# MERRIMACK RIVER MONITORING PROGRAM

A Report for the Study Period 1973

Prepared for

Public Service Company of New Hampshire

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by

NORMANDEAU ASSOCIATES, INC.
BEDFORD, NEW HAMPSHIRE

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# MERRIMACK RIVER MONITORING PROGRAM - 1973

## I. INTRODUCTION

The fourth year of the Merrimack River Monitoring Program was initiated in April, 1973. This program was developed to fulfill a requirement contained in a water-use permit issued to Public Service Company of New Hampshire by the New Hampshire Water Supply and Pollution Control Commission. The monitoring program was designed to detect both seasonal changes in the ecology of the Merrimack River and possible adverse effects caused by thermal discharges from the Merrimack Generating Station. Emphasis was placed on that section of the Merrimack River from Garvins Falls Dam in Concord to the Hooksett Dam in Hooksett, New Hampshire, a distance of 5.75 miles (Figure 1). This area of the river is generally referred to as Hooksett Pond. The Merrimack Generating Station is located near its center at river mile 84. Sampling stations were established and marked on transects located north and south of the mouth of the discharge canal. These were numbered N-1 to N-10, and S-1 to S-24, respectively. Stations N-1 through N-6 are separated by 500 foot intervals while N-6 to N-10 are 1000 feet apart. Stations south of the discharge canal (S-1 to S-24) are located at 500 foot intervals. The north stations, particularly N-10, were

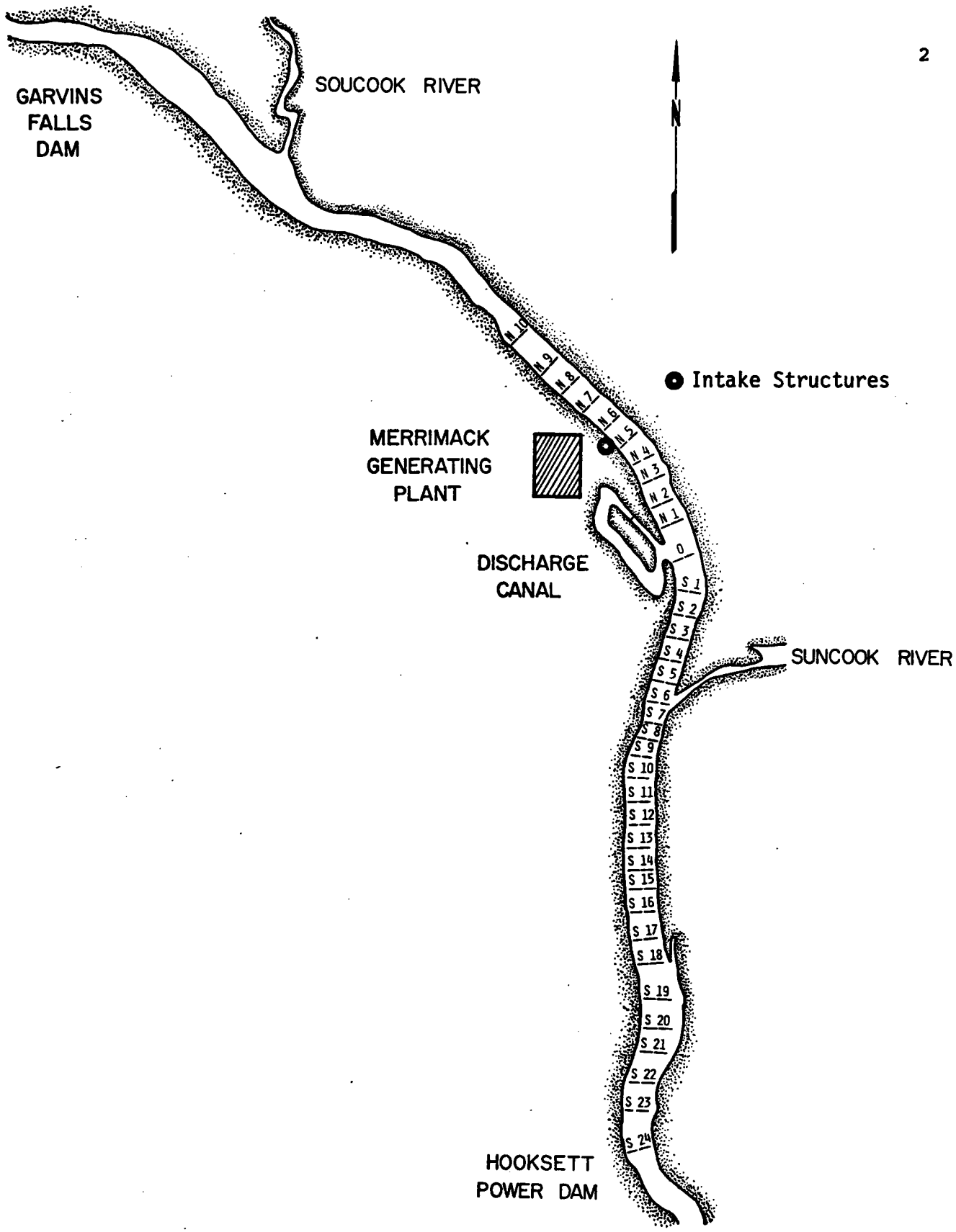


Figure 1. Location of sampling stations -- Merrimack River Monitoring Program - Hooksett Pond, New Hampshire.

used to depict ambient river conditions as contrasted to the thermally affected zone south of the discharge. Station Zero-West was established at the mouth of the discharge canal (western extreme of Station Zero) and all samples taken at that location were within the direct influence of the thermal discharge. The portion of the river under study is fairly uniform, and has an average width of 500 to 700 feet. Much of the river is shallow, averaging less than ten feet in depth, although depths of over twenty feet are reached in some sections.

# II. PHYSICAL STUDIES

## A. METHODS

### 1. Flows

River flow measurements were obtained from gauging station data collected at Garvins Falls (Figure 2 ) hydroelectric station by Public Service Company of New Hampshire personnel.

### 2. Depth of Visibility

Weekly Secchi Disc visibility measurements were taken at Stations N-10, Zero-West, S-4, and S-17. Results were recorded to the nearest one-half foot and represent the depth at which the disc disappeared from view.

### 3. Temperature

Three types of temperature studies were conducted during the 1973-74 project year: a) continuous monitoring of surface temperatures; b) weekly temperature profiles; and c) seasonal cross-sectional temperature profiles. Supplementary temperature information was also taken in conjunction with biological studies.

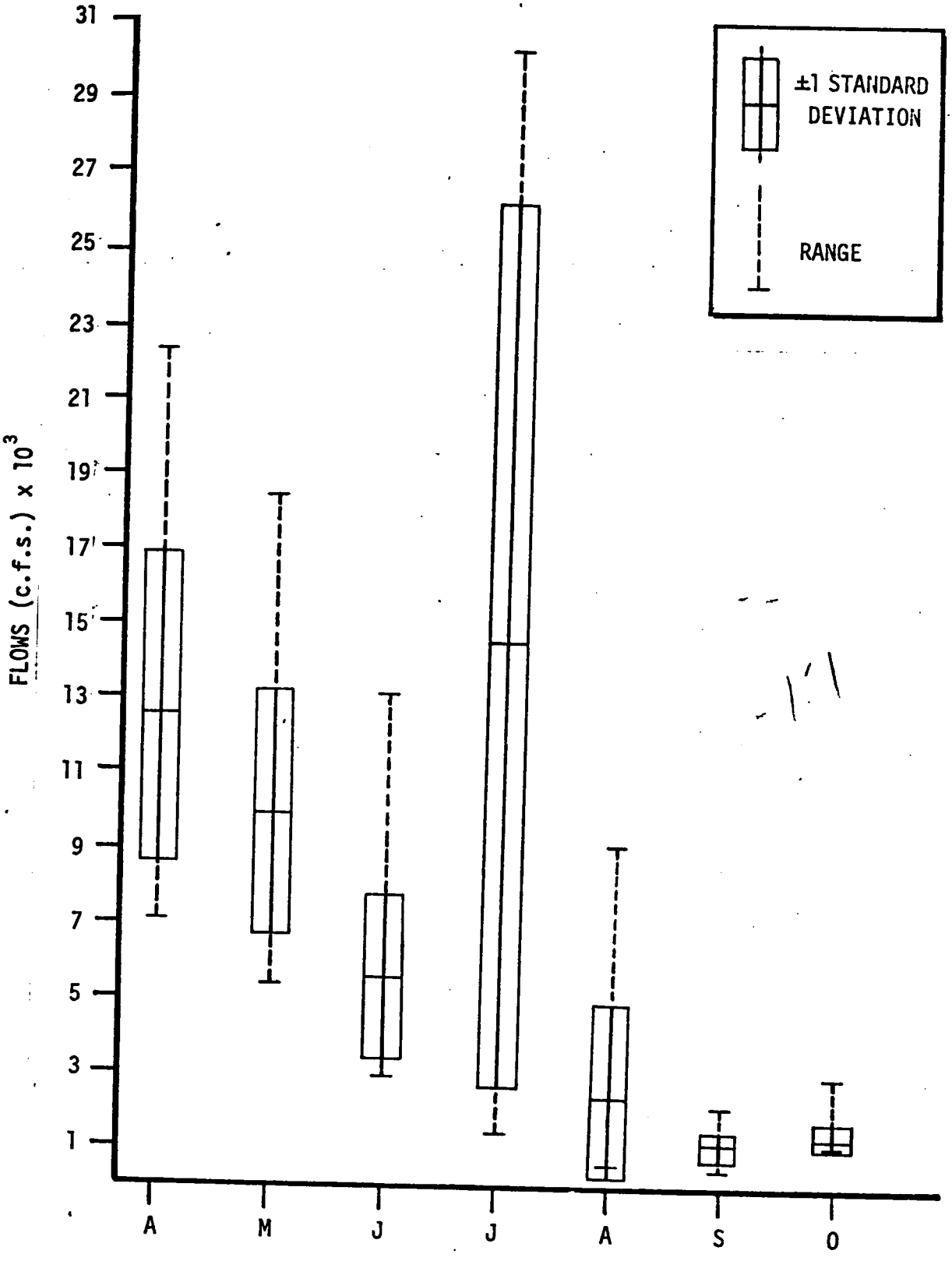


Figure 2. Mean monthly flows ± standard deviation, and flow ranges -- Garvin's Falls, Merrimack River, 1973.

a) CONTINUOUS MONITORING

Surface temperature monitoring was conducted by personnel of the Public Service Company of New Hampshire at Stations N-10, Zero-West, and S-4. Instrumentation consisted of YSI thermivolt thermometers connected to Westinghouse (Hagen) signal converters and Sangamo digital pulse recorders. These units were checked weekly.

b) WEEKLY TEMPERATURE PROFILES

Weekly temperature profiles were taken with a YSI field thermistor system at one data point each at Stations N-10, Zero-West, S-4, and S-17 in conjunction with biological samplings. All temperatures, with the exception of those taken at Station Zero-West, were measured at mid- river. Periodic calibration of the field thermistor unit was accomplished with a precision grade mercury thermometer.

c) SEASONAL TEMPERATURE PROFILES

Thermal stratification in the Merrimack River was measured in July, August, and September of 1973 with a Martek Model 101 temperature, depth, and conductivity meter, and a YSI field thermistor unit. These instruments were checked periodically with a precision grade mercury thermometer. Temperatures were taken north and south of the generating station (Stations N-10, N-5, N-1,

Zero, S-10, S-14, S-18, S-22, and S-24) at six points across the river at one-foot depth intervals. Ambient temperature was monitored at N-5 (intake structure) with a Rustrak Strip Recorder during these studies.

## B. RESULTS AND DISCUSSION

### 1. Flows

Mean monthly flows ±1 standard deviation and flow ranges are shown in Figure 2. Mean 24-hour flows for the year ranged from a low of 696 cfs on September 3, to a high of 29,575 cfs on July 6, 1973. Flooding occurred during the first two weeks of July and resulted in discharge values of up to ten times those occurring during the same period in 1971 (Normandeau Associates, 1972) and 1972 (Normandeau Associates, 1973). Low flows for the year occurred in September with 23% of the discharge values falling below 1000 cfs. With the exception of unusually high July discharges, flows for 1973 were generally comparable to those of 1972, but higher than those in 1971.

### 2. Depth of Visibility

Weekly depth of visibility measurements are presented in Table 1. Measurements were generally comparable between stations. Readings ranged from a low of 1.0 foot during July flooding, to a high of 10.5 feet in October. As was the case in 1970 (Normandeau Associates, 1971) and 1971

TABLE 1. WEEKLY DEPTH OF VISIBILITY MEASUREMENTS [1]

HOOKSETT POND, MERRIMACK RIVER-APRIL THROUGH OCTOBER, 1973

| SAMPLING DATES 1973 | STATIONS | | | |
|---|---|---|---|---|
| | N-10 | ZERO-WEST | S-4 | S-17 |
| April 10 | 5.0 | 5.0 | 6.5 | 6.0 |
| April 18 | 7.0 | 7.0 | 7.0 | 7.0 |
| April 25 | 4.0 | 4.0 | 4.0 | 4.0 |
| April 30 | 4.5 | 3.5 | 4.0 | 4.0 |
| May 8 | 6.5 | 5.5 | 6.5 | 6.5 |
| May 14 | 4.0 | 4.5 | 4.5 | 5.0 |
| May 21 | 5.5 | 4.5 | 5.0 | 5.0 |
| May 29 | 6.0 | 5.5 | 5.5 | 6.0 |
| June 5 | 5.5 | 5.0 | 5.5 | 5.5 |
| June 12 | 6.0 | 5.5 | 6.0 | 6.0 |
| June 18 | 4.5 | 4.5 | 5.0 | 4.5 |
| June 25 | 7.0(B) [2] | 4.5 | 6.0 | 6.5 |
| July 3 | 1.0 | 1.0 | 1.0 | 1.0 |
| July 11 | 1.0 | 1.0 | 1.0 | 1.0 |
| July 16 | 3.0 | 3.0 | 3.0 | 3.0 |
| July 24 | 6.5 | 4.5(B) | 6.5 | 6.0(B) |
| July 30 | 6.5(B) | 3.5(B) | 7.5 | 6.5(B) |
| Aug. 6 | 5.0 | 4.0 | 5.5 | 5.5 |
| Aug. 13 | 6.5 | 4.5(B) | 6.5 | 6.0 |
| Aug. 20 | 6.5 | 4.5(B) | 5.5 | 5.5 |
| Aug. 28 | 5.5 | 4.5(B) | 5.5 | 5.5 |
| Sept. 4 | 5.0 | 4.0(B) | 4.5 | 4.5 |
| Sept. 10 | 6.0 | 5.5(B) | 6.5 | 7.0 |
| Sept. 18 | 7.0 | 4.0(B) | 6.5 | 6.5 |
| Sept. 25 | 8.0(B) | 4.5(B) | 8.0 | 7.5(B) |
| Oct 1 | 7.0(B) | 4.5(B) | 10.5 | 7.0(B) |
| Oct 10 | 7.5(B) | 4.5(B) | 7.0 | 7.0(B) |
| Oct 16 | 7.0(B) | 4.0(B) | 8.5 | 7.0(B) |
| Oct 23 | 7.0(B) | 5.0(B) | 10.0 | 7.0(B) |
| Oct 31 | 6.5 | 4.5 | 5.0 | 5.0 |

[1] All values are in feet

[2] Bottom

(Normandeau Associates, 1972), highest depths of visibility were evident in fall as primary production declined. River flow at this time was low.

## 3. Temperature

### a) CONTINUOUS TEMPERATURE MONITORING

Daily surface water temperature maxima by station from January to December, 1973, are shown in Figure 3. Data used in the preparation of this figure as well as daily temperature minima and times of sampling are presented in Appendix A. Substantial data gaps occurred during the study as a result of spring flooding and a severe thunderstorm in late August which rendered the monitoring instruments inoperable.

Temperature maxima at Station N-10 (ambient conditions) ranged from 32.5°F. to 89.8°F.[1] At stations Zero-West and S-4, maxima ranged from 32.9°F. to 89.0°F. and 33.2°F. to 91.0°F., respectively. Highest temperatures occurred during August at stations N-10 and S-4. Considerable fluctuations in temperature were evident at Zero-West.

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1. The upper range is suspect as a possible thermistor malfunction may have occurred, resulting in high readings during July and August.

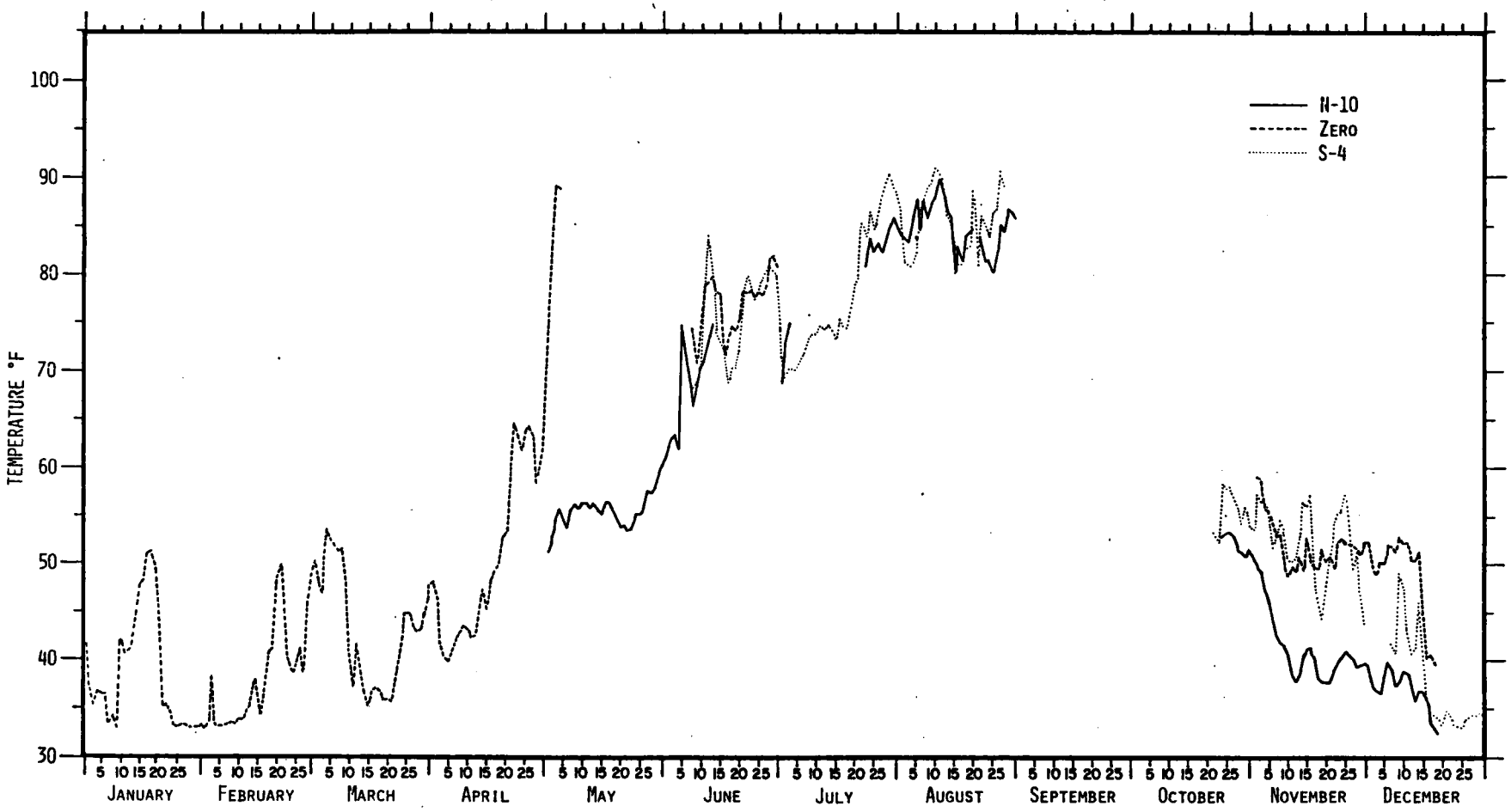


Figure 3. Daily temperature maxima[1] by station - Hooksett Pond - Merrimack River - 1973.

[1]Public Service Company of New Hampshire continuous temperature monitoring data.

b) WEEKLY VERTICAL TEMPERATURE PROFILES

During the study year (April-October, 1973) temperatures at Station N-10 ranged from 40.6°F. in April to 79.4°F. in September. (Table 2). Temperatures at Zero-West ranged from 50.0°F in April to 92.1°F in September.

Monthly surface temperature ranges and means, mean surface to bottom $\Delta t$'s by station, and mean monthly $\Delta t$'s between stations (temperature increase over N-10 temperature) are presented in Table 2.

Maximum mean surface to bottom $\Delta t$'s and $\Delta t$'s between stations occurred during September and resulted primarily from the lowered flows. This same phenomenon was noted in the 1972 study. As in the past, bottom temperatures in the majority of the river profiles were only slightly affected (1°F. - 2°F.) by the thermal plume.

c) SEASONAL TEMPERATURE PROFILES

July 31, 1973 -- Figure 4: Both units I and II were in operation during the survey. Ambient water temperatures at Stations N-10 and N-5 ranged from 76.8° to 78.0° and flows averaged 1596 cfs. Monitoring of intake water temperatures showed a temperature increase of 2.8°F during the survey. Station N-5 showed no stratification, but at N-1, a finger-like projection of 78.0° to 81.0° water extended upstream along the western bank. Water temperature measured at the discharge

TABLE 2. MEAN MONTHLY SURFACE TEMPERATURES AND RANGES, MEAN MONTHLY SURFACE-TO-BOTTOM Δt's AND BETWEEN STATION TEMPERATURE DIFFERENCES, HOOKSETT POND, MERRIMACK RIVER, 1973

| STATIONS | Month | | | | | | |
|---|---|---|---|---|---|---|---|
| | APR | MAY | JUN | JUL | AUG | SEPT | OCT |
| | | | Monthly Temperature Ranges and Means (°F) | | | | |
| N-10 | 40.6-53.5[1] | 52.6-54.9 | 62.0-71.1 | 66.2-76.4 | 75.9-76.9 | 58.0-79.4 | 49.5-59.1 |
| | 47.4[2] | 53.8 | 66.4 | 71.7 | 76.4 | 66.5 | 53.6 |
| O-W | 50.0-67.0 | 55.0-59.5 | 66.8-85.6 | 69.0-90.0 | 87.2-90.2 | 72.1-92.1 | 50.2-73.8 |
| | 56.4 | 57.7 | 76.6 | 79.4 | 89.2 | 80.3 | 64.5 |
| S-4 | 42.0-57.0 | 53.0-55.8 | 62.2-79.7 | 66.1-86.6 | 82.3-87.5 | 68.5-88.0 | 50.2-65.8 |
| | 49.0 | 54.3 | 71.6 | 75.6 | 85.2 | 76.0 | 59.1 |
| S-17 | 41.5-54.8 | 53.0-55.8 | 62.0-74.0 | 66.4-78.7 | 78.0-84.9 | 63.7-88.0 | 50.2-63.8 |
| | 48.2 | 54.3 | 67.7 | 73.6 | 81.1 | 72.9 | 56.7 |
| | | | Mean Surface-to-Bottom Δt's | | | | |
| N-10 | 0.08 | 0.1 | 0.2 | 0.2 | 0.4 | 0.2 | 0.2 |
| O-W | 5.8 | 3.6 | 9.1 | 6.1 | 8.1 | 9.2 | 9.6 |
| S-4 | 1.3 | 0.3 | 5.0 | 3.8 | 8.9 | 9.2 | 5.0 |
| S-17 | 0.2 | 0.3 | 0.2 | 1.0 | 3.8 | 4.8 | 1.2 |
| | | | Mean Δt's By Station | | | | |
| N-10 | ---[3] - ---[4] | --- | --- | --- | --- | --- | --- |
| O-W | 6.7 - 9.5 | 1.8- 3.9 | 6.2-10.2 | 6.0- 8.5 | 10.4-13.3 | 10.0-13.9 | 8.0-10.8 |
| S-4 | 1.1- 1.7 | 0.3- 1.7 | 1.2- 5.3 | 1.3- 4.02 | 2.1- 8.8 | 2.9- 9.7 | 2.6- 5.5 |
| S-17 | 0.9- 1.0 | 0.3- 0.5 | 1.3- 1.3 | 1.6- 1.9 | 2.6- 5.0 | 4.1- 6.5 | 2.3- 3.0 |

[1] Range
[2] Mean
[3] Δt's computed from the mean temperatures of the vertical profile of each station.
[4] Δt's computed from the peak temperatures recorded at stations throughout the month.

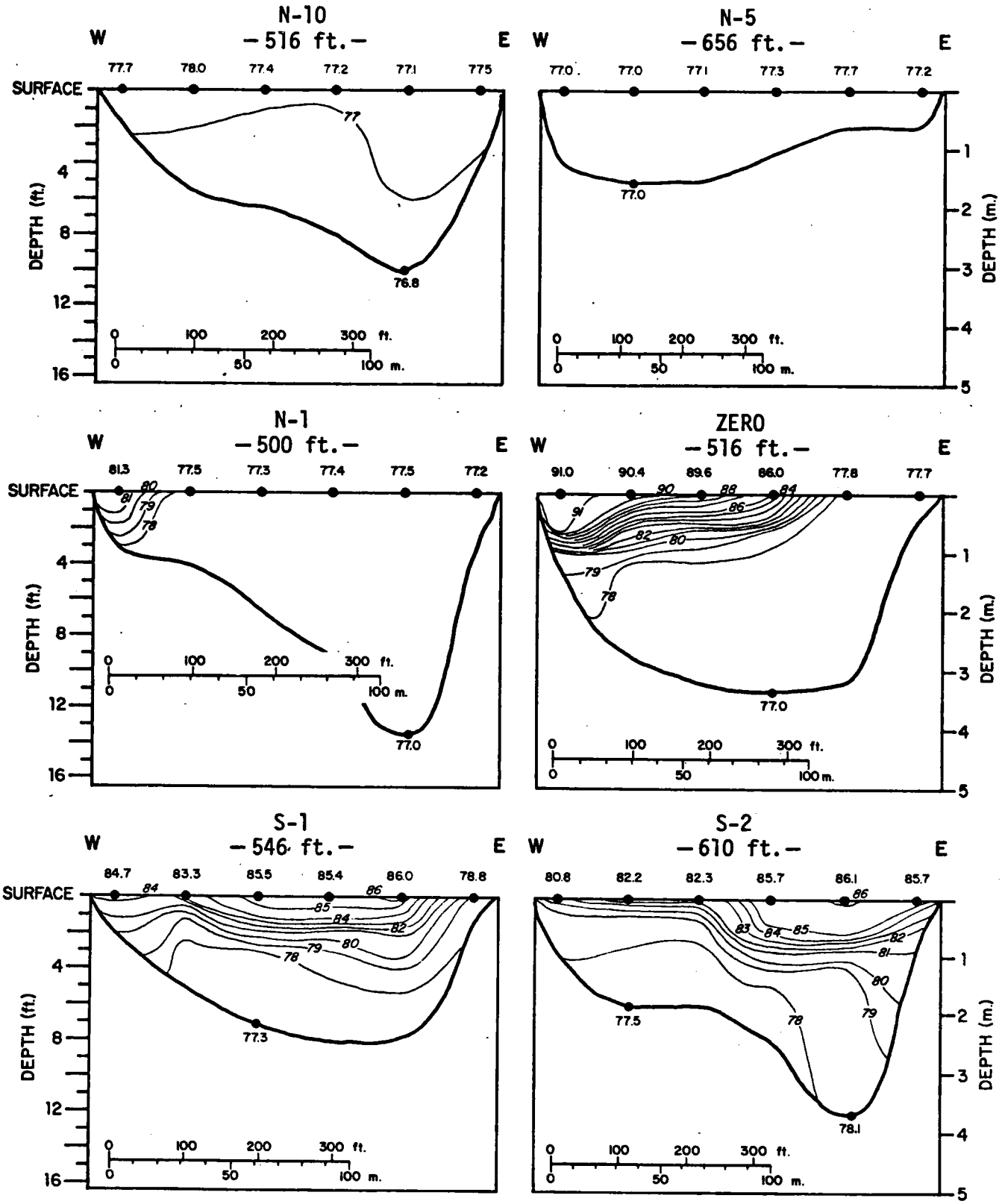


Figure 4. Isothermal cross-sections of Merrimack River sampling stations - July 31, 1973.

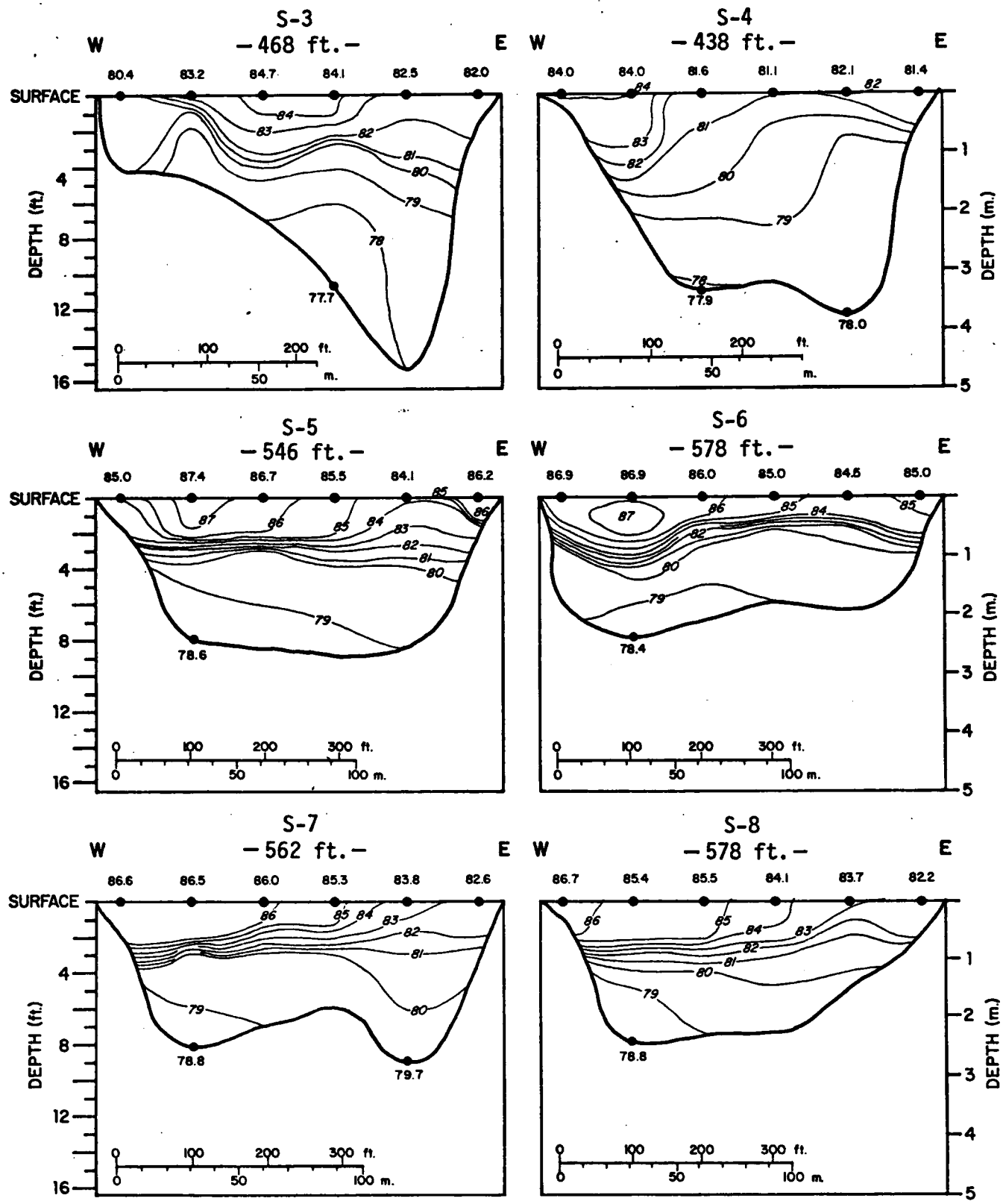


Figure 4. (Continued) Isothermal cross-sections of Merrimack River sampling stations - July 31, 1973.

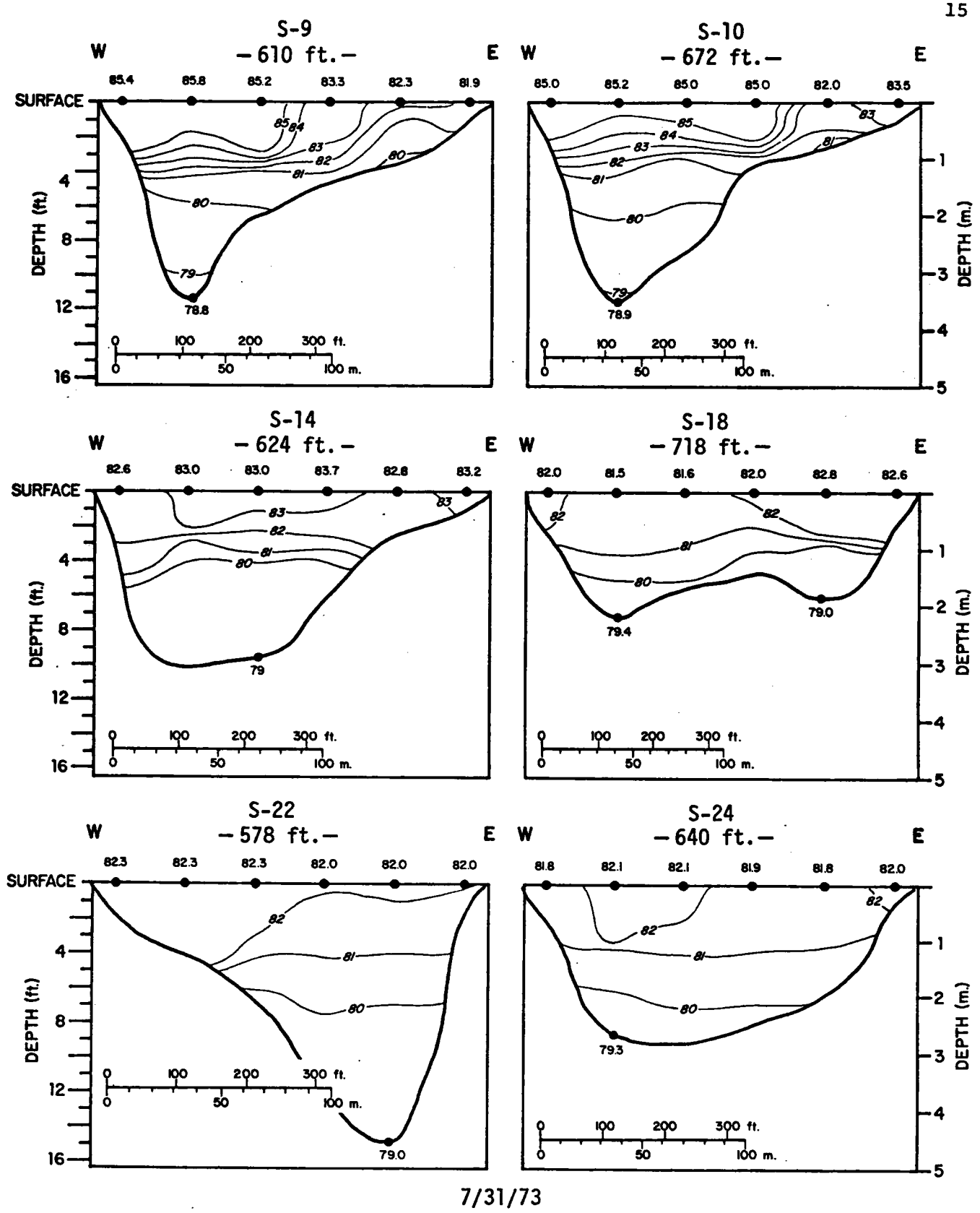


Figure 4. (Continued) Isothermal cross-sections of Merrimack River sampling stations - July 31, 1973.

weir was a homogeneous 103.5°F., but cooled to 91.0°F. before entering the river at Station Zero-West. At Stations S-1 to S-4, temperature strata were generally confined to the upper six feet of water and ranged from 77.3° to 86.1°F. Changes in discharge volumes, ambient temperatures, or Δt's at Zero-West caused the increased Δt's encountered from Station S-5 to S-10. Most thermal layering at these stations was found in the upper four feet of water with temperatures ranging from 78.4° to 87.4°F. The heated discharge became progressively less distinguishable from Station S-9 downstream to S-24, where there existed only a 2.8°F.[1] surface-to-bottom temperature differential compared to a 14.0°F. difference at Station Zero-West. Temperatures ranged from 78.8° to 85.8°F. at these stations.

August 23, 1973 -- Figure 5: Both units I and II were in operation during the survey. Ambient water temperatures at Station N-10 and N-5 ranged from 70.3° to 72.0°F. and flows for this date averaged 951 cfs. Changes in ambient temperature during the course of the survey were not monitored due to instrumentation failure. Station N-1 was heavily stratified with a substantial portion of the river cross-section measuring 80°F or more. Temperature of the heated effluent at the discharge weir was a uniform 93.6°F., cooling to 83.7°F. before entering the river at Station Zero-West.

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[1] Due in part to change in monitored ambient temperatures.

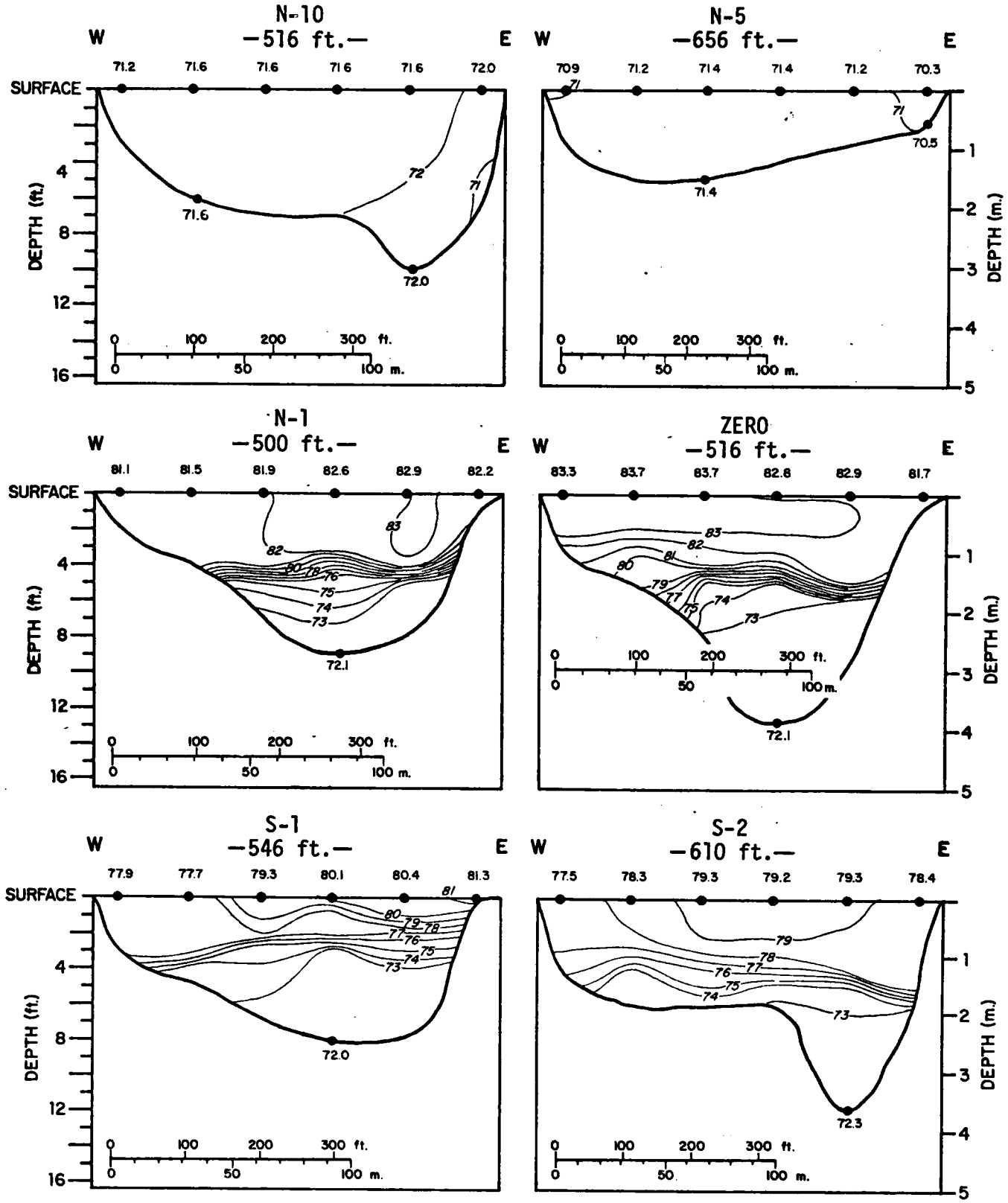


Figure 5. Isothermal cross-sections of Merrimack River sampling stations - August 23, 1973.

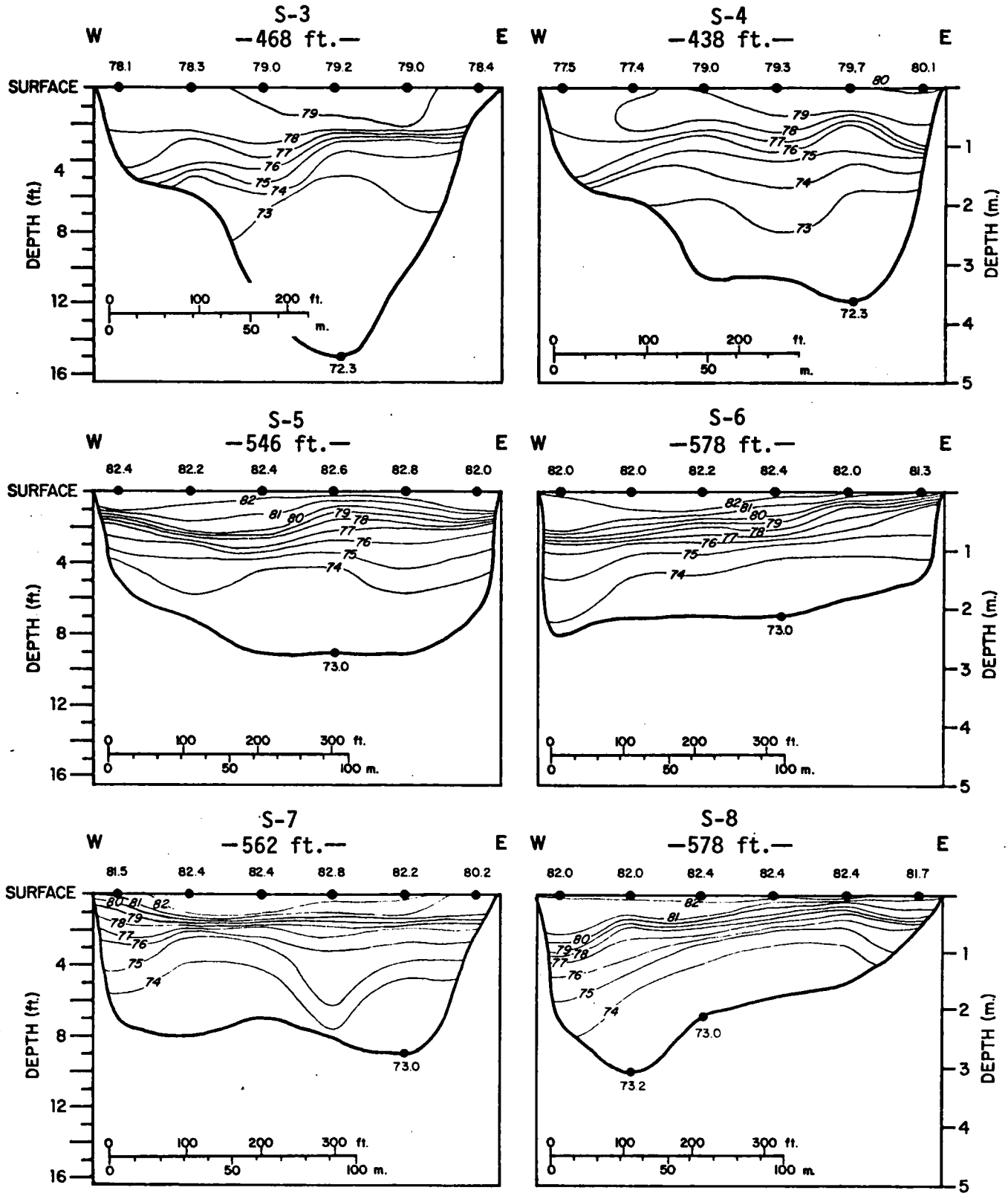


Figure 5 . Isothermal cross-sections of Merrimack River sampling stations - (Continued) August 23, 1973.

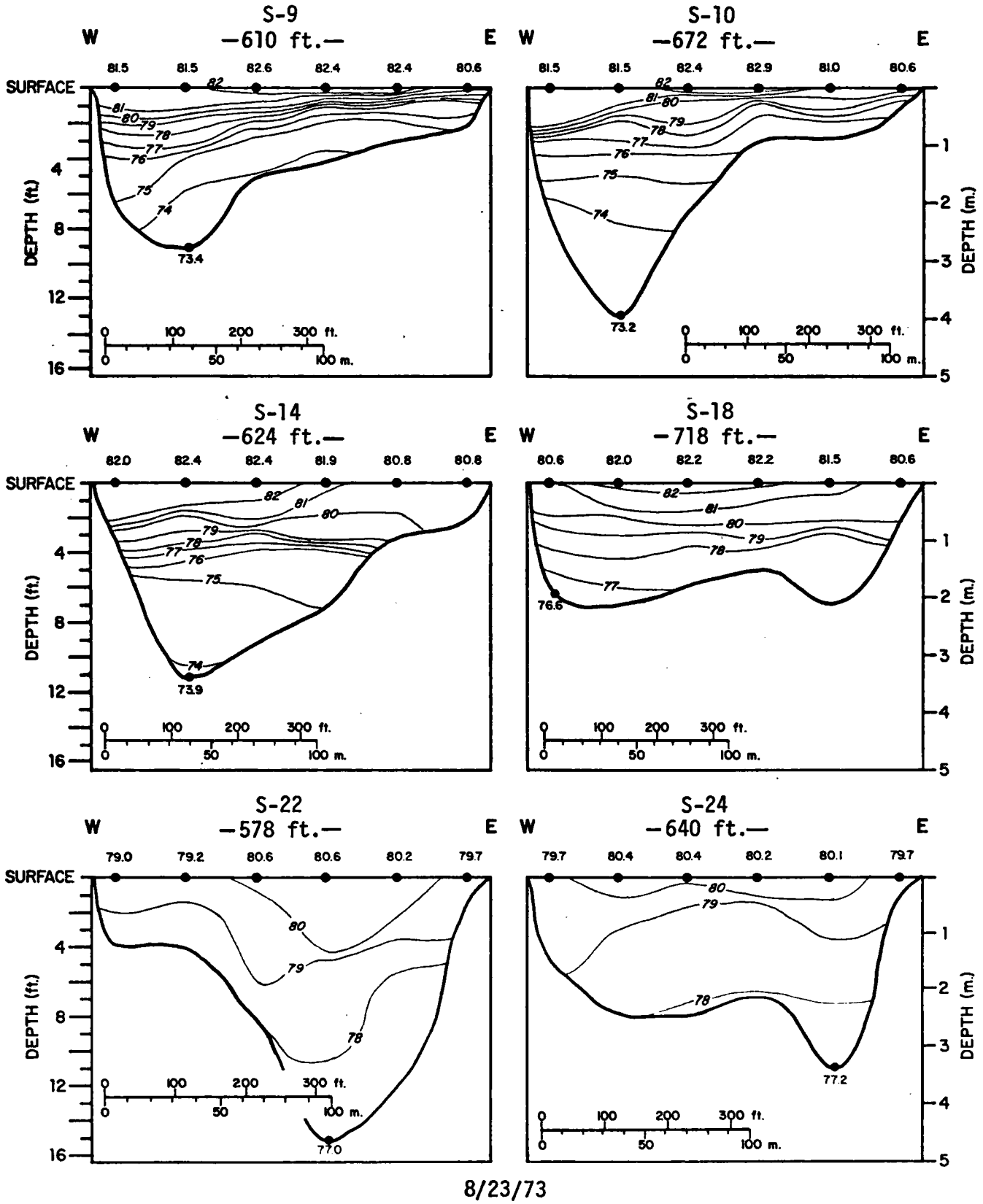


Figure 5. (Continued) Isothermal cross-sections of Merrimack River sampling stations - August 23, 1973.

From Stations S-1 to S-4, temperatures ranged from 72.0° to 81.3°F. with the upper six feet of water exhibiting maximum stratification. As in July, the discharged water cooled noticeably from Station Zero to S-3. However, at S-4 a $\Delta t$ increase was detected that persisted to a varying extent at each subsequent southern station. This effect was the result of factors previously noted in reference to the July 31 survey (i.e., change in discharge volumes, ambient temperatures, and $\Delta t$'s). Stations S-5 to S-18 showed a temperature range fo 73.0° to 82.9°F., with most thermal stratification occurring within the upper four feet. Homogeneity of the water column progressively increased, proceeding southward until only a 3.2°F surface-to-bottom difference existed at S-24, compared to an 11.6° change at Station Zero-West.

September 20, 1973 -- Figure 6: Unit #1 was in operation throughout this survey. River temperatures at N-10 and N-5 ranged from 60.4° to 61.0°F. and the daily flows averaged 1095 cfs. Monitoring of intake water temperatures showed a temperature increase of 1.9°F. during the survey. Water temperature at the discharge weir was 78.0°F. cooling to 72.8°F. as it met the river. Again, some of the heated effluent extended upstream to Station N-1. From Station Zero to S-18, a pronounced vertical gradient occurred that separated a relatively large and homogeneous mass of the effluent from the deeper, near-ambient water. The profiles for Stations S-1 through S-18 were quite

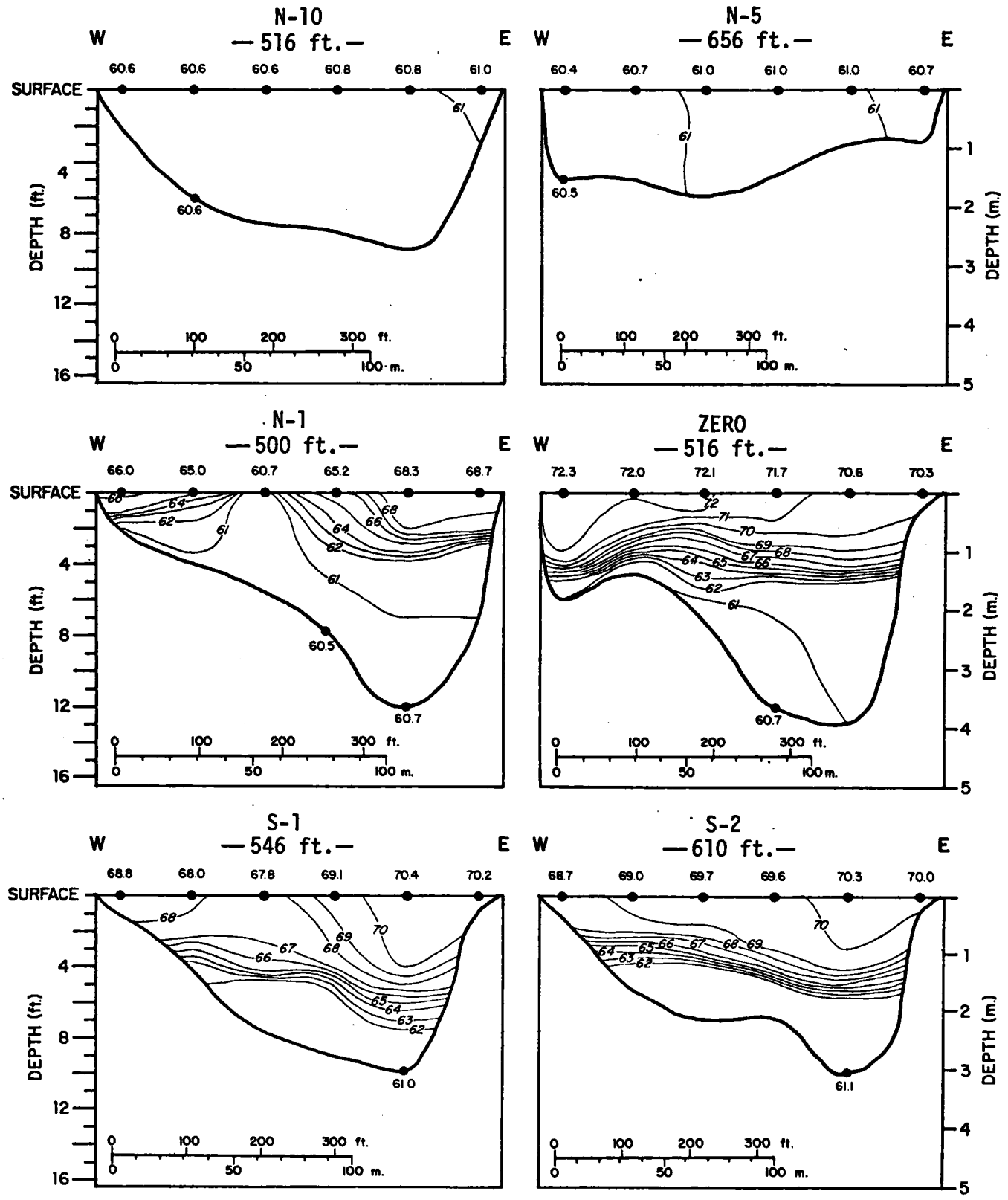


Figure 6. Isothermal cross-sections of Merrimack River sampling stations - September 20, 1973.

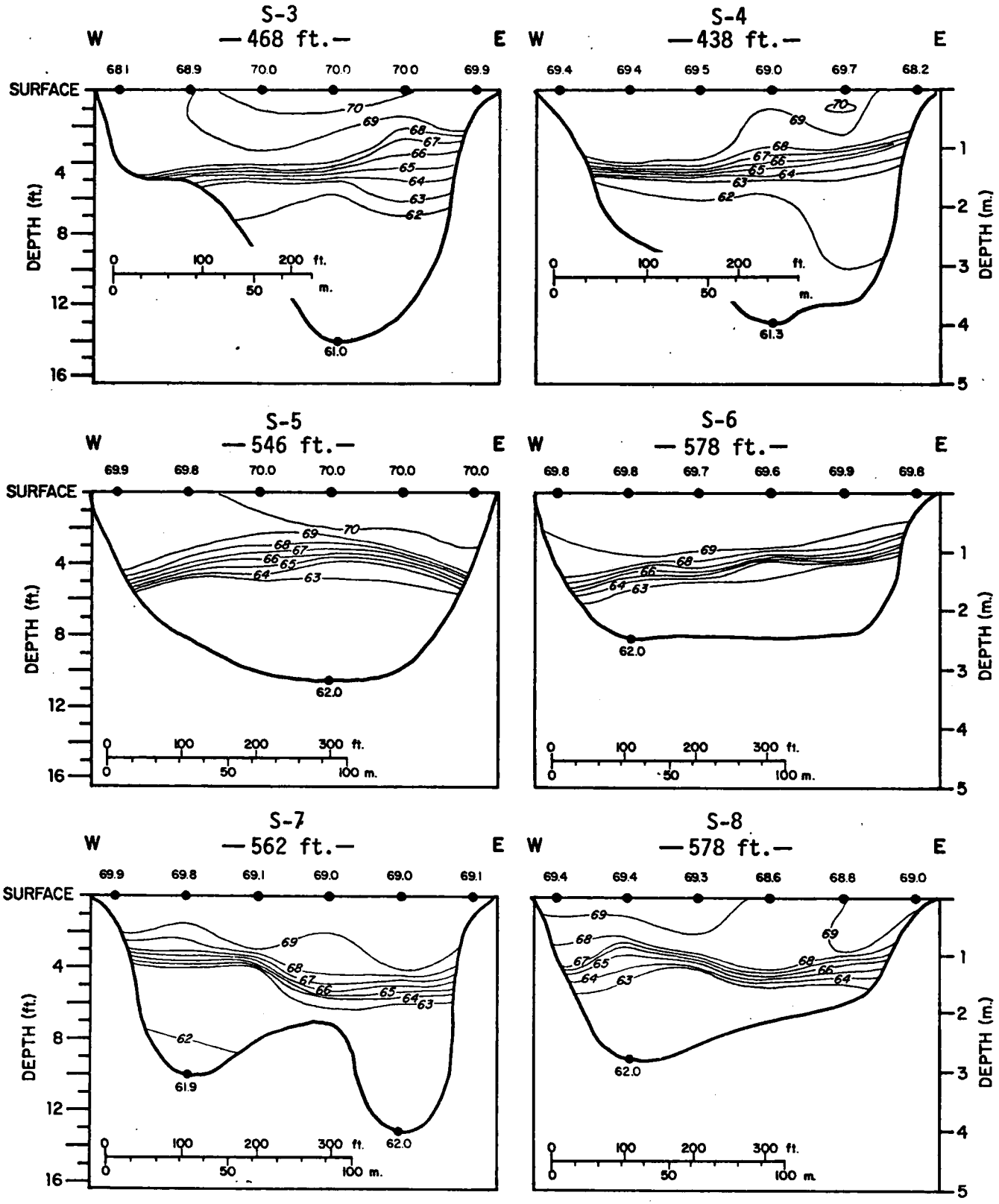


Figure 6. (Continued) Isothermal cross-sections of Merrimack River sampling stations - September 20, 1973.

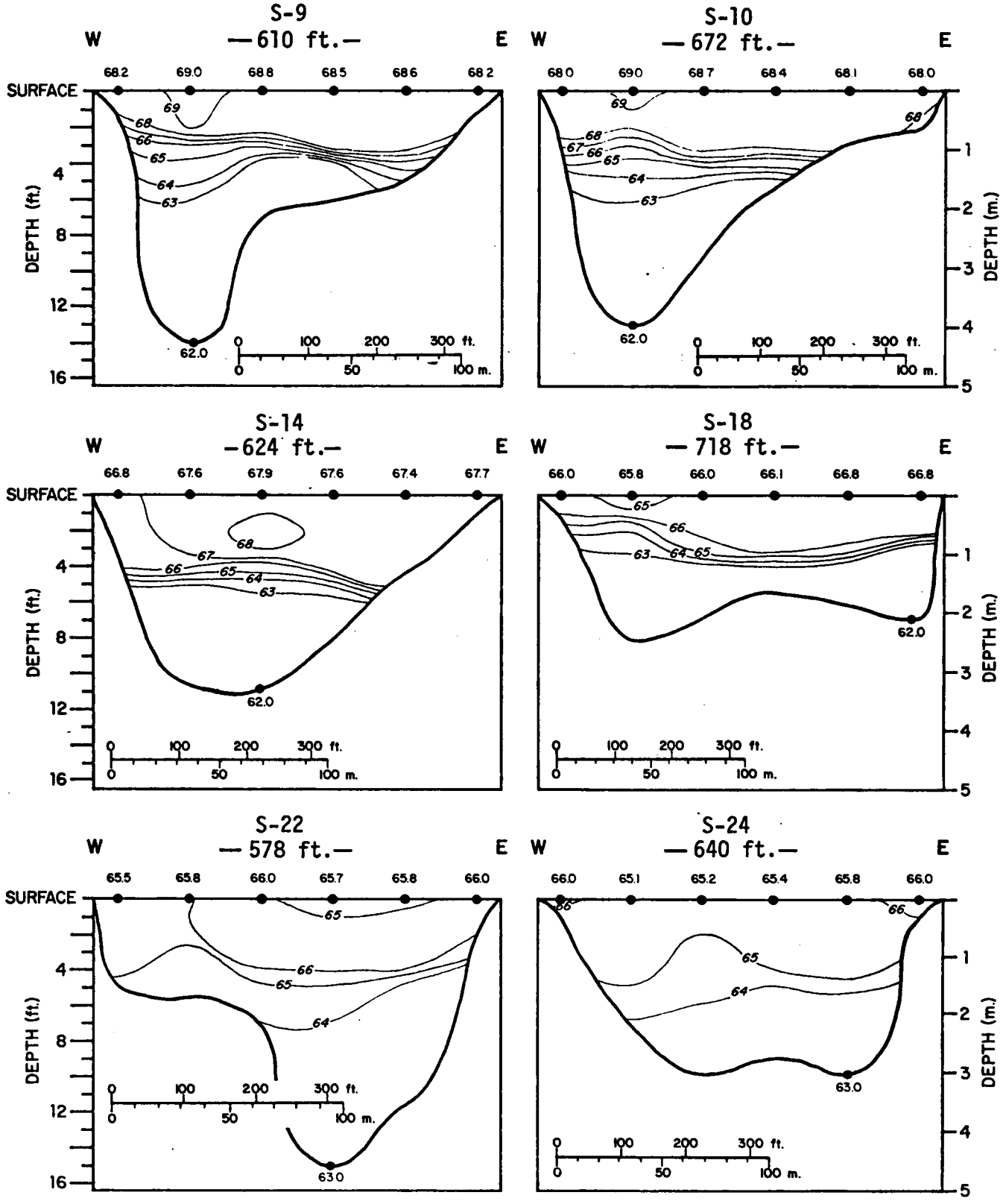


Figure 6. (Continued) Isothermal cross-sections of Merrimack River sampling stations - September 20, 1973.

similar with temperatures ranging from 61.9° to 70.0°F. Mixing appeared to be nearly accomplished at Station S-24 where only a 3.0°[1] surface-to-bottom difference remained, compared to an 11.6° change at Station Zero.

## C. SUMMARY AND CONCLUSIONS

During the spring months, slightly lower depth of visibility readings resulted from high flows and associated sediment loads. Markedly low readings occurred at all stations during the period of July floodings. Weekly samplings indicated that periods of low flow (September) did not coincide with consistent peak ambient temperatures (August), although low flows appeared to be the primary determinant of peak mean $\Delta t$'s. The maximum mean $\Delta t$ at Station Zero-West (weekly temperature profile data) occurred in September and was 13.9°F. Temperature stratification extended to the southern-most stations with $\Delta t$'s decreasing with distance downstream. As flows decreased, the thermal plume was noted to move northward as indicated by increased stratification at Station N-1. Bottom temperatures were only slightly affected during the study period.

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[1] Due in part to a change in monitored ambient temperature.

# III. WATER QUALITY STUDIES

## A. METHODS

### 1. Nutrients

Weekly water samples were taken at Stations N-10, Zero-West, S-4, and S-17 and analyzed for nutrient content. Nitrate, nitrite, and poly-, ortho, and total-phosphate analyses were performed in accordance with techniques presented in the 13th Edition of Standard Methods for the Examination of Water and Wastewater (1971).

### 2. pH

Measurements of pH were taken throughout the study period at Stations N-10, Zero-West, S-4 and S-17. The pH of water samples was determined with an Orion Research Model 401 specific ion meter.

### 3. Dissolved Oxygen

Weekly dissolved oxygen sampling was conducted as part of the normal monitoring activities at Stations N-10, Zero-West, S-4, and S-17. Surface samples were taken and analyzed using the azide modification of the iodometric method as described in the 13th Edition of Standard Methods for the Examination of Water and Wastewater (1971). A 24-hour dissolved oxygen survey was conducted from August 22 to 23, utilizing a Martek

Mark II unit which was regularly calibrated with the iodometric method described above. Stations N-10, Zero-West, S-4, S-17, and S-24 were sampled at mid-channel and west and east littoral zones at 4-hour intervals throughout the 24-hour period.

## B. RESULTS AND DISCUSSION

### 1. Nutrients

Results of the 1973 nutrient samplings are shown in Table 3. As in past years, no important differences in concentrations were noted among stations, although slightly higher values for most nutrients did occur at Station N-10. A possible reason for this is a sub-surface effluent located in the east side of the river just upstream of this station. Maximum mean monthly values of nutrients surveyed, occurred during September and October during periods of declining productivity. Concentrations of nutrients were generally lower than in 1967 - 1970. (Range of mean ambient T $PO_4$ = 0.44 - 1.10 ppm), higher than in 1971 ($\bar{X}$ T $PO_4$ = .004 ppm), but comparable to 1972 ($\bar{X}$ T $PO_4$ = .037 ppm), indicating a trend toward reduced organic enrichment.

### 2. pH

Mean monthly and seasonal pH values by station are presented in Table 4. As in previous years, with the exception of May, mean monthly values were comparable. During May, higher pH values were observed at

TABLE 3. MEAN MONTHLY NUTRIENT CONCENTRATION (mg/L) BY STATION

HOOKSETT POND, MERRIMACK RIVER, 1973

| | | N-10 (mg/L) | ZERO-WEST (mg/L) | S-4 (mg/L) | S-17 (mg/L) |
|---|---|---|---|---|---|
| April | $NO_2$ | .005 | .004 | .004 | .004 |
| | $NO_3$ | .133 | .113 | .066 | .072 |
| | $T\text{-}PO_4$ | .011 | .008 | .004 | .005 |
| | $O\text{-}PO_4$ | .004 | .004 | .004 | .004 |
| May | $NO_2$ | .005 | .004 | .004 | .004 |
| | $NO_3$ | .113 | .122 | .119 | .098 |
| | $T\text{-}PO_4$ | .014 | .017 | .016 | .016 |
| | $O\text{-}PO_4$ | .006 | .007 | .008 | .010 |
| June | $NO_2$ | .007 | .007 | .007 | .007 |
| | $NO_3$ | .114 | .143 | .132 | .125 |
| | $T\text{-}PO_4$ | .023 | .022 | .021 | .023 |
| | $O\text{-}PO_4$ | .012 | .013 | .012 | .013 |
| July | $NO_2$ | .006 | .007 | .004 | .007 |
| | $NO_3$ | .112 | .085 | .119 | .118 |
| | $T\text{-}PO_4$ | .032 | .032 | .033 | .031 |
| | $O\text{-}PO_4$ | .014 | .015 | .016 | .017 |
| August | $NO_2$ | .007 | .008 | .007 | .007 |
| | $NO_3$ | .257 | .216 | .122 | .118 |
| | $T\text{-}PO_4$ | .048 | .040 | .038 | .039 |
| | $O\text{-}PO_4$ | .016 | .016 | .015 | .014 |
| September | $NO_2$ | .008 | .009 | .008 | .006 |
| | $NO_3$ | .232 | .134 | .290 | .136 |
| | $T\text{-}PO_4$ | .046 | .043 | .043 | .045 |
| | $O\text{-}PO_4$ | .021 | .013 | .016 | .016 |
| October | $NO_2$ | .006 | .007 | .006 | .006 |
| | $NO_3$ | .099 | .101 | .100 | .098 |
| | $T\text{-}PO_4$ | .066 | .060 | .056 | .056 |
| | $O\text{-}PO_4$ | .042 | .038 | .039 | .038 |

TABLE 4 . MEAN MONTHLY AND SEASONAL pH VALUES BY STATION

HOOKSETT POND -- MERRIMACK RIVER -- 1973

| MONTH | N-10 | ZERO-WEST | S-4 | S-17 |
|---|---|---|---|---|
| APRIL | 7.93 | 7.49 | 7.47 | 7.80 |
| MAY | 7.71 | 6.74 | 6.45 | 6.58 |
| JUNE | 5.24 | 5.57 | 5.46 | 5.78 |
| JULY | 5.69 | 5.95 | 6.04 | 5.98 |
| AUGUST | 6.10 | 6.24 | 6.36 | 6.46 |
| SEPTEMBER | 5.45 | 5.54 | 5.66 | 5.75 |
| OCTOBER | 5.33 | 5.29 | 5.47 | 5.51 |
| MEAN FOR SAMPLING PERIOD | 6.21 | 6.12 | 6.13 | 6.36 |

Station N-10 than at the southern stations. Consistently low values at all stations (below 6.0) during the year were suspect, as they were well below the expected range (6.4 - 7.2). During periods of high productivity (August - September, as determined by chlorophyll *a* and plankton abundance), pH values should have been higher than in previous months, but this was not the case.

## 3. Dissolved Oxygen

### a) SURFACE DISSOLVED OXYGEN

Surface dissolved oxygen relationships in 1973 continued the marked consistency noted in previous study years. As in 1970 - 1972, mean oxygen concentration at Station Zero-West was approximately 1.0 mg/L less than at Station N-10 (Table 5). Also, as in previous years, oxygen differentials between N-10 and downstream stations tended to lessen as the season progressed, probably due to increased water temperature and resultant oxygen demands at the ambient station (N-10). In general, 1973 oxygen levels were comparable to those of 1970 - 1972. As indicated by the range of concentrations noted (5.5 mg/L - 13.3 mg/L) this portion of the river is fairly typical of a slow-moving, slightly enriched stream. No values fell below 5.0 ppm, which is generally accepted as a minimal value for a diverse fishery.

TABLE 5. MEAN MONTHLY SURFACE DISSOLVED OXYGEN CONCENTRATIONS AND MONTHLY RANGES HOOKSETT POND -- MERRIMACK RIVER -- 1973

| STATION | | A | M | J | J | A | S | O |
|---|---|---|---|---|---|---|---|---|
| N-10 | $\bar{X}$ | 12.1 | 10.5 | 8.6 | 7.5 | 7.4 | 8.8 | 9.7 |
| | Range | 10.9-13.3 | 10.2-10.8 | 7.5-9.7 | 6.8-8.1 | 6.8-8.2 | 8.6-9.2 | 8.9-10.4 |
| O-W | $\bar{X}$ | 10.5 | 10.2 | 7.9 | 6.6 | 7.7 | 8.1 | 9.3 |
| | Range | 9.1-11.8 | 9.8-10.5 | 6.8-9.2 | 5.5-7.5 | 6.8-8.7 | 7.1-8.6 | 8.6-10.5 |
| S-4 | $\bar{X}$ | 11.7 | 10.5 | 8.3 | 7.1 | 7.4 | 8.5 | 9.5 |
| | Range | 10.0-13.0 | 10.2-10.7 | 7.2-9.5 | 6.2-8.1 | 6.9-8.0 | 8.2-8.7 | 8.9-10.5 |
| S-17 | $\bar{X}$ | 11.8 | 10.6 | 8.3 | 7.2 | 7.9 | 8.8 | 9.8 |
| | Range | 11.0-12.3 | 10.3-10.7 | 6.5-9.7 | 6.6-7.6 | 7.4-8.5 | 8.6-9.0 | 9.2-11.2 |

### b) 24-HOUR DISSOLVED OXYGEN STUDY

Results of the 24-hour dissolved oxygen study are shown in Table 6. Mean discharge for the survey period was approximately 657 cfs. In general, normal dissolved oxygen trends were observed at Station N-10. During daylight, higher concentrations were observed in the upper euphotic zone than at greater depths; at night, values were nearly equal. At Stations Zero and S-4, dissolved oxygen levels during the survey showed slightly lower concentrations in the upper, thermally affected zone,compared to the deeper and thus cooler water. Station Zero had consistently lower concentrations of dissolved oxygen than did Station N-10. Effects of the heated discharge were largely negated at Stations S-17 and S-24. The lowest concentration of dissolved oxygen recorded was 6.4 mg/L, which occurred at Station Zero, at 2400 and at Station and S-17 at 0400.

## C. SUMMARY AND CONCLUSIONS

As in 1970 - 1972, concentrations of nutrients did not vary significantly among stations and followed expected seasonal trends. Dissolved oxygen concentrations were similar to those encountered in past years. Results of the 24-hour dissolved oxygen survey and surface dissolved oxygen samplings indicated no critical dissolved oxygen concentrations at any of the stations sampled. The low pH values which were recorded at all stations during the season cannot be explained at this time.

TABLE 6. MEANS AND RANGES OF TEMPERATURE AND DISSOLVED OXYGEN PROFILES
24 - HOUR DISSOLVED OXYGEN STUDY -- 22 and 23 AUGUST, 1973

1200 - 22 August 1973

| Stations | West | | Mid River | | East | |
|---|---|---|---|---|---|---|
| | D. O. (ppm) | Temp. (°F) | D. O. (ppm) | Temp. (°F) | D. O. (ppm) | Temp. (°F) |
| N-10 | R[1] 7.1 - 7.1 | 73.2 - 73.2 | 7.0 - 7.1 | 72.7 - 72.7 | 7.8 - 7.8 | 73.0 - 73.0 |
| | M[2] 7.1 | 73.2 | 7.0 | 72.7 | 7.8 | 73.0 |
| Zero | R 6.5 - 6.7 | 85.8 - 86.0 | 7.1 - 7.7 | 73.6 - 85.6 | 6.8 - 6.9 | 84.7 - 84.9 |
| | M 6.6 | 86.0 | 7.3 | 79.6 | 6.8 | 84.8 |
| S-4 | R 6.9 - 7.3 | 82.4 - 82.4 | 6.8 - 7.3 | 73.6 - 82.8 | 6.7 - 6.8 | 81.0 - 81.0 |
| | M 7.1 | 82.4 | 7.1 | 76.1 | 6.7 | 81.0 |
| S-17 | R 7.2 - 7.5 | 77.4 - 77.4 | 7.1 - 7.5 | 75.0 - 78.8 | 7.3 - 7.3 | 76.8 - 76.8 |
| | M 7.4 | 77.4 | 7.3 | 76.6 | 7.3 | 76.8 |
| S-24 | R 7.7 - 7.8 | 75.2 - 75.2 | 7.0 - 7.7 | 75.2 - 76.5 | 7.5 - 7.5 | 75.2 - 75.2 |
| | M 7.7 | 75.2 | 7.2 | 75.4 | 7.5 | 75.2 |

[1] Range

[2] Mean

Continued

TABLE 6. (Continued)

1600 - 22 August 1973

| Stations | | West D. O. (ppm) | West Temp. (°F) | Mid River D. O. (ppm) | Mid River Temp. (°F) | East D. O. (ppm) | East Temp. (°F) |
|---|---|---|---|---|---|---|---|
| N-10 | R | 7.5 - 7.5 | 72.5 - 72.5 | 7.3 - 7.6 | 72.5 - 72.5 | 7.0 - 7.2 | 72.5 - 72.9 |
| | M | 7.5 | 72.5 | 7.5 | 72.5 | 7.1 | 72.7 |
| Zero | R | 6.5 - 6.7 | 85.8 - 85.8 | 6.6 - 7.4 | 74.3 - 85.8 | 6.7 - 6.8 | 85.1 - 85.1 |
| | M | 6.6 | 85.8 | 7.1 | 79.9 | 6.7 | 85.1 |
| S-4 | R | 7.3 - 7.3 | 82.2 - 82.2 | 7.2 - 7.5 | 73.4 - 82.4 | 7.2 - 7.2 | 82.4 - 82.4 |
| | M | 7.3 | 82.2 | 7.4 | 76.0 | 7.2 | 82.4 |
| S-17 | R | 7.6 - 7.7 | 77.4 - 77.9 | 7.4 - 7.9 | 74.3 - 78.8 | 8.0 - 8.0 | 78.8 - 79.2 |
| | M | 7.6 | 77.6 | 7.6 | 76.4 | 8.0 | 79.0 |
| S-24 | R | 8.0 - 8.0 | 77.0 - 77.0 | 7.3 - 8.0 | 75.2 - 77.9 | 7.6 - 7.6 | 77.2 - 77.2 |
| | M | 8.0 | 77.0 | 7.6 | 76.0 | 7.6 | 77.2 |

2000 - 22 August 1973

| Stations | | West D. O. (ppm) | West Temp. (°F) | Mid River D. O. (ppm) | Mid River Temp. (°F) | East D. O. (ppm) | East Temp. (°F) |
|---|---|---|---|---|---|---|---|
| N-10 | R | 7.0 - 7.2 | 73.4 - 73.4 | 7.4 - 7.4 | 73.4 - 73.4 | 7.7 - 7.8 | 73.4 - 73.4 |
| | M | 7.1 | 73.4 | 7.4 | 73.4 | 7.7 | 73.4 |
| Zero | R | 6.5 - 6.9 | 86.9 - 89.6 | 6.7 - 7.4 | 77.0 - 87.4 | 6.5 - 6.8 | 86.5 - 86.5 |
| | M | 6.7 | 87.9 | 7.0 | 83.1 | 6.6 | 86.5 |
| S-4 | R | 7.2 - 7.2 | 81.5 - 81.5 | 7.1 - 7.8 | 75.2 - 81.5 | 6.9 - 7.0 | 79.3 - 82.4 |
| | M | 7.2 | 81.5 | 7.6 | 76.6 | 6.9 | 80.8 |
| S-17 | R | 7.5 - 7.6 | 78.8 - 78.8 | 7.4 - 7.7 | 75.6 - 80.2 | 7.4 - 7.7 | 78.4 - 78.8 |
| | M | 7.5 | 78.8 | 7.5 | 77.0 | 7.5 | 78.6 |
| S-24 | R | 8.0 - 8.1 | 77.9 - 77.9 | 7.4 - 8.1 | 76.1 - 78.8 | 7.8 - 8.0 | 77.7 - 77.9 |
| | M | 8.0 | 77.9 | 7.6 | 77.0 | 7.9 | 77.8 |

Continued

TABLE 6. (Continued)

2400 - 22 August 1973

| Stations | | West D. O. (ppm) | West Temp. (°F) | Mid River D. O. (ppm) | Mid River Temp. (°F) | East D. O. (ppm) | East Temp. (°F) |
|---|---|---|---|---|---|---|---|
| N-10 | R | 7.0 - 7.0 | 72.5 - 72.5 | 7.2 - 7.2 | 72.5 - 72.5 | 7.2 - 7.2 | 72.5 - 72.5 |
| | M | 7.0 | 72.5 | 7.2 | 72.5 | 7.2 | 72.5 |
| Zero | R | 6.8 - 7.0 | 84.2 - 85.1 | 6.6 - 7.1 | 74.3 - 85.1 | 7.1 - 7.2 | 84.7 - 85.1 |
| | M | 6.8 | 84.9 | 6.8 | 80.0 | 7.1 | 84.9 |
| S-4 | R | 6.9 - 6.9 | 80.6 - 80.6 | 7.0 - 7.2 | 74.3 - 81.5 | 6.6 - 6.7 | 80.6 - 80.6 |
| | M | 6.9 | 80.6 | 7.1 | 76.7 | 6.6 | 80.6 |
| S-17 | R | 7.2 - 7.2 | 77.9 - 77.9 | 7.0 - 7.4 | 75.9 - 77.9 | 6.4 - 6.8 | 77.0 - 77.7 |
| | M | 7.2 | 77.9 | 7.2 | 77.0 | 6.6 | 77.3 |
| S-24 | R | 7.2 - 7.2 | 77.0 - 77.9 | 7.1 - 7.4 | 76.1 - 77.9 | 7.0 - 7.0 | 76.6 - 77.0 |
| | M | 7.2 | 77.4 | 7.2 | 77.2 | 7.0 | 76.8 |

0400 - 23 August 1973

| Stations | | West D. O. (ppm) | West Temp. (°F) | Mid River D. O. (ppm) | Mid River Temp. (°F) | East D. O. (ppm) | East Temp. (°F) |
|---|---|---|---|---|---|---|---|
| N-10 | R | 7.0 - 7.1 | 69.8 - 69.8 | 7.1 - 7.2 | 70.7 - 71.6 | 7.2 - 7.4 | 70.7 - 71.6 |
| | M | 7.0 | 69.8 | 7.2 | 71.3 | 7.3 | 71.2 |
| Zero | R | 7.0 - 7.0 | 82.4 - 83.3 | 6.4 - 7.0 | 72.5 - 83.3 | 6.7 - 6.8 | 82.4 - 82.4 |
| | M | 7.0 | 82.9 | 6.7 | 79.2 | 6.7 | 82.4 |
| S-4 | R | 7.0 - 7.0 | 77.0 - 77.2 | 6.8 - 7.0 | 72.5 - 78.8 | 7.0 - 7.4 | 77.0 - 77.4 |
| | M | 7.0 | 77.1 | 7.0 | 74.7 | 7.2 | 77.2 |
| S-17 | R | 7.6 - 7.6 | 73.6 - 74.3 | 7.0 - 7.2 | 75.2 - 75.2 | 6.4 - 6.4 | 73.6 - 73.8 |
| | M | 7.6 | 74.0 | 7.1 | 75.2 | 6.4 | 73.7 |
| S-24 | R | 7.1 - 7.2 | 75.2 - 75.2 | 7.0 - 7.2 | 74.3 - 75.2 | 6.8 - 7.0 | 74.3 - 75.2 |
| | M | 7.1 | 75.2 | 7.0 | 75.1 | 6.9 | 74.8 |

Continued

TABLE 6. (Continued)

0800 - 23 August 1973

| Stations | | West D. O. (ppm) | West Temp. (°F) | Mid River D. O. (ppm) | Mid River Temp. (°F) | East D. O. (ppm) | East Temp. (°F) |
|---|---|---|---|---|---|---|---|
| N-10 | R | 6.8 - 6.9 | 71.1 - 71.1 | 7.0 - 7.2 | 71.2 - 72.0 | 7.0 - 7.0 | 71.1 - 72.0 |
| | M | 6.8 | 71.1 | 7.1 | 71.7 | 7.0 | 71.6 |
| Zero | R | 6.9 - 7.2 | 83.7 - 83.7 | 6.5 - 6.8 | 72.9 - 82.8 | 6.7 - 6.8 | 82.8 - 82.8 |
| | M | 7.0 | 83.7 | 6.7 | 77.5 | 6.7 | 82.8 |
| S-4 | R | 6.8 - 6.9 | 78.3 - 78.4 | 6.7 - 7.0 | 73.0 - 80.1 | 6.6 - 6.7 | 79.2 - 79.2 |
| | M | 6.8 | 78.3 | 6.8 | 75.2 | 6.6 | 79.2 |
| S-17 | R | 7.0 - 7.0 | 76.5 - 76.5 | 6.8 - 7.0 | 76.5 - 76.6 | 6.6 - 6.6 | 75.6 - 75.6 |
| | M | 7.0 | 76.5 | 6.9 | 76.5 | 6.6 | 75.6 |
| S-24 | R | 7.2 - 7.2 | 74.8 - 74.8 | 6.9 - 7.0 | 75.0 - 75.6 | 6.8 - 6.8 | 74.8 - 75.6 |
| | M | 7.2 | 74.8 | 7.0 | 75.4 | 6.8 | 75.2 |

1200 - 23 August 1973

| Stations | | West D. O. (ppm) | West Temp. (°F) | Mid River D. O. (ppm) | Mid River Temp. (°F) | East D. O. (ppm) | East Temp. (°F) |
|---|---|---|---|---|---|---|---|
| N-10 | R | 7.4 - 7.7 | 70.2 - 72.0 | 7.6 - 7.6 | 71.4 - 72.0 | 7.6 - 7.7 | 72.1 - 72.3 |
| | M | 7.5 | 71.4 | 7.6 | 71.8 | 7.6 | 72.2 |
| Zero | R | 7.1 - 7.2 | 81.9 - 83.1 | 7.1 - 7.4 | 71.1 - 83.3 | 7.3 - 7.3 | 82.2 - 82.2 |
| | M | 7.1 | 82.6 | 7.2 | 76.1 | 7.3 | 82.2 |
| S-4 | R | 6.9 - 8.0 | 72.1 - 79.3 | 6.6 - 7.3 | 71.2 - 81.0 | 6.6 - 7.2 | 72.3 - 79.7 |
| | M | 7.3 | 76.2 | 7.0 | 74.4 | 6.9 | 76.9 |
| S-17 | R | 6.7 - 7.8 | 75.0 - 77.2 | 7.4 - 7.8 | 75.7 - 76.8 | 7.4 - 7.7 | 75.2 - 76.1 |
| | M | 7.4 | 76.6 | 7.6 | 76.4 | 7.6 | 75.7 |
| S-24 | R | 7.8 - 7.9 | 76.5 - 77.2 | 6.7 - 7.7 | 74.5 - 76.5 | 7.6 - 7.6 | 75.9 - 76.1 |
| | M | 7.8 | 76.8 | 7.2 | 75.4 | 7.6 | 75.9 |

# IV. BIOLOGICAL STUDIES

## A. METHODS

### 1. Chlorophyll *a*

Weekly surface water samples were obtained from Stations N-10, Zero-West, S-4, and S-17. Chlorophyll *a* determinations were made using the trichromatic method outlined in the 13th Edition of Standard Methods for the Examination of Water and Wastewater (1971).

### 2. Plankton

Metered plankton nets (#20 mesh) were used to collect weekly plankton samples at Station N-10, Zero-West, S-4, and S-17. At Stations N-10 and S-4, both surface and sub-surface (approximately six-foot depths) samplings were made, while at Stations Zero-West and S-17, only surface tows were taken. Plankton in each sample were identified and enumerated in the laboratory by examining 45 fields (3 primaries - 15 fields each) of a Sedgewick-Rafter cell at 100x for phytoplankton and 9 vertical strips (3 for each primary) at 40x for zooplankton.

### 3. Periphyton

Periphyton accumulators were installed at Stations N-10, Zero-

West, S-4, and S-17 approximately two feet below the surface of the water. At Stations N-10 and S-4 additional accumulators were placed at depths of six feet, which is below the level of significant thermal influence. Samples were collected weekly (short-term) and monthly (long-term) to determine the effects of the heated discharge on the periphyton community. Biota were identified to major groups (green, blue-green, diatoms) and percent composition of each was determined based on cellular counts of the groups.

### 4. Aquatic Plants

Aquatic plants were sampled in spring and late summer at the discharge canal and Stations N-10 through S-24. Relative abundance of each species was noted during the course of observations. In cases where field identifications were not possible, type specimens were returned to the laboratory for more detailed classification. General habitat types were noted at each survey station.

### 5. Aquatic Insects

Qualitative samples were taken in June and August from the east and west banks at Stations N-10, Zero, S-4, and S-17. Collections were made by two field personnel working for 10 minutes at each station. Substrate types at each sample location were noted. Organisms were preserved in 10% buffered formalin for identification and enumeration.

## 6. Benthic Invertebrates

Stations N-10, Zero-West, S-4, and S-17 were sampled with a Ponar grab in June, August, and October. Two replicate samples were taken at mid-river and from the east and west banks at each station. Samples were sieved in the field and preserved. Two and one-half milliliters of rosebengal stain were added to the preservative solution to facilitate sorting. Benthic samples were returned to the laboratory for sorting, identification and enumeration.

## 7. Fish Surveys

### a) IMMATURE FISH SEINING

Seining activities were conducted when flows permitted at Stations N-10, Zero, S-2, and S-17 from early June through July. Numbers, species and size ranges of immature fish collected in two "hauls" of a 15-foot,1/4" mesh seine at each station were recorded.

### b) ELECTROFISHING

Fish were collected by shocking 1000-foot sections along both the east and west banks of the river at the following stations: N-9 and N-10; N-6 and N-7; Zero and S-1; S-4 and S-5; S-17 and S-18. Fish collected during the study (June, August, and September) were identified, weighed and counted.

c) FYKE NETTING

Four fyke netting stations (N-10 East, N-10 West, S-3 East, and S-2 West) were sampled monthly from June through October to monitor populations of smallmouth bass (*Micropterus dolomieui*), yellow perch (*Perca flavescens*) and pumpkinseed sunfish (*Lepomis gibbosus*). Nets were set twice per week for two day periods for a total of 16 net days each month. Captured fish were weighed, measured, and sexed. Where possible, scale samples from ten fish per "inch-class" of each species were taken for aging. Age determinations were used to verify findings of length/frequency analyses which were employed to gain a better insight into the Merrimack River fish populations in the area of the Merrimack Generating Plant.

## B. RESULTS AND DISCUSSION

### 1. Chlorophyll *a*

Monthly means of chlorphyll *a* concentrations by station are shown in Table 7. In all months, with the exception of October, mean concentrations of chlorophyll *a* were lower at Station Zero-West than at Station N-10. From June to October, Station S-17 had higher chlorophyll *a* concentrations than other stations sampled, possibly as a result of the influence of the Suncook River. A progressive seasonal increase in concentration was noted at all stations as water warmed and flows diminished. Peak concentrations

TABLE 7.

MEAN MONTHLY CONCENTRATIONS ($mg/m^3$) OF CHLOROPHYLL *a* AT STATIONS N-10, ZERO-WEST, S-4, AND S-17

HOOKSETT POND, MERRIMACK RIVER - 1973

| MONTH | STATIONS | | | |
|---|---|---|---|---|
| | N-10 | ZERO-WEST | S-4 | S-17 |
| April | 2.41 | 2.14 | 2.33 | 2.44 |
| May | 2.19 | 2.17 | 2.54 | 2.47 |
| June | 3.06 | 2.73 | 2.64 | 3.62 |
| July* | 5.36 | 3.44 | 3.94 | 6.31 |
| August | 8.60 | 6.93 | 7.46 | 9.11 |
| September | 15.39 | 11.84 | 13.82 | 15.99 |
| October | 2.49 | 2.53 | 2.71 | 2.52 |

*Due to high sediment load caused by flooding, it was impossible to analyze two (July 3 and July 11) of five July samples.

were reached in September; lowest occurred during high flow months (April-May).

In general, concentrations of chlorophyll *a* in 1973 were less than those in 1971, but greater than those during the 1972 study.

## 2. Plankton

Major groups of plankton considered were diatoms (Chrysophyta), green algae (Chlorophyta), bluegreen algae (Cyanophyta), and zooplankton. Golden brown algae (Pyrrophyta) and red algae (Rhodophyta) were also enumerated, collectively.

### SURFACE

#### a) DIATOMS

Numbers of diatoms per 100 liters of water are shown in Figure 7 according to station. Dominant forms collected were *Asterionella* sp., *Melosira* sp. and *Tabellaria* sp. Results of a Friedman two-way analysis of variance (Sokal and Rohlf, 1969) indicated significant among-station differences ($p < .001$) with Station N-10 having the greatest abundance of diatoms (N-10 > S-4 > S-17 > O-W) over the season. A trend toward higher numbers (similar to those found at Station N-10) was noted at more southerly stations. A parametric two-way analysis of variance showed a significant reduction in the percentage of diatoms at all stations ($p < .005$) during July, August, and

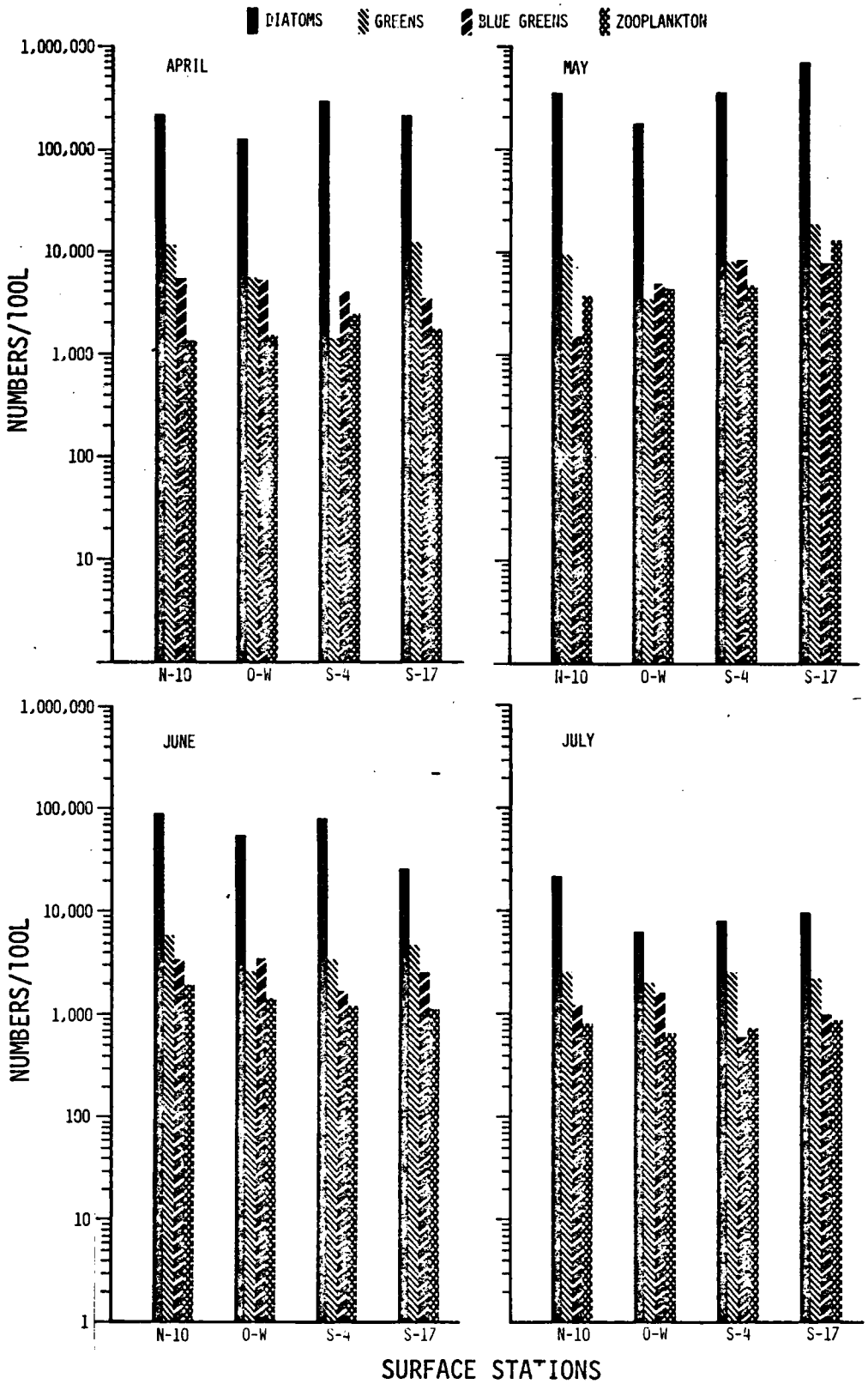
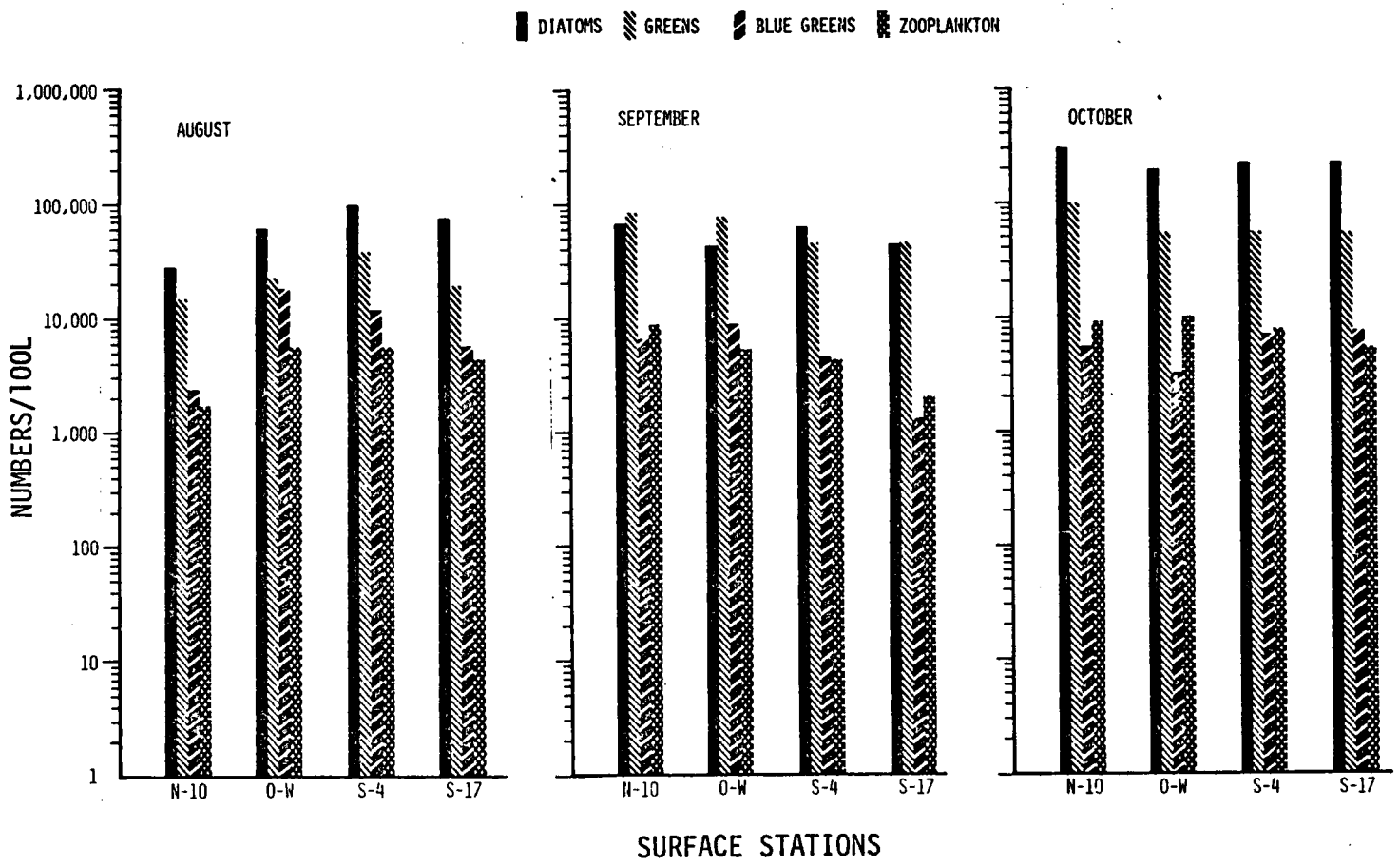



Figure 7. Mean monthly abundance of plankton organisms in surface plankton samples - Hooksett Pond, Merrimack River, 1973.

Figure 7 . (Continued)



September, the higher temperature months.

b) GREEN ALGAE

Dominant forms of green algae collected in surface tows were *Microspora* sp., and *Spirogyra* sp. As was true with diatoms, throughout the study period less numbers of green algae were collected at Station Zero-West (N-10 > S-4 > S-17 > O-W) than at Station N-10 and among-station differences were significant ($p = .032$) over the season. During most months sampled, Stations S-4 and S-17 had comparable or greater mean numbers of green algae than did Zero-West. Percentages of green algae increased significantly at all stations ($p < .005$) during August and September, months when high temperatures and low flows prevailed.

c) BLUEGREEN ALGAE

The dominant genus of bluegreen algae collected was *Oscillatoria*. Station Zero-West had greater numbers of bluegreen forms than did N-10, S-4 or S-17 (O-W > N-10 >S-4 > S-17) as shown in Figure 7. Among-station differences were significant ($p < .001$) over the season. The greater abundance of bluegreen algae was probably related to the dense mats of *Oscillatoria* sp. on bottom substrates in the discharge canal. These mats could have been loosened by turbulence resulting in their introduction into the river at Station

Zero-West. In general, percentages of bluegreen algae increased in the months of July, August, and September at all stations.

d) ZOOPLANKTON

The predominant zooplankton forms collected in surface samples were rotifers and ciliphorans. No statistically significant differences between numbers of organisms were found among stations over the season. During August, the month of highest ambient temperatures, numbers of zooplankton increased over N-10 numbers at stations south of the discharge canal. In September, the month of lowest flows, zooplankton were reduced at Zero-West, S-4 and S-17, with the amount of the reduction increasing with downstream movement. It is not possible to ascertain whether this was the result of impacts experienced at Station Zero-West or of natural variability in river plankton. In general, an increase in percentage of zooplankton was noted in August and September at all stations.

e) OTHERS

Total numbers of all other phytoplankton groups (i.e., golden brown and red algae), found in low numbers throughout the season were also tested for differences among stations. Significant among-station differences were noted over the season ($p < .001$) with Zero-West showing the lowest abundances (S-17 > N-10 > S-4 > 0-W).

SUB-SURFACE

Dominant plankton forms collected in subsurface tows (Figure 8) were the same as those noted for the surface samples. Stations N-10 and S-4 were similar to each other in total numbers and composition with the exception of the green algae. Station N-10 had significantly more green algae than S-4 [p = .015, Wilcoxin Matched Pairs Signed Ranks Test (Sokal and Rohlf, 1969)] over the study period at the sub-surface depth.

In summary, results of the 1973 plankton survey were similar to those of 1971 and 1972 due to a consistent numerical reduction of planktonic forms at Station Zero-West. The plankton community exhibited expected seasonal trends with diatoms showing peak abundance in the cooler spring and fall months while other forms increased during the warmer summer months. Chlorophyll *a* concentrations generally substantiated these findings.

## 3. Periphyton

### a) WEEKLY SAMPLING

Weekly periphyton slides were examined to determine effects of thermal impacts on initial periphyton colonization. During 1973 diatoms were the dominant organisms at all depths (Figures 9 to 11). A Friedman non-parametric two-way analysis of variance (Sokal and Rohlf, 1969) testing abundance differences among stations over the season showed that Station N-10 had significantly more diatoms

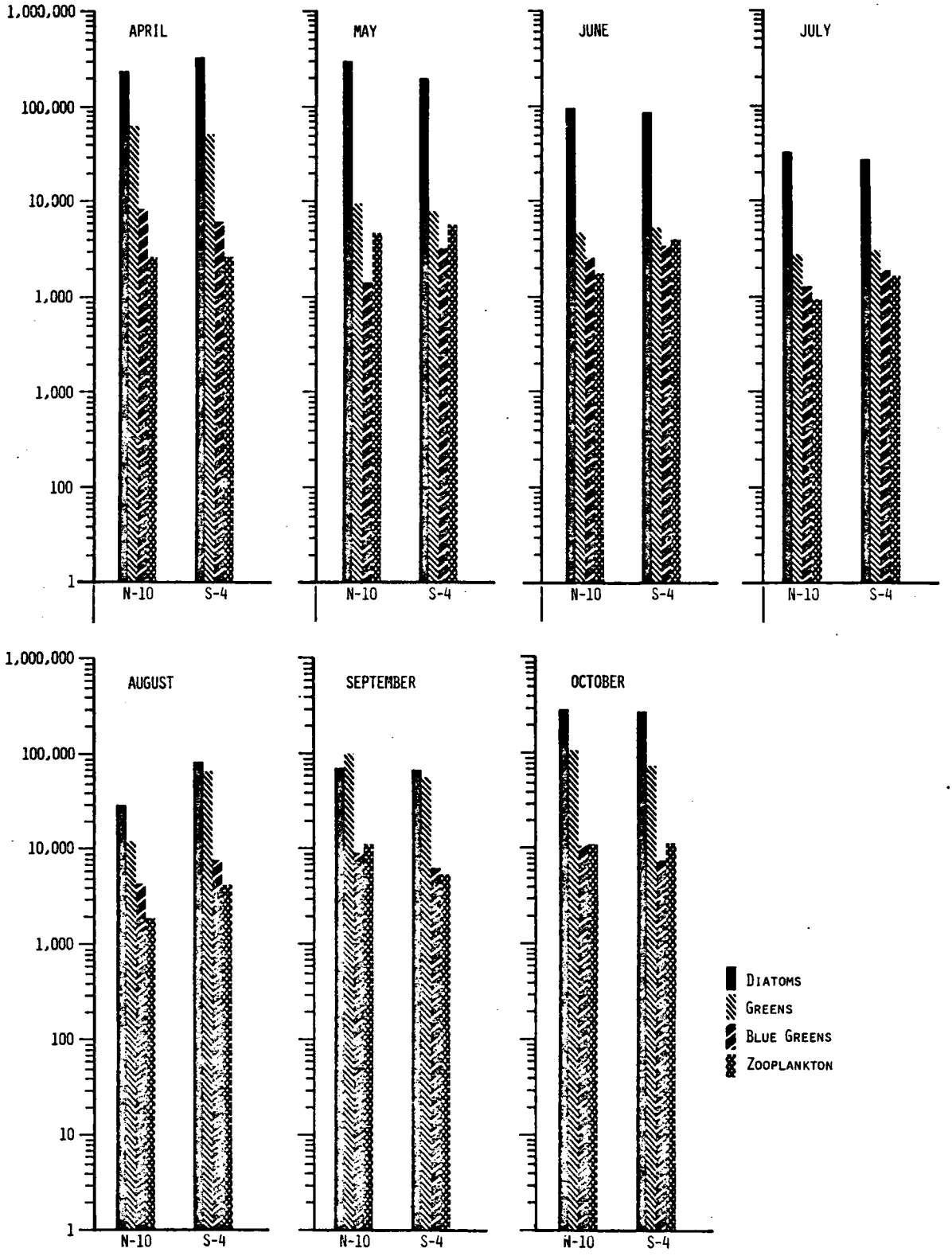



Figure 8. Mean monthly abundance of plankton organisms in subsurface plankton samples - Hooksett Pond, Merrimack River, 1973.

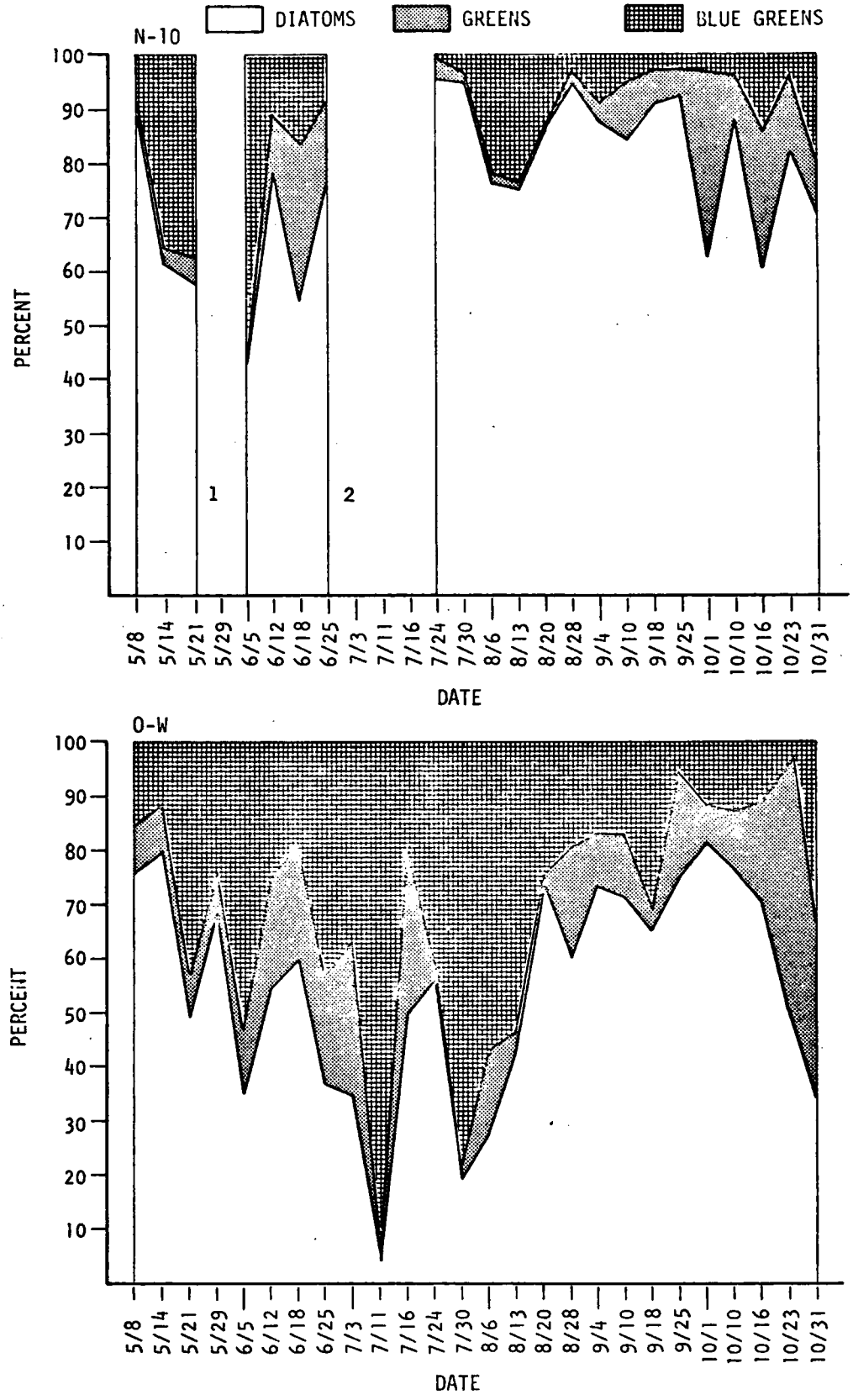



Figure 9 . Percent composition of diatoms, green and bluegreen algae on weekly periphyton slides at Stations N-10 and Zero-West at two foot depth.
1. Accumulator loss
2. Data loss due to flooding

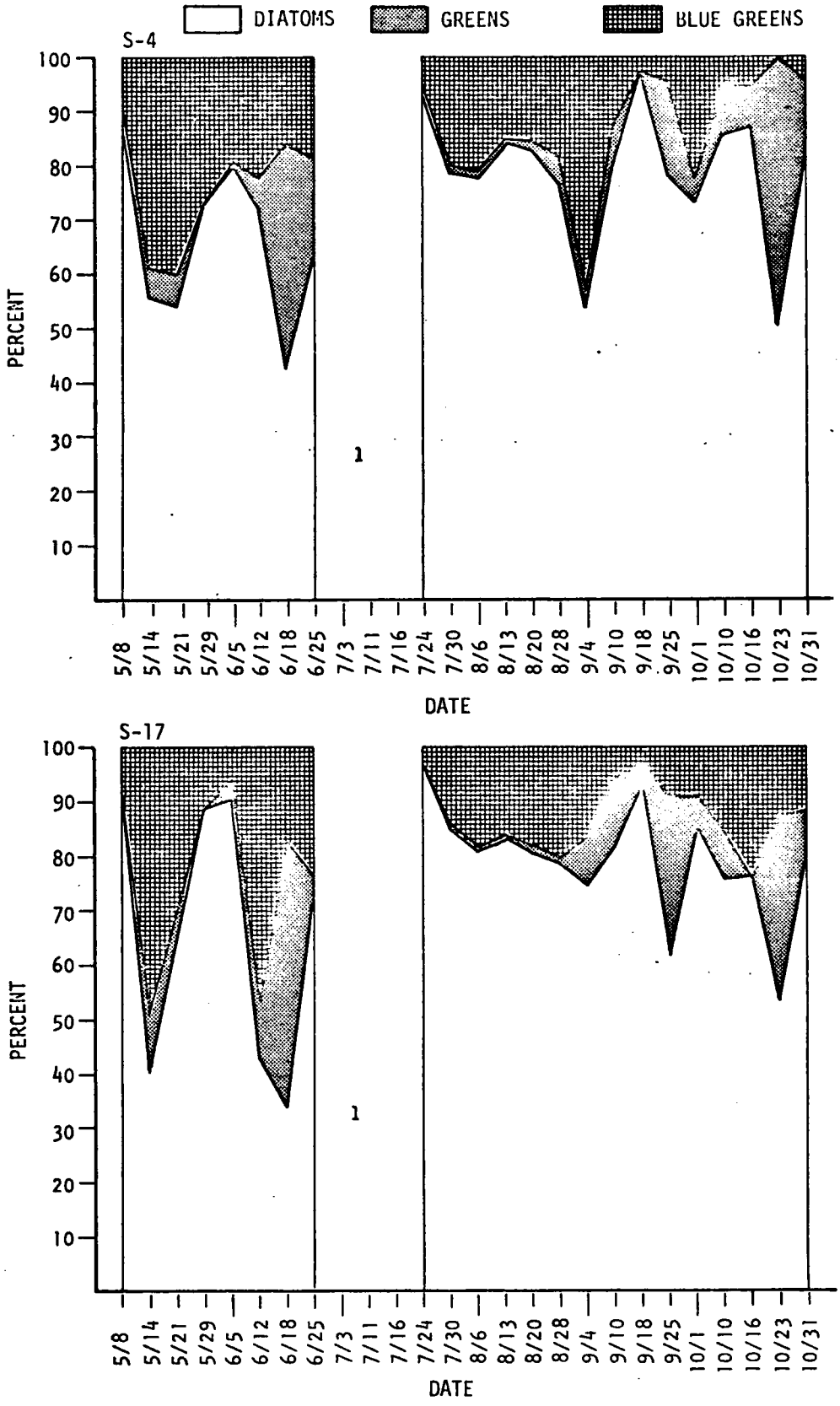



Figure 10. Percent composition of diatoms, green and bluegreen algae on weekly periphyton slides at Stations S-4 and S-17 at two foot depth.
1. Data loss due to flooding

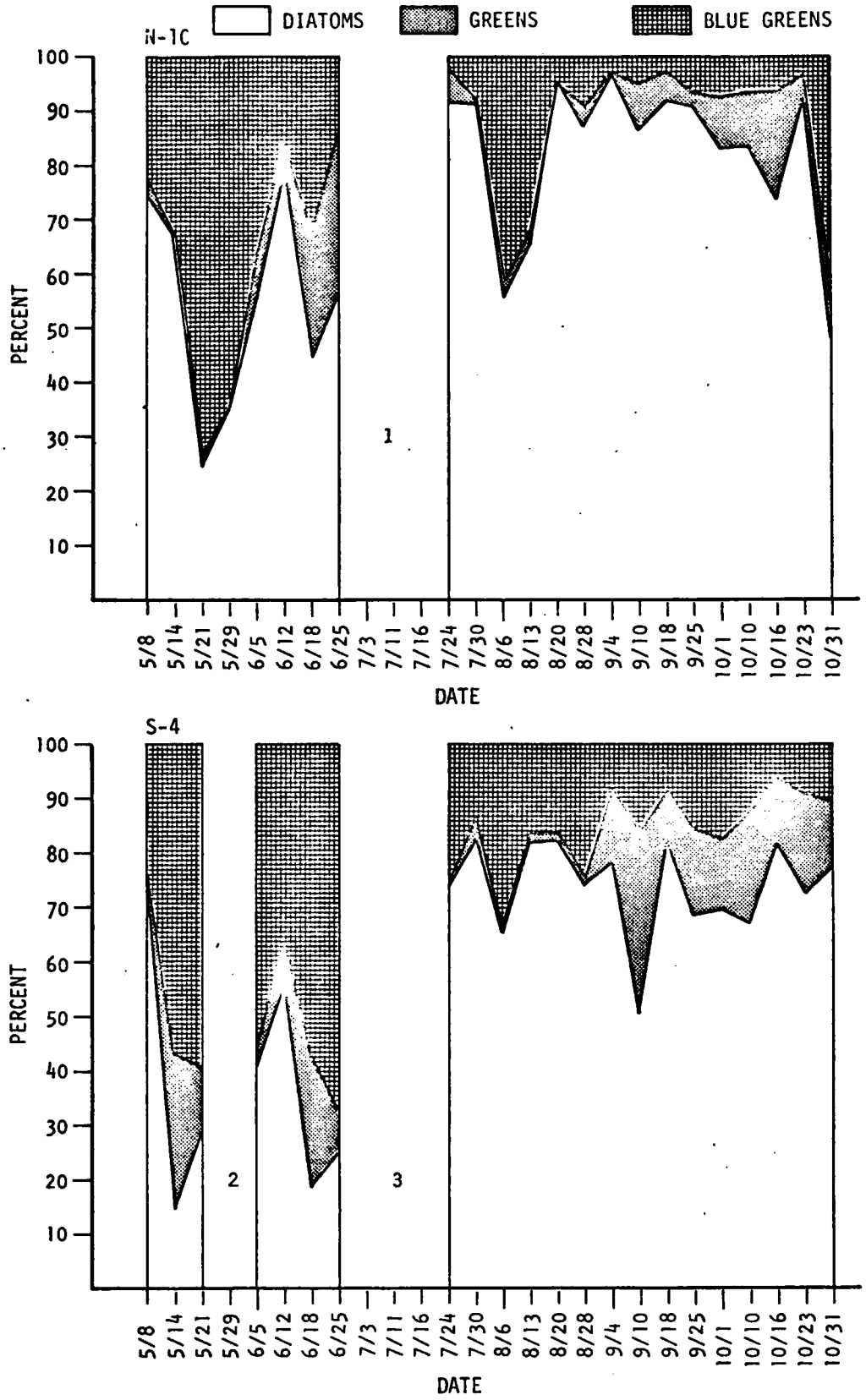



Figure 11. Percent composition of diatoms, green and bluegreen algae on weekly periphyton slides at Stations N-10 and S-4 at six foot depth.
1. Data loss due to flooding
2. Accumulator loss
3. Data loss due to flooding

($p = .018$) at the two-foot depth than stations south of the discharge canal. Lowest numbers of diatoms were found at Station Zero-West. As shown by Figure 9 and 11, results of a two-way analysis of variance, Station Zero-West (all depths) also had a greater percentage of bluegreen algae ($P < .001$) than did other stations. Comparisons of abundances of diatoms at the six-foot depth at Stations N-10 and S-4 [Wilcoxon Match Pairs, Signed Ranks Test (Sokal and Rohlf, 1969)] showed Station N-10 to have greater numbers of diatoms ($p = .0002$) as well as more green algae. At both stations (N-10 and S-4) slides at the two-foot depth had a greater abundance of periphyton than those at the six-foot depth.

b) MONTHLY SAMPLING

Statistical tests failed to reveal any significant differences over the study season in abundances (Figures 12 to 13 ) or percentage composition (Figures 14 to 15) among stations at the two or six-foot depths. In general, diatoms dominated at all stations. At the two-foot depth, reductions of diatom numbers (Figure 12) at Station Zero-West were noted for June, September and October. During September (low flow month) diatoms were strongly reduced at Station S-4 (Figure 13) at the six-foot depth. Percentage composition data (Figure 14) indicated higher percentages of bluegreen algae at the two-foot depth of the more southern stations than at N-10. Composition of periphyton groups was similar. At the six-foot depth, no major differences were evident.

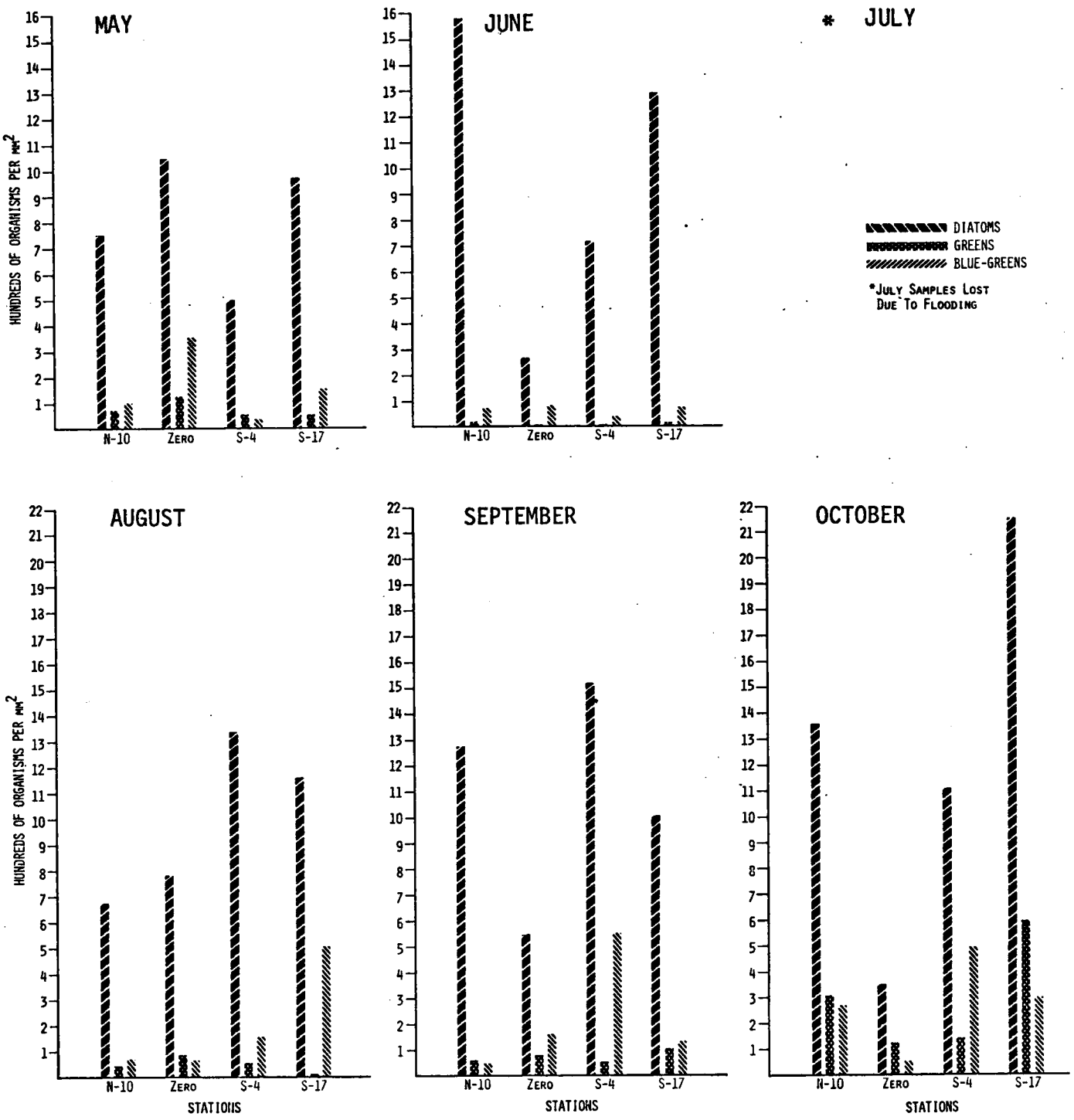



Figure 12. Abundance of periphyton organisms collected monthly per square millimeter of slide surface at two foot depth.

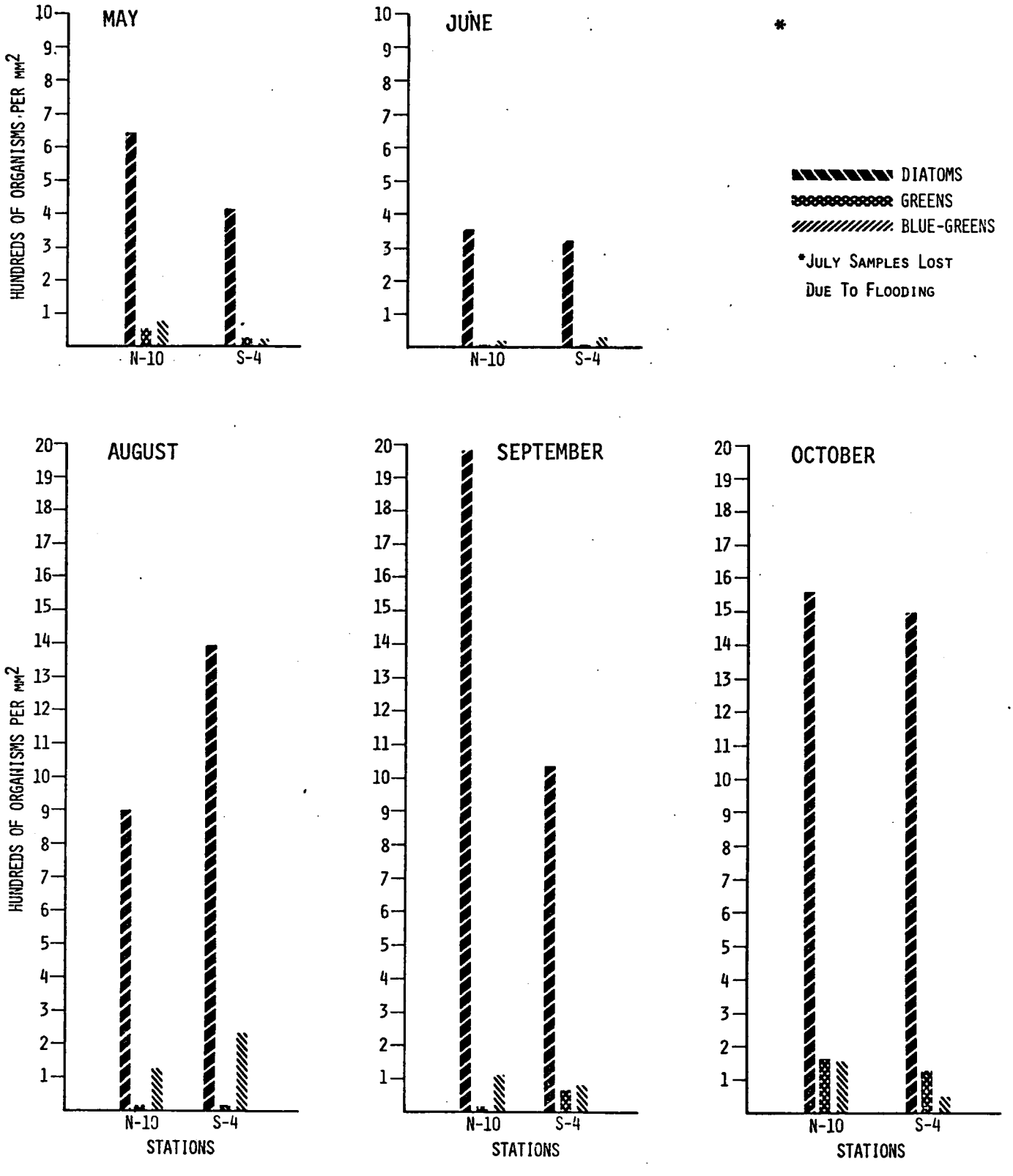



Figure 13. Abundance of periphyton organisms collected monthly per square millimeter of slide surface at six foot depth.

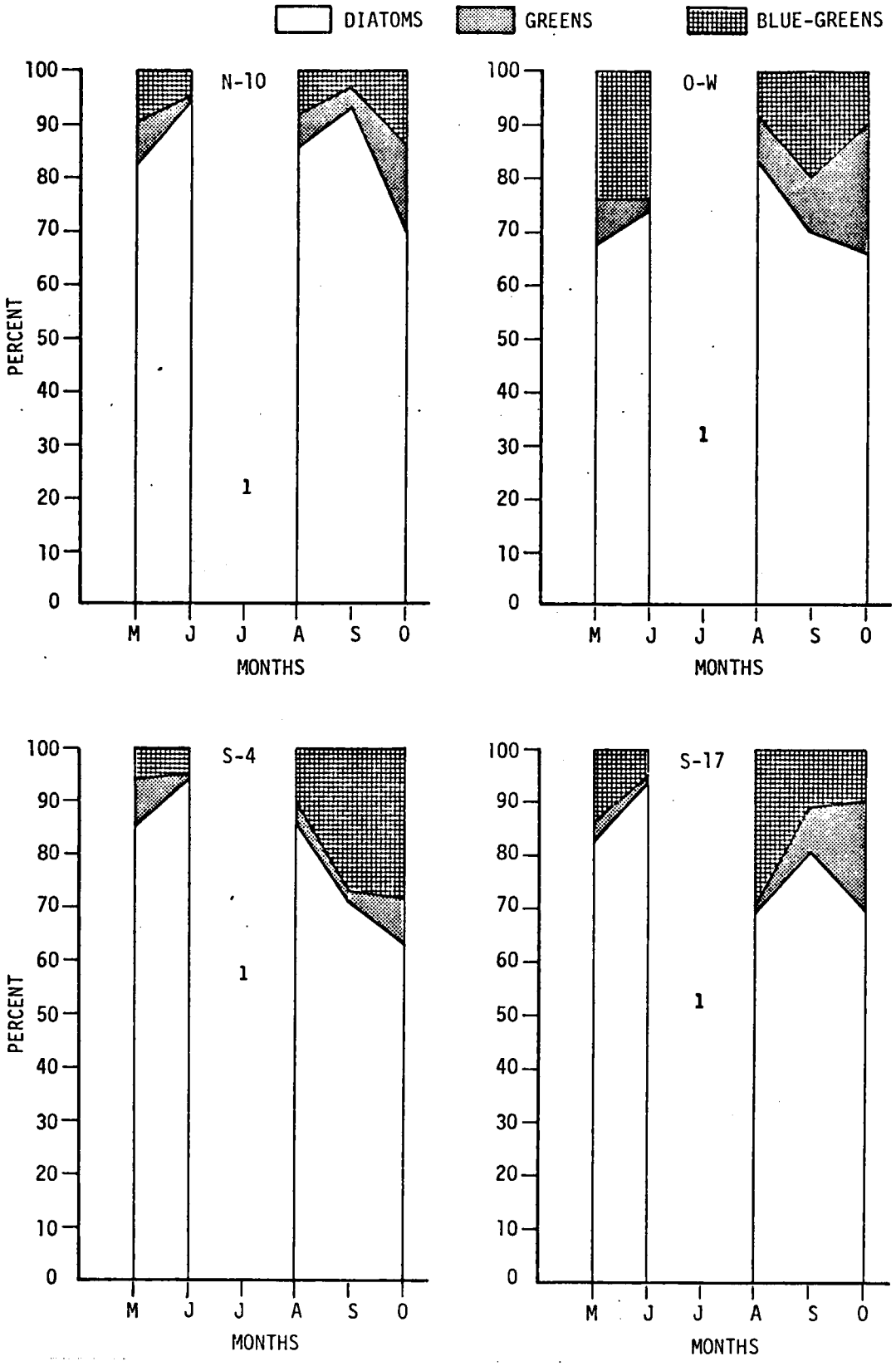



Figure 14. Percent composition of diatoms, green and bluegreen algae on monthly periphyton slides at Stations N-10, Zero-West, S-4, and S-17 at two foot depth.
1. Data loss due to flooding

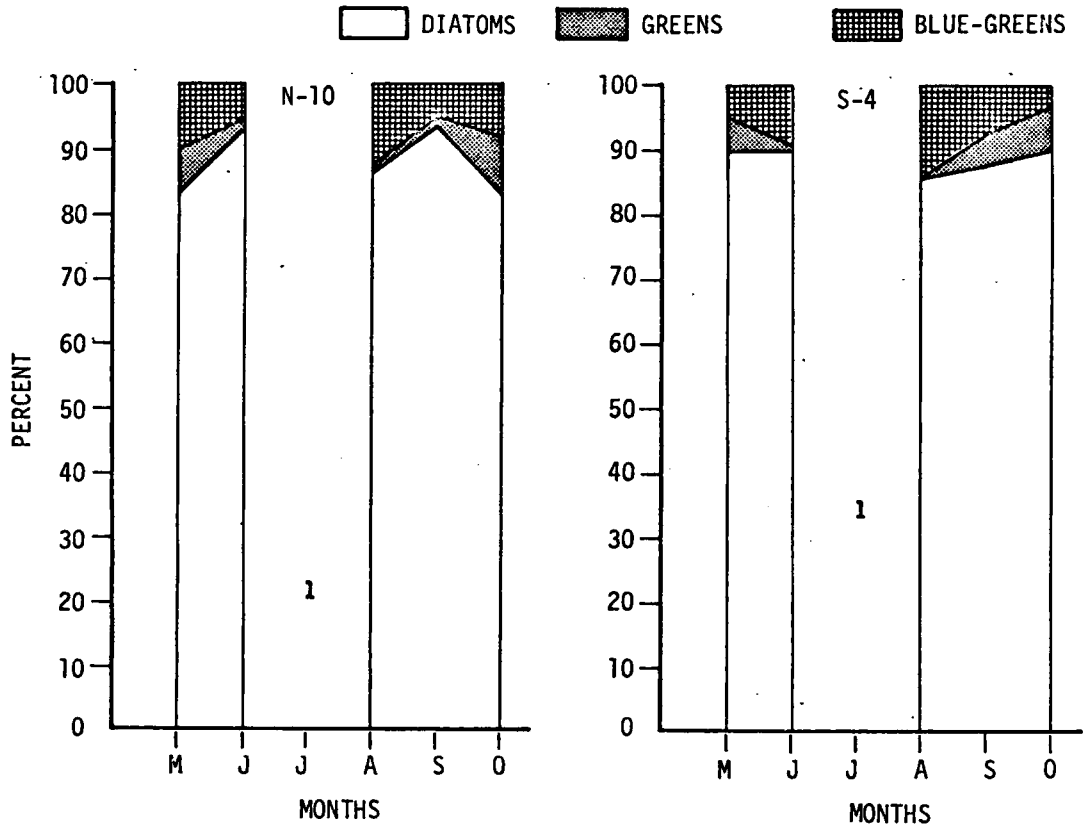



Figure 15. Percent composition of diatoms, green and bluegreen algae on monthly periphyton slides at Stations N-10 and S-4 at the six foot depth.
1. Data loss due to flooding

In summary, 1973 monthly periphyton data indicated a less marked reduction of diatom populations south of the discharge canal than occurred in 1972 although 1973 flows were comparable and temperatures greater. Findings of the 1973 survey were generally consistent with 1971 results. Higher percentages of bluegreen algae at thermally influenced stations on both weekly and monthly slides likely relate both to their greater thermal tolerance and their abundance in the discharge canal.

## 4. Aquatic Plants

Results of aquatic plant surveys (Tables 8 and 9 ) indicated that presence or absence of plants at any one station was largely determined by substrate and depth. Ten genera of aquatic vascular macrophytes were collected during the June and August surveys.

### JUNE 19, 1973

During the June 1973 survey, Station N-5 East produced the highest abundance of plants likely due to an expansive shallow water zone, while Zero-East had the greater diversity. A total of 9 genera were noted in the Hooksett Pond study area. *Anacharis* sp. and *Sagittaria* sp. were found at Station Zero-West in the region of maximum river temperature (71.0°F). In the Discharge Canal (weir area), where water temperatures of 84.6°F were recorded, *Eleocharis* sp., *Sagittaria* sp. and *Ludwigia* sp. were found. In the 1971 and 1972 June surveys no plants were found at Station Zero-West while only *Eleocharis* sp were noted in the Discharge Canal, possibly as a result of canal construction activities.

# TABLE 8 . RELATIVE ABUNDANCES OF AQUATIC PLANTS - HOOKSETT POND - MERRIMACK RIVER - JUNE 19, 1973

| STATIONS | SURFACE TEMP. °F | *Potamogeton* sp. | *Anacharis canadensis* | *Pontederia cordata f. taenia* | *Scirpus* sp. | *Eleocharis* sp. | *Sagittaria cristata* | *Sagittaria cristata* (submerged rosettes) | *Nymphaea* sp. | *Ludwigia* sp. |
|---|---|---|---|---|---|---|---|---|---|---|
| N-10 E | 62.9 | | VA | | | | | | | |
| W | 62.5 | P | | | | | | | | |
| N-9 E | 62.9 | A | VA | | | | | A | | |
| W | 62.2 | P | VA | | | | | | | |
| N-8 E | 63.0 | P | P | | | | | | | |
| W | 62.3 | P | | | | | | | | |
| N-7 E | 63.3 | VA | VA | | | | | P | | |
| W | 62.3 | P | VA | | | VA | | | | |
| N-6 E | 63.3 | | VA | VA | | VA | | A | | |
| W | 62.3 | | VA | | | | | | | |
| N-5 E | 63.5 | | VA | VA | VA | A | P | VA | | |
| W | 62.1 | P | A | P | | | | | | |
| N-4 E | 63.1 | P | VA | | | P | | | | |
| W | 62.1 | | | | | | | | | |
| N-3 E | 63.1 | P | P | | | P | | | | |
| W | 62.2 | | P | | | | | | | |
| N-2 E | 63.0 | A | P | | | | | | | |
| W | 62.2 | | A | | | | | | | |
| N-1 E | 63.1 | | P | | | | | | | |
| W | 63.2 | P | VA | | | VA | | | | |
| Discharge Canal | 84.6 | | | | | VA | A | | | A |
| Zero E | 63.0 | A | P | P | P | A | P | P | | |
| W | 71.0 | | P | | | | P | | | |
| S-1 E | 63.0 | | | | | | | | | |
| W | 70.5 | | A | | | | | | | |
| S-2 E | 63.0 | P | | P | | | | | | |
| W | 67.4 | | P | VA | VA | | P | | | |
| S-3 E | 66.9 | | | | | | | | | |
| W | 67.0 | | | | A | | | | | |
| S-4 E | 65.5 | | | | | | | | | |
| W | 65.8 | | | | | | | | | |
| S-5 E | 65.5 | | | | | | | | | |
| W | 66.0 | P | | | | | | | | |
| S-6 E | 64.9 | P | P | VA | | | P | | | |
| W | 64.1 | | | | | | | | | |
| S-7 E | 64.8 | | | A | | | A | | | |
| W | 65.1 | | | | | | | | | |
| S-8 E | 64.8 | | | | | | | | | |
| W | 63.9 | | P | | | | | | | |
| S-9 E | 65.0 | P | | P | | | P | VA | | |
| W | 63.9 | | P | | | | | | | |
| S-10 E | 65.1 | P | | VA | | A | VA | A | | |
| W | 63.9 | | | | | | | | | |

Table 8 (Continued)

| STATIONS | | SURFACE TEMP. °F | *Potamogeton* sp. | *Anacharis canadensis* | *Pontederia cordata f. taenia* | *Scirpus* sp. | *Eleocharis* sp. | *Sagittaria cristata* | *Sagittaria cristata* (submerged rosettes) | *Nymphaea* sp. | *Ludwigia* sp. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S-11 | E | 65.0 | P | | | | | | P | | |
| | W | 64.0 | A | P | | | | | | | |
| S-12 | E | 65.0 | P | A | P | | | | | | |
| | W | 63.9 | | | | | | | | | |
| S-13 | E | 65.0 | P | | | P | | | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-14 | E | 65.0 | P | | A | VA | | | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-15 | E | 64.9 | P | | | | | | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-16 | E | 64.6 | P | P | | | | | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-17 | E | 64.5 | P | | | | | | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-18 | E | 64.5 | VA | | P | VA | | A | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-19 | E | 64.4 | A | | | | | | VA | | |
| | W | 64.0 | | | | | | | | | |
| S-20 | E | 64.0 | A | | VA | VA | | | VA | VA | |
| | W | 64.0 | P | | | | | | | | |
| S-21 | E | 64.0 | VA | | VA | | VA | A | | VA | |
| | W | 64.0 | VA | VA | VA | | | | P | | |
| S-22 | E | 64.0 | P | | A | | | | A | | |
| | W | 64.0 | A | | VA | A | A | A | | | |
| S-23 | E | 64.0 | P | | A | | | | A | | |
| | W | 64.0 | A | P | VA | | | A | A | | |
| S-24 | E | 64.8 | | | | | | | | | |
| | W | 64.4 | | A | VA | VA | | A | VA | | |

P = Present
A = Abundant
VA = Very Abundant

E = East
W = West

# TABLE 9. RELATIVE ABUNDANCES OF AQUATIC PLANTS - HOOKSETT POND - MERRIMACK RIVER - AUGUST 7, 1973

| STATIONS | | SURFACE TEMP. °F | *Potamogeton* sp. | *Anacharis canadensis* | *Pontederia cordata f. taenia* | *Scirpus* sp. | *Eleocharis* sp. | *Sagittaria cristata* | *Sagittaria cristata* (submerged rosettes) | *Nymphaea* sp. | *Ludwigia* sp. | *Fontinalis* sp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-10 | E | 78.0 | | | | | | | | | | |
| | W | 76.5 | A | A | | | | | | | | |
| N-9 | E | 78.0 | | VA | | | | | | | | |
| | W | 76.5 | A | VA | | | | | | | | |
| N-8 | E | 77.0 | | A | | | P | P | | | | |
| | W | 76.0 | A | VA | | | P | | | | | |
| N-7 | E | 77.0 | | VA | P | | | P | P | | | |
| | W | 76.0 | A | | | | VA | | | | | |
| N-6 | E | 77.9 | VA | VA | | | | P | P | | | |
| | W | 75.4 | A | A | | | | | | | | |
| N-5 | E | 77.2 | | | VA | A | A | A | | | | |
| | W | 76.0 | P | | | | | P | | | | |
| N-4 | E | 77.5 | A | VA | P | P | P | | | | | |
| | W | 75.1 | | | | | | | | | | |
| N-3 | E | 77.5 | A | P | | | | | | | | |
| | W | 75.1 | A | A | | | | | | | | |
| N-2 | E | 77.5 | A | A | | | | P | | | | |
| | W | 75.0 | A | VA | | | | P | | | | |
| N-1 | E | 77.5 | VA | | | | P | | | | | P |
| | W | 77.0 | A | VA | | | | | | | | |
| Discharge Canal | | 101.8 | | | | | VA | | P | | P | |
| Zero | E | 77.5 | VA | | P | P | | P | P | | | |
| | W | 87.9 | | | | | | | | | | |
| S-1 | E | 78.2 | A | | P | | | | | | | |
| | W | 82.5 | P | | | | | | | | | |
| S-2 | E | 86.0 | VA | P | P | | P | | | | | |
| | W | 80.0 | | | VA | A | | P | | | | |
| S-3 | E | 84.0 | VA | | | | | | | | | |
| | W | 78.5 | | | | P | | | | | | |
| S-4 | E | 79.0 | | | | | | | | | | |
| | W | 77.0 | | | | | | | | | | |
| S-5 | E | 79.9 | P | P | P | | | P | | | | |
| | W | 79.0 | | | | | | | | | | |
| S-6 | E | 79.9 | | | P | P | | A | | | | |
| | W | 79.0 | P | | | | | | | | | |
| S-7 | E | 79.0 | P | | P | | | | P | | | |
| | W | 79.0 | | | | | | | | | | |
| S-8 | E | 79.3 | P | | P | | | | | | | |
| | W | 79.0 | | | | | | | | | | |
| S-9 | E | 79.3 | P | | VA | | P | VA | | | | |
| | W | 79.0 | | | | | | | | | | |
| S-10 | E | 79.0 | P | | A | | | | | | | |
| | W | 78.9 | A | | | | | | | | | |

TABLE 9 (Continued)

| STATIONS | | SURFACE TEMP. °F | *Potamogeton* sp. | *Anacharis canadensis* | *Pontederia cordata f. taenia* | *Scirpus* sp. | *Eleocharis* sp. | *Sagittaria cristata* | *Sagittaria cristata* (submerged rosettes) | *Nymphaea* sp. | *Ludwigia* sp. | *Fontinalis* sp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-11 | E | 78.2 | VA | P | P | | | | VA | | | |
| | W | 78.0 | A | | | | | | | | | |
| S-12 | E | 78.5 | VA | | P | | | | A | | | |
| | W | 78.0 | P | | | | | | | | | |
| S-13 | E | 78.6 | A | A | | P | P | P | VA | | | |
| | W | 78.0 | | | | | | | | | | |
| S-14 | E | 79.8 | VA | | P | A | | P | VA | | | |
| | W | 79.0 | | | | | | | | | | |
| S-15 | E | 80.1 | VA | A | | P | | | VA | | | |
| | W | 79.0 | | | | | | | | | | |
| S-16 | E | 79.9 | VA | A | | | | | VA | | | |
| | W | 79.0 | | | | | | | | | | |
| S-17 | E | 80.0 | VA | | | | | | VA | | | |
| | W | 78.5 | VA | | | | | | | | | |
| S-18 | E | 80.5 | VA | | | A | | | VA | | | |
| | W | 78.0 | P | | | | | | | | | |
| S-19 | E | 79.5 | P | | | | | | | | | |
| | W | 78.2 | | | | | | | | | | |
| S-20 | E | 79.2 | A | | | | | | VA | | | |
| | W | 78.0 | A | | | | | | P | | | |
| S-21 | E | 79.2 | VA | | A | A | | | VA | VA | | |
| | W | 78.0 | VA | A | VA | | | | | | | |
| S-22 | E | 79.5 | VA | | A | | | | VA | | | |
| | W | 78.4 | VA | | VA | A | | A | | | | |
| S-23 | E | 79.0 | | | P | | | | | | | |
| | W | 78.5 | A | | VA | | | A | P | | | |
| S-24 | E | 79.0 | P | | | | | | P | | | |
| | W | 79.0 | | VA | VA | A | | A | VA | | | |

P = Present
A = Abundant
VA = Very Abundant

E = East
W = West

AUGUST 7, 1973

During the August survey, Station N-5 East again had the highest abundance of plants while S-13 East produced the greatest diversity. Numbers of aquatic plants increased over June abundances and a new species, *Fontinalis* sp. was noted at Station N-1 East. At Station Zero-West (87.9°F) no plants were found, possibly due to increased temperatures, although high July flows and resulting turbulence could have contributed to their absence. In the Discharge Canal (101.8°F) no change in species composition was noted from that of the June survey.

In general, results of the 1973 aquatic plant surveys were consistent with those of 1971 and 1972.

## 5. Aquatic Insects

During the June and August samplings, dominant insect groups encountered were Diptera (midges), Coleoptera (beetles), Ephemeroptera (mayflies), Odonata (dragon and damsel flies), and Trichoptera (caddisflies). Organisms collected during the surveys are shown in Tables 10 and 11.

In June, 82% of the total number of insects collected were dipteran larvae. Dipterans were predominant at all stations with the exception of S-17 West, where 63% of the organisms were coleopterans. Numbers of insects ranged from a high of 258 at S-4 West to a low of 81 at N-10 East. The area around the discharge weir produced 65 organisms of which 60 were dipterans. The most diverse community was found at Station N-10

TABLE 10. (Continued)

| STATION | TEMPERATURE *(°F) S | B | TAXA | NUMBERS |
|---|---|---|---|---|
| EAST | | | | |
| S-4 | 66.2 | 66.1 | Diptera | |
| | | | Tendipedidae pupae | 5 |
| | | | Tendipedidae larvae | 60 |
| | | | *Pentaneura* sp. larvae | 6 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. larva | 1 |
| | | | *Enochrus* sp. larva | 1 |
| | | | Hydroporinae larvae | 2 |
| | | | Trichoptera | |
| | | | Leptoceridae larva | 1 |
| | | | Ephemeroptera | |
| | | | *Ephemerella* sp. nymphs | 12 |
| S-17 | 67.0 | 66.6 | Diptera | |
| | | | Tendipedidae pupae | 4 |
| | | | Tendipedidae larvae | 213 |
| | | | *Pentaneura* sp. larvae | 2 |
| | | | Ceratopogonidae larva | 1 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 15 |
| | | | *Dubiraphia* sp. larvae | 2 |
| | | | *Berosus* sp. larva | 1 |
| | | | Elmidae larva | 1 |
| | | | Trichoptera | |
| | | | Limnephilidae larva | 1 |
| | | | Ephemeroptera | |
| | | | *Ephemerella* sp. nymph | 1 |
| | | | Baetidae nymph | 1 |

| STATION | TEMPERATURE *(°F) S | B | TAXA | NUMBERS |
|---|---|---|---|---|
| WEST | | | | |
| S-4 | 67.7 | 67.1 | Diptera | |
| | | | Tendipedidae pupae | 11 |
| | | | Tendipedidae larvae | 220 |
| | | | *Pentaneura* sp. larva | 1 |
| | | | Coleoptera | |
| | | | *Berosus* sp. larva | 1 |
| | | | Trichoptera | |
| | | | Leptoceridae larva | 1 |
| | | | Ephemeroptera | |
| | | | *Ephemerella* sp. nymphs | 12 |
| | | | Baetidae nymph | 1 |
| S-17 | 65.1 | 64.9 | Diptera | |
| | | | Tendipedidae pupae | 2 |
| | | | Tendipedidae larvae | 13 |
| | | | *Pentaneura* sp. larva | 1 |
| | | | Ceratopogonidae larva | 1 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 48 |
| | | | *Dubiraphia* sp. larvae | 4 |
| | | | Elmidae larvae | 3 |
| | | | Trichoptera | |
| | | | Leptoceridae larvae | 2 |
| | | | Odonata | |
| | | | *Lestes* sp. nymphs | 2 |
| | | | Ephemeroptera | |
| | | | *Ephemerella* sp. nymphs | 4 |
| | | | *Stenonema* sp. nymph | 1 |
| | | | Neuroptera | |
| | | | *Climacia* sp. larva | 1 |

* S = Surface

B = Bottom

# TABLE 11. RESULTS OF AQUATIC INSECT SURVEY -- HOOKSETT POND -- MERRIMACK RIVER -- AUGUST 6, 1973

| STATION | TEMPERATURE *(°F) S | B | TAXA | NUMBERS |
|---|---|---|---|---|
| EAST | | | | |
| N-10 | 77.3 | 77.7 | Diptera | |
| | | | Tendipedidae pupae | 2 |
| | | | Tendipedidae larvae | 103 |
| | | | *Pentaneura* sp. larva | 1 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 2 |
| | | | *Ancyronyx* sp. adults | 12 |
| | | | *Dineutus* sp. larvae | 2 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymphs | 13 |
| | | | *Ameletus* sp. nymphs | 2 |
| ZERO | 78.1 | 78.1 | Diptera | |
| | | | Tendipedidae pupae | 3 |
| | | | Tendipedidae larvae | 55 |
| | | | *Pentaneura* sp. larvae | 4 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 5 |
| | | | *Dubiraphia* sp. larva | 1 |
| | | | *Ancyronyx* sp. adults | 10 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymphs | 5 |
| | | | *Ameletus* sp. larva | 1 |
| S-4 | 79.7 | 79.4 | Diptera | |
| | | | Tendipedidae pupa | 1 |
| | | | Tendipedidae larvae | 51 |
| | | | *Pentaneura* sp. larvae | 10 |
| | | | Rhagionidae larvae | 1 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 2 |
| | | | *Dubiraphia* sp. larva | 1 |
| | | | *Ancyronyx* sp. adults | 13 |
| | | | Elmidae larva | 1 |

| STATION | TEMPERATURE *(°F) S | B | TAXA | NUMBERS |
|---|---|---|---|---|
| WEST | | | | |
| N-10 | 76.0 | 76.7 | Diptera | |
| | | | Tendipedidae pupae | 2 |
| | | | Tendipedidae larvae | 118 |
| | | | *Pentaneura* sp. larva | 1 |
| | | | Coleoptera | |
| | | | *Ancyronyx* sp. adults | 9 |
| | | | Trichoptera | |
| | | | Trichopteran cases | 6 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymphs | 8 |
| DISCHARGE | | | | |
| WEIR | 100.3 | 100.3 | Diptera | |
| | | | Tendipedidae larvae | 7 |
| | | | Coleoptera | |
| | | | *Berosus* sp. adults | 3 |
| | | | Trichoptera | |
| | | | Trichopteran cases | 3 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymph | 1 |
| ZERO | 86.8 | 86.1 | Diptera | |
| | | | Tendipedidae larvae | 14 |
| | | | *Pentaneura* sp. larvae | 3 |
| | | | Trichoptera | |
| | | | Leptoceridae larva | 1 |
| | | | Hydroptilidae larva | 1 |
| | | | Trichopteran case | 1 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymphs | 2 |
| | | | *Ameletus* sp. nymph | 1 |
| S-4 | 78.2 | 78.2 | Diptera | |
| | | | Tendipedidae pupae | 2 |
| | | | Tendipedidae larvae | 119 |
| | | | *Pentaneura* sp. larvae | 10 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 7 |
| | | | *Ancyronyx* sp. adults | 16 |
| | | | *Dineutus* sp. larva | 1 |

TABLE 11. (Continued)

| STATION | TEMPERATURE *(°F) S | B | TAXA | NUMBERS |
|---|---|---|---|---|
| EAST S-4 (Continued) | | | Trichoptera | |
| | | | Leptoceridae larvae | 2 |
| | | | Leptoceridae case | 1 |
| | | | Psychomyiidae larva | 1 |
| | | | Hydroptilidae cases | 14 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymphs | 10 |
| | | | *Ameletus* sp. nymphs | 12 |
| | | | Neuroptera | |
| | | | *Climacia* sp. larvae | 38 |
| S-17 | 78.7 | 78.9 | Diptera | |
| | | | Tendipedidae larvae | 17 |
| | | | *Pentaneura* sp. larva | 1 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 4 |
| | | | *Dubiraphia* sp. larvae | 7 |
| | | | *Ancyronyx* sp. adults | 3 |
| | | | Trichoptera | |
| | | | Hydroptilidae cases | 2 |
| | | | Trichopteran cases | 4 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymphs | 8 |
| | | | *Ameletus* sp. nymphs | 10 |

| STATION | TEMPERATURE *(°F) S | B | TAXA | NUMBERS |
|---|---|---|---|---|
| WEST S-4 (Continued) | | | Odonata | |
| | | | *Lestes* sp. nymph | 1 |
| | | | *Gomphus* sp. nymph | 1 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymph | 1 |
| | | | *Ameletus* sp. nymphs | 2 |
| | | | *Ephemerella* sp. nymph | 1 |
| S-17 | 79.2 | 79.5 | Diptera | |
| | | | Tendipedidae pupae | 2 |
| | | | Tendipedidae larvae | 16 |
| | | | *Pentaneura* sp. larvae | 2 |
| | | | Coleoptera | |
| | | | *Dubiraphia* sp. adults | 8 |
| | | | *Dubiraphia* sp. larva | 1 |
| | | | Trichoptera | |
| | | | *Cheumatopsyche* sp. larva | 1 |
| | | | Psychomyiidae larva | 1 |
| | | | Trichopteran cases | 22 |
| | | | Trichopteran pupa and case | 1 |
| | | | Ephemeroptera | |
| | | | *Stenonema* sp. nymph | 1 |
| | | | *Ephemerella* sp. nymph | 1 |
| | | | *Ameletus* sp. nymphs | 2 |
| | | | Neuroptera | |
| | | | *Climacia* sp. larvae | 8 |

* S = Surface

B = Bottom

West, and the least at S-4 West and Zero-East. With the exception of an area in the vicinity of the discharge weir, temperature did not appear to play a significant role in the distribution of aquatic insects.

In August, as in June, dipterans were the most common organisms, forming 61% of the total collected. At Station S-17 West, coleopterans were again dominant, comprising 60% of the total number of insects. The largest numbers of organisms were again collected at Station S-4 West (161). Lowest numbers (22) were found at Zero-West. The reduced numbers at Station Zero-West may have been related to high temperatures (86.1°F), although poorer natural substrate at that station plus possible impacts of July flooding make such a conclusion questionable. Highest community diversity was noted at S-4 East and S-17 West, and the lowest at N-10 West. The discharge weir produced 11 organisms of which 7 were dipterans. Total numbers of organisms collected at all stations were reduced from the numbers collected in June. This reduction might have been the result of July flooding.

In general, substrate composition and habitat appeared to play more of a role in determining insect diversity and numbers than did temperature. This was true at all stations except the discharge weir and possible Zero-West. Results were comparable to those of 1971 and 1972.

## 6. Benthic Invertebrates

Results of the 1973 benthic invertebrate surveys are presented in Tables 12 to 14. As in 1970, 1971 and 1972 dipterans and oligochaetes were dominant. Total numbers of organisms collected ranged from 5064 (June) to 21,654 (October) with the largest numbers being found in the shallow more productive littoral zone. Abundance showed a marked increase over 1972 (range: 1009-4863). The reasons for this increase are difficult to ascertain, although the following may be contributing factors:

1. In 1972, higher flows were recorded later into the summer season.
2. Ambient temperatures in 1972 were lower than in 1973; and
3. In 1973 the rose-bengal staining technique improved sorting efficiency.

Tendepedidae dominated all sampling months with the exception of October when greater numbers of oligochaetes were found.

During June, August and October highest total numbers of macrobenthis were found at Stations S-17 West , S-4 West and N-10 West. Lowest numbers were consistently found at Station Zero-West, probably due to coarse sandy substrate deposited as a result of past canal construction activities. In general, as in past years, numbers and diversity of benthic organisms at individual stations appeared to be more of a response to substrate characteristics than to thermal discharge. The fact that

# TABLE 12. RESULTS OF BENTHIC INVERTEBRATE SURVEY - MERRIMACK RIVER - JUNE 1973

| STATION | | TEMP. (°F) S | M | B* | Nematoda | Oligochaeta | Hirudinea | Isopoda | Hydracarina | Arachnoidea | Ephemerella nymphs | Hydroptilidae larvae | Dubiraphia sp. larvae | Hydroporinae larvae | Pentaneura sp. larvae | Tendipes sp. larvae | Ceratopogonidae larvae | Tendipedidae pupae | Tendipedidae larvae | Dipteran pupae | Dipteran sp. | Amnicola decisum | Campeloma sp. | Helisoma complanatus | Elliptio | Sphaeriidae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-10 W | a | 62.0 | 61.5 | 61.5 | | | | 78 | | | | | | | | | | 1 | 129 | 3 | | | 6 | | | |
| | b | | | | | | | 125 | | | | 2 | | | | 4 | | | 82 | | 2 | 1 | 4 | | | 1 |
| N-10 M | a | 61.5 | 61.5 | 61.5 | | | | | | | | | | | | | | 2 | | | | | 2 | | | |
| | b | | | | | | | | | | | | | | | | | | | | | | | | | |
| N-10 E | a | 61.5 | 61.0 | 61.0 | | | | 182 | | | | | | | | | | | 349 | | | | 7 | 4 | | |
| | b | | | | | | | 130 | | | | | | | | | 1 | | 328 | 1 | | | 2 | | | 1 |
| Zero W | a | 66.0 | 65.5 | 65.5 | | | | 77 | | | | | | | | | 10 | | 25 | | | | | 2 | | |
| | b | | | | | | 1 | 100 | | | | | 1 | 1 | | | 7 | 1 | 56 | 1 | | | 1 | 1 | | |
| Zero M | a | 62.0 | 61.5 | 61.5 | | | 1 | 1 | | | | | | | | | | 13 | 1 | | | | 2 | 1 | | 1 |
| | b | | | | | | | | | | | | | | | | | 5 | 1 | | | | | | | 1 |
| Zero E | a | 62.0 | 62.0 | 62.0 | | | 1 | 101 | 1 | | 1 | | | | | | 1 | 2 | 244 | 5 | | | 3 | 7 | 1 | | 1 |
| | b | | | | | | | 60 | | 1 | 2 | 1 | | | | | 1 | 3 | 155 | 2 | | | 6 | 13 | 1 | | |
| S-4 W | a | 64.0 | 63.5 | 63.5 | | | | 97 | | | | | | | | | 1 | | 37 | | | | 4 | 6 | | |
| | b | | | | | | | 153 | | | | | | | | | 6 | | 39 | 1 | | | | 1 | | |

TABLE 12. (Continued)

| STATION | | TEMP. (°F) S | M | B* | Nematoda | Oligochaeta | Hirudinea | Isopoda | Hydracarina | Arachnoidea | Ephemerella nymphs | Hydroptilidae larvae | Dubiraphia sp. larvae | Hyaroporinae larvae | Pentaneura sp. larvae | Tendipes sp. larvae | Ceratopogonidae larvae | Tendipedidae pupae | Tendipedidae larvae | Dipteran pupae | Dipteran sp. | Amnicola decisum | Campeloma sp. | Helisoma | Elliptio complanatus | Sphaeriidae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-4 M | a | 64.5 | 62.0 | 62.0 | | 1 | | | | | | | | | | | | 4 | 2 | | | | | | | 2 |
| | b | | | | | | | | | | | | | | | | | 4 | | | | | | | | |
| S-4 E | a | 62.0 | 62.0 | 62.0 | | | 26 | | | | | | | | | | | | 132 | | | | | 31 | | |
| | b | | | | | | 42 | | | | | | | | | 1 | | | 191 | | | | 5 | 32 | 1 | |
| S-17 W | a | 63.0 | 62.5 | 62.5 | | | 626 | | | | | | | | 1 | | | 1 | 94 | | | | | 27 | | |
| | | | | | | | 427 | 1 | | | | | | 1 | | | 1 | 1 | 93 | 3 | | | 4 | 32 | | |
| S-17 M | a | 63.0 | 62.5 | 62.5 | | | 3 | | | | | | | | | | | | 2 | | | | 1 | | | |
| | b | | | | | | | | | | | | | | | | | | 3 | 6 | | | 4 | | | 1 |
| S-17 E | a | 64.5 | 64.5 | 64.5 | | | 155 | 8 | | | | | | | | | | 1 | 51 | 1 | | | | 1 | 1 | |
| | b | | | | | | 292 | | | | | | | | | | | | 20 | 2 | | | | 5 | | 1 |

* S = Surface

M = Mid-depth

B = Bottom

TABLE 13. RESULTS OF BENTHIC INVERTEBRATE SURVEY - HOOKSETT POND - MERRIMACK RIVER - AUGUST 13, 1973

| STATION | | TEMP. (°F)* S | M | B | Nematoda | Oligochaeta | Hirudinea | Isopoda | Gammarus sp. | Dugesia tigrina | Hydracarina | Arachnoidea | Ephemerella sp. | Ephoron sp. nymphs | Heptageniidae nymphs | Stenonema sp. nymph | Baetidae nymphs | Hydroptilidae nymphs | Psychomyiidae larvae | Leptoceridae larvae | Cheumatopsyche sp. larvae | Trichoptera pupae | Dubiraphia sp. larvae | Hydroporinae adults | Gomphus sp. nymphs | Pentaneura sp. larvae | Tendipes sp. larvae | Empididae larvae | Tendipedidae larvae | Tendipedidae larvae | Ceratopogonidae pupae | Dipteran larvae | Amnicola sp. | Campeloma decisum | Elliptio complanatus | Sphaeriidae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-10 W | a | 77.4 | 77.4 | 77.3 | | | 191 | | | | | | | | | | | | | | | | | 2 | | | | | | | 37 | 7 | 4 | | 1 | | | |
| | b | | | | | | 239 | | | | | | | | | | | | | | 3 | | | 2 | | | | 2 | | | | 69 | 21 | 1 | | | | | |
| N-10 M | a | 77.8 | 77.8 | 77.9 | | | 1 | | | | | 2 | | | | | | | | | | | 3 | 3 | 2 | | | | | | 35 | 8 | 12 | | | | | |
| | b | | | | | | | | | | | 8 | | | | | 1 | | | | | 1 | 5 | 12 | | | | | | | 146 | 5 | 23 | | | 1 | | 3 |
| N-10 E | a | 78.5 | 78.7 | 78.7 | | | 505 | | | | | | | 2 | | | | | | | 1 | | | | 2 | 7 | 1 | | 11 | | | 464 | 3 | 40 | 2 | | | | 2 |
| | b | | | | | | 502 | 6 | | 1 | | 1 | | 1 | | | | | | | | | | | 2 | 7 | | | 10 | 11 | | 630 | 6 | 39 | | | | | |
| Zero W | a | 91.6 | 81.5 | 79.9 | | | 57 | | | | | 1 | | | 1 | 1 | | 1 | | | | 1 | 1 | 1 | | | | | | | 1 | 111 | 25 | 15 | | 4 | | | 11 |
| | b | | | | | 3 | 56 | 1 | | | | 1 | | | | | | | | | | | | 2 | | | | | | | | 53 | 8 | 7 | | | | | 1 |
| Zero M | a | 78.0 | 78.0 | 78.0 | | 3 | | | | | | 5 | | | | | | | | | | | | 3 | | | | | | | | 100 | 18 | 78 | | | | | 4 |
| | b | | | | | 1 | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zero E | a | 77.0 | 78.0 | 77.8 | | | 195 | 1 | | | | | | | | | | | | 4 | | | | 1 | 1 | | | 1 | | | 1 | 382 | 34 | 1 | 1 | | 2 | | |
| | b | | | | | 1 | 70 | | | | | | | | | | | | | 3 | | | | | | | | | | | | | 53 | 13 | 2 | | | | | |
| S-4 W | a | 78.5 | 78.5 | 78.5 | | | 534 | 1 | | | | | | | | | | | | | | | | | | | | 1 | 1 | 4 | | 599 | 62 | 5 | | | | | 5 |
| | b | | | | | 2 | 817 | 1 | | | | 2 | | | | | | | | | | | | 1 | | | | | | 3 | | 453 | 60 | 10 | | | | | 10 |

CONTINUED

TABLE 13. (Continued)

| STATION | | TEMP. (°F)* S | M | B | Nematoda | Oligochaeta | Hirudinea | Isopoda | Gammarus sp. | Dugesia tigrina | Hydracarina | Arachnoidea | Ephemerella sp. nymphs | Ephoron sp. nymphs | Stenonema sp. nymphs | Baetidae nymphs | Hydroptilidae nymphs | Cheumatopsyche sp. larvae | Psychomyiidae larvae | Leptoceridae larvae | Trichoptera pupae | Dubiraphia sp. larvae | Dubiraphia sp. adults | Hydroporinae | Odonata nymphs | Pentaneura sp. | Tendipes sp. larvae | Rhagionidae larvae | Tendipedidae larvae | Tendipedidae larvae | Ceratopogonidae pupae | Dipteran larvae | Dipteran adult | Campeloma sp. | Amnicola decisum | Elliptio complanatus | Sphaeriidae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-4 M | a | 85.0 | 78.8 | 78.6 | 1 | 12 | | | | | | | | | | | | | | | | | 1 | | | | | | | | 105 | 11 | | | | 1 | 1 | 18 |
| | b | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | 9 | 3 | 1 | | | | | |
| S-4 E | a | 82.0 | 82.3 | 82.3 | 1 | 169 | 1 | | | | | | | | | | | | | | | | 3 | | | 3 | 1 | 14 | | 764 | 9 | 5 | | | 3 | | 3 |
| | b | | | | 1 | 175 | 2 | | | | | | | | 1 | | | | | | | | | | | | | 20 | | 440 | 21 | 3 | | | 1 | | 3 |
| S-17 W | a | 79.8 | 79.8 | 79.8 | 1 | 354 | | | | | 3 | 1 | | | | | | | | | 2 | | 1 | | | | | | | 10 | 3 | 5 | | | 2 | 8 | |
| | b | | | | 4 | 686 | | | | | | | | | | | | | | | 2 | | 8 | | | | | | | 74 | 4 | 11 | | | | 1 | 3 |
| S-17 M | a | 79.9 | 80.0 | 79.9 | | 5 | | | | | | 3 | | | | | | | | | | | | | | | | | | 12 | 3 | 2 | | | 3 | | 8 |
| | b | | | | 1 | 4 | | | | | | | | | | 2 | | | | | | | | | | | | | | 14 | 5 | 2 | | | 2 | | 12 |
| S-17 E | a | 79.9 | 80.0 | 80.0 | 1 | 55 | 43 | 1 | | | 15 | | | | 2 | | | | | | 2 | | 9 | 1 | | | 4 | | | 27 | | 2 | | | 6 | 1 | 3 |
| | b | | | | 7 | 88 | 35 | 1 | | | 4 | | | | 1 | | | 3 | | | 7 | 1 | 16 | | | 1 | 2 | | | 17 | | 11 | | | 2 | | 5 |

* S = Surface

M = Mid-depth

B = Bottom

TABLE 14. RESULTS OF BENTHIC INVERTEBRATE SURVEY - HOOKSETT POND - MERRIMACK RIVER - OCTOBER 12, 1973

| STATION | | TEMP. (°F)* S | M | B | Hydra sp. | Nematoda | Oligochaeta | Polychaeta Nereis sp. | Hirudinea | Dugesia tigrina | Hydracarina | Paraleptophlebia sp. nymphs | Stenonema sp. nymphs | Gomphus sp. nymphs | Didymops sp. nymphs | Lestes sp. nymphs | Leptoceridae larvae | Psychomyiidae larvae | Limnephilidae larvae | Hydropsychidae larvae | Hydroporinae larvae | Elmidae larvae | Tendipedidae larvae | Tendipedidae larvae | Tendipedidae pupae | Tendipes sp. adults | Dipteran sp. larvae | Ceratopogonidae larvae | Campeloma decisum | Physidae | Elliptio complanatus | Sphaeriidae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-10 W | a | 54.1 | 54.1 | 54.1 | | | 1 | 1,148 | 4 | 1 | | | | | | 1 | | | | | | | | 2,083 | | 1 | | | 4 | 1 | | |
| | b | | | | | | 3 | | | | 1 | | | | 1 | | 1 | | | | | | | 1,071 | 1 | 2 | | | 2 | 2 | | 1 |
| N-10 M | a | 54.0 | 54.2 | 54.2 | | | | 23 | | | | | | | | | | | | | | 2 | | 27 | | | 10 | 1 | 10 | 3 | 1 | 1 |
| | b | | | | | | | 34 | 1 | | | | | | 2 | | | | | | | 6 | | 80 | 1 | | 2 | | 15 | 2 | | 2 |
| N-10 E | a | 54.1 | 54.3 | 54.2 | | | 1 | 888 | | 10 | 2 | | | | | | | | | | | | | 746 | 1 | 1 | 5 | 1 | 6 | 1 | | 1 |
| | b | | | | | | 2 | 1,084 | | 2 | 1 | | | | | 1 | | | | | | | | 1,044 | | | 28 | | 2 | 2 | | 1 |
| Zero W | a | 68.8 | 68.3 | 56.2 | | | 1 | 294 | | | | 1 | | | | | | | | | | 1 | | 31 | | | | | 1 | 1 | | 8 |
| | b | | | | | | 2 | 420 | | | | 1 | | | | | | | | | | | | 33 | | | | | 1 | 1 | | 12 |
| Zero M | a | 66.9 | 54.8 | 54.5 | | | | 22 | | | | 4 | | | | | | | | | | 5 | | 10 | 1 | | | | 1 | | | 1 |
| | b | | | | | | | 21 | | | | 1 | | | | | | | | | | | | 11 | | | | | 4 | 1 | | |
| Zero E | a | 62.7 | 72.4 | 61.0 | | | 1 | 368 | 1 | | | | | | | | | | | | | | | 335 | | | | | 6 | 2 | | 4 |
| | b | | | | | | | 631 | | | | | | | | | | | | | | | | 311 | | 1 | | | 7 | | | 3 |
| S-4 W | a | 62.8 | 62.9 | 62.7 | | | | 523 | | | 2 | | | | | 3 | | | | | | | 1 | 68 | | | | | 15 | 1 | | |
| | b | | | | | | | 682 | | | | | | | | 1 | | | | | | | | 99 | | | | | 14 | 1 | | 2 |

TABLE 14. (Continued)

| STATION | | TEMP. (°F)* S | M | B | Hydra sp. | Nematoda | Oligochaeta | Polychaeta | Hirudinea | Dugesia tigrina | Paraleptophlebia sp. nymphs | Hydracarina | Stenonema sp. nymphs | Gomphus sp. nymphs | Didymops sp. nymphs | Lestes sp. nymphs | Leptoceridae larvae | Psychomyiidae larvae | Limnephilidae larvae | Hydropsychidae larvae | Hydroporinae larvae | Elmidae larvae | Tendipedidae larvae | Tendipedidae larvae | Tendipedidae pupae | Tendipes sp. adults | Dipteran sp. larvae | Pentaneura sp. larvae | Ceratopogonidae larvae | Cambeloma decisum larvae | Elliptio complanatus | Physidae | Sphaeriidae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-4 M | a | 64.0 | 55.0 | 55.0 | | | | 118 | | | | | | | | | | | | | | | | 32 | | | 3 | | | 1 | 4 | | 1 |
| | b | | | | | | 1 | 95 | | 1 | | 1 | | | | | | | | | | | | 22 | | | 2 | | | | 2 | | 5 |
| S-4 E | a | 58.0 | 58.1 | 58.0 | | | 1 | 737 | | 1 | 5 | | | | | 3 | | | | | | | | 626 | 1 | 1 | | | | 1 | 4 | | 1 |
| | b | | | | | 1 | 2 | 1,037 | | | 26 | | | 1 | | 2 | | | | | 1 | | | 752 | | | 14 | | | 1 | 20 | 1 | 3 |
| S-17 W | a | 56.0 | 55.8 | 55.9 | | | 2 | 886 | | | 31 | | | | | 2 | | | 1 | 4 | | | 1 | 96 | | | | | | | 1 | 1 | 4 | |
| | b | | | | | | 2 | 913 | | 1 | 82 | | | | | 1 | | 1 | | 5 | | | 3 | 170 | 1 | | | | | 3 | 12 | 8 | | 9 |
| S-17 M | a | 56.1 | 56.0 | 55.7 | | | | 35 | | | 1 | | | | | | | | | | | | | 15 | | | | | | 2 | 17 | | | 24 |
| | b | | | | | | 1 | 81 | | | | 1 | | | | | | | | | | | | 12 | | | | | | 4 | 15 | | | 22 |
| S-17 E | a | 55.6 | 55.6 | 55.6 | | 4 | 13 | 583 | | 23 | 23 | | | | | | | | 2 | 1 | | 4 | | 61 | | | | | | 1 | 6 | | | 5 |
| | b | | | | | | 9 | 520 | | 22 | 12 | | | | | | | | | 4 | | | | 40 | | | | | | 12 | | | | 5 |

* S = Surface

M = Mid-depth

B = Bottom

most organisms encountered are members of the more tolerant taxa could possible preclude a noticeable response to any but the most severe of thermal conditions.

## 7. Fish Surveys

### a) IMMATURE FISH

Predominant species were white suckers (*Catostomus commersoni*), yellow perch (*Perca flavescens*), and fallfish (*Semotilus* sp.). The June 5 and June 22 surveys, which were limited by water depth to visual observations and periodic dip-netting to note relative abundance and species similarities, showed a uniform distribution of post-larval fish both north and south of the discharge canal. The dominant species was the white sucker.

Results of the June 22 - July 26 surveys are shown in Tables 15 to 18. Species diversity was highest at southern stations throughout the survey period. On most sampling dates Station Zero and S-2 produced the greatest abundance of immature fish. However, on July 26, the sampling date when highest temperatures were recorded (N-10 = 74.5°F, Zero-East = 84.4°F), this was not the case. Northern stations produced the most fish while numbers of fish at Station Zero-West (83.7°F) dropped significantly from the abundance recorded on July 20 (79.0°F).

In general, it is difficult to separate effects of habitat differences and temperature impacts on distribution of immature fish.

TABLE 15. RESULTS OF IMMATURE FISH SEINING SURVEY - HOOKSETT POND, MERRIMACK RIVER - JUNE 22, 1973.

| STATION | TEMP °F S[1] | M | B | WHITE SUCKER | FALLFISH | SUNFISH | SMALLMOUTH BASS | LARGEMOUTH BASS | YELLOW PERCH | BROWN BULLHEAD | GOLDEN SHINER | JOHNNY DARTER | CHAIN PICKEREL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-10 W Above Stream | 68.0 | 67.6 | 67.5 | | | | | | | | | | |
| Stream Mouth | 68.0 | 67.6 | 67.5 | | | | | | | | | | |
| Below Stream | 68.0 | 67.6 | 67.5 | 8 (1)[2] | | | | | | | | | |
| N-10 E Above Outfall | 69.0 | -- | 68.7 | | | | | | | | | | |
| Below Outfall | 69.0 | -- | 68.7 | 1 (1) | | | | | 1 (1) | | | | |
| N-7 W | 68.0 | 67.5 | 67.5 | | | | | | | | | | |
| N-7 E | 68.8 | -- | 68.8 | 12 (1) | | | | | | | | | |
| Zero West | 78.3 | 74.8 | 70.0 | 30 (1) | | 3 (1) | | | 2 (1) | | | | |
| Zero East | 68.1 | -- | 68.0 | 25 (1) | | | | | 7 (1) | | | | |
| S-2 W | 71.0 | 70.0 | 70.0 | 40 (1/2-1) | | 1 (1/2-1) | | | 34 (1/2-1) | | | | |
| S-2 E | 79.6 | 79.3 | 78.9 | 19 (1) | | | 1 (2) | | 4 (1) | | | | |
| S-17 W | 70.9 | 70.7 | 70.6 | 3 (1) | | 1 (4 1/2) | | | | | | | |
| S-17 E | 70.9 | -- | 70.4 | 3 (1) | | | | | 1 (1) | | | | |

[1] S = Surface
M = Mid-depth (In some instances water depth was too shallow for a mid-depth reading.
B = Bottom

[2] Approximate lengths or length range in inches

## TABLE 16. RESULTS OF IMMATURE FISH SEINING SURVEY - HOOKSETT POND, MERRIMACK RIVER - JULY 20, 1973

| STATION | TEMP °F S[1] | M | B | WHITE SUCKER | FALLFISH | SUNFISH | SMALLMOUTH BASS | LARGEMOUTH BASS | YELLOW PERCH | BROWN BULLHEAD | GOLDEN SHINER | JOHNNY DARTER | CHAIN PICKEREL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N - 10 W Above Stream | 72.7 | -- | 72.6 | | | 1(2½) | | | | | | | |
| Stream Mouth | 72.7 | -- | 72.6 | | | 2(1½-2) | | 2(2) | | | | | |
| Below Stream | 72.7 | -- | 72.6 | | 38(1-3)[2] | | | | 1(2) | | | | 1(3) |
| N - 10 E Above Outfall | 73.2 | -- | 73.0 | | 3(1-2) | | | 4(1) | 46(1-1½) | | | | |
| Below Outfall | 73.2 | -- | 73.0 | 1(1) | 9(2-3) | | | 1(1) | 9(1-2) | | | | 2(2½) |
| N - 7 W | 73.2 | -- | 73.0 | | | | | | | | | | |
| N - 7 E | 73.6 | -- | 73.4 | | 36(½-1½) | 7(½) | 1(½) | 6(½-1) | | | | | 1(2) |
| Zero West | 79.0 | -- | 77.0 | 18(½-1½) | 10(1-2) | 44(½-1) | | 3(½-1) | 7(½-1) | | | | |
| Zero East | 73.3 | -- | 73.2 | 2(1) | 58(½-1) | | 1(1½) | 12(1-2) | | | | 2(1) | |
| S - 2 W | 75.9 | -- | 75.6 | 2(1) | 74(½-2) | 2(½) | | 5(½-1) | 25(½-2) | | | | 1(3) |
| S - 2 E | 73.4 | -- | 73.3 | 10(1-2) | 358(½-1) | | 2(½-1) | 3(1-2) | | | | | |
| S - 17 W | 74.5 | 74.2 | 74.2 | | | | | | | | | | |
| S - 17 E | 74.9 | -- | 74.7 | | 1(1½) | 2(½-3½) | 1(1) | | 1(1) | | | | |

[1] S = Surface
M = Mid-depth
B = Bottom

[2] Approximate lengths or length range in inches

TABLE 17. RESULTS OF IMMATURE FISH SEINING SURVEY - HOOKSETT POND, MERRIMACK RIVER - JUNE 28, 1973

| STATION | TEMP °F S[1] | M | B | WHITE SUCKER | FALLFISH | SUNFISH | SMALLMOUTH BASS | LARGEMOUTH BASS | YELLOW PERCH | BROWN BULLHEAD | GOLDEN SHINER | JOHNNY DARTER | CHAIN PICKEREL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N - 10 W | | | | | | | | | | | | | |
| Above Stream | 69.4 | 69.4 | 69.4 | | | | | | | | | | |
| Stream Mouth | 69.4 | 69.4 | 69.4 | 3(1)[2] | | | | | | 1(1) | | | |
| Below Stream | 69.4 | 69.4 | 69.4 | 15(1) | 10(1) | | | 2(1) | | | | 1(1) | |
| N - 10 E | | | | | | | | | | | | | |
| Above Outfall | 70.5 | -- | 70.4 | 1(1) | 2(1) | | | 1(1) | | | | | |
| Below Outfall | 70.5 | -- | 70.4 | | 1(1) | | | | 2(1) | | | | |
| N - 7 W | 70.5 | -- | 70.5 | | 4(1) | | | | | | | | |
| N - 7 E | 71.2 | -- | 70.6 | 21(1) | 26(1) | | | 2(1) | 1(1) | | | | |
| Zero West | 79.2 | -- | 76.5 | 57(1) | 63(1) | 24(1) | | 22(1) | 28(1) | | | | |
| Zero East | 71.6 | -- | 71.4 | 22(1) | 27(1) | | | | | | | | |
| S - 2 West | 79.4 | -- | 78.7 | 75(1) | 215(1-4) | 2(4) | | 3(1/2) | 66(1) | | 5(3-4) | | |
| S - 2 E | 79.2 | -- | 79.2 | 5(1) | 15(1) | 1(1) | | 2(1) | 6(1) | | | | |
| S - 17 W | 73.5 | 73.5 | 73.5 | | 2(1) | | | | | | | | |
| S - 17 E | | | | 1(1/2) | 3(1/2) | | | | | | | | 1(3) |

[1] S = Surface
M = Mid-depth
B = Bottom

[2] Approximate lengths or length range in inches

TABLE 18. RESULTS OF IMMATURE FISH SEINING SURVEY - HOOKSETT POND, MERRIMACK RIVER - JULY 26, 1973.

| STATION | TEMP °F S[1] | M | B | WHITE SUCKER | FALLFISH | SUNFISH | SMALLMOUTH BASS | LARGEMOUTH BASS | YELLOW PERCH | BROWN BULLHEAD | GOLDEN SHINER | JOHNNY DARTER | CHAIN PICKEREL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N - 10 W | | | | | | | | | | | | | |
| Above Stream | 74.5 | -- | 74.5 | | | | | | | | | | |
| Stream Mouth | 74.5 | -- | 74.5 | 1(1)[2] | 61(1-1½) | | | 1(1) | | | | | |
| Below Stream | 74.5 | -- | 74.5 | | | | | 1(1) | 2(1) | | | | |
| N - 10 E | | | | | | | | | | | | | |
| Above Outfall | 74.7 | -- | 74.6 | | 16(½-1) | | | | | | | | |
| Below Outfall | 74.7 | -- | 74.6 | | 16(½-3) | | | 3(1-1½) | | | | | |
| N - 7 W | 74.7 | -- | 74.6 | | | | | | | | | | |
| N - 7 E | 74.9 | -- | 74.7 | | 60(½-1) | | | 2(½) | | | | | |
| Zero West | 83.7 | -- | 79.6 | | | | | 3(½-1) | | | | | |
| Zero East | 84.4 | -- | 83.6 | | 2(½-1) | 4(½) | | 1(1) | | | | | |
| S - 2 W | 77.3 | -- | 76.6 | | 1(1) | 5(½) | 1(1) | 1(1) | 9(½-1½) | | | | |
| S - 2 E | 82.9 | -- | 82.9 | | 4(1) | 3(½-1) | 1(½) | 10(½-1½) | 8(½-1½) | | | | |
| S - 17 W | 76.5 | 76.7 | 76.7 | | 17(½-1) | | | | | | | 1(2½) | |
| S - 17 E | 76.3 | -- | 76.3 | | | 2(½) | | 7(1-1½) | 13(1-1½) | | | | 4(3-4) |

[1] S = Surface
M = Mid-depth
B = Bottom

[2] Approximate lengths or length range in inches

However, on July 26, the effects of the thermal plume on fish distribution appeared evident. It was impossible to sample in later months due to lowered water and the absence of shallow littoral zones, and consequently substantiating data during higher temperature months could not be obtained.

b) ELECTROFISHING

Electrofishing data on species diversity and total numbers of fish collected during the June, August and September surveys are presented in Figures 16 and 17. An enumerative species list is shown in Tables 19-21.

During June, Station N-6/N-7 East produced the largest numbers of fish while Stations S-4/S-5 East and S-17/S-18 East yielded highest diversities. The pumpkinseed sunfish (*Lepomis gibbosus*) was the most abundant species, followed by the yellow perch (*Perca flavescens*). Lowest diversity and numbers were encountered at N-6/N-7 West and N-9/N-10 West, respectively. A total of 454 fish were collected in June, compared to 340 in the same month in 1972. Unlike 1972, the white sucker (*Catostomus commersoni*) did not occur in any great numbers, and incidences of skin fungus on yellow perch were rare and without correlation to increased temperature conditions.

In August, pumpkinseed sunfish were again dominant, followed by yellow perch. Largest numbers of fish were collected at Station

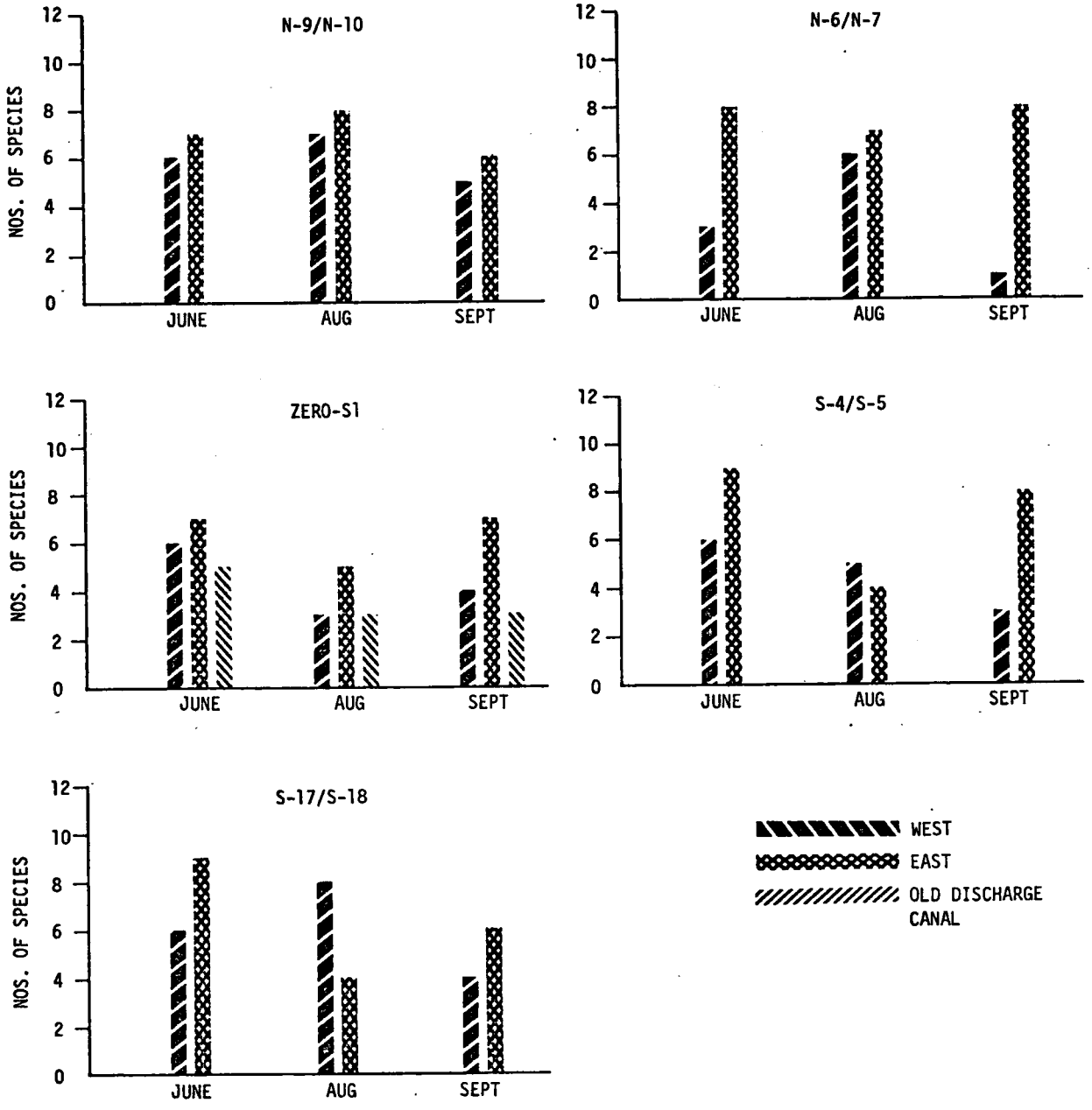



Figure 16. Numbers of species of fish collected by electrofishing at five stations during June, August and September, Hooksett Pond, Merrimack River.

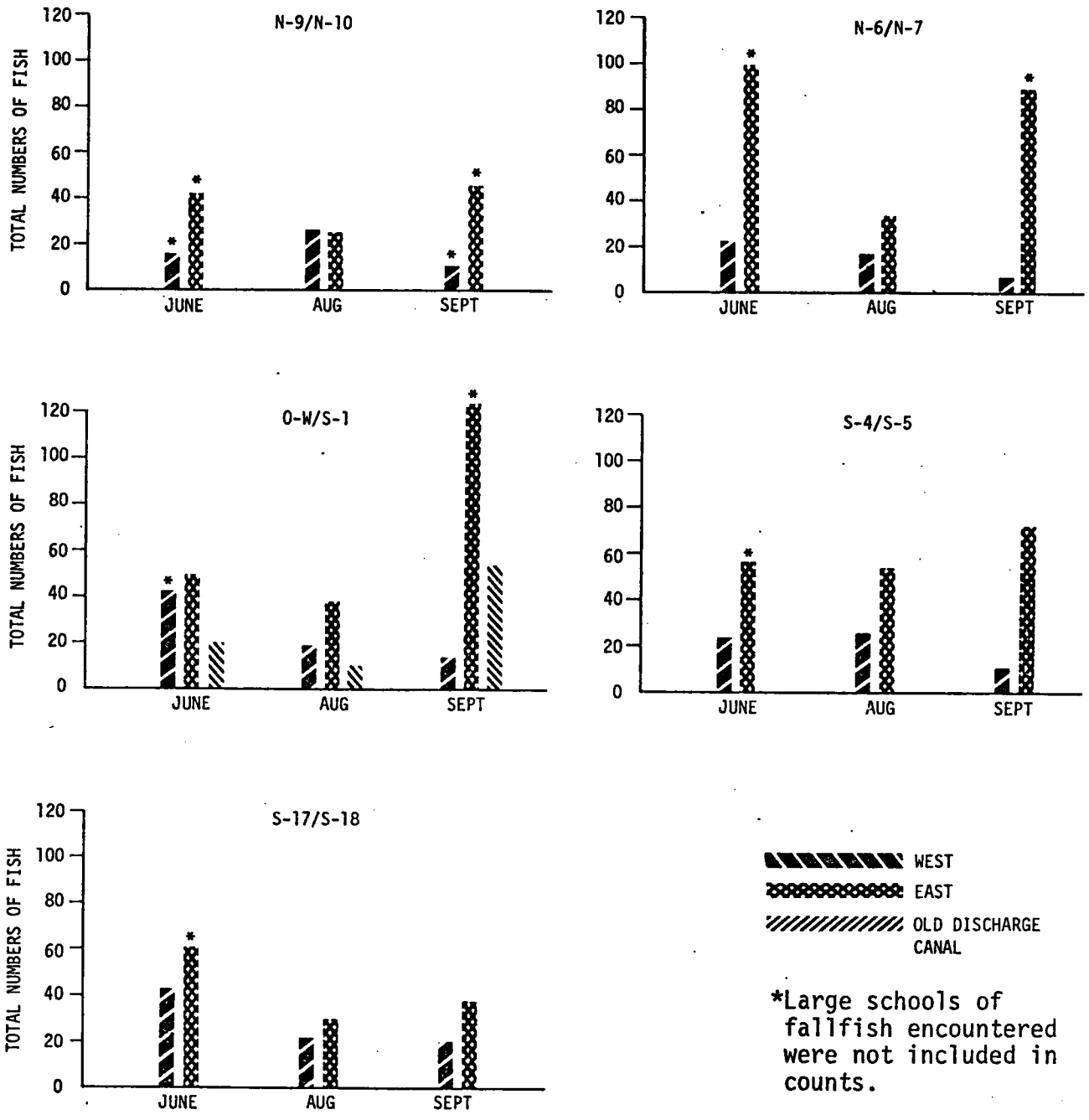



Figure 17. Total numbers of fish collected by electrofishing at five stations during June, August and September, Hooksett Pond, Merrimack River.

TABLE 19. RESULTS OF ELECTROFISHING SURVEY -- HOOKSETT POND - MERRIMACK RIVER - JUNE 26-27, 1973

| STATION | | TEMP. (°F)* S | M | B | PUMPKINSEED SUNFISH | REDBREAST SUNFISH | YELLOW PERCH | WHITE PERCH | SMALLMOUTH BASS | LARGEMOUTH BASS | BROWN BULLHEAD | YELLOW BULLHEAD | CHAIN PICKEREL | GOLDEN SHINER | FALLFISH | COMMON SHINER | WHITE SUCKER | AMERICAN EEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-9/N-10 | West | 69.9 | 69.9 | 69.9 | 3 | 4 | 6 | | | | | 1 | 1 | | 1 | | | |
| | East | 70.0 | 70.0 | 70.0 | 22 | 4 | 13 | | | | 1 | 1 | | | | many | 1 | 1 |
| N-6/N-7 | West | 70.0 | 70.0 | 70.0 | 9 | 3 | 10 | | | | | | | | | | | |
| | East | 70.1 | 70.0 | 70.0 | 51 | 14 | 18 | | 1 | | 9 | | 2 | | many | | | 4 |
| Zero/S-1 | West | 78.0 | 73.5 | 72.5 | 31 | 2 | 3 | | | | 5 | | | 1 | | many | | |
| | East | 80.0 | 78.5 | 73.5 | 13 | 12 | 10 | | | | | | 2 | 5 | | 1 | 2 | |
| S-4/S-5 | West | 75.5 | 74.0 | 72.5 | 17 | 1 | 1 | | 1 | | 1 | | | | 2 | | | |
| | East | 72.5 | 71.5 | 71.5 | 36 | 5 | 5 | | | | 1 | | 1 | 7 | many | | | 1 |
| S-17/S-18 | West | 73.0 | 72.0 | 72.0 | 9 | 20 | 8 | | 1 | | 4 | | 1 | | | | | |
| | East | 72.0 | 70.5 | 70.5 | 27 | 12 | 15 | | 1 | 1 | 3 | | | | many | | 1 | 1 |

*S = Surface
M = Mid-depth
B = Bottom

TABLE 20. RESULTS OF ELECTROFISHING SURVEY -- HOOKSETT POND - MERRIMACK RIVER - AUGUST 8-9, 1973

| STATION | | TEMP. (°F)* S | M | B | PUMPKINSEED SUNFISH | REDBREAST SUNFISH | YELLOW PERCH | WHITE PERCH | SMALLMOUTH BASS | LARGEMOUTH BASS | BROWN BULLHEAD | YELLOW BULLHEAD | TADPOLE MADTOM | CHAIN PICKEREL | GOLDEN SHINER | FALLFISH | COMMON SHINER | WHITE SUCKER | AMERICAN EEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-9/N-10 | West | 77.9 | --- | --- | 10 | 4 | 7 | | | 2 | 1 | | | | 1 | 1 | | | |
| | East | 78.4 | --- | --- | 11 | 2 | 4 | | 1 | 3 | 1 | | | | | 2 | | 1 | |
| N-6/N-7 | West | 77.2 | --- | --- | 7 | | 4 | | 1 | 1 | | | | | | 1 | | | 2 |
| | East | 78.5 | --- | --- | 11 | | 13 | | | 1 | 2 | | | 1 | | | | 2 | 3 |
| Zero/S-1 | West | 89.4 | --- | --- | 14 | | 4 | | | 1 | | | | | | | | | |
| | East | 89.5 | --- | --- | 25 | 3 | 6 | | 1 | 1 | | | | 1 | 1 | | | | |
| [illegible] | | 91.0 | | | [illegible] | | | | | | | | | | | | | | |
| S-4/S-5 | West | 81.7 | --- | --- | 19 | 1 | 4 | 1 | | | | | | | 1 | | | | |
| | East | 79.4 | --- | --- | 44 | 2 | 5 | | | 3 | | | | | | | | | |
| S-17/S-18 | West | 79.9 | --- | --- | 4 | 6 | 4 | | 1 | 2 | 2 | 1 | 2 | | | | | | |
| | East | 79.0 | --- | --- | 21 | 2 | 5 | | | | 2 | | | | | | | | |

* Only Surface Temperatures Taken

TABLE 21. RESULTS OF ELECTROFISHING SURVEY -- HOOKSETT POND - MERRIMACK RIVER - SEPTEMBER 11-12, 1973

| STATION | | TEMP. (°F)* S | M | B | PUMPKINSEED SUNFISH | REDBREAST SUNFISH | YELLOW PERCH | SMALLMOUTH BASS | LARGEMOUTH BASS | BROWN BULLHEAD | YELLOW BULLHEAD | CHAIN PICKEREL | GOLDEN SHINER | FALLFISH | WHITE SUCKER | AMERICAN EEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N-9/N-10 | West | 66.4 | 66.5 | 66.4 | 6 | 2 | 2 | 1 | | | | | | 1 | | |
| | East | 66.8 | 66.7 | 66.6 | 21 | 5 | 12 | 4 | | | | | | 2 | | 4 |
| N-6/N-7 | West | 66.5 | 66.7 | 66.7 | 7 | | | | | | | | | | | |
| | East | 67.1 | 67.1 | 67.1 | 62 | | 14 | 7 | | 2 | | 1 | | 2 | 1 | 2 |
| Zero/S-1 | West | 75.3 | 69.8 | 67.0 | 7 | 1 | | 4 | | | | | | | | 2 |
| | East | 76.6 | 66.8 | 66.9 | 71 | 13 | 1 | 36 | 1 | | | 2 | | 1 | | |
| [illegible] | | | | | | | | 10 | | | | | | | | |
| S-4/S-5 | West | 76.1 | 68.2 | 67.2 | 5 | 5 | | 1 | | | | | | | | |
| | East | 76.5 | 67.2 | 67.0 | 38 | 4 | 14 | 9 | 2 | 1 | 1 | | | | | 3 |
| S-17/S-18 | West | 74.0 | 68.4 | 67.9 | 9 | 4 | 6 | 1 | | | | | | | | |
| | East | 69.6 | 69.4 | 67.4 | 12 | 2 | 5 | 16 | | | | 1 | 2 | | | |

*S = Surface
M = Mid-depth
B = Bottom

S-4/S-5 East; least were collected at N-6/N-7 West. Highest diversities were noted at Stations N-9/N-10 East; lowest diversities occurred at Stations S-17/S-18 West and Zero-S-1 West. Total number of fish collected during August was 299, a decrease from June. Results were similar to those of August, 1972, in that 259 fish were collected and pumpkinseed and yellow perch predominated. Also, during 1972, lowest diversity was encountered at Station Zero/S-1 West. However both highest numbers and highest diversity occurred at N-6/N-7 West rather than at S-4/S-5 East and N-9/N-10 East.

Four hundred eighty-three fish were collected during the September survey. Pumpkinseed sunfish and smallmouth bass *(Micropterus dolomieui)* were dominant. Most of the smallmouths were caught south of the discharge canal. The most numerically productive station was Zero/S-1 East; the least, as in August, was N-6/N-7 West. The most diverse samples were taken at Stations N-6/N-7 East and S-4/S-5 East; the least at N-6/N-7 West. One sample, dominated by pumpkinseeds and largemouth bass *(Micropterus salmoides)*, totaled 1,013 individuals. In both 1972 and 1973, as waters cooled, numbers of bass *(Micropterus* spp.) increased at stations both north and south of the discharge canal.

For the most part, as in past years, numbers and diversity of fish appeared to be related largely to natural habitat suitability. However in August, as temperatures approached or slightly exceeded 90°F, numbers and diversity of fish were reduced in the old discharge

canal and at Station Zero/S-1 West. Similar results were noted during the 1971 survey under comparable temperature conditions.

c) FYKE NETTING

A total of 16 fish species were captured by fyke netting during the 1973 sampling period. The only species captured which were not collected during 1972 was a single tadpole madtom (*Noturus gyrinus*) and walleye (*Stizostedion vitreum vitreum*).

In 1972, the most frequently encountered species, both north and south of the discharge canal, was the brown bullhead (Normandeau Associates, Inc., 1973). During 1973 pumpkinseed sunfish were more abundant than brown bullheads south of the discharge canal (Table 22). These species were followed in numerical abundance by white suckers, yellow perch, smallmouth bass, yellow bullhead (*Ictaluris natalis*), and redbreast sunfish (*Lepomis auritus*). The other 9 species captured in the fyke nets were of little numerical importance, comprising only 5.5% of the total season catch (Table 22). In 1972, chain pickerel (*Esox niger*), and yellow bullheads were captured more frequently north of the discharge canal; and white suckers, white perch (*Morone americana*), and brown bullheads (*Ictaluris nebulosus*) were more frequently encountered south of the canal. During 1973, brown bullheads were more abundant north of the canal. White perch and white suckers were equally abundant in both areas. Only chain pickerel remained more abundant north of the discharge canal

TABLE 22. FISH SPECIES COLLECTED BY FYKE NETTING NORTH AND SOUTH OF THE DISCHARGE CANAL DURING JUNE, JULY, AUGUST, SEPTEMBER, AND OCTOBER, 1973

| COMMON NAME | JUNE | | JULY | | AUGUST | | SEPTEMBER | | OCTOBER | |
|---|---|---|---|---|---|---|---|---|---|---|
| | NORTH | SOUTH | NORTH | SOUTH | NORTH | SOUTH | NORTH | SOUTH | NORTH | SOUTH |
| White sucker | 64 | 23 | 8 | 19 | 28 | 44 | 66 | 5 | 72 | 51 |
| Chain pickerel | 1 | -- | 5 | 9 | 7 | 5 | 10 | 2 | 6 | 3 |
| Yellow bullhead | 1 | 2 | -- | 9 | 15 | 6 | 28 | 3 | 23 | 14 |
| Brown bullhead | 11 | 44 | 11 | 41 | 39 | 61 | 168 | 65 | 189 | 47 |
| Redbreast sunfish | 4 | 19 | 4 | 17 | 5 | 1 | 13 | -- | -- | 9 |
| Smallmouth bass | 29 | 13 | 39 | 27 | 18 | 40 | 6 | 1 | 12 | 16 |
| Largemouth bass | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1 |
| White perch | 2 | 1 | 1 | 9 | 2 | 5 | 6 | 7 | 4 | 2 |
| Golden shiner | 2 | -- | -- | 4 | -- | 2 | -- | 1 | 1 | -- |
| Walleye | -- | -- | -- | -- | -- | -- | 1 | -- | -- | -- |
| American eel | -- | 3 | -- | 4 | 7 | 2 | 4 | 2 | 2 | 2 |
| Tadpole madtom | -- | -- | 1 | -- | -- | -- | -- | -- | -- | -- |

(Table 22). Numerical abundance of species present north and south of the discharge canal revealed little difference in the make-up of the fish community sampled by fyke nets.

Among the principal fish species investigated (pumpkinseed, smallmouth bass, and yellow perch) north-south differences in abundance, as measured by fyke net catch, are obvious only for pumpkinseed (Table 22). As in 1972, the southern stations yielded more individuals of this species, as well as slightly greater numbers of yellow perch, than did the northern stations. Smallmouth bass were equally abundant in both areas. During 1972, smallmouth bass were more abundant at the northern stations.

Samples were grouped "summer" (June - August) and "autumn" (September and October) for analysis of mean lengths. One-way analysis of variance was performed (Sokal and Rohlf, 1969) on the mean length for pumpkinseed, smallmouth bass, and yellow perch (Table 23). Significance among location total length differences was observed for summer and autumn age II pumpkinseed ($P < .001$), autumn age III pumpkinseed ( $P < .001$), and summer age II yellow perch ($P < .015$). No significant total length differences were observed for smallmouth bass ($P > .05$). In all cases where significant within age-class total length differences were observed the greatest mean length was associated with Station S-2 West (Table 23). Smallest mean total length was consistently found at Station N-10 East. These trends are illustrated graphically in the form of monthly length-frequency distributions (Figures 18 through 22).

TABLE 23. DIFFERENCES IN MEAN LENGTHS AT TIME OF CAPTURE BY SPECIES, STATION AND SEASON DETERMINED BY ONE-WAY ANALYSIS OF VARIANCE.

| Species | Age | Season | MEAN LENGTH N-10W | N-10E | S-2W | S-3E | P | Greatest length at: | Smallest length at: |
|---|---|---|---|---|---|---|---|---|---|
| *L. gibbosus* (pumpkinseed sunfish) | 2 | S[1] | 5.14 | 4.76 | 5.91 | 5.06 | <.001 | S-2 W | N-10 E |
| | | F[2] | 5.3 | 4.84 | 5.97 | 5.37 | <.001 | S-2 W | N-10 E |
| | 3 | S | 6.02 | 5.5 | 6.34 | 6.27 | .1>P>.05 | No Significant difference | |
| | | F | 5.98 | 5.55 | 6.36 | 6.17 | <.001 | S-2 W | N-10 E |
| *M. dolomieui* (smallmouth bass) | 2 | S | 7.46 | 8.74 | 9.13 | 10.14 | .25>P>.1 | No Significant difference | |
| | | F | Insufficient Data | | | | | | |
| | 3 | S | 11.09 | 11.58 | 9.98 | 11.49 | .1>P>.05 | No Significant difference | |
| | | F | Insufficient Data | | | | | | |
| *P. flavescens* (yellow perch) | 2 | S | 7.071 | 6.53 | 7.44 | 7.23 | .0151 | S-2 W | N-10 E |
| | | F | Insufficient Data | | | | | | |
| | 3 | S | 7.32 | 7.1 | 7.61 | 7.3 | .5>P>.25 | No Significant difference | |
| | | F | Insufficient Data | | | | | | |

[1] Summer

[2] Fall

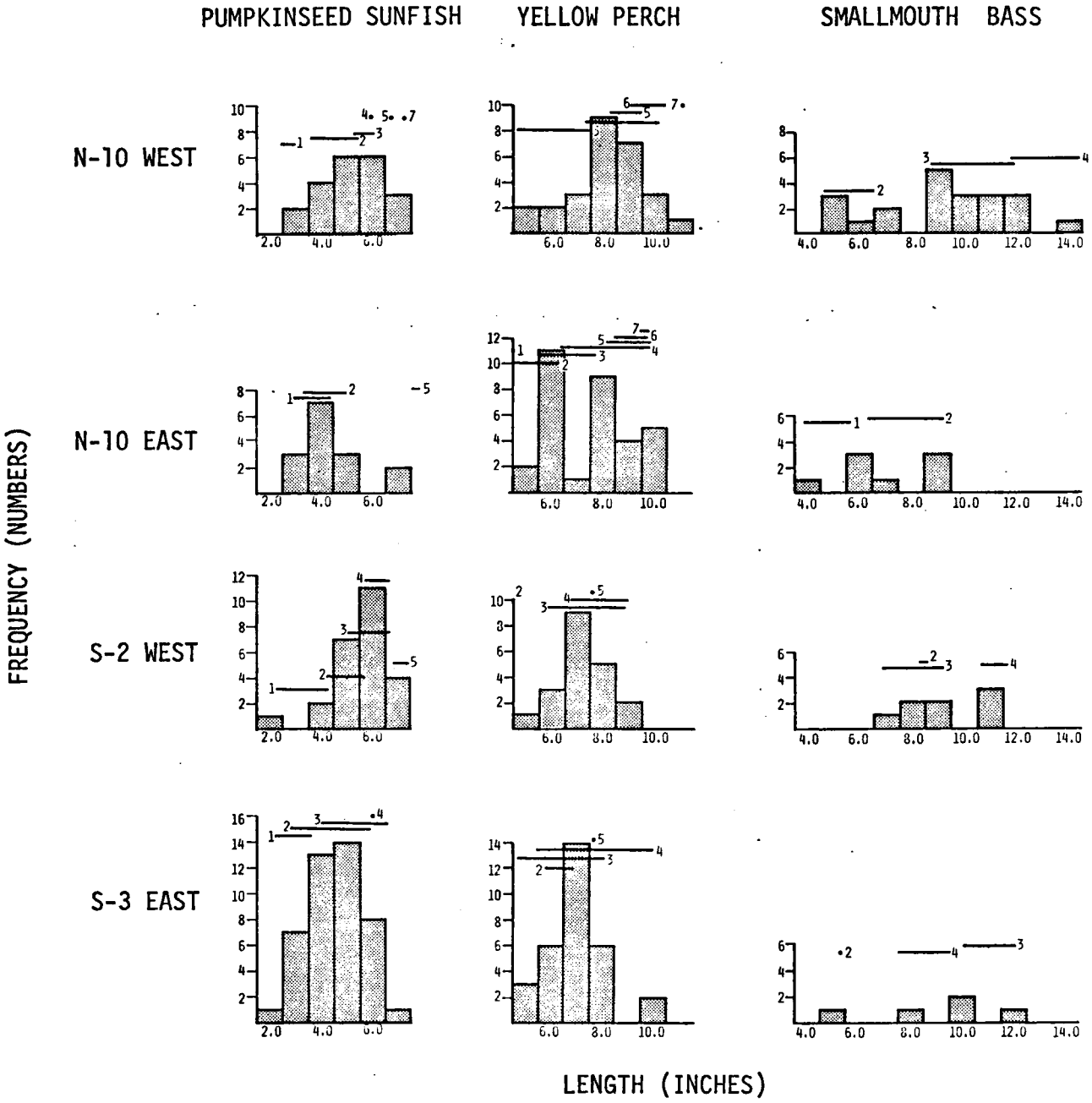



Figure 18. Length frequency distributions and age ranges for three species of fish collected by fyke netting, June, 1973.

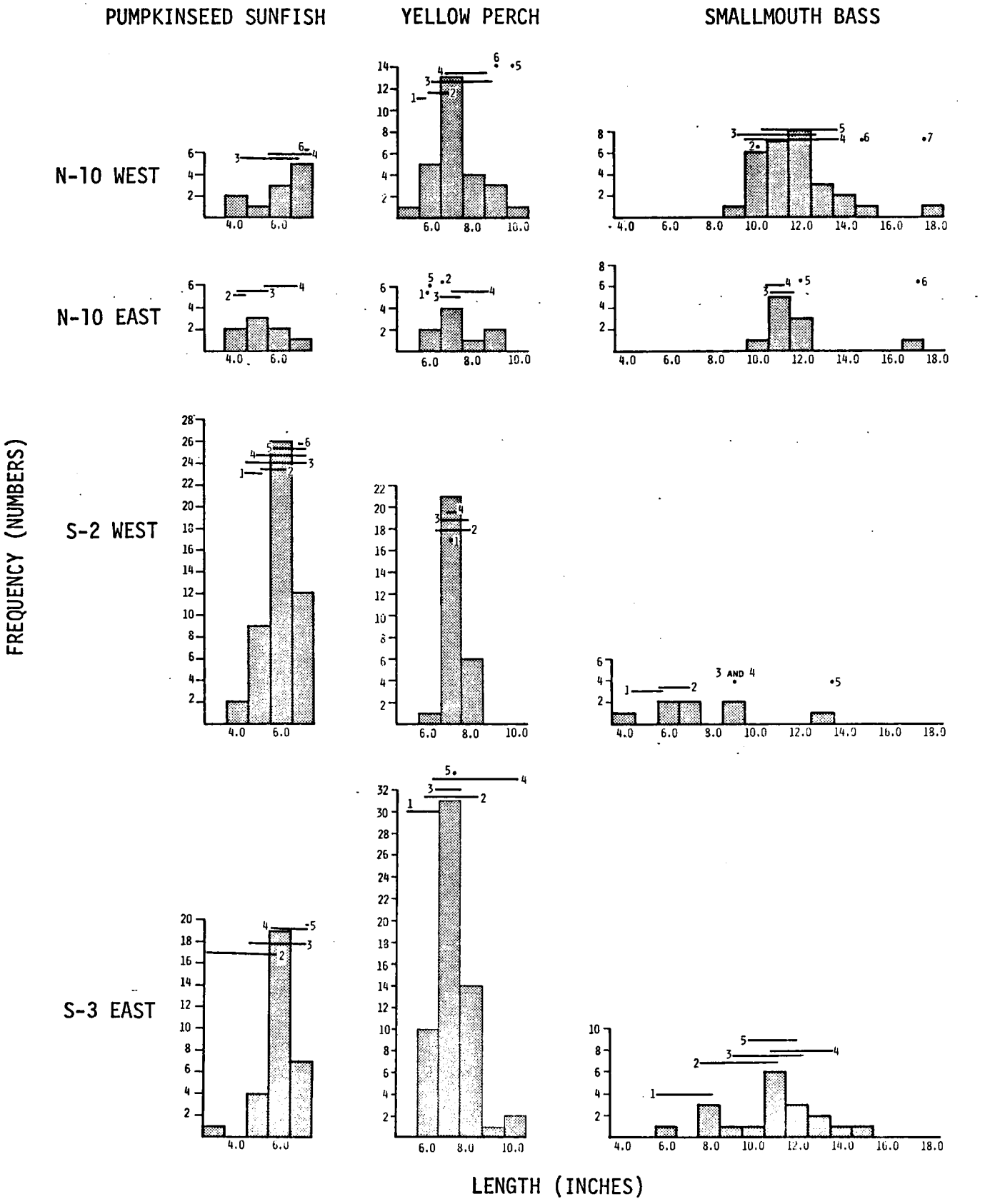



Figure 19. Length frequency distributions and age ranges for three species of fish collected by fyke netting, July, 1973.

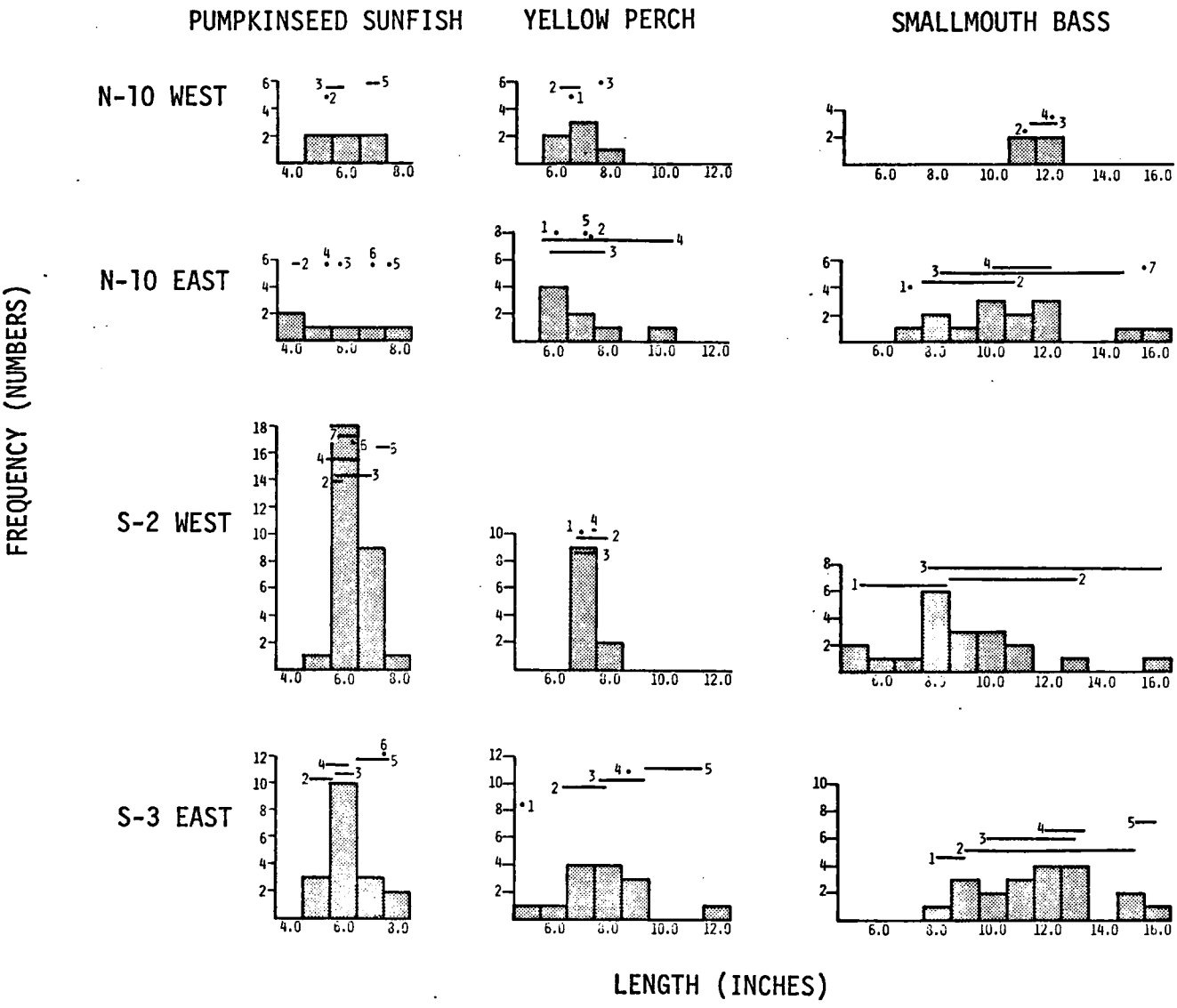



Figure 20. Length frequency distributions and age ranges for three species of fish collected by fyke netting, August, 1973.

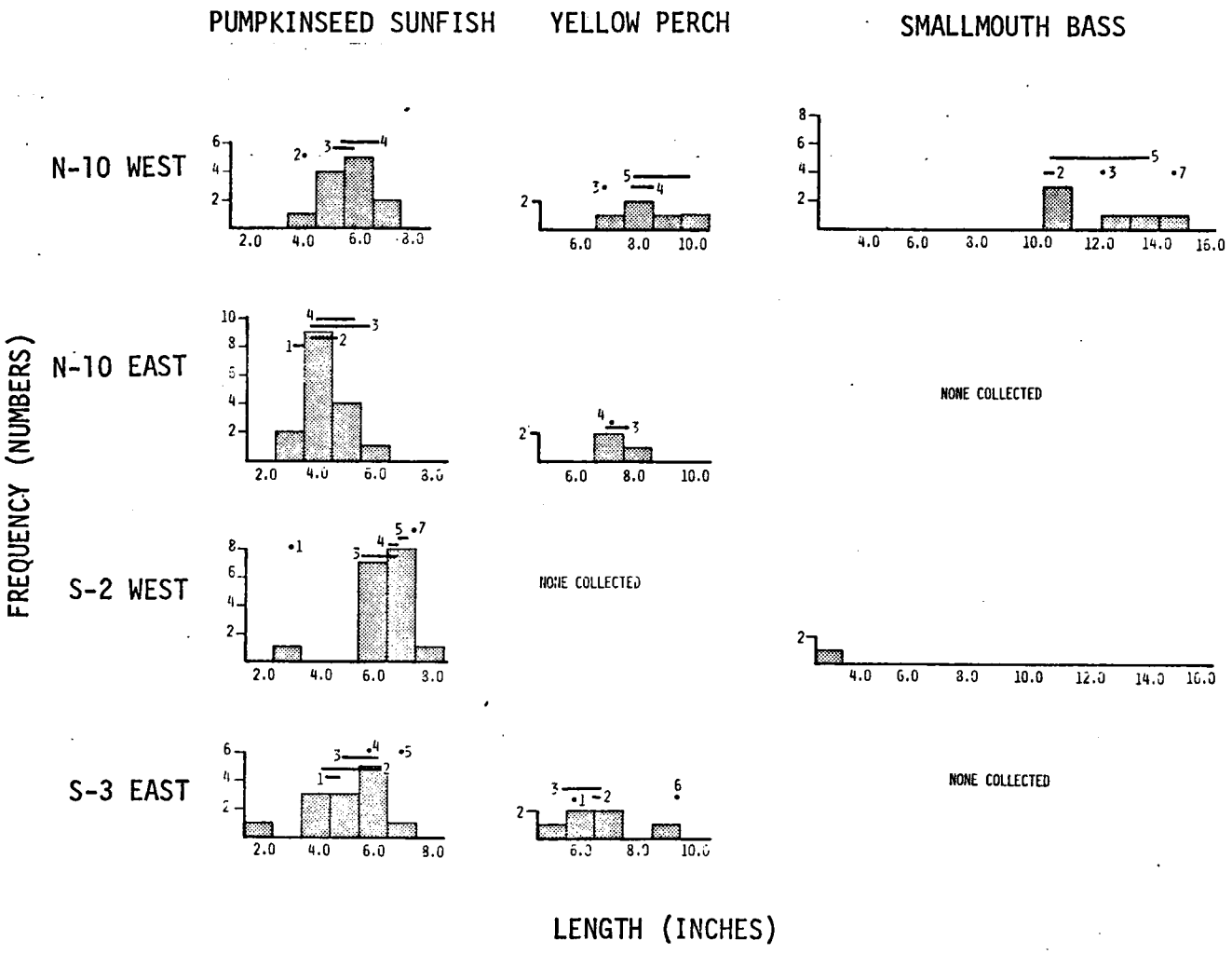



Figure 21. Length frequency distributions and age ranges for three species of fish collected by fyke netting, September, 1973.

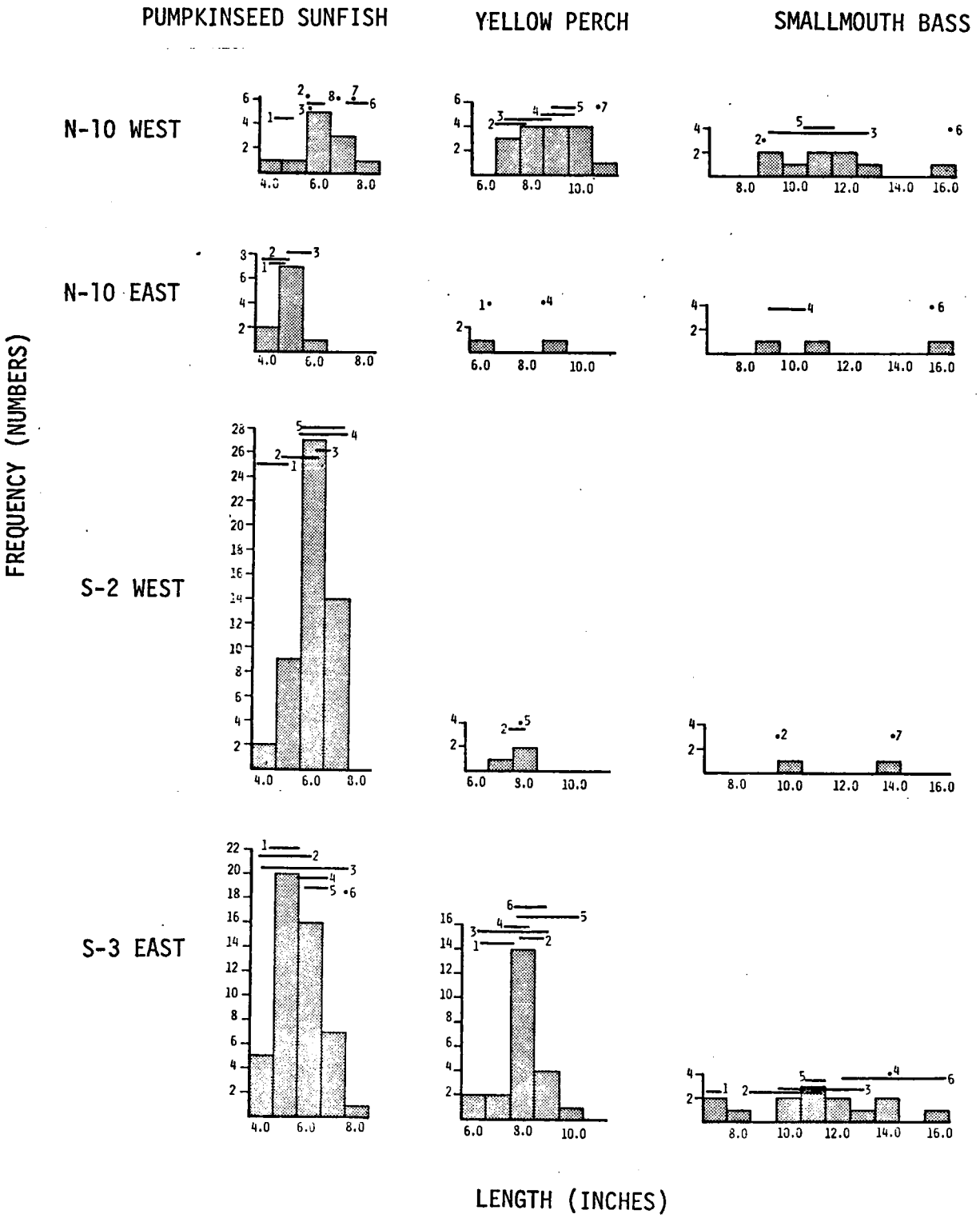



Figure 22. Length frequency distributions and age ranges for three species of fish collected by fyke netting, October, 1973.

The distribution of age groups, by station and species, in the monthly fyke net samples is presented in Tables 24 through 27 and Figures 18 through 22. These illustrations indicate that fyke net selectivity is such that age II and younger pumpkinseed, smallmouth bass, and yellow perch are not sampled as efficiently as are older, larger individuals. Since significance among station length at age differences have been demonstrated for two of the three species investigated, the relative abundance of younger fish in the monthly catches is biased. Analysis of age composition, then, should be restricted to age III and older age groups.

Generally, the distribution of age III and older individuals within the monthly samples was highly variable for all three species investigated (Table 24 through 27; Figures 18 through 22). As in 1972, the generally greater overall abundance of pumpkinseeds at the southern stations (Table 22) is reflected in the higher number of older individuals captured. In contrast, age III and older smallmouth bass were distributed more or less identically north and south of the discharge canal. During 1972, greater numbers of older, larger smallmouth bass were captured at the northern stations than at the southern stations.

Length-weight relationships of the form

$$\log Wt = \log c + n \log TL$$

or

$$Wt = c + TL$$

TABLE 24. MONTHLY SPECIES AGE GROUP TOTAL BY STATION

YELLOW PERCH

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| June | N-10 W | | | | 7 | 13 | 4 | 2 | 1 |
| | N-10 E | | 1 | 7 | 5 | 6 | 7 | 2 | 3 |
| | S-2 W | | | 1 | 11 | 7 | 1 | | |
| | S-3 E | | | 3 | 12 | 10 | 1 | | |
| July | N-10 W | | 3 | 2 | 10 | 5 | 1 | 1 | |
| | N-10 E | | 1 | 1 | 2 | 4 | 1 | | |
| | S-2 W | | 1 | 13 | 10 | 2 | 1 | | |
| | S-3 E | | 3 | 21 | 9 | 10 | 1 | | |
| Aug. | N-10 W | | 1 | 4 | 1 | | | | |
| | N-10 E | | 1 | 1 | 3 | 2 | 1 | | |
| | S-2 W | | 1 | 4 | 4 | 2 | | | |
| | S-3 E | | 1 | 6 | 4 | 1 | 2 | | |
| Sept. | N-10 W | | | | 1 | 2 | 2 | | |
| | N-10 E | | | | 2 | 1 | | | |
| | S-Z W | | | | | | | | |
| | S-3 E | | 1 | 2 | 2 | | | | |
| Oct. | N-10 W | | | 2 | 7 | 3 | 3 | | 1 |
| | N-10 E | | 1 | | | 1 | | | |
| | S-2 W | | | 2 | | | 1 | | |
| | S-3 E | | 2 | 3 | 8 | 4 | 4 | 2 | |
| | TOTAL | | 17 | 72 | 98 | 73 | 30 | 7 | 5 |

TABLE 25. MONTHLY SPECIES AGE GROUP BY STATION

PUMPKINSEED SUNFISH

| Month | Station | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| June | N-10 W | | 2 | 11 | 4 | 1 | 2 | | | |
| | N-10 E | | 6 | 7 | | | 2 | | | |
| | S-2 W | | 2 | 8 | 10 | 3 | 2 | | | |
| | S-3 E | | 6 | 28 | 8 | 1 | | | | |
| July | N-10 W | | | | 5 | 4 | | 2 | | |
| | N-10 E | | | 2 | 3 | 3 | | | | |
| | S-2 W | | 2 | 5 | 14 | 16 | 4 | 2 | | |
| | S-3 E | | | 3 | 10 | 8 | 2 | | | |
| Aug. | N-10 W | | | 1 | 2 | | 1 | | | |
| | N-10 E | | | 2 | 1 | 1 | 1 | 1 | | |
| | S-2 W | | | 5 | 10 | 7 | 2 | 1 | 2 | |
| | S-3 E | | | 3 | 3 | 7 | 4 | 1 | | |
| Sept. | N-10 W | | | 1 | 8 | 3 | | | | |
| | N-10 E | | 3 | 8 | 3 | 2 | | | | |
| | S-2 W | 1 | | | 9 | 3 | 3 | | 1 | |
| | S-3 E | 1 | 2 | 3 | 5 | 1 | 1 | | | |
| Oct. | N-10 W | | 2 | 1 | 2 | 2 | | 2 | 1 | 1 |
| | N-10 E | | 2 | 5 | 3 | | | | | |
| | S-2 W | | 5 | 10 | 6 | 9 | 10 | | | |
| | S-3 E | | 6 | 10 | 14 | 9 | 4 | 1 | | |
| | TOTAL | 2 | 38 | 113 | 120 | 80 | 38 | 10 | 4 | 1 |

TABLE 26. MONTHLY SPECIES AGE GROUP TOTAL BY STATION

SMALLMOUTH BASS

| Month | Station | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| June | N-10 W | | | 6 | 11 | 4 | | | |
| | N-10 E | | 2 | 6 | | | | | |
| | S-2 W | | | 2 | 3 | 3 | | | |
| | S-3 E | | | 1 | 2 | 2 | | | |
| July | N-10 W | | | 2 | 9 | 12 | 4 | 1 | 1 |
| | N-10 E | | | 2 | 3 | 3 | | | |
| | S-2 W | | 2 | 3 | 1 | 1 | 1 | | |
| | S-3 E | | 2 | 3 | 5 | 7 | 2 | | |
| Aug. | N-10 W | | | 1 | 2 | | 1 | | |
| | N-10 E | | 1 | 3 | 7 | 2 | | | 1 |
| | S-2 W | 1 | 6 | 5 | 8 | | | | |
| | S-3 E | | 2 | 5 | 8 | 3 | 2 | | |
| Sept. | N-10 W | | | 2 | 1 | | | | |
| | N-10 E | | | | | | | | |
| | S-2 W | | | | | | | | |
| | S-3 E | | | | | | | | |
| Oct. | N-10 W | | | 1 | 4 | | 3 | 1 | |
| | N-10 E | | | | | 2 | 1 | | |
| | S-2 W | | | 1 | | | | | |
| | S-3 E | | 2 | 2 | 3 | 1 | 2 | 4 | |
| | TOTAL | 1 | 17 | 45 | 67 | 40 | 16 | 6 | 2 |

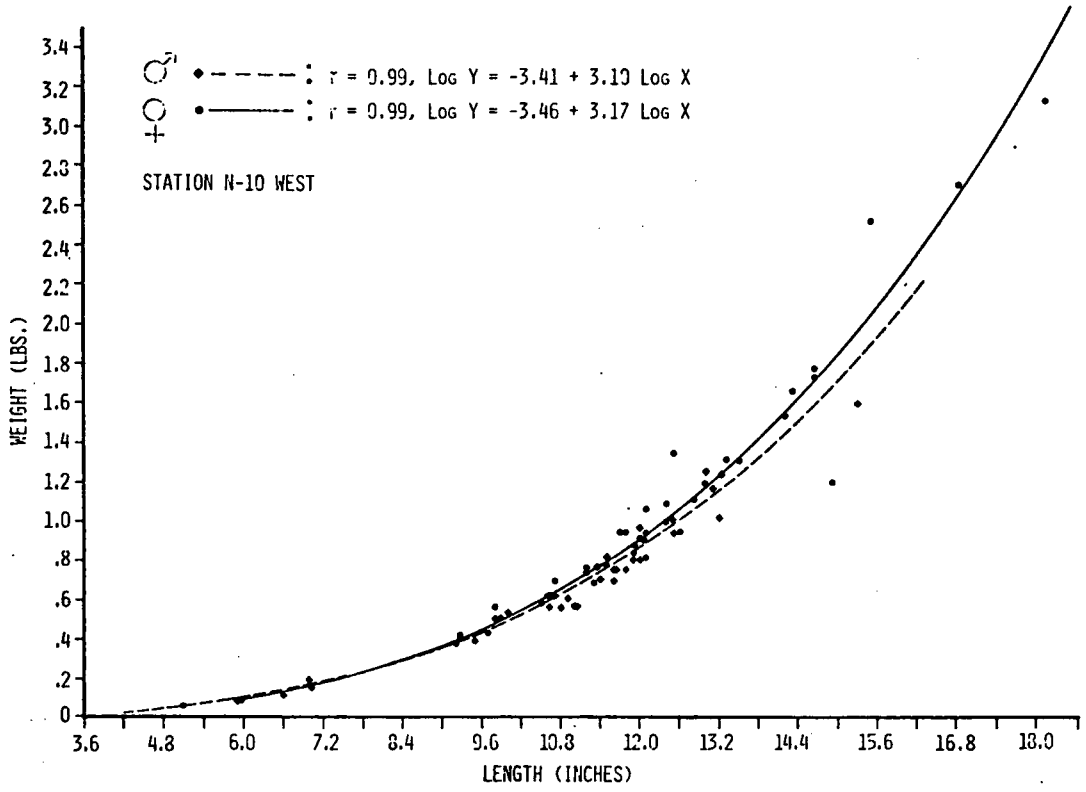
TABLE 27. SEASON AGE-GROUP TOTALS BY SPECIES AND STATION

| Station | Age | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| N-10 W | | 4 | 14 | 21 | 10 | 3 | 4 | 1 | 1 | Pumpkinseed Sunfish |
| N-10 E | | 11 | 22 | 10 | 6 | 2 | 1 | | | |
| S-2 W | 1 | 9 | 28 | 49 | 38 | 21 | 3 | 3 | | |
| S-3 E | 1 | 14 | 47 | 40 | 26 | 15 | 2 | | | |
| N-10 W | | | 12 | 27 | 16 | 8 | 2 | 1 | | Smallmouth Bass |
| N-10 E | | 3 | 11 | 10 | 7 | | | 1 | | |
| S-2 W | 1 | 8 | 11 | 12 | 6 | 1 | | | | |
| S-3 E | | 6 | 11 | 18 | 3 | 6 | 4 | | | |
| N-10 W | | 4 | 8 | 26 | 23 | 10 | 3 | 1 | | Yellow Perch |
| N-10 E | | 4 | 9 | 12 | 14 | 9 | 2 | | | |
| S-2 W | | 2 | 20 | 25 | 12 | 3 | | | | |
| S-3 E | | 6 | 35 | 35 | 25 | 7 | 2 | | | |

where Wt = weight in pounds, TL - total length in inches, and c and n are constants (Tesch, 1968) were computed for male and female smallmouth bass, pumpkinseed, and yellow perch (Figures 23 through 25). Correlation coefficients, which represent a measure of dispersion about the computed regression, were also calculated.

Computed results indicate that the pattern of length and weight accretion within species is similar for all locations sampled. Differences in slope and intercept values (log C and n) which do exist can most likely be attributed to differences in numerical abundance and the distribution of length and weight within samples. This is especially evident for yellow perch, where sample sizes were small and size range within samples limited. Pumpkinseed sunfish differences, however, are not artifacts of sample differences. Both male and female pumpkinseed from the northern stations are heavier at a given total length than are specimens of a comparable total length from the southern stations as is evidenced by greater log C (intercept values; (Figure 24). In 1972, this difference was not noted.

In summary, results of the 1973 fyke netting program indicated no substantial differences between age structure or length-weight relationships in smallmouth bass, yellow perch, or pumpkinseed populations at stations north and south of the discharge canal. Significant among location total length differences within summer and autumn pumpkinseed and autumn yellow perch collections were noted. Greatest total length was always associated



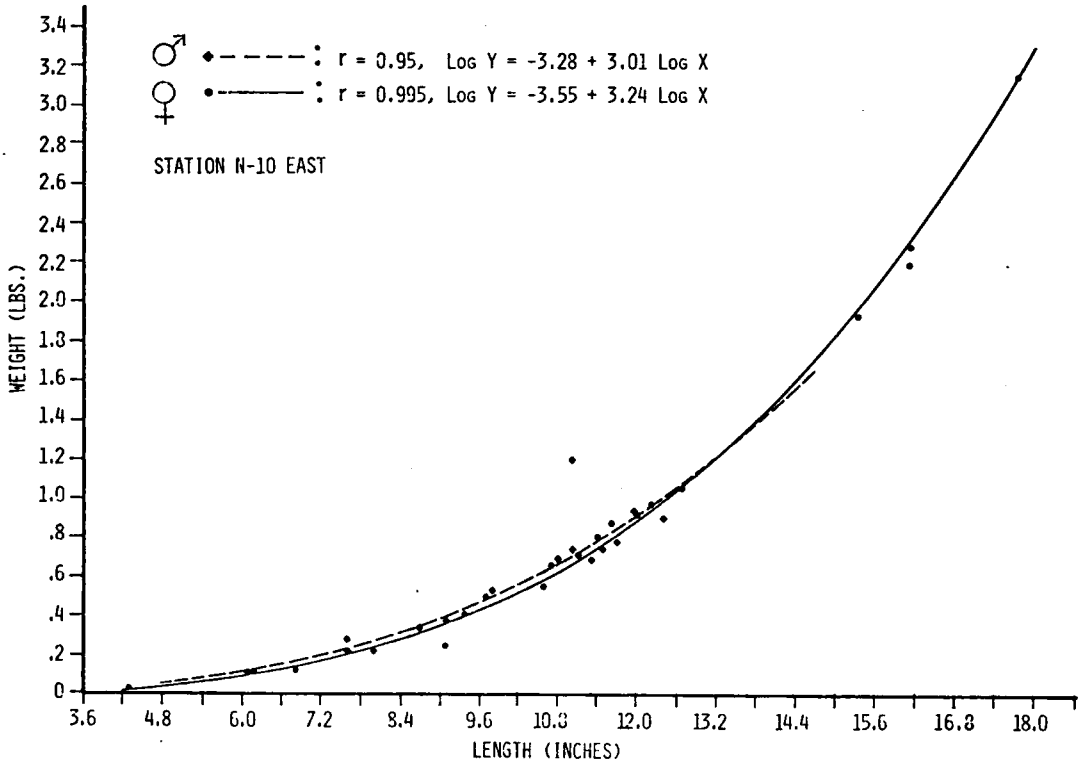
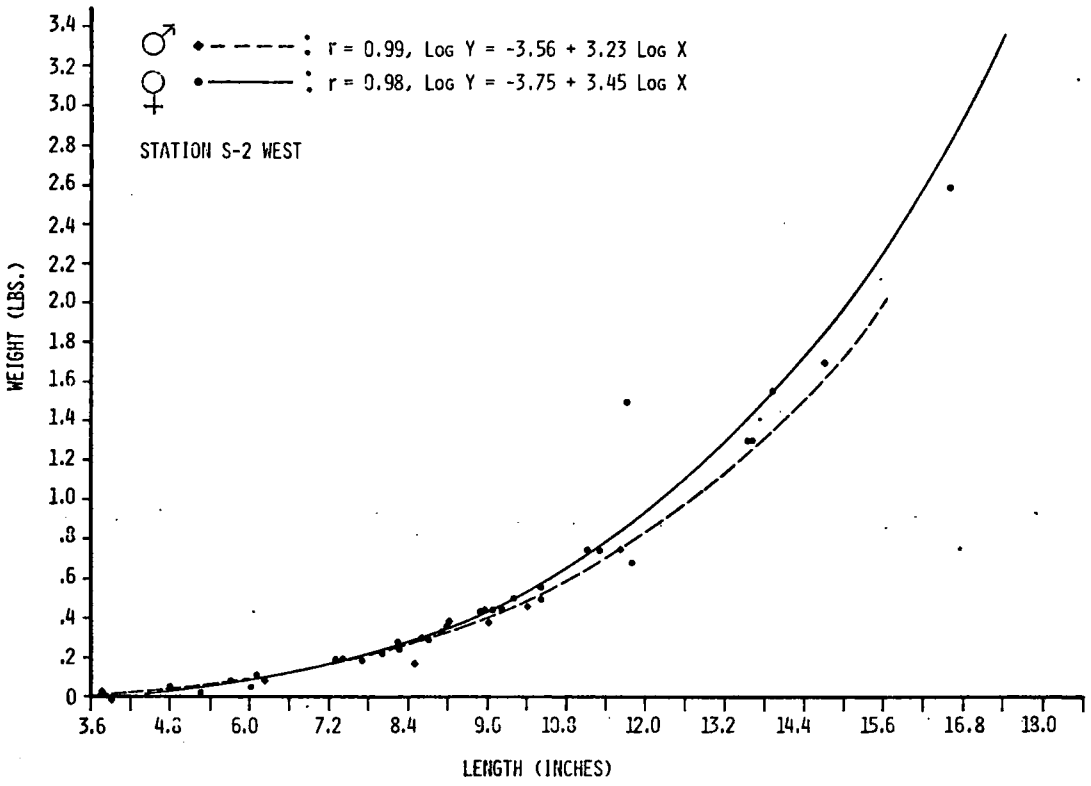




Figure 23. Length/weight relationships of smallmouth bass collected by fyke netting - Hooksett Pond, Merrimack River - 1973.



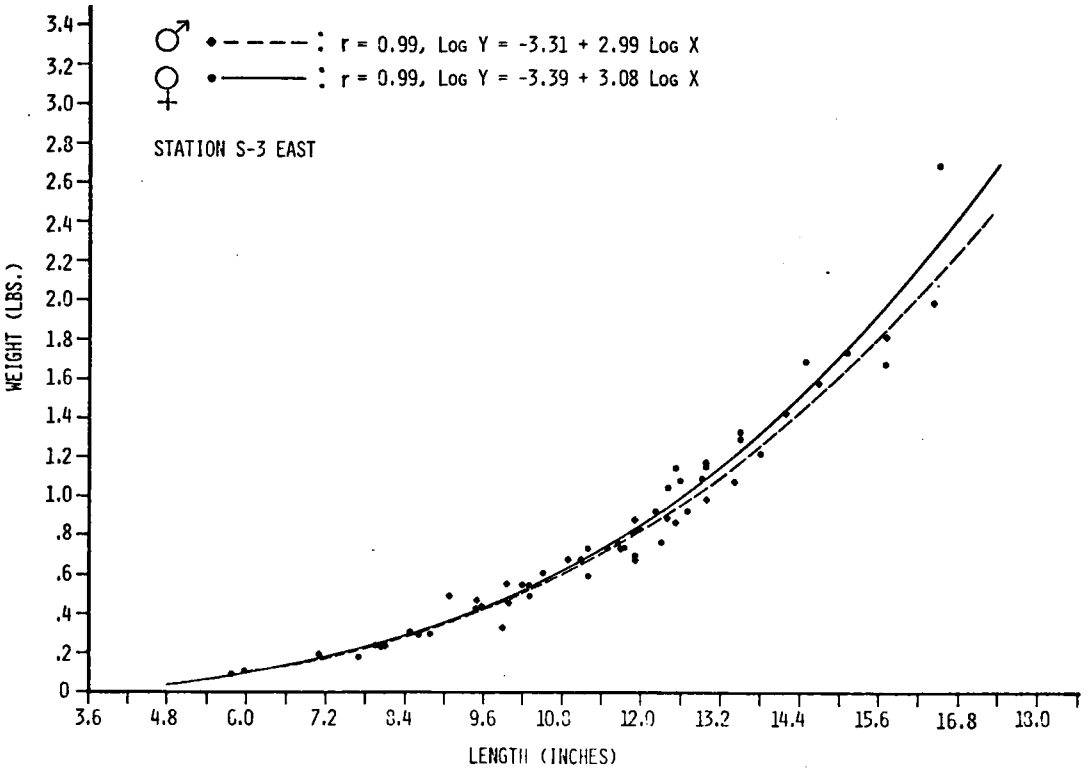




Figure 23. (Continued) Length/weight relationships of smallmouth bass collected by fyke netting - Hooksett Pond, Merrimack River - 1973.

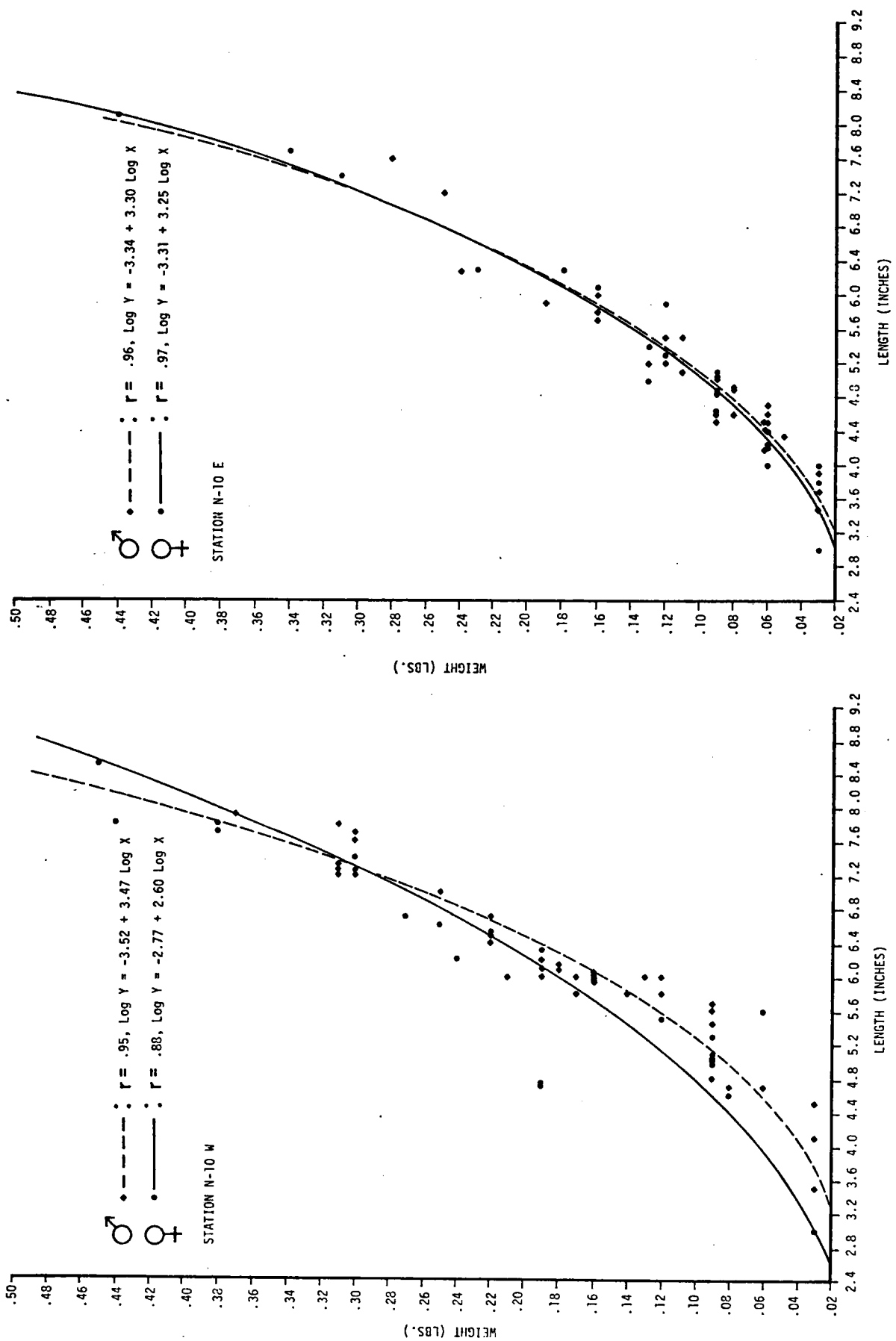



Figure 24. Length/weight relationships of pumpkinseed sunfish collected by fyke netting - Hooksett Pond, Merrimack River - 1973.

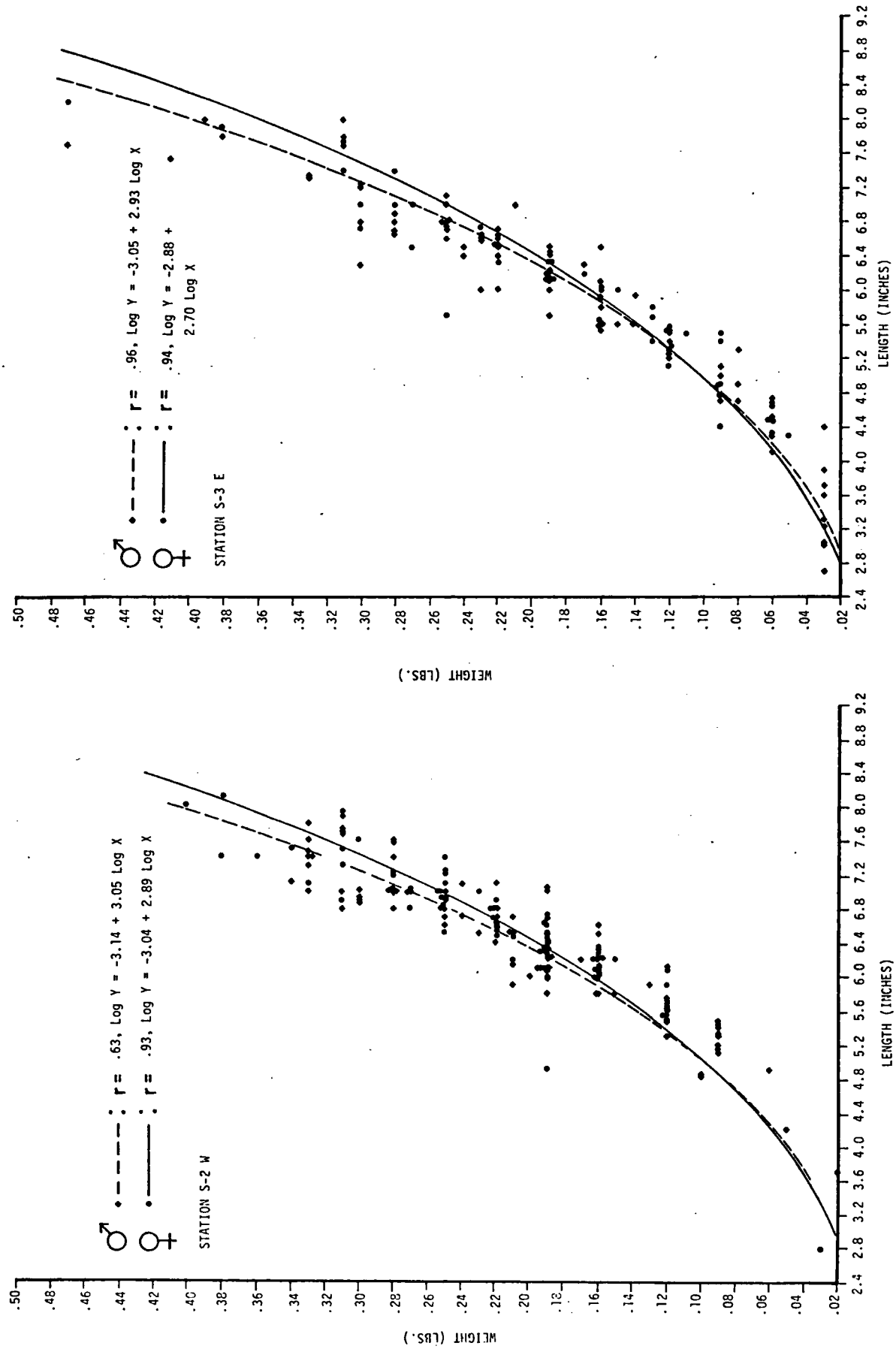
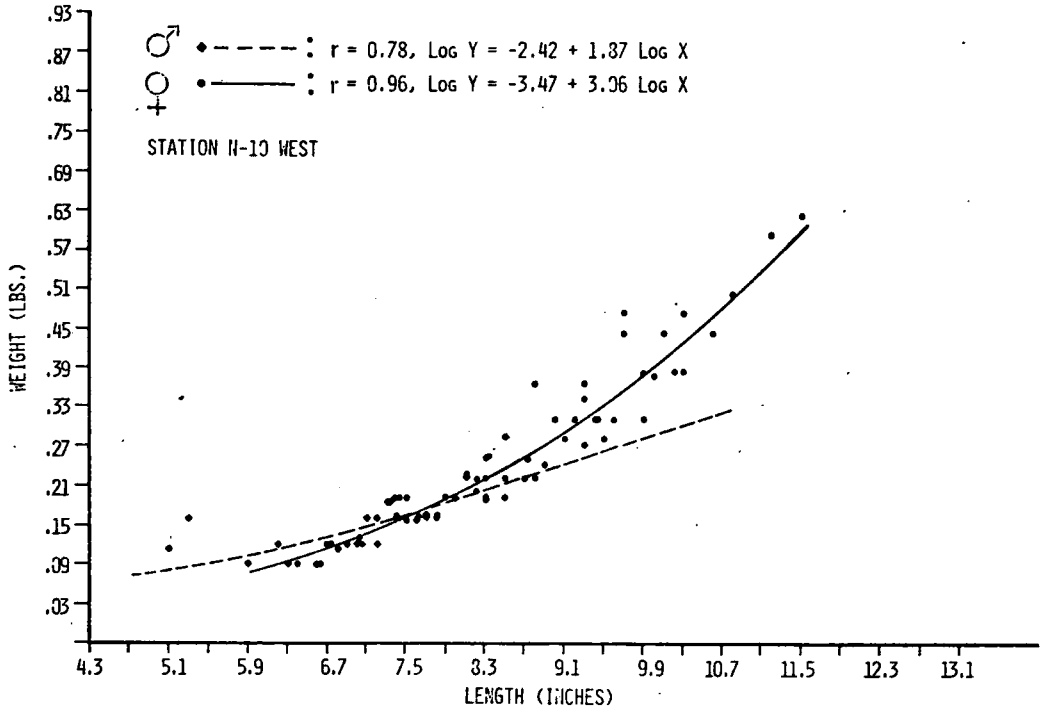



Figure 24. Length/weight relationships of pumpkinseed sunfish collected by (Continued) fyke netting - Hooksett Pond, Merrimack River - 1973.



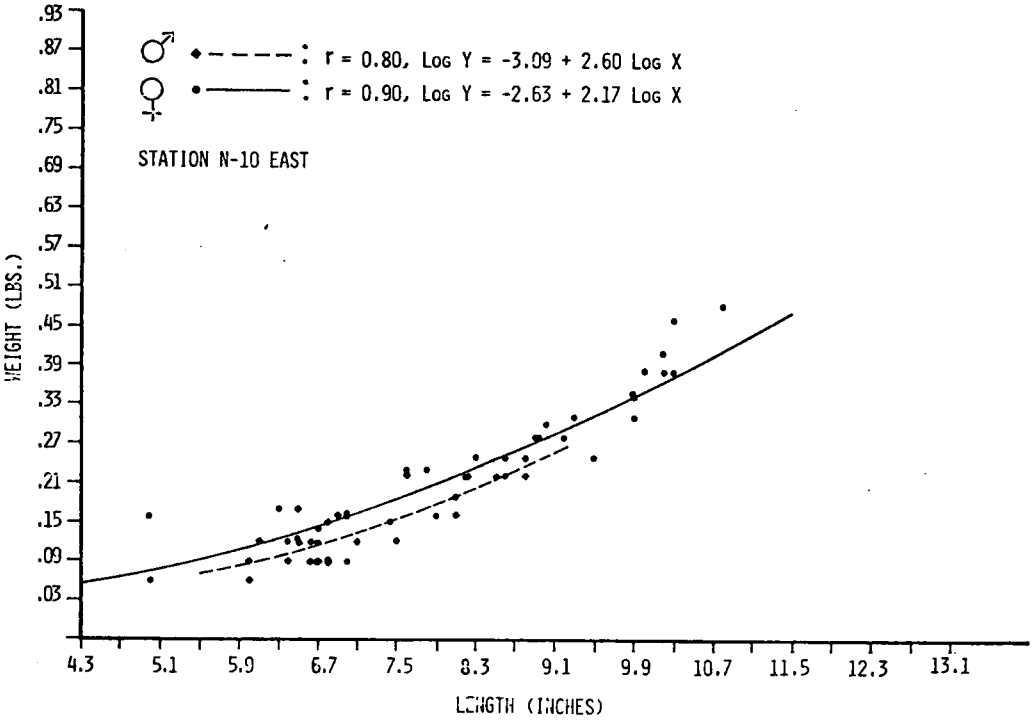
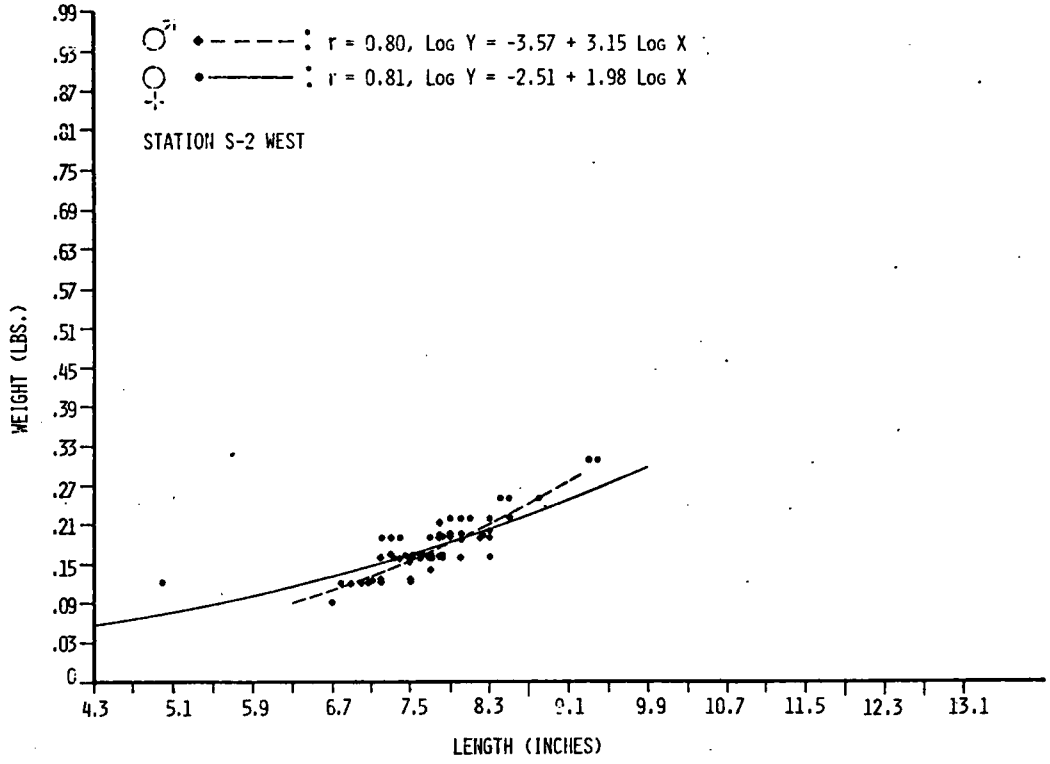




Figure 25. Length/weight relationships of yellow perch collected by fyke netting - Hooksett Pond, Merrimack River - 1973.



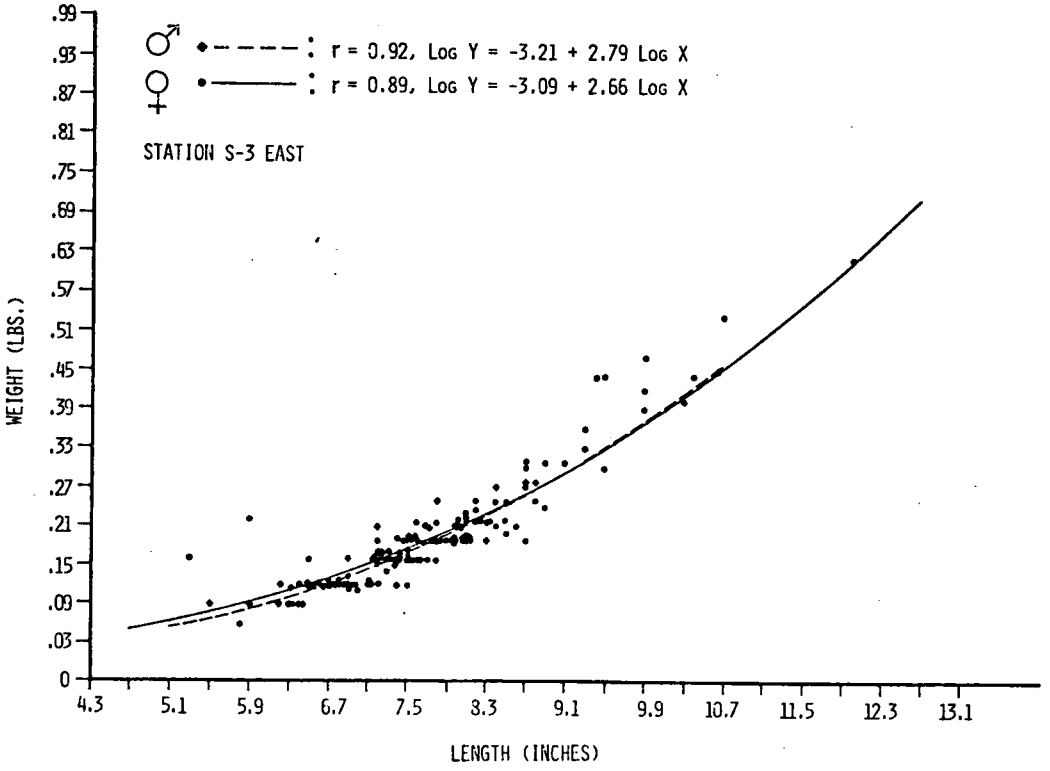




Figure 25. (Continued) Length/weight relationships of yellow perch collected by fyke netting - Hooksett Pond, Merrimack River - 1973.

with Station S-2 West. Smallest total length was consistently found at Station N-10 East. The greatest number of pumpkinseed and yellow perch was also captured at the southern stations. No growth or relative abundance differences between smallmouth bass collections from north and south of the discharge canal were observed. The relative contribution of the species present which were not intensively investigated was similar north and south of the discharge canal. The brown bullhead was the most frequently encountered species at both locations. Other species contributing substantially to the total catch were the white sucker, yellow bullhead, and red-breast sunfish.

# V. SUMMARY AND CONCLUSIONS

As in past years, pH and nutrient concentrations showed little or no differences among stations while dissolved oxygen concentrations were slightly reduced at stations south of the discharge canal. Levels of chlorophyll *a* corresponded to seasonal trends in phytoplankton numbers and were generally less at Station Zero-West than at other stations sampled. Numbers of planktonic diatoms and green algae in surface samples were reduced at Station Zero-West while numbers of bluegreen algae increased. Green algae were also reduced in sub-surface tows. Periphyton communities on weekly slides south of the discharge canal showed less abundance than at the ambient station (N-10) with diatoms being primarily affected. Monthly periphyton slides showed some reduction in diatom abundance at Station Zero-West but these reductions were not statistically significant.

Reduced abundance of aquatic plants and insects at Station Zero-West could have been thermally related, although impacts of high July flows cannot be discounted. Benthic invertebrates occurred in higher numbers than in past years at all stations and their distribution appeared to be largely habitat related. Electrofishing and immature fish surveys indicated some limitation of fish abundance at Station Zero-West and S-1 concurrent with high summer temperature. Fyke netting data showed pumpkinseed sunfish and yellow perch of given ages to be of greater total length at Station S-2 west than at other stations during the summer and autumn. Other species sampled showed little or no substantial differences among stations north and south of the discharge canal.

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TABLE 8-1. HOOKSETT POND FINFISH SPECIES LIST. MERRIMACK RIVER SUMMARY REPORT, 1979.

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| Anguillidae | |
| *Anguilla rostrata* | American eel |
| Clupeidae | |
| *Alosa sapidissima* | American shad |
| Salmonidae | |
| *Salmo gairdneri* | Rainbow trout |
| *Salmo salar* | Atlantic salmon |
| *Salmo trutta* | Brown trout |
| *Salvelinus fontinalis* | Brook trout |
| Osmeridae | |
| *Osmerus mordax* | Rainbow smelt |
| Esocidae | |
| *Esox niger* | Chain pickerel |
| Cyprinidae | |
| *Notemigonus crysoleucas* | Golden shiner |
| *Notropis cornutus* | Common shiner |
| *Notropis hudsonius* | Spottail shiner |
| *Notropis* spp. (Larvae) | |
| *Semotilus corporalis* | Fallfish |
| *Semotilus* spp. (Larvae) | |
| Catostomidae | |
| *Catostomus commersoni* | White sucker |
| Ictaluridae | |
| *Ictalurus natalis* | Yellow bullhead |
| *Ictalurus nebulosus* | Brown bullhead |
| *Noturus gyrinus* | Tadpole madtom |
| *Noturus insignus* | Margined madtom |
| Percichthyidae | |
| *Morone americana* | White perch |
| Centrarchidae | |
| *Lepomis auritus* | Redbreast sunfish |
| *Lepomis gibbosus* | Pumpkinseed |
| *Lepomis macrochirus* | Bluegill |
| *Micropterus dolomieui* | Smallmouth bass |
| *Micropterus salmoides* | Largemouth bass |
| Percidae | |
| *Etheostoma nigrum* | Johnny darter |
| *Perca flavescens* | Yellow perch |
| *Stizostedion vitreum* | Walleye |

# APPENDIX I.

## ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK N-10

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 MAY 73 | 51.29 | 1945 | 48.82 | 615 |
| 2 MAY 73 | 52.86 | 1445 | 51.05 | 330 |
| 3 MAY 73 | 54.84 | 1545 | 52.44 | 530 |
| 4 MAY 73 | 55.69 | 1515 | 54.06 | 715 |
| 5 MAY 73 | 54.97 | 15 | 53.70 | 2315 |
| 6 MAY 73 | 53.70 | 15 | 53.10 | 715 |
| 7 MAY 73 | 55.57 | 1645 | 53.10 | 530 |
| 8 MAY 73 | 56.23 | 1645 | 54.24 | 830 |
| 9 MAY 73 | 55.63 | 15 | 54.78 | 1100 |
| 10 MAY 73 | 56.35 | 1745 | 54.66 | 415 |
| 11 MAY 73 | 56.29 | 15 | 54.78 | 1130 |
| 12 MAY 73 | 55.63 | 15 | 54.36 | 930 |
| 13 MAY 73 | 56.35 | 1800 | 54.00 | 415 |
| 14 MAY 73 | 55.75 | 15 | 54.30 | 830 |
| 15 MAY 73 | 55.03 | 15 | 54.18 | 645 |
| 16 MAY 73 | 56.29 | 1700 | 53.76 | 630 |
| 17 MAY 73 | 56.47 | 1545 | 54.60 | 715 |
| 18 MAY 73 | 55.81 | 15 | 53.34 | 2300 |
| 19 MAY 73 | 54.60 | 1430 | 53.22 | 400 |
| 20 MAY 73 | 53.82 | 1215 | 52.56 | 630 |
| 21 MAY 73 | 54.00 | 1430 | 53.34 | 2345 |
| MAY 73 | 53.40 | 15 | 52.50 | 2300 |
| 23 MAY 73 | 53.82 | 1700 | 50.03 | 1000 |
| 24 MAY 73 | 55.15 | 1815 | 38.52 | 915 |
| 25 MAY 73 | 55.09 | 15 | 54.78 | 2345 |
| 26 MAY 73 | 55.81 | 1715 | 54.84 | 145 |
| 27 MAY 73 | 57.67 | 1645 | 55.21 | 645 |
| 28 MAY 73 | 57.25 | 30 | 55.93 | 2400 |
| 29 MAY 73 | 58.10 | 1645 | 55.87 | 245 |
| 30 MAY 73 | 59.66 | 2100 | 57.01 | 600 |
| 31 MAY 73 | 60.51 | 1700 | 59.36 | 100 |
| AVERAGE | 55.60 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK N-10

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 JUN 73 | 61.95 | 2130 | 59.54 | 630 |
| 2 JUN 73 | 62.97 | 1545 | 61.11 | 545 |
| 3 JUN 73 | 63.28 | 1630 | 60.93 | 615 |
| 4 JUN 73 | 62.85 | 1600 | 61.65 | 645 |
| 5 JUN 73 | 74.60 | 830 | 61.77 | 445 |
| 6 JUN 73 | 71.41 | 1445 | 68.94 | 815 |
| 7 JUN 73 | 69.06 | 30 | 61.89 | 645 |
| 8 JUN 73 | 66.11 | 1730 | 63.58 | 545 |
| 9 JUN 73 | 69.48 | 2100 | 65.20 | 515 |
| 10 JUN 73 | 70.14 | 2200 | 66.11 | 545 |
| 11 JUN 73 | 71.41 | 1630 | 68.15 | 545 |
| 12 JUN 73 | 73.45 | 1230 | 70.74 | 530 |
| 13 JUN 73 | 74.96 | 515 | 71.95 | 2400 |
| 14 JUN 73 | 74.90 | 1700 | 71.10 | 330 |
| 15 JUN 73 | NO DATA FOR THIS DAY | | | |
| 16 JUN 73 | NO DATA FOR THIS DAY | | | |
| 17 JUN 73 | NO DATA FOR THIS DAY | | | |
| 18 JUN 73 | NO DATA FOR THIS DAY | | | |
| 19 JUN 73 | NO DATA FOR THIS DAY | | | |
| 20 JUN 73 | NO DATA FOR THIS DAY | | | |
| 21 JUN 73 | NO DATA FOR THIS DAY | | | |
| 22 JUN 73 | NO DATA FOR THIS DAY | | | |
| 23 JUN 73 | NO DATA FOR THIS DAY | | | |
| 24 JUN 73 | NO DATA FOR THIS DAY | | | |
| 25 JUN 73 | NO DATA FOR THIS DAY | | | |
| 26 JUN 73 | NO DATA FOR THIS DAY | | | |
| 27 JUN 73 | NO DATA FOR THIS DAY | | | |
| 28 JUN 73 | NO DATA FOR THIS DAY | | | |
| 29 JUN 73 | NO DATA FOR THIS DAY | | | |
| 30 JUN 73 | NO DATA FOR THIS DAY | | | |
| AVERAGE | 69.04 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK N-10

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 JUL 73 | 68.70 | 2030 | 67.67 | 2245 |
| 2 JUL 73 | 72.79 | 2200 | 66.41 | 945 |
| 3 JUL 73 | 74.84 | 730 | 72.85 | 415 |
| 4 JUL 73 | NO DATA FOR THIS DAY | | | |
| 5 JUL 73 | NO DATA FOR THIS DAY | | | |
| 6 JUL 73 | 72.85 | 1915 | 71.10 | 1000 |
| 7 JUL 73 | NO DATA FOR THIS DAY | | | |
| 8 JUL 73 | NO DATA FOR THIS DAY | | | |
| 9 JUL 73 | NO DATA FOR THIS DAY | | | |
| 10 JUL 73 | NO DATA FOR THIS DAY | | | |
| 11 JUL 73 | NO DATA FOR THIS DAY | | | |
| 12 JUL 73 | NO DATA FOR THIS DAY | | | |
| 13 JUL 73 | NO DATA FOR THIS DAY | | | |
| 14 JUL 73 | NO DATA FOR THIS DAY | | | |
| 15 JUL 73 | NO DATA FOR THIS DAY | | | |
| 16 JUL 73 | NO DATA FOR THIS DAY | | | |
| 17 JUL 73 | NO DATA FOR THIS DAY | | | |
| 18 JUL 73 | NO DATA FOR THIS DAY | | | |
| 19 JUL 73 | NO DATA FOR THIS DAY | | | |
| 20 JUL 73 | NO DATA FOR THIS DAY | | | |
| 21 JUL 73 | NO DATA FOR THIS DAY | | | |
| 22 JUL 73 | NO DATA FOR THIS DAY | | | |
| 23 JUL 73 | 80.62 | 2015 | 75.92 | 2315 |
| JUL 73 | 83.87 | 1045 | 74.18 | 745 |
| 25 JUL 73 | 82.30 | 2045 | 75.98 | 915 |
| 26 JUL 73 | 83.21 | 115 | 75.68 | 2115 |
| 27 JUL 73 | 82.30 | 2345 | 75.68 | 1915 |
| 28 JUL 73 | 83.51 | 1230 | 74.42 | 500 |
| 29 JUL 73 | 84.77 | 2300 | 77.97 | 515 |
| 30 JUL 73 | 85.98 | 1745 | 77.19 | 230 |
| 31 JUL 73 | 84.77 | 2230 | 78.39 | 215 |
| AVERAGE | 80.04 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK N-10

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 AUG 73 | 84.11 | 115 | 77.97 | 1315 |
| 2 AUG 73 | 83.75 | 515 | 78.57 | 2115 |
| 3 AUG 73 | 83.15 | 2100 | 76.04 | 800 |
| 4 AUG 73 | 84.89 | 2345 | 77.13 | 245 |
| 5 AUG 73 | 87.78 | 1445 | 77.85 | 715 |
| 6 AUG 73 | 84.47 | 1030 | 77.31 | 730 |
| 7 AUG 73 | 87.66 | 2130 | 78.57 | 745 |
| 8 AUG 73 | 85.68 | 515 | 77.61 | 630 |
| 9 AUG 73 | 87.36 | 1445 | 78.51 | 830 |
| 10 AUG 73 | 87.78 | 2400 | 81.46 | 1330 |
| 11 AUG 73 | 89.83 | 100 | 80.50 | 2345 |
| 12 AUG 73 | 89.23 | 2100 | 79.05 | 445 |
| 13 AUG 73 | 86.52 | 2245 | 77.73 | 730 |
| 14 AUG 73 | 85.92 | 230 | 76.82 | 1715 |
| 15 AUG 73 | 80.02 | 145 | 74.90 | 1915 |
| 16 AUG 73 | 82.91 | 1345 | 74.90 | 1415 |
| 17 AUG 73 | 81.40 | 130 | 75.62 | 715 |
| 18 AUG 73 | 83.81 | 2015 | 76.58 | 200 |
| 19 AUG 73 | 84.29 | 945 | 78.09 | 1130 |
| 20 AUG 73 | 84.71 | 1430 | 76.76 | 815 |
| 21 AUG 73 | ~~92.12~~ | ~~1230~~ | 76.82 | 15 |
| 22 AUG 73 | 83.93 | 1500 | 76.04 | 2300 |
| 23 AUG 73 | 81.34 | 1330 | 73.87 | 900 |
| 24 AUG 73 | 81.58 | 1845 | 74.36 | 2245 |
| 25 AUG 73 | 80.20 | 2015 | 73.33 | 145 |
| 26 AUG 73 | 82.00 | 2030 | 73.99 | 715 |
| 27 AUG 73 | 85.14 | 2045 | 74.66 | 715 |
| 28 AUG 73 | 84.53 | 2215 | 76.76 | 445 |
| 29 AUG 73 | 86.70 | 2300 | 76.52 | 600 |
| 30 AUG 73 | 86.46 | 1915 | 78.69 | 1100 |
| 31 AUG 73 | 85.80 | 1445 | 63.76 | 1745 |
| AVERAGE | 85.00 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK N-10

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 OCT 73 | NO DATA FOR THIS DAY | | | |
| 2 OCT 73 | NO DATA FOR THIS DAY | | | |
| 3 OCT 73 | NO DATA FOR THIS DAY | | | |
| 4 OCT 73 | NO DATA FOR THIS DAY | | | |
| 5 OCT 73 | NO DATA FOR THIS DAY | | | |
| 6 OCT 73 | NO DATA FOR THIS DAY | | | |
| 7 OCT 73 | NO DATA FOR THIS DAY | | | |
| 8 OCT 73 | NO DATA FOR THIS DAY | | | |
| 9 OCT 73 | NO DATA FOR THIS DAY | | | |
| 10 OCT 73 | NO DATA FOR THIS DAY | | | |
| 11 OCT 73 | NO DATA FOR THIS DAY | | | |
| 12 OCT 73 | NO DATA FOR THIS DAY | | | |
| 13 OCT 73 | NO DATA FOR THIS DAY | | | |
| 14 OCT 73 | NO DATA FOR THIS DAY | | | |
| 15 OCT 73 | NO DATA FOR THIS DAY | | | |
| 16 OCT 73 | NO DATA FOR THIS DAY | | | |
| 17 OCT 73 | NO DATA FOR THIS DAY | | | |
| 18 OCT 73 | NO DATA FOR THIS DAY | | | |
| 19 OCT 73 | NO DATA FOR THIS DAY | | | |
| 20 OCT 73 | NO DATA FOR THIS DAY | | | |
| 21 OCT 73 | NO DATA FOR THIS DAY | | | |
| 22 OCT 73 | NO DATA FOR THIS DAY | | | |
| 23 OCT 73 | NO DATA FOR THIS DAY | | | |
| 24 OCT 73 | 52.80 | 1345 | 51.89 | 1100 |
| 25 OCT 73 | 53.10 | 1730 | 52.38 | 800 |
| 26 OCT 73 | 53.22 | 1430 | 52.56 | 600 |
| 27 OCT 73 | 52.98 | 1515 | 51.29 | 2400 |
| 28 OCT 73 | 51.35 | 15 | 50.09 | 730 |
| 29 OCT 73 | 50.21 | 15 | 49.49 | 2400 |
| 30 OCT 73 | 50.75 | 1730 | 49.36 | 330 |
| 31 OCT 73 | 51.59 | 1630 | 50.03 | 800 |
| AVERAGE | 52.00 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK N-10

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 NOV 73 | 50.93 | 15 | 49.30 | 2400 |
| 2 NOV 73 | 49.79 | 1615 | 48.88 | 730 |
| 3 NOV 73 | 49.30 | 15 | 47.44 | 2345 |
| 4 NOV 73 | 47.44 | 15 | 46.23 | 2345 |
| 5 NOV 73 | 46.17 | 30 | 44.25 | 2400 |
| 6 NOV 73 | 44.25 | 15 | 42.68 | 2400 |
| 7 NOV 73 | 42.62 | 15 | 41.84 | 730 |
| 8 NOV 73 | 41.90 | 900 | 41.48 | 2145 |
| 9 NOV 73 | 41.54 | 30 | 40.51 | 2345 |
| 10 NOV 73 | 40.45 | 15 | 38.46 | 2015 |
| 11 NOV 73 | 38.65 | 1300 | 37.44 | 730 |
| 12 NOV 73 | 37.92 | 1445 | 37.20 | 430 |
| 13 NOV 73 | 38.46 | 2400 | 37.50 | 15 |
| 14 NOV 73 | 40.51 | 2230 | 38.40 | 15 |
| 15 NOV 73 | 41.11 | 1530 | 40.15 | 515 |
| 16 NOV 73 | 41.42 | 1400 | 40.27 | 2400 |
| 17 NOV 73 | 40.27 | 15 | 38.22 | 2345 |
| 18 NOV 73 | 38.28 | 30 | 37.62 | 830 |
| 19 NOV 73 | 37.74 | 15 | 37.14 | 2345 |
| 20 NOV 73 | 37.68 | 1400 | 36.54 | 715 |
| 21 NOV 73 | 37.62 | 1330 | 36.48 | 530 |
| NOV 73 | 38.83 | 2300 | 37.56 | 30 |
| 23 NOV 73 | 39.67 | 2345 | 38.83 | 15 |
| 24 NOV 73 | 40.45 | 2230 | 39.37 | 645 |
| 25 NOV 73 | 40.99 | 1500 | 40.27 | 715 |
| 26 NOV 73 | 40.45 | 1315 | 39.61 | 615 |
| 27 NOV 73 | 40.15 | 715 | 39.37 | 2315 |
| 28 NOV 73 | 39.37 | 15 | 39.13 | 1500 |
| 29 NOV 73 | 39.55 | 1900 | 39.19 | 630 |
| 30 NOV 73 | 39.61 | 1530 | 39.07 | 415 |
| AVERAGE | 41.44 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK M-1J

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 DEC 73 | 39.43 | 30 | 37.38 | 2400 |
| 2 DEC 73 | 37.38 | 30 | 36.42 | 845 |
| 3 DEC 73 | 36.66 | 1415 | 36.12 | 845 |
| 4 DEC 73 | 36.48 | 1430 | 36.18 | 330 |
| 5 DEC 73 | 37.98 | 2345 | 36.42 | 15 |
| 6 DEC 73 | 39.73 | 1700 | 37.98 | 15 |
| 7 DEC 73 | 39.01 | 15 | 37.32 | 2315 |
| 8 DEC 73 | 37.26 | 15 | 36.12 | 1815 |
| 9 DEC 73 | 37.86 | 2345 | 36.18 | 30 |
| 10 DEC 73 | 38.89 | 1630 | 37.92 | 15 |
| 11 DEC 73 | 38.71 | 15 | 37.68 | 2330 |
| 12 DEC 73 | 37.68 | 15 | 35.82 | 2400 |
| 13 DEC 73 | 35.82 | 15 | 35.03 | 845 |
| 14 DEC 73 | 36.78 | 2000 | 35.27 | 30 |
| 15 DEC 73 | 36.66 | 15 | 35.57 | 2345 |
| 16 DEC 73 | 35.57 | 15 | 33.83 | 2400 |
| 17 DEC 73 | 33.83 | 15 | 33.41 | 1030 |
| 18 DEC 73 | 33.59 | 100 | 32.44 | 1830 |
| 19 DEC 73 | 32.50 | 30 | 32.44 | 15 |
| 20 DEC 73 | NO DATA FOR THIS DAY | | | |
| 21 DEC 73 | NO DATA FOR THIS DAY | | | |
| DEC 73 | NO DATA FOR THIS DAY | | | |
| 23 DEC 73 | NO DATA FOR THIS DAY | | | |
| 24 DEC 73 | NO DATA FOR THIS DAY | | | |
| 25 DEC 73 | NO DATA FOR THIS DAY | | | |
| 26 DEC 73 | NO DATA FOR THIS DAY | | | |
| 27 DEC 73 | NO DATA FOR THIS DAY | | | |
| 28 DEC 73 | NO DATA FOR THIS DAY | | | |
| 29 DEC 73 | NO DATA FOR THIS DAY | | | |
| 30 DEC 73 | NO DATA FOR THIS DAY | | | |
| 31 DEC 73 | NO DATA FOR THIS DAY | | | |
| AVERAGE | 36.94 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-0

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 JAN 73 | 41.96 | 400 | 33.32 | 1945 |
| 2 JAN 73 | 37.16 | 345 | 32.72 | 2130 |
| 3 JAN 73 | 35.12 | 1200 | 32.72 | 115 |
| 4 JAN 73 | 36.80 | 2130 | 32.78 | 100 |
| 5 JAN 73 | 36.50 | 1215 | 32.78 | 345 |
| 6 JAN 73 | 36.50 | 1415 | 32.66 | 1930 |
| 7 JAN 73 | 33.44 | 315 | 32.60 | 345 |
| 8 JAN 73 | 34.34 | 830 | 32.66 | 1700 |
| 9 JAN 73 | 32.90 | 1030 | 32.72 | 200 |
| 10 JAN 73 | 42.08 | 1145 | 32.78 | 30 |
| 11 JAN 73 | 40.58 | 200 | 32.84 | 800 |
| 12 JAN 73 | 40.38 | 2130 | 33.98 | 1530 |
| 13 JAN 73 | 41.18 | 1815 | 33.14 | 315 |
| 14 JAN 73 | 44.12 | 2200 | 33.32 | 645 |
| 15 JAN 73 | 47.61 | 1845 | 39.56 | 1000 |
| 16 JAN 73 | 48.09 | 2115 | 40.88 | 330 |
| 17 JAN 73 | 51.03 | 1730 | 37.52 | 1015 |
| 18 JAN 73 | 51.09 | 1845 | 42.98 | 915 |
| 19 JAN 73 | 49.83 | 1545 | 41.00 | 2215 |
| 20 JAN 73 | 45.80 | 115 | 32.78 | 2130 |
| 21 JAN 73 | 35.00 | 1045 | 32.72 | 330 |
| JAN 73 | 35.18 | 2200 | 32.78 | 630 |
| 23 JAN 73 | 34.58 | 30 | 32.84 | 2130 |
| 24 JAN 73 | 33.08 | 315 | 32.84 | 545 |
| 25 JAN 73 | 33.02 | 1145 | 32.78 | 230 |
| 26 JAN 73 | 33.14 | 1400 | 32.84 | 30 |
| 27 JAN 73 | 33.08 | 430 | 32.84 | 145 |
| 28 JAN 73 | 32.96 | 15 | 32.84 | 2000 |
| 29 JAN 73 | 32.96 | 1430 | 32.84 | 115 |
| 30 JAN 73 | 32.96 | 1500 | 32.78 | 2045 |
| 31 JAN 73 | 33.02 | 1115 | 32.84 | 100 |
| AVERAGE | 38.58 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-0

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 FEB 73 | 32.90 | 1100 | 32.84 | 1115 |
| 2 FEB 73 | 33.50 | 2245 | 32.84 | 45 |
| 3 FEB 73 | 38.36 | 200 | 32.90 | 2200 |
| 4 FEB 73 | 33.02 | 1015 | 32.84 | 145 |
| 5 FEB 73 | 33.02 | 1130 | 32.84 | 2245 |
| 6 FEB 73 | 33.02 | 1130 | 32.84 | 100 |
| 7 FEB 73 | 33.20 | 1245 | 32.84 | 315 |
| 8 FEB 73 | 33.44 | 1830 | 32.90 | 30 |
| 9 FEB 73 | 33.26 | 145 | 32.84 | 430 |
| 10 FEB 73 | 33.80 | 1430 | 32.84 | 30 |
| 11 FEB 73 | 33.62 | 630 | 32.84 | 415 |
| 12 FEB 73 | 34.64 | 1815 | 32.84 | 30 |
| 13 FEB 73 | 35.18 | 1730 | 32.96 | 745 |
| 14 FEB 73 | 37.64 | 2000 | 32.96 | 245 |
| 15 FEB 73 | 36.20 | 230 | 32.96 | 700 |
| 16 FEB 73 | 34.40 | 15 | 32.90 | 2015 |
| 17 FEB 73 | 38.66 | 2115 | 32.78 | 1900 |
| 18 FEB 73 | 40.88 | 1600 | 32.72 | 200 |
| 19 FEB 73 | 41.00 | 1415 | 33.02 | 315 |
| 20 FEB 73 | 48.15 | 845 | 37.10 | 900 |
| 21 FEB 73 | 50.01 | 1415 | 36.50 | 800 |
| 22 FEB 73 | 45.32 | 800 | 36.02 | 930 |
| 23 FEB 73 | 40.10 | 30 | 34.40 | 1000 |
| 24 FEB 73 | 38.96 | 1115 | 33.80 | 2400 |
| 25 FEB 73 | 39.26 | 2000 | 33.32 | 130 |
| 26 FEB 73 | 41.12 | 1730 | 33.44 | 715 |
| 27 FEB 73 | 38.72 | 1630 | 32.90 | 215 |
| 28 FEB 73 | 45.68 | 1915 | 32.90 | 600 |
| AVERAGE | 37.75 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- ER S-0

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 MAR 73 | 48.87 | 1415 | 38.36 | 230 |
| 2 MAR 73 | 50.37 | 2130 | 40.10 | 845 |
| 3 MAR 73 | 48.03 | 15 | 40.22 | 2215 |
| 4 MAR 73 | 46.65 | 2130 | 39.92 | 15 |
| 5 MAR 73 | 53.85 | 1930 | 40.28 | 845 |
| 6 MAR 73 | 52.71 | 1545 | 40.94 | 830 |
| 7 MAR 73 | 51.27 | 145 | 39.50 | 845 |
| 8 MAR 73 | 51.51 | 615 | 40.64 | 845 |
| 9 MAR 73 | 47.61 | 45 | 38.72 | 845 |
| 10 MAR 73 | 40.58 | 30 | 35.24 | 900 |
| 11 MAR 73 | 37.04 | 2400 | 34.64 | 415 |
| 12 MAR 73 | 41.60 | 800 | 34.58 | 545 |
| 13 MAR 73 | 39.68 | 230 | 35.48 | 715 |
| 14 MAR 73 | 36.62 | 15 | 35.06 | 2400 |
| 15 MAR 73 | 35.06 | 15 | 34.40 | 815 |
| 16 MAR 73 | 36.56 | 1900 | 34.64 | 615 |
| 17 MAR 73 | 37.04 | 2345 | 36.02 | 200 |
| 18 MAR 73 | 36.74 | 30 | 35.72 | 2315 |
| 19 MAR 73 | 35.72 | 15 | 35.18 | 800 |
| 20 MAR 73 | 35.90 | 1600 | 35.06 | 600 |
| 21 MAR 73 | 35.66 | 30 | 35.06 | 645 |
| MAR 73 | 36.68 | 2215 | 35.24 | 630 |
| 23 MAR 73 | 39.74 | 1615 | 35.72 | 530 |
| 24 MAR 73 | 41.78 | 1500 | 37.04 | 645 |
| 25 MAR 73 | 44.96 | 1600 | 39.26 | 845 |
| 26 MAR 73 | 44.78 | 1345 | 40.46 | 615 |
| 27 MAR 73 | 43.46 | 145 | 40.34 | 730 |
| 28 MAR 73 | 42.98 | 1700 | 40.46 | 615 |
| 29 MAR 73 | 43.22 | 2300 | 40.82 | 830 |
| 30 MAR 73 | 45.50 | 800 | 40.94 | 1000 |
| 31 MAR 73 | 47.91 | 2030 | 41.54 | 1045 |
| AVERAGE | 42.91 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-0

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 APR 73 | 44.15 | 315 | 42.98 | 1030 |
| 2 APR 73 | 46.77 | 130 | 41.84 | 2400 |
| 3 APR 73 | 41.84 | 15 | 40.10 | 2400 |
| 4 APR 73 | 40.16 | 15 | 39.32 | 2400 |
| 5 APR 73 | 39.56 | 1400 | 38.60 | 615 |
| 6 APR 73 | 40.82 | 1900 | 39.08 | 615 |
| 7 APR 73 | 42.14 | 2245 | 40.40 | 630 |
| 8 APR 73 | 42.68 | 1530 | 41.90 | 145 |
| 9 APR 73 | 43.58 | 1600 | 42.02 | 630 |
| 10 APR 73 | 43.16 | 1545 | 41.36 | 2330 |
| 11 APR 73 | 42.32 | 1545 | 39.92 | 2330 |
| 12 APR 73 | 43.04 | 1615 | 39.14 | 600 |
| 13 APR 73 | 45.20 | 1745 | 40.04 | 630 |
| 14 APR 73 | 47.37 | 1615 | 40.28 | 845 |
| 15 APR 73 | 45.20 | 1630 | 41.54 | 545 |
| 16 APR 73 | 48.03 | 1615 | 43.16 | 700 |
| 17 APR 73 | 49.47 | 1615 | 45.92 | 715 |
| 18 APR 73 | 49.89 | 1500 | 47.37 | 345 |
| 19 APR 73 | 52.53 | 2330 | 49.35 | 45 |
| 20 APR 73 | 53.01 | 1715 | 51.21 | 730 |
| 21 APR 73 | 58.11 | 2245 | 50.97 | 915 |
| 22 APR 73 | 64.84 | 1815 | 54.69 | 930 |
| 23 APR 73 | 63.70 | 15 | 59.19 | 645 |
| 24 APR 73 | 61.60 | 2230 | 55.65 | 745 |
| 25 APR 73 | 63.76 | 2030 | 55.77 | 930 |
| 26 APR 73 | 64.24 | 1515 | 57.75 | 815 |
| 27 APR 73 | 63.46 | 15 | 53.19 | 1645 |
| 28 APR 73 | 58.29 | 1645 | 55.23 | 145 |
| 29 APR 73 | 60.97 | 2315 | 57.21 | 30 |
| 30 APR 73 | 66.70 | 2400 | 60.45 | 500 |
| AVERAGE | 51.02 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-0

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 MAY 73 | 76.31 | 2400 | 66.58 | 15 |
| 2 MAY 73 | 83.57 | 2315 | 76.01 | 15 |
| 3 MAY 73 | 89.33 | 2100 | 82.73 | 130 |
| 4 MAY 73 | 88.97 | 130 | 83.63 | 515 |
| 5 MAY 73 | NO DATA FOR THIS DAY | | | |
| 6 MAY 73 | NO DATA FOR THIS DAY | | | |
| 7 MAY 73 | NO DATA FOR THIS DAY | | | |
| 8 MAY 73 | NO DATA FOR THIS DAY | | | |
| 9 MAY 73 | NO DATA FOR THIS DAY | | | |
| 10 MAY 73 | NO DATA FOR THIS DAY | | | |
| 11 MAY 73 | NO DATA FOR THIS DAY | | | |
| 12 MAY 73 | NO DATA FOR THIS DAY | | | |
| 13 MAY 73 | NO DATA FOR THIS DAY | | | |
| 14 MAY 73 | NO DATA FOR THIS DAY | | | |
| 15 MAY 73 | NO DATA FOR THIS DAY | | | |
| 16 MAY 73 | NO DATA FOR THIS DAY | | | |
| 17 MAY 73 | NO DATA FOR THIS DAY | | | |
| 18 MAY 73 | NO DATA FOR THIS DAY | | | |
| 19 MAY 73 | NO DATA FOR THIS DAY | | | |
| 20 MAY 73 | NO DATA FOR THIS DAY | | | |
| 21 MAY 73 | NO DATA FOR THIS DAY | | | |
| MAY 73 | NO DATA FOR THIS DAY | | | |
| 23 MAY 73 | NO DATA FOR THIS DAY | | | |
| 24 MAY 73 | NO DATA FOR THIS DAY | | | |
| 25 MAY 73 | NO DATA FOR THIS DAY | | | |
| 26 MAY 73 | NO DATA FOR THIS DAY | | | |
| 27 MAY 73 | NO DATA FOR THIS DAY | | | |
| 28 MAY 73 | NO DATA FOR THIS DAY | | | |
| 29 MAY 73 | NO DATA FOR THIS DAY | | | |
| 30 MAY 73 | NO DATA FOR THIS DAY | | | |
| 31 MAY 73 | NO DATA FOR THIS DAY | | | |
| AVERAGE | 84.40 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- SK S-O

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 JUN 73 | NO DATA FOR THIS DAY | | | |
| 2 JUN 73 | NO DATA FOR THIS DAY | | | |
| 3 JUN 73 | NO DATA FOR THIS DAY | | | |
| 4 JUN 73 | NO DATA FOR THIS DAY | | | |
| 5 JUN 73 | NO DATA FOR THIS DAY | | | |
| 6 JUN 73 | NO DATA FOR THIS DAY | | | |
| 7 JUN 73 | NO DATA FOR THIS DAY | | | |
| 8 JUN 73 | 74.44 | 1530 | 69.94 | 2400 |
| 9 JUN 73 | 70.60 | 1545 | 67.48 | 545 |
| 10 JUN 73 | 74.29 | 2200 | 69.64 | 130 |
| 11 JUN 73 | 77.65 | 1615 | 73.30 | 645 |
| 12 JUN 73 | 79.19 | 1745 | 75.64 | 430 |
| 13 JUN 73 | 79.61 | 745 | 77.09 | 400 |
| 14 JUN 73 | 78.23 | 1845 | 75.94 | 700 |
| 15 JUN 73 | 77.99 | 1100 | 71.62 | 2400 |
| 16 JUN 73 | 71.38 | 15 | 68.20 | 2400 |
| 17 JUN 73 | 73.12 | 2400 | 66.82 | 630 |
| 18 JUN 73 | 74.56 | 1615 | 69.76 | 530 |
| 19 JUN 73 | 74.14 | 1200 | 70.78 | 515 |
| 20 JUN 73 | 75.10 | 1545 | 70.78 | 745 |
| 21 JUN 73 | 78.29 | 1700 | 73.96 | 215 |
| JUN 73 | 78.11 | 730 | 74.68 | 2330 |
| 23 JUN 73 | 78.17 | 1645 | 74.44 | 45 |
| 24 JUN 73 | 77.51 | 1530 | 75.58 | 900 |
| 25 JUN 73 | 78.47 | 1600 | 75.10 | 1045 |
| 26 JUN 73 | 77.87 | 1915 | 75.52 | 600 |
| 27 JUN 73 | 79.89 | 1945 | 76.79 | 900 |
| 28 JUN 73 | 81.59 | 1945 | 76.55 | 345 |
| 29 JUN 73 | 81.83 | 1715 | 69.58 | 615 |
| 30 JUN 73 | 80.69 | 15 | 70.54 | 2230 |
| AVERAGE | 77.10 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-0

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 NOV 73 | NO DATA FOR THIS DAY | | | |
| 2 NOV 73 | 59.13 | 2315 | 54.63 | 1145 |
| 3 NOV 73 | 58.95 | 30 | 53.43 | 1300 |
| 4 NOV 73 | 55.77 | 2130 | 51.45 | 1115 |
| 5 NOV 73 | 55.53 | 115 | 50.67 | 1300 |
| 6 NOV 73 | 54.39 | 115 | 47.13 | 1315 |
| 7 NOV 73 | 53.01 | 2200 | 46.65 | 1300 |
| 8 NOV 73 | 53.07 | 500 | 44.84 | 1100 |
| 9 NOV 73 | 50.31 | 1930 | 43.64 | 2130 |
| 10 NOV 73 | 48.81 | 2400 | 42.20 | 1600 |
| 11 NOV 73 | 49.89 | 000 | 43.28 | 1600 |
| 12 NOV 73 | 49.41 | 115 | 42.50 | 1530 |
| 13 NOV 73 | 50.73 | 745 | 44.18 | 915 |
| 14 NOV 73 | 49.35 | 2345 | 42.02 | 1200 |
| 15 NOV 73 | 52.89 | 1130 | 44.60 | 800 |
| 16 NOV 73 | 50.43 | 1030 | 42.14 | 1700 |
| 17 NOV 73 | 49.65 | 2200 | 43.34 | 530 |
| 18 NOV 73 | 49.53 | 2045 | 44.36 | 1100 |
| 19 NOV 73 | 51.63 | 845 | 46.11 | 1500 |
| 20 NOV 73 | 50.37 | 1645 | 44.00 | 645 |
| 21 NOV 73 | 50.79 | 830 | 42.44 | 1700 |
| NOV 73 | 49.71 | 1330 | 42.80 | 2315 |
| 23 NOV 73 | 52.17 | 1915 | 43.28 | 530 |
| 24 NOV 73 | 52.77 | 1345 | 43.58 | 15 |
| 25 NOV 73 | 52.35 | 730 | 43.52 | 2345 |
| 26 NOV 73 | 52.11 | 1430 | 43.70 | 630 |
| 27 NOV 73 | 51.91 | 1745 | 46.53 | 730 |
| 28 NOV 73 | 51.51 | 1400 | 44.72 | 615 |
| 29 NOV 73 | 50.85 | 245 | 44.90 | 1130 |
| 30 NOV 73 | 52.23 | 2030 | 49.71 | 15 |
| AVERAGE | 52.04 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-O

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 DEC 73 | 52.47 | 30 | 44.60 | 1515 |
| 2 DEC 73 | 49.59 | 15 | 43.70 | 1930 |
| 3 DEC 73 | 48.93 | 1915 | 42.14 | 815 |
| 4 DEC 73 | 50.13 | 1930 | 46.65 | 630 |
| 5 DEC 73 | 50.01 | 830 | 45.38 | 900 |
| 6 DEC 73 | 52.05 | 1315 | 45.02 | 1015 |
| 7 DEC 73 | 51.99 | 130 | 48.21 | 2115 |
| 8 DEC 73 | 51.15 | 2230 | 47.31 | 1015 |
| 9 DEC 73 | 52.95 | 1730 | 48.81 | 1915 |
| 10 DEC 73 | 52.23 | 2345 | 49.11 | 845 |
| 11 DEC 73 | 52.11 | 30 | 45.44 | 1000 |
| 12 DEC 73 | 50.49 | 1745 | 41.96 | 330 |
| 13 DEC 73 | 50.43 | 1915 | 41.72 | 1315 |
| 14 DEC 73 | 51.27 | 800 | 45.68 | 2400 |
| 15 DEC 73 | 46.05 | 30 | 35.12 | 2400 |
| 16 DEC 73 | 35.12 | 15 | 33.44 | 2315 |
| 17 DEC 73 | 35.60 | 2115 | 33.14 | 300 |
| 18 DEC 73 | 34.82 | 115 | 32.12 | 1800 |
| 19 DEC 73 | NO DATA FOR THIS DAY | | | |
| 20 DEC 73 | NO DATA FOR THIS DAY | | | |
| 21 DEC 73 | NO DATA FOR THIS DAY | | | |
| DEC 73 | NO DATA FOR THIS DAY | | | |
| 23 DEC 73 | NO DATA FOR THIS DAY | | | |
| 24 DEC 73 | NO DATA FOR THIS DAY | | | |
| 25 DEC 73 | NO DATA FOR THIS DAY | | | |
| 26 DEC 73 | NO DATA FOR THIS DAY | | | |
| 27 DEC 73 | NO DATA FOR THIS DAY | | | |
| 28 DEC 73 | NO DATA FOR THIS DAY | | | |
| 29 DEC 73 | NO DATA FOR THIS DAY | | | |
| 30 DEC 73 | NO DATA FOR THIS DAY | | | |
| 31 DEC 73 | NO DATA FOR THIS DAY | | | |
| AVERAGE | 48.19 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-4

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 JUN 73 | NO DATA FOR THIS DAY | | | |
| 2 JUN 73 | NO DATA FOR THIS DAY | | | |
| 3 JUN 73 | NO DATA FOR THIS DAY | | | |
| 4 JUN 73 | NO DATA FOR THIS DAY | | | |
| 5 JUN 73 | NO DATA FOR THIS DAY | | | |
| 6 JUN 73 | NO DATA FOR THIS DAY | | | |
| 7 JUN 73 | NO DATA FOR THIS DAY | | | |
| 8 JUN 73 | 68.14 | 1845 | 66.83 | 2400 |
| 9 JUN 73 | 68.62 | 1645 | 66.18 | 445 |
| 10 JUN 73 | 71.35 | 2330 | 67.43 | 730 |
| 1 JUN 73 | 79.32 | 1845 | 69.74 | 515 |
| 2 JUN 73 | 84.07 | 1515 | 72.42 | 200 |
| 13 JUN 73 | 80.15 | 45 | 72.96 | 800 |
| 4 JUN 73 | 74.26 | 1915 | 71.23 | 745 |
| 5 JUN 73 | 73.25 | 15 | 69.92 | 2400 |
| 16 JUN 73 | 69.80 | 15 | 67.43 | 2400 |
| 17 JUN 73 | 68.62 | 1615 | 66.18 | 600 |
| 8 JUN 73 | 70.28 | 1715 | 67.31 | 615 |
| 19 JUN 73 | 70.22 | 1545 | 67.60 | 600 |
| 20 JUN 73 | 73.31 | 1600 | 66.18 | 745 |
| 1 JUN 73 | 77.24 | 1315 | 69.51 | 215 |
| 2 JUN 73 | 79.85 | 1500 | 71.17 | 1645 |
| 2 JUN 73 | 78.49 | 15 | 70.99 | 45 |
| 4 JUN 73 | 77.47 | 1345 | 71.77 | 2015 |
| 5 JUN 73 | 78.13 | 1700 | 70.99 | 1000 |
| 26 JUN 73 | 79.14 | 1445 | 74.32 | 830 |
| 27 JUN 73 | 80.39 | 1300 | 77.36 | 30 |
| 8 JUN 73 | 80.63 | 1430 | 78.55 | 1200 |
| 29 JUN 73 | 80.39 | 1445 | 76.64 | 400 |
| 30 JUN 73 | 78.01 | 15 | 71.94 | 2400 |
| AVERAGE | 75.70 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-4

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 JUL 73 | 71.83 | 15 | 69.27 | 2400 |
| 2 JUL 73 | 69.39 | 15 | 68.44 | 945 |
| 3 JUL 73 | 70.22 | 1945 | 68.50 | 545 |
| 4 JUL 73 | 70.10 | 15 | 69.21 | 730 |
| 5 JUL 73 | 70.34 | 1630 | 69.51 | 530 |
| 6 JUL 73 | 71.35 | 1915 | 69.45 | 530 |
| 7 JUL 73 | 72.30 | 2000 | 70.22 | 600 |
| 8 JUL 73 | 73.31 | 1945 | 71.59 | 545 |
| 9 JUL 73 | 73.61 | 1630 | 72.18 | 600 |
| 10 JUL 73 | 73.61 | 1915 | 72.72 | 600 |
| 11 JUL 73 | 74.74 | 1700 | 72.84 | 745 |
| 12 JUL 73 | 74.32 | 15 | 73.37 | 730 |
| 13 JUL 73 | 74.62 | 1645 | 73.13 | 600 |
| 14 JUL 73 | 74.32 | 15 | 72.66 | 645 |
| 15 JUL 73 | 73.19 | 15 | 71.77 | 2215 |
| 16 JUL 73 | 75.22 | 1700 | 71.35 | 600 |
| 17 JUL 73 | 74.62 | 1530 | 72.78 | 630 |
| 18 JUL 73 | 74.38 | 1745 | 72.24 | 730 |
| 19 JUL 73 | 76.40 | 1415 | 72.66 | 630 |
| 20 JUL 73 | 78.78 | 1515 | 74.98 | 645 |
| 21 JUL 73 | 79.50 | 2245 | 74.15 | 2400 |
| 22 JUL 73 | 82.71 | 1945 | 73.07 | 630 |
| 23 JUL 73 | 85.15 | 1800 | 73.61 | 630 |
| 24 JUL 73 | 83.78 | 1830 | 74.62 | 645 |
| 25 JUL 73 | 86.27 | 1830 | 75.51 | 700 |
| 26 JUL 73 | 84.67 | 1800 | 80.63 | 1415 |
| 27 JUL 73 | 86.39 | 1630 | 80.75 | 2045 |
| 28 JUL 73 | 87.76 | 1900 | 82.11 | 415 |
| 29 JUL 73 | 89.37 | 1200 | 82.89 | 1415 |
| 30 JUL 73 | 90.26 | 1345 | 77.24 | 730 |
| 31 JUL 73 | 89.01 | 1400 | 83.78 | 745 |
| AVERAGE | 77.79 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

1066.45

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-4

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 AUG 73 | 88.30 | 2015 | 78.43 | 700 |
| 2 AUG 73 | 86.93 | 15 | 80.75 | 1130 |
| 3 AUG 73 | 81.46 | 15 | 75.93 | 615 |
| 4 AUG 73 | 80.86 | 1800 | 78.31 | 100 |
| 5 AUG 73 | 82.47 | 1930 | 78.49 | 445 |
| 6 AUG 73 | 84.79 | 1745 | 78.31 | 730 |
| 7 AUG 73 | 87.52 | 1530 | 78.84 | 700 |
| 8 AUG 73 | 88.89 | 1515 | 82.77 | 645 |
| 9 AUG 73 | 89.07 | 1330 | 84.25 | 815 |
| 10 AUG 73 | 91.03 | 1645 | 86.16 | 630 |
| 11 AUG 73 | 90.02 | 1645 | 87.35 | 615 |
| 12 AUG 73 | 88.59 | 1730 | 83.84 | 1500 |
| 13 AUG 73 | 86.39 | 115 | 78.60 | 845 |
| 14 AUG 73 | 85.15 | 15 | 81.82 | 615 |
| 15 AUG 73 | 84.43 | 1130 | 81.64 | 2400 |
| 16 AUG 73 | 81.16 | 15 | 73.13 | 715 |
| 17 AUG 73 | 81.16 | 1515 | 74.32 | 515 |
| 18 AUG 73 | 82.59 | 1230 | 76.11 | 630 |
| 19 AUG 73 | 82.65 | 1330 | 79.62 | 445 |
| 20 AUG 73 | 88.77 | 1500 | 79.38 | 2400 |
| 21 AUG 73 | 80.69 | 1530 | 77.30 | 600 |
| AUG 73 | 86.10 | 1515 | 78.25 | 30 |
| 23 AUG 73 | 85.03 | 1545 | 79.50 | 915 |
| 24 AUG 73 | 83.66 | 1030 | 80.09 | 1000 |
| 25 AUG 73 | 85.98 | 1545 | 79.73 | 815 |
| 26 AUG 73 | 86.57 | 1930 | 83.36 | 700 |
| 27 AUG 73 | 90.50 | 1730 | 84.31 | 700 |
| 28 AUG 73 | 89.07 | 15 | 65.64 | 1130 |
| 29 AUG 73 | NO DATA FOR THIS DAY | | | |
| 30 AUG 73 | NO DATA FOR THIS DAY | | | |
| 31 AUG 73 | NO DATA FOR THIS DAY | | | |
| AVERAGE | 85.71 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-4

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 OCT 73 | NO DATA FOR THIS DAY | | | |
| 2 OCT 73 | NO DATA FOR THIS DAY | | | |
| 3 OCT 73 | NO DATA FOR THIS DAY | | | |
| 4 OCT 73 | NO DATA FOR THIS DAY | | | |
| 5 OCT 73 | NO DATA FOR THIS DAY | | | |
| 6 OCT 73 | NO DATA FOR THIS DAY | | | |
| 7 OCT 73 | NO DATA FOR THIS DAY | | | |
| 8 OCT 73 | NO DATA FOR THIS DAY | | | |
| 9 OCT 73 | NO DATA FOR THIS DAY | | | |
| 10 OCT 73 | NO DATA FOR THIS DAY | | | |
| 11 OCT 73 | NO DATA FOR THIS DAY | | | |
| 12 OCT 73 | NO DATA FOR THIS DAY | | | |
| 13 OCT 73 | NO DATA FOR THIS DAY | | | |
| 14 OCT 73 | NO DATA FOR THIS DAY | | | |
| 15 OCT 73 | NO DATA FOR THIS DAY | | | |
| 16 OCT 73 | NO DATA FOR THIS DAY | | | |
| 17 OCT 73 | NO DATA FOR THIS DAY | | | |
| 18 OCT 73 | NO DATA FOR THIS DAY | | | |
| 19 OCT 73 | NO DATA FOR THIS DAY | | | |
| 20 OCT 73 | NO DATA FOR THIS DAY | | | |
| 21 OCT 73 | NO DATA FOR THIS DAY | | | |
| OCT 73 | 53.33 | 1300 | 51.73 | 2330 |
| 23 OCT 73 | 52.32 | 1445 | 50.90 | 900 |
| 24 OCT 73 | 58.21 | 1945 | 51.25 | 430 |
| 25 OCT 73 | 57.62 | 1315 | 53.39 | 600 |
| 26 OCT 73 | 57.97 | 1715 | 54.70 | 1015 |
| 27 OCT 73 | 57.02 | 130 | 52.86 | 900 |
| 28 OCT 73 | 55.83 | 1230 | 52.80 | 815 |
| 29 OCT 73 | 54.34 | 15 | 50.72 | 1545 |
| 30 OCT 73 | 55.95 | 2115 | 50.90 | 845 |
| 31 OCT 73 | 53.99 | 15 | 51.07 | 500 |
| AVERAGE | 55.66 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-4

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 NOV 73 | 53.69 | 230 | 50.42 | 2400 |
| 2 NOV 73 | 57.38 | 2000 | 50.24 | 315 |
| 3 NOV 73 | 56.54 | 45 | 48.87 | 2400 |
| 4 NOV 73 | 55.95 | 2215 | 48.22 | 2030 |
| 5 NOV 73 | 55.00 | 145 | 45.96 | 2200 |
| 6 NOV 73 | 51.67 | 2200 | 44.53 | 1745 |
| 7 NOV 73 | 52.98 | 2030 | 43.82 | 1015 |
| 8 NOV 73 | 54.64 | 2400 | 48.64 | 1245 |
| 9 NOV 73 | 53.87 | 15 | 42.21 | 2345 |
| 10 NOV 73 | 50.72 | 1915 | 41.44 | 645 |
| 11 NOV 73 | 50.18 | 1845 | 41.26 | 1600 |
| 12 NOV 73 | 50.54 | 1945 | 41.56 | 800 |
| 13 NOV 73 | 52.74 | 2015 | 41.92 | 1400 |
| 14 NOV 73 | 56.60 | 2115 | 48.04 | 1015 |
| 15 NOV 73 | 56.37 | 1930 | 48.10 | 1315 |
| 16 NOV 73 | 57.20 | 1100 | 42.39 | 2315 |
| 17 NOV 73 | 49.59 | 615 | 41.62 | 700 |
| 18 NOV 73 | 46.44 | 1930 | 41.20 | 530 |
| 19 NOV 73 | 44.42 | 45 | 41.09 | 845 |
| 20 NOV 73 | 48.10 | 1930 | 40.73 | 730 |
| 21 NOV 73 | 50.13 | 1315 | 41.09 | 845 |
| 22 NOV 73 | 54.17 | 2015 | 41.32 | 1245 |
| 23 NOV 73 | 55.12 | 200 | 41.92 | 2145 |
| 24 NOV 73 | 55.42 | 1715 | 42.45 | 930 |
| 25 NOV 73 | 57.32 | 300 | 42.87 | 1315 |
| 26 NOV 73 | 54.92 | 315 | 42.51 | 1030 |
| 27 NOV 73 | 49.59 | 100 | 42.33 | 2215 |
| 28 NOV 73 | 51.49 | 645 | 41.98 | 445 |
| 29 NOV 73 | 46.85 | 45 | 41.98 | 700 |
| 30 NOV 73 | 43.76 | 515 | 42.27 | 630 |
| AVERAGE | 52.44 | | | |

ALL TEMPERATURE READINGS IN DEGREES F

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ENVIRONMENTAL TEMPERATURE TAPE -- MERRIMACK RIVER -- MK S-4

| DAY | MAX. TEMP. | TIME | MIN. TEMP. | TIME |
|---|---|---|---|---|
| 1 DEC 73 | 43.70 | 45 | 41.56 | 1630 |
| 2 DEC 73 | NO DATA FOR THIS DAY | | | |
| 3 DEC 73 | NO DATA FOR THIS DAY | | | |
| 4 DEC 73 | NO DATA FOR THIS DAY | | | |
| 5 DEC 73 | NO DATA FOR THIS DAY | | | |
| 6 DEC 73 | NO DATA FOR THIS DAY | | | |
| 7 DEC 73 | 41.80 | 1415 | 40.01 | 2400 |
| 8 DEC 73 | 40.79 | 245 | 38.77 | 1145 |
| 9 DEC 73 | 49.05 | 1930 | 39.18 | 830 |
| 10 DEC 73 | 47.51 | 330 | 41.74 | 900 |
| 11 DEC 73 | 43.52 | 15 | 40.49 | 2345 |
| 12 DEC 73 | 40.79 | 1215 | 38.11 | 2400 |
| 13 DEC 73 | 41.50 | 2330 | 36.27 | 615 |
| 14 DEC 73 | 46.14 | 1330 | 36.51 | 130 |
| 15 DEC 73 | 40.19 | 15 | 36.15 | 2245 |
| 16 DEC 73 | 36.15 | 15 | 34.43 | 2400 |
| 17 DEC 73 | 34.54 | 1915 | 34.13 | 345 |
| 18 DEC 73 | 34.43 | 115 | 33.12 | 1900 |
| 19 DEC 73 | 33.36 | 1330 | 33.12 | 45 |
| 20 DEC 73 | 33.47 | 2315 | 33.12 | 100 |
| 21 DEC 73 | 34.94 | 1945 | 33.24 | 100 |
| 22 DEC 73 | 34.43 | 15 | 33.12 | 830 |
| 23 DEC 73 | 33.41 | 2000 | 33.12 | 30 |
| 24 DEC 73 | 33.30 | 15 | 33.12 | 300 |
| 25 DEC 73 | 33.24 | 1345 | 33.12 | 15 |
| 26 DEC 73 | 33.83 | 2300 | 33.18 | 15 |
| 27 DEC 73 | 34.25 | 1945 | 33.83 | 15 |
| 28 DEC 73 | 34.49 | 1500 | 34.07 | 715 |
| 29 DEC 73 | 34.43 | 1930 | 33.83 | 730 |
| 30 DEC 73 | 34.66 | 1300 | 34.37 | 45 |
| 31 DEC 73 | 34.49 | 15 | 33.89 | 1645 |
| AVERAGE | 37.79 | | | |

ALL TEMPERATURE READINGS IN DEGREES F