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Special Report

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Upper Mississippi River System
Long Term Resource Monitoring Program

Water and Sediment Component Annual Report

Pool 13, 1989

September 1996

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by

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Preface

The Long Term Resource Monitoring Program (LTRMP) was authorized under the Water Resources Development Act of 1986 (Public Law 99-662) as an element of the U.S. Army Corps of Engineers' Environmental Management Program. The LTRMP is being implemented by the Environmental Management Technical Center, a National Biological Service Science Center, in cooperation with the five Upper Mississippi River System (UMRS) States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The U.S. Army Corps of Engineers provides guidance and has overall Program responsibility. The mode of operation and respective roles of the agencies are outlined in a 1988 Memorandum of Agreement.

The UMRS encompasses the commercially navigable reaches of the Upper Mississippi River, as well as the Illinois River and navigable portions of the Kaskaskia, Black, St. Croix, and Minnesota Rivers. Congress has declared the UMRS to be both a nationally significant ecosystem and a nationally significant commercial navigation system. The mission of the LTRMP is to provide decision makers with information for maintaining the UMRS as a sustainable large river ecosystem given its multiple-use character. The long-term goals of the Program are to understand the system, determine resource trends and effects, develop management alternatives, manage information, and develop useful products.

This document is an annual summary of LTRMP water quality data for Pool 13. This report satisfies, for 1989, Task 2.2.3.6 *Evaluate and Summarize Current Monitoring Results* as specified in Goal 2, *Monitor and Evaluate the Condition of the Upper Mississippi River Ecosystem* of the Operating Plan (USFWS 1993) for the LTRMP.

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Abstract

Resource Trend Analysis water quality sampling in Upper Mississippi River Pool 13 was initiated in August 1988 as a part of the Long Term Resource Monitoring Program. Mississippi Monitoring Station personnel continued water quality sampling in Pool 13 throughout 1989 using equipment and techniques consistent with the Procedures Manual for the Long Term Resource Monitoring Program (LTRMP).

A total of 8,382 observations were recorded by the LTRMP water quality component in Pool 13 during the sampling period January 1 through December 31, 1989. Data collected in 1989 reflect water quality characteristics during a second consecutive year of low water conditions. Mean dissolved oxygen (DO) concentrations were higher in channel-associated habitats than in backwater habitats. Dissolved oxygen concentrations were typically above the 5.0 mg/L threshold established by the LTRMP to support healthly aquatic life. However, oxygen depletion was noted in backwater contiguous habitat at both shallow and deep water sites. Nephelometric turbidity, Secchi disk transparency, and current velocity values are linked to discharge rate through Lock and Dam 12. Turbidity exhibited a positive relationship to discharge, especially in channel-associated habitats. Turbidity in backwater habitats was influenced by peak spring discharges, but wind fetch and fish activity influenced turbidity peaks during summer and fall periods. Secchi disk transparency correlated to turbidity values. Current velocity observations in channel-associated habitats were positively correlated to Lock and Dam 12 discharges, while backwater habitats exhibited negligible velocities except during peak discharges. Similar specific conductance was observed among all habitats throughout the sampling period. Comparisons of 1988 and 1989 data revealed minimal differences in all water quality variables. Nephelometric turbidity and DO values were influenced by the presence of aquatic macrophyte during peak biomass in backwater contiguous and impounded habitats.

Introduction

The Environmental Management Program supports an effective management plan for the Upper Mississippi River System (UMRS) and promotes the system's survival as a sustainable fish and wildlife resource. Adequate water quality, coupled with habitat availability, are important prerequisites for maintaining the fish and wildlife potential of the UMRS. Biota inhabiting the complex systems of the UMRS are ultimately dependent on adequate water quality to ensure survival.

Long Term Resource Monitoring Program (LTRMP) staff members monitor water quality for such limiting biological factors as water temperature, dissolved oxygen (DO), turbidity, current velocity, Secchi disk transparency, and water depth. Through analysis of these variables, long-term trends can be delineated and limiting factors can be identified for specific communities. Examination of water quality data in specific habitats provides valuable information relating to impacts caused by sedimentation, navigation, and water level fluctuations.

Collected water quality data also provide a valuable link to other LTRMP components. Vegetation and fisheries components currently under study are strongly influenced by water quality factors. A knowledge of water quality trends will be vital in understanding changes in these and other components.

Methods

The methods we used to collect and handle data are outlined in the LTRMP Procedures Manual (Rasmussen and Wloskinski 1988).

We used a YSI (Yellow Springs Instrument Co., Inc., Yellow Springs, OH) model 57 DO meter for DO and temperature measurements. Air calibration of the DO meter was performed at the beginning and end of each sampling day. Exceptions were made during winter sampling when air calibration was performed at each sampling site, and in other situations when a calibration check was deemed necessary by the crew leader. Air calibration of the DO meter was performed as specified in the owner's manual, using a YSI model 5075A stainless steel calibration chamber.

We checked the precision and accuracy of the YSI DO meter monthly. Comparisons were made using the Winkler method. Adjustments to the YSI DO meter were not needed since precision and accuracy readings fell within accepted limits. All daily and monthly calibration data were recorded in appropriate log books.

We measured specific conductance with a Cole Parmer (Cole Parmer, Niles, IL) model 4070 conductivity meter from August 1, 1988, to November 30, 1989. We calibrated the meter daily with a standard 1,000 μmol/cm solution purchased from the Cole Parmer Company. The K value for the probe was adjusted daily to this standard solution. Precision and accuracy data were recorded daily in a log book. We changed instrumentation in December 1989 to a LabComp model SCT conductivity meter (LabComp Inc., San Leandro, CA). Monthly calibration was performed according to LabComp procedures using the standard 1,000 μmol/cm solution. Precision and accuracy data were recorded during each calibration procedure.

We measured nephelometric turbidity with a Hach model 16800 turbidimeter (Hach Company, Loveland, CO), calibrated monthly using a set of Gelex lab standards. Daily calibrations were performed using a second set of Gelex field standards that were adjusted monthly to the lab standard reference set. If discrepancies occurred, we purchased new Gelex secondary standards to replace the field standards. Records of monthly calibrations are retained in a log book. The lens in the turbidity meter was cleaned weekly, or as needed, and the sample vials were carefully wiped with a clean cotton cloth prior to each sample.

We measured current velocity with a Marsh-McBirney 201D flow meter (Marsh-McBirney, Inc., Gaithersburg, MD). The sensor unit was mounted on a pole and oriented into the current for most observations. A torpedo weight was used to orient the sensor in deep water. Internal calibration was checked at each sample site. We sent meters to Marsh-McBirney for factory calibration annually.

We determined water clarity with a Secchi disk at each sample site. For consistency, readings were taken on the shaded side of the boat by the same person throughout the sample day.

We determined current velocity direction with a Silva type 20 hand-held compass when velocity meter sensor orientation was known. We measured wind velocity with an Omega HH-F10 electronic air velocity indicator and determined wind direction with a Silva type 20 hand-held compass.

A report code was used to indicate the crew leader's confidence in the accuracy of the data collected. We assigned a report code of 5 if the crew leader determined the data collected were accurate and representative of conditions observed at the site that day. Report codes 1- 4 indicate disturbances at the site or suspected equipment malfunctions that may have produced data not representative of the sample site. Report code 5 was assigned for 99.7% of the observations recorded in 1989 (Table 1).

Sampling Sites

We sampled 18 sites on Pool 13 between Bellevue and Clinton, Iowa (Table 2, Fig. 1). Sampling sites were segregated into five habitat types: channel border wingdam (CBW), channel border unstructured (CBU), impounded (IMP), backwater contiguous (BWC), and backwater isolated (BWI). Sampling sites in channel border and backwater habitat types were duplicated in upper and lower pool segments for intrahabitat comparison. The BWC and IMP habitats were further divided into vegetated and nonvegetated sites to assess the influence of vegetation beds.

The CBU sites are situated immediately adjacent to the main channel along an outside bend, typified by steep slopes into the main channel trough, and influenced by activity in the main channel. The CBW sites are located on the wing dam top and a companion site is located in the wing dam eddy.

The BWC sites situated in both upper and midpool locations represent the diverse features typified by this habitat type. Sites in Crooked Slough (M551.3M and M551.3N) are nonvegetated and compare a deep water side channel with an associated shallow depression lake. Comparisons of vegetated and nonvegetated sites are represented at Lower Brown's Lake (M544.2C and M544.2D) and Town Lake (M535.9J and M535.9K). The BWI sites (landlocked water bodies during normal summer water levels) are typified in Pin Oak Lake (M542.7C) and Barge Lake (M536.4B). We sampled Barge Lake monthly; however, the Pin Oak site was usually inaccessible because of low water levels.

Sites located in IMP habitat (M525.5L and M525.5N) represent vegetated and nonvegetated sites and are typified by uniform water depth (1.2 m) and firm substrates.

Results

The data collected during 1989 are presented in Tables 3-10. Data are arranged in weekly means and ranges by habitat type.

Discussion

We recorded a total of 8,382 water quality observations during the period January 1 to December 31, 1989. Data collected in 1989 reflect water quality characteristics during a second consecutive year of low water conditions. Tailwater stage levels at Lock and Dam 12 averaged 23% below the 53-yr mean during 1989 (Fig. 2).

Responses to discharge at Lock and Dam 12 during 1989 are evidenced in nephelometric turbidity, Secchi disk, and current velocity data. An increase in mean flow during the spring thaw in early April (week 13) (Fig. 3) is reflected in increased mean nepthelometric turbidity levels in all channel-associated habitats (Fig. 4, Table 3). Turbidity levels in channel-associated habitats averaged 90% higher than backwater habitats during this spring runoff period. Although backwater habitats exhibit increasing mean turbidity levels during this period, this is a result of a gradual increase in mean turbidity levels from winter ice and flow regimes rather than runoff. Elevated mean turbidity levels found at CBU sites prior to April are not evidenced at other habitats and may be linked to ice breakup and sediment disturbance at near shore locations. The highest turbidity levels recorded in channel-associated habitat occurred during ice breakup, with peak turbidity levels of 144 nephelometric turbidity units (NTUs) recorded at Smith Bay day mark (M529.7M) (Fig. 5, CBU).

The highest turbidity levels recorded during 1989 occurred in BWC habitat Crooked Slough (M551.3M) with a peak value of 220 NTUs (Fig. 5). Wind fetch, fish activity, and dredge disturbance likely caused elevated turbidity levels in BWC habitat. Fish activity and wind action were major contributing factors leading to high turbidity levels during weeks 31 and 32 at Crooked Slough, site M551.3M. Dredge activity in Brown's Lake as part of the Brown's Lake Habitat Rehabilitation and Enhancement Project contributed to elevated turbidity levels during week 18.

Secchi disk transparency observations (Table 4, Fig. 6) correlate to nepthelometric turbidity data at most habitats. Although Secchi disk transparency readings showed trends similar to turbidity data, responses to suspended solid changes are more easily identifiable using turbidity data.

All habitats exhibit a positive relationship between peak annual discharge and mean surface current velocity during spring runoff (Figs. 3 and 7). Although current velocity peaks occurred simultaneously in all habitats, magnitudes differed depending upon habitat type. The highest velocities were recorded in channel-associated habitats at CBW locations (1.30 m/s), followed by CBU (0.74 m/s) and IMP sites (0.40 m/s) (Table 5). Backwater sites exhibited similar responses during April, but velocity peaks were less than channel-associated values. Responses to additional discharge in June and September are evidenced only in channel-associated habitats. These later discharge events were of a smaller magnitude and duration than peak spring discharge and produced negligible current velocity increases in backwater habitats.

Mean DO concentrations were higher in channel-associated habitats than in backwater habitats during 1989, with mean values of 10.98 mg/L for channel and 9.12 mg/L for backwater habitats. A reduction in DO concentrations during the summer months (Fig. 8) caused by reduced oxygen saturation levels in warmer water was noted in all habitats. Mean monthly DO concentrations were consistently above the 5.0 mg/L threshold established by the LTRMP as a commonly accepted minimum for healthy aquatic biota, except in BWI habitat during September. Aquatic macrophyte decomposition at these sites during September may be responsible for an increased oxygen demand, leading to oxygen depletion.

Weekly ranges of surface DO concentrations reveal depletion below the 5.0 mg/L threshold at BWC and IMP habitats during July and August (Table 6, Fig. 9). This timing corresponds to periods of peak water temperatures (Fig. 10) when DO saturation levels are lowest. Although mean weekly values remained above 5.0 mg/L in BWC and IMP habitats during this period, oxygen levels at individual sites fell below this threshold during 12 consecutive weeks in BWC habitat and 4 consecutive weeks in IMP habitat. Backwater contiguous sites exhibiting DO concentrations below the threshold level are equally divided between open water and vegetated sites. However, we noted correlations between water depth and oxygen deficiency. Seventy-four percent of surface observations with DO concentrations below the 5.0 mg/L threshold were at shallow water sites (mean water depth 0.7 m). Backwater contiguous sites with greater mean water depth (2.6 m) represented 26% of surface observations below 5.0 mg/L.

Dissolved oxygen concentrations below 5.0 mg/L were most frequently found in bottom samples at deep water sites (mean depth 2.6 m) with 30% of all bottom observations below 5 mg/L (Table 7). Severe oxygen depletion, with concentrations below 3.0 mg/L, was most prevalent in these bottom samples. We noted values below 3.0 mg/L in 16% of the bottom deep water observations, primarily during the months of June, July, and August.

We observed similar monthly mean surface temperatures in all habitats (Table 8, Fig. 10). All habitat types attained peak water temperature in early July followed by steadily decreasing temperatures in all habitats. Backwater contiguous sites exhibited the greatest range in weekly surface temperature values (Fig. 11). The highest water temperature we observed was recorded in BWC habitat with a maximum of 30 °C.

Severe thunderstorm activity during the week of July 16-22 (week 29) affected surface water temperature values recorded at all sites sampled that week. Mean water temperatures in BWC habitat fell 24% from mean temperatures the previous week. Channel-associated habitats responded to this thunderstorm with mean surface water temperature declines of 19% in IMP, 14% in CBU, and 13% in CBW habitats. Water temperatures at BWC sites quickly rebounded the following week, but channel-associated habitats remained at reduced temperatures. The homogeneity of channel habitats is illustrated by comparisons of surface and bottom temperatures (Tables 8 and 9). Weekly mean temperatures were similiar between surface and bottom measurements in channel and impounded habitats. By contrast, weekly mean temperatures in backwater habitats frequently differed between surface and bottom strata, especially in midsummer with thermogradients up to 2.9 °C.

We observed similar mean specific conductivity in all habitats (Table 10, Fig. 12). Sites in BWC habitat produced the greatest variation in specific conductance, ranging from 190 to 577 μmol/cm during March. Fluctuations during this period were likely caused by ice breakup and the associated disturbance of substrate material. Backwater contiguous sites also exhibited less uniformity of specific conductance values than other habitats within most sample weeks. Weekly values frequently ranged 30 to 50 μmol/cm in BWC habitat, whereas little variation was noted in other habitats sampled.

Annual Comparisons

Comparison of all data types reveals little difference between data collected in 1989 and data collected from August to December 1988. Relatively low, uniform flow through Pool 13 and much of the UMRS during 1988 and 1989 contributed to uniform conditions during the first 2 yr of LTRMP data collection.

Uniformity of current velocity, nephelometric turbidity, and Secchi disk transparency during the first 2 yr of LTRMP data collection was influenced by consistent water levels. Mean tailwater stage levels during much of 1988 and 1989 were similar and below the 53-yr mean (Fig. 2). Minor deviations, particularly in turbidity and Secchi disk transparency, were likely caused by localized conditions such as wind action, fish activity, or algal blooms.

We also found similar DO concentrations and water temperatures in 1988 and 1989 datasets. However, a decline in DO concentrations at BCW sites in late 1989 was unique and not present in 1988 data (Fig. 13). Unusually cold temperatures during December 1989 may have sealed shallow backwater areas and triggered DO declines.

Aquatic Macrophyte Influence

Aquatic macrophytes influenced selected water quality variables, particularly in IMP habitat (Fig. 14). Turbidity and DO concentrations were influenced by vegetation during July and August, whereas minimal effects were noted in other variables.

Turbidity levels were lower at vegetated sites compared to nonvegetated sites in IMP habitats during the growing season (Fig. 14). Differences were also noted in DO concentrations between vegetated and nonvegetated sites during midsummer when plant production peaked and diurnal oxygen shifts were common (Fig. 14). Lower oxygen concentrations at vegetated sites during this time were likely caused by aquatic plant respiration early in the day (when water quality samples were routinely taken). However, diel fluctuation could not be determined due to infrequency of sampling.

Lower mean current velocities recorded at the vegetated IMP site (M525.5N) throughout all of 1989 were likely caused by thalweg proximity rather than aquatic macrophyte influence (Fig. 14). Because of low inherent current velocities in BWC habitat, no correlation was found between vegetation and mean current velocity.

Acknowledgments

We would like to express our appreciation to the U.S. Army Corps of Engineers for their fiscal support and management of the Environmental Management Program. We would also like to thank the U.S. Fish and Wildlife Service, Region 3, for their administration of the LTRMP and the Environmental Management Technical Center for their management of the LTRMP and development of sampling procedures. Also, thanks to the Iowa Department of Natural Resources for administration of the field station budget and operations.

The Rock Island District of the U.S. Army Corps of Engineers furnished flow and pool stage data for Pool 13 and the National Climatic Data Center of the U.S. Department of Commerce supplied temperature and precipitation data for the Pool 13 area.

Last, thanks to the Bellevue LTRMP field station staff for their assistance and logistical support in data collection and preparation of this report.

References

Rasmussen, J. L., and J. H. Wlosinski. 1988. Procedures manual of the Long Term Resource Monitoring Program for the Upper Mississippi River System. U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 88-03. 216 pp.

U.S. Fish and Wildlife Service. 1993. Operating Plan for the Upper Mississippi River System Long Term Resource Monitoring Program. Environmental Management Technical Center, Onalaska, Wisconsin, Revised September 1993. EMTC 91-P002R. 179 pp. (NTIS #PB94-160199)

Table 1. Weekly water quality data measurements by habitat type, Upper Mississippi River Pool 13, 1989.

The number to the left of the slash is the number of measurements made that were associated with report codes of "5" (i.e., measurements met all reporting criteria). The number to the right of the slash is the number of measurements for which the report code did not equal "5."

	Habitat code				
Variable	**CBU**	**CBW**	**IMP**	**BWC**	**BWI**
Dissolved oxygen	162/2	137/2	166/0	593/0	52/0
Water temperature	166/2	141/2	166/0	600/0	53/0
Nephelometric turbidity	177/2	112/1	138/0	435/0	39/0
Secchi disk transparency	86/1	83/1	81/0	298/0	26/0
Current velocity	159/2	262/2	155/0	509/0	46/0
Specific conductance	141/2	110/1	135/0	447/0	39/0

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 2. Weekly water and sediment sampling sites, Upper Mississippi River Pool 13, 1989.

Location code	Location name	Habitat code	Pool position code	Base vegetation code
M554.8F	Bellevue light	CBU	U	OP
M551.3M	Crooked Slough	BWC	U	OP
M551.3N	Crooked Slough	BWC	U	OP
M550.5L	Sand Prairie wing dam top	CBW	U	OP
M550.4L	Sand Prairie wingdam eddy	CBW	U	OP
M546.5L	Maquoketa levee light	CBU	U	OP
M544.2C	Lower Brown's Lake	BWC	U	OP
M544.2D	Lower Brown's Lake	BWC	U	FL
M542.7C	Pin Oak Lake	BWI	U	OP
M542.5E	Pin Oak Lake	BWC	U	OP
M536.4B	Barge Lake	BWI	L	OP
M535.9J	Town Lake	BWC	L	FL
M535.9K	Town Lake	BWC	L	OP
M530.3K	Smith Bay wing dam top	CBW	L	OP
M530.2K	Smith Bay wing dam eddy	CBW	L	OP
M529.7M	Smith Bay day mark	CBU	L	OP
M525.5L	Pomme de Terre transect	IMP	L	OP
M525.5N	Pomme de Terre transect	IMP	L	SB

Location codes include a single character to represent the river being sampled, a river mile designator, and a letter (A-Z) indicating relative distance (west to east) across the floodplain.

Key to habitat codes:

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Key to Pool position codes:

L = Lower pool
U = Upper pool

Key to base vegetation codes (defined during the summer of 1988):

FL = Floating-leaf rooted vegetation
OP = Open water
SB = Submergent rooted vegetation

Table 3. Surface nephelometric turbidity means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	8 (3 - 12)	7 (7 - 7)	---	---	---
02	9 (5 - 13)	8 (8 - 8)	9 (9 - 9)	---	4 (4 - 4)
03	7 (4 - 10)	6 (6 - 6)	34 (34 - 34)	---	36 (31 - 40)
04	7 (4 - 13)	6 (6 - 6)	6 (5 - 6)	6 (5 - 7)	5 (5 - 5)
05	21 (8 - 44)	8 (7 - 8)	63 (8 - 118)	11 (11 - 11)	---
06	11 (11 - 11)	10 (10 - 10)	53 (53 - 53)	10 (10 - 10)	10 (10 - 10)
07	9 (3 - 15)	12 (12 - 12)	18 (4 - 42)	6 (6 - 6)	7 (6 - 7)
08	5 (2 - 8)	5 (5 - 5)	73 (2 - 144)	3 (2 - 4)	5 (4 - 5)
09	16 (6 - 26)	---	2 (2 - 2)	3 (3 - 3)	---
10	9 (4 - 20)	12 (12 - 12)	17 (3 - 42)	5 (3 - 6)	4 (3 - 4)
11	27 (6 - 37)	32 (32 - 32)	52 (41 - 62)	60 (60 - 60)	---
12	16 (13 - 20)	13 (13 - 13)	32 (31 - 33)	32 (32 - 32)	24 (24 - 24)
13	16 (12 - 20)	---	28 (21 - 40)	32 (29 - 35)	44 (34 - 54)
14	21 (15 - 26)	22 (17 - 26)	49 (41 - 56)	60 (52 - 67)	80 (76 - 84)
15	19 (14 - 24)	---	33 (29 - 37)	28 (26 - 29)	43 (32 - 53)
16	22 (17 - 28)	---	28 (23 - 32)	23 (21 - 25)	24 (17 - 30)
17	29 (20 - 48)	---	28 (24 - 32)	26 (26 - 26)	---
18	53 (27 - 153)	---	30 (24 - 35)	22 (22 - 22)	---

Table 3. Continued

Week	BWC	BWI	CBU	CBW	IMP
19	26 (19 - 34)	29 (21 - 37)	33 (29 - 39)	30 (26 - 33)	48 (43 - 52)
20	28 (19 - 38)	16 (16 - 16)	35 (33 - 36)	25 (22 - 28)	31 (23 - 39)
21	32 (26 - 43)	---	25 (22 - 29)	27 (23 - 30)	28 (25 - 31)
22	31 (22 - 52)	23 (13 - 33)	37 (33 - 39)	33 (27 - 39)	41 (40 - 42)
23	19 (8 - 30)	---	32 (28 - 36)	27 (21 - 33)	29 (28 - 30)
24	48 (24 - 79)	---	25 (24 - 25)	17 (14 - 19)	21 (21 - 21)
25	26 (20 - 35)	---	28 (26 - 31)	20 (19 - 21)	18 (14 - 22)
26	49 (23 - 68)	---	22 (22 - 22)	14 (14 - 14)	---
27	32 (15 - 62)	7 (7 - 7)	25 (19 - 30)	27 (24 - 30)	19 (10 - 28)
28	48 (22 - 97)	---	32 (22 - 37)	23 (19 - 27)	23 (12 - 34)
29	60 (24 - 106)	---	24 (19 - 27)	24 (23 - 25)	23 (10 - 35)
30	36 (25 - 53)	---	23 (20 - 26)	17 (14 - 19)	15 (5 - 25)
31	57 (14 - 160)	14 (14 - 14)	27 (19 - 40)	21 (18 - 23)	18 (7 - 28)
32	70 (18 - 220)	---	21 (19 - 23)	21 (20 - 22)	30 (25 - 35)
33	32 (11 - 61)	---	21 (19 - 22)	20 (17 - 22)	19 (15 - 22)
34	40 (14 - 96)	---	24 (21 - 28)	21 (21 - 21)	21 (13 - 28)
35	46 (15 - 100)	---	26 (24 - 27)	25 (23 - 27)	22 (17 - 26)
36	44 (24 - 92)	8 (8 - 8)	41 (38 - 42)	33 (29 - 37)	24 (15 - 32)
37	41 (17 - 75)	---	33 (30 - 35)	37 (36 - 37)	34 (33 - 34)

Table 3. Continued

Week	BWC	BWI	CBU	CBW	IMP
38	39 (28 - 58)	---	31 (27 - 38)	26 (25 - 27)	23 (20 - 26)
39	44 (15 - 87)	---	27 (26 - 28)	25 (22 - 28)	35 (34 - 35)
40	30 (16 - 55)	14 (14 - 14)	24 (23 - 25)	24 (24 - 24)	23 (18 - 28)
41	29 (13 - 66)	---	23 (22 - 24)	22 (21 - 23)	29 (26 - 31)
42	19 (7 - 39)	---	31 (23 - 46)	23 (21 - 25)	61 (39 - 82)
43	28 (16 - 56)	---	19 (16 - 23)	17 (16 - 17)	15 (13 - 17)
44	27 (15 - 45)	---	23 (22 - 24)	20 (17 - 23)	28 (21 - 35)
45	19 (12 - 25)	8 (8 - 8)	16 (16 - 17)	18 (16 - 20)	14 (12 - 16)
46	22 (12 - 56)	---	15 (14 - 16)	15 (14 - 16)	19 (18 - 19)
47	15 (10 - 20)	---	11 (10 - 12)	13 (11 - 14)	11 (11 - 11)
48	14 (8 - 24)	30 (30 - 30)	9 (8 - 11)	9 (8 - 10)	8 (8 - 8)
49	6 (5 - 7)	---	5 (5 - 5)	---	---
50	9 (6 - 15)	4 (4 - 4)	---	5 (5 - 5)	---
51	10 (7 - 14)	---	---	---	---
52	5 (4 - 5)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 4. Secchi disk transparency means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	69 (69 - 69)	76 (76 - 76)	---	---	---
02	69 (50 - 114)	74 (74 - 74)	130 (130 - 130)	---	---
03	70 (38 - 99)	49 (49 - 49)	131 (131 - 131)	---	---
04	79 (61 - 90)	---	108 (98 - 117)	92 (92 - 92)	---
05	58 (27 - 93)	64 (64 - 64)	49 (12 - 85)	73 (73 - 73)	---
06	65 (64 - 66)	68 (68 - 68)	20 (20 - 20)	---	59 (58 - 59)
07	56 (38 - 76)	74 (74 - 74)	10 (10 - 10)	59 (59 - 59)	60 (54 - 65)
08	59 (42 - 79)	45 (45 - 45)	40 (8 - 71)	75 (72 - 78)	68 (56 - 80)
09	58 (38 - 78)	---	121 (121 - 121)	93 (93 - 93)	---
10	92 (35 - 153)	59 (59 - 59)	64 (32 - 95)	97 (69 - 98)	---
11	48 (35 - 80)	31 (31 - 31)	33 (25 - 41)	34 (34 - 34)	---
12	57 (36 - 73)	---	34 (34 - 34)	34 (34 - 34)	50 (48 - 52)
13	64 (51 - 78)	---	44 (32 - 56)	49 (38 - 60)	42 (38 - 46)
14	46 (40 - 52)	49 (40 - 57)	30 (19 - 40)	32 (28 - 36)	35 (35 - 35)
15	50 (44 - 62)	---	46 (43 - 49)	54 (52 - 56)	44 (42 - 45)
16	49 (38 - 65)	---	49 (48 - 49)	53 (42 - 64)	52 (42 - 61)
17	35 (23 - 45)	---	42 (42 - 42)	48 (48 - 48)	---
18	35 (12 - 48)	---	38 (38 - 38)	49 (49 - 49)	---

Table 4. Continued

Week	BWC	BWI	CBU	CBW	IMP
19	46 (38 - 53)	42 (31 - 53)	42 (35 - 49)	42 (35 - 49)	34 (32 - 35)
20	41 (36 - 50)	58 (58 - 58)	41 (40 - 42)	56 (54 - 58)	51 (45 - 57)
21	36 (29 - 40)	---	44 (44 - 44)	59 (52 - 56)	41 (40 - 42)
22	40 (26 - 50)	58 (39 - 76)	39 (36 - 42)	44 (43 - 45)	36 (35 - 37)
23	45 (32 - 58)	---	45 (42 - 48)	47 (45 - 49)	38 (37 - 38)
24	26 (18 - 37)	---	50 (48 - 52)	63 (63 - 63)	49 (40 - 58)
25	42 (32 - 52)	---	46 (41 - 51)	52 (50 - 54)	55 (48 - 62)
26	25 (20 - 30)	---	58 (58 - 58)	75 (75 - 75)	---
27	48 (26 - 54)	78 (78 - 78)	65 (51 - 78)	73 (71 - 74)	38 (38 - 38)
28	36 (13 - 52)	---	43 (38 - 48)	46 (44 - 48)	52 (38 - 65)
29	30 (17 - 56)	---	45 (42 - 48)	54 (54 - 54)	60 (42 - 78)
30	32 (14 - 46)	---	49 (46 - 52)	65 (65 - 65)	52 (52 - 52)
31	26 (6 - 50)	70 (70 - 70)	48 (45 - 50)	---	38 (38 - 38)
32	34 (14 - 50)	---	53 (52 - 54)	50 (50 - 50)	39 (38 - 40)
33	42 (21 - 60)	---	48 (48 - 48)	53 (53 - 53)	54 (48 - 59)
34	39 (18 - 60)	---	48 (48 - 48)	55 (55 - 55)	38 (38 - 38)
35	38 (16 - 60)	---	47 (46 - 48)	55 (55 - 55)	49 (38 - 60)
36	33 (20 - 44)	54 (54 - 54)	39 (38 - 40)	46 (46 - 46)	40 (35 - 45)
37	35 (20 - 70)	---	40 (38 - 42)	40 (38 - 42)	40 (40 - 40)

Table 4. Continued

Week	BWC	BWI	CBU	CBW	IMP
38	30 (24 - 36)	---	39 (38 - 40)	46 (46 - 46)	42 (40 - 43)
39	32 (14 - 48)	---	39 (38 - 40)	38 (38 - 38)	35 (32 - 38)
40	33 (16 - 46)	70 (70 - 70)	44 (44 - 44)	42 (42 - 42)	50 (44 - 56)
41	37 (24 - 58)	---	48 (45 - 50)	45 (45 - 45)	39 (38 - 40)
42	66 (36 - 106)	---	47 (42 - 52)	50 (43 - 56)	30 (22 - 38)
43	41 (24 - 52)	---	58 (54 - 62)	66 (66 - 66)	65 (60 - 70)
44	43 (30 - 65)	---	51 (50 - 52)	44 (44 - 44)	47 (40 - 54)
45	55 (44 - 70)	---	62 (58 - 65)	58 (58 - 58)	69 (68 - 70)
46	60 (33 - 75)	---	62 (52 - 72)	60 (60 - 60)	50 (50 - 50)
47	59 (40 - 70)	---	80 (80 - 80)	77 (77 - 77)	73 (72 - 74)
48	70 (41 - 88)	---	85 (82 - 88)	88 (88 - 88)	82 (82 - 82)
49	120 (120 - 120)	---	109 (109 - 109)	---	---
50	80 (59 - 120)	---	---	---	---
51	66 (66 - 66)	---	---	---	---
52	100 (100 - 100)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 5. Surface water velocity means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	---	---	---
02	0.0 (0.0 - 0.01)	0.0 (0.0 - 0.0)	0.05 (0.01 - 0.09)	0.39 (0.39 - 0.39)	0.05 (0.0 - 0.10)
03	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.03 (0.03 - 0.03)	---	0.04 (0.01 - 0.07)
04	0.0 (0.0 - 0.02)	0.0 (0.0 - 0.0)	0.15 (0.10 - 0.20)	0.15 (0.11 - 0.20)	0.05 (0.03 - 0.07)
05	0.0 (0.0 - 0.02)	0.0 (0.0 - 0.0)	0.19 (0.19 - 0.19)	0.29 (0.29 - 0.30)	---
06	0.01 (0.0 - 0.02)	0.0 (0.0 - 0.0)	0.03 (0.03 - 0.03)	0.32 (0.32 - 0.32)	0.01 (0.0 - 0.02)
07	0.0 (0.0 - 0.03)	0.0 (0.0 - 0.0)	0.10 (0.0 - 0.21)	0.36 (0.30 - 0.42)	0.07 (0.03 - 0.12)
08	0.0 (0.0 - 0.03)	0.0 (0.0 - 0.0)	0.07 (0.03 - 0.11)	0.44 (0.27 - 0.54)	0.10 (0.05 - 0.15)
09	0.0 (0.0 - 0.0)	---	0.11 (0.11 - 0.11)	0.11 (0.03 - 0.19)	---
10	0.0 (0.0 - 0.02)	0.0 (0.0 - 0.0)	0.08 (0.08 - 0.09)	0.26 (0.16 - 0.42)	0.0 (0.0 - 0.0)
11	0.03 (0.0 - 0.09)	0.0 (0.0 - 0.0)	0.26 (0.26 - 0.26)	0.18 (0.03 - 0.34)	---
12	0.0 (0.0 - 0.01)	0.0 (0.0 - 0.0)	0.33 (0.33 - 0.33)	0.45 (0.41 - 0.50)	---
13	0.04 (0.0 - 0.14)	---	0.35 (0.30 - 0.40)	0.79 (0.73 - 0.86)	0.26 (0.12 - 0.40)
14	0.09 (0.0 - 0.40)	0.03 (0.01 - 0.06)	0.29 (0.27 - 0.31)	1.17 (0.87 - 1.30)	0.14 (0.14 - 0.14)
15	0.07 (0.0 - 0.35)	---	0.27 (0.25 - 0.30)	0.88 (0.66 - 1.17)	0.13 (0.02 - 0.25)
16	0.02 (0.01 - 0.07)	---	0.34 (0.25 - 0.44)	0.92 (0.74 - 1.16)	0.19 (0.14 - 0.25)
17	0.01 (0.0 - 0.04)	---	0.36 (0.36 - 0.36)	0.71 (0.69 - 0.74)	---
18	0.0 (0.0 - 0.01)	---	0.35 (0.35 - 0.35)	0.57 (0.51 - 0.63)	---
19	0.02	0.0	0.27	0.64	0.14

Table 5. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(0.0 - 0.08)	(0.0 - 0.0)	(0.26 - 0.29)	(0.53 - 0.76)	(0.09 - 0.19)
20	0.01 (0.0 - 0.03)	0.02 (0.02 - 0.02)	0.22 (0.13 - 0.31)	0.64 (0.53 - 0.78)	0.14 (0.05 - 0.23)
21	0.02 (0.0 - 0.06)	---	0.16 (0.09 - 0.24)	0.55 (0.42 - 0.61)	0.11 (0.04 - 0.19)
22	0.01 (0.0 - 0.03)	0.0 (0.0 - 0.01)	0.74 (0.74 - 0.74)	0.98 (0.88 - 1.09)	0.20 (0.08 - 0.32)
23	0.02 (0.0 - 0.04)	---	0.19 (0.08 - 0.31)	1.00 (0.85 - 1.25)	0.15 (0.04 - 0.27)
24	0.01 (0.0 - 0.05)	---	0.08 (0.03 - 0.13)	0.37 (0.22 - 0.43)	0.06 (0.0 - 0.13)
25	0.01 (0.0 - 0.06)	---	0.21 (0.15 - 0.27)	0.45 (0.43 - 0.47)	0.20 (0.20 - 0.20)
26	0.0 (0.0 - 0.01)	---	0.19 (0.19 - 0.19)	0.27 (0.24 - 0.31)	---
27	0.0 (0.0 - 0.01)	0.0 (0.0 - 0.0)	0.11 (0.09 - 0.14)	0.35 (0.17 - 0.51)	0.07 (0.0 - 0.15)
28	0.0 (0.0 - 0.03)	---	0.11 (0.03 - 0.19)	0.30 (0.20 - 0.43)	0.05 (0.0 - 0.11)
29	0.01 (0.0 - 0.03)	---	0.17 (0.14 - 0.21)	0.21 (0.06 - 0.32)	0.04 (0.0 - 0.09)
30	0.0 (0.0 - 0.03)	---	0.13 (0.07 - 0.19)	0.18 (0.10 - 0.27)	0.05 (0.0 - 0.10)
31	0.01 (0.0 - 0.04)	0.0 (0.0 - 0.0)	0.09 (0.07 - 0.12)	0.16 (0.05 - 0.26)	0.01 (0.0 - 0.03)
32	0.0 (0.0 - 0.01)	---	0.06 (0.03 - 0.10)	0.19 (0.03 - 0.39)	0.04 (0.0 - 0.09)
33	0.01 (0.0 - 0.07)	---	0.12 (0.11 - 0.14)	0.14 (0.04 - 0.25)	0.03 (0.0 - 0.07)
34	0.01 (0.0 - 0.04)	---	0.09 (0.0 - 0.19)	0.25 (0.08 - 0.40)	0.04 (0.01 - 0.08)
35	0.01 (0.0 - 0.07)	---	0.12 (0.05 - 0.19)	0.28 (0.10 - 0.43)	0.05 (0.0 - 0.10)
36	0.03 (0.0 - 0.14)	0.0 (0.0 - 0.0)	0.17 (0.08 - 0.26)	0.31 (0.10 - 0.47)	0.05 (0.0 - 0.10)
37	0.01 (0.0 - 0.04)	---	0.18 (0.12 - 0.25)	0.44 (0.19 - 0.69)	0.09 (0.01 - 0.17)
38	0.01	---	0.13	0.14	0.03

Table 5. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(0.0 - 0.06)		(0.06 - 0.21)	(0.0 - 0.25)	(0.0 - 0.06)
39	0.0 (0.0 - 0.03)	---	0.12 (0.12 - 0.12)	0.18 (0.06 - 0.36)	0.02 (0.01 - 0.03)
40	0.02 (0.0 - 0.04)	0.0 (0.0 - 0.0)	0.01 (0.01 - 0.01)	0.21 (0.08 - 0.34)	0.04 (0.0 - 0.09)
41	0.01 (0.0 - 0.01)	---	0.13 (0.11 - 0.15)	0.22 (0.08 - 0.37)	0.04 (0.01 - 0.07)
42	0.0 (0.0 - 0.02)	---	0.09 (0.01 - 0.17)	0.13 (0.05 - 0.27)	0.05 (0.01 - 0.09)
43	0.0 (0.0 - 0.02)	---	0.09 (0.04 - 0.15)	0.21 (0.08 - 0.33)	0.04 (0.01 - 0.07)
44	0.01 (0.0 - 0.04)	---	0.18 (0.15 - 0.21)	0.24 (0.13 - 0.35)	0.06 (0.02 - 0.11)
45	0.0 (0.0 - 0.01)	0.0 (0.0 - 0.0)	0.20 (0.11 - 0.29)	0.30 (0.22 - 0.42)	0.05 (0.01 - 0.09)
46	0.0 (0.0 - 0.03)	---	0.14 (0.10 - 0.19)	0.25 (0.14 - 0.42)	0.03 (0.02 - 0.05)
47	0.01 (0.0 - 0.05)	---	0.09 (0.09 - 0.09)	0.23 (0.21 - 0.26)	0.03 (0.0 - 0.06)
48	0.0 (0.0 - 0.01)	0.0 (0.0 - 0.0)	0.12 (0.12 - 0.13)	0.15 (0.05 - 0.23)	0.07 (0.06 - 0.08)
49	0.0 (0.0 - 0.01)	---	0.13 (0.13 - 0.13)	---	---
50	0.0 (0.0 - 0.01)	0.0 (0.0 - 0.0)	---	0.10 (0.10 - 0.10)	---
51	0.0 (0.0 - 0.0)	---	---	---	---
52	0.0 (0.0 - 0.0)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 6. Surface dissolved oxygen means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	12.6 (7.2 - 18.1)	3.6 (3.6 - 3.6)	---	---	---
02	16.3 (11.1 - 19.9)	6.0 (6.0 - 6.0)	16.4 (16.0 - 16.8)	15.2 (15.2 - 15.2)	16.1 (15.6 - 16.7)
03	13.8 (11.2 - 16.0)	9.4 (9.4 - 9.4)	---	---	17.6 (17.6 - 17.6)
04	12.9 (11.2 - 14.4)	11.3 (11.3 - 11.3)	18.7 (18.2 - 19.2)	18.0 (17.0 - 19.0)	18.2 (18.2 - 18.2)
05	15.6 (13.1 - 17.7)	14.5 (13.4 - 15.7)	18.0 (18.0 - 18.0)	17.6 (17.6 - 17.6)	---
06	14.2 (13.6 - 14.9)	13.2 (13.2 - 13.2)	---	---	18.2 (16.9 - 19.6)
07	13.9 (10.6 - 17.0)	13.9 (11.5 - 16.4)	17.0 (16.9 - 17.1)	17.8 (17.8 - 17.8)	18.1 (17.8 - 18.5)
08	13.6 (12.3 - 15.9)	11.9 (11.9 - 11.9)	15.7 (14.2 - 17.2)	14.9 (14.6 - 15.2)	14.2 (14.2 - 14.2)
09	12.9 (12.9 - 12.9)	---	14.4 (14.4 - 14.4)	12.3 (12.3 - 12.3)	---
10	12.9 (12.4 - 13.2)	17.6 (17.6 - 17.6)	14.9 (14.6 - 15.3)	14.6 (14.2 - 15.1)	16.1 (15.9 - 16.3)
11	12.6 (11.2 - 14.2)	11.8 (11.8 - 11.8)	12.8 (12.8 - 12.8)	12.7 (12.7 - 12.7)	---
12	15.3 (11.3 - 20.0)	16.1 (16.1 - 16.1)	11.4 (11.4 - 11.4)	11.4 (11.4 - 11.4)	11.8 (11.6 - 12.0)
13	9.8 (9.4 - 10.2)	---	9.7 (9.7 - 9.7)	9.5 (9.5 - 9.5)	9.9 (9.8 - 10.0)
14	10.0 (9.1 - 13.0)	9.5 (9.4 - 9.7)	9.4 (9.4 - 9.4)	9.2 (9.2 - 9.2)	9.8 (9.6 - 10.0)
15	13.6 (11.0 - 17.0)	---	11.7 (11.5 - 12.0)	11.5 (11.0 - 12.1)	11.6 (11.6 - 11.6)
16	14.0 (13.1 - 15.9)	---	14.0 (14.0 - 14.1)	13.0 (12.6 - 13.5)	13.5 (12.8 - 14.2)
17	11.5 (10.6 - 12.6)	---	10.9 (10.9 - 10.9)	10.8 (10.8 - 10.8)	---
18	11.1 (7.2 - 14.0)	---	12.0 (12.0 - 12.0)	12.0 (12.0 - 12.0)	---
19	15.5 (15.0 - 16.2)	15.0 (14.1 - 16.0)	14.2 (14.0 - 14.4)	13.8 (13.5 - 14.2)	14.0 (13.7 - 14.3)

Table 6. Continued

Week	BWC	BWI	CBU	CBW	IMP
20	8.3 (7.3 - 9.6)	9.6 (9.6 - 9.6)	9.0 (8.4 - 9.7)	9.8 (9.5 - 10.2)	10.2 (10.2 - 10.3)
21	8.6 (5.7 - 11.4)	---	12.0 (10.7 - 13.4)	11.7 (10.2 - 13.2)	11.6 (10.1 - 13.2)
22	9.4 (6.4 - 12.3)	7.6 (7.0 - 8.2)	9.4 (9.0 - 9.8)	9.4 (8.5 - 10.3)	9.9 (9.6 - 10.2)
23	8.8 (7.1 - 11.6)	---	7.4 (6.9 - 8.0)	7.6 (7.4 - 7.8)	8.9 (8.4 - 9.5)
24	6.9 (4.3 - 10.4)	---	8.2 (8.2 - 8.3)	8.4 (8.1 - 8.6)	9.6 (9.3 - 10.0)
25	9.5 (5.4 - 13.6)	---	9.9 (9.8 - 10.0)	10.3 (10.2 - 10.4)	11.5 (10.8 - 12.2)
26	10.0 (8.4 - 11.8)	---	7.7 (7.7 - 7.7)	9.1 (9.1 - 9.1)	---
27	5.9 (2.2 - 10.8)	6.8 (6.8 - 6.8)	7.8 (7.0 - 8.6)	8.4 (8.3 - 8.5)	7.8 (7.5 - 8.1)
28	4.5 (0.5 - 9.5)	---	8.0 (7.3 - 8.8)	8.2 (8.1 - 8.3)	5.7 (3.8 - 7.7)
29	4.3 (2.1 - 5.8)	---	7.6 (7.3 - 7.9)	7.7 (7.6 - 7.8)	5.4 (3.9 - 7.0)
30	5.5 (0.6 - 8.6)	---	8.9 (8.0 - 9.9)	9.4 (9.2 - 9.6)	6.7 (4.6 - 8.9)
31	6.9 (0.3 - 13.3)	5.4 (5.4 - 5.4)	8.8 (8.8 - 8.8)	9.4 (8.8 - 10.1)	5.5 (3.9 - 7.1)
32	6.1 (2.1 - 11.2)	---	9.7 (9.6 - 9.8)	8.7 (8.2 - 9.4)	8.2 (7.4 - 9.1)
33	5.6 (0.1 - 9.2)	---	7.7 (7.6 - 7.8)	7.8 (7.7 - 8.0)	6.5 (6.0 - 7.0)
34	4.5 (2.3 - 6.6)	---	8.1 (7.5 - 7.7)	8.4 (8.3 - 8.5)	7.3 (7.1 - 7.5)
35	5.2 (1.5 - 9.8)	---	8.1 (8.1 - 8.2)	8.8 (8.7 - 9.0)	7.1 (6.3 - 8.0)
36	7.1 (4.0 - 10.4)	2.6 (2.6 - 2.6)	8.4 (7.5 - 9.4)	9.2 (8.8 - 9.7)	8.9 (8.8 - 9.0)
37	6.3 (3.1 - 9.2)	---	7.8 (7.6 - 8.1)	7.7 (7.2 - 8.3)	7.2 (7.1 - 7.3)
38	6.8 (3.5 - 8.9)	---	10.1 (9.8 - 10.5)	10.7 (10.6 - 10.8)	9.0 (8.1 - 10.0)
39	9.9	---	10.7	11.0	10.3

Table 6. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(7.8 - 11.4)		(10.2 - 11.2)	(10.6 - 11.4)	(10.0 - 10.6)
40	9.4 (7.8 - 10.6)	7.6 (7.6 - 7.6)	11.0 (11.0 - 11.0)	10.5 (10.4 - 10.6)	11.1 (10.8 - 11.5)
41	9.1 (7.2 - 11.1)	---	10.6 (10.2 - 11.0)	10.5 (10.4 - 10.7)	10.6 (10.6 - 10.7)
42	9.9 (7.8 - 12.7)	---	10.4 (10.3 - 10.6)	9.9 (9.8 - 10.0)	10.3 (10.0 - 10.6)
43	9.9 (6.8 - 11.9)	---	11.7 (11.4 - 12.0)	12.0 (11.8 - 12.2)	12.3 (11.9 - 12.7)
44	8.4 (5.5 - 12.6)	---	10.5 (10.5 - 10.6)	10.4 (10.4 - 10.4)	10.6 (10.4 - 10.9)
45	11.6 (10.9 - 13.1)	13.4 (13.4 - 13.4)	11.4 (11.4 - 11.5)	11.4 (11.4 - 11.4)	11.9 (11.7 - 12.2)
46	12.0 (10.1 - 15.4)	---	12.2 (11.9 - 12.5)	13.2 (12.9 - 13.5)	14.1 (13.8 - 14.4)
47	14.4 (13.2 - 15.2)	---	13.8 (13.6 - 14.1)	13.9 (13.8 - 14.0)	14.3 (14.2 - 14.4)
48	13.5 (11.5 - 16.3)	13.9 (13.9 - 13.9)	15.2 (15.1 - 15.4)	15.4 (15.0 - 15.9)	14.9 (14.8 - 15.0)
49	12.6 (9.8 - 14.0)	---	15.8 (15.8 - 15.8)	---	---
50	9.9 (7.2 - 12.6)	---	---	17.0 (17.0 - 17.0)	---
51	12.0 (8.1 - 15.5)	---	---	---	---
52	9.0 (5.8 - 12.2)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 7. Bottom dissolved oxygen means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	12.4 (6.5 - 18.4)	3.2 (3.2 - 3.2)	---	---	---
02	15.1 (9.8 - 18.8)	5.6 (5.6 - 5.6)	16.9 (16.7 - 17.2)	15.2 (15.2 - 15.2)	16.2 (15.6 - 16.8)
03	13.1 (10.8 - 16.0)	8.4 (8.4 - 8.4)	---	---	17.6 (17.6 - 17.6)
04	12.6 (10.4 - 14.4)	10.7 (10.7 - 10.7)	18.7 (18.2 - 19.2)	17.0 (16.9 - 17.2)	18.2 (18.2 - 18.2)
05	13.0 (13.0 - 18.9)	13.8 (13.8 - 13.8)	18.2 (18.2 - 18.2)	18.6 (18.6 - 18.6)	---
06	14.0 (13.4 - 14.6)	13.2 (13.2 - 13.2)	---	---	18.3 (16.8 - 19.9)
07	14.1 (9.9 - 16.8)	11.3 (11.3 - 11.3)	17.0 (17.0 - 17.0)	16.3 (16.3 - 16.3)	17.8 (17.8 - 17.9)
08	10.3 (5.3 - 13.3)	5.3 (5.3 - 5.3)	---	14.6 (14.6 - 14.6)	14.2 (14.2 - 14.2)
09	8.6 (8.6 - 8.6)	---	14.4 (14.4 - 14.4)	12.3 (12.3 - 12.3)	---
10	9.9 (7.5 - 12.2)	14.2 (14.2 - 14.2)	14.8 (14.7 - 15.0)	14.8 (14.5 - 15.1)	15.9 (15.9 - 16.0)
11	12.4 (11.2 - 14.2)	5.5 (5.5 - 5.5)	12.8 (12.8 - 12.8)	12.0 (12.0 - 12.0)	---
12	13.4 (11.3 - 17.7)	16.5 (16.5 - 16.5)	11.4 (11.4 - 11.4)	11.5 (11.5 - 11.5)	11.8 (11.6 - 12.0)
13	9.8 (9.3 - 10.5)	---	9.7 (9.7 - 9.7)	9.5 (9.5 - 9.5)	9.9 (9.9 - 10.0)
14	9.6 (9.1 - 11.1)	9.6 (9.3 - 9.9)	9.4 (9.4 - 9.4)	---	9.6 (9.6 - 9.7)
15	13.3 (11.0 - 16.6)	---	11.7 (11.6 - 11.9)	11.4 (10.8 - 12.0)	11.6 (11.6 - 11.6)
16	13.3 (10.3 - 17.0)	---	14.0 (14.0 - 14.0)	13.0 (12.6 - 13.5)	13.4 (12.7 - 14.2)
17	11.0 (9.6 - 12.6)	---	10.9 (10.9 - 10.9)	10.7 (10.7 - 10.7)	---
18	11.0 (7.1 - 14.0)	---	12.0 (12.0 - 12.0)	12.0 (12.0 - 12.0)	---
19	13.9 (11.8 - 16.6)	15.1 (14.4 - 15.8)	14.2 (14.0 - 14.4)	13.8 (13.3 - 14.4)	13.9 (13.7 - 14.2)

Table 7. Continued

Week	BWC	BWI	CBU	CBW	IMP
20	5.9 (0.7 - 9.5)	7.0 (7.0 - 7.0)	9.1 (8.6 - 9.7)	9.7 (9.4 - 10.2)	10.1 (10.1 - 10.2)
21	6.5 (4.4 - 9.3)	---	11.4 (10.8 - 12.0)	10.7 (10.1 - 11.4)	11.2 (10.0 - 12.4)
22	7.5 (5.5 - 11.0)	7.0 (5.6 - 8.4)	9.4 (9.0 - 9.8)	10.3 (10.3 - 10.3)	9.6 (9.6 - 9.7)
23	6.3 (4.0 - 7.6)	---	7.4 (6.8 - 8.1)	---	8.7 (8.0 - 9.4)
24	3.8 (2.5 - 6.0)	---	8.2 (8.1 - 8.3)	8.5 (8.5 - 8.6)	9.3 (9.0 - 9.7)
25	4.6 (2.1 - 11.6)	--- (9.7 - 9.8)	9.7 (10.0 - 10.5)	10.2 (10.5 - 11.2)	10.8
26	5.6 (0.7 - 12.2)	---	7.5 (7.5 - 7.5)	8.5 (8.5 - 8.5)	---
27	1.6 (0.5 - 2.6)	4.8 (4.8 - 4.8)	7.7 (6.9 - 8.5)	8.1 (8.1 - 8.1)	7.4 (6.8 - 8.0)
28	2.5 (1.6 - 4.4)	---	7.6 (7.1 - 8.2)	8.1 (8.0 - 8.3)	5.5 (3.6 - 7.5)
29	4.3 (3.4 - 5.4)	---	7.6 (7.4 - 7.9)	7.7 (7.7 - 7.7)	5.5 (3.9 - 7.2)
30	1.4 (0.5 - 3.1)	---	8.7 (7.8 - 9.6)	8.9 (8.9 - 9.0)	5.5 (2.3 - 8.8)
31	2.7 (0.4 - 5.3)	3.6 (3.6 - 3.6)	8.7 (8.7 - 8.7)	8.3 (8.3 - 8.3)	4.9 (2.8 - 7.0)
32	2.9 (0.5 - 5.3)	---	9.5 (9.5 - 9.6)	8.2 (8.2 - 8.2)	7.3 (5.8 - 8.8)
33	2.7 (0.1 - 5.7)	---	7.9 (7.8 - 8.0)	7.2 (7.2 - 7.2)	5.7 (4.6 - 6.9)
34	3.0 (0.2 - 4.3)	---	7.6 (7.5 - 7.7)	7.9 (7.9 - 7.9)	6.7 (6.2 - 7.3)
35	2.4 (1.6 - 4.3)	---	8.1 (8.0 - 8.2)	8.4 (8.4 - 8.4)	6.9 (6.0 - 7.9)
36	4.9 (2.6 - 7.6)	1.7 (1.7 - 1.7)	8.3 (7.5 - 9.2)	8.6 (8.6 - 8.6)	8.0 (7.5 - 8.5)
37	4.8 (2.4 - 8.5)	---	7.8 (7.6 - 8.1)	7.2 (7.2 - 7.2)	6.9 (6.8 - 7.1)
38	6.6 (4.8 - 9.0)	---	10.1 (9.8 - 10.5)	10.2 (10.2 - 10.2)	9.1 (8.1 - 10.1)

Table 7. Continued

Week	BWC	BWI	CBU	CBW	IMP
39	8.4 (7.4 - 9.7)	---	10.7 (10.2 - 11.2)	10.1 (10.1 - 10.1)	10.3 (10.0 - 10.6)
40	8.5 (7.4 - 10.2)	7.7 (7.7 - 7.7)	10.8 (10.8 - 10.8)	10.2 (10.2 - 10.2)	11.1 (10.7 - 11.6)
41	8.4 (7.2 - 10.1)	---	10.5 (10.1 - 11.0)	10.5 (10.5 - 10.5)	10.6 (10.6 - 10.6)
42	9.4 (7.7 - 11.2)	---	10.2 (10.2 - 10.3)	9.6 (9.6 - 9.6)	10.3 (10.0 - 10.6)
43	8.9 (7.4 - 11.9)	---	11.6 (11.4 - 11.8)	12.0 (12.0 - 12.0)	12.4 (12.0 - 12.8)
44	7.2 (5.5 - 9.2)	---	10.5 (10.5 - 10.6)	10.4 (10.4 - 10.4)	10.6 (10.4 - 10.9)
45	11.0 (10.4 - 11.5)	13.4 (13.4 - 13.4)	11.4 (11.4 - 11.5)	11.4 (11.4 - 11.4)	11.9 (11.6 - 12.2)
46	12.3 (10.0 - 15.4)	---	12.2 (11.9 - 12.6)	13.8 (13.8 - 13.8)	14.0 (13.7 - 14.4)
47	14.4 (13.1 - 15.4)	---	14.1 (14.1 - 14.1)	14.1 (14.1 - 14.1)	14.5 (14.4 - 14.6)
48	12.9 (11.3 - 15.4)	---	15.3 (15.1 - 15.6)	15.0 (15.0 - 15.0)	15.1 (14.9 - 15.3)
49	12.1 (9.1 - 13.8)	---	16.0 (16.0 - 16.0)	---	---
50	7.0 (7.0 - 7.0)	---	---	---	---
51	11.8 (11.8 - 11.8)	---	---	---	---
52	5.6 (5.6 - 5.6)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 8. Surface temperature means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	0.7 (0.5 - 1.0)	1.2 (1.2 - 1.2)	---	---	---
02	1.0 (0.4 - 2.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
03	1.1 (0.0 - 2.8)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	---	0.0 (0.0 - 0.0)
04	0.7 (0.0 - 1.6)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.1 (0.0 - 0.2)
05	1.6 (0.1 - 3.8)	1.6 (1.2 - 2.0)	0.5 (0.5 - 0.5)	0.4 (0.4 - 0.4)	---
06	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
07	0.3 (0.0 - 1.5)	1.4 (1.0 - 1.8)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
08	0.0 (0.0 - 0.2)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
09	0.0 (0.0 - 0.0)	---	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	---
10	0.7 (0.0 - 2.2)	1.1 (1.1 - 1.1)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
11	0.0 (0.0 - 0.1)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	---
12	2.9 (1.1 - 5.2)	4.9 (4.9 - 4.9)	0.5 (0.5 - 0.5)	0.3 (0.3 - 0.3)	1.4 (1.3 - 1.6)
13	5.0 (4.0 - 7.0)	---	5.5 (4.8 - 6.2)	4.5 (3.0 - 6.0)	6.2 (6.1 - 6.3)
14	5.3 (4.9 - 6.5)	5.4 (4.9 - 6.0)	5.1 (5.0 - 5.2)	4.6 (4.2 - 5.0)	5.4 (5.1 - 5.7)
15	7.2 (6.1 - 9.0)	---	7.4 (7.0 - 7.8)	6.4 (6.0 - 6.8)	6.7 (6.2 - 7.2)
16	12.2 (9.8 - 14.7)	---	12.1 (11.7 - 12.5)	11.1 (10.8 - 11.5)	11.4 (10.9 - 12.0)
17	15.3 (15.0 - 16.1)	---	14.8 (14.8 - 14.8)	14.5 (14.5 - 14.5)	---
18	13.0 (11.8 - 14.0)	---	12.5 (12.5 - 12.5)	12.1 (12.1 - 12.1)	---
19	15.0	15.5	13.0	12.5	13.0

Table 8. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(14.0 - 16.1)	(14.0 - 17.1)	(13.0 - 13.0)	(12.5 - 12.5)	(12.5 - 13.5)
20	20.0 (19.1 - 21.9)	18.4 (18.4 - 18.4)	19.1 (19.1 - 19.1)	18.9 (18.7 - 19.2)	19.2 (18.5 - 19.9)
21	21.3 (18.6 - 24.5)	---	20.6 (20.0 - 21.2)	20.5 (20.0 - 21.1)	20.0 (20.0 - 20.0)
22	23.0 (22.0 - 24.1)	23.3 (22.1 - 24.6)	21.1 (21.0 - 21.2)	20.6 (20.2 - 21.0)	20.8 (20.6 - 21.0)
23	24.1 (22.9 - 26.8)	---	22.9 (22.2 - 23.8)	22.3 (22.1 - 22.6)	21.5 (21.0 - 22.0)
24	20.6 (18.0 - 22.0)	---	19.5 (19.5 - 19.5)	19.1 (19.1 - 19.2)	19.0 (18.9 - 19.2)
25	26.3 (25.1 - 28.4)	---	23.1 (22.9 - 23.4)	23.0 (23.0 - 23.1)	23.4 (23.0 - 23.8)
26	26.6 (25.9 - 27.2)	---	25.0 (25.0 - 25.0)	25.1 (25.1 - 25.1)	---
27	28.1 (26.5 - 29.1)	28.9 (28.9 - 28.9)	27.3 (26.8 - 27.8)	27.3 (27.2 - 27.5)	26.8 (26.3 - 27.3)
28	28.0 (26.3 - 29.9)	---	28.6 (28.1 - 29.2)	28.6 (28.2 - 29.0)	28.7 (28.5 - 28.9)
29	21.4 (19.9 - 22.2)	---	24.7 (23.9 - 25.6)	24.9 (24.0 - 25.8)	23.5 (22.1 - 25.0)
30	26.4 (24.5 - 27.9)	---	24.7 (24.6 - 24.8)	24.5 (24.5 - 24.6)	24.4 (24.2 - 24.7)
31	26.6 (24.8 - 29.2)	26.1 (26.1 - 26.1)	26.1 (26.0 - 26.2)	25.8 (25.5 - 26.1)	25.1 (24.8 - 25.5)
32	24.6 (22.1 - 27.1)	---	25.0 (25.0 - 25.1)	24.7 (24.7 - 24.8)	24.8 (24.3 - 25.3)
33	24.1 (22.0 - 26.0)	---	24.1 (24.1 - 24.2)	24.4 (24.1 - 24.8)	23.1 (22.2 - 24.1)
34	25.2 (22.6 - 27.0)	---	25.0 (25.0 - 25.0)	24.8 (24.6 - 25.0)	24.5 (24.2 - 24.8)
35	24.6 (23.6 - 26.9)	---	24.5 (24.2 - 24.8)	24.9 (24.9 - 25.0)	23.7 (23.3 - 24.1)
36	23.9 (23.5 - 24.8)	22.7 (22.7 - 22.7)	23.2 (23.2 - 23.2)	23.3 (23.2 - 23.5)	22.8 (22.4 - 23.3)
37	19.5 (18.0 - 22.5)	---	21.2 (20.0 - 22.5)	21.2 (20.2 - 22.2)	22.3 (22.2 - 22.5)
38	20.8	---	20.0	20.1	19.5

Table 8. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(20.0 - 21.8)		(20.0 - 20.0)	(20.1 - 20.2)	(19.2 - 19.8)
39	16.6 (15.1 - 17.5)	---	16.8 (16.8 - 16.9)	16.9 (16.9 - 17.0)	15.3 (14.2 - 16.5)
40	13.5 (12.1 - 15.0)	13.0 (13.0 - 13.0)	15.9 (15.9 - 15.9)	15.9 (15.8 - 16.0)	14.5 (13.5 - 15.5)
41	12.9 (11.9 - 14.5)	---	12.8 (12.8 - 12.9)	12.9 (12.8 - 13.0)	11.9 (11.3 - 12.6)
42	8.6 (6.0 - 12.9)	---	11.0 (10.1 - 12.0)	11.6 (11.0 - 12.2)	10.0 (8.3 - 11.8)
43	14.2 (12.0 - 17.1)	---	11.5 (11.1 - 11.9)	11.2 (10.6 - 11.8)	11.2 (10.9 - 11.6)
44	11.1 (10.2 - 12.5)	---	11.6 (11.3 - 11.9)	11.9 (11.8 - 12.1)	11.5 (11.5 - 11.5)
45	7.9 (7.2 - 8.5)	8.3 (8.3 - 8.3)	8.4 (8.1 - 8.8)	8.3 (7.9 - 8.8)	8.7 (8.5 - 9.0)
46	7.0 (6.4 - 7.8)	---	6.3 (6.1 - 6.6)	5.9 (5.9 - 6.0)	6.2 (6.1 - 6.3)
47	1.9 (1.2 - 2.5)	---	1.9 (1.8 - 2.1)	2.1 (1.8 - 2.4)	1.6 (1.3 - 2.0)
48	2.9 (1.0 - 6.0)	2.0 (2.0 - 2.0)	1.0 (1.0 - 1.1)	0.9 (0.8 - 1.0)	1.1 (1.1 - 1.1)
49	2.0 (1.0 - 3.9)	---	0.0 (0.0 - 0.0)	---	---
50	1.6 (0.2 - 2.6)	0.5 (0.5 - 0.5)	---	0.0 (0.0 - 0.0)	---
51	0.2 (0.1 - 0.5)	---	---	---	---
52	0.9 (0.8 - 1.0)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 9. Bottom temperature means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	0.5 (0.1 - 1.0)	0.8 (0.8 - 0.8)	---	---	---
02	1.3 (0.5 - 3.0)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
03	1.2 (0.0 - 3.2)	1.1 (1.1 - 1.1)	0.0 (0.0 - 0.0)	---	0.0 (0.0 - 0.0)
04	1.1 (0.1 - 3.1)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.1 (0.0 - 0.2)
05	1.9 (0.1 - 4.1)	2.2 (2.2 - 2.2)	0.5 (0.5 - 0.5)	0.3 (0.3 - 0.3)	---
06	0.5 (0.0 - 1.0)	0.0 (0.0 - 0.0)	---	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
07	0.7 (0.0 - 1.7)	1.0 (1.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
08	1.0 (0.0 - 1.8)	1.9 (1.9 - 1.9)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
09	1.1 (1.1 - 1.1)	---	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	---
10	1.1 (0.5 - 1.8)	3.0 (3.0 - 3.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
11	0.2 (0.0 - 0.9)	2.2 (2.2 - 2.2)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	---
12	2.8 (1.1 - 4.1)	4.2 (4.2 - 4.2)	0.5 (0.5 - 0.5)	0.3 (0.3 - 0.3)	1.5 (1.3 - 1.7)
13	4.8 (4.0 - 7.0)	---	5.4 (4.7 - 6.2)	4.5 (3.0 - 6.0)	6.2 (6.1 - 6.3)
14	5.2 (4.9 - 6.0)	5.4 (4.9 - 6.0)	5.1 (5.0 - 5.2)	--- (5.0 - 5.7)	5.3
15	7.1 (6.0 - 8.9)	---	7.4 (7.0 - 7.8)	6.4 (6.0 - 6.8)	6.6 (6.2 - 7.1)
16	11.2 (9.0 - 13.0)	---	12.1 (11.7 - 12.5)	11.1 (10.8 - 11.5)	11.4 (10.9 - 11.9)
17	15.3 (15.0 - 16.1)	---	14.8 (14.8 - 14.8)	14.6 (14.6 - 14.6)	---
18	13.0 (11.8 - 14.0)	---	12.5 (12.5 - 12.5)	12.1 (12.1 - 12.1)	---
19	13.5	15.0	13.0	12.5	13.0

Table 9. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(12.0 - 15.8)	(14.0 - 16.0)	(13.0 - 13.0)	(12.5 - 12.5)	(12.5 - 13.5)
20	18.8 (14.9 - 20.1)	16.8 (16.8 - 16.8)	19.0 (19.0 - 19.1)	18.9 (18.7 - 19.2)	18.8 (18.5 - 19.2)
21	19.6 (18.6 - 22.0)	---	20.6 (20.0 - 21.2)	20.5 (20.0 - 21.1)	20.0 (20.0 - 20.0)
22	21.7 (20.5 - 23.5)	21.9 (21.4 - 22.5)	21.1 (21.0 - 21.2)	21.0 (21.0 - 21.0)	20.8 (20.6 - 21.0)
23	22.2 (21.4 - 23.0)	---	22.9 (22.0 - 23.9)	---	21.9 (21.9 - 22.0)
24	19.2 (18.2 - 19.9)	---	19.4 (19.3 - 19.5)	19.1 (19.1 - 19.2)	18.9 (18.7 - 19.2)
25	23.5 (20.0 - 26.3)	---	23.0 (22.9 - 23.1)	23.0 (23.0 - 23.1)	22.6 (22.3 - 23.0)
26	24.9 (23.3 - 27.1)	---	24.9 (24.9 - 24.9)	25.0 (25.0 - 25.0)	---
27	25.2 (22.9 - 27.2)	25.6 (25.6 - 25.6)	27.3 (26.8 - 27.8)	27.1 (27.1 - 27.1)	26.7 (26.1 - 27.4)
28	27.4 (26.3 - 29.0)	---	28.5 (28.1 - 29.0)	28.6 (28.2 - 29.0)	28.6 (28.5 - 28.8)
29	21.9 (21.8 - 22.1)	---	24.7 (23.9 - 25.5)	25.9 (25.9 - 25.9)	23.6 (22.1 - 25.1)
30	24.0 (22.2 - 26.0)	---	24.7 (24.6 - 24.8)	24.4 (24.3 - 24.6)	24.0 (23.9 - 24.1)
31	24.9 (24.0 - 25.8)	24.2 (24.2 - 24.2)	26.1 (26.0 - 26.3)	26.0 (26.0 - 26.0)	25.0 (24.5 - 25.5)
32	23.6 (23.1 - 24.4)	---	25.0 (24.9 - 25.1)	24.8 (24.8 - 24.8)	24.7 (24.4 - 25.1)
33	23.2 (22.0 - 23.8)	---	24.0 (24.0 - 24.1)	24.5 (24.5 - 24.5)	23.0 (22.0 - 24.1)
34	24.5 (23.6 - 25.5)	---	25.0 (25.0 - 25.0)	24.5 (24.5 - 24.5)	24.1 (24.0 - 24.2)
35	23.9 (23.6 - 24.5)	---	24.5 (24.2 - 24.8)	24.8 (24.8 - 24.8)	23.6 (23.2 - 24.1)
36	23.1 (22.2 - 23.8)	21.8 (21.8 - 21.8)	23.2 (23.2 - 23.2)	23.0 (23.0 - 23.0)	22.4 (21.8 - 23.1)
37	19.4 (17.3 - 22.5)	---	21.2 (20.0 - 22.5)	22.2 (22.2 - 22.2)	22.2 (22.2 - 22.2)
38	20.4	---	20.0	20.0	19.5

Table 9. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(20.0 - 20.7)		(20.0 - 20.0)	(20.0 - 20.0)	(19.1 - 19.9)
39	15.8 (15.1 - 17.5)	---	16.8 (16.8 - 16.9)	16.9 (16.9 - 16.9)	15.3 (14.2 - 16.5)
40	13.0 (12.0 - 14.5)	12.0 (12.0 - 12.0)	15.5 (15.5 - 15.5)	15.3 (15.3 - 15.3)	14.1 (12.9 - 15.3)
41	12.2 (11.9 - 13.1)	---	12.8 (12.8 - 12.9)	12.5 (12.5 - 12.5)	11.9 (11.2 - 12.6)
42	9.0 (6.8 - 12.9)	---	11.0 (10.0 - 12.0)	12.0 (12.0 - 12.0)	10.0 (8.3 - 11.8)
43	13.4 (10.8 - 15.8)	---	11.0 (10.4 - 11.7)	10.2 (10.2 - 10.2)	11.1 (10.7 - 11.5)
44	10.9 (10.0 - 12.5)	---	11.6 (11.3 - 11.9)	12.1 (12.1 - 12.1)	11.5 (11.5 - 11.5)
45	7.9 (7.8 - 8.0)	8.2 (8.2 - 8.2)	8.4 (8.1 - 8.8)	8.8 (8.8 - 8.8)	8.7 (8.5 - 9.0)
46	7.1 (6.9 - 7.8)	---	6.3 (6.1 - 6.5)	5.8 (5.8 - 5.8)	6.2 (6.1 - 6.3)
47	1.8 (1.0 - 2.5)	---	1.8 (1.8 - 1.8)	1.8 (1.8 - 1.8)	1.4 (1.0 - 1.9)
48	2.3 (2.0 - 3.0)	---	1.0 (1.0 - 1.0)	0.8 (0.8 - 0.8)	1.4 (1.1 - 1.7)
49	1.4 (1.2 - 1.8)	---	0.0 (0.0 - 0.0)	---	---
50	1.6 (0.6 - 2.6)	---	---	---	---
51	0.8 (0.8 - 0.8)	---	---	---	---
52	1.0 (1.0 - 1.0)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Table 10. Specific conductivity means and ranges (in parentheses) by week and habitat type, Upper Mississippi River Pool 13, 1989.

Week	BWC	BWI	CBU	CBW	IMP
01	411 (371 - 450)	390 (390 - 390)	---	---	---
02	422 (335 - 549)	428 (428 - 428)	391 (386 - 395)	376 (376 - 376)	372 (368 - 376)
03	412 (383 - 480)	439 (439 - 439)	382 (382 - 382)	---	---
04	387 (346 - 495)	388 (388 - 388)	358 (352 - 364)	365 (365 - 365)	357 (353 - 361)
05	325 (220 - 399)	328 (286 - 369)	350 (340 - 360)	360 (360 - 360)	---
06	387 (376 - 397)	424 (424 - 424)	362 (362 - 362)	---	363 (360 - 366)
07	411 (395 - 425)	401 (395 - 406)	390 (381 - 398)	394 (394 - 394)	375 (374 - 376)
08	428 (398 - 482)	442 (442 - 442)	413 (398 - 428)	384 (383 - 385)	395 (393 - 396)
09	417 (405 - 429)	---	368 (368 - 368)	353 (353 - 353)	---
10	413 (326 - 577)	389 (389 - 389)	379 (377 - 380)	392 (381 - 402)	381 (371 - 391)
11	322 (283 - 348)	250 (250 - 250)	335 (335 - 335)	320 (320 - 320)	---
12	275 (190 - 330)	280 (280 - 280)	312 (312 - 312)	308 (308 - 308)	308 (306 - 310)
13	315 (298 - 325)	---	310 (309 - 310)	295 (283 - 307)	300 (300 - 300)
14	279 (268 - 290)	280 (276 - 284)	253 (251 - 255)	244 (242 - 245)	253 (250 - 255)
15	245 (233 - 252)	---	252 (251 - 253)	239 (230 - 248)	253 (252 - 254)
16	261 (247 - 285)	---	256 (247 - 265)	266 (260 - 272)	256 (255 - 257)
17	284 (267 - 297)	---	276 (276 - 276)	273 (273 - 273)	---
18	311 (270 - 376)	---	278 (278 - 278)	273 (273 - 273)	---
19	303	299	267	267	265

Table 10. Continued

Week	BWC	BWI	CBU	CBW	IMP
	(285 - 330)	(288 - 310)	(252 - 281)	(255 - 278)	(260 - 270)
20	301 (287 - 324)	302 (302 - 302)	272 (254 - 290)	274 (263 - 285)	270 (264 - 276)
21	324 (307 - 341)	---	291 (289 - 292)	288 (286 - 289)	286 (285 - 286)
22	305 (298 - 312)	306 (296 - 315)	283 (280 - 286)	292 (285 - 298)	290 (288 - 291)
23	270 (261 - 281)	---	245 (240 - 249)	240 (227 - 253)	254 (253 - 255)
24	324 (282 - 350)	---	266 (265 - 267)	260 (260 - 260)	263 (254 - 272)
25	299 (280 - 325)	---	258 (255 - 260)	245 (241 - 248)	258 (253 - 263)
26	297 (280 - 317)	---	274 (274 - 274)	264 (264 - 264)	---
27	314 (275 - 340)	322 (322 - 322)	280 (279 - 281)	278 (275 - 280)	286 (286 - 286)
28	327 (306 - 352)	---	283 (275 - 291)	294 (292 - 295)	290 (287 - 292)
29	307 (287 - 327)	---	295 (292 - 297)	301 (299 - 303)	294 (290 - 297)
30	290 (244 - 341)	---	290 (280 - 300)	288 (286 - 290)	290 (282 - 297)
31	300 (279 - 327)	306 (306 - 306)	294 (289 - 299)	293 (292 - 293)	296 (290 - 301)
32	313 (293 - 327)	---	302 (294 - 310)	317 (311 - 322)	304 (301 - 307)
33	321 (308 - 338)	--- (317 - 332)	325 (318 - 325)	322 (316 - 324)	320
34	322 (309 - 344)	---	314 (304 - 323)	307 (302 - 311)	320 (314 - 325)
35	314 (305 - 319)	---	316 (308 - 323)	310 (301 - 318)	323 (321 - 325)
36	310 (292 - 324)	247 (247 - 247)	297 (295 - 298)	300 (290 - 309)	310 (303 - 316)
37	302 (264 - 338)	---	309 (307 - 311)	321 (307 - 334)	310 (309 - 310)
38	325 (313 - 345)	---	322 (317 - 327)	311 (297 - 324)	323 (317 - 328)

Table 10. Continued

Week	BWC	BWI	CBU	CBW	IMP
39	316 (280 - 333)	---	324 (311 - 337)	323 (313 - 333)	331 (324 - 337)
40	357 (349 - 364)	337 (337 - 337)	356 (356 - 356)	347 (330 - 364)	340 (338 - 342)
41	344 (324 - 357)	---	358 (358 - 358)	349 (348 - 349)	347 (346 - 348)
42	365 (342 - 386)	---	333 (288 - 378)	390 (386 - 393)	358 (352 - 364)
43	349 (334 - 365)	---	350 (343 - 356)	317 (284 - 349)	327 (320 - 334)
44	369 (320 - 393)	---	375 (368 - 381)	368 (360 - 376)	364 (359 - 368)
45	374 (365 - 400)	375 (375 - 375)	354 (351 - 356)	354 (349 - 358)	357 (355 - 359)
46	369 (356 - 382)	---	324 (324 - 324)	334 (334 - 334)	337 (337 - 337)
47	349 (326 - 376)	---	327 (325 - 329)	324 (317 - 330)	326 (325 - 326)
48	350 (335 - 370)	287 (287 - 287)	326 (325 - 326)	326 (325 - 327)	321 (321 - 321)
49	378 (309 - 403)	---	243 (243 - 243)	---	---
50	448 (395 - 529)	445 (445 - 445)	---	377 (377 - 377)	---
51	465 (385 - 578)	---	---	---	---
52	437 (415 - 459)	---	---	---	---

BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

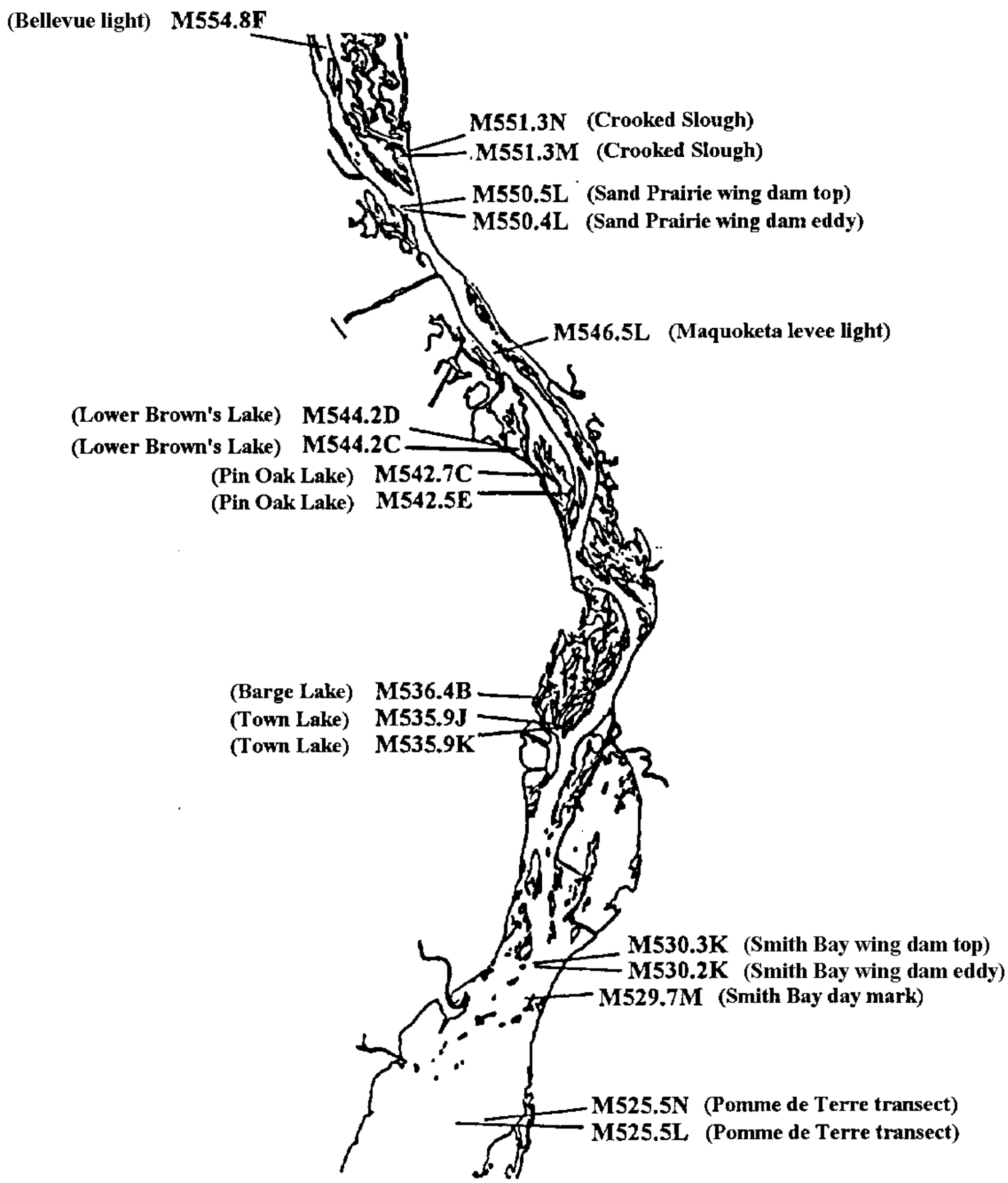


Figure 1. Location of Resource Trend Analysis sites, Upper Mississippi River, Pool 13.

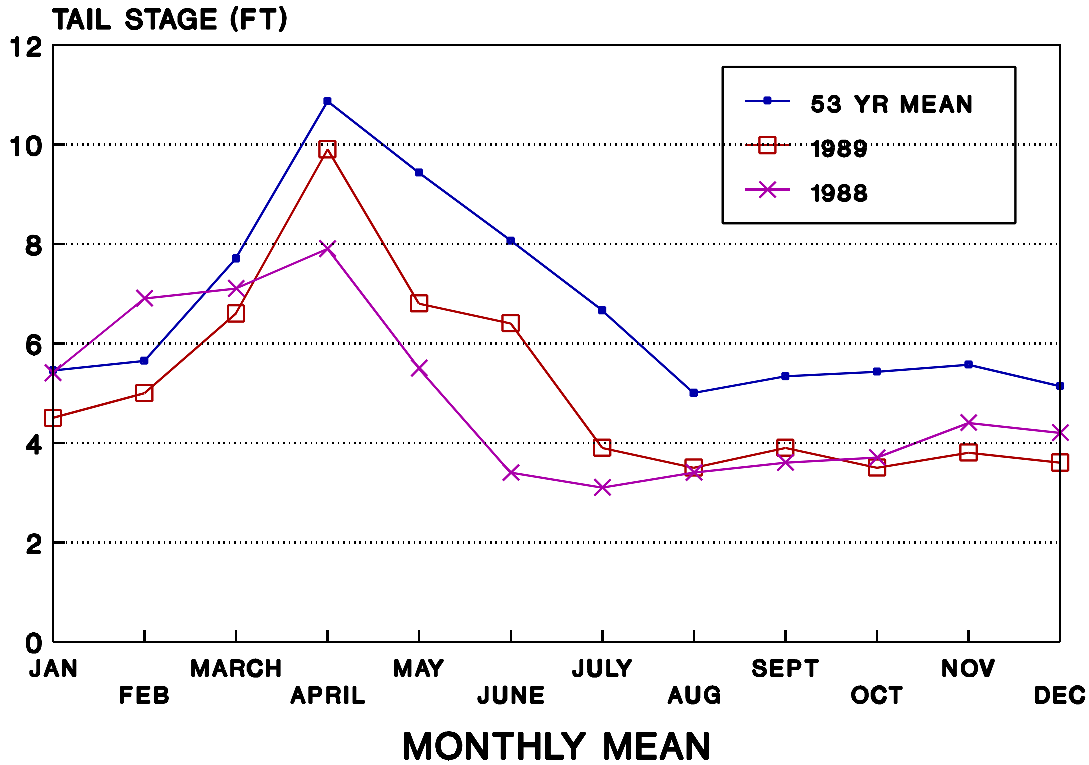


Figure 2. Comparisons of 1988, 1989, and 53-yr mean tailwater stages at Lock and Dam 12, Upper Mississippi River.

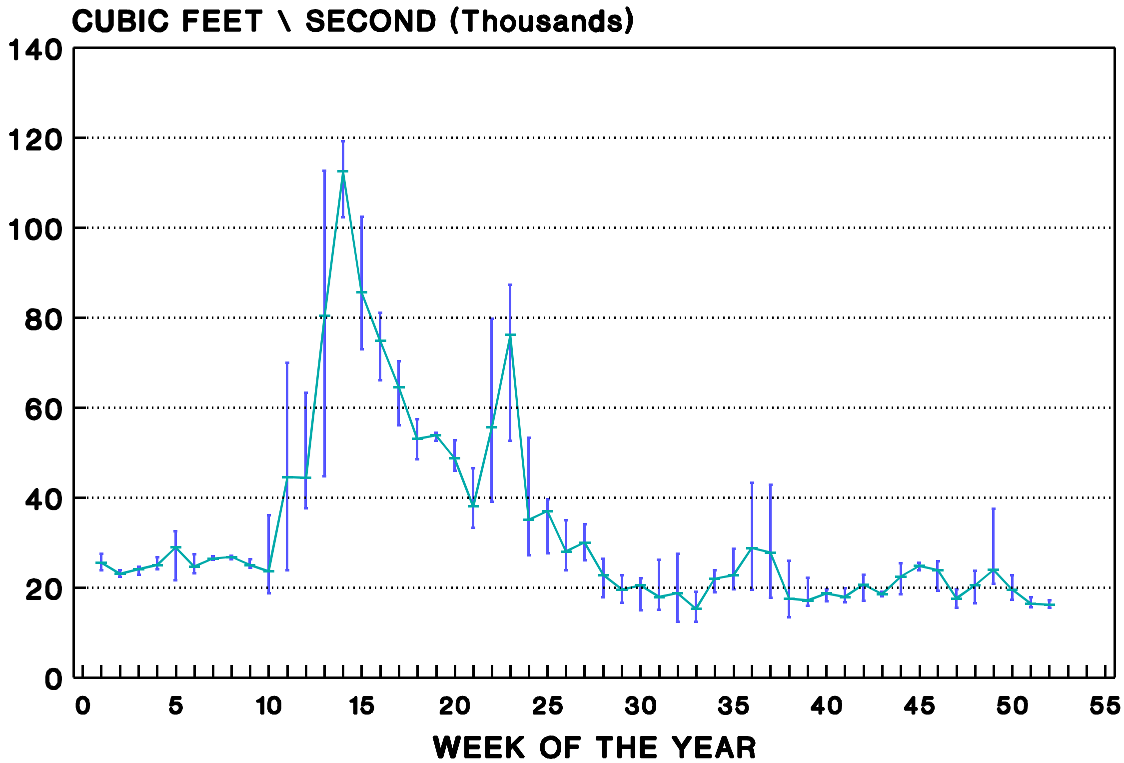
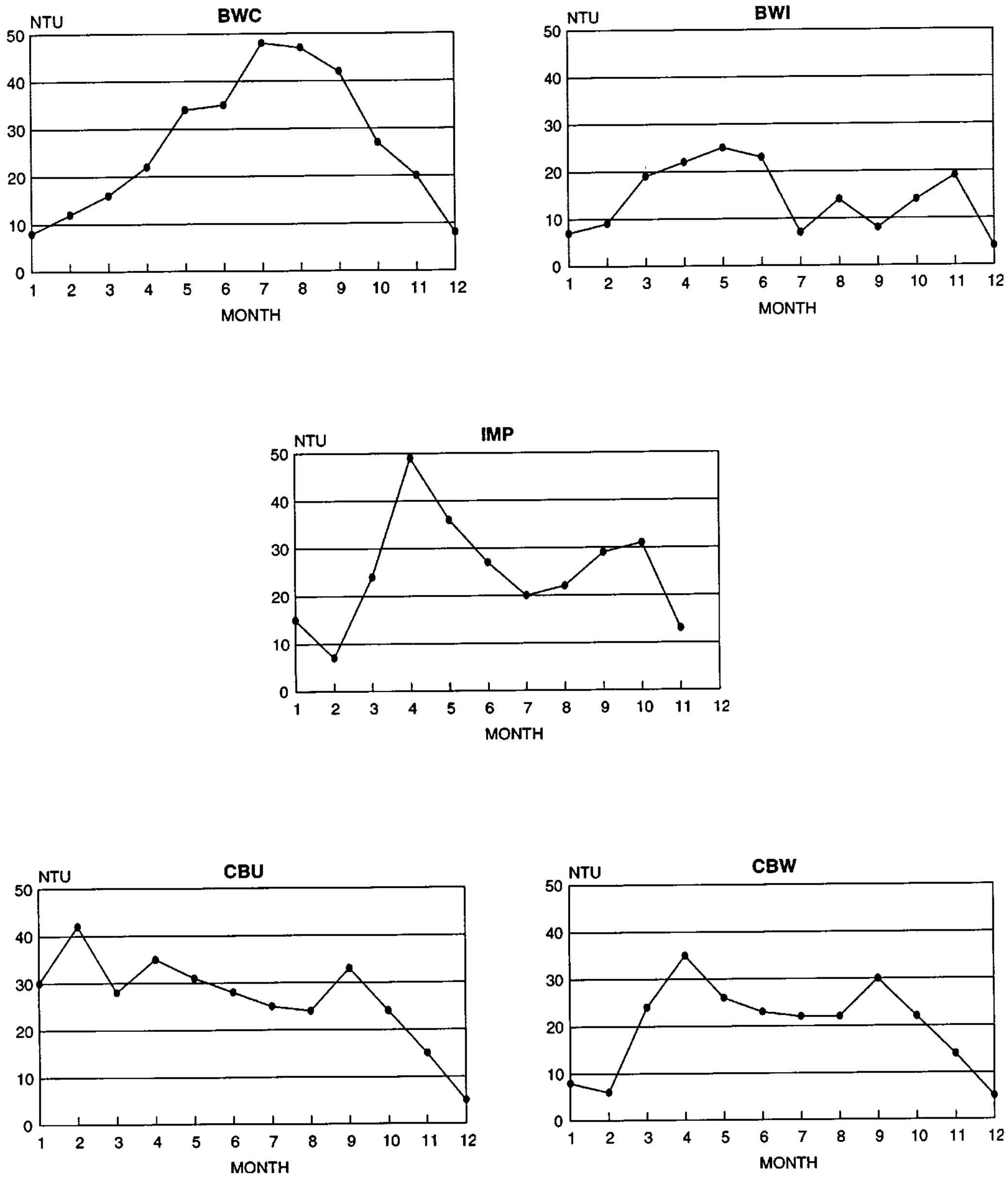
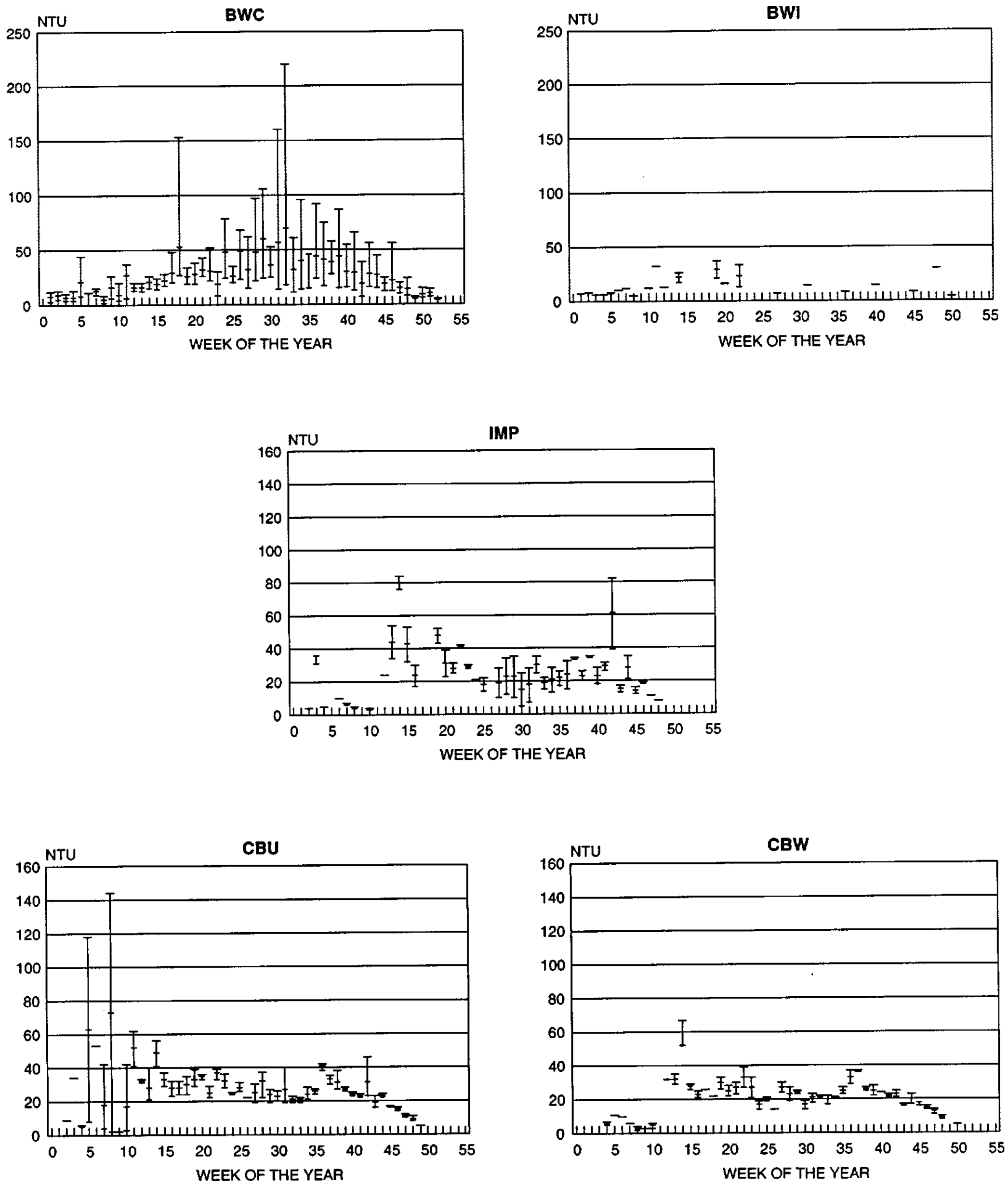


Figure 3. Weekly means and ranges of tailwater discharges at Lock and Dam 12, Upper Mississippi River Pool 12, 1989.



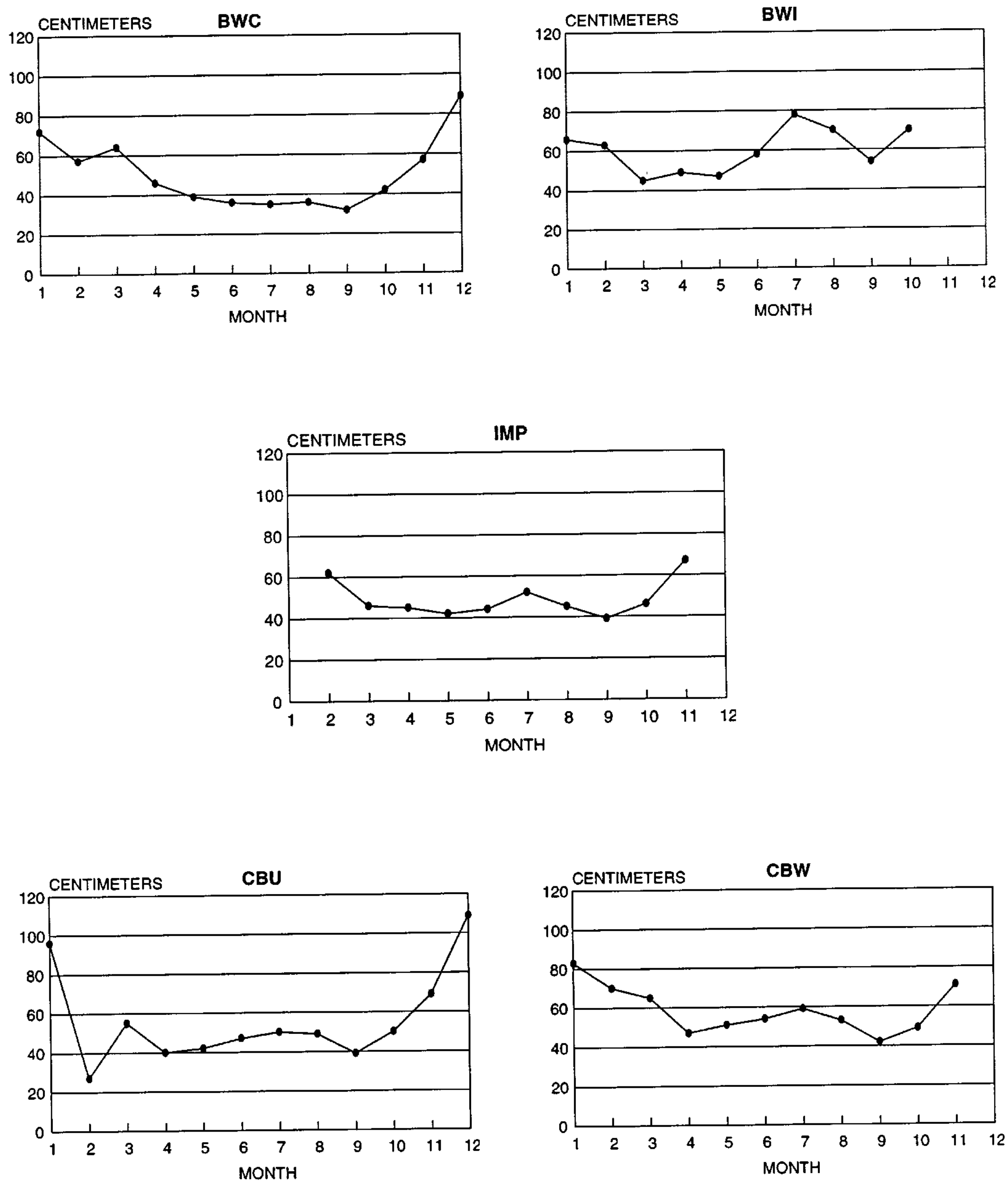
BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 4. Monthly mean nephelometric turbidity for all habitats sampled, Upper Mississippi River Pool 13, 1989.



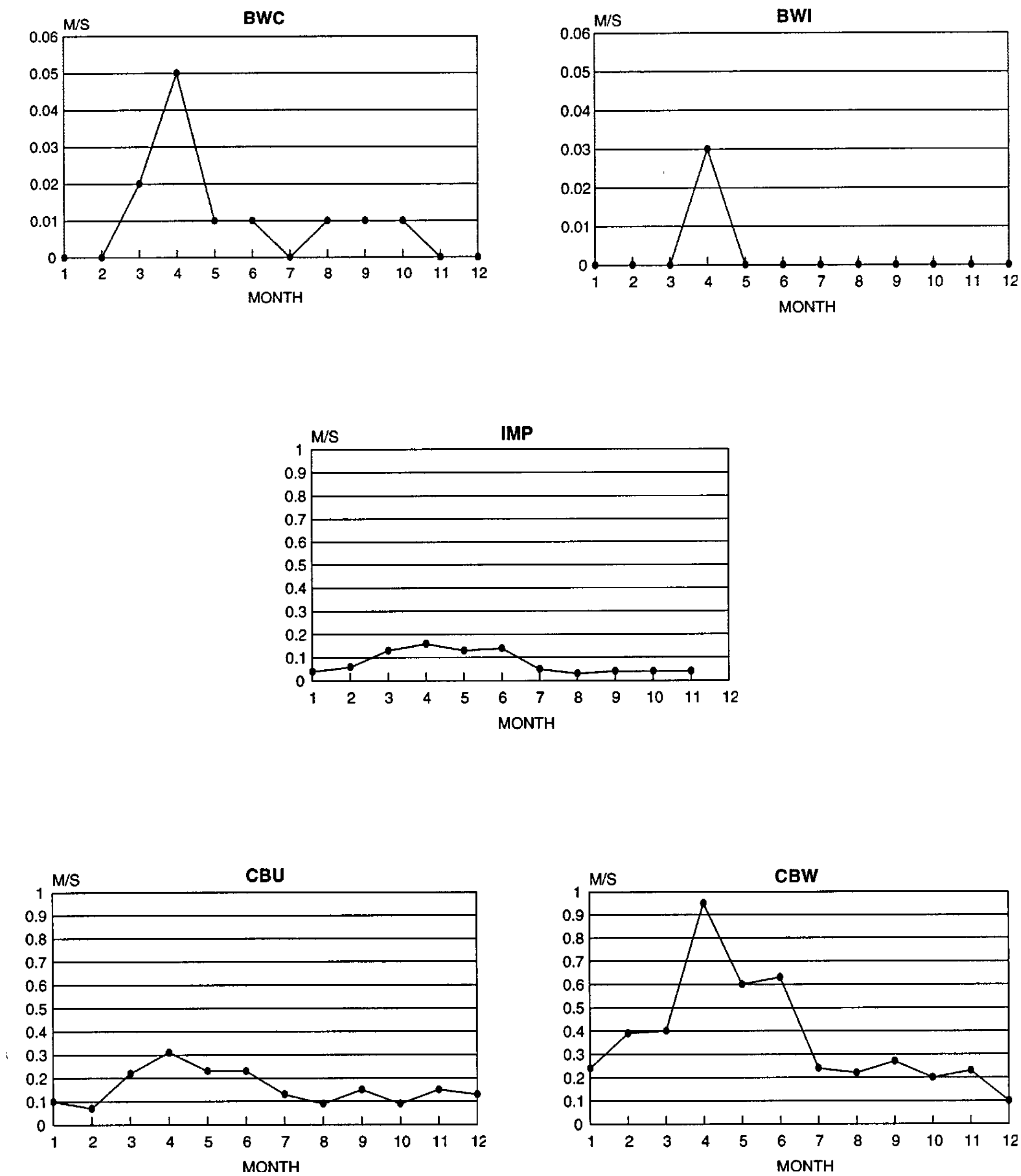
BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 5. Weekly surface nephelometric turbidity means and ranges for all habitats sampled, Upper Mississippi River Pool 13, 1989.



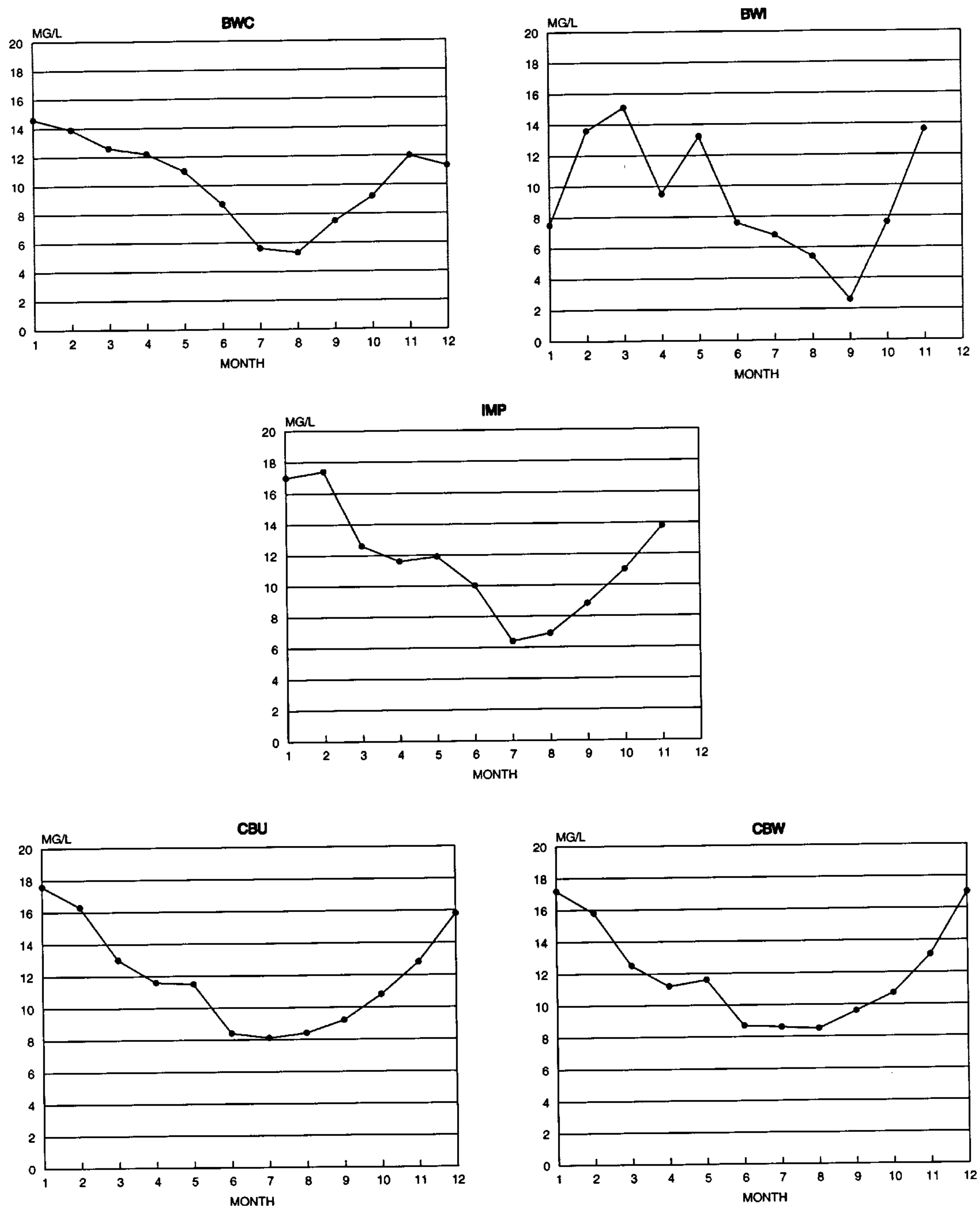
BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 6. Monthly mean Secchi disk transparency for all habitats sampled, Upper Mississippi River Pool 13, 1989.



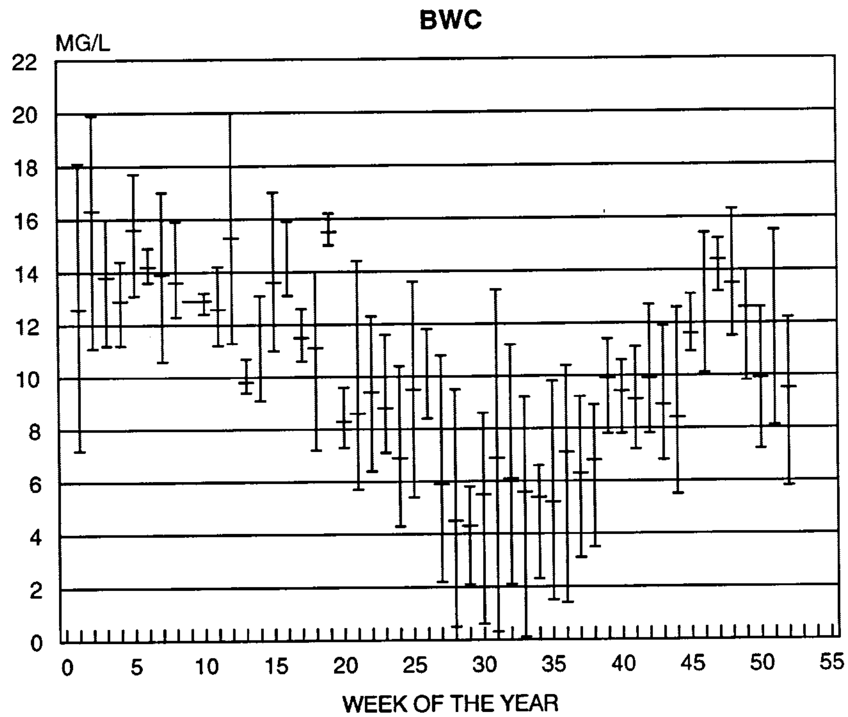
BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 7. Monthly mean surface velocity for all habitats sampled, Upper Mississippi River Pool 13, 1989.



BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 8. Monthly mean surface dissolved oxygen for all habitats sampled, Upper Mississippi River Pool 13, 1989.



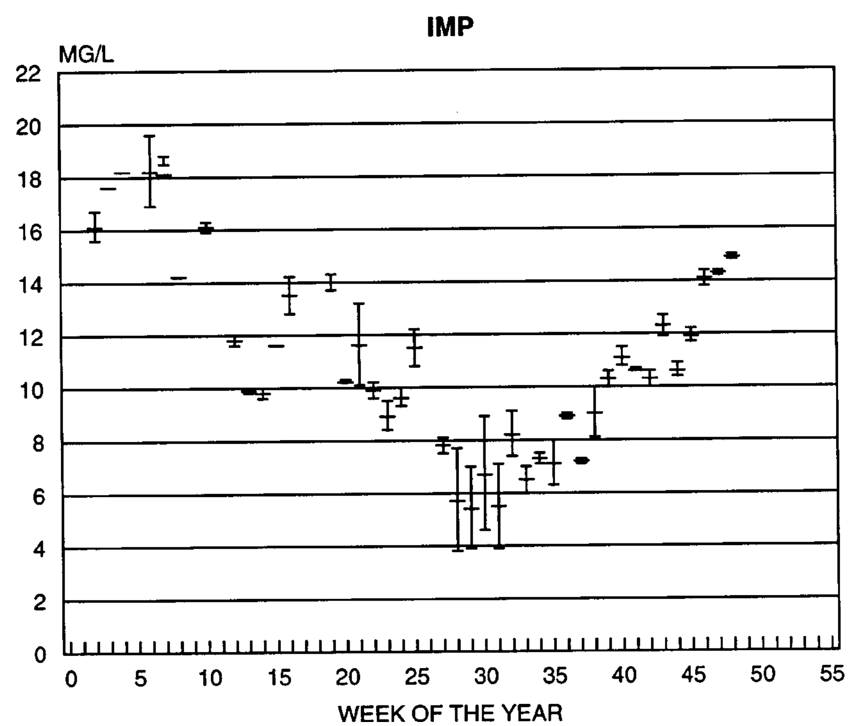
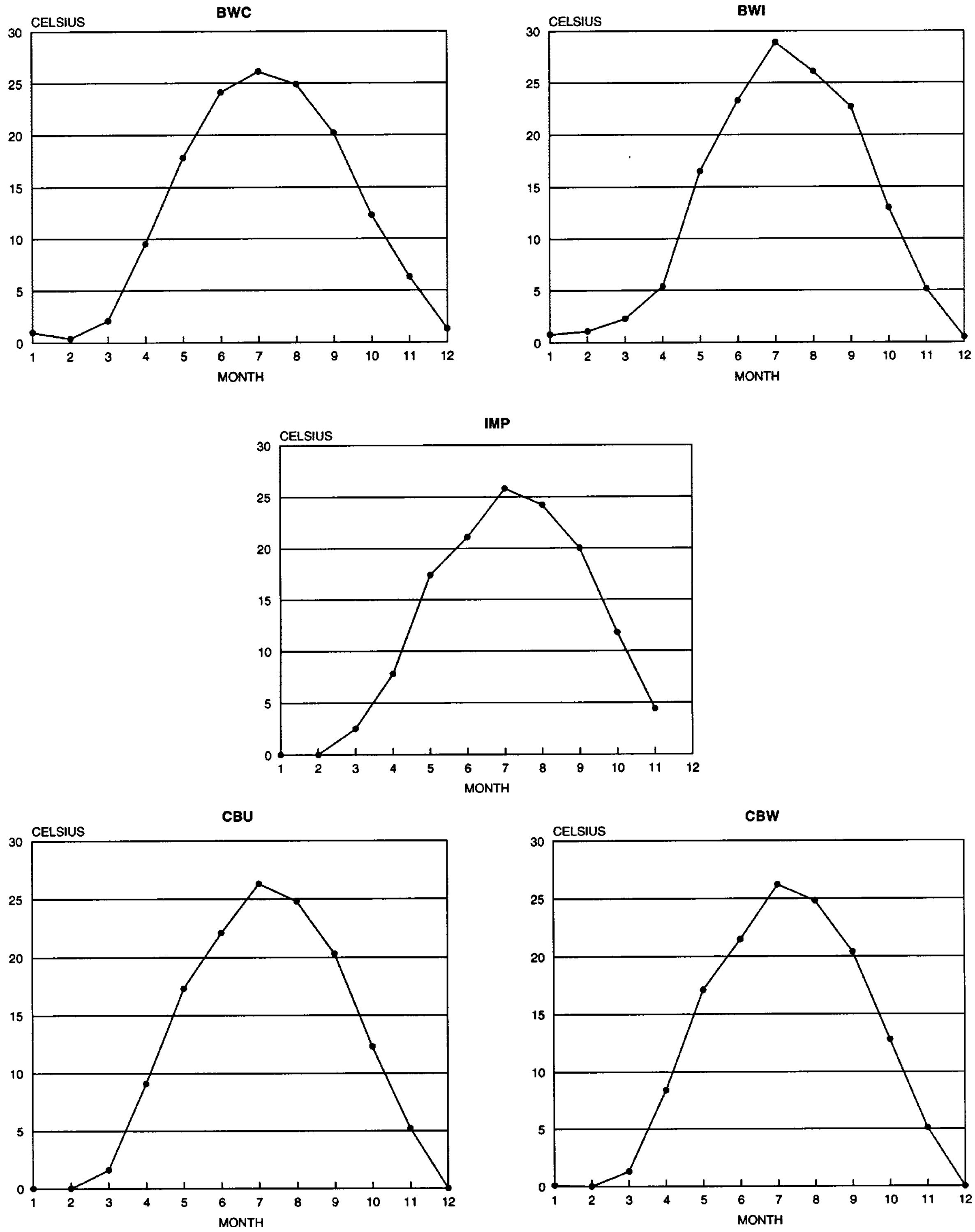
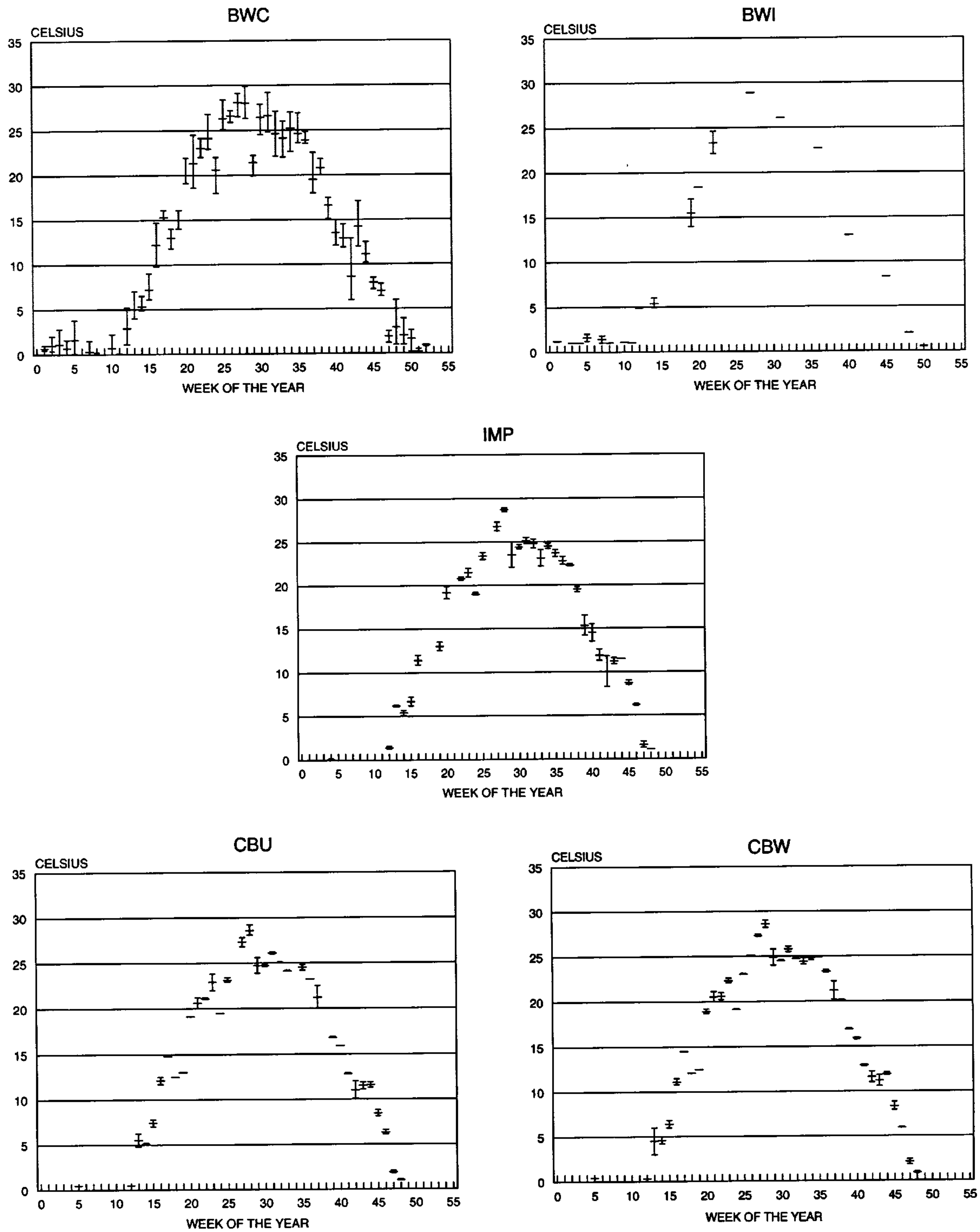


Figure 9. Weekly dissolved oxygen means and ranges for backwater contiguous (BWC) and impounded (IMP) habitats, Upper Mississippi River Pool 13, 1989.



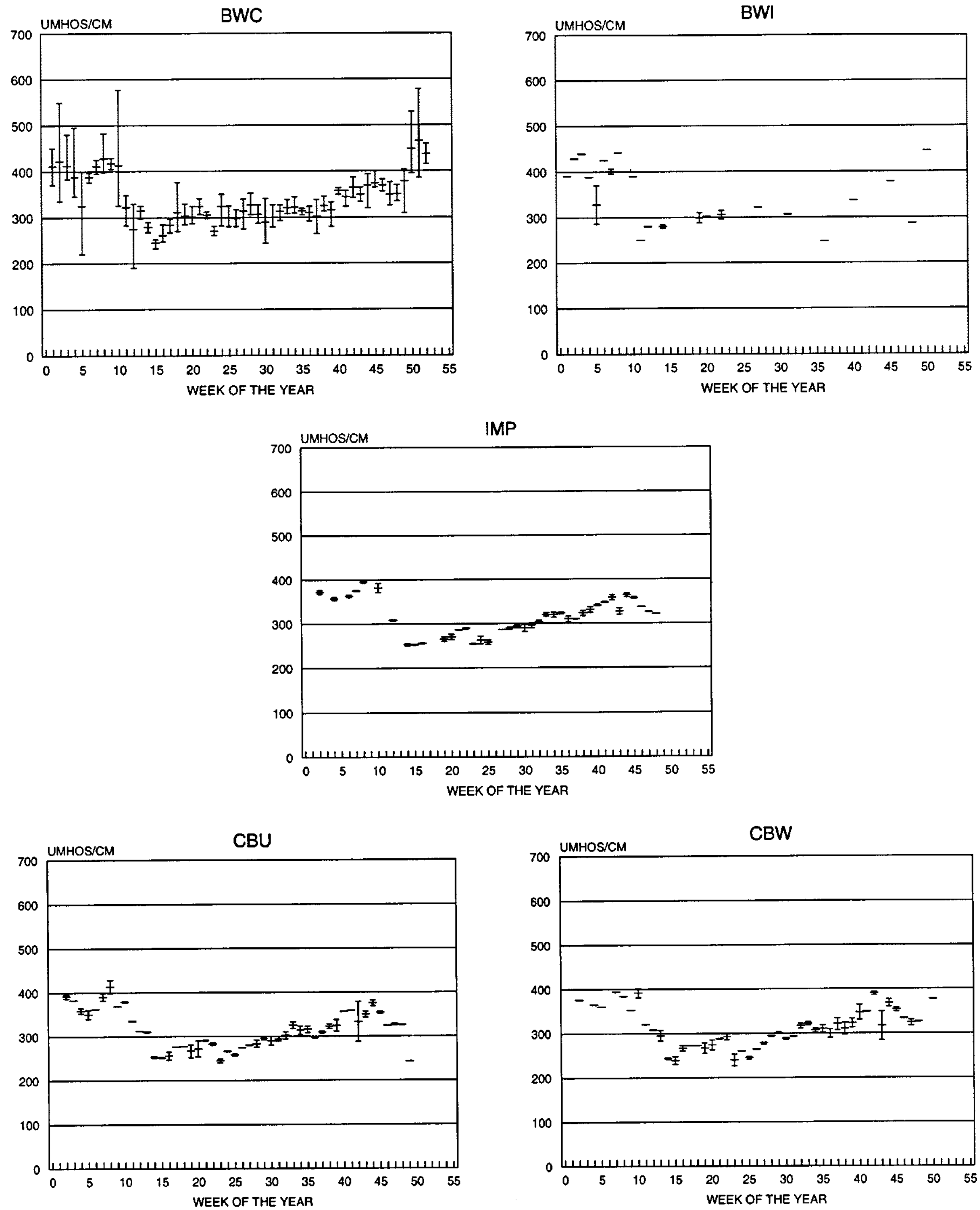
BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 10. Monthly mean surface temperature for all habitats sampled, Upper Mississippi River Pool 13, 1989.



BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

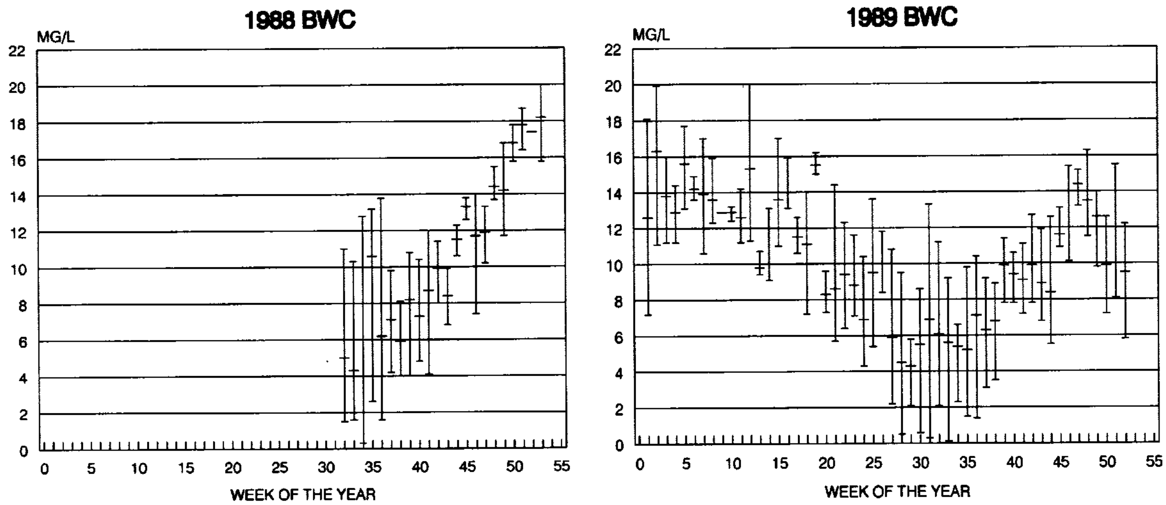
Figure 11. Weekly surface water temperature means and ranges for all habitats sampled, Upper Mississippi River Pool 13, 1989.



BWC = Backwater contiguous
BWI = Backwater isolated
CBU = Channel border unstructured
CBW = Channel border wing dam
IMP = Impounded

Figure 12. Weekly specific conductance means and ranges for all habitats sampled, Upper Mississippi River Pool 13, 1989.

SURFACE DISSOLVED OXYGEN



BOTTOM DISSOLVED OXYGEN

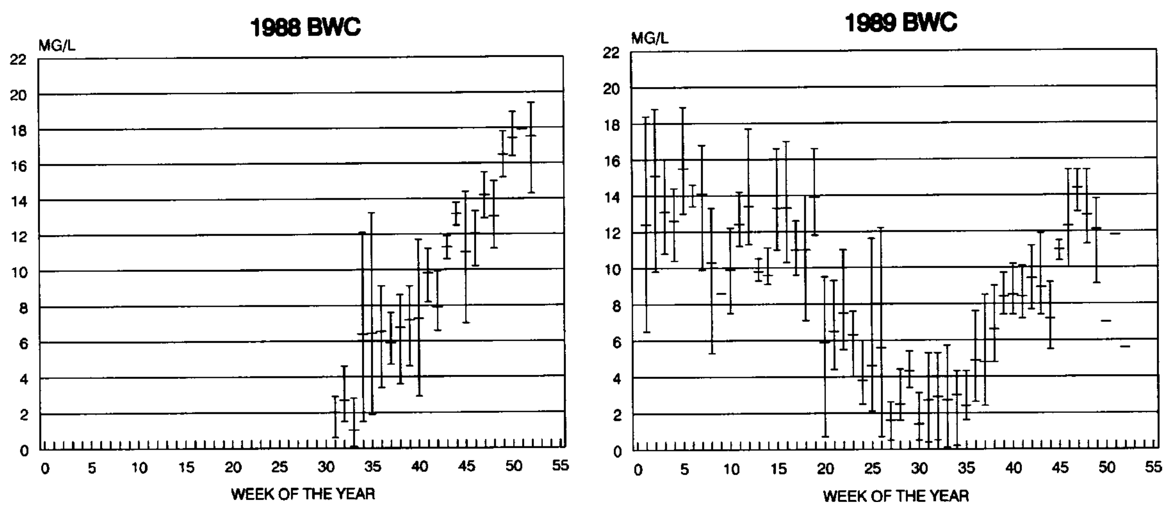


Figure 13. Comparison of surface and bottom dissolved oxygen for backwater contiguous (BWC) habitat, Upper Mississippi River Pool 13, 1989.

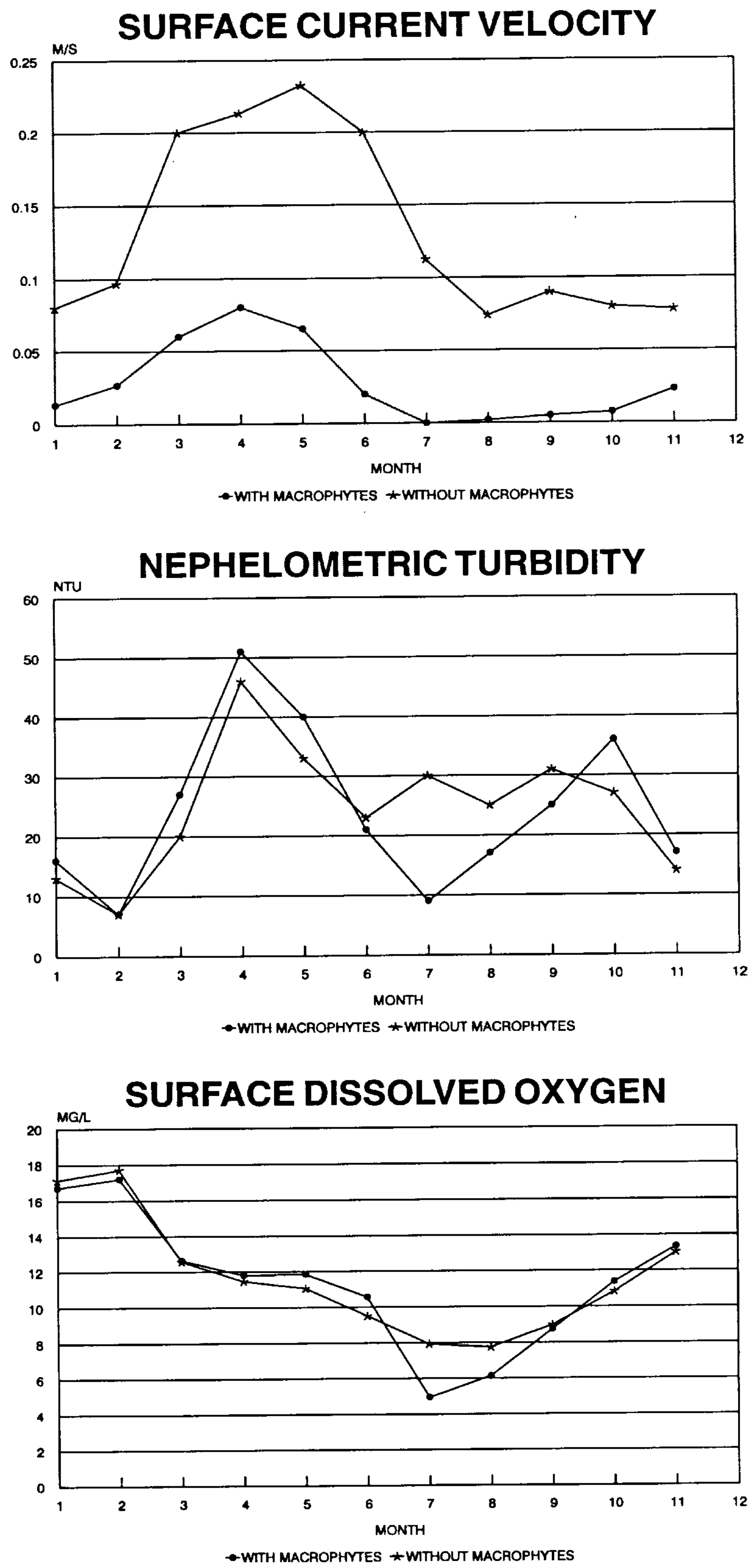


Figure 14. Comparison of monthly mean surface current velocity, nephelometric turbidity, and surface dissolved oxygen for impounded habitat, Upper Mississippi River Pool 13, 1989.

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13. ABSTRACT (Maximum 200 words) Resource Trend Analysis water quality sampling in Upper Mississippi River Pool 13 was initiated in August 1988 as a part of the Long Term Resource Monitoring Program. Mississippi Monitoring Station personnel continued water quality sampling in Pool 13 throughout 1989 using equipment and techniques consistent with the Procedures Manual for the Long Term Resource Monitoring Program (LTRMP). A total of 8,382 observations were recorded by the LTRMP water quality component in Pool 13 during the sampling period January 1 through December 31, 1989. Data collected in 1989 reflect water quality characteristics during a second consecutive year of low water conditions. Mean dissolved oxygen (DO) concentrations were higher in channel-associated habitats than in backwater habitats. Dissolved oxygen concentrations were typically above the 5.0 mg/L threshold established by the LTRMP to support healthly aquatic life. However, oxygen depletion was noted in backwater contiguous habitat at both shallow and deep water sites. Nephelometric turbidity, Secchi disk transparency, and current velocity values are linked to discharge rate through Lock and Dam 12. Turbidity exhibited a positive relationship to discharge, especially in channel-associated habitats. Turbidity in backwater habitats was influenced by peak spring discharges, but wind fetch and fish activity influenced turbidity peaks during summer and fall periods. Secchi disk transparency correlated to turbidity values. Current velocity observations in channel-associated habitats were positively correlated to Lock and Dam 12 discharges, while backwater habitats exhibited negligible velocities except during peak discharges. Similar specific conductance was observed among all habitats throughout the sampling period. Comparisons of 1988 and 1989 data revealed minimal differences in all water quality variables. Nephelometric turbidity and DO values were influenced by the presence of aquatic macrophyte during peak biomass in backwater contiguous and impounded habitats.				
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The Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System was authorized under the Water Resources Development Act of 1986 as an element of the Environmental Management Program. The mission of the LTRMP is to provide river managers with information for maintaining the Upper Mississippi River System as a sustainable large river ecosystem given its multiple-use character. The LTRMP is a cooperative effort by the National Biological Service, the U.S. Army Corps of Engineers, and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin.