

JOB PROGRESS REPORT

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FEDERAL AID IN FISHERIES RESTORATION ACT

TEXAS

Federal Aid Project No. F-2-R-19

REGION 2-B FISHERIES STUDIES

Job No. B-27: The Effects of a Thermal Effluent on the  
Seasonal Criteria of Decker Lake

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## JOB PROGRESS REPORT

State of Texas

Project No. F-2-R-19

Name: Region 2-B Fisheries Studies

Job No. B-27

Title: The Effects of a Thermal Effluent  
on the Seasonal Criteria of  
Decker Lake

Period Covered: February 1, 1971 to January 31, 1972

### Objectives:

1. To review existing literature relative to the effects of a thermal effluent to aquatic life.
2. To determine the seasonal changes in the physical, chemical, and biotic parameters of the waters of Decker Lake.

### Procedures:

This job was scheduled to begin February 1, 1971. However, since the project was involved with plans and preparations to renovate Lake Lyndon B. Johnson and all time and manpower was devoted to this renovation, the first collections and samplings of Decker Lake was postponed until July, 1971. The generating plant was in test operation at this time and discharging into the lake. This was completed during November and no generation will be carried out until April 1972.

Existing literature was reviewed concerning the effects of temperature on aquatic life and is continuing throughout the job.

In June, 1971, seven water sampling stations were selected for measuring physical and chemical water criteria (Figure I). These stations were marked with styrofoam bouys to insure sampling at the same site each time. Water samples were collected at the surface and bottom at each station monthly and the following criteria was measured: Temperature at five-foot intervals, dissolved oxygen, alkalinity, pH, water transparency, and specific conductance. Temperature profiles were also measured at five-foot intervals at the 32 bottom sampling stations.

Temperatures were measured with an electric thermometer and the dissolved oxygen determined by the Winkler Method. The alkalinity was determined by the indicator method. The pH was measured by the use of the Hach wide range comparator and the conductivity with a Beckman model RA-2A conductivity meter. A Secchi disc was used to determine water transparency.

Benthos samples were collected monthly with a 6 in. X 6 in. Ekman dredge from four transects, two located on the inlet side and two on the discharge side (Figure II). Eight samples were collected from each of the transects. These samples were first collected from the seven water sampling sites but were changed in September to transects to collect more meaningful data. The samples were washed in the field and preserved in 80% alcohol until they could be separated and identified. The organisms

were taxonomically classified to genera in the laboratory and recorded for future computations.

Netting surveys were conducted quarterly since the job began. Ten stations were sampled in each survey with 150 feet experimental gill nets. The fish collected were weighed, measured and examined to determine sexual development. The composite of these netting surveys is included in this report (Table I). Seining collections were also made at various stations.

Due to the time spent on other jobs during this segment and a shortage of personnel, it was not possible to carry out the food habit study as planned. The process of collecting and examining the stomach samples would have required more time than was available to do justice to the study. It was also the plans to use the Carbon-14 method to determine productivity. However, the equipment needed could not be obtained in time to use on this job.

It was decided by project and department personnel that plankton collections should be made although an extensive study in this area would not be possible. Plankton samples will be collected during the next segment as soon as the necessary equipment can be obtained. These samples will be collected at one station in the cool water and one station in the area of the thermal influence in an attempt to observe any drastic change that might take place.

#### Findings:

Since only six months of data has been collected this segment, no conclusions or definite findings can be made at this time. More complete analysis of the data will be made for the next segment when more data has been collected and available for analysis

#### Water Quality

From July to November of this segment, the power plant was in operation. This discharge had some affect on the water quality in the areas of stations #1 and #2 in the form of higher temperatures at these two stations and slightly lower dissolved oxygen readings as a result of these higher temperatures. The surface temperatures at station #1, approximately 100 yards from the discharge, ranged from a high of 88 degrees F. in August to a low of 55 degrees in February when the generation had stopped. During the time the plant was generating the influence of this discharge was not carried past station #2 during most sampling periods. The data indicates a cooling of the water past station #2 and a warming trend of the water in the shallower, cool side during the warmer months. A three degree temperature change was observed between the discharge and intake areas during July, one degree in August, six degrees in September and October, and an equalization of temperatures in these areas after generation was stopped. Other project activities prohibited sampling during the month of November.

Decker Lake was stratified at the date of the first sampling in July. During this month the thermocline was observed at 25-30 feet with a depletion of dissolved oxygen below 30 feet. This decreased in depth in August to a thermocline at 20 feet and zero oxygen below 25 feet. Destratification began in September and the thermocline had dropped to between 35 and 40 feet and dissolved oxygen as deep as 35 feet. By December high concentrations of dissolved oxygen were measured at all stations and depths as a result of destratification and lack of thermal discharge. This condition

continued through February.

Only carbonate alkalinity was found in all samplings remaining relatively constant except during stratification. Both the high and low readings were observed during the months of August at different depths. The low of 109 mg/l was measured at the surface and the high of 198 mg/l at 60 feet. Carbonate alkalinity averaged approximately 120 mg/l increasing slightly with depth during periods of stratification.

Dissolved oxygen ranged from a low of 6.8 ppm at station #1 in July to 10.6 ppm in December also at station #1. The lower reading was most likely due to the warmer water from the discharge layering out on the surface at this station having a lower saturation potential due to the increased temperature. A summary of the temperature readings on the surface and bottom is included in this report (Figures III-IX) as are the oxygen readings (Table II).

Like the alkalinity, the lowest and highest pH readings were also recorded during August with a pH of 8.0 at the surface and 7.0 at 60 feet. In other sampling months the pH was consistently around 7.2 units.

### Benthos

Benthic samples were collected at thirty-two stations, eight in each transect. Collections from this segment were separated and classified to genus. Calculations will be made when more data have been collected and the results statistically analyzed to compare different areas of the lake and the different seasons.

Community diversity (H), diversity per individual ( $\bar{H}$ ), maximum diversity ( $H_{max}$ ), minimum diversity ( $H_{min}$ ), and redundancy (R) will be calculated using equations presented by Patten (1962):

$$H = - \sum_{i=1}^m n_i \log_2 \frac{n_i}{N}$$

$$\bar{H} = - \sum_{i=1}^m \frac{n_i}{N} \log_2 \frac{n_i}{N}$$

$$H_{max} = \log_2 N ! - m \log_2 \left( \frac{N}{m} \right) !$$

$$H_{min} = \log_2 N ! - \log_2 [N - (m-1)] !$$

$$R = \frac{H_{max} - H}{H_{max} - H_{min}}$$

where N is the total number individuals, ( $n_i$ ) the number of individuals of the i-th species, and m the number of species.

Indices of diversity (d) and heterogeneity (IH) will be calculated using equations given by Margalef (1958):

$$d = \frac{m-1}{\ln N}$$

$$IH = \frac{d(A+B) - d(A) - d(B)}{2}$$

where (m) is the number of species, (N) the total number of organisms,  $[d(A)]$  the diversity at station A,  $[d(B)]$  the diversity at station B, and  $[d(A+B)]$  the diversity of the pooled samples A and B.

A great diversity of organism has not been observed in the samples collected thus far but rather a large number of a few species. The most predominant species collected were Hexagenia sp., Chaoborus sp., and Tendipes sp. Other species found regularly but not in as great a number are Pentaneura sp., and various species of Tricoptera, Odonata, and scuds.

#### Netting Results

Gill netting surveys were conducted during May, August and December of 1971. The predominant rough fishes in Decker Lake are smallmouth buffalo, Ictiobus bubalus, and gizzard shad, Dorosoma cepedianum. These species will most likely remain a constant problem since the water lost to evaporation in the lake is replaced by pumping from the Colorado River. These species and the river carpsucker, Carpionodes carpio, are management problems in all of the lakes in the Colorado chain.

A composite of the netting results can be found on Table I of this report. Fish collected on the discharge were tabulated separately from those collected from the intake and will be analyzed as such when enough data have been collected to statistically analyze the data. Literature is now being reviewed to determine the best method to statistically treat the data collected.

Decker Lake was impounded in 1968 and the frequency distributions reflect the presence of five age classes of channel catfish and largemouth bass although the sample size was smaller than preferred. This indicates excellent reproduction since the hatchery stocking of this lake in 1968.

The netting results also reflect a large population of sunfish with an average of over 10 sunfish caught per 100 feet of net.

Since the job began in July, 1971, no data could be collected concerning spawning times. However, efforts will be made during the next segment to collect fishes from different areas of the lake with electro-fishing equipment to determine if early sexual development occurs in the area influenced by the heated discharge. If time and manpower permits, scale samples will be collected in an attempt to correlate the influx of heated water on the growth of certain species.

Conclusions and Recommendations:

The data collected this segment represent a categorizing of the waters of Decker Lake from July to February, before the introduction of a substantial heated effluent. This data will be collected through April when the power plant will begin full operation and then through the next segment while the plant is operating.

With the increasing use of impounded waters for use as cooling waters, it is recommended that this job be carried to completion next segment to determine what affect, if any, a thermal effluent of this magnitude may have on the chemical, physical, and biotic parameters influencing a sport fishery.

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Approved by:

David L. Pilschod

Date: January 18, 1973

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Regional Director of Inland Fisheries



Table I  
Decker Lake Netting Results  
1971

Collection Periods: May-10 nets  
August-10 nets  
December-10 nets

<u>Species</u>	<u>Number</u>	<u>Number 100 ft. net</u>	<u>Weight</u>	<u>Weight lbs. 100 ft. net</u>
<u>Dorosoma cepedianum</u>	214	4.76	149.90	3.33
<u>Ictiobus bubalus</u>	102	2.27	1234.04	27.42
<u>Carpionodes carpio</u>	8	0.18	32.27	0.72
<u>Notemigonus chrysoleucas</u>	15	0.33	4.58	0.10
<u>Ictalurus punctatus</u>	160	3.56	542.53	12.06
<u>Ictalurus melas</u>	117	2.60	45.59	1.01
<u>Micropterus salmoides</u>	49	1.09	59.29	1.32
<u>Chaenobryttus cyanellus</u>	42	0.93	6.95	0.15
<u>Lepomis microlophus</u>	72	1.60	26.26	0.58
<u>Lepomis macrochirus</u>	332	7.38	54.32	1.21
<u>Lepomis megalotis</u>	42	0.93	6.31	0.14
<u>Pomoxis annularis</u>	30	0.67	35.34	0.79
	<hr/> 1184		<hr/> 2204.63	

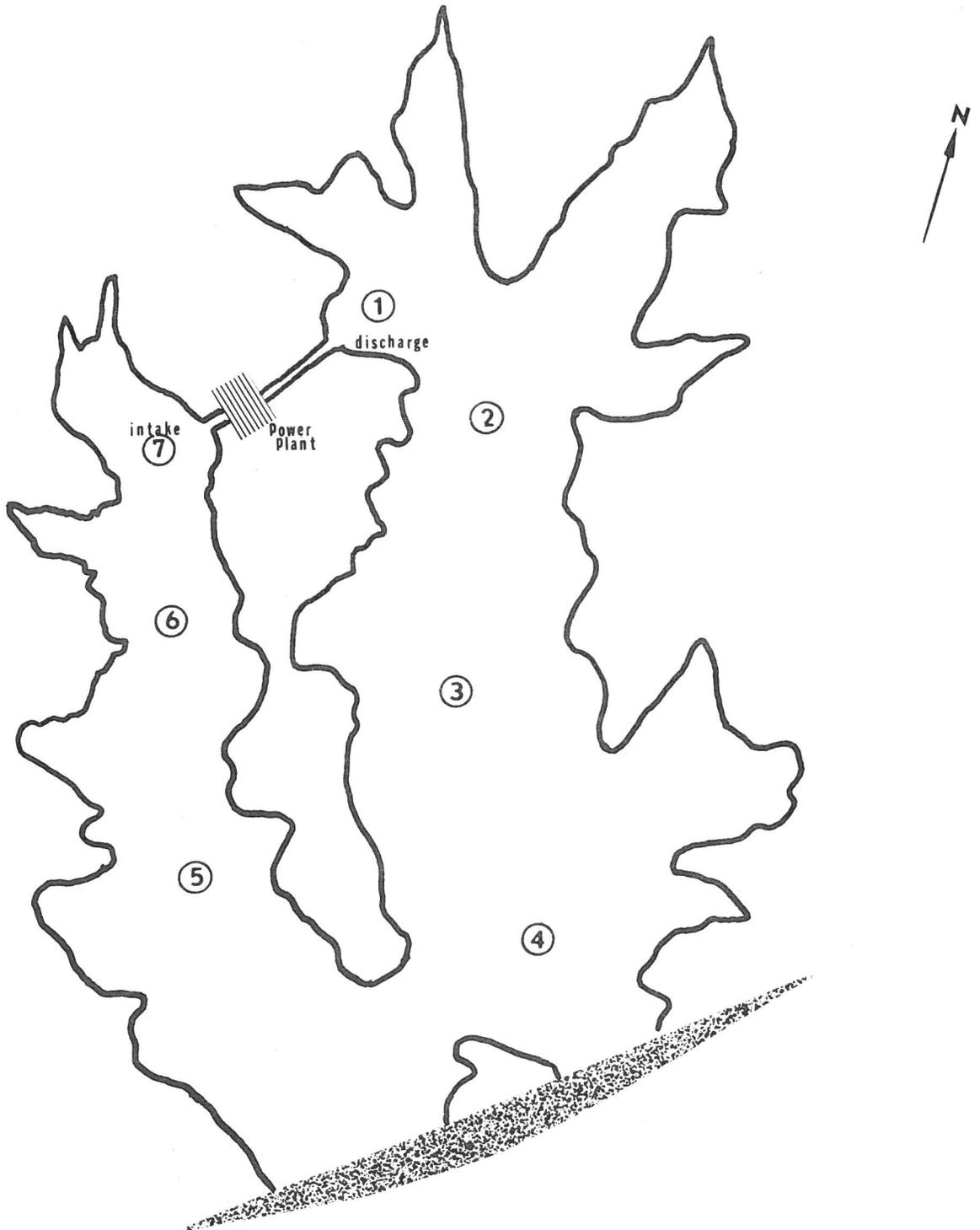
Per cent rough fish - 38.51% by number      66.51% by weight  
Per cent game fish - 72.49% by number      44.49% by weight

Table II

Dissolved Oxygen - mg/l

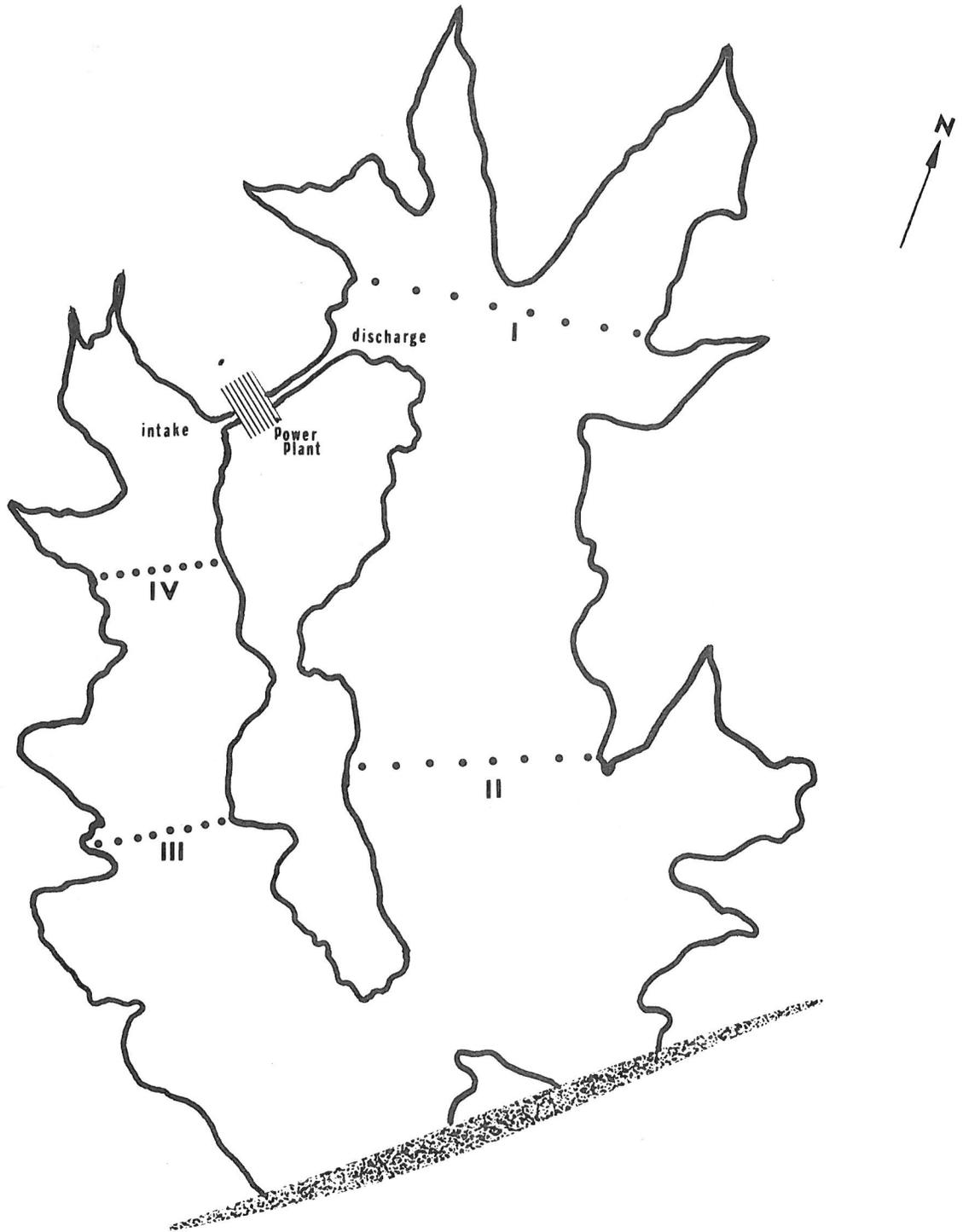
	July	August	September	October	December	January	February	
Surface	6.8	7.4	7.8	8.0	10.6	9.6	9.0	Station #1
Bottom 10'	7.0	6.1	7.0	8.0	9.2	9.7	9.0	
Surface	7.0	7.5	7.4	8.0		9.7	9.0	Station #2
Bottom 30'	0.0	0.0	4.5	7.0	9.0	8.4	9.0	
Surface	7.4	8.1	7.9	8.0	10.0	9.8	9.0	Station #3
Bottom 45'	0.0	0.0	0.0	6.0	9.2	7.2	7.0	
Surface	7.0	7.8	7.9	8.0	9.8	9.8	9.0	Station #4
Bottom 60'	0.0	0.0	0.0	0.0	8.0	7.2	7.0	
Surface	7.0	7.6	7.6	7.0	9.6	9.9	9.0	Station #5
Bottom 35'	0.0	0.0	3.8	7.0	9.0	9.6	7.0	
Surface	7.2	7.8	7.6	8.0	10.2	9.8	9.0	Station #6
Bottom 25'	4.0	1.5	6.5	7.0	8.5	9.4	8.0	
Surface	7.0	7.8	7.6	8.0	9.4	9.4	-	Station #7
Bottom 10'	7.2	7.4	7.6	8.0	9.4	9.2	-	

Figure 1



DECKER LAKE  
WATER SAMPLING STATIONS

Figure II



DECKER LAKE

BOTTOM SAMPLING STATIONS

Figure III

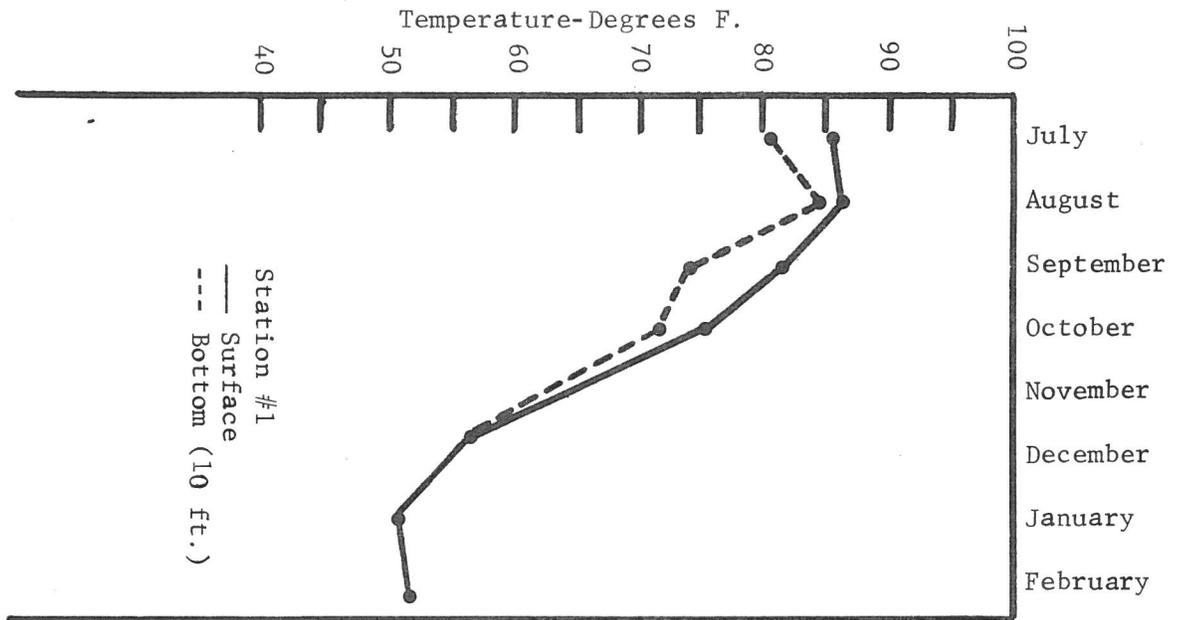


Figure IV

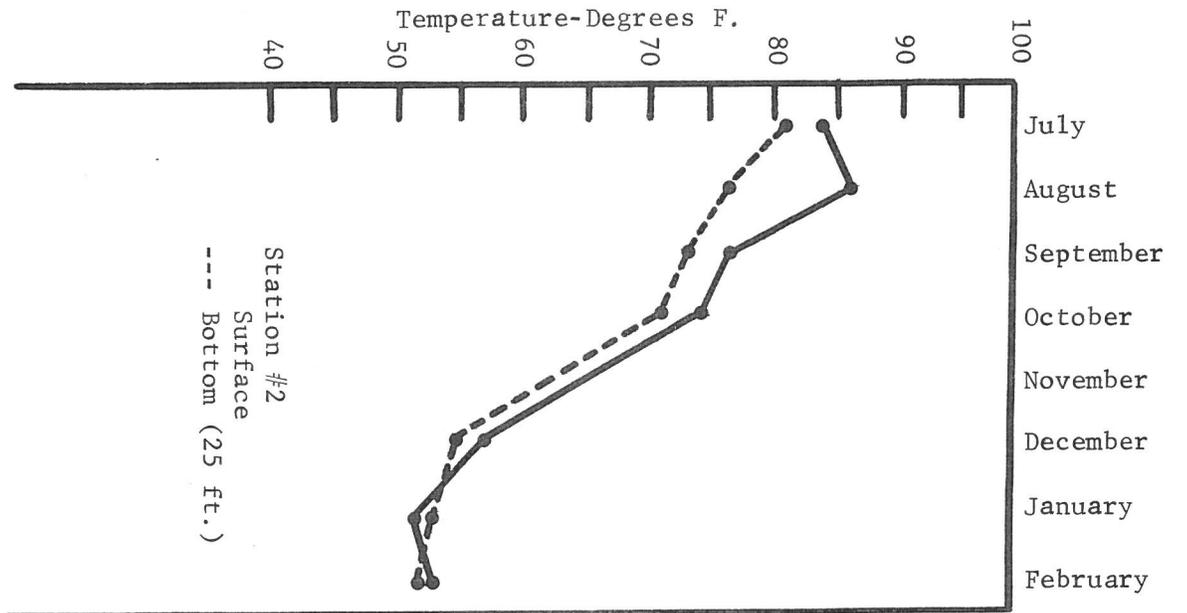


Figure V

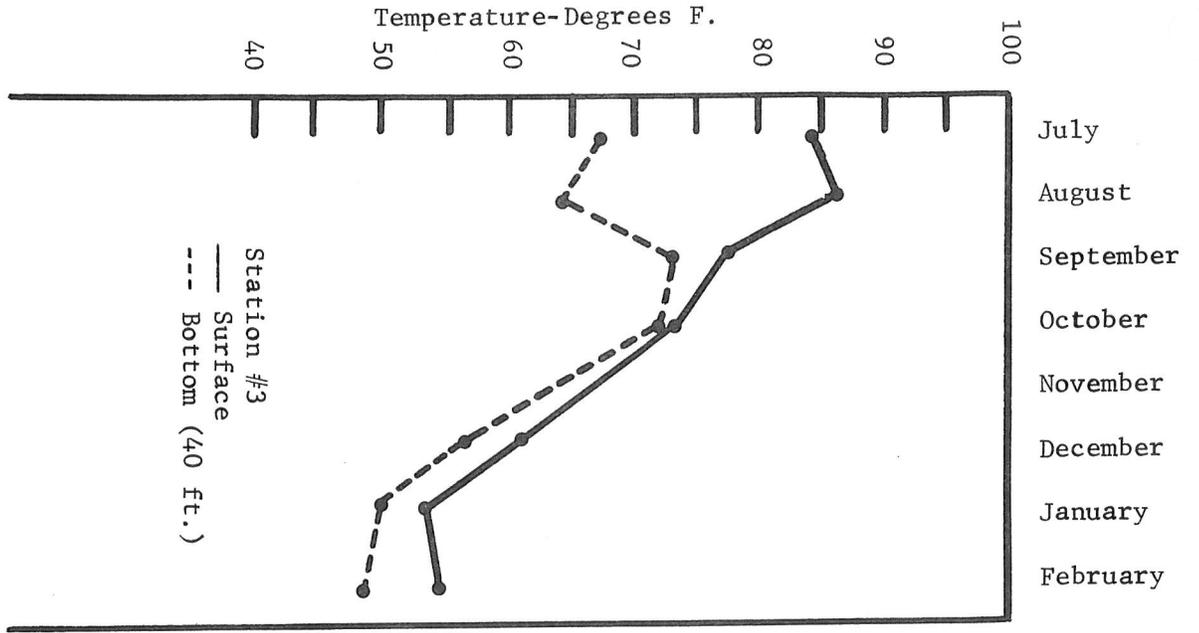


Figure VI

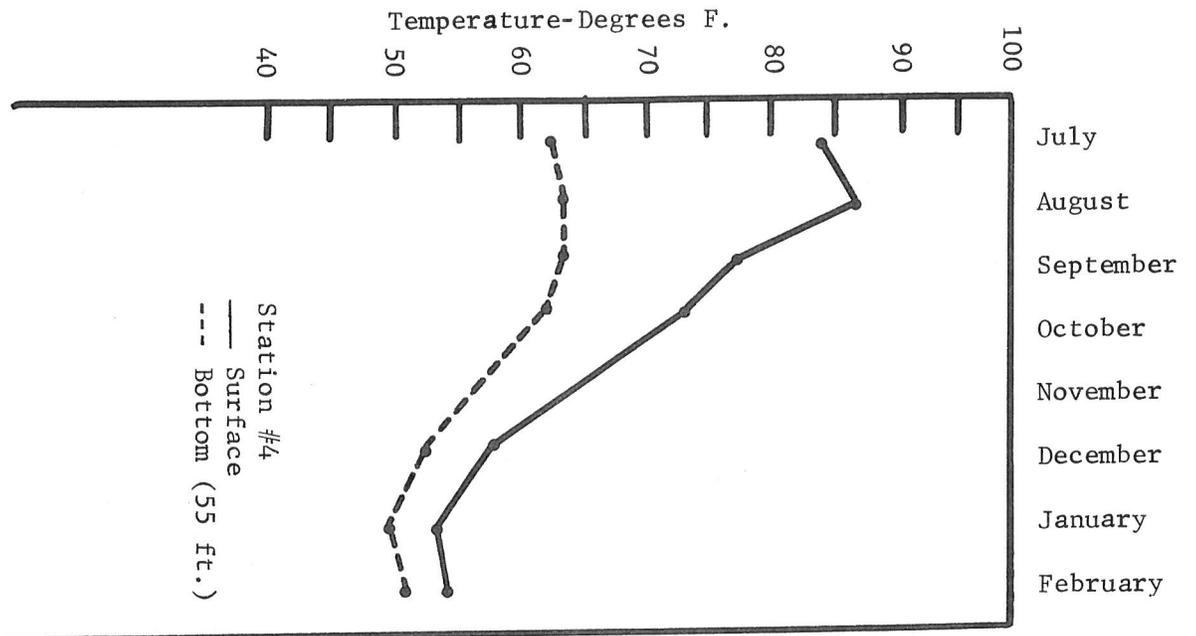


Figure VII

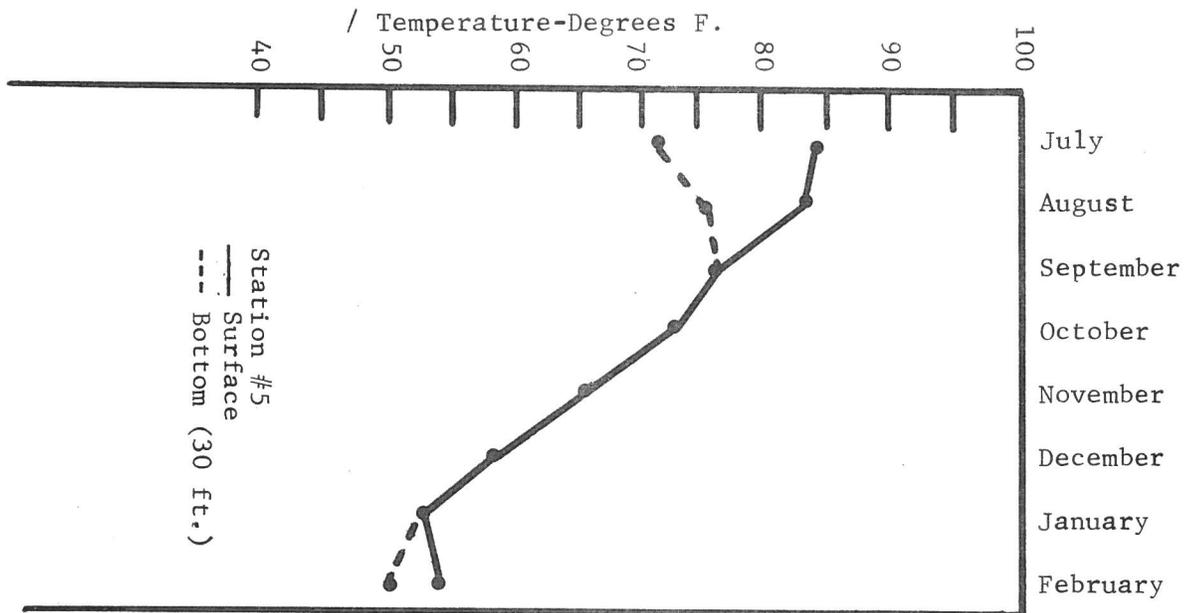


Figure VIII

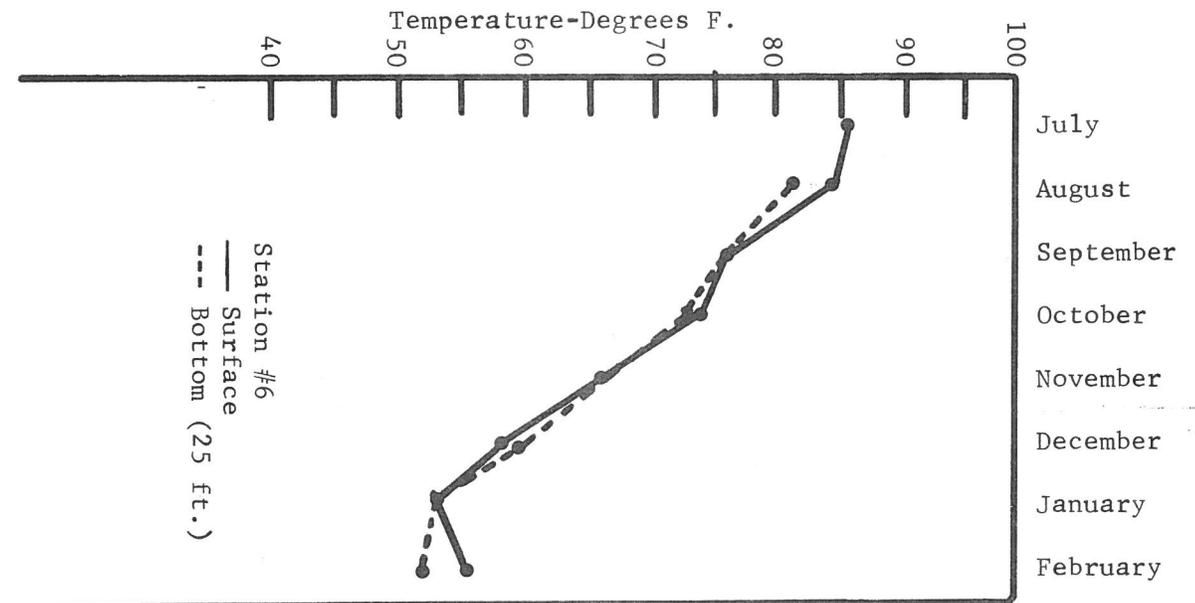


Figure IX

Temperature-Degrees F.

