Chapter 13. Electrofishing Catch Per Unit Effort and Relative Abundance

Introduction and Methods:

Historically, in Newton Lake, at least six (but usually twelve) hours of electrofishing per year has been done by the Illinois Department of Natural Resources (IDNR). All electrofishing data collected by IDNR will be used to compare pre- and post-Variance catch-per-hour (CPUE) by species, relative weight, relative abundance and structural indices. Fish collected by Southern Illinois University Fisheries Lab personnel (SIUC) for Job 10 (Food Habits) and Job 11 (Age and Growth) during September, October, November and December of each year were also used to calculate these parameters. In addition to the above effort, we attempted to electrofish each segment of Newton Lake for four hours in August of 1998, and 1999, and, although not required, August 1997 with a 5000 watt, boat-mounted, pulsed-DC unit. One person dipped fish while another maneuvered the boat. All fish were collected, identified, counted, and (except for gizzard shad) weighed and measured. CPUE and relative abundance, etc., results were compared to the 1995 Environmental Science and Engineering, Inc. (ESE) summer study. The ESE (1995) study used a pulsed-DC electrofishing unit. Different types of electrofishing systems tend to yield different CPUE values (Heidinger et al. 1983); thus we used the same type of unit.

Data from historic IDNR fall electrofishing samples from Coffeen Lake were used to compare trends in CPUE and relative abundance. IDNR has agreed to collect fall data each year of this study from Coffeen Lake. SIUC obtained fall CPUE and relative abundance data on the fish populations from Lake of Egypt. A three-phase, AC, boat-mounted electrofishing unit was used for this sample.

Results and Discussion:

CPUE

The trends in electrofishing catch-per-unit-effort, expressed as number of fish captured per hour of active electrofishing, for largemouth bass were similar for samples collected in Newton Lake by the Illinois Department of Natural Resources (IDNR) and for these studies during the years 1997, 1998, and 1999 (Table 13.1). The IDNR sampling has tended to show a general decline in CPUE over the years between 1995 and 1999. In our sampling, bluegill were captured at a greater rate than other species from all three study lakes. Largemouth bass were second most frequently caught in all lakes.

Differences in our AC electrofishing CPUE data among years, lakes, and segments within lakes were only analyzed for bluegill since the sonic tracking study results show that largemouth bass and channel catfish both move freely throughout the lakes (see Job 13: Supplemental Data Tables: for lake and segment breakdowns of AC electrofishing CPUE for all species captured). There were significant differences found in AC electrofishing CPUE of bluegill between Newton Lake and the Lake of Egypt, and Lake of Egypt and Coffeen Lake but not between Coffeen Lake and Newton Lake (Tukey; alpha=0.05). There was no significant interaction effect across years among the three lakes (i.e., the trends in CPUE were consistent across years among the lakes for bluegill)(GLM; p=0.3942). CPUEs were significantly higher for bluegill in segment 1 of Lake of Egypt than in segment 2 (GLM; p=0.0116). There was no significant difference between the segments of Coffeen Lake (GLM; p=0.5304) or Newton Lake (GLM; p=0.2247). In Newton Lake, there were no significant differences in AC electrofishing CPUEs between segments 1, 3, and 4. However, segment 2 was significantly different from the other three segments (Tukey;

alpha=0.05) (Table 13.2). There was no significant segment by year interaction effect for AC CPUEs from Newton Lake (GLM; p=0.5584).

Environmental Science and Engineering, Inc. sampled eight zones of Newton Lake in August of 1995 (Figure 13.1). We used similar equipment to sample these zones in August 1997, 1998, and 1999 (Table 13.3) Zones 1, 2 and 3 are in our segment 1, zone 4 is in segment 2, zone 5 is in segment 3, and zones 6, 7 and 8 are in our segment 4.

Length frequencies

Based on the fall 1997, 1998, and 1999 length-frequency data for bluegill in the four segments of Newton Lake, there didn't appear to be any clear trends in size structure related to the "instream" position of the segments (Figure 13.2). However, the spring 1998 and 1999 data suggests that the bluegill were somewhat segregated by size with smaller fish being more abundant in segments 1 and 2 (Figure 13.3). The length-frequency distributions of largemouth bass collected during the spring of 1998 and 1999 appear to show two reasonably strong cohorts (one in the 3-6 inch range, and one in the 7 to 10 inch range) which possibly moved to the7 to 10 inch and 11 to 14 inch range, respectively (Figure 13.4). The cohort in the 16 to 20 inch range during spring of 1999 was likely a year older than the 11 to 14 inch cohort (See Job 11: Age, Growth, and Mortality). As in the segment data, there was no clear overall trend in the spring length frequencies of bluegill across the years 1998 and 1999. This was probably indicative of stunting in the bluegill population. The spring length frequencies of channel catfish, though, show a similar pattern to the largemouth bass with a predominate cohort of 8 to 11 inch fish apparent during 1998 that had moved to the 11 to 14 inch range during the spring of 1999. There was a lack of the smaller fish during spring 1999 but this probably didn't relate to recruitment failure since fish that would have been at these smaller sizes were represented in the samples taken during the fall of 1998 in a proportion similar to the fall samples taken during 1997 (Figure 13.5). Based on the age-frequency data obtained for calculating mortality (See Job 11: Age, Growth, and Mortality) these recruits may have represented age-3 or older individuals. The back-calculated length-at-age data for channel catfish taken from Newton Lake indicate very slow growth with 10 to 12 year old fish reaching lengths of only 12 to 14 inches and 0.5 to 0.8 lbs. The fall length-frequency data for largemouth bass captured from Newton Lake is not particularly informative, except to note that there appeared to be a strong cohort that probably represented young-of-the-year individuals. The fall 1997-1999 length-frequency data for bluegill, however, is similar to that seen during spring 1998-1999 sampling.

The fall length frequency data for largemouth bass collected from Coffeen Lake doesn't show any outstanding trends (Figure 13.6). However, the bluegill length frequencies seem to show a pattern of only relatively small fish being present from year to year similar to that seen in Newton Lake. The low numbers of fish appearing in the length-frequency data taken during fall of 1997 and 1998 make the assessment of trends for channel catfish problematical. However, from the fall 1999 data, it is apparent that there were more of the larger size classes than were found in Newton Lake.

Again, the fall length-frequency data for largemouth bass collected from the Lake of Egypt doesn't show any outstanding trends (Figure 13.7). However, the bluegill length frequencies indicate that larger individuals were present in the population with some individuals in the 8 to 9 inch range being present. There were so few fish in the length-frequency data set for Lake of Egypt during 1997 and 1998 that one would be remiss to draw any conclusions except to note that the individuals present were larger than those seen during the same two years in Newton Lake or Coffeen Lake.

It is apparent, from the Newton Lake length-frequency data for largemouth bass and channel catfish collected during 1998 and 1999 provided to us by the IDNR, that dead and dying fish of both species collected by us during routine sampling from 1 June 1999 through 31 August 1999, were disproportionately large as compared with the populations of these two species as a whole (Figures 13.8-13.11). The larger size classes, though, do not seem to be under-represented in the 1999 data as compared with the 1998 data for either species.

IDNR provided considerable data on length-frequency distribution obtained from fall of 1976 through fall of 1999. Based on this data, the population of largemouth bass appeared to be in decent shape, showing good recruitment and a good distribution of size classes (Table 13.4). The bluegill population, on the other hand, has been dominated by small fish during the entire period of this record (Table 13.5). Despite their slow growth, the bluegill have shown consistently good recruitment during the 23 years.

Between the years of 1976 and 1986, white crappie in Newton Lake apparently had decent recruitment and showed a good distribution of size classes (Table 13.6). However, around 1986, their population crashed. Based on the lack of smaller size classes in the sample, there was apparently a problem with recruitment to the population. In 1988, a 10 inch size limit and 10 fish-per-day creel limit was imposed on white crappie in the lake. Despite decent growth of white crappie in Newton Lake, this creel limit failed to prevent the populations decline and failed to reestablish recruitment of strong year-classes.

The channel catfish population in Newton Lake during this period showed a trend similar to that exhibited by white crappie. The exception being that the demise of the channel catfish population was more protracted, becoming evident after 1992 when the majority of large fish had disappeared. The delay of the manifestation of size distribution problems in this population is likely due to the relative longevity of channel catfish as compared with white crappie. Recruitment, to this date, does not appear to be a problem. However, the population is dominated by smaller size classes of fish. This points to a population that is experiencing slow growth of individuals. This observation is borne out, as discussed earlier, in the small size of very old fish (See Job 11: Age, Growth, and Mortality).

Literature Cited:

ESE. 1995. Newton Lake 1995 aquatic biota and water quality surveys. ESE Project No. 5195-125-0400. Environmental Science and Engineering, Inc., St. Louis, Missouri.

Heidinger, R.C., D.R. Helms, T.I. Heibert, and P.H. Howe. 1983. Operational comparison of three electrofishing systems. North American Journal of Fisheries Management 3:254-257.

Table 13.1. Summary of fall and spring electrofishing catch per hour (CPUE) obtained by the Illinois Department of Natural Resources (IDNR) from 1995 through 1999 for Newton Lake, and Lake Coffeen. The 1997 and 1998 electrofishing CPUE data for Lake of Egypt were obtained during the months of November and December by Southern Illinois University Fisheries Research Lab (SIU) for this study.

	Newton Lake		Coffeen		Lake of Egypt	
Year	Hours of Electrofishing	Catch per Hour	Hours of Electrofishing	Catch per Hour	Hours of Electrofishing	Catch per Hour
Largemouth Bass						
1995	12	70	7.5	111	-	-
1996	12	83	7.5	82	-	-
1997	12	30	7.5	79	13	41
1998	12	59	7.5	43	10	41
1999	12	43	-	-	-	-
Bluegill						
1995	12	103	-	-	-	-
1996	12	52	-	-	-	-
1997	12	45	7.5	196	10	129
1998	12	44	7.5	99	9	92
1999	12	69	-	-	-	-
Channel Catfish						
1995	12	44	-	-	-	-
1996	12	12	-	-	-	-
1997	12	4	7.5	9	13	0.5
1998	12	13	7.5	12	11	0.8
1999	12	12	-	-	-	-

Table 13.2. Summary of AC electrofishing catch-per-unit-effort for bluegill captured within the four segments of Newton Lake during the months September through December of 1997, 1998, and 1999.

	Segment 1		Segment 2		Segment 3		Segment 4	
Year	Effort (hrs)	Catch/hr	Effort (hrs)	Catch/hr	Effort (hrs)	Catch/hr	Effort (hrs)	Catch/hr
1997	3.0	144	2.4	154	3.2	139	2.7	83
1998	2.6	42	1.2	161	1.8	68	1.6	91
1999	1.6	71	0.5	186	1.6	84	1.6	77

Table 13.3. Catch-per-unit-effort of fish collected in August with pulsed DC electrofishing within eight zones of Newton Lake. ESE collected the 1995 data.

Station	Species	1995		1997		1998		1999	
		Temp. (°F)	Catch/hr.	Temp (°F)	Catch/hr.	Temp (°F)	Catch/hr.	Temp (°F)	Catch/hr.
Zone 1	Gizzard shad	102.2	3.8	95.0	-	96.5	-	100.1	283.0
	Carp		-		-		3.0		13.6
	Bluegill		3.8		-		15.0		61.4
	Longear sunfish		22.5		-		-		3.4
	Hybrid sunfish		11.2		-		-		-
	Largemouth bass		30.0		-		15.0		-
			71.3		-		33.0		361.4
Zone 2	Gizzard shad	102.2	20.00	95.0	3.0	96.5	48.0	100.1	-
	Bluegill		-		-		6.0		-
	Hybrid sunfish		-		-		6.0		-
			20.00		3.0		60.0		
Zone 3	Gizzard shad	95.0	96.00	90.5	12.0	96.0	-	95.2	-
	Carp		-		2.4		-		-
	Green sunfish		-		2.4		-		-
	Bluegill		68.00		16.8		-		-
	Longear sunfish		28.00		4.8		-		-
	Hybrid sunfish		4.00		2.4		-		-
	Largemouth bass		60.00		-		-		-
			256.00		40.8				

Table 13.3. Continued

Station	Species	1995 Temp. (°F)	1995 Catch/hr.	1997 Temp (°F)	1997 Catch/hr.	1998 Temp (°F)	1998 Catch/hr.	1999 Temp (°F)	1999 Catch/hr.
Zone 4	Gizzard shad	93.2	728.00	90.5	-	92.6	15.0	91.4	67.9
	Carp		4.00		-		-		-
	Orange spotted sunfish		-		-		9.0		-
	Bluegill		36.00		6.0		-		319.3
	Longear sunfish		4.00		-		-		-
	Hybrid sunfish		4.90		3.0		12.0		4.5
	Largemouth bass		8.00		-		-		4.5
			784.00		9.0		36.0		396.2
Zone 5	Gizzard shad	93.2	33.0	85.3	-	88.1	27.5	90.6	55.8
	Channel catfish		4.0		-		-		4.7
	Bluegill		88.0		3.0		10.0		14.0
	Green sunfish		12.0		-		-		-
	Longear sunfish		16.0		3.0		5.0		4.7
	Hybrid sunfish		16.0		-		-		-
	Largemouth bass		-		-		2.5		-
			268.0		6.0		55.0		79.2
Zone 6	Gizzard shad	90.5	76.0	85.3	-	96.5	32.4	87.1	17.2
	Channel catfish		4.0		-		-		-
	Bluegill		244.0		-		-		58.6
	Green Sunfish		-		-		-		10.3
	Longear sunfish		76.0		-		-		31.0
	Hybrid sunfish		8.0		-		22.7		3.5
	Largemouth bass		-		-		3.2		17.2
			408.0		-		58.3		137.8

Table 13.3. Continued

Station	Species	1995		1997		1998		1999	
		Temp. (°F)	Catch/hr.	Temp (°F)	Catch/hr.	Temp (°F)	Catch/hr.	Temp (°F)	Catch/hr.
Zone 7	Gizzard shad	89.6	124.0	85.3	-	96.5	26.9	86.7	-
	Carp		4.0		3.0		-		-
	Channel catfish		4.0		-		-		-
	Bluegill		76.0		3.0		-		-
	Longear		24.0		-		-		-
	Hybrid sunfish		4.0		-		11.9		-
	Largemouth bass		8.0		3.0		3.0		-
			244.0		9.0		51.8		
Zone 8	Gizzard shad	87.8	475.0	85.3	12.0	96.5	45.6	86.7	582.9
	Carp		8.0		3.0		-		-
	Channel catfish		8.0		3.0		-		-
	Green sunfish		4.0		3.0		3.3		34.3
	Bluegill		72.0		3.0		16.3		114.3
	Longear sunfish		4.0		6.0		-		34.3
	Hybrid sunfish		-		-		3.3		-
	Largemouth bass		36.0		3.0		26.1		62.9
	White bass		-		-		-		5.7
			572.0		33.0		94.6		834.4

Table 13.4. Changes in the size-frequency distribution of largemouth bass in Newton Lake based on IDNR fall and spring electrofishing samples from fall 1976 to fall 1999.

		Length (inches)			
Year	Sample Size	12	14	16	18
1976 Fall	79	51	51	1	0
1977 Spring	137	59	51	2	0.5
1977 Fall	211	84	61	22	3
1978 Spring	342	92	73	46	4
1978 Fall	427	82	74	49	10
1979 Spring	364	95	86	71	21
1979 Fall	1622	79	65	29	10
1980 Spring	273	90	79	57	21
1980 Fall	462	74	65	31	11
1981 Spring	471	84	73	47	18
1981 Fall	522	71	66	31	12
1982 Spring	592	86	71	42	19
1982 Fall	445	72	61	21	8
1983 Spring	1006	82	64	27	13
1983 Fall	No Data	No Data	No Data	No Data	No Data
1984 Spring	344	88	74	47	14
1984 Fall	356	70	66	30	13
1985 Spring	266	82	75	51	23
1985 Fall	310	59	56	12	6
1986 Spring	343	85	72	43	27
1986 Fall	363	71	62	25	10
1987 Spring	245	78	70	40	22
1987 Fall	469	70	60	20	8
1988 Spring	586	80	72	43	21
1988 Fall	377	82	69	38	15
1989 Spring	663	89	74	48	21
1989 Fall	623	66	62	24	9
1990 Spring	520	85	74	49	18
1990 Fall	518	69	60	20	7
1991 Spring	721	86	64	28	12
1991 Fall	534	70	66	31	13
1992 Spring	383	80	71	43	18
1992 Fall	642	62	57	14	5

Table 13.4. Continued

		Length (inches)			
Year	Sample Size	12	14	16	18
1993 Spring	509	69	60	21	8
1993 Fall	637	69	56	11	6
1994 Spring	809	52	50	0	0
1994 Fall	1126	79	53	6	2
1995 Spring	548	53	50	0	0
1995 Fall	840	44	32	14	2
1996 Spring	592	85	73	43	9
1996 Fall	1000	58	47	27	7
1997 Spring	718	84	70	46	14
1997 Fall	357	24	19	12	5
1998 Spring	691	63	53	41	15
1998 Fall	705	53	41	31	6
1999 Spring	--	--	--	--	--
1999 Fall	514	50	38	13	4

Table 13.5. Changes in the size frequency distribution of bluegill in Newton Lake based on IDNR fall and spring electrofishing samples from fall 1976 to fall 1999.

		Length (inches)		
Year	Sample Size	6	7	8
1976 Fall	103	38	6	0
1977 Spring	200	45	5	0
1977 Fall	73	29	3	0
1978 Spring	548	43	9	0
1978 Fall	259	31	4	0
1979 Spring	466	24	3	0
1979 Fall	361	7	0.8	0
1980 Spring	113	15	0	0
1980 Fall	262	13	0.8	0
1981 Spring	379	15	2	0
1981 Fall	264	20	0	0
1982 Spring	1026	13	0.2	0
1982 Fall	363	3	0.3	0
1983 Spring	534	25	3	0
1983 Fall	No Data	No Data	No Data	No Data
1984 Spring	399	29	1	0
1984 Fall	181	18	2	0
1985 Spring	367	13	0.5	0
1985 Fall	550	6	0	0
1986 Spring	312	10	0	0
1986 Fall	125	16	0	0
1987 Spring	472	6	0	0
1987 Fall	372	5	0	0
1988 Spring	150	5	0.7	0
1988 Fall	376	3	0	0
1989 Spring	120	9	0.8	0
1989 Fall	628	5	0	0
1990 Spring	95	17	4	2
1990 Fall	107	5	2	2
1991 Spring	512	5	0.8	0
1991 Fall	108	4	0	0
1992 Spring	108	14	1	0
1992 Fall	78	15	0	0

Table 13.5. Continued

Year	Sample Size	Length (inches)		
		6	7	8
1993 Spring	112	21	3	0.9
1993 Fall	620	14	3	0
1994 Spring	106	0	0	0
1994 Fall	289	0	0	0
1995 Spring	133	0	0	0
1995 Fall	1236	<1	0	0
1996 Spring	434	5	2	0.5
1996 Fall	618	0	0	0
1997 Spring	368	4	2	0
1997 Fall	542	2	1	0
1998 Spring	348	28	8	0
1998 Fall	522	2	1	0
1999 Spring	--	--	--	--
1999 Fall	832	1	0	0

Table 13.6. Changes in the size frequency distribution of white crappie in Newton Lake based on IDNR fall and spring electrofishing samples from fall 1976 to fall 1999.

		Length (inches)		
Year	Sample Size	6	7	10
1976 Fall	6	33	33	33
1977 Spring	6	17	17	17
1977 Fall	6	100	83	83
1978 Spring	37	70	30	19
1978 Fall	11	100	64	18
1979 Spring	65	100	23	8
1979 Fall	0	33	33	33
1980 Spring	24	100	100	62
1980 Fall	57	100	96	17
1981 Spring	185	100	85	5
1981 Fall	78	100	100	44
1982 Spring	89	100	98	31
1982 Fall	140	100	96	36
1983 Spring	793	100	95	14
1983 Fall	No Data	No Data	No Data	No Data
1984 Spring	63	100	63	13
1984 Fall	178	100	97	26
1985 Spring	279	100	85	6
1985 Fall	188	100	95	28
1986 Spring	103	100	80	24
1986 Fall	104	100	100	62
1987 Spring	24	100	100	54
1987 Fall	38	100	100	76
1988 Spring	6	100	100	83
1988 Fall	7	100	100	100
1989 Spring	0	0	0	0
1989 Fall	9	100	100	56
1990 Spring	2	100	100	0
1990 Fall	3	100	100	33
1991 Spring	18	33	22	17
1991 Fall	0	0	0	0
1992 Spring	0	0	0	0
1992 Fall	0	0	0	0

Table 13.6. Continued

		Length (inches)		
Year	Sample Size	6	7	10
1993 Spring	5	60	40	0
1993 Fall	3	100	0	0
1994 Spring	3	43	0	0
1994 Fall	3	100	100	100
1995 Spring	1	100	100	0
1995 Fall	2	100	100	50
1996 Spring	0	0	0	0
1996 Fall	1	0	0	0
1997 Spring	0	0	0	0
1997 Fall	2	100	100	0
1998 Spring	2	100	100	100
1998 Fall	1	100	100	100
1999 Spring	--	--	--	--
1999 Fall	22	100	100	5

Table 13.7. Changes in the size frequency distribution of channel catfish in Newton Lake based on IDNR fall and spring electrofishing samples from fall 1976 to fall 1999.

		Length (inches)		
Year	Sample Size	12	16	20
1976 Fall	0	0	0	0
1977 Spring	0	0	0	0
1977 Fall	0	0	0	0
1978 Spring	4	100	0	0
1978 Fall	0	0	0	0
1979 Spring	19	100	53	26
1979 Fall	22	82	77	27
1980 Spring	6	50	33	17
1980 Fall	51	12	6	2
1981 Spring	52	40	31	27
1981 Fall	87	90	23	7
1982 Spring	148	64	18	9
1982 Fall	80	72	28	8
1983 Spring	87	49	9	2
1983 Fall	No Data	No Data	No Data	No Data
1984 Spring	327	45	13	0.3
1984 Fall	115	62	23	6
1985 Spring	267	93	8	1
1985 Fall	381	50	17	4
1986 Spring	336	49	11	1
1986 Fall	105	48	15	5
1987 Spring	148	31	8	3
1987 Fall	85	27	12	5
1988 Spring	238	31	7	2
1988 Fall	227	44	12	4
1989 Spring	191	35	7	1
1989 Fall	221	24	10	1
1990 Spring	82	46	7	1
1990 Fall	114	60	19	4
1991 Spring	396	48	13	3
1991 Fall	186	58	13	3
1992 Spring	44	43	5	2
1992 Fall	139	40	18	7

Table 13.7. Continued

		Length (inches)		
Year	Sample Size	12	16	20
1993 Spring	73	36	15	1
1993 Fall	193	4	0	0
1994 Spring	72	42	19	0
1994 Fall	137	28	8	1
1995 Spring	186	0.5	0	0
1995 Fall	528	9	2	1
1996 Spring	177	14	0	0
1996 Fall	149	13	2	0
1997 Spring	54	32	2	0
1997 Fall	49	35	10	2
1998 Spring	111	8	1	1
1998 Fall	161	33	4	0
1999 Spring	--	--	--	--
1999 Fall	142	37	1	0

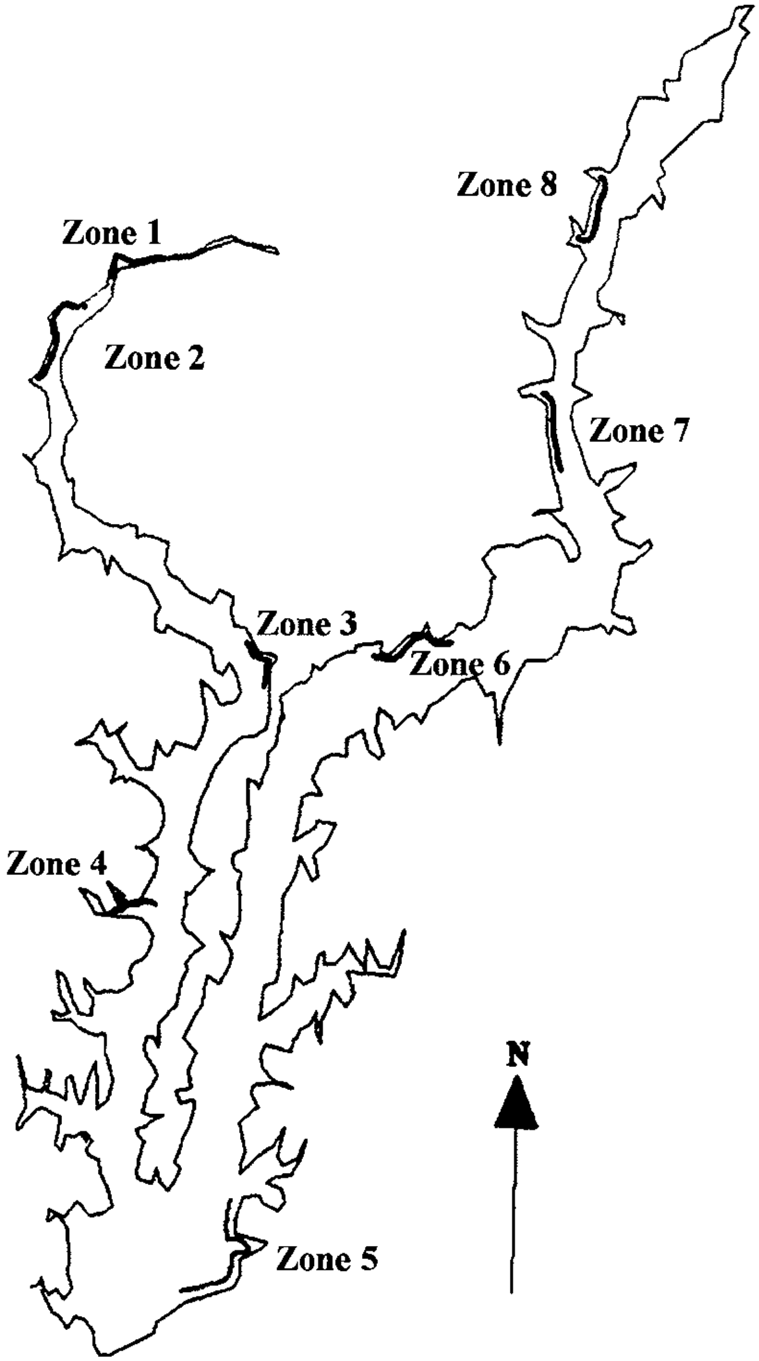

Figure 13.1. Environmental Science and Engineering Inc. sampling zones used for DC electrofishing in Newton Lake, Illinois.

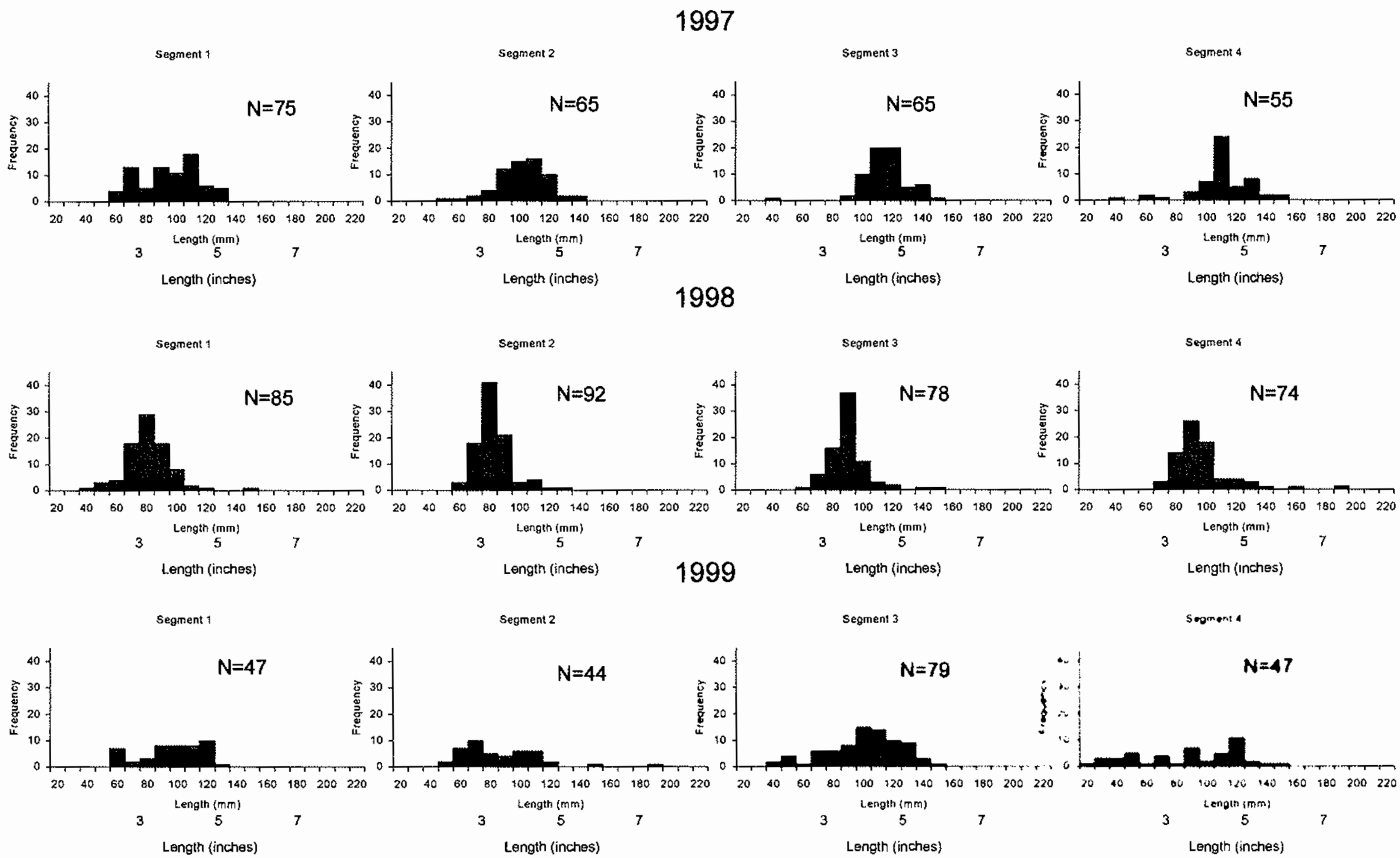

Figure 13.2. Length-frequency histograms of bluegill captured in each segment of Newton Lake during October and November 1997, 1998, and 1999. Lengths are combined into 10-mm groups.

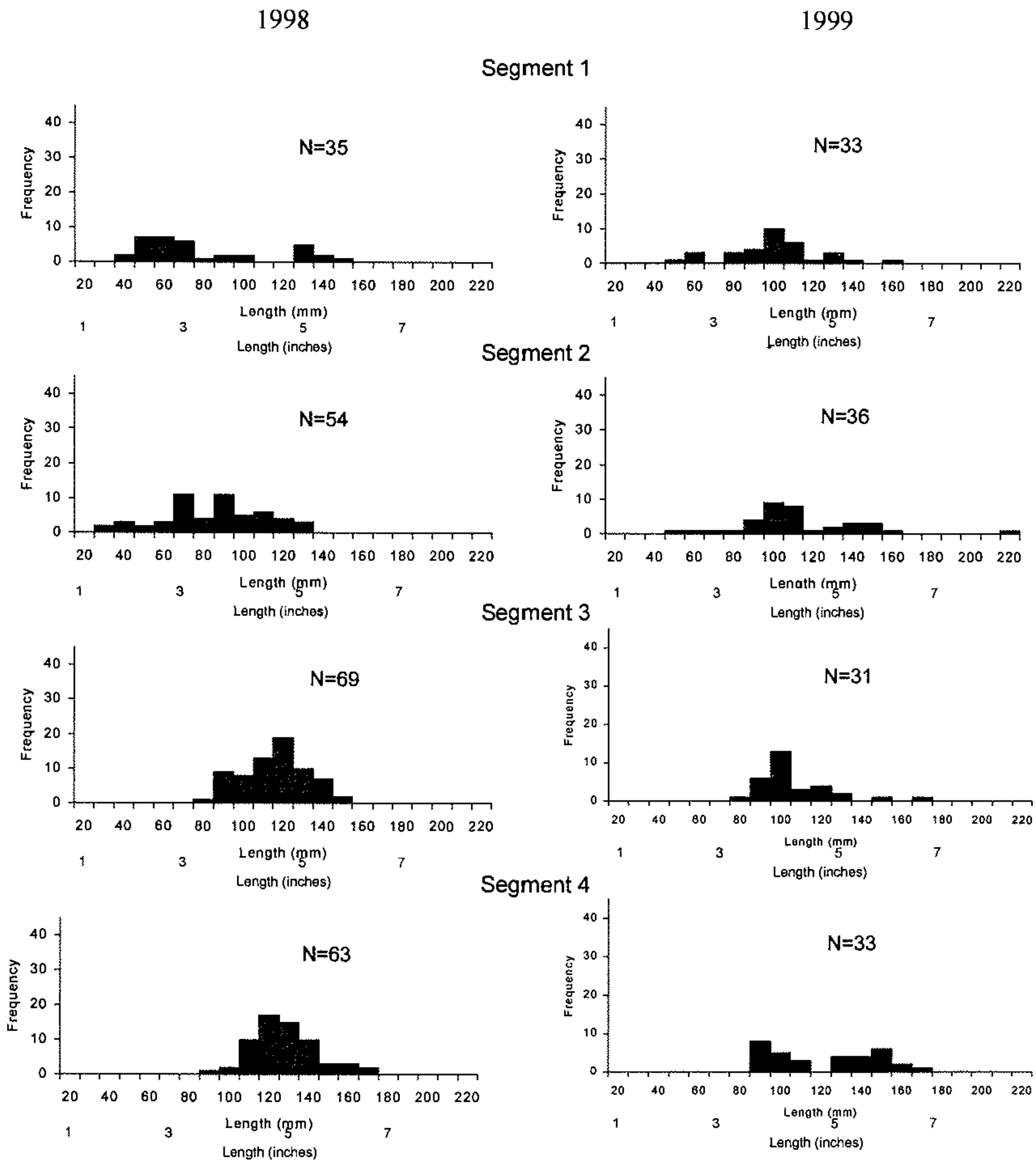

Figure 13.3. Length-frequency histograms of bluegill captured in each segment of Newton Lake during the months of March and April 1998, and 1999. Lengths are combined into 10-mm groups.

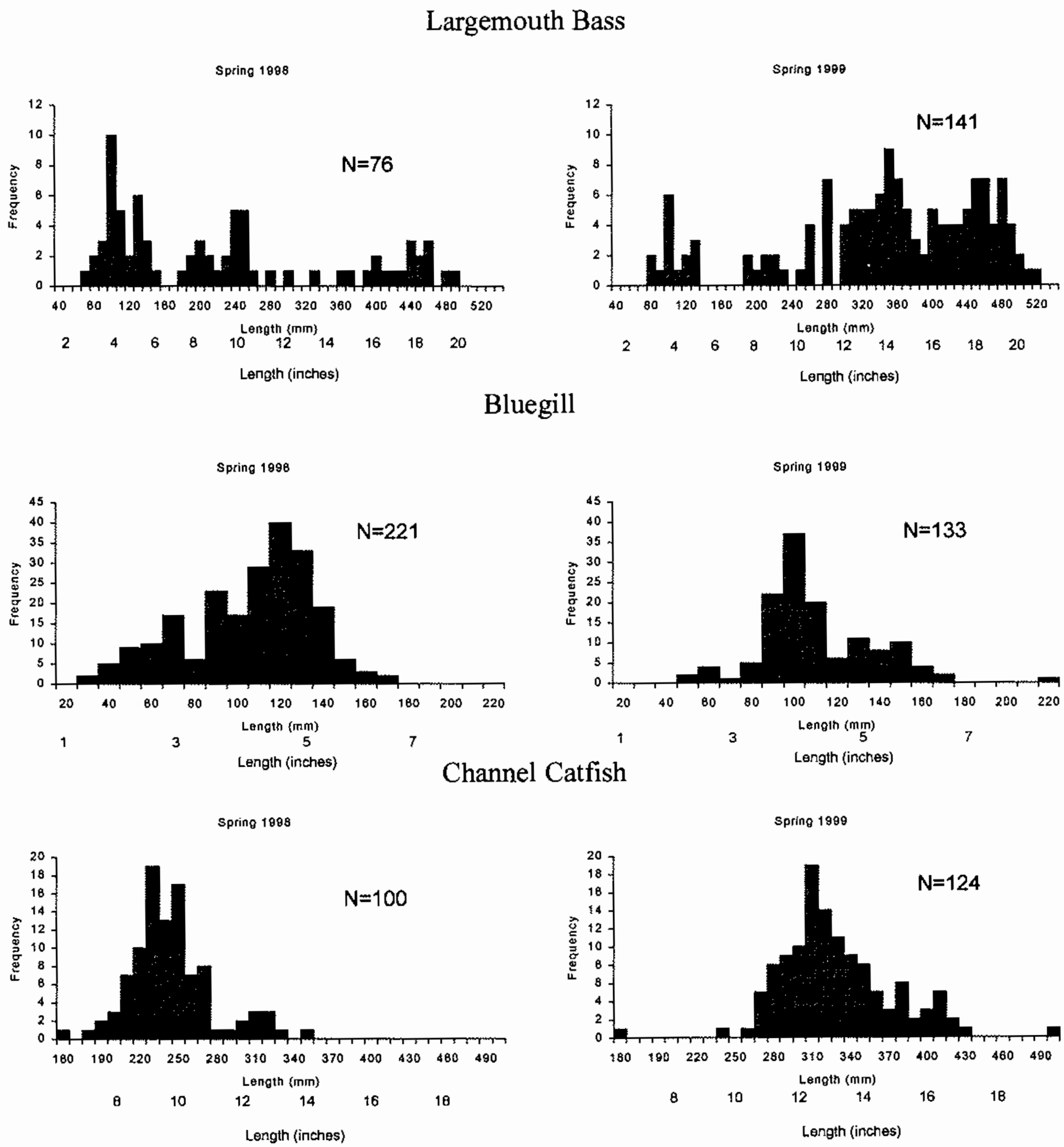

Figure 13.4. Length-frequency histograms of largemouth bass, bluegill, and channel catfish captured in Newton Lake during the months of March and April 1998, and 1999. Lengths are combined into 10-mm groups.

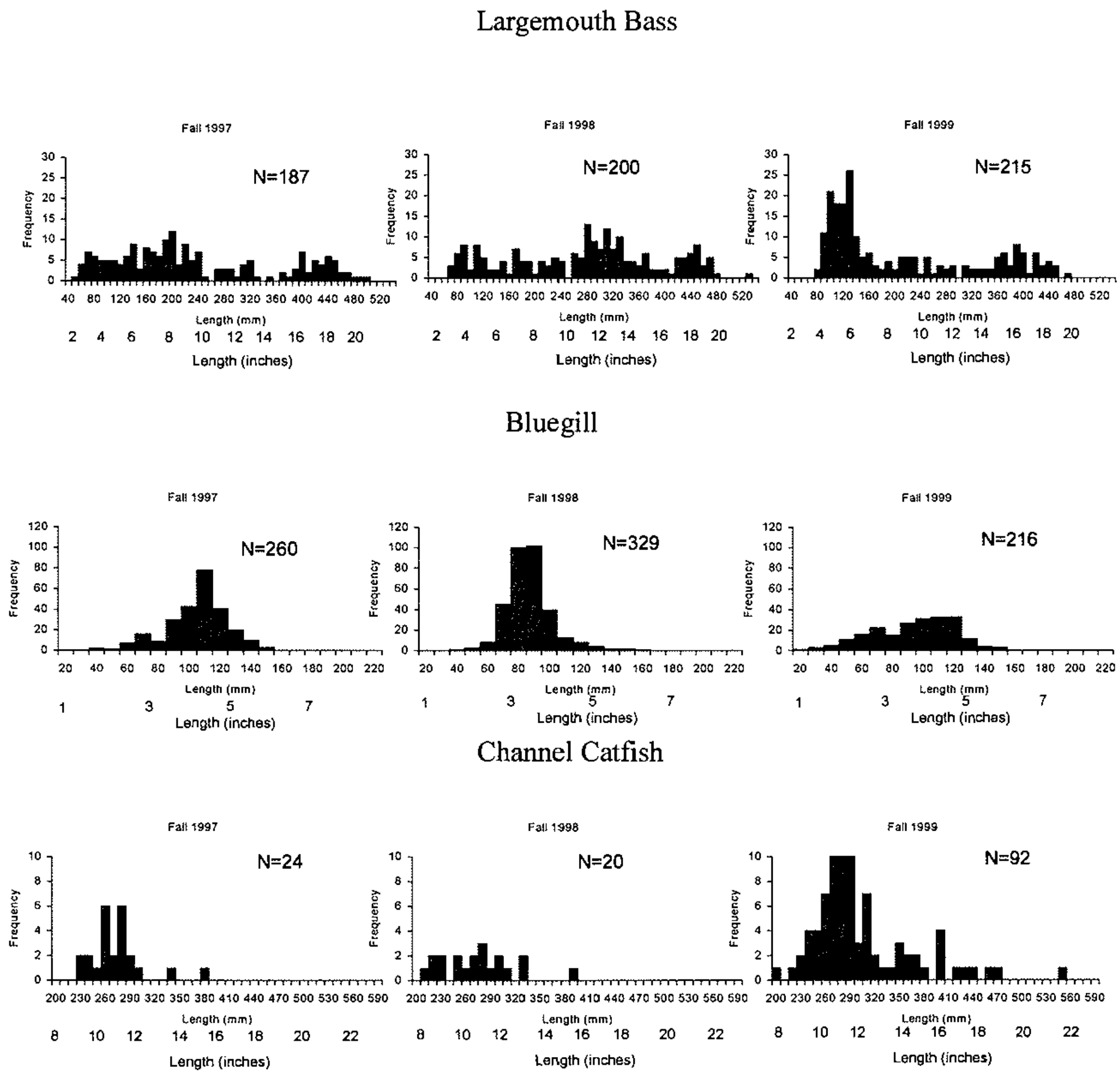

Figure 13.5. Length-frequency histograms of largemouth bass, bluegill, and channel catfish captured in Newton Lake during the months of October and November 1997, 1998, and 1999. Lengths are combined into 10-mm groups

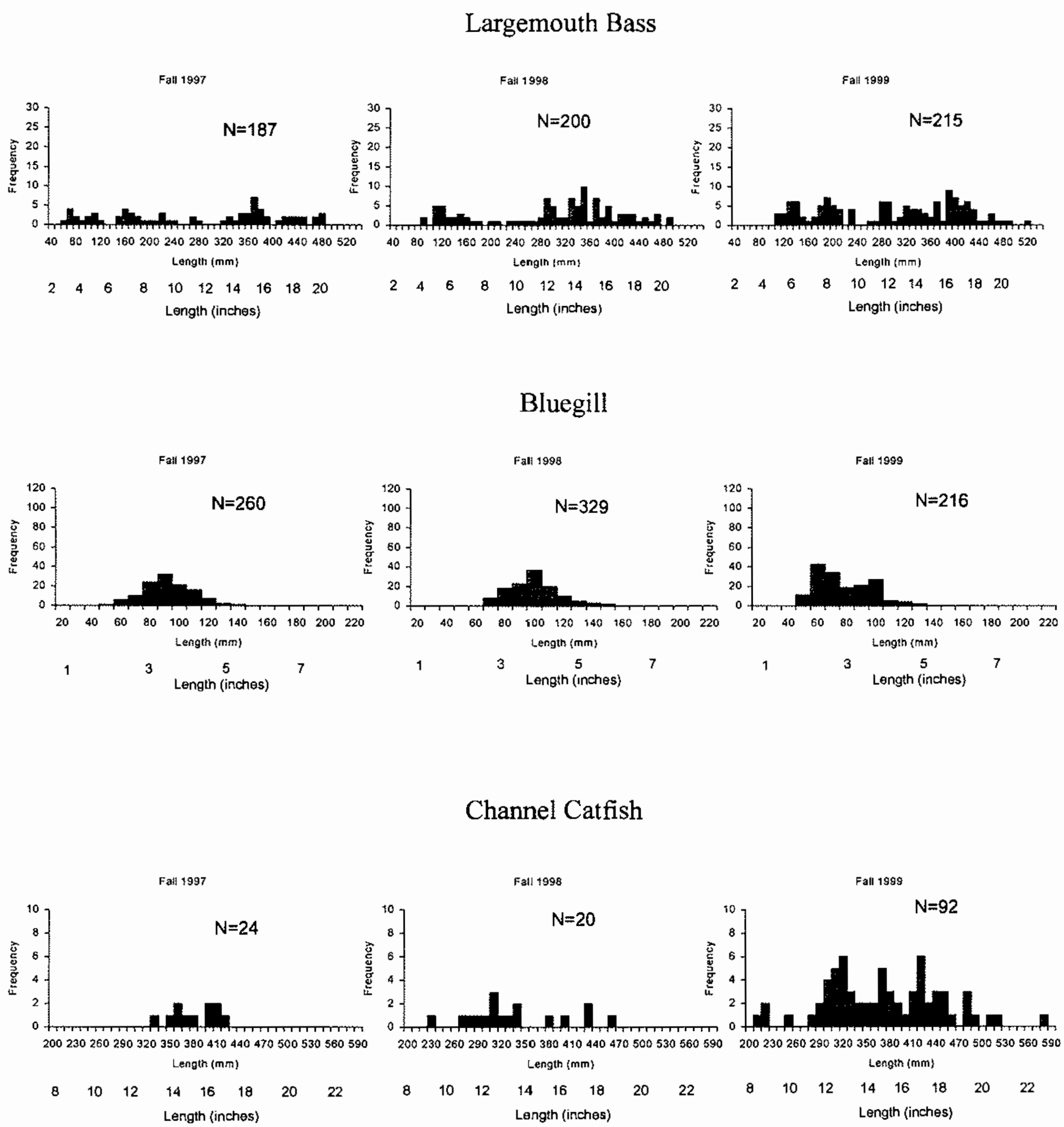

Figure 13.6. Length-frequency histograms of largemouth bass, bluegill, and channel catfish captured in Coffeen Lake during the months of October and November 1997, 1998, and 1999. Lengths are combined into 10-mm groups.

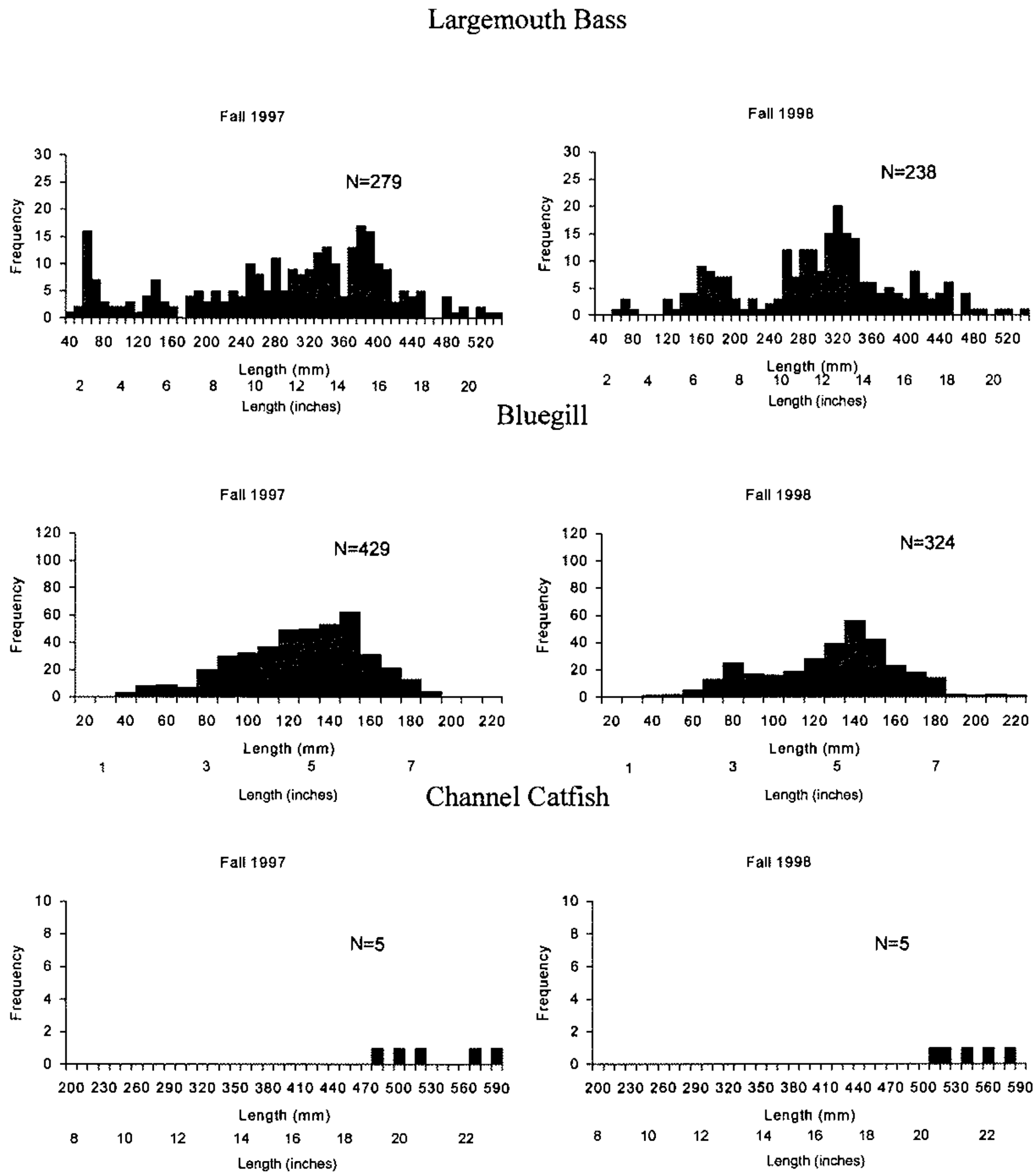

Figure 13.7. Length-frequency histograms of largemouth bass, bluegill, and channel catfish captured in Lake of Egypt during the months of October and November 1998, and 1999. Lengths are combined into 10-mm groups.

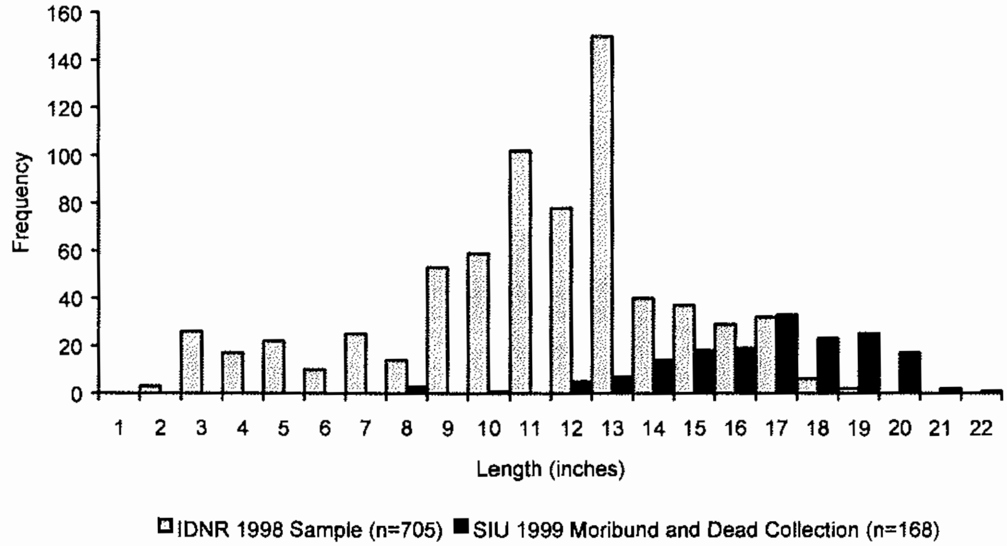

Figure 13.8. Comparison of the length-frequency histograms of largemouth bass obtained by 12 hours of electrofishing during fall 1998 on Newton Lake by the Illinois Department of Natural Resources (IDNR)(N=705), and dead and moribund fish collected between 1 June 1999 and 31 August 1999 by Southern Illinois University Fisheries Research Lab (SIU) during routine sampling trips (N=168).

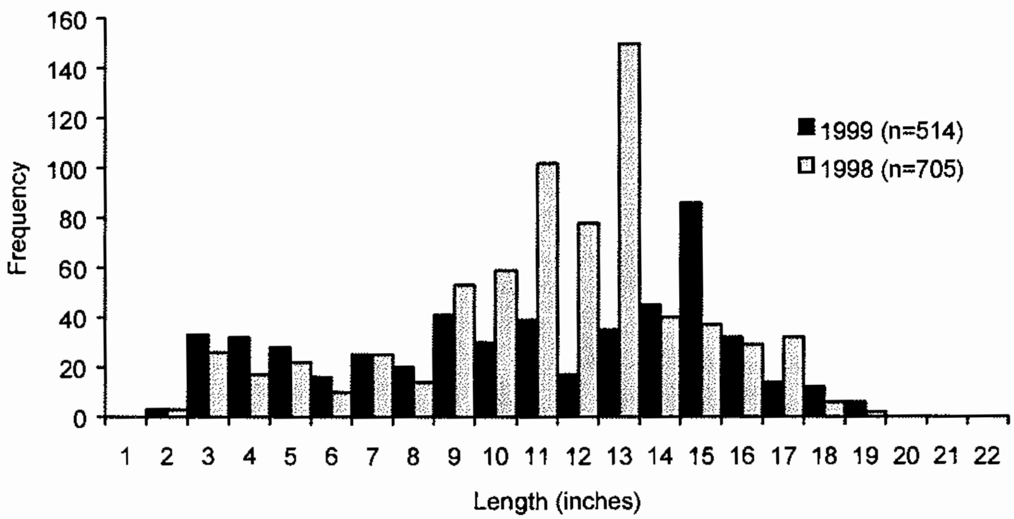

Figure 13.9. Comparison of the length-frequency histograms of largemouth bass obtained in fall of 1998 (N=705) and 1999 (N=514) from 12 hours of electrofishing on Newton Lake, data provided by the Illinois Department of Natural Resources.

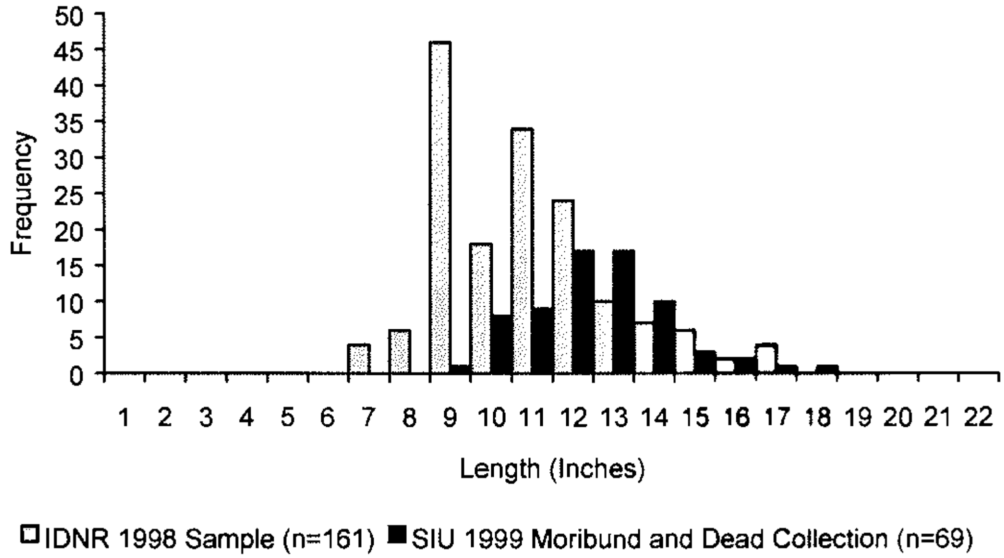

Figure 13.10. Comparison of the length-frequency histograms of channel catfish obtained by 12 hours of electrofishing during fall 1998 from Newton Lake by the Illinois Department of Natural Resources (IDNR)(N=161), and dead and moribund fish collected between 1 June 1999 and 31 August 1999 by Southern Illinois University Fisheries Research Lab (SIU) during routine sampling trips (N=69).

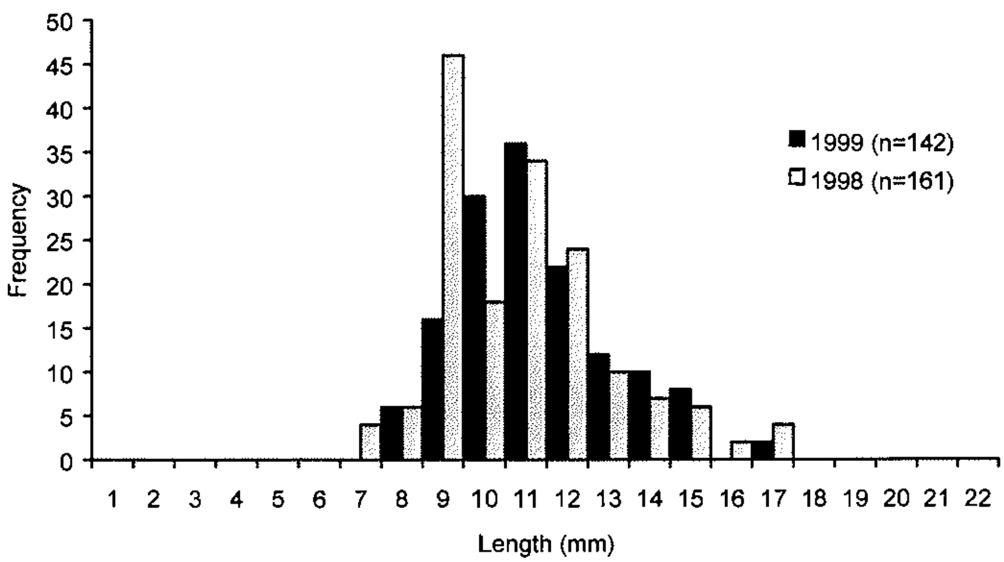

Figure 13.11. Comparison of the length-frequency histograms of channel catfish obtained in 1998 (N=161) and 1999 (N=142) from 12 hours of electrofishing during fall on Newton Lake, data provided by the Illinois Department of Natural Resources.

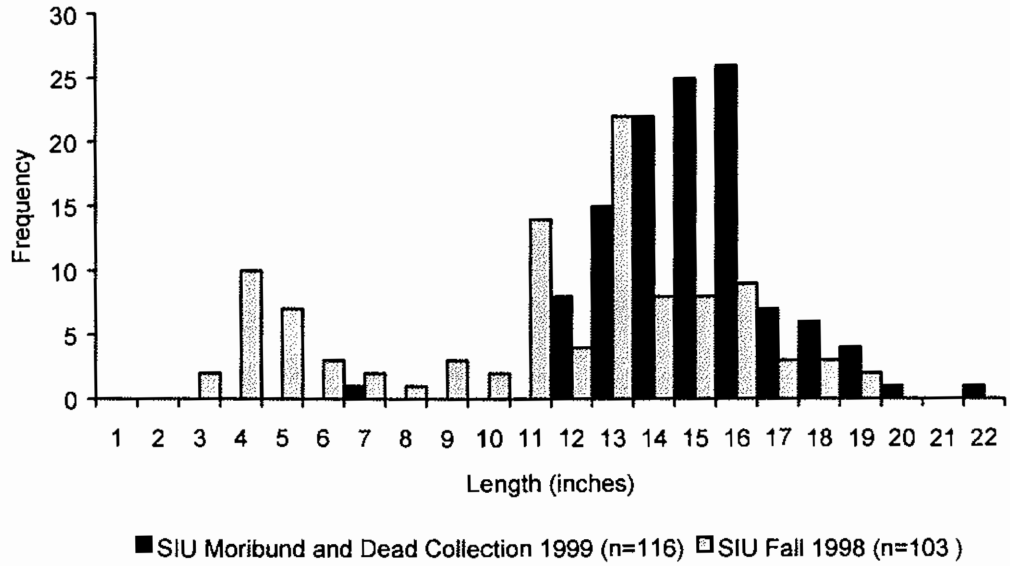

Figure 13.12. Comparison of the length-frequency histograms of largemouth bass obtained by electrofishing during fall 1998 on Coffeen Lake by Southern Illinois University Fisheries Research Lab (N=103), and dead and moribund fish collected between 1 June 1999 and 31 August 1999 by SIU during routine sampling trips (N=116).

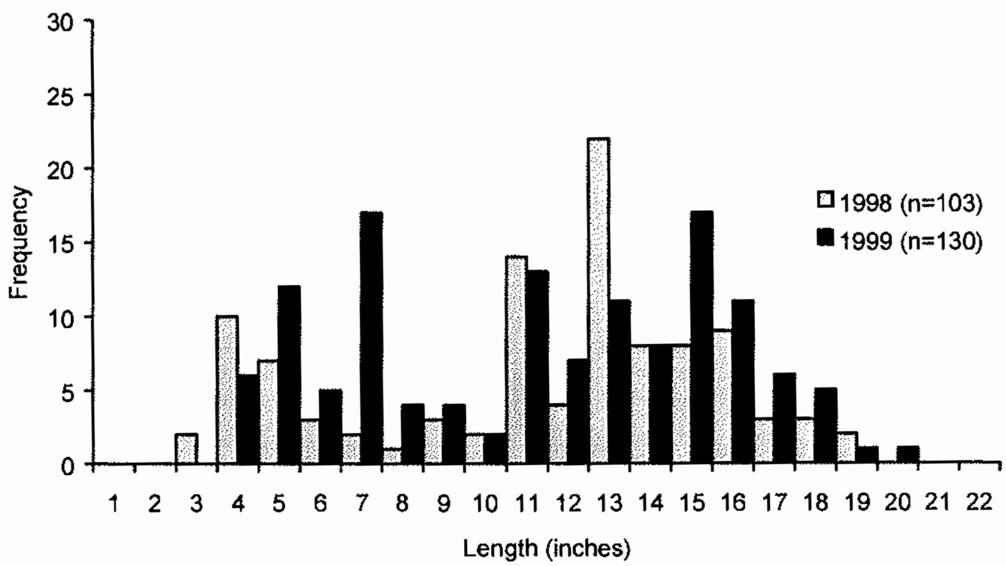

Figure 13.13. Comparison of the length-frequency histograms of largemouth bass obtained in fall of 1998 (N=103) and 1999 (N=130) by electrofishing on Coffeen Lake by Southern Illinois University Fisheries Research Lab.

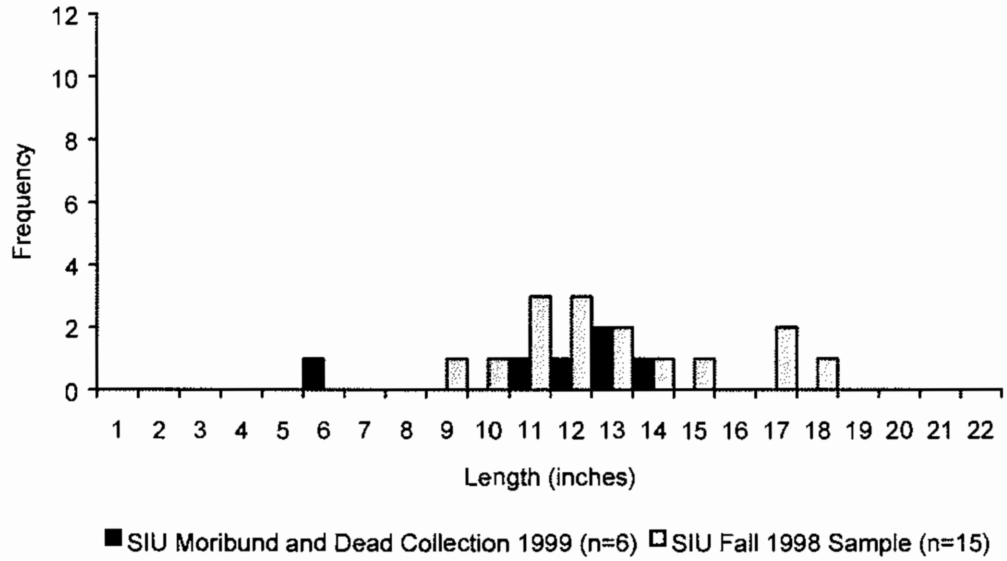

Figure 13.14. Comparison of the length-frequency histograms of channel catfish obtained by electrofishing during fall 1998 on Coffeen Lake by Southern Illinois University Fisheries Research Lab (N=15), and dead and moribund fish collected between 1 June 1999 and 31 August 1999 by SIU during routine sampling trips (N=6).

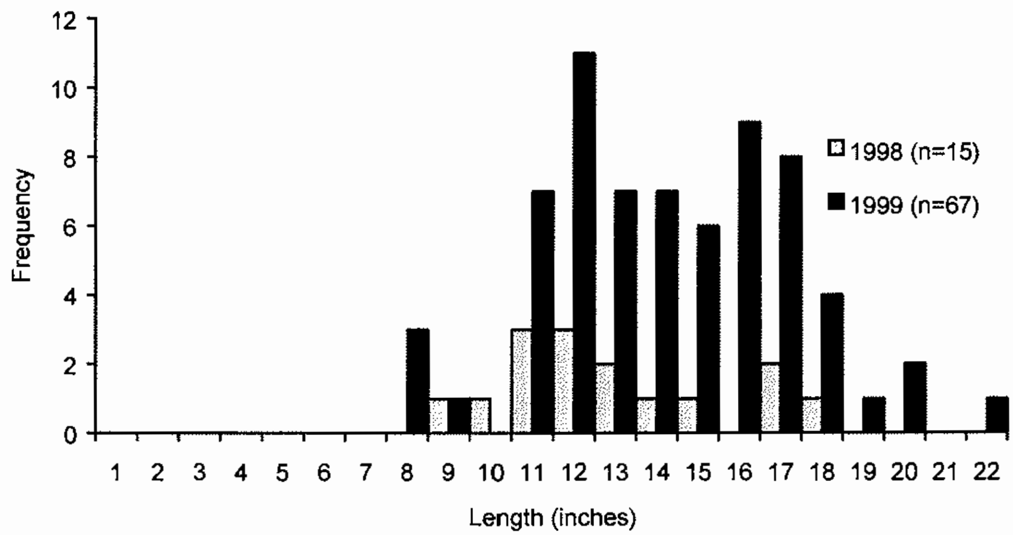

Figure 13.15. Comparison of the length-frequency histograms of channel catfish obtained in fall of 1998 (N=15) and 1999 (N=67) by electrofishing on Coffeen Lake by Southern Illinois University Fisheries Research Lab.

Chapter 13. Appendix: Supplemental Data Tables.

Table 13.A1. AC electrofishing catch-per-unit-effort (CPUE) of all species captured in Coffeen Lake during November through December of 1997 through 1999.

Year	Species	Catch (N)	Effort (hrs)	CPUE
1997	largemouth bass	116	4.8	24.4
	bluegill	274	4.0	69.1
	redear sunfish	5	6.0	0.8
	green sunfish	7	6.0	1.2
	white crappie	31	6.0	5.2
	channel catfish	34	6.0	5.7
	yellow bass	17	6.0	2.8
	Orange-spotted sunfish	10	6.0	1.7
1998	largemouth bass	109	7.3	15.0
	bluegill	126	2.1	58.7
	white crappie	8	7.9	1.0
	channel catfish	17	7.9	2.2
1999	largemouth bass	141	5.1	27.9
	bluegill	166	1.0	163.3
	white crappie	52	10.2	5.1
	channel catfish	68	10.2	6.6

Table 13.A2. AC electrofishing catch-per-unit-effort (CPUE) of all species captured in Lake of Egypt during the months November through December of 1997 and 1998.

Year	Species	Catch (N)	Effort (hrs)	CPUE
1997	largemouth bass	518	12.6	41.0
	bluegill	1337	10.4	129.0
	redear sunfish	489	12.9	38.0
	green sunfish	131	12.9	10.2
	warmouth	12	12.9	0.9
	longear sunfish	227	12.9	17.6
	white crappie	36	12.9	2.8
	black crappie	26	12.9	2.0
	channel catfish	6	12.9	0.5
	yellow bullhead	3	12.9	0.2
	common carp	14	12.9	1.1
	white bass	2	12.9	0.2
	grass pickerel	1	12.9	0.1
	golden shiner	11	12.9	0.9
	white x striper	1	12.9	0.1
	gizzard shad	290	12.9	22.5
	threadfin shad	4	12.9	0.3
	bluntnose minnow	1	12.9	0.1
	topminnow	4	12.9	0.3
	brook silverside	1	12.9	0.1
	Orange-spotted sunfish	13	12.9	1.0
	spotted sucker	2	12.9	0.2
1998	largemouth bass	419	10.2	41.2
	bluegill	839	9.1	92.0
	redear sunfish	274	11.2	24.5
	green sunfish	22	11.2	2.0
	warmouth	8	11.2	0.7
	longear sunfish	125	11.2	11.2
	white crappie	4	11.2	0.4
	black crappie	34	11.2	3.0
	channel catfish	9	11.2	0.8
	yellow bullhead	6	11.2	0.5
	common carp	13	11.2	1.2

Table 13.A2. Continued

Year	Species	Catch (N)	Effort (hrs)	CPUE
1998	golden shiner	7	11.2	0.6
	white x striper	8	11.2	0.7
	gizzard shad	155	11.2	13.9
	threadfin shad	34	11.2	3.0
	brook silverside	17	11.2	1.5
	hybrid sunfish	10	11.2	0.9
	spotted sucker	12	11.2	1.1

Table 13.A3. AC electrofishing catch-per-unit-effort (CPUE) of all species captured in Newton Lake during the months November through December of 1997 through 1999.

Year	Species	Catch (N)	Effort (hrs)	CPUE
1997	largemouth bass	344	9.3	37.1
	bluegill	1468	11.3	130.1
	channel catfish	52	16.6	3.1
1998	largemouth bass	318	6.3	50.6
	bluegill	565	7.2	78.8
	green sunfish	43	10.0	4.3
	longear sunfish	93	10.0	9.3
	channel catfish	73	10.0	7.3
	common carp	5	10.0	0.5
	gizzard shad	230	10.0	23.1
	hybrid sunfish	23	10.0	2.3
1999	largemouth bass	330	9.0	36.7
	bluegill	472	4.8	97.6
	white crappie	23	17.6	1.3
	channel catfish	130	17.8	7.3
	white bass	1	17.8	0.1

Table 13.A4. AC electrofishing catch-per-unit-effort (CPUE) of all species captured in each segment of Coffeen Lake during the months November through December of 1997 through 1999.

Year	Segment	Species	Catch (N)	Effort (hrs)	CPUE
1997	1	largemouth bass	30	1.4	21.4
		bluegill	16	0.7	22.9
		white crappie	31	1.4	22.1
		channel catfish	23	1.4	16.4
	2	largemouth bass	86	3.4	25.7
		bluegill	258	3.3	79.0
		redear sunfish	5	4.6	1.1
		green sunfish	7	4.6	1.5
		channel catfish	11	4.6	2.4
		yellow bass	17	4.6	3.7
		Orange-spotted sunfish	10	4.6	2.2
1998	1	largemouth bass	54	3.4	16.0
		bluegill	57	1.0	55.1
		channel catfish	17	3.4	5.0
	2	largemouth bass	55	3.9	14.1
		bluegill	69	1.1	62.0
		white crappie	8	4.5	1.8
1999	1	largemouth bass	47	3.1	15.4
		bluegill	116	0.9	133.8
		white crappie	4	4.5	0.9
		channel catfish	19	4.5	4.2
	2	largemouth bass	94	2.0	46.7
		bluegill	50	0.2	333.3
		white crappie	48	5.8	8.3
		channel catfish	49	5.8	8.5

Table 13.A5. AC electrofishing catch-per-unit-effort (CPUE) of all species captured in each segment of Lake of Egypt during the months November through December of 1997 and 1998.

Year	Segment	Species	Catch (N)	Effort (hrs)	CPUE
1997	1	largemouth bass	383	5.8	65.7
		bluegill	633	4.9	130.1
		redear sunfish	341	6.1	56.1
		green sunfish	68	6.1	11.2
		warmouth	6	6.1	1.0
		longear sunfish	140	6.1	23.0
		white crappie	29	6.1	4.8
		black crappie	15	6.1	2.5
		channel catfish	6	6.1	1.0
		yellow bullhead	3	6.1	0.5
		common carp	7	6.1	1.2
		white bass	2	6.1	0.3
		golden shiner	7	6.1	1.2
		white x striper	1	6.1	0.2
		gizzard shad	117	6.1	19.2
		threadfin shad	1	6.1	0.2
		bluntnose minnow	1	6.1	0.2
		brook silverside	1	6.1	0.2
		Orange-spotted sunfish	7	6.1	1.2
		spotted sucker	1	6.1	0.2
	2	largemouth bass	135	6.8	19.9
		bluegill	704	5.5	128.0
		redear sunfish	148	6.8	21.8
		green sunfish	63	6.8	9.3
		warmouth	6	6.8	0.9
		longear sunfish	87	6.8	12.8
		white crappie	7	6.8	1.0
		black crappie	11	6.8	1.6
		common carp	7	6.8	1.0
		grass pickerel	1	6.8	0.1
		golden shiner	4	6.8	0.6
		gizzard shad	173	6.8	25.4
		threadfin shad	3	6.8	0.4

Table 13.A5. Continued

Year	Segment	Species	Catch (N)	Effort (hrs)	CPUE
1997	2	topminnow	4	6.8	0.6
		Orange-spotted sunfish	6	6.8	0.9
		spotted sucker	1	6.8	0.1
1998	1	largemouth bass	274	4.9	56.1
		bluegill	420	4.5	93.0
		redear sunfish	221	5.6	39.8
		green sunfish	7	5.6	1.3
		warmouth	6	5.6	1.1
		longear sunfish	53	5.6	9.5
		white crappie	3	5.6	0.5
		black crappie	21	5.6	3.8
		channel catfish	4	5.6	0.7
		yellow bullhead	6	5.6	1.1
		common carp	8	5.6	1.4
		golden shiner	3	5.6	0.5
		white x striper	8	5.6	1.4
		gizzard shad	88	5.6	15.9
		threadfin shad	7	5.6	1.3
		brook silverside	8	5.6	1.4
		hybrid sunfish	7	5.6	1.3
		spotted sucker	4	5.6	0.7
	2	largemouth bass	145	5.3	27.4
		bluegill	419	4.6	91.1
		redear sunfish	53	5.6	9.4
		green sunfish	15	5.6	2.7
		warmouth	2	5.6	0.4
		longear sunfish	72	5.6	12.8
		white crappie	1	5.6	0.2
		black crappie	13	5.6	2.3
		channel catfish	5	5.6	0.9
		common carp	5	5.6	0.9
		golden shiner	4	5.6	0.7
		gizzard shad	67	5.6	11.9
		threadfin shad	27	5.6	4.8
		brook silverside	9	5.6	1.6
		hybrid sunfish	3	5.6	0.5
		spotted sucker	8	5.6	1.4

Table 13.A6. AC electrofishing catch-per-unit-effort (CPUE) of all species captured in each segment of Newton Lake during the months November through December of 1997 through 1999.

Year	Segment	Species	Catch (N)	Effort (hrs)	CPUE
1997	1	largemouth bass	80	1.3	60.0
		bluegill	437	3.0	144.1
		channel catfish	9	5.7	1.6
	2	largemouth bass	75	2.7	28.0
		bluegill	365	2.4	154.2
		channel catfish	20	3.8	5.3
	3	largemouth bass	113	3.3	34.2
		bluegill	442	3.2	138.8
		channel catfish	9	4.4	2.0
	4	largemouth bass	76	1.9	39.1
		bluegill	224	2.7	83.0
		channel catfish	14	2.7	5.2
1998	1	largemouth bass	81	1.5	53.4
		bluegill	110	2.6	41.7
		green sunfish	7	3.2	2.2
		longear sunfish	9	3.2	2.8
		channel catfish	11	3.2	3.4
		gizzard shad	37	3.2	11.4
		hybrid sunfish	1	3.2	0.3
	2	largemouth bass	76	1.0	80.0
		bluegill	191	1.2	161.1
		green sunfish	8	2.3	3.5
		longear sunfish	26	2.3	11.5
		channel catfish	15	2.3	6.6
		common carp	3	2.3	1.3
		gizzard shad	9	2.3	4.0
		hybrid sunfish	4	2.3	1.8
1998	3	largemouth bass	77	2.1	37.3
		bluegill	121	1.8	68.0

Table 13.A6. Continued

Year	Segment	Species	Catch (N)	Effort (hrs)	CPUE
1998	3	green sunfish	13	2.3	5.7
		longear sunfish	32	2.3	13.9
		channel catfish	20	2.3	8.7
		common carp	1	2.3	0.4
		gizzard shad	55	2.3	23.9
		hybrid sunfish	13	2.3	5.7
	4	largemouth bass	84	1.8	48.0
		bluegill	143	1.6	91.1
		green sunfish	15	2.2	6.9
		longear sunfish	26	2.2	12.0
		channel catfish	27	2.2	12.5
		common carp	1	2.2	0.5
		gizzard shad	129	2.2	59.5
		hybrid sunfish	5	2.2	2.3
1999	1	largemouth bass	70	3.4	20.5
		bluegill	115	1.6	71.1
		white crappie	4	4.6	0.9
		channel catfish	15	4.9	3.1
	2	largemouth bass	75	2.2	34.6
		bluegill	99	0.5	185.6
		white crappie	4	4.3	0.9
		channel catfish	36	4.3	8.3
	3	largemouth bass	95	2.1	44.9
		bluegill	131	1.6	84.2
		white crappie	1	4.2	0.2
		channel catfish	59	4.2	13.9
		white bass	1	4.2	0.2
	4	largemouth bass	90	1.8	49.5
		bluegill	127	1.6	77.1
		white crappie	14	4.9	2.8
		channel catfish	20	4.9	4.1

Chapter 14: Movement of Largemouth Bass and Channel Catfish
(Primary Responsibility-Joseph L. Rush)

Introduction:

The goal of this phase of the study was to determine seasonal, three-dimensional movement of largemouth bass (*Micropterus salmoides*) and channel catfish (*Ictalurus punctatus*) in three Illinois power cooling lakes. Sonic-telemetry studies were conducted to assess whether habitat utilization by largemouth bass and channel catfish differs among Newton Lake, Lake of Egypt, and Coffeen Lake. Observing fish movement is of great importance because it provides insight into the habitat being utilized and therefore may indicate if habitat is being lost. The water column is separated into three layers; an upper warm, lighter layer - the epilimnion; a cool denser layer – the hypolimnion; and a transitional zone between them - the metalimnion. If utilization of the epilimnion decreases during summer for these species, and the epilimnion expands in depth, then there may be a loss of fish habitat. On the other hand, the habitat utilization information may indicate that the elevated temperatures provide more habitat for these species during other seasons in Newton Lake. Attempts were also made to ascertain diel movement to determine if differences occurred due to seasonal changes in photoperiod and temperature.

Materials and Methods:

Due to thermal stratification and water conductivity, temperature sensitive (± 0.5 °C [0.9 °F]) sonic transmitters (Sonotronics Model CTT-83-3) were used to track the fish instead of radio wave frequency transmitters. The transmitters were approximately 17 mm in diameter and mm long and transmitted at a frequency of 75 khz. Each transmitter weighed approximately 8 g in water and thus, should not have affected the movement of study fish due to the fishes' relatively large size (> 537 g for channel catfish and > 552 g for largemouth bass). Each transmitter was pulse-coded to allow differentiation between specific fish and has an estimated life expectancy of approximately 36 months. DH-2 directional hydrophones, and a Sonotronics narrow band receiver (Model USR-96) were used to track largemouth bass and channel catfish in all three lakes. Once detected, the fishes' locations were determined with a Garmin Model 45XL hand held Global Positioning System (G.P.S). In addition, locations were marked on a map of the lake. The G.P.S. coordinates were imported into ArcView Geographic Information System for observed linear distance analysis.

A Model-50B Yellow Springs Instrument unit was used to determine temperature, dissolved oxygen, and depth. Using a certified thermometer, the temperature sensors were calibrated at three temperatures that bracketed the temperatures recorded in the field. Field measurements were adjusted as required by the calibration curve. The oxygen probe was calibrated each time it was used following the manufacturers recommended method. In addition, the oxygen probe was calibrated once a month using the method recommended in APHA (1995).

Transmitter Calibration

The sonic transmitters were individually calibrated in the laboratory prior to use. Calibration was accomplished by recording pulse intervals (PI) at two different measured temperatures: room temperature and freezing. Measurements were taken after the transmitters had time to stabilize to the surrounding temperature (approximately two hours). The measurements were labeled as PI_1 and T_1. A second set of measurements was taken after letting the transmitters equilibrate overnight in a styrofoam cup filled with water and ice and placed in a refrigerator. This measurement was labeled as PI_2. The resultant temperature factor was obtained as follows: $T_f = T_1 / (PI_2 - PI_1)$.

The pulse interval in the field was used to determine the ambient temperature of the surrounding environment. Ambient temperature was derived as follows: $(PI_2\text{-}PI)T_f$

Collection and Surgical Procedure

Largemouth bass and channel catfish were obtained by electroshocking using a three-phase, AC, boat-mounted electrofishing system. Attempts were also made to collect channel catfish using a low pulse, DC electroshocking unit. In addition, hoop nets were set in Newton Lake's warm water discharge in attempt to obtain channel catfish. Length distributions of largemouth bass used for transmitter implantation on all three lakes ranged from 362 mm (14.25 in.) to 522 mm (20.55 in.) total length. Total lengths for channel catfish ranged from 412 mm (16.22 in.) to 635 mm (25.00 in.).

Once obtained, fish were placed into a holding tank that was two-thirds full of fresh lake water oxygenated to super saturation. After fish were recovered from the initial electroshock, they were relocated to a second tank containing buffered water used for anesthetization. Carbon dioxide gas was diffused into the anesthetization tank until the fish were anesthetized. This was determined by visually observing the fishes' voluntary muscle response (i.e., lack of buoyancy control and dorso-ventral orientation). Carbon dioxide was used in order to avoid the FDA requirement of holding the fish for a prescribed time before release. For example, FDA requires that MS-222 anesthetized fish be held for 21 days before release. This methodology is well documented for walleye (*Stizostedium vitrieum*), sauger (*S. canadense*), largemouth bass, and pallid sturgeon (*Scaphirhynchus albus*) (Heidinger et al. 1988, Heidinger et al. 1991, Heidinger et al. 1996).

After anesthetization, fish were removed from the holding tank, weighed, measured, and placed on an operating table for surgery. For largemouth bass, the incision location was prepared by removing approximately three rows of scales roughly 25 mm (0.98 in.) in length at 25-30 mm (0.98 –1.18 in.) anterior of the anal opening, at the location where ventral coloration converts to dorsal coloration. For channel catfish, the incision location was slightly more anterior and ventral. Prior to making the incision, an anti-bacterial solution (betadine) was used to disinfect the body surfaces. All utensils used in the surgical procedures were sterilized in 70% ethanol prior to surgery. A scalpel and hemostat were used to make incisions large enough to insert the sonic transmitters. The hemostat was used to lift muscle tissue away from the internal organs which ensured no organs were incised. Once the surgical openings were created, attempts were made to visually sex the fish with minimal amounts of probing to prevent damage to internal organs and tissues. Sonic transmitters were inserted into the incisions using a slight rotation to prevent binding of internal organs. Following insertion, the transmitters were pulled back until they were past the posterior end of the incision to minimize internal pressure on the sutures. This technique should decrease chances of transmitter expulsion and should relieve any pressure on organs that might have occurred during insertion. The incisions were closed with simple interrupted sutures using Ethilon® monofilament nylon sutures attached to FS-1 curved cutting needles. The incisions and sutures were sealed with cyanoacrylate resin to prevent contamination and suture knot failure. The fish were placed in a recovery tank supplemented with oxygen and monitored. After the fish attained control of buoyancy and orientation, they were released at the capture sites. The fish were not released unless they were able to swim under their own power.

Weekly and Monthly Sampling Regime

Initial sonic transmitter implantation began in October 1997. Once the transmitters were implanted, attempts were made to determine locations of individual fish in each lake beginning in November 1997 and ending during the last week of August 1999. In each lake, tracking was conducted once a month from October to March and weekly from April to September. A DH-2 directional hydrophone was used to detect signals from the sonic transmitters. An USR-96 narrow band receiver was used to convert signals to audible pulses, which were then counted to determine transmitter sequences. The transmitter sequences determined which fish was located. After triangulating the location, an anchor was dropped, and the location was recorded on a map. Latitude and longitude coordinates were then recorded using the Garmin 45XL handheld G.P.S. The pulse intervals were also recorded. As previously described, pulse intervals determined the ambient temperatures of the transmitters, which were a direct reflection of internal body temperatures and the surrounding environment. Depth, temperature, and dissolved oxygen profiles were taken at 0.5-m (1.6 ft) intervals using a Yellow Springs Instrument unit. The entire lake was covered on each sampling trip, when possible.

Diel Sampling Regime

An attempt was made to track diel movements of four fish in each lake twice during a two-week period, and the sampling was repeated during several seasons. Sampling schedules consisted of two weeks between May and June, two weeks in August, and two weeks between December and January. The first sampling began in May 1998 and ended in mid-August 1999.

Each sampling date consisted of tracking two largemouth bass and two channel catfish over a 24-hour period. If two channel catfish were not available, then largemouth bass were substituted. Attempts were made to locate each fish every three hours. Once the fish were located, data were collected in the same manner as the weekly and monthly collections.

Transmitter Recovery

Attempts were also made to recover sonic transmitters that had been "lost" by the fish due to trans-intestinal expulsion by channel catfish (Summerfelt 1984) or by natural mortality of both species. When a fish did not move over an extended period of time, an attempt was made to recover that sonic transmitter. If the transmitter could not be recovered, it was deemed "un-recoverable." If the water was shallow, the transmitter was recovered by wading or snorkeling using a mask, fins, and snorkel. In water over 2-m in depth, a recovery team consisting of two certified SCUBA divers and one signal person were used. The signal person stayed in the boat listening to the receiver while the divers, descended with the hydrophone. When a signal was detected, the person in the boat would signal the divers with a tugging motion on the coaxial cable of the hydrophone. The tugging would become more erratic with the stronger signal, which would let the divers know they were on a "hot" signal. This method proved invaluable in the recovery of these transmitters. Length of the coaxial cable limited recovery of some transmitters located in water deeper than 30 feet.

Results:

Considerable effort was made to surgically implant and track largemouth bass and channel catfish. Sonic transmitters were inserted into 100 largemouth bass and 42 channel catfish from October 1997 through May 1999 (Table 14.1) and a total of 31 days were spent tagging (Table 14.2). Efforts were made to distribute transmitters throughout the lake with 27 sites in Newton Lake (Table 14.3, Figure 14.1), 26 sites in Coffeen Lake (Table 14.4, Figure 14.2), and 23 sites in Lake of Egypt (Table 14.5, Figure 14.3). Implanted largemouth bass lengths ranged from 362 mm (14.25 in.) to 522 mm (20.55 in.) and they weighed from 552 g (1.22 lbs.) to 2,440 g (5.38 lbs.). Channel catfish lengths ranged from 412 mm (16.22 in.) to 635 mm (25.00 in.) and weighed from 537 g (1.18 lbs.) to 3,012 g (6.64 lbs.)(Tables 14.3-14.5). Tracking was conducted a total of 190 days on the three lakes from October 1997 through August 1999 (Table 14.2). Total transmitter loss of at least 64% for largemouth bass and 93% to 100% for channel catfish occurred on all three lakes throughout the course of this study (Table 14.6). The history of transmitter usage and the dates transmitters were active in each lake are shown in Tables 14.7-14.9 along with the number of contacts made for each individual transmitter throughout the study. Most fish had been located on several occasions prior to tag loss.

Mean Internal Body Temperature

Mean internal body temperatures of largemouth bass during 1998 in Newton Lake ranged from 8.0 °C (46.4 °F) in December to 29.0 °C (84.2 °F) in July. The 1999 results were similar in that the lowest mean internal temperature (7.9 °C [46.2 °F]) was in January and the highest (30.3 °C [86.5 °F]) was in July (Figure 14.4). Largemouth bass in Coffeen Lake during 1998 reached their minimum mean internal body temperatures of 9.6 °C (49.3 °F) in March and their maximum of 31.4 °C (88.5 °F) in July. The 1999 data for Coffeen Lake largemouth bass shows the minimum of 13.8 °C (56.8 °F) and maximum of 32.0 °C (89.6 °F) mean temperatures being attained in January and July (Figure 14.5). During 1998, largemouth bass in Lake of Egypt were located in temperature extremes in February (5.8 °C [42.4 °F]) and July (30.0 °C [86.0 °F]).

Data from 1999 was consistent with Coffeen Lake largemouth bass since coolest mean internal body temperatures were attained in January (7.7 °C [45.9 °F]) and warmest (29.5 °C [85.0 °F]) in July (Figure 14.6). Minimum and maximum recorded internal body temperatures for largemouth bass in Newton Lake for 1998 and 1999 were attained in January and July. The 1998 minimum was 6.2 °C (43.2 °F), and the maximum was 32.3 °C (90.1 °F). During 1999, the temperature minimum was 6.4 °C (43.5 °F), and the maximum was 35.0 °C (95.0 °F) (Table 14.10). Coffeen Lake largemouth bass internal temperatures ranged from 6.3 °C (43.3 °F) to 35.3 °C (95.5 °F) during 1998. The minimum temperature was recorded in March and the maximum in July. During 1999, the temperature ranged from 8.4 °C (47.1 °F) in February and March to 36.3 °C (97.3 °F) in July (Table 14.11). Minimum and maximum ranges were consistent with means for Lake of Egypt largemouth bass, and the minimum occurred in February and the maximum in July 1998. The 1998 internal body temperatures ranged from 3.5 °C (38.3 °F) to 33.5 °C (92.3 °F), and the 1999 internal body temperature ranged from 4.1 °C (39.4 °F) in January to 34.1 °C (93.4 °F) in July (Table 14.12).

Laboratory Study

Internal body temperatures were not always within the range of the water temperature, depth, and dissolved oxygen profiles taken where the fish were located. This is possibly due to the fish changing locations. When fish move, they may be moving from cooler water to warmer water or vice versa, and therefore, internal body temperatures may not have coincided with the external temperatures. In such cases, depth and dissolved oxygen where fish were located could not be determined. Since internal transmitters were used, there is an initial latency in temperature equilibration for the transmitters (Weller et al. 1984, Reynolds 1977, and Kubb et al.1980).

Internal lag time was investigated in a laboratory study conducted in October 1999 at Southern Illinois University Carbondale. This study was designed to establish temperature lag time between internal body temperature and external environmental temperature for largemouth bass implanted with ultrasonic transmitters. Transmitter implanted largemouth bass were acclimated to room temperature in a holding tank and transmitter temperatures were recorded. The acclimated fish were individually placed in a test tank chilled 10 °C (18 °F) cooler than the holding tank. Transmitter temperatures and tank temperatures were recorded every 30 seconds until the transmitter equilibrated to the test-tank temperature. Equilibration times ranged from 38.5 minutes to 68.5 minutes for largemouth bass ranging in size from 362 mm (14.3 in.) to 520 mm (20.5 in.), weighing 606 g (1.3 lbs.) to 2,376 g (5.2 lbs.), and with body wall thickness' of 5.5 mm (0.22 in.) to 8.9 mm (0.35 in.)(Table 14.13). Weller et al. (1984) reported that largemouth bass exchanged heat (k) at a faster rate (ratio for $k_h/k_c = 1.31$) when warming (k_h) than when cooling (k_c), but they also reported that the lag when warming (L_h) was significantly greater than the cooling lag (L_c)(ratio for $L_h/L_c = 1.59$). This apparent inconsistency was thought to be due to the initial time required for the largemouth bass to start dissipating heat.

Depth, Dissolved Oxygen, and Internal Body Temperature Relationships

A separate data set was established to determine depth, dissolved oxygen, and internal body temperature relationships. Only those contacts that were within a depth, dissolved oxygen, and temperature profile were utilized in this data set. Depth and dissolved oxygen at the point of contact were determined by correlating the internal body temperature to that of the profile. If the correlating body temperature was between the 0.5-meter (1.6 ft) profile readings, then the deeper of the two were used. If a range of profile readings matched the internal body temperature, then the mean of the range was utilized. June, July, and August data will be discussed since the summer month temperatures are of greatest concern due to a possible reduction in available habitat. During the summer of 1998 in Newton Lake, mean internal body temperatures for largemouth bass ranged from 24.1 °C (75.4 °F) to 31.7 °C (89.1 °F) and a maximum of 32.3 °C (90.1 °F) was recorded. During 1999, summer internal body temperatures ranged from 26.3 °C (79.3 °F) to 33.0 °C (91.4 °F), and a maximum of 35.0 °C (95.0 °F) was recorded (Table 14.14, Figure 14.7). Largemouth bass in Coffeen Lake had mean internal body temperatures ranging from 26.6 °C (79.9 °F) to 33.1 °C (91.6 °F) and a maximum of 35.3 °C (95.5 °F) was recorded for the summer of 1998. The 1999 means ranged from 26.4 °C (79.5 °F) to 35.9 °C (96.6 °F), and the maximum was 36.3 °C (97.3 °F)(Table 14.15, Figure 14.8). Largemouth bass located in Lake of Egypt had mean internal body temperatures that ranged between 27.4 °C (81.3 °F) and 32.0 °C (89.6 °F). A maximum of 33.4 °C (92.1 °F) was recorded for the summer of 1998. Mean for Lake of Egypt during summer of 1999 ranged from 26.4 °C (79.5 °F) to 32.1 °C (89.8 °F) and a maximum of 34.1 °C (93.4 °F) was recorded (Table 14.16, Figure 14.9). Mean dissolved oxygen where the fish were located (within the water column) ranged from 1.4 mg/L to 13.5 mg/L and a minimum of 0.1 mg/L and a maximum of 17.2 mg/L was recorded in Newton Lake during 1998. Mean dissolved oxygen during 1999 ranged from 1.7 mg/L to 7.1 mg/L. A minimum of 0.8 mg/L and a maximum of 6.4 mg/L were recorded (Table 14.14, Figure 14.10). Fish in Coffeen Lake were located in water with mean dissolved oxygen ranging from 2.8 mg/L to 7.1 mg/L for 1998. A minimum of 1.1 mg/L and a maximum of 9.2 mg/L were recorded. During 1999, fish were located in water with mean dissolved oxygen ranging between 3.1 mg/L and 7.4 mg/L, and a minimum of 1.1 mg/L and a maximum of 12.5 mg/L were recorded (Table 14.15, Figure 14.11). Mean dissolved oxygen levels for fish in Lake of Egypt ranged from 1.8 mg/L to 11.1 mg/L in 1998, and a minimum of 1.2 mg/L and a maximum of 12.3 mg/L were recorded. Dissolved oxygen ranges during 1999 were from 2.9 mg/L to 6.8 mg/L, and a minimum of 0.2 mg/L and a maximum of 10.3 mg/L were recorded (Table 14.16, Figure 14.12).

The relationships among temperature, depth, and dissolved oxygen all followed a basic trend: As summer progressed, internal body temperature increased, fish then moved deeper in the water column, and dissolved oxygen in the areas where fish were located decreased (Figures 14.13-14.18). This trend was seen for fish in all lakes during both years, with the exception of Coffeen Lake in the summer of 1999 (Figure 14.16). As internal body temperatures increased, fish moved shallower and dissolved oxygen increased. This may have been due to lower dissolved oxygen in late July. As dissolved oxygen decreased at greater depths, fish migrated up in the water column and endured higher body temperatures for higher dissolved oxygen levels.

Largemouth bass, in all three lakes, utilized areas with higher dissolved oxygen at shallower depths during winter than during summer. Mean dissolved oxygen did not drop below 8 mg/L during winter or spring for largemouth bass located in Newton Lake, and fish did not occupy depths greater than 11 feet during winter (Table 14.17, Figure 14.19). Similarly, largemouth bass in Coffeen Lake and Lake of Egypt utilized shallower depths during winter, however; mean dissolved oxygen was sporadic during fall, and winter (Table 14.18, 14.19, Figure 14.20, 14.21).

Observed Linear Distance

Extensive linear movements were observed in Newton and Coffeen Lakes between individual contacts. Individual transmitter-implanted largemouth bass mean movement between contacts ranged from 58.0 m (0.04 miles) to 3,799.5 m (2.36 miles) in Newton Lake, and channel catfish mean movements ranged from 78.0 m (0.05 miles) to 5,880.1 m (3.65 miles) (Table 14.20). Largemouth bass in Coffeen Lake had mean individual movements that ranged from 63.7 m (0.04 miles) to 3,509.7 m (2.18 miles) and channel catfish mean movement ranged from 62.9 m (0.04 miles) to 1,786.3 m (1.11 miles) (Table 14.21). Lake of Egypt largemouth bass mean individual movements ranged from 82.6 m (0.05 miles) to 1,903.9 m (1.18 miles), and channel catfish ranged from 52.2 m (0.03 miles) to 537.3 m (0.33 miles) (Table 14.22). Scatter plots show the observed movements between contacts throughout the study (Figures 14.22 – 14.27). In Newton Lake, 18.2% of largemouth bass observed movements between contacts were over 1,613.3 m (1 mile), and 2.8% of contacts were over 4,990.4 m (3.10 miles) apart. Over 20% of observed channel catfish movements in Newton Lake were greater than 1,662.4 m (1.03 miles) and 9.6% of observed movements were greater than 4,884.3 m (3.04 miles). In Coffeen Lake, 15.9% of largemouth bass had observed movements that were greater than 1,620.4 m (1.01 miles), and 1.5% of the observations were greater than 4,988.5 m (3.10 miles). Channel catfish observed movements in Coffeen Lake resulted in 13.8% of the observations being greater than 1,701.0 m (1.06 miles). Largemouth bass observed movements in Lake of Egypt were much less extensive. Only 1.5% of the observed movements were greater than 1,625.8 m (1.01 miles), and only 0.5% were greater than 3,260.6 m (2.03 miles). Observed movements of channel catfish in Lake of Egypt were much less than those in Coffeen and Newton lakes. Only 0.5% (one individual movement) of the observations were greater than 2,469.7 m (1.53 miles). Thus, extensive linear movement was exhibited for largemouth bass and channel catfish in Newton and Coffeen Lakes, and comparatively less movement was observed in Lake of Egypt.

Twenty-four Hour Diel Movement

This extensive linear movement was also supported by the 24-hour diel movement data. Movements greater than two miles were observed for 11.5% of implanted largemouth bass in Newton Lake, and 9.1% of bass in Coffeen Lake. While movements over two miles were not observed in Lake of Egypt, 3.3% of the movement observations were between 1.0 and 2.0 miles, and the majority of observations were less than one-half mile (Table 14.23). The range for largemouth bass in Newton Lake was 415.2 m (0.26 miles) to 5,558.0 m (3.45 miles), and Coffeen Lake largemouth bass movement ranged from 273.3 m (0.17 miles) to 4,850.7 m (3.01 miles) (Tables 14.24, 14.25). Largemouth bass movement in Lake of Egypt ranged from 421.4 m (0.26 miles) to 2,203.0 m (1.37 miles) (Table 14.26). Channel catfish observed 24-hour diel movements in Newton Lake were limited to one individual that moved 11,762.2 m (7.31 miles). Coffeen Lake catfish ranged from 543.6 m (0.34 miles) to 5,054.1 m (3.14 miles). Diel movement observations of channel catfish in Lake of Egypt had a range of 335.9 m (0.21 miles) to 1,804.0 m (1.12 miles). These extreme diel movements are shown in Figures 14.25 - 14.29. When comparing the mean seasonal movements, the greatest observed movements were made during summer sampling periods in all three lakes, and observed movements in Newton and Coffeen lakes were much greater than those observed in Lake of Egypt (Figure 14.30).

Seasonal Migrations

Migrations away from the discharge were observed for largemouth bass in Newton Lake for summer months and towards the discharge throughout the remaining seasons (Figure 14.31). Segment one and two were rarely utilized in the summer. Similar migrations were also observed for largemouth bass in Coffeen Lake. However, they were less extreme (Figure 14.32). Migrations towards the discharge in summer months were observed for largemouth bass in Lake of Egypt in segment one (Figure 14.33). Largemouth bass implanted in segment two showed no migratory behavior.

Discussion:

Considerable effort was expended to study channel catfish (AC electroshocking, DC electroshocking, and hoop nets), however, due to the severe problems associated with obtaining useable size channel catfish and retaining transmitters in those fish (>93% transmitter loss), limited data was obtained for this species. For the purpose of discussion, the focus will be on largemouth bass, but channel catfish will be addressed where appropriate.

Mean Internal Body Temperature

Largemouth bass have a preferred laboratory temperature of 29.0 °C (84.2 °F) (Venables et al. 1978). Mean internal body temperatures exceeded the preferred temperature in Newton Lake in July and August 1999, and the upper internal body temperature ranges exceeded the preference temperature from May through September 1998 and May through August 1999. Similarly, Coffeen Lake mean internal body temperatures exceeded the preferred temperature in July and August of 1998 and 1999. The maximum internal body temperatures exceeded the preference temperature from April through September 1998 and April through August 1999.

Mean internal body temperatures of largemouth bass in Lake of Egypt also exceeded the preferred temperature in July and August 1998 and 1999. Maximum internal body temperatures exceeded the preference temperature in June through September 1998 and June through August 1999. This suggests that the preferred temperatures in these lakes are higher than those found in the literature.

Largemouth bass in Coffeen Lake had consistently higher mean internal body temperatures than those in Newton Lake and Lake of Egypt. Largemouth bass in Coffeen Lake also utilized warmer temperatures throughout the winter months than did largemouth bass in Newton Lake and Lake of Egypt.

Depth, Dissolved Oxygen, and Internal Body Temperature Relationships

Only conditions found during summer months are discussed here since they are of greatest biological concern. The general trend for largemouth bass in this study was to go deeper as temperatures increased; however, as the fish went deeper, less dissolved oxygen was available to them. Largemouth bass in Newton Lake consistently utilized areas with dissolved oxygen less than 3 mg/L in the summer of 1999. Also, in 1999, largemouth bass in Coffeen Lake had higher internal body temperatures; however, dissolved oxygen levels utilized were consistently higher than those utilized in Newton Lake. Largemouth bass in Lake of Egypt also consistently utilized areas with higher dissolved oxygen. This suggests that largemouth bass in Newton Lake are forced into higher temperatures and lower dissolved oxygen areas. It also implies loss of available habitat to the bass. The differences observed in Coffeen Lake and Newton Lake can be explained by the morphology and thermodynamics of the reservoirs' basins. Coffeen Lake has a deeper basin with much more vegetation. These factors allow for a larger temperature and dissolved oxygen gradient in Coffeen Lake (See Chapter 15: Temperature and Dissolved Oxygen).

The trend for internal body temperatures of largemouth bass was consistent in the summer of 1998 and 1999. Largemouth bass attained higher internal body temperatures earlier in 1998, but internal body temperature peaked much higher in late July 1999. Similar results were seen for largemouth bass in Coffeen Lake. Data for largemouth bass in Lake of Egypt show similar results in that the bass attained higher internal temperatures earlier in the summer, but the peak in 1998 (mid July) was similar in magnitude to the 1999 peak (early August). Dissolved oxygen in areas utilized by largemouth bass in summer 1998 were higher than those areas utilized in summer 1999 in Newton Lake. Dissolved oxygen in areas utilized by largemouth bass in Coffeen Lake were higher in summer 1999 than 1998, and the dissolved oxygen was fairly consistent in areas of Lake of Egypt where study fish were located. Fish were found at greater depths in summer 1999 than in summer 1998 in Newton Lake. The depth ranges utilized by largemouth bass were consistent between years in Coffeen Lake, but they were inverse when compared to Newton Lake. As the summer progressed, largemouth bass utilized shallower water in 1999 than in 1998. As internal body temperature increased, fish moved shallower, and dissolved oxygen increased. This may have been due to lower dissolved oxygen in late July. As dissolved oxygen decreased at greater depths, fish migrated up in the water column exchanging higher body temperatures for higher dissolved oxygen levels. Largemouth bass in Lake of Egypt were found at shallower depths in summer 1999 than in summer 1998. Temperature, depth, and dissolved oxygen were more variable in summer 1999 in Lake of Egypt where study fish were located. Newton Lake largemouth bass were utilizing areas of lower temperature than those in Coffeen Lake, but they were also utilizing areas of lower dissolved oxygen.

As established earlier, largemouth bass have internal temperature lag times as compared to the surrounding water temperature. The data in this report show that largemouth bass may be utilizing areas of low dissolved oxygen as a thermoregulatory process. As Weller et al. (1984) established, the internal body cavity of largemouth bass has a longer initial temperature lag when warming than when cooling, and they retain their cooler temperatures for a longer period of time. This means that largemouth bass can cool faster, and retain cooler temperatures for a longer time period. Thus, largemouth bass may be utilizing areas of lower dissolved oxygen as a thermoregulatory process. It is possible that the largemouth bass are moving into the lower metalimnion or upper hypolimnion for temperature relief and then going back up to utilize available dissolved oxygen.

Observed Linear Distance, Diel Movement, and Seasonal Migrations

Largemouth bass in Newton Lake and Coffeen Lake were observed moving consistently more than those in Lake of Egypt. Observed movements between contacts exceeding one mile were common in Newton and Coffeen lakes, and observed movements over one-half mile were uncommon for largemouth bass in Lake of Egypt. When comparing this data to the literature, largemouth bass in Newton and Coffeen lakes are moving more than those described elsewhere. Comparisons of mean observed movement between contacts in this study and mean observed movement between contacts for the Sangchris Lake study (Tranquilli et al 1981) show that largemouth bass in Newton and Coffeen lakes were usually moving much greater distances than largemouth bass in the Sangchris study (Table 14.27). Lewis and Flickinger (1967) reported that

96% of the recaptures in their largemouth bass tagging study were found within 91 m (300 ft) of the point of initial capture. Funk (1957) reported that Missouri streams have "mobile" and "sedentary" individuals within the population. Our data show it is possible that there are mobile and sedentary individuals in Newton Lake and Coffeen Lake populations as well.

Largemouth bass and channel catfish are capable of extensive long-range movements in a relatively short period of time in Newton and Coffeen Lakes. The diel data show that largemouth bass were usually moving more in the summer months than in the spring or winter. Mean observed 24-hour movements in excess of one mile were common for largemouth bass in the summer months in Coffeen Lake, and observed movements in excess of 1.5 miles were common in Newton Lake.

Migrations observed for largemouth bass in Newton and Coffeen Lakes were similar in that there were summer migrations away from the discharge, however, the migrations in Newton Lake were more extensive than those in Coffeen Lake. Morphology and thermodynamics of the reservoir basins may explain these migrations. Segment one in Newton Lake is fairly shallow, approximately 3 m (9.8 feet) deep. This shallow area spans a distance of approximately two miles. Segment one in Coffeen Lake has much greater depths (>7 m (23 feet)) within one-half mile from the discharge. These deeper areas allow largemouth bass to utilize areas closer to the discharge due to available dissolved oxygen. Also, Coffeen Lake has a larger temperature and dissolved oxygen gradient than Newton Lake (See Chapter 15: Temperature and Dissolved Oxygen). Migrations in Lake of Egypt may be explained by the forage base. Gizzard shad migrate into the discharge during summer months, and the largemouth bass were consistently observed schooling and feeding in the discharge area in Lake of Egypt.

Literature Cited:

APHA. 1995. Standard methods for the examination of water and wastewater, nineteenth edition. A.D. Eaton, L.S. Clesceri, and A.E. Greeberg, eds., American Public Health Association, Washington, D.C.

Funk, J.L. 1957. Movement of stream fishes in Missouri. Trans. Am. Fish. Soc. 85: 39-57.

Heidinger, R.C., K.C. Clodfelter, and E.J. Hansen. 1988. Sport fishery potential of power plant cooling reservoirs. Supplemental report. RP1743. January 1, 1988-June 3, 1988. Commonwealth Edison Co., Chicago, IL. 53 pp.

Heidinger, R.C., E.J. Hansen, and R.C. Brooks. 1996. Illinois River sauger and walleye project. Completion report. F-85-R. 276 pp.

Heidinger, R.C., B.L. Tetzlaff, and B. Woolard. 1991. Lower Ohio River largemouth bass project. Final report F-59-R. July 1, 1990-June 30, 1991. 27 pp.

Kubb, R.N., J.R. Spotila, and D.R. Pendergast. 1980. Mechanisms of heat transfer and time-dependent modeling of body temperatures in the largemouth bass (*Micropterus salmoides*). Physiol. Zool. 53: 222-239.

Lewis, W.M., and S. Flickinger. 1967. Home range tendency of the largemouth bass (*Micropterus salmoides*). Ecology, 48(6): 1020-1023.

Reynolds, W.W. 1977. Thermal equilibration rates in relation to heartbeat and ventilatory frequencies in largemouth blackbass, *Micropterus salmoides*. Comp. Biochem. Physiol. 56A: 195-201.

Summerfelt, R.C., D. Mosier. 1984. Transintestinal expulsion of surgically implanted dummy transmitters by channel catfish. Trans Am. Fish. Society. 113: 760-766.

Tranquilli, J.A., D.W. Dufford, R.W.Larimore, R. Kocher, and J.M. McNurney. 1981. Radiotelemetry observations on the behavior of largemouth bass in a heated reservoir. Illinois Natural History Bulletin 32(4): 559-584.

Venables, B.J., L.C. Fitzpatrick, and W.D. Pearson. 1978. Laboratory measurement of preferred body temperature of adult largemouth bass (*Micropterus salmoides*). Hydrobiologia. 58: 33-36.

Weller, D.E., D.J. Anderson, D.L. DeAngelis, and C.C. Coutant. 1984. Rates of heat exchange in largemouth bass: experiment and model. Physiol. Zool. 57(4): 413-427.

Table 14.1. History of sonic transmitter disposition from October 1997 through May 1999 in three Illinois power cooling reservoirs.

	Total tagged	Largemouth bass tagged	Channel catfish tagged
Newton	55	39	16
Coffeen	43	31	12
Lake of Egypt	44	30	14
Total	142	100	42

Table 14.2. Effort (days) in determining movement of largemouth bass and channel catfish from October 1997 through August 1999 in three Illinois power cooling reservoirs.

	Tracking	Tagging	Recovery dives	24-hour tracking
Newton	67	11	1	20
Coffeen	61	11	1	20
Lake of Egypt	62	9	2	20
Total:	190	31	4	60
Total Effort:	285			

Table 14.3. Release sites, total length, and weight of sonic transmitter implanted largemouth bass (LMB) and channel catfish (CCAT) in Newton Lake, Jasper Co. Illinois from October 1997 through April 1999.

Release sites	Date	Transmitter number	Species	Total length mm (inches)	Weight grams (pounds)
21	21-Oct-97	285	LMB	404 (15.91)	1010 (2.23)
14	21-Oct-97	447	LMB	433 (17.05)	1280 (2.82)
12	21-Oct-97	456	LMB	396 (15.59)	1020 (2.25)
15	21-Oct-97	2524	LMB	430 (16.93)	1360 (3.00)
17	21-Oct-97	2633	LMB	427 (16.81)	1200 (2.65)
24	22-Oct-97	88	LMB	463 (18.23)	1760 (3.88)
8	22-Oct-97	97	LMB	441 (17.36)	1475 (3.25)
22	22-Oct-97	249	LMB	456 (17.95)	1630 (3.59)
3	22-Oct-97	258	LMB	453 (17.83)	1420 (3.13)
20	22-Oct-97	375	LMB	415 (16.34)	1090 (2.40)
4	22-Oct-97	555	LMB	446 (17.56)	1410 (3.11)
26	22-Oct-97	2345	LMB	475 (18.70)	1800 (3.97)
11	22-Oct-97	2533	LMB	431 (16.97)	1410 (3.11)
2	22-Oct-97	3334	LMB	445 (17.52)	1200 (2.65)
6	22-Oct-97	3335	LMB	487 (19.17)	1580 (3.48)
8	13-Apr-98	335	CCAT	430 (16.93)	674 (1.49)
5	13-Apr-98	9-11	CCAT	415 (16.34)	537 (1.18)
1	12-May-98	275	CCAT	630 (24.80)	3012 (6.64)
1	12-May-98	338	CCAT	530 (20.87)	1564 (3.45)
1	12-May-98	374	CCAT	526 (20.71)	1368 (3.02)
1	12-May-98	2543	CCAT	528 (20.79)	1236 (2.73)
1	12-May-98	3337	CCAT	592 (23.31)	1837 (4.05)
1	12-May-98	4444	CCAT	628 (24.72)	2146 (4.73)
1	12-May-98	12-4	CCAT	511 (20.12)	1120 (2.47)
5	12-May-98	13-3	LMB	468 (18.43)	1503 (3.31)
1	12-May-98	5-8-10	CCAT	520 (20.47)	1393 (3.07)
25	21-Jul-98	248	CCAT	412 (16.22)	624 (1.38)
25	21-Jul-98	284	CCAT	458 (18.03)	921 (2.03)
25	21-Jul-98	293	CCAT	424 (16.69)	603 (1.33)
25	21-Jul-98	446	CCAT	475 (18.70)	892 (1.97)
25	21-Jul-98	2443	LMB	522 (20.55)	1872 (4.13)

Table 14.3. Continued

Release sites	Date	Transmitter number	Species	Total length mm (inches)	Weight grams (pounds)
23	22-Jul-98	246	LMB	474 (18.66)	1637 (3.61)
23	22-Jul-98	365	LMB	432 (17.01)	1434 (3.16)
25	22-Jul-98	368	CCAT	454 (17.87)	779 (1.72)
25	22-Jul-98	557	CCAT	494 (19.45)	1084 (2.39)
25	22-Jul-98	2246	LMB	444 (17.48)	1230 (2.71)
21	22-Jul-98	3434	LMB	416 (16.38)	1144 (2.52)
27	19-Nov-98	248	LMB	454 (17.87)	1651 (3.64)
3	19-Nov-98	356	LMB	453 (17.83)	1520 (3.35)
8	19-Nov-98	456	LMB	416 (16.38)	1248 (2.75)
27	19-Nov-98	689	LMB	467 (18.39)	2058 (4.54)
18	19-Nov-98	2237	LMB	501 (19.72)	2038 (4.49)
3	19-Nov-98	2273	LMB	426 (16.77)	1222 (2.69)
5	19-Nov-98	2435	LMB	461 (18.15)	1636 (3.61)
4	19-Nov-98	2452	LMB	418 (16.46)	1155 (2.55)
2	19-Nov-98	2633	LMB	511 (20.12)	2440 (5.38)
17	19-Nov-98	3343	LMB	395 (15.55)	988 (2.18)
14	19-Nov-98	12-4	LMB	445 (17.52)	1387 (3.06)
7	19-Nov-98	6-11-13	LMB	470 (18.50)	1585 (3.49)
13	16-Apr-99	257	LMB	482 (18.98)	1682 (3.71)
9	16-Apr-99	444	LMB	417 (16.42)	1078 (2.38)
16	16-Apr-99	2362	LMB	474 (18.66)	1788 (3.94)
19	16-Apr-99	14-2	LMB	454 (17.87)	1692 (3.73)
10	16-Apr-99	9-11	LMB	438 (17.24)	1430 (3.15)

Table 14.4. Release sites, total length, and weight of sonic transmitter implanted largemouth bass (LMB) and channel catfish (CCAT) in Coffeen Lake, Montgomery Co. Illinois from October 1997 through May 1999.

Release sites	Date	Transmitter number	Species	Total length mm (inches)	Weight grams (pounds)
18	28-Oct-97	339	LMB	453 (17.83)	1337 (2.95)
12	28-Oct-97	348	LMB	470 (18.50)	1663 (3.67)
8	28-Oct-97	384	LMB	506 (19.92)	2033 (4.48)
26	28-Oct-97	2336	LMB	401 (15.79)	1087 (2.40)
16	28-Oct-97	2363	LMB	437 (17.20)	1259 (2.78)
10	28-Oct-97	2425	LMB	425 (16.73)	1134 (2.50)
25	28-Oct-97	2542	LMB	460 (18.11)	1576 (3.48)
9	28-Oct-97	11-5	LMB	450 (17.72)	1426 (3.14)
3	29-Oct-97	267	LMB	405 (15.94)	1041 (2.30)
6	29-Oct-97	2228	LMB	382 (15.04)	764 (1.68)
14	29-Oct-97	2246	LMB	485 (19.09)	2017 (4.45)
4	29-Oct-97	2327	LMB	398 (15.67)	1031 (2.27)
7	29-Oct-97	2426	LMB	413 (16.26)	1123 (2.48)
13	29-Oct-97	2435	LMB	432 (17.01)	1283 (2.83)
1	29-Oct-97	2444	LMB	410 (16.14)	1155 (2.55)
22	05-Nov-97	347	CCAT	470 (18.50)	1038 (2.29)
12	05-Nov-97	455	CCAT	465 (18.31)	927 (2.04)
1	03-Dec-97	7777	CCAT	540 (21.26)	1260 (2.78)
1	07-Jan-98	224	CCAT	463 (18.23)	910 (2.01)
1	07-Jan-98	268	CCAT	500 (19.69)	1245 (2.75)
1	07-Jan-98	468	CCAT	489 (19.25)	811 (1.79)
1	07-Jan-98	2632	CCAT	635 (25.00)	2364 (5.21)
1	07-Jan-98	3343	CCAT	456 (17.95)	897 (1.98)
17	31-Mar-98	379	CCAT	436 (17.17)	819 (1.81)
24	27-Jul-98	239	CCAT	426 (16.77)	658 (1.45)
19	27-Jul-98	266	LMB	465 (18.31)	1134 (2.50)
22	27-Jul-98	568	CCAT	491 (19.33)	932 (2.06)
20	27-Jul-98	2353	LMB	366 (14.41)	837 (1.85)
23	27-Jul-98	3335	LMB	451 (17.76)	1059 (2.34)
20	27-Jul-98	4444	LMB	404 (15.91)	1013 (2.23)
26	27-Jul-98	5-12-14	CCAT	447 (17.60)	848 (1.87)
19	27-Jul-98	6-11-13	LMB	382 (15.04)	838 (1.85)

Table 14.4. Continued

Release sites	Date	Transmitter number	Species	Total length mm (inches)		Weight grams (pounds)	
24	27-Jul-98	6-12-14	LMB	394	(15.51)	924	(2.04)
2	23-Nov-98	239	LMB	422	(16.61)	1230	(2.71)
1	23-Nov-98	246	LMB	461	(18.15)	1830	(4.04)
4	23-Nov-98	557	LMB	390	(15.35)	965	(2.13)
7	23-Nov-98	568	LMB	405	(15.94)	1179	(2.60)
4	23-Nov-98	2227	LMB	490	(19.29)	1930	(4.26)
5	23-Nov-98	3434	LMB	455	(17.91)	1626	(3.59)
21	28-May-99	379	LMB	407	(16.02)	929	(2.05)
11	28-May-99	2335	LMB	369	(14.53)	630	(1.39)
15	28-May-99	2363	LMB	396	(15.59)	818	(1.80)
19	28-May-99	2534	LMB	409	(16.10)	989	(2.18)

Table 14.5. Release sites, total length, and weight of sonic transmitter implanted largemouth bass (LMB) and channel catfish (CCAT) in Lake of Egypt, Williamson / Johnson Co. Illinois from October 1997 through March 1999.

Release sites	Date	Transmitter number	Species	Total length mm	(inches)	Weight grams	(pounds)
16	14-Oct-97	366	LMB	362	(14.25)	618	(1.36)
5	14-Oct-97	2255	LMB	414	(16.30)	957	(2.11)
18	14-Oct-97	2264	LMB	409	(16.10)	836	(1.84)
1	14-Oct-97	2273	LMB	364	(14.33)	552	(1.22)
3	14-Oct-97	2434	LMB	384	(15.12)	695	(1.53)
18	14-Oct-97	2453	LMB	393	(15.47)	756	(1.67)
2	14-Oct-97	2525	LMB	396	(15.59)	887	(1.96)
8	14-Oct-97	10-6	LMB	395	(15.55)	745	(1.64)
7	16-Oct-97	294	LMB	412	(16.22)	721	(1.59)
12	16-Oct-97	2237	CCAT	438	(17.24)	905	(2.00)
12	16-Oct-97	2443	LMB	441	(17.36)	1188	(2.62)
1	16-Oct-97	2534	CCAT	452	(17.80)	957	(2.11)
20	17-Oct-97	276	LMB	375	(14.76)	610	(1.35)
23	17-Oct-97	357	LMB	410	(16.14)	795	(1.75)
21	17-Oct-97	465	LMB	405	(15.94)	847	(1.87)
22	17-Oct-97	2452	LMB	401	(15.79)	680	(1.50)
19	17-Oct-97	3344	LMB	460	(18.11)	1204	(2.65)
3	11-Nov-97	235	CCAT	598	(23.54)	2068	(4.56)
3	11-Nov-97	356	CCAT	596	(23.46)	2325	(5.13)
3	11-Nov-97	479	CCAT	580	(22.83)	2056	(4.53)
2	17-Nov-97	266	CCAT	564	(22.20)	1708	(3.77)
1	17-Nov-97	457	CCAT	498	(19.61)	1433	(3.16)
1	17-Nov-97	689	CCAT	520	(20.47)	1370	(3.02)
2	17-Nov-97	2263	CCAT	498	(19.61)	983	(2.17)
2	17-Nov-97	14-2	CCAT	514	(20.24)	1215	(2.68)
13	27-Mar-98	2222	CCAT	544	(21.42)	1434	(3.16)
4	25-Jul-98	346	CCAT	473	(18.62)	901	(1.99)
4	25-Jul-98	347	LMB	401	(15.79)	824	(1.82)
2	25-Jul-98	2227	CCAT	495	(19.49)	1055	(2.33)
10	25-Jul-98	2263	LMB	410	(16.14)	943	(2.08)
17	25-Jul-98	2326	LMB	399	(15.71)	780	(1.72)
4	25-Jul-98	2344	CCAT	494	(19.45)	910	(2.01)

Table 14.5. Continued

Release sites	Date	Transmitter number	Species	Total length mm (inches)		Weight grams (pounds)	
4	25-Jul-98	2534	LMB	413	(16.26)	894	(1.97)
5	25-Jul-98	2543	LMB	400	(15.75)	746	(1.64)
8	09-Nov-98	224	LMB	397	(15.63)	727	(1.60)
11	09-Nov-98	275	LMB	405	(15.94)	817	(1.80)
3	09-Nov-98	338	LMB	382	(15.04)	805	(1.78)
1	09-Nov-98	375	LMB	492	(19.37)	1669	(3.68)
5	09-Nov-98	455	LMB	385	(15.16)	653	(1.44)
15	09-Nov-98	2246	LMB	459	(18.07)	1406	(3.10)
11	09-Nov-98	2327	LMB	441	(17.36)	1220	(2.69)
6	09-Nov-98	3335	LMB	456	(17.95)	1273	(2.81)
14	26-Mar-99	455	LMB	407	(16.02)	940	(2.07)
9	26-Mar-99	2534	LMB	397	(15.63)	724	(1.60)

Table 14.6. Total sonic transmitter losses from October 1997 through August 1999 in three Illinois power cooling reservoirs.

Lake	Largemouth bass (%)	Channel catfish (%)	Total (%)
Newton	64	100	75
Coffeen	74	100	81
Lake of Egypt	70	93	77

Table 14.7. History of contacts and time period sonic transmitters were active for largemouth bass (LMB) and channel catfish (CCAT) in Newton Lake, Jasper Co. Illinois.

Transmitter sequence	Species	Number of locations	Dates active	Last date found
248	CCAT	9	7/98-10/98	
275	CCAT	16	5/98-10/98	
284	CCAT	8	7/98-10/98	Un-recoverable
293	CCAT	34	7/98-8/99	
335	CCAT	2	4/98-missing	23-Apr-98
338	CCAT	15	5/98-10/98	
368	CCAT	1	7/98-missing	28-Jul-98
374	CCAT	8	5/98-missing	07-Jul-98
446	CCAT	6	7/98-missing	09-Jun-99
557	CCAT	10	7/98-10/98	
2543	CCAT	4	5/98-6/98	
3337	CCAT	1	5/98-missing	21-May-98
4444	CCAT	3	5/98-6/98	
12-4	CCAT	18	5/98-10/98	
5-8-10	CCAT	8	5/98-missing	07-Jul-98
9-11	CCAT	1	4/98-missing	23-Apr-98
88	LMB	38	10/97-missing	12-May-99
97	LMB	31	10/97-missing	25-Nov-98
246	LMB	6	7/98-10/98	
248	LMB	20	11/98-7/99	
249	LMB	41	10/97-8/99	Transmitter failure
257	LMB	18	4/98-8/99	
258	LMB	19	10/97-missing	28-Dec-98
285	LMB	6	10/97-missing	28-Jul-98
356	LMB	25	11/98-8/99	
365	LMB	30	7/98-missing	27-Jul-99
375	LMB	24	10/97-8/98	

Table 14.7. Continued

Transmitter sequence	Species	Number of locations	Dates active	Last date found
444	LMB	20	4/99-8/99	
447	LMB	24	10/97-missing	18-Aug-98
455	LMB	1	7/98-7/98	
456	LMB	26	10/97-9/98	
456	LMB	20	11/98-8/99	
555	LMB	56	10/97-8/99	
689	LMB	22	11/98-8/99	
2237	LMB	23	11/98-8/99	
2246	LMB	10	7/98-10/98	
2273	LMB	23	11/98-8/99	
2345	LMB	4	10/97-missing	12-Feb-98
2362	LMB	19	4/99-8/99	
2435	LMB	0	11/98-missing	28-Dec-99
2443	LMB	0	7/98-missing	Never found
2452	LMB	0	11/98-4/99	Transmitter failure
2524	LMB	47	10/97-7/99	
2533	LMB	57	10/97-8/99	
2633	LMB	24	10/97-8/98	
2633	LMB	13	11/98-missing	28-Jan-99
3334	LMB	53	10/97-8/99	
3335	LMB	2	10/97-2/98	
3343	LMB	25	11/98-8/99	
3434	LMB	4	7/98-8/98	
12-4	LMB	1	5/98-10/98	
13-3	LMB	1	5/98-missing	13-May-98
14-2	LMB	18	4/99-8/99	
6-11-13	LMB	26	11/98-7/99	
9-11	LMB	19	4/99-8/99	

Table 14.8. History of contacts and time period sonic transmitters were active for largemouth bass (LMB) and channel catfish (CCAT) in Coffeen Lake, Montgomery Co. Illinois.

Transmitter sequence	Species	Number of locations	Dates active	Last date found
224	CCAT	22	1/98-10/98	
239	CCAT	4	7/98-8/98	
268	CCAT	17	1/98-10/98	
347	CCAT	17	11/97-7/98	
379	CCAT	23	3/98-1/99	
455	CCAT	18	11/97-7/98	
468	CCAT	10	1/98-missing	10-Jul-98
568	CCAT	3	7/98-8/98	
2632	CCAT	22	1/98-8/98	
3343	CCAT	22	1/98-10/98	
7777	CCAT	12	12/97-missing	16-Jun-98
5-12-14	CCAT	2	7/98-missing	08-Aug-98
239	LMB	24	11/98-8/99	
246	LMB	2	11/98-3/99	
266	LMB	29	7/98-7/99	
267	LMB	46	10/97-7/99	
339	LMB	35	10/97-missing	06-May-99
348	LMB	37	10/97-missing	20-May-99
379	LMB	13	5/99-8/99	
384	LMB	17	10/97-missing	10-Jul-98
557	LMB	19	11/98-missing	16-Jul-99
568	LMB	25	11/98-8/99	
2227	LMB	21	11/98-8/99	
2228	LMB	39	10/97-missing	14-May-99
2246	LMB	16	10/97-7/98	
2327	LMB	22	10/97-8/98	
2335	LMB	13	5/99-8/99	

Table 14.8. Continued

Transmitter sequence	Species	Number of locations	Dates active	Last date found
2336	LMB	32	10/97-missing	06-Apr-99
2353	LMB	34	7/98-8/99	
2363	LMB	42	10/97-5/99	
2363	LMB	12	5/99-8/99	
2425	LMB	49	10/97-missing	21-Jul-99
2426	LMB	30	10/97-missing	08-Oct-98
2435	LMB	23	10/97-8/98	
2444	LMB	49	10/97-missing	21-Jul-99
2534	LMB	13	5/99-8/99	
2542	LMB	10	10/97-missing	22-May-98
3335	LMB	4	7/98-8/98	
3434	LMB	24	11/98-8/99	
4444	LMB	9	7/98-missing	25-Sep-98
11-5	LMB	33	10/97-missing	01-Dec-98
6-11-13	LMB	28	7/98-8/98	
6-12-14	LMB	12	7/98-6/99	

Table 14.9. History of contacts and time period sonic transmitters were active for largemouth bass (LMB) and channel catfish (CCAT) in Lake of Egypt, Williamson / Johnson Co. Illinois.

Transmitter sequence	Species	Number of locations	Dates active	Last date found
235	CCAT	21	11/97-present	Un-recoverable
266	CCAT	16	11/97-7/98	
346	CCAT	9	7/98-9/98	Un-recoverable
356	CCAT	22	11/97-9/98	
457	CCAT	4	11/97-missing	19-May-98
479	CCAT	23	11/97-9/98	Un-recoverable
689	CCAT	24	11/97-9/98	
2222	CCAT	22	3/98-9/98	Un-recoverable
2227	CCAT	8	7/98-9/98	
2237	CCAT	27	10/97-9/98	
2263	CCAT	12	11/97-7/98	
2344	CCAT	28	7/98-8/99	
2534	CCAT	18	10/97-7/98	
14-2	CCAT	1	11/97-3/98	
224	LMB	13	11/98-7/99	
275	LMB	2	11/98-missing	03-Dec-98
276	LMB	57	10/97-8/99	
294	LMB	13	10/97-5/99	14-Apr-98
338	LMB	25	11/98-8/99	
347	LMB	3	7/98-present	11-Aug-98
357	LMB	48	10/97-8/99	
366	LMB	36	10/97-6/99	Transmitter Failure
375	LMB	26	11/98-8/99	
455	LMB	3	11/98-1/99	
455	LMB	21	3/99-8/99	
465	LMB	35	10/97-missing	04-Feb-99
2246	LMB	24	11/98-8/99	

Table 14.9. Continued

Transmitter sequence	Species	Number of locations	Dates active	Last date found
2255	LMB	53	10/97-8/99	
2263	LMB	32	7/98-8/99	
2264	LMB	16	10/97-missing	12-Jun-98
2273	LMB	26	10/97-9/98	
2326	LMB	35	7/98-8/99	
2327	LMB	10	11/98-5/99	
2434	LMB	24	10/97-8/98	Un-recoverable
2443	LMB	17	10/97-7/98	
2452	LMB	14	10/97-9/98	
2453	LMB	44	10/97-8/99	
2525	LMB	27	10/97-9/98	Un-recoverable
2534	LMB	14	7/98-2/99	
2534	LMB	3	4/99-missing	20-Apr-99
2543	LMB	9	7/98-missing	24-Sep-98
3335	LMB	23	11/98-8/99	
3344	LMB	36	10/97-missing	25-May-99
10-6	LMB	51	10/97-8/99	

Table 14.10. Largemouth bass internal body temperature, as determined by temperature sensitive ultrasonic telemetry, in Newton Lake, Jasper Co. Illinois.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max.temp. C (F)	Standard deviation C (F)
Aug-97	--	--	--	--	--
Sep-97	--	--	--	--	--
Oct-97	--	--	--	--	--
Nov-97	12	15.2 (59.4)	9.7 (49.5)	19.9 (67.8)	6.6 (11.9)
Dec-97	10	10.7 (51.3)	6.7 (44.1)	19.7 (67.5)	3.5 (6.2)
Jan-98	12	9.4 (48.9)	6.2 (43.2)	16.7 (62.1)	2.8 (5.1)
Feb-98	12	11.5 (52.7)	6.4 (43.5)	16.7 (62.1)	4.0 (7.3)
Mar-98	9	10.7 (51.3)	7.7 (45.9)	13.8 (56.8)	1.9 (3.4)
Apr-98	34	17.1 (62.8)	12.4 (54.3)	22.8 (73.0)	3.0 (5.3)
May-98	38	24.6 (76.3)	16.1 (61.0)	30.2 (86.4)	3.1 (5.6)
Jun-98	44	26.6 (79.9)	20.6 (69.1)	31.5 (88.7)	3.1 (5.6)
Jul-98	36	29.0 (84.2)	24.7 (76.5)	32.3 (90.1)	2.3 (4.1)
Aug-98	41	28.9 (84.0)	23.6 (74.5)	32.0 (89.6)	2.2 (3.9)
Sep-98	35	26.2 (79.2)	21.7 (71.1)	30.6 (87.1)	2.3 (4.2)
Oct-98	5	21.5 (70.7)	18.4 (65.1)	22.7 (72.9)	1.8 (3.2)
Nov-98	16	15.8 (60.4)	12.2 (54.0)	22.4 (72.3)	2.6 (4.7)
Dec-98	10	8.0 (46.4)	6.9 (44.4)	11.3 (52.3)	1.4 (2.6)
Jan-99	12	7.9 (46.2)	6.4 (43.5)	10.5 (50.9)	1.3 (2.3)
Feb-99	11	11.2 (52.2)	7.1 (44.8)	15.8 (60.4)	2.4 (4.3)
Mar-99	6	15.1 (59.2)	12.0 (53.6)	19.4 (66.9)	2.9 (5.3)
Apr-99	65	16.9 (62.4)	9.7 (49.5)	24.5 (76.1)	2.8 (5.1)
May-99	72	23.2 (73.8)	15.9 (60.6)	29.8 (85.6)	3.0 (5.3)
Jun-99	82	27.7 (81.9)	14.9 (58.8)	34.4 (93.9)	2.9 (5.2)
Jul-99	62	30.3 (86.5)	25.2 (77.4)	35.0 (95.0)	2.3 (4.1)
Aug-99	54	29.3 (84.7)	24.4 (75.9)	33.8 (92.8)	2.0 (3.6)

Table 14.11. Largemouth bass internal body temperature, as determined by temperature sensitive ultrasonic telemetry, in Coffeen Lake, Montgomery Co. Illinois.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max.temp. C (F)	Standard deviation C (F)
Aug-97	--	--	--	--	--
Sep-97	--	--	--	--	--
Oct-97	--	--	--	--	--
Nov-97	9	15.2 (59.4)	11.9 (53.4)	21.4 (70.5)	2.7 (4.9)
Dec-97	12	17.2 (63.0)	12.8 (55.0)	23.6 (74.5)	4.0 (7.2)
Jan-98	14	13.1 (55.6)	7.8 (46.0)	22.9 (73.2)	4.7 (8.4)
Feb-98	15	14.1 (57.4)	10.1 (50.2)	19.2 (66.6)	2.5 (4.5)
Mar-98	12	9.6 (49.3)	6.3 (43.3)	16.9 (62.4)	3.6 (6.4)
Apr-98	57	19.8 (67.6)	13.6 (56.5)	29.3 (84.7)	3.7 (6.7)
May-98	52	25.8 (78.4)	18.0 (64.4)	34.3 (93.7)	3.6 (6.4)
Jun-98	46	27.4 (81.3)	18.5 (65.3)	34.4 (93.9)	2.8 (5.0)
Jul-98	58	31.4 (88.5)	26.7 (80.1)	35.3 (95.5)	1.8 (3.3)
Aug-98	52	30.9 (87.6)	25.2 (77.4)	33.3 (91.9)	1.8 (3.2)
Sep-98	53	28.9 (84.0)	23.1 (73.6)	32.9 (91.2)	2.1 (3.7)
Oct-98	11	21.4 (70.5)	19.4 (66.9)	22.4 (72.3)	0.9 (1.7)
Nov-98	11	18.1 (64.6)	13.9 (57.0)	25.2 (77.4)	3.3 (5.9)
Dec-98	16	16.0 (60.8)	10.5 (50.9)	23.3 (73.9)	3.9 (7.0)
Jan-99	14	13.8 (56.8)	9.7 (49.5)	19.4 (66.9)	3.2 (5.8)
Feb-99	14	14.2 (57.6)	8.4 (47.1)	22.7 (72.9)	5.1 (9.2)
Mar-99	15	15.7 (60.3)	8.4 (47.1)	23.2 (73.8)	5.6 (10.1)
Apr-99	56	21.7 (71.1)	17.3 (63.1)	30.3 (86.5)	2.8 (5.1)
May-99	46	25.3 (77.5)	19.3 (66.7)	31.5 (88.7)	2.9 (5.2)
Jun-99	61	27.8 (82.0)	19.9 (67.8)	32.7 (90.9)	1.9 (3.5)
Jul-99	42	32.0 (89.6)	29.5 (85.1)	36.3 (97.3)	1.6 (2.8)
Aug-99	33	31.3 (88.3)	28.6 (83.5)	34.5 (94.1)	1.4 (2.6)

Table 14.12. Largemouth bass internal body temperature, as determined by temperature sensitive ultrasonic telemetry, in Lake of Egypt, Williamson / Johnson Co. Illinois.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max.temp. C (F)	Standard deviation C (F)
Aug-97	--	--	--	--	--
Sep-97	--	--	--	--	--
Oct-97	--	--	--	--	--
Nov-97	14	11.9 (53.4)	10.8 (51.4)	13.8 (56.8)	0.9 (1.5)
Dec-97	11	10.1 (50.2)	8.1 (46.6)	13.9 (57.0)	1.8 (3.3)
Jan-98	11	8.7 (47.7)	5.7 (42.3)	13.8 (56.8)	2.6 (4.7)
Feb-98	10	5.8 (42.4)	3.5 (38.3)	8.6 (47.5)	1.4 (2.5)
Mar-98	10	9.4 (48.9)	5.9 (42.6)	14.3 (57.7)	2.7 (4.9)
Apr-98	42	15.0 (59.0)	12.2 (54.0)	18.1 (64.6)	1.5 (2.8)
May-98	30	23.3 (73.9)	18.7 (65.7)	28.3 (82.9)	3.1 (5.5)
Jun-98	35	28.0 (82.4)	25.5 (77.9)	33.3 (91.9)	1.8 (3.3)
Jul-98	43	30.0 (86.0)	27.4 (81.3)	33.5 (92.3)	1.7 (3.0)
Aug-98	50	29.6 (85.3)	27.3 (81.1)	33.0 (91.4)	1.3 (2.4)
Sep-98	40	28.1 (82.6)	25.6 (78.1)	31.2 (88.2)	1.4 (2.6)
Oct-98	11	19.6 (67.2)	18.3 (64.9)	22.5 (72.5)	1.1 (2.0)
Nov-98	15	15.5 (59.9)	13.1 (55.6)	22.1 (71.8)	2.7 (4.9)
Dec-98	17	15.1 (59.1)	12.5 (54.5)	20.6 (69.1)	2.3 (4.1)
Jan-99	19	7.7 (45.9)	4.1 (39.4)	16.1 (61.0)	3.0 (5.3)
Feb-99	16	8.2 (46.8)	5.2 (41.4)	15.9 (60.6)	3.2 (5.7)
Mar-99	16	9.3 (48.7)	7.6 (45.7)	13.0 (55.4)	1.5 (2.7)
Apr-99	63	16.9 (62.5)	12.9 (55.2)	22.8 (73.0)	2.0 (3.5)
May-99	53	22.8 (73.0)	18.5 (65.3)	27.4 (81.3)	2.0 (3.6)
Jun-99	64	26.9 (80.3)	22.5 (72.5)	33.4 (92.1)	2.1 (3.7)
Jul-99	44	29.5 (85.0)	23.0 (73.4)	34.1 (93.4)	1.9 (3.3)
Aug-99	39	29.1 (84.4)	26.0 (78.8)	33.1 (91.6)	1.5 (2.8)

Table 14.13. Equilibration times and morphometrics of largemouth bass utilized in a sonic telemetry study to determine internal body temperature lag times.

Number	Length mm (inches)	Weight grams (pounds)	Wall thickness mm (inches)	Equilibration time minutes
569	483 (19.0)	1499 (3.3)	7.4 (0.29)	59.0
2237	385 (15.2)	777 (1.7)	5.5 (0.22)	49.0
668	480 (18.9)	1485 (3.3)	8.0 (0.31)	65.5
479	419 (16.5)	1037 (2.3)	5.5 (0.22)	53.0
2227	389 (15.3)	736 (1.6)	6.0 (0.24)	41.0
578	503 (19.8)	1720 (3.8)	7.6 (0.30)	58.5
379	362 (14.3)	606 (1.3)	5.5 (0.22)	39.5
299	505 (19.9)	1773 (3.9)	7.5 (0.30)	63.0
61214	419 (16.5)	822 (1.8)	5.0 (0.20)	38.5
2354	520 (20.5)	2376 (5.2)	8.9 (0.35)	63.5
246	476 (18.7)	1412 (3.1)	6.8 (0.27)	58.0
389	444 (17.5)	1230 (2.7)	8.0 (0.31)	68.5

Table 14.14. Largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where located in Newton Lake, Jasper Co. Illinois for summer months in 1998 and 1999. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
03-Jun-98	2	27.1 (80.8)	27.0 (80.6)	27.1 (80.8)	3.0 (9.84)	2.5 (8.20)	3.5 (11.48)	6.80	4.13	9.47
10-Jun-98	3	24.1 (75.4)	23.5 (74.3)	24.5 (76.1)	2.3 (7.54)	1.0 (3.28)	4.0 (13.12)	13.45	8.21	17.24
19-Jun-98	4	27.7 (81.9)	23.6 (74.5)	30.0 (86.0)	1.9 (6.23)	1.5 (4.92)	2.5 (8.20)	9.29	6.84	11.67
23-Jun-98	4	28.2 (82.8)	27.2 (81.0)	29.9 (85.8)	3.5 (11.48)	1.5 (4.92)	5.0 (16.40)	5.61	4.08	8.30
30-Jun-98	4	31.0 (87.8)	29.5 (85.1)	31.5 (88.7)	2.3 (7.54)	0.0 (0.00)	4.5 (14.76)	5.30	0.90	8.51
07-Jul-98	6	29.9 (85.8)	26.4 (79.5)	31.3 (88.3)	3.8 (12.46)	2.0 (6.56)	5.5 (18.04)	3.89	0.19	7.74
13-Jul-98	4	30.7 (87.3)	29.7 (85.5)	31.9 (89.4)	4.1 (13.45)	3.5 (11.48)	5.0 (16.40)	4.13	1.24	9.04
21-Jul-98	4	31.7 (89.1)	31.2 (88.2)	32.3 (90.1)	3.5 (11.48)	2.5 (8.20)	4.0 (13.12)	1.37	0.76	2.99
28-Jul-98	3	30.3 (86.5)	29.5 (85.1)	31.3 (88.3)	4.0 (13.12)	3.0 (9.84)	4.5 (14.76)	3.90	2.86	5.00
07-Aug-98	3	29.9 (85.8)	28.8 (83.8)	30.8 (87.4)	3.2 (10.50)	0.0 (0.00)	6.0 (19.68)	4.54	0.30	7.46
12-Aug-98	4	29.9 (85.8)	29.4 (84.9)	30.3 (86.5)	2.8 (9.18)	0.5 (1.64)	5.0 (16.40)	6.37	4.42	8.39
18-Aug-98	5	29.6 (85.3)	25.9 (78.6)	31.2 (88.2)	4.6 (15.09)	2.5 (8.20)	6.5 (21.32)	2.52	0.40	8.01
27-Aug-98	5	29.9 (85.8)	28.2 (82.8)	30.8 (87.4)	4.2 (13.78)	1.5 (4.92)	6.0 (19.68)	3.02	0.12	6.44

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
03-Jun-99	10	26.3 (79.3)	24.8 (76.6)	29.1 (84.4)	3.7 (12.14)	1.0 (3.28)	5.0 (16.40)	5.02	3.06	4.18
09-Jun-99	13	28.6 (83.5)	24.2 (75.6)	34.4 (93.9)	4.0 (13.12)	1.0 (3.28)	6.0 (19.68)	4.13	4.12	6.41
14-Jun-99	11	29.5 (85.1)	26.1 (79.0)	31.7 (89.1)	3.9 (12.79)	2.0 (6.56)	5.0 (16.40)	2.99	2.94	5.71
22-Jun-99	13	28.2 (82.8)	27.2 (81.0)	31.7 (89.1)	3.2 (10.50)	1.0 (3.28)	5.5 (18.04)	7.13	4.50	5.74
29-Jun-99	5	28.4 (83.1)	27.3 (81.1)	30.9 (87.6)	4.1 (13.45)	2.5 (8.20)	5.5 (18.04)	1.69	1.69	2.88
07-Jul-99	10	30.3 (86.5)	26.4 (79.5)	31.7 (89.1)	4.3 (14.10)	3.5 (11.48)	5.5 (18.04)	1.87	1.86	2.61
15-Jul-99	10	29.2 (84.6)	27.7 (81.9)	31.7 (89.1)	4.2 (13.78)	1.5 (4.92)	6.0 (19.68)	2.91	2.60	3.95
20-Jul-99	12	30.8 (87.4)	27.6 (81.7)	32.8 (91.0)	4.0 (13.12)	1.5 (4.92)	6.0 (19.68)	2.40	2.12	6.30
27-Jul-99	10	33.0 (91.4)	29.7 (85.5)	35.0 (95.0)	4.0 (13.12)	3.0 (9.84)	5.0 (16.40)	2.27	2.04	2.67
05-Aug-99	8	31.2 (88.2)	29.7 (85.5)	32.3 (90.1)	4.6 (15.09)	1.5 (4.92)	6.0 (19.68)	3.21	3.05	4.31
09-Aug-99	6	29.5 (85.1)	28.4 (83.1)	30.3 (86.5)	5.6 (18.37)	4.5 (14.76)	6.5 (21.32)	2.06	1.92	3.62
18-Aug-99	12	29.3 (84.7)	27.0 (80.6)	31.0 (87.8)	4.8 (15.74)	3.5 (11.48)	7.0 (22.96)	2.80	2.74	2.43
26-Aug-99	6	30.0 (86.0)	29.8 (85.6)	30.3 (86.5)	4.3 (14.10)	3.5 (11.48)	5.0 (16.40)	2.57	0.78	2.12

Table 14.15. Largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where located in Coffeen Lake, Montgomery Co. Illinois for summer months in 1998 and 1999. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
05-Jun-98	4	28.0 (82.4)	25.5 (77.9)	31.5 (88.7)	2.9 (9.51)	0.0 (0.00)	8.5 (27.88)	7.11	5.52	8.72
11-Jun-98	8	26.6 (79.9)	24.9 (76.8)	28.5 (83.3)	2.4 (7.87)	0.0 (0.00)	5.0 (16.40)	5.91	4.88	7.64
16-Jun-98	4	27.7 (81.9)	26.6 (79.9)	28.8 (83.8)	2.0 (6.56)	1.0 (3.28)	4.5 (14.76)	4.38	3.48	4.84
26-Jun-98	4	28.1 (82.6)	23.9 (75.0)	31.7 (89.1)	5.3 (17.38)	1.0 (3.28)	9.0 (29.52)	4.50	2.29	7.33
03-Jul-98	6	31.5 (88.7)	29.5 (85.1)	34.6 (94.3)	5.0 (16.40)	0.5 (1.64)	7.5 (24.60)	2.91	1.38	6.29
10-Jul-98	8	33.1 (91.6)	31.6 (88.9)	35.3 (95.5)	2.9 (9.51)	1.5 (4.92)	4.0 (13.12)	3.72	1.89	5.67
14-Jul-98	4	31.9 (89.4)	30.7 (87.3)	32.8 (91.0)	3.8 (12.46)	1.0 (3.28)	5.5 (18.04)	4.25	1.65	9.21
24-Jul-98	3	33.0 (91.4)	32.3 (90.1)	33.9 (93.0)	5.3 (17.38)	3.5 (11.48)	6.5 (21.32)	2.76	1.64	3.76
31-Jul-98	7	31.3 (88.3)	30.8 (87.4)	31.9 (89.4)	2.6 (8.53)	0.5 (1.64)	5.5 (18.04)	6.10	1.22	7.70
08-Aug-98	6	30.7 (87.3)	28.7 (83.7)	32.8 (91.0)	3.6 (11.81)	1.5 (4.92)	8.0 (26.24)	4.17	1.08	6.13
13-Aug-98	6	31.1 (88.0)	28.7 (83.7)	32.9 (91.2)	4.3 (14.10)	2.5 (8.20)	8.0 (26.24)	4.53	3.02	5.23
19-Aug-98	8	31.1 (88.0)	29.0 (84.2)	32.3 (90.1)	5.0 (16.40)	3.0 (9.84)	8.5 (27.88)	4.94	1.63	6.93
28-Aug-98	6	31.7 (89.1)	29.7 (85.5)	32.9 (91.2)	2.8 (9.18)	0.0 (0.00)	8.5 (27.88)	5.74	1.92	7.56

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
02-Jun-99	6	26.4 (79.5)	19.9 (67.8)	29.1 (84.4)	4.4 (14.43)	1.0 (3.28)	9.5 (31.16)	5.58	2.47	7.34
08-Jun-99	10	28.1 (82.6)	24.7 (76.5)	32.7 (90.9)	4.6 (15.09)	0.5 (1.64)	8.0 (26.24)	6.85	3.33	12.52
15-Jun-99	8	28.6 (83.5)	24.7 (76.5)	31.1 (88.0)	3.7 (12.14)	0.0 (0.00)	9.0 (29.52)	6.84	1.52	9.73
23-Jun-99	6	27.3 (81.1)	26.1 (79.0)	28.5 (83.3)	5.1 (16.73)	1.0 (3.28)	7.5 (24.60)	5.38	2.11	8.08
30-Jun-99	5	29.3 (84.7)	28.6 (83.5)	30.0 (86.0)	3.6 (11.81)	0.5 (1.64)	5.5 (18.04)	6.81	4.85	7.98
08-Jul-99	9	31.0 (87.8)	29.5 (85.1)	33.2 (91.8)	5.2 (17.06)	1.5 (4.92)	7.0 (22.96)	5.32	2.89	9.35
16-Jul-99	5	31.9 (89.4)	31.4 (88.5)	32.6 (90.7)	3.9 (12.79)	2.5 (8.20)	5.5 (18.04)	6.45	5.70	7.30
21-Jul-99	7	32.8 (91.0)	31.4 (88.5)	34.1 (93.4)	5.1 (16.73)	4.0 (13.12)	6.0 (19.68)	4.22	2.77	5.30
28-Jul-99	2	35.9 (96.6)	35.5 (95.9)	36.3 (97.3)	4.3 (14.10)	3.5 (11.48)	5.0 (16.40)	3.07	2.68	3.45
06-Aug-99	2	30.5 (86.9)	28.7 (83.7)	32.3 (90.1)	1.5 (4.92)	0.5 (1.64)	2.5 (8.20)	5.93	5.90	5.95
10-Aug-99	6	32.3 (90.1)	31.4 (88.5)	33.1 (91.6)	3.1 (10.17)	1.0 (3.28)	6.5 (21.32)	7.36	5.25	11.58
19-Aug-99	5	31.2 (88.2)	29.8 (85.6)	32.1 (89.8)	3.6 (11.81)	1.0 (3.28)	8.0 (26.24)	5.42	1.10	7.55
27-Aug-99	5	30.9 (87.6)	30.3 (86.5)	31.1 (88.0)	3.7 (12.14)	2.5 (8.20)	5.0 (16.40)	7.00	5.42	8.02

Table 14.16. Largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where located in Lake of Egypt, Williamson / Johnson Co. Illinois for summer months in 1998 and 1999. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
04-Jun-98	3	27.6 (81.7)	26.9 (80.4)	28.1 (82.6)	2.8 (9.18)	1.0 (3.28)	4.5 (14.76)	6.49	4.60	8.37
12-Jun-98	5	27.4 (81.3)	25.7 (78.3)	28.6 (83.5)	1.7 (5.58)	0.5 (1.64)	3.5 (11.48)	11.12	9.86	12.34
18-Jun-98	1	29.4 (84.9)	--	--	0.0 (0.00)	--	--	6.55	--	--
25-Jun-98	4	31.2 (88.2)	29.5 (85.1)	33.3 (91.9)	1.5 (4.92)	0.0 (0.00)	2.5 (8.20)	6.05	5.34	6.64
02-Jul-98	2	29.7 (85.5)	29.4 (84.9)	30.0 (86.0)	2.8 (9.18)	2.5 (8.20)	3.0 (9.84)	5.31	5.27	5.34
09-Jul-98	6	31.4 (88.5)	30.0 (86.0)	32.7 (90.9)	2.4 (7.87)	0.0 (0.00)	4.5 (14.76)	6.10	3.30	8.00
16-Jul-98	6	29.7 (85.5)	28.3 (82.9)	33.4 (92.1)	1.4 (4.59)	0.0 (0.00)	3.5 (11.48)	6.19	3.33	7.50
23-Jul-98	4	32.0 (89.6)	30.3 (86.5)	33.4 (92.1)	2.5 (8.20)	0.5 (1.64)	3.5 (11.48)	5.92	4.86	7.52
30-Jul-98	8	29.1 (84.4)	28.1 (82.6)	30.7 (87.3)	2.0 (6.56)	1.0 (3.28)	4.0 (13.12)	1.80	1.23	2.15
04-Aug-98	3	29.5 (85.1)	28.6 (83.5)	30.0 (86.0)	1.7 (5.58)	1.0 (3.28)	2.5 (8.20)	6.68	5.60	7.79
10-Aug-98	11	29.4 (84.9)	27.5 (81.5)	31.7 (89.1)	2.0 (6.56)	0.0 (0.00)	4.5 (14.76)	6.14	2.50	8.72
16-Aug-98	8	29.6 (85.3)	28.5 (83.3)	30.8 (87.4)	2.1 (6.89)	0.5 (1.64)	4.0 (13.12)	9.05	5.28	12.04
25-Aug-98	5	30.7 (87.3)	29.8 (85.6)	31.7 (89.1)	1.8 (5.90)	0.5 (1.64)	2.5 (8.20)	2.97	2.19	3.75

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
01-Jun-99	6	26.4 (79.5)	24.5 (76.1)	29.0 (84.2)	1.3 (4.26)	0.0 (0.00)	4.0 (13.12)	6.20	4.54	8.60
06-Jun-99	8	27.1 (80.8)	24.1 (75.4)	30.2 (86.4)	2.7 (8.86)	0.0 (0.00)	5.5 (18.04)	6.77	2.00	10.34
18-Jun-99	6	27.4 (81.3)	25.6 (78.1)	30.9 (87.6)	2.4 (7.87)	0.5 (1.64)	6.0 (19.68)	5.93	4.00	7.90
25-Jun-99	9	27.3 (81.1)	25.6 (78.1)	28.9 (84.0)	2.9 (9.51)	0.0 (0.00)	5.5 (18.04)	6.38	2.01	8.93
28-Jun-99	8	28.3 (82.9)	26.9 (80.4)	30.9 (87.6)	3.0 (9.84)	0.5 (1.64)	4.0 (13.12)	6.41	4.88	7.79
09-Jul-99	7	29.6 (85.3)	27.6 (81.7)	31.0 (87.8)	4.0 (13.1)	1.5 (4.92)	5.5 (18.04)	5.21	3.32	7.98
13-Jul-99	10	28.2 (82.8)	23.0 (73.4)	30.1 (86.2)	3.0 (9.84)	0.5 (1.64)	6.0 (19.68)	6.13	4.43	7.15
22-Jul-99	3	30.3 (86.5)	28.8 (83.8)	32.8 (91.0)	4.0 (13.1)	1.5 (4.92)	5.5 (18.04)	3.51	1.82	6.28
29-Jul-99	6	31.4 (88.5)	29.5 (85.1)	34.1 (93.4)	3.8 (12.4)	1.5 (4.92)	5.5 (18.04)	2.86	0.22	5.75
03-Aug-99	3	32.1 (89.8)	31.4 (88.5)	33.1 (91.6)	2.0 (6.56)	1.5 (4.92)	2.5 (8.20)	3.73	3.24	4.13
12-Aug-99	6	30.3 (86.5)	29.5 (85.1)	31.7 (89.1)	2.9 (9.51)	1.5 (4.92)	5.5 (18.04)	5.00	3.23	6.62
16-Aug-99	6	28.5 (83.3)	26.5 (79.7)	29.3 (84.7)	3.0 (9.84)	1.5 (4.92)	4.5 (14.76)	4.61	4.00	5.75
25-Aug-99	2	28.4 (83.1)	28.3 (82.9)	28.5 (83.3)	2.8 (9.18)	2.5 (8.20)	3.0 (9.84)	4.12	2.67	5.56

Table 14.17. Largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where located in Newton Lake, Jasper Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
Sept	11	27.8 (82.0)	24.8 (76.6)	30.6 (87.1)	2.8 (9.18)	0.5 (1.64)	6.0 (19.68)	5.42	3.10	7.63
Oct	2	21.9 (71.4)	21.3 (70.3)	22.4 (72.3)	1.3 (4.26)	1.0 (3.28)	1.5 (4.92)	8.42	8.39	8.45
Nov	3	15.4 (59.7)	13.1 (55.6)	18.7 (65.7)	3.2 (10.50)	1.5 (4.92)	4.0 (13.12)	10.33	9.74	11.03
Dec	5	8.3 (46.9)	6.9 (44.4)	11.3 (52.3)	3.5 (11.48)	2.0 (6.56)	4.5 (14.76)	9.84	9.60	10.35
Jan	6	7.6 (45.7)	6.7 (44.1)	8.4 (47.1)	2.9 (9.51)	0.0 (0.00)	4.5 (14.76)	10.42	9.55	11.44
Feb	2	10.5 (50.9)	10.5 (50.9)	10.5 (50.9)	1.5 (4.92)	1.5 (4.92)	1.5 (4.92)	10.78	10.60	10.95
Mar	7	16.6 (61.9)	12.0 (53.6)	19.6 (67.3)	1.9 (6.23)	0.5 (1.64)	3.0 (9.84)	12.06	8.65	14.99
Apr	28	18.0 (64.4)	14.1 (57.4)	22.1 (71.8)	1.5 (4.92)	0.0 (0.00)	3.5 (11.48)	10.26	5.06	14.62
May	43	23.6 (74.5)	18.1 (64.6)	29.8 (85.6)	2.7 (8.86)	0.0 (0.00)	7.0 (22.96)	8.33	1.25	14.64
Jun	52	28.2 (82.8)	24.2 (75.6)	34.4 (93.9)	3.7 (12.14)	1.0 (3.28)	6.0 (19.68)	4.58	0.00	12.87
Jul	42	30.8 (87.4)	26.4 (79.5)	35.0 (95.0)	4.1 (13.45)	1.5 (4.92)	6.0 (19.68)	2.37	0.01	8.70
Aug	32	29.9 (85.8)	27.0 (80.6)	32.3 (90.1)	4.8 (15.74)	1.5 (4.92)	7.0 (22.96)	2.72	0.06	7.52

Table 14.18. Largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where located in Coffeen Lake, Montgomery Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
Sept	14	30.2 (86.4)	27.0 (80.6)	32.9 (91.2)	3.9 (12.79)	0.5 (1.64)	9.5 (31.16)	5.48	2.95	7.38
Oct	2	21.6 (70.9)	21.0 (69.8)	22.2 (72.0)	1.3 (4.26)	1.0 (3.28)	1.5 (4.92)	6.76	5.73	7.79
Nov	1	25.2 (77.4)	--	--	1.0 (3.28)	--	--	4.00	--	--
Dec	6	17.3 (63.1)	13.7 (56.7)	23.3 (73.9)	2.2 (7.22)	1.0 (3.28)	4.5 (14.76)	10.09	9.07	10.88
Jan	6	15.6 (60.1)	12.0 (53.6)	17.9 (64.2)	2.0 (6.56)	1.0 (3.28)	5.0 (16.40)	4.40	4.13	4.69
Feb	3	18.7 (65.7)	12.1 (53.8)	22.7 (72.9)	1.2 (3.94)	1.0 (3.28)	1.5 (4.92)	8.22	7.64	9.29
Mar	6	19.8 (67.6)	10.0 (50.0)	23.2 (73.8)	1.3 (4.26)	0.0 (0.00)	2.5 (8.20)	9.33	8.84	11.00
Apr	28	21.8 (71.2)	17.8 (64.0)	28.2 (82.8)	2.6 (8.53)	0.0 (0.00)	8.0 (26.24)	7.77	5.83	9.01
May	25	25.8 (78.4)	19.3 (66.7)	30.2 (86.4)	3.8 (12.46)	0.0 (0.00)	9.0 (29.52)	7.20	3.59	9.51
Jun	34	27.9 (82.2)	19.9 (67.8)	32.7 (90.9)	4.3 (14.10)	0.0 (0.00)	9.5 (31.16)	6.36	1.51	12.52
Jul	23	32.2 (90.0)	29.5 (85.1)	36.3 (97.3)	4.8 (15.74)	1.5 (4.92)	7.0 (22.96)	5.04	2.68	9.35
Aug	18	31.4 (88.5)	28.7 (83.7)	33.1 (91.6)	3.2 (10.50)	0.5 (1.64)	8.0 (26.24)	6.56	1.10	11.58

Table 14.19. Largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where located in Lake of Egypt, Williamson / Johnson Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

Date	Number of locations	Mean temp. C (F)	Min. temp. C (F)	Max. temp. C (F)	Mean depth Meters (Feet)	Min. depth Meters (Feet)	Max. depth Meters (Feet)	Mean DO mg/L	Min. DO mg/L	Max. DO mg/L
Sept	14	28.6 (83.5)	26.6 (79.9)	30.6 (87.1)	1.7 (5.58)	0.0 (0.00)	5.0 (16.40)	4.89	1.50	7.44
Oct	1	19.2 (66.6)	--	--	3.0 (9.84)	--	--	7.90	--	--
Nov	1	15.2 (59.4)	--	--	3.0 (9.84)	--	--	2.27	--	--
Dec	7	16.4 (61.5)	13.2 (55.8)	20.6 (69.1)	2.1 (6.89)	0.5 (1.64)	3.5 (11.48)	7.91	7.24	8.51
Jan	8	7.2 (45.0)	5.4 (41.7)	8.7 (47.7)	1.5 (4.92)	0.0 (0.00)	6.0 (19.68)	5.89	5.69	6.20
Feb	4	11.2 (52.2)	6.8 (44.2)	15.9 (60.6)	0.6 (1.97)	0.5 (1.64)	1.0 (3.28)	11.00	10.32	11.93
Mar	7	10.3 (50.5)	8.5 (47.3)	13.0 (55.4)	1.1 (3.61)	0.0 (0.00)	2.5 (8.20)	4.26	3.43	5.73
Apr	27	17.6 (63.7)	14.3 (57.7)	22.8 (73.0)	1.3 (4.26)	0.0 (0.00)	3.5 (11.48)	9.40	6.64	12.09
May	27	23.3 (73.9)	19.6 (67.3)	25.7 (78.3)	2.3 (7.54)	0.5 (1.64)	5.0 (16.40)	8.50	5.38	11.73
Jun	37	27.3 (81.1)	24.1 (75.4)	30.9 (87.6)	2.5 (8.20)	0.0 (0.00)	6.0 (19.68)	6.37	2.00	10.34
Jul	26	29.6 (85.3)	23.0 (73.4)	34.1 (93.4)	3.6 (11.81)	0.5 (1.64)	6.0 (19.68)	4.82	0.22	7.98
Aug	17	29.7 (85.5)	26.5 (79.7)	33.1 (91.6)	2.8 (9.18)	1.5 (4.92)	5.5 (18.04)	4.53	2.67	6.62

Table 14.20. Observed movements of sonic transmitter implanted largemouth bass (LMB) and channel catfish (CCAT) in Newton Lake, Jasper Co. Illinois.

Species	Transmitter sequence	Number of locations	Total movement meters (miles)	Average movement meters (miles)
CCAT	275	10	36802.39 (22.87)	3680.24 (2.29)
CCAT	284	8	624.20 (0.39)	78.03 (0.05)
CCAT	293	34	7987.30 (4.96)	234.92 (0.15)
CCAT	335	2	4666.90 (2.90)	2333.45 (1.45)
CCAT	338	1	5841.26 (3.63)	5841.26 (3.63)
CCAT	368	1	415.52 (0.26)	415.52 (0.26)
CCAT	374	3	16788.76 (10.43)	5596.25 (3.48)
CCAT	446	14	12932.20 (8.04)	923.73 (0.57)
CCAT	557	10	2920.22 (1.81)	292.02 (0.18)
CCAT	12-4	4	11887.09 (7.39)	2971.77 (1.85)
CCAT	248	9	922.29 (0.57)	102.48 (0.06)
CCAT	2543	2	11760.26 (7.31)	5880.13 (3.65)
CCAT	3337	1	4884.33 (3.04)	4884.33 (3.04)
CCAT	4444	3	17363.86 (10.79)	5787.95 (3.60)
CCAT	5-8-10	8	18379.68 (11.42)	2297.46 (1.43)
LMB	88	38	28312.57 (17.59)	745.07 (0.46)
LMB	97	31	30230.22 (18.79)	975.17 (0.61)
LMB	13-3	1	121.34 (0.08)	121.34 (0.08)
LMB	14-2	18	17619.71 (10.95)	978.87 (0.61)
LMB	246	6	3972.07 (2.47)	662.01 (0.41)
LMB	249	42	63843.03 (39.67)	1520.07 (0.94)
LMB	257	18	28752.22 (17.87)	1597.35 (0.99)
LMB	258	19	29609.45 (18.40)	1558.39 (0.97)
LMB	285	6	22796.82 (14.17)	3799.47 (2.36)
LMB	356	25	23944.84 (14.88)	957.79 (0.60)
LMB	365	30	26392.22 (16.40)	879.74 (0.55)
LMB	375	1	2027.69 (1.26)	2027.69 (1.26)
LMB	444	20	16981.99 (10.55)	849.10 (0.53)
LMB	447	5	3643.68 (2.26)	728.74 (0.45)

Table 14.20. Continued

Species	Transmitter sequence	Number of locations	Total movement meters (miles)	Average movement meters (miles)
LMB	555	56	68899.55 (42.81)	1230.35 (0.76)
LMB	689	22	41640.13 (25.88)	1892.73 (1.18)
LMB	12-4	4	1683.95 (1.05)	420.99 (0.26)
LMB	2237	23	15295.27 (9.50)	665.01 (0.41)
LMB	2246	10	579.61 (0.36)	57.96 (0.04)
LMB	2273	23	41664.37 (25.89)	1811.49 (1.13)
LMB	2345	4	2929.51 (1.82)	732.38 (0.46)
LMB	2362	19	16369.60 (10.17)	861.56 (0.54)
LMB	2435	2	2386.50 (1.48)	1193.25 (0.74)
LMB	2482	20	14739.43 (9.16)	736.97 (0.46)
LMB	2524	47	26421.10 (16.42)	562.15 (0.35)
LMB	2533	57	16496.13 (10.25)	289.41 (0.18)
LMB	3334	53	23075.24 (14.34)	435.38 (0.27)
LMB	3335	2	2628.62 (1.63)	1314.31 (0.82)
LMB	3343	25	9407.95 (5.85)	376.32 (0.23)
LMB	3434	1	1591.82 (0.99)	1591.82 (0.99)
LMB	456 (1)	25	31793.18 (19.76)	1271.73 (0.79)
LMB	456 (2)	20	17225.51 (10.70)	861.28 (0.54)
LMB	9-11	19	14950.79 (9.29)	786.88 (0.49)
LMB	2633	8	4400.59 (2.73)	550.07 (0.34)
LMB	6-11-13	26	26933.56 (16.74)	1035.91 (0.64)

Table 14.21. Observed movements of sonic transmitter implanted largemouth bass (LMB) and channel catfish (CCAT) in Coffeen Lake, Montgomery Co. Illinois.

Species	Transmitter sequence	Number of locations	Total movement meters (miles)	Average movement meters (miles)
CCAT	224	1	177.23 (0.11)	177.23 (0.11)
CCAT	268	1	169.68 (0.11)	169.68 (0.11)
CCAT	347	13	8304.91 (5.16)	638.84 (0.40)
CCAT	455	15	16554.46 (10.29)	1103.63 (0.69)
CCAT	468	10	7011.44 (4.36)	701.14 (0.44)
CCAT	239	2	1713.54 (1.06)	856.77 (0.53)
CCAT	2632	1	1255.16 (0.78)	1255.16 (0.78)
CCAT	3343	1	235.94 (0.15)	235.94 (0.15)
CCAT	379	23	11101.31 (6.90)	482.67 (0.30)
CCAT	568	1	220.96 (0.14)	220.96 (0.14)
CCAT	7777	12	754.55 (0.47)	62.88 (0.04)
CCAT	5-12-14	2	3572.64 (2.22)	1786.32 (1.11)
LMB	11-5	33	26858.89 (16.69)	813.91 (0.51)
LMB	246	2	2918.45 (1.81)	1459.23 (0.91)
LMB	266	6	6634.16 (4.12)	1105.69 (0.69)
LMB	267	46	39186.58 (24.35)	851.88 (0.53)
LMB	339	35	11601.36 (7.21)	331.47 (0.21)
LMB	348	37	13158.89 (8.18)	355.65 (0.22)
LMB	384	17	4960.32 (3.08)	291.78 (0.18)
LMB	557	19	7285.62 (4.53)	383.45 (0.24)
LMB	2227	21	23402.83 (14.54)	1114.42 (0.69)
LMB	2228	39	34125.72 (21.21)	875.02 (0.54)
LMB	2246	14	5207.03 (3.24)	371.93 (0.23)
LMB	2327	15	17980.26 (11.17)	1198.68 (0.74)
LMB	2335	14	11198.84 (6.96)	799.92 (0.50)
LMB	2336	32	32034.81 (19.91)	1001.09 (0.62)
LMB	2353	34	36928.88 (22.95)	1086.14 (0.67)
LMB	239	24	30808.78 (19.14)	1283.70 (0.80)
LMB	2425	49	27609.15 (17.16)	563.45 (0.35)

Table 14.21. Continued

Species	Transmitter sequence	Number of locations	Total movement meters (miles)	Average movement meters (miles)
LMB	2426	30	36595.23 (22.74)	1219.84 (0.76)
LMB	2435	8	28077.47 (17.45)	3509.68 (2.18)
LMB	2444	49	52364.98 (32.54)	1068.67 (0.66)
LMB	2534	13	6284.04 (3.90)	483.39 (0.30)
LMB	2542	10	2311.55 (1.44)	231.16 (0.14)
LMB	3335	4	254.89 (0.16)	63.72 (0.04)
LMB	3434	24	31537.05 (19.60)	1314.04 (0.82)
LMB	379	13	8278.19 (5.14)	636.78 (0.40)
LMB	4444	9	7594.84 (4.72)	843.87 (0.52)
LMB	568	25	24899.64 (15.47)	995.99 (0.62)
LMB	2363 (1)	42	18741.79 (11.65)	446.23 (0.28)
LMB	2363 (2)	12	941.74 (0.59)	78.48 (0.05)
LMB	6-11-13	2	697.05 (0.43)	348.53 (0.22)
LMB	6-12-14	23	6131.34 (3.81)	266.58 (0.17)

Table 14.22. Observed movements of sonic transmitter implanted largemouth bass (LMB) and channel catfish (CCAT) in Lake of Egypt, Williamson / Johnson Co. Illinois.

Species	Transmitter sequence	Number of locations	Total movement meters (miles)	Average movement meters (miles)
CCAT	14-2	1	98.42 (0.06)	98.42 (0.06)
CCAT	235	21	9584.94 (5.96)	456.43 (0.28)
CCAT	266	15	965.62 (0.60)	64.37 (0.04)
CCAT	346	9	531.77 (0.33)	59.09 (0.04)
CCAT	356	22	4569.55 (2.84)	207.71 (0.13)
CCAT	457	4	1359.70 (0.84)	339.93 (0.21)
CCAT	479	15	4269.90 (2.65)	284.66 (0.18)
CCAT	689	23	2827.98 (1.76)	122.96 (0.08)
CCAT	2222	11	1461.71 (0.9)1	132.88 (0.08)
CCAT	2227	8	502.05 (0.31)	62.76 (0.04)
CCAT	2237	8	1068.76 (0.66)	133.60 (0.08)
CCAT	2344	28	8664.01 (5.38)	309.43 (0.19)
CCAT	2263	9	4835.99 (3.01)	537.33 (0.33)
CCAT	2534	10	521.58 (0.32)	52.16 (0.03)
LMB	2273	1	88.31 (0.05)	88.31 (0.05)
LMB	2525	1	171.86 (0.11)	171.86 (0.11)
LMB	2452	2	3807.81 (2.37)	1903.91 (1.18)
LMB	275	2	325.37 (0.20)	162.69 (0.10)
LMB	2534 (1)	3	647.71 (0.40)	215.90 (0.13)
LMB	347	3	542.41 (0.34)	180.80 (0.11)
LMB	455 (1)	3	505.19 (0.31)	168.40 (0.10)
LMB	2543	9	1388.37 (0.86)	154.26 (0.10)
LMB	2327	10	2873.52 (1.79)	287.35 (0.18)
LMB	224	13	4428.27 (2.75)	340.64 (0.21)
LMB	294	13	3799.81 (2.36)	292.29 (0.18)
LMB	2434	14	3585.23 (2.23)	256.09 (0.16)
LMB	2443	14	1156.50 (0.72)	82.61 (0.05)
LMB	2534 (2)	14	2225.01 (1.38)	158.93 (0.10)
LMB	2264	16	6620.41 (4.11)	413.78 (0.26)

Table 14.22. Continued

Species	Transmitter sequence	Number of locations	Total movement meters (miles)	Average movement meters (miles)
LMB	455 (2)	21	2089.06 (1.30)	99.48 (0.06)
LMB	3335	23	4952.34 (3.08)	215.32 (0.13)
LMB	2246	24	7120.27 (4.42)	296.68 (0.18)
LMB	338	25	6900.51 (4.29)	276.02 (0.17)
LMB	375	26	7120.81 (4.42)	273.88 (0.17)
LMB	2263	32	2857.76 (1.78)	89.31 (0.06)
LMB	2326	35	8931.27 (5.55)	255.18 (0.16)
LMB	465	35	5039.96 (3.13)	144.00 (0.09)
LMB	3344	36	7712.99 (4.79)	214.25 (0.13)
LMB	366	36	9020.57 (5.61)	250.57 (0.16)
LMB	2453	44	4529.46 (2.81)	102.94 (0.06)
LMB	357	48	15795.67 (9.82)	329.08 (0.20)
LMB	10-6	51	11757.64 (7.31)	230.54 (0.14)
LMB	2255	53	9788.20 (6.08)	184.68 (0.11)
LMB	276	57	10351.35 (6.43)	181.60 (0.11)

Table 14.23. Classification of 24-hour diel movements of largemouth bass (LMB) and channel catfish (CCAT) in three Illinois power cooling reservoirs.

Lake (species)	Number of fish observed	0.0-0.5 miles %	0.5-1.0 miles %	1.0-2.0 miles %	2.0-3.0 miles %	> 3 miles %
Newton (LMB)	35	22.9	28.6	37.1	8.6	2.9
Coffeen (LMB)	33	33.3	45.5	12.1	3.0	6.1
Lake of Egypt (LMB)	30	50.0	46.7	3.3	--	--
Newton (CCAT)	1	--	--	--	--	100.0
Coffeen (CCAT)	4	50.0	--	25.0	--	25.0
Lake of Egypt (CCAT)	6	50.0	16.7	33.3	--	--

Table 14.24. Total observed 24-hour diel movement of largemouth bass (LMB) and channel catfish (CCAT) in Newton Lake, Jasper Co. Illinois, as described by ultrasonic telemetry.

Date	Transmitter number	Species	Observations	Total observed distance meters (miles)
26-27 May-98	5-8-10	CCAT	7	11762.22 (7.31)
26-27 May-98	2633	LMB	8	415.22 (0.26)
26-27 May-98	555	LMB	8	1238.03 (0.77)
9-10 Jun-98	2524	LMB	9	561.35 (0.35)
9-10 Jun-98	97	LMB	9	1485.27 (0.92)
12-13 Aug-98	555	LMB	9	2537.00 (1.58)
12-13 Aug-98	97	LMB	9	2931.76 (1.82)
12-13 Aug-98	2533	LMB	9	3502.82 (2.18)
18-19 Aug-98	3334	LMB	9	1800.22 (1.12)
18-19 Aug-98	555	LMB	9	2395.06 (1.49)
18-19 Aug-98	2533	LMB	9	2576.51 (1.60)
18-19 Aug-98	456	LMB	9	2699.31 (1.68)
10-11 Jan-99	12-4	LMB	9	638.59 (0.40)
10-11 Jan-99	2533	LMB	9	838.22 (0.52)
10-11 Jan-99	6-11-13	LMB	9	1088.53 (0.68)
10-11 Jan-99	356	LMB	9	3179.19 (1.98)
15-16 Jan-99	365	LMB	9	540.19 (0.34)
15-16 Jan-99	689	LMB	9	575.20 (0.36)
15-16 Jan-99	456	LMB	9	947.64 (0.59)
15-16 Jan-99	555	LMB	9	1082.63 (0.67)
3-4 Jun-99	2237	LMB	9	481.81 (0.30)
3-4 Jun-99	2533	LMB	9	561.67 (0.35)
3-4 Jun-99	555	LMB	9	1581.22 (0.98)
3-4 Jun-99	356	LMB	9	3412.06 (2.12)
14-15 Jun-99	3343	LMB	9	537.93 (0.33)
14-15 Jun-99	2362	LMB	9	1862.08 (1.16)
14-15 Jun-99	456	LMB	6	2009.85 (1.25)
14-15 Jun-99	444	LMB	9	2357.20 (1.46)

Table 14.24. Continued

Date	Transmitter number	Species	Observations	Total observed distance meters (miles)	
9-10 Aug-99	9-11	LMB	9	1302.94	(0.81)
9-10 Aug-99	2362	LMB	9	2471.85	(1.54)
9-10 Aug-99	555	LMB	8	4370.76	(2.72)
9-10 Aug-99	2273	LMB	9	5558.03	(3.45)
17-18 Aug-99	2533	LMB	9	1294.70	(0.80)
17-18 Aug-99	14-2	LMB	9	1306.82	(0.81)
17-18 Aug-99	257	LMB	7	1802.49	(1.12)
17-18 Aug-99	444	LMB	9	2117.11	(1.32)

Table 14.25. Total observed 24-hour diel movement of largemouth bass (LMB) and channel catfish (CCAT) in Coffeen Lake, Montgomery Co. Illinois, as described by ultrasonic telemetry.

Date	Transmitter number	Species	Observations	Total observed distance meters (miles)
28-29 May-98	379	CCAT	9	5054.25 (3.14)
11-12 Jun-98	468	CCAT	9	1813.56 (1.13)
13-14 Aug-98	379	CCAT	9	600.08 (0.37)
19-20 Aug-98	379	CCAT	9	543.64 (0.34)
28-29 May-98	348	LMB	8	273.28 (0.17)
28-29 May-98	2444	LMB	9	1881.08 (1.17)
11-12 Jun-98	267	LMB	8	1010.06 (0.63)
11-12 Jun-98	2363	LMB	9	1347.68 (0.84)
13-14 Aug-98	339	LMB	9	1063.35 (0.66)
13-14 Aug-98	2426	LMB	9	4850.67 (3.01)
13-14 Aug-98	2444	LMB	9	4587.32 (2.85)
19-20 Aug-98	11-5	LMB	9	1022.97 (0.64)
19-20 Aug-98	6-12-14	LMB	9	559.00 (0.35)
11-12 Jan-99	246	LMB	9	708.79 (0.44)
11-12 Jan-99	267	LMB	9	1553.13 (0.97)
11-12 Jan-99	348	LMB	9	585.42 (0.36)
11-12 Jan-99	557	LMB	9	1357.70 (0.84)
16-17 Jan-99	267	LMB	9	2054.64 (1.28)
16-17 Jan-99	557	LMB	9	894.26 (0.56)
16-17 Jan-99	2353	LMB	9	316.98 (0.20)
16-17 Jan-99	2363	LMB	9	802.56 (0.50)
2-3 Jun-99	267	LMB	9	995.88 (0.62)
2-3 Jun-99	379	LMB	9	874.65 (0.54)
2-3 Jun-99	2227	LMB	9	1135.00 (0.71)
2-3 Jun-99	2534	LMB	9	605.23 (0.38)
15-16 Jun-99	557	LMB	9	1000.34 (0.62)
15-16 Jun-99	2335	LMB	9	825.29 (0.51)
15-16 Jun-99	2363	LMB	9	602.79 (0.37)

Table 14.25. Continued

Date	Transmitter number	Species	Observations	Total observed distance meters (miles)
15-16 Jun-99	2444	LMB	9	1423.91 (0.88)
10-11 Aug-99	568	LMB	7	4843.40 (3.01)
10-11 Aug-99	2335	LMB	9	2514.83 (1.56)
10-11 Aug-99	2363	LMB	9	623.53 (0.39)
10-11 Aug-99	2534	LMB	9	341.09 (0.21)
19-20 Aug-99	239	LMB	9	1120.21 (0.70)
19-20 Aug-99	379	LMB	9	906.98 (0.56)
19-20 Aug-99	2353	LMB	9	2148.58 (1.34)
19-20 Aug-99	3434	LMB	9	766.25 (0.48)

Table 14.26. Total observed 24-hour diel movement of largemouth bass (LMB) and channel catfish (CCAT) in Lake of Egypt, Williamson / Johnson Co. Illinois, as described by ultrasonic telemetry.

Date	Transmitter number	Species	Observations	Total observed distance meters (miles)
19-20 May-98	2222	CCAT	9	1803.96 (1.12)
19-20 May-98	2263	CCAT	9	1660.31 (1.03)
7-8 Jun-98	2222	CCAT	9	335.89 (0.21)
7-8 Jun-98	235	CCAT	9	709.09 (0.44)
7-8 Jun-98	479	CCAT	9	516.78 (0.32)
16-17 Aug-98	2344	CCAT	6	1152.43 (0.72)
19-20 May-98	10-6	LMB	9	421.35 (0.26)
19-20 May-98	3344	LMB	9	464.27 (0.29)
7-8 Jun-98	366	LMB	9	947.42 (0.59)
10-11 Aug-98	2326	LMB	9	580.83 (0.36)
10-11 Aug-98	2543	LMB	9	967.99 (0.60)
16-17 Aug-98	2263	LMB	9	748.10 (0.46)
16-17 Aug-98	357	LMB	9	873.06 (0.54)
16-17 Aug-98	465	LMB	9	1356.90 (0.84)
7-8 Jan-99	2246	LMB	9	953.16 (0.59)
7-8 Jan-99	2255	LMB	9	727.73 (0.45)
7-8 Jan-99	2534	LMB	9	573.99 (0.36)
7-8 Jan-99	366	LMB	9	488.92 (0.30)
13-14 Jan-99	2246	LMB	9	904.83 (0.56)
13-14 Jan-99	2326	LMB	9	605.75 (0.38)
13-14 Jan-99	275	LMB	9	512.40 (0.32)
13-14 Jan-99	3335	LMB	9	954.78 (0.59)
6-7 Jun-99	224	LMB	8	425.08 (0.26)
6-7 Jun-99	2255	LMB	9	949.50 (0.59)
6-7 Jun-99	276	LMB	9	514.95 (0.32)
6-7 Jun-99	357	LMB	9	938.77 (0.58)
18-19 Jun-99	10-6	LMB	9	551.06 (0.34)

Table 14.26. Continued

Date	Transmitter number	Species	Observations	Total observed distance meters (miles)
18-19 Jun-99	2246	LMB	9	1065.05 (0.66)
18-19 Jun-99	2326	LMB	9	443.14 (0.28)
18-19 Jun-99	375	LMB	9	2203.03 (1.37)
12-13 Aug-99	10-6	LMB	9	752.67 (0.47)
12-13 Aug-99	2255	LMB	9	704.95 (0.44)
12-13 Aug-99	2326	LMB	9	1217.33 (0.76)
16-17 Aug-99	276	LMB	9	865.21 (0.54)
16-17 Aug-99	338	LMB	9	1461.24 (0.91)
16-17 Aug-99	375	LMB	9	1555.24 (0.97)

Table 14.27. Comparison of mean movements between contacts for largemouth bass in three Illinois power cooling reservoirs as described by ultrasonic telemetry with observed movements of largemouth bass in Lake Sangchris and Lake Shelbyville as described by radio telemetry (Tranquilli 1981).

Lake Sites	Average movement [a] meters (miles)	Standard deviation meters (miles)	Minimum average movements [b] meters (miles)	Maximum average movements [b] meters (miles)
Heated zone: Sangchris	561 (0.35)	336 (0.21)	259 (0.16)	1507 (0.94)
Transition zone: Sangchris	269 (0.17)	149 (0.09)	93 (0.06)	626 (0.39)
Unheated zone: Sangchris	291 (0.18)	195 (0.12)	31 (0.02)	694 (0.43)
Shelbyville	387 (0.24)	307 (0.19)	28 (0.02)	1440 (0.89)
Newton	1031 (0.64)	688 (0.43)	58 (0.04)	3799 (2.36)
Coffeen	819 (0.51)	639 (0.40)	64 (0.04)	3510 (2.18)
Egypt	267 (0.17)	320 (0.20)	83 (0.05)	1904 (1.18)

[a] This is the average of the averages. Total movement for each individual was divided by the number of contacts to yield mean individual movements.
These values for individuals were summed and the means were used to yield the Average Movement
[b] These are the average minimum and maximum observed movements of individual fish throughout the studies.

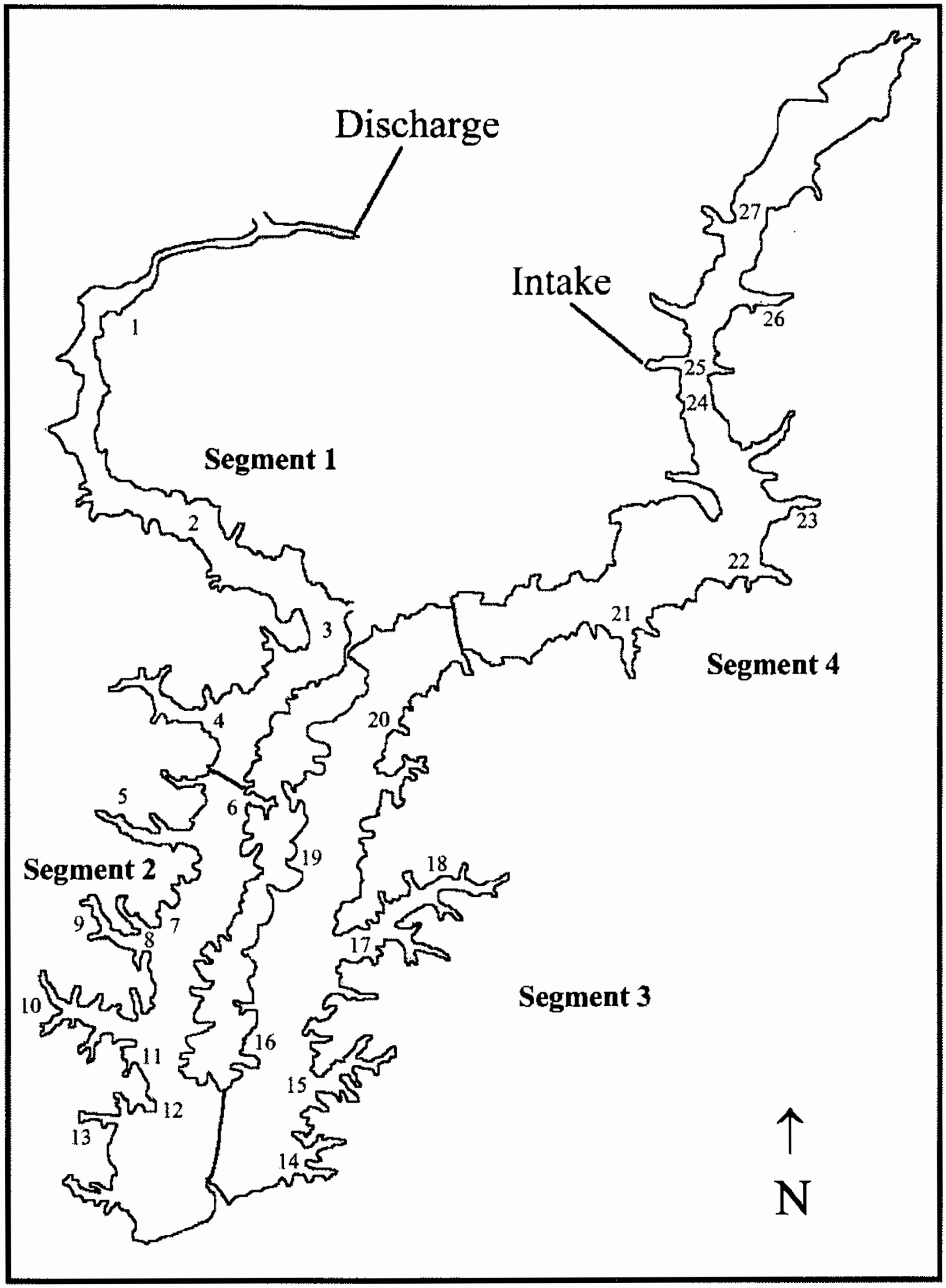

Figure 14.1. Initial release sites for largemouth bass and channel catfish surgically implanted with ultrasonic transmitters in Newton Lake, Jasper Co., Illinois.

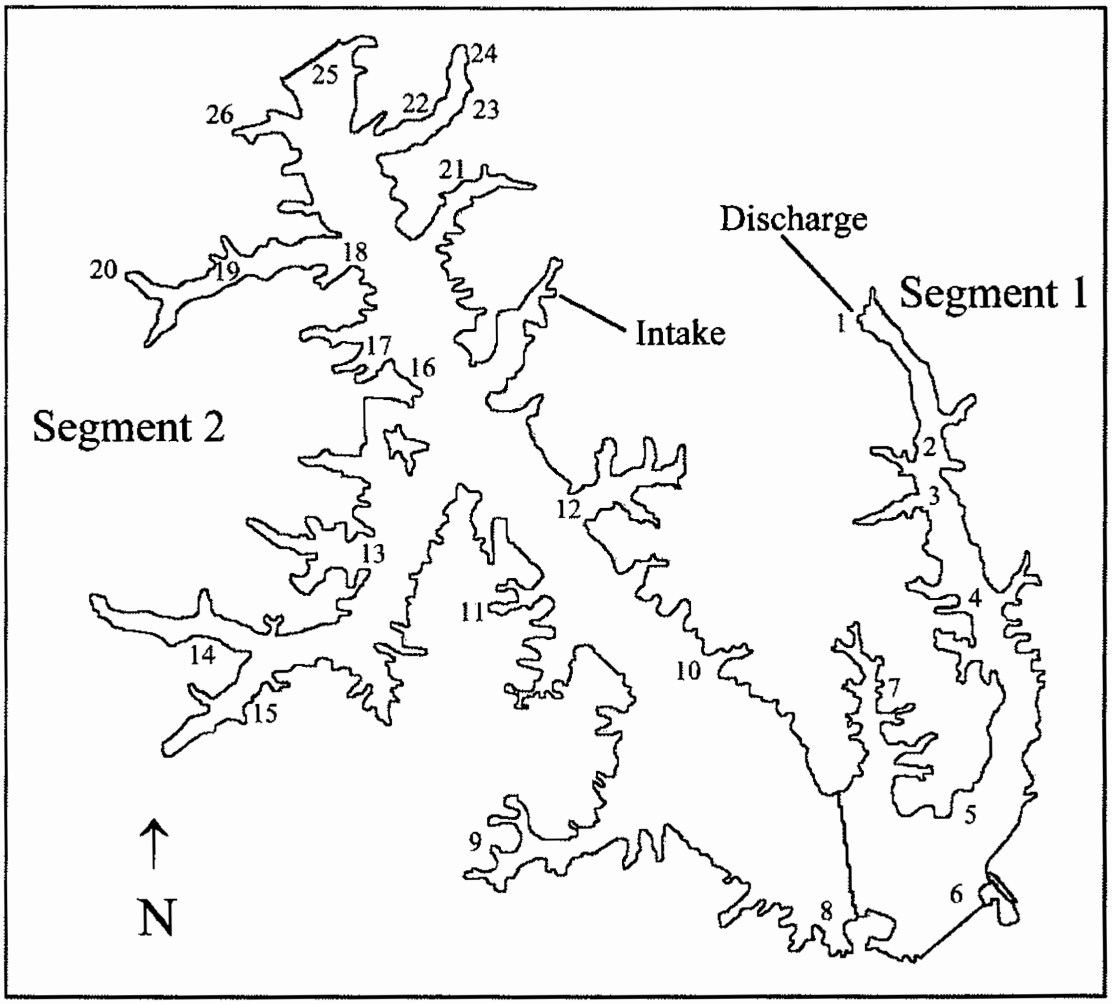

Figure 14.2. Initial release sites for largemouth bass and channel catfish surgically implanted with ultrasonic transmitters in Coffeen Lake, Montgomery Co., Illinois.

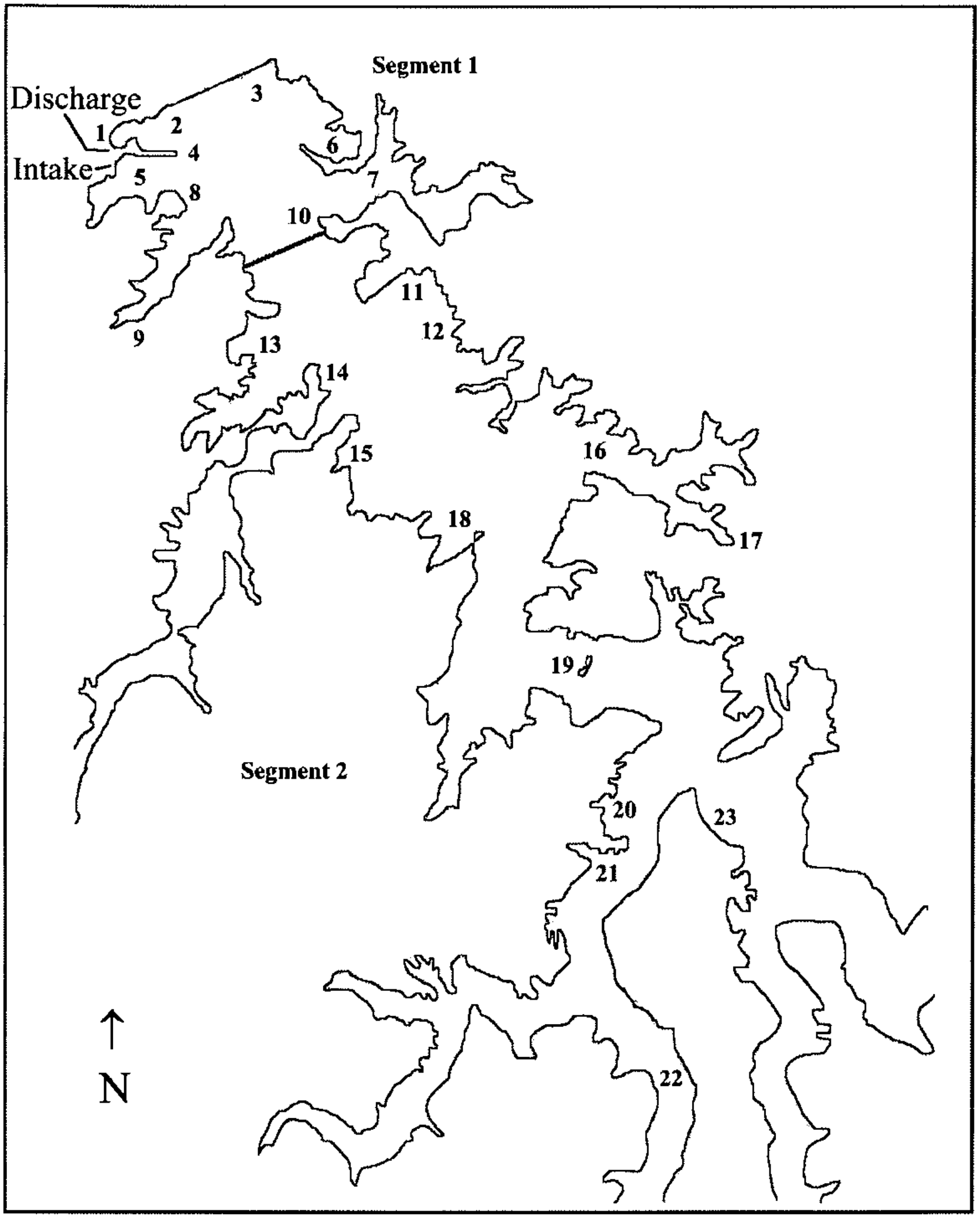

Figure 14.3. Initial release sites for largemouth bass and channel catfish surgically implanted with ultrasonic transmitters in Lake of Egypt, Williamson / Johnson Co., Illinois.

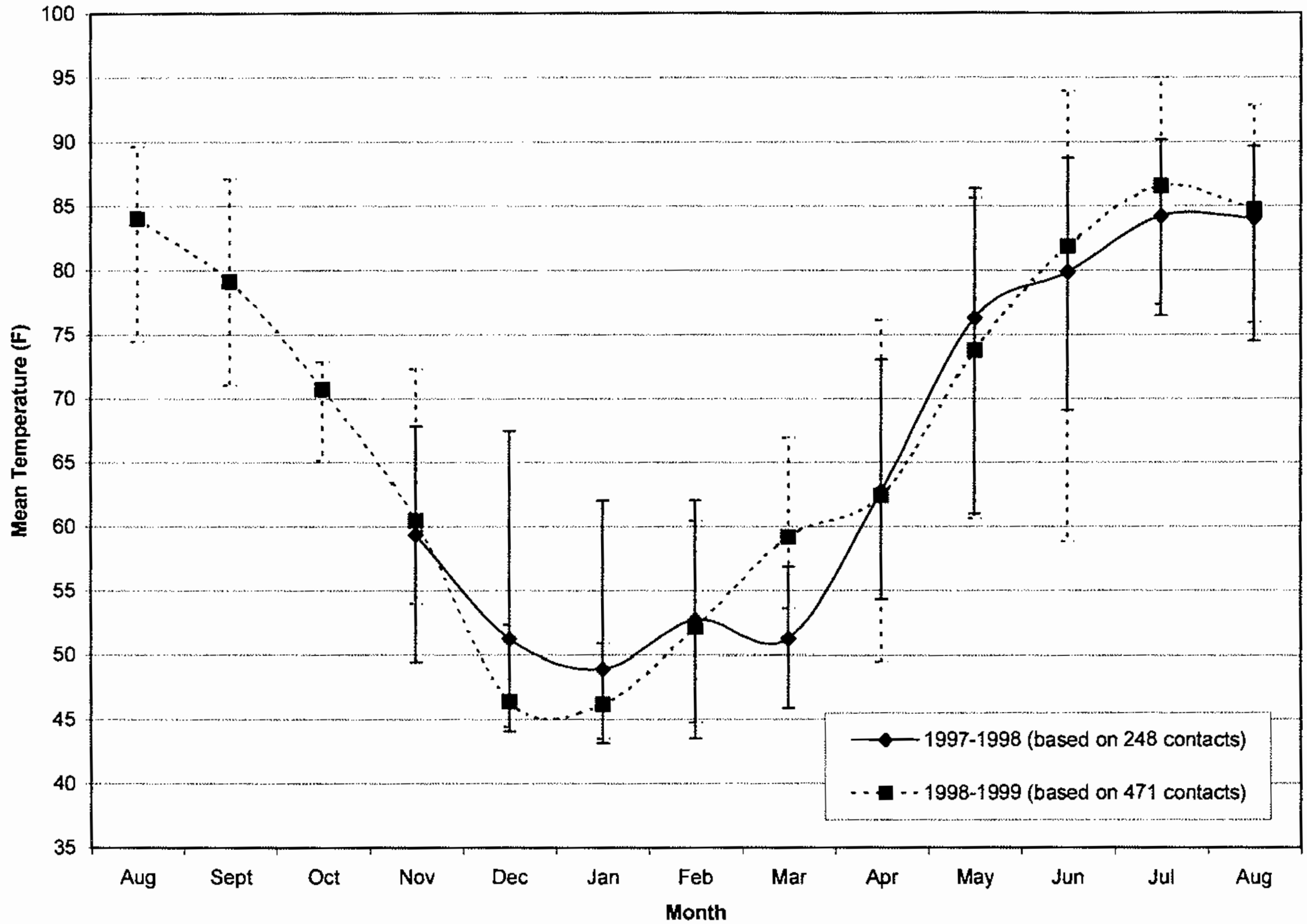

Figure 14.4. Largemouth bass mean temperature preference in Newton Lake, Jasper Co. Illinois, as determined by temperature sensitive ultrasonic transmitters. (Bars represent the range)

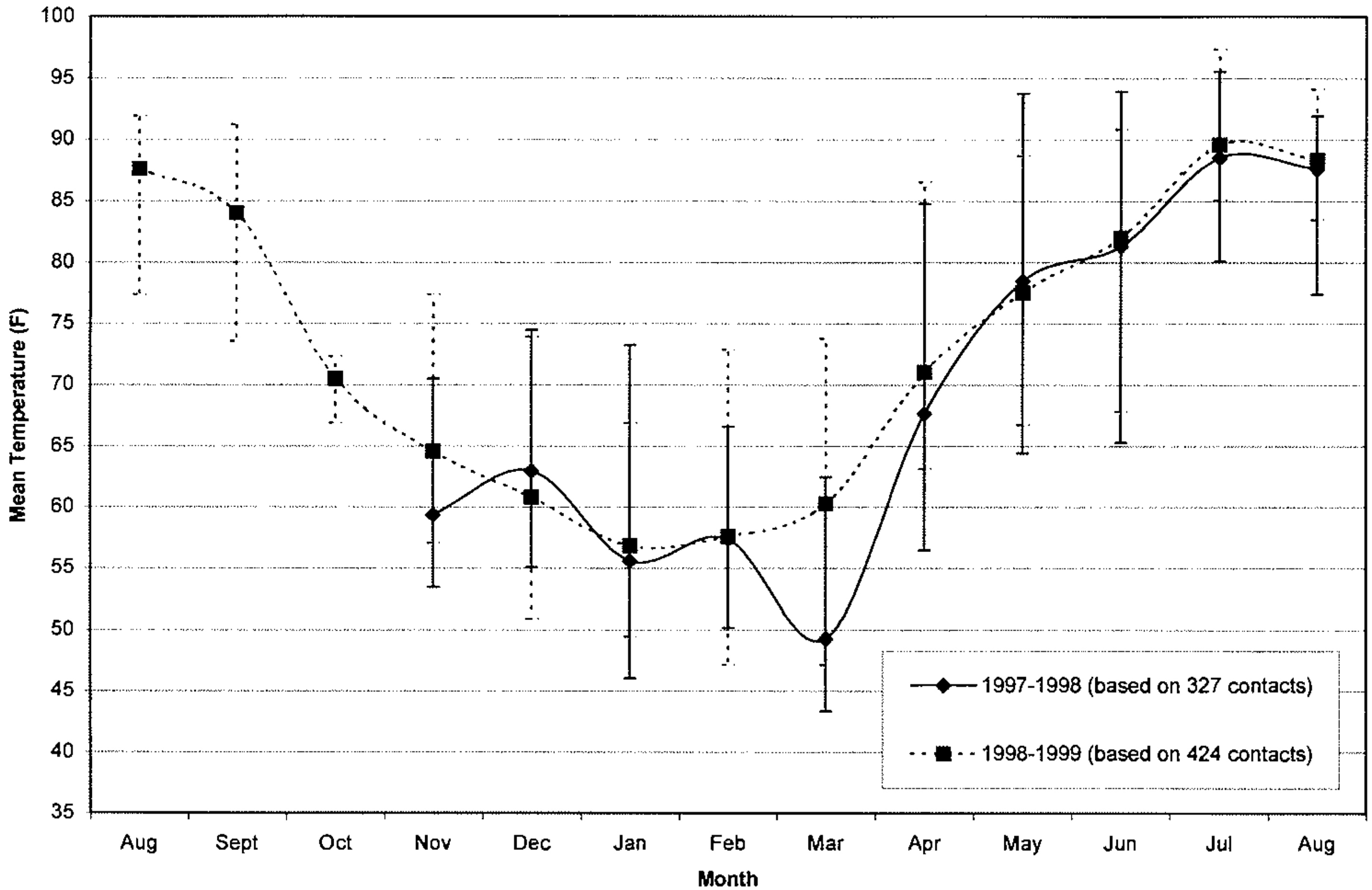

Figure 14.5. Largemouth bass mean temperature preference in Coffeen Lake, Montgomery Co. Illinois, as determined by temperature sensitive ultrasonic transmitters. (Bars represent the range)

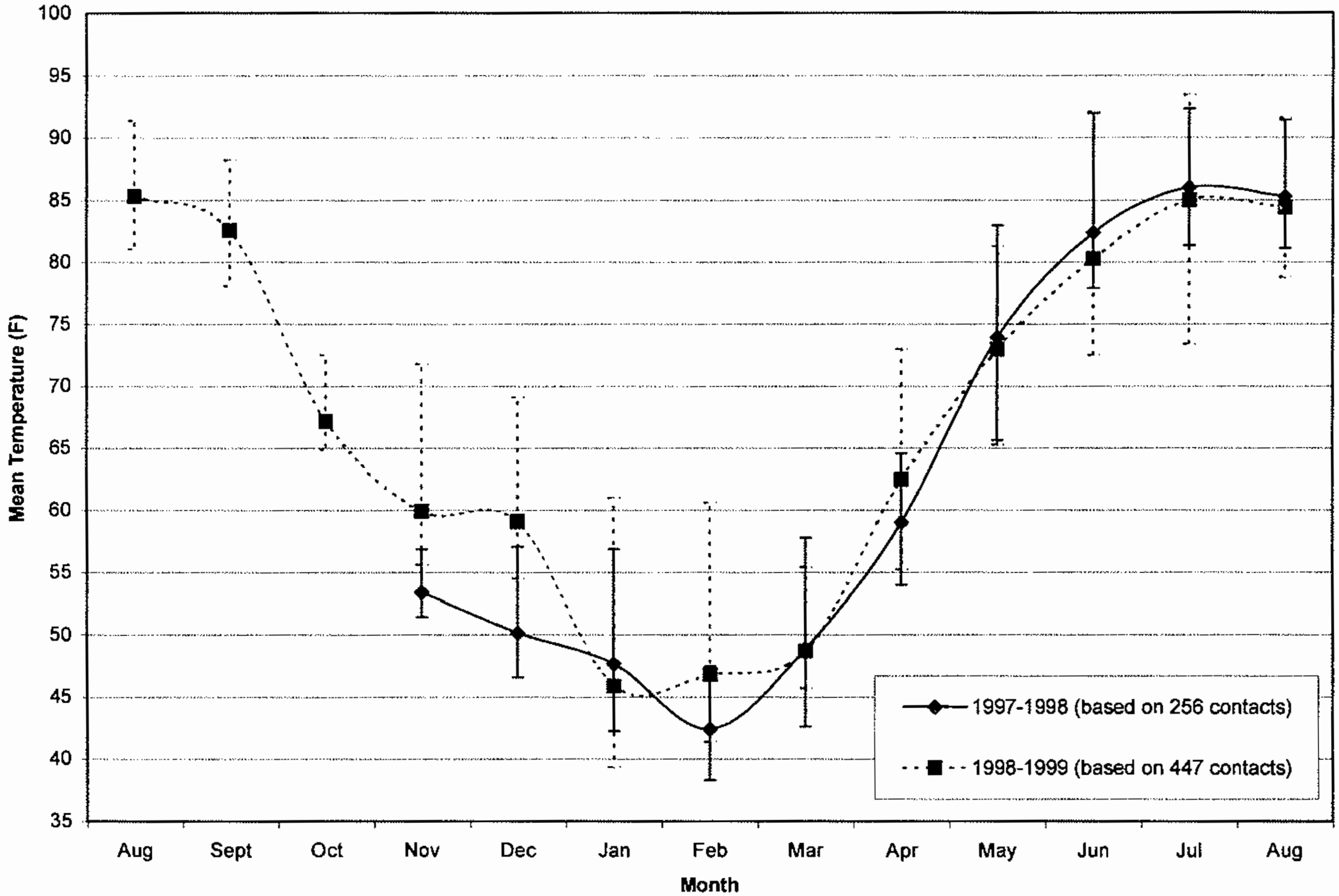

Figure 14.6. Largemouth bass mean temperature preference in Lake of Egypt, Williamson / Johnson Co. Illinois, as determined by temperature sensitive ultrasonic transmitters. (Bars represent the range)

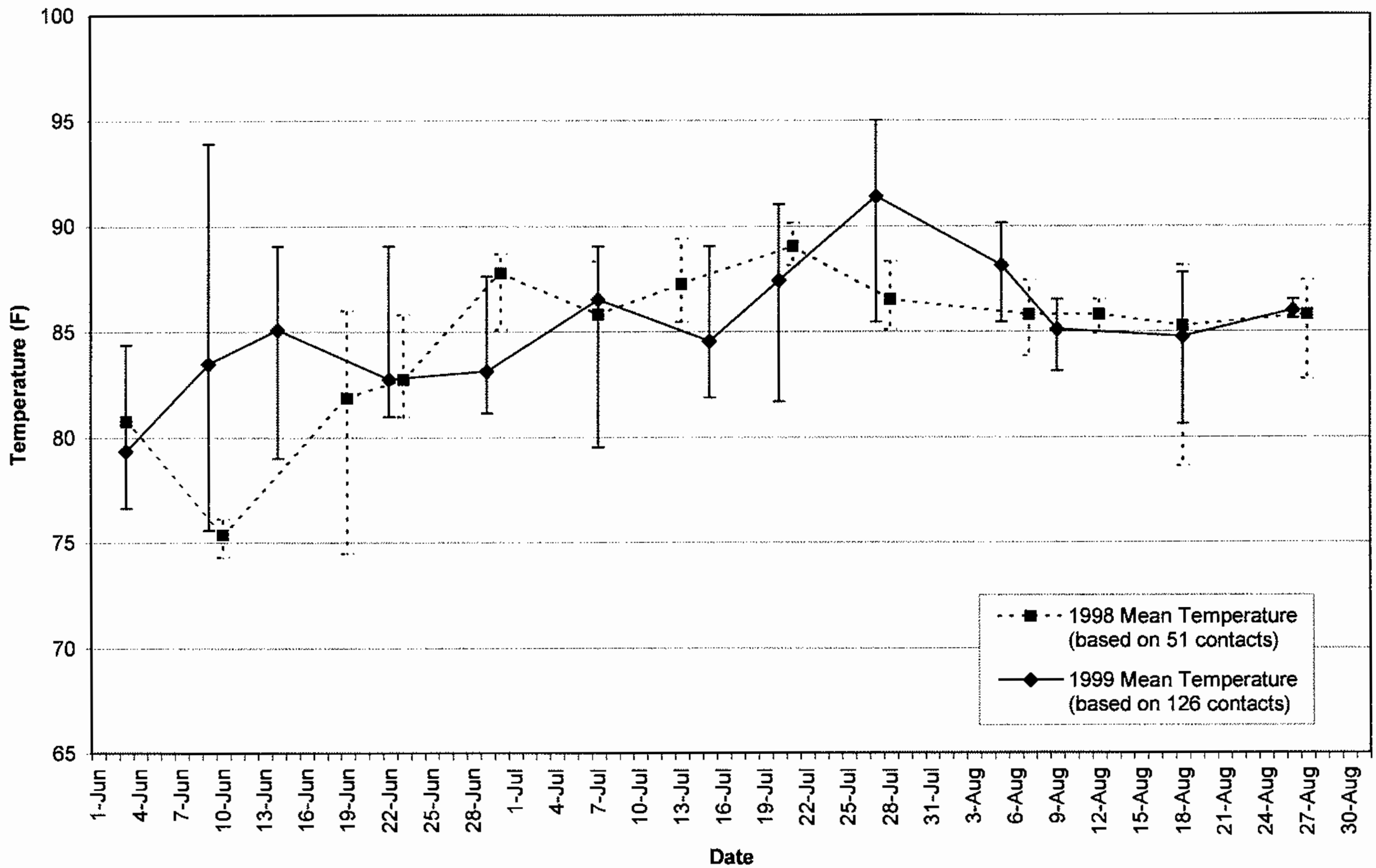

Figure 14.7. Internal body temperatures of largemouth bass in Newton Lake, Jasper Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish. The bars represent ranges.

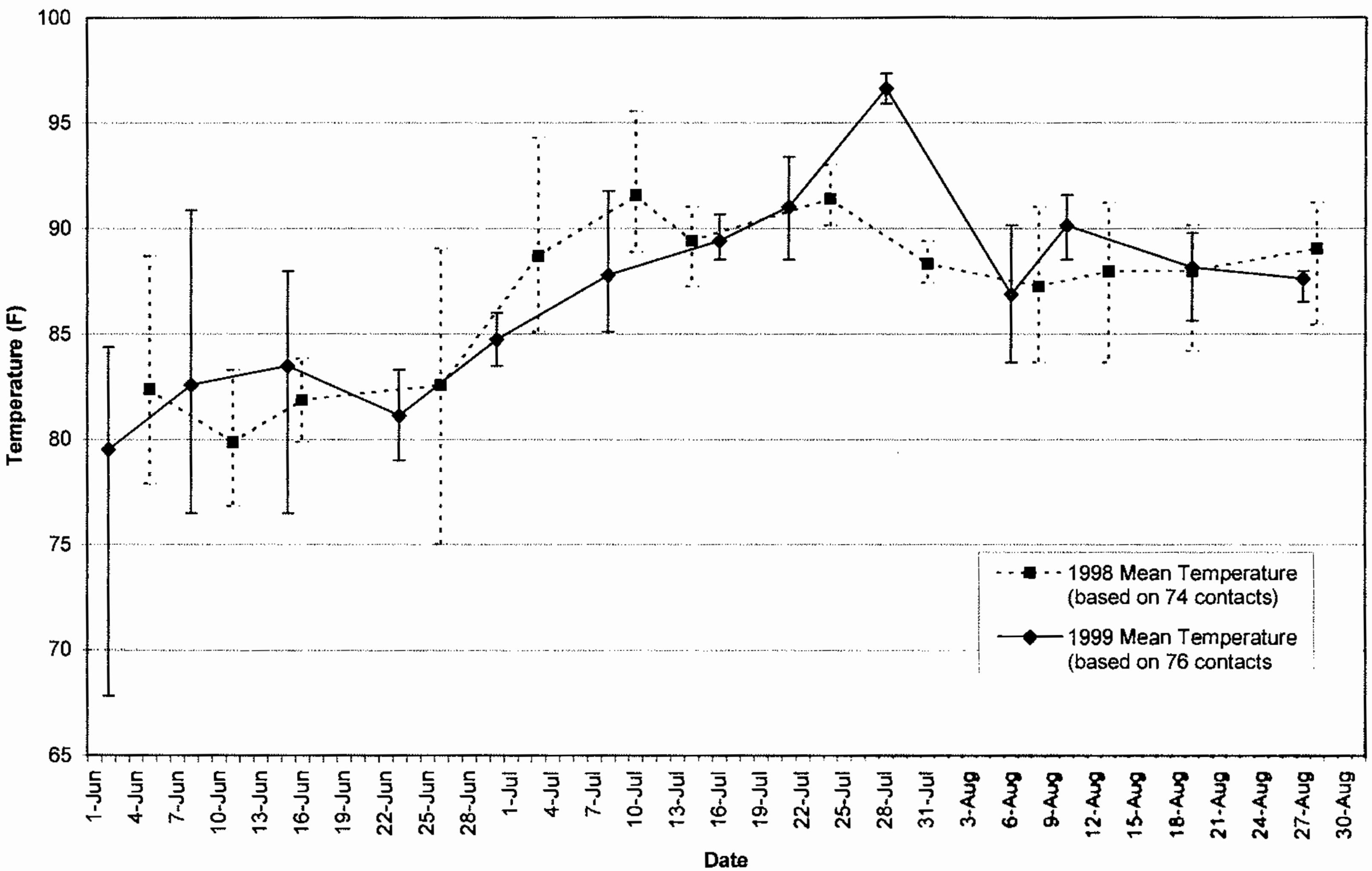

Figure 14.8. Internal body temperatures of largemouth bass in Coffeen Lake, Montgomery Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish. The bars represent ranges.

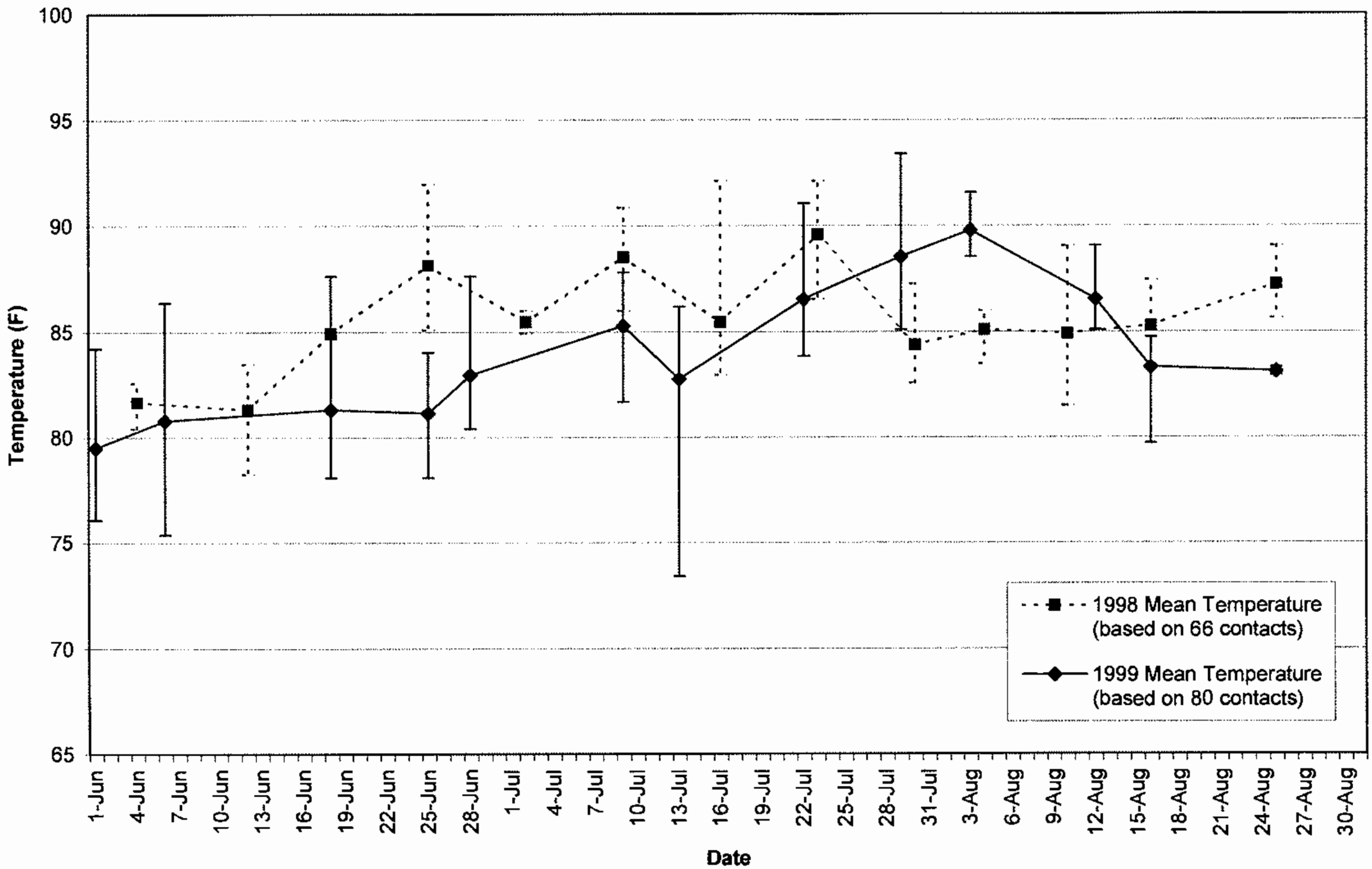

Figure 14.9. Internal body temperatures of largemouth bass in Lake of Egypt, Williamson / Johnson Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish. The bars represent ranges.

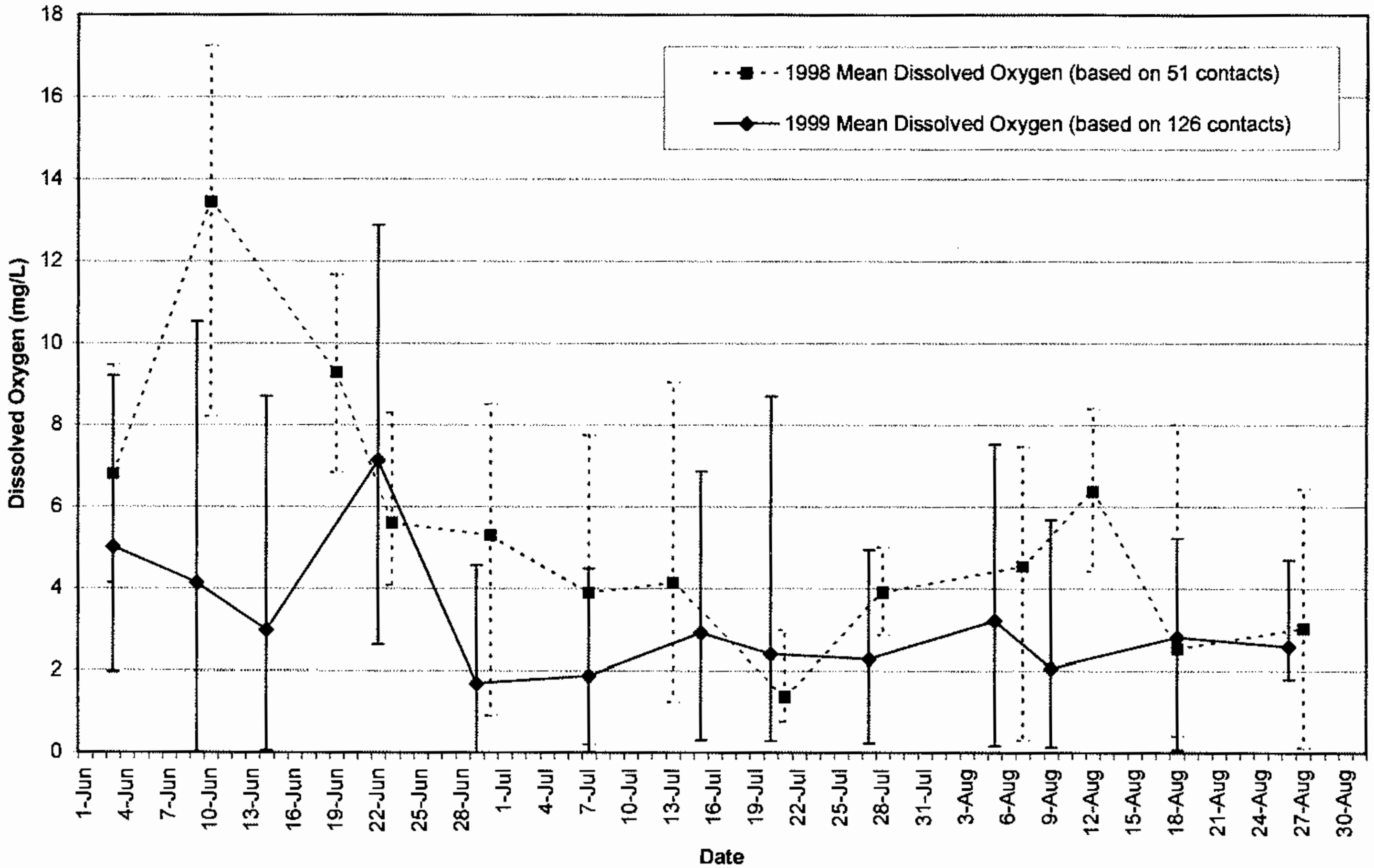

Figure 14.10. Dissolved oxygen levels at the depth where largemouth bass where located in Newton Lake, Jasper Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish. The bars represent ranges.

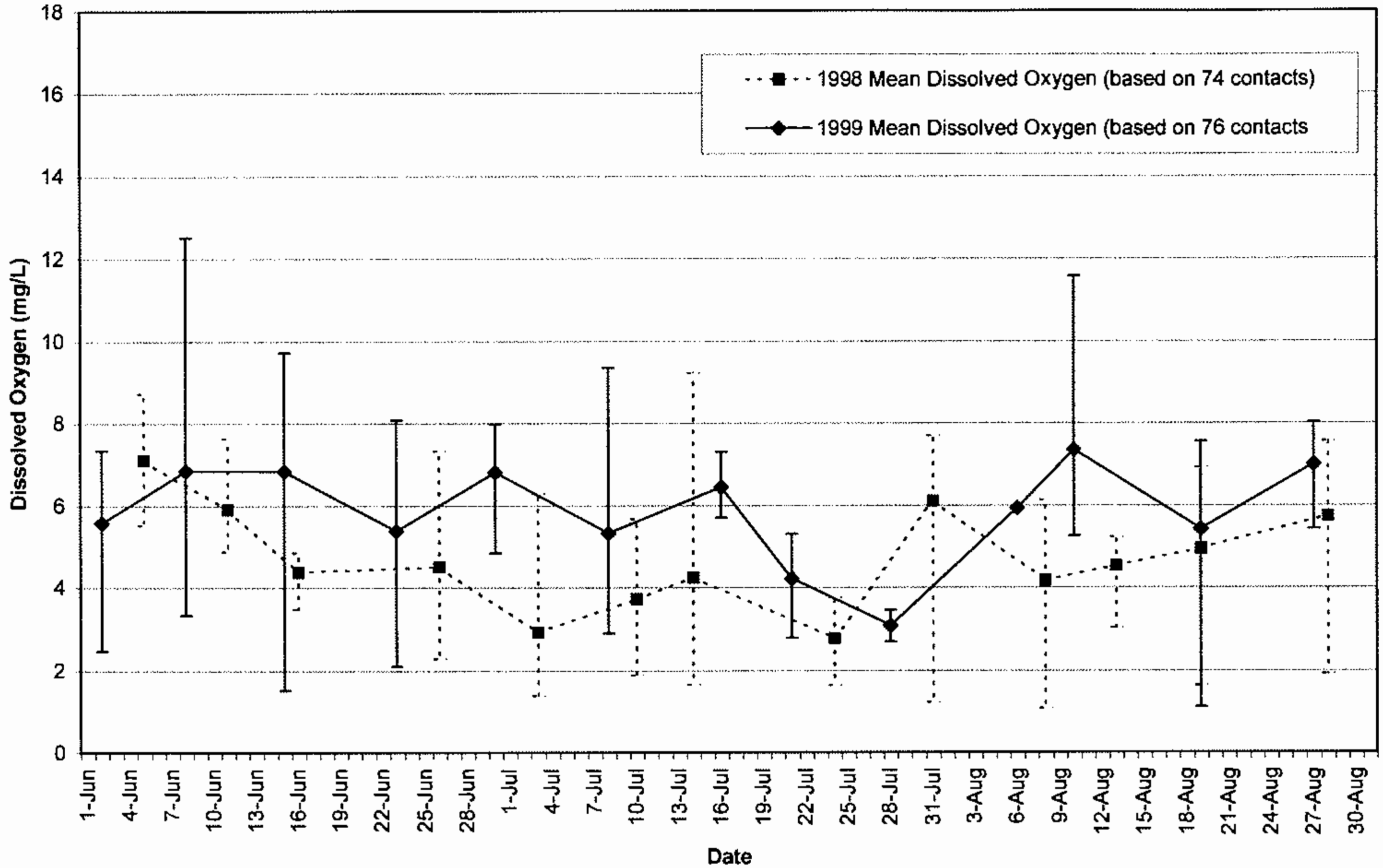

Figure 14.11. Dissolved oxygen levels at the depth where largemouth bass where located in Coffeen Lake, Montgomery Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish. The bars represent ranges.

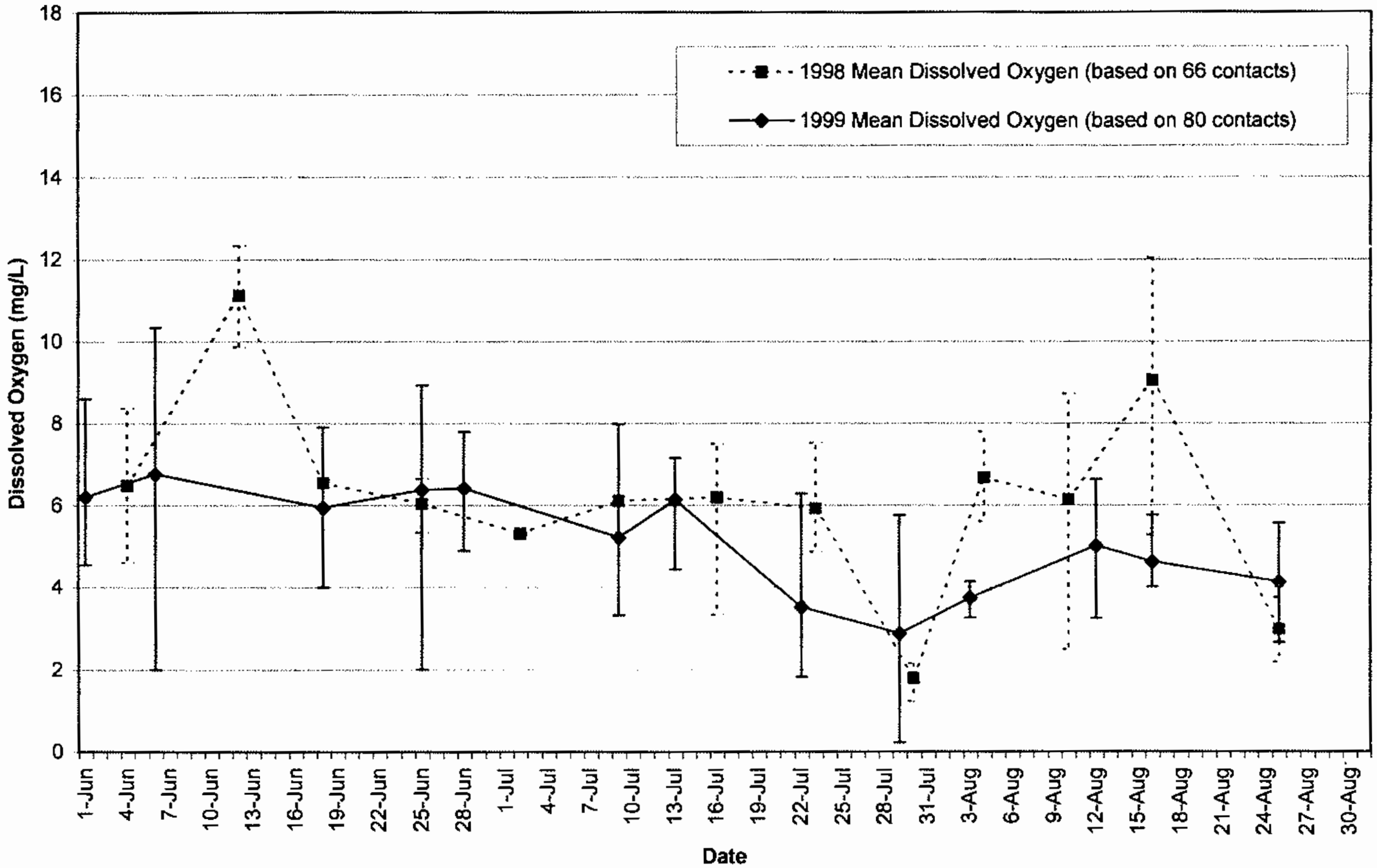

Figure 14.12. Dissolved oxygen levels at the depth where largemouth bass where located in Lake of Egypt, Williamson / Johnson Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish. The bars represent ranges.

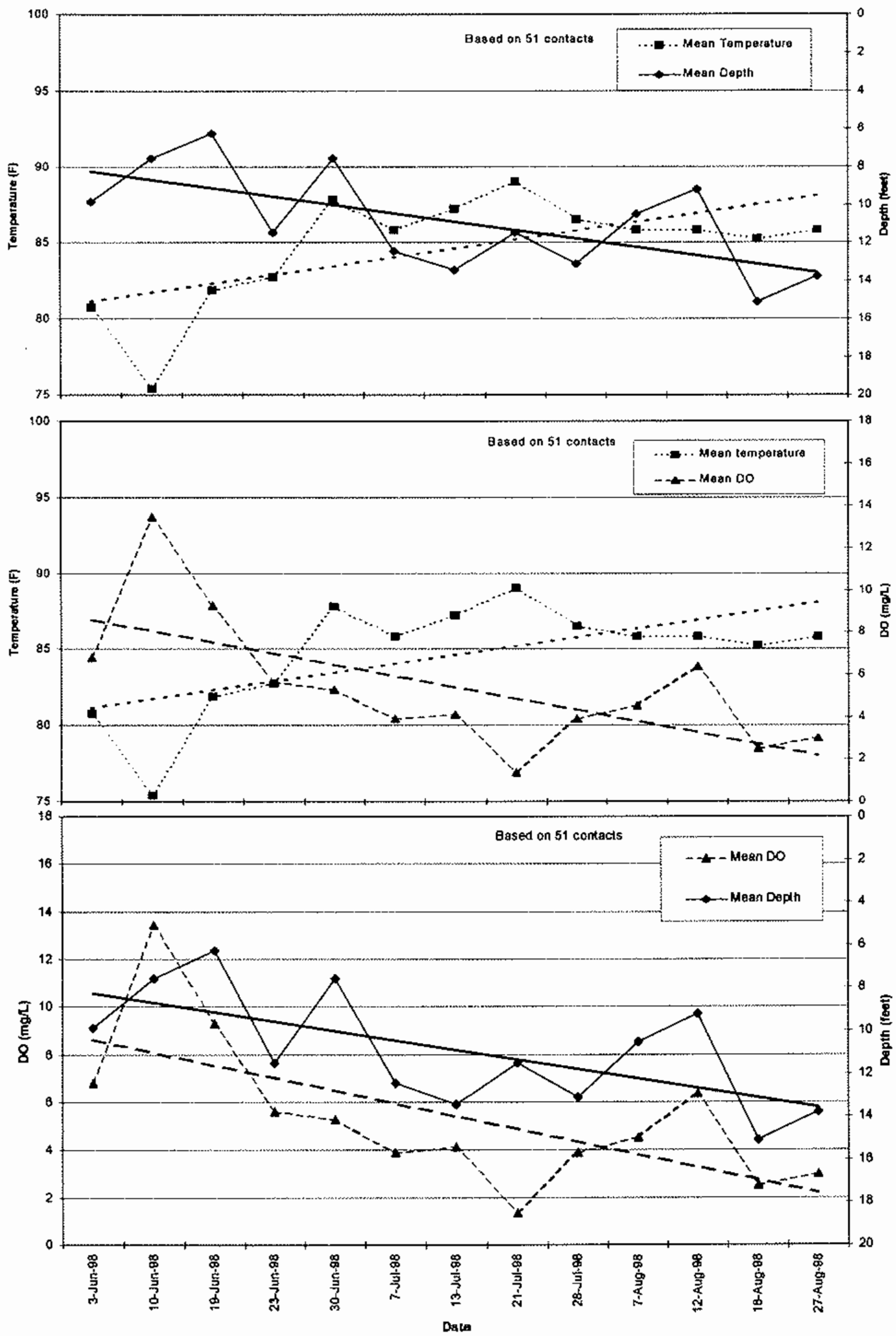

Figure 14.13. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for 1998 summer sampling dates in Newton Lake, Jasper Co. Illinois (straight lines represent trends). Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

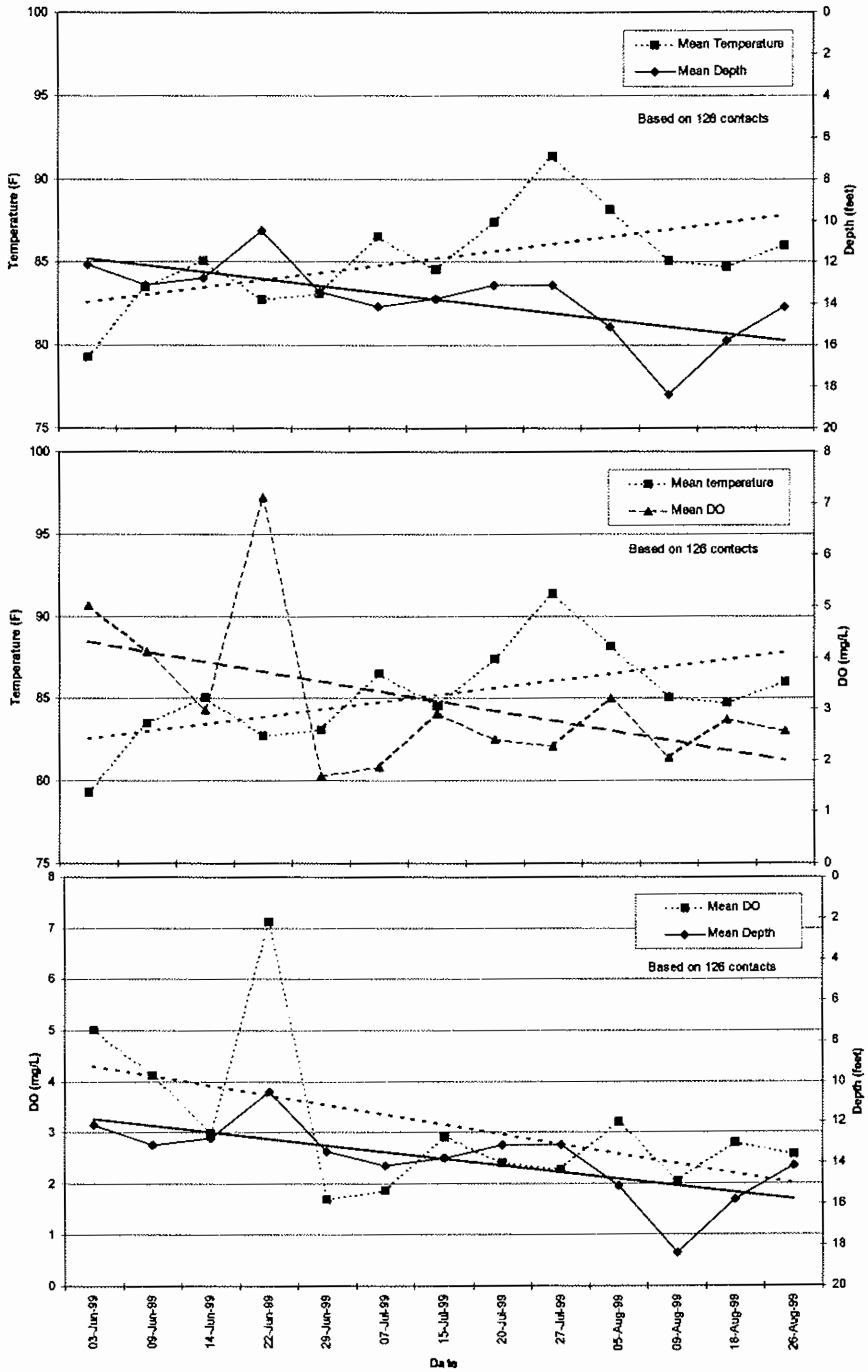

Figure 14.14. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for 1999 summer sampling dates in Newton Lake, Jasper Co. Illinois (straight lines represent trends). Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

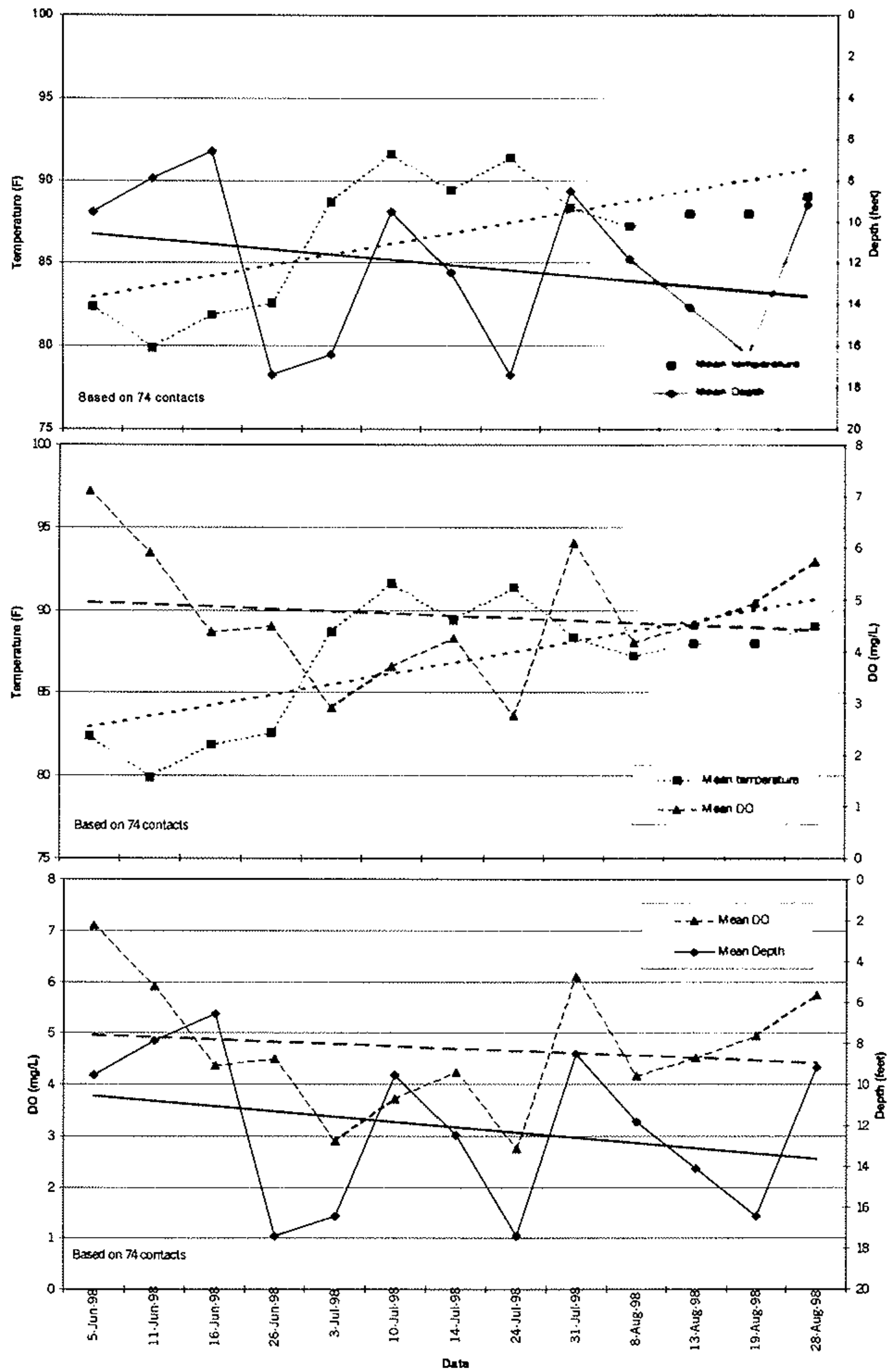

Figure 14.15. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for 1998 summer sampling dates in Coffeen Lake, Montgomery Co. Illinois (straight lines represent trends). Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

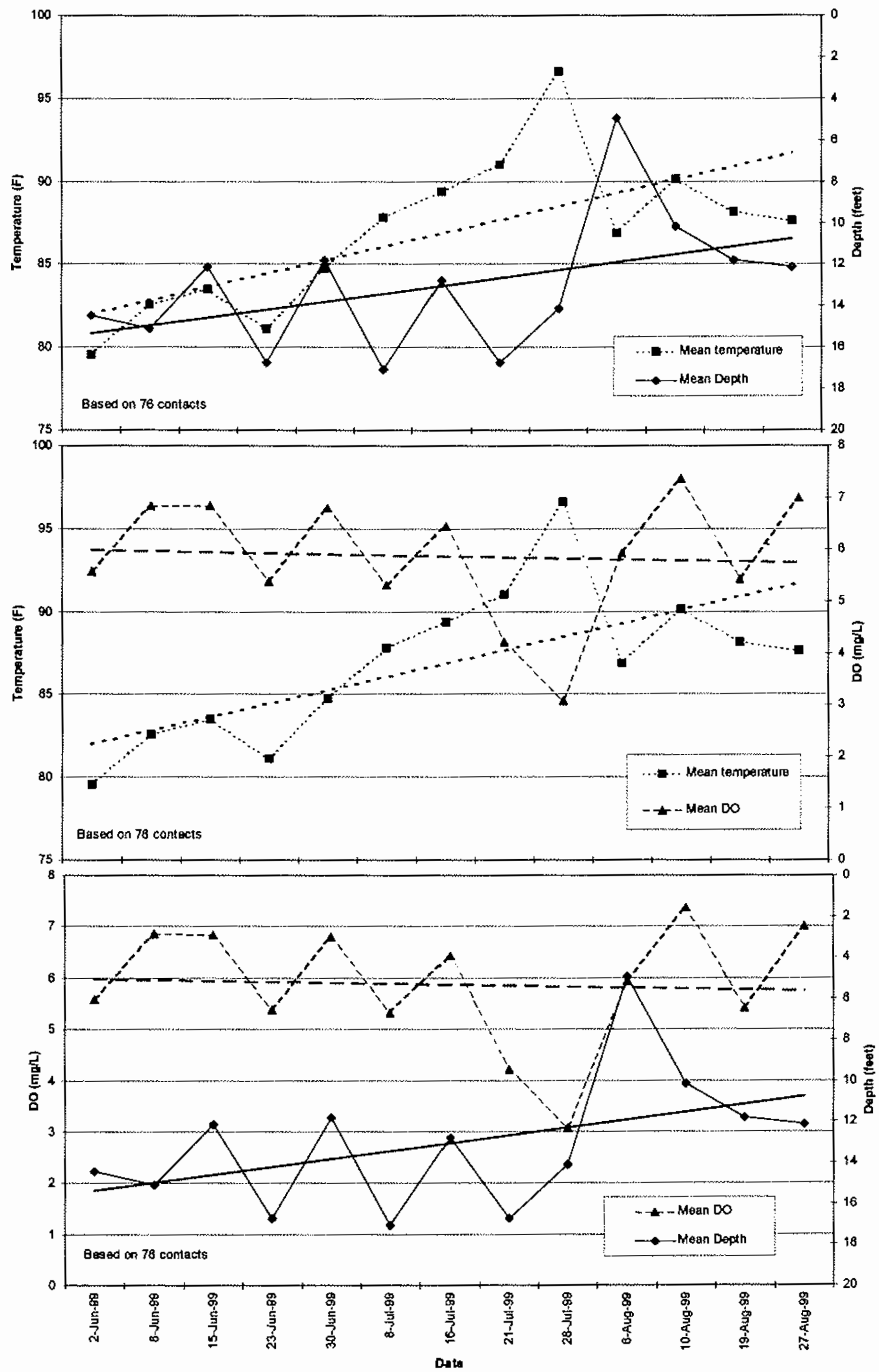

Figure 14.16. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for 1999 summer sampling dates in Coffeen Lake, Montgomery Co. Illinois (straight lines represent trends). Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

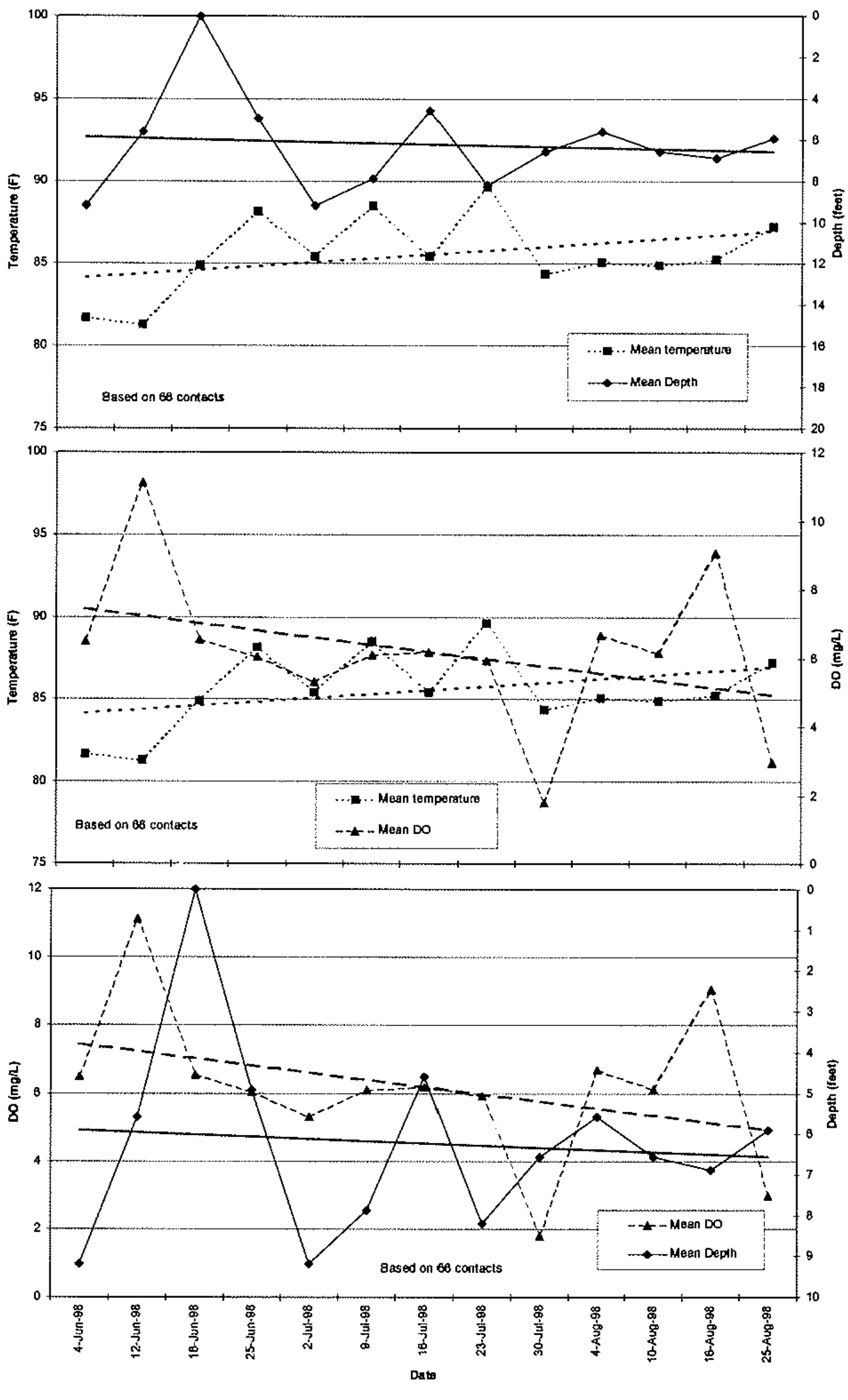

Figure 14.17. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for 1998 summer sampling dates in Lake of Egypt, Williamson / Johnson Co. Illinois (straight lines represent trends). Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

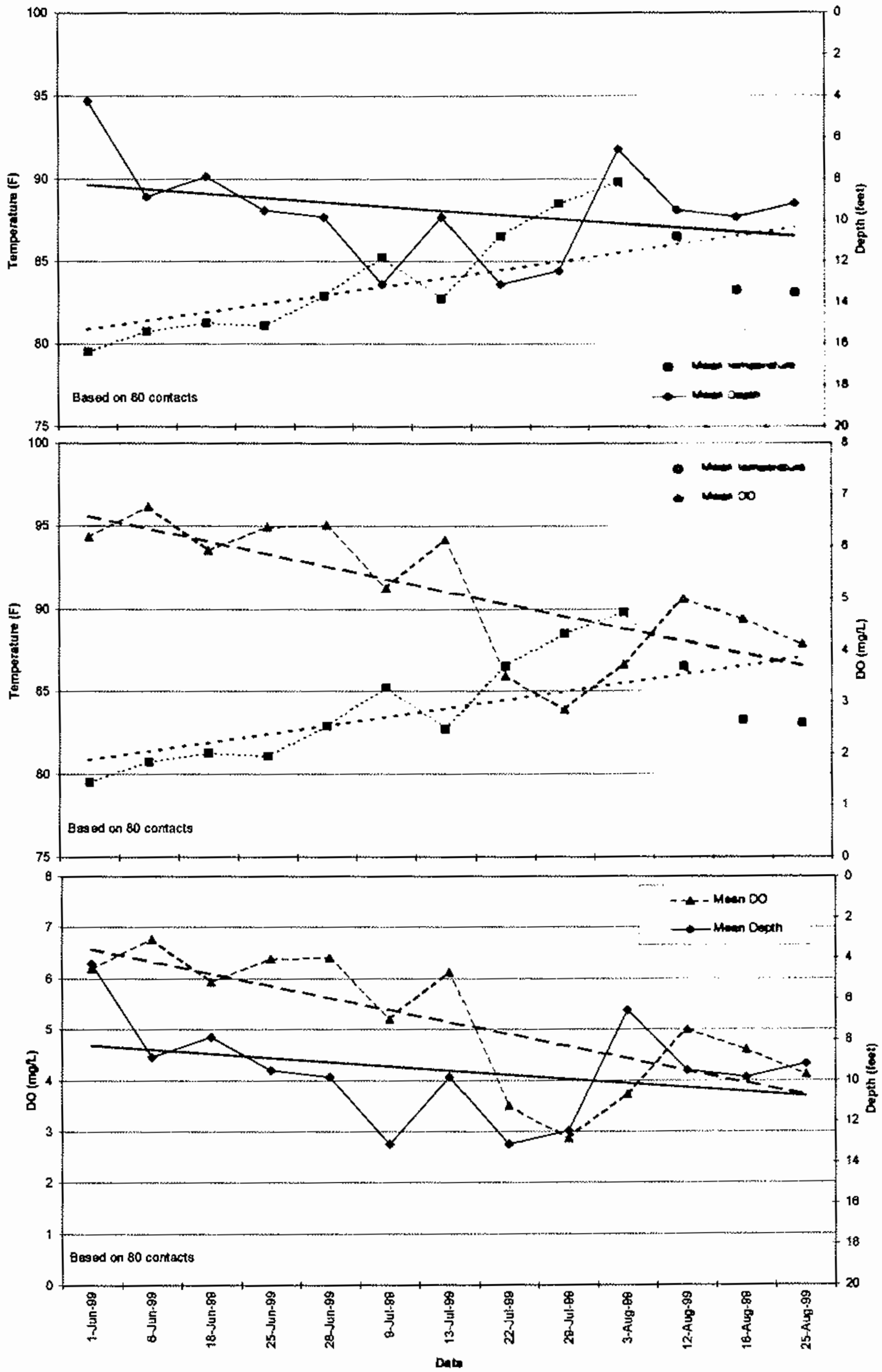

Figure 14.18. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for 1999 summer sampling dates in Lake of Egypt, Williamson / Johnson Co. Illinois (straight lines represent trends). Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

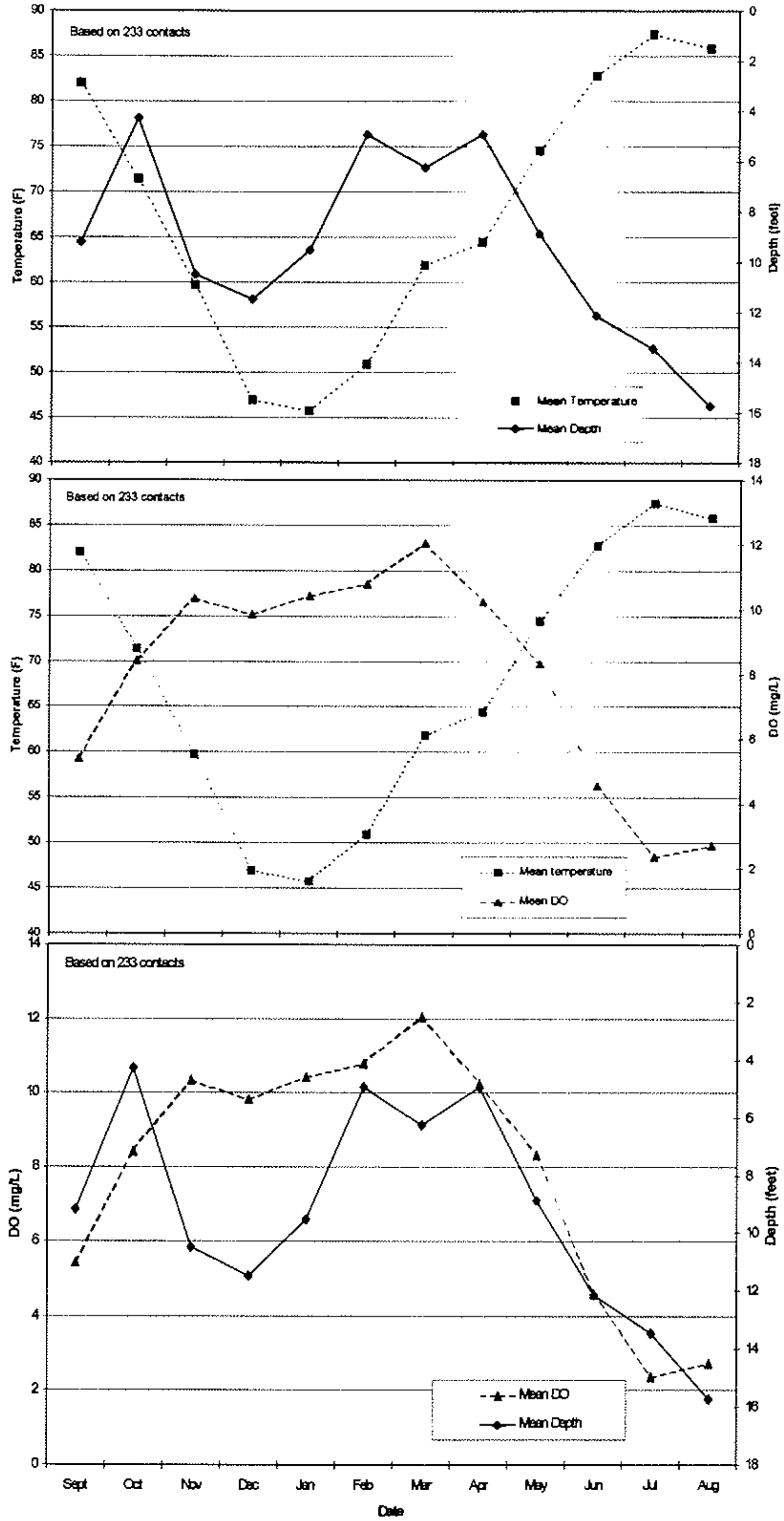

Figure 14.19. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for sampling months in Newton Lake, Jasper Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

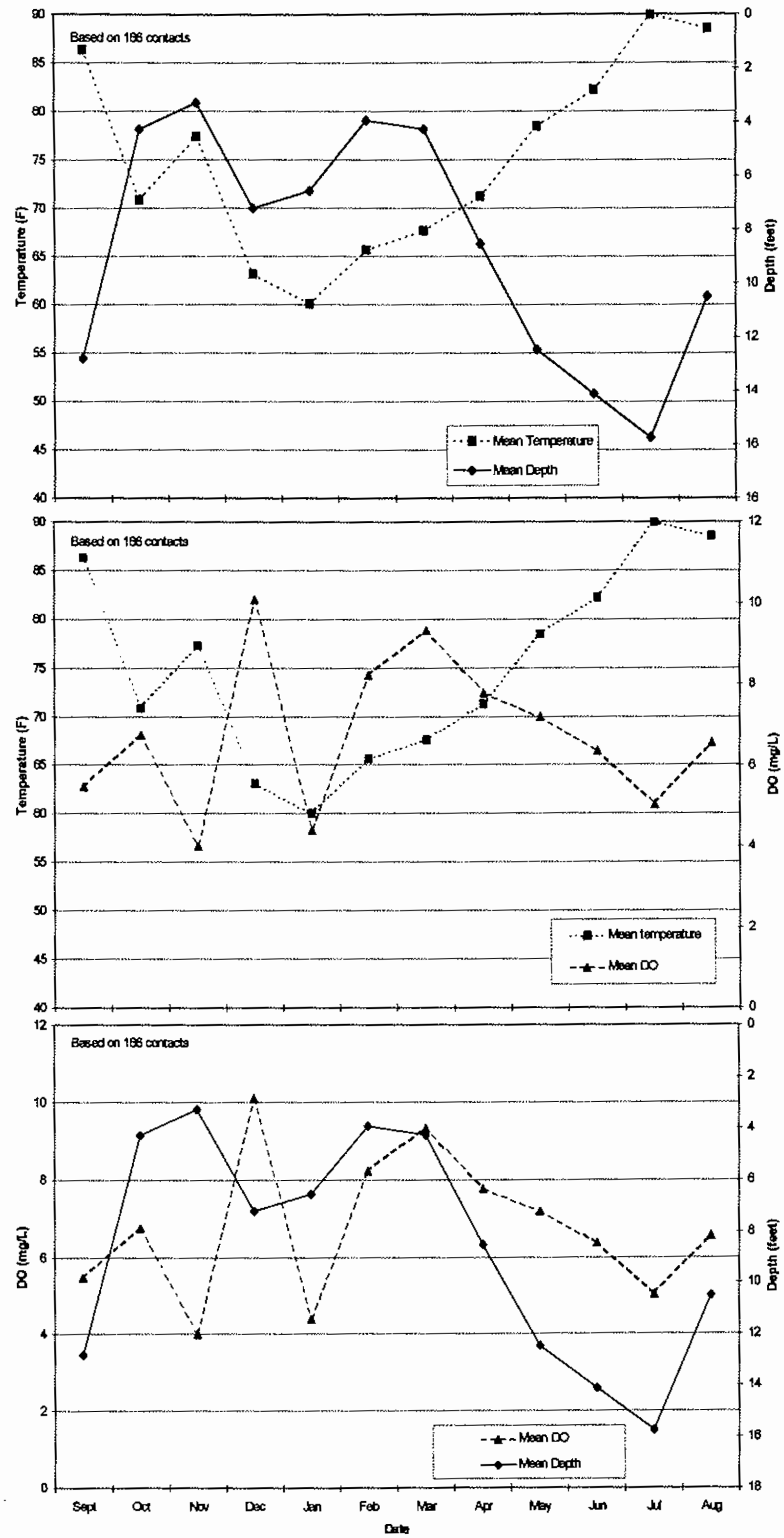

Figure 14.20. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for sampling months in Coffeen Lake, Montgomery Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

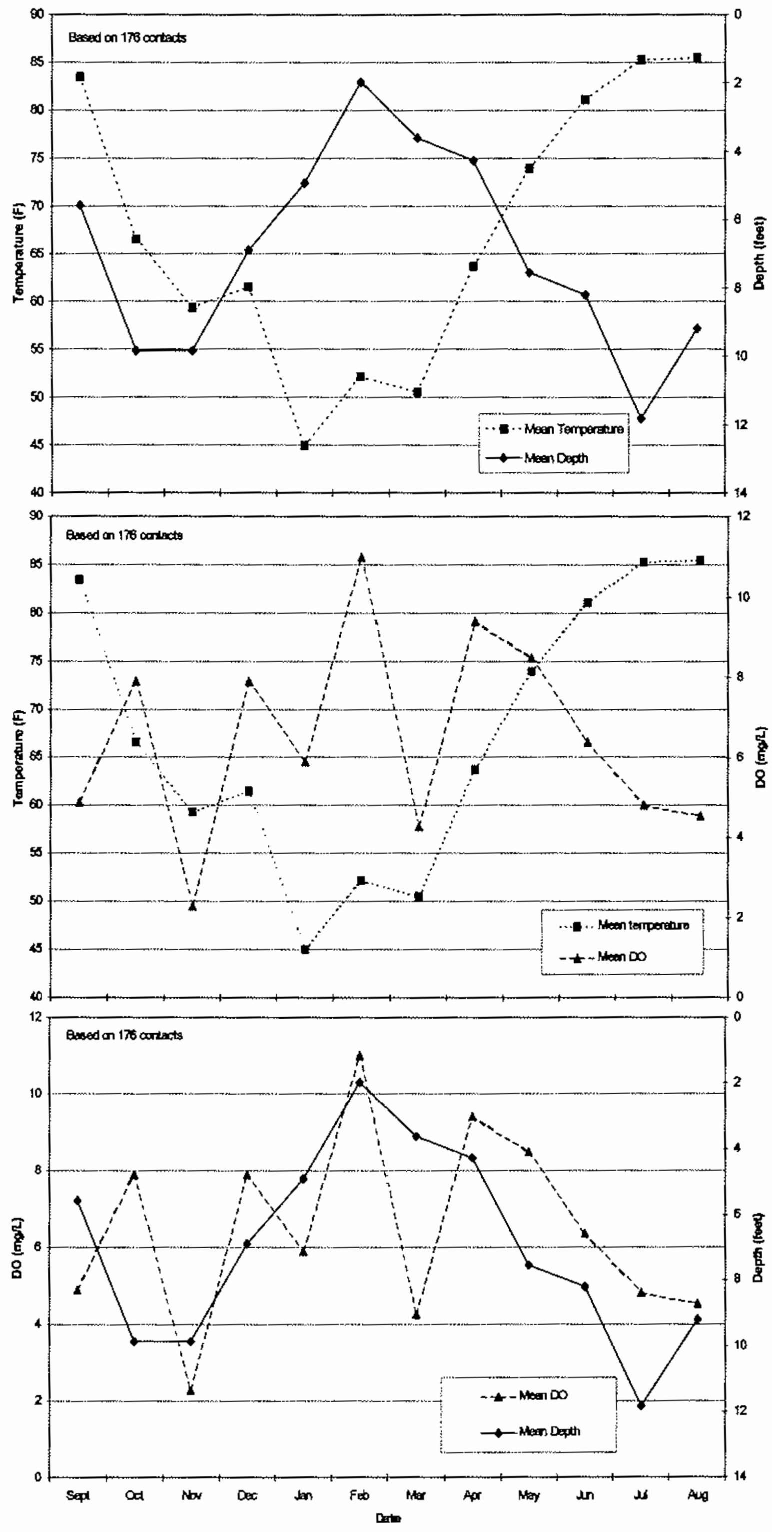

Figure 14.21. Comparison between largemouth bass internal body temperature, depth, and dissolved oxygen (DO) where found for sampling months in Lake of Egypt, Williamson / Johngosn Co. Illinois. Only contacts with largemouth bass were used when their internal body temperatures, determined by the temperature sensitive ultrasonic transmitters, corresponded with a water temperature on the temperature-depth-oxygen profile that was taken at the location of each fish.

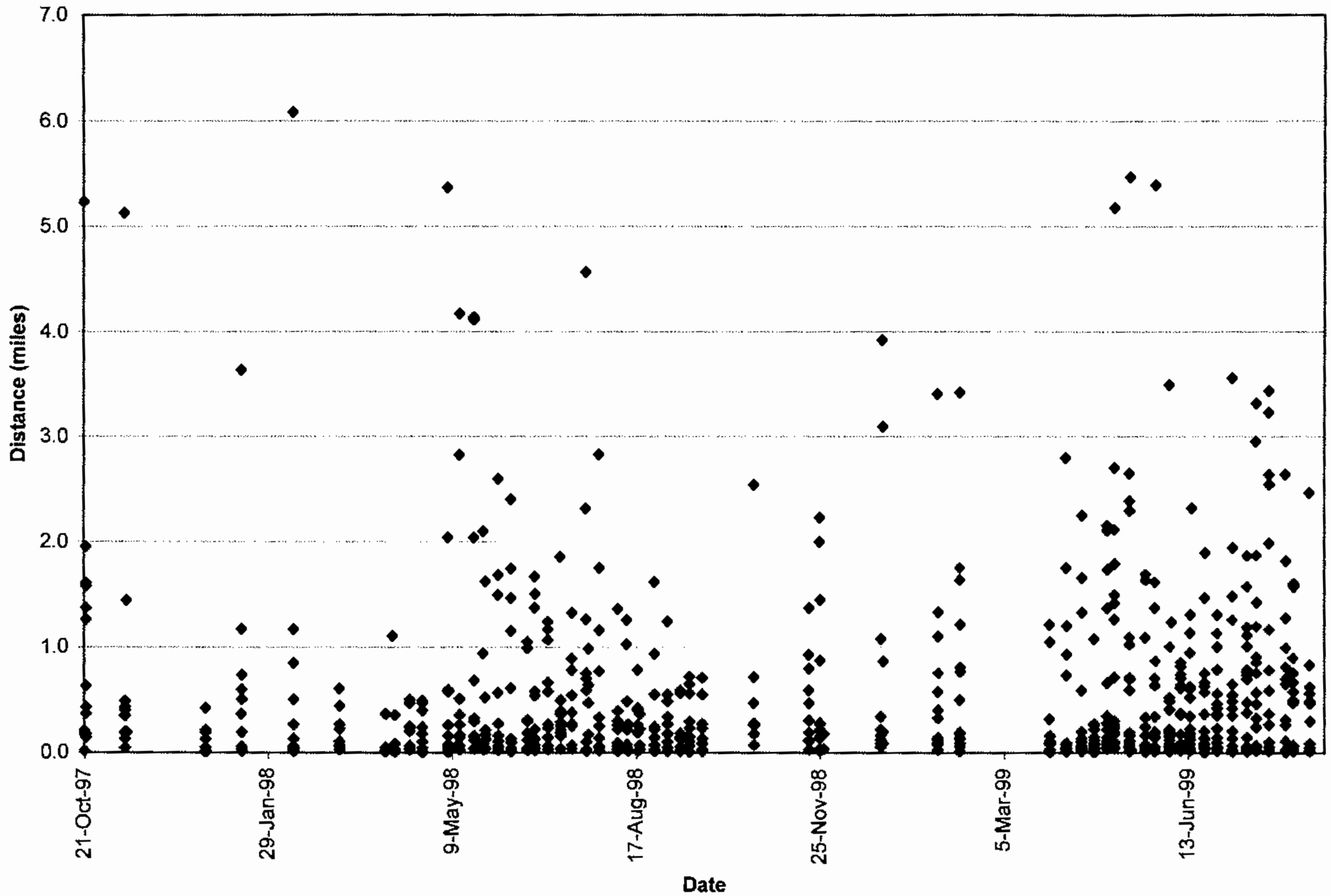

Figure 14.22. Observed largemouth bass movement between contacts from October 1997 through August 1999, determined by ultrasonic telemetry in Newton Lake, Jasper Co. Illinois.

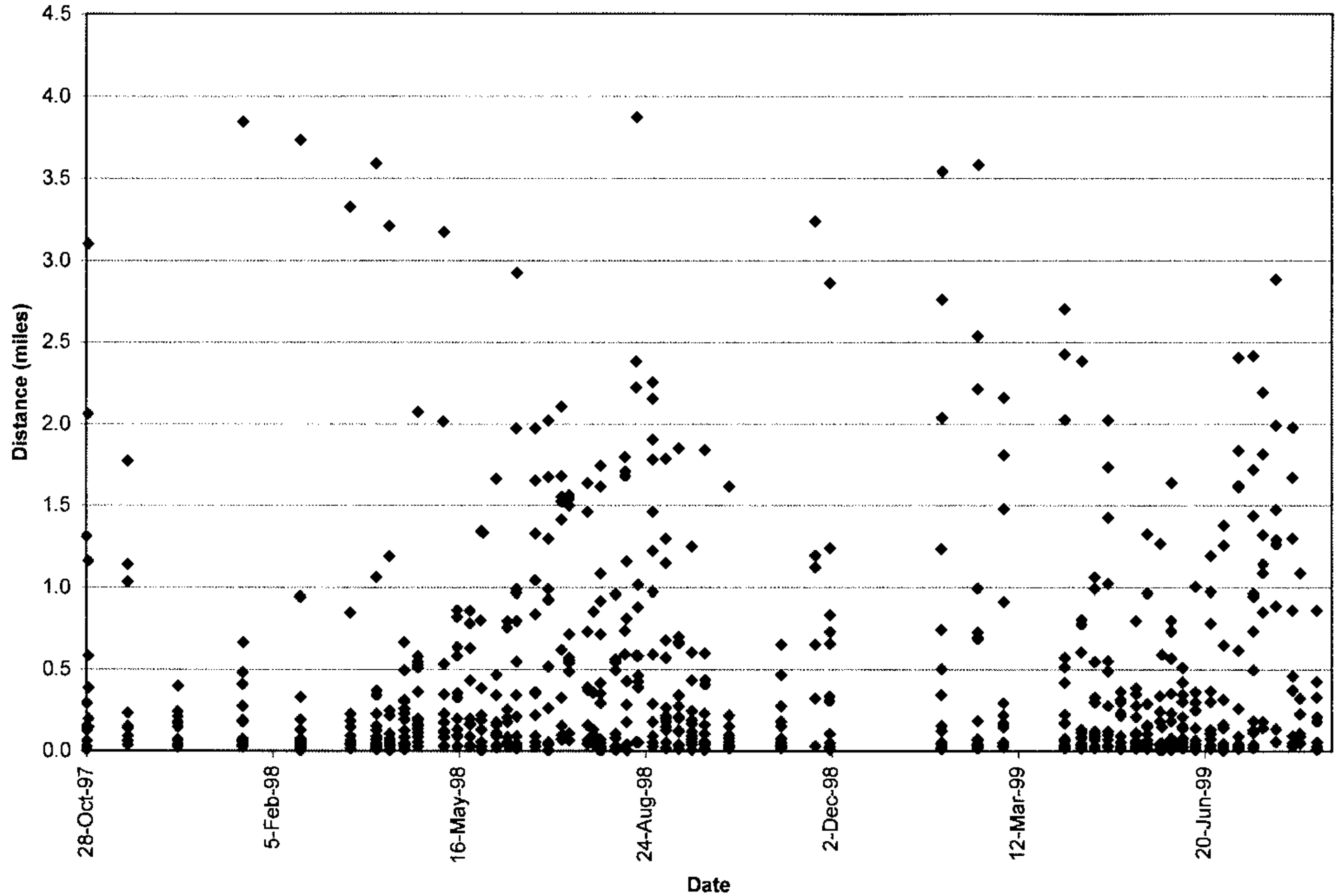

Figure 14.23. Observed largemouth bass movement between contacts from October 1997 through August 1999, determined by ultrasonic telemetry in Coffeen Lake, Montgomery Co. Illinois.

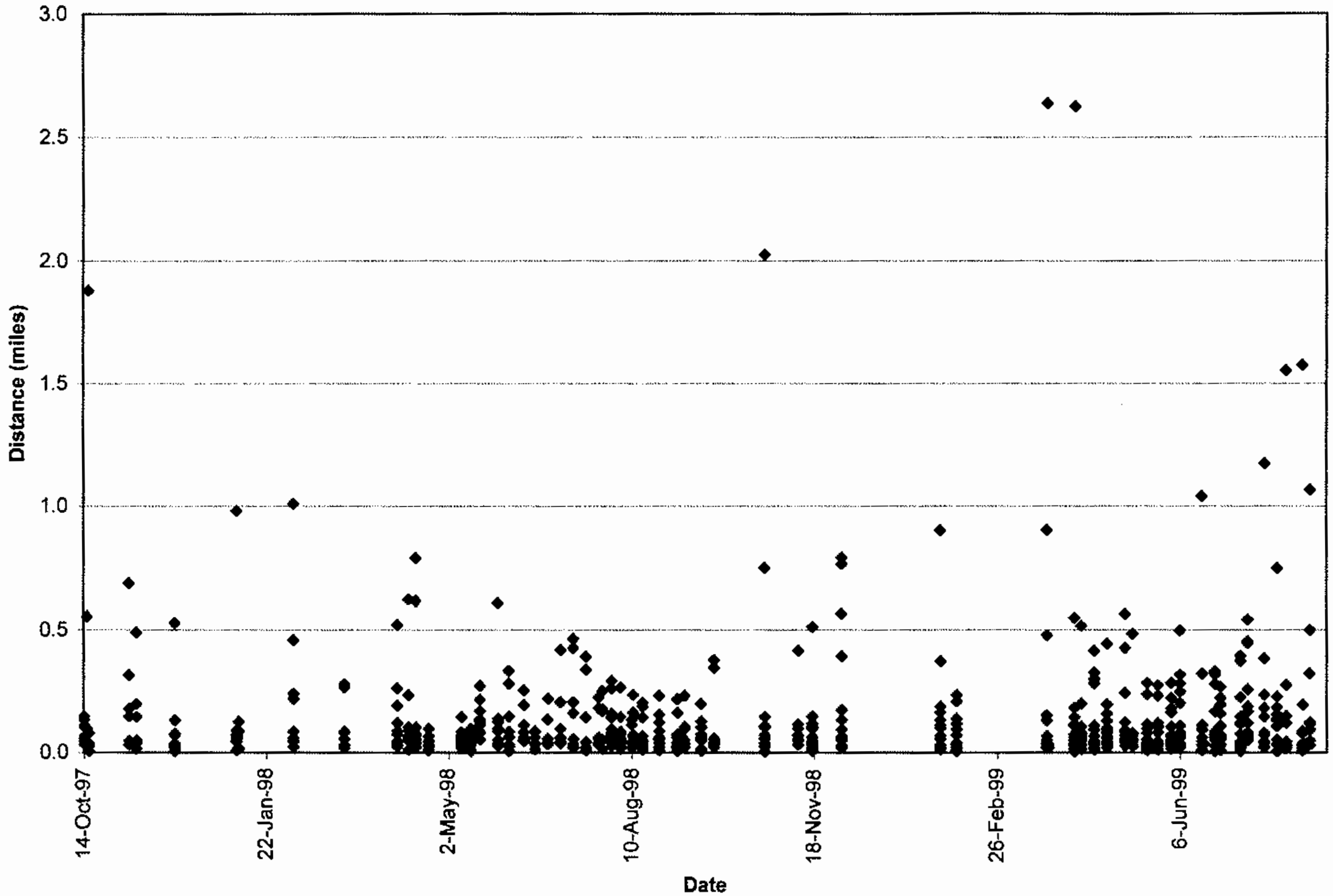

Figure 14.24. Observed largemouth bass movement between contacts from October 1997 through August 1999, determined by ultrasonic telemetry in Lake of Egypt, Williamson / Johnson Co Illinois.

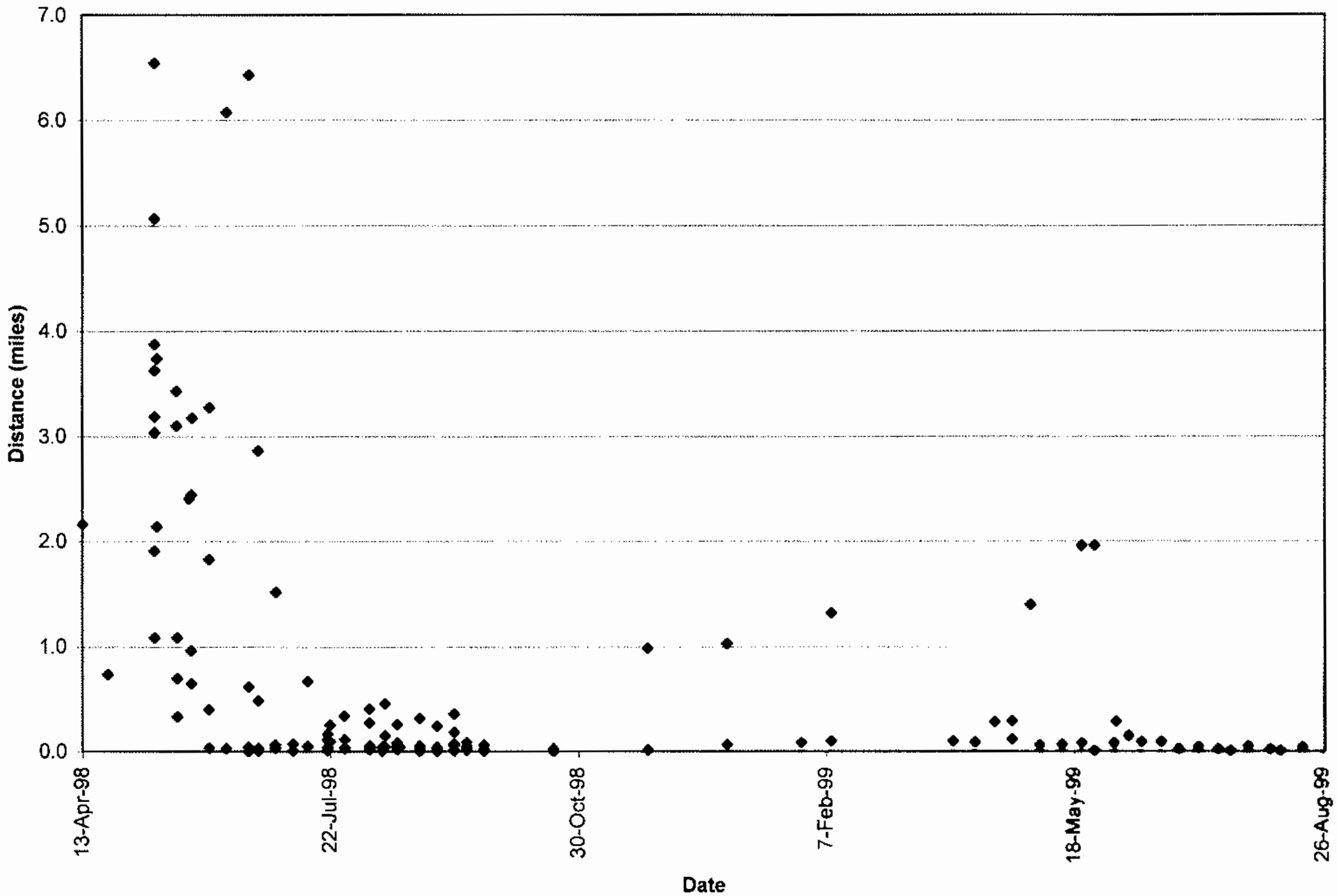

Figure 14.25. Observed channel catfish movement between contacts from October 1997 through August 1999, determined by ultrasonic telemetry in Newton Lake, Jasper Co. Illinois.

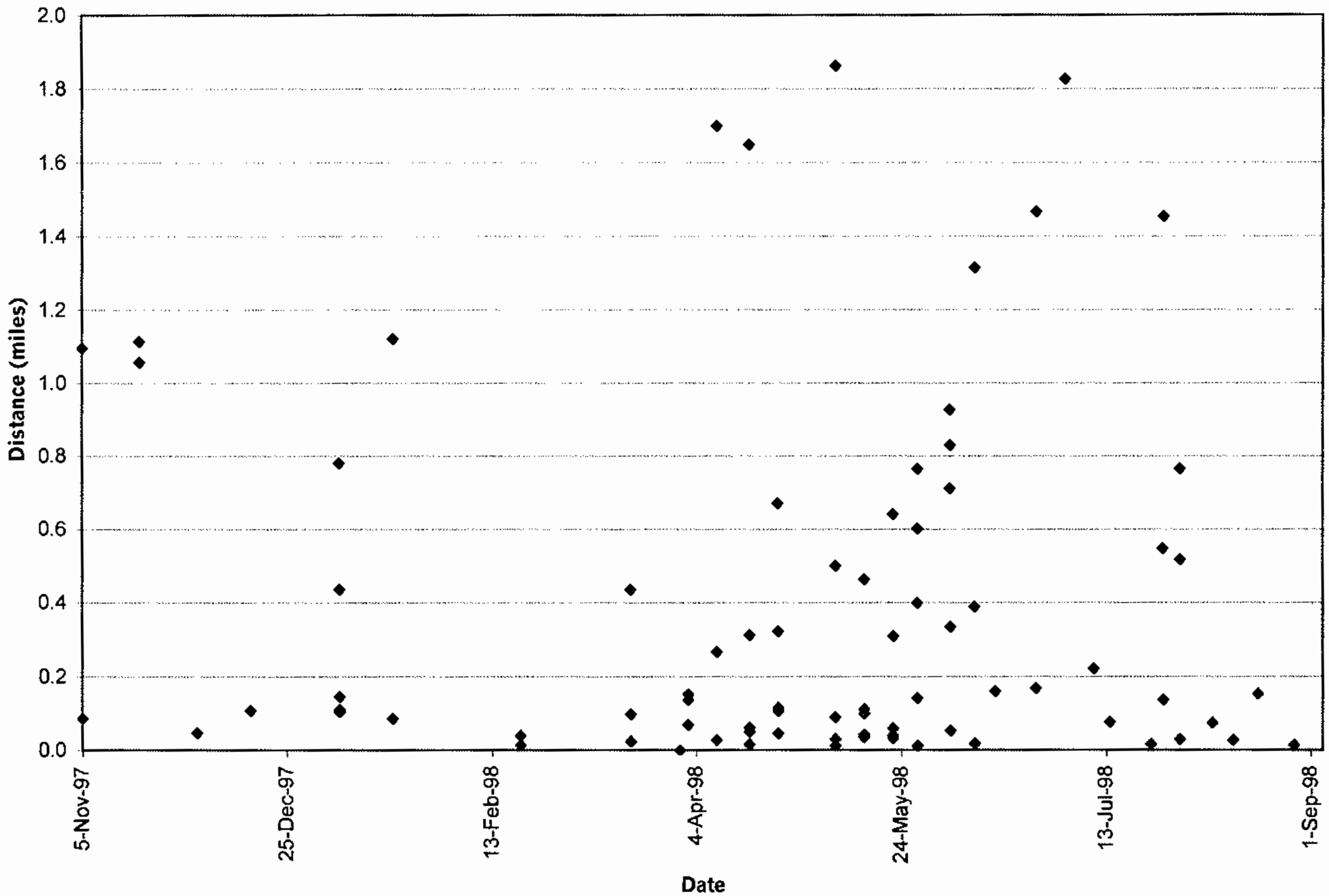

Figure 14.26. Observed channel catfish movement between contacts from October 1997 through August 1999, determined by ultrasonic telemetry in Coffeen Lake, Montgomery Co. Illinois.

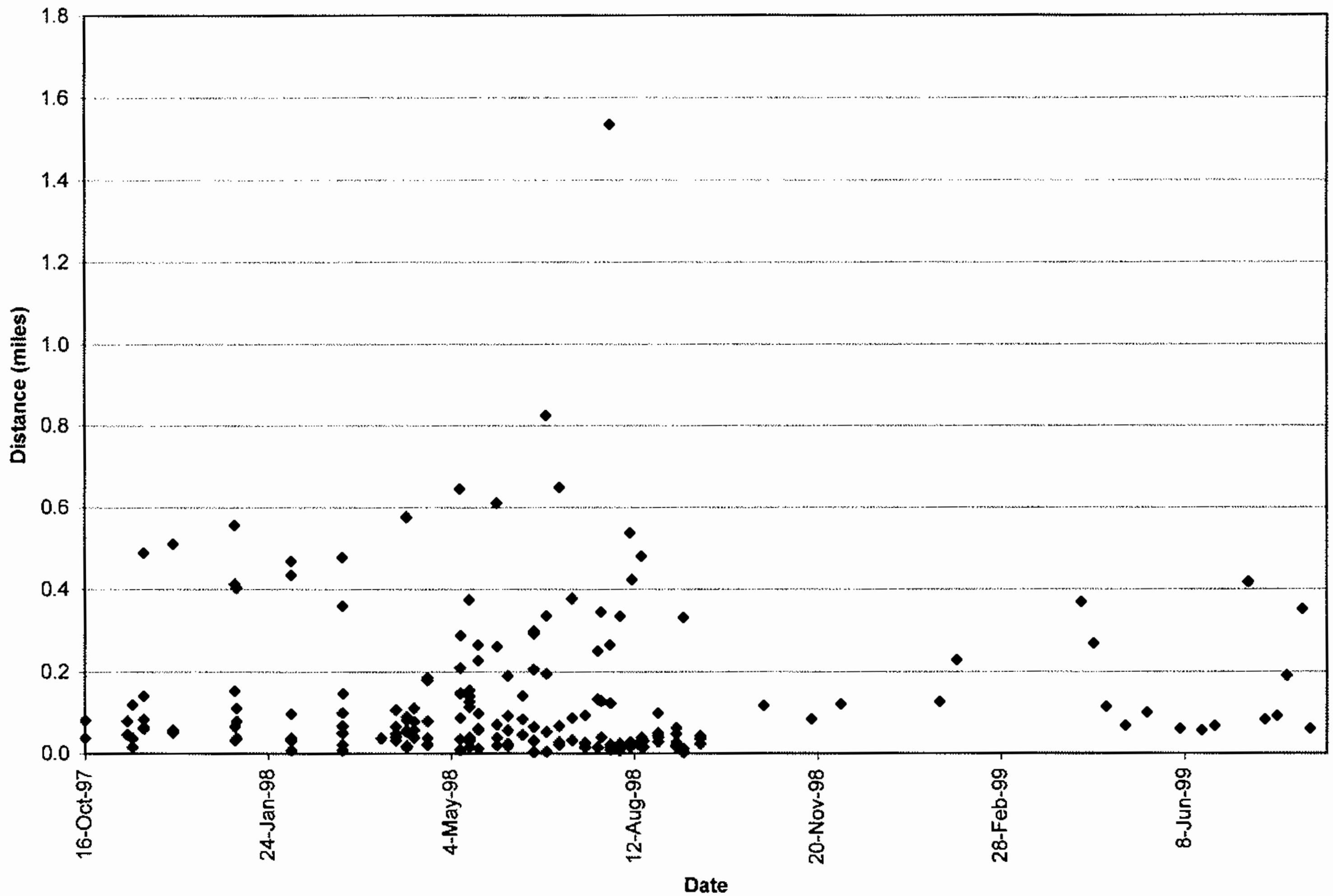

Figure 14.27. Observed channel catfish movement between contacts from October 1997 through August 1999, determined by ultrasonic telemetry in Lake of Egypt, Williamson / Johnson Co. Illinois.

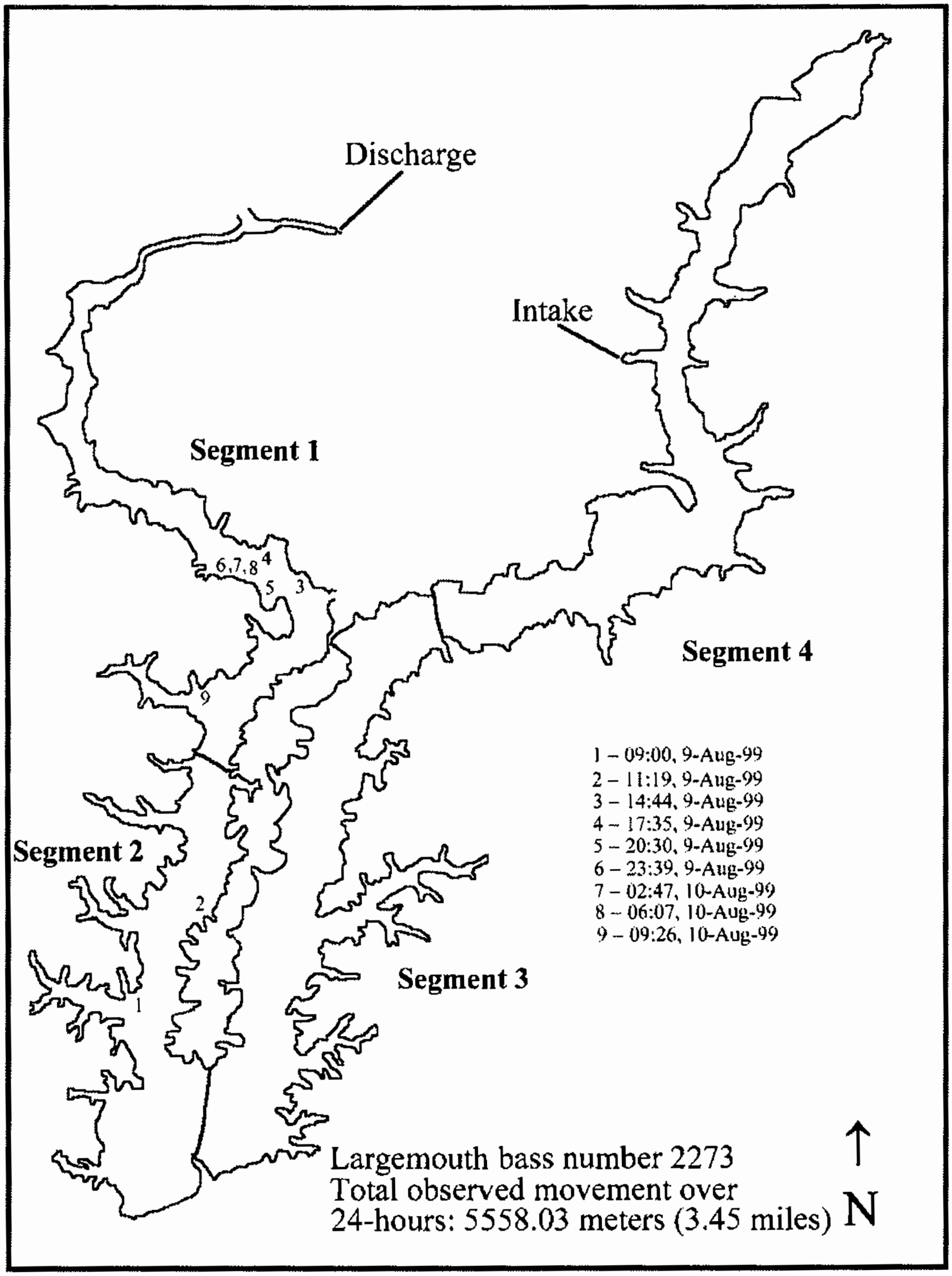

Figure 14.28. Extreme 24-hour diel movement observations of an ultrasonic transmitter implanted largemouth bass in Newton Lake, Jasper Co. Illinois.

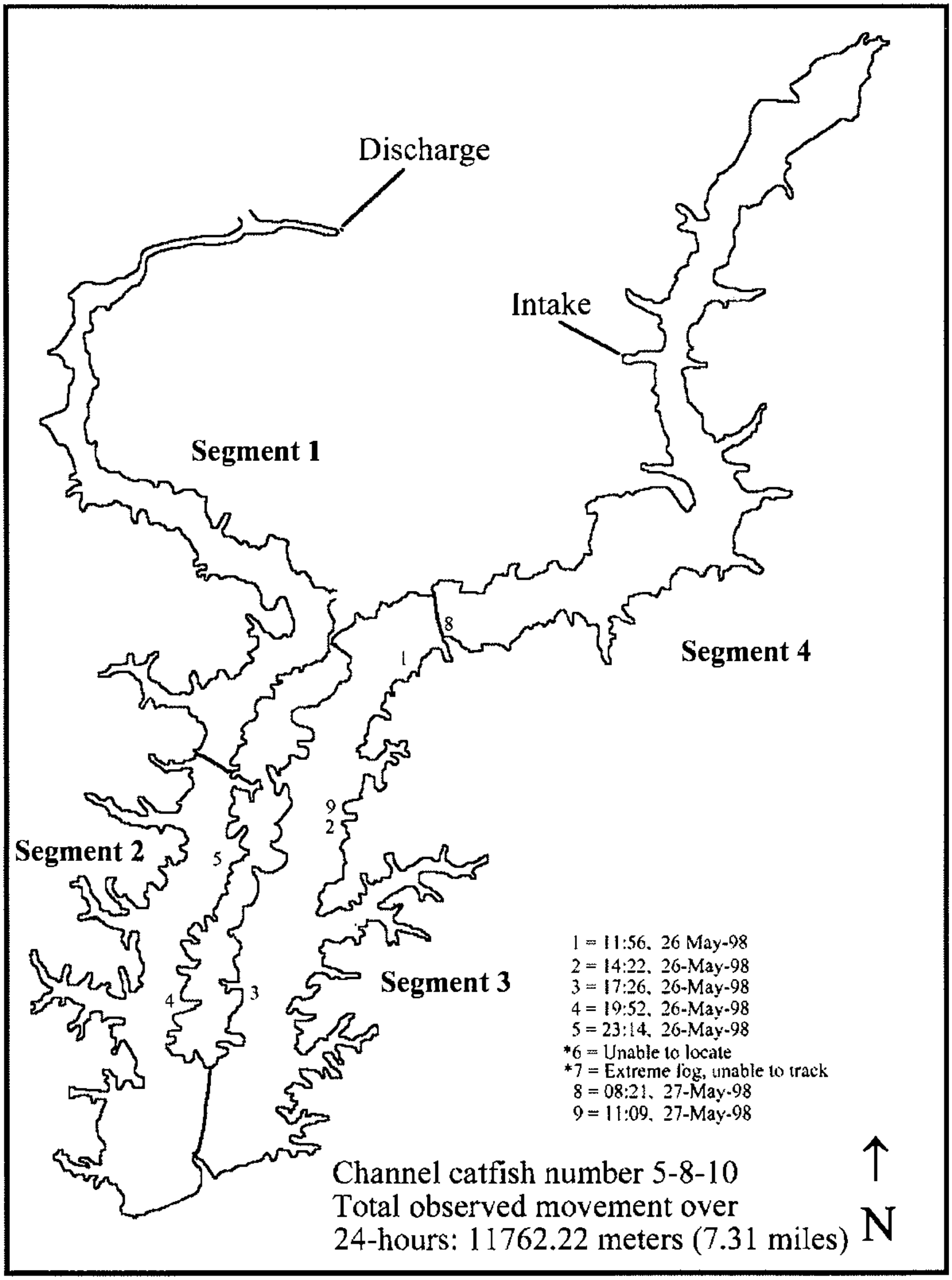

Figure 14.29. Extreme 24-hour diel movement observations of an ultrasonic transmitter implanted channel catfish in Newton Lake, Jasper Co. Illinois.

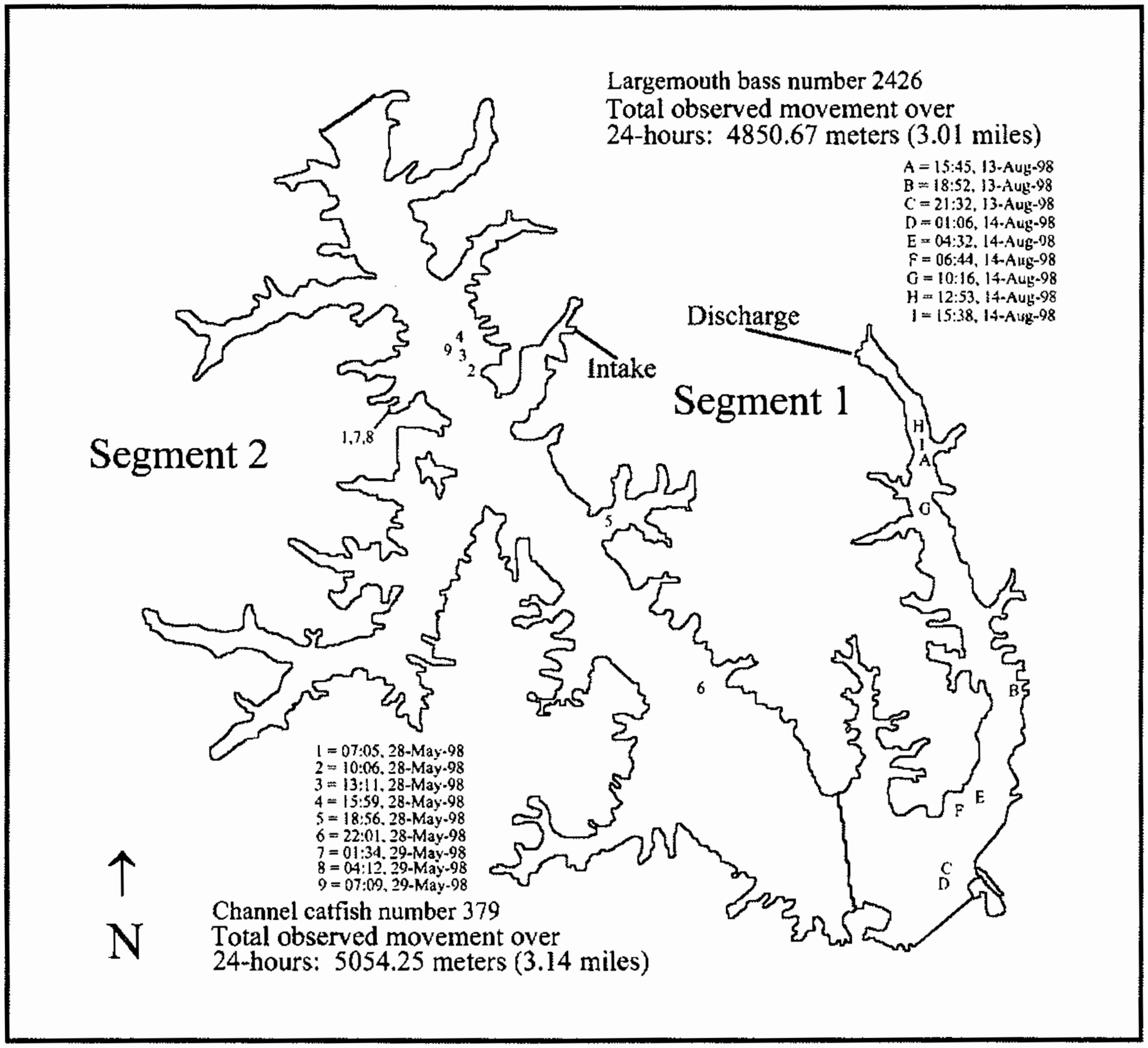

Figure 14.30. Extreme 24-hour diel movement observations of an ultrasonic transmitter implanted largemouth bass and channel catfish in Coffeen Lake, Montgomery Co. Illinois.

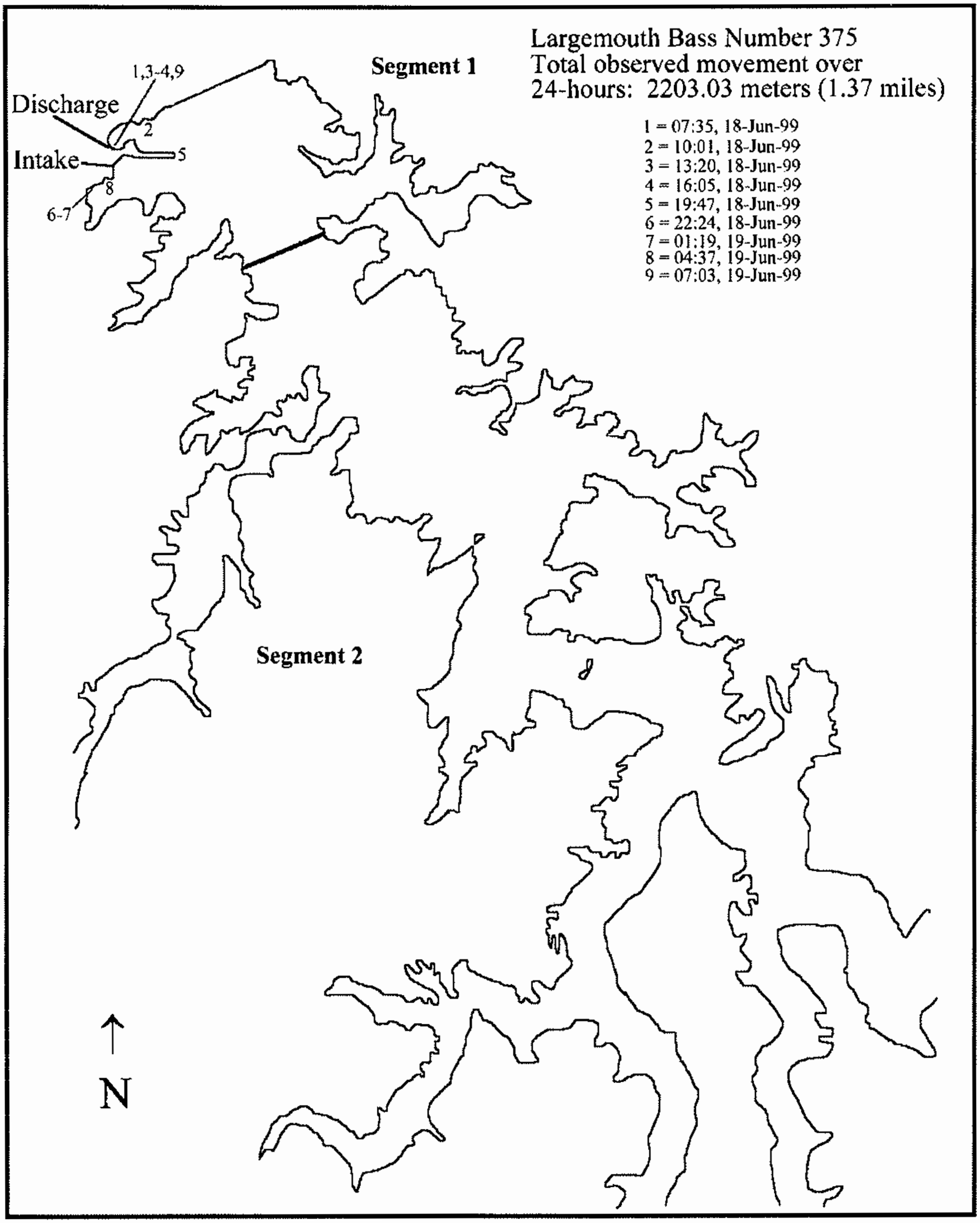

Figure 14.31. Extreme 24-hour diel movement observations of an ultrasonic transmitter implanted largemouth bass in Lake of Egypt, Williamson / Johnson Co. Illinois.

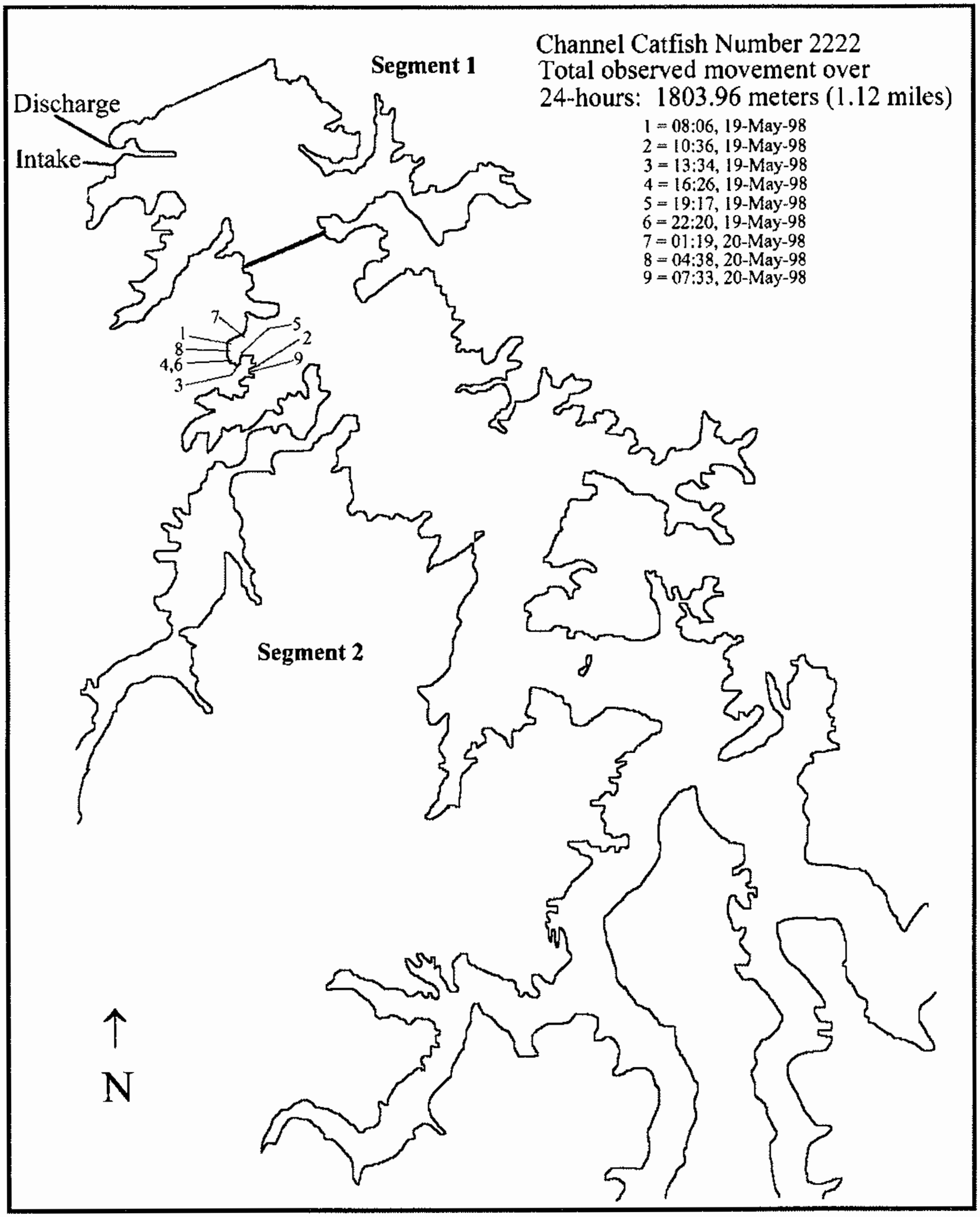

Figure 14.32. Extreme 24-hour diel movement observations of an ultrasonic transmitter implanted channel catfish in Lake of Egypt, Williamson / Johnson Co. Illinois.

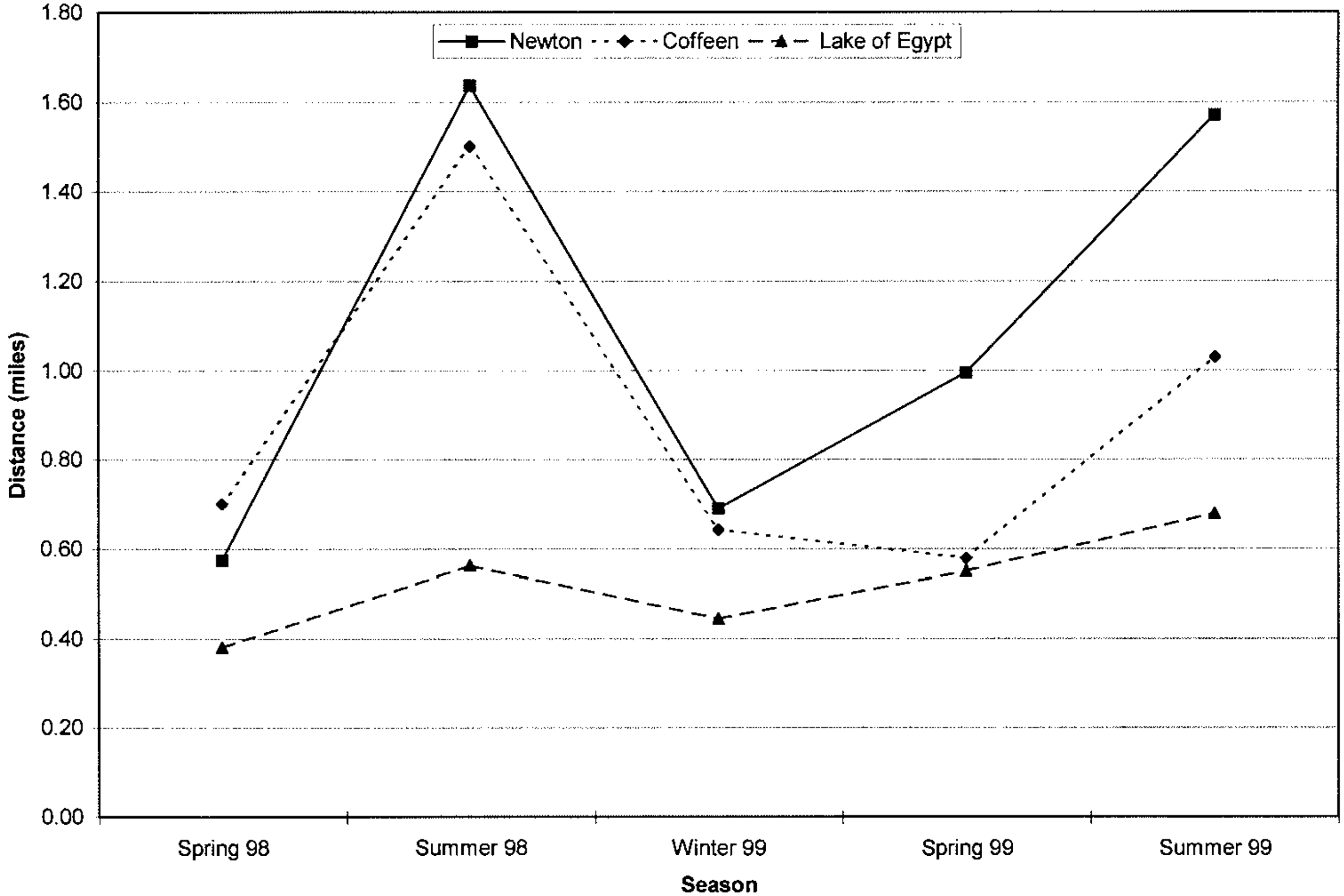

Figure 14.33. Comparison among sampling seasons for largemouth bass mean observed diel movements in three Illinois power cooling reservoirs.

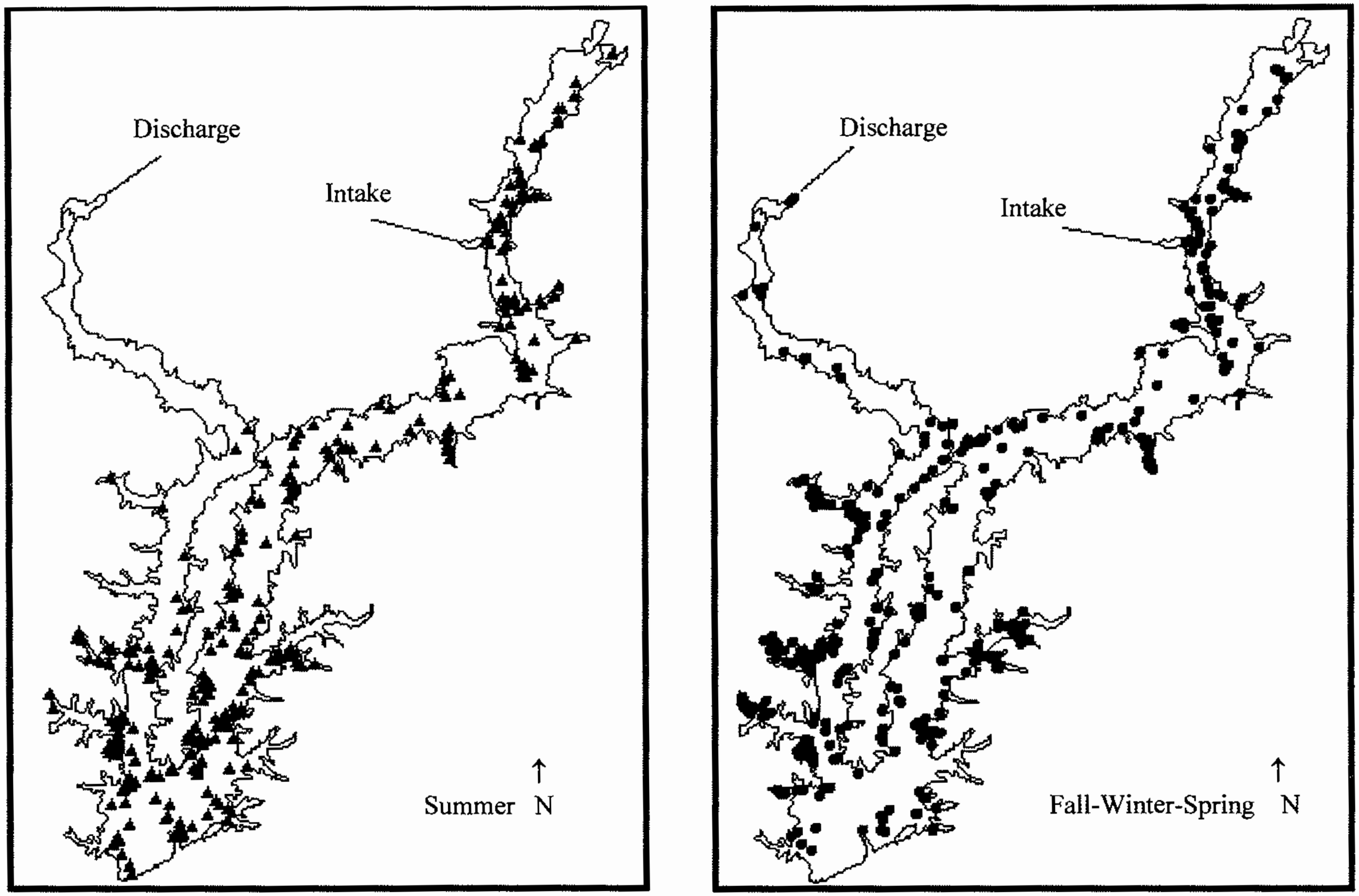

Figure 14.34. Seasonal largemouth bass locations in Newton Lake, Jasper Co. Illinois, as determined by ultrasonic telemetry. June, July, and August represent summer months.

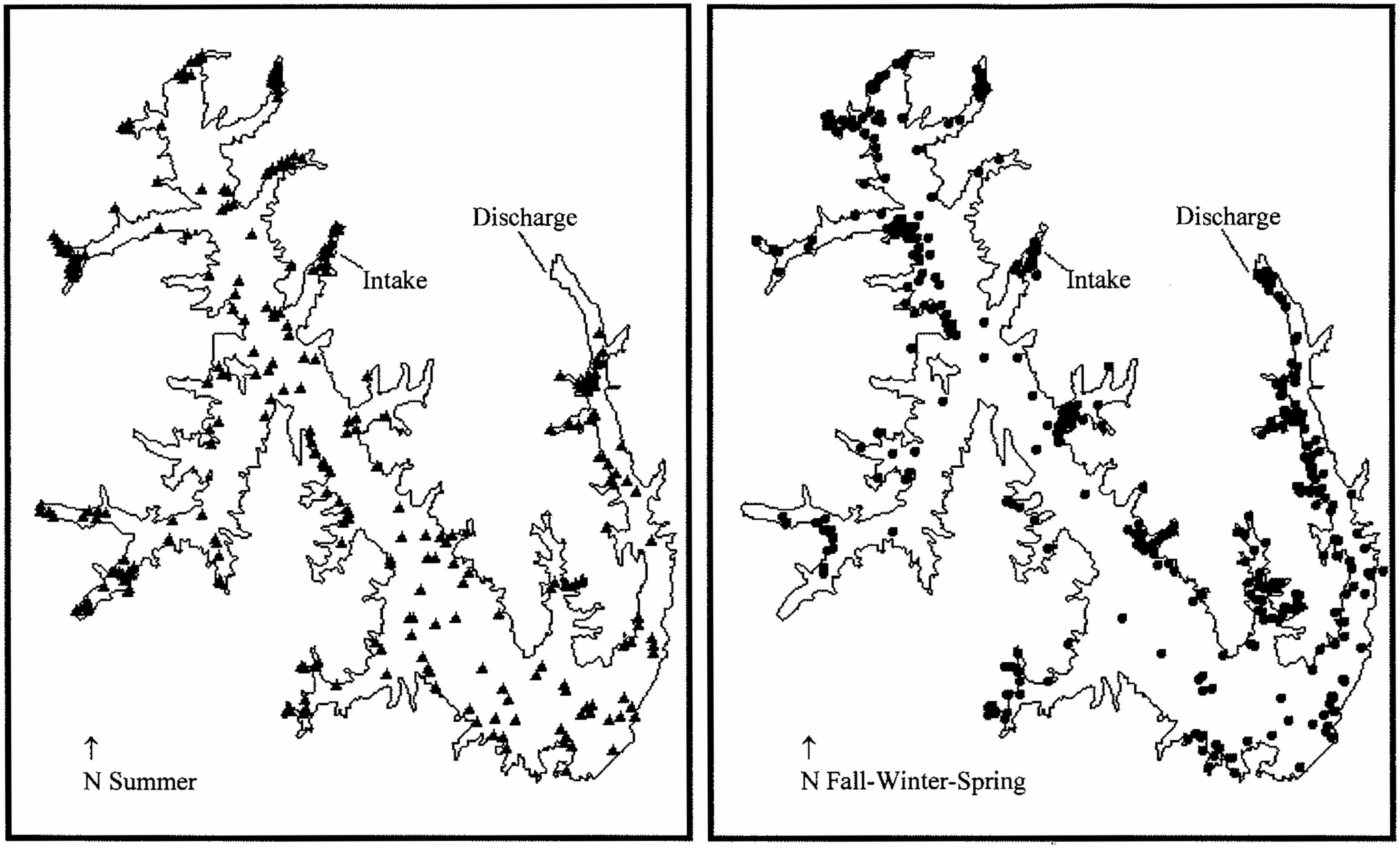

Figure 14.35. Seasonal largemouth bass locations in Coffeen Lake, Montgomery Co. Illinois, as determined by ultrasonic telemetry. June, July, and August represent summer months.

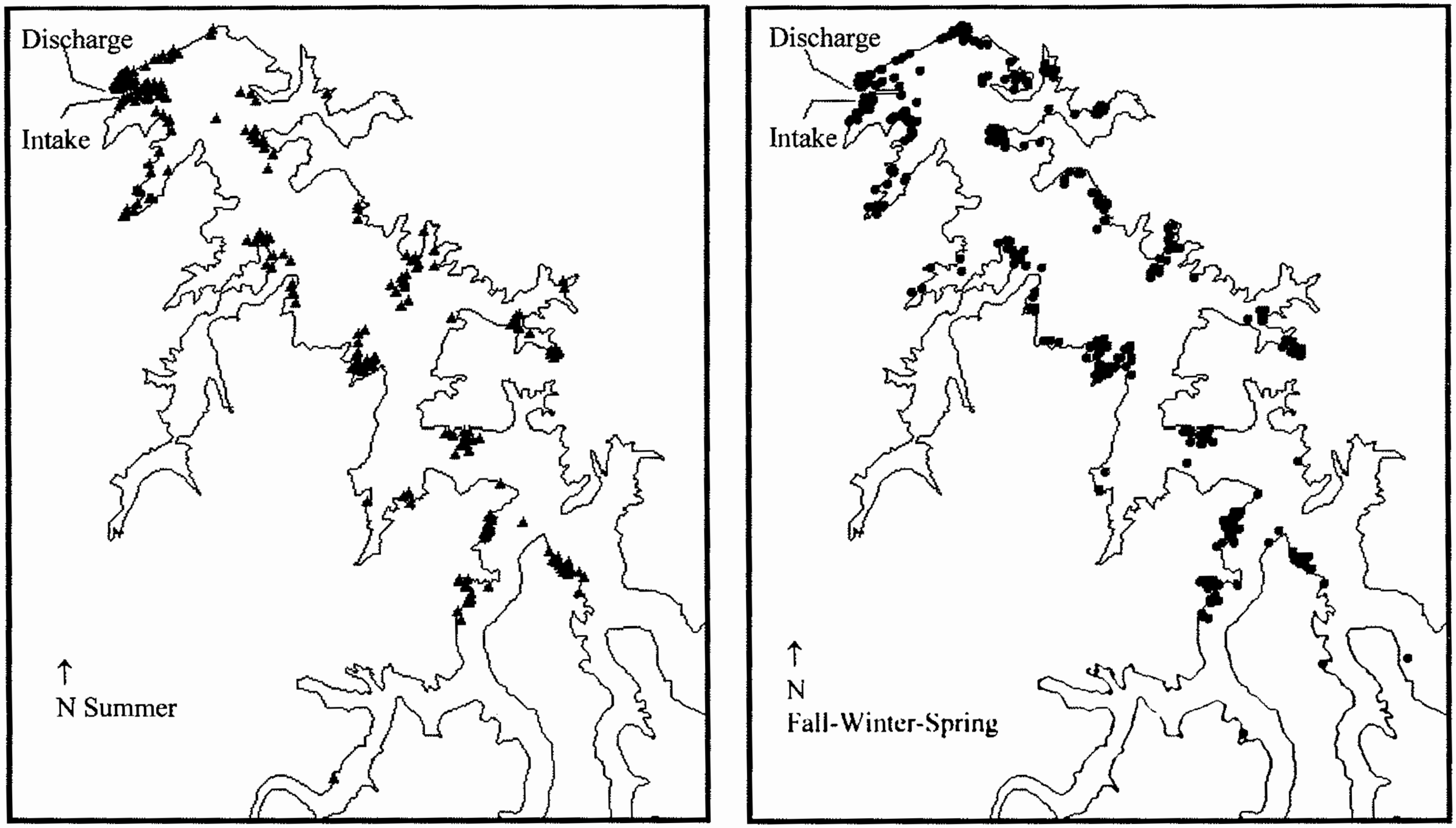

Figure 14.36. Seasonal largemouth bass locations in Lake of Egypt, Williamson / Johnson Co. Illinois, as determined by ultrasonic telemetry. June, July, and August represent summer months.