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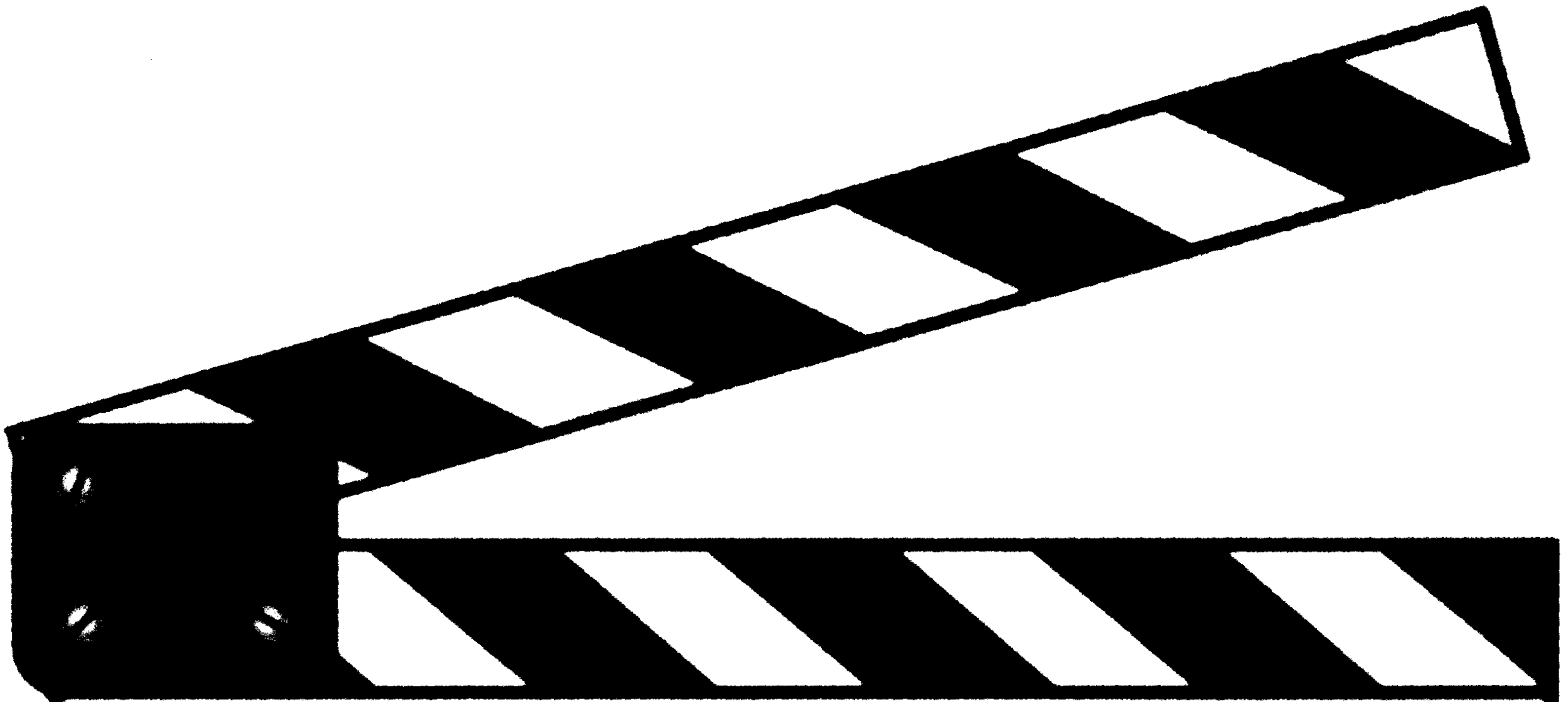

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THE SPATIAL DISTRIBUTION OF PHYTOPLANKTON IN WESTHAMPTON LAKE, RICHMOND, VIRGINIA

BY

JAMES WILLIAM NEWLIN

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

OF THE UNIVERSITY OF RICHMOND

IN CANDIDACY

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THE SPATIAL DISTRIBUTION OF PHYTOPLANKTON

IN WESTHAMPTON LAKE, RICHMOND, VIRGINIA

BY

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ABSTRACT

The hypothesis that spatial distributions of phytoplankton standing crop and photosynthetic capacity in Westhampton Lake are homogeneous was tested. Distributions were analyzed with respect to horizontal and vertical planes separately and combined. The study was divided into three time periods: 1) late summer stratification, 2) early fall mixing, and 3) fall turnover, based on isothermal lines of the lake at the deepest station. Phytoplankton standing crop was measured by spectrophotometric and fluorometric methods. The photosynthetic capacity was measured fluorometrically.

Combined horizontal and vertical spatial distribution of standing crop was clumped for the entire lake and during each time period. Most clumping was vertical rather than horizontal. Vertical clumping was not exhibited at all stations and was not consistent for the stations for each time period. Vertical clumping was most evident at the deepest station for the first two periods. Horizontal distribution was random for each of the three periods when each of the nine stations was analyzed separately. Standing crop was significantly greater at the downlake transect than the other two transects during each of the first two periods.

The combined horizontal and vertical spatial distribution of photosynthetic capacity was random for the entire lake and during the last two periods. Horizontal distributions for both periods were random. Vertical distributions were random, except for the deepest station which was clumped during early fall mixing.

The standing crop was a poor index of photosynthetic capacity as indicated by low coefficients of correlation.

INTRODUCTION

Spatial distribution of organisms may be random, homogeneous, or clumped (Smith, 1974). In a random distribution, the position of each individual is independent of the others; in a homogeneous distribution, individuals are evenly positioned; and in a clumped distribution, individuals are aggregated. The most common distribution is clumped, then homogeneous. Random distributions rarely occur (Smith, 1974).

Limnologists often assume that the surface mixed layer of lakes is homogeneous (Hutchinson, 1961), and that the horizontal variations in phytoplankton standing crop and productivity are minor (Wetzel, 1975). Exceptions are large lakes with strong gradients and sharp discontinuities resulting from complex basins and land drainage regions (Glooschenko, et al., 1974, and Hecky and Kling, 1981) and small lakes with well developed littoral zones (Wetzel, 1975) in which phytoplankton are clumped. In certain small lakes without such obvious gradients and discontinuities, phytoplankton are also clumped (Richards and Happey-Wood, 1979).

Lakes that are vertically stratified, e.g., temperate lakes in the summer, frequently have phytoplankton populations that are clumped vertically (Berman, 1972; and Reynolds, 1976). In unstratified lakes, vertical distribution of phytoplankton ranges from clumped (Moss, 1972) to homogeneous (Brooks and Torke, 1977; and Moss, 1972). The vertical distribution varies with the mixing conditions and is species specific (Moss, 1972).

Few studies have examined simultaneously horizontal and vertical distributions of phytoplankton in small eutrophic lakes. Those that have were limited to the period of summer stratification and distributions were clumped in both planes (George and Heaney, 1978; and Harris and Smith, 1977).

The present study examined horizontal and vertical spatial distributions of phytoplankton in a small lake for each of the time periods: late summer stratification, early fall mixing, and fall turnover. The lake had no obvious horizontal gradients or discontinuities. The hypothesis tested is that the phytoplankton had homogeneous distributions regardless of the state of mixing.

MATERIALS AND METHODS

The study was conducted in Westhampton Lake, Richmond, Virginia. The lake is eutrophic and dimictic with a surface area of 51,400 m^2 and a volume of 145,000 m^3. It is approximately 525 m long, with mean and maximum depths of 2.5 and 6 m, respectively.

Lake properties were measured at half meter intervals of depth from the surface to the bottom at three stations along three transects (Fig. 1) between September 23 and December 4, 1980. Water samples for estimates of phytoplankton standing crop and photosynthetic capacity were collected from a boat with a garden hose connected to a pump (Teel) powered by a generator (Sears 1400 watt). The samples were taken after the hose was at the collection site for 8 sec (time required to clear water from previous site). They were placed in labeled 200 ml clean glass jars and returned to the laboratory.

Concentrations of dissolved oxygen and water temperatures were measured directly from the lake with an oxygen meter (YSI Model 54). The oxygen meter was calibrated each date according to the instructions (Yellow Springs Instrument Co., 1968). The thermistor was calibrated once against a mercury thermometer (VWR Scientific Inc.). Both registered 0^0 C in ice water and the same values between 0^0 and 30^0 C.

Phytoplankton standing crop was estimated by two methods: 1) fluorometry and 2) spectrophotometry. Fluorometry was measured according to method of Lorenzen (1966). A water sample of 5 ml was put in a clean glass cuvette which was placed in a fluorometer (Turner Model 111 modified for in vivo chlorophyll measurements). The primary and secondary filters in the fluorometer corrected for turbidity (Turner Associates, 1975). It was felt, however, that the effect of turbidity on chlorophyll a fluorescence should be examined because the range of turbidity in the lake was great. Five ml of a water sample with an actual turbidity of 25 JTU and a fluorescence of 39 were used. The turbidity was increased roughly by intervals of 5 JTU up to 80 JTU and the fluorescence readings remained at 39. This showed that chlorophyll a fluorescence was not affected by turbidity. The fluorometric method did not distinguish pheopigment from chlorophyll a.

For the spectrophotometric method a water sample of 200 ml was filtered onto a 5.5 cm glass microfiber filter (Whatman GF/C). A small amount of $MgCO_3$ was added using six filter holders (Millipore Pyrex) and a vacuum pump (Welch Duo-Seal Model 1400). The filters were folded and placed in labeled support pads (Millipore MF) and stored in a refrigerated desiccator at 10° C.

The filters were trimmed and ground in a tissue grinder (Teflon) run by a motor (Eberbach Con-Torque). They were extracted with 90% acetone and 10% water. The extract was transferred to a 15 ml centrifuge tube and brought to a final volume of 10 ml with 90% acetone. The tubes were covered with Parafilm and placed in the refrigerator overnight to allow for maximum extraction; they were centrifuged the next day. The supernatant was transferred to 1 cm cuvettes and the absorbance was read on a spectrophotometer (Bausch and Lomb Spectronic 70) at 665 and 750 mμ. Two drops of 1 N HCL were added and read again at 665 and 750 mμ. These readings were entered into Lorenzen's equations and yielded estimates of chlorophyll a and pheopigment. This technique corrected for turbidity and pheopigment and did not measure any other chlorophylls (Lorenzen, 1967).

Photosynthetic capacity was measured by the method of Samuelsson et al. (1977). By this method the photosynthetic capacity was estimated by fluorescence increase after 3—(3,4—dichlorophenyl)—1,1—dimethyl urea was added to the samples. This herbicide inhibits photosynthesis by stopping electron transport which results in chlorophyll fluorescence reaching maximum. The same 5 ml of samples previously used in the fluorometer were changed to another clean glass cuvette and one drop of herbicide was added to make a final concentration of 10^{-5}M. The fluorescence was read again after the dial stopped increasing or at least 15 sec later. The 15 sec interval was adequate for detecting minor fluorescence changes.

The turbidity of the top four depths at each of the nine stations was measured on a turbidometer (Hach Portable Water Engineer's Laboratory Model DR-EL).

Contour maps of lake properties were produced by the computer program SYMAP (Dougenik, et al., 1977). The variance to mean ratio method (Cox, 1980) was used to test the extent to which the spatial

Contour maps of lake properties were produced by the computer program SYMAP (Dougenik, et al., 1977). The variance to mean ratio method (Cox, 1980) was used to test the extent to which the spatial distributions of standing crop and photosynthetic capacity in the lake were homogeneous. Analyses of variance (ANOVA) and Scheffe multiple range tests were done by the computer program SPSS (Nie, et al., 1975). They were used to test the relation of the measured lake properties with the transects, stations, and depths. The .05 level of significance was used in all statistical tests.

RESULTS

Isothermal lines of the lake at the middle (deepest) station at the downlake transect during the study are shown in Fig. 2. From September 23 to October 2, the lake was strongly stratified. Surface temperatures ranged from 20° C and above compared to the bottom temperatures of less than 15° C. From October 7 to October 23, the lake was partially stratified. Surface temperatures were 15° C and above compared with bottom temperatures of less than 15° C. From October 30 to December 4, the lake was unstratified. These temperature profiles of the lake were used to separate the study into three time periods: 1) late summer stratification, 2) early fall mixing (partial mixing), and 3) fall turnover.

Three distinct layers, 10-15, 15-20, and 20-25° C, existed during late summer stratification (Fig. 3). Two layers, 10-15 and 15-20° C, existed during early fall mixing (Fig. 4). During fall turnover the lake was relatively isothermal from the surface to the bottom (Fig. 5).

Lake temperatures varied significantly with depth during late summer stratification and early fall mixing, but did not vary horizontally (Tables 1 and 2). Lake temperatures did not vary significantly horizontally or vertically in fall turnover (Table 3).

The lake was stratified with respect to the concentrations of dissolved oxygen throughout most of the study (Fig. 6). From September 23 to October 23 the concentrations were greater than 5 PPM at 3 m depth and above and less than 5 PPM below 3 m. From October

30 to November 14 the concentrations were greater than 5 PPM at most depths. From November 25 to December 4 concentrations were greater than 10 PPM at most depths.

Concentrations of dissolved oxygen for the lake varied significantly with depth during all three time periods (Tables 4, 5, and 6). During the early fall mixing period dissolved oxygen concentrations were significantly related to the transect alone and the interaction of transect and depth (Table 5).

Standing Crop

The two measures of standing crop, fluorometric and spectrophotometric readings of chlorophyll a were significantly correlated (Tables 7 and 8). Fluorometric measurements were also significantly correlated with spectrophotometric readings of pheopigment (Tables 7 and 8). As fluorometric measurements included pheopigment and chlorophyll a, they were considered a less valid index of standing crop. Therefore, only spectrophotometer readings of chlorophyll a were used as an index of standing crop. Concentrations of chlorophyll a for each of the three time periods were analyzed with respect to horizontal and vertical spatial distribution.

Period One. Late Summer Stratification

Combined horizontal and vertical spatial distribution of chlorophyll a was clumped for the entire lake (Table 9). Horizontal distribution of each of the nine stations was random. Vertical distribution was clumped for all stations at the downlake transect and the west station of the middle transect (Table 10). Vertical distribution was random for all other stations.

At the downlake transect chlorophyll a had strong vertical stratification (Fig. 7). The densest concentrations (> 60 mg/m^3) were at the middle station at depths of 0.5, 3.5 to 4, and 6 m. The lowest concentrations (< 20 mg/m^3) were at middle depths, 2 to 3 m, on the west side and middle station. At the middle transect chlorophyll a was less vertically stratified (Fig. 8). Lower concentrations (< 20 mg/m^3) were at depths around 2.5 m along this transect. Concentrations at the uplake transect were almost uniform with lower ones (< 20 mg/m^3) at the bottom on the west side and at 1.5 m and the bottom on the east side (Fig. 9).

Concentrations of chlorophyll a varied significantly with transect and depth alone and with the interaction of transect and depth (Table 11). Concentrations of chlorophyll a at the downlake transect were significantly greater than those at the other two transects (Table 12). Concentrations at the depth of 4 m were significantly greater than those at 2, 2.5, and 3 m (Table 13).

Period Two. Early Fall Mixing

Combined horizontal and vertical spatial distribution of chlorophyll a was clumped for the entire lake (Table 9). Horizontal distributions were random for all stations. The vertical distribution was clumped only for the middle station at the downlake transect (Table 10). Vertical distribution for all other stations was random.

At the downlake transect chlorophyll a was stratified (Fig. 10). The densest concentrations (> 60 mg/m^3) were at 5 to 6 m at the middle station. The lowest concentrations (< 20 mg/m^3) were at mid depths and on the east side. At the middle transect the densest concentrations (20 to 40 mg/m^3) extended from the middle to east stations from depths 0.5 to 1.5 and 1.5 to 2 m, respectively (Fig. 11). At the uplake transect there were several less dense concentrations (< 20 mg/m^3) (Fig. 12).

Chlorophyll a varied significantly with transect and depth (Table 14). The concentrations at the downlake transect were significantly greater than those at the middle transect (Table 12). The densest concentrations were at 5 to 6 m depth which were significantly greater than those at 4.5 m and above (Table 13). Concentrations at 4.5, 5, and 6 m depth were significantly greater than those at 4 m and above. Concentrations at 4.5 m depth were significantly greater than those at 3 m.

<u>Period Three.</u> Fall Turnover

Combined horizontal and vertical spatial distribution of chlorophyll a was clumped for the entire lake (Table 9). Horizontal distributions were random for all stations. The vertical distribution was clumped for the entire middle transect and the west station of the uplake transect (Table 10). Vertical distributions for all other stations were random. At all three transects there was vertical stratification with a denser concentration (20 to 40 mg/m^3) on top (Figs. 13, 14, and 15). Chlorophyll a varied significantly with depth (Table 13), however, average values of chlorophyll a did not differ significantly with transect or depth (Tables 12 and 13).

Photosynthetic Capacity

Fluorescence increase (F.I.), fluorescence after the addition of herbicide, was an index of photosynthetic capacity and was measured only during the periods of early fall mixing and fall turnover.

Period Two. Early Fall Mixing

Combined horizontal and vertical spatial distribution of F.I. was random for the entire lake. Horizontal distributions were random at all stations. The vertical distribution was clumped for the middle station at the downlake transect (Table 16) and random for all other stations. At the downlake transect the F.I. was vertically stratified with the greatest F.I. (6 to 9) being just below the surface to 3.5 m depth (Fig. 16). There was a less dense pocket (3 to 6) at 1.5 m at the middle station. At the middle transect the F.I. varied both vertically and along the transect with areas of F.I. in the ranges of 3 to 6 and 6 to 9 (Fig. 17). At the uplake transect the F.I. was the same at the middle station and most of the west side (Fig. 18). On the east side the lowest F.I. (3 to 6) was at the surface and the greatest increase (9 to 15) near the bottom of the lake.

F.I. varied significantly with depth (Table 17).

Period Three. Fall Turnover

Combined horizontal and vertical spatial distribution of F.I. was random for the entire lake. The horizontal and vertical distributions were random for all stations. At the downlake transect the F.I. was the same (3 to 6) at the west side and at the middle station below 2.5 m (Fig. 19). The greatest F.I. (9 to 15) was at the middle station continuing to the east side at depths of 1 to 1.5 m and 0.5 to 1 m, respectively. It was also located at 3.5 m on the east side. At the middle transect the greatest F.I. (6 to 9) was at depths of 0 to 0.5 m at the west station, 3 m at the middle station, and at 1 to 2 m on the east side (Fig. 20). At the uplake transect the greatest F.I. (9 to 15) was at 1 m depth at the middle station with a patch of less F.I. (6 to 9) around it at the middle station and continuing to the west side (Fig. 21).

There was no significant variation in F.I. (Table 18).

Relation of Photosynthetic Capacity to Standing Crop

The photosynthetic capacity and standing crop were poorly correlated (Table 19). During early fall mixing photosynthetic capacity and standing crop were negatively correlated for the total water column and depths of 4 to 6 m. During fall turnover they were positively correlated for depths of 0 to 1 and 0 to 2 m. The change from negative to positive correlations and lack of significant correlations at all depths indicated that standing crop was a poor index of photosynthetic capacity.

DISCUSSION

In Westhampton Lake the spatial distribution of phytoplankton standing crop and photosynthetic capacity was not homogeneous for any of the three periods of the study; therefore, the hypothesis of homogeneous distributions was rejected. Combined horizontal and vertical spatial distributions of phytoplankton standing crop were clumped for the entire lake and during each of the three time periods. Most clumping was vertical rather than horizontal. For each time period, the standing crop varied significantly with depth.

Vertical clumping was not exhibited at all nine stations and was not consistently observed at any one station for each time period. The depths of maximum concentration varied with the time period and station. Most vertical clumping was during late summer stratification and fall turnover when clumping occurred at four stations. Vertical distribution of standing crop was random at the remaining five stations. During early fall mixing standing crop was clumped only at one station and random at the other stations. Clumping was most evident at the downlake transect during late summer stratification and partial mixing and at the middle transect during fall turnover.

The observations of vertical clumping of the standing crop in Westhampton Lake during late summer stratification is consistent with numerous previous studies (Bishop, 1971; Brooks and Torke, 1977; George and Heaney, 1978; Harris and Smith, 1977; and Reynolds, 1976). Vertical clumping during fall turnover, however, was inconsistent with findings of Brooks and Torke (1977) who found a homogeneous vertical distribution at fall turnover.

Vertical clumping during fall turnover perhaps is a result of incomplete or slow vertical mixing. Although isothermal conditions of the lake at this time period indicate complete mixing, the stratified dissolved oxygen concentrations indicate that the mixing was slow.

During late summer stratification and early fall mixing, highest concentrations of standing crop occurred at the greatest depths; next highest were at and near the surface; and the least were at middle depths. In contradiction Bishop (1971) found the highest concentration of standing crop at a depth of 5 ft during summer stratification in Westhampton Lake. Brooks and Torke (1977) found the highest concentration at greater depths (10 to 30 m) during summer stratification which is like the present findings. However, their highest concentration was dispersed during early fall mixing, increasing the concentration in the epilimnion as the overall chlorophyll levels declined. This contradicts the present findings where the highest concentration remained at the greatest depths during early fall mixing. During fall turnover in the present study, highest concentrations were at and near the surface followed by greatest depths and the least was at the middle depths. Brooks and Torke (1977) found a homogeneous vertical distribution during fall turnover.

The present study dealt with the spatial distribution of the entire phytoplankton community. Not all species of phytoplankton have the same spatial distribution and species composition varies from season to season. The zone of the highest concentration of standing crop is a function of the species composition. Reynolds (1976) found that green algae were confined largely to superficial layers; diatoms tended to occupy the deepest epilimnetic layers, except when turbulent mixing prevailed; and blue-green algae showed a tendency to preferentially inhabit deeper layers.

Horizontal distribution of standing crop was random for each of the three periods when each of the nine stations was analyzed separately. When the stations along each transect were combined, the standing crop of the downlake transect was significantly greater than that of the other two transects during late summer stratification and partial mixing, indicating a clumped horizontal distribution. The different results of these two analyses, random versus clumped, may result from a difference in the sensitivity of the two statistical tests. However, these results might indicate a difference in the scales of clumping, i.e., phytoplankton standing crop random on small-scale and clumped on a larger scale.

Few studies have been done on the horizontal distribution of phytoplankton in small eutrophic lakes. Previous studies have shown horizontal clumping in small lakes during summer stratification (George and Heaney, 1978; Harris and Smith, 1977; and Richards and Happey-Wood, 1979). Richards and Happey-Wood (1979) found the horizontal distributions of four species of phytoplankton to be clumped. George and Heaney (1978) found horizontal clumping only when buoyant blue-green algae or the dinoflagellate Ceratium hirundinella were present. On most days the horizontal variations followed clear systematic patterns related to the vertical distribution of phytoplankton and to wind-induced water movements. Harris and Smith (1977) observed clumping in a mixing zone between two distinct water masses, one more eutrophic than the other.

The combined horizontal and vertical spatial distribution of the phytoplankton photosynthetic capacity was random for each of the last two time periods in Westhampton Lake. Distribution of photosynthetic capacity was not measured and therefore was unknown during late summer stratification. Vertical distribution was random for each station and each time, with one exception of vertical clumping at the deepest station during early fall mixing. Photosynthetic capacity varied only significantly with depth during early fall mixing. The highest photosynthetic capacity was in the surface to the middle depths for each of the last two periods.

To the author's knowledge, there have been no previous studies on spatial distribution of photosynthetic capacity in lakes. Studies on spatial distribution of photosynthetic rates, however, provide some basis for comparisons. In most small eutrophic lakes the photosynthetic rates are greatest in the top two meters of water (Wetzel, 1975). A vertical depth distribution of photosynthesis in which a zone of maximum of photosynthetic rates at light saturation is underlain by a zone of near-exponential decline of rates with increasing depth are frequently found (Wetzel, 1975). Bishop (1971) and Moore (1973) found this type of vertical distribution of photosynthesis in Westhampton Lake. The distribution was attributed to decreasing light at greater depths. In the present study the random vertical and horizontal distribution of photosynthetic capacity means that there were localized regions of phytoplankton with the ability to carry on photosynthesis at greater rates than other regions. These regions of high photosynthetic capacity were not confined to the top two meters.

The horizontal distribution of photosynthetic capacity was random for each of the last two periods when analyzed separately or combined along the transects. These findings contradict the assumption that phytoplankton productivity and photosynthetic rates are horizontally homogeneous in small eutrophic lakes (Wetzel, 1975).

Regions of high standing crop were not associated with high photosynthetic capacity. The most obvious example was located at and near the bottom of the deepest station during early fall mixing which had high standing crop and very little photosynthetic capacity. The standing crop and photosynthetic capacity for all depths were not strongly related and at these lower depths they were inversely related as shown by a large negative correlation coefficient. This poor relation supports Moore's findings (1973) that primary productivity and chlorophyll a were not significantly correlated. Wright (1960) reported that the relationship between photosynthesis and chlorophyll a concentrations was not linear, and that an increase in the concentration of phytoplankton led to a lowering of the photosynthetic rate.

The present study was confined to the description of spatial distributions. Further studies of the mechanisms which effect these distributions are needed. These mechanisms influence four kinds of patterns (Margalef, 1960): vectorial which depends on gradients of ecological factors, e.g., light, temperature, and winds; reproductive which results from the rates of division compared to the rates of diffusion; coactive which depends on interaction, segregation, and grazing; and stochastic which results from random forces, e.g., turbulent water movements.

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Table 1. Analysis of variance of water temperature by transect, station, and depth during late summer stratification.

Source of Variation	Sum of Squares	df	Mean Square	F	Signif-icance of F
Main Effects	1589.289	16	99.331	14.517	.001*
Transect	2.704	2	1.352	.198	.821
Station	.024	2	.012	.002	
Depth	1207.947	12	100.662	14.712	
2-way Interactions	3.974	29	.137	.020	.999
Transect Station	.574	4	.144	.021	.999
Transect Depth	1.597	12	.133	.019	.999
Station Depth	1.973	13	.152	.022	.999
3-way Interactions	2.839	22	.129	.019	.999
Transect Station Depth	2.839	22	.129	.019	.999
Residual	896.333	131	6.842		
Total	2492.435	198	12.588		

*significant at the .05 level

Table 2. Analysis of variance of water temperature by transect, station, and depth during partial mixing period.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	310.883	16	19.430	14.451	.001*
Transect	2.727	2	1.363	1.014	.364
Station	.967	2	.484	.360	.698
Depth	252.203	12	21.017	15.631	.001*
2-way Interactions	5.516	30	.184	.137	.999
Transect Station	1.040	4	.260	.193	.942
Transect Depth	2.930	12	.244	.182	.999
Station Depth	1.564	14	.112	.083	.999
3-way Interactions	3.032	22	.138	.103	.999
Transect Station Depth	3.032	22	.138	.103	.999
Residual	371.100	276	1.345		
Total	690.532	344	2.007		

*significant at the .05 level

Table 3. Analysis of variance of water temperature by transect, station, and depth during fall turnover.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	49.162	16	3.073	.384	.985
Transect	1.413	2	.707	.088	.915
Station	.349	2	.174	.022	.978
Depth	45.646	12	3.804	.476	.928
2-way Interactions	18.150	30	.605	.076	.999
Transect Station	.350	4	.087	.011	.999
Transect Depth	3.353	12	.279	.035	.999
Station Depth	15.134	14	1.081	.135	.999
3-way Interactions	1.686	22	.077	.010	.999
Transect Station Depth	1.686	22	.077	.010	.999
Residual	2150.375	269	7.994		
Total	2219.373	337	6.586		

*significant at the .05 level

Table 4. Analysis of variance of dissolved oxygen by transect, station, and depth during late summer stratification.

Source of Variation	Sum of Square	df	Mean Square	F	Significance of F
Main Effects	1645.358	16	102.835	70.694	.001*
Transect	.970	2	.485	.344	.717
Station	3.005	2	1.503	1.033	.359
Depth	1515.806	12	126.317	86.837	.001*
2-way Interactions	38.743	29	1.336	.918	.590
Transect Station	6.132	4	1.533	1.054	.382
Transect Depth	24.538	12	2.045	1.406	.171
Station Depth	7.799	13	.600	.412	.963
3-way Interactions	7.284	22	.331	.228	.999
Transect Station Depth	7.284	22	.331	.228	.999

*significant at the .05 level

Table 5. Analysis of variance of dissolved oxygen by transect, station, and depth during partial mixing period.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	2199.426	16	137.464	26.744	.001*
Transect	113.781	2	56.891	11.068	.001*
Station	17.587	2	8.794	1.711	.183
Depth	1598.300	12	133.192	25.912	.001*
2-way Interactions	123.699	30	4.123	.802	.762
Transect Station	1.755	4	.439	.085	.987
Transect Depth	111.492	12	9.291	1.808	.047*
Station Depth	8.145	14	.582	.113	.999
3-way Interactions	12.204	22	.555	.108	.999
Transect Station Depth	12.204	22	.555	.108	.999
Residual	1418.656	276	5.140		
Total	3753.986	344	10.913		

*significant at the .05 level

Table 6. Analysis of variance of dissolved oxygen by transect, station, and depth during fall turnover.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	473.249	16	29.578	4.892	.001*
Transect	5.146	2	2.573	.426	.654
Station	8.280	2	4.140	.685	.505
Depth	452.948	12	37.746	6.243	.001*
2-way Interactions	144.247	30	4.808	.795	.771
Transect Station	1.512	4	.378	.063	.993
Transect Depth	72.500	12	6.042	.999	.450
Station Depth	65.741	14	4.696	.777	.694
3-way Interactions	15.942	22	.725	.120	.999
Transect Station Depth	15.942	22	.725	.120	.999
Residual	1626.420	269	6.046		
Total	2259.858	337	6.706		

*significant at the .05 level

Table 7. Regression of fluorometric measurement of standing crop with spectrophotometric measurements of chlorophyll a and pheopigment for all depths.

Independent Variable	Simple R	Multiple R
Chlorophyll a	0.17*	0.17*
Pheopigment	-0.01*	0.19*

*Significant at the .05 level

Table 8. Regression of fluorometric measurement of standing crop with spectrophotometric measurements of chlorophyll a and pheopigment for top two meters.

Independent Variable	Simple R	Multiple R
Chlorophyll a	0.24*	0.24*
Pheopigment	0.12*	0.29*

*Significant at the .05 level

Table 9. Spatial distribution for entire lake (all transects, stations, and depths) of chlorophyll a. Values are ratios of variances to means. Only cases in which distribution is significantly different from random are shown.

Time Period[1]	Variance/Mean Ratio	Distribution[2]
SS	8.30*	C
PM	5.78*	C
FT	2.45*	C

[1]Time Periods are late summer stratification (SS), partial mixing (PM), and fall turnover (FT)

*Significant at the .05 level

[2]Distributions are either clumped (C) or homogeneous (H)

Table 10. Vertical distribution of chlorophyll a. Values are ratios of variances to means. Only cases in which distribution is significantly different from random are shown.

Time Period[1]	Transect	Station	Variance/Mean Ratio	Distribution[2]
SS	Downlake	West	6.64*	C
SS	Downlake	Middle	12.30*	C
SS	Downlake	East	8.13*	C
SS	Middle	West	5.21*	C
PM	Downlake	Middle	14.60*	C
FT	Middle	West	4.18*	C
FT	Middle	Middle	4.59*	C
FT	Middle	East	2.57*	C
FT	Uplake	West	4.06*	C

[1]Time Periods are late summer stratification (SS), partial mixing (PM), and fall turnover (FT)

*Significant at the .05 level

[2]Distributions are either clumped (C) or homogeneous (H)

Table 11. Analysis of variance of chlorophyll a by transect, station, and depth during late summer stratification.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	34122.749	16	2132.672	5.586	.001*
Transect	3149.416	2	1574.708	4.125	.018*
Station	761.580	2	380.790	.997	.372
Depth	22671.437	12	1889.286	4.948	.001*
2-way Interactions	12908.411	29	445.118	1.166	.275
Transect Station	801.401	4	200.350	.525	.718
Transect Depth	8485.771	12	707.148	1.852	.046*
Station Depth	3531.448	13	271.650	.712	.749
3-way Interactions	2398.142	22	109.006	.286	.999
Transect Station Depth	2398.142	22	109.006	.286	.999
Residual	50014.473	131	381.790		
Total	99443.775	198	502.241		

*significant at the .05 level

Table 12. Scheffe multiple range test of concentrations of chlorophyll a (mg/m^3) at different transects during three time periods. (Means grouped by a common underline are not significantly different at the .05 level.)

Late Summer Stratification

Transects	Middle	Uplake	Downlake
Mean concentrations	24.58	25.74	38.23

Partial Mixing Period

Transects	Middle	Uplake	Downlake
Mean concentrations	17.01	21.48	24.23

Fall Turnover

Transects	Middle	Downlake	Uplake
Mean concentrations	20.07	20.59	23.04

Table 13. Scheffe multiple range test of concentrations of chlorophyll a (mg/m^3) at different depths (m) during three time periods. (Means grouped by a common underline are not significantly different at the .05 level.)

Late Summer Stratification

Depths	2.5	3.0	2.0	1.5	1.0	0.0	5.0	0.5	4.5	5.5	3.5	6.0	4.0
Mean concentrations	13.12	21.03	21.86	30.10	32.11	32.12	39.20	39.65	43.21	47.22	52.31	65.49	81.53
	———	———	———	———	———	———	———	———	———	———	———	———	
				———	———	———	———	———	———	———	———	———	———

Partial Mixing

Depths	3.0	4.0	2.5	2.0	3.5	1.0	0.5	0.0	1.5	4.5	5.0	6.0	5.5
Mean concentrations	14.51	16.30	16.57	17.48	18.20	19.26	20.30	20.62	22.17	39.83	60.41	67.36	72.44
	———	———	———	———	———	———	———	———	———				
		———	———	———	———	———	———	———	———	———			
										———	———	———	
											———	———	———

Fall Turnover

Depths	5.0	4.0	3.5	3.0	4.5	2.5	2.0	5.5	6.0	1.5	1.0	0.0	0.5
Mean concentrations	10.00	11.22	13.56	14.66	15.50	16.76	17.49	22.45	22.72	22.86	25.09	26.52	26.80
	———	———	———	———	———	———	———	———	———	———	———	———	———

Table 14. Analysis of variance of chlorophyll a by transect, station, and depth during partial mixing period.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	37485.653	16	2342.853	26.805	.001*
Transect	734.694	2	367.347	4.203	.016*
Station	60.463	2	30.231	.346	.708
Depth	31142.379	12	2595.198	29.692	.001*
2-way Interactions	2250.827	30	75.028	.858	.683
Transect Station	397.446	4	99.361	1.137	.339
Transect Depth	1137.787	12	94.816	1.085	.373
Station Depth	771.036	14	55.074	.630	.839
3-way Interactions	2576.562	22	117.116	1.340	.145
Transect Station Depth	2576.562	22	117.116	1.340	.145
Residual	24123.118	276	87.403		
Total	66436.161	344	193.128		

*significant at the .05 level

Table 15. Analysis of variance of chlorophyll a by transect, station and depth during fall turnover.

Source of Variation	Sum of Squares	df	Mean Square	F	Signif-icance of F
Main Effects	9397.362	16	587.335	2.215	.005*
Transect	229.867	2	114.933	.434	.649
Station	816.834	2	408.417	1.540	.216
Depth	8051.519	12	670.960	2.531	.004*
2-way Interactions	5254.932	30	175.164	.661	.914
Transect Station	470.367	4	117.592	.444	.777
Transect Depth	3372.988	12	281.082	1.060	.394
Station Depth	1343.432	14	95.959	.362	.984
3-way Interactions	2183.994	22	99.272	.374	.996
Transect Station Depth	2183.994	22	99.272	.374	.996
Residual	71317.958	269	265.123		
Total	88154.246	337	261.585		

*significant at the .05 level

Table 16. Vertical distribution of photosynthetic capacity as measured by fluorescence increase. Value is ratio of variance to mean. Only cases in which distribution is significantly different from random are shown.

Time Period[1]	Transect	Station	Variance/Mean Ratio	Distribution[2]
PM	Downlake	Middle	4.82*	C

[1]Time Period is partial mixing (PM)

*Significant at the .05 level

[2]Distributions are either climped (C) or homogeneous (H)

Table 17. Analysis of variance of fluorescence increase by transect, station, and depth during partial mixing period.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	831.912	16	51.994	4.504	.001*
Transect	49.281	2	24.640	2.135	.121
Station	1.468	2	.734	.064	.938
Depth	602.133	12	50.178	4.347	.001*
2-way Interactions	319.884	30	10.663	.924	.585
Transect Station	37.362	4	9.340	.809	.521
Transect Depth	143.585	12	11.965	1.037	.417
Station Depth	152.877	14	10.920	.946	.510
3-way Interactions	113.777	22	5.172	.448	.985
Transect Station Depth	113.777	22	5.172	.448	.985
Residual	2389.500	207	11.543		
Total	3655.072	275	13.291		

*significant at the .05 level

Table 18. Analysis of variance of fluorescence increase by transect, station, and depth during fall turnover.

Source of Variation	Sum of Squares	df	Mean Square	F	Significance of F
Main Effects	758.069	16	47.379	1.513	.095
Transect	86.933	2	43.467	1.388	.251
Station	120.094	2	60.047	1.918	.149
Depth	651.439	12	54.287	1.734	.060
2-way Interactions	508.878	30	16.963	.542	.977
Transect Station	274.049	4	68.512	2.188	.071
Transect Depth	76.365	12	6.364	.203	.998
Station Depth	181.780	14	12.984	.415	.970
3-way Interactions	548.305	22	24.923	.796	.730
Transect Station Depth	548.305	22	24.923	.796	.730
Residual	8423.367	269	31.314		
Total	10238.618	337	30.382		

*significant at the .05 level

Table 19. Coefficients of correlation between photosynthetic capacity (fluorescence increase) and standing crop (chlorophyll a).

Time Period[1]	Simple R			
		Depth Region		
	Total	0 to 1(m)	0 to 2(m)	4 to 6(m)
PM	-0.25*	0.11	0.11	-0.73*
FT	0.25	0.32*	0.29*	-0.17

[1]Time Periods are partial mixing (PM) and fall turnover (FT)

*Significant at the .05 level

Figure 1. Bathometric map of Westhampton Lake showing transects and stations (A=west, B=middle, C=east).

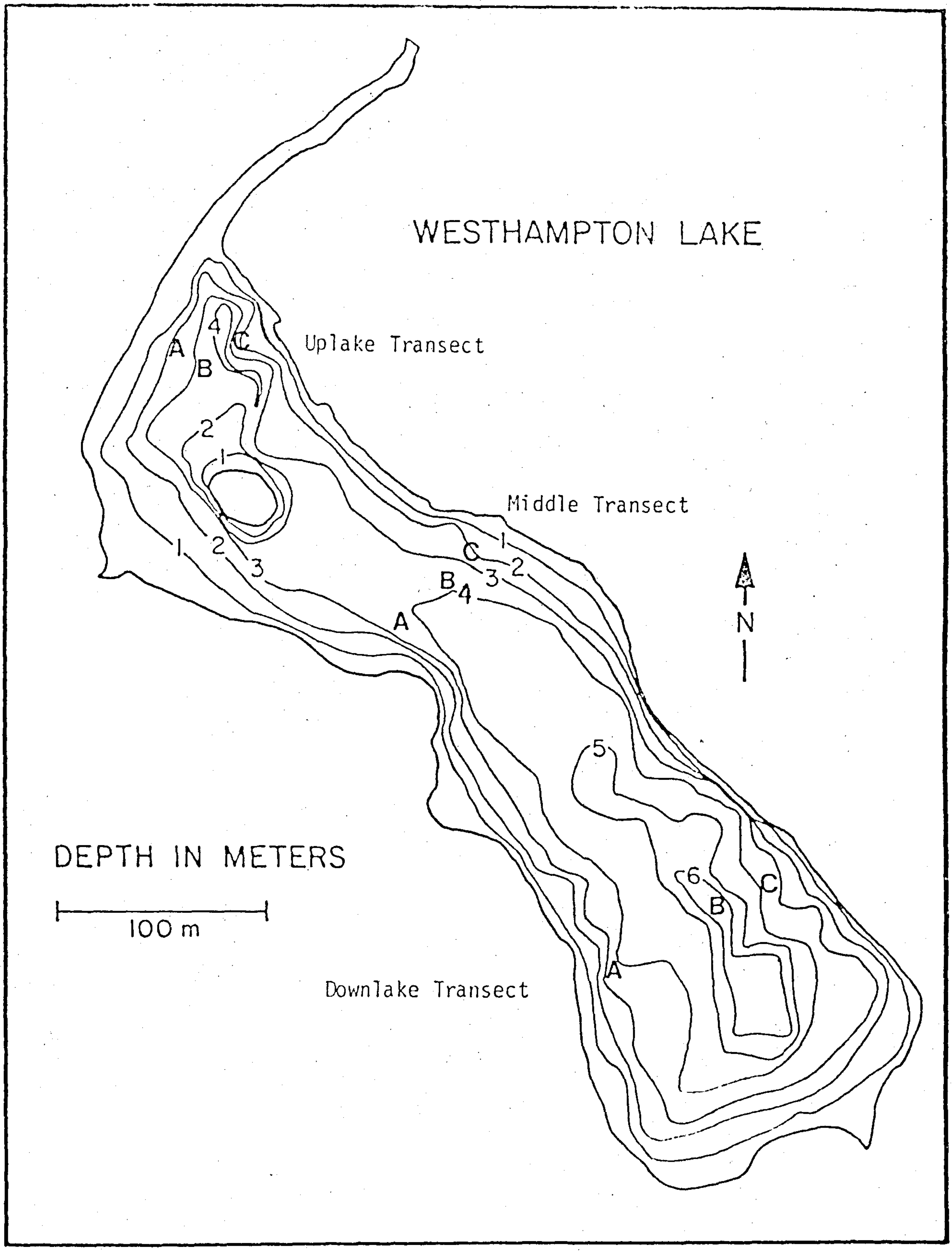
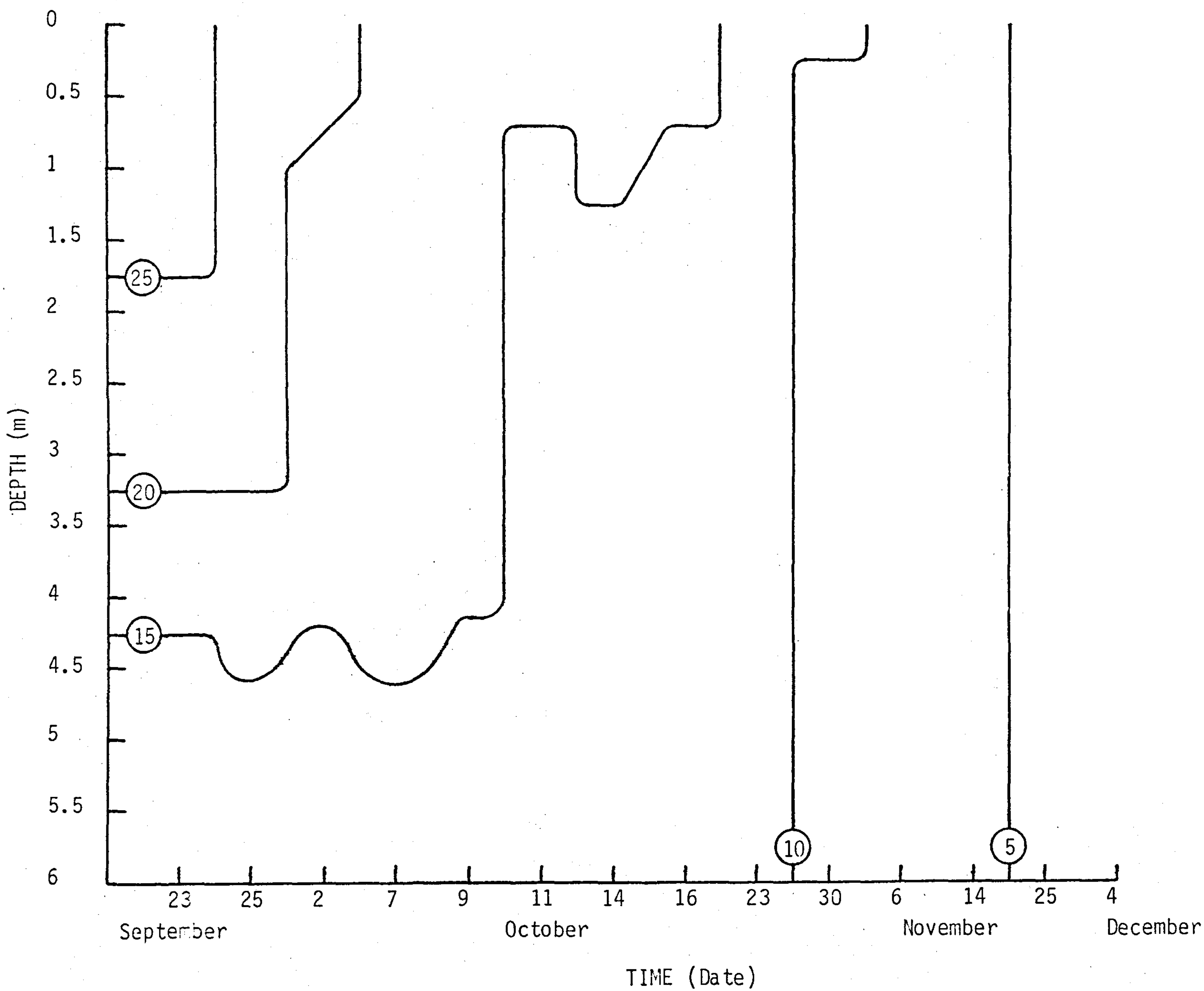
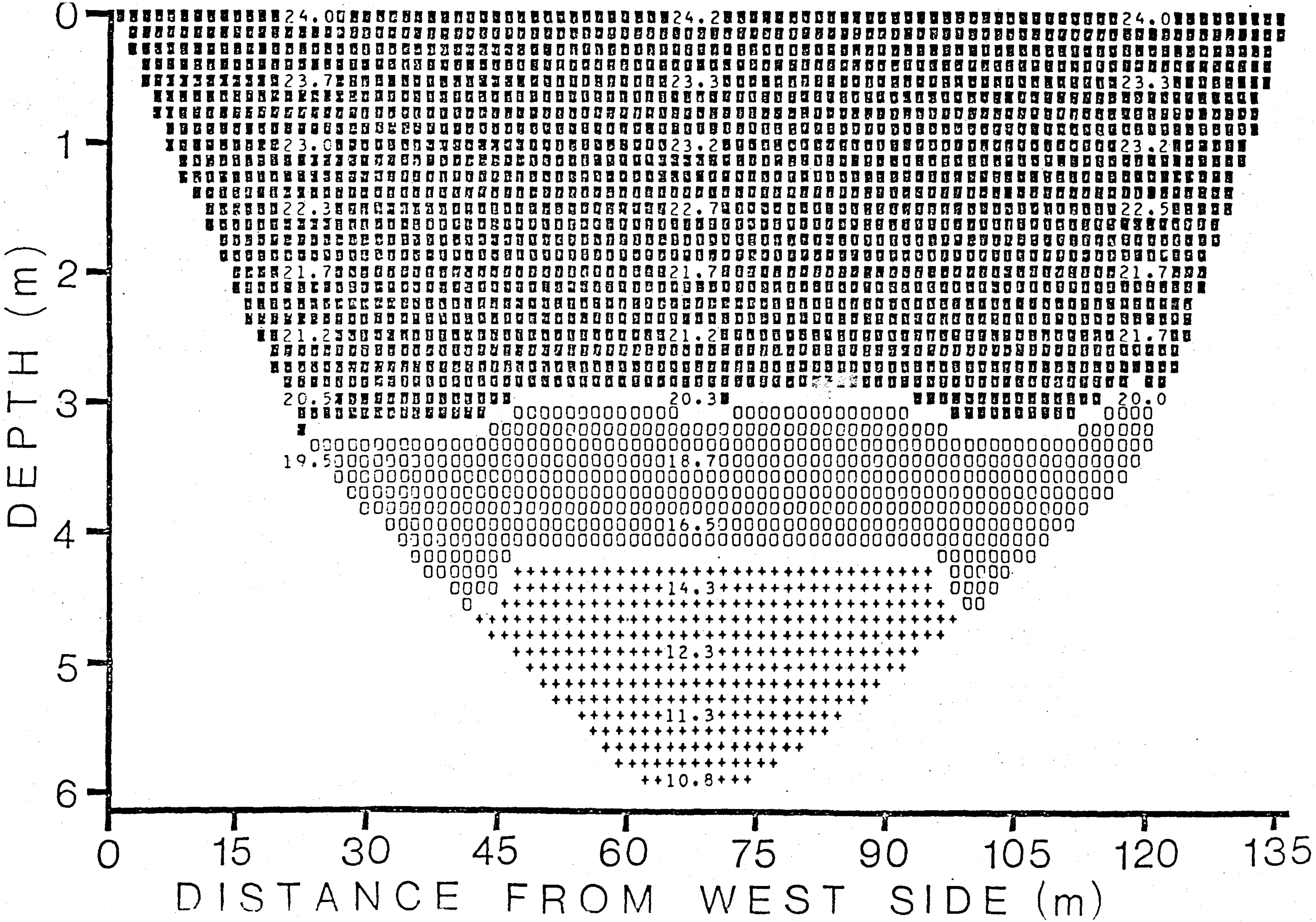

WESTHAMPTON LAKE
Uplake Transect
Middle Transect
Downlake Transect
DEPTH IN METERS
100 m
N
A
B
C
1
2
3
4
5
6

Figure 2. Isothermal lines (^{o}C) for middle (deepest) station at downlake transect during study period.



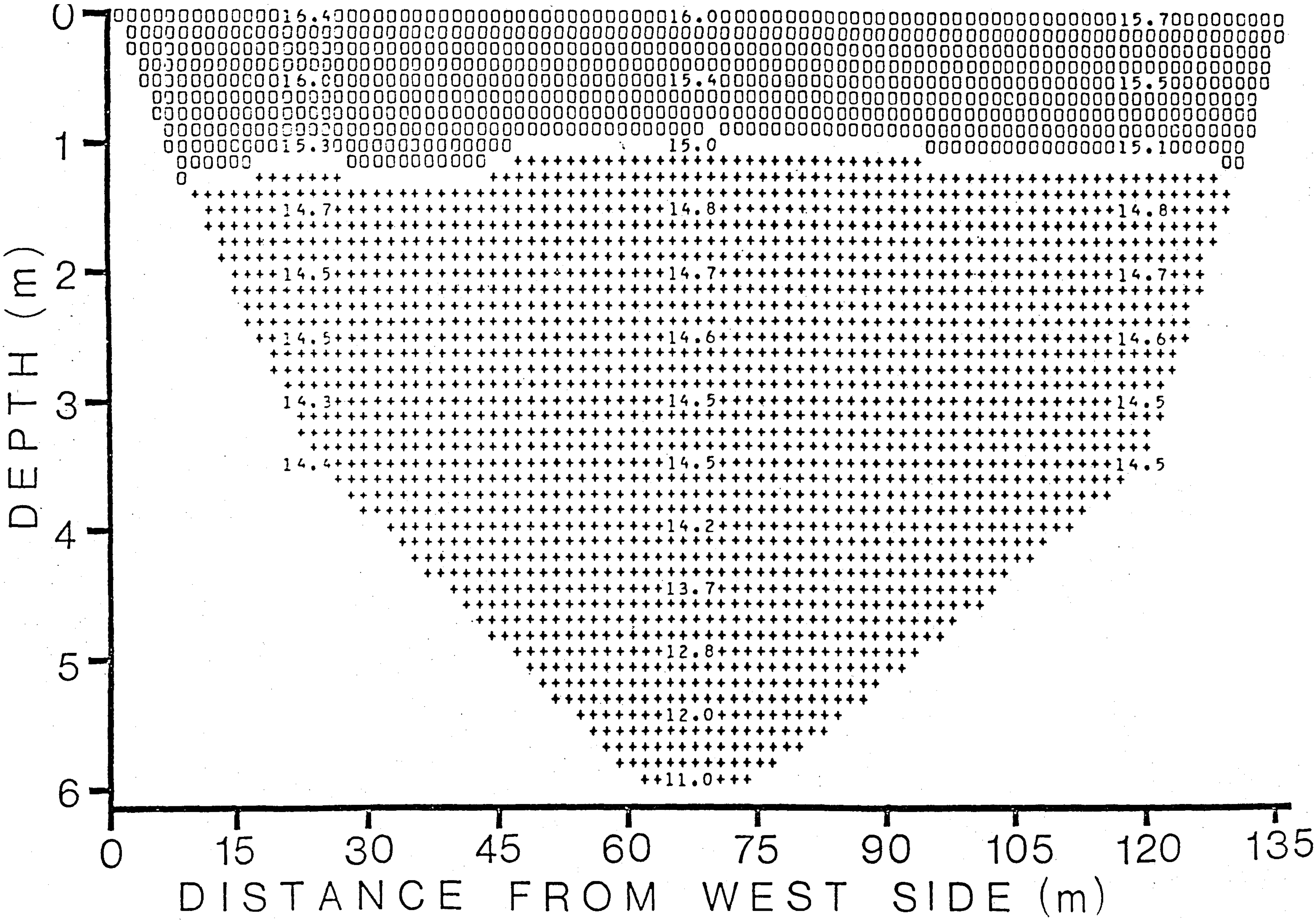
DEPTH (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
25
20
15
10
5
23
25
2
7
9
11
14
16
23
30
6
14
25
4
September
October
November
December
TIME (Date)

Figure 3. Contour map of water temperatures (^{o}C) at downlake transect during late summer stratification (•=0-10, +=10-15, 0=15-20, ●=20-25) by SYMAP.



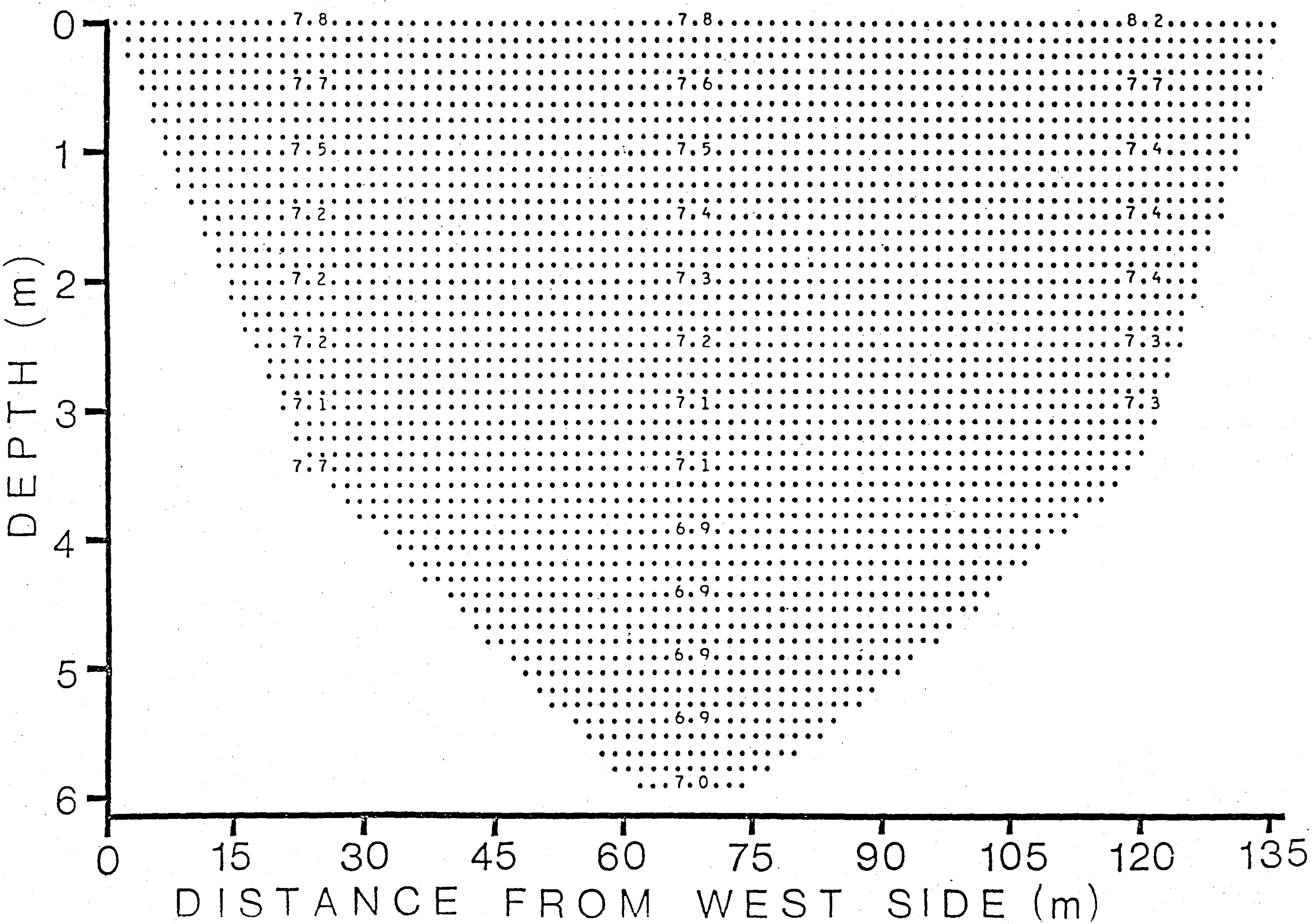
24.0
24.2
24.0
23.7
23.3
23.3
23.0
23.2
23.2
22.3
22.7
22.5
21.7
21.7
21.7
21.2
21.2
21.7
20.5
20.3
20.0
19.5
18.7
16.5
14.3
12.3
11.3
10.8
DEPTH (m)
0
1
2
3
4
5
6
0
15
30
45
60
75
90
105
120
135
DISTANCE FROM WEST SIDE (m)

Figure 4. Contour map of water temperatures (^{o}C) at downlake transect during partial mixing period (·=0-10, +=10-15, 0=15-20, ●=20-25) by SYMAP.



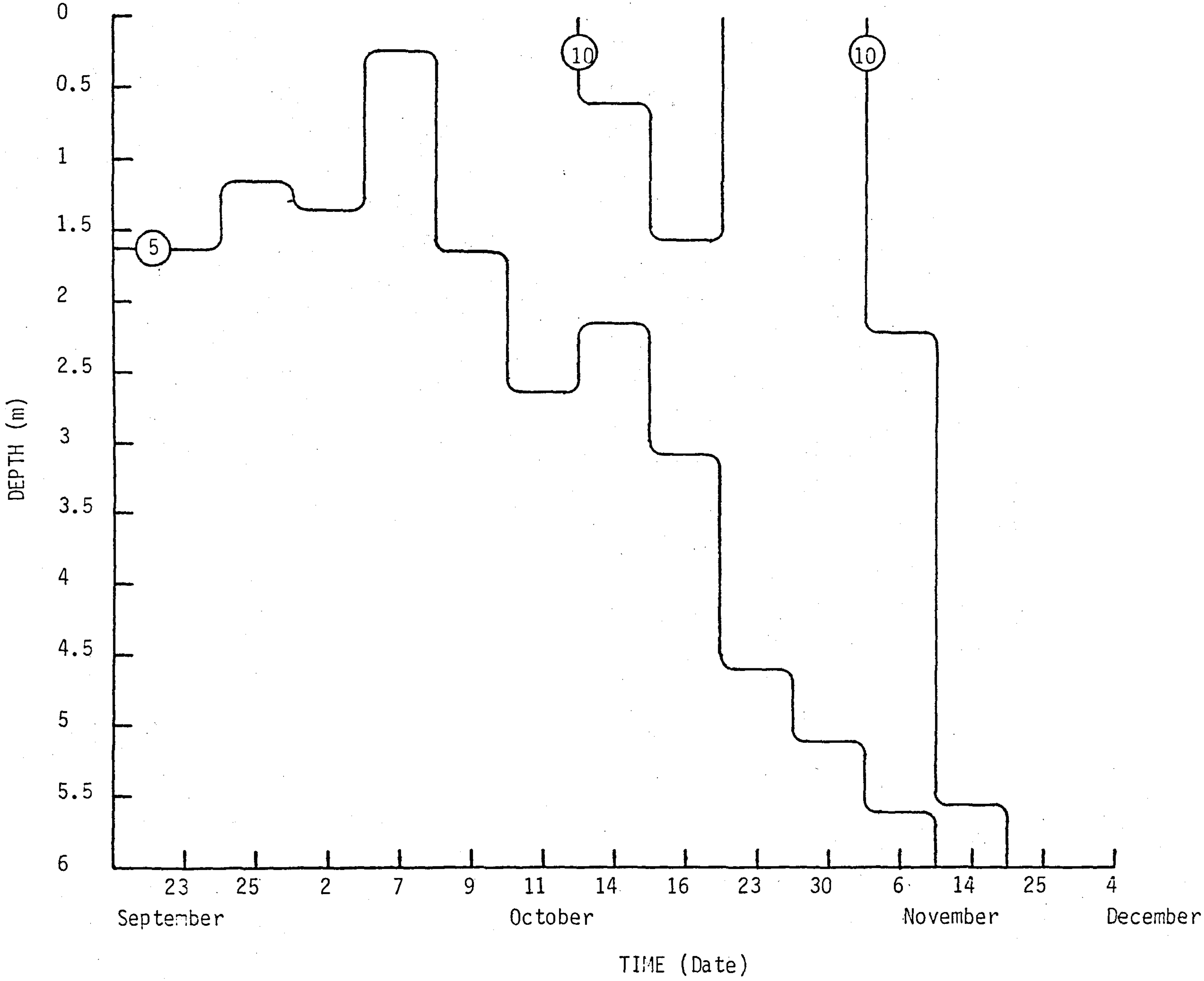
DEPTH (m)
DISTANCE FROM WEST SIDE (m)
0
1
2
3
4
5
6
0
15
30
45
60
75
90
105
120
135
16.4
16.0
15.7
16.0
15.4
15.5
15.3
15.0
15.1
14.7
14.8
14.8
14.5
14.7
14.7
14.5
14.6
14.6
14.3
14.5
14.5
14.4
14.5
14.5
14.2
13.7
12.8
12.0
11.0

Figure 5. Contour map of water temperatures (^{o}C) at downlake transect during fall turnover (·=0-10, +=10-15, 0=15-20, ●=20-25) by SYMAP.



7.8
7.8
8.2
7.7
7.6
7.7
7.5
7.5
7.4
7.2
7.4
7.4
7.2
7.3
7.4
7.2
7.2
7.3
7.1
7.1
7.3
7.7
7.1
6.9
6.9
6.9
6.9
7.0
DEPTH (m)
0
1
2
3
4
5
6
0
15
30
45
60
75
90
105
120
135
DISTANCE FROM WEST SIDE (m)

Figure 6. Isopleths of dissolved oxygen (PPM) for middle (deepest) station at downlake transect during study period.

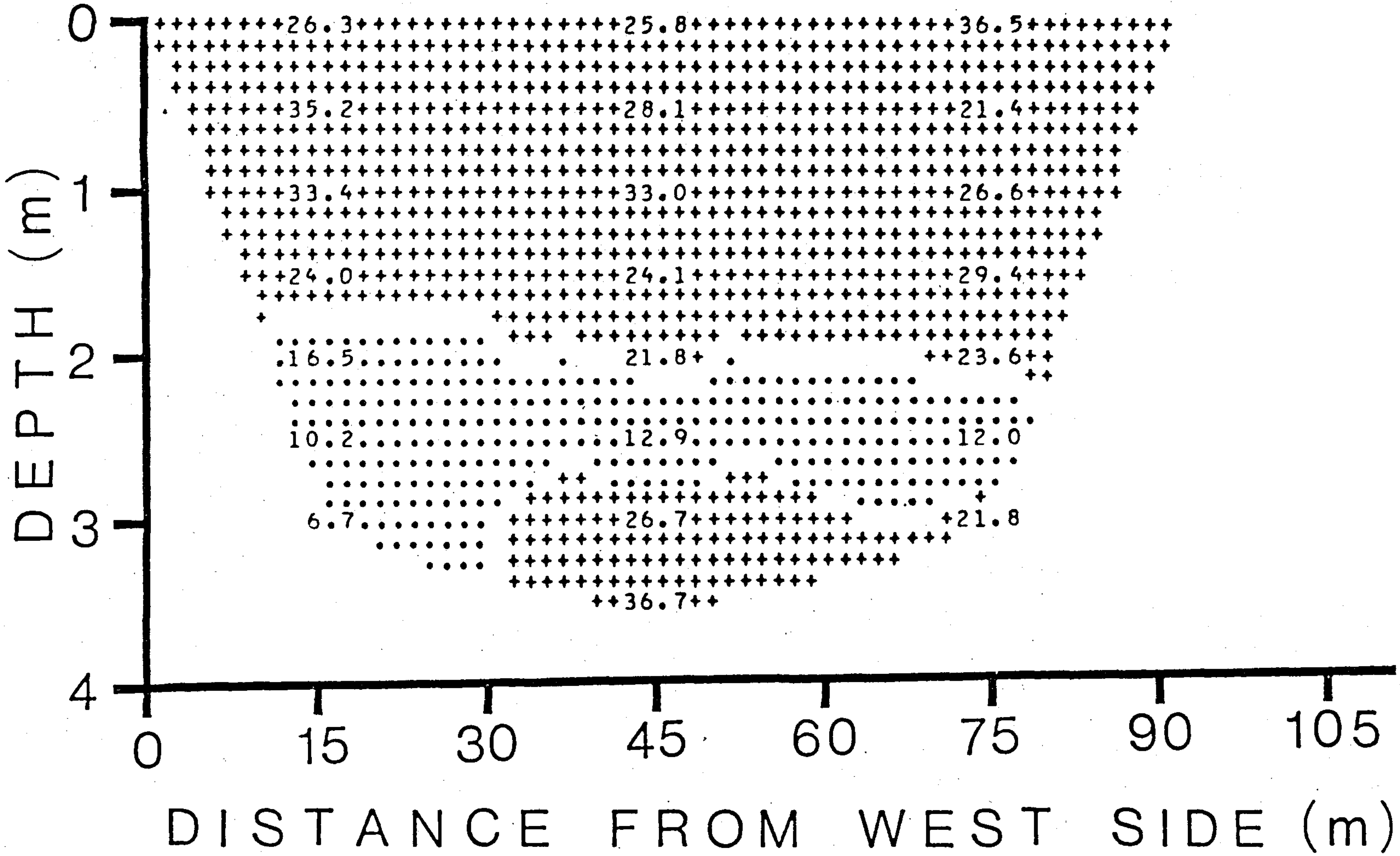


DEPTH (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
5
10
10
23
25
2
7
9
11
14
16
23
30
6
14
25
4
September
October
November
December
TIME (Date)

Figure 7. Contour map of chlorophyll a (mg/m^3) at downlake transect during late summer stratification (·=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.

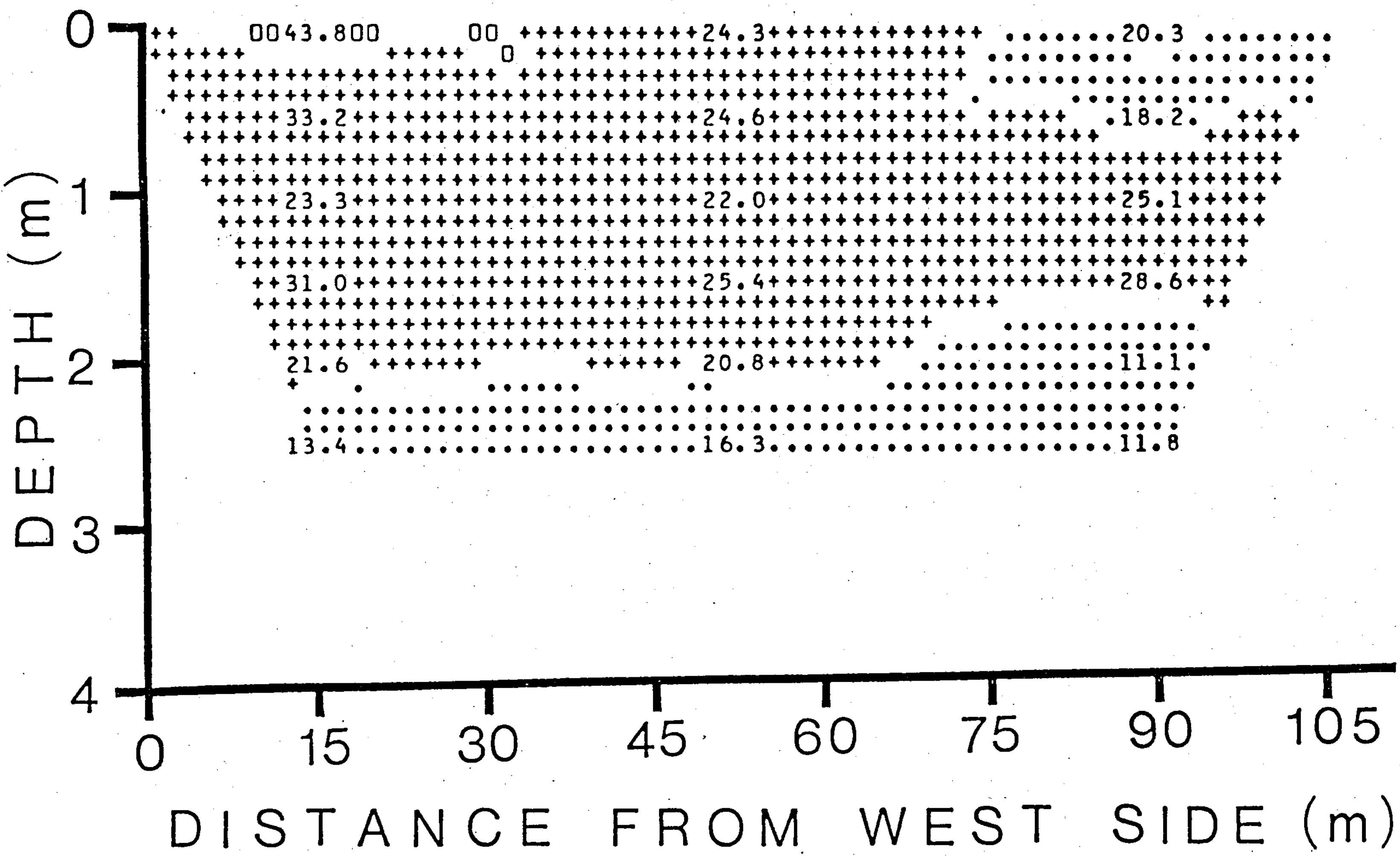
DEPTH (m)
DISTANCE FROM WEST SIDE (m)
0
1
2
3
4
5
6
0
15
30
45
60
75
90
105
120
135
35.2
36.1
49.0
52.6
69.0
61.9
37.4
57.0
37.0
29.4
37.0
25.0
11.1
20.7
20.9
15.6
8.0
13.4
16.5
12.5
38.1
29.4
78.0
81.5
43.2
39.2
47.2
65.5

Figure 8. Contour map of chlorophyll a (mg/m^3) at middle transect during late summer stratification (·=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.



26.3
25.8
36.5
35.2
28.1
21.4
33.4
33.0
26.6
24.0
24.1
29.4
16.5
21.8
23.6
10.2
12.9
12.0
6.7
26.7
21.8
36.7
0
1
2
3
4
DEPTH (m)
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)

Figure 9. Contour map of chlorophyll a (mg/m^3) at uplake transect during late summer stratification (•=0-20, +=20-40, 0=40-60, ▮=60-90) by SYMAP.



0043.800
00
0
24.3
20.3
33.2
24.6
18.2
23.3
22.0
25.1
31.0
25.4
28.6
21.6
20.8
11.1
13.4
16.3
11.8
DEPTH (m)
0
1
2
3
4
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)

Figure 10. Contour map of chlorophyll a (mg/m^3) at downlake transect during partial mixing period (•=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.

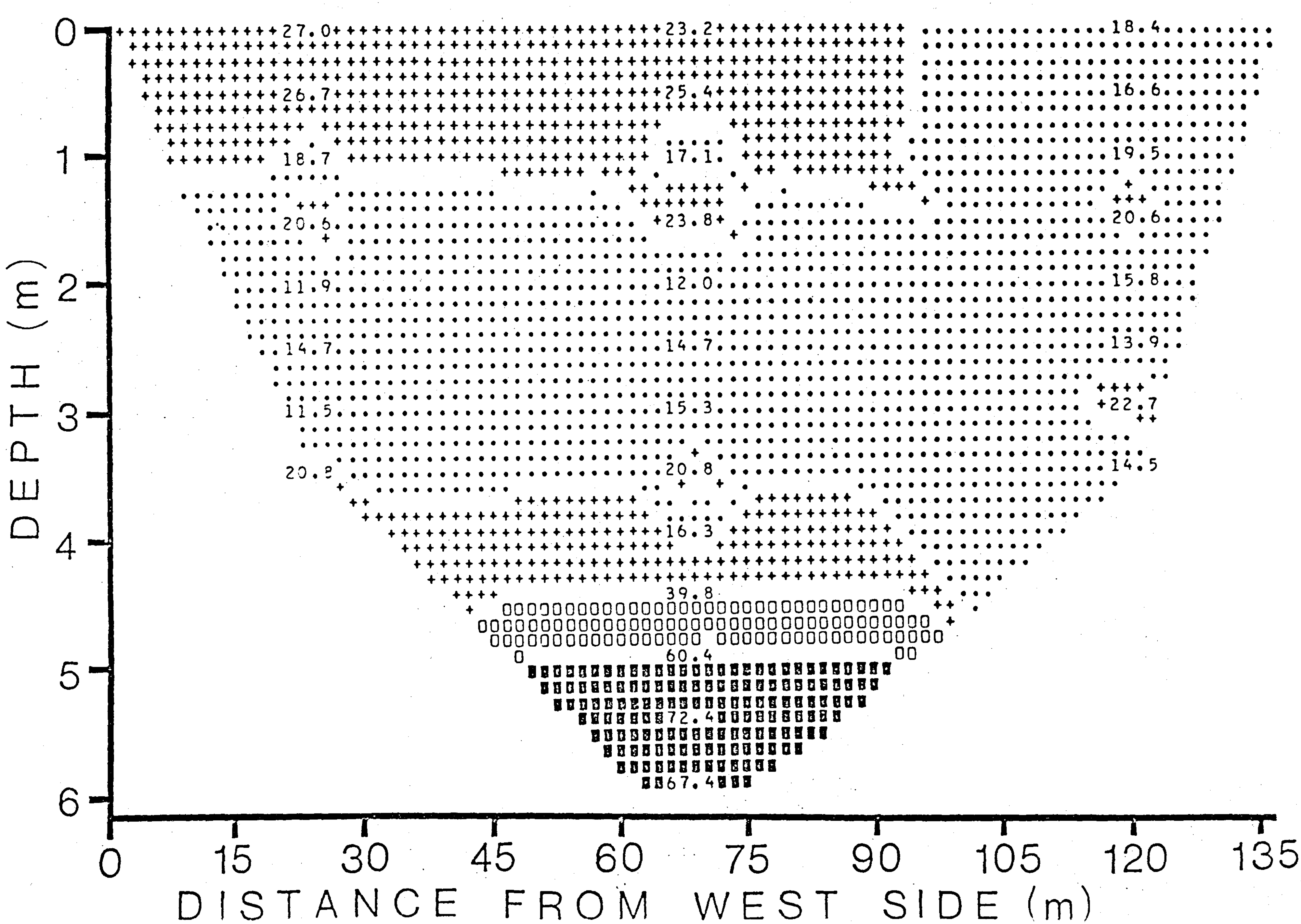
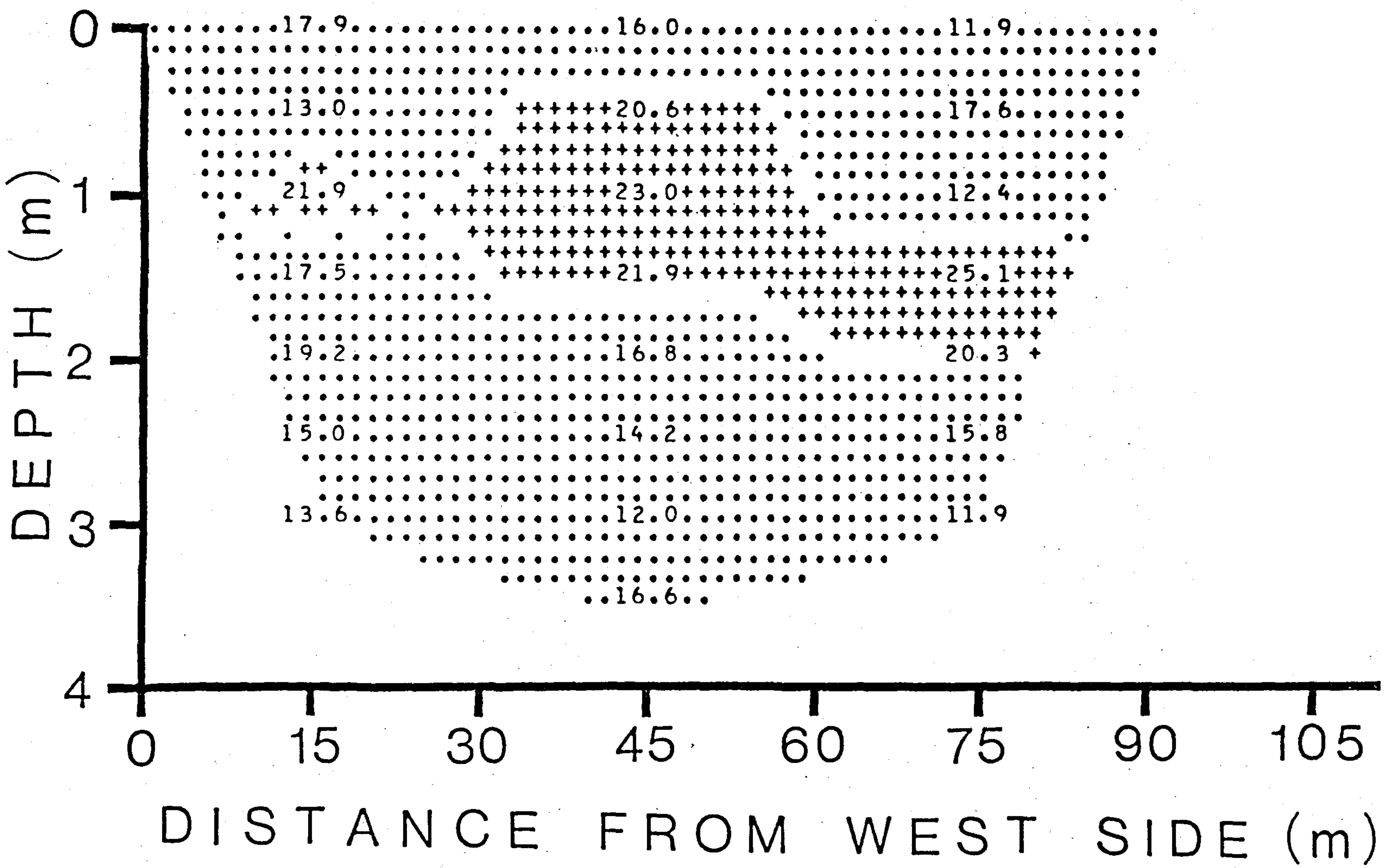
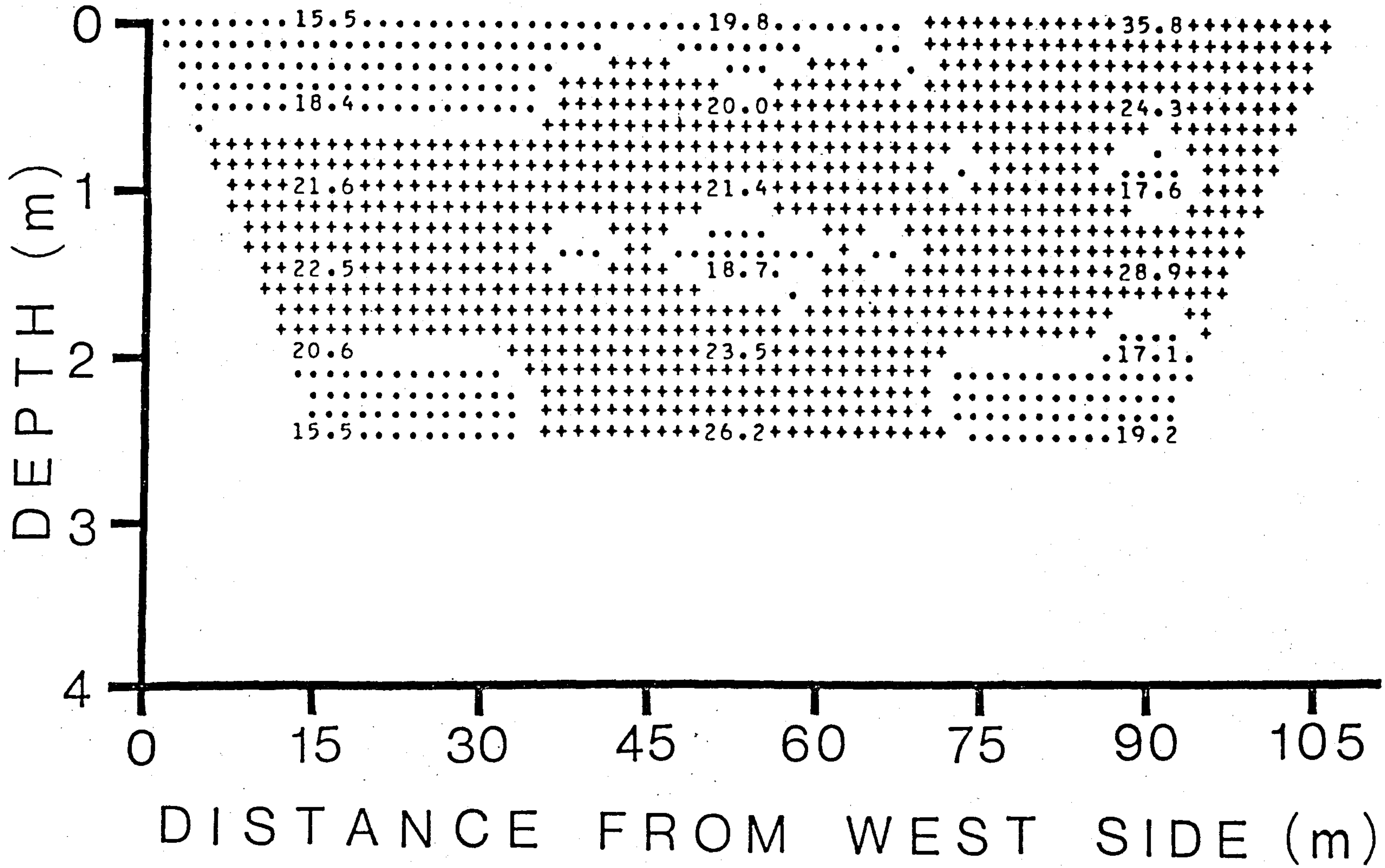

27.0
23.2
18.4
26.7
25.4
16.6
18.7
17.1
19.5
20.6
23.8
20.6
11.9
12.0
15.8
14.7
14.7
13.9
11.5
15.3
22.7
20.8
20.8
14.5
16.3
39.8
60.4
72.4
67.4
DEPTH (m)
DISTANCE FROM WEST SIDE (m)
0
1
2
3
4
5
6
0
15
30
45
60
75
90
105
120
135

Figure 11. Contour map of chlorophyll a (mg/m^3) at middle transect during partial mixing period (•=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.



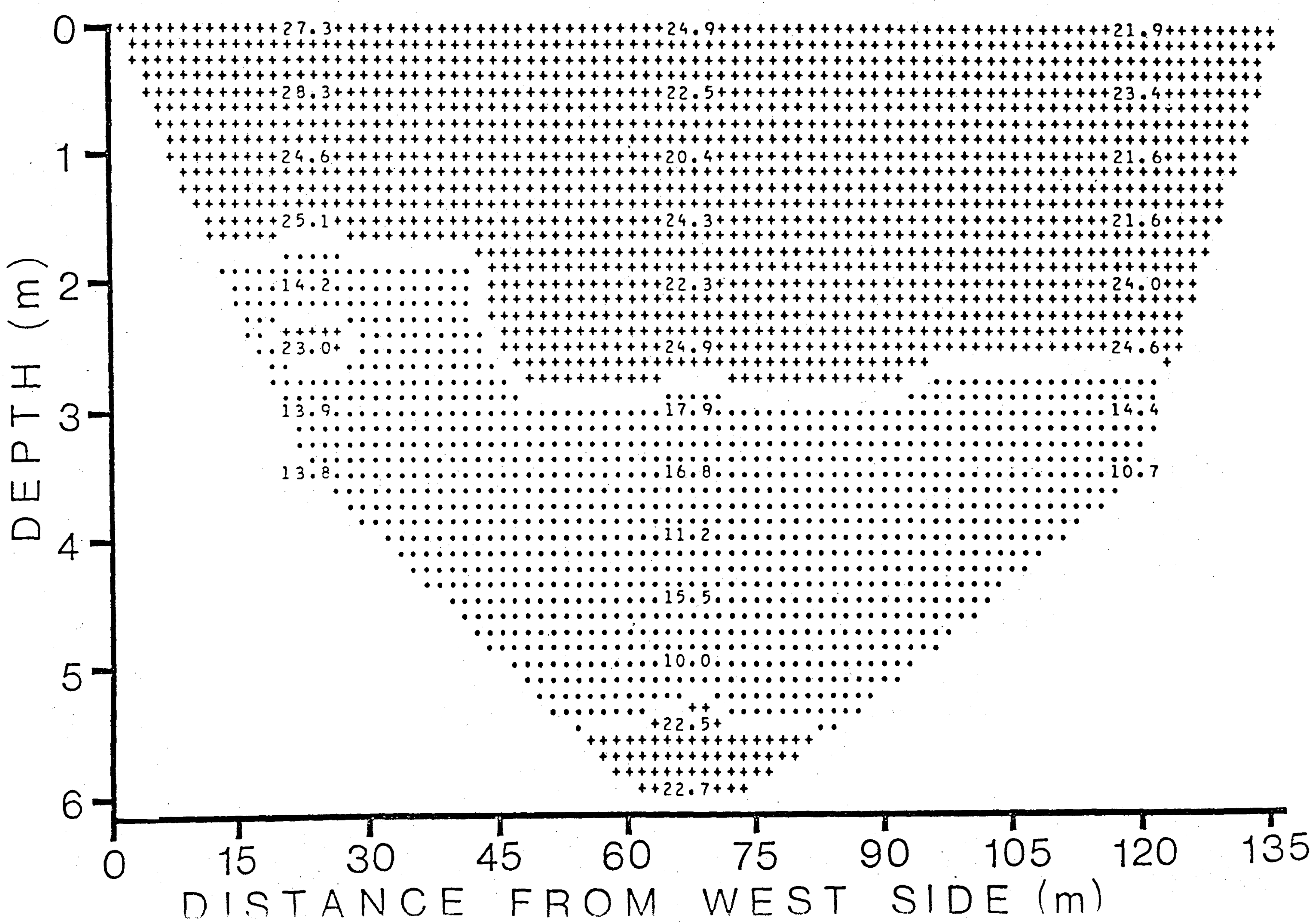
DEPTH (m)
DISTANCE FROM WEST SIDE (m)
0
1
2
3
4
0
15
30
45
60
75
90
105
17.9
16.0
11.9
13.0
20.6
17.6
21.9
23.0
12.4
17.5
21.9
25.1
19.2
16.8
20.3
15.0
14.2
15.8
13.6
12.0
11.9
16.6

Figure 12. Contour map of chlorophyll a (mg/m^3) at uplake transect during partial mixing period (·=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.



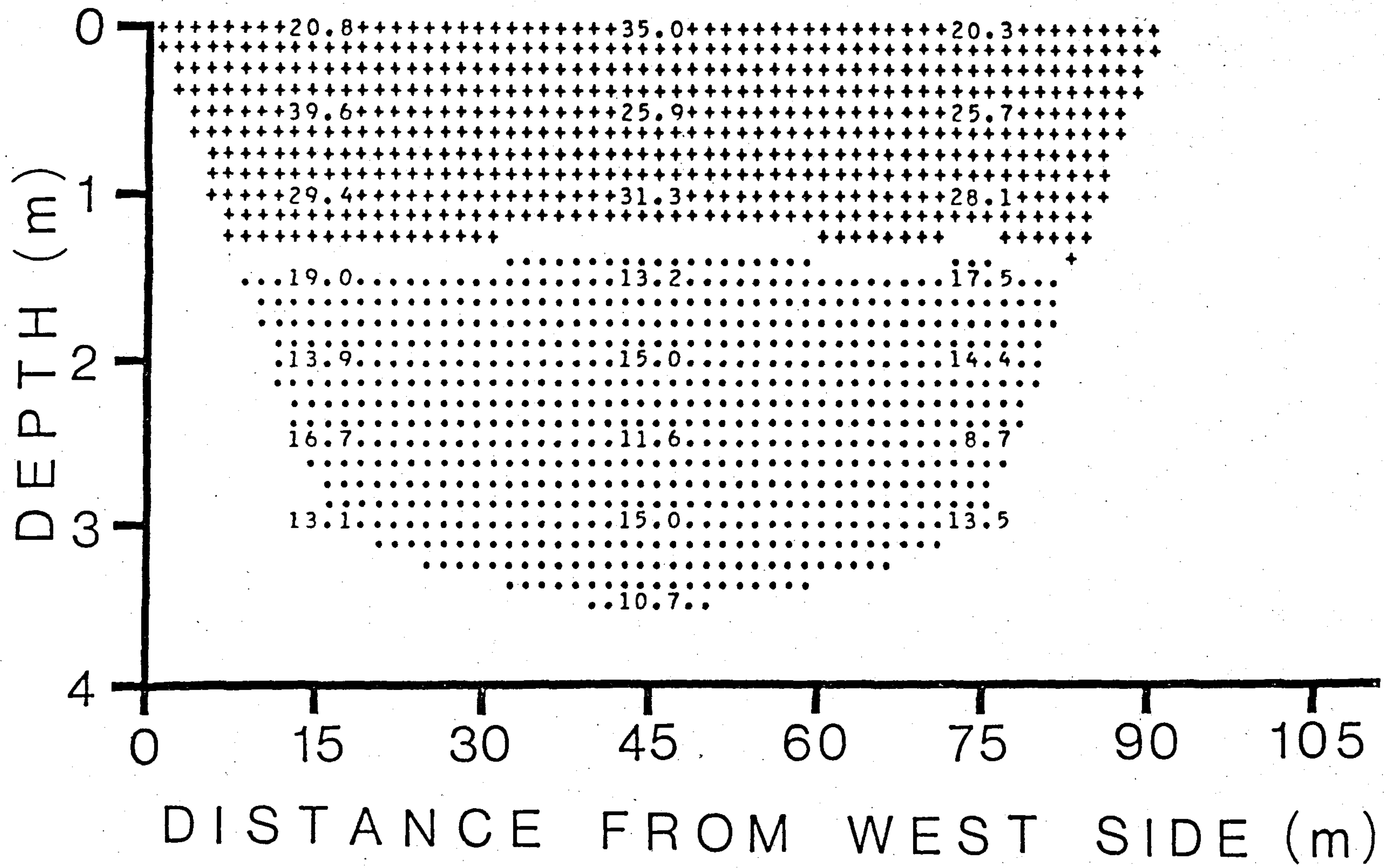
15.5
19.8
35.8
18.4
20.0
24.3
21.6
21.4
17.6
22.5
18.7
28.9
20.6
23.5
17.1
15.5
26.2
19.2
0
1
2
3
4
DEPTH (m)
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)

Figure 13. Contour map of chlorophyll a (mg/m^3) at downlake transect during fall turnover (·=0-20, +=20-40, 0=40-60, ▮=60-90) by SYMAP.



DEPTH (m)
0
1
2
3
4
5
6
DISTANCE FROM WEST SIDE (m)
0
15
30
45
60
75
90
105
120
135
27.3
28.3
24.6
25.1
14.2
23.0
13.9
13.8
24.9
22.5
20.4
24.3
22.3
24.9
17.9
16.8
11.2
15.5
10.0
22.5
22.7
21.9
23.4
21.6
21.6
24.0
24.6
14.4
10.7

Figure 14. Contour map of chlorophyll a (mg/m^3) at middle transect during fall turnover (·=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.



20.8
35.0
20.3
39.6
25.9
25.7
29.4
31.3
28.1
19.0
13.2
17.5
13.9
15.0
14.4
16.7
11.6
8.7
13.1
15.0
13.5
10.7
0
1
2
3
4
DEPTH (m)
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)

Figure 15. Contour map of chlorophyll a (mg/m^3) at uplake transect during fall turnover (•=0-20, +=20-40, 0=40-60, ●=60-90) by SYMAP.

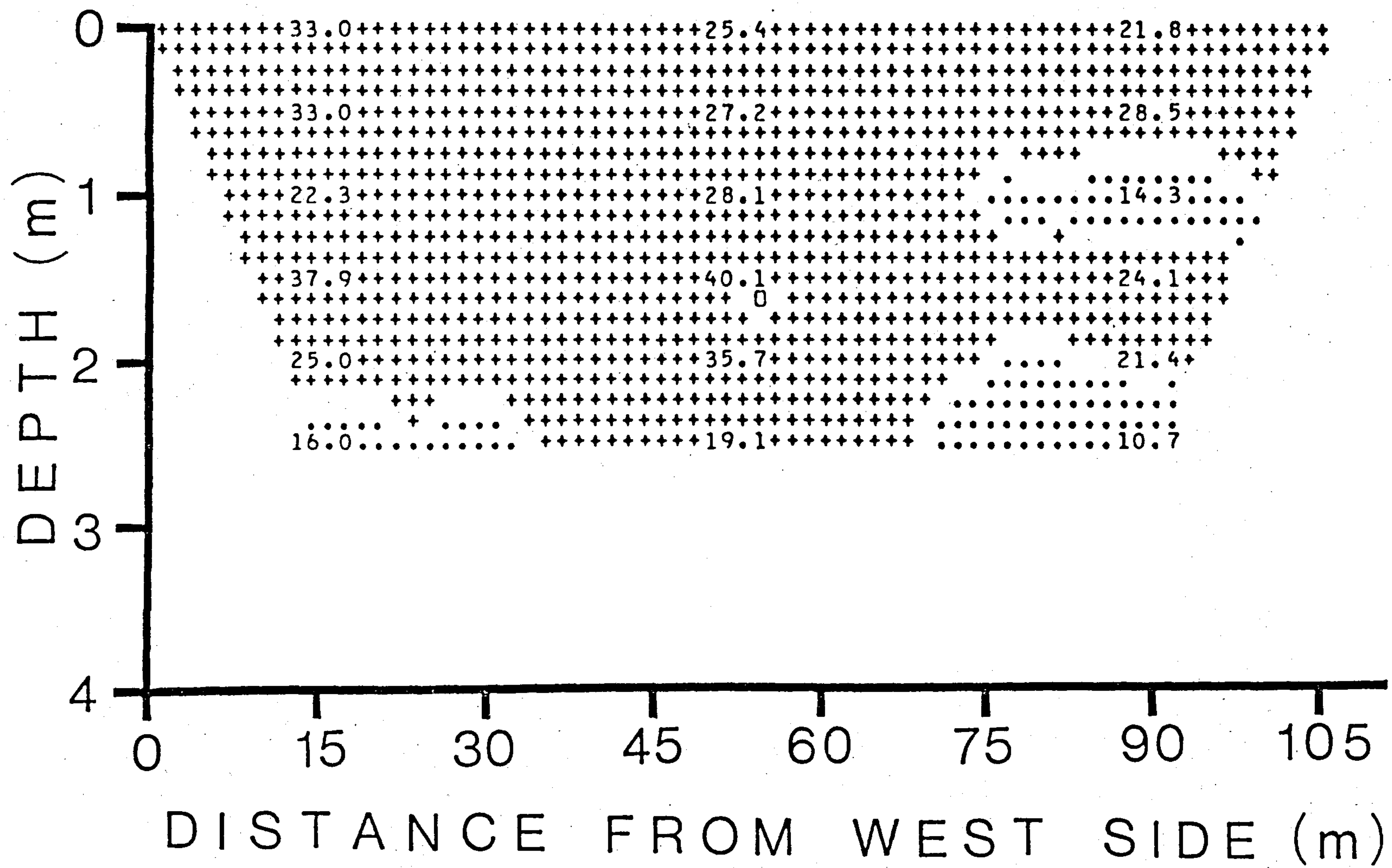

33.0
25.4
21.8
33.0
27.2
28.5
22.3
28.1
14.3
37.9
40.1
24.1
0
25.0
35.7
21.4
16.0
19.1
10.7
0
1
2
3
4
DEPTH (m)
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)

Figure 16. Contour map of fluorescence increase at downlake transect during partial mixing period (•=0-3, +=3-6, 0=6-9, ●=9-15) by SYMAP.

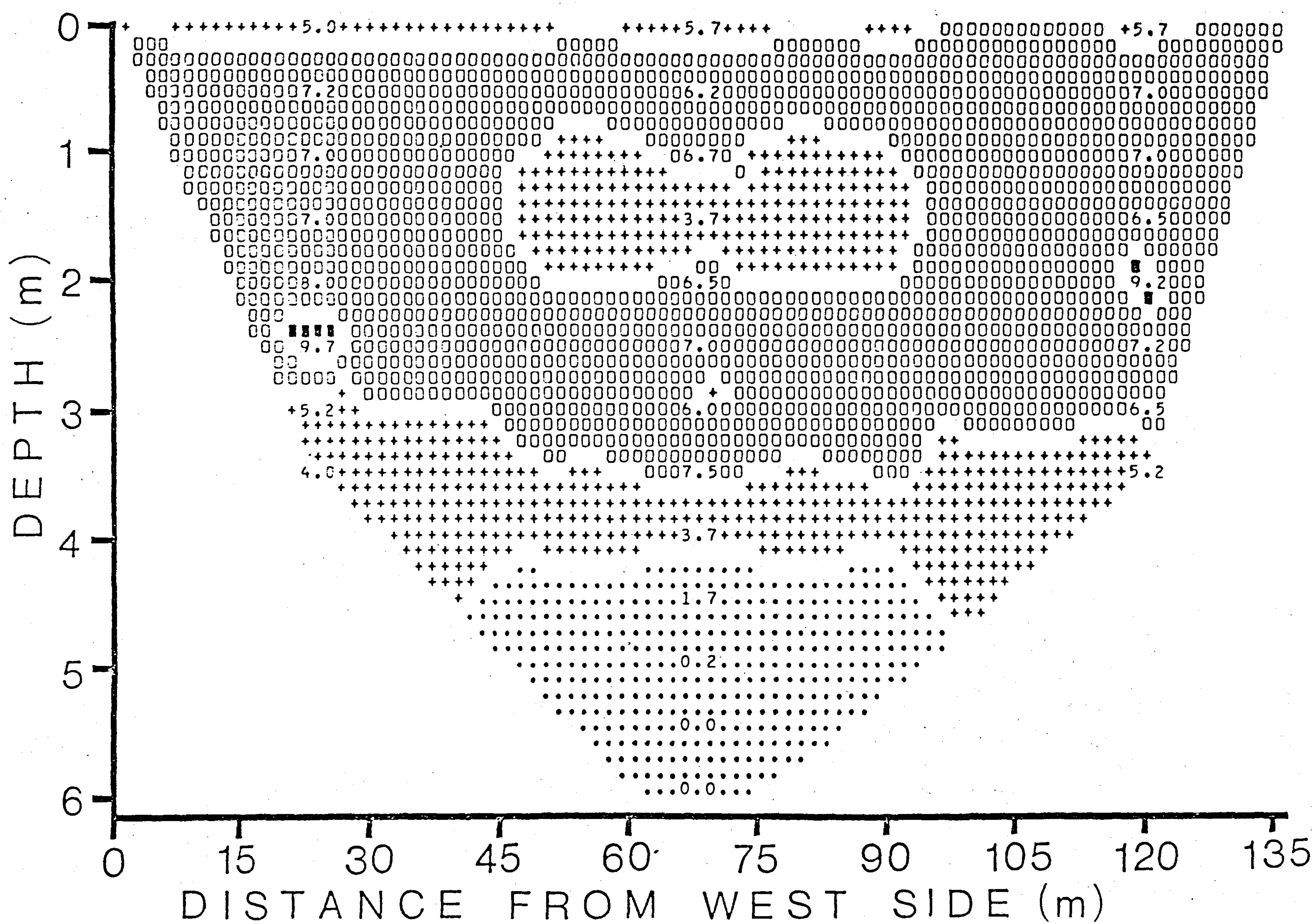

DEPTH (m)
0
1
2
3
4
5
6
0
15
30
45
60
75
90
105
120
135
DISTANCE FROM WEST SIDE (m)

Figure 17. Contour map of fluorescence increase at middle transect during partial mixing period (•=0-3, +=3-6, O=6-9, ●=9-15) by SYMAP.

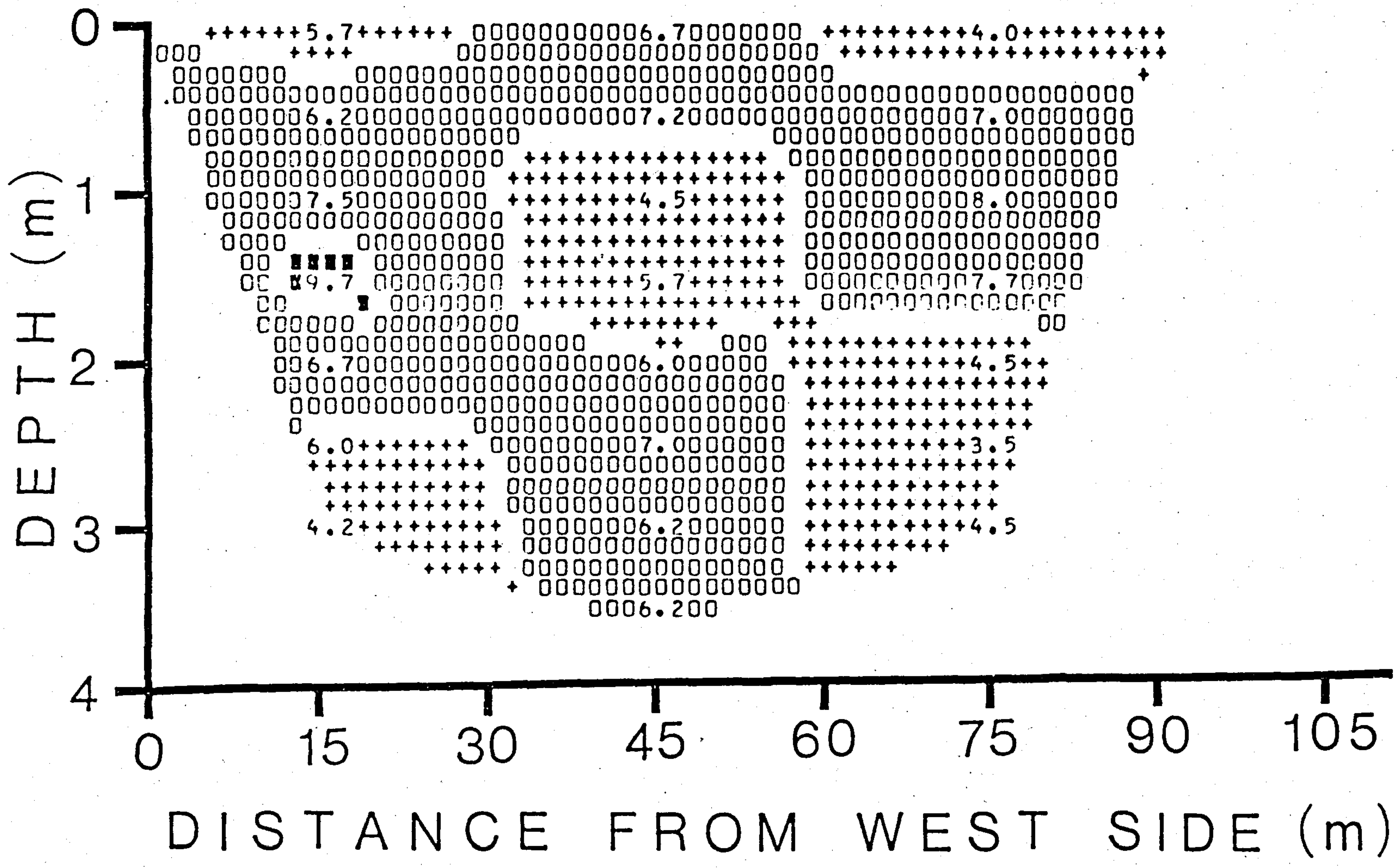

DEPTH (m)
0
1
2
3
4
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)
5.7
6.7
4.0
6.2
7.2
7.0
7.5
4.5
8.0
9.7
5.7
7.7
6.7
6.0
4.5
3.5
7.0
4.2
6.2
4.5
6.2

Figure 18. Contour map of fluorescence increase at uplake transect during partial mixing period (•=0-3, +=3-6, 0=6-9, ●=9-15) by SYMAP.

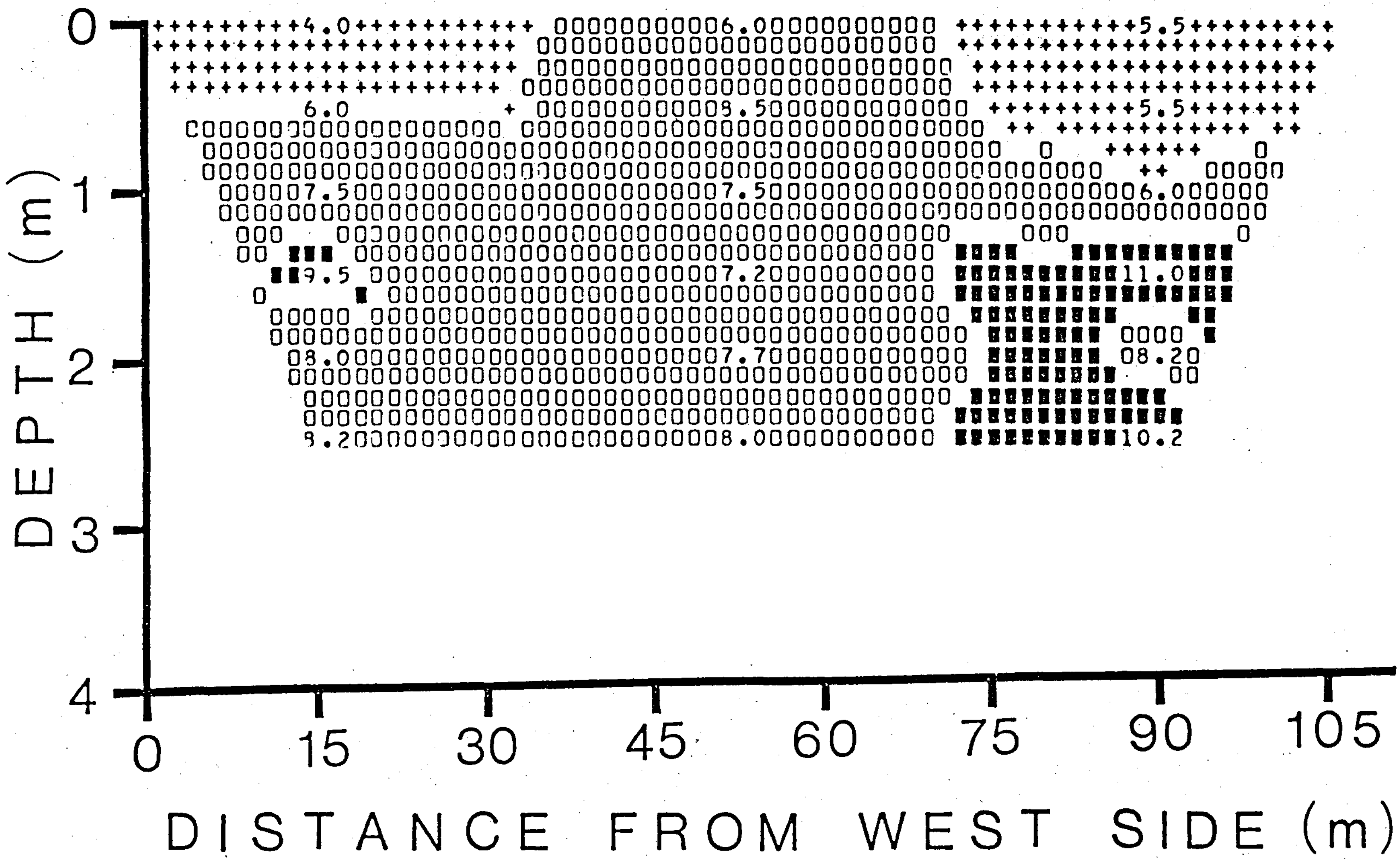

DEPTH (m)
0
1
2
3
4
0
15
30
45
60
75
90
105
DISTANCE FROM WEST SIDE (m)
4.0
6.0
5.5
6.0
8.5
5.5
7.5
7.5
6.0
9.5
7.2
11.0
8.0
7.7
8.20
8.2
8.0
10.2

Figure 19. Contour map of fluorescence increase at downlake transect during fall turnover (•=0-3, +=3-6, 0=6-9, ●=9-15) by SYMAP.

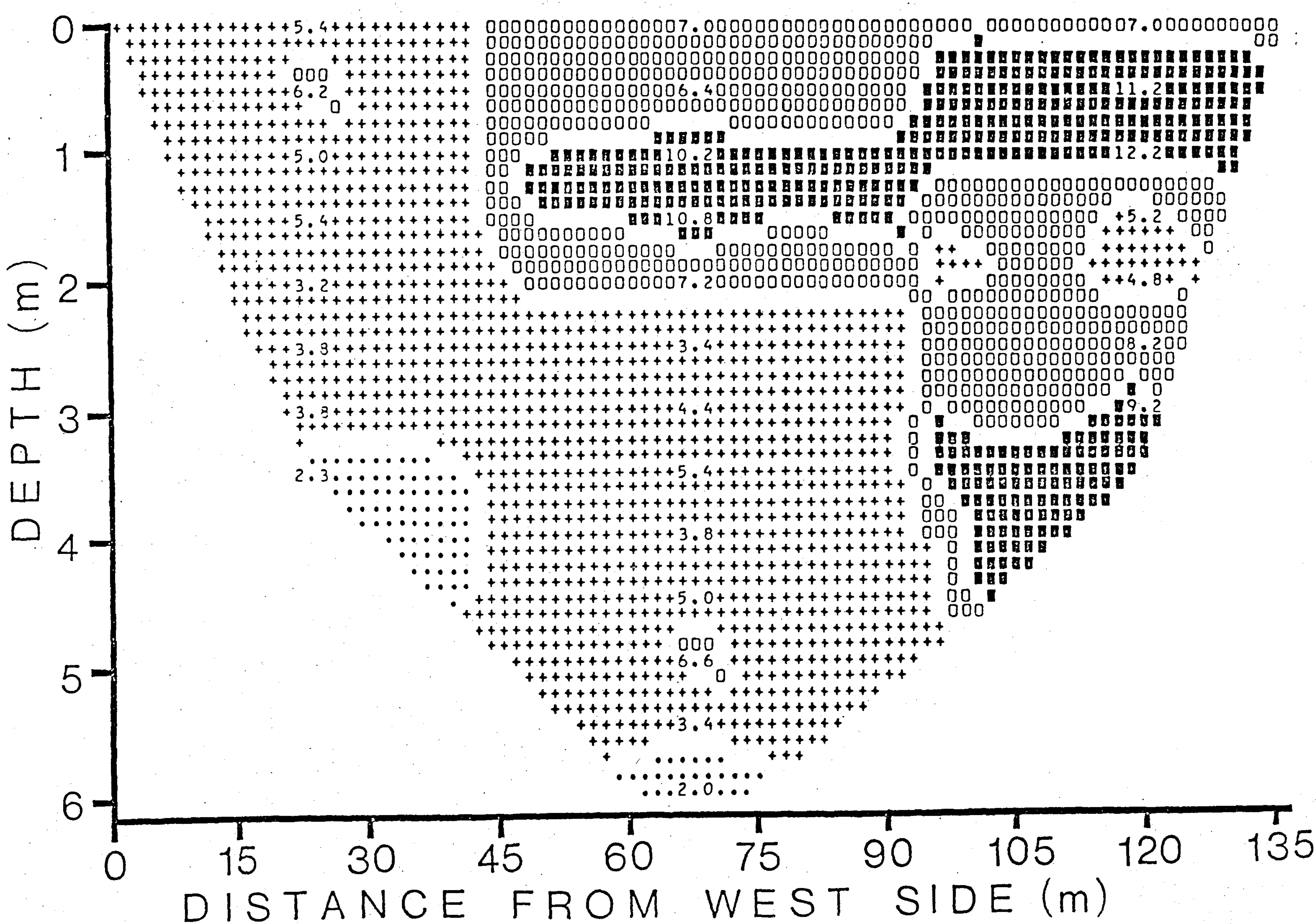
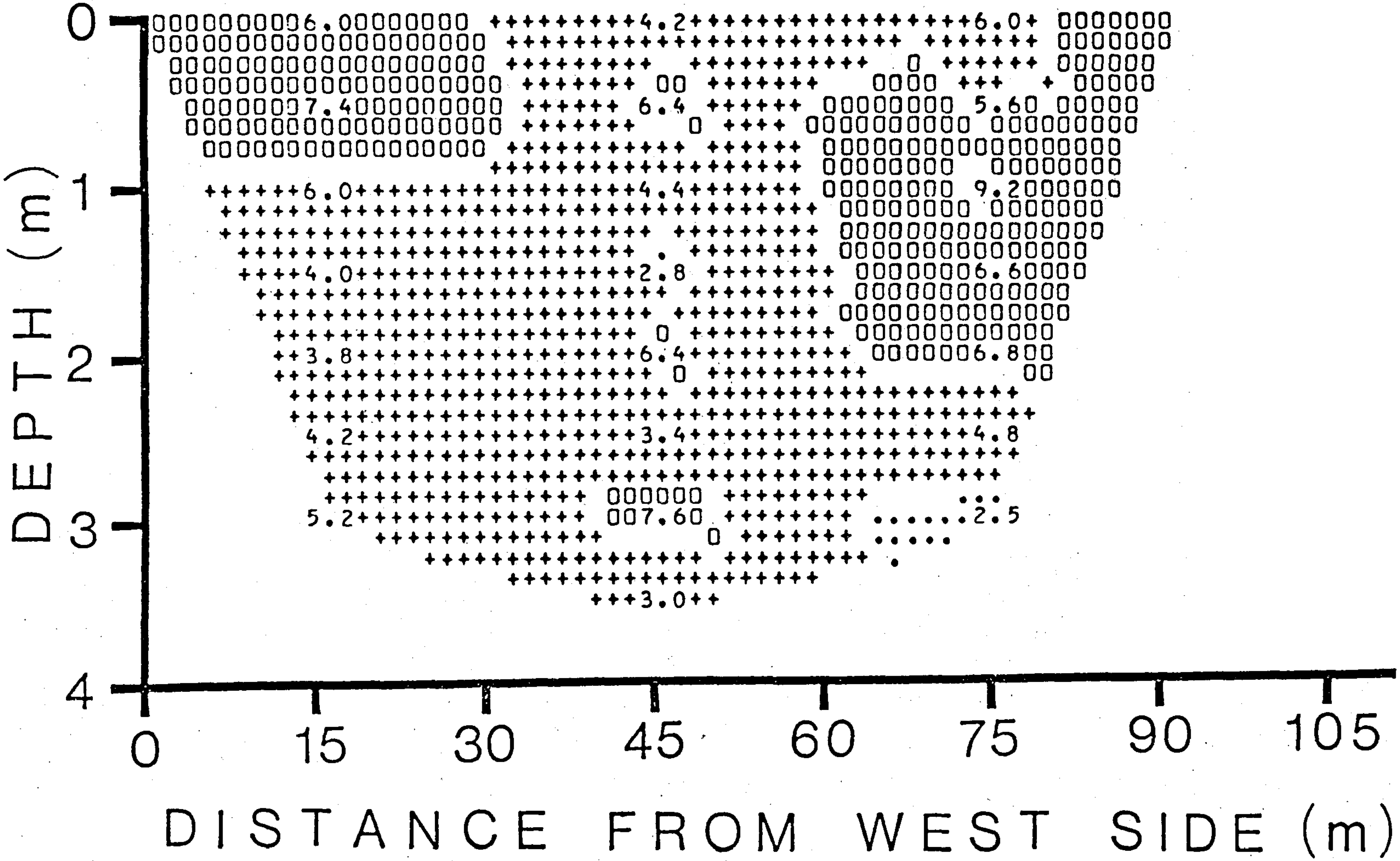
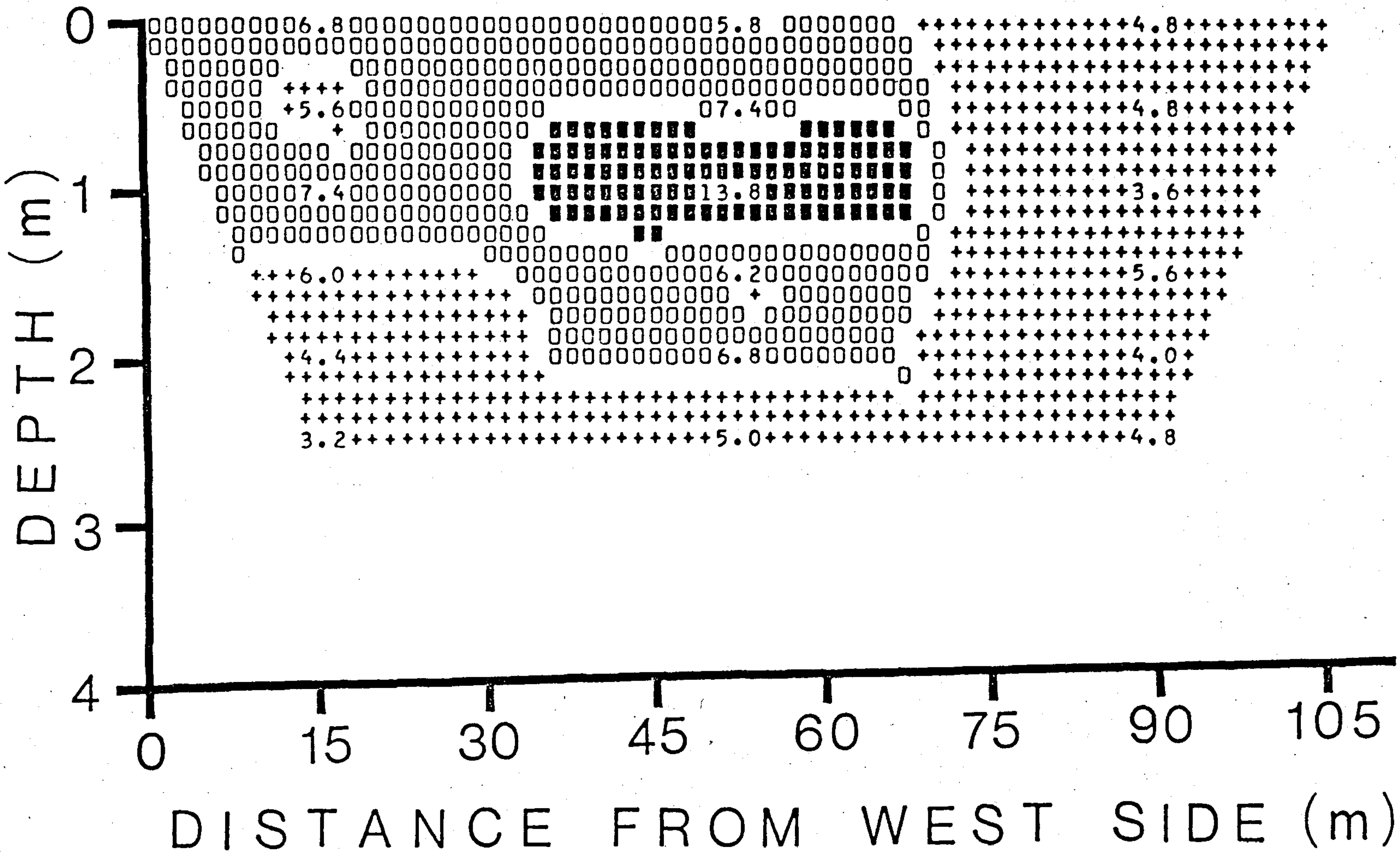

DEPTH (m)
0
1
2
3
4
5
6
DISTANCE FROM WEST SIDE (m)
0
15
30
45
60
75
90
105
120
135
5.4
6.2
5.0
5.4
3.2
3.8
3.8
2.3
7.0
7.0
6.4
11.2
10.2
12.2
10.8
5.2
7.2
4.8
3.4
8.2
4.4
9.2
5.4
3.8
5.0
6.6
3.4
2.0

Figure 20. Contour map of fluorescence increase at middle transect during fall turnover (•=0-3, +=3-6, 0=6-9, ●=9-15) by SYMAP.



DEPTH (m)
0
1
2
3
4
DISTANCE FROM WEST SIDE (m)
0
15
30
45
60
75
90
105

Figure 21. Contour map of fluorescence increase at uplake transect during fall turnover (·=0-3, +=3-6, 0=6-9, ▮=9-15) by SYMAP.



DEPTH (m)
DISTANCE FROM WEST SIDE (m)
0
1
2
3
4
0
15
30
45
60
75
90
105
6.8
5.8
4.8
5.6
7.4
7.4
13.8
3.6
6.0
6.2
5.6
4.4
6.8
4.0
3.2
5.0
4.8

APPENDIXES

Appendix 1. Horizontal distribution (all transects and stations) of chlorophyll a. Values are ratios of variances to means.

Time Period[1]	Depth[2]	Variance/Mean Ratio	Distribution[3]
SS	1	1.99	R
PM	1	1.11	R
FT	1	0.35	R
SS	2	1.10	R
PM	2	0.24	R
FT	2	0.14	R

[1]Time Periods are late summer stratification (SS), partial mixing (PM), and fall turnover (FT)

[2]Depths are the means of all depths (1) and the means of the top 6 depths, 0 to 2.5 meters (2)

[3]Distributions are either random (R), clumped (C), or homogeneous (H)

Appendix 2. Vertical distribution of chlorophyll a. Values are ratios of variances to means.

Time Period[1]	Transect	Station	Variance/Mean Ratio	Distribution[2]
SS	Downlake	West	6.64*	C
SS	Downlake	Middle	12.30*	C
SS	Downlake	East	8.13*	C
SS	Middle	West	5.21*	C
SS	Middle	Middle	2.01	R
SS	Middle	East	2.36	R
SS	Uplake	West	2.38	R
SS	Uplake	Middle	1.93	R
SS	Uplake	East	2.12	R
PM	Downlake	West	1.92	R
PM	Downlake	Middle	14.60*	C
PM	Downlake	East	0.54	R
PM	Middle	West	0.61	R
PM	Middle	Middle	0.84	R
PM	Middle	East	1.52	R
PM	Uplake	West	0.49	R
PM	Uplake	Middle	0.36	R
PM	Uplake	East	2.30	R
FT	Downlake	West	1.81	R
FT	Downlake	Middle	1.28	R
FT	Downlake	East	1.19	R
FT	Middle	West	4.18*	C
FT	Middle	Middle	4.59*	C
FT	Middle	East	2.57*	C
FT	Uplake	West	4.06*	C
FT	Uplake	Middle	0.51	R
FT	Uplake	East	2.58	R

[1]Time Periods are late summer stratification (SS), partial mixing (PM), and fall turnover (FT).

*Significant at the .05 level

[2]Distributions are either random (R), clumped (C), or homogeneous (H)

Appendix 3. Spatial distribution for entire lake (all transects, stations, and depths) and horizontal distribution (all transects and stations) of photosynthetic capacity as measured by fluorescence increase. Values are ratios of variances to means.

Time Period[1]	Distribution[2]	Depth[3]	Variance/Mean Ratio	Distribution[4]
PM	A	1	0.75	R
FT	A	1	1.00	R
PM	B	2	0.16	R
FT	B	2	0.22	R
PM	B	3	0.06	R
FT	B	3	0.31	R

[1]Time Periods are partial mixing (PM) and fall turnover (FT)

[2]Distributions are for entire lake (A) or horizontal (B)

[3]Depths are either all depths (1), means of all depths (2), or means of top 6 depths, 0 to 2.5 meters (3)

[4]Distributions are either random (R), clumped (C), or homogeneous (H)

Appendix 4. Vertical distribution of photosynthetic capacity as measured by fluorescence increase. Values are ratios of variances to means.

Time Period[1]	Transect	Station	Variance/Mean Ratio	Distribution[2]
PM	Downlake	West	0.51	R
PM	Downlake	Middle	4.82*	C
PM	Downlake	East	0.22	R
PM	Middle	West	0.44	R
PM	Middle	Middle	0.12	R
PM	Middle	East	0.64	R
PM	Uplake	West	0.52	R
PM	Uplake	Middle	0.12	R
PM	Uplake	East	0.78	R
FT	Downlake	West	0.39	R
FT	Downlake	Middle	1.17	R
FT	Downlake	East	1.97	R
FT	Middle	West	0.33	R
FT	Middle	Middle	0.68	R
FT	Middle	East	0.70	R
FT	Uplake	West	0.43	R
FT	Uplake	Middle	1.36	R
FT	Uplake	East	0.11	R

[1]Time Periods are partial mixing (PM) and fall turnover (FT)

*Significant at the .05 level

[2]Distributions are either random (R), clumped (C), or homogeneous (H)

Appendix 5. Meanings of columns in Appendix 6.

Column	Name of Property	Unit of Measure Where Applicable	Decimal Point Location Where Applicable[1]	Numerical Code Where Applicable
A	Date	Day from start of study		01=Sept.23,03=Sept.25,10=Oct.2,15=Oct.7,17=Oct.9,22=Oct.14,24=Oct.16,31=Oct.23,38=Oct.30,45=Nov.6,53=Nov.14,64=Nov.25,73=Dec.4
B	Transect			1=Downlake, 2=Middle, 3=Uplake
C	Station			1=West, 2=Middle, 3=East
D	Depth	Meters		1=0,2=0.5,3=1,4=1.5,5=2,6=2.5,7=3,8=3.5,9=4,10=4.5,11=5,12=5.5,13=6
E	Water Temperature	^oC	--•-	
F	Concentration of Dissolved Oxygen	PPM	--•-	
G	Chlorophyll a	mg/m^3	---•--	
H	Pheopigment	mg/m^3	---•--	
I	Fluorescence without DCMU			
J	Fluorescence with DCMU			
K	Percent Fluorescence Increase		--•-	
L	Percent Fluorescence Increase/Chlorophyll a		-•--	
M	Fluorescence Increase			
N	Turbidity	JTU		

[1]Point indicates position of decimal point, e.g., 26.5 represented as --•-

Appendix 6. Values of lake properties for various dates and locations in Westhampton Lake (See Appendix 5 for meanings of columns).

A	B	C	D	E	F	G	H	I
01	1	1	1	27	94	5346	1109	36
01	1	1	2	27	94	8019	1991	28
01	1	1	3	265	90	4277	2740	27
01	1	1	4	25	48	5212	1804	28
01	1	1	5	24	14	1336	2031	17
01	1	1	6	23	8	2005	1270	17
01	1	1	7	215	7	2272	2873	21
01	1	1	8	20	7	1871	3555	13
01	1	2	1	28	94	4143	1751	25
01	1	2	2	27	93	4010	1230	30
01	1	2	3	27	92	4544	1818	29
01	1	2	4	26	64	6282	548	31
01	1	2	5	24	23	2406	1056	20
01	1	2	6	23	11	1069	1644	17
01	1	2	7	21	9	1203	762	16
01	1	2	8	19	9	6415	4437	23
01	1	2	9	16	9	14033	34990	32
01	1	2	10	14	9	4010	4785	12
01	1	2	11	115	9	4143	4557	11
01	1	2	12	105	9	4678	4865	11
01	1	2	13	105	8	7083	3582	15
01	1	3	1	27	94	5881	1042	32
01	1	3	2	27	94	5881	855	30
01	1	3	3	265	92	6014	1376	27
01	1	3	4	255	42	1336	909	15
01	1	3	5	24	13	3475	454	20
01	1	3	6	24	11	1069	1457	15
01	2	1	1	27	89	4945	388	26
01	2	1	2	27	89	4945	949	26
01	2	1	3	26	80	4945	1042	24
01	2	1	4	25	62	4410	361	24
01	2	1	5	24	19	1470	1243	18
01	2	1	6	23	9	1470	1524	16
01	2	2	1	27	92	3876	521	23
01	2	2	2	27	92	4544	1443	29
01	2	2	3	26	88	4410	922	27
01	2	2	4	25	61	3475	1577	23
01	2	2	5	24	23	1470	962	18
01	2	2	6	23	9	1470	962	18
01	2	2	7	22	8	5079	-13552	18
01	2	2	8	19	8	6014	-12095	15
01	2	3	1	27	92	4410	1296	29
01	2	3	2	27	90	2940	5573	13
01	2	3	3	26	86	4110	1002	24
01	2	3	4	25	46	5212	1617	27
01	2	3	5	245	21	1470	1149	17
01	2	3	6	235	8	1470	1056	18
01	2	3	7	215	8	4544	5653	24

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I
01	3	1	1	27	89	3876	615	23
01	3	1	2	27	87	4410	1016	24
01	3	1	3	26	85	3475	1577	25
01	3	1	4	25	61	6014	1096	30
01	3	1	5	25	13	3074	949	21
01	3	1	6	24	9	1604	1203	18
01	3	2	1	28	92	4410	922	25
01	3	2	2	27	92	4811	334	30
01	3	2	3	26	87	4410	922	26
01	3	2	4	25	76	7752	855	29
01	3	2	5	245	12	7785	535	31
01	3	2	6	23	8	3341	962	18
01	3	3	1	28	90	3475	735	24
01	3	3	2	27	90	5212	9476	20
01	3	3	3	26	80	1069	1363	23
01	3	3	4	25	60	2940	708	25
01	3	3	5	245	18	5079	628	18
01	3	3	6	24	9	1737	414	14
03	1	1	1	23	80	3341	1056	19
03	1	1	2	23	77	3608	788	20
03	1	1	3	23	58	2406	869	18
03	1	1	4	23	35	1737	882	11
03	1	1	5	22	21	802	1724	14
03	1	1	6	215	39	1336	1470	15
03	1	1	7	21	13	1336	1470	18
03	1	1	8	19	10	4010	3408	19
03	1	2	1	235	81	2673	788	19
03	1	2	2	23	71	3475	361	21
03	1	2	3	23	62	2673	1069	20
03	1	2	4	23	28	1604	1016	18
03	1	2	5	22	34	1802	2192	16
03	1	2	6	215	44	535	3582	16
03	1	2	7	21	12	1336	1470	18
03	1	2	8	19	10	12429	13485	24
03	1	2	9	17	10	6415	4998	16
03	1	2	10	15	10	4678	4584	13
03	1	2	11	13	11	3208	5119	13
03	1	2	12	12	11	4410	6722	15
03	1	2	13	11	11	4277	6763	18
03	1	3	1	24	85	5346	1390	27
03	1	3	2	235	8	4544	1350	27
03	1	3	3	235	74	1871	936	28
03	1	3	4	23	46	1470	1898	17
03	1	3	5	22	17	1604	2045	15
03	1	3	6	22	36	1470	2646	16
03	1	3	7	21	11	6950	8954	19

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I
03	2	1	1	235	83	1203	3475	20
03	2	1	2	235	82	4277	1336	34
03	2	1	3	235	70	3609	2847	32
03	2	1	4	23	38	1470	963	16
03	2	1	5	225	22	1336	1002	15
03	2	1	6	215	60	802	1630	17
03	2	2	1	235	83	2138	1791	20
03	2	2	2	23	80	2272	628	17
03	2	2	3	23	62	1069	1457	16
03	2	2	4	23	21	1336	1002	14
03	2	2	5	225	28	1470	1524	15
03	2	2	6	22	34	936	1871	17
03	2	2	7	21	18	1871	936	17
03	2	2	8	20	10	1336	3996	19
03	2	3	1	235	86	4143	1002	22
03	2	3	2	23	75	2005	1831	22
03	2	3	3	23	50	1871	1216	17
03	2	3	4	23	27	1069	1363	15
03	2	3	5	225	26	1336	1002	15
03	2	3	6	22	40	1069	1457	17
03	2	3	7	21	9	1336	909	17
03	3	1	1	235	83	4544	695	25
03	3	1	2	23	74	4277	401	33
03	3	1	3	23	65	2807	1123	23
03	3	1	4	23	58	2807	561	22
03	3	1	5	225	58	1737	1069	18
03	3	1	6	22	47	1069	1270	17
03	3	2	1	235	83	2272	1470	20
03	3	2	2	23	68	2005	615	20
03	3	2	3	23	66	2272	535	19
03	3	2	4	23	61	1871	561	17
03	3	2	5	225	59	1203	762	16
03	3	2	6	22	11	1069	615	16
03	3	3	1	235	83	2005	989	20
03	3	3	2	23	78	2272	722	19
03	3	3	3	23	45	2272	1096	19
03	3	3	4	23	34	1871	842	17
03	3	3	5	22	56	802	1069	16
03	3	3	6	22	9	1336	254	16
10	1	1	1	22	82	1871	187	14
10	1	1	2	21	80	4143	628	22
10	1	1	3	195	50	4544	1443	22
10	1	1	4	19	43	1871	936	17
10	1	1	5	19	39	1203	949	16
10	1	1	6	19	35	1336	441	14
10	1	1	7	19	11	1336	1470	16

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I
10	1	2	1	21	92	4010	668	21
10	1	2	2	20	92	13231	802	39
10	1	2	3	195	58	9890	1149	32
10	1	2	4	19	49	3208	2406	22
10	1	2	5	19	42	2005	1176	18
10	1	2	6	19	33	802	601	13
10	1	2	7	19	27	1203	481	14
10	1	2	8	18	11	4544	7150	30
10	1	2	9	165	10	4010	4691	14
10	1	2	10	14	10	4277	5734	13
10	1	2	11	125	10	4410	7845	14
10	1	2	12	115	10	5079	7083	18
10	1	2	13	11	10	8286	15102	29
10	1	3	1	21	92	3475	1016	23
10	1	3	2	195	87	8153	1484	46
10	1	3	3	195	66	3208	6616	47
10	1	3	4	19	49	4678	1123	30
10	1	3	5	19	42	1203	762	14
10	1	3	6	19	35	1470	775	16
10	1	3	7	19	23	668	1016	13
10	2	1	1	205	80	1737	321	18
10	2	1	2	205	76	1336	1470	19
10	2	1	3	20	64	1470	962	18
10	2	1	4	195	53	1336	1189	18
10	2	1	5	19	48	2138	481	19
10	2	1	6	19	29	802	788	14
10	2	1	7	19	9	668	922	14
10	2	2	1	21	87	1737	882	20
10	2	2	2	21	71	1604	1016	18
10	2	2	3	205	86	4410	2419	27
10	2	2	4	20	55	2406	401	18
10	2	2	5	19	34	3608	3969	27
10	2	2	6	19	32	1470	1243	17
10	2	2	7	19	32	1069	521	15
10	2	3	1	21	89	2406	307	20
10	2	3	2	205	88	1470	2085	20
10	2	3	3	20	79	2005	1363	22
10	2	3	4	20	48	2539	3074	24
10	2	3	5	19	32	4277	1243	24
10	2	3	6	19	25	1069	895	15
10	2	3	7	19	9	668	788	14
10	3	1	1	22	85	1470	775	19
10	3	1	2	215	83	1203	481	18
10	3	1	3	21	78	401	1657	18
10	3	1	4	205	67	2539	267	20
10	3	1	5	20	44	2673	695	21
10	3	1	6	19	26	2138	1136	23

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I
10	3	2	1	21	88	936	842	17
10	3	2	2	21	87	1336	535	17
10	3	2	3	21	81	1737	788	18
10	3	2	4	20	63	2406	588	27
10	3	2	5	195	38	1737	1630	21
10	3	2	6	19	26	1336	347	15
10	3	3	1	215	77	1069	1082	16
10	3	3	2	215	75	1069	802	18
10	3	3	3	21	78	936	1403	17
10	3	3	4	20	53	2406	494	20
10	3	3	5	195	37	535	2927	19
10	3	3	6	19	8	134	2299	17
15	1	1	1	16	62	2005	521	17
15	1	1	2	16	56	3475	735	18
15	1	1	3	16	33	2138	1230	18
15	1	1	4	155	31	1604	1109	17
15	1	1	5	155	21	802	1163	16
15	1	1	6	155	33	1203	668	13
15	1	1	7	15	34	1203	762	12
15	1	1	8	15	30	1203	762	13
15	1	2	1	16	55	2940	521	18
15	1	2	2	16	43	2406	1336	18
15	1	2	3	16	34	2406	1056	18
15	1	2	4	16	34	2673	414	16
15	1	2	5	155	30	2005	521	15
15	1	2	6	155	29	668	1764	14
15	1	2	7	155	24	1336	815	13
15	1	2	8	155	24	1470	588	13
15	1	2	9	15	11	1203	762	13
15	1	2	10	145	10	4811	7164	14
15	1	2	11	13	9	6549	7578	15
15	1	2	12	12	9	5747	12590	21
15	1	2	13	11	9	8821	10545	25
15	1	3	1	165	57	1336	2406	16
15	1	3	2	16	48	2807	748	17
15	1	3	3	16	41	2272	909	17
15	1	3	4	16	44	2005	428	17
15	1	3	5	155	42	1604	1296	16
15	1	3	6	155	32	1336	909	14
15	1	3	7	155	31	802	1256	13
15	1	3	8	155	11	1336	535	13
15	2	1	1	165	72	1604	1764	18
15	2	1	2	16	62	2272	441	17
15	2	1	3	16	24	2940	1082	17
15	2	1	4	155	36	1203	762	13
15	2	1	5	155	38	1203	481	12
15	2	1	6	155	41	1203	120	14
15	2	1	7	155	9	535	1149	14

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M
15	2	2	1	16	62	2138	668	19				
15	2	2	2	16	56	2406	1336	19				
15	2	2	3	16	28	3475	922	17				
15	2	2	4	155	28	1470	588	14				
15	2	2	5	155	31	1203	388	14				
15	2	2	6	155	38	267	1417	15				
15	2	2	7	155	46	1069	708	14				
15	2	2	8	15	45	535	869	12				
15	2	3	1	165	54	2272	347	19				
15	2	3	2	16	38	1470	1243	18				
15	2	3	3	16	31	2272	722	17				
15	2	3	4	155	26	2272	-27	15				
15	2	3	5	155	26	1871	561	14				
15	2	3	6	155	37	936	1310	14				
15	2	3	7	155	41	1604	829	14				
15	3	1	1	165	88	2673	1724	18				
15	3	1	2	16	76	4410	624	20				
15	3	1	3	16	65	3608	1350	20				
15	3	1	4	16	62	2673	414	19				
15	3	1	5	155	55	1604	267	16				
15	3	1	6	15	37	1336	254	12				
15	3	2	1	165	76	1737	788	16				
15	3	2	2	16	79	4277	1898	24				
15	3	2	3	16	60	3608	1163	22				
15	3	2	4	16	61	3475	454	20				
15	3	2	5	155	49	2539	1484	20				
15	3	2	6	15	41	8687	-6722	13				
15	3	3	1	16	71	6682	428	27				
15	3	3	2	16	62	4544	882	22				
15	3	3	3	16	48	1871	2432	20				
15	3	3	4	16	41	1871	561	16				
15	3	3	5	155	45	802	1537	15				
15	3	3	6	15	9	1069	521	13				
17	1	1	1	20	90	4544	227	28	37	321	71	9
17	1	1	2	18	94	1470	775	16	23	438	298	7
17	1	1	3	17	92	1604	1203	18	21	167	104	3
17	1	1	4	16	31	2673	414	19	26	368	138	7
17	1	1	5	155	26	2138	855	15	23	533	249	8
17	1	1	6	155	24	2005	615	13	24	846	422	11
17	1	1	7	15	20	1470	1056	11	15	364	248	4
17	1	1	8	15	9	1069	989	10	14	400	374	4
17	1	2	1	19	90	1470	307	15	24	600	408	9
17	1	2	2	17	89	2272	-27	18	29	611	269	11
17	1	2	3	165	90	1203	668	17	22	294	244	5
17	1	2	4	16	61	2539	361	19	24	263	104	5
17	1	2	5	16	31	936	1497	18	25	389	416	7
17	1	2	6	155	17	1737	601	12	19	583	336	7
17	1	2	7	15	16	1069	802	11	16	454	425	5

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M
17	1	2	8	15	11	2807	468	16	19	188	67	3
17	1	2	9	15	9	1737	882	16	18	125	72	2
17	1	2	10	14	9	4811	5760	15	15	0	0	0
17	1	2	11	13	9	6415	9115	17	17	0	0	0
17	1	2	12	12	9	7885	7458	20	20	0	0	0
17	1	2	13	11	9	8821	10638	27	27	0	0	0
17	1	3	1	175	99	1737	882	18	18	0	0	0
17	1	3	2	17	97	936	1310	18	27	500	534	9
17	1	3	3	16	94	2138	13	20	28	400	187	8
17	1	3	4	16	51	2673	227	20	26	300	112	6
17	1	3	5	16	39	1336	535	16	19	188	141	3
17	1	3	6	155	27	1203	481	14	16	143	119	2
17	1	3	7	15	16	1336	909	13	16	231	173	3
17	1	3	8	15	10	455	1056	11	13	182	400	2
17	2	1	1	20	87	1336	441	13	20	538	403	7
17	2	1	2	18	85	1604	922	18	24	333	208	6
17	2	1	3	16	60	2673	134	17	22	294	110	5
17	2	1	4	16	43	2272	535	20	29	450	198	9
17	2	1	5	155	28	2138	388	17	23	353	165	6
17	2	1	6	155	26	1871	1029	14	17	214	114	3
17	2	1	7	15	8	2138	575	13	15	154	72	2
17	2	2	1	19	94	1203	388	15	17	133	110	2
17	2	2	2	18	94	1871	374	17	28	647	346	11
17	2	2	3	17	90	1203	762	17	24	412	342	7
17	2	2	4	16	47	3068	882	22	31	409	133	9
17	2	2	5	155	34	2539	174	16	18	125	49	2
17	2	2	6	155	22	1871	374	14	16	143	76	2
17	2	2	7	15	9	1069	802	12	15	250	234	3
17	2	2	8	15	5	2406	214	13	21	615	256	8
17	2	3	1	19	88	341	1189	13	15	154	452	2
17	2	3	2	18	92	1604	1016	16	18	125	78	2
17	2	3	3	165	87	1069	1550	17	22	294	275	5
17	2	3	4	16	46	2673	321	21	26	238	89	5
17	2	3	5	155	28	2138	386	16	18	125	58	2
17	2	3	6	15	18	1336	535	11	15	364	272	4
17	2	3	7	15	7	936	655	10	13	300	320	3
17	3	1	1	19	91	1871	281	12	16	333	178	4
17	3	1	2	19	89	668	1484	14	20	428	641	6
17	3	1	3	175	89	1203	668	14	17	214	178	3
17	3	1	4	165	80	2406	2085	20	40	1000	416	20
17	3	1	5	16	62	2406	307	19	33	737	306	14
17	3	1	6	16	9	1470	682	14	20	428	291	6
17	3	2	1	18	86	1336	254	14	18	286	214	4
17	3	2	2	18	96	1737	321	14	19	357	206	5
17	3	2	3	165	93	1203	481	14	20	428	356	6
17	3	2	4	16	77	1737	1724	21	28	333	192	7
17	3	2	5	155	57	2406	214	16	24	500	208	8
17	3	2	6	15	11	936	748	13	17	308	329	4

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M
17	3	3	1	205	88	1470	401	13	18	385	262	5
17	3	3	2	19	91	1871	187	16	21	312	167	5
17	3	3	3	17	93	936	1123	16	22	375	401	6
17	3	3	4	16	80	4143	628	23	29	261	63	6
17	3	3	5	16	54	1336	1470	19	25	316	236	6
17	3	3	6	155	7	2272	535	16	24	500	220	8
22	1	1	1	15	91	2406	307	23	25	87	36	2
22	1	1	2	15	86	3742	−94	28	40	428	114	12
22	1	1	3	145	66	2005	1550	27	39	444	221	12
22	1	1	4	14	49	1604	454	23	31	348	217	8
22	1	1	5	14	58	1203	1604	20	34	700	582	14
22	1	1	6	14	61	1604	548	19	35	842	525	16
22	1	1	7	14	5	668	1016	19	29	526	787	10
22	1	1	8	145	4	2138	1042	20	27	350	164	7
22	1	2	1	145	83	4143	−682	31	40	290	70	9
22	1	2	2	145	80	3876	334	29	39	345	89	0
22	1	2	3	14	59	2138	949	26	34	308	144	8
22	1	2	4	14	55	2272	722	24	29	208	92	5
22	1	2	5	14	52	936	1590	20	24	200	214	4
22	1	2	6	14	51	1203	481	19	27	421	350	8
22	1	2	7	14	46	1470	1149	20	25	250	170	5
22	1	2	8	14	47	1604	922	20	31	550	343	11
22	1	2	9	14	58	1336	535	20	25	250	187	5
22	1	2	10	135	14	4811	4170	19	18	59	12	1
22	1	2	11	13	10	6148	7511	16	16	0	0	0
22	1	2	12	12	9	8153	7003	22	22	0	0	0
22	1	2	13	11	9	6415	9021	22	22	0	0	0
22	1	3	1	15	81	1737	788	24	36	500	288	12
22	1	3	2	15	77	1336	1283	22	28	273	204	6
22	1	3	3	145	64	2138	481	24	29	208	97	5
22	1	3	4	14	52	2138	1042	22	27	227	106	5
22	1	3	5	14	51	1871	561	20	36	800	428	16
22	1	3	6	14	38	1871	1029	20	29	450	240	9
22	1	3	7	14	35	2138	949	21	27	286	134	6
22	1	3	8	14	48	2272	1470	25	26	40	18	1
22	2	1	1	15	90	2138	575	24	31	292	136	7
22	2	1	2	15	84	1336	1377	25	28	120	90	3
22	2	1	3	15	58	2406	401	26	39	500	208	13
22	2	1	4	14	57	2539	267	24	37	542	213	13
22	2	1	5	14	64	1470	401	20	24	200	136	4
22	2	1	6	14	67	1336	815	21	26	238	178	5
22	2	1	7	14	68	1737	788	22	30	364	210	8
22	2	2	1	15	95	2539	2513	29	39	345	136	10
22	2	2	2	15	77	2673	2960	25	31	240	90	6
22	2	2	3	145	56	3208	2125	27	33	222	69	6
22	2	2	4	14	51	1871	561	22	26	182	97	4
22	2	2	5	14	56	1604	735	22	30	364	227	8
22	2	2	6	14	62	1737	414	23	29	261	150	6
22	2	2	7	14	72	1871	842	22	28	273	146	6
22	2	2	8	14	72	2406	401	22	25	136	56	3

A	B	C	D	E	F	G	H	I	J	K	L	M	N
22	2	3	1	155	99	1871	1590	22	26	182	97	4	
22	2	3	2	15	75	2940	708	23	32	391	133	9	
22	2	3	3	145	54	1336	2125	23	38	652	488	15	
22	2	3	4	14	50	2807	748	24	34	417	148	10	
22	2	3	5	14	54	2272	909	20	24	200	88	4	
22	2	3	6	14	65	2406	401	20	23	150	62	3	
22	2	3	7	14	69	1470	1804	22	24	91	62	2	
22	3	1	1	16	96	1737	508	23	28	217	125	5	
22	3	1	2	155	94	1336	722	22	30	364	272	8	
22	3	1	3	15	93	1737	508	21	28	333	192	7	
22	3	1	4	15	91	2005	1270	26	30	154	77	4	
22	3	1	5	145	83	2005	1176	24	31	292	146	7	
22	3	1	6	14	9	1871	468	23	29	261	139	6	
22	3	2	1	16	99	1604	735	22	28	273	170	6	
22	3	2	2	155	94	1069	802	21	35	667	624	14	
22	3	2	3	15	94	1470	588	22	33	500	340	11	
22	3	2	4	145	88	1470	1524	24	34	417	284	10	
22	3	2	5	14	85	1871	748	24	29	208	111	5	
22	3	2	6	14	9	1069	1363	22	26	182	170	4	
22	3	3	1	155	99	4811	708	24	30	250	52	6	
22	3	3	2	155	96	2406	120	23	28	217	90	5	
22	3	3	3	15	94	1871	1497	23	33	435	232	10	
22	3	3	4	145	87	3341	869	27	39	444	133	12	
22	3	3	5	14	86	2138	1697	26	49	500	234	13	
22	3	3	6	14	9	1737	695	25	34	360	207	9	
24	1	1	1	17	98	1871	187	30	37	233	124	7	20
24	1	1	2	17	100	2138	668	29	34	172	80	5	25
24	1	1	3	15	85	1069	3421	33	38	152	142	5	20
24	1	1	4	14	74	2406	494	44	50	366	152	6	30
24	1	1	5	14	64	1470	1430	36	40	111	76	4	
24	1	1	6	14	53	1336	1564	28	33	178	133	5	
24	1	1	7	14	5	936	1684	25	29	160	171	4	
24	1	1	8	14	12	2940	1270	30	33	100	34	3	
24	1	2	1	16	104	1737	695	34	38	118	68	4	20
24	1	2	2	15	10	1871	281	31	35	129	69	4	22
24	1	2	3	145	85	936	1029	31	38	226	241	7	22
24	1	2	4	14	81	2406	401	33	36	91	38	3	25
24	1	2	5	14	52	936	936	29	36	241	257	7	
24	1	2	6	14	46	2138	762	25	29	160	75	4	
24	1	2	7	14	44	2046	1243	24	28	167	82	4	
24	1	2	8	14	28	3341	214	23	32	391	117	9	
24	1	2	9	135	12	2539	1390	24	30	250	98	6	
24	1	2	10	135	10	2673	2566	25	27	80	30	2	
24	1	2	11	12	9	6014	8206	21	21	0	0	0	
24	1	2	12	12	9	7484	4771	27	27	0	0	0	
24	1	2	13	11	9	6816	9369	31	31	0	0	0	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
24	1	3	1	155	96	2005	521	33	37	121	60	4	20
24	1	3	2	155	84	1203	1323	32	40	250	208	8	20
24	1	3	3	15	79	1336	722	28	39	393	294	11	20
24	1	3	4	14	59	1871	468	27	32	185	99	5	20
24	1	3	5	14	48	1604	642	27	36	333	208	9	
24	1	3	6	14	45	1336	815	22	31	409	306	9	
24	1	3	7	14	44	2673	227	25	32	280	105	7	
24	1	3	8	14	12	1336	2218	23	28	217	162	5	
24	2	1	1	17	104	1737	976	28	31	107	62	3	20
24	2	1	2	17	98	341	1377	32	41	281	824	9	20
24	2	1	3	14	98	1336	1657	33	40	212	159	7	30
24	2	1	4	14	75	2272	347	35	42	200	88	7	40
24	2	1	5	14	77	3068	414	33	38	152	50	5	
24	2	1	6	14	56	1336	1470	27	31	148	111	4	
24	2	1	7	14	49	1336	441	26	31	192	144	5	
24	2	2	1	17	104	1069	708	28	33	178	166	5	30
24	2	2	2	165	102	1871	374	32	36	125	67	4	40
24	2	2	3	15	94	1470	1336	34	36	59	40	2	40
24	2	2	4	14	64	2940	428	37	42	135	46	5	40
24	2	2	5	14	60	2406	682	33	38	152	63	5	
24	2	2	6	14	54	1604	428	25	39	560	349	14	
24	2	2	7	14	48	1336	1189	25	36	440	329	11	
24	2	2	8	135	9	1336	535	24	34	417	312	10	
24	2	3	1	16	108	802	1630	33	41	242	302	8	40
24	2	3	2	16	102	1336	441	28	35	250	187	7	20
24	2	3	3	155	102	455	1524	30	36	200	440	6	30
24	2	3	4	145	70	2940	895	31	41	322	110	10	30
24	2	3	5	14	48	2138	388	26	31	192	82	5	
24	2	3	6	14	47	1336	628	22	28	273	204	6	
24	2	3	7	14	14	1470	1336	25	31	240	163	6	
24	3	1	1	17	100	1336	441	29	35	207	155	6	35
24	3	1	2	155	100	668	1016	24	28	167	250	4	40
24	3	1	3	15	102	1203	294	27	38	407	338	11	40
24	3	1	4	145	98	1604	1109	31	39	258	161	8	38
24	3	1	5	14	87	2406	401	30	35	167	69	5	
24	3	1	6	14	9	1737	788	29	36	241	139	7	
24	3	2	1	16	102	2138	294	29	36	241	113	7	40
24	3	2	2	15	104	1336	909	30	35	167	125	5	40
24	3	2	3	15	108	1604	174	29	35	207	129	6	40
24	3	2	4	14	102	1470	1336	31	41	322	219	10	35
24	3	2	5	14	102	2807	94	35	45	286	102	10	
24	3	2	6	14	82	1069	1082	27	30	111	104	3	
24	3	3	1	18	104	1871	655	27	30	111	59	3	40
24	3	3	2	17	104	1470	682	28	31	107	73	3	40
24	3	3	3	16	106	1336	1283	28	33	178	133	5	45
24	3	3	4	15	94	3475	174	31	44	419	120	13	40
24	3	3	5	14	92	2005	1457	33	52	273	136	9	
24	3	3	6	14	41	3742	-281	32	45	406	108	13	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
31	1	1	1	14	108	2673	414	46	48	43	16	2	30
31	1	1	2	14	108	2539	735	46	51	109	43	5	30
31	1	1	3	14	106	2539	1296	46	54	174	68	8	20
31	1	1	4	14	77	2005	1363	45	62	156	79	7	20
31	1	1	5	135	80	341	1564	40	46	150	440	6	
31	1	1	6	135	17	1203	2165	40	47	175	145	7	
31	1	1	7	135	11	1470	775	30	38	100	68	3	
31	1	1	8	135	10	3074	1604	26	28	77	25	2	
31	1	2	1	145	106	1336	2125	49	50	20	15	1	20
31	1	2	2	145	112	2272	722	49	59	204	90	10	25
31	1	2	3	14	110	1871	1872	49	56	143	76	7	25
31	1	2	4	14	100	2005	53	44	46	45	22	2	40
31	1	2	5	14	80	1203	842	41	49	195	162	8	
31	1	2	6	14	67	1604	361	36	45	250	156	9	
31	1	2	7	14	52	1737	321	38	48	263	151	10	
31	1	2	8	14	13	1203	481	34	41	206	171	7	
31	1	2	9	135	8	1336	1470	31	33	64	48	2	
31	1	2	10	13	8	2807	2620	25	29	160	57	4	
31	1	2	11	13	8	5079	5399	21	22	48	09	1	
31	1	2	12	12	10	6950	5493	21	21	0	0	0	
31	1	2	13	11	8	2807	10010	24	24	0	0	0	
31	1	3	1	14	98	2406	307	47	54	149	62	7	20
31	1	3	2	14	94	2005	802	47	72	106	53	5	20
31	1	3	3	14	90	1871	748	46	50	87	46	4	20
31	1	3	4	14	56	1604	642	46	56	217	135	10	20
31	1	3	5	14	38	1470	588	46	55	196	133	9	
31	1	3	6	14	15	1203	1791	33	42	273	227	9	
31	1	3	7	14	11	4410	829	39	49	256	58	10	
31	1	3	8	14	9	1871	3555	35	48	371	198	13	
31	2	1	1	14	108	2138	1042	44	50	136	64	6	20
31	2	1	2	14	108	936	1965	46	53	152	162	7	20
31	2	1	3	14	104	1604	1016	45	50	111	69	5	20
31	2	1	4	14	104	455	1524	43	53	232	510	10	20
31	2	1	5	14	92	1737	695	42	54	286	165	12	
31	2	1	6	14	90	1737	788	41	53	293	169	12	
31	2	1	7	135	90	1069	1924	42	44	48	45	2	
31	2	2	1	14	112	1069	802	47	57	213	199	10	30
31	2	2	2	14	110	1470	682	47	55	170	116	8	30
31	2	2	3	14	104	2138	388	48	51	62	29	3	30
31	2	2	4	14	96	1604	361	46	51	109	68	5	30
31	2	2	5	14	95	668	1484	46	55	196	293	9	
31	2	2	6	135	94	1604	642	41	47	146	91	6	
31	2	2	7	135	95	668	1577	41	46	122	183	5	
31	2	2	8	135	95	1604	454	41	45	98	61	4	
31	2	3	1	145	112	668	1858	48	50	42	63	2	30
31	2	3	2	14	110	1470	401	46	56	217	148	10	20
31	2	3	3	14	104	1069	1363	48	54	125	117	6	20
31	2	3	4	14	96	1871	281	44	50	136	73	6	30

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
31	2	3	5	14	90	1737	601	40	47	175	101	7	
31	2	3	6	14	91	1871	1123	42	43	24	13	1	
31	2	3	7	14	92	455	2553	44	51	159	349	7	
31	3	1	1	145	108	134	4918	47	48	21	157	1	30
31	3	1	2	145	106	2138	668	45	51	133	62	6	30
31	3	1	3	14	104	3074	107	50	59	180	58	9	20
31	3	1	4	14	98	2539	1296	47	53	128	50	6	25
31	3	1	5	14	94	1871	1871	45	51	133	71	6	
31	3	1	6	14	96	1336	1564	42	56	333	249	14	
31	3	2	1	145	112	3068	882	52	59	135	44	7	20
31	3	2	2	14	110	1604	1296	49	59	204	127	10	20
31	3	2	3	14	102	2807	1123	51	58	137	49	7	20
31	3	2	4	14	92	1203	3475	46	48	43	36	2	30
31	3	2	5	14	93	2138	1323	44	52	182	85	8	
31	3	2	6	14	93	1336	2593	43	64	488	365	21	
31	3	3	1	145	110	3068	40	47	55	170	55	8	30
31	3	3	2	14	104	1871	1965	49	58	184	98	9	25
31	3	3	3	14	104	2807	561	49	52	61	22	3	25
31	3	3	4	14	93	1604	1671	45	58	289	180	13	20
31	3	3	5	135	87	2272	441	45	50	111	49	5	
31	3	3	6	135	87	802	1724	41	52	268	334	11	
38	1	1	1	102	74	2005	-40	36	39	83	41	3	45
38	1	1	2	102	67	1737	321	36	42	167	96	6	35
38	1	1	3	102	64	1203	762	36	41	139	116	5	35
38	1	1	4	102	63	1203	481	35	45	286	238	10	50
38	1	1	5	102	63	802	1256	34	40	176	219	6	
38	1	1	6	102	63	1203	294	36	37	28	23	1	
38	1	1	7	105	60	936	1123	35	39	114	122	4	
38	1	1	8	105	11	936	1029	39	40	26	28	1	
38	1	2	1	105	73	1604	642	38	53	132	82	5	45
38	1	2	2	105	67	2406	588	37	44	189	78	7	40
38	1	2	3	105	63	668	1484	37	43	162	242	6	30
38	1	2	4	103	62	936	561	38	48	263	281	10	30
38	1	2	5	103	59	341	1096	31	43	387	1135	12	
38	1	2	6	103	59	1336	628	33	40	212	159	7	
38	1	2	7	103	59	455	1056	33	37	121	266	4	
38	1	2	8	103	59	1203	855	34	40	176	146	6	
38	1	2	9	103	61	802	601	37	37	0	0	0	
38	1	2	10	103	60	1871	468	37	43	162	87	6	
38	1	2	11	105	12	267	1230	35	39	114	427	4	
38	1	2	12	107	10	5346	4010	25	26	40	07	1	
38	1	2	13	107	9	6549	4865	24	24	0	0	0	
38	1	3	1	107	67	802	788	35	40	143	178	5	40
38	1	3	2	107	60	455	922	33	44	333	732	11	35
38	1	3	3	105	60	1737	-53	33	48	454	261	15	35
38	1	3	4	105	61	1470	-160	34	38	118	80	4	40
38	1	3	5	105	61	1069	1270	30	35	167	156	5	
38	1	3	6	105	11	802	1163	37	50	351	438	13	
38	1	3	7	105	10	1203	481	32	47	469	390	15	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
38	2	1	1	105	79	1470	962	38	41	79	54	3	35
38	2	1	2	105	73	1336	909	36	41	139	104	5	35
38	2	1	3	103	66	1203	1510	36	44	222	184	8	45
38	2	1	4	102	66	1604	267	35	45	286	178	10	40
38	2	1	5	102	68	936	1403	35	40	143	153	5	
38	2	1	6	102	69	1604	267	35	44	257	160	9	
38	2	1	7	102	10	936	1403	32	43	344	368	11	
38	2	2	1	105	79	1203	855	38	39	26	22	1	40
38	2	2	2	105	70	1069	1924	38	40	53	50	2	40
38	2	2	3	102	67	1470	307	32	39	219	149	7	30
38	2	2	4	102	66	802	1256	34	41	206	257	7	30
38	2	2	5	102	66	1203	762	35	45	286	238	10	
38	2	2	6	102	67	1203	481	32	34	62	52	2	
38	2	2	7	102	68	1336	1377	33	38	152	114	5	
38	2	2	8	102	65	1069	895	32	38	188	176	6	
38	2	3	1	107	80	1336	1096	37	40	81	61	3	35
38	2	3	2	105	77	1203	1417	36	37	28	23	1	40
38	2	3	3	105	72	2005	615	36	42	167	83	6	45
38	2	3	4	102	69	455	1804	35	41	171	376	6	40
38	2	3	5	102	65	1470	1711	34	46	353	240	12	
38	2	3	6	103	61	802	695	34	46	353	440	12	
38	2	3	7	103	10	1203	1510	35	43	229	190	8	
38	3	1	1	105	88	2940	1457	63	69	95	32	6	45
38	3	1	2	105	88	3208	722	47	53	128	40	6	35
38	3	1	3	105	85	2005	2018	44	65	250	125	11	40
38	3	1	4	102	72	2539	922	38	53	395	156	15	40
38	3	1	5	102	70	802	2005	33	40	212	264	7	
38	3	1	6	102	10	1737	1818	31	41	322	185	10	
38	3	2	1	107	87	4010	575	35	48	371	92	13	40
38	3	2	2	105	85	2539	267	30	36	200	79	6	35
38	3	2	3	103	78	1871	2526	47	59	255	136	12	40
38	3	2	4	102	73	668	2232	32	39	219	328	7	30
38	3	2	5	102	71	1203	1697	34	43	265	220	9	
38	3	2	6	103	71	1737	1256	68	75	103	59	7	
38	3	3	1	107	91	2005	2018	47	67	213	106	10	30
38	3	3	2	105	83	267	2820	32	37	156	584	5	40
38	3	3	3	103	78	2272	909	39	45	154	68	6	35
38	3	3	4	103	76	2272	1657	47	65	170	75	8	40
38	3	3	5	103	73	802	2285	31	39	258	322	8	
38	3	3	6	102	10	1604	922	47	56	191	119	9	
45	1	1	1	105	92	1871	561	40	51	275	147	11	15
45	1	1	2	105	96	2138	1884	36	49	361	169	13	60
45	1	1	3	10	80	2138	294	42	48	143	67	6	15
45	1	1	4	9	77	1737	1163	35	42	200	115	7	15
45	1	1	5	9	76	936	1497	33	35	61	65	2	
45	1	1	6	9	72	1336	909	34	44	294	220	10	
45	1	1	7	9	72	1069	1082	34	42	235	220	8	
45	1	1	8	9	44	1203	481	33	38	152	126	5	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
45	1	2	1	10	96	2005	708	38	58	526	262	20	35
45	1	2	2	95	89	2005	240	38	52	368	184	14	35
45	1	2	3	95	89	1336	722	37	50	351	263	13	20
45	1	2	4	9	81	1336	160	35	45	286	214	10	20
45	1	2	5	9	79	668	1484	36	46	278	416	10	
45	1	2	6	9	76	1470	962	34	38	118	80	4	
45	1	2	7	9	75	455	1524	33	44	333	732	11	
45	1	2	8	9	76	1737	227	35	44	257	148	9	
45	1	2	9	85	81	1737	548	35	46	314	181	11	
45	1	2	10	85	83	1871	187	34	50	470	251	16	
45	1	2	11	85	78	2005	-414	35	46	314	157	11	
45	1	2	12	85	17	1069	428	35	42	200	187	7	
45	1	2	13	9	11	1470	1898	40	47	175	119	7	
45	1	3	1	11	102	1203	1697	41	49	195	162	8	30
45	1	3	2	9	80	802	976	36	47	306	382	11	30
45	1	3	3	9	79	1604	829	35	48	371	231	13	30
45	1	3	4	9	78	2138	481	34	43	265	124	9	35
45	1	3	5	9	78	1737	508	35	43	228	131	8	
45	1	3	6	9	75	1871	1590	34	44	294	157	10	
45	1	3	7	9	75	2272	441	34	53	559	246	19	
45	2	1	1	10	104	1604	1764	42	48	143	89	6	25
45	2	1	2	10	102	2272	535	39	41	51	22	2	25
45	2	1	3	95	86	1871	1029	39	46	179	96	7	30
45	2	1	4	9	84	2406	401	35	37	57	24	2	25
45	2	1	5	9	87	1737	508	35	39	114	66	4	
45	2	1	6	9	88	2138	294	36	40	111	52	4	
45	2	1	7	85	89	802	2005	36	46	278	347	10	
45	2	2	1	10	98	3208	1002	45	50	111	35	5	25
45	2	2	2	10	90	2005	802	36	47	306	153	11	30
45	2	2	3	9	84	2807	561	53	62	170	60	9	25
45	2	2	4	9	84	1737	882	35	38	86	50	3	30
45	2	2	5	9	86	1604	361	36	39	83	52	3	
45	2	2	6	9	88	1470	775	33	42	273	186	9	
45	2	2	7	85	89	2138	107	33	63	909	425	30	
45	2	3	1	10	92	1470	1056	38	58	526	358	20	35
45	2	3	2	95	90	2673	601	37	48	297	111	11	35
45	2	3	3	9	92	1604	1016	35	47	343	214	12	35
45	2	3	4	9	90	2539	361	35	42	200	79	7	20
45	2	3	5	85	88	802	1069	32	44	375	468	12	
45	2	3	6	85	66	1604	454	34	38	118	74	4	
45	2	3	7	85	41	1336	347	33	34	30	22	1	
45	3	1	1	10	106	3208	254	40	45	125	39	5	30
45	3	1	2	10	104	2940	2486	46	59	283	96	13	35
45	3	1	3	95	102	3208	535	43	61	419	131	18	30
45	3	1	4	9	94	2673	321	40	45	125	47	5	30
45	3	1	5	85	89	1871	1310	36	40	111	59	4	
45	3	1	6	85	83	802	2098	32	32	0	0	0	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
45	3	2	1	10	100	2272	1376	38	40	53	23	2	40
45	3	2	2	95	100	1470	1149	38	47	237	161	9	30
45	3	2	3	95	98	2807	936	40	60	500	178	20	30
45	3	2	4	9	94	2005	1924	41	46	122	61	5	30
45	3	2	5	85	95	2138	481	36	41	139	65	5	
45	3	2	6	85	93	1069	1176	35	41	171	160	6	
45	3	3	1	10	97	1203	3288	38	46	210	174	8	30
45	3	3	2	10	100	668	1951	37	48	297	445	11	30
45	3	3	3	9	92	1604	3074	56	59	54	34	3	30
45	3	3	4	9	99	3074	13	37	45	216	70	8	35
45	3	3	5	9	98	2539	80	35	45	286	113	10	
45	3	3	6	85	63	802	1256	36	46	278	347	10	
53	1	1	1	9	112	2807	655	29	37	276	98	8	20
53	1	1	2	85	112	2272	1657	33	38	152	67	5	25
53	1	1	3	8	107	2005	1176	28	30	71	35	2	25
53	1	1	4	75	92	1069	1503	26	31	192	180	5	25
53	1	1	5	8	92	1737	1350	27	30	111	64	3	
53	1	1	6	8	93	2272	67	27	28	37	16	1	
53	1	1	7	75	94	1470	494	24	28	167	114	4	
53	1	2	1	9	126	2539	2419	51	57	118	46	6	30
53	1	2	2	85	122	2940	989	48	57	188	64	9	30
53	1	2	3	8	114	2673	4531	73	99	356	138	26	30
53	1	2	4	8	112	2539	642	36	64	778	306	28	20
53	1	2	5	8	106	1069	2205	29	39	345	323	10	
53	1	2	6	75	94	2138	949	33	35	61	28	2	
53	1	2	7	75	95	1069	802	25	29	160	150	4	
53	1	2	8	75	95	1470	1336	26	34	308	210	8	
53	1	2	9	75	92	668	1858	25	32	280	419	7	
53	1	2	10	75	84	1069	615	26	26	0	0	0	
53	1	2	11	75	83	455	2178	28	46	643	1413	18	
53	1	2	12	75	82	1336	535	25	31	240	180	6	
53	1	2	13	75	12	1203	1417	24	25	42	35	1	
53	1	3	1	9	114	3876	1082	39	46	179	46	7	25
53	1	3	2	9	117	1737	2753	43	59	372	214	16	25
53	1	3	3	8	114	2673	601	38	47	237	89	9	30
53	1	3	4	8	106	936	1590	31	40	290	310	9	20
53	1	3	5	8	98	1737	1911	31	37	194	112	6	
53	1	3	6	75	94	668	1577	28	34	214	320	6	
53	1	3	7	75	56	1203	855	32	36	125	104	4	
53	2	1	1	95	120	2005	2392	41	48	171	85	7	30
53	2	1	2	95	116	3742	936	37	43	162	43	6	20
53	2	1	3	85	110	5747	615	51	55	78	14	4	20
53	2	1	4	8	106	3074	1417	28	33	178	58	5	25
53	2	1	5	75	102	2005	2392	29	34	172	86	5	
53	2	1	6	75	98	2940	1831	32	37	156	53	5	
53	2	1	7	8	66	2138	1510	28	30	71	33	2	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
53	2	2	1	9	116	4410	1016	34	42	235	53	8	30
53	2	2	2	9	118	3208	3154	38	51	342	107	13	30
53	2	2	3	8	112	4277	869	34	35	29	07	1	30
53	2	2	4	8	102	455	4050	26	28	77	169	2	30
53	2	2	5	75	98	2406	1149	24	41	708	294	17	
53	2	2	6	75	96	1203	2165	23	27	174	145	4	
53	2	2	7	8	96	1604	1390	20	21	50	31	1	
53	2	2	8	75	90	1203	1884	20	24	200	166	4	
53	2	3	1	85	122	4010	1136	33	38	152	38	5	25
53	2	3	2	9	120	5079	909	42	54	286	56	12	35
53	2	3	3	85	120	7484	-94	43	66	535	71	23	35
53	2	3	4	8	112	2940	2486	37	55	486	165	18	40
53	2	3	5	75	106	2138	575	24	32	333	156	8	
53	2	3	6	75	98	668	2326	26	32	231	346	6	
53	2	3	7	75	94	2406	495	23	23	0	0	0	
53	3	1	1	10	114	2005	2018	24	30	250	125	6	25
53	3	1	2	95	116	3742	936	30	31	33	09	1	30
53	3	1	3	95	118	2539	2326	33	37	121	48	4	30
53	3	1	4	85	118	5480	882	36	39	83	15	3	35
53	3	1	5	8	42	5212	495	30	35	167	32	5	
53	3	1	6	75	42	1871	1029	20	25	250	134	5	
53	3	2	1	10	120	2138	2446	30	36	200	94	6	30
53	3	2	2	95	122	6415	508	41	60	463	72	19	40
53	3	2	3	9	120	2807	3836	44	79	795	283	35	40
53	3	2	4	8	116	6415	227	44	62	409	64	18	25
53	3	2	5	75	17	4410	3261	39	57	462	105	18	
53	3	2	6	75	14	2807	561	22	32	454	162	10	
53	3	3	1	10	118	2807	936	31	35	129	46	4	35
53	3	3	2	10	118	3475	922	33	38	152	44	5	35
53	3	3	3	9	120	5747	895	32	38	188	33	6	30
53	3	3	4	8	112	6014	534	33	44	333	55	11	30
53	3	3	5	75	94	802	2379	17	19	118	147	2	
53	3	3	6	75	42	1203	1604	14	16	143	119	2	
64	1	1	1	55	112	5747	1644	32	36	125	22	4	55
64	1	1	2	55	116	6549	187	44	50	136	21	6	50
64	1	1	3	55	118	5613	0	34	45	324	58	11	55
64	1	1	4	55	117	6682	241	34	39	147	78	5	55
64	1	1	5	55	116	2406	3675	34	36	59	24	2	
64	1	1	6	55	116	4945	855	34	38	118	24	4	
64	1	1	7	5	114	1871	3929	34	37	88	47	3	
64	1	2	1	55	115	5212	401	33	36	91	17	3	40
64	1	2	2	55	113	2539	2887	35	36	28	11	1	40
64	1	2	3	55	116	5079	535	35	39	114	22	4	50
64	1	2	4	55	118	6148	-67	35	40	143	23	5	50
64	1	2	5	55	118	7083	-254	35	37	57	08	2	
64	1	2	6	55	118	6014	-2085	34	36	59	10	2	
64	1	2	7	5	116	5346	1016	32	34	62	12	2	
64	1	2	8	5	112	2539	1203	22	25	136	54	3	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
64	1	2	9	45	110	1336	1470	19	19	0	0	0	
64	1	2	10	45	108	936	1123	16	18	125	134	2	
64	1	2	11	45	108	1203	949	17	17	0	0	0	
64	1	2	12	45	108	668	829	17	19	118	177	2	
64	1	2	13	45	64	936	561	16	16	0	0	0	
64	1	3	1	6	124	4010	3288	40	54	350	87	14	30
64	1	3	2	55	123	5346	267	37	50	351	66	13	40
64	1	3	3	55	123	3208	2406	36	57	583	182	21	40
64	1	3	4	55	124	5079	628	37	40	81	16	3	35
64	1	3	5	55	126	5613	94	38	41	79	14	3	
64	1	3	6	55	125	6816	-80	33	43	303	44	10	
64	1	3	7	55	112	802	6495	33	40	212	264	7	
64	1	3	8	5	66	1336	722	19	20	53	40	1	
64	2	1	1	55	112	3608	5560	42	55	310	86	13	35
64	2	1	2	55	114	10959	-294	41	62	512	47	21	40
64	2	1	3	5	114	4277	4740	52	61	173	40	9	35
64	2	1	4	5	110	1604	922	17	19	118	74	2	20
64	2	1	5	45	106	936	1684	15	19	267	285	4	
64	2	1	6	45	105	1203	294	15	17	133	90	2	
64	2	1	7	45	105	1203	575	15	15	0	0	0	
64	2	2	1	55	116	7083	-535	37	41	108	15	4	40
64	2	2	2	55	116	5079	1564	36	40	111	22	4	35
64	2	2	3	5	114	4811	1082	53	56	57	12	3	45
64	2	2	4	5	110	1604	1016	21	22	48	30	1	20
64	2	2	5	45	105	1069	708	15	15	0	0	0	
64	2	2	6	45	105	341	909	15	16	67	196	1	
64	2	2	7	45	105	936	240	16	17	62	66	1	
64	2	2	8	45	105	802	695	14	15	71	88	1	
64	2	3	1	55	116	2539	80	21	22	48	19	1	25
64	2	3	2	5	114	1737	882	21	22	48	28	1	25
64	2	3	3	5	110	1203	200	16	18	125	104	2	25
64	2	3	4	45	106	802	1069	15	15	0	0	0	25
64	2	3	5	45	106	1203	107	18	19	56	46	1	
64	2	3	6	45	104	341	815	16	17	62	182	1	
64	2	3	7	45	102	455	401	15	16	67	147	1	
64	3	1	1	6	116	12697	-1002	58	74	276	22	16	55
64	3	1	2	55	118	4010	388	26	33	269	67	7	35
64	3	1	3	5	114	2406	1524	24	27	125	52	3	30
64	3	1	4	5	112	2673	414	22	25	136	51	3	25
64	3	1	5	5	110	668	829	18	20	111	166	2	
64	3	1	6	45	106	936	655	16	16	0	0	0	
64	3	2	1	6	114	2807	2900	34	41	206	73	7	45
64	3	2	2	5	112	668	735	15	16	67	100	1	15
64	3	2	3	5	112	3074	-80	20	21	50	16	1	20
64	3	2	4	5	106	2272	347	17	17	0	0	0	25
64	3	2	5	45	105	936	1684	14	15	71	76	1	
64	3	2	6	45	100	1069	708	16	17	62	58	1	

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
64	3	3	1	6	116	2272	1751	28	29	36	16	1	35
64	3	3	2	55	116	2673	788	20	22	100	37	2	40
64	3	3	3	5	114	1604	3074	20	22	100	62	2	25
64	3	3	4	5	112	1203	481	15	15	0	0	0	25
64	3	3	5	5	108	455	588	13	13	0	0	0	
64	3	3	6	45	54	1069	53	14	16	143	134	2	
73	1	1	1	4	116	1203	949	15	16	67	56	1	20
73	1	1	2	4	112	1470	1243	16	17	62	42	1	20
73	1	1	3	4	112	1336	1096	17	18	59	44	1	30
73	1	1	4	4	105	1871	748	16	16	0	0	0	20
73	1	1	5	35	105	1203	1323	15	18	200	60	3	
73	1	1	6	35	105	1737	695	15	18	200	115	3	
73	1	1	7	35	105	1604	735	15	15	0	0	0	
73	1	1	8	35	105	2005	428	13	14	77	38	1	
73	1	2	1	4	122	1069	1176	17	18	59	55	1	25
73	1	2	2	4	114	1336	815	16	17	62	46	1	15
73	1	2	3	4	112	455	2272	16	18	125	275	2	10
73	1	2	4	4	112	1203	1230	16	17	62	52	1	15
73	1	2	5	35	108	2005	1363	15	17	133	66	2	
73	1	2	6	35	108	1470	588	15	17	133	90	2	
73	1	2	7	35	108	1604	735	16	17	62	39	1	
73	1	2	8	35	108	1470	775	15	16	67	46	1	
73	1	2	9	35	108	1069	1550	15	16	67	63	1	
73	1	2	10	35	108	2005	334	15	16	67	33	1	
73	1	2	11	35	108	1069	1457	15	15	0	0	0	
73	1	2	12	35	108	2807	-1684	15	16	67	24	1	
73	1	2	13	35	106	1203	1323	14	16	143	119	2	
73	1	3	1	45	124	1069	708	15	16	67	63	1	40
73	1	3	2	45	120	3341	-1751	16	22	312	93	5	45
73	1	3	3	4	118	1604	1109	15	18	200	125	3	10
73	1	3	4	4	116	1203	2259	15	16	67	56	1	25
73	1	3	5	4	114	1871	1216	14	16	143	76	2	
73	1	3	6	4	113	2138	294	13	15	154	72	2	
73	1	3	7	4	106	1737	788	15	16	67	39	1	
73	1	3	8	4	104	802	2098	15	15	0	0	0	
73	2	1	1	4	105	1737	508	13	14	77	44	1	15
73	2	1	2	4	108	1470	588	13	16	231	157	3	20
73	2	1	3	4	108	1604	454	14	16	143	89	2	20
73	2	1	4	4	105	802	2660	13	14	77	96	1	25
73	2	1	5	35	104	1336	1189	13	14	77	82	1	
73	2	1	6	35	105	455	1524	13	14	77	169	1	
73	2	1	7	35	104	1470	1336	14	17	214	146	3	
73	2	2	1	4	122	1604	1203	16	19	188	117	3	25
73	2	2	2	4	113	1604	1951	14	16	143	89	2	15
73	2	2	3	4	110	2272	815	14	16	143	63	2	15
73	2	2	4	4	106	2005	802	13	14	77	38	1	25

Appendix 6. (Continued).

A	B	C	D	E	F	G	H	I	J	K	L	M	N
73	2	2	5	35	104	1203	1417	13	15	154	128	2	
73	2	2	6	35	104	1604	1671	14	15	71	44	1	
73	2	2	7	35	104	1470	682	14	15	71	48	1	
73	2	2	8	3	102	1203	762	11	12	91	76	1	
73	2	3	1	4	124	802	2566	14	15	71	88	1	30
73	2	3	2	4	116	2138	481	15	18	200	94	3	25
73	2	3	3	4	112	1737	1256	14	17	214	123	3	35
73	2	3	4	4	105	2005	989	14	16	143	71	2	20
73	2	3	5	35	104	1604	1109	14	15	71	44	1	
73	2	3	6	35	102	936	1684	12	13	83	89	1	
73	3	1	1	35	116	1069	989	13	14	77	72	1	20
73	3	1	2	35	105	2673	695	16	17	62	23	1	25
73	3	1	3	35	104	1470	1804	17	18	59	42	1	30
73	3	1	4	35	104	2138	1042	15	19	267	125	4	20
73	3	1	5	35	104	2272	535	17	21	235	103	4	
73	3	1	6	35	100	1336	1096	12	13	83	62	1	
73	3	2	1	3	114	936	1590	13	14	77	82	1	20
73	3	2	2	35	108	1203	1136	11	13	182	151	2	15
73	3	2	3	35	108	455	2459	16	17	62	136	1	30
73	3	2	4	35	104	1336	1283	13	14	77	58	1	25
73	3	2	5	35	104	1737	508	12	13	83	48	1	
73	3	2	6	35	104	1470	1898	12	13	83	59	1	
73	3	3	1	5	106	1871	1123	12	13	83	44	1	25
73	3	3	2	4	104	2005	1550	16	17	62	31	1	30
73	3	3	3	4	103	1336	1377	15	16	67	50	1	25
73	3	3	4	35	100	1737	508	15	16	67	38	1	25
73	3	3	5	35	100	936	936	12	12	0	0	0	
73	3	3	6	35	78	1203	575	12	13	83	69	1	

Appendix 7. Lorenzen's equations for chlorophyll a and pheopigment (Lorenzen, 1967).

Chlorophyll a (mg/m^3) $= \dfrac{A \times K \times (665_o - 665_a) \times v}{V_f \times L}$

Pheopigment (mg/m^3) $= \dfrac{A \times K \ (R[665_a] - 665_o) \times v}{V_f \times L}$

where

A = 11.0	(absorption coefficient of chlorophyll)
K = 2.43	(factor to equate the reduction in absorbancy to initial chlorophyll concentration, 1.7:0.7)
665_o	(absorbance before acidification, $665_1 - 750_1$)
665_a	(absorbance after acidification, $665_2 - 750_2$)
v = 10	(volume of acetone used for extraction in ml)
V_f = 0.2	(liters of water filtered)
L = 1	(path length of cuvette in cm)
R = 1.7	(maximum ratio of 665_o:665_a in the absence of pheopigments)

VITA

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