass in West Point. Gizzard shad are an abundant food supply; however, the majority of this species are too large to be eaten by most of the largemouth bass. This situation would seem to be simply a waste of potential prey and that the large gizzard shad would still be a valuable component of the community through their continued contribution from reproduction. Again, an unresolved ecological situation exists that complicates this relationship.

182. During 1979, 80, and 81 the gizzard shad reproduction was very poor; few young-of-year gizzard shad were sampled in these years. On the other hand, threadfin shad reproduction has been highly successful. One hypothesis is that interspecific competition is resulting in the reduced reproduction by gizzard shad; however, an intraspecific relationship may also be hampering gizzard shad reproduction. The latter case is commonly thought to limit gizzard shad reproduction in reservoirs across the southeast.

183. Two potential mechanisms can be employed to reduce the overabundant shad but only one is a viable option. Chemical treatment has been accomplished in the U.S. but cannot be considered practical for West Point Lake. The alternative is to increase predation on the larger shad. The introduced hybrid striped bass does not select prey proportional to their size; striped bass and the hybrid tend to feed on the abundant YOY shad. Largemouth bass could be the solution and this might be attainable through a shift of size structure toward more, large individuals. This approach obviously involves harvest restrictions and is presently being discussed by the Cooperators in the Departments of Conservation of Alabama and Georgia.

Harvest

184. During the past two years, active discussions have been conducted between personnel of the Georgia DNR, Alabama DCNR, and Auburn University. A length limit on largemouth bass that is higher than the contemporary one is being proposed. For example Alabama commonly imposes a 16" length limit on harvest of largemouth bass in some of its public fishing lakes. This would protect bass from harvest and permit their retention in the reservoir, to grow and become effective predators on the larger gizzard shad. The actual length limit must be determined and put into effect by the State Departments; however, a limit that would be effective must be at lest 15 or 16 inches. This restriction would require public approval and acceptance but the impetus has now

been initiated in both states. If approved, we will measure the effect on the community dynamics.

185. A very important component of this evaluation will involve monitoring the catch; thus the creel survey will continue to be a basic component of the investigation. The creel can also function in a direct management capacity.

186. The creel survey is valuable through its direct contact with fishermen. It permits documenting catch, harvest, and effort but also presents the opportunity for public interaction.

187. Further, the catch information can be fully utilized. For example a public service can be developed from information on species distribution and the measured catch success. Timely dissemination of this information to the public would be enthusiastically received.

LITERATURE CITED

Aggus, L. R., and G. V. Elliott. 1975. Effects of cover and food on year-class strength of largemouth bass. Pages 317-322 in R. H. Stroud and H. Clepper, eds. Black bass biology and management. Sport Fishing Institute, Washington, D.C.

Ahlstrom, E. H. 1940. A revision of the rotatorian genera Brachionus and Platyias with descriptions of one new species and two new varieties. Bull. Am. Mus. Nat. Hist. 77:143-184.

Bayne, D. R., J. M. Lawrence, W. L. Shelton, and W. D. Davies. 1980. Fisheries and Limnological Studies on West Point Reservoir, Alabama-Georgia. Job Compl. Rpt. Mobile District Corps of Engineers, Mobile, AL. 238 pp.

Beck, W. M. 1976. Biology of the larval chironomids. Technical Series 2(1) State of Florida, Dept. of Env. Regulation. 57 pp.

Bishop, R. D. 1968. Evaluation of striped bass (Roccus saxatilis) and white bass (R. chrysops) hybrids after two years. Proc. Southeast. Assoc. Game Fish Comm. 21(1967):245-254.

Chance, C. J. 1958. How should population surveys be made? Assoc. Game Fish Comm. 11(1957):84-89.

Cocke, E. C. 1967. The Myxophyceae of North Carolina. Wake Forest University, Winston-Salem, NC. 206 pp.

Council, K. A. and J. T. Helwig, eds. 1979. SAS users guide 1979 edition. SAS Institute, Cary, North Carolina, USA.

Davies, W. D., D. R. Bayne, J. M. Lawrence, and W. L. Shelton. 1979. Fisheries and limnological studies on West Point Reservoir, Alabama-Georgia. Technical Report EL-79-4. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. 233 pp.

Davies, W. D., and W. L. Shelton. 1983. Sampling with toxicants. Chapter 10 in L. A. Nielsen and D. L. Johnson, Editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland. 496 pp.

Davies, W. D., W. L. Shelton, and S. P. Malvestuto. 1982. Prey-dependent recruitment of largemouth bass: a conceptual model. Fisheries 7(6):12-15.

Edmondson, W. T., ed. 1959. Freshwater biology. 2nd ed. John Wiley and Sons, Inc., New York. 1,248 pp.

Edmunds, G. F., Jr., S. L. Jensen, and L. Berner. 1976. The Mayflies of North and Central America. Univ. Minnesota Press, Minneapolis. 330 pp.

Fogg, G. E. 1975. Algal cultures and phytoplankton ecology. 2nd ed. The University of Wisconsin Press, Madison, Wisconsin. 167 pp.

Hall, G. E. 1974. Sampling reservoir fish populations with rotenone. Pages 249-259 in R. L. Welcomme, ed. Symposium on methodology for the survey, monitoring, and appraisal of fishery resources in lakes and large rivers. Eur. Inland Fish. Advis. Comm. Tech. Pap. No. 23.

Hauer, J. 1953. Zur Rotatorienfauna von Nordostbrasilien. Arch. Hydrobio. 48:154-172.

Hester, F. E., and J. S. Dendy. 1962. A multiple-plate sampler for aquatic macroinvertebrates. Trans. Am. Fish. Soc. 91(4):420-421.

Jenkins, R. M. 1968. The influence of some environmental factors on standing crop and harvest of fishes in U.S. reservoirs. Pages 298-321 in Reservoir fisheries symposium, Southern Div. Am. Fish Soc., Athens, GA.

Lawrence, J. M. 1958. Estimated sizes of various forage fishes largemouth bass can swallow. Proc. Southeast. Assoc. Game Fish Comm. 11(1957):220-225.

Lawrence, J. M., S. P. Malvestuto, W. D. Davies, D. R. Bayne, and W. L. Shelton. 1982. Fisheries and limnological studies on West Point Lake, Alabama-Georgia. Draft Final Report. U.S. Army Corps of Engineers, Mobile District, Mobile, Al. 214 pp.

Malvestuto, S. P., W. D. Davies, and W. L. Shelton. 1978. An evaluation of the roving creel survey with nonuniform probability sampling. Trans. Am. Fish. Soc. 107(2):255-262.

Malvestuto, S. P., W. D. Davies, and W. L. Shelton. 1979. Predicting the precision of creel survey estimates of fishing effort by use of climatic variables. Trans. Am. Fish. Soc. 108(1):43-45.

Mason, W. T. 1973. An introduction into the identification of chironomid larvae. U.S. Dept. Interior, Fed. Water Poll. Control Admin., Div. Poll. Surveillance. Cincinnati, OH. 90 pp.

Merritt, R. W., and K. W. Cummins, eds. 1978. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Iowa. 441 pp.

Miranda, L. E. 1981. Dynamics of young-of-the-year largemouth bass in relation to water level management. M.S. Thesis, Auburn Univ., Auburn, AL. 63 pp.

Parrish, K. F., ed. 1975. Keys to water quality indicative organisms (Southeastern United States). U.S. Dept. Interior, Fed. Water Poll. Control Admin., Cincinnati.

Patrick, R. 1970. Benthic stream communities. Am. Scient. 58:546-549.

Pennak, R. W. 1978. Fresh-water invertebrates of the United States, 2nd edition. John Wiley & Sons, Inc., New York. 803 pp.

Pourriot, R. 1965. Notes taxinomiques sur quelques rotiferes planctoniques. Hydrobiologia 25-26:579-604.

Prescott, G. W. 1970. How to know the freshwater algae. Wm. C. Brown Co., Dubuque, Iowa. 348 pp.

Ransom, J. D., and T. C. Dorris. 1972. Analysis of benthic community structure in a reservoir by use of diversity indices. Am. Midl. Nat. 87:434-447.

Ruttner-Kolisko, A. 1974. Plankton rotifers, biology and taxonomy. 146 pp. (Transl. by Gertrude Kolisko). Condensed translation from Die Binnengewasser XXIV, part 1. E. Schweizerbart'sche Verlagsbuchhandlung (N. Obermiller), Stuttgart.

Shelton, W. L., W. D. Davies, T. A. King, and T. J. Timmons. 1979. Variation in the growth of the initial year class of largemouth bass in West Point Reservoir, Alabama and Georgia. Trans. Am. Fish Soc. 108(2):142-149.

Shelton, W. L., J. M. Lawrence, W. D. Davies, and D. R. Bayne. 1981. Fisheries and limnological studies on West Point Reservoir, Alabama-Georgia. Job Completion Report, U.S. Army Engineer District, Mobile, Mobile, AL. 159 pp.

Smith, G. M. 1950. The fresh-water algae of the United States. 2nd ed. McGraw-Hill Book Co. Inc., New York. 719 pp.

Steel, G. D., and H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Co. Inc., New York. 481 pp.

Sudzuki, M. 1964. New systematical approach to the Japanese planktonic Rotatoria. Hydrobiologia 23-24:1-124.

Swingle, W. E. 1972. Length-weight relationships of Alabama fishes. Fisheries and Allied Aquacultures, Departmental Series No. 1. Auburn Univ. Agr. Exp. Sta., Auburn, AL. 89 pp.

Taylor, M. P. 1971. A TVA technique for using carbon-14 to measure phytoplankton productivity. T.V.A., Div. of Environ. Res. and Development, Environ. Bio. Branch. 34 pp.

Timmons, T. J., W. L. Shelton, and W. D. Davies. 1980a. Differential growth of largemouth bass in West Point Reservoir, Alabama-Georgia. Trans. Am. Fish. Soc. 109:176-186.

________. 1980b. Sexual maturity and fecundity of largemouth bass in West Point Reservoir, Alabama and Georgia. U.S. Fish. Wildl. Tech. Paper 100. 6 pp.

Usinger, R. L., ed. 1956. Aquatic insects of California. Univ. of California Press, Berkeley. 508 pp.

Ware, F. J. 1975. Progress with the Morone hybrids in fresh water. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 28(1974):48-53.

Weber, C. I. 1971. A guide to the common diatoms at water pollution surveillance system stations. U.S. Environmental Protection Agency, Cincinnati, OH. 101 pp.

Weber, C. I., ed. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. U.S. Environmental Protection Agency, Washington, D.C.

Wetzel, R. G. 1975. Limnology. W. B. Saunders Co., Philadelphia. 743 pp.

Whitford, L. A., and G. J. Schumacher. 1973. A manual of fresh-water algae. Sparks Press, Raleigh, NC. 324 pp.

Wiggins, G. B. 1977. Larvae of the North American caddisfly genera. Univ. Toronto Press, Toronto. 401 pp.

Williams, H. W. 1971. Preliminary studies of certain aspects of the life history of the hybrid (striped bass x white bass) in two South Carolina reservoirs. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 25(1970):424-431.

APPENDIX

APPENDIX

Table 1

Hydrological and meteorological data for West Point Lake study, October 1980-September 1981.

Year	Month	Mean Daily Inflow[1] (cfs)	Mean Daily Discharge[2] (cfs)	Lake Elevation[2] (msl)	Total Rainfall[3] (inches)	Solar Radiation[4] (Langleys)
1980	October	2,950	3,356	625.1	1.5	10,427
	November	2,014	1,789	625.2	2.3	7,408
	December	1,887	2,519	626.3	1.3	7,022
1981	January	1,643	2,285	625.1	0.8	8,639
	February	4,386	5,850	628.6	7.1	8,754
	March	2,699	2,713	629.2	5.6	13,492
	April	2,628	3,121	633.7	3.8	14,274
	May	2,466	2,335	635.8	3.9	15,997
	June	1,982	2,831	635.6	1.4	16,776
	July	1,920	3,556	633.0	3.3	14,776
	August	2,685	4,382	628.3	3.5	12,207
	September	2,454	3,183	622.7	1.5	13,052

[1]Inflow USGS Gaging Station, Whitesburg, Georgia.

[2]Lake levels and discharge Powerhouse of West Point Reservoir.

[3]Rainfall accumulations NOAA, National Weather Service Station, LaGrange, Georgia.

[4]Continuous Solar Radiation NOAA, National Weather Service Station, Auburn, Alabama.

APPENDIX

Table 2

Temperatures (°C) of West Point Lake waters at indicated stations and depths for sampling periods from 4 November 1980 to 3 September 1981.

Sta.	Depth, m	4 Nov 80	10 Dec 80	27 Jan 81	25 Mar 81	13 May 81	11 Jun 81	4 Aug 81	3 Sep 81
A	0	17.0	---*	---	---	20.0	---	---	---
	2	17.0	---	---	---	19.0	---	---	---
B	0	18.0	11.0	12.0	15.0	21.5	32.0	33.0	23.0
	2	17.0	11.0	10.0	14.5	21.0	29.0	28.0	23.0
	4	16.5	11.0	10.0	11.5	21.0	29.0	28.0	22.0
	8	---	11.0	8.0	11.0	20.5	27.5	28.0	21.0
	12	---	11.0	---	10.0	19.5	26.5	---	21.0
C	0	18.5	11.0	8.0	15.0	23.0	31.0	31.0	28.7
	2	18.0	11.0	8.0	14.0	22.5	31.0	29.0	28.0
	4	17.0	11.0	8.0	13.5	22.0	29.5	29.0	27.5
	8	16.5	11.0	7.5	12.5	21.0	25.5	29.0	26.5
	16	16.5	11.0	6.5	11.5	16.5	23.0	26.0	25.5
D	0	18.5	11.5	7.0	13.0	23.5	29.5	28.5	27.0
	2	18.0	11.5	7.0	13.0	22.5	29.3	28.5	27.0
	4	17.5	11.5	7.0	13.0	22.0	28.3	28.5	26.8
	8	17.5	11.0	7.5	12.0	21.5	26.5	28.5	26.2
	16	17.0	11.0	7.5	11.8	17.5	20.0	26.0	26.0
	24	17.0	11.0	7.0	11.5	15.0	20.0	24.0	24.0
E	0	17.0	11.0	---	11.5	20.0	22.0	30.5	26.0
F	0	18.0	11.0	9.5	13.5	22.5	31.0	31.0	28.5
	2	17.5	10.5	9.5	13.0	22.8	31.3	30.5	28.0
	4	16.8	10.5	9.0	13.0	21.0	29.0	30.0	27.5
G	0	19.0	10.5	9.5	13.5	21.5	31.0	33.5	---
	2	18.0	10.0	9.0	13.0	22.0	30.0	30.0	---
	4	16.5	9.5	9.0	12.0	21.5	30.0	30.0	---

*Dash (---) indicates no data for that date and depth.

APPENDIX
Table 3

Turbidities (JTU's) of West Point Lake waters at indicated stations and depths for sampling periods from 4 November 1980 to 3 September 1981.

Sta.	Depth, m	4 Nov 80	10 Dec 80	27 Jan 81	25 Mar 81	13 May 81	11 Jun 81	4 Aug 81	3 Sep 81
A	0	9.1	28.0	6.7	8.9	56.0	24.0	26.0	76.0
	2	10.0	31.0	7.2	9.6	74.0	29.0	25.0	78.0
B	0	14.0	8.0	5.9	11.0	3.4	7.5	6.5	12.0
	2	13.0	8.6	6.5	10.5	4.4	5.8	6.7	17.0
	4	13.0	9.2	6.9	10.0	4.4	8.9	7.9	19.0
	8	19.0	12.0	7.0	11.0	10.0	14.0	13.5	14.0
	12	--- *	12.0	7.9	14.0	13.5	44.0	---	20.0
C	0	4.0	3.4	2.9	4.5	1.8	2.5	2.7	3.8
	2	4.4	3.4	3.2	3.5	2.0	2.7	2.5	3.0
	4	5.5	3.5	2.5	4.4	2.3	3.5	3.3	3.9
	8	4.8	3.3	4.5	7.5	4.4	12.0	2.7	5.5
	16	8.1	---	6.0	4.7	16.5	27.0	60.0	17.0
D	0	2.5	6.4	2.0	10.5	1.0	1.1	2.7	3.8
	2	2.7	6.0	1.9	9.6	1.4	1.4	2.8	2.2
	4	3.5	6.0	2.3	10.5	1.4	1.6	2.7	4.6
	8	5.5	5.1	4.4	11.0	1.9	1.3	2.7	36.0
	16	13.0	5.0	1.9	10.0	2.3	9.5	14.5	9.7
	24	17.0	5.0	---	12.0	2.7	9.5	19.0	11.0
E	0	5.3	4.5	2.4	10.5	2.4	2.2	5.7	4.1
F	0	7.0	6.8	6.6	29.0	1.4	2.0	2.7	4.2
	2	7.4	7.6	7.2	32.0	2.1	2.3	3.1	4.6
	4	9.9	8.6	8.0	32.0	1.8	2.7	3.4	5.8
G	0	5.4	3.3	2.7	10.0	1.1	2.3	2.5	2.9
	2	5.3	3.5	2.7	9.8	1.7	2.7	2.6	3.0
	4	6.0	4.5	3.6	10.5	1.9	2.7	2.8	2.4

*Dash (---) indicates no data for that date and depth.

APPENDIX

Table 4

Mean phytoplankton densities (organisms/ml) reported by algal division at each station and date for the 1980-81 sampling year at West Point Lake. Values are means of counts made at all depths at each station.

Date	Algal Division	Station A	B	C	D	E	F	G
		Organisms/ml						
4 Nov 80	Chrysophyta	210	247	216	348	407	419	170
	Chlorophyta	304	324	1285	1039	828	1199	691
	Cyanophyta	41	21	77	56	37	42	31
	Others	24	22	206	21	50	103	32
	Total	579	614	1588	1464	1322	1763	924
27 Jan 81	Chrysophyta	1016	567	1103	1676	1710	822	913
	Chlorophyta	398	390	557	838	474	476	883
	Cyanophyta	50	38	103	154	82	28	43
	Others	20	44	41	31	41	87	96
	Total	1484	1039	1804	2699	2307	1413	1935
13 May 81	Chrysophyta	357	787	536	126	202	585	1258
	Chlorophyta	161	792	1611	404	687	1078	1624
	Cyanophyta	34	134	472	282	315	222	1165
	Others	24	66	33	27	0	7	37
	Total	576	1779	2652	839	1204	1892	4084
4 Aug 81	Chrysophyta	241	3763	3369	2627	2293	1909	793
	Chlorophyta	148	3136	2676	2144	1958	1644	1341
	Cyanophyta	35	1311	2865	3298	1193	1638	5235
	Others	32	108	61	0	0	93	92
	Total	456	8318	8971	8069	5444	5284	7461

APPENDIX

Table 5

Mean zooplankton densities (organisms/l) by station and date for 1980-81. Immature copepods are included in these counts.

Date	Zooplankton Group	Station						
		A	B	C	D	E	F	G
		Organisms/l						
17 Oct 79	Rotatoria	4.0	155.3	401.0	248.8	287.0	366.7	466.0
	Copepoda	0.4	4.0	9.8	67.7	98.0	36.2	17.6
	Cladocera	0.1	3.9	0.9	8.8	13.9	4.1	0.9
	Others	0.1	0.1	0.0	0.0	1.8	0.0	0.4
	Total	4.6	163.3	411.7	325.3	400.7	407.0	484.9
12 Feb 80	Rotatoria	9.5	17.0	16.3	30.3	35.0	15.7	66.3
	Copepoda	3.1	4.2	8.0	14.8	20.8	9.3	12.6
	Cladocera	0.4	0.7	0.9	1.3	0.1	1.7	0.2
	Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	13.0	21.9	25.2	46.4	55.9	26.7	79.1
9 May 80	Rotatoria	2.0	19.7	608.3	542.5	143.0	124.3	456.3
	Copepoda	0.7	3.9	10.4	55.0	27.4	133.1	34.7
	Cladocera	0.1	0.7	8.5	85.9	50.4	16.1	46.7
	Others	0.1	0.0	0.0	0.0	0.0	1.5	0.7
	Total	2.9	24.3	627.2	683.4	220.8	275.0	538.4
5 Aug 80	Rotatoria	1.0	33.0	20.3	10.5	1.0	17.0	16.0
	Copepoda	0.3	2.2	4.4	1.6	0.9	7.9	7.0
	Cladocera	0.2	0.5	0.5	0.4	0.1	2.3	0.9
	Others	0.2	0.0	0.0	0.0	0.2	0.0	0.0
	Total	1.7	35.7	25.2	12.5	2.0	27.2	23.9

APPENDIX

Table 6

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples taken at each of the 12 sampling stations on West Point Lake 27 August 1980.

Organism	Station	1		2		3		4		5		6		7		8		9		10		11		12		Total	$\bar{x}$	%
	Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Nematoda		1								4	4		16					4		18	9	4	4			64	2.7	1.9
Planaria																												
Oligochaeta																												
Naididae																					2					2	0.1	T*
Tubificidae		71	41	61	41	160	21	252	73	152	93	105	151	81	266	124	54	130	131	87	14	60	44	43	228	2483	104.3	75.0
Hirudinea																												
Cladocera											4					4	1				2					11	0.5	0.3
Copepoda				1		1										12					1	4	8			27	1.1	0.8
Malacostraca																												
Isopoda																												
Amphipoda																												
Decapoda																												
Collembola																				1						1	T	T
Ephemeroptera																												
Ephemeridae																												
Hexagenia			1			1			1	4									1	1	3					12	0.5	0.4
Caenidae																												
Caenis		13	4			4		4	13		3															41	1.7	1.2
Ephemerellidae																												
Ephemerella																												
Unidentified																												
Odonata																												
Coenagrionidae																												
Argia																												
Gomphidae																												
Gomphus																												
Corduliidae																												
Hemiptera																												
Corixidae																												
Megaloptera																												
Sialidae																												
Sialis																												
Trichoptera																												
Hydroptilidae																												
Hydroptila																												
Orthotrichia																												
Polycentropidae																												
Cyrnellus																												
Neureclipsis																												
Leptoceridae																												
Oecetis													4		5				4							1.3	0.5	0.4
Unidentified																												
Trichopteran pupae																												
Diptera																												
Chironomidae																												
Tanypodinae													4													4	0.2	0.1
Ablabesmyia																												
A. annulata																												
A. mallochi																												
A. ornata																												
A. parajanta																												
A. tarella																												
Anatopynia																												

APPENDIX
Table 6, continued

Organism	Station / Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Tanypodinae, cont'd.																												
Clinotanypus																												
Coelotanypus			2							1			1	9	4			2	4	1	1					25	1.1	0.8
C. concinnus																												
C. scapularis																												
Nilotanypus																												
Pentaneura			1			4				1										1	1		1			9	0.4	0.3
Procladius				1	1		4								1		1			13	1	20	38		1	81	3.4	2.4
Tanypus																												
Chironominae																												
Chironomini																4										4	0.2	0.1
Chironomus																												
Cladopelma																												
Cryptochironomus		8	5	3	4			5	1	1	3	4				1	5		8	3	1		5			57	2.4	1.7
Cryptotendipes					5					4			16										4			29	1.2	0.9
Dicrotendipes																												
D. lobus																												
D. nervosus																												
Einfeldia																												
Endochironomus																												
E. sp.																												
E. nigricans																												
Glyptotendipes						4		8											2							14	0.6	0.4
Harnischia																												
Kiefferulus																												
Leptochironomus																												
Parachironomus																	1	4	4	1						10	0.4	0.3
P. monochromus																												
P. pectinatellae																												
Paracladopelma																												
Paralauterborniella																												
Paratendipes																												
P. connectens																												
P. subequalis																												
Polypedilum																												
P. halterale																1					1					2	0.1	T
P. illinoense																												
Pseudochironomus		1	1					4	3				4													13	0.5	0.4
Stictochironomus																												
S. devinctus																												
Tribelos																												
T. jucundus																												
Xenochironomus																3	2									5	0.2	0.2
Tanytarsini		4			1																	4				9	0.4	0.3
Cladotanytarsus										4	9					4		8	12	3						40	1.7	1.2
Micropsectra																												
Paratanytarsus																												
Rheotanytarsus																												
Tanytarsus		4				8		8								9	2		4	3	1					39	1.6	1.2
Orthocladiinae																												
Brillia																												
Corynoneura																												
Cricotopus																												
Psectrocladius																												
Rheocricotopus																												

APPENDIX
Table 6, continued

Organism	Station / Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	x̄	%
Chironomidae, cont'd.																												
Unidentified									4																	4	0.2	0.1
Chironomid pupae									4		4				4	4	1									17	0.7	0.5
Chironomid adults																												
Chaoboridae																												
Chaoborus					1																	37	24		1	63	2.6	1.9
Ceratopogonidae			4		4				4	4	4									9	15					44	1.8	1.3
Sumuliidae																												
Tipulidae																												
Hymenoptera																												
Ichneumonidae																												
Hydracarina																4					3					7	0.3	0.2
Mollusca																												
Gastropoda																												
Pelecypoda																												
Corbicula				53				21	36							20	40		8	1	1					179	7.5	5.4
TOTAL		102	59	119	57	182	25	302	139	175	124	109	196	90	280	190	107	148	178	140	57	129	128	43	230	3309		

*T denotes trace (<0.1).

APPENDIX
Table 7

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples taken at each of the 12 sampling stations on West Point Lake 5 December 1980.

Organism	Station 1		2		3		4		5		6		7		8		9		10		11		12		Total	$\bar{x}$	s
Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Nematoda	16	5			5					1	2	4	4			4							10	2	53	2.2	1.5
Planaria																											
Oligochaeta																											
Naididae	8		8		24	20																			60	2.5	1.7
Tubificidae	31	157	77	62	66	69	22	58	13	77	80	203	35	94		126	77	46	76	39	56	47	12	18	1664	69.3	46.1
Hirudinea										1								1							2	0.1	T*
Cladocera				4	4	4		1		1	14	8			1							4			41	1.7	1.1
Copepoda	24	2		2	12	20			12		19	28			8	12									139	5.8	3.8
Malacostraca																											
Isopoda																											
Amphipoda																											
Decapoda																											
Collembola																							2		2	0.1	T
Ephemeroptera																											
Ephemeridae																											
Hexagenia	13	1							14												4	4			36	1.5	1.0
Caenidae																											
Caenis																											
Ephemerellidae																											
Ephemerella																											
Unidentified																											
Odonata																											
Coenagrionidae																											
Argia																											
Gomphidae																											
Gomphus																											
Corduliidae																											
Hemiptera																											
Corixidae			1																						1	T	T
Megaloptera																											
Sialidae																											
Sialis																											
Trichoptera																											
Hydroptilidae																											
Hydroptila																											
Orthotrichia																											
Polycentropidae																											
Cyrnellus																											
Neureclipsis																											
Leptoceridae																											
Oecetis	4																								4	0.2	0.1
Unidentified																											
Trichopteran pupae																											
Diptera																											
Chironomidae																											
Tanypodinae																											
Ablabesmyia																											
A. annulata																											
A. mallochi																											
A. ornata																											
A. parajanta																											
A. tarella																											

APPENDIX
Table 7, continued

Organism	Station	1		2		3		4		5		6		7		8		9		10		11		12		Total	x̄	%
	Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Tanypodinae, cont'd.																												
Anatopynia																							1			1	T	T
Clinotanypus																												
Coelotanypus		9								27						1	1						4			42	1.8	1.2
C. concinnus																												
C. scapularis																												
Nilotanypus																												
Pentaneura		15								14							1									30	1.3	0.8
Procladius						4																	11			15	0.6	0.4
Tanypus																							1			1	T	T
Chironominae																												
Chironomini													4			4								1		9	0.4	0.2
Chironomus		3	4	2	3		9	1	1	2	6	17	10	26	71	49	53	2	1	48	27	15	5			355	14.9	9.8
Cladopelma																												
Cryptochironomus		12	27	8	8	34	39	1		1	1	9	53	2	12	4	6	10	9	1	4	1				242	10.2	6.7
Cryptotendipes																												
Dicrotendipes			1				4																			5	0.2	0.1
D. lobus																												
D. nervosus																												
Einfeldia																												
Endochironomus																												
E. sp.																												
E. nigricans																												
Glyptotendipes		4	1		1	2	3	1	1			8	11			12		1								45	1.9	1.2
Harnischia																												
Kiefferulus																												
Leptochironomus																												
Parachironomus		11	9		1	5					2	7														35	1.5	1.0
P. monochromus																												
P. pectinatellae																												
Paracladopelma																												
Paralauterborniella																												
Paratendipes																												
P. connectens																												
P. subequalis																												
Polypedilum		4																1								5	0.2	0.1
P. halterale																			1					6		7	0.3	0.2
P. illinoense																												
Pseudochironomus		73	13		3																					89	3.7	2.5
Stictochironomus																												
S. devinctus					1																					1	T	T
Tribelos																												
T. jucundus																												
Xenochironomus																												
Tanytarsini																												
Cladotanytarsus																												
Micropsectra																												
Paratanytarsus																												
Rheotanytarsus																												
Tanytarsus		8				4							8		4		36	1	1			5				67	2.8	1.8
Orthocladiinae																												
Brillia																												
Corynoneura																												

APPENDIX
Table 7, continued

Organism	Station / Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	x̄	%
Orthocladiinae, cont'd.																												
Cricotopus																												
Psectrocladius																												
Rheocricotopus																												
Unidentified		4															4									8	0.3	0.2
Chironomid pupae																												
Chironomid adult																												
Chaoboridae																												
Chaoborus																							21			21	0.9	0.6
Ceratopogonidae				1		4	4					2	5				4				4			7		31	1.3	0.9
Simuliidae																												
Tipulidae				1				1																		2	0.1	T
Hymenoptera																												
Ichneumonidae																												
Hydracarina												3												1		4	0.2	0.1
Mollusca																												
Gastropoda													4												1	5	0.2	0.1
Pelecypoda		60	128	176	8	40	12	19	16	64	6	2		4	8	8	4	6				4		16		581	24.4	16.1
Corbicula					1			1																		2	0.1	T
TOTAL		299	348	274	94	204	184	46	77	147	95	163	338	71	189	210	251	98	59	125	74	89	98	56	21	3610		

*T denotes trace (<0.1).

APPENDIX

Table 8

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples taken at each of the 12 sampling stations on West Point Lake 20 March 1981.

Organism	Station / Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Nematoda			8			2	8			1	1		3	2	1	4	4			1	4	2	6	4	6	57	2.4	3.3
Planaria																												
Oligochaeta																												
Naididae		2	5	7		23	33	1	1	3	1	10	2	3	1	1	4	9	2	1	1	4	5	4	4	127	5.3	7.4
Tubificidae			16	8	2	10	54	1	12	7	3	18	3	8	5	11	39	34	12	7	10	16	11	24	47	358	15.0	21.0
Hirudinea																												
Cladocera				3		1	2		2	1		2	1	1		1		1					1		2	18	0.8	1.1
Copepoda		6	3	3	6	29	16	2	1	2	4	2		3	4	5	25	31	4	1	2	2	8	1	3	163	6.8	9.6
Malacostraca																												
Isopoda																												
Amphipoda																						2				2	0.1	0.1
Decapoda																												
Collembola														2					1			1	2			6	0.3	0.4
Ephemeroptera																												
Ephemeridae																												
Hexagenia		11										1														12	0.5	0.7
Caenidae																												
Caenis												1														1	T*	T
Ephemerellidae																												
Ephemerella																												
Unidentified																												
Odonata																												
Coenagrionidae																												
Argia																												
Gomphidae																												
Gomphus																												
Corduliidae																												
Hemiptera																												
Corixidae																												
Megaloptera																												
Sialidae																												
Sialis																												
Trichoptera																												
Hydroptilidae																												
Hydroptila																												
Orthotrichia																												
Polycentropidae																												
Cyrnellus																												
Neureclipsis																												
Leptoceridae																												
Oecetis			1																							1	T	T
Unidentified																												
Trichopteran pupae																												
Diptera																												
Chironomidae																												
Tanypodinae			2				3															1				6	0.3	0.4
Ablabesmyia																												
A. annulata																												
A. mallochi																							1			1	T	T
A. ornata																						1				1	T	T
A. parajanta																												
A. tarella																												
Anatopynia																												
Clinotanypus																												

APPENDIX
Table 8, continued

Organism	Station 1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Tanypodinae, cont'd.																											
Coelotanypus	20																								20	0.8	1.2
C. concinnus																											
C. scapularis																											
Nilotanypus																											
Pentaneura	14																								14	0.6	0.8
Procladius	8	15	1		13	10			2			2						1			6	1			59	2.5	3.5
Tanypus																											
Chironominae																											
Chironomini																											
Chironomus		6			1	6	2		2				7	1	5		2				2	2			36	1.5	2.1
Cladopelma																											
Cryptochironomus	4	8	1	3	12	24	4	1		11	14	5	2	5	5	3		4	1	1			1		109	4.6	6.4
Cryptotendipes																					2				2	0.1	0.1
Dicrotendipes											2														2	0.1	0.1
D. lobus																					1				1	T	T
D. nervosus																3									3	0.1	0.2
Einfeldia																											
Endochironomus																											
E. sp.																											
E. nigricans																											
Glyptotendipes			1	1			12	1			7	6		1			3	3							35	1.5	2.0
Harnischia																											
Kiefferulus																			1						1	T	T
Leptochironomus																											
Parachironomus																											
P. monochromus																											
P. pectinatellae																											
Paracladopelma																						1			1	T	T
Paralauterborniella																											
Paratendipes																											
P. connectens																											
P. subequalis													2								10	7			19	0.8	1.1
Polypedilum		4			2	6					6			1		3		1	3	3		2			31	1.3	1.8
P. halterale																											
P. illinoense																											
Pseudochironomus			1																						1	T	T
Strictochironomus																											
S. devinctus																											
Tribelos																											
T. juncundus																			1		2	1	1		5	0.2	0.3
Xenochironomus																											
Tanytarsini	2				2					4								1							9	0.4	0.5
Cladotanytarsus			1	11	4		7		28	80	5	4	4	6	9	63	1	10							233	9.8	13.7
Micropsectra																					2	1			3	0.1	0.1
Paratanytarsus																											
Rheotanytarsus																											
Tanytarsus		8	1	6	12	27	1	1	7		9	3	5	4	2	6	1	9			10	10			122	5.1	7.2
Orthocladiinae																					1	1			2	0.1	0.1
Brillia																											
Corynoneura																											
Cricotopus																			1		2		1		4	0.2	0.2
Psectrocladius																											
Rheocricotopus																											

APPENDIX
Table 8, continued

Organism	Station / Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Chironomidae, cont'd.																												
Unidentified		1																								1	T	T
Chironomid pupae			1	2	2			1	2		1			2	4	2					1	3	4			25	1.1	1.5
Chironomid adult												1										1				2	0.1	0.1
Chaoboridae																												
Chaoborus			1																					1	1	3	0.1	0.2
Ceratopogonidae		22	6		1	5	9			4		7		9	2	1		1		2	3	4	10	2		88	3.7	5.2
Simuliidae		2				2																				4	0.2	0.2
Tipulidae						3										1								2	1	7	0.3	0.4
Hymenoptera																												
Ichneumonidae																												
Hydracarina		4	1	3					1	1		7														17	0.7	1.0
Mollusca																												
Gastropoda																												
Pelecypoda		2	1	65	11	2	8	1	1						2											93	3.9	5.5
Corbicula																												
TOTAL		98	86	97	43	123	206	32	23	58	105	92	28	50	38	46	151	82	49	19	25	75	74	41	64	1705		

*T denotes trace (<0.1).

APPENDIX

Table 9

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples taken at each of the 12 sampling stations on West Point Lake 8 June 1981.

Organism / Station	1		2		3		4		5		6		7		8		9		10		11		12		Total	$\bar{x}$	%
Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Nematoda	23	60	17	7	3	5	120	35	30	32	2	15	8	2	9	19	64	13	7	11	16	9	3	4	514	21.5	11.4
Planaria																					1				1	T*	T
Oligochaeta																											
Naididae					5	8	9	7	26	24		1	10	21	19	13		4	7	3	4	1			162	6.8	3.6
Tubificidae	10	6	3	3	52	25	36	85	200	49		32	64	50	32	77	23	72	63	18	63	17	126	50	1156	48.6	25.5
Hirudinea																											
Cladocera	2	2	5	6	5	8	2	4	7	9			1	10	14	10	1	7	24	13	11	7	1	3	152	6.4	3.4
Copepoda	1		6	1	3	1	13	12	9	14	1		4	27	58	21	58	51		1	4				285	12.0	6.3
Malacostraca																											
Isopoda																											
Amphipoda																											
Decapoda																											
Collembola												2									1				3	0.1	0.1
Ephemeroptera																											
Ephemeridae																											
Hexagenia																											
Caenidae																											
Caenis						1											2	1							4	0.2	0.1
Ephemerellidae																											
Ephemerella																											
Unidentified																											
Odonata																											
Coenagrionidae																											
Argia																											
Gomphidae																											
Gomphus																											
Cordullidae																											
Hemiptera																											
Corixidae																											
Megaloptera																											
Sialidae																											
Sialis					1						1	1													3	0.1	0.1
Trichoptera																											
Hydroptilidae																											
Hydroptila														1											1	T	T
Orthotrichia					1																				1	T	T
Polycentropidae																											
Cyrnellus						1		1																	2	0.1	T
Neureclipsis																											
Leptoceridae																											
Oecetis	1							2		3		3	1	2				3	2	5		2			24	1.0	0.5
Unidentified																											
Trichopteran pupae																											
Diptera																											
Chironomidae																											
Tanypodinae																											
Ablabesmyia																											
A. annulata					6	2				6						8		6							28	1.2	0.6
A. mallochi					11	5			10	36				11	37	25	29	12	4	13	29		1		223	9.4	4.9
A. ornata															9										9	0.4	0.2
A. parajanta	1											2	3												6	0.3	0.1
A. tarella						3			3																6	0.3	0.1

APPENDIX

Table 9, continued

Organism	Station / Sample Replicate	1		2		3		4		5		6		7		8		9		10		11		12		Total	$\bar{x}$	%
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Tanypodinae, cont'd.																												
Anatopynia																												
Clinotanypus																												
Coelotanypus																												
C. concinnus																												
C. scapularis																												
Nilotanypus																												
Pentaneura																												
Procladius		3	1	5	15	22	5	2	11	19			12		3	18	12	58	29	49	38	50	16			368	15.5	8.1
Tanypus																												
Chironominae																												
Chironomini													2													2	0.1	T
Chironomus		1														10										11	0.5	0.2
Cryptochironomus		3	4	24	15	16	5	6	9	13	24		11	37	32	10	17		17	15	25	14	13			310	13.0	6.8
Cladopelma						16	2	1																		19	0.8	0.4
Cryptotendipes								3		6			14										3			26	1.1	0.6
Dicrotendipes																												
D. lobus																9			17							26	1.1	0.6
D. nervosus																												
Einfeldia																												
Endochironomus																												
E. sp.																9		7	6							22	0.9	0.5
E. nigricans			1															7								8	0.3	0.2
Glyptotendipes		2					5		2		18		9	5		74	17	21	17			8	3			181	7.6	4.0
Harnischia								1																		1	T	T
Kiefferulus																												
Leptochironomus								2	2						3					4			7			18	0.8	0.4
Parachironomus																												
P. monochromus																												
P. pectinatellae																												
Paracladopelma									6	3	6							7	6	4	4		3			39	1.6	0.9
Paralauterborniella										3								7								10	0.4	0.2
Paratendipes																												
P. connectens																												
P. subequalis																												
Polypedilum																												
P. halterale			6	8	2	27	18	4		3	36		5	7	18	37	16	7		4	13	43	19	2	7	282	11.8	6.2
P. illinoense		8	5	11	3			2	2	3				5	3					7	4	7	10			70	2.9	1.5
Pseudochironomus					3		3																			6	0.3	0.1
Stictochironomus																												
S. devinctus																												
Tribelos																												
T. jucundus																												
Xenochironomus																												
Tanytarsini																												
Cladotanytarsus			1	5	10	6	8	1	11	6					4											52	2.2	1.1
Micropsectra			1			22	5	11	5	4	6		2	5	11			36	12					1		121	5.1	2.7
Paratanytarsus																			12							12	0.5	0.3
Rheotanytarsus																												
Tanytarsus		2	4	14	15	11	2	2	6	6	18				3	18	8		6	7	9	23	7			167	7.0	3.7
Orthocladinae																			5							5	0.2	0.1
Brillia																												
Corynoneura																												

APPENDIX
Table 9, continued

Organism / Station Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Orthocladiinae, cont'd.																											
Cricotopus																								1	1	T	T
Psectrocladius																											
Rheocricotopus																											
Unidentified	1																								1	T	T
Chironomid pupae		2	5	1	12	4	3	4	5	5		2	2	10	5	2	16	12	1						91	3.8	2.0
Chironomid adult																											
Chaoboridae																											
Chaoborus			2											1							14	16			33	1.4	0.7
Ceratopogonidae				1						1					2	5	1	2	1	1				1	15	0.6	0.3
Simuliidae																											
Tipulidae															1								2		3	0.1	0.1
Hymenoptera																											
Ichneumonidae																											
Hydracarina		2		1	1				1	1		1		1	1	2	1	2	1	3	5	1			24	1.0	0.5
Mollusca																											
Gastropoda										1		1						1							3	0.1	0.1
Pelecypoda	2	1	5	1		4		2				1			3			1			1				21	0.9	0.5
Corbicula																											
TOTAL	60	96	110	84	220	120	218	206	357	289	4	116	152	213	375	252	345	314	200	162	299	134	136	66	4528		

*T denotes trace (<0.1).

APPENDIX
Table 10

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 on West Point Lake 24 September 1980.

Organism	Station 1	2	3	4	5	6	7**	8**	9	10	11**	Total	$\bar{x}$	%
Nematoda	0.8		0.2	0.2		1.2			1.5	0.5		4.4	0.5	T*
Planaria														
Oligochaeta														
Naididae	4.2	0.5	3.2	3.5	1.0	19.0			18.8	38.5		88.7	11.1	0.8
Tubificidae														
Hirudinea										1.5		1.5	0.2	T
Cladocera	18.0	38.8	7.8	2.8	123.0	4332.0			4418.2			8940.6	1117.6	80.0
Copepoda	1.2	0.2							0.2	1.0		2.6	0.3	T
Amphipoda										0.5		0.5	T	T
Collembola														
Entomobryidae														
Ephemeroptera														
Ephemeridae														
Hexagenia										0.5		0.5	T	T
Caenidae														
Caenis	2.2	1.0	1.0	1.5	0.5							6.2	0.8	T
Ephemerellidae														
Ephemerella														
Heptageniidae														
Stenonema														
Leptophlebiidae														
Leptophlebia														
Siphlonuridae														
Isonychia														
Tricorythidae														
Tricorythodes														
Unidentified														
Odonata														
Coenagrionidae														
Argia									0.5	0.5		1.0	0.1	T
Coleoptera														
Elmidae														
Megaloptera														
Sialidae														
Sialis														
Trichoptera														
Leptoceridae														
Oecetis														
Hydropsychidae														
Hydropsyche														
Macronema														
Hydroptilidae														
Hydroptila														
Orthotrichia						0.2			7.0			7.2	0.9	T
Philopotamidae														
Chimarra														
Polycentropidae														
Cyrnellus	44.0	23.8	71.5	45.2	16.0	19.8			20.8	8.0		249.1	31.1	2.2
Neureclipsis														
Unidentified														
Trichopteran pupae		1.0	2.0	2.8	1.5	2.0			10.2	3.0		22.5	2.8	0.2
Trichopteran adult	0.2											0.2	T	T

APPENDIX
Table 10, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	x̄	%
Diptera															
Chironomidae															
Tanypodinae															
Ablabesmyia										4.2			4.2	0.5	T
A. americana															
A. annulata															
A. mallochi		3.0	1.8				5.5			14.2	0.5		25.0	3.1	0.2
A. ornata															
A. parajanta				0.8			2.0						2.8	0.4	T
A. tarella															
Clinotanypus															
Coelotanypus															
C. concinnus															
C. scapularis															
Labrundinia															
L. johannseni															
Pentaneura															
Procladius															
Chironominae															
Chironomini		2.0	3.2		2.8		4.0			11.5			23.5	2.9	0.2
Chironomus					4.0								4.0	0.5	T
Cryptochironomus															
C. blarina															
C. fulvus															
Cryptotendipes															
Dicrotendipes		15.0	71.5	26.0	13.5	72.0	39.0			66.8	6.5		310.3	38.8	2.8
D. lobus		3.2	28.2	5.5	21.2		10.2			27.5			95.8	12.0	0.9
D. nervosus		8.5	44.2	16.2	27.8		38.2			87.0			221.9	27.7	2.0
Einfeldia						5.5							5.5	0.7	T
Endochironomus															
E. nigricans															
Glyptotendipes		57.2	131.5	31.8	104.2	114.0	120.2			485.5	8.5		1052.9	131.6	9.4
Harnischia															
Leptochironomus															
Nilothauma															
Parachironomus															
P. carinatus															
P. directus															
P. monochromus				0.5			2.8				1.5		4.8	0.6	T
P. pectinatellae															
Paracladopelma															
Polypedilum															
P. convictum															
P. halterale															
P. illinoense															
Pseudochironomus															
Tribelos															
Xenochironomus															

APPENDIX
Table 10, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Chironominae, cont'd.															
Tanytarsini			0.8	12.0									12.8	1.6	0.1
Cladotanytarsus															
Micropsectra															
Rheotanytarsus															
Tanytarsus															
Orthocladiinae											0.5		0.5	T	T
Brillia															
Corynoneura															
Cricotopus							2.0						2.0	0.2	T
C. bicinctus															
C. sp. T															
Eukiefferiella															
E. cerulescens															
Psectrocladius															
P. vernalis											0.5		0.5	T	T
Rheocricotopus															
Thienemanniella															
Unidentified										7.2			7.2	0.9	T
Chironomid pupae		1.8	5.2	1.0	0.2	4.5	10.8			15.2			38.7	4.8	0.3
Chiromonid adults			1.0							0.2			1.2	0.1	T
Empididae															
Simuliidae															
Ceratopogonidae															
Hydracarina		0.2	1.8		0.2						0.5		2.7	0.3	T
Hydra											2.5		2.5	0.3	T
Mollusca															
Gastropoda		0.2		0.2	0.2					0.2			0.8	0.1	T
Pelecypoda		0.5	1.8	0.2	2.5	3.0				1.8	11.5		21.3	2.7	0.2
TOTAL		162.0	356.5	179.9	232.6	341.0	4608.9			5198.5	86.5		11165.9		

*Trace denotes trace (<0.1).
**No data from these stations.

APPENDIX
Table 11

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 on West Point Lake 27 January 1981.

Organism	Station	1	2	3	4	5	6	7**	8	9	10	11**	Total	$\bar{x}$	%
Nematoda			0.2										0.2	T*	T
Planaria															
Oligochaeta															
Naididae		4.8	0.2	0.2	4.0	1.8	8.5		8.5	1.0			29.0	3.2	6.7
Tubificidae									0.2				0.2	T	T
Hirudinea					0.5		0.2						0.7	T	0.2
Cladocera		16.5	50.8	5.2	17.2	39.5	188.5		8.5	26.2	2.2		354.6	39.4	82.3
Copepoda			0.2										0.2	T	T
Amphipoda															
Collembola															
Entomobryidae															
Ephemeroptera															
Ephemeridae															
Hexagenia															
Caenidae															
Caenis															
Ephemerellidae															
Ephemerella															
Heptageniidae															
Stenonema															
Leptophlebiidae															
Leptophlebia															
Siphlonuridae															
Isonychia															
Tricorythidae															
Tricorythodes															
Unidentified															
Odonata															
Coenagrionidae															
Argia															
Coleoptera															
Elmidae															
Megaloptera															
Sialidae															
Sialis															
Trichoptera															
Leptoceridae															
Oecetis															
Hydropsychidae															
Hydropsyche															
Macronema															
Hydroptilidae															
Hydroptila			0.8										0.8	0.1	0.2
Orthotrichia															
Philopotamidae															
Chimarra															
Polycentropidae															
Cyrnellus															
Neureclipsis															
Unidentified															
Trichopteran pupae															
Trichopteran adult															

APPENDIX

Table 11, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	X̄	%
Diptera															
Chironomidae															
Tanypodinae															
Ablabesmyia															
A. americana															
A. annulata															
A. mallochi															
A. ornata															
A. parajanta															
A. tarella															
Clinotanypus															
Coelotanypus															
C. concinnus															
C. scapularis															
Labrundinia															
L. johannseni															
Pentaneura															
Procladius															
Chironominae															
Chironomini															
Chironomus					0.2	0.2			0.5				0.9	0.1	0.2
Cryptochironomus						0.2							0.2	T	T
C. blarina															
C. fulvus															
Cryptotendipes															
Dicrotendipes			0.8			0.2			0.2		0.2		1.4	0.2	0.3
D. lobus															
D. nervosus															
Einfeldia															
Endochironomus															
E. nigricans							0.5						0.5	T	0.1
Glyptotendipes		0.5	0.5	0.2	0.5	1.5	8.0		0.5	0.5			12.2	1.4	2.8
Harnischia															
Leptochironomus															
Nilothauma															
Parachironomus															
P. carinatus															
P. directus															
P. monochromus															
P. pectinatellae															
Paracladopelma															
Polypedilum															
P. convictum															
P. halterale															
P. illinoense															
Pseudochironomus															
Tribelos															
Xenochironomus															

APPENDIX
Table 11, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	X̄	%
Tanytarsini															
Cladotanytarsus						0.2	0.2						0.4	T	0.1
Micropsectra															
Rheotanytarsus															
Tanytarsus						0.2				0.2			0.4	T	0.1
Orthocladiinae		0.2	0.2		0.2								0.6	T	0.1
Brillia															
Corynoneura															
Cricotopus		2.2	1.5	0.5		1.0	0.5				13.0		18.7	2.1	4.3
C. bicinctus															
C. sp. I															
Eukiefferiella															
E. cerulescens															
Psectrocladius					0.2		1.0		0.5		3.0		4.7	0.5	1.1
P. vernalis															
Rheocricotopus		0.2											0.2	T	T
Thienemanniella															
Unidentified															
Chironomid pupae							0.2		0.2		0.8		1.2	0.1	0.3
Chironomid adult											0.2		0.2	T	T
Empididae															
Simuliidae															
Ceratopogonidae															
Hydracarina							0.2						0.2	T	T
Hydra															
Mollusca															
Gastropoda										1.0			1.0	0.1	0.2
Pelecypoda		0.8	1.5				0.2						2.3	0.3	0.5
TOTAL		25.2	56.7	6.1	22.8	44.8	207.8		19.1	28.9	19.4		430.8		

*T denotes trace (<0.1).
**No data from these stations.

APPENDIX
Table 12

Mean number of macroinvertebrates (organisms/ft^2 = ogranisms/0.093 m^2) collected from plate samples taken at stations 1-11 on West Point Lake 28 April 1981.

Organism	Station 1	2	3**	4	5**	6	7**	8	9	10**	11	Total	$\bar{x}$	%
Nematoda		0.5							1.0			1.5	0.2	T*
Planaria														
Oligochaeta														
Naididae	8.0	18.5		33.0		3.0		3.2	18.0		30.0	113.7	16.2	0.7
Tubificidae														
Hirudinea														
Cladocera	251.3	1111.2		439.2		5040.0		6456.0	698.5		224.3	14220.5	2031.5	88.8
Copepoda														
Amphipoda														
Collembola														
Entomobryidae														
Ephemeroptera														
Ephemeridae														
Hexagenia														
Caenidae														
Caenis														
Ephemerellidae														
Ephemerella														
Heptageniidae														
Stenonema														
Leptophlebiidae														
Leptophlebia														
Siphlonuridae														
Isonychia														
Tricorythidae														
Tricorythodes														
Unidentified														
Odonata														
Coenagrionidae														
Argia								0.2				0.2	T	T
Coleoptera														
Elmidae														
Megaloptera														
Sialidae														
Sialis														
Trichoptera														
Leptoceridae														
Oecetis														
Hydropsychidae														
Hydropsyche														
Macronema														
Hydroptilidae														
Hydroptila														
Orthotrichia		2.8										2.8	0.4	T
Philopotamidae														
Chimarra														
Polycentropidae														
Cyrnellus	2.5			3.5								6.0	0.9	T
Neureclipsis														
Unidentified		0.5		0.2					0.2			0.9	0.1	T
Trichopteran pupae						0.5		1.3	0.5		0.2	2.5	0.3	T
Trichopteran adult														

APPENDIX
Table 12, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Diptera															
Chironomidae															
Tanypodinae															
Ablabesmyia															
A. americana															
A. annulata															
A. mallochi							2.5			3.0			5.5	0.8	T
A. ornata															
A. parajanta							0.2						0.2	T	T
A. tarella															
Clinotanypus															
Coelotanypus															
C. concinnus															
C. scapularis															
Labrundinia															
L. johannseni															
Pentaneura															
Procladius															
Chironominae															
Chironomini															
Chironomus															
Cryptochironomus															
C. blarina															
C. fulvus															
Cryptotendipes												0.5	0.5	T	T
Dicrotendipes			5.2				12.5		7.3	1.8			26.8	3.8	0.2
D. lobus							1.5					0.7	2.2	0.3	T
D. nervosus					44.0		1.5		180.3	91.5		47.0	364.3	52.0	2.3
Einfeldia		1.8	64.0										65.8	9.4	0.4
Endochironomus															
E. nigricans							0.2					0.7	0.9	0.1	T
Glyptotendipes		119.5	126.2		300.0		5.0		370.3	181.0		10.7	1112.7	158.9	6.9
Harnischia															
Leptochironomus															
Nilothauma															
Parachironomus															
P. carinatus															
P. directus															
P. monochromus							1.5		7.3				8.8	1.3	T
P. pectinatella															
Paracladopelma															
Polypedilum															
P. convictum															
P. halterale															
P. illinoense															
Pseudochironomus															
Tribelos															
Xenochironomus															

APPENDIX
Table 12, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Chironominae, cont'd.															
Tanytarsini															
Cladotanytarsus															
Micropsectra															
Rheotanytarsus												0.7	0.7	0.1	T
Tanytarsus							0.2						0.2	T	T
Orthocladiinae															
Brillia															
Corynoneura															
Cricotopus		8.2	2.5				5.0		8.3			1.0	25.0	3.6	0.1
C. bicinctus															
C. sp.I															
Eukiefferiella															
E. cerulescens															
Psectrocladius															
P. vernalis							0.8						0.8	0.1	T
Rheocricotopus															
Thienemanniella															
Unidentified															
Chironomid pupae		3.8	7.8		13.8		1.5		13.3	5.0		5.7	50.9	7.3	0.3
Chironomid adult		0.8	0.5		0.2		0.2		0.3	0.2		0.7	2.9	0.4	T
Empididae															
Simuliidae															
Ceratopogonidae												0.3	0.3	T	T
Hydracarina															
Hydra															
Mollusca															
Gastropoda							0.8						0.8	0.1	T
Pelecypoda															
TOTAL		395.9	1393.7		833.9		5076.9		7047.8	1000.7		322.5	16017.4		

*T denotes trace (<0.1).
**No data from these stations.

APPENDIX
Table 13

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 on West Point Lake 4 August 1981.

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	s
Nematoda		0.2			0.5		3.8		2.0	0.2			6.7	0.6	0.2
Planaria				3.2	1.8		2.0	1.2					8.2	0.7	0.3
Oligochaeta															
Naididae		0.2				0.5				0.5			1.2	0.1	T*
Tubificidae							0.5						0.5	T	T
Hirudinea				0.2									0.2	T	T
Cladocera			4.3	0.2	0.2	0.5	0.5		0.5		1.2		7.4	0.7	0.3
Copepoda		0.2								0.2			0.4	T	T
Amphipoda															
Collembola															
Entomobryidae															
Ephemeroptera															
Ephemeridae															
Hexagenia															
Caenidae															
Caenis		1.5			0.2	4.0	0.2	0.2	1.0	0.8	0.5		8.4	0.8	0.3
Ephemerellidae															
Ephemerella															
Heptageniidae															
Stenonema															
Leptophlebiidae															
Leptophlebia															
Siphlonuridae															
Isonychia															
Tricorythidae															
Tricorythodes															
Unidentified				0.2									0.2	T	T
Odonata															
Coenagrionidae															
Argia		0.5					1.8				1.5		3.8	0.3	T
Coleoptera															
Elmidae															
Megaloptera															
Sialidae															
Sialis							0.2						0.2	T	T
Trichoptera															
Leptoceridae															
Oecetis					0.2		0.5		1.0				1.7	0.1	T
Hydropsychidae															
Hydropsyche															
Macronema															
Hydroptilidae															
Hydroptila		0.2											0.2	T	T
Orthotrichia		0.5				1.0	4.0	3.2	2.5	1.2	2.2		14.6	1.3	0.6
Philopotamidae															
Chimarra															
Polycentropidae															
Cyrnellus		26.0	1.3	48.5	19.8	39.8	3.0	43.8	3.5	40.2	71.8	115.8	413.5	37.6	17.1
Neureclipsis								2.0					2.0	0.2	T
Unidentified							0.2						0.2	T	T
Trichopteran pupae		0.5		0.2	1.0	1.2	4.0	1.8	3.0	1.0	4.8	3.0	20.5	1.9	0.8
Trichopteran adult															

APPENDIX
Table 13, continued

Organism	Station 1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	s
Diptera														
Chironomidae														
Tanypodinae														
Ablabesmyia	1.5				1.2	0.5				1.5	1.5	6.2	0.6	0.2
A. americana						4.0						4.0	0.4	0.1
A. annulata														
A. mallochi	0.2	0.3	1.0		3.2		16.0	10.5	4.8			36.0	3.3	1.5
A. ornata	0.2					4.0	3.8					8.0	0.7	0.3
A. parajanta				2.5	5.5	2.2	13.2	51.2	8.2	4.5	18.0	105.3	9.6	4.4
A. tarella		0.3										0.3	T	T
Clinotanypus														
Coelotanypus														
C. concinnus														
C. scapularis														
Labrundinia														
L. johannseni						1.8						1.8	0.2	T
Pentaneura				2.5					2.0			4.5	0.4	0.2
Procladius														
Chironominae														
Chironomini			0.2			1.8	2.0					4.0	0.4	0.1
Chironomus														
Cryptochironomus														
C. blarina														
C. fulvus														
Cryptotendipes														
Dicrotendipes	4.2		2.8	11.5	0.2		4.0		1.8	11.0	7.5	43.0	3.9	1.8
D. lobus	4.2	0.3	2.0		0.8	0.5	0.5					8.3	0.7	0.3
D. nervosus	7.0		1.3	19.5	1.8		24.0	6.2	7.0	59.2	89.8	215.8	19.6	8.9
Einfeldia									41.8			41.8	3.8	1.7
Endochironomus														
E. nigricans						0.5						0.5	T	T
Glyptotendipes	92.5	3.3	16.8	178.0	50.8	141.2	73.2	648.2	76.2	48.8	14.8	1343.8	122.2	55.7
Harnischia														
Leptochironomus		0.7	0.5									1.2	0.1	T
Nilothauma														
Parachironomus	0.2	0.7				0.2			1.5		3.8	6.4	0.6	0.3
P. carinatus														
P. directus														
P. monochromus														
P. pectinatellae											1.5	1.5	0.1	T
Paracladopelma														
Polypedilum														
P. convictum														
P. halterale														
P. illinoense														
Pseudochironomus														
Tribelos														
Xenochironomus														

APPENDIX
Table 13, continued

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Chironominae, cont'd.															
Tanytarsini															
Cladotanytarsus							0.5						0.5	T	T
Micropsectra															
Rheotanytarsus															
Tanytarsus			0.7										0.7	T	T
Orthocladiinae															
Brillia															
Corynoneura															
Cricotopus															
C. bicinctus															
C. sp. I															
Eukiefferiella															
E. cerulescens															
Psectrocladius							2.0			1.5			3.5	0.3	0.1
P. vernalis															
Rheocricotopus															
Thienemanniella															
Unidentified				0.8									0.8	T	T
Chironomid pupae		1.8	0.7		29.0	0.5	0.8	17.0	9.5	6.0	4.5	3.8	73.6	6.7	3.0
Chironomid adult					2.0							0.5	2.5	0.2	0.1
Empididae															
Simuliidae															
Ceratopogonidae							4.8						4.8	0.4	0.2
Hydracarina							0.2		2.5	0.8		0.5	4.0	0.4	0.1
Hydra															
Mollusca															
Gastropoda					0.2	1.0		0.2	0.5				1.9	0.2	T
Pelecypoda															
TOTAL		141.6	12.6	77.9	268.9	112.0	185.7	206.1	742.1	195.7	211.5	260.5	2414.6		

*T denotes trace (<0.1).

END

FILMED

3-85

DTIC