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ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2010

South Dakota
Department of
Game, Fish and Parks
Wildlife Division
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ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2010

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PREFACE

Information collected from Lewis and Clark Lake during 2010 is summarized in this report. Copies of this report and references to the data can be made with permission from the author or the Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, South Dakota 57501-3182.

The author would like to acknowledge the following individuals from South Dakota Game, Fish and Parks who helped with data collection, analysis, editing, and manuscript preparation: Jason Sorensen, Gary Knecht, Kristen Pitts, Steve LaBay, Rachel Trible, Justin Seibert, Jordan Hull, Matt Ward, and Chris Longhenry. 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-43. Statewide Fish Management Surveys. Some of this data has been previously reported in segment F-21-37 through 42.

EXECUTIVE SUMMARY

Information presented in this report was derived from fish population surveys conducted on Lewis and Clark Reservoir and the Missouri River below Gavins Point Dam during 2010. Trends in fish population structure are reported and compared with previous surveys. These surveys are used to determine the relative health of the fishery, to evaluate management strategies and objectives outlined in the Missouri River Program Strategic Plan, and to guide management recommendations to improve the current fishery.

Sauger, walleye, channel catfish and freshwater drum were the most abundant species sampled with gill nets in 2010. Walleye and sauger catch per unit effort (CPUE) were 7.2 and 7.8/gill net, respectively. Nine mature year classes of walleye were present (2000-2008) and five (2004-2008) were present for sauger. Size structure for walleye and sauger populations met or exceeded most management objectives. Proportional size distribution of walleye was within the management objective range of 30-60, but PSD-P (6) was below the management objective of 10. Sauger PSD was slightly above the management objective and PSD-P was well above the objective. Gill net CPUE's were also above the management objectives of 4.0 and 6.0 fish/net night for walleye and sauger, respectively.

Channel catfish continue to be relatively abundant during the fall gill net survey (3.9/gill net) and exceeded the CPUE objective of 3/gill net. Channel catfish size structure indices were above average in 2010, and surpassed the set objective levels for PSD and PSD-P. Creel surveys indicate channel catfish continue to be underutilized in the Missouri River of South Dakota.

Largemouth and smallmouth bass CPUE continues to be well above the management objective of 10 fish/h. PSD was within the management objective range of 30 to 60 for some populations of smallmouth, and above the 30 to 60 range for largemouth. However, size structure parameters are based on low sample sizes.

Sixteen species of fish were sampled during the seining survey on Lewis and Clark Lake in 2010. Catches of most species were reduced causing total catch rates to fall below the long-term average. CPUE of emerald shiners was down slightly from last year, although they were the most abundant fish caught in seines. No age-0 walleye or sauger were sampled with seines in 2010. Both species are typically collected, and this is the first recorded absence of age-0 walleye since annual sampling began in 1981. Several uncommon cyprinids were collected in 2010 including a Northern redbelly dace and a creek chub.

Anglers spent an estimated 75,049 hours fishing Lewis and Clark Lake during the April 1- November 30, 2010 daylight creel survey period. Total fish harvest was estimated at 16,667, including 5,982 walleye. Catch rates for walleye were 0.257 fish/angler-hour. Sauger, white bass, and channel catfish were also commonly harvested. Anglers from South Dakota and eight other states generated a local economic impact estimated at about $1.26 million.

TABLE OF CONTENTS

PREFACE ..... **ii**
EXECUTIVE SUMMARY ..... **iii**
TABLE OF CONTENTS ..... **iv**
LIST OF TABLES ..... **v**
LIST OF FIGURES ..... **xi**
LIST OF APPENDICES ..... **xiii**
LIST OF ABBREVIATIONS ..... **xiv**
INTRODUCTION **1**
MANAGEMENT OBJECTIVES **2**
Reservoir-wide Objectives and Strategies 2
Species Specific/Lake Specific Objectives 2
Sampling Objectives (Federal Aid Code 2102) 3
STUDY AREA **4**
METHODS **6**
Fish Population Surveys 6
Lewis and Clark Lake *7*
Missouri River *8*
Data Analysis *9*
Angler Use and Sportfish Harvest Surveys 10
RESULTS AND DISCUSSION **11**
Lewis and Clark Lake 11
Seines *11*
Gill Nets *14*
Walleye population parameters *16*
Sauger population parameters *21*
Channel catfish population parameters *26*
Electrofishing *29*
Smallmouth bass population parameters *29*
Flathead catfish population parameters *32*
Missouri River 36
Electrofishing *36*
Largemouth bass population parameters *36*
Smallmouth bass population parameters *39*
Niobrara Delta near Running Water 39
Gavins Point Dam Tailwaters 39
Fort Randall Dam Tailwaters 43
Hoop Nets *46*
Channel catfish population parameters *46*
Seines *49*
Angler Use and Sportfish Harvest Survey **51**
Fishing Pressure 51
Fish Harvest and Release 52
Harvest, Release, and Catch Rates 57
Angler Demographics and Economics 59
RARE FISH OBSERVATIONS **61**
FISHERY STATUS **61**
MANAGEMENT RECOMMENDATIONS **63**
LITERATURE CITED **64**
APPENDICES **69**

LIST OF TABLES

Table 1. Sampling methods, target species and effort for Lewis and Clark Lake sampling, 2010. GPDT = Gavin's Point Dam tailwater, FRDT = Fort Randall Dam tailwater, Age-0 = age-0 walleye and sauger. 6

Table 2. Length categories (mm) used for calculating stock density indices for targeted fish species (Gabelhouse 1984; Quinn 1991). 9

Table 3. Catch per unit effort (fish/seine haul) for seining surveys at Lewis and Clark Lake, South Dakota, 1956 and 2005-2010, including age-0 and adults. Standard error (SE) is included 2005-2010. *total number sampled. 13

Table 4. Catch per unit effort (fish/net night) for gill nets at Lewis and Clark Lake, South Dakota, 1956, 1983, 2004-2010. Standard error (SE) is included (no standard errors are listed for 1956 sampling). 15

Table 5. Mean gill net catch per unit effort (fish/net night) for sauger and walleye, 381 mm and longer collected in standard gill net surveys, Lewis and Clark Lake, 2002-2010. Standard error (SE) is included in parenthesis. 17

Table 6. Walleye proportional size distribution (PSD) and proportional size distribution of preferred and memorable-length fish (PSD-P and PSD-M) collected in standard gill net surveys, Lewis and Clark Lake, South Dakota, 2002-2010. 19

Table 7. Mean length at age of capture, as determined by ages estimated from otolith analysis, for walleye collected in the standard September gill net survey 2006-2010, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented. 19

Table 8. Mean annual growth increments for walleye collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2006-2010. 20

Table 9. Mean relative weight (Wr) by length category of walleye, collected during the standard September gill net surveys on Lewis and Clark Lake, South Dakota, 2002-2010. Sample size (N) and standard error (SE) are also presented. 20

Table 10. Age distribution of walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010, as determined from scales (2002 – 2005) and otoliths (2006 – 2010). Mean age excludes age-0 fish. 21

Table 11. Catch curve estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (-Z) for walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Age range is the range of ages used to calculate catch curve statistics. Scales (2002-2005) and otoliths (2006-2010) were used to estimate ages. 21

Table 12. Sauger proportional size distribution (PSD) and proportional size distribution for preferred and memorable-length fish (PSD-P and PSD-M) collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. 23

Table 13. Mean length at age of capture, as determined by ages estimated from otolith analysis, for sauger collected in the standard September gill net survey 2006-2010, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented. 23

Table 14. Mean annual growth increments for sauger collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2006-2010..... 25

Table 15. Mean relative weight of sauger, by length categories, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included. 25

Table 16. Age distribution of sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Scales (2002-2005) and otoliths (2006-2010) were used to estimate ages. Mean age excludes age-0 fish..... 26

Table 17. Catch curve estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (-Z) for sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Age range is the range of ages used to calculate catch curve statistics. Scales (2002-2005) and otoliths (2006-2010) were used to estimate ages. 26

Table 18. Channel catfish proportional size distribution (PSD) and proportional size distribution for preferred and memorable length fish (PSD-P and PSD-M), collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010..... 27

Table 19. Relative weight of channel catfish, by incremental stock density indices, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included..... 27

Table 20. Age distribution, of channel catfish collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2003-2010. Mean age excludes age-0 fish. 29

Table 21. Mean back-calculated total lengths (mm) for each age class of channel catfish sampled during the standard September gill-net survey in Lewis and Clark Lake, South Dakota, 2010. Ages beyond 10 are excluded from the table, however, sample mean, standard error, and length increment are calculated from the complete sample..... 29

Table 22. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and mean relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-memorable length (P-M) smallmouth bass collected by electrofishing Gavins Point Dam face, Lewis and Clark Lake, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included. 30

Table 23. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, May 2010..... 30

Table 24. Age distribution of smallmouth bass collected by electrofishing Lewis and Clark Lake near Gavins Point Dam, 2002-2010, as determined from scales..... 32

Table 25. Catch per unit effort (CPUE), proportional size distribution, proportional size distribution for preferred and memorable length fish (PSD-P, PSD-M), and relative weights of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) fish for flathead catfish collected by electrofishing Lewis and Clark Lake, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included..... 33

Table 26. Age distribution of flathead catfish sampled by electrofishing Lewis and Clark Lake during 2002-2008, and 2010 as determined from pectoral spines. In 2010 spines were sectioned at both the articulating process (a) and at the basal recess (b). 33

Table 27. Mean back-calculated total lengths (mm) for each age class of flathead catfish sampled by low amperage daytime electrofishing in Lewis and Clark Lake, South Dakota, May 2010. Ages were determined from pectoral spines sectioned at the basal recess. Ages beyond 10 are excluded from the table, however, sample mean, standard error, and length increment are calculated from the complete sample. 34

Table 28. Mean back-calculated total lengths (mm) for each age class of flathead catfish sampled by low amperage daytime electrofishing in Lewis and Clark Lake, South Dakota, May 2010. Ages were determined from pectoral spines sectioned at the articulating process. Ages beyond 10 are excluded from the table, however, sample mean, standard error, and length increment are calculated from the complete sample..... 34

Table 29. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) largemouth bass sampled by spring electrofishing Springfield area of the Niobrara delta, 2003-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included. 36

Table 30. Mean back-calculated total lengths (mm) for each age class of largemouth bass sampled by daytime electrofishing in the Springfield area of the Niobrara delta, Lewis and Clark Lake, South Dakota, May 2010. Ages were determined from scales. 37

Table 31. Age distribution of largemouth bass sampled by electrofishing in the Springfield area of the Niobrara Delta, 2003-2010, as determined from scales. 37

Table 32. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by daytime electrofishing in the Running Water area of the Niobrara delta, May 2010. Ages were determined from scales. 39

Table 33. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass sampled by spring electrofishing the Missouri River below Gavins Point Dam, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included. 40

Table 34. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by daytime electrofishing in the Missouri River below Gavins Point Dam, South Dakota, May 2010. Ages were determined from scales..... 40

Table 35. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May, 2002-2010, as determined from scales. 41

Table 36. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass sampled by fall nighttime electrofishing the Missouri River below Fort Randall Dam, 2002-2010 (2010a = June sample; 2010b = October sample). Sample size (N = number of fish in the respective category) and standard error (SE) are also included..... 45

Table 37. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by nighttime electrofishing in the Missouri River below Fort Randall Dam, South Dakota, June 2010. Ages were determined from scales..... 45

Table 38. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by nighttime electrofishing in the Missouri River below Fort Randall Dam, South Dakota, October 2010. Ages were determined from scales. 46

Table 39. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Fort Randall Dam, 2002-2010 (2010a = June sample; 2010b = October sample), as determined from scales..... 46

Table 40. Total annual hoop net catches (CPUE) of channel catfish from the Missouri River and Niobrara delta near Springfield, SD, 2002-2004 and 2006-2010. Standard error (SE) is also included. 47

Table 41. Proportional size distribution (PSD), proportional size distribution for preferred and memorable length fish (PSD-P, PSD-M), and mean relative weight (standard error) for stock-quality (S-Q), quality-preferred (Q-P), and preferred-memorable length (P-M) channel catfish sampled with hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 2002-2004 and 2006-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included. 48

Table 42. Mean back-calculated total lengths (mm) for each age class of channel catfish sampled during the hoop net survey in the Missouri River and Niobrara delta near Springfield, SD, 2010. 49

Table 43. Age distribution of channel catfish sampled in hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 2002, 2004, and 2006-2010, as determined from pectoral spines. 49

Table 44. Catch per unit effort (fish/seine haul) for July seining surveys in the Missouri River near Springfield, South Dakota, 2004-2009, includes both age-0 and adults. Trace (T) indicates a value is less than 0.05. Standard error (SE) is in parenthesis. 50

Table 45. Comparison of estimated total fishing pressure (angler hours), by month for Lewis and Clark Lake, 2009-2010. Standard error (SE) is included 51

Table 46. Estimated total angler hours for boat anglers, shore anglers, and all combined by month, Lewis and Clark Lake, April-November, 2010..... 51

Table 47. Estimated number of fish harvested and released, by month, for anglers fishing Lewis and Clark Lake, April-November, 2010. Standard error (SE) is included. 53

Table 48. Percentage of surveyed anglers that harvested or released specific numbers of walleye per completed trip, Lewis and Clark Lake, April-November, 2010. 55

Table 49. Percentage of surveyed anglers that harvested or released specific numbers of channel catfish per completed trip, Lewis and Clark Lake, April-November, 2010. 55

Table 50. Percentage of surveyed anglers that harvested or released specific numbers of white bass per completed trip, Lewis and Clark Lake, April-November, 2010.. .. 56

Table 51. Estimated harvest, release and catch rates (# fish / hour) for walleye, sauger, channel catfish, and all species combined by month, for anglers fishing Lewis and Clark Lake, April-November, 2010. Standard error (SE) is included..... 58

List of Tables Continued Page

Table 52. State residency of surveyed anglers fishing Lewis and Clark Lake, April-November, 2010, by number and percent of the total. 59

Table 53. Estimated mean party size, completed trip length, pressure, and angler days for anglers fishing Lewis and Clark Lake, April-November, 2010. 60

Table 54. Percentage of anglers fishing for a preferred fish species at Lewis and Clark Lake, April-November, 2010. 60

Table 55. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution–preferred (PSD-P) and species specific management objectives for walleye, sauger, channel catfish, largemouth and smallmouth bass, in Lewis and Clark Lake, 2010. Bold values were not within the objective range. 62

LIST OF FIGURES

Figure 1. An illustration of the Missouri River from Fort Randall Dam to the South Dakota downstream border with select sampling locations in Lewis and Clark Lake. 5

Figure 2. Monthly and long-term average outflows from Gavins Point Dam, South Dakota, 2010. 6

Figure 3. Mean number of fish captured per seine haul from Lewis and Clark Lake, South Dakota, 1981-2010. Dotted line represents long-term mean catch per haul. 11

Figure 4. Number of each species collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2010. Abbreviations used are defined in Appendix 1. 16

Figure 5. Length frequency of walleye collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2009 and 2010. 18

Figure 6. Length frequency of sauger collected during the standard gill net surveys from Lewis and Clark Lake, South Dakota, 2009 and 2010. 24

Figure 7. Length frequency for channel catfish collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2009 and 2010. 28

Figure 8. Length frequency for smallmouth bass sampled by nighttime electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, 2009 and 2010. 31

Figure 9. Length frequency of flathead catfish sampled by electrofishing Lewis and Clark Lake during June 2009 and 2010. 35

Figure 10. Length frequency of largemouth bass sampled by electrofishing in the Niobrara delta near Springfield, South Dakota during May 2009 and 2010..... 38

Figure 11. Length frequency of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May 2009 and 2010. 42

Figure 12. Length frequency of smallmouth bass sampled by nighttime electrofishing the Missouri River below Fort Randall Dam in June and October 2010. 44

Figure 13. Length frequency for channel catfish collected in hoop nets from the Missouri River and Niobrara delta near Springfield, SD 2010. 48

Figure 14. Estimated hours of fishing pressure by year, April-September, on Lewis and Clark Lake. Exceptions: 1 – Survey conducted May – September; 2 – Survey conducted April – December; 3 – Survey area extended from Lewis and Clark Lake upstream into the riverine portion below Fort Randall Dam; 4 – Survey conducted April – October; 5 – Survey conducted April – November. 52

Figure 15. Estimated walleye harvest by year for anglers fishing Lewis and Clark Lake (Zone 3). Surveys were conducted April-September except in 1995 surveys were from May-September, in 2009 from April-October, and in 2010 April-November. 54

Figure 16. Length frequencies of angler-harvested walleye from Lewis and Clark Lake, April-November, 2010. 56

Figure 17. Length frequencies of angler-harvested channel catfish from Lewis and Clark Lake, April-November, 2010. 57

LIST OF APPENDICES

Appendix Page

Appendix 1. Common and scientific names of fishes mentioned in this report 69

Appendix 2. Standard weight equations used for relative weight calculations. Length is in millimeters and weight is in grams. 71

Appendix 3. Select information from previous angler harvest and use surveys; L&C = the reservoir system including Fort Randall tailwaters downstream to Gavins Point Dam. GPDT = Gavins Point Dam tailwater, LMR = Lower Missouri River from GPDT to the confluence with the Big Sioux River near the Iowa, Nebraska border. Survey dates differed; 1984, 1994, 2001, and 2005 were conducted April-September, 1995 was conducted May-September, 2000 was conducted April-December, 2010 was conducted April-November. 72

LIST OF ABBREVIATIONS

a ..... annual mortality
CI ..... confidence interval
CPUE ..... catch per unit effort
DC ..... direct current
g ..... grams
h ..... hour
ha ..... hectares
in ..... inches
km ..... kilometers
M ..... memorable-length
m ..... meters
mm ..... millimeters
min ..... minutes
N ..... sample size
P ..... preferred-length
PSD ..... proportional size distribution
Q ..... quality length
RM ..... river mile
PSD-M ..... proportional size distribution for memorable-length fish
PSD-P ..... proportional size distribution for preferred-length fish
S ..... stock length
SD ..... South Dakota
s ..... survival
spp. ..... species (multiple)
TL ..... total length
W_r ..... relative weight
W_s ..... standard weight
-z ..... instantaneous mortality rate

ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2010

INTRODUCTION

Lewis and Clark Lake was formed by the construction of Gavins Point Dam, which was completed in 1955. Lewis and Clark Lake is the lowermost of four Missouri River reservoirs in South Dakota that was impounded under the authority of the Pick-Sloan Act. The main purposes of dam construction along the Missouri River were to lessen flooding in the lower basin, provide flows for navigation in the un-impounded portion of the river, provide irrigation, and generate power. Recreation was a small part of the original purpose of the Missouri River reservoirs, but became the largest financial contributor to the State of South Dakota. Based on the average $79/trip estimate for resident and nonresident anglers combined (U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census 2008), reservoir fisheries contribute over 39 million dollars annually to the economy of South Dakota. The four reservoirs produce over 500,000 angler days annually (Adams et al. 2009a, Adams et al. 2009b, Sorensen and Knecht 2009). In 2009, there were over 100,000 angler days from the Fort Randall Dam tailwaters to the confluence of the Missouri River and the Big Sioux River near the Nebraska, Iowa border (Bouska and Longhenry 2010). The estimated economic impact of this entire stretch was $8.14 million. The Lewis and Clark reservoir system contributed over 36,000 angler days with an estimated economic impact of $2.86 million (Bouska and Longhenry 2010). Creel surveys conducted by Nebraska in 2010 focused specifically on Lewis and Clark Lake and estimated 16,002 angler days generating an economic impact of $1.26 million.

Sedimentation is an influential process in every reservoir system. The slowing of water flows decreases the ability to transport sediment, which then will accumulate in the upper end of the reservoir. In Lewis and Clark Lake, rapid deposition of sediment from the Niobrara River has formed what is known as the Niobrara Delta. Although this delta has decreased the storage capacity and has lessened the area available for recreation, there are some positive qualities that it provides. The braided channels and backwaters provide river fishes with habitats that were previously lost when the reservoir was formed. For example, Graeb (2006) showed a shift in the sauger spawning location from below Fort Randall Dam to within the Niobrara River delta. Also, it must be noted that the endangered pallid sturgeon is captured more frequently in the delta (Klumb USFWS personal communication).

The purpose of this report is to provide a summary of the data collected from Lewis and Clark Lake and the Missouri River downstream from Gavins Point Dam during 2010, and to provide management recommendations to enhance or conserve the recreational sport fisheries contained therein.

MANAGEMENT OBJECTIVES

Reservoir-wide Objectives and Strategies

- Provide a fishery which can annually support 25,000 angler trips with a catch rate of 0.5 fish/hour.
- Annually protect and enhance the quality and diversity of the fish community and aquatic habitats in Lewis and Clark Lake and the river reach upstream.
- Increase public knowledge and awareness of problems and issues affecting Lewis and Clark Lake.
- Continually maintain adequate access.

Species Specific/Lake Specific Objectives

<u>Walleye</u>

- Maintain three mature year classes in the population.
- Manage for a balanced population with a PSD between 30 and 60 and a PSD-P of at least 10.
- Maintain a population survey gill net catch per unit effort of at least 4 fish/net-night.
- Provide a population that can sustain 25,000 angler days annually, with a harvest of 10,000 walleye at a rate of 0.1 fish/hour.

<u>Sauger</u>

- Maintain three mature year classes in the population.
- Manage for a balanced population with a PSD between 30 and 60 and a PSD-P of at least 10.
- Maintain a population survey gill net catch per unit effort of at least 6 fish/net-night.
- Provide a population that can sustain 25,000 angler days annually, with a harvest of 5,000 sauger at a rate of 0.1 fish/hour.

Channel catfish

- Manage for a balanced population with a PSD between 30 and 60 and a PSD-P of at least 10.
- Maintain a gill net CPUE of 3.0 fish/net night.

Largemouth and smallmouth bass

- Maintain a PSD between 30 and 60 and a PSD-P of 20 for each species.
- Maintain an electrofishing catch rate of 10 fish/hour for both species.
- Document or index population structure and function.

Sampling Objectives (Federal Aid Code 2102)

- Species composition
- Relative abundance
- Age structure
- Growth
- Condition
- Reproduction and recruitment
- Survival and mortality rates
- Population size structure
- Effects of regulations

Emphasis is given to important sport and prey species, as well as species that are threatened or endangered. Common and scientific names and abbreviations of fishes contained in this report are provided in Appendix 1.

STUDY AREA

Lewis and Clark Lake is the lowermost reservoir of the Missouri River system. Stretching 110 km from Fort Randall Dam to Gavins Point Dam, the Lewis and Clark Lake system contains reservoir, delta and riverine habitats (Figure 1). The upstream river reach (referred to as the Missouri River) is approximately 60-km long and extends from Springfield, SD, upstream to Fort Randall Dam. Normal pool elevation for Lewis and Clark Lake is 1,208 feet above mean sea level. Reservoir surface area is 12,707 ha at normal pool, with a storage capacity of 6.06 million cubic meters. Maximum depth is 13.7 m with a mean depth of 5.0 m. There is approximately 144 km of shoreline surrounding the lake when it is at normal pool elevation. The Lewis and Clark Lake watershed drains 41,440 square kilometers, with the area above Gavins Point Dam draining 682,410 square kilometers. The small size of the Lewis and Clark reservoir system makes it more sensitive to water releases by the USACOE. When releases from Gavins Point Dam reach maximum flow, all the water in the reservoir can be replaced in just a few days. The timing, duration, and magnitude of releases can effect primary and secondary production, fish recruitment, and other ecological variables within the reservoir, though it is not fully known to what extent. Monthly water releases in 2010 were above the long-term averages for much of the year (Figure 2).

The annual fish population surveys divide the reservoir into two sections for monitoring purposes; Lewis and Clark Lake and the Missouri River. The lake section starts at Gavins Point Dam and extends upstream to the first sandbars of the Niobrara Delta (river mile 838). The Missouri River section starts at the first sandbars of the Niobrara Delta and extends upstream to Fort Randall Dam. The river section includes many diverse habitat types including free flowing river, braided channels, and backwaters, while the lake section is primarily lacustrine habitat. Fish surveys were also conducted at the Gavins Point Dam tailwaters.

Major sedimentation processes in the reservoir include shoreline erosion, littoral drift and delta encroachment. Beginning in Wyoming and running through Nebraska, the Niobrara River is the main tributary entering Lewis and Clark Lake from the southwest. Draining over 31,000 square kilometers of the Nebraska Sandhills, the Niobrara River contributes over half of the 4 million tons of sediment deposited in the lake annually.

Authorized water uses for Lewis and Clark Lake, as listed in the U.S. Army Corps of Engineers Master Plan, include flood control, navigation, hydropower, fish and wildlife, recreation, irrigation, and municipal and industrial water supply.

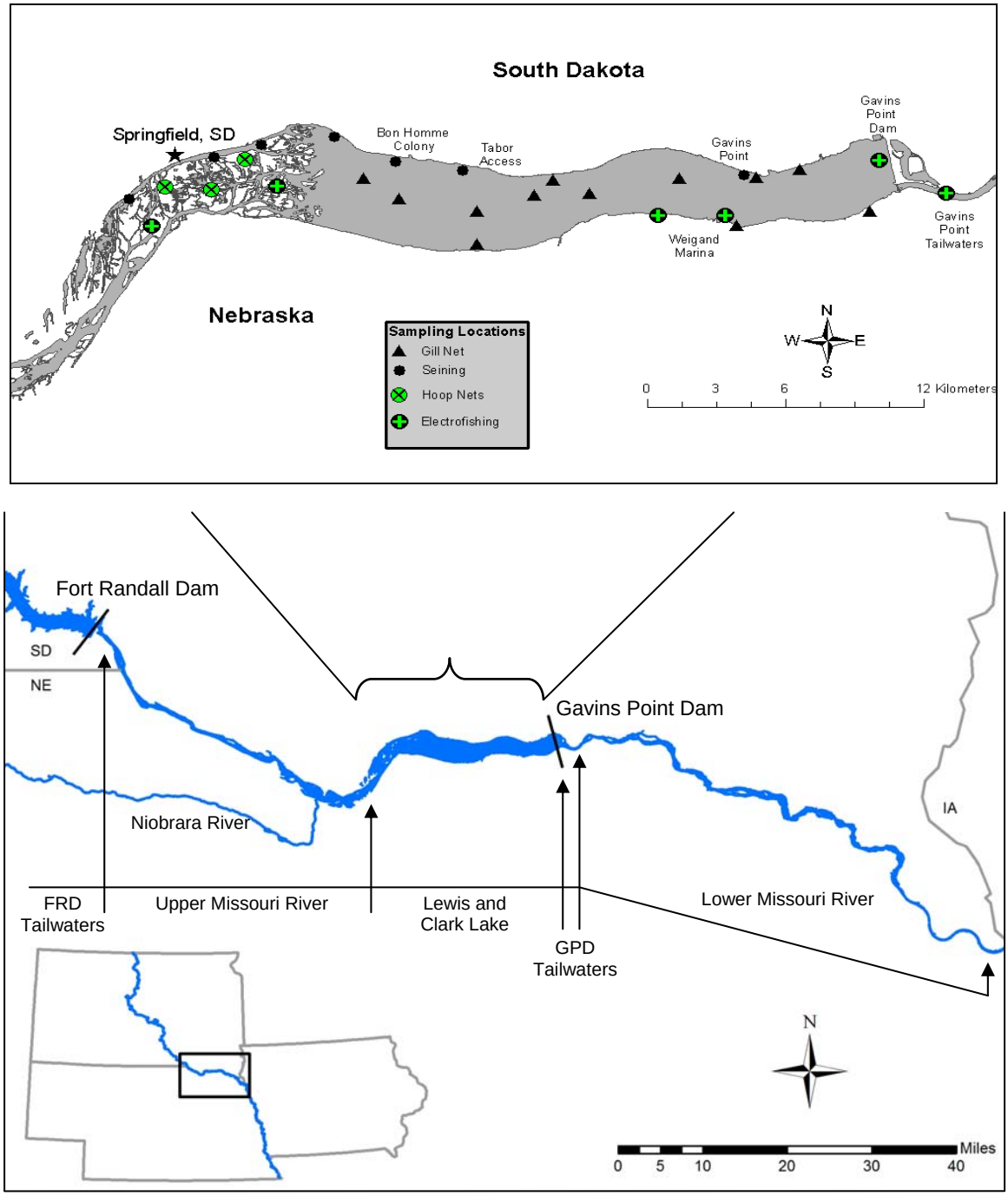

Figure 1. An illustration of the Missouri River from Fort Randall Dam to the South Dakota downstream border with select sampling locations in Lewis and Clark Lake.

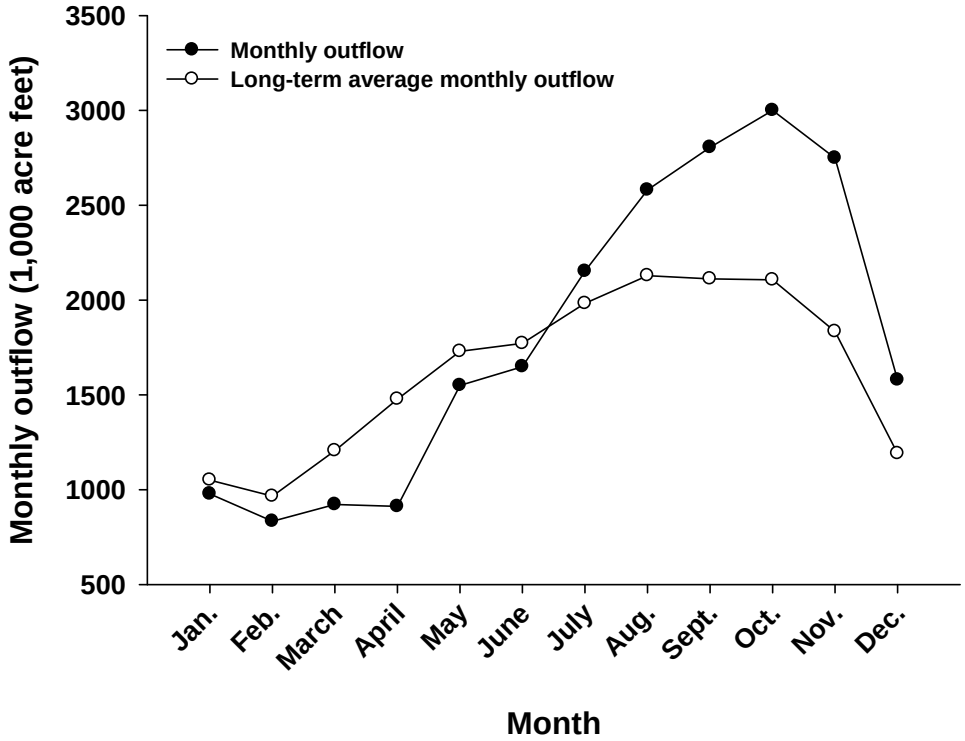

Figure 2. Monthly and long-term average outflows from Gavins Point Dam, South Dakota, 2010.

METHODS

Fish Population Surveys

Fish populations in Lewis and Clark Lake were sampled with gill nets, hoop nets, shoreline seines, and daytime and nighttime electrofishing during 2010. Table 1 provides sampling efforts for the various gears and locations.

Table 1. Sampling methods, target species and effort for Lewis and Clark Lake sampling, 2010. GPDT = Gavin's Point Dam tailwater, FRDT = Fort Randall Dam tailwater, Age-0 = age-0 walleye and sauger.

Area	**Lewis and Clark Lake**					**Delta**				**GPDT**	**FRDT**
Method	**Gill Net**	**Electrofish**			**Seine**	**Electrofish**		**Seine**	**Hoop Net**	**Electrofish**	
Target	All	SMB	FCF	Age-0	All	LMB	SMB	All	CCF	SMB	SMB
Effort	12 net nights	60 min	120 min	120 min	8 hauls	97 min	60 min	N/A	64 net nights	60 min	120 min

Lewis and Clark Lake

Experimental multifilament gill nets were used on September 21 and 22, 2010. Gill nets were 91.4 m in length and 1.8 m deep and consisted of 15.2 m panels of 12.7, 19.1, 25.4, 31.8, 38.1 and 50.8 mm bar mesh. Twelve nets were set overnight for a total of 12 net nights of effort. Fixed net locations were randomly chosen during the 2007 survey (Knecht et al. 2008). Total length (mm) and weight (g) were recorded for all species captured. Otoliths were collected from walleye and sauger (Tesch 1971) and pectoral spines were collected from channel catfish for age analyses (Sneed 1951; Ashley and Garling 1980).

A bag seine was used to target age-0 fishes and adult prey species (e.g., shiner spp., cyprinid spp.) in Lewis and Clark Lake. Seine dimensions were 30.5 m long by 2.4 m deep and composed of 6.4-mm bar measure nylon mesh, with bag dimensions of 1.8 m by 1.8 m. The quarter-arc haul method was used as described by Hayes et al. (1996). Seine collections took place on July 19 and 20, 2010. Two seine hauls were made at each of the following sites: Sand Creek (RM 828), Charlie Creek (RM 825), Bon Homme colony (RM 822), and Gavins Point (RM 815). All fish collected were identified and enumerated.

Smallmouth bass were sampled by nighttime electrofishing near Gavins Point Dam on May 18, 2010, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of three runs totaling 60 minutes. Effort was measured in pedal time which was defined as the amount of time the generator was creating an electric current. All smallmouth bass were measured for total length (mm) and weight (g) and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Flathead catfish were collected by electrofishing along riprap areas in Lewis and Clark Lake on June 24 and 30, 2010, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 460 volts, 2 amps and 15 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of six runs totaling 120 minutes. All flathead catfish were measured for total length (mm), and weight (g), and a pectoral spine was collected for age analysis (Turner 1982; DeVries and Frie 1996).

Fall night electrofishing was initiated in 2008 at twelve randomly chosen locations as a new method to index age-0 walleye and sauger recruitment in the reservoir. These sites were resampled October 28, 2010 with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of 10 minutes at each site. Collected fish were identified and measured.

Missouri River

Shoreline seine surveys are typically used to target age-0 fishes and adult prey species (e.g., shiner spp., cyprinid spp.) in the Missouri River between RM 829 and 835 during July. Unfortunately, heavy rainfall and above average releases from Fort Randall dam inundated all suitable seining habitat within the Niobrara River delta and seining surveys could not be safely conducted in 2010.

Smallmouth bass were sampled by daytime electrofishing from the Gavins Point Dam tailwater area on May 19, 2010, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of three runs totaling 60 minutes. All smallmouth bass were measured for total length (mm), and weight (g), and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Smallmouth bass were collected by night electrofishing from the Fort Randall Dam tailwater area on June 9, 2010 and October 12, 2010, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of three runs totaling 60 minutes each time (six runs, 120 minutes total effort). All smallmouth bass were measured for total length (mm), and weight (g), and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Smallmouth bass were also collected by daytime electrofishing in the Running Water area of the Niobrara delta, Missouri River, near Springfield, South Dakota on May 17, 2010, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of four runs totaling 60 minutes. Smallmouth bass were measured for total length (mm), and weight (g), and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Largemouth bass were collected by daytime electrofishing near Springfield, South Dakota on May 18, 2010, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of six runs totaling 97 minutes. Largemouth bass were measured for total length (mm), and weight (g), and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Channel catfish were collected from the Niobrara River delta area using hoop nets on August 11 and 13, 2010. Twenty-four nets were baited with cheese and remained in the water for two consecutive nights. Hoop net diameter and mesh size varied. Nineteen nets had a diameter of 508 mm with two different mesh sizes; 25 mm (N=10) and 38 mm (N=9). Five other nets had larger diameters ranging from 891-960 mm and mesh sizes ranging from 19-32 mm. Eight of the deployed nets were not recovered. Loss of nets

could be attributed to above normal flows (Figure 2) resulting in the movement of nets from set locations to deeper habitats or downriver sites where they could not be located, entanglement of debris around the floats causing them to sink below the water surface, or the theft of nets by unauthorized individuals. Remaining nets were reset and remained in the water for two additional nights for a total of 64 net nights of effort. All channel catfish were measured for total length (mm), weight (g), and a pectoral fin ray was collected from channel catfish for age analysis (Sneed 1951; Ashley and Garling 1980).

Data Analysis

Structural indices were used to describe recruitment, growth, and mortality of sport fish species. Relative abundance was expressed as catch per unit effort (CPUE) for standard gill netting (number/net night), seining (number/seine haul), electrofishing (number/hour) and hoop netting (number/net night) surveys. Length data were described by proportional size distribution (PSD; Anderson 1980; Gablehouse 1984; Guy et al 2007). Species specific length categories are listed in Table 2.

Table 2. Length categories (mm) used for calculating stock density indices for targeted fish species (Gabelhouse 1984; Quinn 1991).

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	250	380	510	630	760
Sauger	200	300	380	510	630
Channel catfish	280	410	610	710	910
Flathead catfish	350	510	710	860	1020
Largemouth bass	200	300	380	510	630
Smallmouth bass	180	280	350	430	510

Condition was assessed through relative weight calculations by dividing the weight of a fish by a length-specific standard weight for that species (Wege and Anderson 1978). Standard weight equations used for walleye (Murphy et al. 1990), sauger (Guy et al. 1990), smallmouth bass (Kolander et al 1993), largemouth bass (Henson 1991) channel catfish (Brown et al. 1995), and flathead catfish (Bister et al. 2000) are listed in Appendix 2.

Age and growth information was obtained from otoliths, scales, and pectoral fin rays (DeVries and Frie 1996). Aging structures were removed from all walleye, sauger, channel catfish, flathead catfish, largemouth bass, and smallmouth bass and ages were estimated based on enumeration of annuli. Age distributions were developed for the entire sample (i.e., fish without estimated ages were assigned an age with an age-length key). Scale ages were determined by counting annuli and back-calculations were made using Topeka Shiner 1.1 (Francis 2010) computer software. Back-calculations were used

to determine mean length at age, which was then compared with statewide averages or averages from other Missouri River reservoirs when available. Otoliths were removed from walleye and sauger by methods described in DeVries and Frie (1996), allowed to dry and were then cracked through the focus. One otolith from each fish was sanded with a precision rotary tool using the rotating disc sander attachment to clarify annuli and subsequently viewed under a microscope. Pectoral spines were allowed to dry, then sectioned using a low speed diamond blade saw and viewed under a microscope (Sneed 1951; Ashley and Garling 1980). Back-calculated lengths were also estimated for channel and flathead catfish aged with pectoral fin rays. Age distributions were generated with Topeka Shiner 1.1 analysis using the expanded age-length summary table which uses an age-length key to provide age distributions for the entire sample of fish collected.

Catch curve estimates of annual survival, annual mortality and instantaneous mortality rates were made utilizing FAST 2.1 software (FAST 2001) from methods developed by Ricker (1975). Catch curves were visually analyzed to determine what age classes were fully recruited to the sampling gear. To reduce the effects of variable recruitment, two consecutive years of age distribution data were combined for analysis. Also, more than two consecutive years were combined to increase precision for species with small sample size.

Angler Use and Sportfish Harvest Surveys

The University of Nebraska, Lincoln in cooperation with the Nebraska Game and Parks Commission, conducted an angler use and sportfish harvest survey on Lewis and Clark Lake, April – November, 2010. Select results of this survey have been reported with permission from the Nebraska Game and Parks Commission.

RESULTS AND DISCUSSION

Lewis and Clark Lake

Seines

Sixteen species were sampled in 2010. Catch per unit effort, or number of fish per seine haul fell back below the long-term average in 2010 (Figure 3). Emerald shiner CPUE was comparable to 2009, dropping slightly from 85.6 per seine haul to 75.8 per seine haul (Table 3). Age-0 emerald shiners and gizzard shad were the most common species sampled although gizzard shad CPUE in 2010 was lower than recent years and much lower than 2009 (Table 3). Catches of most species were reduced from 2009 to 2010, with the exception of Johnny darters, which were more abundant than normal. No age-0 walleye or sauger were sampled with seines in 2010. Both species are typically collected, and this is the first recorded absence of age-0 walleye since annual sampling began in 1981. Several uncommon cyprinids were collected in 2010 including a Northern redbelly dace and a creek chub. Otherwise, species composition was relatively similar to the 2009 sample.

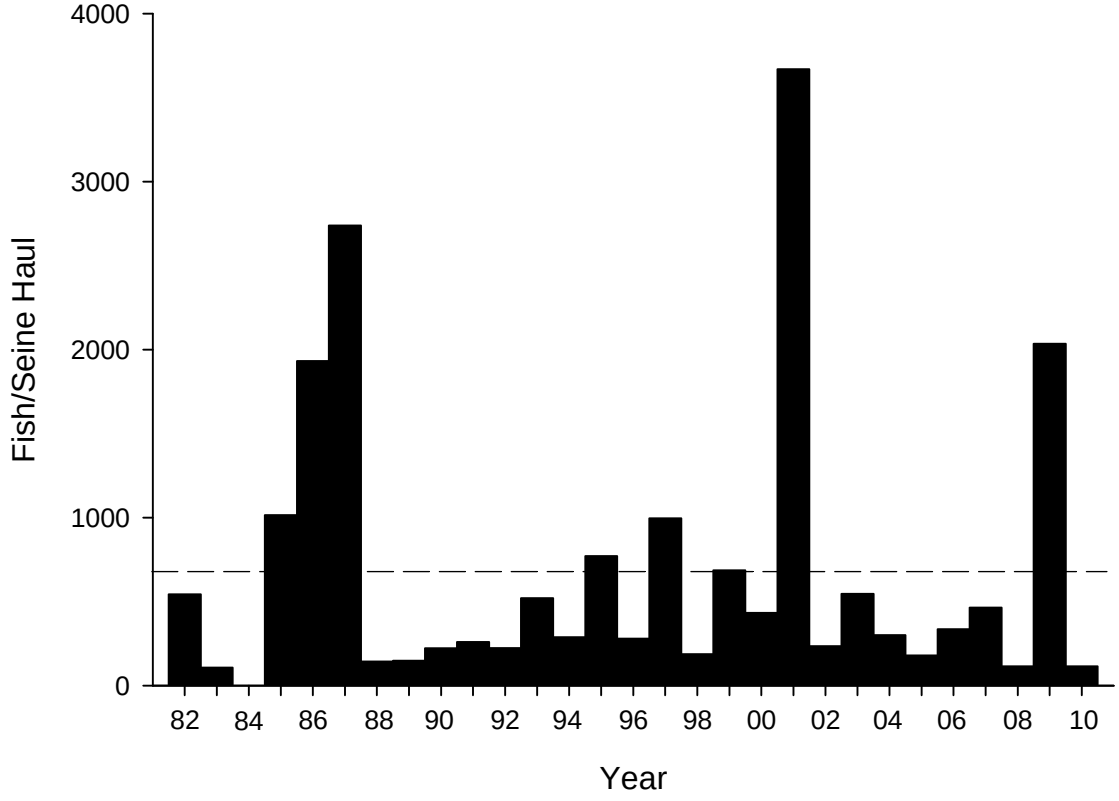

Figure 3. Mean number of fish captured per seine haul from Lewis and Clark Lake, South Dakota, 1981-2010. Dotted line represents long-term mean catch per haul.

Shields (1957) listed 22 species captured with seines in 1956 during the second year of impoundment of Lewis and Clark Lake (Table 3). Abundant species sampled included common carp, river carpsucker, buffalo spp., and a wide variety of minnows, chubs and shiners. Species such as western silvery minnow, redfin shiner, silverstripe shiner, flathead chub and sand shiner were sampled during the period directly after impoundment; however, these species are rarely sampled during current surveys.

Newly formed delta habitats have been shown to affect fish habitat utilization (Graeb 2006) and species richness and diversity. Kaemingk et al. (2007) showed species richness was greater in the Niobrara River delta (N=37 species) compared to Lewis and Clark Lake (N=23). Thirteen species were found exclusively in the delta area, while no species were found exclusively in the reservoir area. These findings, along with decreases in species richness following impoundment, imply that the delta formation increases species richness by creating habitats that are characteristic of a natural riverine environment (i.e., braided channels and backwaters).

Seining efficiency can vary greatly for individual species. Species most vulnerable to collection by seine include those that inhabit the middle of the water column, while benthic species are less vulnerable and subsequently can be underestimated (Lyons 1986, Parsley et al. 1989). As a method of assessing age-0 and small littoral fishes, seining may underestimate species such as darters, redhorse species, and river carpsucker. Additionally, fluvial habitats can inhibit proper deployment of seining gear as can woody debris and vegetation. Heavy spring and summer rains raised water levels in the Missouri River reservoirs in 2010. Evacuation of these flood waters resulted in both greater current velocities and higher river stages than are normally experienced during this survey (Figure 2). These factors could have contributed to lower catch rates.

Table 3. Catch per unit effort (fish/seine haul) for seining surveys at Lewis and Clark Lake, South Dakota, 1956 and 2005-2010, including age-0 and adults. Standard error (SE) is included 2005-2010. *total number sampled.

Species	1956*	2005	2006	2007	2008	2009	2010
Bigmouth buffalo	91	--	--	0.1 (0.1)	0.1 (0.1)	--	--
Black bullhead	4	--	--	--	--	--	--
Black crappie	191	--	--	0.1 (0.1)	--	0.1 (0.1)	--
Bluegill	15	--	1.1 (1.0)	0.9 (0.4)	--	1.6 (1.6)	0.3 (0.3)
Bluntnose minnow	--	0.9 (0.6)	--	--	--	--	--
Central stoneroller	--	--	--	--	--	0.1 (0.1)	--
Channel catfish	1	--	--	0.4 (0.3)	--	0.3 (0.2)	0.1 (0.1)
Common carp	1951	--	--	0.1 (0.1)	0.3 (0.3)	--	0.1 (0.1)
Common shiner	--	--	--	--	--	0.3 (0.3)	--
Creek chub	--	--	--	--	--	--	0.1 (0.1)
Emerald shiner	34	65.4 (15.5)	91.9 (39.9)	374.5 (237)	6.8 (0.8)	85.6 (47.8)	75.8 (46.4)
Fathead minnow	24	--	--	--	--	--	1.6 (1.1)
Flathead catfish	--	--	--	0.1 (0.1)	--	--	--
Freshwater drum	--	4.8 (1.7)	8.3 (4.4)	13.3 (7.9)	21.9(12.4)	1.1 (0.7)	0.3 (0.3)
Gizzard shad	132	93.3 (29.5)	200.3 (103.0)	74.0 (37.5)	69.4 (9.0)	1876.5 (1873.2)	20.3 (20.1)
Green sunfish	1	--	--	--	--	--	--
Johnny darter	--	1.8 (1.2)	0.8 (0.4)	0.5 (0.4)	1.3 (1.1)	2.3 (2.0)	7.9 (5.2)
Largemouth bass	63	0.3 (0.2)	0.6 (0.5)	0.4 (0.3)	--	--	--
N. Redbelly dace	--	--	--	--	--	--	0.1 (0.1)
Orangespotted sunfish	2	--	--	0.1 (0.1)	--	--	--
Red shiner	--	0.4 (0.4)	0.4 (0.3)	0.9 (0.4)	5.3 (3.9)	1.0 (1.0)	--
Redfin shiner	48	--	--	--	--	--	--
River carpsucker	575	--	0.1 (0.1)	0.3 (0.3)	0.3 (0.3)	0.3 (0.2)	0.5 (0.4)
Sauger	21	0.1 (0.1)	0.1 (0.1)	--	--	0.4 (0.2)	--
Shorthead redhorse	33	--	--	1.5 (0.8)	0.8 (0.4)	1.0 (0.8)	0.3 (0.3)
Shortnose gar	9	--	--	0.5 (0.5)	--	0.1 (0.1)	0.1 (0.1)
Silverstripe shiner	4	--	--	--	--	--	--
Smallmouth bass	--	1.0 (0.3)	4.3 (1.2)	1.0 (0.7)	0.1 (0.1)	1.0 (0.5)	--
Smallmouth buffalo	164	--	--	--	--	--	--
Spotfin shiner	--	3.5 (2.0)	0.1 (0.1)	--	1.3 (1.3)	1.9 (1.5)	5.0 (4.0)
Spottail shiner	--	1.1 (0.7)	2.0 (1.2)	--	1.8 (0.8)	0.6 (0.2)	1.1 (0.4)
Walleye	--	0.8 (0.4)	0.8 (0.4)	0.3 (0.2)	1.5 (1.1)	1.5 (0.4)	--
Western silvery	1843	--	--	--	--	--	--
White bass	--	5.9 (2.3)	25.4 (9.6)	11.6 (9.2)	4.6 (1.7)	59.6 (44.1)	0.8 (0.5)
White crappie	196	--	--	0.3 (0.2)	--	--	--
Yellow perch	92	0.1 (0.1)	--	1.9 (1.7)	--	--	--

Gill Nets

Thirteen species were captured with gill nets in 2010 (Table 4). Sauger were the most abundant species sampled in gill nets representing 30 percent of the total fish captured (Figure 4). Walleye, channel catfish, and freshwater drum were the second, third, and fourth most abundant species sampled, respectively. Most species showed slight decreases in abundance since the 2009 sample, except for river carpsucker (2009 = 0.4 per net night, 2010 = 1.3 fish per net night; Table 4). Although walleye CPUE fell from 10.7 in 2009 to 7.2 in 2010, relative abundance is still higher than the 25-year average (5.8 /net night).

Species sampled with gill nets has varied over the years. Gill net sampling shortly after the closure of Gavins Point Dam in 1955 captured nineteen species throughout the entire sampling season with seventeen species sampled during fall netting (Table 4; Shields 1957). Common carp, bigmouth buffalo and channel catfish were the most abundant species sampled in 1956 with low numbers of sauger and no walleye sampled (Table 4; Shields 1957). Blue sucker, pallid sturgeon and shovelnose sturgeon were routinely sampled in the years following Gavins Point Dam closure. Since the early 1970's, these species have been mostly absent from gill net samples, although one shovelnose sturgeon was captured in this survey. In 1983, ten species were sampled with gizzard shad, sauger, and walleye being the most abundant.

River species (e.g., blue sucker, sturgeon spp.) have been negatively impacted to the greatest extent by impoundment and reservoir formation. Delta development in Lewis and Clark Lake has led to some changes in fish communities (Graeb 2006, Kaemingk 2007). As the sedimentation process proceeds, species richness and diversity could increase in delta areas.

Table 4. Catch per unit effort (fish/net night) for gill nets at Lewis and Clark Lake, South Dakota, 1956, 1983, 2004-2010. Standard error (SE) is included (no standard errors are listed for 1956 sampling).

Species	1956	1983	2004	2005	2006	2007	2008	2009	2010
Bigmouth buffalo	8.2	--	0.1 (0.1)	--	--	--	0.2 (0.2)	0.1 (0.1)	0.1 (0.1)
Black bullhead	0.1	--	--	--	--	--	--	--	--
Black crappie	--	--	--	--	--	0.3 (0.2)	--	--	--
Blue catfish	0.1	--	--	--	--	--	--	--	--
Blue sucker	0.3	--	--	--	--	--	--	--	--
Channel catfish	5.8	3.0 (1.3)	2.6 (0.6)	7.0 (2.2)	2.5 (0.6)	8.2 (2.0)	5.5 (2.2)	4.3 (1.2)	3.9 (2.2)
Common carp	25.6	0.8 (0.3)	0.3 (0.1)	1.1 (0.3)	0.1 (0.1)	0.8 (0.2)	0.7 (0.4)	0.7 (0.3)	0.3 (0.2)
Emerald shiner	--	--	0.2 (0.1)	--	--	--	--	--	--
Flathead catfish	--	--	--	--	0.1 (0.1)	--	--	--	--
Freshwater drum	0.8	9.5 (5.3)	4.5 (1.1)	3.0 (0.8)	5.5 (1.5)	4.2 (1.0)	3.6 (1.1)	6.4 (1.5)	2.9 (1.0)
Gizzard shad	2.8	24.4 (23.1)	3.3 (1.1)	10.6 (5.7)	1.3 (0.9)	3.8 (1.2)	11.9 (6.3)	1.8 (0.8)	1.6 (1.1)
Goldeye	3.1	--	--	0.2(0.1)	--	--	--	--	--
Northern pike	--	--	--	--	--	--	--	--	0.1 (0.1)
Paddlefish	--	--	--	--	--	--	0.3 (0.1)	--	--
River carpsucker	3.1	3.0 (2.5)	1.8 (0.6)	0.3 (0.1)	1.4 (0.7)	1.1 (0.5)	2.2 (1.2)	0.4 (0.2)	1.3 (0.6)
Rock bass	--	--	--	--	0.1 (0.1)	--	--	--	--
Sauger	0.9	14.9 (1.4)	4.5 (0.8)	4.7 (1.2)	4.7 (0.7)	6.4 (1.8)	9.6 (2.1)	8.3 (1.4)	7.8 (2.0)
Shorthead redhorse	1.0	--	0.3 (0.2)	2.3 (0.9)	0.8 (0.4)	1.6 (0.7)	2.3 (0.8)	1.3 (0.5)	0.8 (0.3)
Shortnose gar	1.7	--	0.1 (0.1)	0.6 (0.3)	0.1 (0.1)	0.2 (0.1)	0.3 (0.1)	--	--
Shovelnose sturgeon	3.3	--	--	--	--	--	--	--	0.1 (0.1)
Smallmouth buffalo	0.5	--	0.1 (0.1)	--	0.1 (0.1)	0.2 (0.1)	0.1 (0.1)	0.1 (0.1)	--
Spottail shiner	--	--	--	--	0.1 (0.1)	--	--	--	--
Walleye	--	13.1 (1.8)	4.3 (0.9)	9.1 (2.4)	4.5 (0.6)	9.0 (2.1)	14.0 (3.3)	10.7 (1.7)	7.2 (1.4)
White bass	--	0.1 (0.1)	0.2 (0.1)	--	0.1 (0.1)	--	2.3 (0.8)	0.3 (0.2)	0.2 (0.1)
White crappie	0.6	1.9 (1.7)	0.1 (0.1)	--	0.2 (0.1)	0.1 (0.1)	0.3 (0.1)	0.4 (0.3)	0.3 (0.2)
Yellow perch	0.3	0.2 (0.1)	--	--	--	--	0.1 (0.1)	--	--

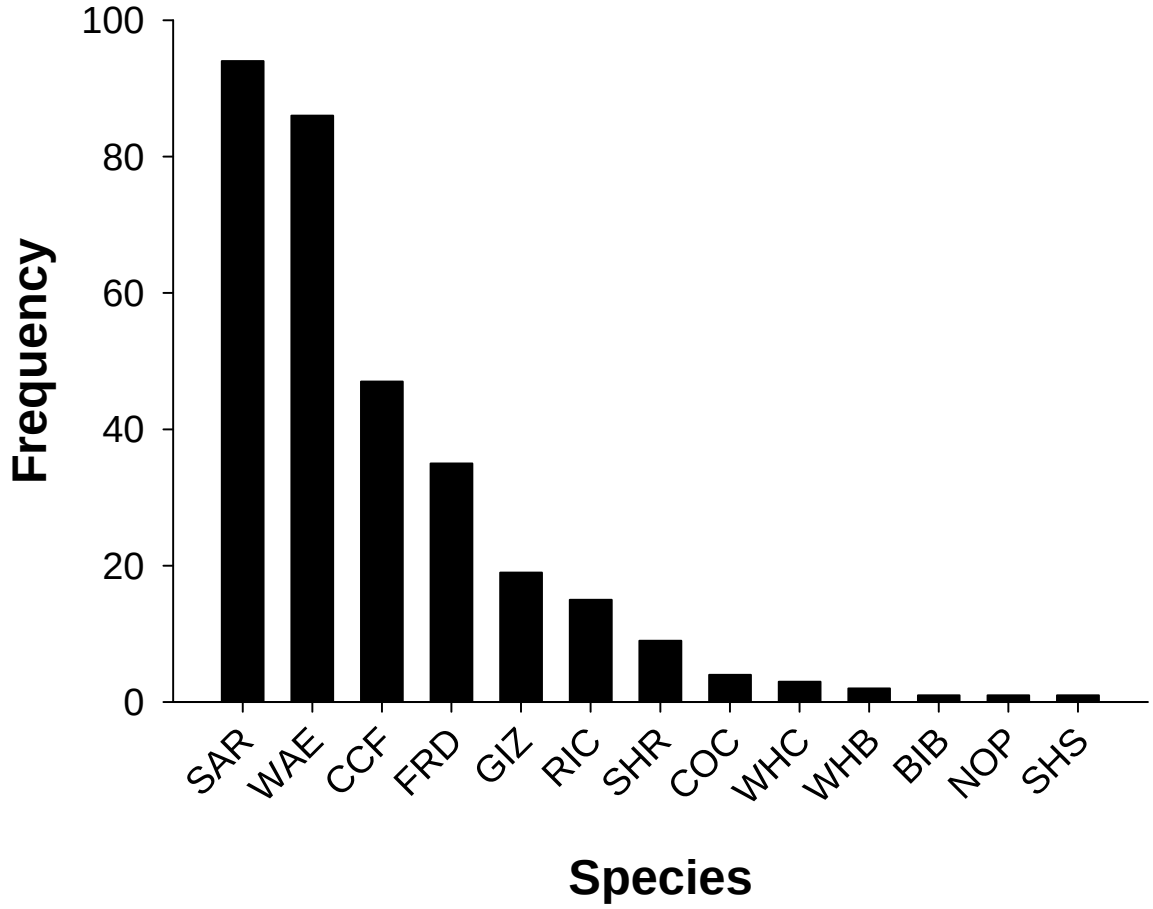

Figure 4. Number of each species collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2010. Abbreviations used are defined in Appendix 1.

Walleye population parameters

A total of 86 walleye were sampled during the standard September gill net survey resulting in a CPUE of 7.2 walleye per gill net (Table 4). Although CPUE fell slightly from 2009, the 2010 sample was still above the long-term average (5.8/net night). CPUE of harvestable size walleye (381 mm or 15 inches) was 2.5, indicating that about 30% of the walleye population is available for angler harvest. This is a slight reduction from 2009 when about 50% of sampled walleye were a harvestable size (Table 5, Figure 5).

Walleye size structure is quantified with proportional size distribution (PSD; Anderson 1980; Gablehouse 1984; Guy et al 2007). In 2010, walleye PSD was 38, and within the desired range of 30 – 60 (Anderson and Weithman 1978). However, PSD-P was 6, below the objective of 10 (Table 6).

Walleye exhibit fast growth, typically attaining mean lengths in excess of 381 mm during the third growing season (Table 7, Table 8). Elevated growth rates in Lewis and Clark Lake are likely a result of being the lowermost reservoir, thus experiencing warmer temperatures and a longer growing season. Also, the diverse habitats included in the reservoir (i.e. river, backwater, delta, and lake) likely contribute by providing a wide variety of prey species such as gizzard shad, shiner spp., freshwater drum, and river carpsucker. Wickstrom (2006) found that walleye

in Lewis and Clark Lake primarily consumed river carpsucker and freshwater drum in the spring. During the summer months, mayfly larvae and shiner spp. were important, while gizzard shad and freshwater drum were the most common food items during the autumn months. Mean relative weights for all size classes were similar to those observed in 2009, and comparable to previous years (Table 9).

Walleye recruitment in Lewis and Clark Lake is currently indexed with gill net CPUE of age-0 walleye. In 2010, only three age-0 walleye were sampled (CPUE = 0.25), indicating a small year class was produced. Lott et al. (2006) suggested that age-0 CPUE could be used as an indicator of year class strength because correlation analysis of age-0 CPUE and age-1 CPUE during the following year provided a strong correlation ($r = 0.8$, $p < 0.01$). This relationship in Lewis and Clark Lake is not as strong ($r = 0.56$, $p < 0.01$), but provides a rough index to recruitment. Fall night electrofishing was instituted in 2008 at 12 randomly selected sites in the lake portion of the reservoir to provide another useful index of age-0 walleye abundance (Serns 1982; Serns 1983). Conversely, others have indicated utility of this sampling method could be based upon water temperatures at the time of sampling (Borkholder and Parsons 2001). Also, Hansen et al. (2004) indicated that CPUE from fall night electrofishing should only be used as a crude index to abundance. CPUE of age-0 walleye collected by night electrofishing has dropped for two consecutive years from 76.5/hour in 2008 to 24.5/hour in 2009 to 8.5/hour in 2010 (age-0 walleye and sauger combined). Collectively, the lack of age-0 walleye and sauger in gillnet, seining, and night electrofishing surveys suggests a low year-class was produced in 2010.

Mean age of walleye sampled in 2010 (2.5) was unchanged from 2009. Strong year classes were formed in 2007 and 2008 and have contributed to the decrease in mean age. Despite this decrease in mean age, all age classes out to age-9 were present in the sample (Table 10). Annual survival for 2009-2010 pooled walleye data as estimated from catch curve analysis (Ricker 1975) was 0.37 (Table 11). Catch curves were visually inspected to locate the age class that represents the beginning of the decreasing limb. The analysis included all age classes that had at least five fish in the sample.

Table 5. Mean gill net catch per unit effort (fish/net night) for sauger and walleye, 381 mm and longer collected in standard gill net surveys, Lewis and Clark Lake, 2002-2010. Standard error (SE) is included in parenthesis.

Year	Sauger	Walleye
2002	3.8 (0.9)	2.2 (0.5)
2003	4.0 (0.7)	4.3 (0.7)
2004	2.3 (0.6)	2.0 (0.7)
2005	3.1 (1.0)	6.2 (1.9)
2006	2.0 (0.4)	3.0 (0.3)
2007	2.7 (0.7)	4.6 (1.2)
2008	3.8 (1.4)	7.6 (1.8)
2009	2.4 (1.0)	5.3 (1.0)
2010	2.0 (0.5)	2.5 (0.8)

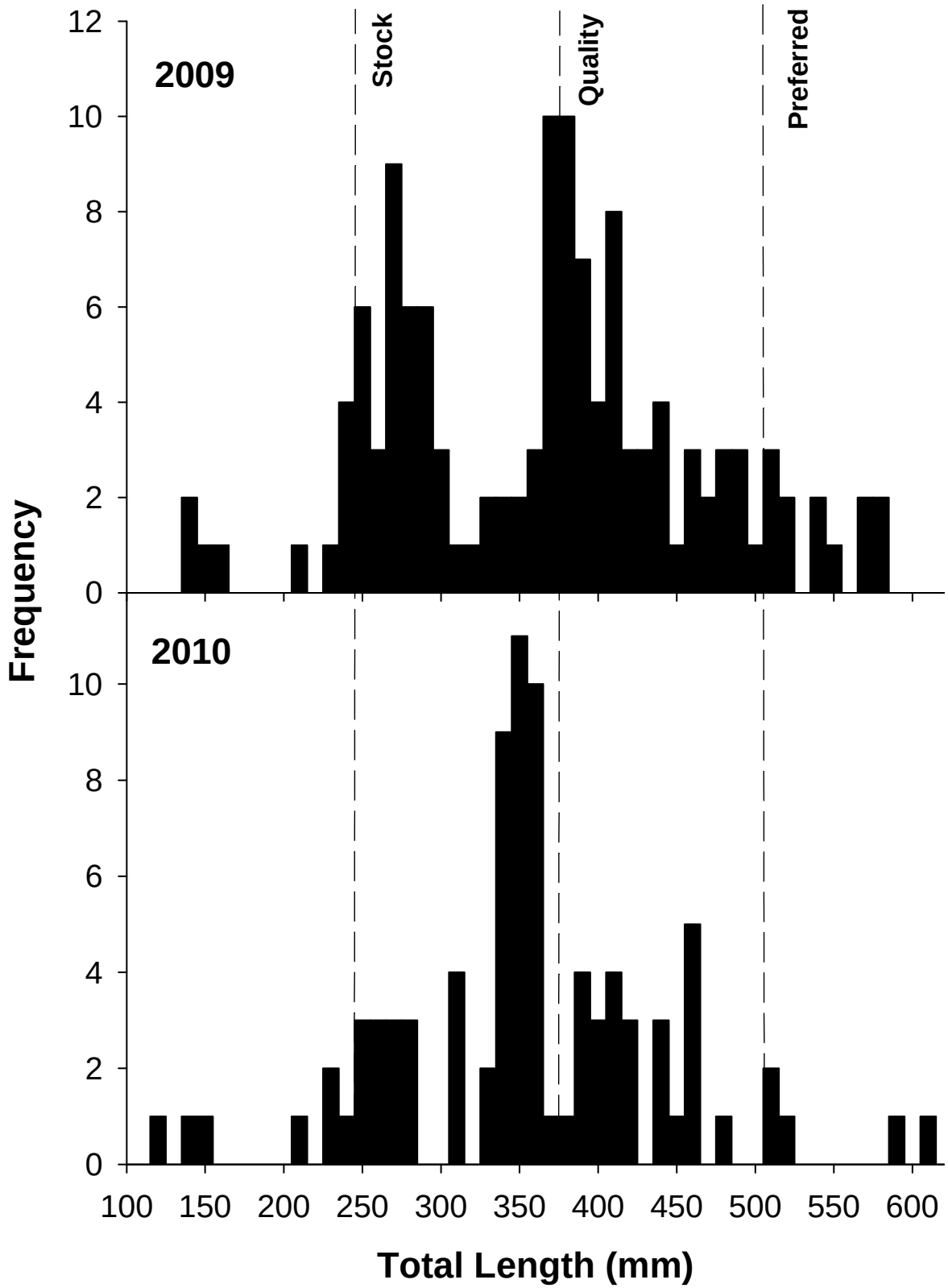

Figure 5. Length frequency of walleye collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2009 and 2010.

Table 6. Walleye proportional size distribution (PSD) and proportional size distribution of preferred and memorable-length fish (PSD-P and PSD-M) collected in standard gill net surveys, Lewis and Clark Lake, South Dakota, 2002-2010.

Year	PSD	PSD-P	PSD-M	Sample Size
2002	42	4	0	100
2003	61	11	0	127
2004	58	2	0	51
2005	88	7	0	109
2006	72	5	0	59
2007	79	17	0	108
2008	64	16	0	168
2009	54	10	0	128
2010	38	6	0	86

Table 7. Mean length at age of capture, as determined by ages estimated from otolith analysis, for walleye collected in the standard September gill net survey 2006-2010, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented.

		Length at age of capture (mm)												
Year		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2006	**Mean**	144	320	397	440	473	494	473	--	--	--	--	517	--
	N	2	10	14	13	9	3	1	--	--	--	--	1	--
	SE	6	11.3	4.4	7.3	11.8	23.4	--	--	--	--	--	--	--
2007	**Mean**	185	339	419	468	509	516	495	505	--	535	--	--	--
	N	38	14	22	17	8	3	3	2	--	1	--	--	--
	SE	3.3	11.5	5.8	6.5	14	14.2	42.5	50	--	--	--	--	--
2008	**Mean**	172	335	428	493	489	530	492	487	520	--	525	497	--
	N	25	51	23	36	14	6	6	1	1	--	1	2	--
	SE	5.7	3.7	6	5.5	9.4	17.3	29.2	--	--	--	--	10	--
2009	**Mean**	150	279	399	418	515	495	509	546	--	521	--	517	543
	N	4	44	53	6	6	4	2	3	--	1	--	4	1
	SE	4.4	4.4	4.4	17.6	22	28.3	13.5	19.9	--	--	--	14.2	--
2010	**Mean**	139	260	354	420	454	538	463	515	541	516	--	--	529
	N	3	16	40	16	2	2	2	1	2	1	--	--	1
	SE	8.8	4.8	3.1	6.2	8.5	52.5	2.0	--	75.0	--	--	--	--
Mean of means		158	307	399	448	488	515	486	513	531	524	525	510	536

Table 8. Mean annual growth increments for walleye collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2006-2010.

Year	Growth increment added during period (mm)							
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**
2006-2007	195	99	71	69	43	1	32	--
2007-2008	150	89	74	21	21	--	--	15
2008-2009	107	64	--	22	6	--	54	--
2009-2010	110	75	21	36	23	--	6	--
Mean	141	82	55	37	23	1	31	15

Table 9. Mean relative weight (Wr) by length category of walleye, collected during the standard September gill net surveys on Lewis and Clark Lake, South Dakota, 2002-2010. Sample size (N) and standard error (SE) are also presented.

	Stock-quality		**Quality-preferred**		**Preferred-memorable**	
Year	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	80 (0.4)	44	81 (1.0)	29	84 (1.0)	3
2003	87 (0.7)	42	82 (0.3)	54	80 (1.5)	12
2004	81 (0.9)	20	80 (0.6)	27	83 (--)	1
2005	81 (1.8)	10	83 (0.2)	69	80 (0.3)	6
2006	87 (1.5)	16	83 (0.4)	38	85 (3.7)	3
2007	89 (1.3)	15	91 (0.5)	44	87 (1.0)	12
2008	91 (0.3)	52	91 (0.6)	68	88 (0.4)	23
2009	83 (0.4)	54	81 (0.8)	52	82 (1.3)	12
2010	81 (0.4)	49	82 (0.6)	25	78 (2.7)	5

Table 10. Age distribution of walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010, as determined from scales (2002 – 2005) and otoliths (2006 – 2010). Mean age excludes age-0 fish.

Year	Age														
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Mean**
2002	24	39	21	5	11	0	0	0	0	0	0	0	0	0	1.8
2003	19	24	52	10	6	5	1	2	4	3	0	1	0	0	2.8
2004	3	7	20	13	7	1	0	0	0	0	0	0	0	0	2.5
2005	24	6	15	28	23	4	4	4	0	0	0	0	0	0	3.4
2006	2	10	14	14	9	6	1	0	0	0	0	1	0	0	3.0
2007	38	14	22	17	9	3	3	2	0	1	0	0	0	0	2.8
2008	25	51	23	37	15	6	6	1	1	0	1	2	0	0	2.7
2009	4	44	53	6	6	4	2	3	0	1	0	4	1	0	2.5
2010	3	16	40	16	2	2	2	1	2	1	0	0	1	0	2.5

Table 11. Catch curve estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (-Z) for walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Age range is the range of ages used to calculate catch curve statistics. Scales (2002-2005) and otoliths (2006-2010) were used to estimate ages.

Years	S	A	-Z	R^2	Age range
2002-2003	0.45	0.55	0.807	0.85	2-5
2003-2004	0.44	0.56	0.818	0.98	2-5
2004-2005	0.37	0.63	0.982	0.84	3-5
2005-2006	0.48	0.52	0.737	0.94	3-6
2006-2007	0.54	0.46	0.614	0.99	3-5
2007-2008	0.52	0.49	0.663	0.91	3-6
2008-2009	0.55	0.46	0.606	0.98	2-6
2009-2010	0.37	0.63	0.983	0.94	2-5
2002-2010	0.56	0.44	0.587	0.98	2-9

Sauger population parameters

Sauger are an important component of the fishery and are commonly sampled at higher relative densities than walleye. In 2010, 94 sauger were sampled during the gill net survey with a CPUE of 7.8 fish/net night (Table 4). Mean gill net CPUE for sauger 381-mm (15 inches) and longer decreased slightly from 2009 to 2.0 fish/net night, but is still comparable to catches from recent years (Table 5).

Sauger PSD-Q (82) increased in 2010 while PSD-P (26) was reduced, compared to 61 and 36, respectively, during the 2009 sampling (Table 12). While a generally accepted stock density index range is not readily available for sauger, the generally accepted range for walleye is 30-60. In 2010, the strong 2008 year class attained the quality-to-preferred length category which resulted in a PSD of 82 (Table 12, Figure 6).

Sauger generally grow slower than walleye (Malison et al. 1990); however, growth rates of Lewis and Clark Lake sauger are typically similar to walleye growth rates (Table 7, Table 13). Sauger growth observed in 2010 was increased from 2009 and near the four year average (Table 14).

Sauger relative weights for Lewis and Clark Lake are generally between 77 and 85 (Table 15). In 2010, sauger relative weights were within this range for all size groups indicating sufficient prey availability. Wickstrom (2006) suggested that diet overlap with walleye combined with insufficient quantity and quality of prey items could be a possible explanation for moderate relative weights of sauger in Lewis and Clark Lake during most years.

Similar to walleye, sauger recruitment is indexed with age-0 CPUE from the September gill net survey. In 2010, age-0 CPUE was 0.1, indicating low recruitment, less than 2009 (CPUE = 1.3; Table 16). Fall night electrofishing showed a similar decrease in age-0 CPUE from 34.5/hour in 2008 to 3.5/hour in 2009, and a walleye/sauger combined CPUE of 8.5/hour in 2010. However, CPUE from fall night electrofishing should only be used as a crude index to abundance (Hansen et al. 2004). Mean age of sauger (2.1 years) increased slightly from 2009 but was still reduced from previous years. Age-2 sauger was the most prevalent sampled age class in 2010 comprising 53% of the total sample, excluding age-0 fish.

Annual survival for 2009-2010 pooled sauger data was 28% (Table 17), as estimated from catch curve analysis (Ricker 1975). Pooling several years of data can reduce variability by including data from older year classes as long as the population is assumed to be in equilibrium except for random variations in recruitment (i.e., no steady decreases or increases are observed for mortality or recruitment) (Ricker 1975). The 2002-2010 pooled catch curve provided an estimated survival of 50%, which is likely a more accurate estimate for this population because data for age classes 2-7 were used for the analysis.

Many sauger populations have experienced declines during the last several decades, leading to listing as a ‘species of concern’ in some areas (McMahon and Gardner 2001; Pegg et al. 1996). The sauger population in Lewis and Clark Lake appears to be one of the most stable in their range. Niobrara River delta habitat is expanding annually, increasing the amount of habitat resembling the pre-dam Missouri River with increases in channel braiding, backwater area and turbidity. This expanding habitat should help enhance the current sauger population in Lewis and Clark Lake. However, the loss of pure sauger from this stretch of Missouri River due to high levels of natural hybridization with walleye (Graeb 2006) could greatly impact this sauger fishery.

Table 12. Sauger proportional size distribution (PSD) and proportional size distribution for preferred and memorable-length fish (PSD-P and PSD-M) collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010.

Year	PSD	PSD-P	PSD-M	Sample Size
2002	76	53	3	107
2003	93	62	2	96
2004	86	63	4	54
2005	96	78	6	56
2006	98	51	3	59
2007	69	59	0	77
2008	93	51	10	115
2009	61	36	2	99
2010	82	26	0	94

Table 13. Mean length at age of capture, as determined by ages estimated from otolith analysis, for sauger collected in the standard September gill net survey 2006-2010, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented.

		Length at age of capture (mm)											
Year		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2006	**Mean**	--	315	378	426	479	478	481	443	--	--	--	--
	N	0	15	25	2	8	3	1	1	--	--	--	--
	SE	--	4.6	4.0	32.0	10.4	20.6	--	--	--	--	--	--
2007	**Mean**	198	313	402	432	500	--	480	--	--	--	--	--
	N	33	8	17	16	2	0	1	--	--	--	--	--
	SE	3.0	7.3	3.7	7.8	5.0	--	--	--	--	--	--	--
2008	**Mean**	174	336	437	463	482	502	496	490	--	--	--	466
	N	30	40	12	12	10	4	2	3	0	0	0	1
	SE	2.7	12.7	26.1	69	97.6	174	325	41.8	--	--	--	--
2009	**Mean**	145	277	380	441	469	444	482	470	490	--	--	--
	N	16	37	31	7	3	1	2	1	1	--	--	--
	SE	2.8	3.3	5.0	14.8	30.9	--	54.0	--	--	--	--	--
2010	**Mean**	155	275	352	395	437	440	--	--	--	--	--	--
	N	1	19	49	19	3	3	--	--	--	--	--	--
	SE	--	4.5	2.7	7.6	33.8	14.5	--	--	--	--	--	--
Mean of means		168	303	390	431	473	466	485	468	490	--	--	466

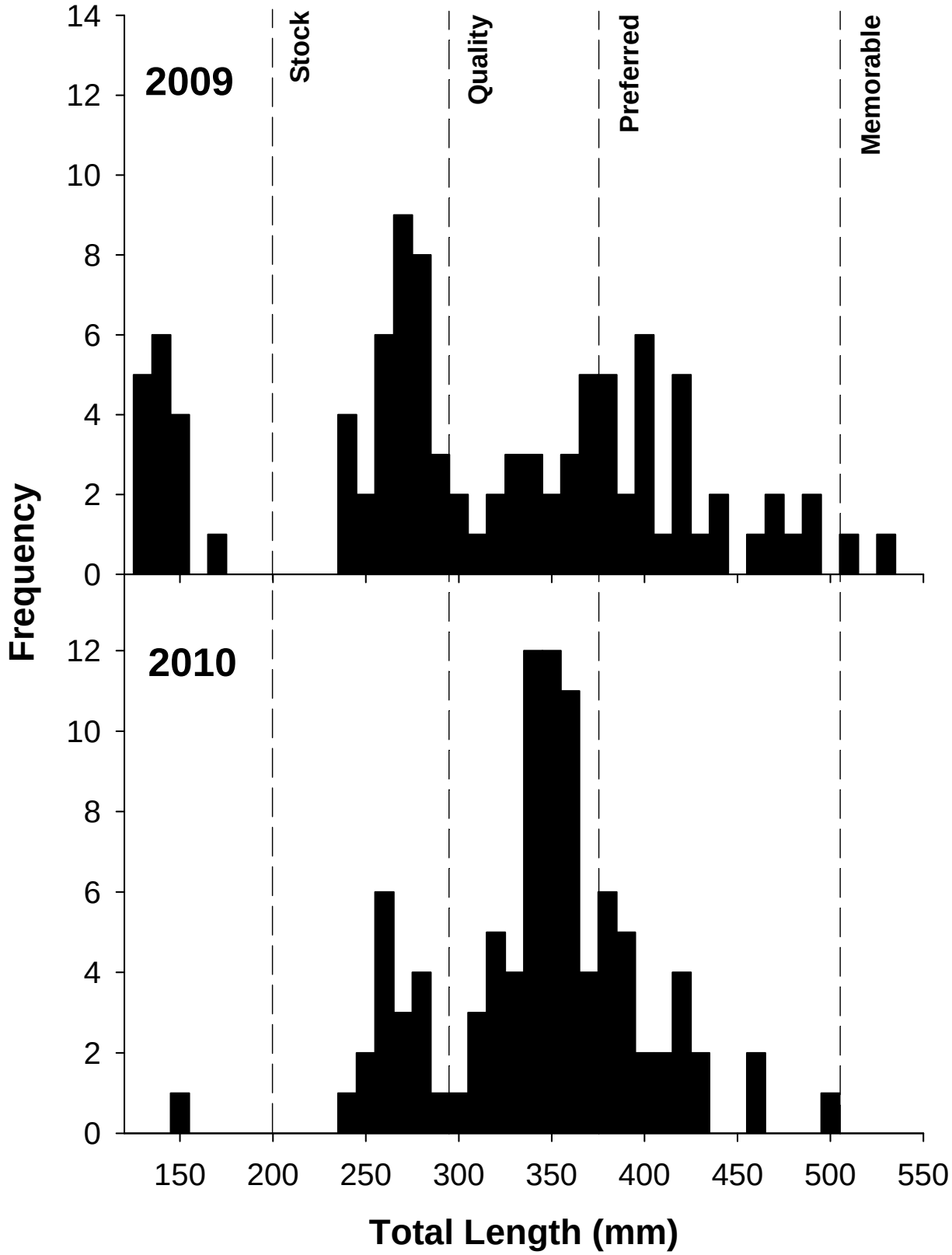

Figure 6. Length frequency of sauger collected during the standard gill net surveys from Lewis and Clark Lake, South Dakota, 2009 and 2010.

Table 14. Mean annual growth increments for sauger collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2006-2010.

Year	Growth increment added during period (mm)							
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**
2006-2007	--	87	54	74	--	2	--	--
2007-2008	138	125	61	50	2	--	10	--
2008-2009	103	44	4	6	--	--	--	--
2009-2010	130	75	15	--	--	--	--	--
Mean	124	83	34	33	--	--	--	--

Table 15. Mean relative weight of sauger, by length categories, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	Stock-quality		**Quality-preferred**		**Preferred-memorable**	
Year	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	77 (0.8)	24	78 (0.5)	24	78 (0.5)	51
2003	79 (1.4)	6	80 (0.6)	25	78 (0.5)	49
2004	78 (0.6)	7	77 (0.5)	12	76 (0.3)	30
2005	78 (0.0)	2	81 (0.8)	9	82 (0.5)	35
2006	82 (--)	1	80 (0.5)	28	80 (0.9)	28
2007	83 (0.6)	18	84 (2.0)	6	85 (0.4)	35
2008	85 (1.3)	6	85 (0.6)	37	88 (0.6)	36
2009	80 (0.4)	32	82 (0.8)	21	78 (0.6)	28
2010	79 (0.7)	17	77 (0.3)	52	78 (2.7)	24

Table 16. Age distribution of sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Scales (2002-2005) and otoliths (2006-2010) were used to estimate ages. Mean age excludes age-0 fish.

Year	Age											
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**
2002	5	34	32	6	23	4	1	2	0	0	0	2.4
2003	14	6	20	28	13	12	3	0	0	0	0	3.2
2004	3	7	7	28	7	1	1	0	0	0	0	2.8
2005	7	0	12	18	11	3	2	1	0	0	0	3.3
2006	0	15	26	2	8	3	1	1	0	0	0	2.4
2007	33	8	17	16	2	0	1	0	0	0	0	2.4
2008	30	41	12	12	10	4	2	3	0	0	1	2.4
2009	16	37	31	7	3	1	2	1	1	0	0	2.0
2010	1	19	49	19	3	3	0	0	0	0	0	2.1

Table 17. Catch curve estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (-Z) for sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Age range is the range of ages used to calculate catch curve statistics. Scales (2002-2005) and otoliths (2006-2010) were used to estimate ages.

Years	S	A	-Z	R^2	Age range
2002-2003	0.71	0.29	0.342	0.83	2-5
2003-2004	0.47	0.53	0.748	0.95	3-5
2004-2005	0.31	0.70	1.188	0.98	3-5
2005-2006	0.58	0.42	0.544	0.88	2-5
2006-2007	0.48	0.52	0.738	0.99	2-4
2007-2008	0.66	0.34	0.419	0.89	1-4
2008-2009	0.51	0.49	0.678	0.98	2-5
2009-2010	0.28	0.72	1.276	0.99	2-4
2002-2010	0.50	0.50	0.682	0.98	2-7

Channel catfish population parameters

A total of 47 channel catfish were sampled with lengths ranging from 163-819 mm. Mean gill net CPUE for channel catfish decreased from 4.3 fish/net-night in 2009 to 3.9 fish/net night in 2010 (Table 4). However, size structure of sampled fish remained excellent in 2010 (Figure 7, Table 18). Channel catfish PSD for the 2010 gill net sample was 52 and PSD-P was 11 compared with 56 and 20, respectively, during the 2009 sampling. Channel catfish in Lewis and Clark Lake exhibit fast growth compared with the other South Dakota Missouri River

Reservoirs. Lewis and Clark channel catfish typically reach 400 mm during their 4th growing season, while Lake Francis Case and Lake Oahe channel catfish reach 400 mm during their 7th and 8th growing seasons, respectively (Bouska et al. 2011). In 2010, mean Wr for quality-preferred length channel catfish was 92 (Table 19), above the normal range of 85 to 90. Although not reported in Table 19, four channel catfish were collected in the memorable-trophy range (710-910 mm) with a Wr of 105 (SE 7.4).

Channel catfish recruitment is relatively stable in Lewis and Clark Lake. On average, it takes 3-4 years for each year class to recruit to the gill nets. Analysis of the age distribution reveals that most year classes beyond 3 or 4 are present during most years, indicating stable recruitment patterns (Table 20, Table 21).

Table 18. Channel catfish proportional size distribution (PSD) and proportional size distribution for preferred and memorable length fish (PSD-P and PSD-M), collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010.

Year	PSD	PSD-P	PSD-M	Sample Size
2002	70	3	0	39
2003	62	24	7	29
2004	52	0	0	31
2005	64	11	0	84
2006	85	46	8	31
2007	66	16	2	98
2008	29	8	3	66
2009	58	20	10	52
2010	52	11	9	47

Table 19. Relative weight of channel catfish, by incremental stock density indices, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	Stock-quality		Quality-preferred		Preferred-memorable	
Year	Wr (SE)	N	Wr (SE)	N	Wr (SE)	N
2002	85 (1.9)	9	85 (1.0)	22	84 (--)	1
2003	86 (1.6)	11	88 (2.0)	11	88 (2.5)	5
2004	90 (1.8)	13	84 (1.7)	14	--	0
2005	79 (1.3)	29	86 (0.8)	42	95 (2.3)	9
2006	87 (0.8)	4	94 (2.0)	10	87 (2.9)	10
2007	86 (0.4)	30	87 (0.7)	43	90 (1.6)	12
2008	87 (0.7)	42	86 (1.4)	12	94 (7.0)	3
2009	91 (1.5)	17	94 (1.0)	15	92 (5.8)	4
2010	85 (1.0)	21	92 (4.4)	18	95	1

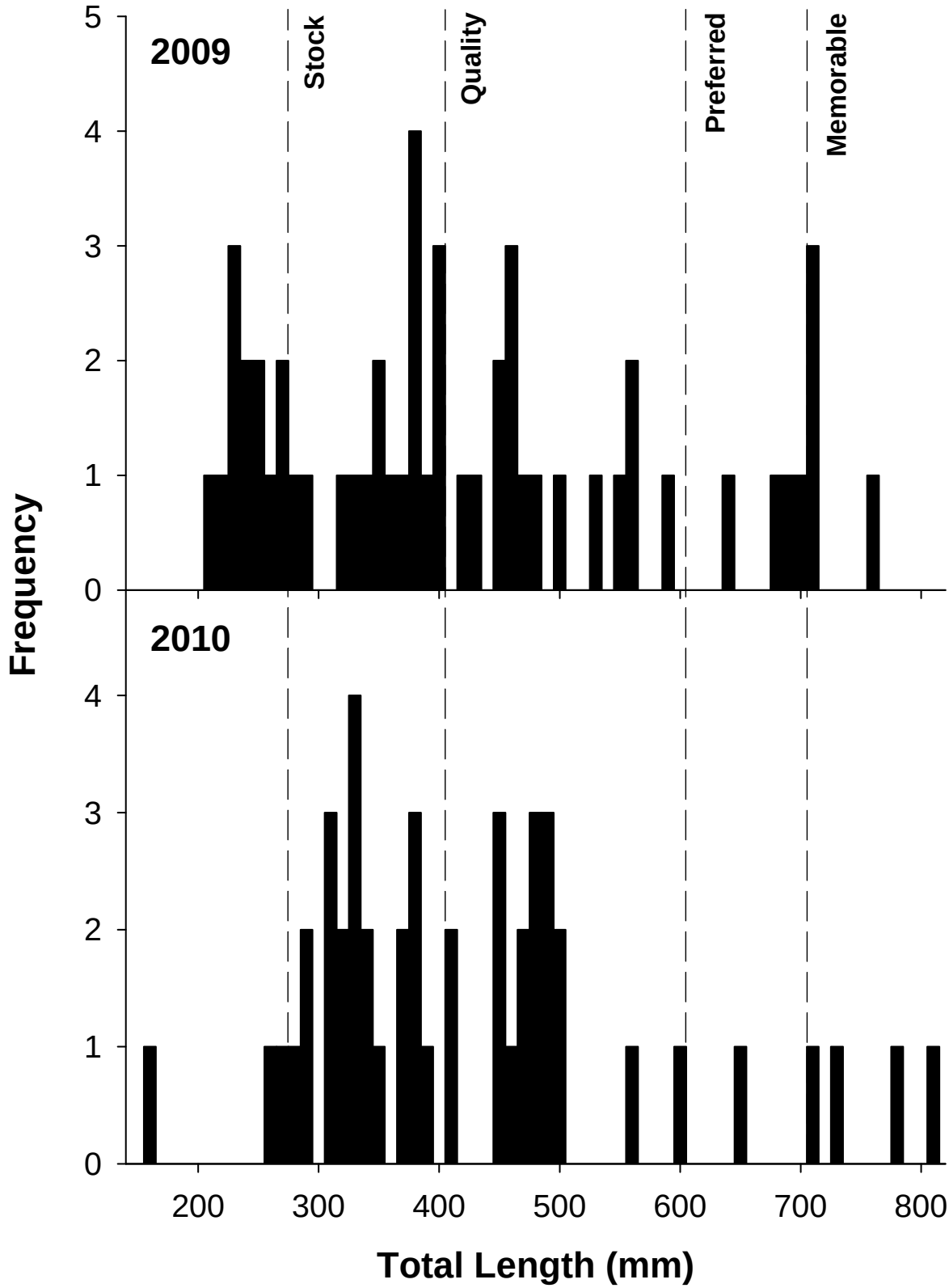

Figure 7. Length frequency for channel catfish collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2009 and 2010.

Table 20. Age distribution, of channel catfish collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2003-2010. Mean age excludes age-0 fish.

	Age																		
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**Mean**
2003	0	0	1	9	0	4	3	1	3	1	2	1	2	1	1	0	0	0	6.5
2005	0	0	7	10	13	23	5	5	5	8	4	3	0	0	0	0	0	0	5.6
2006	0	0	3	2	3	1	1	3	3	1	3	4	2	1	1	0	0	0	7.6
2007	1	7	18	13	9	10	8	5	4	9	3	6	2	0	0	0	1	0	5.3
2008	0	2	13	32	7	2	2	1	1	0	1	0	2	0	3	0	0	0	4.0
2010	0	1	4	17	5	11	3	0	0	1	1	0	3	0	0	0	0	1	4.8

Table 21. Mean back-calculated total lengths (mm) for each age class of channel catfish sampled during the standard September gill-net survey in Lewis and Clark Lake, South Dakota, 2010. Ages beyond 10 are excluded from the table, however, sample mean, standard error, and length increment are calculated from the complete sample.

Year			Annulus									
class	**Age**	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2009	1	1	67									
2008	2	4	82	156								
2007	3	17	83	160	251							
2006	4	5	99	195	311	376						
2005	5	11	98	157	284	376	423					
2004	6	3	101	176	294	365	413	443				
2001	9	1	122	190	312	350	434	472	518	549	579	
2000	10	1	117	210	319	420	463	521	564	600	622	644
Sample mean (mm)			105	181	285	374	434	487	538	573	600	632
Standard error			8	8	10	8	8	14	11	14	14	18
Length increment			76	104	89	60	53	51	35	27	32	26

Electrofishing

Smallmouth bass population parameters

Smallmouth bass CPUE has been highly variable during the past eight years in Lewis and Clark Lake, ranging from 25/h in 2003 to a high of 112/h in 2010. The CPUE for 2010 was more than double the 43/h in 2009 (Table 22). Smallmouth bass size structure is known to be underestimated with electrofishing (Beamesderfer and Rieman 1988; Milewski and Willis 1991). This may have been the case in 2010 where a majority of sampled fish fell above stock-length but below quality-length, resulting in a PSD of 13 (Figure 8, Table 22). The percentage of smallmouth bass sampled near Gavins Point Dam above quality length is often low, while creel survey results indicate larger smallmouth bass are regularly caught and released. For example,

creel survey results indicated that over 75% of the smallmouth bass harvested in 2009 were above quality length, and trophy-class fish (≥ 510 mm) were also harvested (Bouska and Longhenry 2010).

Growth appears to be higher than the state average, however this is based on a sample with few individuals from older year classes (Table 23, Table 24). Wr of stock-quality smallmouth was 89, while Wr of quality-preferred smallmouth was 83, both down slightly from 2009 (Table 22).

Table 22. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and mean relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-memorable length (P-M) smallmouth bass collected by electrofishing Gavins Point Dam face, Lewis and Clark Lake, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	CPUE				**S-Q**		**Q-P**		**P-M**	
Year	**(fish/h)**	**PSD**	**PSD-P**	**PSD-M**	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	75 (12.5)	49	11	3	92 (0.6)	37	88 (0.9)	27	93 (4.2)	6
2003	25 (8.2)	48	22	9	90 (1.6)	12	91 (1.9)	6	96 (1.5)	3
2004	44 (11.1)	38	10	0	91 (0.6)	26	87 (1.2)	12	86 (2.6)	4
2005	51 (22.7)	37	5	2	94 (1.3)	26	83 (1.6)	13	75 (--)	1
2006	62 (3.6)	19	6	0	89 (0.5)	39	91(3.1)	6	82 (2.7)	3
2007	41 (12.8)	20	13	0	90 (1.0)	24	82 (2.4)	2	74 (0.9)	4
2008	79 (55)	17	8	2	88 (0.3)	54	93 (0.9)	6	81 (14.4)	4
2009	43 (3.9)	39	19	3	97 (1.5)	19	86 (7.1)	6	91 (1.6)	5
2010	112 (19.1)	13	3	0	89 (0.4)	63	83 (2.1)	7	75 (0.9)	2

Table 23. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, May 2010.

Year Class	Age	N	Annulus						
			1	2	3	4	5	6	7
2009	1	3	107						
2008	2	53	93	174					
2007	3	41	90	161	234				
2006	4	11	78	148	227	288			
2005	5	3	87	165	221	293	342		
2003	7	1	79	159	254	294	355	401	420
Sample mean			89	161	234	292	349	401	420
Standard Error			4	4	7	2	6	--	--
Length Increment			72	73	58	57	57	19	--

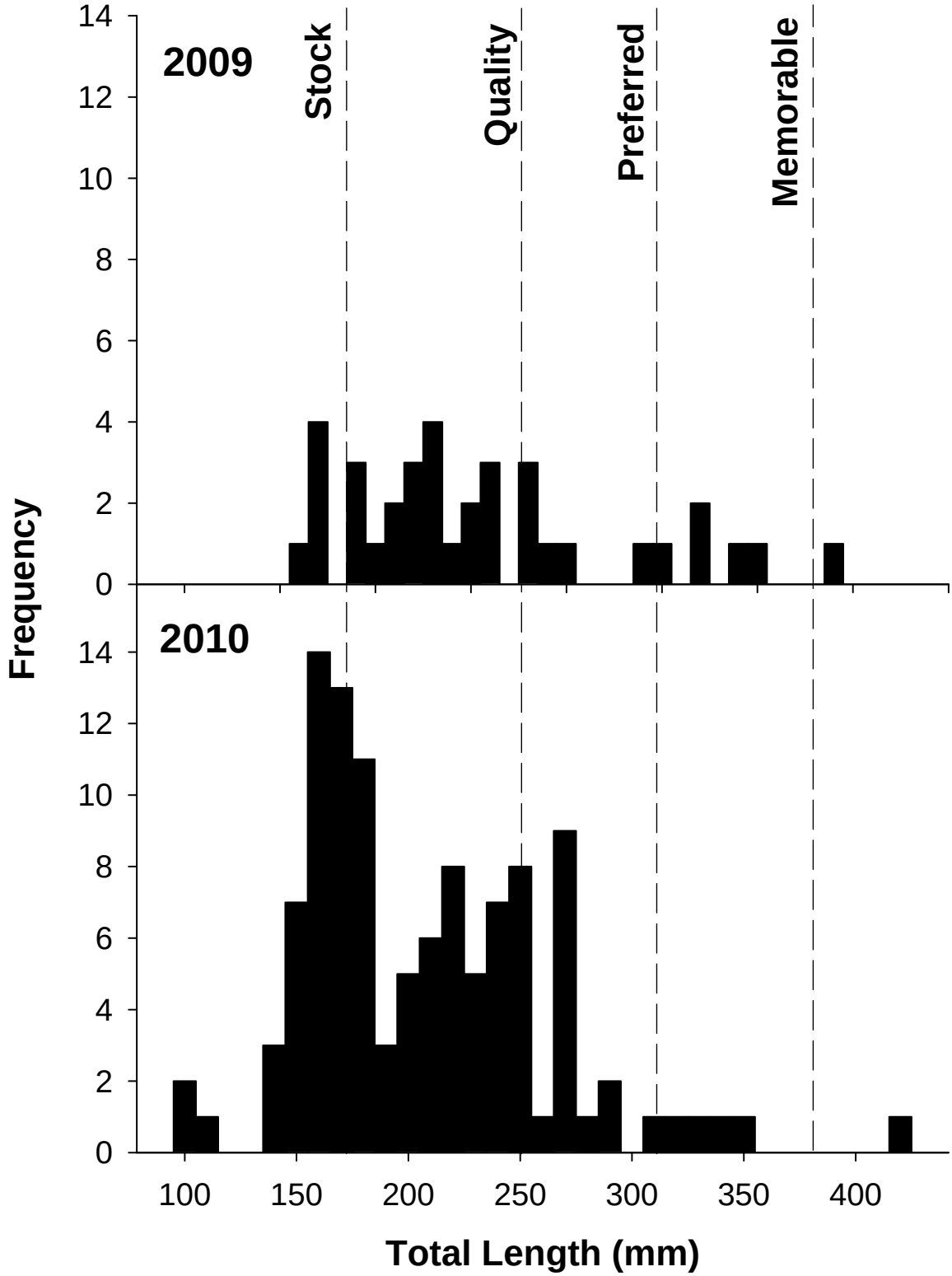

Figure 8. Length frequency for smallmouth bass sampled by nighttime electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, 2009 and 2010.

Table 24. Age distribution of smallmouth bass collected by electrofishing Lewis and Clark Lake near Gavins Point Dam, 2002-2010, as determined from scales.

	Age								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
2002	2	29	33	5	1	5	0	0	2.9
2003	0	9	8	1	5	0	1	0	3.3
2004	1	16	16	9	1	0	0	0	2.8
2005	3	23	13	10	0	0	0	1	2.7
2006	1	36	19	1	3	1	0	0	2.5
2007	5	16	7	2	2	1	2	0	2.7
2008	3	56	12	1	0	0	0	1	2.2
2009	0	12	15	5	1	1	1	0	3.1
2010	3	53	40	11	3	0	1	0	2.7

Flathead catfish population parameters

Low amperage daytime electrofishing along riprap areas in Lewis and Clark Lake collected 82 flathead catfish in 2010 with a CPUE of 41/h (Table 25). Catch rates in the 2010 survey increased from 2009. Although preferred and memorable-sized fish were absent from the 2010 survey, the size distribution was similar to the 2009 survey, with a majority of the total catch smaller than stock length (Figure 9). PSD for the 2010 sample was 39 (Table 25).

In previous years, flathead catfish have been aged by sectioning the pectoral spine at the basal recess and counting the annuli. However, this methodology may be flawed. Research has shown that more accurate age estimates can be obtained by viewing sections cut at the articulating process compared to sections from the basal recess of flathead catfish pectoral spines (Nash and Irwin 1999). But when compared to otoliths, both types of spine sections may under estimate the age after age-5 (Nash and Irwin 1999). In 2010, sections were taken from both the basal recess and the articulating process. Compared to the articulating process, sections taken from the basal recess underestimated age by one year in 10% of the paired samples (Table 26). Flathead catfish growth was determined by back-calculating lengths from pectoral spine annuli using both section locations. The different section locations did result in slightly different back calculated lengths (Table 27, Table 28). Similar to previous years, growth was relatively slow, taking four or five years to surpass stock length (350 mm; Adams 2007, Knecht et al. 2008, Longhenry 2009). Relative weight values for both stock-quality and quality-preferred length fish were slightly down from 2009, but still within the long-term average (Table 25).

In future surveys, it may be beneficial to compare pectoral spine age estimates with otolith age estimates in order to see whether there is significant disagreement among methods (Nash and Irwin 1999). It may also be advantageous to consider additional sampling strategies that will target larger fish, and possibly produce catches more representative of the flathead catfish population (Stauffer and Koenen 1999).

Table 25. Catch per unit effort (CPUE), proportional size distribution, proportional size distribution for preferred and memorable length fish (PSD-P, PSD-M), and relative weights of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) fish for flathead catfish collected by electrofishing Lewis and Clark Lake, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	CPUE				S-Q		Q-P		P-M	
Year	**(fish/h)**	**PSD**	**PSD-P**	**PSD-M**	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	38 (9.5)	4	0	0	89 (0.4)	23	88 (--)	1	--	0
2003	23 (4.0)	21	0	0	87 (1.0)	15	88 (1.4)	4	--	0
2004	24 (5.5)	12	0	0	88 (0.2)	11	--	0	--	0
2005	22 (5.5)	20	0	0	91 (2.7)	8	80 (1.8)	2	--	0
2006	20 (4.2)	10	0	0	88 (1.5)	9	87 (--)	1	--	0
2007	68 (11.4)	24	0	0	86 (1.7)	13	87 (0.8)	4	--	0
2008	52 (10.5)	30	0	0	91 (0.8)	26	92 (2.5)	11	--	0
2009	25 (5.8)	64	14	7	91 (5.2)	5	89 (1.2)	7	63	1
2010	41 (6.2)	39	0	0	86 (2.6)	8	85 (1.7)	5	--	0

Table 26. Age distribution of flathead catfish sampled by electrofishing Lewis and Clark Lake during 2002-2008, and 2010 as determined from pectoral spines. In 2010 spines were sectioned at both the articulating process (a) and at the basal recess (b).

	Age															
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Mean**
2002	7	12	13	36	17	1	5	2	0	1	0	0	0	0	0	3.9
2003	6	10	9	7	11	9	1	2	2	1	0	1	0	0	0	4.3
2004	0	3	21	10	3	8	4	2	2	0	0	0	0	0	0	4.4
2005	9	10	7	10	1	4	4	0	1	0	0	0	0	0	0	3.4
2006	7	7	4	7	4	0	3	1	1	0	0	0	0	0	0	3.5
2007	63	12	7	5	4	1	2	4	0	0	0	0	0	0	0	2
2008	12	43	17	13	8	4	4	3	6	5	1	1	2	0	0	4.1
2010a	18	29	11	4	2	1	0	0	1	3	2	0	0	0	1	3
2010b	22	29	12	2	2	1	0	0	1	3	2	0	0	1	0	2.9

Table 27. Mean back-calculated total lengths (mm) for each age class of flathead catfish sampled by low amperage daytime electrofishing in Lewis and Clark Lake, South Dakota, May 2010. Ages were determined from pectoral spines sectioned at the basal recess. Ages beyond 10 are excluded from the table, however, sample mean, standard error, and length increment are calculated from the complete sample.

Year class	Age	N	Annulus 1	2	3	4	5	6	7	8	9	10
2009	1	23	102									
2008	2	29	85	155								
2007	3	12	86	152	238							
2006	4	2	87	146	261	309						
2005	5	2	89	129	186	296	351					
2004	6	1	145	222	365	413	452	480				
2001	9	1	90	149	303	380	405	422	431	456	490	
2000	10	3	123	226	333	394	453	490	522	546	575	607
1999	11	2	121	178	277	360	421	449	466	490	524	552
1995	14	1	181	229	324	420	436	452	475	483	491	507
Sample mean (mm)			111	176	286	367	420	459	474	494	520	556
Standard error			10	13	20	18	16	12	19	19	20	29
Length increment			65	110	81	53	39	15	20	26	36	

Table 28. Mean back-calculated total lengths (mm) for each age class of flathead catfish sampled by low amperage daytime electrofishing in Lewis and Clark Lake, South Dakota, May 2010. Ages were determined from pectoral spines sectioned at the articulating process. Ages beyond 10 are excluded from the table, however, sample mean, standard error, and length increment are calculated from the complete sample.

Year class	Age	N	Annulus 1	2	3	4	5	6	7	8	9	10
2009	1	22	112									
2008	2	30	104	173								
2007	3	11	100	165	235							
2006	4	4	99	159	235	295						
2005	5	2	95	132	174	253	337					
2004	6	1	140	205	334	398	444	472				
2001	9	1	92	166	277	357	382	425	437	456	474	
2000	10	3	185	264	339	381	426	458	495	531	570	602
1999	11	2	93	157	252	311	366	397	407	434	494	554
1995	15	1	109	224	333	363	399	418	430	454	466	478
Sample mean (mm)			113	183	272	337	392	434	442	469	501	545
Standard error			9	14	21	20	16	14	19	21	24	36
Length increment			70	89	65	55	42	8	27	32	44	

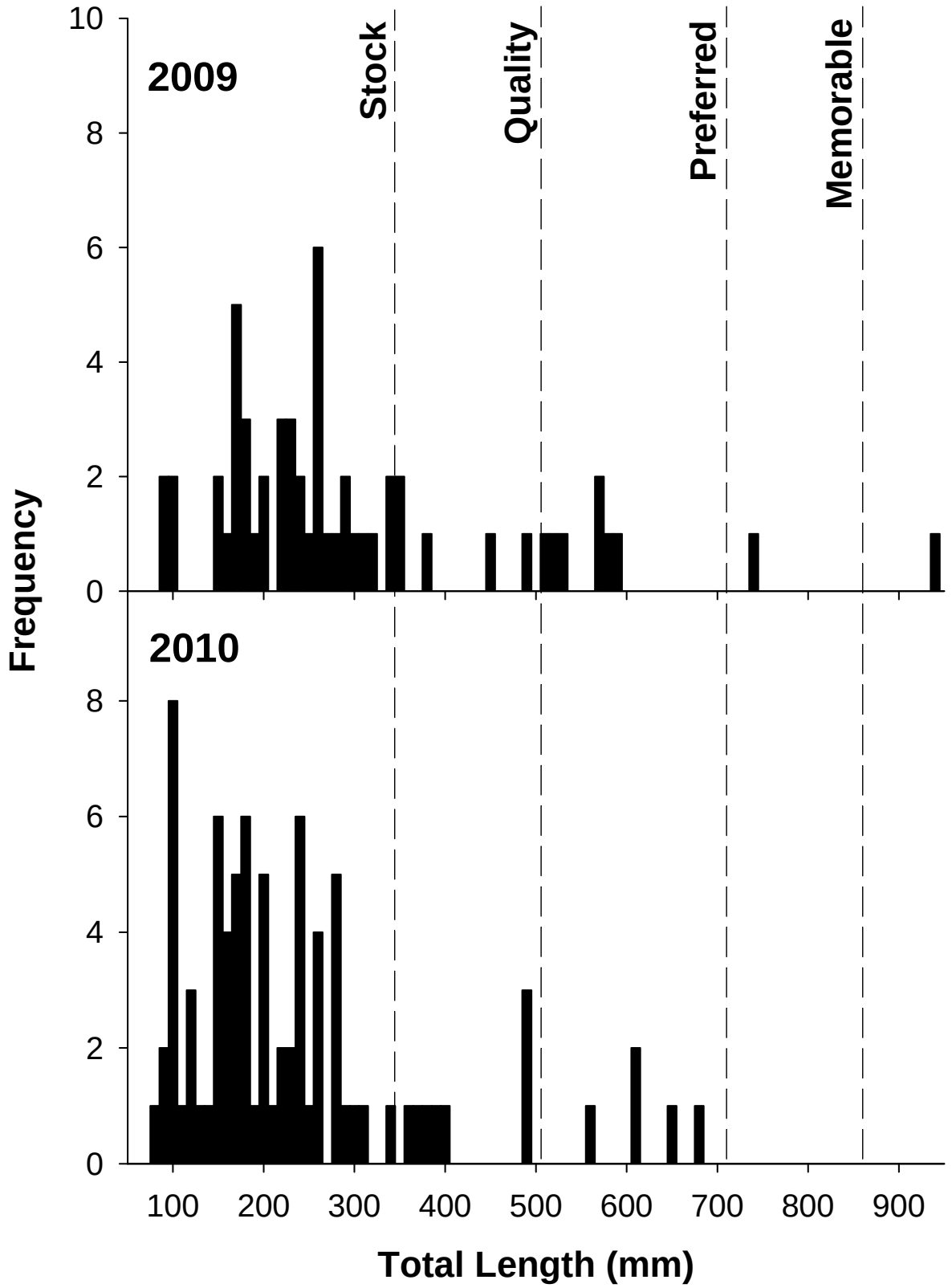

Figure 9. Length frequency of flathead catfish sampled by electrofishing Lewis and Clark Lake during June 2009 and 2010.

Missouri River

Electrofishing

Largemouth bass population parameters

Daytime electrofishing was conducted in the Springfield area of the Niobrara delta to sample largemouth bass. A total of 52 largemouth bass were sampled with a CPUE of 29/h (Table 29). CPUE in 2010 was considerably lower than 2009 because of a reduction in sub-stock length fish in the sample. CPUE of largemouth during this survey is quite variable and is likely more dependent on water levels than actual abundance. For example, daily water level fluctuations either allow or prevent access into targeted backwater habitats that hold largemouth bass. Despite this obvious shortfall, the data collected is still useful for examining size structure and growth.

The 2010 largemouth bass sample had a quality size structure (PSD = 87 and PSD-P = 57), with fish ranging in size from 77-455 mm total length (Figure 10). The majority of the sample was dominated by fish in the preferred-memorable range (Table 29). The growth characteristics of this population (Table 30) is faster than the state average, and is similar to the upper quartile for largemouth bass populations reported by Willis et al. (2001). The age distribution (Table 31) shows a relatively even number of fish in each age class out to 8, however, because of the annual variability in CPUE, few inferences can be made about recruitment patterns.

Table 29. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) largemouth bass sampled by spring electrofishing Springfield area of the Niobrara delta, 2003-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	CPUE				S-Q		Q-P		P-M	
Year	**(fish/h)**	**PSD**	**PSD-P**	**PSD-M**	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2003	67 (26.4)	62	38	0	107 (2.6)	8	103 (1.5)	5	103 (5.2)	8
2004	20 (3.2)	75	50	0	98 (1.8)	7	99 (1.0)	7	97 (0.9)	14
2005	9 (3.4)	84	36	0	108 (2.6)	4	105 (0.8)	12	101 (2.2)	9
2006	14 (8.1)	100	18	0	--	0	102 (1.1)	9	99 (4.8)	2
2008	31 (10.7)	88	66	0	95 (3.1)	4	100 (0.7)	8	101 (2.9)	21
2009	81 (23.7)	85	36	0	100 (3.8)	6	104 (0.8)	19	103 (1.9)	14
2010	29 (10.3)	87	57	0	105 (1.5)	5	108 (0.9)	11	104 (1.7)	21

Table 30. Mean back-calculated total lengths (mm) for each age class of largemouth bass sampled by daytime electrofishing in the Springfield area of the Niobrara delta, Lewis and Clark Lake, South Dakota, May 2010. Ages were determined from scales.

Year Class	Age	N	Annulus							
			1	2	3	4	5	6	7	8
2008	1	46	99							
2007	2	2	81	237						
2006	3	6	73	190	243					
2005	4	6	83	198	295	330				
2004	5	10	82	178	267	324	345			
2003	6	5	80	211	280	343	376	388		
2002	7	8	84	180	270	322	360	384	394	
2001	8	3	60	187	273	323	366	389	404	412
Sample mean			80	198	271	329	362	387	399	412
Standard Error			4	8	7	4	6	1	5	--
Length Increment			117	74	57	33	25	12	13	--

Table 31. Age distribution of largemouth bass sampled by electrofishing in the Springfield area of the Niobrara Delta, 2003-2010, as determined from scales.

Year	**Age**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Mean**
2003	58	13	4	2	2	3	3	2	0	0	0	0	1.9
2004	5	3	7	6	4	9	4	2	0	0	0	0	4.4
2005	1	0	7	9	0	2	3	3	0	0	0	0	4.6
2006	0	1	0	0	0	2	4	5	0	0	0	0	6.8
2008	3	4	5	4	3	7	8	0	3	0	0	0	4.9
2009	20	2	6	6	10	4	7	3	0	0	0	0	3.7
2010	7	9	5	7	7	11	5	1	0	0	0	0	4.1

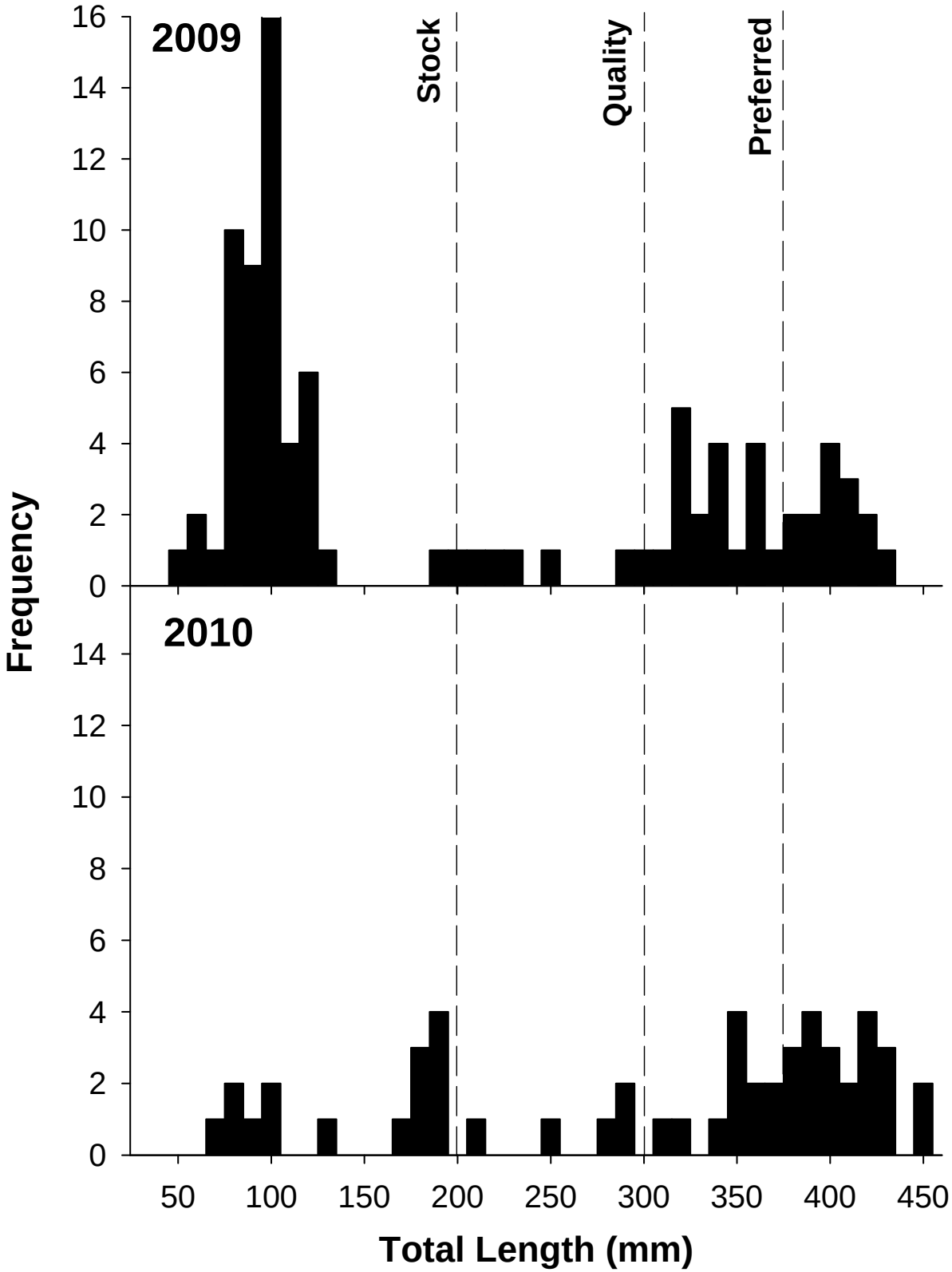

Figure 10. Length frequency of largemouth bass sampled by electrofishing in the Niobrara delta near Springfield, South Dakota during May 2009 and 2010.

Smallmouth bass population parameters

Niobrara Delta near Running Water

Smallmouth bass have been sampled occasionally in the Niobrara delta area near Springfield, SD. In 2009, preliminary sampling was initiated in an effort to index smallmouth bass in the Running Water area of the delta. In 2010, sample size increased slightly but CPUE nearly doubled. A total of 30 smallmouth bass were collected with a CPUE of 30/h, compared to 21 fish at 16/h in 2009. All fish sampled in 2010 were under stock-length, except for one that measured 345 mm. This was a contradiction to the 2009 sample which collected very few sub-stock length fish, and several fish in the quality-preferred and preferred to memorable size classes. Three age classes were collected in 2010 compared to six age classes collected in 2009 (Table 32). It is hard to make any assumptions about this population based on such a small sample size. The future success of smallmouth bass surveys in the delta will be dependent on water level fluctuations and access to certain habitats for sampling.

Table 32. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by daytime electrofishing in the Running Water area of the Niobrara delta, May 2010. Ages were determined from scales.

Year class	Age	N	Annulus					
			1	2	3	4	5	6
2009	1	6	105					
2008	2	8	72	145				
2004	6	1	68	104	158	218	291	334
Sample mean			82	124	158	218	291	334
Standard error			12	20	--	--	--	--
Length increment			42	34	60	73	43	--

Gavins Point Dam Tailwaters

A total of 151 smallmouth bass were sampled in the Gavins Point Dam tailwater area with lengths ranging from 84-395 mm (Figure 11). Mean CPUE for smallmouth bass was 151 fish/h; one of the highest on record, and up from 97 fish/h in 2009 (Table 33). Smallmouth bass PSD, PSD-P and PSD-M decreased slightly from 2009 to 2010. Relative weights increased slightly for all length categories, and were within the normal range for this population (Table 33).

Five age classes (1-5) were sampled in 2010 (Table 34, Table 35), down from six in 2009. There is evidence that larger (older) fish are less susceptible to the sampling methods used, which could contribute to their under-representation in the sample (Beamesderfer and Rieman 1988; Milewski and Willis 1991).

Table 33. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass sampled by spring electrofishing the Missouri River below Gavins Point Dam, 2002-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	CPUE				S-Q		Q-P		P-M	
Year	**(fish/h)**	**PSD**	**PSD-P**	**PSD-M**	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	53 (31.5)	0	0	0	96 (1.1)	16	--	0	--	0
2003	34 (5.3)	4	4	0	88 (0.8)	26	--	0	90 (--)	1
2004	66 (24)	10	0	0	97 (0.7)	38	96 (0.7)	4	--	0
2005	78 (45)	11	0	0	92 (0.5)	62	90 (2.7)	8	--	0
2006	34 (17.1)	30	4	0	93 (0.9)	16	93 (1.5)	6	95 (-)	1
2007	56 (12.0)	23	9	2	94 (0.7)	34	92 (0.7)	6	90 (4.8)	3
2008	76 (6.6)	12	0	0	89 (0.6)	37	91 (3.2)	5	--	0
2009	97 (32.8)	30	7	1	92 (0.5)	49	92 (1.3)	16	93 (6.3)	4
2010	151 (26.9)	21	4	0	95 (0.2)	85	92 (1.0)	18	94 (3.6)	4

Table 34. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by daytime electrofishing in the Missouri River below Gavins Point Dam, South Dakota, May 2010. Ages were determined from scales.

Year class	**Age**	**N**	**Annulus**				
			1	**2**	**3**	**4**	**5**
2009	1	8	116				
2008	2	101	96	186			
2007	3	30	107	190	265		
2006	4	8	96	168	249	313	
2005	5	3	117	235	306	340	374
Sample mean			106	195	273	326	374
Standard error			5	14	17	14	--
Length increment			89	78	53	48	--

Table 35. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May, 2002-2010, as determined from scales.

Year	Age							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Mean**
2002	13	18	4	0	0	0	0	1.7
2003	3	24	5	0	1	0	0	2.2
2004	1	29	10	3	0	0	0	2.3
2005	1	50	24	2	0	0	0	2.4
2006	8	19	3	3	1	0	0	2.1
2007	30	19	14	8	1	1	1	2.2
2008	32	38	6	0	0	0	0	1.7
2009	15	48	23	4	3	1	0	2.3
2010	8	99	30	8	3	0	0	2.3

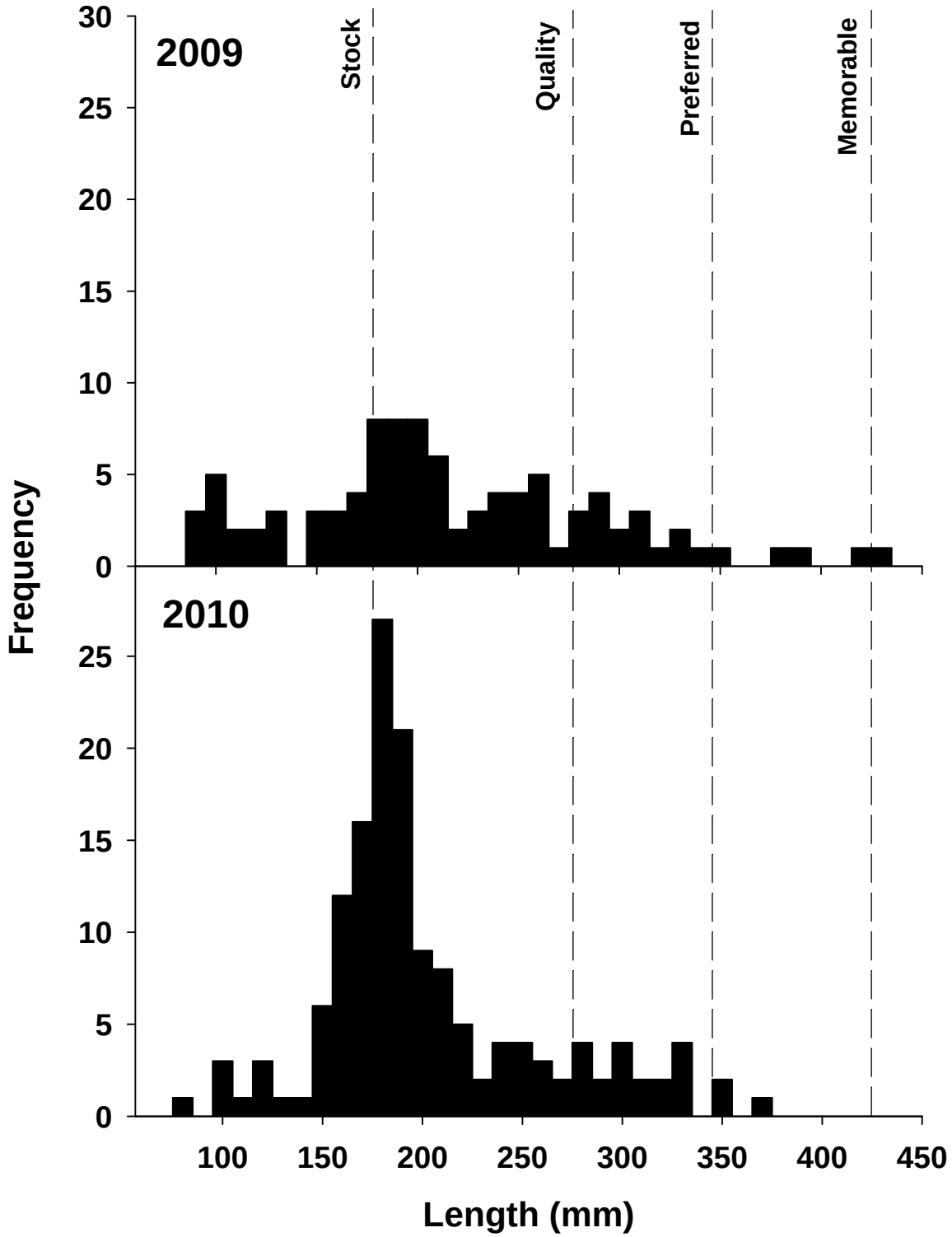

Figure 11. Length frequency of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May 2009 and 2010.

Fort Randall Dam Tailwaters

Smallmouth bass sampling in the Fort Randall Dam tailwaters typically occurs in the fall while other smallmouth bass sampling on the reservoir system occurs in the spring. In 2010, smallmouth bass were sampled from the Fort Randall tailwaters in both the spring and the fall to investigate how the population may change seasonally, and to investigate the possibility of standardizing the time period when smallmouth bass are sampled across the reservoir system. In the spring, a total of 51 smallmouth bass were sampled during a cumulative 60 minutes of night electrofishing. Lengths ranged from 104 to 363 mm with about 41% of the sample longer than stock length (180 mm; Figure 12). The fall sample collected 48 smallmouth bass in one hour of night electrofishing. Lengths ranged from 68 to 387 mm with about two thirds of the sample longer than stock-length

Size structure indices were lower than previous years (Table 36). Growth rates of smallmouth bass in the Fort Randall Tailrace reach (Table 37) are lower than those estimated for the Gavins Point Dam Tailrace and Lewis and Clark Lake, but are nearly identical to the state and Missouri River reservoir averages (Willis et al. 2001). Relative weights were at or near 100 for all size classes sampled in the spring and over 100 for all size classes sampled in the fall (Table 36). Average relative weights are typically above 95 for this population indicating adequate prey is available.

Similar to the other smallmouth surveys, age distribution of the Fort Randall Tailrace smallmouth was dominated by fish three years of age or less (Table 38, Table 39). In most Fort Randall Tailwater surveys, age classes up to 4 are present indicating consistent recruitment. In spring of 2010, all age classes out to six were present with a mean age of 2.7 years. In the fall survey, only fish out to age four were sampled, and the mean age dropped to 1.6 years (Table 39). Additional seasonal comparisons may be necessary, but standardization of smallmouth bass sampling times in the Lewis and Clark reservoir system will facilitate comparisons among populations within the reservoir system, and should be a priority in the future.

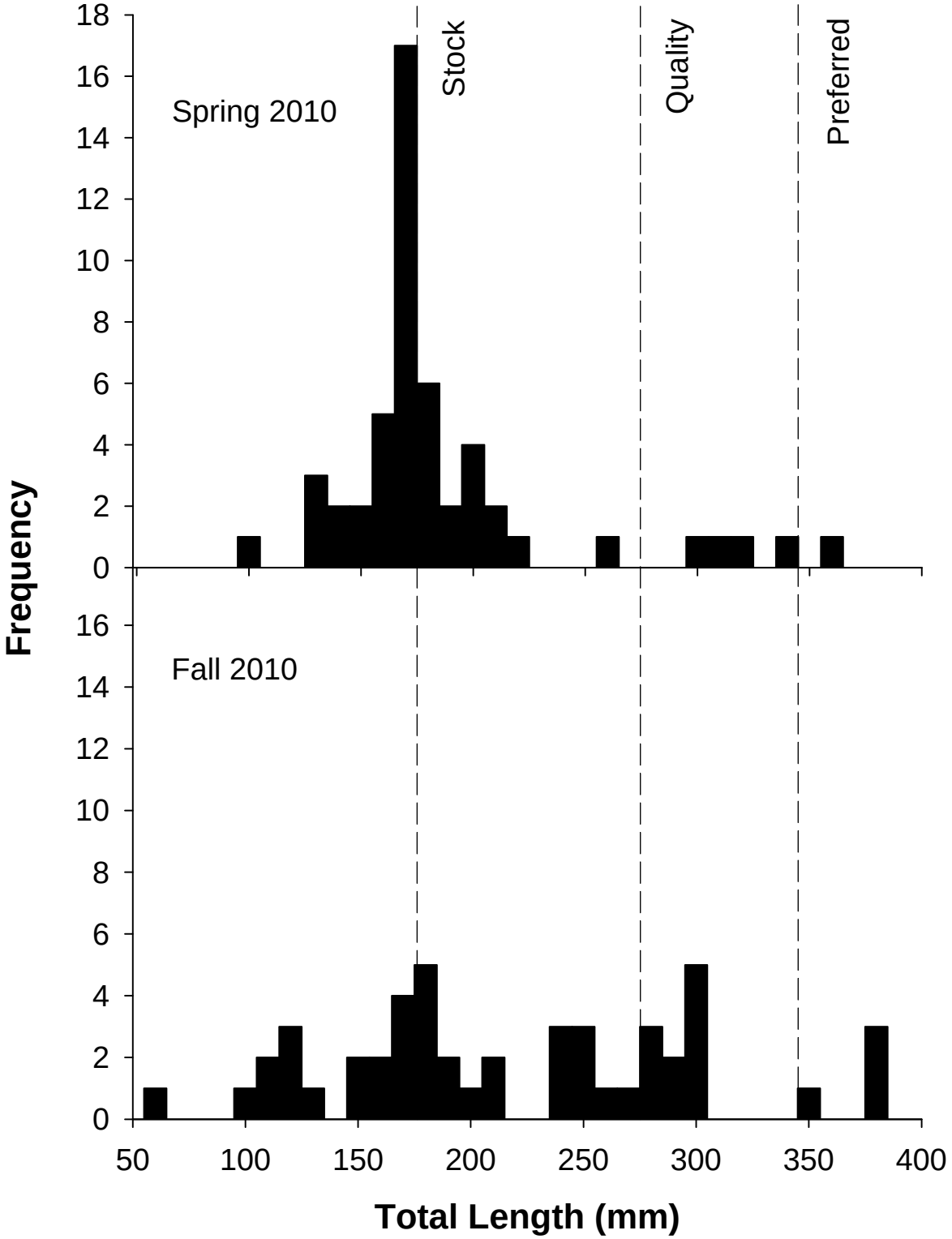

Figure 12. Length frequency of smallmouth bass sampled by nighttime electrofishing the Missouri River below Fort Randall Dam in June and October 2010.

Table 36. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass sampled by fall nighttime electrofishing the Missouri River below Fort Randall Dam, 2002-2010 (2010a = June sample; 2010b = October sample). Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

	CPUE				**S-Q**		**Q-P**		**P-M**	
Year	**(fish/h)**	**PSD**	**PSD-P**	**PSD-M**	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	92 (23.5)	58	26	5	106 (2.3)	8	99 (2.6)	6	93 (3.3)	4
2003	50 (10.1)	22	11	4	104 (1.5)	21	93 (0.0)	3	95 (4.2)	2
2004	14 (2.6)	58	8	0	108 (5.1)	5	107 (2.3)	6	106 (--)	1
2005	78 (45)	67	13	0	112 (3.9)	5	103 (1.3)	8	99 (3.1)	2
2006	--	--	--	--	--	--	--	--	--	--
2007	119 (19.1)	39	5	0	94 (1.3)	23	103 (1.5)	13	105 (2.2)	2
2008	100 (29.6)	36	11	2	101 (1.8)	30	109 (2.4)	12	112 (4.0)	4
2009	39 (7.6)	15	--	--	102 (0.4)	22	91 (0.0)	2	--	--
2010a	51 (25.0)	24	5	--	100 (0.4)	16	99 (3.9)	4	88 (--)	1
2010b	48 (22.5)	44	13	--	112 (1.4)	18	109 (0.6)	10	107 (0.3)	4

Table 37. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by nighttime electrofishing in the Missouri River below Fort Randall Dam, South Dakota, June 2010. Ages were determined from scales.

Year class	Age	N	Annulus					
			1	2	3	4	5	6
2009	1	1	104					
2008	2	23	87	166				
2007	3	21	83	119	186			
2006	4	3	91	150	248	294		
2005	5	2	82	152	243	284	328	
2004	6	1	72	137	206	306	351	363
Sample mean			86	145	221	295	339	363
Standard error			4	8	15	6	11	--
Length increment			59	76	74	44	24	--

Table 38. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by nighttime electrofishing in the Missouri River below Fort Randall Dam, South Dakota, October 2010. Ages were determined from scales.

Year class	Age	N	Annulus			
			1	2	3	4
2009	1	18	79			
2008	2	7	87	156		
2007	3	10	83	129	192	
2006	4	4	89	159	232	295
Sample mean			84	148	212	295
Standard error			2	9	20	--
Length increment			64	64	83	--

Table 39. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Fort Randall Dam, 2002-2010 (2010a = June sample; 2010b = October sample), as determined from scales.

Year	**Age**									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
2002	66	12	5	2	5	0	2	0	0	2.3
2003	17	22	6	2	1	0	1	0	1	1.8
2004	0	5	7	1	1	0	0	0	0	1.9
2005	0	3	5	3	6	0	0	0	0	2.4
2006	--	--	--	--	--	--	--	--	--	--
2007	42	45	11	16	3	1	0	1	0	1.8
2008	2	50	30	13	2	2	0	0	0	1.7
2009	9	0	16	11	2	0	0	0	0	2.5
2010a	0	1	23	21	3	2	1	0	0	2.7
2010b	9	18	7	10	4	0	0	0	0	1.6

Hoop Nets

Channel catfish population parameters

A total of 35 channel catfish were sampled with hoop nets in the Missouri River and Niobrara delta near Springfield, SD on August 11 and 13, 2010 (Table 40). This was a significant decrease in sample size from 2009 (N=197) but up from 2008 (N=17). Sampling effort decreased in 2010 to 64 net-nights (Table 41), a result of habitat conditions and potential theft of sampling gear. Twenty-four hoop nets were initially deployed in the same general locations as the 2009 sample. Upon returning to check and reset the nets, eight were missing, and three

others were located away from their initial deployment locations. Higher water levels and current velocities could be to blame for some net loss/displacement. Floating debris was also a possible culprit, snagging on the float lines and sinking them below the waters surface where they could not be located. However, in one instance, a hoop net was found across the channel from where it was previously set. It was opened, and showed signs of tampering. Therefore it is possible that some of the nets were removed by unauthorized individuals.

The sampled channel catfish population in the Missouri River and Niobrara delta was dominated by smaller fish below stock length (<280 mm). However, 29% of fish were above quality length (410 mm), and preferred and memorable length fish were also observed (Figure 13; Table 41). Fish from nine different age classes were sampled, out to age thirteen. Most fish were two or three years old although a number of older fish pushed the average age to 4.0 years (Table 42, Table 43).

Table 40. Total annual hoop net catches (CPUE) of channel catfish from the Missouri River and Niobrara delta near Springfield, SD, 2002-2004 and 2006-2010. Standard error (SE) is also included.

Year	Number of fish	Net-nights	CPUE	Mean length (mm)
2002	141	86	1.6 (0.7)	276 (6.3)
2003	203	82	2.5 (0.9)	299 (6.6)
2004	81	82	1.0 (0.6)	314 (12.8)
2006	37	80	0.5 (0.2)	287 (14.6)
2007	21	78	0.3 (0.1)	335 (34.3)
2008	17	76	0.2 (0.1)	245 (7.7)
2009	197	100	2.0 (0.6)	268 (5.7)
2010	35	64	0.5 (0.2)	349 (24.3)

Table 41. Proportional size distribution (PSD), proportional size distribution for preferred and memorable length fish (PSD-P, PSD-M), and mean relative weight (standard error) for stock-quality (S-Q), quality-preferred (Q-P), and preferred-memorable length (P-M) channel catfish sampled with hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 2002-2004 and 2006-2010. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

				S-Q		Q-P		P-M	
Year	**PSD**	**PSD-P**	**PSD-M**	**Wr (SE)**	**N**	**Wr (SE)**	**N**	**Wr (SE)**	**N**
2002	22	2	0	84 (0.8)	36	79 (2.8)	9	68 (--)	1
2003	23	5	3	84 (0.5)	66	80 (1.5)	16	79 (--)	1
2004	30	12	2	86 (0.4)	30	80 (3.2)	8	83 (2.3)	4
2006	27	9	0	81 (6.5)	8	84 (4.1)	2	75 (--)	1
2007	25	25	8	94 (2.7)	9	--	0	79 (1.4)	2
2008	0	0	0	97 (0.0)	2	--	0	--	0
2009	13	6	4	84 (0.4)	48	84 (4.8)	4	72 (--)	1
2010	50	10	5	88 (1.5)	10	89 (2.1)	8	94 (--)	1

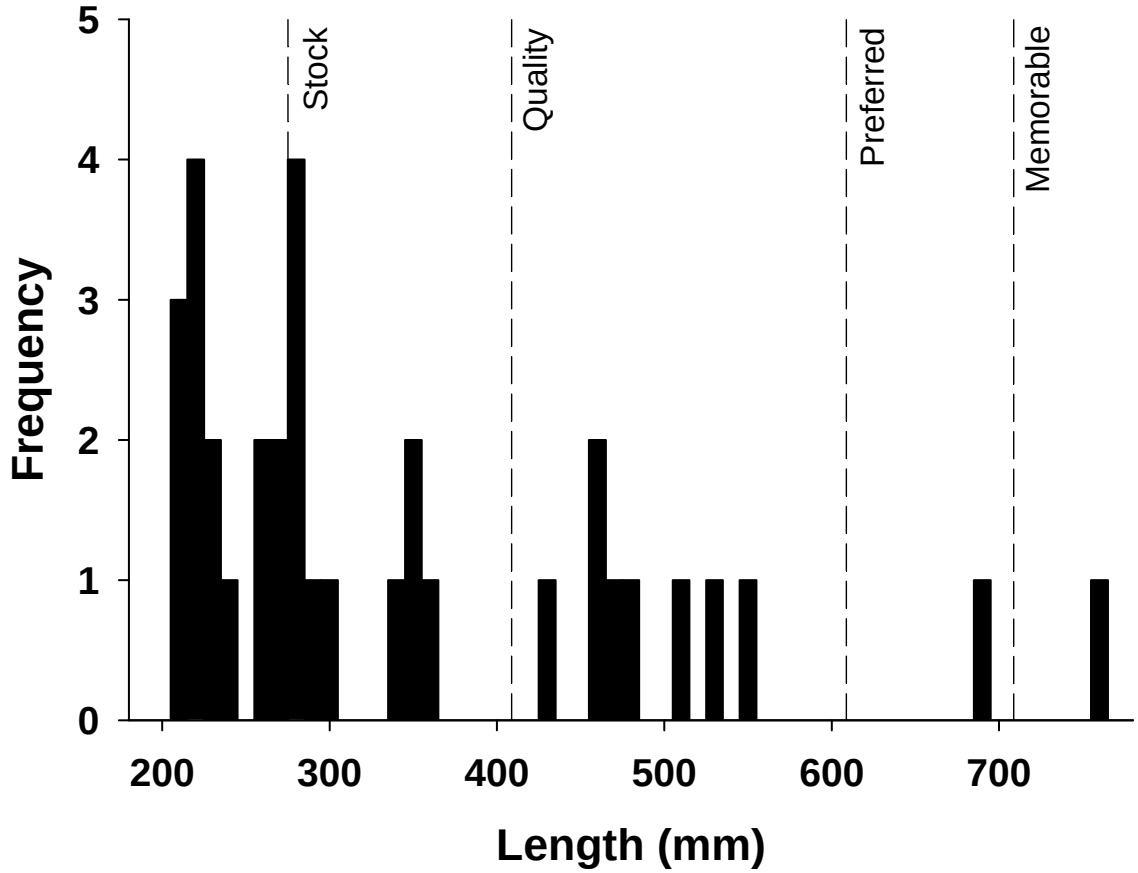

Figure 13. Length frequency for channel catfish collected in hoop nets from the Missouri River and Niobrara delta near Springfield, SD 2010.

Table 42. Mean back-calculated total lengths (mm) for each age class of channel catfish sampled during the hoop net survey in the Missouri River and Niobrara delta near Springfield, SD, 2010.

Year class	Age	N	Annulus												
			1	2	3	4	5	6	7	8	9	10	11	12	13
2008	2	12	86	160											
2007	3	13	104	176	255										
2006	4	1	122	300	397	449									
2005	5	1	97	176	323	402	445								
2003	7	1	111	165	294	382	457	504	518						
2002	8	3	122	195	261	307	365	413	448	477					
2001	9	1	106	182	213	259	312	365	396	426	472				
1999	11	1	111	155	301	404	448	492	543	580	609	639	668		
1997	13	1	134	271	375	431	447	543	575	600	632	664	688	704	720
Sample mean (mm)			110	198	302	376	412	464	496	521	571	651	678	704	720
Standard error			5	17	22	26	24	32	33	41	50	13	10		
Length increment			88	104	74	36	52	32	25	50	80	27	26	16	

Table 43. Age distribution of channel catfish sampled in hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 2002, 2004, and 2006-2010, as determined from pectoral spines.

Year	Age														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean
2002	0	73	19	25	16	3	1	1	0	1	1	1	0	0	3.2
2004	0	27	32	7	2	2	2	2	1	3	2	0	0	1	3.8
2006	0	21	4	2	3	1	1	1	1	1	0	0	0	0	3.3
2007	1	9	7	0	0	0	0	0	1	1	1	0	0	0	3.5
2008	1	12	4	0	0	0	0	0	0	0	0	0	0	0	2.2
2009	26	116	27	18	3	1	0	0	0	3	1	0	1	0	2.5
2010	0	12	13	2	1	0	1	3	1	0	1	0	1	0	4.0

Seines

Water level fluctuations within the delta can greatly influence seining efficiency. High water levels inundated terrestrial vegetation in 2010, and there was no suitable habitat anywhere in the delta to conduct seine surveys. Data from previous seine surveys is presented for reference (Table 44).

Table 44. Catch per unit effort (fish/seine haul) for July seining surveys in the Missouri River near Springfield, South Dakota, 2004-2009, includes both age-0 and adults. Trace (T) indicates a value is less than 0.05. Standard error (SE) is in parenthesis.

Species	2004	2005	2006	2007	2008	2009
Bigmouth buffalo	--	--	--	--	0.1 (0.1)	--
Black crappie	--	--	T	--	0.1 (0.1)	--
Bluegill	--	0.2 (0.1)	--	T	T	--
Bluntnose minnow	--	0.2 (0.1)	--	--	0.1 (0.1)	--
Emerald shiner	4.0 (2.9)	0.9 (0.2)	0.6 (0.4)	1.1 (1.0)	0.4 (0.3)	0.1 (0.1)
Freshwater drum	--	--	--	--	0.1 (0.1)	--
Gizzard shad	T	3.1 (2.5)	0.6 (0.3)	13 (0.9)	T	--
Grass pickerel	--	--	--	--	--	0.1 (0.1)
Green sunfish	--	--	--	--	T	--
Johnny darter	--	--	--	T	0.1 (0.1)	0.1 (0.1)
Largemouth bass	0.4 (0.2)	0.8 (0.3)	T	--	0.3 (0.2)	0.8 (0.5)
Northern pike	--	--	--	--	--	0.1 (0.1)
Rock bass	T	--	--	--	--	--
Red shiner	--	0.1 (0.1)	--	26 (0.9)	--	1.6 (1.1)
River carpsucker	T	0.4 (0.2)	0.1 (0.1)	5 (1.0)	5.7 (3.0)	0.2 (0.2)
Sauger	--	--	--	T	0.1 (0.1)	--
Shorthead redhorse	--	--	--	--	T	--
Smallmouth bass	0.1 (0.1)	0.4 (0.2)	--	T	--	0.2 (0.2)
Smallmouth buffalo	--	--	--	--	T	--
Spotfin shiner	0.3 (0.1)	0.4 (0.2)	--	--	1.4 (0.6)	3.6 (1.3)
Spottail shiner	--	--	--	--	0.1 (0.1)	--
Walleye	T	0.2 (0.1)	--	--	0.1 (0.1)	--
White bass	T	0.2 (0.1)	--	T	--	0.1 (0.1)
White crappie	--	0.2 (0.1)	--	T	--	--
Yellow perch	T	--	--	--	--	--

Angler Use and Sportfish Harvest Survey

Fishing Pressure

Estimated fishing pressure was 75,049 hours during the April 1 through November 30, 2010 daylight creel survey period (Table 45), or about 6.2 angler hours per hectare (Table 46). This was about a 14 % decrease in estimated fishing pressure from 2009 (Table 45). Peak fishing pressure occurred in May, June, and October (Table 45). The Lewis and Clark angler use and harvest survey has not been conducted annually, so trends in pressure and harvest are difficult to describe. The 2010 survey showed decreased fishing pressure for all months except October compared to the 2009 survey. In 2010 Lewis and Clark Lake had the lowest estimated pressure of all surveyed years since 1994 (Figure 14).

Table 45. Comparison of estimated total fishing pressure (angler hours), by month for Lewis and Clark Lake, 2009-2010. Standard error (SE) is included.

Year	April	May	June	July	August	September	October	November	Total
2009	4,963	21,164	20,568	10,674	9,985	9,565	10,228	--	87,147
	(672)	(3,046)	(2,312)	(920)	(1,070)	(901)	(1,071)	--	(4,362)
2010	3,833	13,741	16,061	6,586	7,788	8,548	13,174	5,317	75,049
	(459)	(1,905)	(1,774)	(596)	(462)	(809)	1,195	(731)	(3,189)

Table 46. Estimated total angler hours for boat anglers, shore anglers, and all combined by month, Lewis and Clark Lake, April-November, 2010.

	Boat			Shore			Combined		
Month	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha
April	2,140	3.5	0.18	1,693	12.4	0.14	3,833	5.1	0.32
May	12,259	20.0	1.01	1,482	10.8	0.12	13,741	18.3	1.13
June	12,842	20.9	1.06	3,219	23.6	0.27	16,061	21.4	1.32
July	4,914	8.0	0.40	1,673	12.2	0.14	6,586	8.8	0.54
August	6,517	10.6	0.54	1,271	9.3	0.10	7,788	10.4	0.64
September	6,947	11.3	0.57	1,601	11.7	0.13	8,548	11.4	0.70
October	11,282	18.4	0.93	1,892	13.9	0.16	13,174	17.6	1.08
November	4,489	7.3	0.37	828	6.1	0.07	5,317	7.1	0.44
Total	61,390	100.0	5.05	13,659	100.0	1.12	75,049	100	6.18

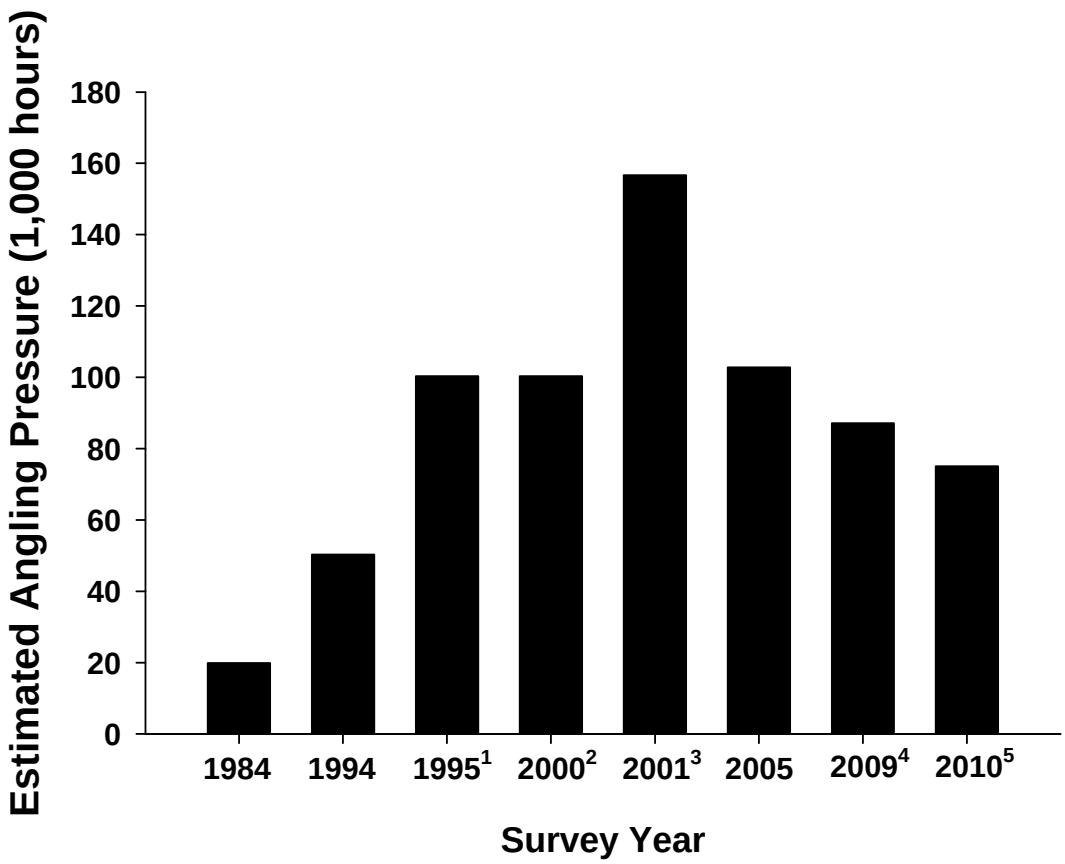

Figure 14. Estimated hours of fishing pressure by year, April-September, on Lewis and Clark Lake. Exceptions: 1 – Survey conducted May – September; 2 – Survey conducted April – December; 3 – Survey area extended from Lewis and Clark Lake upstream into the riverine portion below Fort Randall Dam; 4 – Survey conducted April – October; 5 – Survey conducted April – November.

Fish Harvest and Release

Anglers fishing Lewis and Clark Lake, April-November, 2010, harvested an estimated 16,667 fish, all species and fishing methods combined, including an estimated walleye harvest of 5,982 (Table 47). Walleye made up the majority of the overall harvest (35.9 %). Species also common in the angler harvest included white bass (28.4 %), and channel catfish (18.3 %; Table 47). The majority of the walleye harvest in Lewis and Clark Lake occurred in May, with high harvest also occurring in June and October (Table 47, Figure 15). The overall estimated walleye harvest in 2010 was less than half the walleye harvest estimate from 2009. Estimated sauger harvest was also down approximately 50% from 2009. See appendix 3 for a summary of angler use and harvest information from 1984 to present.

Table 47. Estimated number of fish harvested and released, by month, for anglers fishing Lewis and Clark Lake, April-November, 2010. Standard error (SE) is included.

Month	WAE		SAR		CCF		SMB		WHB		FRD		Other*		Total	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	293 (75.1)	305 (76.7)	70 (18.9)	34 (17.0)	151 (61.1)	7 (4.2)	16 (5.2)	327 (103.0)	148 (44.6)	10 (3.9)	0 --	148 (53.7)	1,053 --	2,557 --	1,731 (395.5)	3,388 (1,094.0)
May	1,944 (376.5)	4,304 (857.9)	46 (21.3)	23 (14.8)	193 (50.1)	37 (12.5)	4 (2.2)	106 (40.5)	190 (59.8)	1,121 (237.9)	19 (7.9)	790 (121.5)	103 --	184 --	2,499 (438.8)	6,565 (1,068.0)
June	1,041 (223.7)	6,486 (1,586.8)	62 (18.8)	10 (3.2)	717 (230.0)	121 (50.2)	0 --	646 (125.9)	959 (279.0)	1,287 (251.6)	40 (14.4)	492 (79.1)	146 --	413 --	2,965 (362.8)	9,455 (1,967.0)
July	285 (116.4)	631 (154.4)	0 --	0 --	713 (221.5)	146 (26.1)	10 (5.8)	88 (26.2)	234 (58.2)	54 (23.3)	30 (11.1)	200 (48.4)	183 --	183 --	1,455 (263.4)	1,302 (157.7)
Aug.	138 (60.9)	530 (92.1)	23 (13.9)	3 (1.9)	797 (147.0)	126 (30.8)	51 (16.6)	135 (21.5)	1,740 (279.4)	1,212 (202.4)	41 (19.3)	276 (91.3)	46 --	218 --	2,836 (303.8)	2,500 (296.5)
Sept.	438 (76.6)	2,650 (430.5)	29 (10.5)	394 (188.0)	461 (137.5)	22 (9.2)	0 --	143 (25.8)	630 (183.0)	526 (72.2)	106 (35.9)	339 (87.8)	43 --	339 --	1,707 (278.1)	4,413 (579.5)
Oct.	1,352 (214.5)	3,337 (342.7)	118 (26.7)	143 (41.5)	11 (6.3)	85 (42.0)	76 (45.3)	270 (49.9)	775 (141.6)	732 (102.3)	20 (6.9)	573 (141.1)	130 --	464 --	2,482 (359.5)	5,604 (561.3)
Nov.	492 (87.9)	792 (149.6)	116 (25.4)	100 (28.5)	0 --	7 (4.4)	7 (3.2)	35 (10.9)	53 (16.8)	167 (29.2)	19 (8.4)	161 (42.4)	305 --	221 --	992 (158.6)	1,483 (229.5)
Total	5,982 (523.7)	19,035 (1,901.9)	463 (53.2)	708 (196.0)	3,042 (385.7)	551 (78.7)	163 (49.0)	1,750 (180.3)	4,729 (467.6)	5,109 (421.8)	275 (46.6)	2,977 (252.9)	2,013 --	4,580 --	16,667 (934.9)	34,710 (2,650.1)

* Other includes bluegill, largemouth bass, flathead catfish, blue catfish, northern pike, tiger muskellunge, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, yellow perch, and common carp.

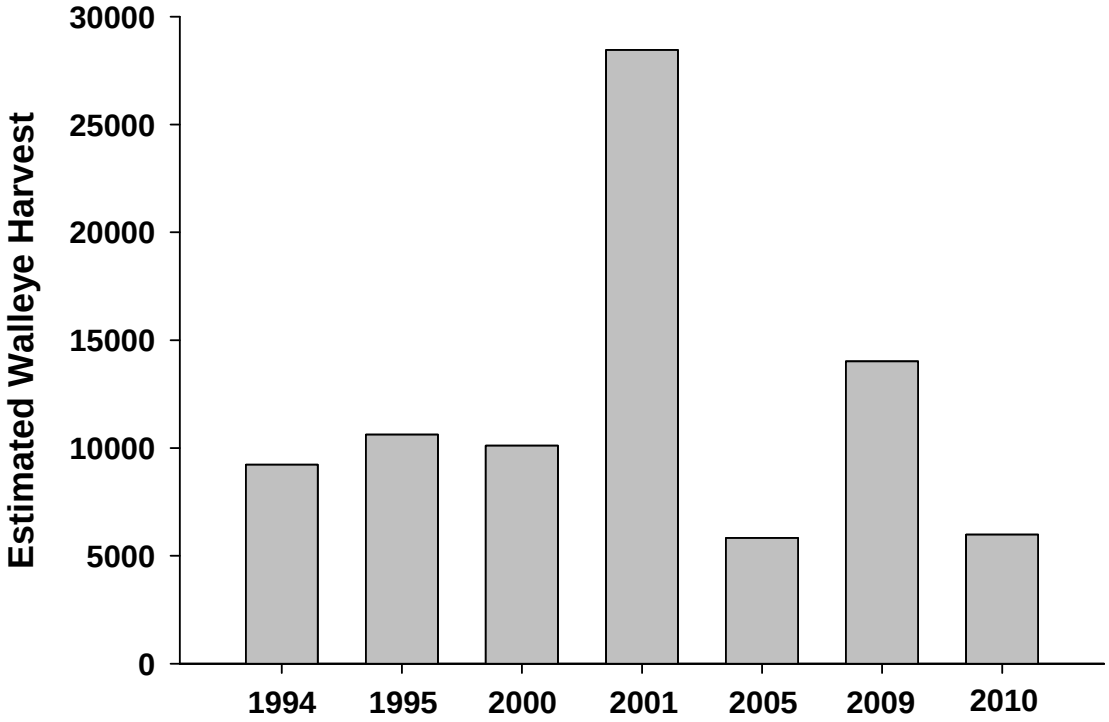

Figure 15. Estimated walleye harvest by year for anglers fishing Lewis and Clark Lake (Zone 3). Surveys were conducted April-September except in 1995 surveys were from May-September, in 2009 from April-October, and in 2010 April-November.

Length frequencies of angler-harvested walleye and catfish were developed (Figure 16, Figure 17). On Lewis and Clark Lake there is a 381 mm minimum length limit in effect for walleye year-round. Creel clerks did measure two illegal walleye harvested in Lewis and Clark Lake in 2010 (370 - 379 mm; Figure 16). Lengths of harvested walleyes ranged from 370 – 719 mm and mean total length of harvested walleye was 451 mm. Harvested channel catfish lengths ranged from 310 – 809 mm, with a mean total length of 543 mm (Figure 17).

Catch and release, either mandated by length-limit regulations or voluntary, has become an important part of the Missouri River sport fishery. The estimated number of fish caught and released from Lewis and Clark Lake, April-November, 2010, was 34,710. Release estimates exceeded the number of fish harvested for every species except channel catfish (Table 47). The estimate of released fish is based on an angler's ability to recall what they released, and therefore may be biased. Estimates of the number of released sauger may also be biased by an angler's ability to correctly identify the species. It is possible that some released sauger were reported by anglers as released walleye. However, this data is useful for analyzing trends over time and estimating catch rates.

The overall estimate of the number of fish caught in Lewis and Clark Lake by anglers in 2010 (harvested plus released fish) was 51,377.

From April – November, 2010, among surveyed anglers that had completed their fishing trip, only 3.7% harvested a limit of walleye (Table 48). This was a dramatic reduction from 2009, when it was estimated that nearly 13% of all surveyed anglers harvested a limit of walleye (Bouska and Longhenry 2010). The percentages of anglers harvesting specific numbers of channel catfish and white bass in 2010 were more similar to 2009 estimates (Table 49, Table 50; Bouska and Longhenry 2010).

Table 48. Percentage of surveyed anglers that harvested or released specific numbers of walleye per completed trip, Lewis and Clark Lake, April-November, 2010.

Harvest Per Angler	Harvested	Released
0	43.4	10.4
0.1-0.9	18.3	22.2
1.0-1.9	15.1	20.4
2.0-2.9	13.9	16.6
3.0-3.9	5.6	11.7
4.0-4.9	3.7	4.5
5.0-5.9	--	4.9
6.0-6.9	--	3.1
7.0-7.9	--	1.1
8.0-8.9	--	1.4
9.0-9.9	--	0.6
10.0-10.9	--	1.0
$\geq$ 11.0	--	2.1

Table 49. Percentage of surveyed anglers that harvested or released specific numbers of channel catfish per completed trip, Lewis and Clark Lake, April-November, 2010.

Harvest Per Angler	Harvested	Released
0	33.2	51.4
0.1-.9	31.3	34.7
1.0-1.9	6.3	8.3
2.0-2.9	6.3	2.8
3.0-3.9	7.6	2.1
4.0-4.9	9.0	0.7
5.0	6.3	0

Table 50. Percentage of surveyed anglers that harvested or released specific numbers of white bass per completed trip, Lewis and Clark Lake, April-November, 2010..

Harvest Per Angler	Harvested	Released
0	56.8	27.0
0.1-.9	13.9	33.2
1.0-1.9	7.2	19.4
2.0-2.9	7.4	8.3
3.0-3.9	6.5	7.2
4.0-4.9	1.7	2.6
5.0-5.9	1.5	0.6
6.0-6.9	2.4	0.4
7.0-7.9	1.3	0
8.0-8.9	0	0.2
9.0-9.9	0	0
10.0-10.9	0	0.9
11.0-11.9	0	0.2
12.0-12.9	0	0
13.0-13.9	0.9	0
14.0-14.9	0	0
15.0-15.9	0.4	0

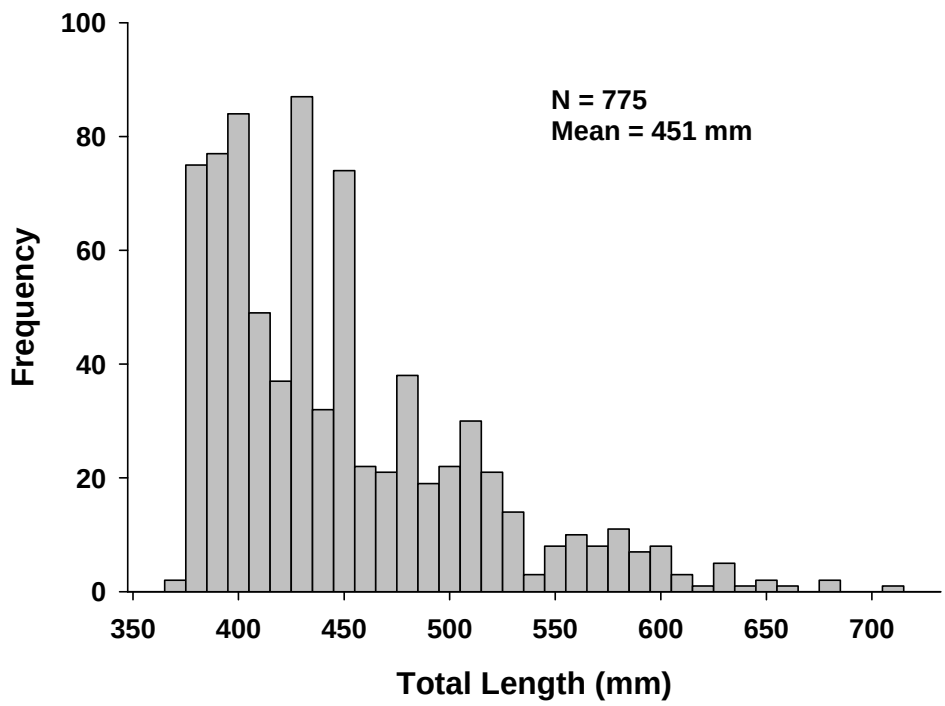

Figure 16. Length frequencies of angler-harvested walleye from Lewis and Clark Lake, April-November, 2010.

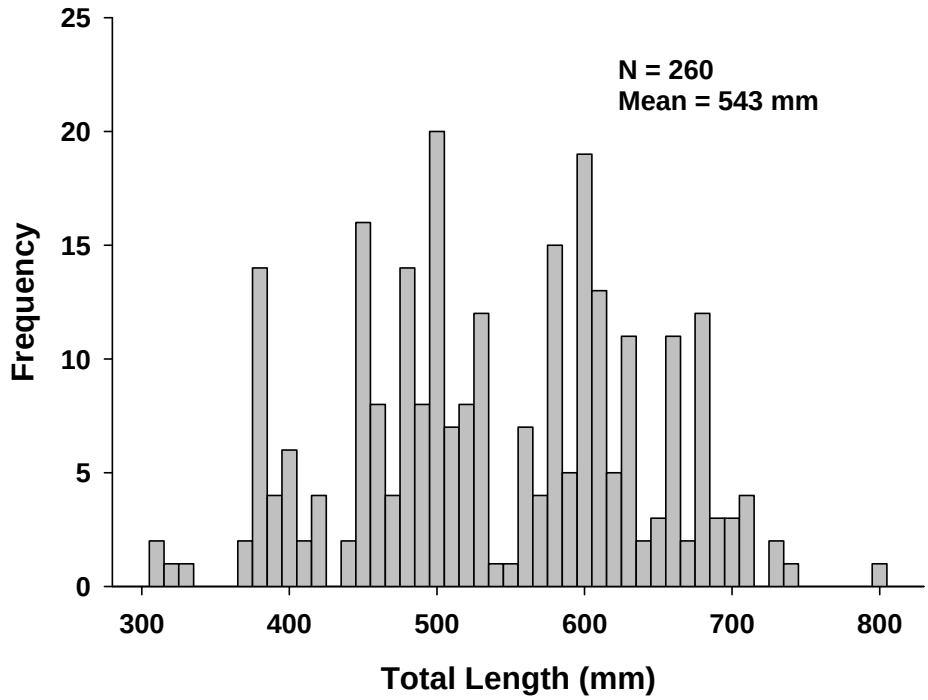

Figure 17. Length frequencies of angler-harvested channel catfish from Lewis and Clark Lake, April-November, 2010.

Harvest, Release, and Catch Rates

The overall mean harvest rates for anglers fishing Lewis and Clark Lake, April-November, 2010 was 0.2361 fish/angler-hour (Table 51). The overall catch rate (estimated harvest rate plus the estimated release rate) was 0.6328 fish/angler-hour, above the reservoir-wide management objective of 0.5 fish/angler-hour. The highest estimated harvest rate occurred in August (0.3901 fish/angler-hour; Table 51) and was attributed to a high harvest of white bass (Table 47). The highest estimated catch rate was 0.7636 fish/angler-hour and occurred in June (Table 51).

The overall walleye harvest rate for Lewis and Clark Lake was 0.0653 fish/angler-hour. The overall catch rate (estimated harvest rate plus the estimated release rate of 0.3967 fish/angler-hour) was 0.2565 fish/angler-hour (Table 51). This value is close to the 0.30 fish/angler-hour benchmark, which is considered by most biologists to be characteristic of high quality walleye fisheries (Colby et al. 1979). However, estimated walleye harvest and catch rates were reduced from 2009, and walleye harvest rates did not meet the reservoir-wide management goal of 0.1 fish/angler-hour. Harvest rates for sauger were 0.0065 fish/angler-hour, well short of the management goal of 0.1 fish/angler-hour, although release rates may be underestimated for sauger based on angler misidentification (Table 51).

Table 51. Estimated harvest, release and catch rates (# fish / hour) for walleye, sauger, channel catfish, and all species combined by month, for anglers fishing Lewis and Clark Lake, April-November, 2010. Standard error (SE) is included.

Month	Walleye			Sauger			Channel catfish			All species		
	Harvest	Release	Catch	Harvest	Release	Catch	Harvest	Release	Catch	Harvest	Release	Catch
April	0.0777 (0.029)	0.1088 (0.060)	0.1865 (0.070)	0.0198 (0.010)	0.0048 (0.002)	0.0247 (0.011)	0.0304 (0.018)	0.006 (0.008)	0.0364 (0.019)	0.2886 (0.055)	0.4396 (0.105)	0.7281 (0.146)
May	0.0974 (0.034)	0.2217 (0.074)	0.3190 (0.102)	0.0014 (0.001)	0.0006 (0.000)	0.0020 (0.001)	0.0129 (0.006)	0.0013 (0.001)	0.0142 (0.007)	0.1354 (0.038)	0.4475 (0.138)	0.5829 (0.148)
June	0.0400 (0.011)	0.2245 (0.051)	0.2646 (0.058)	0.0025 (0.001)	0.0006 (0.000)	0.0031 (0.001)	0.1056 (0.067)	0.0129 (0.011)	0.1185 (0.075)	0.3284 (0.121)	0.4353 (0.092)	0.7636 (0.183)
July	0.0337 (0.026)	0.0825 (0.049)	0.1162 (0.064)	0.0000 (0.000)	0.0000 (0.000)	0.0000 (0.000)	0.1163 (0.062)	0.0227 (0.008)	0.1390 (0.064)	0.2258 (0.069)	0.2019 (0.057)	0.4277 (0.101)
August	0.0197 (0.017)	0.0654 (0.020)	0.0850 (0.035)	0.0076 (0.010)	0.0009 (0.001)	0.0085 (0.010)	0.0891 (0.042)	0.0167 (0.008)	0.1057 (0.042)	0.3901 (0.089)	0.3459 (0.086)	0.7361 (0.156)
September	0.0608 (0.023)	0.2860 (0.073)	0.3468 (0.089)	0.0080 (0.004)	0.0147 (0.007)	0.0227 (0.008)	0.0357 (0.022)	0.0012 (0.001)	0.0370 (0.021)	0.1742 (0.039)	0.5262 (0.092)	0.7004 (0.105)
October	0.0972 (0.025)	0.2454 (0.034)	0.3426 (0.048)	0.0084 (0.003)	0.0094 (0.003)	0.0178 (0.004)	0.0003 (0.000)	0.0038 (0.004)	0.0041 (0.004)	0.1776 (0.040)	0.4040 (0.051)	0.5816 (0.082)
November	0.0844 (0.026)	0.1029 (0.031)	0.1873 (0.051)	0.0220 (0.011)	0.0102 (0.004)	0.0322 (0.013)	0.0000 (0.000)	0.0011 (0.001)	0.0011 (0.001)	0.2116 (0.055)	0.2077 (0.047)	0.4193 (0.095)
Combined	0.0653 (0.024)	0.3967 (0.092)	0.2565 (0.070)	0.0065 (0.005)	0.0046 (0.003)	0.0112 (0.006)	0.0501 (0.040)	0.0079 (0.007)	0.0580 (0.043)	0.2361 (0.074)	0.3967 (0.092)	0.6328 (0.137)

Angler Demographics and Economics

Over 51% of anglers fishing Lewis and Clark Lake, April-November, 2010 were not South Dakota residents. This reservoir is a Nebraska border water and a popular destination with anglers in that state, so it is not surprising to see Nebraska residents comprising about 42% of all surveyed anglers. Non-resident anglers traveled from eight different states to fish Lewis and Clark Lake, about 8.8% of all anglers came from Iowa, and 0.3% came from Minnesota (Table 52). The majority of surveyed anglers came from southeastern South Dakota and Northeastern Nebraska; about 28% of all surveyed anglers resided in Yankton County, South Dakota.

Previous surveys have shown Lewis and Clark Lake to be a popular destination for non-resident anglers, who often make up a greater proportion of the total anglers compared to other Missouri River Reservoirs in the state (Adams et al. 2009a; Adams et al. 2009b; Bouska and Longhenry 2010; Sorensen and Knecht 2009). The popularity of Lewis and Clark Lake with nonresidents is likely due in part to its position as the southernmost Missouri River reservoir, and the closest Missouri River reservoir to major population centers such as Sioux City, IA and Omaha, NE.

Table 52. State residency of surveyed anglers fishing Lewis and Clark Lake, April-November, 2010, by number and percent of the total.

State	N	%
Iowa	181	8.8
Kansas	4	0.2
Massachusetts	1	0.05
Minnesota	6	0.3
Missouri	1	0.05
Nebraska	861	41.9
New Mexico	5	0.2
Oregon	2	0.1
South Dakota	999	48.5
Total	2,060	100

Mean completed trip length (boat and shore anglers combined) for the entire surveyed reach from April-November, 2010 during the daylight period, was 4.69 hours (Table 53). Angling parties averaged approximately two members in size (Table 53). The number of angler days can be estimated by dividing the estimated pressure (angler-hours) by the mean completed trip length. Estimates show 16,002 angler days for Lewis and Clark Lake (Table 53). Based on the average $79/trip estimate for resident and nonresident anglers combined (U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census 2008), the direct economic impact by anglers on Lewis and Clark Lake in 2010 was $1.26 million.

Table 53. Estimated mean party size, completed trip length, pressure, and angler days for anglers fishing Lewis and Clark Lake, April-November, 2010.

	Mean Party Size	Number Surveyed	Mean Completed Trip Length (h)	Total Angler Hours	Boating Hours	Total Angler Days	Boat Days
L&C	1.91	2,060	4.69	75,049	61,390	16,002	13,090

Lewis and Clark Lake provides many diverse fishing opportunities. Overall, the majority of interviewed anglers were specifically targeting walleye and sauger (68.8 %, Table 54). Anglers not specifically targeting a fish species (fishing for “anything”) came in second overall (16.4 %), but angling parties were also interviewed that were specifically targeting eight other species including catfish (8.8 %), large and smallmouth bass, and others (Table 54).

Table 54. Percentage of anglers fishing for a preferred fish species at Lewis and Clark Lake, April-November, 2010.

Species	N	%
Walleye/Sauger	1,417	68.8
Catfish Species	182	8.8
Smallmouth Bass	12	0.6
Largemouth Bass	17	0.8
White Bass	41	2.0
Carp/Buffalo Spp.	3	0.2
Northern Pike	6	0.3
Crappie	43	2.1
Bluegill	2	0.1
Anything	337	16.4
Total	2,060	100

RARE FISH OBSERVATIONS

One shovelnose sturgeon was collected during the 2010 gill net survey on Lewis and Clark Lake. Although not under protection during the time of collection (September 21, 2010), since October 1, 2010 the shovelnose sturgeon has been listed as a threatened species under the similarities of appearance provisions of the endangered species act (USFWS 2010). Although once common in Lewis and Clark Lake in the years immediately after impoundment, shovelnose sturgeon have since declined in abundance and are now rarely sampled.

FISHERY STATUS

The results from the 2010 standard sampling indicate that most of the sport fish populations in Lewis and Clark Lake continue to remain abundant. Walleye and sauger abundance in 2010 remained above the long-term average. However, consecutive years of low reproduction may be indicative of reduced abundance in the future. Currently the two species have quality size structures with a third of the sampled walleye and a quarter of the sampled sauger being longer than the 15 inch minimum length limit in place on the reservoir.

Some species specific management objectives were met for both walleye and sauger in 2010, while others were not (Table 55). Eight mature year classes of walleye were present (2001-2008) and four (2005-2008) for sauger. Proportional size distribution was within the management objective range for walleye while PSD-P was not. For sauger, PSD was above the management objective range of 30-60, and PSD-P was higher than the management objective of 10 (Table 55). Gill net CPUE's were also above the management objectives of 4.0 and 6.0 fish/net night for walleye and sauger respectively. Estimated total harvest and harvest rate (number of fish per hour) for walleye were below the objective of 10,000 and 0.1 fish/hour. Sauger also did not meet harvest or harvest rate objectives (Table 55). With the 2008 year class finally surpassing minimum harvest length restrictions, anglers should find adequate numbers of walleye and sauger available for harvest during 2011.

Channel catfish continue to be relatively abundant during the fall gill net survey (4.3/gill net) and exceeded the CPUE objective of 3/gill net (Table 55). Channel catfish size structure indices were within the set objective levels for PSD, and greater than objective levels for PSD-P (Table 55).

Largemouth and smallmouth bass CPUE continues to be well above the management objective of 10 fish/h, while PSD was below the management objective range of 30 to 60 for smallmouth and above the 30 to 60 range for largemouth (Table 55). However, size structure parameters are based on low sample sizes. Gilliland (1985) suggested that a sample size of 50 was insufficient for largemouth bass, while a sample size of 150 mirrored that of 500 when analyzing size structure. With sample sizes generally below 100, an increase in sampling effort for largemouth and smallmouth bass in Lewis and Clark Lake may be necessary for better representation of population structure.

Currently, objectives in the Missouri River Fisheries strategic plan address angler days and harvest rates for all waters in the Missouri River system in South Dakota. The Lewis and Clark Lake strategic plan also contains objectives for angler days and fish harvest rates, verifying the importance of these metrics to fisheries management. The most accurate method of evaluating these objectives is with angler use and harvest surveys. It is important to conduct these surveys

at least every four years, and more frequently if possible. Lewis and Clark Lake may not annually provide as many angler days as other Missouri River reservoirs, but it is an important fishery for the people of southeast South Dakota, Nebraska and other surrounding states.

Table 55. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution–preferred (PSD-P) and species specific management objectives for walleye, sauger, channel catfish, largemouth and smallmouth bass, in Lewis and Clark Lake, 2010. Bold values were not within the objective range.

Species and Objectives	CPUE	PSD	PSP-P	Harvest	Harvest rate
Walleye	7.2 / gill net	38	**6**	**5,982**	**0.0653**
Objectives	≥4 / gill net	30-60	≥10	10,000	0.1 / hour
Sauger	7.8 / gill net	**82**	26	**463**	**0.0065**
Objectives	≥6 / gill net	30-60	≥10	5,000	0.1 / hour
Channel catfish	3.9 / gill net	52	11		
Objectives	≥3 / gill net	30-60	≥10		
Largemouth bass	29 / hour	**87**	57		
Objectives	≥10 / hour	30-60	≥20		
Smallmouth bass	112 / hour	**13**	**3**		
Objectives	>10 / hour	30-60	>20		

Reservoir aging, more specifically sedimentation and delta formation, is an ongoing issue in Missouri River reservoirs. As these systems age, the amount of sediment present increases, leading to decreased capacity for water storage and access issues for recreational use. The Niobrara River delta on Lewis and Clark Lake has been expanding and will continue to expand over time. The full impact of this novel habitat on the fish communities present in Lewis and Clark Lake is unknown. Research has shown that fish habitat use for certain species has changed over time as the habitats themselves have changed. As this process continues to occur, fish communities will continue to utilize and adapt to new available habitats. Increases in habitat diversity through delta formation may promote greater species diversity and provide increased habitat for various native species (Kaemingk et al. 2007). It should be noted that the Army Corps of Engineers is currently investigating strategies to remove sediment from Lewis and Clark Lake. Any undertaking of this nature could have a tremendous impact on the fish community.

Presently, fish population trends seem stable in the Lewis and Clark Reservoir system with many population structural index values similar or higher than those of previous surveys. However, water levels and flow regimes in this system and their effects on fish populations are relatively

unknown. Combined with the changing nature of the system due to expansion of the Niobrara River delta and overall increases in the rate of sediment deposition, the fishery present in Lewis and Clark Lake and the upstream Missouri River stretch will likely exhibit more variability in population structure and fish habitat use in the future.

MANAGEMENT RECOMMENDATIONS

- Update Lewis and Clark Lake strategic plan. The current strategic plan was developed in 1998 and should be updated to address current issues and changes in the fishery.

- Continue to evaluate sampling strategies for all species in Lewis and Clark Lake. Although long term data sets are extremely valuable for detecting changes in fishery characteristics, it is important to incorporate new knowledge and technology to sampling techniques to provide the most accurate and useful data possible. This may include increasing sampling effort or adding new sampling techniques where necessary.

- Determine alternate sampling methods or increase effort for smallmouth/largemouth bass sampling. The sample sizes for both black bass species is consistently small and needs to be addressed. Sampling times for bass populations should also be standardized if possible.

- Continue work to determine if fall nighttime electrofishing could provide a more reliable index of walleye recruitment and year class strength in Lewis and Clark Lake.

- Continue comparisons among aging structures for flathead catfish in order to determine the most accurate structure for use on our surveys.

- Acquire additional information on species diversity in the Niobrara River delta. This relatively new formation provides native river species with important habitat types that were previously lost during the construction of the mainstem reservoirs. As this area continues to develop, native species will likely show increases in composition and abundance.

- Identify future research needs in the Niobrara River system that will aid in sport fish management. The delta area of the reservoir provides quality fishing for walleye, sauger, largemouth, and smallmouth bass.

- Utilize Federal Aid projects to aid in sport fish management in Lewis and Clark Lake.

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APPENDICES

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

Common name	Scientific name	Abbreviation
Bigmouth buffalo	*Ictiobus cyprinellus*	BIB
Black bullhead	*Ameiurus melas*	BLB
Black crappie	*Pomoxis nigromaculatus*	BLC
Bluegill	*Lepomis macrochirus*	BLG
Blue sucker	*Cycleptus elongatus*	BSR
Bluntnose minnow	*Pimephales notatus*	BLM
Brassy minnow	*Hybognathus hankinsoni*	BRM
Buffalo spp.	*Ictiobus spp.*	--
Channel catfish	*Ictalurus punctatus*	CCF
Common carp	*Cyprinus carpio*	COC
Common shiner	*Notropis cornutus*	COS
Creek chub	*Semotilus atromaculatus*	CRC
Emerald shiner	*Notropis atherinoides*	EMS
Fathead minnow	*Pimephales promelas*	FHM
Flathead catfish	*Pylodictis olivaris*	FHC
Flathead chub	*Platygobio gracilis*	FLC
Freshwater drum	*Aplodinotus grunniens*	FRD
Gizzard shad	*Dorosoma cepedianum*	GZD
Golden shiner	*Notemigonus crysoleucas*	GOS
Goldeye	*Hiodon alosoides*	GOE
Grass pickerel	*Esox americanus vermiculatus*	GRP
Green sunfish	*Lepomis cyanellus*	GRS
Johnny darter	*Etheostoma nigrum*	JOD
Largemouth bass	*Micropterus salmoides*	LMB
Northern pike	*Esox lucius*	NOP
Orangespotted sunfish	*Lepomis humilis*	ORS
Paddlefish	*Polyodon spathula*	PAH
Pallid sturgeon	*Scaphirhynchus albus*	PLS
Rainbow smelt	*Osmerus mordax*	RBS
Red shiner	*Notropis lutrensis*	RES
Redfin shiner	*Lythrurus umbratilis*	RES
River carpsucker	*Carpiodes carpio*	RIC

Appendix 1. Continued.

Common name	**Scientific name**	**Abbreviation**
Rock bass	*Ambloplites rupestris*	RKB
Sauger	*Sander canadense*	SAR
Sand shiner	*Notropis stramineus*	SAS
Shorthead redhorse	*Moxostoma macrolepidotum*	SHR
Shortnose gar	*Lepisosteus platostomus*	SNG
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	SHS
Silverstripe shiner	*Notropis stilbius*	SIS
Smallmouth bass	*Micropterus dolomieu*	SMB
Smallmouth buffalo	*Ictiobus bubalus*	SAB
Spotfin shiner	*Notropis spilopterus*	SFS
Spottail shiner	*Notropis hudsonius*	SPS
Walleye	*Sander vitreus*	WAE
Western silvery minnow	*Hybognathus argyritis*	WSM
White bass	*Morone chrysops*	WhB
White crappie	*Pomoxis annularis*	WHC
Yellow perch	*Perca flavescens*	YEP

Appendix 2. Standard weight equations used for relative weight calculations. Length is in millimeters and weight is in grams.

Species	Equation
Channel catfish	$Log_{10}(Ws)= 3.2494*Log_{10}(TL)-5.800$
Flathead catfish	$Log_{10}(Ws)= 3.082*Log_{10}(TL)-5.156$
Largemouth bass	$Log_{10}(Ws)= 3.19*Log_{10}(TL)-5.316$
Sauger	$Log_{10}(Ws)= 3.187*Log_{10}(TL)-5.492$
Smallmouth bass	$Log_{10}(Ws)= 3.200*Log_{10}(TL)-5.329$
Walleye	$Log_{10}(Ws)= 3.180*Log_{10}(TL)-5.453$

Appendix 3. Select information from previous angler harvest and use surveys; L&C = the reservoir system including Fort Randall tailwaters downstream to Gavins Point Dam. GPDT = Gavins Point Dam tailwater, LMR = Lower Missouri River from GPDT to the confluence with the Big Sioux River near the Iowa, Nebraska border. Survey dates differed; 1984, 1994, 2001, and 2005 were conducted April-September, 1995 was conducted May-September, 2000 was conducted April-December, 2010 was conducted April-November.

	1984[1]			1994[2]			1995[3]			2000[4]		
	L&C	GPDT	LMR	L&C	GPDT	LMR	L&C	GPDT	LMR	L&C	GPDT	LMR
WAE Harvest	12,167	6,554	x	16,915	6,550	x	22,772	7,182	x	22,883	4,820	1,973
WAE Release			x	41,856	44,419	x	27,029	15,199	x	52,158	14,474	3,288
WAE Caught			x	58,771	50,969	x	49,801	22,385	x	75,041	19,294	5,261
CCF Harvest	9,002	2,138	x	10,073	8,917	x	5,525	3,885	x	20,490	10,473	5,538
CCF Release			x	1,876	3,043	x	1,371	2,932	x	21,260	20,233	18,006
CCF Caught			x	11,949	11,960	x	6,896	6,817	x	41,750	30,706	23,544
Overall Harvest	33,412	45,101	x	39,302	81,450	x	47,994	36,328	x	81,022	63,454	14,944
Overall Release			x	64,462	126,842	x	63,101	51,649	x	141,439	122,412	32,718
Overall Caught			x	103,764	208,292	x	111,095	87,977	x	222,459	185,866	47,663
Pressure (angler-h)	106,818	79,743	x	121,932	92,002	x	191,543	92,123	x	249,029	147,545	62,176
Boat Hours	85,603	40,581	x	101,318	46,391	x	165,736	44,806	x	x	x	x
Mean Trip Length	4.1	4.2	x	3.5	3.3	x	3.4	2.8	x	reported 5.9 combined		x
Boating Days	20,879	9,662		28,948	14,058	x	48,746	16,002	x	n/a	n/a	n/a
WAE Harvest Rate	0.12	0.08	x	0.139	0.071	x	0.119	0.078	x	0.092	0.033	0.032
WAE Catch Rate			x	0.482	0.554	x	0.26	0.243	x	0.301	0.131	0.085
CCF Harvest Rate	0.08	0.03		0.083	0.097	x	0.029	0.042	x	0.082	0.071	0.089
CCF Catch Rate				0.098	0.13	x	0.036	0.074	x	0.168	0.208	0.379
Overall Harvest Rate	0.31	0.4	x	0.322	0.885	x	0.251	0.394	x	0.325	0.43	0.24
Overall Catch Rate			x	0.851	2.264	x	0.58	0.955	x	0.893	1.26	0.767

Appendix 3 continued.

	2001[5]			2005[6]			2009[7]			2010*		
	L&C	GPDT	LMR	L&C	GPDT	LMR	L&C	GPDT	LMR	L&C	GPDT	LMR
WAE Harvest	34,617	1,396	x	9,001	x	x	20,996	5,093	1,633	5,982	x	x
WAE Release	29,829	5,600	x	11,330	x	x	43,330	12,193	5,527	19,035	x	x
WAE Caught	64,446	6,996	x	20,331	x	x	64,326	17,286	7,160	25,017	x	x
CCF Harvest	18,672	4,706	x	12,282	x	x	4,958	7,569	611	3,042	x	x
CCF Release	13,740	6,147	x	5,381	x	x	3,569	9,148	6,085	551	x	x
CCF Caught	32,412	10,853	x	17,663	x	x	8,527	16,717	6,696	3,593	x	x
Overall Harvest	67,338	26,097	x	35,972	x	x	51,508	53,623	12,620	16,667	x	x
Overall Release	91,321	49,764	x	46,431	x	x	94,085	104,711	43,827	34,710	x	x
Overall Caught	158,659	75,861	x	82,403	x	x	145,593	158,334	56,447	51,377	x	x
Pressure (angler-h)	250,219	81,093	x	165,028	x	x	166,239	127,903	78,239	75,049	x	x
Boat Hours	215,457	27,119	x	130,698	x	x	131,078	44,365	61,030	61,390	x	x
Mean Trip Length	3.76	3.32	x	4.41	x	x	4.41	3.79	2.36	4.69	x	x
Boating Days	57,303	8,168	x	29,612	x	x	28,190	11,706	25,860	13,090	x	x
WAE Harvest Rate	0.138	0.017	x	0.055	x	x	0.126	0.04	0.021	0.065	x	x
WAE Catch Rate	0.258	0.086	x	0.123	x	x	0.387	0.135	0.092	0.257	x	x
CCF Harvest Rate	0.075	0.058	x	0.074	x	x	0.03	0.059	0.008	0.05	x	x
CCF Catch Rate	0.13	0.134	x	0.107	x	x	0.051	0.131	0.086	0.058	x	x
Overall Harvest Rate	0.269	0.322	x	0.218	x	x	0.31	0.419	0.161	0.236	x	x
Overall Catch Rate	0.634	0.935	x	0.499	x	x	0.876	1.238	0.721	0.633	x	x

1. Stone 1985. 2. Wickstrom 1995. 3. Wickstrom 1996. 4. Wickstrom 2001; Mestl et al. 2001. 5. Wickstrom et al. 2002. 6. Wickstrom and Schuckman 2006. 7. Bouska and Longhenry 2010. * The 2010 creel survey was conducted only on the lake portion of the reservoir system, from Gavins Point Dam to the first sandbars of the Niobrara Delta.