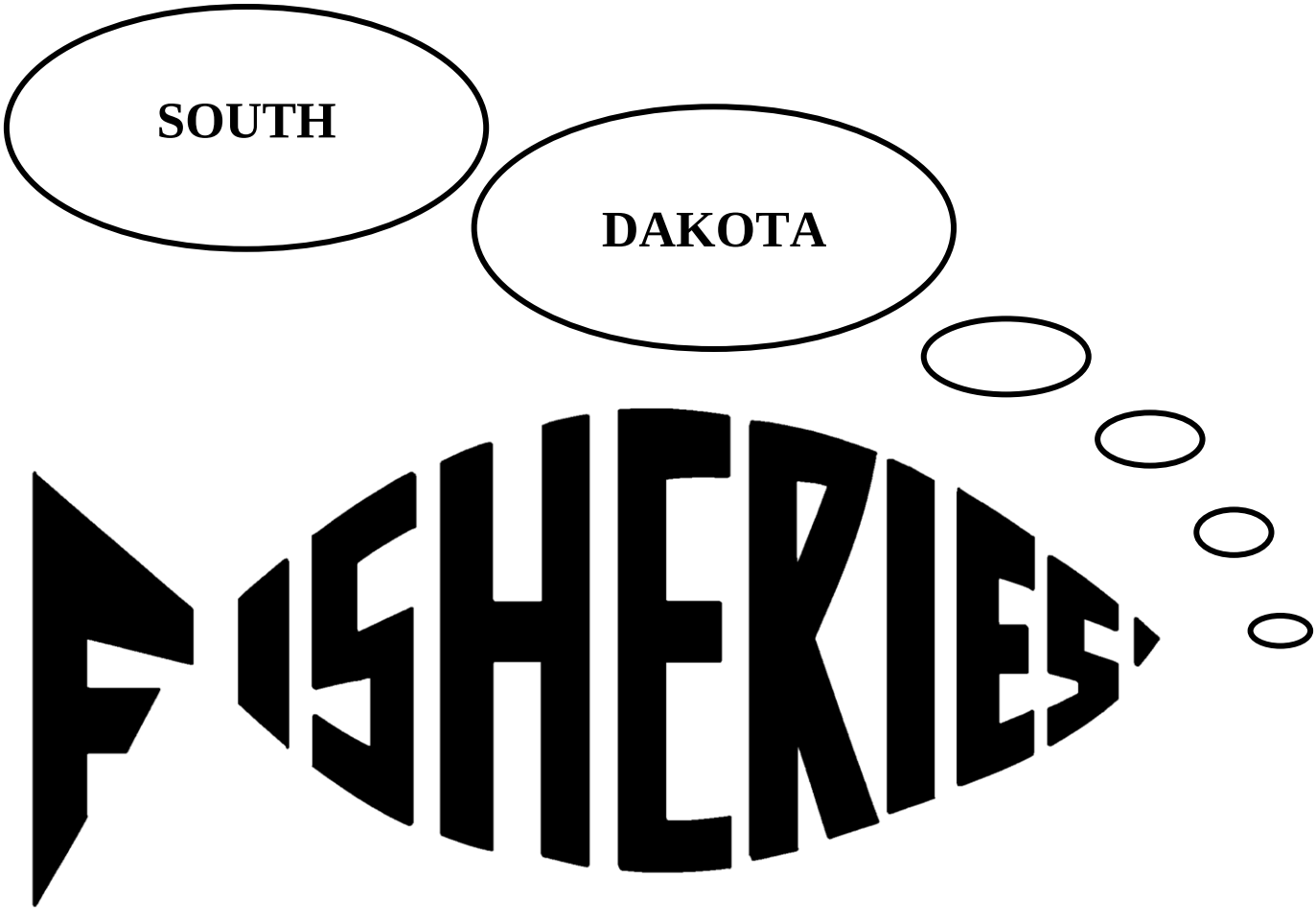

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST, AND PREFERENCE SURVEYS ON LAKE SHARPE, SOUTH DAKOTA, 2015

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

Annual Report
No. 16-05

ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE SHARPE, SOUTH DAKOTA, 2015

By

Michael Greiner,
Robert Hanten, Mark J. Fincel, Hilary Meyer, Kyle Potter, and Mike Smith
Ft. Pierre District Office
South Dakota Dept. of Game, Fish, and Parks

Annual Report

Dingell-Johnson Project ----------F-21-R-48
Job Numbers---------- 2102 and 2109
Date ---------- May 2016

PREFACE

Information collected during 2015 is summarized in this report. Copies of this report and references to the data can be made with permission from the authors or the Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, SD 57501.

The authors would like to thank the following individuals from the South Dakota Department of Game, Fish and Parks who helped with data collection, data entry, manuscript preparation, and report editing: C. Anderson, C. Burback, L. Collett, A. McGuigan, B. Schwery, G. Tibbs, J. Tostenson, and F. Turner.

The collection and analysis of data for these surveys was funded, in part, by Federal Aid in Sport Fish Restoration, (D-J) project F-21-R-48, Statewide Fish Management Surveys. Some of these data have been presented previously in segments F-21-23 through 47.

EXECUTIVE SUMMARY

This report includes annual fish population data and angler use, harvest, and preference data collected in 2015, for Lake Sharpe, South Dakota. In 2014, a reduction in manpower and budgetary constraints necessitated a reduction in creel effort on Lake Sharpe. Therefore, the angler use and harvest survey was reduced from the traditional April-September period to an abbreviated May-July period. In 2015, the angler use and harvest survey was expanded to include the May-August period. Fish population data and angler use and harvest survey data from previous years are referenced in this report. Results of these surveys are used to evaluate progress towards strategic plan objectives as outlined in the Missouri River Fisheries Program Strategic Plan 2014.

We collected walleye ranging from 160- to 530-mm during the August 2015 gill net survey. Mean catch per unit effort (CPUE) of walleye in gillnets (14.2 fish/net-night) during 2015 remained below the five year average. Walleye CPUE was the seventh lowest observed for 254-381 mm length walleye and the ninth lowest observed for 382-457 mm length walleye since the survey was initiated. However, proportional size distribution (PSD) was 41 and similar to the previous ten year mean (43). Seventy percent of the walleye sampled during the August gill net survey in 2015 were below the September-June 381mm minimum harvest length limit.

Twenty four species of age-0 and/or small-bodied prey fishes were collected by shoreline seining in 2015, all of which had been collected previously in Lake Sharpe. Average gizzard shad seine survey CPUE was 1001 fish/haul which was higher than the five year average. Lake Sharpe gizzard shad were once again used for stocking programs on Lake Oahe (168) in central South Dakota as well as Lakes Alvin (50) and Marindahl (74) in eastern South Dakota. In total, 292 pre-spawn adult gizzard shad were removed from Hipple Lake in 2015.

An estimated 314,064 h angler hours were spent on Lake Sharpe during the May-August 2015 daylight period, the fourth highest pressure observed since 2006. Estimated walleye harvest was 116,826 fish which was the sixth highest May-August total since 2006 and exceeded the long term mean of 106,266 for Lake Sharpe.

Estimated hourly harvest rate for all species combined for the May-August 2015 daylight period (0.43 fish/angler-h) was higher than the strategic plan objective (0.35 fish/angler-h). The walleye catch, harvest, and release rates for all anglers in 2015 (0.97, 0.37, 0.60 fish/angler-h, respectively) were approximately average for this fishery. The 2015 smallmouth bass catch rates remain low (0.20 fish/angler-h) and white bass catch rates were second highest since 2006 (0.11 fish/angler-h), respectively.

About 79% of angling parties interviewed in 2015 indicated some degree of satisfaction with their fishing trip, which surpasses the Lake Sharpe strategic plan objective of 70%. Fishing on Lake Sharpe contributed an estimated $6.2 million to the local and regional economy during the May-August 2015 daylight period (93,194 trips; $67 per trip; U.S. Department of the Interior-Fish and Wildlife Service, and U.S. Department of Commerce-Bureau of the Census 2012).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

The Missouri River system represents one of the most economically and recreationally important aquatic resources in the state of South Dakota. Anglers spent over 2.4 million hours fishing the Missouri River system in South Dakota in 2008 (Bouska and Longhenry 2009; Sorenson and Knecht 2009; Longhenry et al. 2010). In 2010, approximately 37% of all angler days in South Dakota were spent on the Missouri River system (Gigliotti 2011), and about 50% of all South Dakota resident licensed anglers fished the Missouri River system (Gigliotti 2011). The South Dakota Department of Game, Fish and Parks (SDGFP) developed the Missouri River fisheries management area plan to effectively guide management of the resource and direct future research (SDGFP 2014).

Lake Sharpe has supported between 26,321 and 97,339 angler days and generated between $1.8 and 6.2 million annually to the local and regional economy during the May-August daylight period between 2005-2015. Lake Sharpe is an important resource in South Dakota and its habitat and fish assemblage must be managed to enhance its value to various user groups. The importance of Lake Sharpe to Missouri River fisheries is documented in the goals, objectives and strategies developed for management of this system (SDGFP 2014). Information gathered during standardized creel and fish population surveys is used to evaluate objectives and to identify future management strategies. This report includes data collected from Lake Sharpe in 2015, as well as comparisons of 2015 data to previous years. A list of common and scientific names for fish and emergent vegetation mentioned in this report are presented in Appendix 1 and 2, respectively.

STUDY AREA

Lake Sharpe is located in central South Dakota (Figure 1) and extends from Oahe Dam to Big Bend Dam. Lake Sharpe is a 128-km long mainstem Missouri River flow-through reservoir and has a surface area of 24,686 ha (Table 1). The reservoir has been divided into three zones for survey purposes. The upper zone extends from Oahe Dam to the downstream end of LaFramboise Island, the middle zone extends from the downstream end of LaFramboise Island to DeGrey Lakeside Use Area, and the lower zone extends from DeGrey to Big Bend Dam. Standard gill netting and seining locations have historically included Farm Island, DeGrey/Fort George Lakeside Use Area, Joe Creek Lakeside Use Area, and North Shore Lakeside Use Area.

Hipple Lake and LaFramboise Bay are large backwaters located on upper Lake Sharpe. These embayments are generally warmer compared to the main lake (Longhenry et al. 2010). Emergent vegetation, including curly leaf pondweed, Eurasian water milfoil, fan-leafed crowfoot, American elodea, and sago pondweed is prevalent in embayments throughout Lake Sharpe. Cattail and round stem bulrush stands are more common in Hipple Lake, but can also be found in LaFramboise.

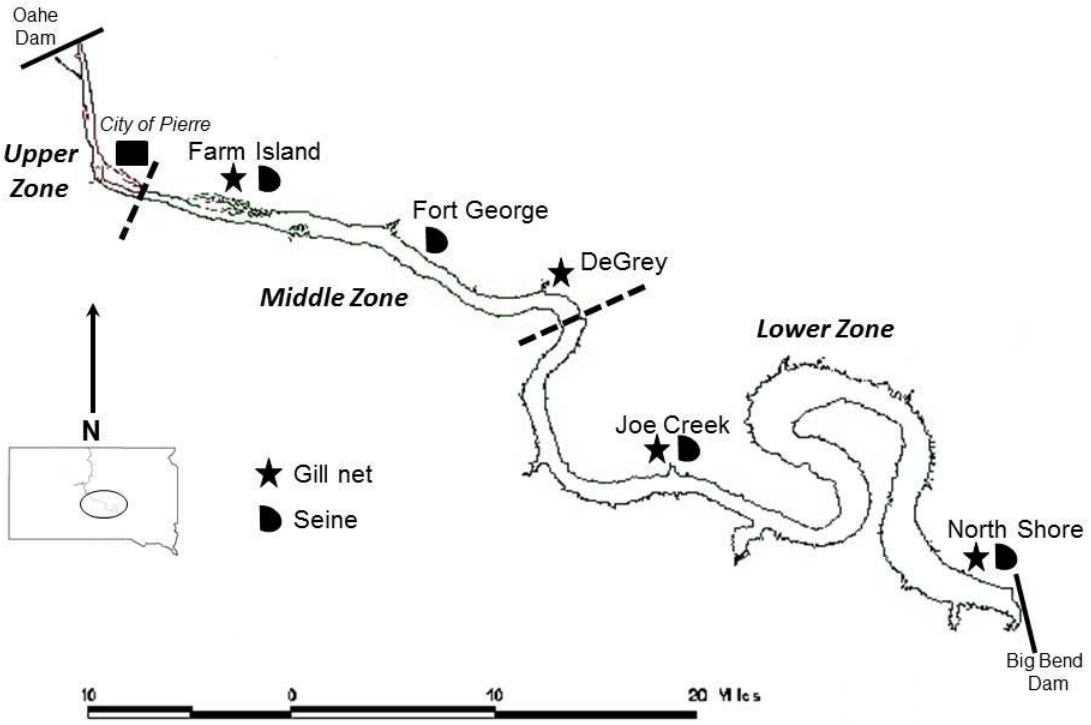

Figure 1. Gill net and seine locations on Lake Sharpe, South Dakota, including zone designations, 2015.

Table 1. Physical characteristics at normal pool elevation, management classification and sampling times and depths for annual fish population surveys on Lake Sharpe, South Dakota.

Characteristic:	Description
Location:	From Oahe Dam to Big Bend Dam
Surface area (ha):	25,000
Depth (m)-maximum:	23.5
-mean:	9.5
Bottom substrate:	Sand, gravel, shale and silt
Water source:	Missouri River and tributaries
Management classification:	Cool and warm water permanent
Gill net depths (m):	0.0 - 9.0 9.1 - 18.3
Number of gill nets:	24
Gill netting survey month	August
Number of seine hauls:	16
Seining survey months	July/August

REGULATION HISTORY

Fish population and angler use and harvest survey data are essential when evaluating special management regulations. Walleye harvest regulations for Lake Sharpe have differed from standard statewide regulations since 1990 when an April through June 356-mm (14-in) minimum length limit was implemented (Table 2). In 1999, the minimum length limit was increased to 381-mm (15-in) during all months except July and August and a stipulation that, at most, one fish in the daily limit could be 457-mm (18-in) or longer was added. These changes were made to reduce harvest during a period of high angler use and increase the abundance of walleye longer than 457-mm (18-in) in the population. The daily limit was reduced to three fish for 2004 and 2005 to reduce harvest during a period of low walleye abundance. In 2006, the daily limit was returned to the statewide limit of four and the one walleye over 457-mm (18-in) length regulation was increased to 508-mm (20-in).

Experimental regulations for smallmouth bass were implemented in 2003 and evaluated through 2011 for their effectiveness at increasing the size structure of the population in Lake Sharpe (Table 2). Special regulations for smallmouth bass from 2003 through 2007 included a 306- to 457-mm (12- to 18-inch) protected slot length limit with, at most, one fish 457-mm (18-in) or longer in the daily limit. In 2008, the smallmouth bass regulations on Lake Sharpe were altered to include a 355- to 457-mm (14- to 18-in) protected slot length limit with, at most, one fish 457-mm (18-in) or longer in the daily limit. The regulation change was implemented with a goal to decrease abundance and increase size structure through increased harvest of smaller smallmouth bass. The slot limit regulation for smallmouth bass was evaluated beginning in 2011 and deemed unsuccessful, thus, this regulation was removed at the end of calendar year 2011 (Fincel et al. 2015).

Table 2. History of special harvest regulations for walleye and smallmouth bass on Lake Sharpe, South Dakota, 1968-2015.

Species	Period	Daily limit	Possession limit	Length restrictions
Walleye/Sauger in combination	1968-1983	8	16	None
	1984-1989	6	12	None
	1990-1998	4	8	• April-June 356-mm minimum length
	1999-2003	4	8	• Sept.-June 381-mm minimum length • At most one equal to or longer than 457-mm
	2004-2005	3	8	• Sept.-June 381-mm minimum length • At most one equal to or longer than 457-mm
	2006-present	4	8	• Sept.-June 381-mm minimum length • At most one equal to or longer than 508-mm
Smallmouth bass	2003-2007	5	10	• Only fish shorter than 306-mm or 457-mm and longer may be kept and at most one fish in the daily limit may be 457-mm or longer.
	2008-2011	5	10	• Only fish shorter than 306-mm or 457-mm and longer may be kept and at most one fish in the daily limit may be 457-mm or longer.
	2012-present	5	10	None

SAMPLING METHODS

Fish Population Surveys

Data Collection

In 2015, experimental-mesh gill nets and a nylon mesh bag seine were used to survey fish populations in Lake Sharpe (Figure 1). Four locations on Lake Sharpe were sampled with six, 91.4-m multifilament gill nets submerged overnight (about 20 h). Three nets were placed ≤ 9-m depth and three were placed in > 9-m where possible (Figure 1). Bar mesh dimensions included 13-, 19-, 25-, 32-, 38-, and 51-mm. All fish collected were identified and enumerated. The first 50 individuals of each species were measured (TL; mm) and weighed (g) at each sampling location. All walleye and sauger were measured, weighed, and otoliths removed for age-estimation (10 per 2.5-cm length group per sampling location).

A 6.4-mm nylon mesh bag seine, measuring 30.5-m long by 2.4-m deep with a 1.8-m by 1.8-m bag, was used to collect age-0 and small-bodied littoral fishes. A quarter-arc seine haul was accomplished using methods described in Martin et al. (1981). Four seine hauls were made at each sampling station. All fish collected were identified, counted, and classified by age.

Data Analysis

Relative abundance of fish species was indexed using mean catch per unit effort (CPUE) for gill net (No./net night) and seine (No./haul) catches. Age and growth analyses were conducted using whole otoliths that were submersed in glycerol and viewed under a compound microscope. Otoliths were cracked at the focus and charred for age-estimation of fish greater than 350-mm (DeVries and Frie 1996; Isermann et al. 2003). Proportional size distribution (PSD; Anderson 1980, Gablehouse 1984, Guy et al. 2007) was calculated for walleye, sauger, and channel catfish. Relative weight (W_r; Anderson 1980) was calculated using standard weight (W_s) equations developed for walleye (Murphy et al. 1990) and channel catfish (Brown et al. 1995).

Angler Use, Sportfish Harvest and Preference Surveys

Data Collection

Prior to 2003, angler use and sport-fish harvest survey techniques were designed using a template by Schmidt (1975) consisting of two independent parts. First, aerial pressure counts were used to estimate fishing pressure. Second, angler interviews were used to obtain estimates of individual angler harvest, catch, and release rates. Since 2003, a bus route survey design (Jones and Robson 1991) has been used for the angler use and harvest survey to increase the statistical reliability of the pressure estimates generated. 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).

Creel surveys were conducted from 1-May, 2015 through 31-August, 2015 for the sunrise-to-sunset (daytime) period. For diagrams of bus routes used on Lake Sharpe during the May-August survey period consult Fincel et al. (2012). Day selection

(weekday or weekend/holiday), shift time (day beginning at sunrise or ending at sunset), route direction (forward or backwards), starting location, and route selection were randomly selected.

Questions posed in standard interviews gathered information on trip length, type of fishing (boat or shore), target species, zip code, number in party, number, and species of fish harvested and released, and lengths of walleye harvested by anglers. Angler satisfaction questions were included in each interview during the 2015 reservoir-wide angler use and harvest survey. In addition to asking anglers how satisfied they were with their fishing trip, anglers were also asked what factors would help increase their satisfaction level to "very satisfied" and whether they were aware of new regulations for boat plug removal and live bait transport (Appendix 3).

Data Analysis

Pressure count and angler interview data were analyzed using the Creel Application Software (CAS) package (Soupir and Brown 2002) and 80% confidence intervals were calculated for estimates of fishing pressure and harvest. Catch, harvest, and release numbers and rates were calculated. Median values of satisfaction question responses were calculated for each month and for the entire May-August survey period.

RESULTS AND DISCUSSION

August Gill Net Population Assessment

Species Composition and Relative Abundance

Walleye and channel catfish comprised 38 and 13% of the gill net catch in 2015, respectively (Table 3). Other species commonly caught included sauger, common carp, and yellow perch. Walleye and channel catfish CPUE (14.2 and 4.8 fish/net-night, respectively) increased from 2014 (Table 4). Moreover, CPUE of walleye in 2015 was the fourth lowest observed since 1986. Additionally, the 2014 and 2015 surveys represent the second lowest back-to-back walleye gillnet catches observed. Catch per unit effort has historically been used as an index of population abundance or density; however, changes in fish behavior due to floods and/or changes in lake volume can affect CPUE of gill nets (Hubert 1996). Therefore, caution should be used when inferring density or abundance of fish species captured in the standard gill net survey from CPUE compared temporally.

Population Characteristics of Walleye

Multiple year classes were present in 2015 with a large proportion of quality and preferred length walleye (Figure 2). Approximately 30% of walleye in the 2015 gill net sample were ≥ 381-mm (15-in) and less than 1% were ≥ 508-mm (20-in). However, CPUE was the seventh lowest observed since the survey was initiated (1986) for walleye 254-380 mm TL and the ninth lowest observed for walleye 381-457 mm TL (Figure 3). Proportional size distribution decreased from 51 in 2014 to 41 in 2015, but was in the range of the previous four years (range 39-60). Proportional size distribution – preferred were similar to values observed in the past four years for walleye (0 PSD-P) but was high for sauger (60 PSD-P; Table 5).

Historically, walleye condition (W_r) for Lakes Sharpe, Francis Case, and Lewis and Clark are generally between 80 and 90 (Fincel et al. 2013). Condition of walleye (stock length and greater) in Lake Sharpe in 2015 was 79, which is similar to the five-year average (Table 6). Variability in walleye condition in Lake Sharpe likely occurs due to the seasonal availability of gizzard shad and entrainment of rainbow smelt through Oahe Dam (Wuellner et al 2010).

Walleye growth in Lake Sharpe is generally considered good and walleye typically reach the 381-mm (15-in) minimum length limit during their fourth growing season (Fincel et al. 2013). However from 2013-2015, walleye surpassed 381-mm (15-in) at age-3 (Table 7). In 2015, walleye incremental growth was above average for age-4 and younger year classes compared to the five year average (Table 8). Age-2 and -3 walleye (i.e., produced in 2013 and 2012) represented 74 percent of the 2015 gill net sample (Table 9). Thirty-four age-1 walleye were captured during the gill net survey in 2015 which was close to the five year average (Table 9).

Population Characteristics of Sauger

Forty-five sauger were collected during the gill net survey, for a mean CPUE of 1.9 fish/net-night (Figure 4). PSD of sauger is generally high in Lake Sharpe with a PSD-P of 60 in 2015. This was a substantial increase compared to a PSD-P of 30 in 2013

(Table 5). The maximum age of sauger collected in the 2015 gill net survey was age-9. Growth of sauger in 2015 was slow for all age classes except age 6 compared to the five year average (Table 10). No age-0 or age-1 sauger were collected with gill nets in 2015 (Table 11).

Population Characteristics of Channel Catfish

Channel catfish PSD decreased to 68 yet still exceeded the low values documented in 2012 and 2013 (Table 12). Relative weight remained relatively unchanged. Catch-per-unit effort of channel catfish during 2015 (4.8 fish/net night) increased slightly from 2014 (3.8 fish/net night; Figure 5). Channel catfish appear long lived but grow slowly which may explain the limited changes in population indices over time (Elrod 1974).

Shoreline Seining Survey

Eighteen species of small-bodied littoral fishes were collected by shoreline seining in 2015 (Table 13). All species had previously been collected in Lake Sharpe. The overall catch rate for all species in combination was 1,182 fish/seine haul which is above the long term mean of 699 fish/seine haul. Age-0 gizzard shad CPUE comprised the majority of the catch (i.e., 1,001 fish/seine haul). Age-0 walleye CPUE was 5 fish/seine haul which is similar to the long term average. However, caution should be used when making inferences based on seining catch data as highly variable catch rates are an inherent bias of the gear and values may not represent true relative abundance (Lyons 1986, Parsley et al. 1989).

Table 3. Relative species composition as percent of total catch collected during the standard August gill net survey on Lake Sharpe, South Dakota, 2011-2015. Trace (T) indicates values < 0.5%.

Species	Year				
	2011	**2012**	**2013**	**2014**	**2015**
Walleye	60	52	45	36	38
Channel catfish	9	16	16	15	13
Yellow perch	9	4	7	4	10
Common carp	6	4	8	5	5
Sauger	5	2	5	6	5
White bass	1	T	3	1	T
Gizzard shad	1	13	T	4	2
Freshwater drum	1	1	1	T	2
Smallmouth bass	1	1	4	2	2
*Others	7	6	12	27	22

*Others includes: black bullhead, black crappie, burbot, flathead catfish, goldeye, lake herring, largemouth bass, northern pike, rainbow trout, river carpsucker, shorthead redhorse, shortnose gar, shovelnose sturgeon, smallmouth buffalo, spottail shiner, white crappie, and white sucker.

Table 4. Mean catch per unit effort (CPUE; No./net-night) and standard error (SE) for fish species collected with standard coolwater gill net sets in Lake Sharpe, South Dakota, 2011-2015. Trace (T) indicates a value <0.05.

Species	Year									
	2011		2012		2013		2014		2015	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Burbot	0	--	0	--	0	--	T	--	0	--
Black bullhead	0.2	0.1	0.1	0.1	0	--	0	--	0	--
Black crappie	0.1	0.1	T	--	T	--	0	--	0.1	0.1
Channel catfish	3.0	0.6	7.3	1.6	4.7	1.2	3.8	1.1	4.8	0.9
Common carp	1.9	0.5	1.9	0.5	2.5	0.5	1.2	0.5	2.0	0.6
Freshwater drum	0.2	0.1	0.5	0.2	0.2	0.1	0.1	0.1	0.9	0.4
Gizzard shad	0.4	0.4	5.6	3.1	T	--	0.9	0.5	0.6	0.4
Goldeye	0	--	0.6	0.3	T	--	0.1	0.1	0.4	0.2
Lake herring	0	--	0	--	0	--	0	--	0.6	0.3
Largemouth bass	0	--	0	--	0	--	T	--	0	--
Northern pike	0.1	0.1	T	--	T	---	0	--	T	--
Rainbow trout	0	--	T	--	0	--	T	--	0	--
River carpsucker	0.6	0.4	0.3	0.2	0.5	0.3	2.0	0.8	2.7	1.3
Sauger	1.8	0.6	0.9	0.3	1.4	0.5	1.6	0.5	1.9	0.5
Shorthead redhorse	0.7	0.5	0.8	0.4	1.3	0.3	0.7	0.3	1.5	0.6
Shortnose gar	0.2	0.1	0.3	0.2	0.3	0.2	0.6	0.4	0.2	0.1
Shovelnose sturgeon	0.1	0.1	0.4	0.2	1.1	0.6	3.3	1.8	2.5	1.8
Smallmouth bass	0.3	0.2	0.3	0.2	1.1	0.7	0.6	0.5	0.8	0.8
Smallmouth buffalo	0	--	0	--	T	--	0.1	0.1	T	--
Spottail shiner	0.1	0.1	0	--	0	--	0	--	T	--
Walleye	20.1	3.1	23.2	4.5	13.4	2.2	9.4	2.2	14.2	3.1
White bass	0.4	0.2	0.1	0.1	0.8	0.5	0.2	0.2	T	--
White crappie	0.1	0.1	T	--	0	--	0	--	0	--
White sucker	0.3	0.2	0	--	0.1	0.1	0	--	T	--
Yellow perch	3.1	0.9	1.9	0.7	2.0	0.7	1.1	0.5	3.7	1.5

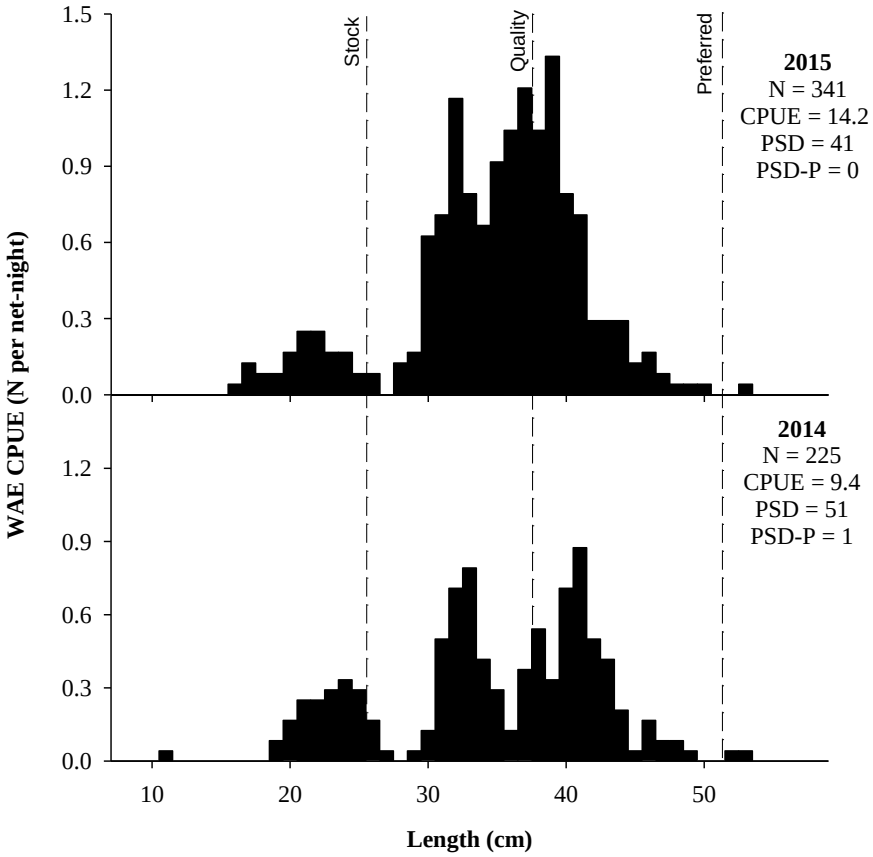

Figure 2. Length-frequency of walleye collected in standard gill-net sets in Lake Sharpe, South Dakota, in August 2014 and 2015.

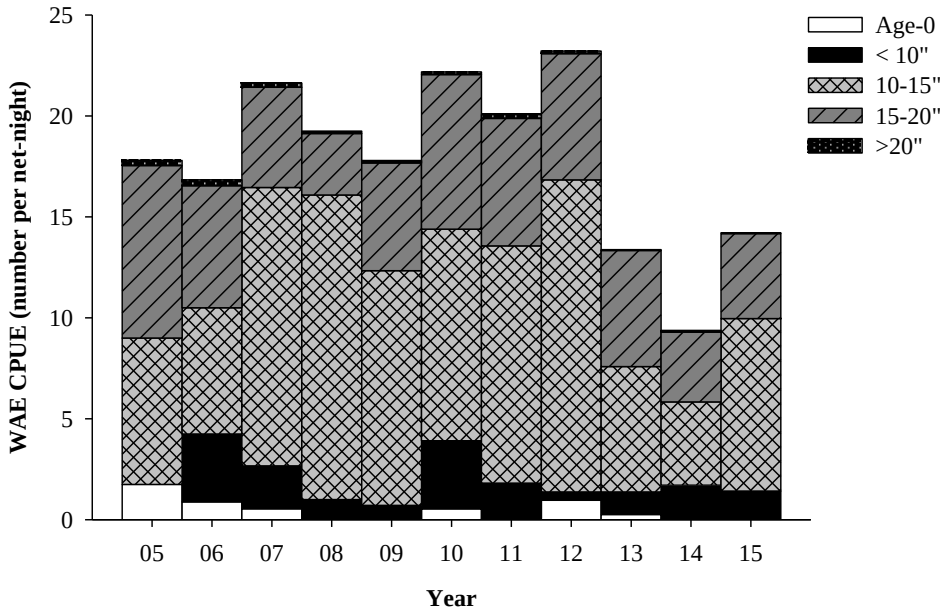

Figure 3. Size structure and relative abundance (CPUE) of walleye collected in the standard gill net survey in Lake Sharpe, South Dakota, August 2005-2015.

Table 5. Walleye and sauger proportional size distribution (PSD), PSD of preferred (PSD-P) and memorable length (PSD-M) fish collected in the standard gill net survey on Lake Sharpe, South Dakota, 2011-2015.

Year	Walleye				Sauger			
	PSD	PSD-P	PSD-M	N	PSD	PSD-P	PSD-M	N
2011	39	1	0	295	86	43	0	28
2012	41	1	0	525	95	48	0	21
2013	60	0	0	299	94	30	0	31
2014	51	1	0	191	92	66	5	38
2015	41	0	0	309	98	60	2	45

Table 6. Mean relative weight (W_r) of walleye by length group and number of fish in a specified length group (N) for Lake Sharpe, South Dakota, 2011-2015.

Year	Length group							
	Stock-quality		Quality-preferred		Preferred-trophy		>Stock length	
	W_r	N	W_r	N	W_r	N	W_r	N
2011	82	180	84	111	80	3	83	294
2012	85	308	79	213	70	3	82	524
2013	87	117	82	178	77	1	84	296
2014	88	91	81	93	85	2	84	186
2015	80	182	79	125	84	1	79	308

Table 7. Mean length-at-age-at-capture (mm), number (N) and standard error (SE) for walleye collected in the standard August gill net survey on Lake Sharpe, South Dakota, 2011-2015.

Year		Length at age at capture (mm)								
		1	2	3	4	5	6	7	8	9
2011	**Mean**	232	340	388	435	436	463	403	504	-
	N	34	163	45	29	25	12	1	3	-
	SE	5.7	1.9	5.6	4.4	5.8	8.3	-	31.6	-
2012	**Mean**	248	311	362	396	422	448	459	-	478
	N	13	63	95	23	20	20	15	-	7
	SE	3.2	2.4	2.8	6.5	5.7	10.5	8.2	-	29.9
2013	**Mean**	248	343	381	401	401	428	466	445	428
	N	33	18	64	68	20	14	7	4	1
	SE	3.7	6.5	2.7	3.1	7.2	5.2	11.6	15.7	-
2014	**Mean**	234	334	392	397	424	428	426	458	458
	N	41	67	9	24	29	14	7	3	4
	SE	3.1	3.0	5.1	6.0	5.9	9.7	4.0	37.3	8.1
2015	**Mean**	214	325	384	448	430	425	420	438	465
	N	34	89	89	5	13	16	9	5	1
	SE	24.0	2.2	2.7	8.4	9.9	5.9	15.5	19.1	--
Mean of means		235	331	381	415	423	438	435	461	457

Table 8. Mean annual growth increment estimates (mm/y) for walleye collected in the standard coolwater gill net survey on Lake Sharpe, South Dakota, for the 2010-2011, 2011-2012, 2012-2013, 2013-2014 and 2014-2015 periods.

Year	Growth increment (mm) added at age							
	1-2	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**	**8-9**
2010-2011	77	40	41	22	45	--	56	--
2011-2012	79	22	8	--	12	--	--	--
2012-2013	95	70	39	5	6	18	--	--
2013-2014	86	49	16	23	27	--	--	13
2014-2015	91	50	56	33	1	--	12	7

Table 9. Age distribution of walleye collected from Lake Sharpe, South Dakota, 2011-2015, with standard gill net sets as determined by age-estimation from otoliths.

Year	Age												
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2011	1	34	163	45	29	25	12	1	3	0	1	3	2
2012	23	13	88	268	65	39	28	18	0	9	0	1	0
2013	6	35	23	101	94	28	16	7	4	2	0	1	2
2014	1	44	76	10	28	34	16	9	3	4	0	0	0
2015	0	34	121	130	5	15	18	11	6	1	0	0	0

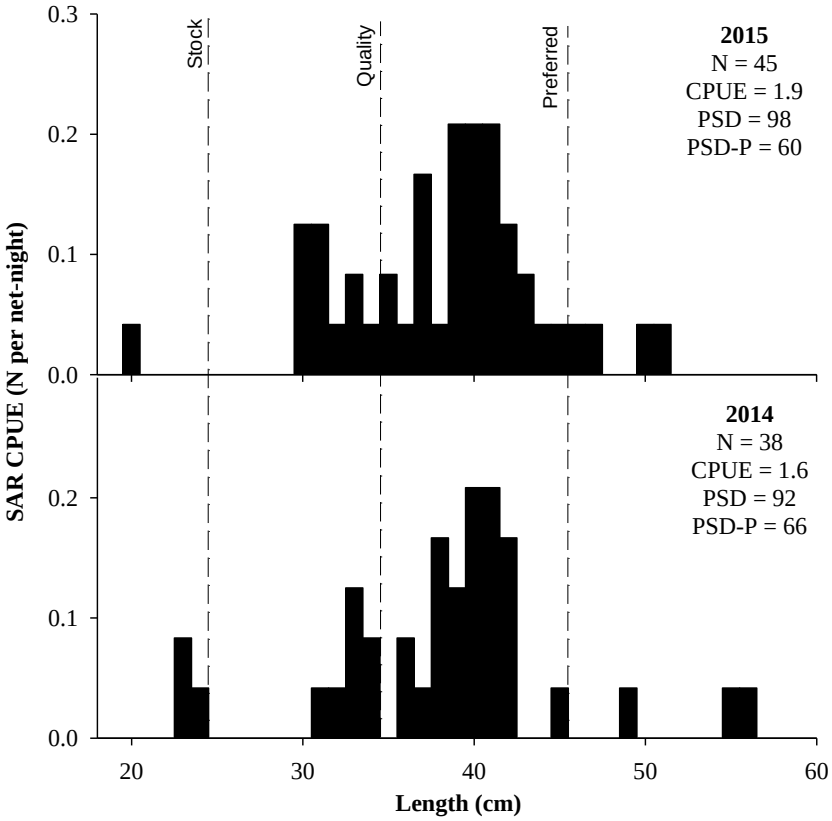

Figure 4. Length-frequency of sauger collected in the standard gill net survey in August 2014 and 2015 on Lake Sharpe, South Dakota.

Table 10. Mean length-at-age-at-capture (mm) for sauger collected in the standard coolwater gill net survey, 2011-2015, on Lake Sharpe, South Dakota.

Year		Length at age at capture (mm)								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2011	**Mean**	204	341	414	504	456	464	--	--	--
	N	4	12	4	1	5	2	--	--	--
	SE	1.9	6.3	16.9	--	16.7	39.0	--	--	--
2012	**Mean**	--	308	380	--	--	429	442	--	--
	N	--	4	11	--	--	3	3	--	--
	SE	--	10.7	6.2	--	--	37.8	9.6	--	--
2013	**Mean**	253	347	371	381	426	--	--	463	--
	N	2	7	13	7	1	--	--	2	--
	SE	1.5	4.9	4.4	7.1	--	--	--	17.0	--
2014	**Mean**	265	344	388	409	419	--	564	--	526
	N	4	7	8	10	5	--	1	--	2
	SE	24.8	9.0	6.3	6.6	3.0	--	--	--	30.0
2015	**Mean**	--	319	391	409	416	460	--	410	445
	N	--	8	19	2	7	3	--	1	2
	SE	--	5.0	8.4	9.0	6.6	34.0	--	--	15.0
Mean of means		241	332	389	426	429	451	503	437	486

Table 11. Age distributions of sauger collected in the standard gill net survey from Lake Sharpe, South Dakota, 2011-2015.

Year	Age										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2011	0	4	12	4	1	5	2	0	0	0	0
2012	0	0	4	11	0	0	3	3	0	0	0
2013	0	2	7	13	8	1	0	0	2	0	0
2014	0	4	7	8	10	5	0	1	0	2	0
2015	0	0	9	19	2	7	3	0	1	2	0

Table 12. Proportional size distribution (PSD), proportional size distribution of preferred and memorable-length (PSD-P and PSD-M) channel catfish, and relative weight (W_r) for 2011-2015, from Lake Sharpe, South Dakota. Mean W_r values are for stock-length fish and greater.

Year	PSD	PSD-P	PSD-M	W_r	N
2011	82	2	0	89	45
2012	53	5	1	90	158
2013	53	4	0	86	106
2014	77	15	0	86	73
2015	68	13	0	89	96

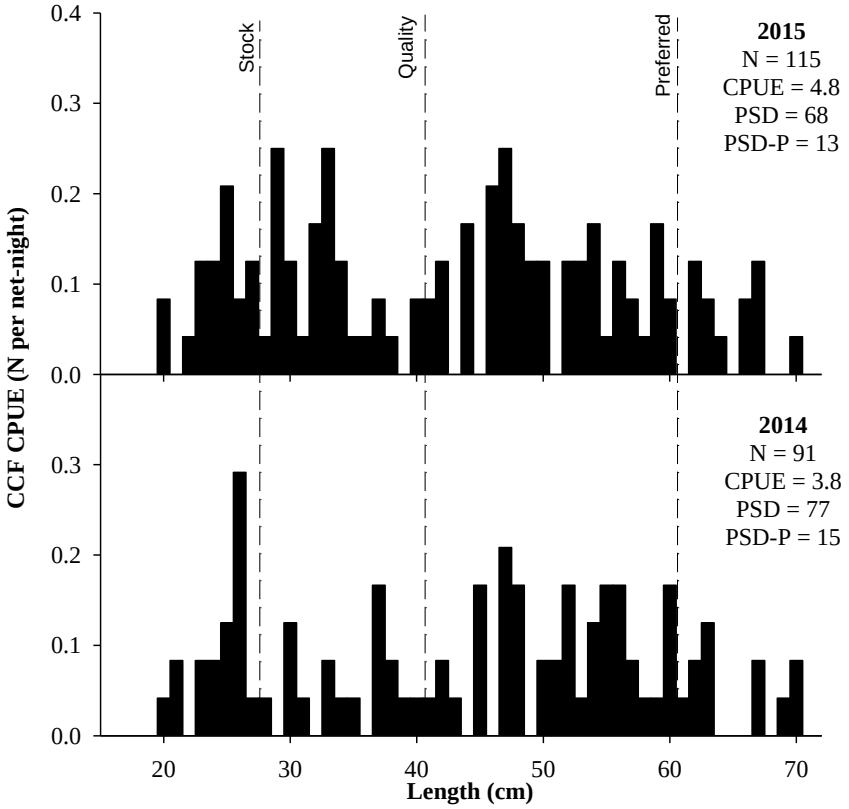

Figure 5. Length-frequency of channel catfish collected in the standard gill net survey in August 2014 and 2015 on Lake Sharpe, South Dakota.

Table 13. Mean catch per unit effort (CPUE; No./haul) and standard error (SE) values for fish species collected in the standard August seine survey on Lake Sharpe, South Dakota, 2011-2015. Catches are for age-0 fishes except where noted. Asterisk (*) indicates age-0 and adult fish included in CPUE.

Species	Year									
	2011		2012		2013		2014		2015	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0	--	0	--	0.3	0.1	0	--	0.4	0.2
Black crappie	0.1	0.1	0	--	0	--	0.7	0.3	3.9	1.6
Bluegill	0.2	0.3	1.0	0.7	0	--	0.1	0.1	0	--
Bluntnose minnow	0.3	0.2	3.0	1.3	1.1	0.5	2.3	1.3	1.2	0.7
Brassy minnow*	0.1	0.1	0	--	0	--	0	--	0	--
Channel catfish	0.1	0.1	0	--	0.5	0.3	0.1	0.1	0.2	0.1
Common carp	0.1	0.1	0.1	0.1	0.1	0.1	0	--	0.1	0.1
Emerald shiner*	8.3	6.8	13.2	4.5	7.3	3.7	14.5	6.7	105.6	66.5
Freshwater drum	0	--	5.1	1.8	32.3	13.7	14.8	6.5	5.4	3.9
Fathead minnow	0.7	0.7	0	--	0	--	0	--	0	--
Gizzard shad	13.3	8.0	1,350.9	508.9	400.9	106.6	755.8	369.8	1,000.8	826.3
Goldeye	0	--	0	--	0.1	0.1	0	--	0.7	0.3
Johnny darter*	1.5	0.8	0.5	0.5	4.2	3.2	3.5	1.7	1.1	0.6
Largemouth bass	0.1	0.1	0.1	0.1	0.2	0.1	0.6	0.3	0.2	0.1
Rainbow smelt	0.3	0.2	0	--	0	--	0	--	0	--
River carpsucker	0.3	0.2	3.8	1.9	0	--	0.8	0.4	0.1	0.1
Sand shiner	0.2	0.1	0	--	0	--	0	--	0	--
Sauger	0	--	0	--	0	--	0	--	0	--
Shorthead redhorse	0	--	0	--	0	--	0.1	0.1	0	--
Smallmouth bass	1.6	0.9	4.3	1.3	7.4	1.4	11.1	3.4	3.3	1.5
Smallmouth buffalo	0	--	0	--	2.9	1.2	0.3	0.2	0	--
Spottail shiner*	3.8	1.9	5.5	4.1	0.7	0.4	1.9	0.9	3.0	1.9
Walleye	0.8	0.5	3.4	1.5	12.0	4.6	13.0	5.6	5.1	2.0
White bass	6.9	5.0	2.1	1.0	11.5	4.9	3.7	2.2	23.3	13.5
White crappie	0.1	0.1	3.3	1.8	3.1	2.7	0	--	0	--
White sucker	0.2	0.1	0.1	0.1	0	--	0.4	0.2	0.1	0.1
Yellow perch	1.8	1.3	23.4	10.5	54.6	18.2	41.3	15.0	27.6	18.4
OVERALL	40.9	13.5	1,420.1	509.7	539.2	103.5	864.9	379.1	1,181.9	825.0

Angler Use, Sportfish Harvest and Preference Surveys

Angler Use

Estimated fishing pressure for the May-August 2015 daylight period (314,064 h) was greater than the long term average for Lake Sharpe (271,571 angler-h; Table 14). Estimated angler days (trips) spent on Lake Sharpe during the 2015 survey period (93,194 days) was the fourth highest observed on Lake Sharpe since 2006.

Peak fishing pressure on Lake Sharpe occurred in May and June (Table 15). Most of the angling pressure on Lake Sharpe (93%) occurred in the lower (215,107angler-h) and upper (77,799 angler-h) zones in 2015 (Table 15). Similar to previous years, the upper zone of Lake Sharpe experienced the highest angling pressure per unit of area where fishing pressure was 84.7 h/ha, compared to 5.0 and 11.6 h/ha on the middle and lower zones (Table 16). Boat fishing was again the most popular form of angling on Lake Sharpe (11.8 h/ha; Table 17).

Catch, Harvest and Release Estimates

Walleye were the most abundant species caught from May-August 2015 (305,774 fish), and above the long term average (287,734 fish; Table 18). Walleye harvest (116,826 fish) on Lake Sharpe exceeded the long term average harvest (112,940 fish) but was below the 117,643 walleye harvested in 2014 (Table 18). The highest level of walleye harvest occurred in July (Table 19). Walleye were followed by smallmouth bass (17,190), white bass (9,389), and channel catfish (4,591) in decreasing order of estimated harvest. Estimated walleye harvest was highest in the lower zone (95,679 fish), followed by the upper zone (19,938 fish), with the middle zone having the lowest harvest (1,209 fish; Table 20). Walleye were also the most frequently released species with an estimated 188,948 walleye caught and released in Lake Sharpe in 2015 (Table 21). Smallmouth bass, white bass and channel catfish were also commonly caught and released (45,920, 24,843 and 9,460 fish released, respectively). Walleye greater than 381-mm were primarily harvested on Lake Sharpe the month of June compared to higher numbers of less than 381-mm walleye harvested in July and August when the 381-mm (15-in) minimum length limit was removed (Figure 6).

Hourly Catch, Harvest and Release Rates

The estimated hourly catch rate was 1.39 fish/angler-h and estimated release rate was 0.9 fish/angler-h, for all species combined during the May-August daylight period in 2015 (Table 22). In 2015, anglers targeting walleye had a mean hourly catch rate of 1.92 (fish/angler-h), similar to 2014 (2.31 fish/angler-h; Table 23). Hourly catch rates for anglers targeting smallmouth bass, white bass, and channel catfish were 3.26, 3.43, and 0.30 fish/angler-h, respectively (Table 23). Hourly catch rates of smallmouth bass in 2015 were well below the ten-year average (Table 24). Catch rates of white bass and channel catfish slightly exceeded the ten-year average but were similar to recent years (Table 24).

Hourly catch rates for walleye were highest in June and hourly harvest rates were highest in July (Table 25). The removal of the minimum length limit in July and August normally results in a decrease in release rate; however, release rate in July remained high

at 0.73 fish/angler-h. This is likely a result of high catch rates on Lake Sharpe. The number of parties that caught four or more walleye remained similar in 2014 and 2015 (33% and 31%, respectively; Table 26). The number of anglers that harvested a limit of four walleye in 2015 (14%) was similar to 2014 (18%; Table 26).

Angler Demographics and Economic Impacts

For the May-August 2015 daylight period, Lake Sharpe anglers contributed about $5 million to local economies, based on 74,238 trips at an estimated $67 per trip (U.S. Department of the Interior-Fish and Wildlife Service, and U.S. Department of Commerce-Bureau of the Census 2012).

Non-residents made up 19% of the angler contacts on Lake Sharpe in 2015, similar to estimates from the previous four years (Table 27). Most non-resident anglers using Lake Sharpe in 2015 were from Iowa, Nebraska, and Minnesota (Table 28). Residents of 34 states were interviewed while fishing Lake Sharpe. Patterns in angler state of residency in 2015 remained similar to previous years (Fincel et al. 2014).

About 48% of resident angling parties interviewed on Lake Sharpe during the 2015 survey were local anglers from Hughes and Stanley counties (Table 29; Figure 7). Minnehaha (Sioux Falls), Pennington (Rapid City), and Beadle (Huron) county residents made up 10%, 7%, and 5% of the interviewed angling parties, respectively. Patterns in angler's county of residency in 2015 remained similar to previous years (Fincel et al. 2014).

Travel is required for many anglers fishing Lake Sharpe as the reservoir is located a fair distance from large population centers. Many (44%) anglers drove >100 miles to fish on Lake Sharpe (Table 30). Residents of Hughes and Stanley counties composed the majority of anglers traveling <25 miles and 25-49 miles, one way, to fish Lake Sharpe in 2015. Anglers from Minnehaha, Pennington, and Beadle counties composed the majority of anglers traveling 100-199 miles to fish Lake Sharpe. The percent of anglers traveling in excess of 200 miles (one way) to fish Lake Sharpe in 2015 remained similar to 2014 (Table 30). Walleye remain the primary species targeted by roughly two thirds (65%) of the anglers on Lake Sharpe in 2015. Approximately 27% of anglers surveyed were generalist in nature (Table 31).

Angler Satisfaction and Attitudes

Anglers' perception of their fishing experience is important to the success of a fishery. Angler responses to satisfaction questions help fisheries managers determine if current management practices are providing a fishery that meets angler needs and expectations. In 2015, anglers were asked to consider all factors when evaluating their level of satisfaction with their fishing trip. The median trip rating for the May-August 2015 period was "moderately satisfied" (median of 2; Table 32). About 79% of angling parties interviewed in 2015 indicated some degree of satisfaction, which surpasses the Lake Sharpe Strategic Plan objective of 70%. Neutral/no opinion anglers made up 9% of all contacts, and more importantly, dissatisfied anglers represented only 12% of all contacts in 2015.

Gigliotti (2004) proposed that factors other than the number of walleye harvested likely influence trip satisfaction. However, anglers that harvested three or more walleye on average were "very satisfied" In general as mean walleye catch rate increased, the

level of satisfaction increased, similar to previous years (Table 33; Fincel et al. 2014). Although both are considered a "satisfied" level, the number of walleye harvested likely effects angler satisfaction rankings.

To better understand factors influencing satisfaction, anglers were asked the supplemental question: "What would help increase your satisfaction level to 'very satisfied'?" Forty-four percent of anglers interviewed gave a "very satisfied" response and were not asked this question. The majority (63%) of anglers interviewed responded with a "catch more fish" response followed by "improve weather" (14%), and "catch larger fish" (12%). When looking at the high levels of satisfaction on Lake Sharpe combined with the high catch and high release rates, it appears that current management regulations and practices are serving the public well. At the very least, the 381-mm minimum length limit on walleye does not appear to be negatively impacting angler satisfaction.

Anglers were also asked a question regarding new regulations aimed at preventing the spread of aquatic invasive species (AIS): "Are you aware of the new regulations for boat plug removal and live bait transport?" Ninety-one percent of respondents were aware of the new regulations.

Table 14. Angler use and harvest estimates for surveys conducted 2006 to 2015 during the May-August daylight period.

Year	Fishing pressure (h)	Angler days	Estimated fish harvest	Estimated walleye harvest
2006	269,907	82,965	117,467	92,357
2007	273,348	71,806	116,429	95,033
2008	238,962	74,434	99,562	71,347
2009	329,617	109,596	177,023	132,728
2010	328,818	89,840	148,832	124,590
2011*	119,720	31,968	58,244	47,674
2012	243,742	83,003	156,338	130,711
2013	323,932	93,535	231,718	200,491
2014**	273,601	78,396	142,538	117,643
2015	314,064	93,194	154,786	116,826
Mean	271,571	80,874	140,294	112,940

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 15. Estimated fishing pressure (angler-h), by month and zone, with 80% confidence intervals (CI), for the May-August 2015 daylight period.

Zone	Month				
	May	**June**	**July**	**August**	**Total**
Lower	60,718	59,965	56,123	38,302	215,107
80% CI	17,588	12,733	9,437	7,643	24,878
Middle	11,753	3,755	3,357	2,293	21,157
80% CI	4,696	1,328	609	640	4,959
Upper	32,402	13,122	10,851	21,424	77,799
80% CI	7,715	4,120	3,674	6,281	11,377
Total	104,873	76,842	70,331	62,019	314,064
80% CI	19,771	13,449	10,145	9,913	27,802

Table 16. Estimated fishing pressure, expressed as angler-hours (h) and hour per hectare (h/ha), by reservoir zone, for standard creel surveys conducted during the May-August daylight period, 2006-2015.

Year	Zone							
	Lower		Middle		Upper		Total	
	h	h/ha	H	h/ha	H	h/ha	H	h/ha
2006	119,105	6.4	21,792	5.1	129,013	140.5	269,910	11.4
2007	178,310	9.6	12,347	2.9	82,692	90.1	273,349	11.6
2008	148,480	8.0	18,614	4.4	71,867	78.3	238,961	10.1
2009	197,924	10.7	18,375	4.3	113,317	123.4	329,616	13.9
2010	216,638	11.7	16,703	3.9	95,477	104.0	328,818	13.9
2011*	76,169	4.1	17,796	4.2	25,756	28.1	119,721	5.1
2012	122,078	6.6	13,673	3.2	107,992	117.6	243,743	10.3
2013	165,193	8.9	29,820	7.0	128,919	140.4	323,932	13.7
2014**	158,01	8.5	22,567	5.3	93,025	101.3	273,602	11.6
2015	215,107	11.6	21,157	5.0	77,799	84.7	314,064	13.3
Zone size (ha)	18,483		4,262		918		23,663	

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews. Asterisk (**) denotes survey was conducted May-July, 2014.

Table 17. Estimated fishing pressure, expressed as angler-hours (h) and hours per hectare (h/ha), by type of fishing, with 80% confidence intervals (CI), for the standard May-August daylight survey period, 2011-2015.

Type of fishing	Year				
	2011*	**2012**	**2013**	**2014****	**2015**
Boat (h)	102,837	202,099	289,567	236,729	278,380
80% CI	14,782	18,843	27,925	27,823	26,718
H/ha	4.3	8.5	12.2	10.0	11.8
Shore (h)	16,884	41,643	34,365	36,872	35,684
80% CI	4,9848	8,761	5,351	7,564	6,868
H/ha	0.7	1.8	1.5	1.6	1.5

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 18. Estimated number of walleye caught, harvested and released during the May-August daylight period, 2006-2015.

Year	Caught	Harvested	Released	Percent Harvested
2006	159,985	92,357	67,629	58
2007	300,788	95,033	205,755	32
2008	236,785	71,347	165,438	30
2009	433,408	132,728	300,680	31
2010	251,379	124,590	126,790	50
2011*	96,815	47,674	49,141	49
2012	441,596	130,711	310,886	30
2013	354,968	200,491	154,477	56
2014**	295,844	117,643	178,201	40
2015	305,774	116,826	188,947	38
Mean	287,734	112,940	174,794	41

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 19. Estimated number of fish harvested, by species and month, with 80% confidence intervals (CI), for the May-August 2015 daylight period. Crappie includes black and white species.

Species	Month				
	May	June	July	August	Total
Walleye	31,606	23,826	35,850	25,544	116,826
80% CI	8,327	5,854	8,569	6,067	14,624
Sauger	61	245	51	69	426
80% CI	74	167	83	72	213
Channel catfish	673	349	3,122	446	4,591
80% CI	453	278	1,599	290	1,710
White bass	3,318	5,818	175	78	9,389
80% CI	1,491	820	300	83	1,730
Smallmouth bass	8,644	6,241	1,018	1,286	17,190
80% CI	4,460	2,559	648	638	5,222
Crappie	1,336	306	0	17	1,659
80% CI	964	116	--	24	971
Rainbow trout	147	14	0	50	211
80% CI	138	15	--	54	148
Yellow perch	532	418	1,625	818	3,393
80% CI	243	203	686	263	800
Other*	333	181	55	534	1,101
Total	46,650	37,398	41,896	28,842	154,786
80% CI	12,613	7,776	9,700	6,760	18,956

*Other includes bluegill, Chinook salmon, freshwater drum, goldeye, and northern pike.

Table 20. Estimated number of fish harvested, for selected species, by zone, with 80% confidence intervals (CI), for the May-August 2015 daylight period. Crappie includes black and white species.

Species	Zone			
	Upper	**Middle**	**Lower**	**Total**
Walleye	19,938	1,209	95,679	116,826
80% CI	6,026	1,110	13,378	14,624
Sauger	230	0	196	426
80% CI	165	--	135	213
Channel catfish	2,625	576	1,390	4,591
80% CI	1,567	469	498	1,710
White bass	6,236	568	2,585	9,389
80% CI	698	370	1,539	1,730
Smallmouth bass	130	194	16,866	17,190
80% CI	110	179	5,217	5,222
Crappie	0	352	1,307	1,659
80% CI	--	279	930	971
Rainbow trout	179	32	0	211
80% CI	143	41	--	148
Yellow perch	0	9	3,384	3,393
80% CI	--	13	800	800
Other*	471	208	421	1,101
Total	29,809	3,148	121,828	154,786
80% CI	5,599	1,541	18,045	18,956

*Other includes bluegill, Chinook salmon, freshwater drum, goldeye, and northern pike.

Table 21. Estimated number of fish released, by species and month, with 80% confidence intervals (CI) for the May-August 2015 daylight period. Crappie includes black and white species.

Species	Month				
	May	**June**	**July**	**August**	**Total**
Walleye	33,469	83,933	51,399	20,146	188,948
80% CI	10,393	18,616	12,106	3,966	24,836
Sauger	175	0	0	25	200
80% CI	273	--	--	31	275
Channel catfish	243	838	5,828	2,551	9,460
80% CI	173	255	1,054	726	1,316
White bass	12,482	5,795	5,727	838	24,843
80% CI	6,336	4,251	4,853	647	9,066
Smallmouth bass	14,917	20,620	6,559	3,824	45,920
80% CI	5,580	8,621	2,113	1,209	10,554
Crappie	26	90	0	17	133
80% CI	29	59	--	18	68
Rainbow trout	91	42	0	25	157
80% CI	46	34	--	27	63
Yellow perch	94	55	1,557	3,030	4,736
80% CI	74	55	633	1,518	1,647
Other*	1,163	1,100	2,805	2,730	7,798
Total	62,660	112,473	73,875	33,186	282,195
80% CI	15,771	24,683	16,393	6,809	34,250

*Other includes black bullhead, bluegill, common carp, freshwater drum, goldeye, lake herring, largemouth bass, northern pike, shorthead redhorse, and white sucker.

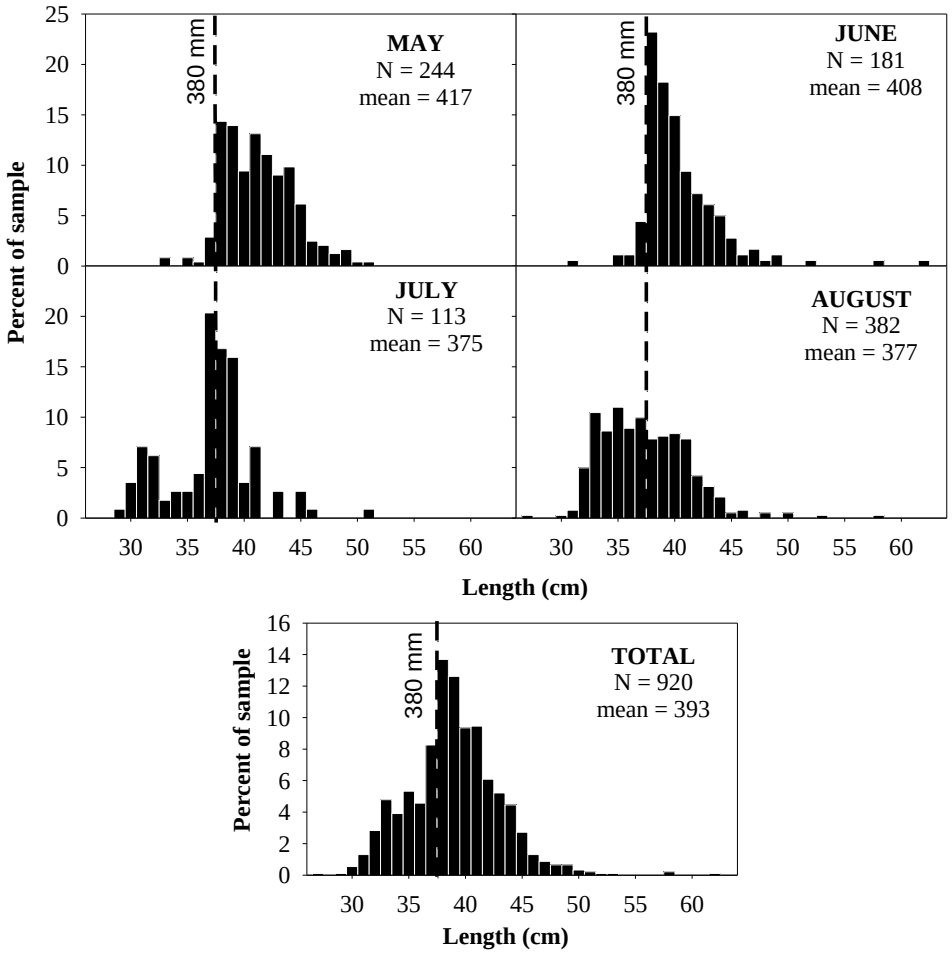

Figure 6. Monthly length-frequency distribution of walleye harvested by anglers during the May-August 2015 daylight period. Vertical line represents the 380- mm minimum length limit in effect from September-June.

Table 22. Estimated hourly catch, harvest and release rates, by species, for all anglers interviewed during the May-August 2015 daylight survey period. Trace (T) indicates values >0 but <0.005. Crappie includes black and white species.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	0.97	0.37	0.60
Sauger	T	T	T
White bass	0.11	0.03	0.08
Smallmouth bass	0.20	0.05	0.15
Crappie	0.01	T	T
Channel catfish	0.04	0.01	0.03
Rainbow trout	T	T	T
Yellow perch	0.03	0.01	0.02
Other*	0.03	0.01	0.02
Total	1.39	0.49	0.90

*Other includes black bullhead, bluegill, common carp, freshwater drum, goldeye, lake herring, largemouth bass, northern pike, shorthead redhorse, and white sucker.

Table 23. Estimated hourly catch, harvest and release rates, by species, for anglers targeting the species listed during the May-August 2015 daylight period.

Target species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	1.92	0.79	1.13
White bass	3.43	0.84	2.59
Smallmouth bass	3.26	0.63	2.63
Channel catfish	0.30	0.06	0.24

Table 24. Estimated hourly catch rates for walleye, smallmouth bass, white bass, channel catfish and all fish combined, by year, for all anglers, for the May-August daylight survey period, 2006-2015.

Year	Catch rate (fish/angler-h)				
	Walleye	Smallmouth bass	White bass	Channel catfish	All fish
2006	0.59	0.31	0.09	0.05	1.17
2007	1.10	0.63	0.10	0.04	1.94
2008	0.99	0.47	0.07	0.04	1.63
2009	1.31	0.37	0.14	0.03	1.91
2010	0.74	0.26	0.10	0.03	1.21
2011*	0.81	0.29	0.07	0.02	1.25
2012	1.81	0.20	0.05	0.02	2.23
2013	1.10	0.15	0.04	0.03	1.40
2014**	1.08	0.20	0.07	0.02	1.43
2015	0.97	0.20	0.11	0.04	1.39
Mean of means	1.05	0.31	0.08	0.03	1.56

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 25. Estimated hourly catch, harvest and release rates (fish/angler-h), for walleye and all species combined, by month, for the May-August 2015 daylight survey period.

Month	Walleye			All fish combined		
	Catch Rate	Harvest rate	Release rate	Catch rate	Harvest rate	Release rate
May	0.62	0.30	0.32	1.04	0.44	0.60
June	1.40	0.31	1.09	1.95	0.49	1.46
July	1.24	0.51	0.73	1.65	0.60	1.05
August	0.74	0.41	0.33	1.00	0.47	0.53
Total	0.97	0.37	0.60	1.39	0.49	0.90

Table 26. Percentage of angling parties that caught (top panel) or harvested (bottom panel) a specified number of walleye or sauger per angler in each reservoir zone during the May–July 2014 and May–August 2015 daylight survey periods.

Number/ trip	Catch per trip							
	2014				2015			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	12	70	50	39	12	80	53	37
≥ 0.1	88	30	50	61	88	20	47	63
≥ 1	83	19	42	53	81	8	34	53
≥ 2	75	13	31	44	70	5	25	44
≥ 3	70	7	25	38	61	2	17	36
≥ 4	62	6	20	33	53	2	13	31
≥ 5	54	6	14	27	43	1	9	25
≥ 6	43	4	9	21	36	1	6	20
≥ 7	38	2	5	17	29	0	3	15
≥ 8	30	1	3	13	25	0	2	13
≥ 9	28	1	3	12	21	0	1	10
≥10	24	1	2	10	16	0	1	8

Number/ trip	Harvest per trip							
	2014				2015			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	61	79	25	51	19	89	65	46
≥ 0.1	39	21	75	49	81	11	35	54
≥ 1	32	12	68	42	68	4	25	43
≥ 2	25	8	52	32	48	2	14	29
≥ 3	18	6	37	23	33	1	10	20
4(limit)	15	6	28	18	24	1	6	14

Table 27. Percent of total angler contacts and number of contacts (N) for resident and non-resident (states combined) anglers during the May-August daylight period, 2011-2015.

Zone		Year				
		2011*	**2012**	**2013**	**2014****	**2015**
Lower	**N**	279	324	225	288	434
	Residents (%)	69	71	72	69	70
	Non-residents (%)	31	29	28	31	30
Middle	**N**	140	132	160	140	131
	Residents (%)	91	92	92	94	96
	Non-residents (%)	9	8	8	6	4
Upper	**N**	104	355	329	352	316
	Residents (%)	91	91	81	82	90
	Non-residents (%)	9	9	19	18	10
Total	**N**	523	811	714	780	881
	Residents (%)	79	83	81	79	81
	Non-residents (%)	21	17	19	21	19

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 28. Percent of total non-resident angler contacts for anglers from the states listed during the May-August daylight survey period, 2011-2015.

State	Percent by Year				
	2011*	2012	2013	2014**	2015
Nebraska	30	34	26	33	24
Iowa	24	20	23	23	34
Minnesota	23	20	21	20	14
Colorado	7	4	7	3	5
Wisconsin	3	1	1	3	1
Wyoming	1	5	4	3	6
Other[a]	12	16	18	15	16

[a]Other includes Arizona, California, Georgia, Idaho, Illinois, Indiana, Kansas, Louisiana, Michigan, Missouri, Montana, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Washington and West Virginia. Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 29. Percent of resident anglers contacted, county of residence and major cities within a county for anglers on Lake Sharpe, during the May-August daylight survey period, 2011-2015.

County	Major City	Percent by year				
		2011*	2012	2013	2014**	2015
Beadle	**Huron**	5	7	3	4	5
Brookings	**Brookings**	2	1	1	1	1
Davison	**Mitchell**	1	3	3	2	2
Hand	**Miller**	3	1	2	1	2
Hughes	**Pierre**	42	46	49	49	44
Lyman	**Presho, Kennebec**	2	2	3	2	3
Minnehaha	**Sioux Falls**	11	6	7	7	10
Pennington	**Rapid City**	4	7	6	7	7
Stanley	**Fort Pierre**	3	7	6	6	4

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

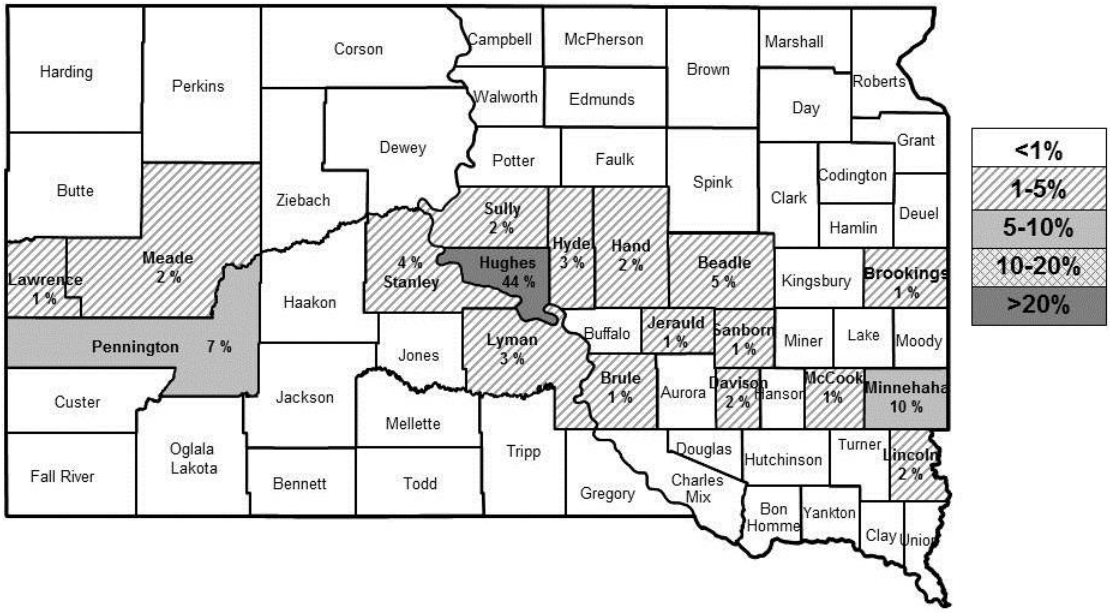

Figure 7. Percent of resident angler contacts by county during the May-August 2015 daylight survey period.

Table 30. Percent of anglers driving a specified distance, one way, to fish on Lake Sharpe, South Dakota during the May-August daylight survey period, 2011-2015.

Distance (miles)	Percent by year				
	2011*	2012	2013	2014**	2015
<25	29	41	42	38	34
25-49	15	10	9	6	13
50-99	9	12	7	8	9
100-199	24	18	20	19	23
≥200	23	19	22	29	21

Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 31. Percent of anglers that specifically target a species on Lake Sharpe, South Dakota during the May-August daylight survey period, 2011-2015.

Target species	Percent by year				
	2011*	2012	2013	2014**	2015
Walleye	69	65	65	62	65
Anything	22	31	28	31	27
Rainbow trout	<0.5	1	<0.05	0	<0.05
White bass	3	1	2	<0.5	2
Smallmouth bass	3	1	3	2	2
Other[a]	3	1	2	5	4

[a]Other includes black crappie, channel catfish, Chinook salmon, common carp, northern pike, smallmouth buffalo, and white crappie. Asterisk (*) denotes survey was conducted during the flood of 2011 when reduced or eliminated creel schedules resulted in fewer angler interviews and asterisks (**) denotes survey was conducted May-July, 2014.

Table 32. Responses of anglers who were asked the following question during the May-August 2015 daylight survey period: "Considering all factors, how satisfied are you with your fishing trip today?" 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral or no opinion (N.O.), 5 = slightly dissatisfied, 6 = moderately dissatisfied, and 7 = very dissatisfied, where N is sample size.

Month	Satisfaction rating								
	Satisfied			Neutral/N.O.	Dissatisfied				
	1	2	3	4	5	6	7	N	Median
May	138	89	24	34	11	16	11	323	2
June	79	57	28	11	12	10	9	206	2
July	63	30	12	10	8	5	6	134	2
August	94	61	18	23	6	6	10	218	2
Total	374	237	82	78	37	37	36	881	2
Percent	79%			9%	12%				

Table 33. Responses of anglers who were asked the following question during the May-August 2015 daylight survey period: "Considering all factors, how satisfied are you with your fishing trip today?" compared to the average number of walleye harvested per trip. 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral/no opinion (N.O.), 5 = slightly dissatisfied, 6 = moderately dissatisfied, and 7 = very dissatisfied where N is sample size.

Walleye/ angler	Satisfaction rating								
	Satisfied			Neutral/N.O.	Dissatisfied			N	Median
	1	2	3	4	5	6	7		
0	124	112	45	46	22	25	30	404	2
0.1-0.9	29	29	12	12	5	6	3	96	2
1.0-1.9	47	38	11	13	7	4	3	123	2
2.0-2.9	36	29	7	5	1	0	0	78	2
3.0-3.9	34	12	4	1	1	1	0	53	1
4	100	16	3	1	1	1	0	122	1
Percent	79%			9%	12%				

Table 34. Responses of anglers who were asked the following question during the May-August 2015 daylight survey period: "What would help increase your satisfaction level to "very satisfied"?" after being asked their overall satisfaction rating (Table 32).

Improvement sought	Percent "very satisfied"	N	Percent	N
Very Satisfied – no improvement	44%	234		
Catch more fish			63%	191
Harvest more fish			2%	5
Improve weather			14%	41
Catch larger fish			12%	35
Improve time			1%	2
Less competition			1%	3
Other			8%	24

Table 35. Response of all anglers who were asked the following question during the May-August 2015 daylight survey period: "Are you aware of the new regulations for boat plug removal and live bait transport?"

Response	Percent	N
Yes	91%	310
No	9%	32

ONGOING RESEARCH PROJECTS

The Missouri River Fisheries staff conducted field work on a number of collaborative and internal research projects in 2015 on Lake Sharpe. Staff assisted South Dakota State University (SDSU) with the collection of several species of fish and water samples throughout the reservoir in an effort to document natality and production of sport and prey fish. This is the second collaborative project utilizing otolith microchemistry and water chemistry signatures to determine where important Lake Sharpe fish species originate in Lake Sharpe and estimate the contribution from specific habitat locations to Lake Sharpe populations (W. Radigan, MS Student). The anticipated completion date for this project is spring of 2017. In 2014, Missouri River Fisheries staff sought to evaluate seasonal movements and identify important over winter habitats of adult gizzard shad in Lake Sharpe. Emphasis is being focused on movements in/out of Hipple Lake and the use of this novel habitat by adult gizzard shad. Staff surgically implanted acoustic transmitters in 40 adult gizzard shad (20 in 2014, 20 in 2015) and released them at multiple locations throughout Lake Sharpe during the spring. Twelve passive receivers continually monitor gizzard shad movements at select locations in Lake Sharpe. The anticipated completion date for this project is spring 2017. Concurrently, 40 rainbow trout (20 spring stock; 20 fall stock) have been implanted with acoustic transmitters and released in Oahe Marina. This project focuses on residence time, and thus, availability of rainbow trout to shore anglers stocked annually in the spring and fall. This is part of a two year study with an additional 40 rainbow trout scheduled to be implanted with transmitters during 2017. The anticipated completion date for this project is spring 2019.

FISHERY STATUS AND 2016 OUTLOOK

The Missouri River flood of 2011 was catastrophic and the extreme flows altered physical and chemical habitats. The effects of the historic 2011 flood are not well understood, and the aftermath may influence this system for a number of years. Despite the large physical changes in Lake Sharpe, anglers continued to fish and success was high in 2015.

In May-August 2015, the harvest rate for all fish species was 0.49 fish/angler-h and angler satisfaction was at 79%. Angler catches in 2016 will likely be dominated by small (<15-inches) walleye owing to a substantial proportion (70%) of the walleye population currently in that size range.

MANAGEMENT RECOMMENDATIONS

- Determine the importance of Hipple Lake and LaFramboise Bay for production, recruitment and over-winter survival of gizzard shad and sport fish in Lake Sharpe.

- Further evaluate effects from the 2011 Missouri River flood.

- Critically evaluate cold-water stocking program in Lake Sharpe tailrace fishery.

- Critically evaluate the role of angler regulations on the Lake Sharpe walleye fishery.

- Evaluate the potential to establish a paddlefish fishery in Lake Sharpe.

- Update the Lake Sharpe Fisheries Management Plan by October 2016.

LITERATURE CITED

Anderson, R.O. 1980. Proportional stock density (PSD) and relative weight (W_r): interpretive indices for fish populations and communities. Pages 27-33 in S. Gloss and B. Shupp, editors. Practical fisheries management: more with less in the 1980's. New York Chapter American Fisheries Society, Ithaca.

Bouska, W., and C. Longhenry. 2009. Annual fish population and angler use and sportfish harvest surveys on Lewis and Clark Lake and the lower Missouri River, South Dakota, 2009. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 10-07, Pierre.

Brown, M.L., F. Jaramillo, Jr., D.M.Gatlim III, and B.R. Murphy. 1995. A revised standard weights (*Ws*) equation for Channel Catfish. Journal of Freshwater Ecology 10:295-302.

DeVries, D.J. and R.V. Frie. 1996. Determination of age and growth. Pages 483-512 in B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd Edition. American Fisheries Society, Bethesda, Maryland.

Elrod, J.H. 1974. Abundance, growth, survival, and maturation of channel catfish in Lake Sharpe, South Dakota. Transactions of the American Fisheries Society 103:53-58.

Fincel, M., K. Potter, K. Edwards, R. Hanten and M. Smith. 2012. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota, 2011. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 12-04, Pierre.

Fincel, M., K. Potter, H. Meyer, R. Hanten and M. Smith. 2013. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota, 2012. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 13-08, Pierre.

Fincel, M., R. Hanten, H. Meyer, K. Potter and M. Smith. 2014. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota, 2013. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 14-03, Pierre.

Fincel, M.F., C.M. Longhenry, and D.A. James. 2015. Effects of a protected slot limit on smallmouth bass size structure and angler harvest. Lake and Reservoir Management 31:180-189.

Gablehouse, D.W., Jr. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Gigliotti. L.M. 2011. Fishing in South Dakota – 2010: fishing activity, harvest and angler opinion survey. South Dakota Department of Game, Fish, and Parks, Wildlife Division, report HD-7-11.AMS, Pierre.

Guy, C.S., R.M. Neumann, D.W. Willis, R.O. Anderson. 2007. Proportional size distribution (PSD): A further refinement of population size structure index terminology. Fisheries 32:348.

Hubert, W.A. 1996. Passive capture techniques. Pages 157-182 *in* B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd Edition. American Fisheries Society, Bethesda, Maryland.

Isermann, D.A., J. Meerbeck, G. Scholten, and D. Willis. 2003. Evaluation of three different structures used for walleye age estimation with emphasis on removal and processing times. North American Journal of Fisheries Management. 23:625-631.

Jones, C.M. and D.S. Robson. 1991. Improving precision in angler surveys: traditional access design versus bus route design. Pages 177-188 in D. Guthrie, J.M. Hoenig, M. Holliday, C.M. Jones, M.J. Mills, S.A. Moberly, K.H. Pollock, and D.R. Talhelm, editors. Creel and angling surveys in fisheries management. American Fisheries Society Symposium 12, Bethesda, Maryland.

Jones, C.M., D.S. Robson, D. Otis, and S. Gloss. 1990. Use of a computer simulation model to determine the behavior of a new survey estimator of recreational angling. Transactions of the American Fisheries Society 119:41-54.

Longhenry, C., K. Potter, K. Edwards, and R. Hanten. 2010. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota, 2009. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 10-02, Pierre.

Lyons, J. A., 1986. Capture efficiency of a beach seine for seven freshwater fishes in a North-temperate lake. North American Journal of Fisheries Management 6:288-289.

Martin, D.B., L.J. Mengel, J.F. Novotny, and C.H. Walburg. 1981. Spring and summer water levels in a Missouri River reservoir: effects of age-0 fish and zooplankton. Transactions of the American Fisheries Society 110:70-381.

Murphy, B.R., M.L. Brown, and T.A. Springer. 1990. Evaluation of the relative weight (Wr) index, with new applications to walleye. North American Journal of Fisheries Management 10:85-97.

Parsley, M.J., D.E. Palmer, and R.W. Burkhardt. 1989. Variation in capture efficiency of a beach seine for small fishes. North American Journal of Fisheries Management 9:239-244.

Robson, D.S. and C.M. Jones. 1989. The theoretical basis of an access site survey design. Biometrics 45:83-98.

Schmidt, B.R. 1975. Results and evaluation of an aerial creel survey technique on Lake Sharpe, South Dakota. Thesis, South Dakota State University, Brookings.

Sorensen, J. and G. Knecht. 2009. Annual fish population and angler use and sport fish harvest surveys on Lake Francis Case, South Dakota, 2007. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report 09-17, Pierre.

Soupir, C.A., and M.L. Brown. 2002. Comprehensive evaluation and modification of the South Dakota angler creel program. South Dakota Department of Game, Fish and Parks, Wildlife Division, Completion Report, Pierre.

South Dakota Department of Game, Fish and Parks. 2014. Fisheries and aquatic resources adaptive management system, Missouri river fisheries management area. Wildlife Division, Pierre.

United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, Bureau of Census 2012. 2011 National Survey of Fishing, Hunting, and Wildlife-associated Recreation. United States Government Printing Office, Washington, D.C.Wuellner, M.R., S.R. Chipps, D.W. Willis, and W.E. Adams. 2010. Interactions between walleyes and smallmouth bass in a

Missouri River Reservoir with consideration of the influence of temperature and prey. North American Journal of Fisheries Management 30:445-463.

APPENDICES

Appendix 1. Common and scientific names of fishes mentioned in this report.

Common name	Scientific name
Bigmouth buffalo	*Ictiobus cyprinellus*
Black bullhead	*Ameiurus melas*
Black crappie	*Pomoxis nigromaculatus*
Bluntnose minnow	*Pimephales notatus*
Brassy minnow	*Hybognathus hankinsoni*
Burbot	*Lota lota*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Common carp	*Cyprinus carpio*
Emerald shiner	*Notropis atherinoides*
Fathead minnow	*Pimephales promelas*
Flathead chub	*Platygobio gracilis*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Goldeye	*Hiodon alosoides*
Golden shiner	*Notemigonus crysoleucas*
Johnny darter	*Etheostoma nigrum*
Lake herring	*Coregonus artedi*
Largemouth bass	*Micropterus salmoides*
Northern pike	*Esox Lucius*
Paddlefish	*Polyodon spathula*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhynchus mykiss*
River carpsucker	*Carpiodes carpio*
Red shiner	*Cyprinella lutrensis*
Sauger	*Sander Canadensis*
Shorthead redhorse	*Moxostoma macrolepidotum*
Shortnose gar	*Lepisosteus platostomus*
Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Silvery minnow	*Hybognathus nuchalis*
Smallmouth bass	*Micropterus dolomieu*
Smallmouth buffalo	*Ictiobus bubalus*
Spottail shiner	*Notropis hudsonius*
Suckermouth minnow	*Phenacobius mirabilis*
Walleye	*Sander vitreus*
White bass	*Morone chrysops*
White crappie	*Pomoxis annularis*
White sucker	*Catostomus commersonii*
Yellow perch	*Perca flavescens*

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

Common name	**Scientific name**
Curly leaf pondweed	*Potamogeton crispus*
Eurasian water milfoil	*Myriophyllum spicatum L*
Fan leafed crowfoot	*Cabomba caroliniana*
American elodea sago	*Elodea canadensis*
pondweed	*Potamogeton* spp
Cattail	*Typha* spp

Appendix 3. Angler satisfaction questions asked as part of the May-August 2015 angler use and harvest survey on Lake Sharpe, South Dakota.

Trip Satisfaction:

1. Considering all factors, how satisfied are you with your fishing trip today?

   1 = Very satisfied
   2 = Moderately satisfied
   3 = Slightly satisfied
   4 = Neutral/ No opinion *(neither satisfied or dissatisfied)*
   5 = Slightly dissatisfied
   6 = Moderately dissatisfied
   7 = Very dissatisfied

2. What would help increase your satisfaction level to "very satisfied"?
   a. More fish caught
   b. Larger fish caught
   c. Improve time
   d. More fish harvested
   e. Improve weather
   f. Less competition
   g. Other:_____

Aquatic invasive species regulation awareness:

Are you aware of the new regulations for boat plug removal and live bait transport?

YES or NO