SOUTH DAKOTA FISHERIES

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST, AND PREFERENCE SURVEYS ON LAKE SHARPE, SOUTH DAKOTA, 2005

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

Annual Report
No. 07-04

ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE SHARPE, SOUTH DAKOTA, 2005

By

John Lott, Robert Hanten, and Kyle Potter
Missouri River Fisheries Center
South Dakota Dept. of Game, Fish, and Parks

Annual Report

Dingell-Johnson Project ---------- F-21-R-38
Job Numbers ---------- 2102 and 2109
Date ---------- March 2007

Missouri River Program Administrator
James Riis

Fisheries Program Administrator
Dennis Unkenholz

Grants Coordinator
Mike Lees

Department Secretary
Jeff Vonk

Wildlife Division Director
Doug Hansen

Assistant Division Director
George Vandel

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 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: Brian Beel, Kit Bramblee, Jack Erickson, Joseph Kean, Darla Kusser, Karli Larsen, Jared Lorensen, Brad Richards, Joe Riis, Jim Riis, Justin Sarvis, Sylvester Schied, Robert Schunot, Jason Sorensen, Jason Stahl, and Gerald Wickstrom.

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-38, Statewide Fish Management Surveys. Some of these data have been presented previously in segments F-21-23 through 36.

EXECUTIVE SUMMARY

This report includes annual fish population data from 2001 through 2005 and angler use, harvest and preference data for 2005, for Lake Sharpe, South Dakota. Angler use and harvest survey data from previous years is also 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.

Mean walleye CPUE in 2005, at 17.8 walleye/net-night, was higher than the 2004 value of 12.9 fish/net-night. Approximately 49% of walleye in the 2005 gill net sample were ≥ 380-mm total length (TL) and 15% were ≥ 460-mm TL. However, walleye between 170 and 270 mm TL were absent from the 2005 gill net catch (age-1 fish), supporting evidence from 2004 surveys that indicated reproduction was low in 2004. Age-2 walleye comprised the largest percentage of the 2005 gill net sample, followed by fish produced in 2000 and 2001. Walleye recruitment was higher in 2005 than during the 2001-2004 period. The 2005 mean electrofishing CPUE, of 88 fish/h was similar to 1995, 1997, 1998, and 2000, and among the highest during the 1995-2005 period, negating the need to consider stocking walleye in 2006.

Nineteen species of age-0 or small prey fishes were collected by shoreline seining in 2005. All species had been previously sampled in Lake Sharpe. Gizzard shad comprised the majority of the catch in 2005, with a mean CPUE of 285 fish/haul. The long-term average CPUE (1982-2005) for gizzard shad in seine hauls is 563 fish/haul.

The current smallmouth bass regulation package on Lake Sharpe was implemented in 2003 and consists of a 306-to-457-mm (12-to-18-inch) protected slot with anglers being allowed to harvest one bass ≥ 457 mm as part of the daily limit. Mean CPUE values of smallmouth bass in the nighttime electrofishing survey for pre- and post-regulation change years have been similar. Proportional stock density and RSD-P initially decreased following the regulation changes and are slowly increasing. Growth is unchanged since the regulation change with mean backcalculated length at age 4 still exceeding Statewide and Missouri River reservoir averages.

Estimated angler days spent on Lake Sharpe during the 2005 April-September period was 75,161 days, below the Lake Sharpe Strategic plan goal of 100,000 angler days. Estimated harvest of walleye during the 2005 survey period was 57,866 fish, similar to the 2004 estimate of 62,585 fish, but well below the Lake Sharpe strategic plan objective of 100,000 fish. Estimated white bass harvest during the 2005 survey period, at 59,784 fish, was 84% higher than the 2004 estimate of 32,410 fish, but will likely decrease in 2006 because of a die-off experienced during the summer of 2005. Estimated numbers of walleye caught, harvested, and released during the standard April-September daylight survey period were the lowest in 2005 of any year in the 1994-2005 period.

Estimated hourly catch rate for all species combined, for the April-September 2005 daylight period, at 0.49 fish/angler-h, was higher than the plan objective of 0.35 fish/angler-h. However, estimated mean harvest rate for walleye, at 0.21 fish/angler-h, was lower than the plan objective of 0.3 fish/angler-h and mean hourly catch rate for walleye was the lowest of the 1993-2005 period. For the entire April-September angler use and harvest survey period of 2005, it was estimated that harvest was reduced by 1,042 walleye, or 2%, by having a three-fish daily limit instead of a four-fish daily limit.

Approximately 65% of angling parties interviewed in 2005 indicated some degree of satisfaction with their fishing trip, a value similar to the 2004 value of 66%, but below the Lake Sharpe Strategic Plan objective of 70%.

For the April-September 2005 daylight period, Lake Sharpe anglers contributed approximately 4.6 million dollars to local economies, based on an estimated 75,161 trips at an estimated $61 per trip for South Dakota's Missouri River reservoirs.

TABLE OF CONTENTS

PREFACE ..... *ii*

EXECUTIVE SUMMARY ..... *iii*

TABLE OF CONTENTS ..... *iv*

LIST OF TABLES ..... *v*

LIST OF FIGURES ..... *ix*

LIST OF APPENDICES ..... *x*

INTRODUCTION *1*

MANAGEMENT OBJECTIVES *1*

Reservoir-wide Objectives **1**

Species Specific Objectives **1**

SAMPLING STRATEGIES *2*

STUDY AREA *3*

REGULATION HISTORY *4*

SAMPLING METHODS *5*

FISH POPULATION SURVEYS **5**

Data Collection and Analysis 5

LAKE SHARPE WHITE BASS DIE-OFF INVESTIGATION METHODS **7**

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS **7**

Data Collection and Analysis 7

RESULTS AND DISCUSSION *8*

FISH POPULATION SURVEYS **8**

Species Composition and Relative Abundance 8

Population Parameters for Walleye 10

Population Parameters for Sauger 18

Population Parameters for Smallmouth Bass 19

Population Parameters for Channel Catfish 22

LAKE SHARPE WHITE BASS DIE-OFF **24**

2005 TROUT STOCKING IN OAHE SUB IMPOUNDMENT **25**

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS **28**

Angler Use 28

Catch, Harvest and Release Estimates 31

Hourly Catch, Harvest, and Release Rates 35

Angler Demographics and Economic Impacts 43

Satisfaction and Attitudes 47

FISHERY STATUS *50*

MANAGEMENT RECOMMENDATIONS *50*

LITERATURE CITED *51*

APPENDICES *55*

LIST OF TABLES

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. 4

Table 2. History of special harvest regulations for walleye and smallmouth bass, on Lake Sharpe, South Dakota, 1968 through 2005. 5

Table 3. Relative species composition, as percent of total catch, of fish species collected during the standard August gill net survey on Lake Sharpe, South Dakota, during 2001 through 2005. Trace (T) indicates values < 0.5%. 8

Table 4. Mean catch per unit effort (CPUE; No./net-night) and standard error values (SE) for fish species collected with standard coolwater gill net sets in Lake Sharpe, South Dakota, 2001-2005. Trace (T) indicates values less that 0.05. 9

Table 5. Mean catch per unit effort (CPUE; No./haul) and standard error (SE) values for fish species collected during the standard August seining survey on Lake Sharpe, South Dakota. Catches are for age-0 fishes except where noted. Trace (T) indicates values less than 0.05. Asterisk (*) indicates both age-0 and adult fish included in CPUE. 10

Table 6. Mean walleye catch per unit effort (No./net-night) in the standard coolwater gill net survey for Lake Sharpe, South Dakota, 1997-2005. Values within sites with no letters in common are significantly different at the *P*<0.05 level of significance. Comparisons were only made among years, within sites. 12

Table 7. Mean walleye catch per unit effort (No./net-night) in the standard gill net survey, by year and length group, for 1997-2005, for Lake Sharpe, South Dakota. Values within length groups, among years, with no letters in common, are significantly different at the *P*<0.05 level of significance. Comparisons were only made within length groups among years. 13

Table 8. Walleye and sauger proportional stock density (PSD) and relative stock density of preferred- (RSD-P) and memorable-length (RSD-M) fish collected during the standard gill net survey on Lake Sharpe, South Dakota, 1997-2005. 14

Table 9. Mean walleye relative weight (*Wr*) values, by length group, for Lake Sharpe, South Dakota, 1997-2005. N is the number of stock-length fish in a sample. Within length classes, values with the same letter code are not significantly different at the *P*<0.05 level of significance. 14

Table 10. Mean length-at-age-at-capture (mm) for walleye collected in the standard August gill net survey, 2002-2005, on Lake Sharpe, South Dakota, and aged from otoliths. 15

Table 11. Mean annual growth (length) increment estimates for walleye collected in the standard coolwater gill net survey on Lake Sharpe, South Dakota, for the 2002-2003, 2003-2004, and 2004-2005 periods, as determined by aging otoliths. 15

Table 12. Age distribution of walleye collected from Lake Sharpe, South Dakota, with standard gill net sets as determined by aging otoliths. Year refers to walleye year class, CPUE is catch per unit effort (No./net-night), and T (trace) indicates mean CPUE values <0.05. 16

List of tables continued

Table 13. Mean nighttime electrofishing catch per unit effort (CPUE; No./h) and total length (mm) for age-0 walleye collected during September and October 1995-2005 on Lake Sharpe, South Dakota. SE is standard error values about means and N is sample size. 17

Table 14. Mean age-0 walleye seine haul catch-per-unit-effort (CPUE; No./haul), mean standard gillnet age-0 walleye CPUE (No./net night), mean age-0 walleye nighttime electrofishing CPUE (No./ h), and mean standard gillnet age-1 walleye CPUE (No./net night) is the following year recruitment for the 1994-2005 period on Lake Sharpe, South Dakota… 17

Table 15. Mean length-at-age-at-capture (mm) values for sauger collected in the standard August coolwater gill net survey, 2002-2005, on Lake Sharpe, South Dakota, as determined by aging otoliths. 18

Table 16. Age distributions of sauger collected from Lake Sharpe, South Dakota, with gill nets during standard surveys conducted from 2002 through 2005. Mean age excludes age–0 fish and ages were determined from otoliths. 19

Table 17. Mean smallmouth bass electrofishing catch-per-unit effort (CPUE; No./h), proportional stock density (PSD), relative stock density of preferred-length (RSD-P) and memorable-length (RSD-M) fish values, for spring, nighttime electrofishing samples at Joe Creek and Big Bend Dam. N is number of electrofishing runs, SE is standard error and Ns is number of stock length fish. 20

Table 18. Mean back-calculated total lengths (mm) at annulus and length increments for each year class of smallmouth bass collected from Lake Sharpe, South Dakota, by nighttime electrofishing during May and June 2005, as determined from scales. N is the number of fish of each age in the sample. 20

Table 19. Mean relative weight (Wr), by length class, for Lake Sharpe smallmouth bass collected by electrofishing during May and June, 2001-2005. N is the number of fish used in calculations. Values with the same letter code, within a year, are not significantly different from one another at the *P* = 0.05 level. 21

Table 20. Channel catfish proportional stock density (PSD), relative stock density of preferred and memorable-length (RSD-P and RSD-M) fish, and relative weight (Wr) for 1997-2005, from Lake Sharpe, South Dakota. Mean Wr values for 2002–2005 are for stock- length fish only and N is the number of fish used in calculations. 22

Table 21 Angler use and harvest estimates for surveys conducted on Lake Sharpe, South Dakota. All surveys were conducted during the April-September daylight period, except where noted. 28

Table 22 Estimated fishing pressure (angler hours), by month and zone, with 95% confidence intervals (CI), for the April-September 2005 daylight period on Lake Sharpe, South Dakota. 29

Table 23 Estimated fishing pressure, expressed as angler-hours (h) and hour per hectare (h/ha), by reservoir zone, for standard creel surveys conducted during the April-September daylight period, on Lake Sharpe, South Dakota, from 1994 through 2005. 30

Table 24 Estimated fishing pressure, expressed as angler-hours (h) and hours per hectare (h/ha), by type of fishing, with 95% confidence intervals (CI), for the standard April-September daylight survey period, on Lake Sharpe, South Dakota, from 2001 through 2005..... 30

List of tables continued

Table 25. Estimated number of fish harvested, by species and month, with 95% confidence intervals (CI), for the April-September 2005 daylight period on Lake Sharpe, South Dakota. 31

Table 26. Estimated number of fish released, by species and month, for the April-September 2005 daylight period, on Lake Sharpe, South Dakota. October data was only collected for upper and middle Lake Sharpe, in 2005 and is not included in totals. 32

Table 27. Estimated number of fish harvested, for selected species, by zone, with 95% confidence intervals (CI), for the April-September 2005 daylight period, on Lake Sharpe, South Dakota. 34

Table 28. Estimated number of walleye caught, harvested, and released during the April-September daylight period for Lake Sharpe, South Dakota 1994 through 2005. 35

Table 29. Estimated hourly catch, harvest, and release rates, by species, for all anglers interviewed on Lake Sharpe, South Dakota, during the April-September 2005 daylight survey period. Trace (T) indicates values >0.0 but <0.05. 38

Table 30. Estimated hourly catch, harvest, and release rates, by species, for anglers specifically fishing for the species listed, on Lake Sharpe, South Dakota during for the April-September 2005 daylight period. Trace (T) indicates values >0.0 but <0.05. 38

Table 31. Estimated hourly catch rates for walleye, smallmouth bass, white bass, channel catfish, and all fish combined, by year, for all anglers, for the April-September daylight survey period on Lake Sharpe, South Dakota, 1993 through 2005. 39

Table 32. Estimated hourly catch, harvest, and release rates, (fish/angler-h), for walleye and all species combined, by month, for the April-September 2005 daylight survey period, on Lake Sharpe, South Dakota. 40

Table 33. Percentage of angling parties catching and harvesting the specified number of walleye and sauger (combined) per person on an angling trip by reservoir zone, for Lake Sharpe, South Dakota, during the April-September 2004 and 2005 daylight survey periods. 41

Table 34. Walleye harvest reduction estimates resulting from the decrease in the daily walleye limit to three fish for 2005, by month, for Lake Sharpe, South Dakota. 42

Table 35. Percentage of angling parties catching and harvesting the specified number of smallmouth bass on an angling trip, per person, for the lower zone of Lake Sharpe, during the April-September daylight survey period, 2001-2005. 43

Table 36. Percentage of total angler contacts for resident and non-resident (states combined) anglers fishing Lake Sharpe during the April-September daylight period, 2001-2005. N is the number of parties interviewed. 44

Table 37. Percentage of total non-resident angler contacts for the states listed, for anglers fishing Lake Sharpe, South Dakota during, the April-September daylight survey period, 2001-2005. 44

Table 38. Percentage of total angler contacts on Lake Sharpe, by residents of the counties listed, for anglers fishing Lake Sharpe, South Dakota during the April-September daylight survey period, 2002-2005. 45

List of tables continued

Table 39. Percentage of anglers driving the specified distances, one way, to fish Lake Sharpe, South Dakota, during the April-September daylight survey period, 2000-2005. 46

Table 40. Target species of anglers fishing Lake Sharpe, South Dakota, during the April-September daylight survey period, expressed as percent of total, 2000 - 2005. T (trace) indicates values > 0.0 but < 0.5. 46

Table 41. Responses of Lake Sharpe anglers who were asked the following question during the April-September 2005 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include “no opinion” responses..... 47

Table 42. Responses of Lake Sharpe anglers who were asked the following question during the April-September 2005 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include “no opinion” responses. 48

Table 43. Responses of anglers interviewed during the April-September 2005 daytime survey on Lake Sharpe that were fishing with the assistance of a guide. N is sample size. 48

LIST OF FIGURES

Figure 1. Lake Sharpe, South Dakota, gill netting, seining and electrofishing locations..... 3

Figure 2. Length frequency, as catch per unit effort, of walleye collected in standard gill-net sets in Lake Sharpe, South Dakota, during August 2002 through 2005. Vertical lines represent the 15-inch and 18-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year. 11

Figure 3. Size structure and abundance (CPUE) of walleye collected in the standard gill-net survey in Lake Sharpe, South Dakota, during August, 1986-2005..... 13

Figure 4. Length frequency, by catch per unit effort, of sauger collected during the standard gill net survey during August 2005, on Lake Sharpe, South Dakota. Vertical lines represent the 15-inch and 18 inch classifications. 19

Figure 5. Length frequency of smallmouth bass collected by nighttime, electrofishing, by site, during May and June 2005 on Lake Sharpe, South Dakota..... 21

Figure 6. Length frequency, by catch per unit effort, of channel catfish collected during the standard, coolwater gill net survey during August 2002 through 2005, on Lake Sharpe, South Dakota. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year. 23

Figure 7. Satellite map of Oahe subimpoundment adjacent to Oahe tailrace on Lake Sharpe. Temperature loggers were located at relief well and outlet indicated with stars on map. 26

Figure 8. Average and maximum daily water temperatures for the Oahe subimpoundment adjacent to Oahe tailrace, April through October, 2005. The dotted line indicates water temperatures rainbow trout can tolerate and the solid line indicates upper lethal limit. 27

Figure 9. Estimated number of fish, harvested, and released, for selected species, for the April-September 2005 daylight period, on Lake Sharpe, South Dakota. Other includes shovelnose sturgeon, smallmouth buffalo, black bullhead, northern pike, goldeye, common carp, bluegill, largemouth bass, white crappie, black crappie, and freshwater drum. 33

Figure 10. Length frequency distribution of walleye harvested by anglers fishing Lake Sharpe, South Dakota, during the April-September 2005 daylight period. 36

Figure 11. Length frequency distribution of smallmouth bass harvested by anglers fishing Lake Sharpe, South Dakota, during the April-September 2005 daylight period..... 37

Figure 12. Percentage of total angler contacts on Lake Sharpe, by residents of the counties listed, during the April-September 2005 daylight survey period 45

Figure 13. Percentage of guided and unguided angling parties catching the specified number of walleye and sauger (combined) per person on an angling trip, Lake Sharpe, South Dakota, during the April-September 2005 daylight survey period. 49

Figure 14. Percentage of guided and unguided angling parties harvesting the specified number of walleye and sauger (combined) per person on an angling trip, Lake Sharpe, South Dakota, during the April-September 2005 daylight survey period. 49

LIST OF APPENDICES

Appendix 1. Common and scientific names of fishes mentioned in this report. 55

Appendix 2 Minimum lengths (mm) for length class designations for smallmouth bass, walleye, sauger, channel catfish, white bass and yellow perch. 56

Appendix 3. Lake Sharpe bus route loop map depicting locations of the 5 overall loops for angler use and harvest surveys during April – September, 2005. 57

Appendix 4. Overall design of the tailrace loop (loop 1) for angler use and harvest surveys for Lake Sharpe, SD during April-September, 2005. 57

Appendix 5. Overall design for the Pierre Loop (loop 2) for the angler use and harvest survey for Lake Sharpe, SD during April-September, 2005. 58

Appendix 6. Overall design for Zone 2 loop (loop 3) for the angler use and harvest survey for Lake Sharpe, SD during April-September, 2005. 58

Appendix 7. Overall design for the Pocket Loop for the angler use and harvest survey for Lake Sharpe, SD during April-September 2005. 59

Appendix 8. Overall design for the Big Bend Loop for the angler use and harvest survey for Lake Sharpe, SD during April-September, 2005. 59

Appendix 9. Angler satisfaction, preference, and attitude questions asked as part of the April-September 2005 angler use and harvest survey on Lake Sharpe, South Dakota. 60

Appendix 10. White bass and yellow perch proportional stock density (PSD) relative stock density of preferred-length fish, and mean relative weight values, for 1999-2004, for fish collected in the standard August gill net survey, on Lake Sharpe South Dakota. 61

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE SHARPE, SOUTH DAKOTA, 2005

INTRODUCTION

Anglers spent over 1.6 million hours fishing the Missouri River system in South Dakota in 2004 (Lott et. al 2006a; Lott et al. 2006b; Sorensen and Knecht 2006). Approximately 48% of South Dakota resident anglers fished the Missouri River system in 2003 and 35% of those anglers fished Lake Sharpe (Gigliotti 2004). Also, approximately 33% of angler days in South Dakota in 2003 were spent on the Missouri River system (Gigliotti 2004). The South Dakota Department of Game, Fish and Parks (SDGFP) recognizes the importance of the Missouri River fisheries program and considers it a major program in strategic planning efforts (SDGFP 1994).

Lake Sharpe is a 128-km long mainstem Missouri River flow-through reservoir and has a surface area of 24,686 ha. Lake Sharpe has supported between 61,000 and 123,000 angler trips, during the April-September daylight period, in recent years (Stone et al. 1994, Johnson et al. 1998; Johnson and Lott 2001; Lott et al. 2006b). Walleye, and to a lesser extent, smallmouth bass, white bass, channel catfish, sauger, and rainbow trout, provide most of the sport fishing opportunity in this reservoir. Current fish population parameters and sport fisheries are good, based on fish abundance and angler catch rates.

Lake Sharpe is an important fisheries resource in South Dakota and its habitat and fish community must be protected and maintained. The importance of Lake Sharpe to Missouri River fisheries is documented in the goals, objectives and strategies developed for management of this system (SDGFP 1994). Conducting annual surveys documenting fish community and population parameters, in association with collecting data on angler use, harvest, attitudes, preferences, and level of satisfaction, are primary strategies outlined in that plan. This information is required to evaluate objectives and strategies and to identify future management strategies. Trends and status of fish populations discussed in this report provide valuable information for evaluation of walleye regulations implemented in 1999 and modified for 2004. This report includes data collected for Lake Sharpe in 2005 and comparisons to data from previous years.

MANAGEMENT OBJECTIVES

Reservoir-wide Objectives

- Provide a minimum of 100,000 angler days of recreation with a harvest rate of 0.35 fish per angler hour, and a 70% angler trip satisfaction rating.

- Continually work to preserve or enhance and protect the existing fish community structure, diversity and aquatic habitats of Lake Sharpe.

Species Specific Objectives

- Provide a walleye fishery that can annually support a minimum of 75,000 angler days of recreation with a harvest of 100,000 walleye and a harvest rate of 0.3 walleye per angler hour.

- Provide a white bass fishery that can annually support a minimum of 5,000 angler days of recreation with a harvest of 30,000 white bass and a harvest rate of 0.3 white bass per angler hour.

- Provide a rainbow trout fishery that can annually sustain a minimum of 5,000 user-days of angling, a catch rate of 0.2 fish per hour for anglers specifically fishing for rainbow trout and an annual harvest of 2,500.

- Provide a smallmouth bass fishery that can sustain a minimum of 5,000 days of smallmouth bass angling opportunity, a harvest of 10,000, and a catch rate of 0.3 fish per angling hour for anglers specifically fishing for smallmouth bass.

- Provide a channel catfish fishery that can sustain a minimum of 10,000 days of recreation, and an annual harvest of 15,000, and a catch rate of 0.33 fish per angling hour for anglers specifically fishing for channel catfish.

- Maintain Lake Sharpe population abundance of gizzard shad, emerald and spottail shiners at or above the five-year average, as indexed by shoreline seining.

SAMPLING STRATEGIES

The sampling strategies used to determine SDGFP's ability to achieve stated fisheries management objectives, as outlined in the strategic plan, are accomplished through fish population and angler surveys which provide the following information:

<u>Annual fish population surveys (Federal Aid Code 2102):</u>

- species composition
- relative abundance
- population age structure
- growth
- condition
- recruitment
- survival and mortality rates
- population size structure
- effects of regulations
- effects of sport fish harvest

<u>Angler use, harvest, and preference surveys (Federal Aid Code 2109):</u>

- recreational angling pressure
- fish harvest, release and catch rates, by species
- angler party size, day length, and state of residency
- annual local economic impact of the sport fishery
- effects of regulations and other management activities
- size structure of fish in the harvest
- angler preference, attitude and satisfaction information

STUDY AREA

Lake Sharpe is located in central South Dakota (Figure 1) and extends from Oahe Dam to Big Bend Dam. 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, and the lower zone extends from DeGrey to Big Bend Dam. Standard gill netting, seining and electrofishing locations have historically been Farm Island, DeGrey/Fort George, Joe Creek and North Shore. Electrofishing is also conducted at LaFramboise Island and the Oahe Dam stilling basin. Historical, biological, chemical and physical parameters have been discussed previously (Benson 1968; Riis 1986; Schmidt 1975). Selected physical characteristics, management classification, and fish population survey schedules for Lake Sharpe are presented in Table 1.

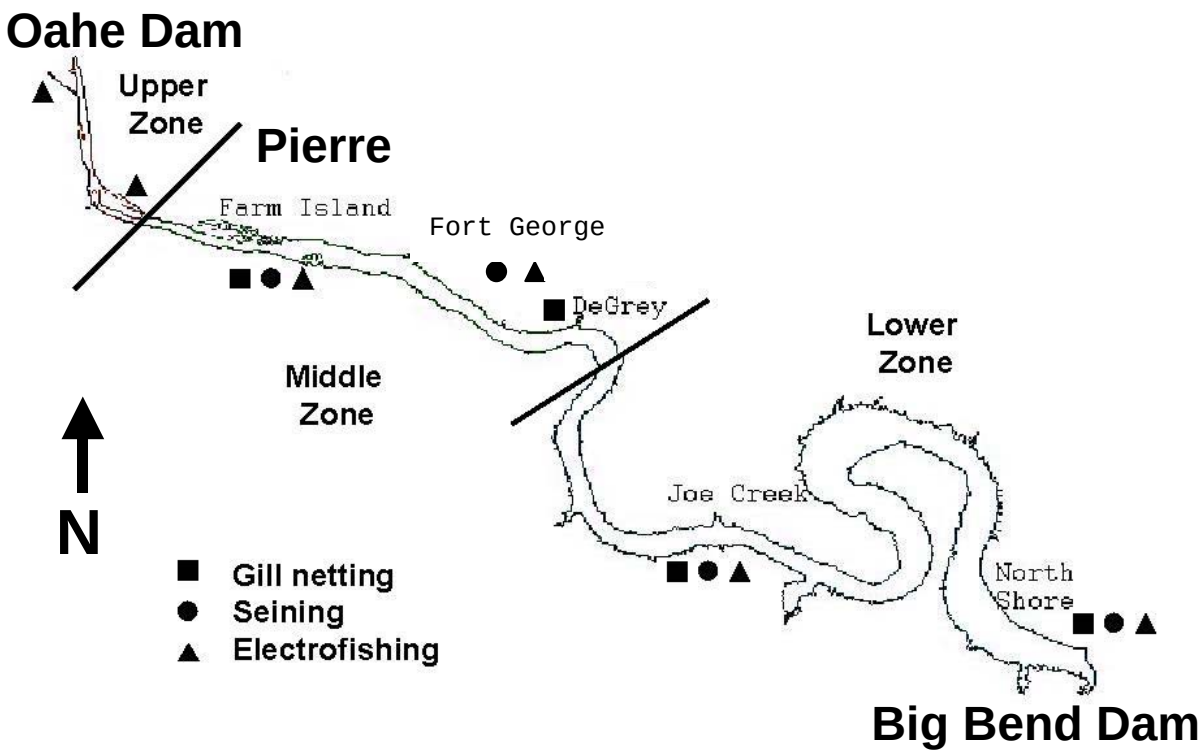


Figure 1. Lake Sharpe, South Dakota, gill netting, seining and electrofishing locations.

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 (X 1000 ha):	25
Depth (m)-maximum: **-mean:**	23.5 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 - 9.1 9.1 - 18.3
Number of gill nets:	24
Gill netting survey date:	August
Number of seine hauls:	16
Seining survey date:	August
Nighttime electrofishing survey dates:	May-June, September-October

REGULATION HISTORY

Fish population and angler use and harvest survey data is 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 14-inch minimum length limit was placed in effect on Lakes Oahe, Sharpe, and Francis Case (Table 2). Beginning in 1999, the minimum length was increased to 15 inches and the minimum length was in effect during all months except July and August. A stipulation that at most one fish in the daily limit could be 18 inches or longer was also added to the walleye regulation package in 1999. Changes implemented for 1999 were made to reduce harvest during a period of high angler use and increase the abundance of walleye longer than 18 inches in the population to increase the quality of the fishery. The daily walleye limit was reduced to three fish for 2004 and 2005 to reduce harvest during a period of low walleye abundance.

Experimental regulations for smallmouth bass were implemented in 2003 and will be evaluated through 2007 for their effectiveness at increasing the size structure of the smallmouth bass population in Lake Sharpe (Table 2). Special regulations for smallmouth bass include a 12-to-18-inch (306-457-mm) protected slot length limit with at most one fish 18 inches or longer in the daily limit.

Table 2. History of special harvest regulations for walleye and smallmouth bass, on Lake Sharpe, South Dakota, 1968 through 2005.

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 14 inch minimum length
	1999-2003	4	8	• Sept.-June 15 inch minimum length • At most one equal to or longer than 18 inches
	2004-2005	3	8	• Sept.-June 15 inch minimum length • At most one equal to or longer than 18 inches
Smallmouth bass	2003-2005	5	10	• Only fish shorter than 12 inches or 18 inches and longer may be kept and at most one fish in the daily limit may be 18 inches or longer.

SAMPLING METHODS

FISH POPULATION SURVEYS

Data Collection and Analysis

Variable-mesh gill nets, seines, and boat electrofishing were used to sample fish populations in Lake Sharpe during 2005 (Figure 1). Three standard gill nets (Lott et al. 1994) were fished overnight, on the bottom, in each depth zone (0-9.1 m and >9.1 m), where possible, at each location (Figure 1). All fish collected were identified and counted. All walleye and sauger captured were measured for total length (TL; mm) and weighed (g). At each sampling station, the first 50 individuals of each species were measured and weighed. Otoliths (10 per cm length group per sampling location) were collected from walleye and sauger captured during the standard gill net survey. Otoliths were cracked in half and charred prior to aging.

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 location. All fish collected with seines were identified and counted.

Spring (May and early June), nighttime electrofishing was used to gather data on smallmouth bass population parameters. Smallmouth bass captured were measured (TL; mm), weighed (g) and scales were taken from 10 smallmouth bass per centimeter length group, at each sampling

location. Six, 15-minute electrofishing runs were conducted at night, during late May and early June, along the shoreline, at each sampling location. A 5.3-m Smith-Root SR-18 electrofishing boat, with a 5.0 GPP electrofisher, was used to conduct the survey. The electrofishing unit was set for pulsed D.C. current and a 30 pulse/sec frequency. Voltage and amperage ranged between 270-300 V and 7-10 A, respectively. Each standard sampling site was sampled on three different occasions (six runs per occasion) during the one-month survey period, to reduce possible biases in size structure and catch rate associated with single sampling events (Lott 1996, 2000).

Fall (Sept./Oct.), nighttime electrofishing for age-0 walleye was included in standard fish population surveys beginning in 1995 to assess walleye reproduction. Beginning in 1998, a sampling location was included at DeGrey to provide uniformity between electrofishing, seining, and gill-netting survey sites. In 2000, electrofishing sites at LaFramboise Island and the Oahe Dam stilling basin were added to the list of standard electrofishing sites. In 2003, DeGrey was replaced with Fort George, as a standard seining and electrofishing station, due to a lack of shoreline access at Degrey, from siltation. The sampling design for fall electrofishing was identical to spring electrofishing. Otoliths were taken from a representative sample of walleye <200-mm TL in length to determine the maximum length for age-0 fish.

A list of common names, scientific names, and species abbreviations for fish mentioned in this report is presented in Appendix 1. Common and scientific names of fishes mentioned in this report..

Relative abundance of fish species were expressed as mean catch per unit effort (CPUE) for standard gill net (No./net night), seine (No./haul) and electrofishing (No./h) catches. A standard net night for the gill-net survey was approximately 20 h. Age and growth analyses were conducted for walleye, sauger, and smallmouth bass. Scales and otoliths were aged according to standard techniques (DeVries and Frie 1996). Back-calculations for scale samples were made with the computer program WinFin Analysis (Francis 2000). A standard y-intercept value for growth analyses of 35 mm was used for smallmouth bass (Carlander 1982). Age distributions for gill-net catches of walleye and sauger were developed by assigning ages to all fish captured during the survey, based on length-at-age-at-time-of-capture information. Proportional stock density (PSD; Anderson 1980) and relative stock density (RSD; Gablehouse 1984) values were calculated for walleye, sauger, smallmouth bass, channel catfish, white bass, and yellow perch. Length categories used in PSD and RSD are listed in Appendix 2 . Proportional stock density and RSD values were tested for differences between years using Chi Square analysis (Conover 1980; SYSTAT 1998).

Relative weight values (*Wr;* Anderson 1980) were calculated using standard weight (W_s) equations developed for smallmouth bass (Kolander et al. 1993), walleye (Murphy et al. 1990), sauger (Guy et al. 1990), channel catfish (Brown et al. 1995), white bass (Brown and Murphy 1991) and yellow perch (Willis et al. 1991). Stock density indices (PSD, RSD). Mean *Wr* values for white bass and yellow perch are presented in Appendix 2.

Walleye *Wr* values for fish in gill net samples and smallmouth bass *Wr* values from electrofishing samples were tested for differences among years, within stock density index groupings, using a one-way analysis of variance (ANOVA, SYSTAT 1998) and a Least Significant Difference (LSD) test. Length and CPUE of age-0 walleye in fall electrofishing samples were tested for differences among years using a one-way ANOVA. Length and CPUE data were $\log_{10}$ N+1 transformed prior to analyses to better meet the assumption of normality. Standard error values were generated for gill net, seine haul, and electrofishing CPUE as a measure of sample variance. An alpha level of 0.05 was established, a priori, for all statistical tests.

Simple linear correlation analyses were conducted between indices of walleye recruitment (age-0 seining, age-0 gill net, age-0 electrofishing and age-1 gill net CPUE).

LAKE SHARPE WHITE BASS DIE-OFF INVESTIGATION METHODS

In late June and early July, 2005 a significant white bass die-off occurred in Lower Lake Sharpe. Onsite fish die-off investigations by Missouri River fisheries staff involved 402 m shoreline walks. Bay and main lake sites were sampled on both sides of the lake in areas that were not accessible to the public. Fish washed up on the shoreline as well as fish visible and easily collected from shore were counted (Southwick and Loftus 2003). Distance was logged with a GPS and all dead fish encountered were identified and counted. A sub-sample of white bass was measured to the nearest millimeter.

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

Data Collection and Analysis

Prior to 2003, angler use and sport-fish harvest survey techniques were patterned after a study designed and conducted on Lake Sharpe, South Dakota, by Schmidt (1975). This survey consisted 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 and catch and release rates. Beginning in 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). 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). Sampling was conducted from April 1, 2005 through September 30, 2005 for the sunrise-to-sunset (daytime) period. Diagrams of bus routes used on Lake Sharpe during the April-September survey period appear from Appendix 3 to Appendix.

Angler satisfaction, preference, and attitude questions were included in each angler interview during the 2005 reservoir-wide angler use and harvest survey. Two different versions (forms A and B) of the angler interview data sheet were created, with different sets of angler attitude or preference questions on each sheet. Clerks alternated between forms A and B during each scheduled survey day. Anglers were asked how satisfied they were with their fishing trip, considering all factors. Anglers were also asked if they were on a guided fishing trip. A question regarding how the 3-fish daily limit for walleye, implemented in 2004, had affected the ability of angling parties to harvest walleye, sauger, and their hybrids was also included in the survey in an attempt to generate a minimal harvest reduction estimate resulting from the decrease in the daily limit. A complete list of satisfaction, attitude and preference questions asked in conjunction with the 2005 angler use and harvest survey appears in Appendix.

Pressure count and angler interview data were entered and analyzed using the Creel Application Software (CAS) package (Soupir and Brown 2002) and 95% confidence intervals were calculated for estimates of fishing pressure and harvest. Median values of satisfaction question responses were calculated for each month and for the entire April-September survey period. Percentage of angler party interviews from specific geographic locations was tested for differences between years or months using Chi Square analysis (Conover 1980; SYSTAT 1998).

RESULTS AND DISCUSSION

FISH POPULATION SURVEYS

Species Composition and Relative Abundance

Channel catfish and walleye dominated catches in the August 2005 gill net survey, comprising 36% and 37% of the total catch, respectively (Table 3). Other species commonly caught during the 2005 survey included yellow perch, common carp, sauger, white bass, gizzard shad, freshwater drum, and smallmouth bass. Catch per unit effort (CPUE) has historically been used as an index of population abundance or density (Hubert 1996). Channel catfish mean CPUE in 2005, at 17.5 fish/net-night, was similar to 2002 through 2004 (Table 4). Mean walleye CPUE in 2005, at 17.8 walleye/net-night, was similar to the 2003 value of 19.6 walleye/net-night. The average mean catch per gill net-night, for the 1986-2005 period, is 24.7 walleye/net-night. The 2004 value of 12.9 walleye/net-night, was the lowest documented during the 1982-2004 period for which gill net surveys have been conducted (Johnson et al. 1998; Lott et al. 2003, 2006b; Michaletz et al. 1986; Wickstrom et al. 1991; Wickstrom et al. 1993). Though not significantly different because of high variation in catches among gill nets, the walleye abundance index appears to have increased from 2004 to 2005. Mean CPUE for all other species in 2005 were within ranges previously documented.

Table 3. Relative species composition, as percent of total catch, of fish species collected during the standard August gill net survey on Lake Sharpe, South Dakota, during 2001 through 2005. Trace (T) indicates values < 0.5%.

Species	Year				
	2001	2002	2003	2004	2005
Walleye	40.6	37.0	31.8	27.9	36.8
Channel catfish	13.0	30.9	30.7	33.3	36.2
Yellow perch	1.9	2.5	1.8	2.6	4.4
Common carp	2.8	2.1	1.3	4.2	4.0
Sauger	7.5	8.8	3.9	5.9	3.7
White bass	4.0	5.7	15.9	5.6	3.5
Gizzard shad	19.7	5.1	10.3	10.3	3.1
Freshwater drum	2.4	2.6	1.5	2.1	3.0
Smallmouth bass	1.3	T	0.5	T	2.8
*Others	6.9	5.6	2.5	8.1	2.4

*Others includes: black crappie, blue sucker, white crappie, northern pike, river carpsucker, shorthead redhorse, goldeye, shovelnose sturgeon, spottail shiner, bigmouth buffalo, lake herring, black bullhead, rainbow trout, shortnose gar, smallmouth buffalo, rainbow smelt, white sucker.

Table 4. Mean catch per unit effort (CPUE; No./net-night) and standard error values (SE) for fish species collected with standard coolwater gill net sets in Lake Sharpe, South Dakota, 2001-2005. Trace (T) indicates values less that 0.05.

Species	Year									
	2001		2002		2003		2004		2005	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	T		0.0		T		T		T	
Black bullhead	0.0		0.0		0.0		0.1	0.1	0.0	
Black crappie	0.0		0.1	0.1	0.0		0.0		0.0	
Channel catfish	9.0	1.7	20.1	4.5	18.7	3.8	15.2	2.2	17.5	4.0
Common carp	1.9	0.6	1.4	0.3	0.8	0.3	2.0	0.4	1.8	0.4
Freshwater drum	1.7	0.5	1.7	0.7	0.9	0.4	1.0	0.7	1.3	0.4
Gizzard shad	13.7	4.9	3.3	1.5	6.3	3.6	5.2	3.5	1.5	0.8
Goldeye	1.5	0.8	1.9	1.0	0.4	0.2	0.7	0.4	0.2	0.1
Northern pike	0.1	0.1	T		0.0		0.0		0.0	
Rainbow smelt	0.0		0.0		0.0		T		0.0	
Rainbow trout	T		0.0		T		0.0		0.0	
River carpsucker	1.7	0.5	0.1	0.1	0.3	0.2	0.4	0.2	0.5	0.3
Sauger	5.2	1.5	5.6	1.3	2.4	0.6	2.7	0.6	1.7	0.5
Shorthead redhorse	0.3	0.1	0.5	0.2	0.4	0.2	1.0	0.4	0.2	0.1
Shortnose gar	0.1	0.1	T		T		0.1	0.1	T	
Shovelnose sturgeon	0.8	0.7	0.8	0.4	0.1	0.1	1.0	0.6	0.1	0.1
Smallmouth bass	0.9	0.7	T		0.3	0.2	T		1.2	0.8
Smallmouth buffalo	0.0		0.0		0.0		T		0.0	
Spottail shiner	T		0.0		0.0		0.0		0.1	0.1
Walleye	28.3	5.4	24.1	5.1	19.6	3.0	12.9	2.2	17.8	2.8
White bass	2.8	1.4	3.7	1.3	9.8	6.8	2.6	0.9	1.5	0.8
White crappie	0.2	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.6	0.4
White sucker	0.1	0.1	0.0		0.0		0.0		T	
Yellow perch	1.3	0.5	1.6	0.6	1.1	0.5	1.3	0.3	2.1	0.7

Nineteen species of age-0 or small prey fishes were collected by shoreline seining in 2005. All species had been previously sampled in Lake Sharpe. Gizzard shad comprised the majority of the catch in 2005, with a mean CPUE of 284.7 fish/haul (Table 5). The long-term average CPUE (1982-2005) for gizzard shad is seine hauls is 563 fish/haul. The mean number of age-0 walleye captured per seine haul in 2005, at 3.9, was the highest since 2001. Mean CPUE for other species captured during the seining survey was within ranges previously documented.

Table 5. Mean catch per unit effort (CPUE; No./haul) and standard error (SE) values for fish species collected during the standard August seining survey on Lake Sharpe, South Dakota. Catches are for age-0 fishes except where noted. Trace (T) indicates values less than 0.05. Asterisk (*) indicates both age-0 and adult fish included in CPUE.

Species	Year									
	2001		2002		2003		2004		2005	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bluegill	0.0		0.1	0.1	0.0		0.0		0.5	0.2
Bluntnose minnow*	0.1	0.1	0.0		0.1	0.1	0.0		1.9	0.9
Brassy minnow*	0.1	0.1	0.0		0.1	0.1	0.0		0.0	
Channel catfish	0.0		0.1	0.1	0.0		0.0		0.3	0.2
Common carp	0.8	0.4	0.0		0.2	0.1	0.3	0.2	0.5	0.3
Emerald shiner*	72.4	30.6	46.6	15.3	15.1	5.7	27.9	9.4	95.4	39.7
Fathead minnow*	0.2	0.1	0.6	0.5	0.1	0.1	0.0		0.0	
Freshwater drum	11.8	6.4	3.8	1.7	0.3	0.2	3.4	1.7	22.4	8.8
Gizzard shad	603.6	241.8	1,459.7	644.7	244.4	105.1	379.4	147.2	284.7	83.8
Goldeye	0.3	0.3	0.0		0.0		0.0		0.1	0.1
Johnny darter*	0.1	0.1	0.1	0.1	0.9	0.8	0.5	0.2	0.2	0.1
Largemouth bass	0.1	0.1	0.1	0.1	0.0		0.3	0.1	0.3	0.1
River carpsucker	4.4	1.6	3.6	2.1	0.0		0.1	0.1	10.9	4.8
Sauger	0.0		0.0		0.0		0.0		0.6	0.4
Smallmouth bass	1.4	0.7	3.4	1.0	1.8	0.7	2.1	0.9	1.5	0.5
Spottail shiner*	13.9	3.5	4.9	2.5	8.7	3.3	5.6	2.0	3.7	1.0
Walleye	3.6	1.8	1.6	0.7	0.3	0.2	0.0		3.9	1.4
White bass	14.6	5.0	14.9	9.2	2.2	1.1	19.1	8.5	6.8	2.8
White crappie	2.1	0.9	0.4	0.3	0.3	0.3	10.9	10.0	2.7	1.8
White sucker	0.3	0.2	0.0		0.1	0.1	0.2	0.1	0.2	0.1
Yellow perch	6.4	2.3	10.9	4.3	15.9	12.3	3.8	1.5	24.9	11.2

Population Parameters for Walleye

Walleye ranging from 110 to 575 mm TL were collected during the August 2005 gill netting survey (Figure 2). Approximately 49% of walleye in the 2005 gill net sample were ≥ 380-mm TL (15-inch minimum length), and 15% were ≥ 460-mm TL (18 inches, Figure 2). However, walleye between 170 and 270 mm TL were absent from the 2005 gill net catch (Figure 2; age-1 fish), supporting evidence from 2004 surveys that indicated reproduction was low during 2004.

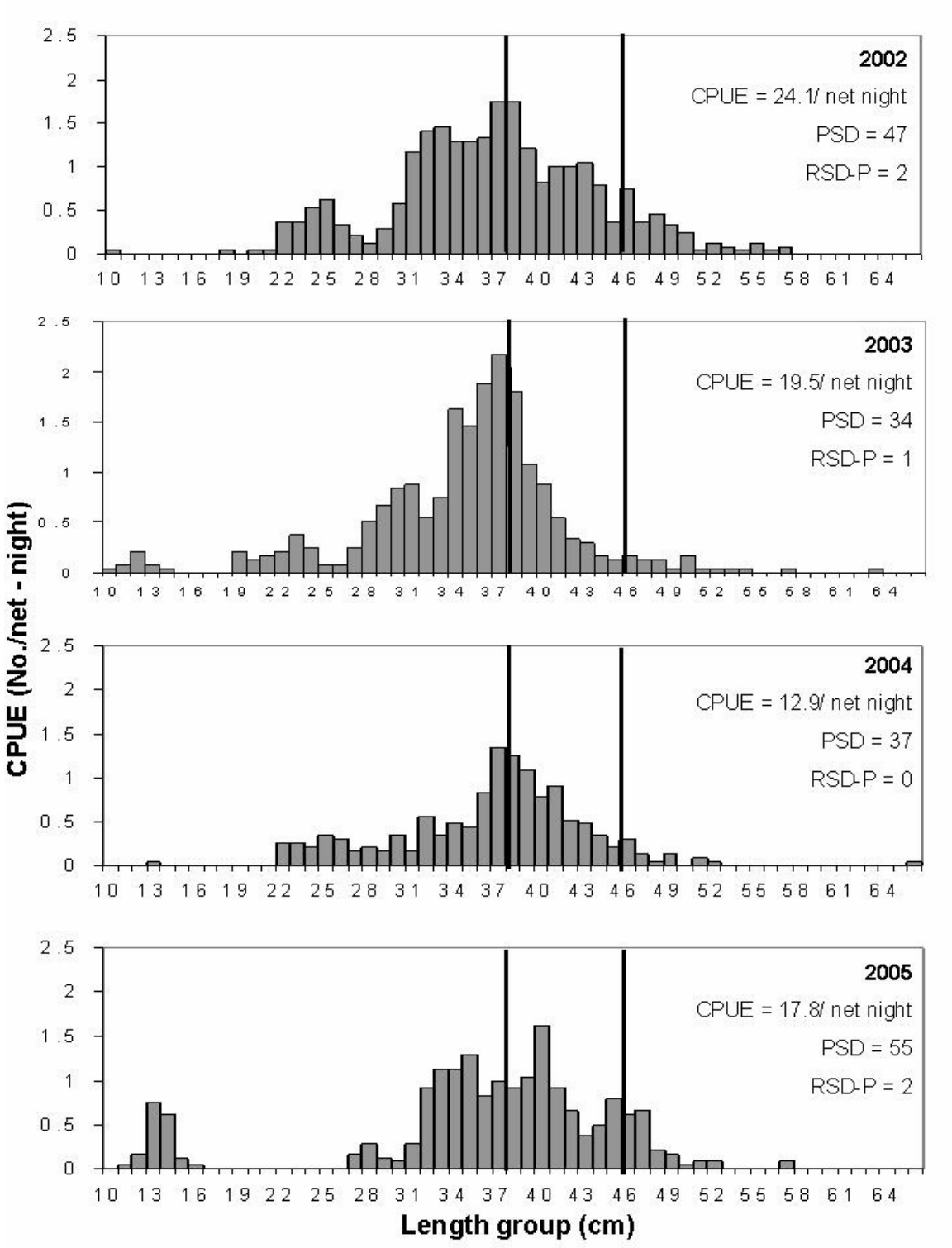


Figure 2. Length frequency, as catch per unit effort, of walleye collected in standard gill-net sets in Lake Sharpe, South Dakota, during August 2002 through 2005. Vertical lines represent the 15-inch and 18-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

Catch-per-net values for individual sampling stations are often not significantly different from one another among years due to high variability in gill net catches among nets and low sample size (Table 6). However, mean gill net CPUE at Joe Creek increased from 2004 to 2005, while mean gill net CPUE at DeGrey decreased (Table 6).

Table 6. Mean walleye catch per unit effort (No./net-night) in the standard coolwater gill net survey for Lake Sharpe, South Dakota, 1997-2005. Values within sites with no letters in common are significantly different at the *P*<0.05 level of significance. Comparisons were only made among years, within sites.

Year	Site				
	North Shore	**Joe Creek**	**DeGrey**	**Farm Island**	**Total**
1997	31.8ac	19.8ac	11.7ab	20.7a	21.0a
1998	23.3acd	28.3ab	27.2ab	6.8a	21.4a
1999	36.7a	37.2ab	17.8ab	10.0a	25.4a
2000	23.8bc	31.8ac	26.8a	15.8a	24.6a
2001	23.0ac	55.0b	14.5ab	20.7a	28.3a
2002	12.8b	44.8bc	12.2ab	26.5a	24.1a
2003	20.2ac	16.2a	12.7ab	29.0a	19.5a
2004	13.0bd	9.0d	14.2ab	14.8a	12.9a
2005	19.2bc	31.8ab	3.2b	17.0	17.8a

Mean walleye CPUE for individual sampling locations are based on six net sets at each location, each year. Because Lake Sharpe is a flow through reservoir, flow characteristics highly influence daily and seasonal fish movement, distribution, and netting efficiency. Variability among gill net catches within and among survey years is due to changes in fish abundance, fish activity in association to current, and fouling of nets with debris in current or shallow-water areas. Current affects netting efficiency at the upper three sampling locations on Lake Sharpe with nets at the DeGrey and Farm Island locations being the most affected. The low gill net catch rate for walleye at DeGrey in 2005 is a perfect example of nets being fouled by debris moved about by wave action and current.

Walleye abundance and population size structure were higher in 2005 than 2004. Mean CPUE of substock-length walleye for 2005 was higher than 2004 and similar to years in the 2000-2003 period (Table 7). Mean CPUE of stock-to-quality-length walleye in 2004 was significantly lower than other years in the 2000-2005 period (Table 7). Mean CPUE of preferred-length walleye is typically below 1.0 fish/net-night, indicating few fish in the population reached preferred length (Table 7). The decrease in walleye CPUE and size structure is also evident from examination of Figure 3.

Proportional stock density for the 2005 walleye gill net sample, at 55, was within the balanced range of 30-60 (Anderson and Weithman 1978; Table 8). Proportional stock density values for 2003 and 2004 were similar and lower than the 2005 value of 55. Preferred-length fish are uncommon in gill net catches as evidenced by RSD-P values for walleye of 3 or less during the 1997-2005 period (Table 8). Mean walleye *Wr* for the 2005 total gill net sample, at 86, was similar to 2004 and higher than 2003 (Table 9). The lower *Wr* value for 2003 is likely due to a low abundance of age-0 gizzard shad. Mean *Wr* values of walleye in the stock-to-quality length group were similar in 2004 and 2005, while *Wr* for quality-to-preferred-length fish increased from 2004 to 2005. Walleye in Lake Sharpe in the preferred-to-trophy length group generally have a lower *Wr* than fish in smaller length categories and this trend was evident in 2005.

Table 7. Mean walleye catch per unit effort (No./net-night) in the standard gill net survey, by year and length group, for 1997-2005, for Lake Sharpe, South Dakota. Values within length groups, among years, with no letters in common, are significantly different at the *P*<0.05 level of significance. Comparisons were only made within length groups among years.

Year	Length group				
	Substock	Stock-quality	Quality-preferred	Preferred	Total
1997	1.0a	14.0c	5.8ab	0.2a	21.0a
1998	1.0a	9.3abc	10.6a	0.5ab	21.4a
1999	3.5b	8.6abc	12.3a	0.9b	25.4a
2000	2.3ab	13.5ac	7.8b	0.9ab	24.6a
2001	2.2ab	16.1c	9.5ab	0.4ab	28.3a
2002	1.5ab	11.9ac	10.2ab	0.6ab	24.1a
2003	1.8ab	11.6ac	5.9b	0.2a	19.5a
2004	0.8a	5.7b	6.2b	0.2a	12.9a
2005	1.7ab	7.3ab	8.5ab	0.3ab	17.8a

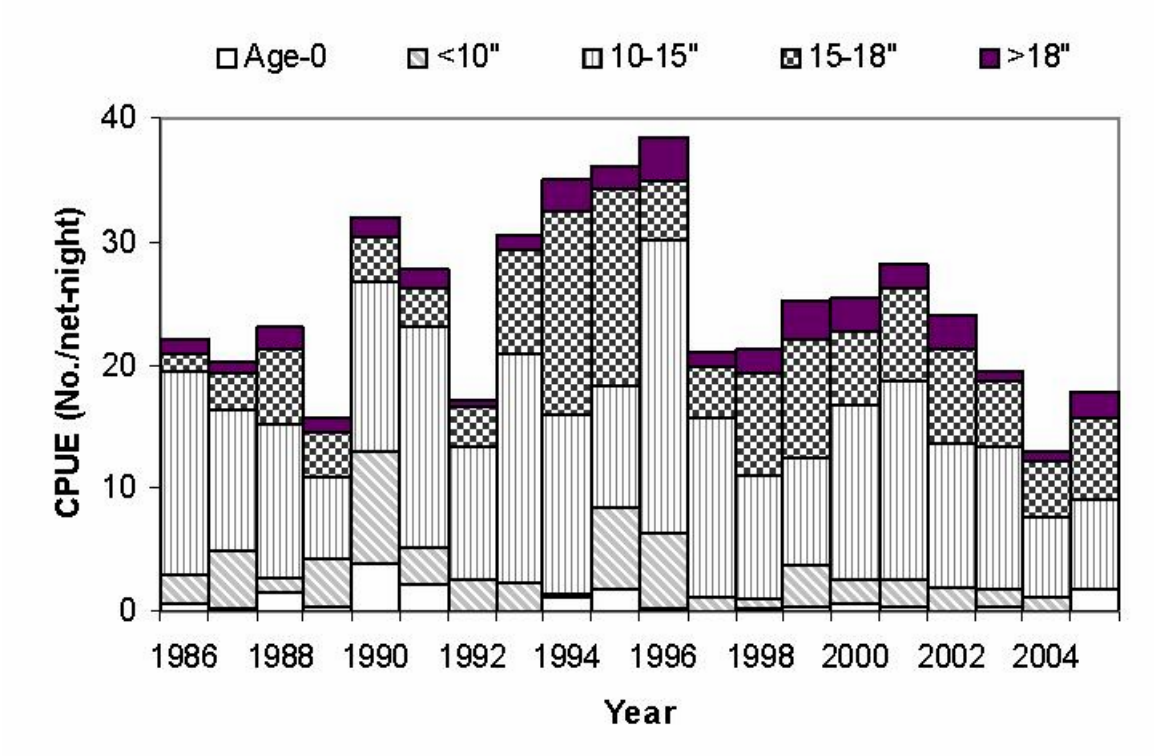


Figure 3. Size structure and abundance (CPUE) of walleye collected in the standard gill-net survey in Lake Sharpe, South Dakota, during August, 1986-2005.

Table 8. Walleye and sauger proportional stock density (PSD) and relative stock density of preferred- (RSD-P) and memorable-length (RSD-M) fish collected during the standard gill net survey on Lake Sharpe, South Dakota, 1997-2005.

Year	Walleye				Sauger			
	PSD	RSD-P	RSD-M	Ns	PSD	RSD-P	RSD-M	Ns
1997	30	1	0	480	100	47	1	72
1998	54	2	0	488	100	66	1	77
1999	60	3	0	519	75	61	2	101
2000	38	3	0	530	82	32	4	161
2001	38	1	0	624	78	23	2	124
2002	47	2	0	539	97	42	2	138
2003	34	1	0	426	100	33	2	57
2004	37	0	0	303	82	37	0	68
2005	55	2	0	384	100	59	0	41

Table 9. Mean walleye relative weight (*Wr*) values, by length group, for Lake Sharpe, South Dakota, 1997-2005. N is the number of stock-length fish in a sample. Within length classes, values with the same letter code are not significantly different at the $P<0.05$ level of significance.

Year	Length group							
	Stock-quality		Quality-preferred		Preferred-trophy		Total sample	
	Wr	N	*Wr*	N	*Wr*	N	*Wr*	N
1997	82a	337	79ab	139	76ac	4	81a	480
1998	86b	224	82a	254	77ac	10	84b	488
1999	84c	207	81a	294	76ac	18	82a	519
2000	82ac	324	78b	188	71ab	18	80a	530
2001	87d	386	83ad	229	75ac	9	85bd	624
2002	83ac	284	81ab	243	73ab	13	82a	539
2003	78d	280	72ad	140	66b	6	75c	426
2004	87b	143	84d	156	76ac	4	85bd	303
2005	86b	174	86d	204	80c	6	86d	384

Beginning in 2002, otoliths were removed from the majority of walleye and sauger collected during the August gill net survey. Mean length at capture for each age group is illustrated in Table 10. Examination of mean length at age at time of capture indicates Lake Sharpe walleye typically reach 381 mm TL at age 3 or 4, meaning that the majority of walleye in the 2005 year class will not surpass the minimum length until the 2008 or 2009 fishing seasons (Table 10).

The change in mean length of fish in a year class from one year to the next is considered the annual growth increment for that year class (Table 11). While not statistically tested, growth for walleye through age 6 appears to have been slower during the 2002-2003 growth period than during the 2003-2004 or 2004-2005 periods. Low relative weight values for walleye in the 2003 gill net survey (Table 9) may be indicative of slower growth during the 2002-2003 period.

Age-2 walleye (produced in 2003) comprised the largest percentage of the 2005 gill net sample of any age group (Table 12), followed by fish produced in 2000 and 2001 (age-4 and age-5 fish). The catch of 42 age-0 walleye in the 2005 gill net survey is indicative of high natural production in 2005 (Table 12).

Table 10. Mean length-at-age-at-capture (mm) for walleye collected in the standard August gill net survey, 2002-2005, on Lake Sharpe, South Dakota, and aged from otoliths.

Year		Length at age at capture (mm)								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2002	**Mean**	247	327	373	410	424	459	489	492	495
	N	42	91	88	80	15	2	10	14	1
	SE	2.8	2.6	2.6	3.6	6.9	31.0	12.2	11.1	NA
2003	**Mean**	224	311	362	385	410	430	426	480	469
	N	22	93	128	76	34	7	3	8	7
	SE	4.6	2.4	1.8	2.5	4.1	12.5	8.0	13.7	11.2
2004	**Mean**	252	312	370	390	401	437	441	495	506
	N	38	32	81	73	34	24	3	2	8
	SE	3.4	3.9	3.1	3.2	5.0	6.0	14.2	23.5	24.2
2005	**Mean**	282	342	379	407	427	438	465	467	476
	N	12	130	38	71	66	33	19	2	2
	SE	2.4	1.7	3.0	3.2	3.9	5.5	11.2	25.5	2.0
Mean of means		251	323	371	398	415	441	455	484	487

Table 11. Mean annual growth (length) increment estimates for walleye collected in the standard coolwater gill net survey on Lake Sharpe, South Dakota, for the 2002-2003, 2003-2004, and 2004-2005 periods, as determined by aging otoliths.

Year	Growth increment added during period (mm)							
	1-2	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**	**8-9**
2002-2003	64	35	12	0	2	--	--	--
2003-2004	88	59	28	16	27	15	56	26
2004-2005	90	67	37	37	37	28	26	--

Table 12. Age distribution of walleye collected from Lake Sharpe, South Dakota, with standard gill net sets as determined by aging otoliths. Year refers to walleye year class, CPUE is catch per unit effort (No./net-night), and T (trace) indicates mean CPUE values <0.05.

2002													
Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Year	**02**	**01**	**00**	**99**	**98**	**97**	**96**	**95**	**94**	**93**	**92**	**91**	**90**
	1	57	153	140	141	29	4	19	23	1	2	5	0
CPUE	T	2.4	6.4	5.8	5.9	1.2	0.2	0.8	1.0	T	0.1	0.2	0.0

2003													
Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Year	**03**	**02**	**01**	**00**	**99**	**98**	**97**	**96**	**95**	**94**	**93**	**92**	**91**
	11	34	110	157	88	38	8	3	8	7	2	1	2
CPUE	0.5	1.4	4.6	6.5	3.7	1.6	0.3	0.1	0.3	0.3	0.1	0.1	0.1

2004													
Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Year	**04**	**03**	**02**	**01**	**00**	**99**	**98**	**97**	**96**	**95**	**94**	**93**	**92**
	1	37	30	81	73	35	23	3	2	8	4	0	0
CPUE	T	1.6	1.3	3.5	3.2	1.5	1.0	0.1	0.1	0.3	0.2	0.0	0.0

2005													
Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Year	**05**	**04**	**03**	**02**	**01**	**00**	**99**	**98**	**97**	**96**	**95**	**94**	**93**
	42	12	131	39	72	66	33	19	2	2	1	6	0
CPUE	1.8	0.5	5.5	1.6	3.0	2.8	1.4	0.8	0.1	0.1	T	0.3	0.0

Walleye recruitment, as indexed by fall nighttime electrofishing CPUE of age-0 fish, was higher in 2005 than during the 2001-2004 period (Table 13). The 2005 mean electrofishing CPUE, of 88.1 fish/h was similar to 1995, 1997, 1998, and 2000, and among the highest during the 1995-2005 period, (Table 13). The sites with the highest CPUE in 2005 was LaFramboise Island, at 213.3 fish/h, while Hipple Lake and Joe Creek had CPUE values of 120 and 100.7 fish/h, respectively. Mean length of age-0 walleye in the 2005 fall electrofishing catch, at 171 mm, was similar to 2001, 2003 and 2004.

Table 13. Mean nighttime electrofishing catch per unit effort (CPUE; No./h) and total length (mm) for age-0 walleye collected during September and October 1995-2005 on Lake Sharpe, South Dakota. SE is standard error values about means and N is sample size.

	Catch per unit effort (No./h)			Mean length (mm)		
Year	**CPUE**	**N**	**SE**	**Length**	**N**	**SE**
1995*	59.6	18	11.6	175	268	1.2
1996*	22.4	18	3.4	136	101	2.9
1997*	42.7	18	9.7	142	197	1.6
1998#	42.2	22	10.4	146	236	1.2
1999+	20.1	36	2.9	130	181	1.3
2000+	75.1	36	8.6	147	522	0.7
2001+	22.9	36	4.1	164	321	1.1
2002+	12.6	36	2.6	147	113	1.6
2003^	19.7	36	5.7	166	177	0.2
2004^	4.9	36	1.4	167	44	3.2
2005^	88.1	36	12.6	171	793	4.9

* North Shore, Joe Creek and Farm Island
# North Shore, Joe Creek, Farm Island and DeGrey
+ North Shore, Joe Creek, Farm Island, DeGrey, LaFramboise Bay and Stilling Basin
^ North Shore, Joe Creek, Farm Island, Fort George, LaFramboise Bay and Stilling Basin

Mean CPUE of age-1 walleye in the August gill net survey has traditionally been used as an index of walleye recruitment in Missouri River reservoirs. Potential early indicators of walleye year class strength were compared to mean age-1 gill net CPUE to determine which indicators or surveys were the best early indicators of walleye recruitment. Potential indicators of walleye recruitment and values for the 1994-2005 period are listed in Table 14.

Table 14. Mean age-0 walleye seine haul catch-per-unit-effort (CPUE; No./haul), mean standard gillnet age-0 walleye CPUE (No./net night), mean age-0 walleye nighttime electrofishing CPUE (No./ h), and mean standard gillnet age-1 walleye CPUE (No./net night) is the following year recruitment for the 1994-2005 period on Lake Sharpe, South Dakota.

Year class	Seine age-0 CPUE	Gillnet age-0 CPUE	Electrofishing age-0 CPUE	Gillnet age-1 CPUE
1994	5.9	1.50	----	12.96
1995	2.5	1.63	59.6	7.89
1996	2.2	0.11	22.4	1.00
1997	1.1	0.08	42.7	0.92
1998	6.9	0.13	42.2	5.63
1999	0.8	0.38	20.1	2.65
2000	11.8	0.52	75.1	4.71
2001	3.6	0.46	22.9	2.42
2002	1.6	0.04	12.6	1.46
2003	0.3	0.46	19.7	1.60
2004	0.0	0.04	4.9	0.50
2005	3.9	1.75	88.1	---

Summer age-0 seining CPUE for the 1994-2004 period, was not significantly correlated with CPUE of age-1 walleye in the standard gill net survey the following year (*P*=0.12, *r*=0.50, *d.f.*=10). However, age-0 walleye gill net and fall nighttime electrofishing CPUE were significantly positively correlated with walleye age-1 gill net CPUE the following year (*P*=0.001, *r*=0.85, *d.f.* =10 and *P*=0.02, *r*=0.74, *d.f.*=10, respectively). Therefore, both age-0 gill net and age-0 electrofishing CPUE show promise as early indicators of walleye recruitment in Lake Sharpe.

Population Parameters for Sauger

Sauger and walleye are managed with the same set of regulations because they are hard for anglers to differentiate and sauger are a very important part of the fishery in Lake Sharpe. Forty-one sauger were collected during the gill net survey in August 2005, for a mean CPUE of 1.7 (Table 4). Sauger CPUE in 2005 was similar to 2003 and 2004. Mean sauger CPUE in the fall nighttime electrofishing survey was 22.1 fish/h in 2005, signifying substantial natural reproduction. Overall condition (mean *Wr*) for sauger in the gill net survey increased from 73 in 2004 to 76 in 2005. Mean length-at-age-at-time-of-capture values for fish in the 2005 sample are presented in Table 15. Sauger up to age 7 were collected in the 2005 gill net survey, with the mean age of sauger being 3.9. The 2000 and 2003 year classes were well represented in the 2005 gill net sample (Table 16). All sauger collected in the 2005 gill net survey exceeded stock length and fish ranged from 312 to 438 mm (Figure 4).

Table 15. Mean length-at-age-at-capture (mm) values for sauger collected in the standard August coolwater gill net survey, 2002-2005, on Lake Sharpe, South Dakota, as determined by aging otoliths.

Year		Length at age at capture (mm)								
		1	2	3	4	5	6	7	8	9
2002	**Mean**	265	329	364	393	404	407	--	448	445
	N	1	41	17	26	6	1	--	7	5
	SE	--	4.2	7.9	15.6	8.5	--	--	24.5	17.9
2003	**Length**	--	315	356	374	391	--	--	--	458
	N	--	2	21	16	8	--	--	--	2
	SE	--	2.5	24.9	5.7	8.6	--	--	--	56.5
2004	**Length**	260	315	353	379	410	414	--	--	--
	N	9	6	8	31	5	8	--	--	--
	SE	3.1	11.7	17.7	4.2	10.5	15.8	--	--	--
2005	**Length**	--	343	396	415	398	411	395	--	--
	N	--	16	6	1	9	3	6	--	--
	SE	--	4.0	12.4	--	4.9	12.0	7.5	--	--
Mean of means		263	326	367	390	401	411	395	448	452

Table 16. Age distributions of sauger collected from Lake Sharpe, South Dakota, with gill nets during standard surveys conducted from 2002 through 2005. Mean age excludes age–0 fish and ages were determined from otoliths.

Year	Age											
	0	1	2	3	4	5	6	7	8	9	10	Mean
2002	0	1	41	17	25	6	1	0	7	5	0	2.9
2003	0	0	2	21	16	8	0	0	0	2	0	3.9
2004	0	8	4	8	28	5	8	0	0	0	1	3.8
2005	0	0	16	6	1	9	3	6	0	0	0	3.9

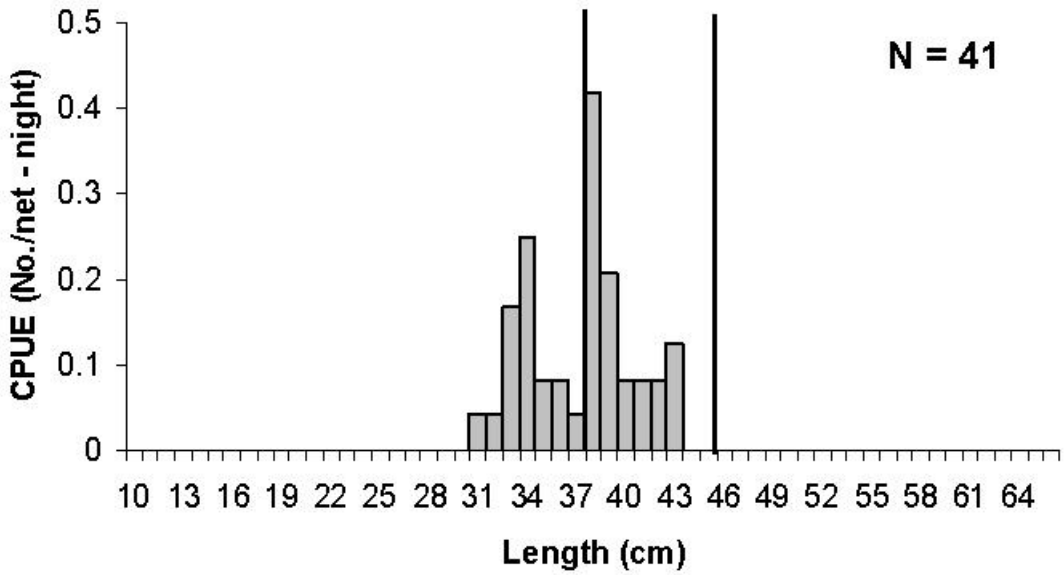


Figure 4. Length frequency, by catch per unit effort, of sauger collected during the standard gill net survey during August 2005, on Lake Sharpe, South Dakota. Vertical lines represent the 15-inch and 18 inch classifications.

Population Parameters for Smallmouth Bass

Beginning in 2002, one rip-rap area (Big Bend Dam) and one natural habitat area (Joe Creek) were sampled every week to 10 days during late-May and early-June, (three dates per site) by nighttime electrofishing. Data collected during 2001to 2004 is included for comparison with 2005 data (Table 17). Prior to 2002, sampling locations were sampled once each year and six 15-minute runs were conducted. Mean CPUE has always been higher at Big Bend Dam than at Joe Creek. However, PSD, RSD-P, and RSD-M values have historically been lower at Big Bend Dam. As an example, PSD at Big Bend Dam in 2005 was 40, while at Joe Creek it was 67. This pattern of higher catch rates and lower stock density indices values and size structure for rip-rap areas was also documented for Lake Oahe (Lott 1996, Lott 2000). Figure 5 illustrates the CPUE and size structure of smallmouth bass collected at Big Bend Dam and Joe Creek.

The current smallmouth bass regulation package on Lake Sharpe was implemented in 2003 and consists of a 306-to-457-mm (12-to-18-inch) protected slot with anglers being allowed to harvest one bass ≥ 457 mm as part of the five-fish daily limit. Mean CPUE values of smallmouth bass in

the nighttime electrofishing survey for pre- and post-regulation change years are similar. Proportional stock density and RSD-P of Joe Creek samples have decreased since the 2003 regulation change, while PSD and RSD-P values for Big Bend Dam samples initially decreased but values for 2005 were similar to pre-regulation change years (Table 17). However, it is believed that electrofishing may not be the best survey method for documenting changes in the size structure of smallmouth bass (Beamesderfer and Riemer. 1988). Therefore, monofilament gill nets (Dan Isermann, Minnesota DNR, personal comm.) are being tested as a survey tool.

Mean back-calculated length at annulus, as determined from scales, for each year class of smallmouth bass in the 2005 sample, was similar to 2004 (Table 18; Lott et al., 2004). Mean back-calculated length at age-4 for the Statewide mean and Missouri River reservoir mean are 301 and 310 mm, respectively, according to Willis et al (2001). For 2005, length at age-4 was above the Statewide and Missouri River reservoir averages.

Table 17. Mean smallmouth bass electrofishing catch-per-unit effort (CPUE; No./h), proportional stock density (PSD), relative stock density of preferred-length (RSD-P) and memorable-length (RSD-M) fish values, for spring, nighttime electrofishing samples at Joe Creek and Big Bend Dam. N is number of electrofishing runs, SE is standard error and Ns is number of stock length fish.

Location	Year	CPUE	N	SE	Ns	PSD	RSD-P	RSD-M
Joe Creek	2001	16.7	6	6.9	56	91	54	7
	2002	12.4	18	2.1	24	88	25	4
	2003	16.2	18	3.7	68	50	21	1
	2004	18.4	18	4.9	81	60	14	0
	2005	11.7	12	3.8	33	67	12	0
Big Bend Dam	2001	42.2	9	17.2	75	39	8	0
	2002	51.1	18	16.3	208	46	11	0
	2003	65.8	18	24.1	211	31	1	0
	2004	65.6	18	16.4	220	25	3	0
	2005	61.1	18	15.4	165	40	10	1

Table 18. Mean back-calculated total lengths (mm) at annulus and length increments for each year class of smallmouth bass collected from Lake Sharpe, South Dakota, by nighttime electrofishing during May and June 2005, as determined from scales. N is the number of fish of each age in the sample.

Year class	Age	N	Annulus					
			1	2	3	4	5	6
2004	1							
2003	2	138	97	168				
2002	3	89	94	181	238			
2001	4	54	104	194	270	313		
2000	5	20	122	207	276	337	359	
1999	6	1	92	229	310	368	389	399
Sample mean		304	100	189	267	338	377	415
Standard error			5	11	13	11	9	16
Length increment			89	78	70	40	38	29
Statewide mean			91	171	242	300	333	
Missouri reservoir mean			88	171	246	299	337	

The mean *Wr* value for stock-to-quality length smallmouth bass in 2005 was 89, the lowest value since 2003 (Table 19). Preferred-to-memorable-length and memorable-to-trophy-length fish had mean *Wr's* of 83 in 2005, values significantly lower than for shorter fish. A trend of decreasing *Wr* with increasing fish length was evident for all years in the 2001-2005 period.

Table 19. Mean relative weight (Wr), by length class, for Lake Sharpe smallmouth bass collected by electrofishing during May and June, 2001-2005. N is the number of fish used in calculations. Values with the same letter code, within a year, are not significantly different from one another at the *P* = 0.05 level.

Year	Sub-stock		Stock-to-quality		Quality-to preferred		Preferred- to memorable		Memorable-to trophy	
	Wr	N	*Wr*	N	*Wr*	N	*Wr*	N	*Wr*	N
2001	98a	11	96a	31	93b	61	87c	110	78d	24
2002	111a	2	102b	26	98c	70	96d	68	86e	7
2003	93a	40	90b	150	91c	45	80d	17	63e	1
2004	93a	35	94a	149	91a	72	81b	15	---	0
2005	97a	79	89b	110	90b	68	83b	18	83ab	2

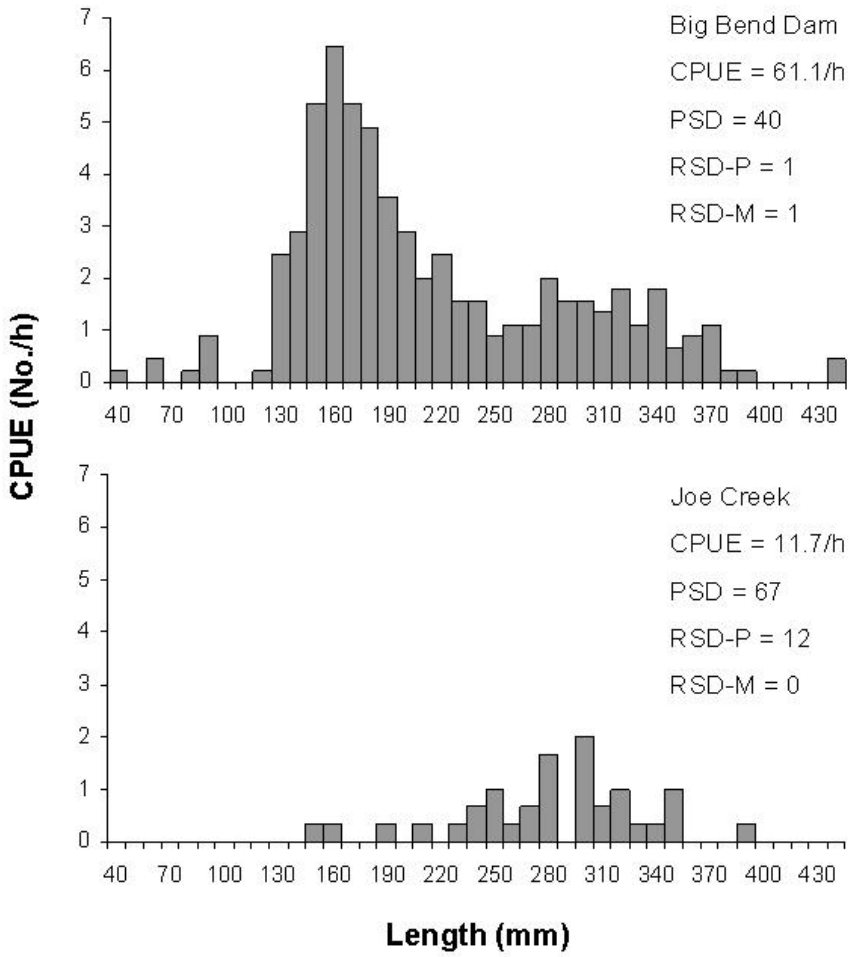


Figure 5. Length frequency of smallmouth bass collected by nighttime, electrofishing, by site, during May and June 2005 on Lake Sharpe, South Dakota.

Population Parameters for Channel Catfish

Channel catfish population indices, such as PSD, RSD-P, RSD-M, and *Wr* exhibited little change during the 1997- 2005 period (Table 20). Growth and age structure data from the 2003 survey indicates channel catfish are long lived but grow slowly in Lake Sharpe (Lott et al 2004b) and this may explain the limited changes in population indices over time. Figure 6 illustrates the CPUE by length for the 2002 to 2005 channel catfish gill net samples. Growth rates have slowed since the closure of Big Bend Dam in 1963. Elrod (1974) documented a gradual reduction in growth rates during the first eight years following impoundment of the reservoir. Due to the slow growth, age structures (pectoral spines) will be collected every four years on Lake Sharpe and 2007 will be the next year of collection.

Table 20. Channel catfish proportional stock density (PSD), relative stock density of preferred and memorable-length (RSD-P and RSD-M) fish, and relative weight (Wr) for 1997-2005, from Lake Sharpe, South Dakota. Mean Wr values for 2002–2005 are for stock- length fish only and N is the number of fish used in calculations.

Year	PSD	RSD-P	RSD-M	*Wr*	N
1997	35	3	0	85	108
1998	37	6	0	83	108
1999	41	4	0	83	139
2000	34	5	0	82	148
2001	27	2	0	82	135
2002	30	1	0	80	171
2003	27	3	0	79	193
2004	25	0	0	85	259
2005	39	1	0	86	146

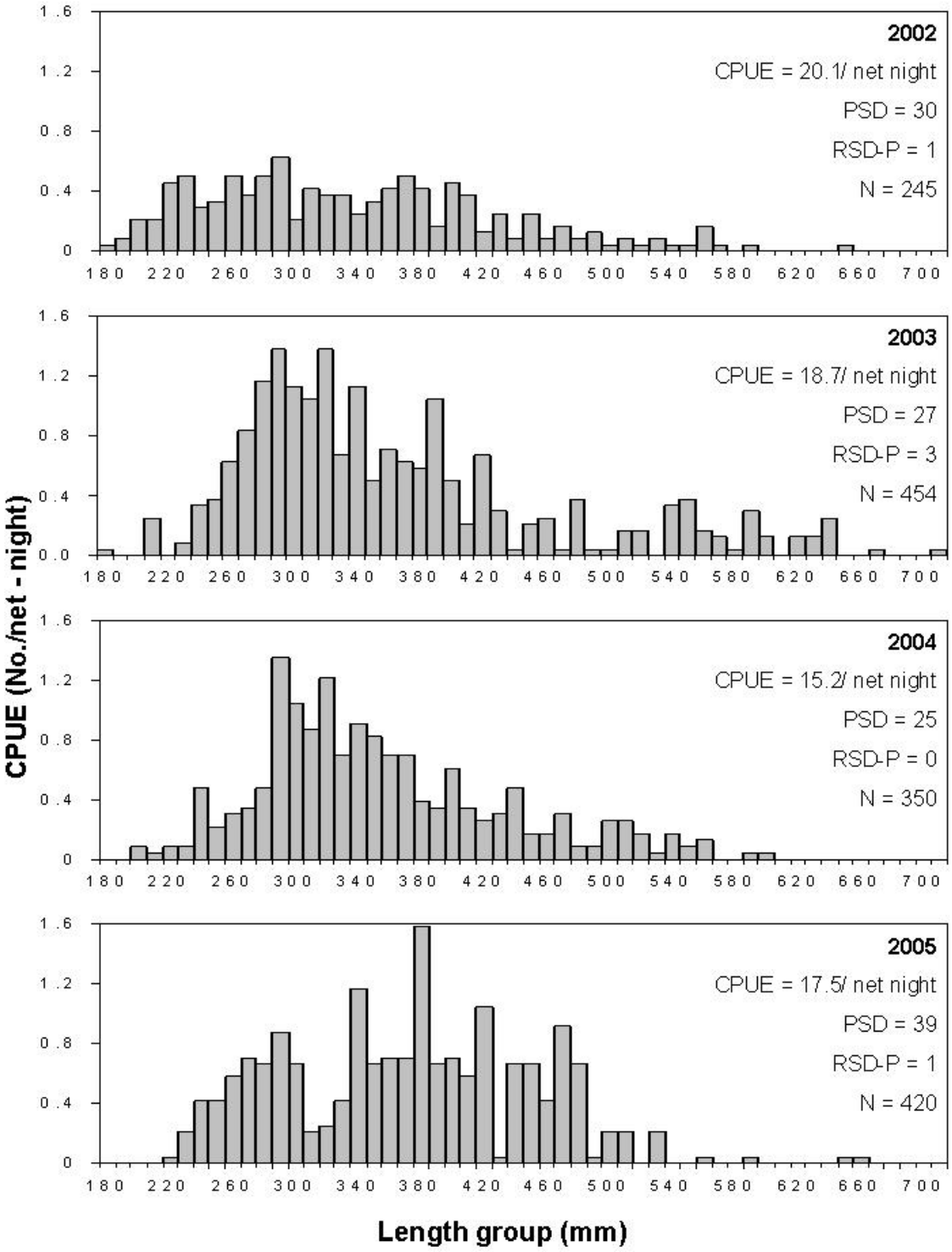


Figure 6. Length frequency, by catch per unit effort, of channel catfish collected during the standard, coolwater gill net survey during August 2002 through 2005, on Lake Sharpe, South Dakota. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

LAKE SHARPE WHITE BASS DIE-OFF

In late June and early July, 2005, a significant white bass die-off occurred in lower Lake Sharpe. The West Bend park manager, on June 28th, reported approximately 100 dead white bass had washed up on the West Bend swimming beach with more floating on the surface. At the same time, U.S. Army Corps of Engineers Park Rangers found dead white bass on the swimming beach at North Shore. At both locations, reports were limited to white bass and no other fish species.

Inspection of North Shore, Counselor and Good Soldier creek area on July 6th revealed a mortality count of 345 white bass, 1 catfish, 1 carp and 1 painted turtle in 2,011 m (1.25 miles) of shoreline. The estimated mortality was 69 dead white bass per 402 m (¼ mile) of shoreline. Surface water temperature was 24.3 ^{o}C (75.7 ^{o}F). Inspection of the West Bend area on July 7th revealed 181 white bass and 2 common carp in 1,609 m (1 mile) of shoreline. The estimated mortality was 45 white bass per ¼ mile of shoreline. Surface water temperature was 25 ^{o}C (77 ^{o}F). The white bass counted were adults between 254-406mm (10-16 inches). Dead white bass condition ranged from bloated to decomposed with only skin and bones remaining. Estimated length of time fish were dead was 1 to 3 weeks. Joe Creek was the farthest upstream site with dead white bass. Shoreline inspections conducted at upstream sites on Lake Sharpe did not document the presence of dead white bass.

Field inspections failed to collect near-dead or impaired white bass to determine cause of mortality. Attempts to identify the cause of the die-off were unsuccessful. Other species counted were in the range of acceptable natural mortality. Similar white bass die-offs have been documented both in-state in Lake Oahe August 2005 (In prep) and Lake Francis Case July 1998 (1999) and out-of-state in numerous Kansas reservoirs (Pollack 1999-Popular Press). The white bass die-off in Lake Oahe (In Prep) and in numerous Kansas and Oklahoma reservoirs (Pollack 1999-Popular Press) was attributed to outbreaks of *Flavobacterium columnaris* otherwise known as columnaris disease. Columnaris bacteria is always present in the water and increases or decreases in density for a variety of reasons, including water temperature, turbidity, decomposing nutrients, sunlight and lack of oxygen. Most species of fish are susceptible to columnaris following environmental stress and elevated water temperatures > 20°C and schooling species of fish, like white bass, are especially susceptible (Wakabayashi 1991). Media accounts have related increased susceptibility to columnaris due to white bass post-spawning stress. In addition, the high angler harvest of adult white bass on Lake Sharpe in 2005 was an indication that the reservoir had a high abundance of adult white bass.

Extrapolating the average number of dead white bass per ¼ mile (402 m) of shoreline over the shoreline length in lower Lake Sharpe yielded an estimate of 25,139 fish. It is important to note estimates of losses based on countable dead fish will be conservative. Very seldom do counts represent more than a modest fraction of the actual fish killed: the counts are based only on fish actually seen once during a dynamic, ongoing process (Southwick and Loftus 2003). The Lake Sharpe fish kill counts did not take into account white bass mortalities that were floating offshore on the surface, sunk, decomposed, covered with shoreline materials, carried off by animals or overlooked (human error). In addition, the length of time fish were dead (i.e., one to three weeks) exacerbated many of the factors listed above. A more realistic die-off estimate of Lake Sharpe white bass was likely 75,000-100,000 fish.

2005 TROUT STOCKING IN OAHE SUB IMPOUNDMENT

The Oahe Dam fish rearing sub impoundment will be referred to in this document as the Oahe Sub impoundment (OSI). The OSI was constructed in 1984 through a program from the United States Army Corps of Engineers as part of the recreation and fishery development plan. The OSI is located in a backwater area at the base of Oahe Dam. The water level in the OSI fluctuates in association to water level changes in the adjacent tailrace. Relief wells capture 10.5^{o}C constant temperature water that seeps through Oahe Dam and into the OSI. A series of 36 wells supply the inflow to the OSI and flow rates of these wells are dependent on the water elevation on Lake Oahe. In 2005 the Lake Oahe elevation was approximately 1575 ft msl and 18 wells were flowing into the OSI at a rate of 1,593 L/min (421gallons/min). At normal operating pool the flow rate would be higher. The original objectives of the OSI were to provide fish rearing habitat adjacent to Oahe dam tailwaters for the rearing of walleye, northern pike, smallmouth bass and crappie fingerlings and to provide holding waters for salmonids such as steelhead, brown trout, cutthroat trout, or Chinook salmon for smoltification, imprint and release to Oahe Dam tailwaters. The OSI was also built to provide aquatic resource education and research capabilities and to provide public fishing during off-season fish rearing use. Original development plans included using the OSI for a put, grow and take trout fishery, when not being used as a rearing impoundment. Limited, if any, fish production or imprinting was completed with this impoundment and its primary use has been as a fishing pond.

On March 30, 2005 the OSI, was stocked with 1,000 catchable size (6.6 fish/kg) McConaughy strain rainbow trout. Satellite imagery estimated the OSI covered 10.2 ha of surface area. In the Black Hills stocking rates for trout in large lakes or impoundments were 10-20 fish/ha. Stocking estimates for the OSI were 16 fish/ha and 6 kg/ha.

The public was informed of the trout stocking in the form of news releases in the local newspaper and interviews on the local radio station. No formal creel was conducted on the OSI during 2005, however, ongoing creel surveys were conducted on Lake Sharpe adjacent to this water. Few anglers were observed fishing for trout on the OSI.

Water temperatures were monitored from April 15 to October 21st at two locations using temperature data loggers . The first location was approximately 30 m downstream of the east relief wells (i.e., well numbers 35 and 36) and the other location was at the water control structure on the south end of the impoundment (Figure 7). Water temperatures from June 15th to September 15th exceeded 21°C and a large part of the time exceeded 25°C. According to Bell (1973) rainbow trout optimum preferred temperature ranges from 12.2 to 18.9^{o}C. However, Scott and Crossman (1973) noted that rainbow trout are most successful with temperatures of 21°C, or slightly below. As long as there is cooler, well-oxygenated water in areas trout can retreat to, they can thrive in lakes with surface waters that warm well over 21°C for long periods in the summer. In the OSI, the maximum water temperature of 30°C was achieved on three different days in July at the OSI outlet (Figure 8). The upper lethal limit stated for rainbow trout is listed as 29.4^{o}C (Bell 1973).

Modified-fyke nets were set in OSI on Oct 31st to November 2nd to determine presence or absence of rainbow trout. A total of eight net- nights of effort failed to capture a single rainbow trout. Boat electrofishing was planned for the trout evaluation but was not completed due to limited boat access.

The combination of upper lethal water temperatures in the summer and lack of rainbow trout captured in the fall is a good indication no rainbow trout survived through the summer and fall.

Recommendations:

1) Do not attempt a spring put-and-take trout stocking again due to lethal summer water temperatures and at low cold water inflows (i.e., low water elevations on Lake Oahe).
2) Investigate a potential fall catchable trout stocking in an attempt to create a put, grow and take ice and spring fishery with the understanding the trout will not likely survive through the summer period (i.e., especially during low coldwater inflows due to low Lake Oahe elevations). Investigate using the outflow control structure to release trout into Oahe Dam tailrace before the summer period.

3) Continue to operate OSI as a bass and panfish fishery.

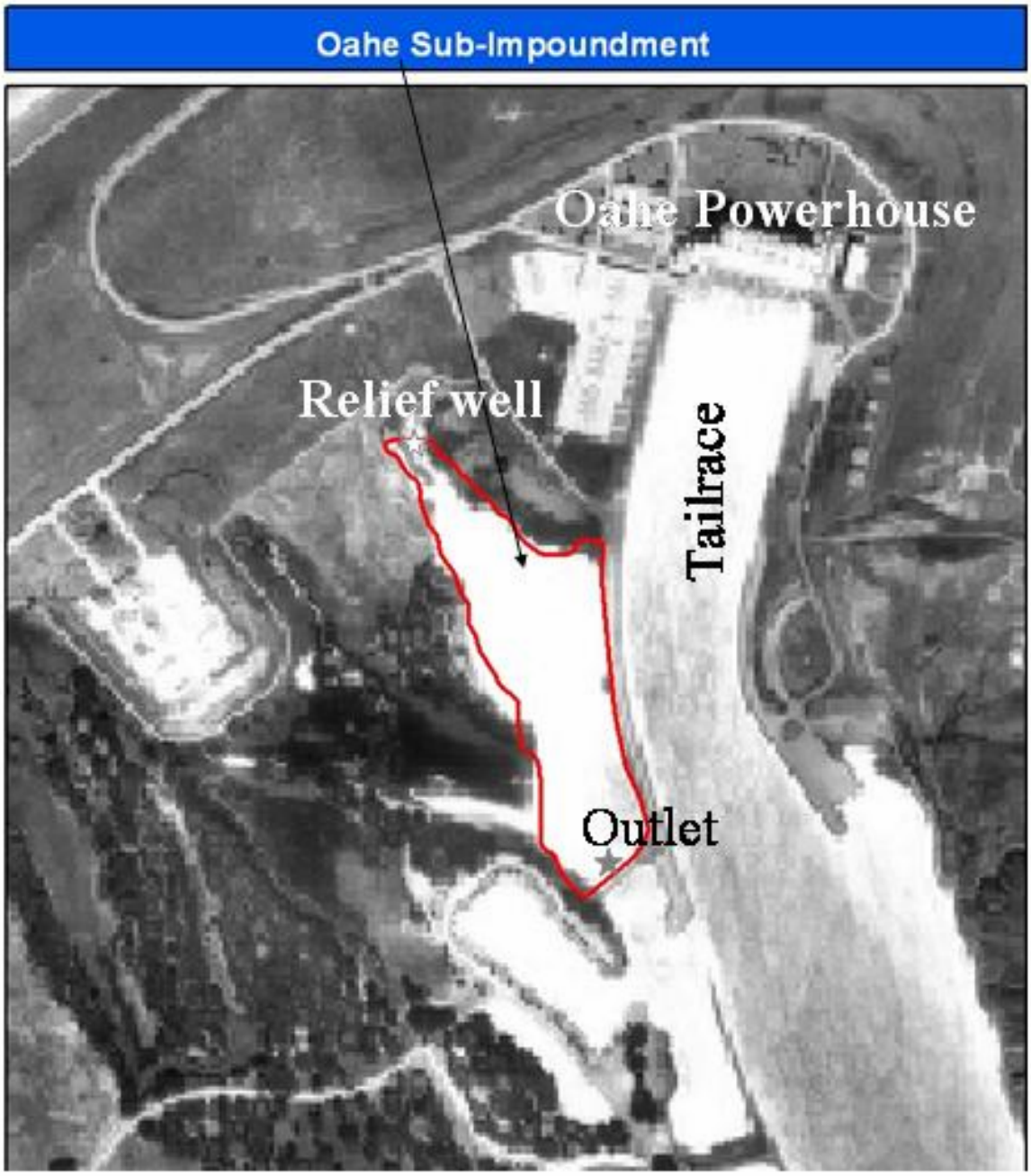


Figure 7. Satellite map of Oahe subimpoundment adjacent to Oahe tailrace on Lake Sharpe. Temperature loggers were located at relief well and outlet indicated with stars on map.

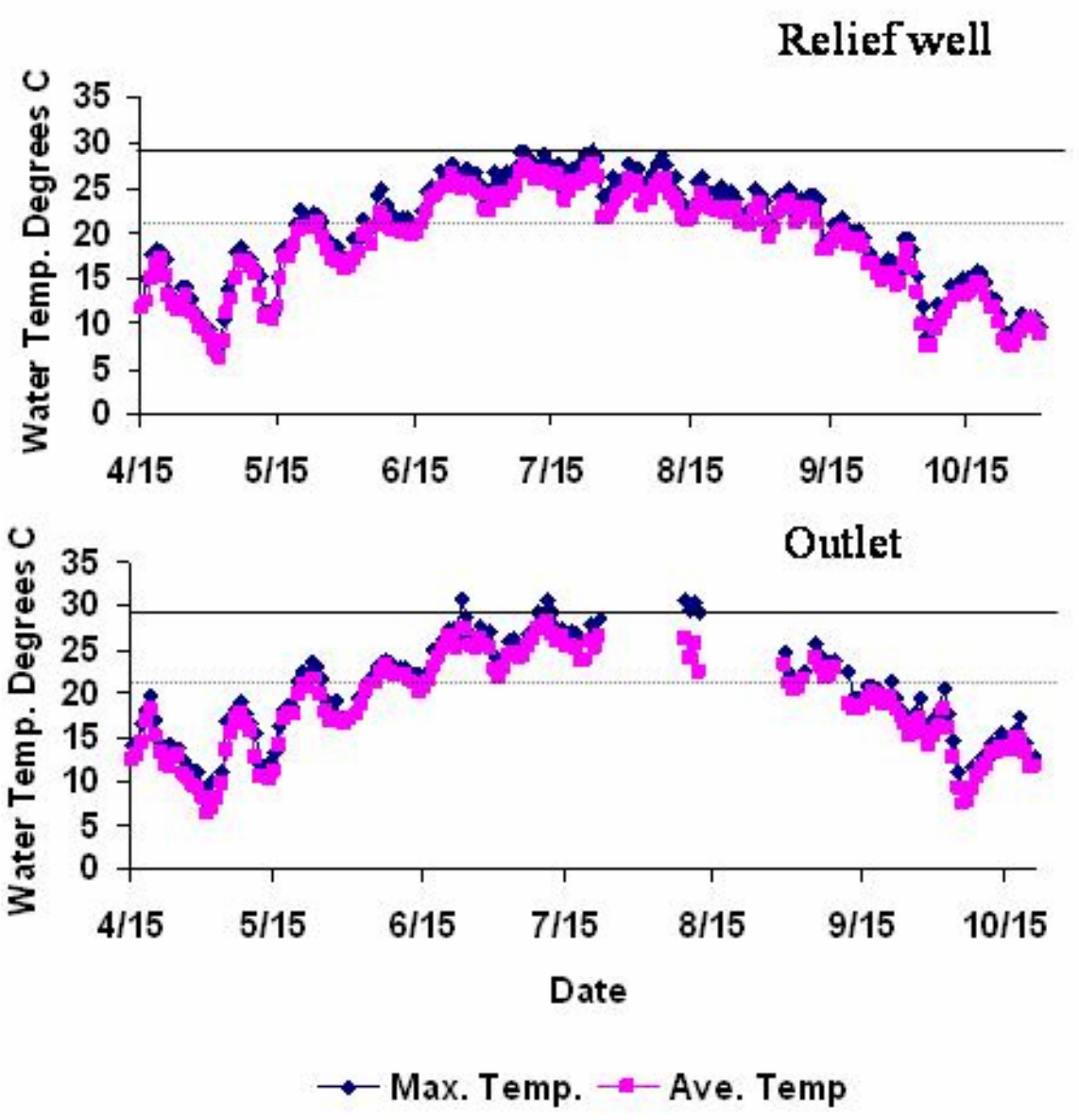


Figure 8. Average and maximum daily water temperatures for the Oahe subimpoundment adjacent to Oahe tailrace, April through October, 2005. The dotted line indicates water temperatures rainbow trout can tolerate and the solid line indicates upper lethal limit.

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

Angler Use

A total of 1,141 angling parties were interviewed during the April-September 2005 daytime angler use and harvest survey. Estimated fishing pressure for the April-September 2005 daylight period, at 271,331 angler-h, was similar to estimates for 2001 and 2004 and lower than estimates for 2002 and 2003 (Table 21). Estimated angler days spent on Lake Sharpe during the 2005 survey period was 75,161 days. The Lake Sharpe Strategic plan goal of 100,000 angler days during the April-September daytime period was last met in 2003, when an estimated 99,627 days of angling effort occurred (Table 21).

Table 21 Angler use and harvest estimates for surveys conducted on Lake Sharpe, South Dakota. All surveys were conducted during the April-September daylight period, except where noted.

Year	Fishing pressure (h)	Angler trips	Estimated fish harvest	Estimated walleye harvest	Reference
1973-1974*	208,800	46,400	76,813	62,479	Schmidt 1975)
1984	241,986	52,605	87,020	64,784	Riis (1986)
1985	274,376	62,358	123,942	66,584	Riis (1986)
1991	303,381	70,554	143,307	93,027	Fielder et al. (1992)
1992	402,543	100,636	219,152	157,220	Stone et al. (1994)
1993	291,970	60,827	102,833	83,133	Stone et al. (1994)
1994	347,125	91,752	152,981	130,009	Riis & Johnson (1995)
1995	356,391	122,893	166,949	140,943	Riis et al. (1996)
1996	477,220	101,536	170,568	142,506	Riis et al. (1997)
1997	442,827	100,097	191,079	159,274	Johnson et al. (1998)
1998	502,631	111,696	252,496	207,144	Johnson and Lott (1999)
1999	386,315	84,784	186,720	155,724	Johnson and Lott 2000
2000	325,532	71,893	144,730	104,076	Johnson and Lott 2001
2001	300,078	77,141	126,382	95,044	Johnson et al. 2002
2002	385,357	89,827	210,781	144,065	Lott et al. 2003
2003	397,220	99,627	157,150	111,938	Lott et al. 2004b
2004	309,663	84,377	124,267	62,585	Lott et al. 2006b
2005	271,331	75,161	133,569	57,866	This study

*June 1973 through May 1974

The peak in fishing pressure for Lake Sharpe typically occurs in May or June (Johnson and Lott 2001; Johnson et al. 2002; Lott et al. 2003; Lott et al. 2006b). In 2005, fishing pressure followed a typical pattern, peaking during the May-June period, but estimated pressure in August was also high and similar to June (Table 22). Peaks in fishing pressure differed among reservoir zones in 2005, peaking in the upper zone during the May-June period, in the middle zone during May, and in the lower zone during the June-July period (Table 22).

Table 22 Estimated fishing pressure (angler hours), by month and zone, with 95% confidence intervals (CI), for the April-September 2005 daylight period on Lake Sharpe, South Dakota.

Zone	Month						
	April	May	June	July	August	Sept.	Total
Lower	5,954	17,727	17,788	23,825	24,717	12,966	102,978
95% CI	3,908	10,950	7,260	10,228	12,867	6,639	22,408
Middle	2,710	7,988	1,203	2,586	2,298	3,388	20,174
95% CI	1,383	5,039	713	748	1,029	2,051	5,800
Upper	20,741	39,685	36,024	11,106	26,964	13,659	148,179
95% CI	7,740	14,531	33,268	3,842	11,652	3,937	39,292
Total	29,406	65,400	55,016	37,517	53,979	30,013	271,331
95% CI	8,780	18,880	34,059	10,951	17,389	7,987	45,603

Distribution of angling effort among reservoir zones changes greatly among years, though the majority of angling effort occurs in the upper and lower zones of the reservoir (Table 23). Approximately 55% of the estimated angling effort during the 2005 survey period occurred in the upper zone of Lake Sharpe, while 7 and 38% of the estimated effort occurred in the middle and lower zones of the reservoir, respectively. However, the bus route survey design used since 2003 is an access-based survey, where fishing pressure is assigned based on access location used, not where fishing actually occurred. Some of the angler hours assigned to access areas in the upper zone may have been spent fishing in the middle zone of the reservoir. Fishing pressure, in terms of hours per hectare (h/ha), for the entire reservoir, ranged from 11.5 to 21.3 h/ha during the 1994-2005 period, with the lowest estimated pressure occurring in 2005 (Table 23). Fishing pressure estimates exceeding 100 or 200 h/ha for upper Lake Sharpe are a result of low surface area for this portion of the reservoir and a portion of the angler use attributed to the upper zone actually occurring in the middle zone, as previously mentioned.

Eighty-four percent of estimated angler hours for the 2005 survey period were by boat angling (Table 24). While shore angling certainly contributes less to the total number of angler hours than boat fishing, shore angler hours may have been underrepresented before the bus route creel survey design (Soupir and Brown 2002) was adopted in 2003. The survey design used for the Lake Sharpe angler use and harvest survey, prior to 2003, used aerial counts of shore anglers and boats to estimate pressure (Schmidt 1975) and not all shore anglers may have been visible from the air.

Table 23 Estimated fishing pressure, expressed as angler-hours (h) and hour per hectare (h/ha), by reservoir zone, for standard creel surveys conducted during the April-September daylight period, on Lake Sharpe, South Dakota, from 1994 through 2005.

Year	Zone							
	Lower		Middle		Upper		Total	
	h	h/ha	h	h/ha	h	h/ha	h	h/ha
1994	171,126	9.3	68,180	16.1	107,820	117.4	347,125	14.7
1995	205,453	11.2	17,526	4.1	133,412	145.3	356,391	15.1
1996	226,054	12.3	34,292	8.1	216,874	236.2	477,220	20.2
1997	213,913	11.6	30,616	7.2	198,298	216.0	442,827	18.7
1998	255,865	13.9	47,887	11.3	198,879	216.6	502,631	21.3
1999	216,972	11.8	38,410	9.1	130,933	142.6	386,315	16.3
2000	187,469	10.2	51,778	12.2	86,285	94.0	325,532	13.8
2001	179,082	9.8	49,885	11.8	71,111	77.4	300,078	12.7
2002	180,568	9.8	91,401	21.6	113,388	123.5	385,357	16.3
2003	211,403	11.5	36,021	8.5	149,796	163.1	397,220	16.8
2004	124,860	6.8	34,773	8.2	150,030	163.4	309,663	13.1
2005	102,978	5.6	20,174	4.7	148,179	161.4	271,331	11.5

Table 24 Estimated fishing pressure, expressed as angler-hours (h) and hours per hectare (h/ha), by type of fishing, with 95% confidence intervals (CI), for the standard April-September daylight survey period, on Lake Sharpe, South Dakota, from 2001 through 2005.

Type of fishing	Year				
	2001	2002	2003	2004	2005
Boat (h)	266,857	353,248	345,135	252,698	228,420
95% CI	62,106	52,515	47,681	32,900	45,155
H/ha	11.3	14.7	14.6	10.6	9.7
Shore (h)	33,221	32,109	52,084	57,966	42,911
95% CI	6,822	6,653	11,783	11,329	9,131
H/ha	1.4	1.3	2.2	2.4	1.8
Combined (h)	300,078	385,357	397,220	309,663	271,331
95% CI	63,810	53,444	49,252	34,241	45,603
h/ha	12.7	16.0	16.8	13.1	11.5

Catch, Harvest and Release Estimates

An estimated 133,569 fish were harvested from Lake Sharpe during the April-September daylight period (Table 25). Estimated harvest of walleye during the 2005 survey period was 57,866 fish, similar to the 2004 estimate of 62,585 fish, and well below the Lake Sharpe strategic plan objective of 100,000 fish. Estimated white bass harvest during the 2005 survey period, at 59,784 fish, was 84% higher than the 2004 estimate of 32,410 fish, but will likely decrease in 2006 because of the die-off experienced during the summer of 2005.

Table 25. Estimated number of fish harvested, by species and month, with 95% confidence intervals (CI), for the April-September 2005 daylight period on Lake Sharpe, South Dakota.

Species	Month						
	April	May	June	July	Aug.	Sept.	Total
Walleye	4,152	7,399	5,731	9,812	22,124	8,648	57,866
95% CI	1,954	3,471	3,292	4,102	9,197	2,392	11,569
Sauger	682	397	52	36	99	95	1,361
95% CI	625	412	88	84	166	83	780
Channel Catfish	619	1,009	1,154	4,630	1,706	238	9,356
95% CI	404	985	1,010	4,038	1,268	286	4,489
White Bass	2,049	39,812	17,622	107	89	105	59,784
95% CI	503	16,093	22,586	87	109	104	27,738
Smallmouth bass	27	655	605	225	201	743	2,456
95% CI	0	531	572	195	206	574	1,009
Rainbow trout	996	0	49	0	0	0	1,045
95% CI	931	0	95	0	0	0	936
Yellow perch	0	25	149	116	0	91	381
95% CI	0	56	278	116	0	109	325
Other*	72	844	60	153	76	120	1320
Total	8,597	50,141	25,422	15,079	24,295	10,036	133,569
95% CI	2,774	20,893	20,716	6,676	9,151	2,658	31,760

*Other includes northern pike, goldeye, common carp, bluegill, largemouth bass, white crappie, black crappie, and freshwater drum.

Though not significantly different based on 95% confidence intervals, estimated harvest of channel catfish, rainbow trout, and smallmouth bass decreased from 2004 to 2005. Walleye harvest was highest in August, when the 381-mm minimum length limit was not in effect and substantial angling effort occurred in both upper and lower zones of Lake Sharpe (Table 22). White bass harvest was highest in May while rainbow trout harvest was highest in April, and channel catfish harvest was highest in July (Table 25).

An estimated 277,929 fish of all species were caught and released during the April-September 2005 daytime period on Lake Sharpe (Table 26). This value is similar to the 2004 estimate of 275,612 fish caught during the standard survey period. Unlike most years, estimated number of walleye released peaked during August, when the 381-mm minimum length limit was not in effect (Table 26). Estimated number of released fish typically peaks in May and June when the 381-mm minimum length limit is in effect and fishing pressure peaks (Lott et al. 2006b, Table 26).

Table 26. Estimated number of fish released, by species and month, for the April-September 2005 daylight period, on Lake Sharpe, South Dakota. October data was only collected for upper and middle Lake Sharpe, in 2005 and is not included in totals.

Species	Month						
	April	May	June	July	Aug.	Sept.	Total
Walleye	3,582	7,807	7,494	5,173	11,763	7,368	43,187
Sauger	793	365	45	0	0	64	1,267
Channel Catfish	210	1,002	1,162	3,415	3,686	1,012	10,487
White Bass	1,555	29,571	15,573	326	1,294	391	48,710
Smallmouth bass	865	6,436	3,979	2,584	5,152	7,922	26,938
Rainbow trout	2,052	172	0	0	0	0	2,225
Yellow perch	129	50	149	552	1,804	1,241	3,926
Other*	1,038	2,105	503	628	2,550	797	7,620
Total	10,224	47,508	28,905	12,678	26,249	18,795	144,360

*Other includes shovelnose sturgeon, smallmouth buffalo, black bullhead, northern pike, goldeye, common carp, bluegill, largemouth bass, white crappie, black crappie, and freshwater drum.

Examination of Table 25, Table 26, and Figure 9 provides a complete picture of catch and harvest of sport fish species for the April-September 2005 survey period. Estimated catch of white bass in 2005, at 108,494 fish, was similar to walleye, unlike previous years when walleye catch was higher than for all other species (Figure 9). Estimated angler catch of walleye during 2005 was 101,053 fish, a value substantially lower than the 2004 estimate of 167,352 fish (Lott et al. 2006b). Walleye was followed by, smallmouth bass, channel catfish, and rainbow trout, in decreasing order of estimated catch (Figure 9).

Besides the high catch and harvest of white bass in 2005, the most notable change in catch of a species was for rainbow trout. Estimated catch of rainbow trout decreased from 12,732 fish in 2004 to 3,270 fish in 2005. Approximately 43% of walleye caught during 2005 were released while percentages of fish released for channel catfish, white bass, smallmouth bass, and rainbow trout were 53%, 45%, 92%, and 68%, respectively. The high percentage of smallmouth bass released was due, in part, to the 306-457-mm protected slot length limit that was implemented in 2003, while the low percentage of walleye released is indicative of low walleye production during the 2001-2004 period (Table 14).

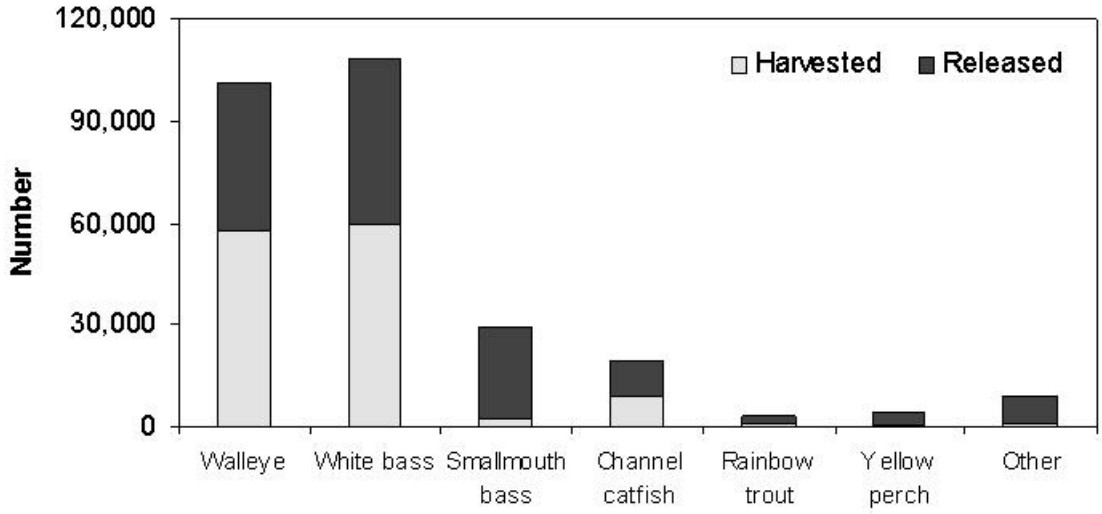


Figure 9. Estimated number of fish, harvested, and released, for selected species, for the April-September 2005 daylight period, on Lake Sharpe, South Dakota. Other includes shovelnose sturgeon, smallmouth buffalo, black bullhead, northern pike, goldeye, common carp, bluegill, largemouth bass, white crappie, black crappie, and freshwater drum.

Estimated walleye harvest during the 2005 April-September standard survey period was highest in lower Lake Sharpe at 32,530 fish (Table 27). White bass and rainbow trout harvest were highest in upper Lake Sharpe, with 77% of the white bass harvest and 97% of the rainbow trout harvest occurring in that zone. Smallmouth bass harvest was highest in lower Lake Sharpe, with over 82% of the estimated harvest for the total reservoir coming from the lower zone in 2005.

Table 27. Estimated number of fish harvested, for selected species, by zone, with 95% confidence intervals (CI), for the April-September 2005 daylight period, on Lake Sharpe, South Dakota.

Species	Zone			
	Upper	Middle	Lower	Total
Walleye	23,172	2,164	32,530	57,866
95% CI	7,271	1,119	8,928	11,569
Sauger	1,175	0	186	1,361
95% CI	766	--	149	780
Channel Catfish	4,302	1,402	3,652	9,356
95% CI	2,556	920	3,573	4,489
White Bass	45,765	12,806	1,212	59,784
95% CI	25,790	10,162	997	27,738
Smallmouth bass	438	0	2,018	2,456
95% CI	366	--	940	1,009
Rainbow trout	1,013	32	0	1,045
95% CI	934	59	--	936
Yellow perch	240	0	141	381
95% CI	299	--	128	325
Total	76,628	16,956	39,985	133,569
95% CI	28,048	10,857	10,206	31,760

Estimated numbers of walleye caught, harvested, and released during the standard April-September daylight survey period were the lowest in 2005 of any year in the 1994-2005 period (Table 28). Percentage of walleye caught that were harvested increased from 37% in 2004 to 57% in 2005. The majority of fish ≥ 381-mm in length in 2005 were from the 2000 and 2001 year classes, while the majority of fish released were likely from the 2003 year class (Table 12 and Figure 2). ≤ 381-mm in length. The percentage of walleye kept by anglers during the standard survey period generally increases as PSD increases (Table 8). The Lake Sharpe management objective of 100,000 walleye harvested during the April-September daytime period each year was achieved during 9 of the 12 years in the 1994-2005 period (Table 28).

Table 28. Estimated number of walleye caught, harvested, and released during the April-September daylight period for Lake Sharpe, South Dakota 1994 through 2005.

Year	Caught	Harvested	Released	Percent Harvested
1994	248,777	130,009	118,718	52
1995	237,615	140,943	96,656	59
1996	499,686	142,506	357,180	29
1997	365,493	159,274	206,219	44
1998	468,578	207,144	261,434	44
1999	348,087	155,724	192,363	45
2000	339,022	104,076	234,946	31
2001	347,135	95,044	252,091	27
2002	379,952	144,064	235,887	38
2003	542,965	111,937	433,786	21
2004	167,353	62,585	104,767	37
2005	101,053	57,866	43,187	57

Length frequency distributions of walleyes harvested each month during the April-September 2005 daylight period illustrate standard trends for Lake Sharpe (Figure 10). Between 91 and 94% of the walleyes harvested during the months that the 381-mm minimum length limit was in effect were between 381 and 457-mm in length (15 and 18 inches). The percentage of walleye kept that were <381 mm during all months when the 381-mm minimum length limit was in effect was ≤ 4%. During July and August, when no minimum length limit was in effect, 51% and 48% of the walleyes harvested were between 381 and 457-mm in length and 48% and 51% were less than 381-mm, respectively. The percentage of walleyes ≥ 457-mm in length in the angler harvest in 2005 ranged from 1% in August to 8% in April. Approximately 4% of walleye harvested during the April-September survey period were 457-mm or longer, and <1% of the harvest exceeded 508 mm (20 inches) in length (Figure 10).

Length frequency histograms for smallmouth bass measured in the angler harvest in 2005, illustrate the effects of the 305-457-mm protected slot length limit placed in effect in 2003 (Figure 11). For the April-September 2005 daylight survey period, approximately 91% of the smallmouth bass harvested were <305-mm in length and 2% were ≥457-mm in length. Approximately 7% of the smallmouth bass measured during angler interviews were within the protected slot length limit (Figure 11).

Hourly Catch, Harvest, and Release Rates

Estimated hourly catch and release rates for all species combined for the April-September 2005 daylight period, at 1.02 fish/h and 0.53 fish/h (Table 29), respectively were lower than values for the same period in 2003 and 2004 (Lott et. al 2004, Lott et al. 2006b). However, estimated mean harvest rate, for all species combined in 2005 was 0.49 fish/angler-h, similar to values for 2003 and 2004 which were 0.39 and 0.40 fish/angler-h, respectively.

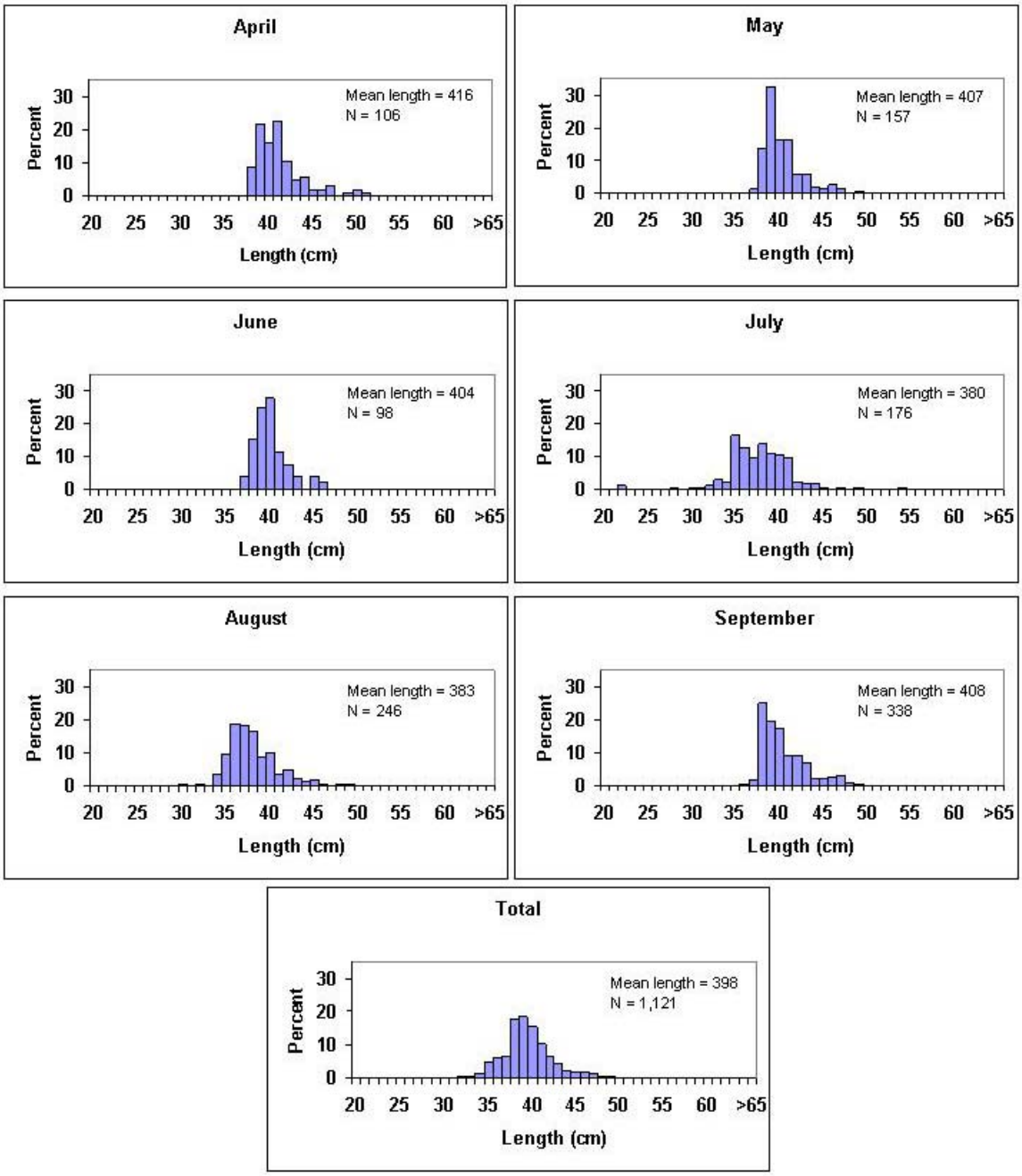


Figure 10. Length frequency distribution of walleye harvested by anglers fishing Lake Sharpe, South Dakota, during the April-September 2005 daylight period.

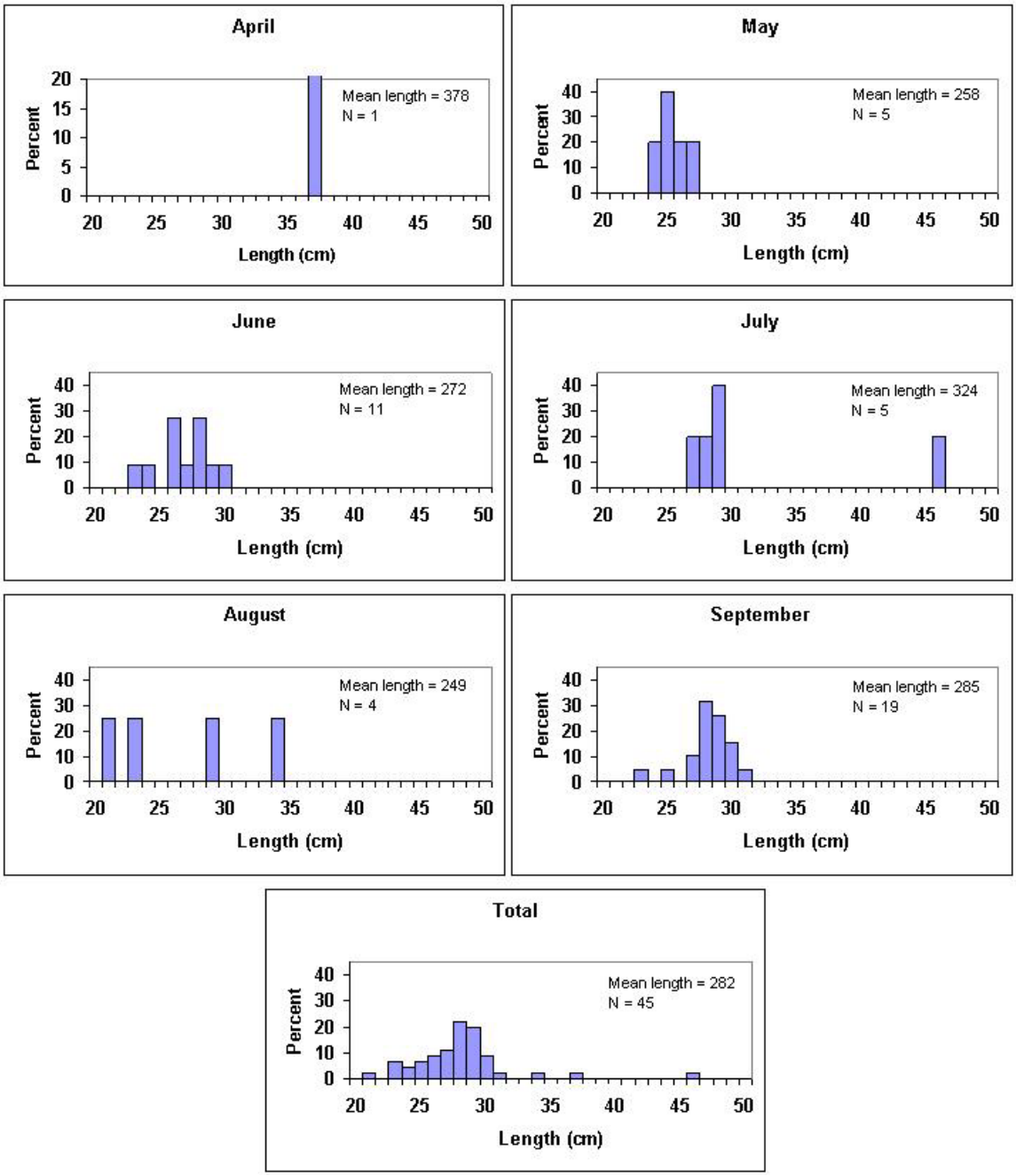


Figure 11. Length frequency distribution of smallmouth bass harvested by anglers fishing Lake Sharpe, South Dakota, during the April-September 2005 daylight period.

For anglers specifically fishing for a certain species, hourly catch, harvest and release rates were substantially higher (Table 30) than those for all anglers combined (Table 29). Anglers specifically fishing for walleyes had a mean hourly catch rate of 0.94 fish/angler-h for the April-September daylight period (Table 30), while the mean catch rate of walleyes by all anglers was 0.37 fish/angler-h (Table 29). Anglers specifically fishing for smallmouth bass, white bass, and channel catfish had mean hourly catch rates of 2.70, 5.82, and 4.53 fish/angler-h, respectively (Table 30).

Table 29. Estimated hourly catch, harvest, and release rates, by species, for all anglers interviewed on Lake Sharpe, South Dakota, during the April-September 2005 daylight survey period. Trace (T) indicates values >0.0 but <0.05.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	0.37	0.21	0.16
Sauger	T	T	T
White bass	0.40	0.22	0.18
Smallmouth Bass	0.11	T	0.10
Channel catfish	0.07	T	T
Rainbow trout	T	T	T
Yellow perch	T	T	T
Other*	0.07	0.06	0.09
Total	1.02	0.49	0.53

*Other includes shovelnose sturgeon, smallmouth buffalo, black bullhead, northern pike, goldeye, common carp, bluegill, largemouth bass, white crappie, black crappie, and freshwater drum.

Table 30. Estimated hourly catch, harvest, and release rates, by species, for anglers specifically fishing for the species listed, on Lake Sharpe, South Dakota during for the April-September 2005 daylight period. Trace (T) indicates values >0.0 but <0.05.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	0.94	0.53	0.41
White bass	5.82	4.53	1.29
Smallmouth Bass	2.70	0.16	2.54
Channel catfish	4.53	3.06	1.47
Rainbow trout	0.70	0.18	0.52

Mean hourly catch rates for walleye, smallmouth bass, white bass, channel catfish, and all fish combined, for the April-September standard survey period, for 1993 through 2005, are presented in Table 31. Mean walleye catch per angler-hour in 2005, at 0.37, was the lowest estimated for surveys conducted from 1993 through 2005, while the 2003 mean walleye catch rate was the highest of the 1993-2005 period (Table 31). The high hourly catch rate for walleye in 2003 was likely related to a high abundance of age-3 fish (2000 year class; Table 12) and low gizzard shad production (Table 5). The low catch rate in 2005 is likely related to below average walleye abundance (Figure 3), and an increase in mean age of fish in the walleye population (Table 12). Even during 2005, the hourly catch rate of walleye in Lake Sharpe has been above 0.3 fish/angler-h, the level indicative of excellent walleye fisheries (Colby et al. 1979).

There was a general trend of increasing catch rates for smallmouth bass, channel catfish, and white bass during the 1993-2004 period (Table 31). However, only white bass hourly catch rate increased from 2004 to 2005.

Table 31. Estimated hourly catch rates for walleye, smallmouth bass, white bass, channel catfish, and all fish combined, by year, for all anglers, for the April-September daylight survey period on Lake Sharpe, South Dakota, 1993 through 2005.

Year	Catch rate (fish/angler-h)				
	Walleye	Smallmouth bass	White Bass	Channel catfish	All fish
1993	0.72	0.01	0.04	0.01	0.84
1994	0.72	0.02	0.03	0.01	0.84
1995	0.67	0.03	0.02	0.02	0.83
1996	1.05	0.05	0.02	0.01	1.18
1997	0.83	0.05	0.06	0.02	1.00
1998	0.93	0.08	0.09	0.01	1.18
1999	0.90	0.13	0.06	0.03	1.20
2000	1.04	0.17	0.09	0.03	1.41
2001	1.16	0.15	0.07	0.06	1.51
2002	0.99	0.14	0.26	0.06	1.52
2003	1.37	0.20	0.26	0.07	2.01
2004	0.54	0.19	0.34	0.10	1.29
2005	0.37	0.11	0.40	0.07	1.02

Hourly catch rates for walleye peaked in August in 2005, while catch rates for all fish combined peaked in May (Table 32), likely because of high white bass catch rates that month. The release rate for walleye was highest in August and September but the rationale for this is unknown. August is a month when the 381-mm minimum length limit is not in place, while the limit is in place in September.

The percentage of angling parties catching zero walleye during a trip was 56 in 2005, a value similar to the 2004 value of 53% (Table 33). The lower hourly catch rate of walleye by anglers fishing Lake Sharpe in 2005 (Table 32) likely contributed to the high percentage of angling parties catching and harvesting zero walleye per trip and the low percentage of angling parties harvesting a three-fish limit per angler (Table 33). Only 10% of angling parties fishing Lake Sharpe in 2005 harvested three walleye per angler while in 4 only 8% of parties harvested three walleye per angler.

Table 32. Estimated hourly catch, harvest, and release rates, (fish/angler-h), for walleye and all species combined, by month, for the April-September 2005 daylight survey period, on Lake Sharpe, South Dakota.

Month	Walleye			All fish combined		
	Catch rate	Harvest rate	Release rate	Catch rate	Harvest rate	Release rate
April	0.26	0.14	0.12	0.64	0.29	0.35
May	0.23	0.11	0.12	1.49	0.77	0.72
June	0.24	0.10	0.14	0.99	0.46	0.53
July	0.40	0.26	0.14	0.74	0.40	0.34
August	0.63	0.41	0.22	0.94	0.45	0.49
September	0.53	0.29	0.24	0.96	0.33	0.63
Total	0.37	0.21	0.16	1.02	0.49	0.53

As part of angler interviews conducted in 2004 and 2005, anglers were asked “Given the current walleye/sauger length regulations for Lake Sharpe, how many additional walleye/sauger did you release today that you otherwise would have harvested had the daily limit been four?” This question was asked in an attempt to estimate the minimal harvest reduction resulting from the decrease in the daily limit from four fish in 2003 to three fish for 2004 and 2005. The estimated harvest reduction generated from this question is considered a minimal estimate because many anglers stop fishing once they have kept their daily limit. Had the daily limit been four fish in 2004, angling parties who harvested three fish per angler may have fished longer and kept more fish of legal size. Not surprisingly, the highest monthly harvest reduction estimate was generated for August (Table 34), the month with the highest estimated catch of walleye. The 381-mm minimum length limit is also not in effect during August, allowing harvest of caught fish to be maximized (Table 24). For the entire April-September angler use and harvest survey period of 2005, it was estimated that harvest was reduced by 1,042 walleye, or 2%, by having a three-fish daily limit instead of a four-fish daily limit.

Table 33. Percentage of angling parties catching and harvesting the specified number of walleye and sauger (combined) per person on an angling trip by reservoir zone, for Lake Sharpe, South Dakota, during the April-September 2004 and 2005 daylight survey periods.

Number /trip	Catch per trip							
	2004				2005			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	29	79	61	53	27	80	66	56
0-1	16	9	7	10	16	4	7	10
1-2	12	3	10	10	15	6	9	10
2-3	11	1	5	6	10	2	6	7
3-4	9	4	5	6	12	3	6	7
4-5	6	2	3	4	6	4	3	4
5-6	2	1	3	2	4	1	0	2
6-7	5	0	1	2	4	0	2	2
7-8	2	0	1	1	1	0	0	0
8-9	2	0	1	1	1	0	0	1
9-10	1	0	1	1	1	0	0	0
≥10	6	0	2	3	3	1	0	1

Number /trip	Harvest per trip							
	2004				2005			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	53	84	72	67	38	84	76	66
0-1	20	5	5	10	15	3	6	8
1-2	13	5	9	10	17	3	8	10
2-3	5	3	5	5	11	4	5	7
≥3	10	3	9	8	20	6	5	10

Table 34. Walleye harvest reduction estimates resulting from the decrease in the daily walleye limit to three fish for 2005, by month, for Lake Sharpe, South Dakota.

	Month						
	April	**May**	**June**	**July**	**August**	**Sept.**	**Total**
Estimated walleye harvest	4,152	7,399	5,731	9,812	22,124	8,648	57,866
Estimated harvest reduction	0	79	63	161	420	282	1,042
Percent reduction in harvest	0	1	1	2	2	3	2

Smallmouth bass catch and harvest per trip frequencies for angling parties fishing the lower zone of Lake Sharpe, from 2001 through 2005 are presented in Table 35 and serve as a valuable tool for evaluating effects of the 305-457-mm protected slot length limit implemented in 2003. While the percentage of angling parties catching zero smallmouth bass per trip was similar among years, the percentage of parties harvesting zero smallmouth bass per trip increased by 10% to 15% from 2001 and 2002 (pre-regulation years) to the 2003-2005 period (post-regulation change years, Table 35). The percentage of angling parties harvesting zero to one and one to two smallmouth bass per angler also decreased from the two years immediately preceding implementation of the regulation to the first three years the regulation has been in effect.

Table 35. Percentage of angling parties catching and harvesting the specified number of smallmouth bass on an angling trip, per person, for the lower zone of Lake Sharpe, during the April-September daylight survey period, 2001-2005.

Number /trip	Catch per trip					Harvest per trip				
	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005
0	45	45	42	39	52	74	75	85	86	91
0-1	21	20	22	14	15	13	13	9	8	5
1-2	16	14	12	15	13	8	8	4	4	2
2-3	6	6	8	10	6	2	3	1	2	1
3-4	4	5	4	5	4	1	1	0	0	1
4-5	3	3	2	4	3	1	1	0	0	0
5-6	2	2	2	3	1	1	0	0	0	0
6-7	2	2	2	3	2					
7-8	1	1	1	1	1					
8-9	1	0	1	1	1	**Daily limit of 5**				
9-10	0	0	0	0	0					
≥10	1	2	3	4	2					

Angler Demographics and Economic Impacts

For the April-September 2005 daylight period, Lake Sharpe anglers contributed approximately 4.6 million dollars to local economies, based on an estimated 75,161 trips (Table 21) at an estimated $61 per trip for South Dakota's Missouri River reservoirs (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2002).

Average party size was 2.2 anglers/party and average trip length was 3.6 h, during the April-September 2005 period. Residents comprised 85% of angling parties interviewed on Lake Sharpe during the April-September daytime survey period, a value similar to 2004 (Table 36). The percentage of resident anglers was lowest in lower Lake Sharpe and highest in middle Lake Sharpe in 2005 (Table 36), following a typical Lake Sharpe pattern. Campground facilities at West Bend and Big Bend Dam and a high percentage of boat anglers in lower Lake Sharpe may contribute to the higher percentage of non-residents fishing this zone of the reservoir. The majority of anglers fishing middle Lake Sharpe are shore anglers, which are generally local resident anglers.

The majority of non-resident anglers fishing Lake Sharpe in 2005 were from the states of Iowa, Nebraska, and Minnesota, similar to other years from 2000-2005 (Table 37).
The percentage of anglers interviewed who were non-residents differed significantly among months and between day types. Approximately 87% of angling parties interviewed on weekends were from South Dakota, while 80 % of parties interviewed on weekdays were from South Dakota. The percentage of anglers interviewed who were non-residents was lowest in April and highest in August in 2005 at 9 and 19%, respectively.

Table 36. Percentage of total angler contacts for resident and non-resident (states combined) anglers fishing Lake Sharpe during the April-September daylight period, 2001-2005. N is the number of parties interviewed.

Zone		Year				
		2001	2002	2003	2004	2005
Lower	**N**	529	656	531	438	363
	Residents (%)	64	68	70	74	79
	Non-residents (%)	36	32	30	26	21
Middle	**N**	146	166	263	208	162
	Residents (%)	86	90	87	90	91
	Non-residents (%)	14	10	13	10	9
Upper	**N**	378	462	667	692	616
	Residents (%)	85	72	86	88	86
	Non-residents (%)	15	28	14	12	14
Total	**N**	1,053	1,284	1,461	1,338	1,141
	Residents (%)	75	72	80	84	85
	Non-residents (%)	25	28	20	16	15

Table 37. Percentage of total non-resident angler contacts for the states listed, for anglers fishing Lake Sharpe, South Dakota during, the April-September daylight survey period, 2001-2005.

State	Percent by Year				
	2001	2002	2003	2004	2005
Iowa	32	35	27	26	28
Nebraska	21	24	25	24	32
Colorado	4	4	5	6	6
Minnesota	26	17	23	21	13
Wisconsin	4	3	3	1	1
Wyoming	1	2	1	4	2
Other*	12	15	16	18	18

*Other includes Alaska, Arizona, California, Florida, Idaho, Illinois, Indiana, Kansas, Kentucky, Massachusetts, Mississippi, Missouri, Montana, Nevada, New Mexico, North Dakota, Oklahoma, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, and Washington.

Distribution of South Dakota resident anglers fishing Lake Sharpe during the April-September 2005 survey period are presented in Figure 12 and Table 38. Approximately 56% of the angling parties interviewed on Lake Sharpe during the 2005 survey were local anglers from Hughes and Stanley counties (Figure 12). Minnehaha (Sioux Falls) and Pennington (Rapid City) residents were interviewed in 8% and 5% of angler interviews, respectively. The percentage of angler interviews for Beadle, Hand, and Minnehaha county residents significantly decreased from 2002 to 2005 (Table 38).

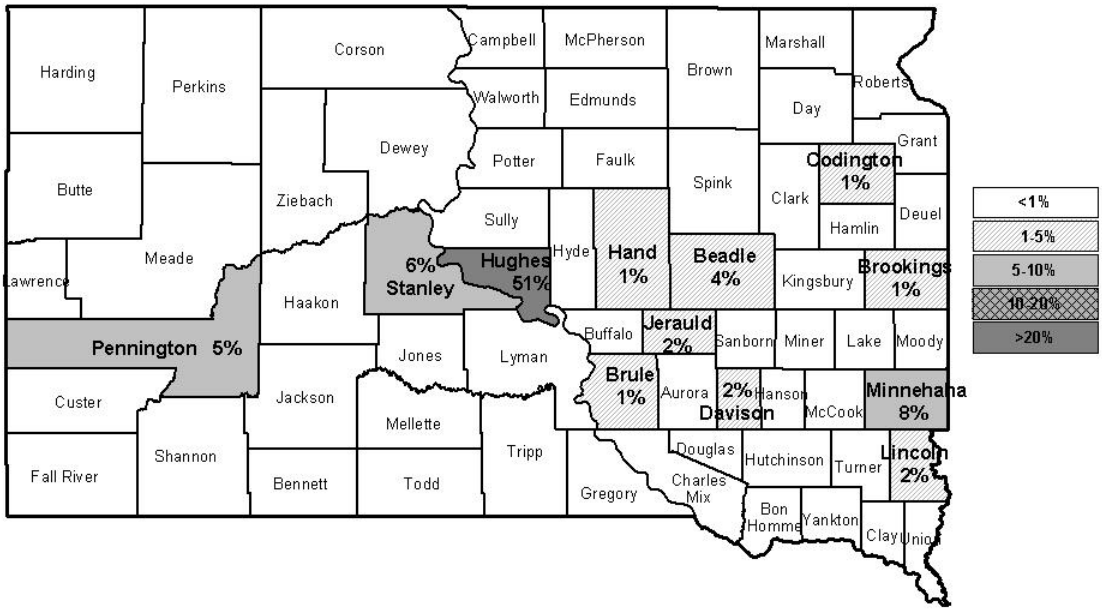


Figure 12. Percentage of total angler contacts on Lake Sharpe, by residents of the counties listed, during the April-September 2005 daylight survey period

Table 38. Percentage of total angler contacts on Lake Sharpe, by residents of the counties listed, for anglers fishing Lake Sharpe, South Dakota during the April-September daylight survey period, 2002-2005.

County	Major City	Percent by year			
		2002	2003	2004	2005
Beadle	**Huron**	9	7	3	4
Brookings	**Brookings**	3	1	1	1
Davison	**Mitchell**	4	3	2	2
Hand	**Miller**	9	2	1	1
Hughes	**Pierre**	36	48	43	51
Lyman	**Presho, Kennebec**	1	1	1	1
Minnehaha	**Sioux Falls**	13	9	7	8
Pennington	**Rapid City**	6	6	5	5
Stanley	**Fort Pierre**	8	7	6	6

The pattern in percentage of anglers traveling certain distances to fish Lake Sharpe during 2005 reflects the pattern in the percentage of angler interviews from South Dakota counties (Table 38, Figure 12). Residents of Hughes and Stanley Counties comprised the majority of anglers traveling <25 miles and 25-49 miles, one way, to fish Lake Sharpe in 2005, while anglers from Minnehaha and Pennington counties comprised the majority of anglers traveling 100-199 miles to fish Lake Sharpe (Table 39). The percentage of angler interviews for anglers traveling in excess of 200 miles, one way, to fish Lake Sharpe in 2005 was within the range observed during other years in the 2001-2005 period.

Table 39. Percentage of anglers driving the specified distances, one way, to fish Lake Sharpe, South Dakota, during the April-September daylight survey period, 2000-2005.

Distance (miles)	Percent by year				
	2001	2002	2003	2004	2005
<25	38	27	40	44	46
25-49	4	7	7	8	6
50-99	8	8	9	8	6
100-199	24	20	17	19	17
≥200	26	38	26	21	25

The change to a bus route design in 2003 for conducting angler use and harvest surveys on Lake Sharpe may have resulted in the changes in percentages of anglers fishing for walleye and "anything" observed in Table 40. The bus route survey design does a better job of capturing shore angler interviews than the previous survey method. This fact is illustrated by the increase in the percentage of anglers fishing for "anything" in the 2003-2005 angler use and harvest surveys (Table 40). The increase in percentage of anglers fishing for anything to values over 30 after 2002 coincided with the change to the bus route survey design. Correspondingly, the percentage of anglers specifically fishing for walleyes decreased after 2002 (Table 40).

Table 40. Target species of anglers fishing Lake Sharpe, South Dakota, during the April-September daylight survey period, expressed as percent of total, 2000 - 2005. T (trace) indicates values > 0.0 but < 0.5.

Target species	Percent by year				
	2001	2002	2003	2004	2005
Walleye	75	80	63	59	57
Anything	18	17	31	33	33
Rainbow trout	4	1	3	4	3
White bass	1	1	1	1	4
Smallmouth bass	1	1	1	2	1
Other*	1	T	1	1	2

*Other includes channel catfish, common carp, northern pike, and black crappie.

Satisfaction and Attitudes

How anglers feel about their fishing experience is important to the success of a fishery. Angler responses help fisheries managers determine if current management practices and regulations are providing a fishery that meets angler needs and expectations.

When anglers were asked to consider all factors when stating their level of satisfaction with their fishing trip, the median trip rating for the April-September period was "slightly satisfied"(median of 3, Table 41). The median satisfaction rating of "slightly satisfied" for 2005 was the same as for 2003 (Lott et al. 2004b) and 2004 (Lott et al. 2006), but lower than the 2002 median value of "moderately satisfied" (median of 2, Lott et al. 2003). Approximately 65% of angling parties interviewed in 2005 indicated some degree of satisfaction, a value similar to the 2004 value of 66%, but below the Lake Sharpe Strategic Plan objective of 70% (reference). Median trip satisfaction increased from "slightly satisfied" to "moderately satisfied", as the average number of walleye harvested per angler increased (Table 42). However, as Gigliotti (2004) documented, other factors besides the number of walleye harvested must influence trip satisfaction, because 65% of anglers keeping zero walleye during their trip expressed some degree of satisfaction with their trip (Table 42).

Table 41. Responses of Lake Sharpe anglers who were asked the following question during the April-September 2005 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

Month	Satisfaction rating								N	Median
	Satisfied			Neutral	Dissatisfied			N.O.		
	1	2	3	4	5	6	7	8		
April	14	21	23	14	8	6	2	11	124	3
May	29	40	26	24	10	6	7	1	143	3
June	12	15	20	13	7	3	5	0	75	3
July	16	26	26	9	10	9	5	0	81	3
August	28	30	17	16	5	2	3	0	64	2
September	16	29	17	17	5	6	6	4	82	3
Total	18	26	21	15	7	5	5	3	569	3
Percent		65				17				

Table 42. Responses of Lake Sharpe anglers who were asked the following question during the April-September 2005 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

Walleye/ angler	Satisfaction rating								N	Median
	Satisfied			Neutral	Dissatisfied			N.O.		
	1	2	3	4	5	6	7	8		
0	13	21	24	18	8	6	5	5	378	3
0-0.9	12	30	20	12	8	10	8	0	50	3
1.0-1.9	25	25	23	15	8	4	0	0	52	2.5
2.0-2.9	20	51	9	6	8	6	0	0	35	2
3.0	50	34	10	4	0	0	2	0	52	1.5
Percent		65				17				

As a part of angler interviews conducted during the April-September 2005 daytime survey period, anglers were asked if they were on a guided trip. Approximately 3% of angling parties interviewed during the standard 2005 survey stated they were on a guided trip, with the highest percentage of total trips that were guided trips occurring in August, at 10% (Table 43). The catch and harvest per trip frequencies of walleye and sauger combined were then determined for guided and unguided angler parties interviewed. While 61% of angler parties not guided caught zero walleye and sauger per angler during the 2005 survey period, only 13% of guided parties caught zero walleye and sauger per angler (Figure 13). When examining frequency distributions of average catch per angler within a party, higher percentages of guided parties caught two or more walleye and sauger per trip than parties not guided (Figure 13). The same trends evident in catch frequencies of guided and unguided parties were evident in harvest frequencies. Seventy percent of unguided parties harvested zero walleye/sauger per angler compared to 13% of guided parties (Figure 14). Also, approximately 6% of unguided fishing parties harvested a three-fish limit of walleye/sauger per person during the 2005 survey period, compared to 48% of anglers on guided trips (Figure 14).

Table 43. Responses of anglers interviewed during the April-September 2005 daytime survey on Lake Sharpe that were fishing with the assistance of a guide. N is sample size.

	Month						
	April	May	June	July	August	Sept.	Total
N	239	287	154	83	62	84	909
Yes (%)	3	2	4	0	10	7	3
No (%)	97	98	96	100	90	93	97

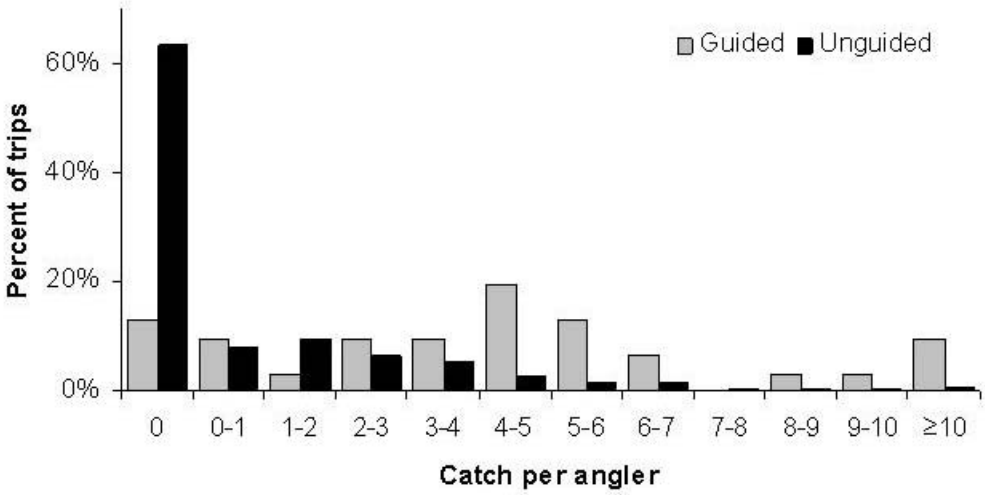


Figure 13. Percentage of guided and unguided angling parties catching the specified number of walleye and sauger (combined) per person on an angling trip, Lake Sharpe, South Dakota, during the April-September 2005 daylight survey period.

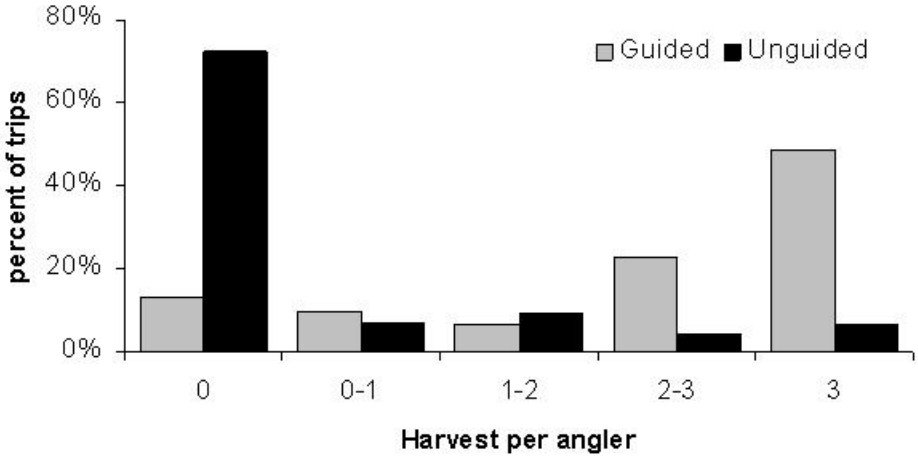


Figure 14. Percentage of guided and unguided angling parties harvesting the specified number of walleye and sauger (combined) per person on an angling trip, Lake Sharpe, South Dakota, during the April-September 2005 daylight survey period.

FISHERY STATUS

The Lake Sharpe fishery met few of the angler use and harvest objectives stated in the strategic plan in 2005. Low angler catch and harvest rates of walleye (Table 31 and Table 32), at least by Lake Sharpe standards, likely contributed to low angler use during 2005. Low hourly catch rates were likely a result of low walleye abundance, a high mean age of walleye in the population, and sufficient prey resources.

High reproduction and potentially recruitment of the 2005 walleye year class followed four years of low recruitment from 2001-2004, and removes the need to consider stocking walleye in Lake Sharpe in 2006. However, the 2005 walleye year class will not recruit to the angler catch until 2007 and not surpass the 381 mm minimum length limit until 2008 at the earliest.

The estimated harvest reduction resulting from the reduced daily limit of three walleye was minimal (3%). It is possible that low abundance of walleye 381-mm and longer during 2004 and 2005 made it difficult for anglers to harvest a daily limit of three fish, let alone four fish. Reducing the daily limit from four fish to three fish would likely have only resulted in a substantial harvest reduction if the potential to harvest four fish per trip was high, and this was not the case in 2004 and 2005.

The white bass die-off that occurred during July of 2005 may have been linked to a high abundance of adult white bass, as indicated by high angler catch and harvest of white bass during May and June of 2005 (Table 25 and Table 26). It is expected that the magnitude of the die off may result in lower angler catch and harvest rates of white bass for the next few years.

Effects of smallmouth bass regulations implemented in 2003 on the smallmouth bass population and smallmouth bass harvest are mixed. While harvest of smallmouth bass has certainly decreased as a result of the regulations, size structure of the smallmouth bass population is currently lower than just before the regulations were changed. However, size structure has steadily increased since 2003 and indices of abundance and growth are unchanged from years before the regulation change.

MANAGEMENT RECOMMENDATIONS

- Continue to conduct annual angler use and harvest surveys.
- Continue to conduct annual fish population surveys.
- Increase the walleye daily limit back to four fish, the same as the statewide standard.
- Investigate use of variable-mesh monofilament gill nets as a sampling method to index smallmouth bass population size structure and acquire fish for age and growth and condition analyses. Preliminary netting efforts were conducted in 2005.
- Determine angler knowledge and acceptance of smallmouth bass regulations and estimate minimum harvest reduction resulting from regulations, by including questions on these topics in the 2006 standard angler survey interview.
- Evaluate management objectives for secondary fisheries to the walleye fishery, including those for white bass, channel catfish, and smallmouth bass, to more accurately reflect the potential of these fisheries, in terms of angler days.
- Update Lake Sharpe Fisheries Management Plan by March 2008.

LITERATURE CITED

Anderson, R.O, and A.S. Weithman. 1978. The concept of balance for coolwater fish populations. Pages 371-378 in R.L. Kendall, editor. Selected coolwater fishes of North America. American Fisheries Society, Bethesda, Maryland.

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.

Beamesderfer, R.C., and B.E. Riemer. 1988. Size selectivity and bias in estimates of population statistics of smallmouth bass, walleye, and northern squawfish, in a Columbia River reservoir. North American Journal of Fisheries Management 8:505-510.

Bell, M. C. 1973. Fisheries handbook of engineering requirements and biological criteria. Reprinted 3rd edition in 1990, Portland, Oregon.

Benson, N.G. 1968. Review of fishery studies on Missouri River mainstem reservoirs, United States Fish and Wildlife Service. Research Report 71, Washington, D.C.

Brown, M.L., and B.R. Murphy. 1991. Standard weights (W_s) for striped bass, white bass and hybrid striped bass. North American Journal of Fisheries Management 11:451-467.

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.

Carlander, K.D. 1982. Standard intercepts for calculating lengths from scale measurements for some centrarchid and percid fishes. Transactions of the American Fisheries Society 111(3): 332-336.

Colby, P.J., R.E. McNicol, and R.A. Ryder. 1979. Synopsis of biological data on the walleye. Food and Agriculture Organization, Fisheries Synopsis Number 119.

Conover, W.J. 1980. Practical nonparametric statistics. Second Edition. John Wiley and Sons, Incorporated, New York.

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.

Fielder, D., J. Riis and C. Stone. 1992. Angler use and sport fishing harvest survey on Lake Sharpe, South Dakota, 1990 and 1991. South Dakota Department of Game, Fish and Parks, Wildlife Division, Progress Report No. 92-11. Pierre.

Francis, J. 2000. WinFin Analysis Version 2.95. Nebraska Game and Parks Commission. Lincoln Nebraska.

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. 2004. Fishing in South Dakota – 2003: fishing activity, harvest and angler opinion survey. South Dakota Department of Game, Fish, and Parks, Wildlife Division, report, Pierre.

Guy, C.S., E.A. Bettross, and D.W. Willis. 1990. A proposed standard weight (W_s) equation for sauger. The Prairie Naturalist 22: 41-48.

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.

Johnson, B., J. Lott, and W. Nelson-Stastny. 1998. Annual fish population and angler use and harvest surveys on Lake Sharpe, 1997. South Dakota Department of Game, Fish and Parks, Wildlife Division, Progress Report No. 98-16, Pierre.

Johnson, B., and J. Lott. 1999. Annual fish population and angler use and harvest surveys on Lake Sharpe, South Dakota, 1998. South Dakota Department of Game, Fish and Parks, Wildlife Division, Report No. 99-4, Pierre.

Johnson, B., and J. Lott. 2000. Annual fish population and angler use and harvest surveys on Lake Sharpe, South Dakota, 1999. South Dakota Department of Game, Fish and Parks, Wildlife Division, Report No. 00-10, Pierre.

Johnson, B., and J. Lott. 2001. Annual fish population and angler use and harvest surveys on Lake Sharpe, South Dakota, 2000. South Dakota Department of Game, Fish and Parks, Wildlife Division, Report No. 01-15, Pierre.

Johnson, B., R. Hanten, and J. Lott. 2002. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota, 2001. South Dakota Department of Game, Fish and Parks, Wildlife Division, Report No. 02-04, Pierre.

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 newsurvey estimator of recreational angling. Transactions of the American Fisheries Society 119:41-54.

Kolander, T.D., D.W. Willis, and B.R. Murphy. 1993. Proposed revision of the standard weight (W_s) equation for smallmouth bass. North American Journal of Fisheries Management 13:398-400.

Lott, J.P. 1996. Relationships between smallmouth bass feeding ecology and population structure and dynamics in lower Lake Oahe, South Dakota. South Dakota Department of Game, Fish and Parks, Wildlife Division Completion Report 96-3, Pierre.

Lott, J.P. 2000. Smallmouth bass movement, habitat use and electrofishing susceptibility in lower Lake Oahe, South Dakota. South Dakota Department of Game, Fish and Parks, Wildlife Division Completion Report 00-15, Pierre.

Lott, J., D. Fielder, B. Johnson, J. Riis, C. Stone and G. Wickstrom. 1994. Annual fish population surveys on South Dakota Missouri River reservoirs, 1993. South Dakota Department of Game, Fish and Parks, Wildlife Division, Progress Report No. 94-8, Pierre.

Lott, J, B. Johnson, and K. Potter. 2003. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota 2002. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 03-11, Pierre.

Lott, J, R. Hanten, and K. Potter. 2004. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota 2003. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 04-15, Pierre.

Lott, J, J. Erickson, A. Leingang, and K. Potter. 2006a. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2004. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 06-17, Pierre.

Lott, J., J. Erickson, R. Hanten, and Kyle Potter. 2006b. Annual fish population and angler use, harvest and preference surveys on Lake Sharpe, South Dakota 2004. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 06-03, Pierre.

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.

Michaletz, P., B. Johnson, J. Riis, C. Stone, D. Unkenholz, and D. Warnick. 1986. Annual fish population surveys on South Dakota Missouri River reservoirs, 1981-1985. South Dakota Department of Game, Fish and Parks, Wildlife Division, Progress Report No. 86-11, Pierre.

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.

Pollock, K.H, C.M. Jones, and T.L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society Special Publication 25. Bethesda, Maryland.

Pollack, M. A. 1999. The Wichita Eagle, 9 Jul 1999.

Riis, J.C. 1986. Angler use and sport fishing harvest survey on Lake Sharpe, South Dakota, 1984-1985. South Dakota Department of Game, Fish and Parks, Wildlife Division, Completion Report No. 86-8, Pierre.

Riis, J., and B. Johnson. 1995. Annual fish population and angler use and harvest surveys on Lake Sharpe, South Dakota, 1994. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report No.95-5, Pierre.

Riis, J., B. Johnson, and J. Lott. 1996. Annual fish population and angler use and harvest surveys on Lake Sharpe, South Dakota, 1995. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report No.96-7, Pierre.

Riis, J., B. Johnson, J. Lott, 1997. Annual fish population and angler use and harvest surveys on Lake Sharpe, South Dakota, 1996. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report No.97-7, Pierre.

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.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Reprinted in 1985, Fisheries research board of Canada, Bulletin 184. Ottawa, Canada.

Sorensen, J. 2004. Annual fish population and angler use and harvest surveys on Lake Francis Case, South Dakota, 2003. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report No. 04-19, Pierre.

Sorensen, J., and G. Knecht 2006. Annual fish population and angler use and harvest surveys on Lake Francis Case, South Dakota, 2004. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report No. 06-20, 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.

Southwick, R. I., and A. J. Loftus, editors. 2003. Investigations and monetary values of fish and freshwater mussel kills. American Fisheries Society, Special Publication 30, Bethesda, Maryland.

South Dakota Department of Game, Fish and Parks. 1994. Systematic approach to management. Wildlife Division, Pierre.

Stone, C., J. Riis, and B. Johnson. 1994. Angler use and sport fishing harvest survey on Lakes Francis Case, Sharpe, and Oahe, South Dakota, 1992 and 1993. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report 94-9, Pierre.

SYSTAT, Inc. 1998. SYSTAT for Windows: Statistics, Version 8.0. Evanston, IL.

United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, Bureau of Census. 2002. 2001 national survey of fishing, hunting, and wildlife-associated recreation. United States Government Printing Office, Washington, D.C.

Wakabayashi H. 1991. Effect of environmental conditions on the infectivity of *Flexibacter columnaris* to fish. Journal of Fish Diseases. 14:279–290.

Wickstrom, G., D. Fielder, B. Johnson, J. Riis, C. Stone, and D. Warnick. 1991. Annual fish population surveys on South Dakota Missouri River reservoirs, 1990. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report 91-14, Pierre.

Wickstrom, G., D. Fielder, B. Johnson, J. Lott, J. Riis, and C. Stone. 1993. Annual fish population surveys on South Dakota Missouri River reservoirs, 1992. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual Report 93-4, Pierre.

Willis, D.W., C.S. Guy, and B.R. Murphy. 1991. Development and evaluation of a standard weight (W_s) equation for yellow perch. North American Journal of Fisheries Management 11:374-380.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota fishes: a statewide summary with means by region and water type. South Dakota Department of Game, Fish and Parks, Wildlife Division, Special Report 01-05, Pierre.

APPENDICES

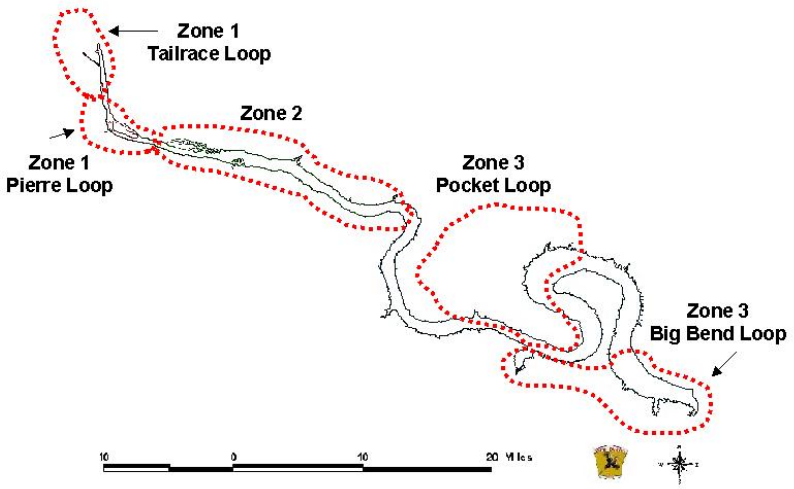
Appendix 1. Common and scientific names of fishes mentioned in this report.

Common Name	Abbreviations	Scientific Name
Bigmouth buffalo	BIB	*Ictiobus cyprinellus*
Black bullhead	BLB	*Ameiurus melas*
Black crappie	BLC	*Pomoxis nigromaculatus*
Bluegill	BLG	*Lepomis macrochirus*
Bluntnose minnow	BLM	*Pimephales notatus*
Channel catfish	CCF	*Ictalurus punctatus*
Common carp	COC	*Cyprinus carpio*
Emerald shiner	EMS	*Notropis atherinoides*
Fathead minnow	FHM	*Pimephales promelas*
Freshwater drum	FRD	*Aplodinotus grunniens*
Gizzard shad	GZD	*Dorosoma cepedianum*
Goldeye	GOE	*Hiodon alosoides*
Johnny darter	JOD	*Etheostoma nigrum*
Largemouth bass	LMB	*Micropterus salmoides*
Northern pike	NOP	*Esox Lucius*
Rainbow smelt	RBS	*Osmerus mordax*
Rainbow trout	RBT	*Oncorhynchus mykiss*
River carpsucker	RIC	*Carpiodes carpio*
Sauger	SAR	*Sander canadensis*
Shorthead redhorse	SHR	*Moxostoma macrolepidotum*
Shortnose gar	SHG	*Lepisosteus platostomus*
Shovelnose sturgeon	SHS	*Scaphirynchus platorynchus*
Smallmouth bass	SMB	*Micropterus dolomieu*
Smallmouth buffalo	SAB	*Ictiobus bubalus*
Spottail shiner	SPS	*Notropis hudsonius*
Walleye	WAE	*Sander vitreus*
White bass	WHB	*Morone chrysops*
White crappie	WHC	*Pomoxis annularis*
White sucker	WHS	*Catostomus commersoni*
Yellow perch	YEP	*Perca flavescens*

Appendix 2. Minimum lengths (mm) for length class designations for smallmouth bass, walleye, sauger, channel catfish, white bass and yellow perch.

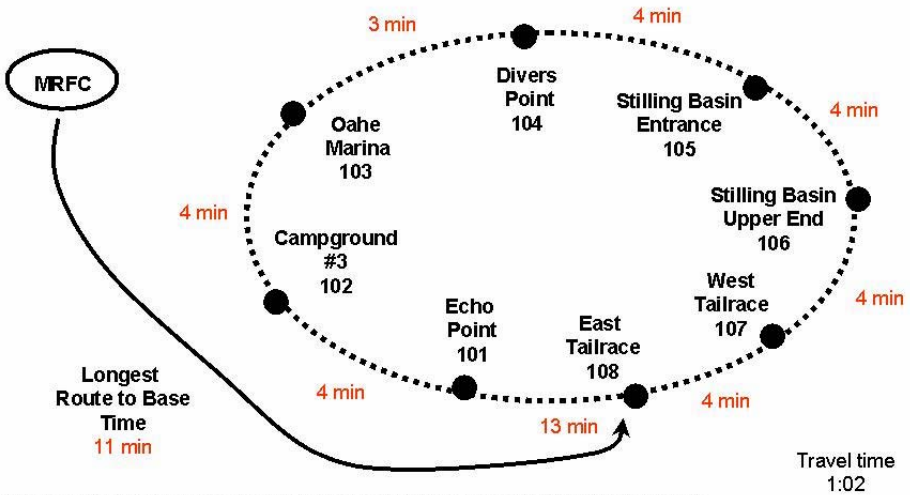
Species	Stock	Quality	Preferred	Memorable	Trophy
Smallmouth Bass	180	280	350	430	510
Walleye	250	380	510	630	760
Sauger	200	300	380	510	630
Channel catfish	280	410	610	710	910
White bass	150	230	300	380	460
Yellow perch	130	200	250	300	380

Lake Sharpe Bus Route Loops



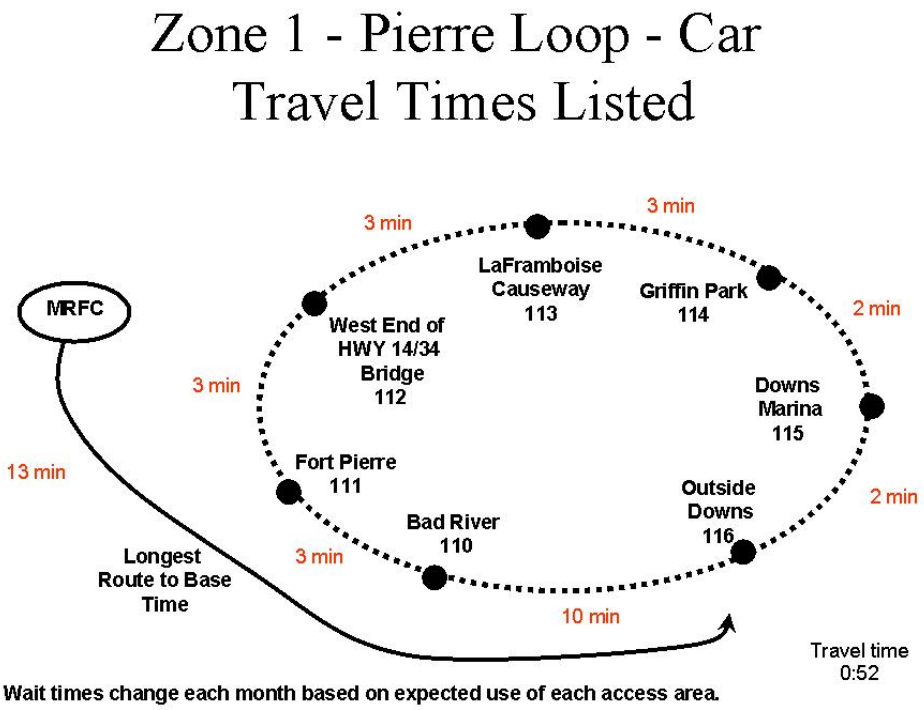
Appendix 3. Lake Sharpe bus route loop map depicting locations of the 5 overall loops for angler use and harvest surveys during April – September, 2005.

Zone 1 - Tailrace Loop - Car Travel Times Listed

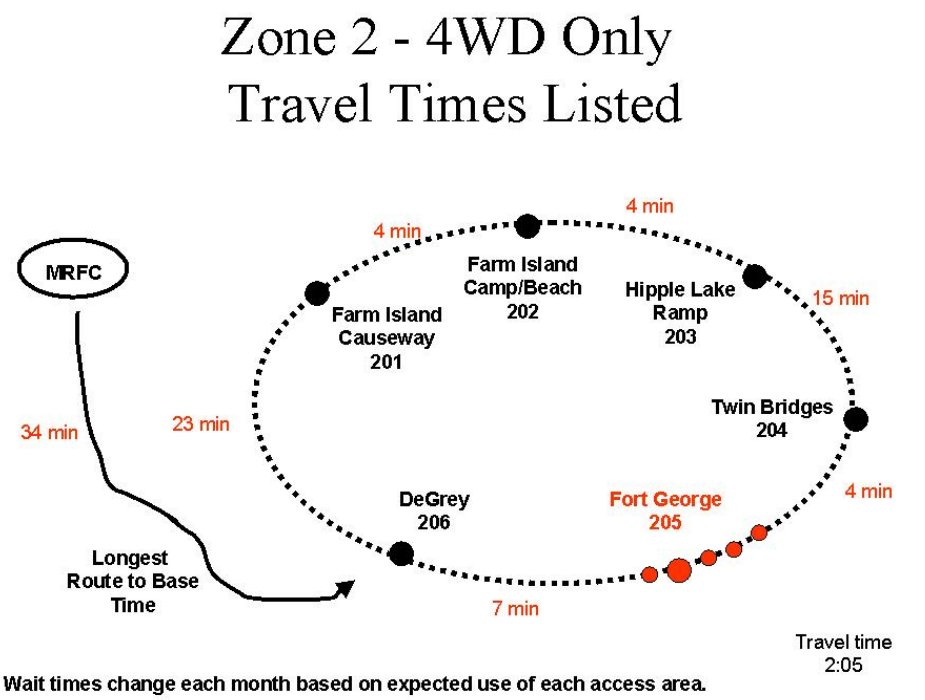


Wait times change each month based on expected use of each access area.

Appendix 4. Overall design of the tailrace loop (loop 1) for angler use and harvest surveys for Lake Sharpe, SD during April-September, 2005.

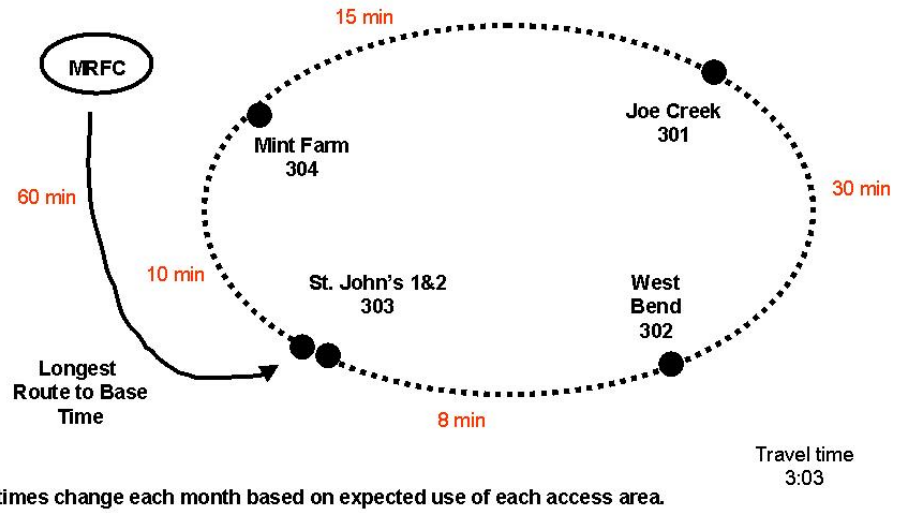


Appendix 5. Overall design for the Pierre Loop (loop 2) for the angler use and harvest survey for Lake Sharpe, SD during April-September, 2005.



Appendix 6. Overall design for Zone 2 loop (loop 3) for the angler use and harvest survey for Lake Sharpe, SD during April-September, 2005.

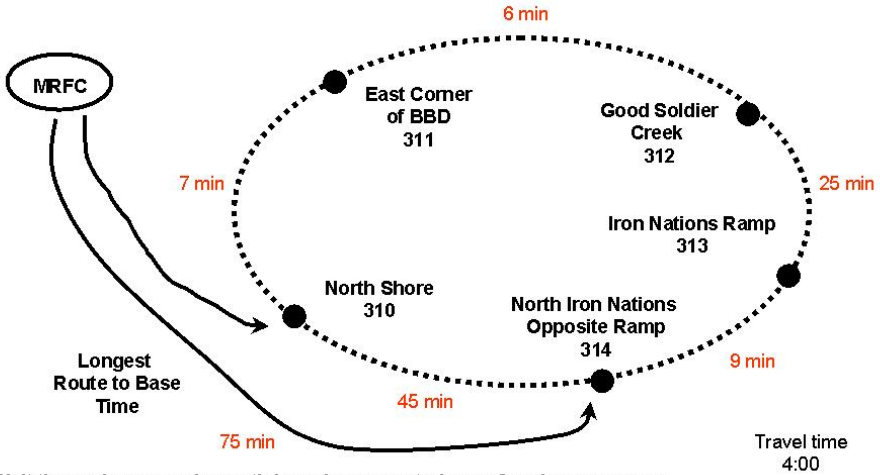
Zone 3 - Pocket Loop - 4WD Only
Travel Times Listed



Wait times change each month based on expected use of each access area.

Appendix 7. Overall design for the Pocket Loop for the angler use and harvest survey for Lake Sharpe, SD during April-September 2005.

Zone 3 - Big Bend Loop - Car
Travel Times Listed



Wait times change each month based on expected use of each access area.

Appendix 8. Overall design for the Big Bend Loop for the angler use and harvest survey for Lake Sharpe, SD during April-September, 2005.

Appendix 9. Angler satisfaction, preference, and attitude questions asked as part of the April-September 2005 angler use and harvest survey on Lake Sharpe, South Dakota.

Trip Satisfaction Question:

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

(Read the following response categories)
1 = VERY
2 = MODERATELY SATISFIED
3 = SLIGHTLY
4 = NEUTRAL *(neither satisfied or dissatisfied)*
5 = SLIGHTLY
6 = MODERATELY DISSATISFIED
7 = VERY
8 = NO OPINION

Guide Fishing Trip Question:

Guided Trip: Yes or No.

Walleye Harvest Reduction Question:

Given the current walleye/sauger length regulations for Lake Sharpe, how many additional walleye/sauger did you release today that you otherwise would have harvested had the daily limit been four?

Appendix 10. White bass and yellow perch proportional stock density (PSD) relative stock density of preferred-length fish, and mean relative weight values, for 1999-2004, for fish collected in the standard August gill net survey, on Lake Sharpe South Dakota.

White bass					
Year	**PSD**	**RSD-P**	**RSD-M**	***Wr***	**N**
1997	96	58	13	94	24
1998	94	94	22	101	18
1999	100	72	24	102	54
2000	98	83	13	99	55
2001	100	91	26	100	46
2002	68	15	8	100	71
2003	96	39	13	91	70
2004	92	74	6	94	62
2005	100	60	0	101	11

Yellow perch					
Year	**PSD**	**RSD-P**	**RSD-M**	***Wr***	**N**
1997	43	4	0	89	23
1998	28	6	0	91	18
1999	59	27	0	82	22
2000	22	6	0	85	36
2001	55	0	0	86	20
2002	42	8	0	77	24
2003	25	8	0	85	23
2004	43	5	0	88	21
2005	23	0	0	86	45