

SOUTH

DAKOTA

A large, stylized graphic of a fish, where the word 'FISHERIES' is written in a bold, blocky font across the body of the fish. The fish's tail is on the left, and its head is on the right, pointing towards the right. Several small, empty circles of varying sizes are arranged in a trail behind the fish's head, suggesting bubbles or movement.

FISHERIES

**ANNUAL FISH POPULATION
AND
ANGLER USE AND SPORT FISH HARVEST SURVEYS
ON
LAKE FRANCIS CASE, SOUTH DAKOTA, 2005**

**South Dakota
Department of
Game, Fish and Parks
Wildlife Division
Joe Foss Building
Pierre, South Dakota 57501-3182**

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No. 07-29**

ANNUAL FISH POPULATION
AND
ANGLER USE AND SPORT FISH HARVEST SURVEYS
ON
LAKE FRANCIS CASE, SOUTH DAKOTA, 2005

by

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PREFACE

Information collected during 2005 is summarized in this report. Copies of this report and references to the data can be made with permission from the authors or Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, South Dakota 57501-3182.

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EXECUTIVE SUMMARY

This report includes annual fish population and angler use and harvest data, from 2001 through 2005, for Lake Francis Case (LFC), South Dakota. These surveys, their results and interpretation, are major strategy and evaluation tools for planning efforts outlined in the Missouri River Fisheries Program Strategic Plan. Results and discussion presented pertain to changes in fish community and population characteristics, sport fishing use and harvest, and evaluation of management activities and regulations.

Walleye catch per unit of effort (CPUE; No./min.), during 2005 spring-spawning-run electrofishing near Chamberlain, increased from 2004 and was within the range of the five-year period. Walleye electrofishing CPUE at the face of Ft. Randall Dam increased from 2004 and was the high of the five-year period.

Fall gill netting collected sixteen fish species. Walleye CPUE (No./net night), in 2005, increased over that observed in 2004 due to a large year class of walleye being produced in 2005. Sauger CPUE decreased from the 2004 value and was at a five-year low. Channel catfish CPUE in 2005 was similar to that observed in 2004. Mean white bass CPUE in 2005 increased from 2004. Smallmouth bass mean CPUE in 2005 remained the same as the 2004 value while yellow perch CPUE increased to a five-year high.

Seventeen species of age-0 fishes or small littoral prey species were collected by seining in 2005. Age-0 gizzard shad were most common in 2005 seine catches, accounting for 81% of the total catch, while age-0 white bass accounted for 8% of the total catch. Emerald shiners, freshwater drum, spottail shiners, smallmouth bass, goldeye, yellow perch, walleye, channel catfish, red shiners, johnny darter, sauger and common carp were also common in seine catches.

Walleye mean age and relative weight (W_r) in 2005 were similar to previous year's values, while proportional stock density (PSD), survival and overall walleye abundance increased. Walleye growth during 2005 increased over that observed the past two years. Sauger gill net CPUE decreased in 2005 to a five-year low. Sauger PSD increased while survival decreased during 2005. Both sauger mean age and growth increased from 2004 to 2005. The number of smallmouth bass collected in fall netting surveys was inadequate to allow meaningful population parameter comparisons.

Anglers spent an estimated 554,440 hours fishing LFC, during the April-September 2005 daylight period, a decrease from the 659,184 hours estimated for 2004 and over 400,000 hours less than the high estimated for 1999. Total fish harvest in 2005 was estimated at 168,883 fish. Walleye dominated the harvest, with an estimated 102,693 fish harvested in the April-September 2005 survey period. Estimated mean length of harvested walleye was 404 mm (15.9 in). White bass, channel catfish, smallmouth bass, and sauger were also common in the harvest. An overall catch rate (harvest and release rates combined) of 0.9 fish/angler-h was estimated for the April-September 2005 daylight period. Total catch, release, and harvest rates for walleye were 0.55 walleye/angler-h, 0.37 walleye/angler-h, and 0.19 walleye/angler-h, respectively. Approximately 69% of LFC anglers expressed some degree of satisfaction with their angling trip. Anglers from South Dakota and 17 other states, fishing LFC, generated a local economic impact estimated at approximately 6.9 million dollars, in 2005. Results from several questions regarding LFC angler attitudes and preferences are reported.

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ANNUAL FISH POPULATION AND ANGLER USE AND SPORT FISH HARVEST SURVEYS ON LAKE FRANCIS CASE, SOUTH DAKOTA, 2005

INTRODUCTION

Lake Francis Case (LFC), a Missouri River mainstem reservoir, has provided more than 100,000 angler days of recreation annually since 1992 (Table 1). The river segments and reservoirs comprising the Missouri River system, in South Dakota, provide a large and diverse portion of the state's available fishing opportunity. The importance of this system to South Dakota anglers was documented in a 1992 Angler Use and Preference Survey (Mendelsohn 1994; Stone 1996a), in which 50 percent of the respondents listed the "Missouri River and its reservoirs" as their preferred fishing area. Recognizing the importance of the Missouri River, strategic planning efforts (SDGFP 1994) by the South Dakota Department of Game, Fish and Parks (SDGFP) have designated the Missouri River as a specific planning program within the overall planning effort.

Walleye, and to a lesser extent smallmouth bass, white bass and channel catfish, provide the majority of sport fishing opportunity available in this reservoir. Over the past 24 years, management of the walleye sport fishery has undergone several significant changes in response to changes in walleye population structure and angler use and harvest (Stone 1990; Stone et al. 1994; Stone and Sorensen 1999, 2001; Sorensen and Knecht 2006). Harvest regulations for walleye/sauger and their hybrids for LFC in 2005 included:

- daily and possession limits of 3 and 8 per angler, respectively.
- a minimum length limit of 381 mm (15 in.) for all months of the year except July and August.
- anglers are allowed only one walleye/sauger or hybrid per day longer than 457 mm (18 in.), year-round.
- anglers are not allowed to "cull" or "hi-grade" walleye/sauger or hybrids.
- anglers fishing through the ice in the lower half of the reservoir are required to keep the first three walleye/sauger or hybrids they catch and size restrictions do not apply.
- closed area: the area in the upper portion of the reservoir, between I-90 and the railroad bridge, referred to as the "dredge hole" is closed to fishing (except shore fishing on the Brule County side) during the months of January through April and December.

LFC anglers fishing in the late 1990s and early 2000s benefited from high walleye abundance resulting from conditions provided by unusually high water levels in 1995 and 1997. However, during 2005, with water yield in the Missouri River Basin entering the sixth consecutive year of below normal conditions, past research (Stone 1997b) and observations would suggest that it will be unrealistic to expect to maintain fish population abundance at the levels observed in the mid-to-late 1990s. Walleye abundance has steadily decreased over the past four years due to persistent drought conditions.

Maintaining LFC as one of South Dakota's most productive fisheries resources requires that it be effectively managed to produce optimal recreational benefits, within the framework of protecting and maintaining the overall integrity of the aquatic community. The Missouri River Fisheries Program Strategic Plan (SDGFP 1994) documents the goal, objectives and strategies developed for management of this system. Annual acquisition and analysis of data describing the fish community and fish population parameters, in association with data describing angler use and sport fish harvest, is a primary strategy outlined in that plan. This work is required for evaluation of objectives and strategies outlined in the strategic plan and as a prerequisite to effective development of future management strategies. This report describes data collected in 2005 from LFC and the discussion focuses on changes in fish populations and associated angler use and sport fish harvest since 2000.

Table 1. Angler use and sport fish harvest statistics from creel surveys conducted on Lake Francis Case since 1954. TL = total length.

Year	Fishing pressure (h)	Angler days	Mean trip length (h)	Total fish harvest (No.)	Walleye harvest (No.)	Total harvest rate (Fish/angler-h)	Walleye harvest rate (Fish/angler-h)	Mean walleye TL(mm) in harvest	Reference
1954	84,000	35,000	2.4	115,000	0	1.369	0.000	-	Shields (1955)
1955	119,000	41,000	2.9	105,000	190	0.882	0.002	-	Shields (1956)
1956	159,000	47,500	3.4	89,500	177	0.563	0.001	-	Shields (1957)
1960	425,000	78,500	5.3	114,310	1,386	0.269	0.003	-	Nelson (1961)
1981*	565,890	99,280	5.7	173,730	145,412	0.307	0.257	-	Miller (1984)
1982	557,570	101,375	5.5	136,150	110,554	0.244	0.198	-	Miller (1984)
1983	425,060	74,570	5.7	102,070	70,434	0.240	0.166	-	Unkenholz et al. (1984)
1984	433,640	86,730	5.0	259,070	242,431	0.597	0.559	-	Stone (1985)
1989	604,100	115,290	5.2	289,854	222,008	0.480	0.368	340	Stone and Wickstrom (1991a)
1990	383,711	81,641	4.7	117,155	64,596	0.305	0.169	368	Stone and Wickstrom (1991b)
1991	409,600	87,521	4.7	139,600	95,298	0.341	0.233	381	Stone and Wickstrom (1992)
1992#	640,215	127,215	5.0	267,105	217,841	0.417	0.339	386	Stone et al. (1994)
1993	589,153	115,520	5.1	126,231	95,425	0.214	0.161	386	Stone et al. (1994)
1994	695,371	131,202	5.3	220,386	174,775	0.317	0.251	386	Stone (1995)
1995	543,414	113,923	4.8	185,354	158,354	0.341	0.292	391	Stone (1996b)
1996	856,421	190,316	4.5	324,221	274,339	0.379	0.320	383	Stone (1997a)
1997	652,510	143,409	4.6	307,297	285,463	0.471	0.437	385	Stone (1998)
1998	961,343	204,324	4.7	397,535	339,889	0.413	0.354	396	Stone and Sorensen (1999)
1999	997,871	212,902	4.7	359,440	285,186	0.360	0.286	417	Stone and Sorensen (2000)
2000	809,806	149,964	5.4	248,234	196,795	0.306	0.243	412	Stone and Sorensen (2001)
2001	780,962	152,830	5.1	242,869	199,372	0.311	0.255	409	Stone and Sorensen (2002)
2002	714,510	148,856	4.8	215,275	178,666	0.301	0.250	405	Stone and Sorensen (2003)
2003	710,078	139,231	5.1	205,705	162,581	0.290	0.229	411	Sorensen (2004)
2004	659,184	134,527	4.9	162,512	113,813	0.247	0.173	407	Sorensen and Knecht (2006)
2005	554,440	113,151	4.9	168,882	102,693	0.305	0.185	404	This study

* Estimate projected from a creel survey for approximately 1/3 of reservoir.

Estimate was for May-August only.

OBJECTIVES

The objectives of the surveys discussed in this report are to provide information on or estimates of:

Annual Fish Population Surveys (Federal Aid Project 2102):

- (1) species composition
- (2) relative abundance
- (3) condition
- (4) age, growth, and recruitment
- (5) survival and mortality rates
- (6) population size structure
- (7) effects of regulations
- (8) effects of stocking and other management activities
- (9) effects of sport fish harvest

Fish tagging was also conducted to provide information on fish movement and angler exploitation.

Angler Use and Sport Fish Harvest Survey (Federal Aid Project 2109):

- (1) recreational angling pressure
- (2) angler catch, harvest, and release, by species
- (3) angler catch, harvest, and release rates, by species
- (4) mean angler party size and mean length of an angler day
- (5) annual direct economic impact of this sport fishery
- (6) effects of regulations
- (7) effects of stocking and other management activities
- (8) angler demographics
- (9) angler preference, satisfaction and attitudes

STUDY AREA

Lake Francis Case is located in south-central South Dakota (Figure 1). Historical, biological, chemical and physical parameters have been discussed in North Central Reservoir Investigation reports (Benson 1968; Gasaway 1970; Walburg 1977). Table 2 presents selected physical characteristics and management statistics for Lake Francis Case.

Water yield in the Missouri River system in 2005 was below normal and was the sixth consecutive year of below normal inflow following six years of above normal yield (Appendix 1; U.S. Army Corps of Engineers, unpublished data). During the spring of 2005, the elevation of LFC increased as was forecasted by the U.S. Army Corps of Engineers (USCOE). Reservoir elevation reached 413 m msl (1354.3 ft. msl) by late March and remained above this level until the annual fall draw-down began in August. Appendix 1 presents monthly data on water released through Ft. Randall Dam.

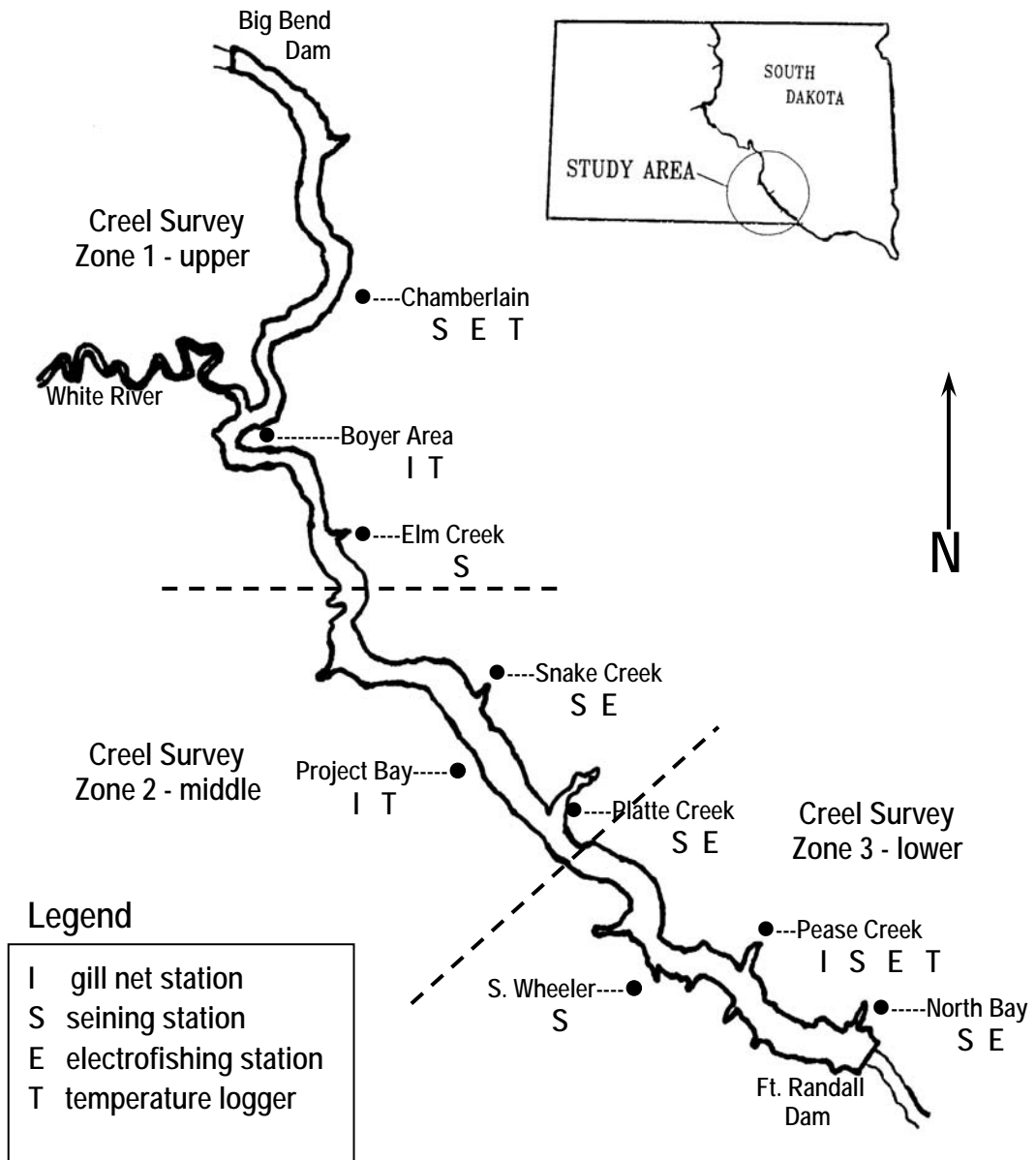


Figure 1. Lake Francis Case study area.

Table 2. Physical characteristics at base of flood control, management classification, and sampling times and depths for annual fish population surveys on Lake Francis Case.

	Lake Francis Case
Location:	From Pickstown to Ft. Thompson, SD
Surface Area (x 1000 ha):	32.0
Depth (m) - maximum: - mean:	42.6 15.2
Substrate:	Sand, gravel, shale and silt
Water source:	Missouri River and tributaries
Management classification:	Cool and warm water permanent
Electrofishing - walleye - smallmouth bass	April, May May, June
Gill net depths:	0-12 m (0-40 ft) 12-24 m (40-80 ft) 24-37 m (80-120 ft)
Number of gill nets:	27
Gill net date:	September
Seine date:	July

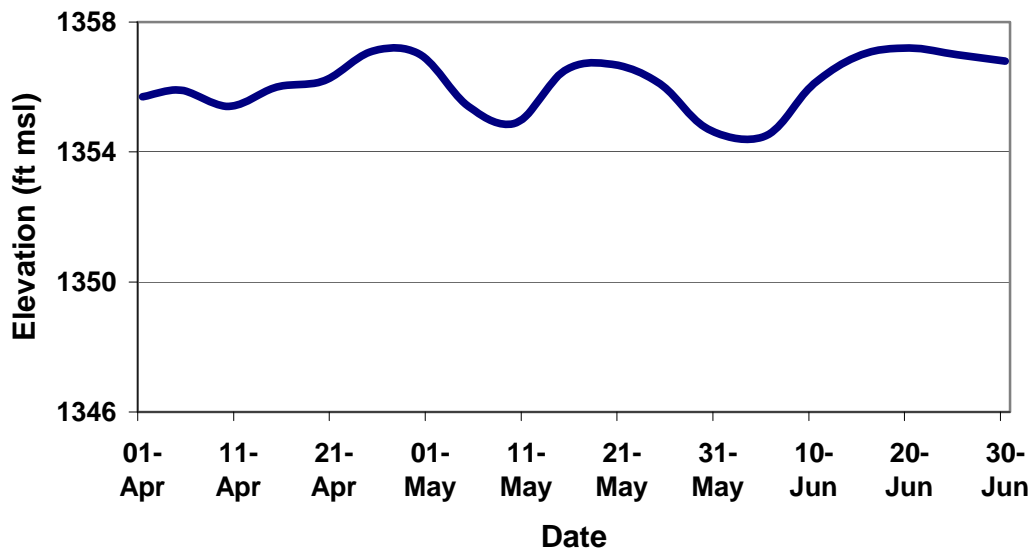


Figure 2. Spring 2005 Lake Francis Case reservoir elevation.

SAMPLING METHODS AND SCHEDULE

FISH POPULATION SURVEYS AND ASSOCIATED WORK ACTIVITIES

Data Collection

Gill nets, seines, and electrofishing were used to sample fish populations in LFC at locations identified in Figure 1. Three variable-mesh standard gill nets (Lott et al. 1994) were fished overnight, on the bottom, in one embayment and in each depth zone (where possible), at each station (Table 2). All fish species collected were identified, counted, measured for total length (TL; mm) and weighed (g). Scale samples and otoliths (100 per species per sampling location) were collected from walleye, sauger, smallmouth bass and white bass, where possible.

Pulsed-DC (60 pps, 6-8 amps) electrofishing, using a Smith Root GPP electrofishing boat, was used to collect walleye during April and smallmouth bass during May and June, for population monitoring (fish/min) and tagging studies. Nine and six 10-minute electrofishing runs were conducted at night near Chamberlain and on the face of Ft. Randall Dam, respectively, to collect walleye. Smallmouth bass were collected at five locations: Chamberlain, Big Bend Dam tailwater, Platte Creek, Pease Creek and near Ft. Randall Dam (Figure 1). Three, 30-minute electrofishing runs were conducted at each sampling location. All fish were measured for total length.

Nylon seines, previously described by Lott et al. (1994), were used to collect age-0 fishes and small littoral species. A quarter-arc seine haul was accomplished by methods described in Martin et al. (1981). Four seine hauls were made at each sampling station; two on each side of the reservoir. All fish collected with seines were identified to species and counted. Walleye were measured for total length.

Water temperature data was collected with submersible HOBO Water Temp Pro temperature loggers. Loggers, configured to record temperature every two hours, were deployed at four locations (Figure 1) on the reservoir April 7, 2005 and retrieved October 19, 2005.

A list of common names, scientific names, and abbreviations of fish mentioned throughout this report is presented in Appendix 2.

Data Analysis

Relative abundance of fish species was expressed as mean catch per unit effort (CPUE) for standard gill net (No./net night), electrofishing (No./min.), and seine catches (No./haul). Age and growth analyses were completed for walleye, sauger and smallmouth bass. Scales and otoliths were aged according to standard techniques (DeVries and Frie 1996). Back-calculations for scale analysis were made with the computer program WINFIN (Francis 1999, 2000). Standard y-intercept values, suggested by Carlander (1982), were used for walleye (55 mm), sauger (55 mm), and smallmouth bass (35 mm). Age distributions from gill net catches were developed, for selected species, by aging approximately 100 fish randomly selected per sampling station (when available). Proportional stock density (PSD) and relative stock density (RSD) values for preferred- (RSD-P) and memorable- (RSD-M) length fish were calculated for channel catfish, sauger, smallmouth bass, walleye, white bass, and yellow perch (Anderson and Weithman 1978; Gabelhouse 1984). Length categories (Gabelhouse 1984) used to calculate PSD and RSD are listed in Table 3.

Table 3. Minimum lengths (mm) of length class designations (Gabelhouse 1984).

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	250	380	510	630	760
Sauger	200	300	380	510	630
Smallmouth Bass	180	280	350	430	510
Channel Catfish	280	410	610	710	910
White Bass	150	230	300	380	460
Yellow Perch	130	200	250	300	380

Relative weight (W_r ; Anderson 1980), for stock-to-quality (S-Q), quality-to-preferred (Q-P), and preferred-length (P) fish (Table 3) was calculated using length designations established by Gablehouse (1984). Relative weight (W_r) values were generated using standard weight (W_s) equations developed for walleye (Murphy et al. 1990), sauger (Guy et al. 1990), smallmouth bass (Kolander and Willis 1991), channel catfish (Brown et al. 1995), yellow perch (Willis et al. 1991), and white bass (Brown and Murphy 1991). Standard weight equations used in this report are provided in Appendix 3. Mean W_r values were tested for differences among length-class designations using a one-way analysis of variance (SYSTAT, 1998). A mean W_r value for stock-length fish is reported when no significant differences were detected among length categories. Statistical significance was set at $P < 0.05$.

Length-weight regression equations were developed for walleye, sauger, and smallmouth bass using Systat 8.0 (SYSTAT 1998). The equations are presented in Appendix 4.

Survival and mortality estimates for walleye, sauger, and smallmouth bass were calculated using catch curves (Ricker 1975). To reduce the effects of variable recruitment, two consecutive years of age-distribution data, from the gill net survey, were combined for analysis. Catch curves were analyzed to determine the age at which each species was fully recruited to the sampling gear. To estimate instantaneous mortality rates (Z), the slope of the regression of the natural logarithm of the number of fish of each age on fish age was used.

ANGLER USE AND SPORT FISH HARVEST SURVEY

A bus route creel survey design (Jones and Robson 1991; Soupir and Brown 2002), first utilized in 2000 (Stone and Sorensen 2001), was conducted to estimate angler use and harvest on LFC. Prior to 2000, fishing pressure was estimated by either aerial counts of fishing boats and shore anglers (Schmidt 1975) or by ground counts of boat trailers and shore anglers (Stone and Sorensen 1999). A bus route design is a modified access survey typically used for fisheries with numerous access sites spread over a broad geographical region (Robson and Jones 1989; Jones et al. 1990). For a more detailed description of the bus route theory and techniques see Robson and Jones (1989), Jones and Robson (1991) and Pollock et al. (1994). Estimates of angler catch, harvest, and release rates, along with information on mean party size, mean angler day length, and angler residency were collected by interviewing anglers. Total fish catch, harvest and release estimates were calculated by multiplying the pressure estimate (angler hours) by the estimated catch, harvest, or release rate (fish/angler-h). Despite the modification to the fishing pressure estimate technique, the survey design provides statistics comparable to those previously determined for LFC (Miller 1984; Unkenholz et al. 1984; Stone 1985; Stone and Wickstrom 1991a, 1991b, 1992; Stone et al. 1994; Stone 1995, 1996b, 1997a, 1998; Stone and Sorensen 1999, 2000, 2001, 2002, 2003; Sorensen 2004; Sorensen and Knecht 2006).

Sampling was conducted from 1 April 2005 through 30 September 2005, for the daylight period (sunrise to sunset). Creel zones are identified in Figure 1.

ANGLER PREFERENCE AND ATTITUDE SURVEY

A series of questions were selected by SDGFP reservoir fisheries biologists and human dimensions staff to measure angler satisfaction, preferences, and attitudes on several management issues. Questions selected were those thought to have a direct relationship to current reservoir fisheries management.

Questions were asked of individual anglers by incorporating two different sets of questions into routine creel-survey-interview forms. One person, from each angling party, was asked one series of questions. The questions appeared on an alternating basis on creel survey interview forms, in an attempt to reduce duplication in subsequent interviews. Responses were encoded into a database for summary and analysis.

RESULTS

FISH POPULATION SURVEYS AND ASSOCIATED WORK ACTIVITIES

Species Composition and Relative Abundance

Results of spring electrofishing, conducted to monitor timing and abundance of spawning walleye, are presented in Tables 4 - 6. Overall walleye electrofishing CPUE in 2005, near Chamberlain, was similar to values measured in previous years (Table 4). Walleye electrofishing CPUEs near Chamberlain were similar between sampling dates during 2005 (Table 6). Sampling near Ft. Randall Dam, during 2005, yielded a CPUE within the range of the five-year period (Table 5). Electrofishing CPUEs near Ft. Randall Dam were similar among sampling dates during 2005 (Table 6).

Table 4. Electrofishing catch of walleye during spring-spawning-run sampling from Lake Francis Case, near Chamberlain, 2001-2005. Catch per unit effort (CPUE) values with the same letter code are not significantly different at the $P = 0.05$ level.

Year	Sampling time (min)	Number of fish	CPUE (fish/min)
2001	83	777	9.4 a
2002	50	623	12.5 a
2003	70	628	9.0 a
2004	90	749	8.3 a
2005	75	773	10.3 a

Table 5. Electrofishing catch of walleye during spring-spawning-run sampling from Lake Francis Case, near Ft. Randall Dam, 2001-2005. Catch per unit effort (CPUE) values with the same letter code are not significantly different at the $P = 0.05$ level.

Year	Total Sampling time (min)	Number of fish	CPUE (fish/min)
2001	66	344	5.2 a
2002	120	445	3.7 a
2003	90	431	4.8 a
2004	60	245	4.1 a
2005	60	360	6.0 a

Table 6. Electrofishing data, by location and date, for walleye from Lake Francis Case, 2005. Catch per unit effort (CPUE) values, by location, with the same letter code are not significantly different at the $P = 0.05$ level.

Location	Date	Water temp. (C)	Total Sampling time (min)	No. of fish	CPUE (fish/min)
Chamberlain	4/12/05	8.2	30	281	9.4 a
Chamberlain	4/18/05	11.4	25	247	9.9a
Chamberlain	4/25/05	10.3	20	245	12.3 a
Ft. Randall Dam	4/24/05	9.8	30	194	6.5 a
Ft. Randall Dam	4/28/05	8.6	30	166	5.5 a

Catch-per-unit-effort of smallmouth bass during 2005 was similar to those measured previously (Table 7). Although not statistically significant, increases in smallmouth bass CPUE were observed at the Platte Creek, Pease Creek and Ft. Randall Dam sampling stations. Smallmouth bass CPUE of 1.6 and 1.0 fish/min. for the Pease Creek and Platte Creek sampling stations, respectively, were the highest of the five-year period for their respective sampling station (Table 7).

Table 7. Electrofishing catch of smallmouth bass during spring sampling, at five locations on Lake Francis Case, 2001-2005. Catch per unit effort (CPUE) values within sites with the same letter code are not significantly different at the $P = 0.05$ level.

Chamberlain			
Year	Sampling time (min)	Number of fish	Fish/min
2001	45	45	1.0 a
2002	49	75	1.5 a
2003	45	122	2.7 a
2004	55	62	1.1 a
2005	60	67	1.1 a
Big Bend Dam Tailwaters			
Year	Sampling time (min)	Number of fish	Fish/min
2001	60	49	0.8 a
2002	90	126	1.4 a
2003	60	112	1.9 a
2004	30	67	2.2 a
2005	60	55	0.9 a
Platte Creek			
Year	Sampling time (min)	Number of fish	Fish/min
2001	60	32	0.5 ab
2002	90	12	0.1 b
2003	90	83	0.9 a
2004	45	30	0.7 ab
2005	60	59	1.0 a
Pease Creek			
Year	Sampling time (min)	Number of fish	Fish/min
2001	60	28	0.5 a
2002	90	50	0.6 a
2003	90	102	1.1 a
2004	55	24	0.4 a
2005	45	71	1.6 a
Ft. Randall Dam			
Year	Sampling time (min)	Number of fish	Fish/min
2001	60	76	1.3 a
2002	90	232	2.6 a
2003	90	175	1.9 a
2004	30	23	0.8 a
2005	60	62	1.0 a

Fall gill-net sampling collected 16 species of fish from LFC in 2005 (Table 8). All species had been previously reported (Lott et al. 1994). Walleye have been the most common species in gill net catches since re-initiation of this survey in 1981 (Michaletz et al. 1986; Lott et al. 1994), and comprised 36% of gill net catches in 2005, followed by channel catfish and sauger, which accounted for 13% and 10% of the catch, respectively. White bass, gizzard shad, yellow perch, goldeye, freshwater drum, smallmouth bass, river carpsucker, smallmouth buffalo, shortnose gar, and common carp were also common in gill-net catches during 2005.

Walleye gill net CPUE of 11.7 fish/net in 2005 increased from 2004 and was the second highest value recorded in the five-year period (Table 8). This increase in abundance can be attributed primarily to high walleye production combined with low angler harvest of walleye in 2005.

Channel catfish gill net CPUE of 4.1 fish/net in 2005 was similar to other years in the five-year period. Fifteen age classes of channel catfish were represented in the 2005 gill net sample ranging from age 1 to age 15. Sauger gill net CPUE in 2005 declined to 3.3 fish/net and is at the low for the five-year period. Smallmouth bass gill net CPUE for 2005 was similar to other years in the five-year period. Yellow perch gill net CPUE increased to 2.4 fish/net, a high for the five-year period. White bass gill net CPUE increased to 3.0 white bass/net during 2005.

Seventeen species of age-0 fishes or small littoral species were collected by seining in 2005 (Table 9). All species had been previously reported for LFC (Lott et al. 1994). Age-0 gizzard shad made up 81% of the total seine catch, as they have for the previous five years. White bass and emerald shiners comprised 9 and 4 percent of the total seine catch, respectively. Channel catfish, common carp, freshwater drum, goldeye, johnny darters, red shiners, sauger, smallmouth bass, spottail shiners, walleye, and yellow perch were also common in seine samples.

The 2005 age-0 walleye seining CPUE of 0.8 fish/seine haul was similar to that measured in 2004. Age-0 walleye collections in 2005 followed a normal LFC pattern, with most of the fish collected in the upper half of the reservoir. Walleye collected in seines, in mid-July, averaged 102.3 mm (Table 10) in 2005, an increase over the previous four years.

Table 8. Mean gill net catch per lift (CPUE; No./net night), sampling stations combined, on Lake Francis Case, 2001-2005. SE is standard error. Trace (T) < 0.1.

Species	2001		2002		2003		2004		2005	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Black bullhead	0.0		0.0		0.0		0.0		0.0	
Channel catfish	4.4	0.5	5.6	0.6	5.6	0.9	4.4	0.8	4.1	0.5
Common carp	0.9	0.3	1.8	0.4	0.9	0.2	0.8	0.2	0.9	0.2
Emerald shiner	T	-	0.0		T	-	0.0		0.0	
Freshwater drum	1.1	0.3	0.7	0.2	0.3	0.1	0.8	0.3	1.3	0.4
Gizzard shad	12.0	3.8	1.8	0.8	1.1	0.7	0.8	0.3	2.8	1.2
Goldeye	2.2	0.9	1.0	0.4	1.2	0.4	1.5	0.6	1.5	0.5
Northern pike	T	-	T	-	0.0		0.0		T	-
Rainbow trout	T	-	0.0		0.0		T	-	0.0	
River carpsucker	0.2	0.1	0.3	0.2	0.1	0.1	0.5	0.2	0.1	0.1
Sauger	4.9	0.7	6.3	1.0	4.0	0.6	4.7	0.7	3.3	0.4
Shorthead redhorse	0.2	0.1	0.3	0.1	0.0		0.1	0.1	T	-
Shortnose gar	0.1	0.1	0.0		0.2	0.1	0.2	0.1	0.1	0.1
Shovelnose sturgeon	T	-	0.0		0.0		0.0		0.0	
Smallmouth bass	0.6	0.2	1.4	0.6	0.9	0.3	0.7	0.4	0.7	0.3
Smallmouth buffalo	0.0		T	-	0.1	0.1	T	-	0.1	0.1
Spottail shiner	T	-	T	-	0.2	0.2	0.1	0.1	T	-
Walleye	11.3	1.1	15.9	2.0	9.6	1.0	8.6	1.0	11.7	1.7
White bass	4.2	1.1	0.9	0.2	1.6	0.4	0.6	0.2	3.0	0.8
White crappie	0.7	0.3	0.1	0.1	0.1	0.1	T	-	0.0	
Yellow perch	0.3	0.1	0.6	0.1	1.0	0.3	1.2	0.4	2.4	0.7

Table 9. Mean catch per seine haul (CPUE; No./haul), sampling stations combined, of age-0 fishes and small littoral species from Lake Francis Case, 2001-2005. SE is standard error. Trace (T) < 0.1

Species	2001		2002		2003		2004		2005	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	T	-	0.0		0.0		0.0		T	-
Black bullhead	0.0		0.0		0.0		0.0		0.0	
Black crappie	T	-	0.0		0.0		0.0		0.0	
Channel catfish	0.2	0.2	0.0		0.0		0.5	0.3	0.2	0.1
Common carp	0.5	0.4	0.1	0.1	0.0		0.6	0.3	0.1	0.1
Common shiner	0.3	0.3	0.0		0.2	0.2	0.0		0.0	
Emerald shiner*	35.4	12.8	26.9	8.9	22.0	8.4	45.1	12.2	17.8	3.3
Fathead minnow*	1.7	1.0	T	-	0.1	0.1	0.0		0.0	
Freshwater drum	0.5	0.3	1.0	0.6	6.3	3.5	0.4	0.2	8.9	2.6
Gizzard shad	793.7	495.1	3659.1	1610.8	934.2	299.3	290.6	100.6	332.8	116.8
Goldeye	0.3	0.3	T	-	0.0		0.1	0.1	2.5	1.5
Johnny darter*	3.2	1.4	0.4	0.3	5.4	2.5	8.4	5.4	0.1	0.1
Largemouth bass	0.0		0.0		0.0		0.0		0.0	
North. Redbelly dace	T	-	0.0		0.0		0.0		0.0	
Red shiner*	0.6	0.3	0.4	0.2	0.1	0.1	0.4	0.2	0.2	0.2
River carpsucker	0.2	0.2	0.3	0.1	0.1	0.1	5.4	1.8	T	-
Sauger	0.3	0.2	T	-	0.0		0.1	0.1	0.1	0.1
Shorthead redhorse	T	-	0.0		0.0		0.0		0.0	
Silvery minnow	0.0		0.0		0.1	0.1	0.0		0.0	
Smallmouth bass	1.5	0.7	1.8	0.7	1.3	0.4	2.6	0.7	2.6	0.5
Smallmouth buffalo	1.8	0.8	T	-	0.0		T	-	T	-
Spottail shiner*	33.4	12.5	3.3	1.3	11.5	2.7	6.8	2.5	6.5	1.9
Walleye	11.9	4.7	3.5	1.3	2.3	1.3	0.3	0.1	0.8	0.3
White bass	389.1	130.0	65.1	23.4	11.2	5.4	65.2	21.0	38.7	16.1
White crappie	0.2	0.1	0.0		0.0		0.0		0.0	
Yellow perch	41.2	25.7	10.0	4.6	3.6	1.4	5.8	2.3	1.7	0.6

*includes both age-0 and adults

Table 10. Number (No.), catch per unit effort (CPUE; No./haul), mean total length (TL) and length range for age-0 walleye collected by seines from Lake Francis Case, 2001 – 2005.

Year	No.	CPUE	Mean TL (mm)	Total length (mm) range
2001	322	11.9	68.3	41 - 91
2002	95	3.5	80.0	63 - 109
2003	65	2.4	88.2	62-103
2004	9	0.3	88.5	85-92
2005	21	0.8	102.3	85-116

Population Parameters for Walleye

Beginning in 2003, otoliths were removed from walleye and sauger collected during the September gill netting survey. Mean length at capture for each age group is listed in Table 11. Mean length at age at time of capture shows Lake Francis Case walleye typically reach the minimum legal length (381 mm) at age 3 suggesting that the 2005 year class won't reach legal length until 2008. One concern with the use of minimum length limits is a reduction in growth rates resulting in "stockpiling" of fish just below the minimum length limit (Noble and Jones 1993). Current LFC length-at-age data suggests that stockpiling is not occurring. Mean annual growth increments for walleye indicate that growth increased during the 2004-2005 period (Table 12). Mean walleye age in gill net samples, at 2.2 years, is similar to values generated for 2001-2004 (Table 13). Walleye from seven year-classes were collected in the 2005 gill net survey (Table 13) and ranged in TL from 110-mm to 520-mm (Figure 3).

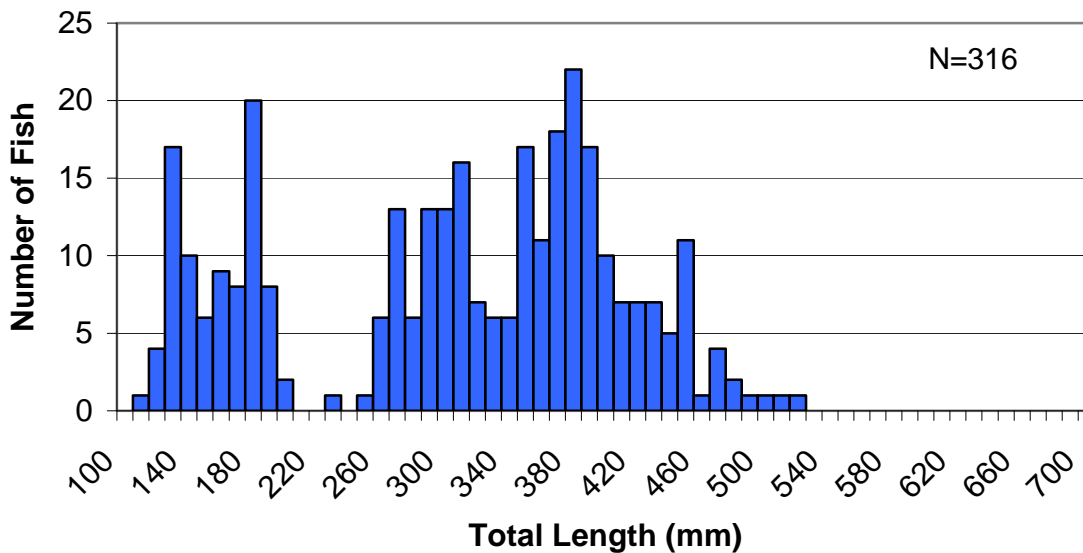


Figure 3. Length frequency of walleye collected with gill nets from Lake Francis Case, 2005. N = sample size.

Annual survival, for pooled 2004 and 2005 data, was estimated at 54% (Table 14), within the range of the five-year period. Relative weights for stock-quality (S-Q) length and quality-preferred (Q-P) length fish sampled in 2005 were similar to previous years (Table 15). Walleye proportional stock density (PSD) for 2005 increased from 2001-2004 values as a result of a strong 2005 year class (Table 16).

Table 11. Mean length-at-age-at-capture (mm) for walleye, as determined by aging otoliths, collected in the standard September gill net survey, 2003-2005, Lake Francis Case, South Dakota. N=sample size

Year	Length at age at capture (mm)											
	1	2	3	4	5	6	7	8	9	10	11	
2003	Mean	262	332	377	423	460	425	460				710
	N	61	66	39	12	7	4	3	0	0	0	1
	SE	2.9	6.0	3.9	8.4	14.5	12.9	33.9				NA
2004	Mean	266	347	385	418	438	410	465	421			
	N	63	75	22	19	12	1	1	1	0	0	0
	SE	3.3	2.9	7.3	4.7	10.7	NA	NA	NA			
2005	Mean	298	374	413	455	447	477					
	N	80	82	40	12	5	7	0	0	0	0	0
	SE	2.0	2.2	4.4	8.2	11.1	15.2					
Mean of means	275	351	392	432	448	437	463	421				710

Table 12. Mean annual growth increments for walleye collected in the standard September gill net survey on Lake Francis Case, South Dakota for 2003-2004, 2004-2005 as determined by aging otoliths. N = sample size.

Year	Growth increment added during period (mm)									
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11
2003-2004	85	53	41	15	0	40	0	--	--	--
2004-2005	108	66	70	29	39	--	--	--	--	--

Table 13. Age distribution, from otolith analysis, of walleye collected from Lake Francis Case with variable-mesh gill nets, 2003-2005. Mean age excludes age-0 fish.

Year	Age												
	0	1	2	3	4	5	6	7	8	9	10	11	Mean
2003	18	61	66	39	12	7	4	3	0	0	0	1	2.3
2004	6	63	75	22	19	12	1	0	2	0	0	0	2.3
2005	6	80	82	40	12	5	7	0	0	0	0	0	2.1

Table 14. Estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (Z) for age-1-and-older fish of selected species, from Lake Francis Case. Years indicate which years of annual gill net survey data were combined for analysis.

Species	Years	S	A	-z	R ²
Walleye	2000-2001	0.43	0.57	0.846	0.911
	2001-2002	0.39	0.61	0.940	0.916
	2002-2003	0.47	0.53	0.755	0.955
	2003-2004	0.46	0.54	0.769	0.954
	2004-2005	0.54	0.46	0.621	0.905
Sauger	2000-2001	0.36	0.64	1.018	0.918
	2001-2002	0.31	0.69	1.166	0.839
	2002-2003	0.34	0.66	1.082	0.861
	2003-2004	0.52	0.48	0.652	0.821
	2004-2005	0.38	0.62	0.977	0.812
Smallmouth bass	2000-2001	0.49	0.51	0.723	0.565
	2001-2002	0.54	0.46	0.607	0.820
	2002-2003	0.45	0.55	0.788	0.853
	2003-2004	0.20	0.80	1.590	0.938
	2004-2005	0.36	0.64	1.010	0.862

Table 15. Mean relative weight, by length category, for Lake Francis Case walleye, sauger, and smallmouth bass, collected in gill net catches in early September, 2001-2005. S-Q = stock-to-quality length, Q-P = quality-to-preferred length, P = preferred length. N = sample size.

Walleye				
Year	S-Q	Q-P	P	N
2001	82	83	78	243
2002	83	81	86	274
2003	81	80	73	196
2004	83	82	77	185
2005	84	84	77	229
Sauger				
Year	S-Q	Q-P	P	N
2001	74	76	75	128
2002	76	73	73	119
2003	74	73	69	88
2004	74	74	73	124
2005	82	75	75	83
Smallmouth bass				
Year	S-Q	Q-P	P	N
2001	111	110	119	12
2002	111	107	101	29
2003	111	110	-	20
2004	112	105	-	15
2005	118	108	110	14

Table 16. Walleye, sauger, and smallmouth bass proportional stock density (PSD) and relative stock density for preferred- and memorable-length fish (RSD-P and RSD-M, respectively), for Lake Francis Case gill net data, 2001-2005.

Species	2001	2002	2003	2004	2005
Walleye	34 (0,0)	34 (1,0)	24 (1,0)	27 (1,0)	42 (1,0)
Sauger	69 (17,0)	63 (20,0)	51 (18,0)	75 (11,0)	95 (41,0)
Smallmouth bass	50 (8,0)	35 (7,0)	25 (0,0)	33 (0,0)	64 (14,0)

Yearly total walleye abundance (CPUE), as indexed by fall gill netting, partitioned by selected age and size groups and plotted with total runoff (millions of acre-feet) into the Missouri River system above Sioux City, IA is presented in Figure 4. Walleye population parameter improvements were noted soon after sport-fishing-regulation changes were implemented in 1990 (Stone and Wickstrom 1991a). The population also positively responded to habitat/nutrient conditions provided by the high runoff into the Missouri River system during 1993–1997 (Stone 1997b). The general decline in overall walleye abundance beginning in 1996 through 2004 can be attributed to angler harvest coupled with declining productivity, as Missouri River water yield returned to more normal levels in 1998 and 1999, followed by six consecutive years of drought conditions. The decrease in abundance can be attributed to poor nutrient conditions caused by reduced localized run off resulting in poor production and recruitment during 2001-2004. Following a sharp decrease in water elevation during the peak walleye egg incubation period in 2002, the Department of Game, Fish and Parks stocked 400,000 walleye fingerlings and 4 million walleye fry. There appeared to be a large walleye year class produced in 2002 and although origin of these age-0 fish could not be determined, their smaller-than-average size in fall gill net samples led to the assumption that a majority of these fish were a result of stocking efforts. Unfortunately, the strong 2002 year class did not translate into a strong age-1 or age-2 year class in 2003 and 2004 and a significant portion of these fish were lost from the population (Table 13). Walleye abundance in 2005 increased to levels similar to the early 2000's, but remains well below abundance levels experienced in the late 1990's. This increase in abundance can be primarily attributed to a strong year class of walleye being produced in 2005. Localized run-off during the spring of 2005 created conditions conducive to good production and survival of walleye fry. Walleye produced in 2005 will not enter the angler harvest until 2008, when they surpass the minimum length limit.

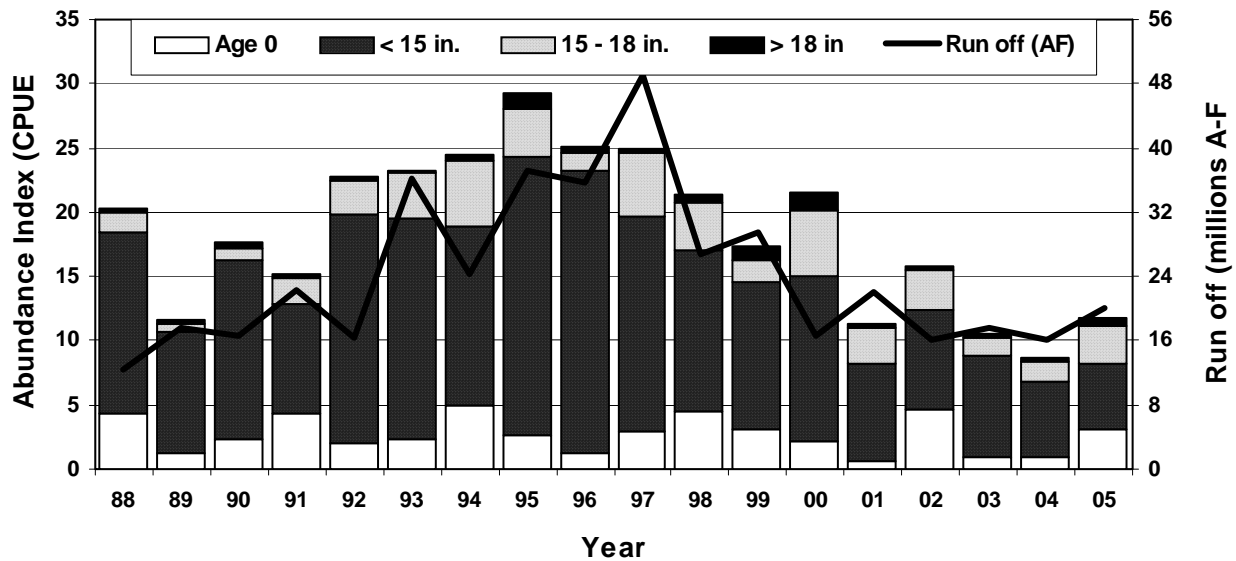


Figure 4. Lake Francis Case total walleye abundance (No. per net night) partitioned by walleye age and length groups and plotted against total runoff (millions of acre-feet) into the Missouri River system above Sioux City, IA. 1988-2005.

Population Parameters for Sauger

The 2005 Lake Francis Case sauger abundance index, at a mean CPUE of 3.3 fish/net night, decreased from 2004, and was the low for the five-year period (Table 8). Lengths of sauger sampled in the 2005 gill net survey ranged from 150 mm to 440 mm TL (Figure 5). Sauger average length-at-age-at-capture indicates that LFC sauger surpass 381mm at age 3 or 4 (Table 17). Sauger up to age six were sampled in the 2005 gill net survey (Table 17). Sauger growth increased for the 2004-2005 period over what was measured during 2003-2004 (Table 18). Mean sauger W_r values, for the various length categories are within the five-year range (Table 15).

Seven year classes of sauger were sampled by gill nets in 2005 (Table 19). The mean age of 2.5 years is an increase over other measures within the five-year period and is indicative of a strong 2002 year class (Table 19). The 2002 and 2003 year classes comprise a majority of the current adult sauger population, with indications that 2004 and 2005 were years of low reproduction. Annual sauger survival for 2004-2005 pooled data decreased to 38% (Table 14). Sauger PSD increased to 95 during 2005, the highest value of the five-year period. This increase can be attributed to the 2002 and 2003 year classes of sauger accounting for the majority of the sauger population with few younger fish in the population.

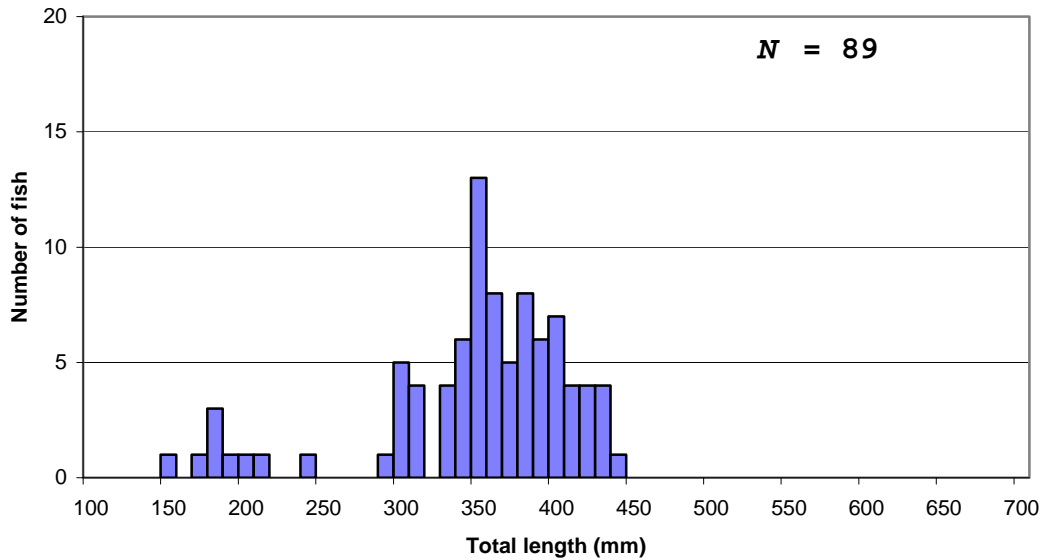


Figure 5. Length frequency of sauger collected with gill nets from Lake Francis Case, 2005. N = sample size.

Table 17. Mean length-at-age-at-capture (mm) for sauger, as determined by aging otoliths, collected in the standard September gill net survey, 2003-2005, Lake Francis Case, South Dakota. N = sample size.

Year		Length at age at capture (mm)					
		1	2	3	4	5	6
2003	Mean	254	346	368	397	380	472
	N	47	13	16	9	1	2
	SE	4.2	7.7	7.7	16.4	NA	1.5
2004	Mean	272	325	362	399	393	397
	N	30	71	13	5	1	1
	SE	5.5	3.0	8.8	10.2	NA	NA
2005	Mean	306	352	392	396	426	439
	N	9	31	32	3	1	1
	SE	2.2	6.4	4.5	24.5	NA	NA
Mean of means		277	341	374	397	400	436

Table 18. Mean annual growth increments for sauger collected in the standard September gill net survey, Lake Francis Case, South Dakota, for 2003-2004, 2004-2005 periods, as determined by aging otoliths. N = sample size.

Year	Growth increment added during period (mm)				
	1-2	2-3	3-4	4-5	5-6
2003-2004	71	16	31	0	17
2004-2005	80	67	34	27	46

Table 19. Age distribution, from otolith analysis, of sauger collected from Lake Francis Case with variable-mesh gill nets, 2003-2005. Mean age excludes age-0 fish.

Year	Age							Mean
	0	1	2	3	4	5	6	
2003	6	47	13	16	9	1	2	2.0
2004	0	30	71	13	5	1	1	2.0
2005	2	9	31	32	3	1	1	2.5

Population Parameters for Smallmouth Bass

Smallmouth bass CPUE for the 2005 gill net survey (Table 8) was similar to other years in the 2001-2005 period. Smallmouth bass CPUE in 2005 electrofishing samples (Table 7), were also similar to 2004 values. Annual growth increments and back-calculated lengths of smallmouth bass from LFC during 2004 (the last full year that growth could be calculated) are presented in Tables 20 and 21. Small sample size prevents meaningful growth comparisons with previous year's data from being made. Smallmouth bass condition remains excellent, as *W_t* values for all length categories sampled in the gill net survey were above 100 (Table 15).

Table 20. Mean annual increments (mm) of back-calculated total lengths for each year class of smallmouth bass collected with variable-mesh gill nets during September 2005 from Lake Francis Case. N = sample size.

Year class	Age	N	Growth increment at age		
			1	2	3
2004	1	4	93		
2003	2	8	102	125	
2002	3	1	80	111	104
All classes			117	86	
N		13	13	9	1

Table 21. Mean back-calculated total lengths (mm) for each year class of smallmouth bass collected with variable-mesh gill nets during September 2005 from Lake Francis Case. N = sample size.

Year class	Age	N	Back-calculated length at age		
			1	2	3
2004	1	4	93		
2003	2	8	102	227	
2002	3	1	80	191	295
All classes			92	209	295
N		13	13	9	1

Four year classes were represented in the 2005 gill net sample, with a mean age of 1.8 years (Table 22). Smallmouth bass PSD for the gill net sample increased from 33 in 2004 to 64 in 2005 (Table 16). Annual survival, for pooled 2004 and 2005 gill net data, was 36%, similar to 2004 and near the low of the five-year period (Table 14). Lengths of fish sampled by spring electrofishing ranged from 80 mm to 470 mm TL, while those collected by fall gill nets ranged from 100 mm to 370 mm TL (Figure 6).

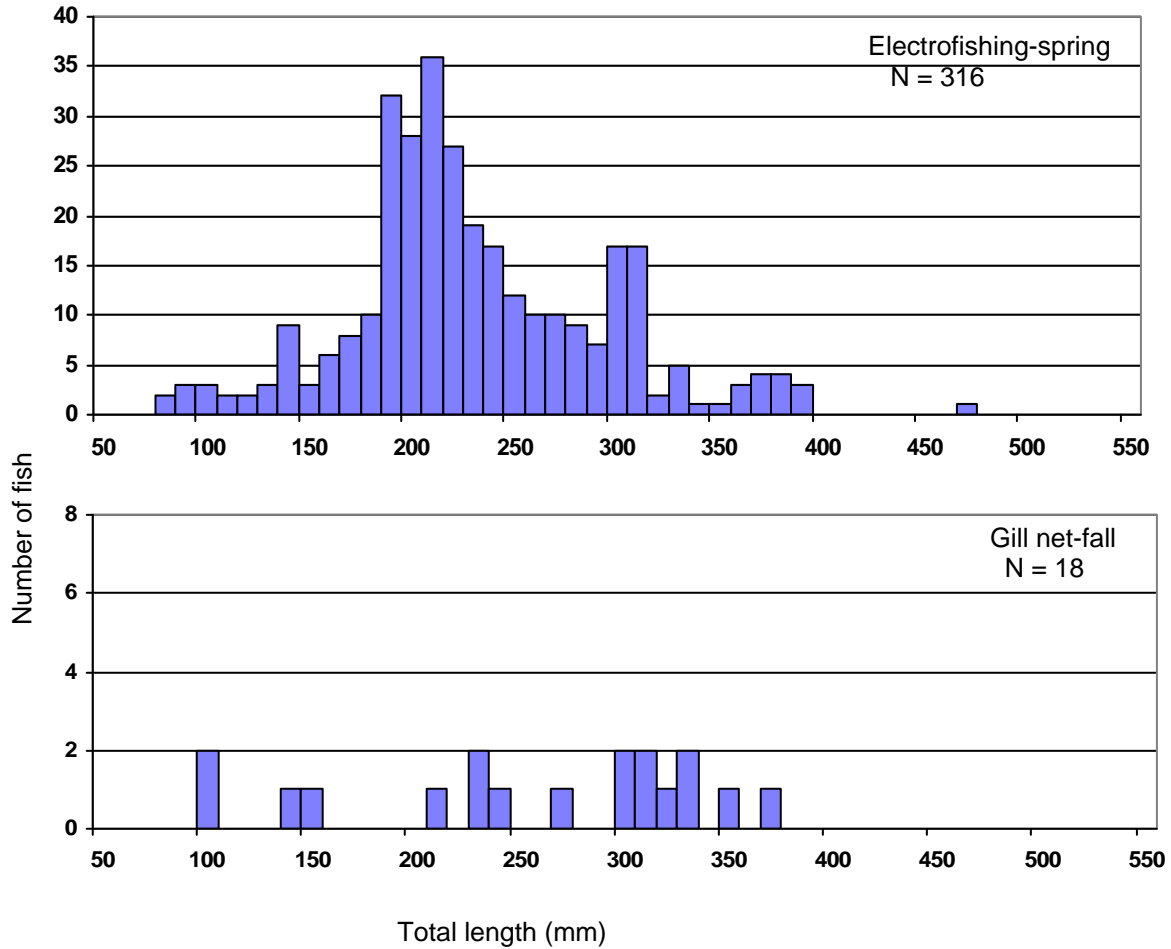


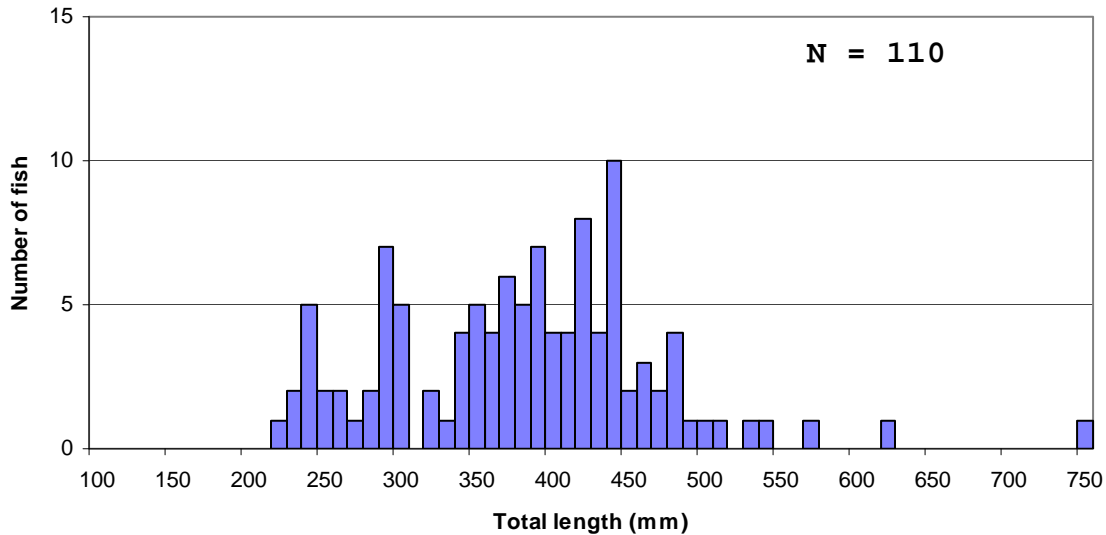
Figure 6. Length frequencies of smallmouth bass collected by spring electrofishing and fall gill netting from Lake Francis Case, 2005. *N* = sample size

Table 22. Age distribution, from scale analysis, of smallmouth bass collected from Lake Francis Case with variable-mesh gill nets, 2001-2005. Mean age excludes age-0 fish.

Year	Age							Mean
	0	1	2	3	4	5	6	
2001	0	4	4	3	1	0	0	2.1
2002	0	22	11	3	0	0	1	1.6
2003	0	13	7	0	0	0	0	1.4
2004	3	11	3	1	0	0	0	1.3
2005	1	4	8	1	0	0	0	1.8

Population Parameters for Channel Catfish

Channel catfish gill net CPUE in 2005 (Table 8) was similar to all years in the five-year period. Channel catfish ranging from 220 mm to 620 mm TL (Figure 7) were collected in the 2005 gill net survey. Back-calculated lengths of channel catfish from LFC during 2004 (the last full year that growth could be calculated), as determined by spine analysis, are presented in Table 23. Channel catfish PSD, RSD and



mean W_r values are presented in Appendix 5.

Figure 7. Length frequency of channel catfish collected with gill nets from Lake Francis Case, 2005. N = sample size.

Table 23. Mean annual back-calculated total lengths (mm) for each year class of channel catfish collected With variable-mesh gill nets during September 2005 from Lake Francis Case. N = sample size.

Year Class	Age	N	Back-calculation age														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	1	0															
2003	2	7	59	154													
2002	3	6	62	142	217												
2001	4	12	66	129	207	265											
2000	5	7	76	166	241	299	332										
1999	6	12	77	159	239	291	320	345									
1998	7	11	87	178	257	318	340	362	384								
1997	8	20	80	160	246	308	347	363	378	398							
1996	9	16	84	146	228	293	339	366	389	406	421						
1995	10	4	92	153	216	274	320	353	369	386	399	412					
1994	11	4	92	167	244	291	340	368	402	424	439	455	467				
1993	12	1	79	188	237	286	334	347	359	383	395	407	420	432			
1992	13	2	94	207	271	327	356	398	426	448	476	497	511	525	547		
1991	14	1	79	178	252	277	302	314	339	364	413	425	463	475	487	500	
1990	15	2	132	268	336	387	438	464	498	532	558	583	609	626	643	660	677
All classes			83	171	246	301	343	368	394	418	443	463	494	515	559	580	677

N	105	105	105	98	92	80	73	61	50	30	14	10	6	5	3	2
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Water Temperature Monitoring

Due to equipment malfunctions and the loss of two temperature loggers, data was only available from the American Creek and Pease Creek sampling stations during 2005 (Figure 8). Water temperatures warmed rapidly, reaching 25 C by early July. The 2005 American Creek and Pease Creek water temperature profiles were similar to the profiles from recent years (Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2003; Sorensen 2004; Sorensen and Knecht 2006).

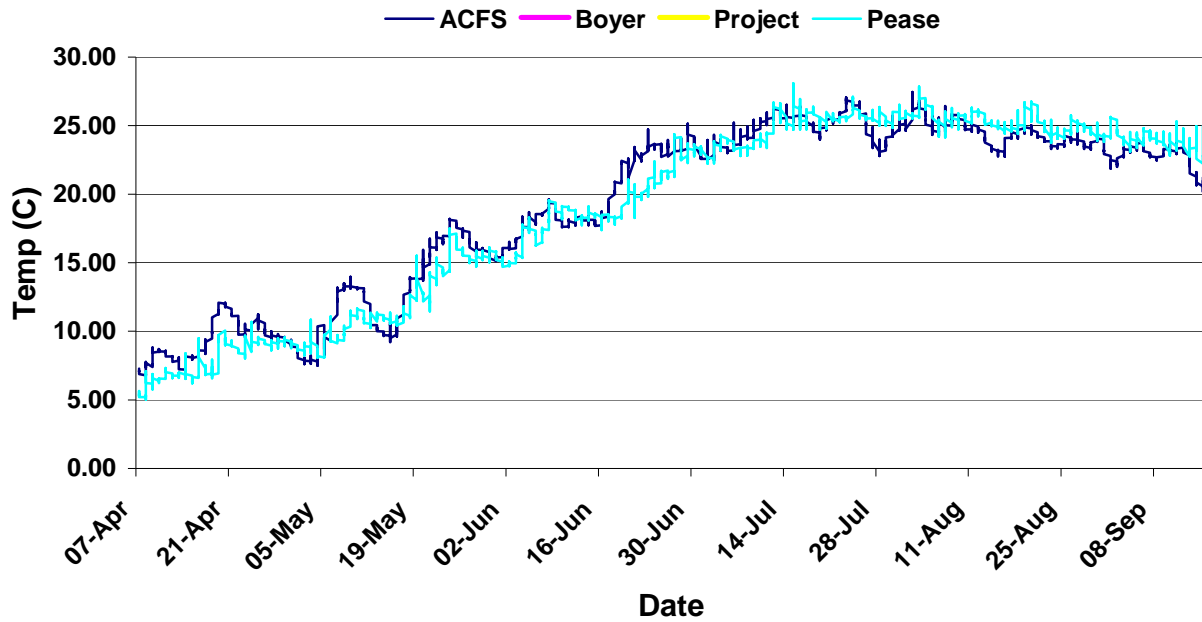


Figure 8. Water temperature in Lake Francis Case at American Creek and Pease Creek, 2005.

ANGLER USE AND SPORT FISH HARVEST SURVEY

Fishing Pressure

Lake Francis Case anglers spent an estimated 554,440 hours (+/- 42,626 h, 80% CI) fishing during the April through September, 2005 creel survey period (Table 24). This estimate is similar to the 659,184 hours estimated for the same period in 2004 but lower than that estimated during the 1998-2001 period (Table 1).

Table 24. Estimated total fishing pressure (angler hours), by month and zone, on Lake Francis Case, April-September, 2005 (+/- 80% confidence interval).

Zone	Apr	May	Jun	Jul	Aug	Sep	Total
1 - upper	46,498 (13,796)	34,534 (14,160)	77,781 (18,546)	27,039 (5,835)	26,635 (6,789)	13,154 (3,414)	225,642 (28,750)
2 - middle	13,678 (7,812)	53,175 (18,658)	52,235 (12,248)	16,411 (2,665)	18,288 (3,948)	4,002 (2,406)	157,789 (24,241)
3 - lower	2,937 (1,146)	26,316 (8,244)	44,698 (6,865)	51,538 (9,571)	37,506 (13,351)	8,015 (4,057)	171,009 (20,067)
Total	63,113 (15,895)	114,025 (24,831)	174,714 (23,262)	94,988 (11,522)	82,429 (15,489)	25,171 (5,822)	554,440 (42,626)

Estimated fishing pressure for the entire reservoir averaged 15.7 angler-h/ha (Table 25). The middle portion of the reservoir (Figure 1) received the heaviest pressure at 17.2 angler-h/ha. The upper and lower portions of the reservoir received 15.4 and 14.9 angler-h/ha respectively (Table 25). Peak fishing pressure occurred in May and June, a typical LFC pattern (Table 24, Figure 9).

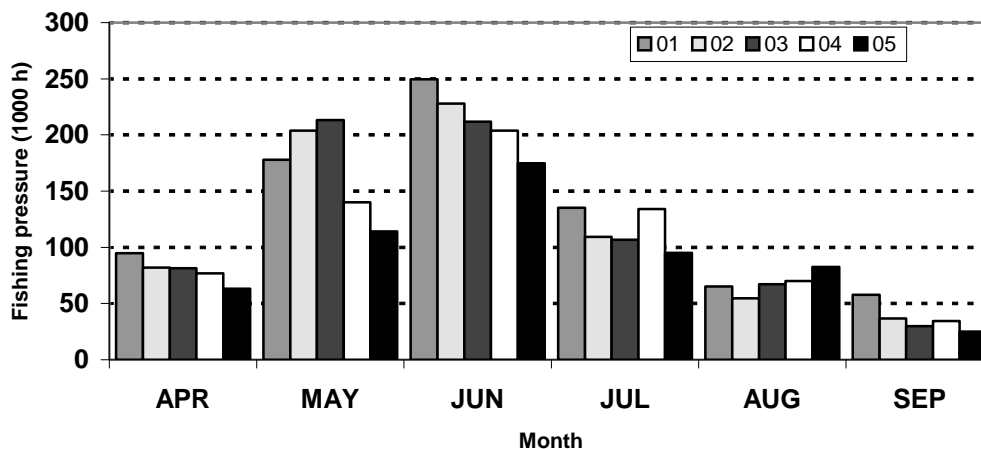


Figure 9. Estimated fishing pressure, by month, on Lake Francis Case, 2001-2005.

Table 25. Estimated total angler hours, for boat anglers, shore anglers, and angling methods combined, by zone, for Lake Francis Case, April-September, 2005.

Zone	Boat			Shore			Combined		
	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha	Total Angler hours	%	No. h/ha
1 - upper	194,058	37	13.3	31,584	82	2.2	225,642	41	15.4
2 - middle	153,745	30	16.8	4,044	10	0.4	157,789	28	17.2
3 - lower	167,896	33	14.6	3,113	8	0.3	171,009	31	14.9
Tot/Avg	515,699	100	14.6	38,741	100	1.1	554,440	100	15.7

Fish Harvest

Anglers fishing LFC, during the April-September 2005 period, harvested an estimated 168,882 fish (+/- 28,295 fish, 80% CI); all species, fishing methods and zones combined, including an estimated walleye harvest of 102,693 fish (+/- 15,609 fish, 80% CI; Table 26). Seventeen species of fish were observed in the 2005 harvest, with walleye accounting for 61% of the total number harvested (Table 26). White bass, channel catfish, and sauger accounted for 19.5%, 8.3% and 3.0% of the 2005 estimated total harvest, respectively. The 102,693 estimated walleye harvest for 2005 was similar to the 2004 estimate of 113,813 walleye (Sorensen and Knecht 2006). The decline in walleye harvest observed over the past few years can be partially attributed to decreases in walleye abundance, fishing use and walleye catch rates. Estimated sauger harvest in 2005 was 4,989 fish (Table 26). Moderate production in 2002 and 2003 will provide harvestable size sauger over the next couple of years. Harvest estimates for 2005 for smallmouth bass and channel catfish were similar to 2004 estimates (Table 26). The 2005 white bass harvest estimate of nearly 33,000 fish was an increase over the 2004 estimate of 22,500 fish (Sorensen and Knecht, 2006; Table 26). High recruitment of a very strong 2001 white bass year-class followed by moderate recruitment of the 2002 white bass year-class (Stone and Sorensen 2002, 2003) contributed to an increase in the 2005 white bass harvest, with indications that 2004 and 2005 were moderate reproductive years for white bass (Table 9). Smallmouth bass harvest increased from 8,781 in 2004 to 10,564 in 2005 (Sorensen and Knecht 2006, this survey). Moderate recruitment in 2002 and 2003 (Stone and Sorensen 2003; Sorensen 2004) and 2004 currently supports most smallmouth bass harvest.

Table 26. Estimated total fish harvest, by month, for anglers fishing Lake Francis Case, April-September, 2005 (+/- 80% confidence interval).

Month	WAE	SAR	SMB	CCF	WHB	NOP	YEP	OTH*	Total
April	9,316 (3,377)	1,449 (377)	1,291 (197)	141 (27)	171 (137)	0 (-)	0 (-)	19 (19)	12,387 (3,588)
May	22,441 (12,936)	1,391 (997)	3,526 (2,015)	657 (502)	2,155 (5,269)	39 (36)	116 (72)	546 (511)	30,871 (16,577)
June	29,417 (5,634)	1,145 (384)	2,624 (1,005)	2,940 (1,397)	26,030 (16,263)	0 (-)	33 (47)	325 (363)	62,514 (20,586)
July	23,768 (4,406)	221 (125)	237 (356)	2,511 (1,564)	1,252 (862)	18 (22)	363 (378)	396 (313)	28,766 (5,930)
August	14,241 (3,648)	644 (278)	1,686 (889)	6,954 (1,859)	2,383 (1,681)	21 (22)	174 (146)	1,171 (929)	27,274 (7,161)
September	3,510 (648)	139 (70)	1,200 (1,075)	908 (502)	993 (628)	0 (-)	28 (38)	293 (371)	7,071 (1,640)
Total	102,693 (15,609)	4,989 (1,175)	10,564 (2,680)	14,111 (2,891)	32,984 (17,211)	78 (48)	714 (416)	2,750 (1,615)	168,883 (28,295)

* OTH includes black crappie, bluegill, common carp, flathead catfish, freshwater drum, goldeye, rainbow trout, smallmouth buffalo, and white crappie.

Estimated fish harvest during 2005, by survey zone (see Figure 1 for zone identification), followed a typical LFC pattern (Stone 1995; Stone et al. 1994; Stone and Wickstrom 1992). Anglers who fished the upper portion of the reservoir accounted for 58% of the harvest, followed by the lower and middle zones with 23 and 19 % of the harvest, respectively (Table 27). Walleye, sauger, channel catfish, and white bass harvest in 2005 was highest in the upper zone, while smallmouth bass harvest was highest in the lower zone of the reservoir (Table 27).

Table 27. Estimated total fish harvest, by zone, for anglers fishing Lake Francis Case, April-September, 2005 (+/- 80% confidence interval).

Zone	WAE	SAR	SMB	CCF	WHB	NOP	YEP	OTH*	Total
1 - upper	53,544 (14,240)	3,689 (1,112)	1,900 (977)	8,902 (2,237)	27,991 (17,121)	61 (41)	110 (118)	1,548 (1,044)	97,745 (26,848)
2 - middle	23,972 (4,156)	752 (271)	1,669 (790)	2,489 (982)	2,573 (1,138)	17 (24)	254 (129)	524 (454)	32,250 (5,238)
3 - lower	25,177 (4,857)	547 (266)	6,995 (2,441)	2,720 (1,546)	2,421 (1,345)	0 (-)	349 (377)	678 (600)	38,887 (7,235)
Total	102,693 (15,609)	4,989 (1,175)	10,564 (2,680)	14,111 (2,891)	32,985 (17,211)	78 (48)	714 (416)	2,750 (1,615)	168,882 (28,295)

* OTH includes black crappie, bluegill, common carp, flathead catfish, freshwater drum, goldeye, rainbow trout, smallmouth buffalo, and white crappie.

Estimated total fish harvest (Table 26) peaked in June during 2005, while walleye harvest was similar in May, June and July (Figure 10), typical of the normal LFC pattern, where pressure and harvest peak in June (Stone 1995; Stone et al. 1994). Changes in walleye harvest regulations, initiated in 1990 and modified in 1999 and 2004, continue to maintain the walleye size structure at a level that allows sufficient numbers of legal-sized fish to be available for harvest during the period of the year that size limit regulations are in effect.

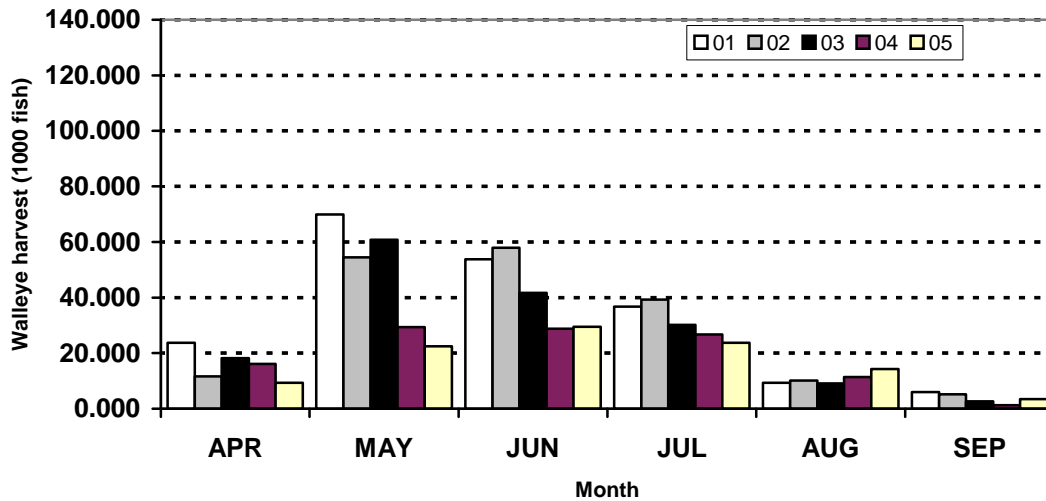


Figure 10. Estimated total walleye harvest, by month, for anglers fishing Lake Francis Case, 2001-2005.

Monthly length frequencies of angler-caught walleye (Figure 11) reflect the impact of the September-June 381-mm (15 inch) minimum-length limit. During April through June and September of 2005, very few walleye under 381 mm were harvested (illegal), while in July and August, fish under 381 mm were common in the walleye harvest. However, mean size of walleye harvested, by month, remained near or above 381 mm (minimum length limit) during all months (Figure 11). Overall, mean length of walleye harvested by sport anglers has been considerably higher since the 1990 changes in walleye sport fishing regulations were implemented (Table 1). Table 28 provides statistics on the percentage of angling parties that caught a daily limit of walleye/sauger. The percentage of angling parties harvesting a limit was 9% in 2005, similar to the previous four years, despite the daily limit being reduced to three fish in 2004.

Monthly length frequencies of angler-caught smallmouth bass are presented in Figure 12. For all months of the April-September creel survey period, except July when no harvested smallmouth bass were observed in the creel, the average length of harvested smallmouth bass exceeded 300 mm.

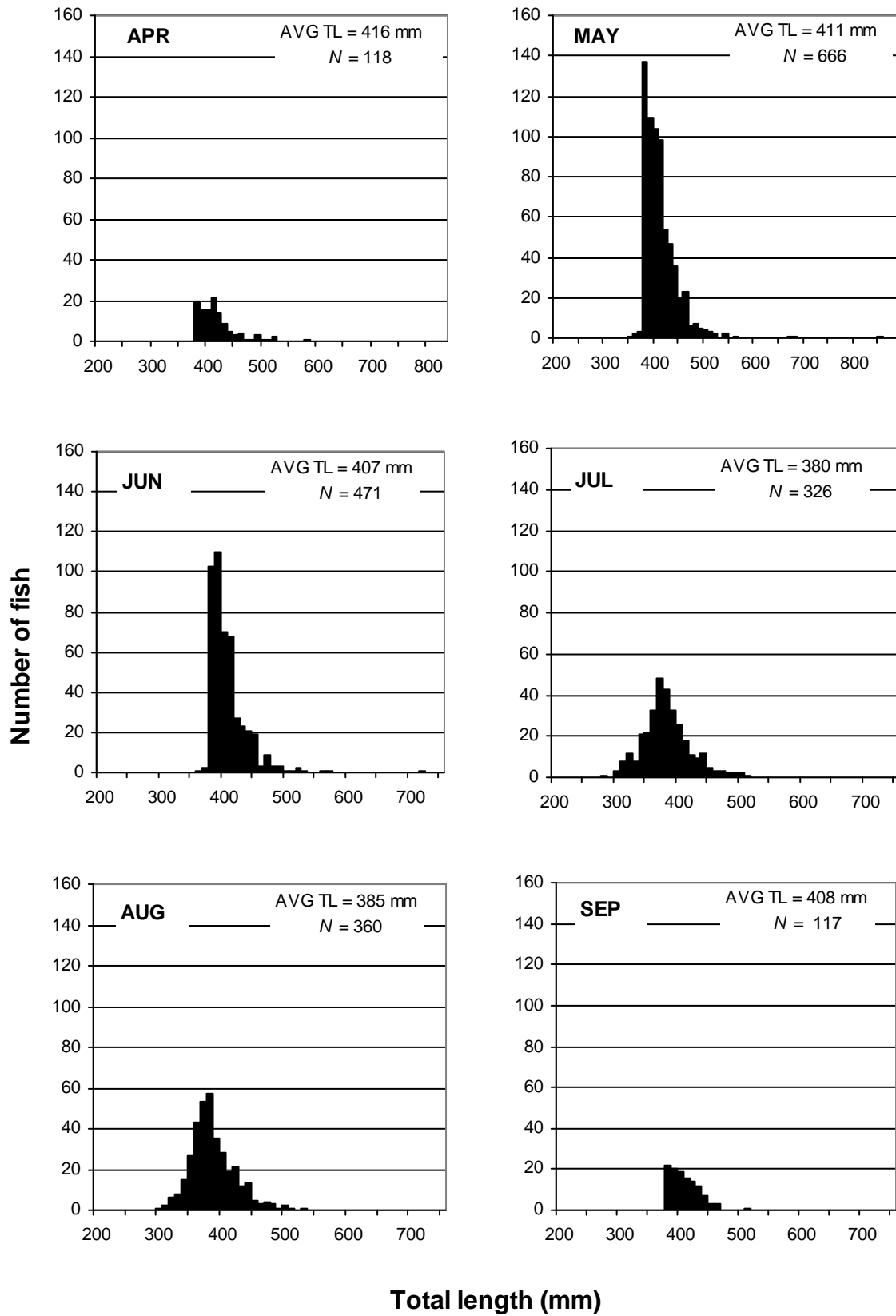


Figure 11. Monthly length frequencies of angler-caught walleye from Lake Francis Case, 2005. N = sample size.

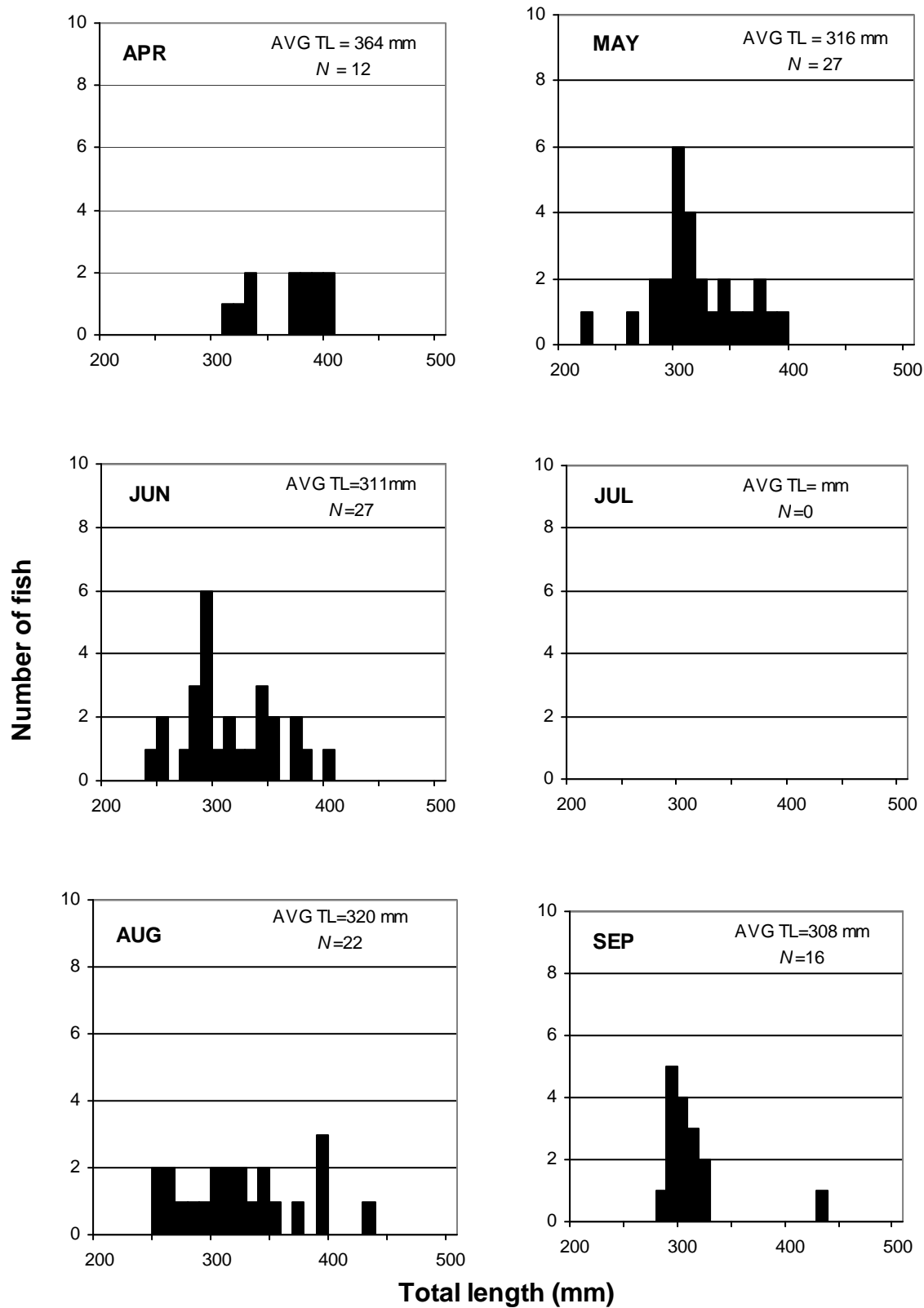


Figure 12. Monthly length frequencies of angler-caught smallmouth bass from Lake Francis Case, 2005. N = sample size.

Table 28. Percent of angling parties harvesting a limit of walleye-sauger/angler, at least three walleye-sauger/angler, at least two walleye-sauger/angler, etc., from Lake Francis Case, 2001-2005.

Party success walleye-sauger/angler	2001	2002	2003	2004*	2005*
Limit (4)	8	8	8		
3.0 - 3.9	6	6	6	9	9
2.0 - 2.9	10	10	10	7	8
1.0 - 1.9	18	18	19	18	15
0.1 - 0.9	16	16	17	17	18
0	42	42	38	49	50

* The daily limit for walleye/sauger was 3 in 2004 and 2005

Fish Caught and Released

Catch and release, either mandated by length-limit regulations or voluntary, has become an important component of the LFC sport fishery. Table 29 presents estimates of the number of fish released by month. For each species listed in Table 29, the number of fish estimated to have been caught and released exceeded harvest estimates (Table 26). While the estimate of released fish is based on the angler's ability to recall what they released and may be biased up or down, it does provide trend data and gives a good indication of the magnitude of fish being released. The overall number of fish estimated to have been released by LFC anglers in 2005 was 325,008, a decrease from the 2004 estimate of 478,934 fish (Sorensen and Knecht 2006). The decrease in the estimated number of fish released in 2005 was expected following a decreasing trend in overall abundance of major sport fish species combined with a decrease in angling use.

Table 29. Estimated number of fish caught and released, by month, for anglers fishing Lake Francis Case, 2005.

Month	WAE	SAR	SMB	CCF	WHB	NOP	YEP	OTH*	Total
April	12,066	1,783	1,512	608	2,144	70	21	160	18,364
May	49,369	1,121	10,452	392	4,926	143	116	2,159	68,678
June	101,831	1,256	12,462	3,108	18,683	88	583	6,134	144,145
July	24,917	0	4,009	7,532	4,819	0	641	4,671	46,589
August	9,844	144	3,381	5,743	1,678	33	1,987	11,887	34,697
September	6,154	35	1,576	1,658	1,811	0	371	930	12,535
Total	204,181	4,339	33,392	19,041	34,061	334	3,719	25,941	325,008

* OTH includes black bullhead, black crappie, bigmouth buffalo, bluegill, chinook salmon, common carp, flathead catfish, freshwater drum, goldeye, green sunfish, largemouth bass, paddlefish, river carpsucker, rock bass, shortnose gar, shovelnose sturgeon, smallmouth buffalo, and tiger muskellunge.

Harvest, Release and Catch Rates

Mean harvest rate (species, type of fishing, and zones combined) for LFC, during 2005, was 0.31 fish/angler-h (Table 30), within the range observed during previous surveys (Table 1). An excellent overall catch rate (the 2005 harvest rate plus estimated release rate of 0.59 fish/angler-h) of 0.89 fish/angler-hour was estimated for the April through September 2005 daylight period (Table 31). Mean catch rates were highest during May and June while the mean harvest rate was highest during June (Table 31).

The mean walleye harvest rate was 0.19 walleye/angler-h (Table 32) for the April–September daytime period. Walleye harvest rates during July and August, when there is no minimum length restriction, were similar to other months in the survey period. When harvest rate for walleye was combined with release rate, an overall catch rate of 0.55 walleye/angler-h was estimated (Table 32). This value is higher than 0.30 fish/angler-h that is considered by most biologists to be indicative of an excellent walleye fishery (Colby et al. 1979).

Catch and harvest rates for smallmouth bass, during 2005, are presented in Table 33. Smallmouth bass harvest and catch rate estimates for 2005 were similar to 2004 (Sorensen and Knecht 2006).

Table 30. Estimated harvest rate, release rate and catch rate, by species (+/- 80% confidence interval), for anglers fishing Lake Francis Case, 2005.

Species	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
Walleye	0.185 (0.042)	0.368 (0.068)	0.554 (0.105)
Sauger	0.009 (0.005)	0.008 (0.002)	0.017 (0.007)
Smallmouth bass	0.019 (0.008)	0.060 (0.015)	0.079 (0.022)
Channel catfish	0.026 (0.007)	0.034 (0.008)	0.060 (0.013)
White bass	0.060 (0.034)	0.061 (0.027)	0.121 (0.058)
Northern pike	0.000 (-)	0.001 (0.001)	0.001 (0.001)
Yellow perch	0.001 (0.001)	0.007 (0.003)	0.008 (0.003)
Other*	0.005 (0.003)	0.047 (0.017)	0.052 (0.019)
Species combined	0.305 (0.072)	0.586 (0.105)	0.891 (0.169)

* Other includes black bullhead, black crappie, bigmouth buffalo, bluegill, chinook salmon, common carp, flathead catfish, freshwater drum, goldeye, green sunfish, largemouth bass, paddlefish, rainbow trout, river carpsucker, rock bass, shortnose gar, shovelnose sturgeon, smallmouth buffalo, tiger muskellunge, and white crappie.

Table 31. Estimated harvest rate, release rate, and catch rate for all species combined (+/- 80% confidence interval), by month, for anglers fishing Lake Francis Case, 2005.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.196 (0.185)	0.291 (0.159)	0.487 (0.238)
May	0.271 (0.213)	0.602 (0.294)	0.873 (0.498)
June	0.358 (0.151)	0.825 (0.252)	1.183 (0.377)
July	0.303 (0.088)	0.491 (0.139)	0.793 (0.218)
August	0.331 (0.170)	0.421 (0.189)	0.752 (0.354)
September	0.281 (0.142)	0.498 (0.344)	0.779 (0.436)
Combined	0.305 (0.072)	0.586 (0.105)	0.891 (0.169)

Table 32. Estimated harvest rate, release rate, and catch rate of walleye (+/- 80% confidence interval), by month, for anglers fishing Lake Francis Case, 2005.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.148 (0.075)	0.191 (0.101)	0.339 (0.172)
May	0.197 (0.163)	0.433 (0.203)	0.630 (0.353)
June	0.168 (0.053)	0.583 (0.174)	0.751 (0.222)
July	0.250 (0.065)	0.262 (0.076)	0.513 (0.132)
August	0.173 (0.092)	0.119 (0.065)	0.292 (0.154)
September	0.140 (0.074)	0.245 (0.213)	0.384 (0.274)
Combined	0.185 (0.042)	0.368 (0.068)	0.554 (0.105)

Table 33. Estimated harvest rate, release rate, and catch rate of smallmouth bass (+/- 80% confidence interval), by month, for anglers fishing Lake Francis Case, 2005.

Month	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
April	0.020 (0.006)	0.024 (0.013)	0.044 (0.018)
May	0.031 (0.034)	0.092 (0.048)	0.123 (0.079)
June	0.015 (0.012)	0.071 (0.039)	0.086 (0.050)
July	0.003 (0.004)	0.042 (0.019)	0.045 (0.019)
August	0.021 (0.016)	0.041 (0.019)	0.062 (0.032)
September	0.048 (0.049)	0.063 (0.039)	0.110 (0.080)
Combined	0.019 (0.008)	0.060 (0.015)	0.079 (0.022)

Angler Demographics and Economics

Thirty three percent of anglers contacted on LFC during 2005 were non-residents, similar to values estimated for the previous five years (Stone and Sorensen 2001, 2002, 2003; Sorensen 2004; Sorensen and Knecht 2006). Non-resident anglers from 16 states were contacted during 2005, (Table 34) with Iowa, Nebraska and Minnesota anglers accounting for the majority of non-resident angler contacts. Figure 13 provides information on the county of residence of South Dakota anglers who fished LFC in 2005. Over 89% of the resident LFC anglers in 2005 came from counties in the southeastern ¼ of the state (Figure 13).

Table 34. Percentage of non-resident anglers who fished Lake Francis Case, 2001-2005, by state of residence, expressed as percent of total non-residents.

State	2001	2002	2003	2004	2005
Iowa	42.9	42.4	46.0	42.0	42.6
Nebraska	38.6	36.6	39.5	36.2	39.2
Minnesota	10.3	14.0	9.1	13.9	12.6
Colorado	0.8	1.3	1.6	1.2	0.7
Wisconsin	1.4	1.3	0.3	0.5	0.7
Kansas	0.5	0.8	0.3	0.7	1.1
Missouri	1.4	0.8	1.2	0.4	-
Illinois	0.4	0.3	0.2	0.7	-
North Dakota	0.7	0.3	0.3	0.5	-
Florida	0.3	0.2	0.5	0.2	0.2
Montana	0.3	0.2	-	0.5	-
Wyoming	0.8	0.2	0.2	0.7	0.9
California	0.4	-	0.3	-	-
Other*	1.2	1.6	0.5	2.5	2.0

*Other includes: Alabama, Alaska, Arizona, Idaho, Michigan, Ohio, Oregon, and Washington.

Mean angler trip length (boat and shore combined) on LFC was 4.9 hours (Table 1), for the April-September, 2005 daylight period. The average angling party consisted of approximately 2.3 individuals in 2005 and anglers traveling at least 100 miles (one-way) to fish LFC, accounted for about 55 % of all trips (Table 35). A majority of anglers fishing Lake Francis Case in 2005 targeted walleye, similar to the past four years (Table 36).

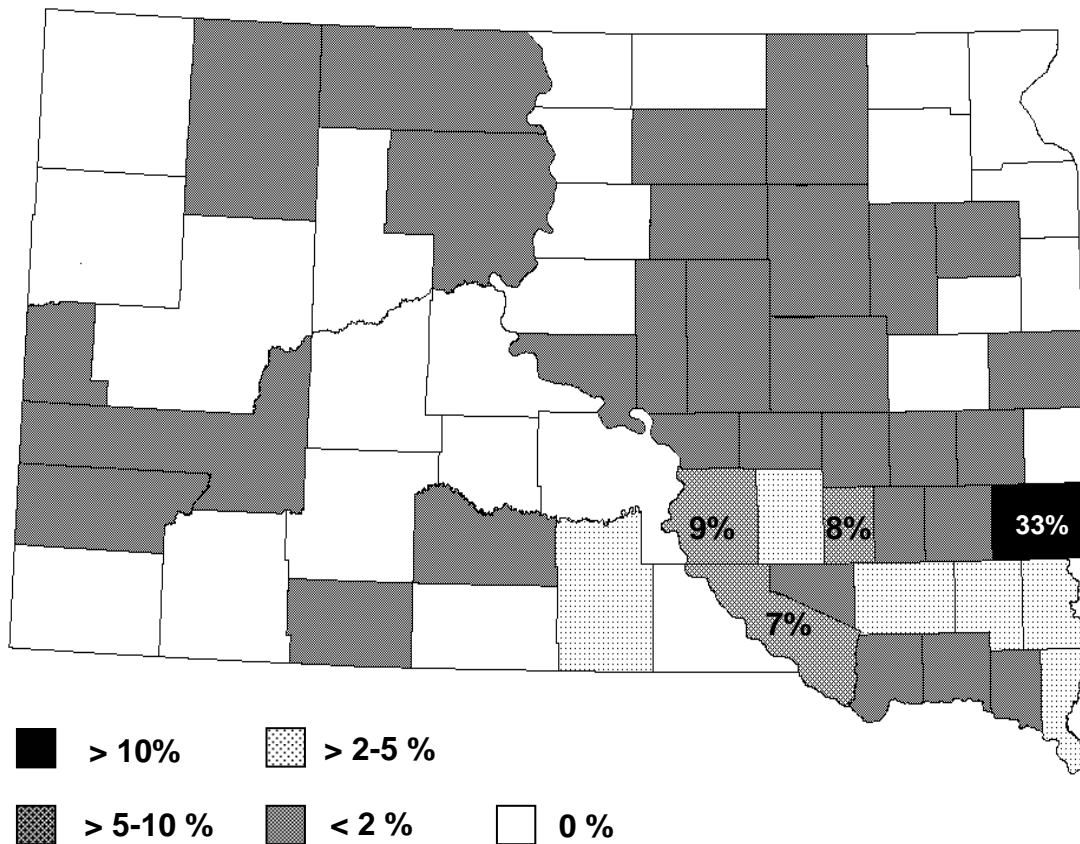


Figure 13. County of residence for resident anglers fishing Lake Francis Case in 2005. Percentage of total resident anglers is shown for the top four represented counties.

The 2005 LFC fishery had an estimated economic impact of nearly 6.9 million dollars to local economies, based on approximately 113,100 angling trips. This estimate is based on an average expenditure of \$61/trip for angling in South Dakota (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of Census 2002).

Table 35. Percentage of anglers traveling specified distances, one way, to fish Lake Francis Case during 2001-2005.

Distance (miles)	2001	2002	2003	2004	2005
<25	10.7	12.1	11.2	13.3	12.2
25-50	17.4	17.8	7.6	17.0	16.5
51-100	19.3	13.4	15.9	16.2	15.5
101-200	37.1	38.7	43.1	37.1	39.8
200+	15.5	18.0	22.2	16.4	16.0

Table 36. Target species of Lake Francis Case anglers, during 2001-2005, expressed as percentage of total angling trips.

Target species	2001	2002	2003	2004	2005
Walleye	97.0	93.5	94.6	94.6	90.9
Anything	0.2	3.8	3.6	2.2	4.6
Smallmouth bass	1.6	1.7	1.2	1.1	1.7
Other	1.2	1.0	0.6	2.1	2.8

ANGLER PREFERENCE AND ATTITUDE SURVEY

Angler attitudes about fishing and their preferences concerning management options are important components of a fishery. Historically, fisheries biologists have primarily focused efforts on understanding biological aspects of fish populations and monitoring sport fish harvest and use. Recently, biologists have realized the necessity and value of understanding angler attitudes, level of satisfaction, and preferences. Consequently, more attitude, preference and satisfaction data has been collected in recent years.

The following results build on angler preference and attitude survey data collected previously from Lake Francis Case (Stone et.al. 1993; Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2001, 2002, 2003; Sorensen 2004; Sorensen and Knecht 2006).

Angling Trip Satisfaction

How anglers feel about their fishing experience is important when evaluating the success of fishery management efforts. Angler responses help evaluate if current management practices and regulations are providing a fishery that meets angler needs and expectations. Overall, 69% of LFC anglers expressed some degree of satisfaction with their days fishing in 2005 versus approximately 24% who expressed some degree of dissatisfaction (Table 37). The 69% satisfaction rating falls below the range of previous surveys (Stone and Sorensen 2001, 2002, 2003; Sorensen 2004; Sorensen and Knecht 2006) and does not meet the Missouri River Fisheries Program management objective of 70 % (SDGFP, unpublished document).

Table 37. Response of 2005 Lake Francis Case anglers, by month, to the question: "Considering all factors, how satisfied are you with your fishing trip today?" 1 = Very Satisfied, 2 = Moderately satisfied, 3 = Slightly satisfied, 4 = Neutral, 5 = Slightly dissatisfied, 6 = Moderately dissatisfied, 7 = Very dissatisfied, N.O. = No opinion. Median excludes those with no opinion.

Month	Satisfied			Neut.	Dissatisfied			N.O.	Total	Median
	1	2	3	4	5	6	7			
Apr	29	21	12	1	9	4	10	3	89	3
May	81	55	34	11	14	10	30	5	240	3
Jun	67	55	25	13	16	15	23	3	217	3
Jul	29	24	7	8	7	9	10	2	96	3
Aug	44	37	12	12	5	7	26	1	144	3
Sep	19	16	16	2	2	3	4	0	62	3
Total	269	208	106	47	53	48	103	14	848	3
Percent	31.7	24.5	12.5	5.5	6.3	5.7	12.1	1.7	100	-
Combined	68.8			5.5	24.0			1.7	100	-

Angler satisfaction positively correlates to the number of walleye harvested per angler (Table 38). These results follow the pattern documented in previous surveys (Stone 1997a, 1998; Stone and Sorensen 1999, 2000, 2001, 2002, 2003; Sorensen 2004; Sorensen and Knecht 2006) showing a decrease in satisfaction and a corresponding increase in dissatisfaction as the number of walleye harvested per angler decreases. However, over 58% of the anglers who did not harvest a walleye still indicated that they were satisfied with their fishing trip. These results follow the suggestion of other studies (Mendelsohn 1994, McPhillips 1989, Kinman and Hoyt 1984) that harvesting fish ranked below other components of a successful fishing trip (i.e. fun, relaxation, etc.). While these results do indicate a relationship between number of walleye harvested and trip satisfaction, they should not be interpreted as a direct relationship, other factors, such as weather or angler type (Gigliotti 1996) may affect catch and harvest rates, and in turn, influence angler response.

Table 38. Responses of 2005 Lake Francis Case anglers to the question: "Considering all factors, how satisfied are you with your fishing trip today?" by number of walleye harvested. Responses are grouped as satisfied, dissatisfied and neutral/no-opinion based on the more detailed breakdowns defined in Table 37.

No. walleye harvested/angler	Satisfied		Dissatisfied		Neutral/No-Opinion	
	No.	Percent	No.	Percent	No.	Percent
3	66	95.7	2	2.9	1	1.4
2 – 2.9	68	89.4	4	5.3	4	5.3
1 – 1.9	104	83.9	17	13.7	3	2.4
0.1 – 0.9	88	64.7	41	30.1	7	5.2
0	256	58.4	142	32.3	41	9.3
Total	582	69.0	206	24.4	56	6.6

With current management regulations requiring the mandatory release of certain sizes of walleye/sauger, coupled with the voluntary release of a significant number of fish by LFC anglers, how anglers feel about their fishing trip, based on the total number of walleye/sauger caught versus harvested, may also be important. Table 39 provides angler satisfaction data categorized by the average number of walleye caught per angler. Similar to results presented in Table 38, over 58% of anglers questioned were still satisfied with their fishing trip despite catching no walleye (Table 39). Over 86% of anglers who caught at least 4 to 7.9 walleye/angler indicated they were satisfied with their trip (Table 39).

Table 39. Responses of 2005 Lake Francis Case anglers to the question: "Considering all factors, how satisfied are you with your fishing trip today?" by the average number of walleye caught per angler. Responses are grouped as satisfied, dissatisfied and neutral/no-opinion, based on the more detailed breakdowns defined in Table 37.

No. WAE Caught/angler	Satisfied		Dissatisfied		Neutral/No-opinion	
	No.	Percent	No.	Percent	No.	Percent
16 or >	7	87.5	1	12.5	0	7.1
12-15.9	16	100.0	0	0.0	0	0.0
8-11.9	39	92.9	2	4.8	1	2.4
4-7.9	106	86.9	14	11.5	2	1.6
>0-3.9	273	66.7	110	26.9	26	6.4
0	151	58.8	79	30.7	27	10.5
Total	592	69.3	206	24.1	56	6.6

Angler Preference and Attitude Survey: Competitive Angling Events

Competitive angling events have increased in popularity in recent years on Lake Francis Case. In an effort to determine the level of participation in fishing tournaments by Lake Francis Case anglers and angler attitudes toward competitive angling events, anglers participating in the 2005 angler use and harvest survey were asked questions concerning these issues. When asked whether or not they had participated in a tournament held on Lake Francis Case within the past twelve months, 16% of those interviewed during 2005 indicated they had (Table 40). Survey results concerning tournament participation in 2005 were consistent with 2004 survey results.

Table 40. Responses of Lake Francis Case anglers to the question: "Within the last 12 months, how many fishing tournaments have you participated in on Lake Francis Case?", 2004-2005. Responses are presented as percentage of total responses. N = number of responses.

Number of Tournaments Participated in	2004		2005	
	N	Percent	N	Percent
0	748	84.5	705	83.5
1	62	7.0	85	10.1
2	33	3.7	26	3.1
3	21	2.4	9	1.1
4	8	0.9	8	0.9
>4	13	1.5	11	1.3

The majority of competitive angling events on Lake Francis Case take place during the April-June period. Angler participation in tournaments during this time frame might be different than other months of the survey period. However, except for the month of April, the percentage of anglers not participating in tournaments was consistent among all months surveyed (Table 41) suggesting that tournament anglers represent a small portion of anglers using Lake Francis Case.

Table 41. Responses of 2005 Lake Francis Case anglers to the question: "Within the last 12 months, how many fishing tournaments have you participated in on Lake Francis Case?" Responses are presented as number of responses with percentage of total responses in parenthesis by month.

Month	Number of Tournaments Participated In						Total
	0	1	2	3	4	>4	
Apr	57 (65.6)	16 (18.4)	9 (10.3)	3 (3.4)	0 (0.0)	2 (2.3)	87
May	205 (83.7)	29 (11.8)	2 (0.8)	0 (0.0)	5 (2.1)	4 (1.6)	245
Jun	186 (88.2)	16 (7.6)	7 (3.3)	2 (0.9)	0 (0.0)	0 (0.0)	211
Jul	84 (84.8)	9 (9.2)	1 (1.0)	2 (2.0)	2 (2.0)	1 (1.0)	99
Aug	121 (85.8)	9 (6.4)	7 (5.0)	2 (1.4)	1 (0.7)	1 (0.7)	141
Sep	52 (85.3)	6 (9.8)	0 (0.0)	0 (0.0)	0 (0.0)	3 (4.9)	61

When anglers were asked how they felt about the number of tournaments held on Lake Francis Case each year, 48% of respondents had no opinion on the issue, suggesting tournaments are not an important issue for this portion of the angling public (Table 42). However, when "no opinion" responses were removed from the analysis, 70% of anglers believed there were too many tournaments on Lake Francis Case (Table 42). In addition, 27% believed there was about the right number, and 3% believed that there were too few tournaments held on Lake Francis Case annually (Table 42).

Table 42. Responses of 2005 Lake Francis Case Anglers to the question: "In General, how do you feel about the number of fishing tournaments held on Lake Francis Case each year?" N = number of responses.

Response	N	Percent
Including "No Opinion" Responses		
Too Many	304	36.1
About the Right Number	117	13.9
Too Few	15	1.8
No Opinion	406	48.2
Excluding "No Opinion" Responses		
Too Many	304	69.8
About the Right Number	117	26.8
Too Few	15	3.4

With increasing frequency of competitive angling events, crowding at access facilities is a concern. To help understand the significance of such user conflicts, anglers were asked if they have ever not used an access site because a tournament was being held there. Overall, 77 percent of interviewed anglers indicated they had not avoided an access site because a tournament was being held there, suggesting that crowding at access sites due to tournament use may not be occurring at this time (Table 43). Due to the early start times of many fishing tournaments, other anglers may not be aware that a fishing tournament is being held at the access site they choose to use and they may just view the access site as being generally crowded. However, with over twenty percent of all anglers being displaced by fishing tournaments and competitive angling events becoming more popular, this issue should be carefully monitored in the future (Table 43).

Table 43. Responses of 2005 Lake Francis Case Anglers to the question: “Did you ever decide not to use an access site on Lake Francis Case because a tournament was being held there?” Responses are presented as number of responses and percentage of total responses by month.

Response				
Month	Yes	No	No Opinion	Total
Apr	14	69	2	85
May	43	201	2	246
Jun	44	167	1	212
Jul	22	76	1	99
Aug	40	100	0	140
Sep	25	36	0	61
Total	188	649	6	843
Percent	22.3	77.0	0.7	

DISCUSSION

Lake Francis Case, supporting one of South Dakota’s most important walleye fisheries, continues to attract anglers from across the upper Midwest. Walleye, ranked the favorite species by 69% of respondents to a 1992 survey of South Dakota anglers (Mendelsohn 1994), continued to remain the target species of most LFC anglers. Since a peak in total walleye abundance in 1995, the LFC walleye population has generally declined in abundance. That decline has been attributed, in part, to angler harvest coupled with continuing drought conditions in the Missouri River basin, limiting walleye reproduction and recruitment. From 1996 through 2001, the estimated LFC walleye harvest was near or exceeded 200,000 fish, peaking at over 339,000 in 1998. This harvest, combined with low recruitment in 2000-2003 began to impact the number of legal-size walleye available for harvest beginning in 2003. A significant portion of the initially abundant 2002 LFC walleye year class did not recruit to age 1, so the expected downturn in population abundance may be longer in duration than previously thought. However, walleye abundance increased during 2005 due to the presence of a strong 2005 year class. Walleye growth rates in 2005 increased over values observed the previous three years. Walleye growth rates will need to be monitored closely in future surveys as the walleye population responds to modifications in size limit regulations and fluctuations in gizzard shad abundance. Walleye condition, as indexed by W_r , has remained unchanged since the initial 1990 regulation changes, despite variability in walleye and gizzard shad abundance over that same time period.

Water yield in the Missouri River system ranged between two extremes during the late 1990’s to early 2000’s; from the record water yield measured in 1997 to drought conditions experienced between 2000 and 2005. These extremes in water yield undoubtedly played a significant role in shaping the fish

populations of LFC. While changes to walleye management regulations in 1990 were given much of the credit for restructuring the LFC walleye population, resulting in the outstanding fishing that occurred throughout the latter half of the 1990's, the high water yield in the mid-1990's played a role that cannot be overlooked (Stone and Lott 2002). While walleye population abundance, size structure, and growth were showing positive trends in the early 1990's, when drought conditions still existed, the high walleye abundance levels reached in 1997 and 1998 were probably the result of improved habitat and nutrient conditions created by high water yield in 1995 and 1997 (Stone 1997b). As water yield in the Missouri River basin returned to normal or below normal levels, it was unrealistic to expect that the high walleye abundance of the mid-1990's could be maintained. Water yield in the Missouri River Basin has been below normal for the past six years. Persistent drought conditions have resulted in poor reproduction and recruitment causing a steady decline in walleye abundance since 1998. Localized runoff events in the spring of 2005 provided conditions favorable to fish production resulting in a strong 2005 walleye year class. Under normal growth rates, these fish will not enter the sport harvest until at least 2008.

Modifications to walleye sport fishing regulations in 2004, combined with decreasing walleye abundance, have reduced walleye harvest rates as well as overall harvest to sustainable levels. Improvements in walleye population structure, as a result of length limit regulations, is reflected in the 407 mm (16.0 in.) mean length of walleye harvested over the past five years, versus the 385 mm (15.2 in.) average the previous eleven years, and the 343 mm (13.5 in.) average estimated in 1989 (Stone 1995). However, despite a decline in overall walleye population abundance the past several years, a proportion of anglers are still attaining the daily creel limit of three walleye during certain periods of the year. In this regard, the daily creel limit remains an important factor in the regulation of the fishery and distribution of the walleye harvest, at least during years of low walleye abundance or high harvest. Survey results also suggests that while most LFC anglers are satisfied with their overall fishing trip experience, they can be less satisfied (based on trip rating) with the numbers and sizes of fish caught (Stone and Sorensen 2002, 2003; Sorensen 2004; Sorensen and Knecht 2006).

Smallmouth bass, which in previous years had ranked second in the sport fishery in terms of total fish caught (harvest and released), remain an important component in angler catches. Initially introduced as an alternative species that could direct fishing pressure away from walleye, they are now the target species of a small portion of LFC anglers. Smallmouth bass abundance, as measured by spring electrofishing CPUE, was similar to values observed during the 2004 survey. The 2002 and 2003 smallmouth bass year classes compose a majority of the current Lake Francis Case smallmouth bass population. In a 1992 survey of South Dakota anglers (Mendelsohn 1994) smallmouth bass were ranked in the top half of 14 species listed as most favorite by over 65% of the respondents. Along with smallmouth bass, sauger continue to contribute to the harvest. The white bass population has a well distributed age and size structure and is capable of providing additional recreational opportunity. Channel catfish have maintained adequate abundance in recent years to support additional harvest.

Results from these surveys document the contribution and importance of the LFC fishery to the overall angling opportunities provided by the Missouri River system in South Dakota. Lake Francis Case continues to meet or exceed the objective of providing 100,000 angler days of recreation annually, as established in the Missouri River Fisheries Program Strategic Plan (SDGFP 1994). Anglers fishing Lake Francis Case in 2006 should expect lower walleye harvest rates than those experienced in 2005. Improvement in overall catch rates are expected with most fish being sub-legal size. A conservative walleye harvest in 2006 is needed to lessen the degree of reduction in fishery quality that anglers have begun to experience. High angler catch rates combined with reduced overall walleye abundance and continuing drought conditions in the basin, will continue to have an effect on the Lake Francis Case walleye population in the near future.

Prey fish abundance remains an additional area of concern. The LFC walleye population relies heavily on annual production of age-0 gizzard shad as prey. A missing year class of shad could greatly impact the growth and condition of LFC walleye. Continued monitoring of fish populations and associated sport fisheries through annual surveys is essential to allow fisheries managers the ability to monitor and react to changing conditions in fish populations, angler demographics and expectations, and reservoir operation.

Factors that will shape the future of this walleye fishery over the next several years include:

1) As discussed previously, history suggests that this walleye fishery is not capable of sustaining the harvest that occurred during 1996-2001, partially attributed to the unusually high water yield in the Missouri River Basin in the mid-late 1990s. If water yield in the basin remains at or below normal, it is expected that walleye abundance will remain low and that the population cannot sustain the high harvest that has occurred in the past. Walleye harvest from LFC will need to be conservative when walleye abundance is low.

2) Reproduction and recruitment of gizzard shad, emerald and spottail shiners, and yellow perch is essential for good growth of major sport fish species. These species provide the majority of fish prey species in the reservoir.

3) Initial results from the 2002 gill net survey suggested that moderate-to-high walleye production occurred. However, these fish did not materialize as a strong age-1 year class in 2003 as a majority of them were lost from the population. Therefore, the downturn in overall walleye abundance will last longer than initially thought due to low reproduction and recruitment during 2000-2004 and will impact Lake Francis Case anglers at least until 2007.

4) The strong walleye year class produced in 2005 will not contribute to the sport harvest until at least 2008. Conservative harvest of legal-sized walleye will lessen the effects of the poor reproduction and recruitment experienced during 2000-2004.

RECOMMENDATIONS

1. Continue and strive to improve reservoir fish population and creel surveys, as described in this report, on an annual basis. These surveys are essential for providing basic information on fish population abundance, reproduction and recruitment, growth and condition, survival and mortality, and sport fish use and harvest. Also, these surveys provide evaluation of progress towards objectives outlined in the Missouri River Fisheries Program Strategic Plan.
2. Revise and update the 1997 Lake Francis Case Fisheries Management Plan, with species specific goals, objectives, and management philosophies for walleye, smallmouth bass and paddlefish.
3. Continue public education efforts focusing on increasing angler awareness and compliance with recent walleye fishing regulation changes and the responsible use and harvest of LFC fisheries resources.
4. Continue annual review and evaluation of sport fishing regulations and their effectiveness.
5. Continue to incorporate angler attitude and preference questions in routine creel survey sampling. This technique provides valuable information with very little additional expense.
6. Continue standardized spring smallmouth bass electrofishing sampling. This technique is providing a more reliable long-term data set than fall gill netting.
7. Future research projects that need to be considered and developed include:
 - a study to evaluate LFC smallmouth bass distribution and movement related to the annual fall draw-down of the reservoir.
 - a study to document LFC gizzard shad life history with special emphasis on spawning and over wintering habitat.
 - working with researchers at South Dakota State University to continue studies to evaluate the effects of inter-basin transfer of nutrients, zooplankton and fish between South Dakota Missouri River reservoirs on fish population status.
8. Increase public awareness of aquatic nuisance species and the threat they pose to waters of the Missouri River system in South Dakota.
9. Continue to document threatened and endangered fish observations and locations.

10. Develop standardized sampling techniques to index annual reservoir productivity.

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Appendix 1. Monthly water volume (1000's acre-feet) released through (power) or over (spill) Ft. Randall Dam, 2001-2005.

Month	2001		2002		2003		2004		2005	
	Power	Spill	Power	Spill	Power	Spill	Power	Spill	Power	Spill
Jan	681	0	672	0	792	0	896	0	754	0
Feb	615	0	594	0	611	0	609	0	342	0
Mar	591	0	976	0	931	0	638	0	817	0
Apr	208	0	1,204	0	1,355	0	1,186	0	958	0
May	783	0	1,266	0	1,464	0	1,580	0	1,156	0
Jun	1,051	0	1,432	0	1,453	0	1,585	0	982	0
Jul	1,250	0	1,619	0	1,494	0	1,561	0	1,279	0
Aug	1,566	0	1,773	0	1,504	0	1,494	0	1,420	0
Sep	1,548	0	1,807	0	1,671	0	1,365	0	1,439	0
Oct	1,620	0	1,808	0	1,664	0	738	0	638	0
Nov	1,455	0	1,363	0	1,205	0	460	0	553	0
Dec	672	0	662	0	725	0	687	0	763	0
Total	12,040	0	15,176	0	14,869	0	12,799	0	11,101	0

Appendix 2. Common and scientific names of fishes mentioned in this report.

Common name	Scientific name	Abbreviation
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	BIB
Black bullhead	<i>Ameiurus melas</i>	BLB
Black crappie	<i>Pomoxis nigromaculatus</i>	BLC
Bluegill	<i>Lepomis macrochirus</i>	BGL
Brown trout	<i>Salmo trutta</i>	BNT
Channel catfish	<i>Ictalurus punctatus</i>	CCF
Common carp	<i>Cyprinus carpio</i>	CAP
Common shiner	<i>Notropis cornutus</i>	CMS
Emerald shiner	<i>Notropis atherinoides</i>	EMS
Fathead minnow	<i>Pimephales promelas</i>	FHM
Flathead catfish	<i>Pylodictis olivaris</i>	FCF
Freshwater drum	<i>Aplodinotus grunniens</i>	FRD
Gizzard shad	<i>Dorosoma cepedianum</i>	GIS
Goldeye	<i>Hiodon alosoides</i>	GOE
Johnny darter	<i>Etheostoma nigrum</i>	JOD
Largemouth bass	<i>Micropterus salmoides</i>	LMB
Northern pike	<i>Esox lucius</i>	NOP
Northern redbelly dace	<i>Phoxinus eos</i>	NRD
Paddlefish	<i>Polyodon spathula</i>	PAH
Rainbow trout	<i>Oncorhynchus mykiss</i>	RBT
Red shiner	<i>Notropis lutrensis</i>	RES
River carpsucker	<i>Carpionodes carpio</i>	CPS
Sauger	<i>Sander canadense</i>	SAR
Shorthead redhorse	<i>Moxostoma macrolepidotum</i>	SHR
Shortnose gar	<i>Lepisosteus platostomus</i>	SNG
Shovelnose sturgeon	<i>Scaphirhynchus platyrhynchus</i>	SNS
Silvery minnow	<i>Hybognathus argyritis</i>	SIM
Smallmouth bass	<i>Micropterus dolomieu</i>	SMB
Smallmouth buffalo	<i>Ictiobus bubalus</i>	SAB
Spottail shiner	<i>Notropis hudsonius</i>	SPS
Walleye	<i>Sander vitreus</i>	WAE
White bass	<i>Morone chrysops</i>	WHB
White crappie	<i>Pomoxis annularis</i>	WHC
Yellow perch	<i>Perca flavescens</i>	YEP

Appendix 3. Standard weight equations used for relative weight calculations. Length is in millimeters, weight is in grams, and logarithms are to the base 10.

Walleye	$\text{LogWs} = 3.180 * \text{LogTL} - 5.453$
Sauger	$\text{LogWs} = 3.187 * \text{LogTL} - 5.492$
Smallmouth bass	$\text{LogWs} = 3.200 * \text{LogTL} - 5.329$
Channel catfish	$\text{LogWs} = 3.294 * \text{LogTL} - 5.800$
Yellow perch	$\text{LogWs} = 3.230 * \text{LogTL} - 5.386$
White bass	$\text{LogWs} = 3.081 * \text{LogTL} - 5.066$

Appendix 4. Total length (TL;mm) - weight (WT;g) regression equations for walleye, sauger, and smallmouth bass from Lake Francis Case, and mean total lengths and weights. Logarithms are to the base 10. *N* = sample size. Mean (X) total lengths and weights do not include age-0 fish.

Species	Year	<i>N</i>	Equation	R ²	X TL (mm)	X WT (gm)
Walleye	2001	288	$\text{LogWT} = 3.209 \text{LogTL} - 5.613$	0.99	335	357
	2002	306	$\text{LogWT} = 3.095 \text{LogTL} - 5.326$	0.99	340	369
	2003	230	$\text{LogWT} = 3.160 \text{LogTL} - 5.498$	0.97	324	324
	2004	206	$\text{LogWT} = 3.153 \text{LogTL} - 5.469$	0.99	336	352
	2005	316	$\text{LogWT} = 3.244 \text{LogTL} - 5.693$	0.99	363	447
Sauger	2001	128	$\text{LogWT} = 3.240 \text{LogTL} - 5.751$	0.98	320	257
	2002	120	$\text{LogWT} = 3.044 \text{LogTL} - 5.267$	0.98	322	256
	2003	88	$\text{LogWT} = 3.101 \text{LogTL} - 5.417$	0.97	310	240
	2004	124	$\text{LogWT} = 3.122 \text{LogTL} - 5.463$	0.94	320	244
	2005	89	$\text{LogWT} = 3.076 \text{LogTL} - 5.333$	0.99	365	374
SM bass	2001	12	$\text{LogWT} = 3.277 \text{LogTL} - 5.463$	0.99	258	400
	2002	30	$\text{LogWT} = 3.104 \text{LogTL} - 5.061$	0.99	258	309
	2003	20	$\text{LogWT} = 3.171 \text{LogTL} - 5.216$	0.99	248	264
	2004	18	$\text{LogWT} = 3.044 \text{LogTL} - 4.914$	0.98	249	259
	2005	18	$\text{LogWT} = 3.286 \text{LogTL} - 5.499$	0.99	297	453

Appendix 5. Channel catfish, white bass, and yellow perch proportional stock density (PSD), relative stock density of preferred and memorable length fish (RSD-P and RSD-M, respectively), and relative weight (W_r), for 2001-2005, for fish collected from Lake Francis Case. N = sample size.

Species	2001				2002				2003				2004				2005			
	PSD	RSD		W_r	PSD	RSD		W_r	PSD	RSD		W_r	PSD	RSD		W_r	PSD	RSD		W_r
		P	M			P	M			P	M			P	M					
Channel catfish	27	4	0	79	35	1	0	76	26	1	0	78	36	0	0	76	46	2	0	78
$N =$	109				139				141				118				110			
White bass	91	91	27	104	100	50	42	99	95	85	32	106	100	83	25	101	22	22	36	99
$N =$	33				12				39				15				81			
Yellow perch	50	50	0	86	11	0	0	78	13	0	0	76	5	0	0	80	23	0	0	80
$N =$	6				9				16				32				66			