SOUTH DAKOTA FISHERIES

ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2011 and 2012

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ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2011 AND 2012

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PREFACE

Information collected from Lewis and Clark Lake during 2011 - 2012 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.

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EXECUTIVE SUMMARY

Information presented in this report was derived from fish population surveys conducted on Lewis and Clark Lake and the Missouri River below Gavins Point Dam during 2011 and 2012. Trends in fish population structure are reported and compared with previous surveys. These surveys are used to determine the status of the fishery, evaluate management strategies and objectives outlined in the Missouri River Program Strategic Plan, and guide management recommendations to improve the fishery.

Walleye, Sauger, Channel Catfish and Freshwater Drum remain the most abundant species sampled with gill nets. Walleye and Sauger catch per unit effort (CPUE) in 2012 were 4.8 and 2.9/gill net, respectively. Proportional size distribution of Walleye was above the management objective range of 30-60 in 2011 and 2012. PSD-P was above management objective of 10 in 2011, but below 10 in 2012. Sauger PSD and PSD-P were well above the management objectives in both 2011 and 2012.

Channel Catfish continue to be abundant during the fall gill net survey (5.8/gill net) and exceeded the CPUE objective of 3.0/gill net. Channel Catfish size structure indices were above average in 2012, and surpassed the set objective levels for PSD and PSD-P.

Largemouth Bass CPUE fell below the management objective of 10 fish/h, while Smallmouth Bass CPUE continues to be well above 10 fish/h. PSD was below the management objective range of 30 to 60 for Smallmouth Bass, while Largemouth Bass PSD was above. However, these size structure parameters are based on low sample sizes.

Twenty-one and sixteen species of fish were sampled during the seining survey on Lewis and Clark Lake in 2011 and 2012, respectively. Relative abundance of most species was reduced causing total catch rates to fall below the long-term average. Emerald shiners remained the most abundant fish caught in seines. Age-0 Walleye or Sauger were sampled with seines in 2011 however, they were not sampled in 2012. Both species are typically collected, and this is the second (2010 and 2012) recorded absence of age-0 Walleye since annual sampling began in 1981. No uncommon species were sampled.

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LIST OF ABBREVIATIONS

CI.....confidence interval
cms.....cubic meter per second
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
rkm.....river kilometer
PSD-M.....proportional size distribution for memorable-length fish
PSD-P.....proportional size distribution for preferred-length fish
S.....stock length
SD.....South Dakota
spp.....species (multiple)
TL.....total length
W_r.....relative weight
W_s.....standard weight

ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2011-2012

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 water for municipal use and irrigation, power generation, provide habitat for fish and wildlife, and provide recreational opportunities Recreation 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.

In 2011, the upper Missouri River Basin experienced late snow-melt runoff and large precipitation events that prompted the USACE to release an unprecedented 4,530 cms through the lower four reservoirs resulting in extensive flooding in the entire basin. While many of the fisheries surveys were completed, conditions were not favorable for standardized sampling and gear efficiency was greatly reduced due to high flows, turbid water, and high amounts of debris carried downstream. The data collected from 2011, is included in this report, however, caution must be used when interpreting the data because of likely biases caused by the flood.

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 lessened the area available for recreation, there are some positive qualities that it provides. 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 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 than the lake (R. 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 2011 and 2012, and to provide management recommendations to enhance or conserve 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/h.
- 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

Walleye

- 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 4.0 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/h.

Sauger

- 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 6.0 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/h.

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/h 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 and extends from Springfield, SD, upstream to Fort Randall Dam. Normal pool elevation for Lewis and Clark Lake is 368 m 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 water in the reservoir can be replaced in just a few days. The timing, duration, and magnitude of releases likely impacts primary and secondary production, fish recruitment, and other ecological variables within the reservoir, though it is not fully known to what extent.

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 km 1349). 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.

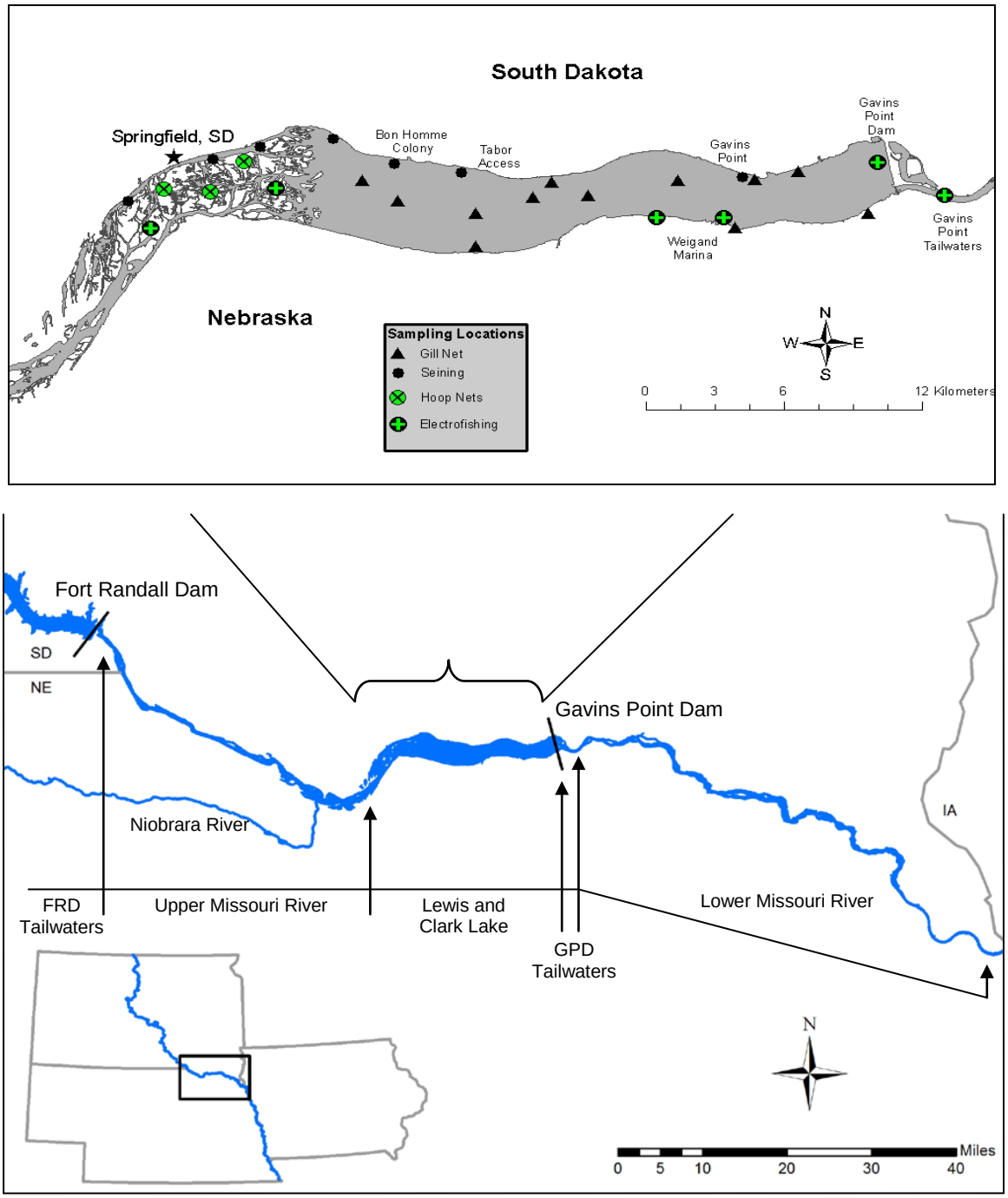

Figure 1. An illustration of the Missouri River from Fort Randall Dam to the South Dakota downstream border with select sampling locations in Lewis and Clark Lake.

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 2011 and 2012 (Table 1).

Table 1. Sampling methods, target species and effort for Lewis and Clark Lake sampling, 2011 and 2012. 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	All	CCF	SMB	SMB
2011 Effort	12 net nights	133 min	115 min	110 min	13 hauls	85 min	15	70 net nights	120 min	60 min
2012 Effort	12 net nights	60 min	140 min	120 min	10 hauls	57 min	49	94 net nights	60 min	60 min

Lewis and Clark Lake

Experimental multifilament gill nets were used in September 2011 and 2012. 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 in Lewis and Clark Lake in July of 2011 and 2012. 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). Thirteen seine hauls were performed at 10 sites (no more than two hauls/site) in 2011 and 10 seine hauls were performed at 5 sites (2 hauls/site) in 2012. All fish collected were identified and enumerated.

Smallmouth Bass were sampled by nighttime electrofishing near Gavins Point Dam in May 2011 and 2012, with a boom-mounted electrofishing boat utilizing pulsed DC of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using two dippers and one boat operator ranged from 60 to 133 minutes (in 2012 and 2011, respectively). 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 during consecutive weeks in June 2011 and 2012, with a boom-mounted electrofishing boat utilizing pulsed DC of 460 volts, 2 amps and 15 pulses/second. Electrofishing effort using two dippers and one boat operator consisted of six runs totaling 115 minutes in 2011 and 140 minutes in 2102. 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; Nash and Irwin 1999).

Fall night electrofishing was conducted to index age-0 Walleye and Sauger recruitment in the reservoir. In 2011 and 2012 (n=11 and n=12 respectively), sites were sampled 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 were used to target age-0 fishes and adult prey species in the Missouri River between rkm 1334 and 1344 in July 2011 and 2012. Seine dimensions were 9.1 m long by 1.2 m deep with 6.6-mm bar mesh. The quarter-arc haul method was used as described by Hayes et al. (1996). Up to five repetitious hauls were made at four sites in 2011 and 10 sites in 2012. Number of repetitions and site were dependent on habitat availability.

Smallmouth Bass were sampled by daytime electrofishing from the Gavins Point Dam tailwater area in May of 2011 and 2012, with a boom-mounted electrofishing boat utilizing pulsed DC of 185 volts, 6-8 amps and 60 pulses/second. 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 night electrofishing from the Fort Randall Dam tailwater area in October 2011 and 2012, with a boom-mounted electrofishing boat utilizing pulsed DC 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 for each year. 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).

Largemouth Bass were collected by daytime electrofishing near Springfield, South Dakota in May, 2011 and 2012, with a boom-mounted electrofishing boat utilizing pulsed DC of 185 volts, 6-8 amps and 60 pulses/second. 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 in August 2011 and 2012. Nets were baited with cheese and remained in the water for two consecutive nights. Approximately half of the hoop nets had 25-mm mesh and the remaining had 38-mm mesh. After the initial two-day set, nets were reset and remained in the water for two additional nights for a total of 70 and 94 net nights of effort for 2011 and 2012, respectively. 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. Relative abundance was expressed as catch per unit effort (CPUE) for standard gill netting (number/net night), seining (number/seine haul), electrofishing (number/h) and hoop netting (number/net night) surveys. Length data were described by proportional size distribution (PSD; Table 2; Anderson 1980; Gabelhouse 1984; Guy et al 2007).

Table 2. Length categories (mm) used for calculating stock density indices for common sport 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). We calculated relative weight using 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; 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 WinFin computer software. Back-calculations were used to determine mean length at age, and then compared to statewide averages or averages from other Missouri River reservoirs when available. Otoliths were removed from Walleye and Sauger, allowed to dry and were then cracked through the focus (DeVries and Frie (1996). 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 at the basal recess (Channel Catfish) or through the articulating process (flathead catfish) using a low speed diamond blade saw and viewed under a microscope (Sneed 1951; Ashley and Garling 1980, Nash and Irwin 1999). Back-calculated lengths were also estimated for channel and flathead catfish aged with pectoral fin rays. Age distributions were generated with WinFin 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.

RESULTS AND DISCUSSION

Lewis and Clark Lake

Seines

Twenty one species were sampled in 2011 and 16 in 2012. Catch per unit effort fell below the long-term average for both 2011 and 2012 (Figure 2). Emerald Shiner was the most abundant species in both years (Table 3). Gizzard Shad CPUE was low in 2011 and no Gizzard Shad were collected in 2012 (Table 3). Catches of most species were reduced from 2011 to 2012. No age-0 Walleye or Sauger were sampled with seines in 2012 and few were sampled in 2011.

Seining efficiency can vary greatly for individual species (Lyons 1986, Parsley et al. 1989). 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. High water levels and flows through the reservoir in 2011 influenced seining efficiency.

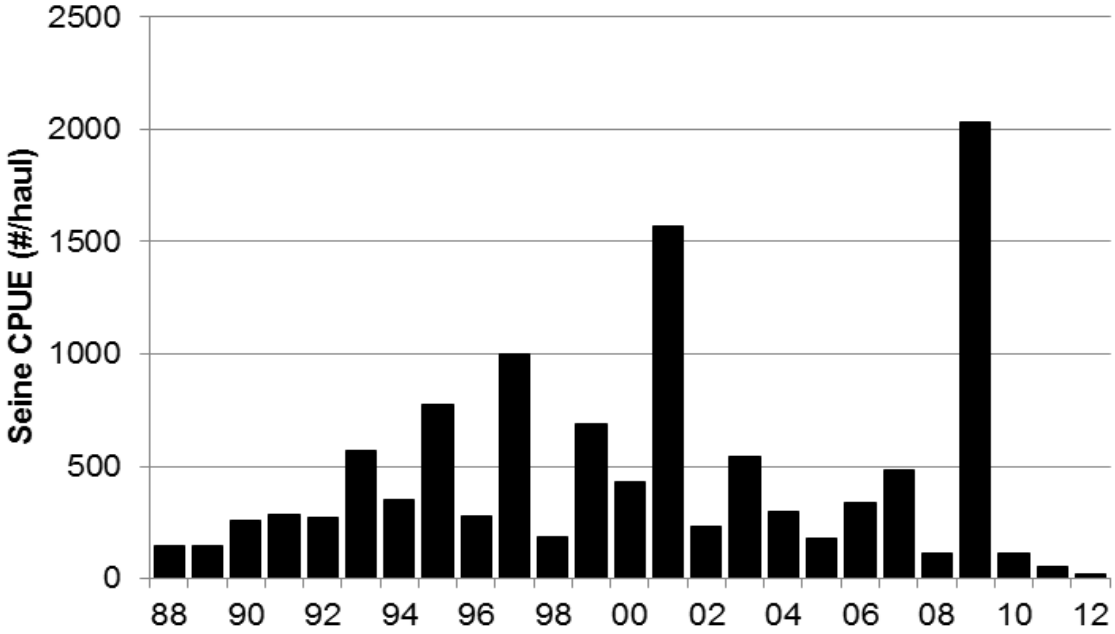

Figure 2. Mean number of fish captured per seine haul from Lewis and Clark Lake, South Dakota, 1988-2012.

Table 3. Catch per unit effort (fish/seine haul) of age-0 fishes during seining surveys at Lewis and Clark Lake, South Dakota, 2008-2012. Standard error (SE) is included. *includes age-0 and adults.

Species	**2008**	**2009**	**2010**	**2011**	**2012**
Bigmouth Buffalo	0.1 (0.1)	--	--	0.2 (0.1)	--
Black Crappie	--	0.1 (0.1)	--	2.9 (2.8)	0.7 (0.5)
Bluegill	--	1.6 (1.6)	0.3 (0.3)	1.6 (06)	3.3 (2.8)
Bluntnose Minnow*	--	--	--	0.6 (0.4)	--
Central Stoneroller*	--	0.1 (0.1)	--	--	--
Channel Catfish	--	0.3 (0.2)	0.1 (0.1)	0.1 (0.1)	0.2 (0.2)
Common Carp	0.3 (0.3)	--	0.1 (0.1)	--	--
Common Shiner*	--	0.3 (0.3)	--	--	--
Creek Chub*	--	--	0.1 (0.1)	--	--
Emerald Shiner*	6.8 (0.8)	85.6 (47.8)	75.8 (46.4)	23.6 (10.3)	9.2 (8.5)
Fathead Minnow*	--	--	1.6 (1.1)	0.3 (0.2)	0.2 (0.2)
Flathead Catfish	--	--	--	--	0.1 (0.1)
Freshwater Drum	21.9(12.4)	1.1 (0.7)	0.3 (0.3)	--	0.1 (0.1)
Gizzard Shad	69.4 (9.0)	1876.5 (1873.2)	20.3 (20.1)	4.4 (3.1)	--
Johnny Darter*	1.3 (1.1)	2.3 (2.0)	7.9 (5.2)	0.5 (0.2)	0.6 (0.4)
Largemouth Bass	--	--	--	0.5 (0.2)	2.0 (1.9)
N. Redbelly Dace*	--	--	0.1 (0.1)	--	--
Red Shiner*	5.3 (3.9)	1.0 (1.0)	--	0.6 (0.4)	0.4 (0.3)
River Carpsucker	0.3 (0.3)	0.3 (0.2)	0.5 (0.4)	0.2 (0.1)	1.7 (0.9)
Sauger	--	0.4 (0.2)	--	0.3 (0.2)	--
Shorthead Redhorse	0.8 (0.4)	1.0 (0.8)	0.3 (0.3)	1.8 (1.4)	0.5 (0.3)
Shortnose Gar	--	0.1 (0.1)	0.1 (0.1)	--	--
Smallmouth Bass	0.1 (0.1)	1.0 (0.5)	--	--	0.5 (0.3)
Smallmouth Buffalo	--	--	--	0.4 (0.3)	--
Spotfin Shiner*	1.3 (1.3)	1.9 (1.5)	5.0 (4.0)	0.6 (0.4)	0.1 (0.1)
Spottail Shiner*	1.8 (0.8)	0.6 (0.2)	1.1 (0.4)	0.1 (0.1)	--
Walleye	1.5 (1.1)	1.5 (0.4)	--	0.9 (0.5)	--
White Bass	4.6 (1.7)	59.6 (44.1)	0.8 (0.5)	10.4 (6.7)	0.3 (0.2)
White Crappie	--	--	--	0.4 (0.4)	--
Yellow Perch	--	--	--	3.0 (1.1)	0.8 (0.8)

Gill Nets

Eleven and sixteen species were captured with gill nets in 2011 and 2012, respectively (Table 4). Freshwater Drum were the most abundant species sampled in gill nets representing 39 and 30 percent of the total fish captured during the 2011 and 2012 surveys (Figure 3). Walleye, Channel Catfish, Sauger and Gizzard Shad were also common species in the sample. Most species showed an increase in abundance from 2011 to 2012 (Table 4). Although Walleye CPUE increased to 4.8, relative abundance is still lower than the previous 25-year average (6.0 /net night).

Species sampled with gill nets have 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.

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.

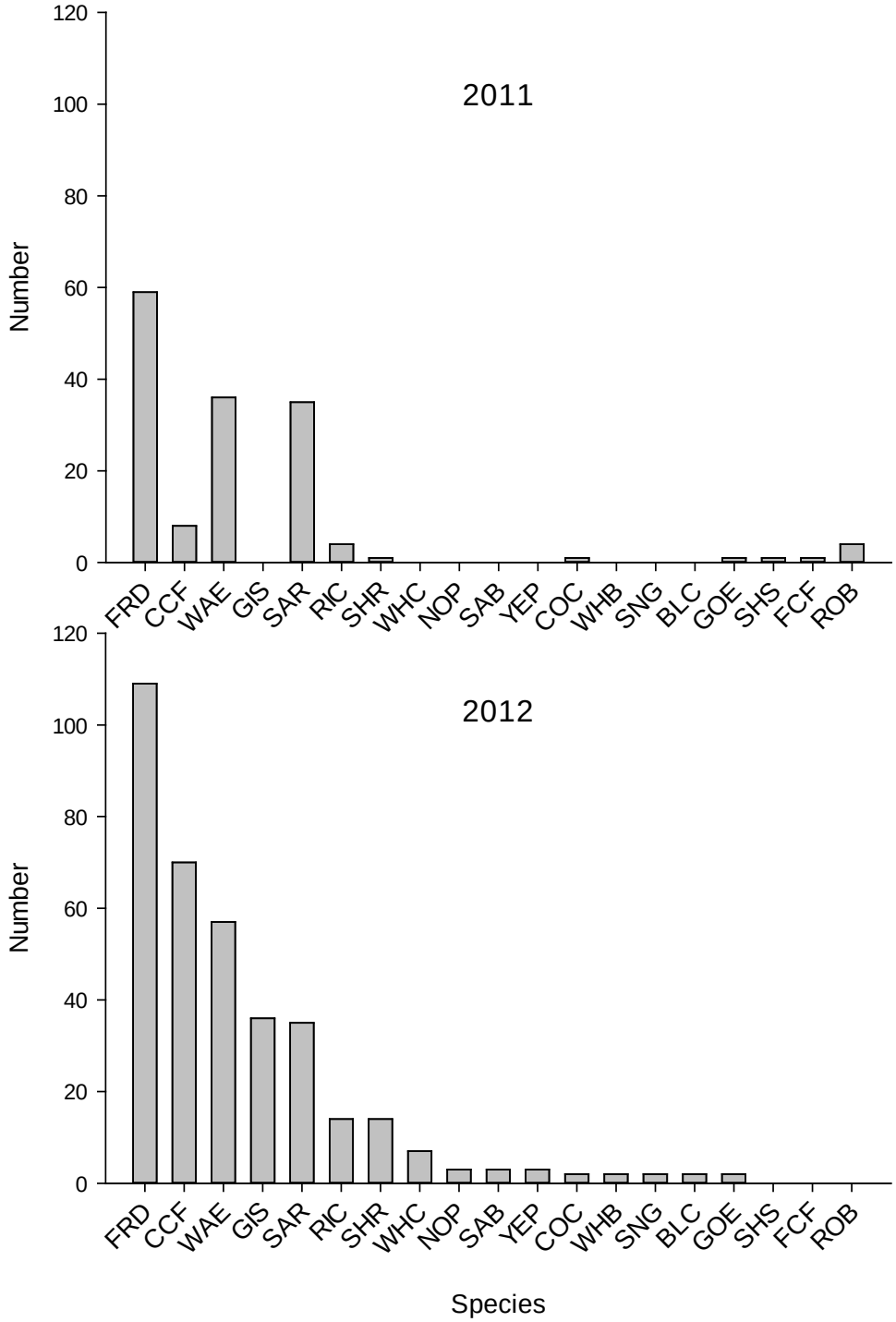

Figure 3. Number of each species collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2011 and 2012. Abbreviations used are defined in Appendix 1.

Table 4. Catch per unit effort (fish/net night) for gill nets in Lewis and Clark Lake, South Dakota, 1956, 1983, 2004-2012. Standard error (SE) is included (no standard errors are listed for 1956 sampling).

Species	**2008**	**2009**	**2010**	**2011**	**2012**
Bigmouth Buffalo	0.2 (0.2)	0.1 (0.1)	0.1 (0.1)	--	--
Black Crappie	--	--	--	--	0.2 (0.2)
Channel Catfish	5.5 (2.2)	4.3 (1.2)	3.9 (2.2)	0.7 (0.2)	5.8 (2.1)
Common Carp	0.7 (0.4)	0.7 (0.3)	0.3 (0.2)	0.1 (0.1)	0.2 (0.2)
Flathead Catfish	--	--	--	0.1 (0.1)	--
Freshwater Drum	3.6 (1.1)	6.4 (1.5)	2.9 (1.0)	4.9 (1.4)	9.1 (2.2)
Gizzard Shad	11.9 (6.3)	1.8 (0.8)	1.6 (1.1)	--	3.0 (1.6)
Goldeye	--	--	--	0.1 (0.1)	0.2 (0.1)
Northern Pike	--	--	0.1 (0.1)	--	0.3 (0.1)
Paddlefish	0.3 (0.1)	--	--	--	--
River Carpsucker	2.2 (1.2)	0.4 (0.2)	1.3 (0.6)	0.3 (0.3)	1.2 (0.5)
Rock Bass	--	--	--	0.3 (0.2)	--
Sauger	9.6 (2.1)	8.3 (1.4)	7.8 (2.0)	2.9 (0.8)	2.9 (0.6)
Shorthead Redhorse	2.3 (0.8)	1.3 (0.5)	0.8 (0.3)	0.1 (0.1)	1.2 (0.7)
Shortnose Gar	0.3 (0.1)	--	--	--	0.2 (0.2)
Shovelnose Sturgeon	--	--	0.1 (0.1)	0.1 (0.1)	--
Smallmouth Buffalo	0.1 (0.1)	0.1 (0.1)	--	--	0.3 (0.2)
Spottail Shiner	--	--	--	--	--
Walleye	14.0 (3.3)	10.7 (1.7)	7.2 (1.4)	3.0 (0.9)	4.8 (1.7)
White Bass	2.3 (0.8)	0.3 (0.2)	0.2 (0.1)	--	0.2 (0.1)
White Crappie	0.3 (0.1)	0.4 (0.3)	0.3 (0.2)	--	0.6 (0.3)
Yellow perch	0.1 (0.1)	--	--	--	0.3 (0.2)

Walleye population parameters

High releases during the 2011 flood event likely impacted sampling efficiency during the 2011 surveys due to large amounts of debris entangled in the gill nets. However, Walleye relative abundance remained lower than average in 2012 indicating there were impacts to the Walleye population. Age-0 catches in 2011 and 2012 were low but similar to 2009 and 2010. Additionally, CPUE of harvestable sized Walleye (381 mm) increased to 3.5/net night in 2012. Thus it appears that there was not a significant impact to the adult portion of the population and the current decreased relative abundance is likely related to poor recruitment from 2009-2012**.**

In 2012, Walleye PSD was 83 and above the desired range of 30 – 60 (Anderson and Weithman 1978) due to low recruitment in recent years. Additionally, PSD-P was 6, below the objective of 10 (Table 6).

Lewis and Clark 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 warmer water temperatures and a longer growing season. Also, the diverse habitats included in the reservoir (i.e. river, backwater, delta, and lake) likely provide a wide variety of prey species such as Gizzard Shad, shiner spp., Freshwater Drum, and River Carpsucker. Walleye in Lewis and Clark Lake primarily consumed River Carpsucker and Freshwater Drum in the spring Wickstrom (2006). During the summer months, mayfly larvae and shiner spp. were important, while Gizzard Shad and Freshwater Drum were the most common food items during autumn months. Mean relative weights for all size classes were similar to the 10-year average (Table 9).

Walleye recruitment in Lewis and Clark Lake is currently indexed with gill net CPUE of age-0 Walleye. In 2012, only four age-0 Walleye were sampled (CPUE = 0.3), indicating a weak year class produced. Age-0 CPUE can 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 ($r = 0.8$, $p < 0.01$ Lott et al. (2006)). 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 evaluate electrofishing as an alternate 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) suggested 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 in 2012 was 51.5/h electrofishing. This is the highest CPUE since 2008 and suggests moderate to strong production occurred compared with 6.5 and 2.3 in 2011 and 2010 respectively. Results from electrofishing are somewhat inconsistent with the age-0 gill net CPUE, therefore, after an adequate sample size is obtained, further analysis will be performed to identify the most accurate index of Walleye recruitment.

Mean age of Walleye sampled in 2012 has increased to 4 years and is directly related to the low levels of recruitment during the 2009 – 2012 period (Table 10).

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, 2003-2012. Standard error (SE) is included in parenthesis.

Year	Sauger	Walleye
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)
2011	1.3 (0.5)	1.6 (0.4)
2012	1.3 (0.3)	3.5 (1.4)

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, 2003-2012.

Year	PSD	PSD-P	PSD-M	Sample Size
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
2011	71	14	0	36
2012	83	6	0	57

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 2006-2012, 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	--	--	--	--
2011	**Mean**	159	--	341	406	460	497	513	--	628	--	--	--	--
	N	8	--	7	9	9	1	1	--	1	--	--	--	--
	SE	4.9	--	7.8	5.1	15.1	--	--	--	--	--	--	--	--
2012	**Mean**	155	300	370	416	454	457	447	474	541	499	--	--	--
	N	4	6	4	13	18	7	1	1	1	1			
	SE	8.2	13.7	18.1	6.5	7.3	4.8	--	--	--	--	--	--	--
Mean of means		158	306	387	437	479	504	485	505	558	518	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 2007-2012.

Year	Growth increment added during period (mm)							
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**
2007-2008	150	89	74	21	21	-24	-8	15
2008-2009	107	64	-10	22	6	-21	54	--
2009-2010	110	75	21	36	23	-32	6	-5
2011-2011	--	81	52	40	43	-25	--	113
2011-2012	141	--	75	48	-3	-50	-39	--
Mean	141	82	47	39	22	-25	9	41

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, 2003-2012. 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**
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
2011	82 (1.4)	8	80 (1.3)	16	80 (0.9)	4
2012	83 (0.9)	9	84 (0.5)	40	83 (1.0)	3

Table 10. Age distribution of Walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2003-2012, as determined from scales (2003 – 2005) and otoliths (2006 – 2012). Mean age excludes age-0 fish.

Year	Age															
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Mean**
2003	19	24	52	10	6	5	1	2	4	3	0	1	0	0	0	2.8
2004	3	7	20	13	7	1	0	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	0	3.4
2006	2	10	14	14	9	6	1	0	0	0	0	1	0	0	0	3.0
2007	38	14	22	17	9	3	3	2	0	1	0	0	0	0	0	2.8
2008	25	51	23	37	15	6	6	1	1	0	1	2	0	0	0	2.7
2009	4	44	53	6	6	4	2	3	0	1	0	4	1	0	0	2.5
2010	3	16	40	16	2	2	2	1	2	1	0	0	1	0	0	2.5
2011	8	0	7	9	9	1	1	0	1	0	0	0	0	0	0	3.4
2012	4	6	4	13	18	7	1	1	1	0	0	1	0	0	1	4.0

Sauger population parameters

Sauger are an important component of the Lewis and Clark Lake fishery and are commonly sampled at higher relative abundance than Walleye. In 2011 and 2012, 35, Sauger were sampled during the gill net survey with a CPUE of 2.9 fish/net night (Table 4). Mean gill net CPUE for Sauger 381 mm (15 inches) and longer has decreased each year since 2008 to 1.3 fish/net night in both 2011 and 2012 (Table 5).

Sauger PSD-Q (100) and PSD-P (59) increased in 2011 compared to 82 and 26, respectively, during 2010 sampling (Table 11). PSD-P increased again in 2012 to 76. While a generally accepted stock density index range is not readily available for Sauger, the generally accepted range for Walleye is 30-60. The 2008 year class was the most abundant year class in the 2012 sample resulting in abnormally high PSD-P. (Table 11; Figure 4).

Sauger generally grow slower than Walleye (Malison et al. 1990); however, growth of Lewis and Clark Lake Sauger are typically similar to Walleye growth rates (Table 7; Table 12). Sauger growth in 2011 and 2012 was slower than the five year average with Sauger attaining the minimum size limit (381 mm) in the fourth growing season (Table 13).

Sauger relative weights for Lewis and Clark Lake are generally between 77 and 85 (Table 14). In 2011, Sauger relative weights were within this range for all size groups indicating sufficient prey availability. In 2012 relative weight (69) was below the range for stock-quality fish and within the range for all other size groups. 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 2011 and 2012, age-0 CPUE was 3 and 15 respectively, indicating low production in 2011 and moderate production in 2012 (Table 15). Fall night electrofishing showed a large increase in age-0 CPUE from 8.5/h in 2010 to 28.5/h in 2012. Mean age of Sauger (3.7 years) increased from 2010 and is above previous years. Age-3 and Age-4 Sauger were the most prevalent age classes in 2011 and 2012 respectively, excluding age-0 fish.

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 11. 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, 2003-2012.

Year	PSD	PSD-P	PSD-M	Sample Size
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
2011	100	59	3	35
2012	95	76	0	35

Table 12. Mean length at age of capture, as determined by ages estimated from otolith analysis, for Sauger collected in the standard September gill net survey 2008-2012, 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**
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	--	--	--	--	--	--
2011	**Mean**	159	--	354	388	414	411	498	495	--	--	--	--
	N	3	--	7	16	5	1	1	2	--	--	--	--
	SE	5.4	--	5.5	5.9	19.6	--	--	39	--	--	--	--
2012	**Mean**	161	314	369	416	433	432	--	--	--	--	--	--
	N	15	1	1	3	13	2	--	--	--	--	--	--
	SE	4.7	--	--	20.4	10.3	24.0	--	--	--	--	--	--
Mean of means		165	305	382	423	459	451	487	475	490	--	--	466

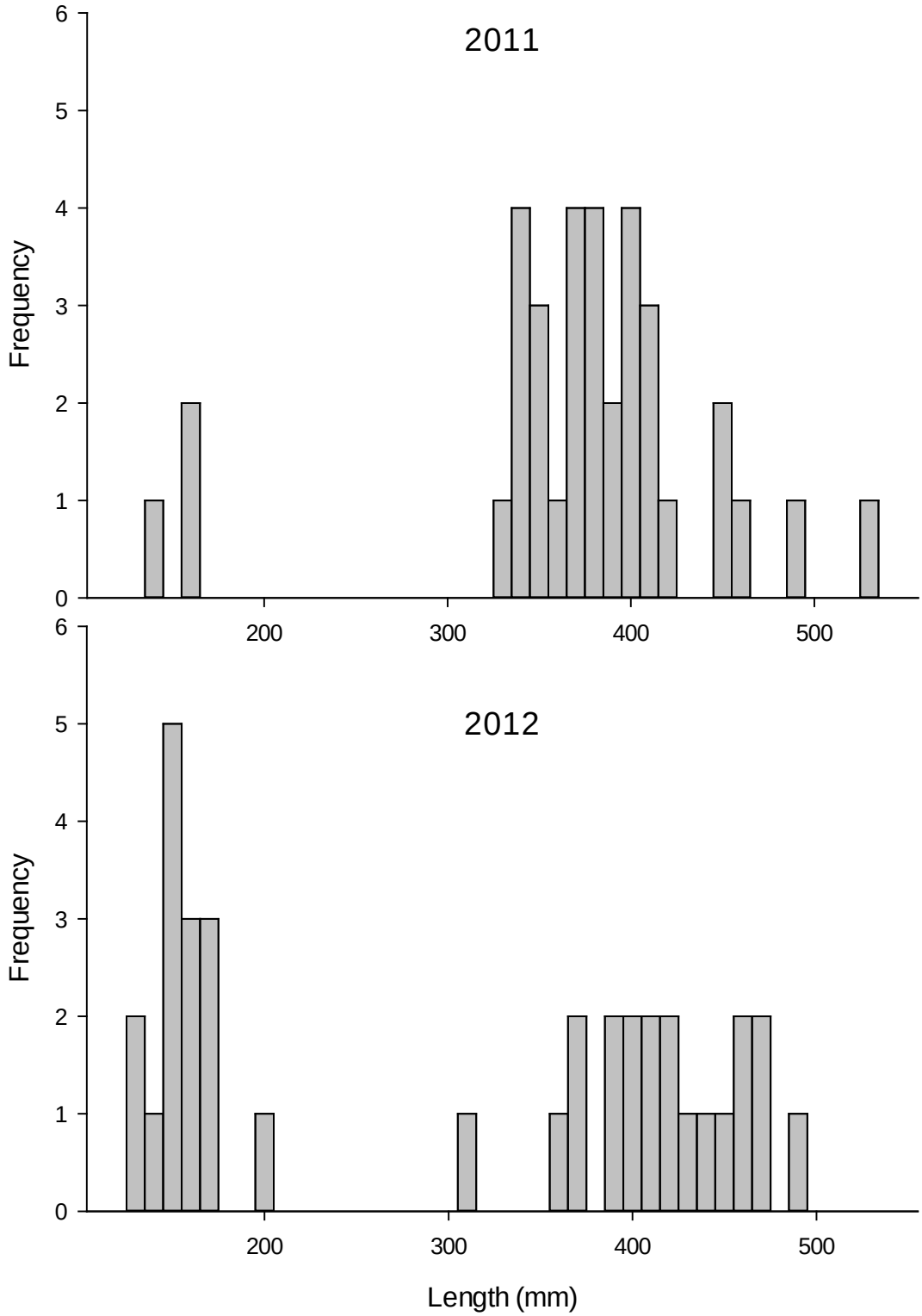

Figure 4. Length frequency of Sauger collected during the standard gill net surveys from Lewis and Clark Lake, South Dakota, 2011 and 2012.

Table 13. Mean annual growth increments for Sauger collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2007-2012.

Year	Growth increment added during period (mm)							
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**
2007-2008	138	125	61	50	2	--	10	--
2008-2009	103	44	4	6	-38	-20	-26	--
2009-2010	130	75	15	-4	-29	--	--	--
2010-2011	--	79	36	19	-26	58	--	--
2011-2012	155	--	62	45	18	--	--	--
Mean	132	82	39	32	-15	13	-8	--

Table 14. Mean relative weight of Sauger, by length categories, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2003-2012. 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**
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
2011	75 (0.8)	13	77 (0.4)	18	70 (--)	1
2012	69 (-)	1	80 (1.4)	4	77 (1.1)	16

Table 15. Age distribution of Sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2003-2012. Scales (2003-2005) and otoliths (2006-2012) 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**
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
2011	3	0	7	16	5	1	1	2	0	0	0	3.3
2012	15	1	1	3	13	2	0	0	0	0	0	3.7

Channel Catfish population parameters

A total of 70 Channel Catfish were sampled with lengths ranging from 147-631 mm. Mean gill net CPUE for Channel Catfish increased to 5.8 fish/net-night in 2012, the highest CPUE since 2007 (Table 4). Size structure of sampled fish remained good in 2012 (Figure 5; Table 16) with PSD = 67 and PSD-P=12, however, no memorable size Channel Catfish were collected. 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 5th 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 2012, mean *Wr* for quality-preferred length Channel Catfish was 80 (Table 17), below the normal range of 85 to 95.

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 2 or 3 are present during most years, indicating stable recruitment patterns (Table 18; Table 19).

Table 16. 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, 2003-2012.

Year	PSD	PSD-P	PSD-M	Sample Size
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
2011	83	0	0	8
2012	67	12	0	70

Table 17. Relative weight of Channel Catfish, by incremental stock density indices, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2003-2012. 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
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
2011	86 (--)	1	105 (2.6)	5	--	0
2012	78 (0.8)	16	80 (0.9)	27	81 (2.3)	6

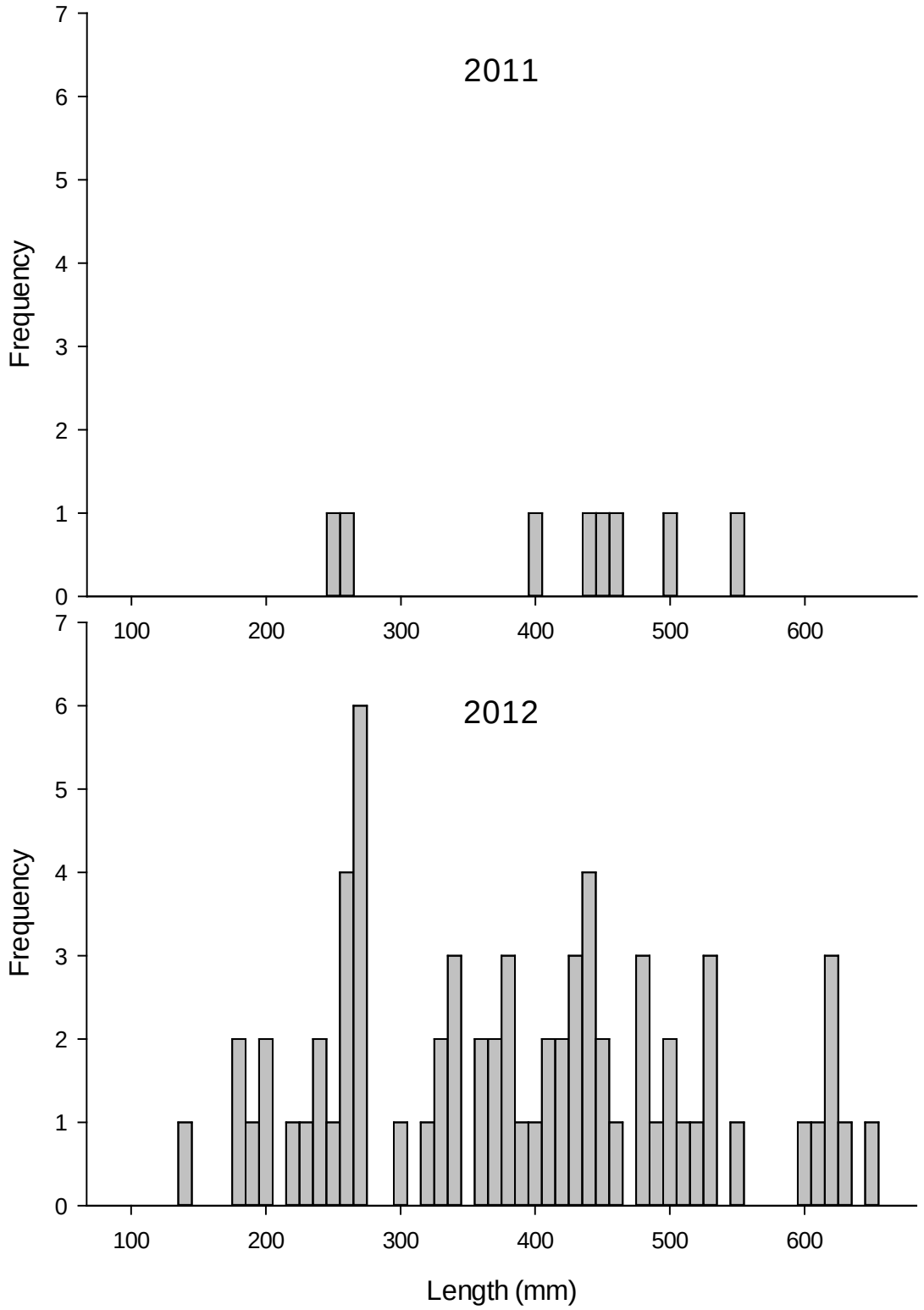

Figure 5. Length frequency for Channel Catfish collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2011 and 2012.

Table 18. Age distribution, of Channel Catfish collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2003-2012. 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
2012	0	8	16	16	10	8	5	1	1	0	3	0	1	1	0	0	0	0	3.8

Table 19. 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, 2012.

Year class	**Age**	**N**	**Annulus**												
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
2011	1	8	103												
2010	2	16	92	200											
2009	3	16	94	193	309										
2008	4	10	128	223	327	407									
2007	5	8	100	176	280	370	429								
2006	6	5	127	228	327	398	460	509							
2005	7	1	135	241	267	307	359	438	531						
2004	8	1	99	236	318	400	442	497	538	579					
2002	10	3	112	205	328	404	449	485	510	541	566	591			
2000	12	1	105	149	239	344	418	463	508	538	553	582	627	642	
1999	13	1	103	233	306	364	393	408	422	437	451	466	480	495	509
Sample mean (mm)			109	208	300	374	422	467	502	523	523	546	554	569	509
Standard error			4	9	10	13	13	16	21	30	36	40	73	74	0
Length increment			100	92	74	47	45	35	22	0	23	7	15	-59	

Electrofishing

Smallmouth Bass population parameters

Smallmouth Bass CPUE has been highly variable during the past ten years in Lewis and Clark Lake, ranging from 25/h in 2003 and 2012 to a high of 112/h in 2010. Smallmouth Bass size structure is known to be underestimated when electrofishing (Beamesderfer and Rieman 1988; Milewski and Willis 1991). 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 21, Table 22). Relative weight of stock-quality and preferred-memorable smallmouth was above average, while *Wr* of quality-preferred Smallmouth Bass was near the 10 year average (Table 20).

Table 20. 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, 2003-2012. 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	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
2011	72 (19.9)	18	4	0	92 (0.7)	89	86 (0.5)	21	90 (2.1)	4
2012	25 (3.6)	23	3	0	97 (1.0)	15	85 (0.6)	6	93 (2.6)	4

Table 21. 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 2011 and 2012.

Year class	Age	N	Annulus (2011)						
			1	2	3	4	5	6	7
2010	1	5	106						
2009	2	60	97	180					
2008	3	64	95	165	250				
2007	4	14	100	170	243	298			
2006	5	1	89	232	303	368	400		
2005	6	3	98	181	279	336	373	388	
Sample mean			98	186	268	334	387	388	
Standard error			2	12	14	20	13	0	
Length increment			88	83	66	52	2		

Year class	Age	N	Annulus (2012)						
			1	2	3	4	5	6	7
2010	2	4	87	192					
2009	3	13	96	171	258				
2008	4	6	90	173	344				
Sample mean			91	179	263	344			
Standard error			3	7	5	0			
Length increment			88	84	81				

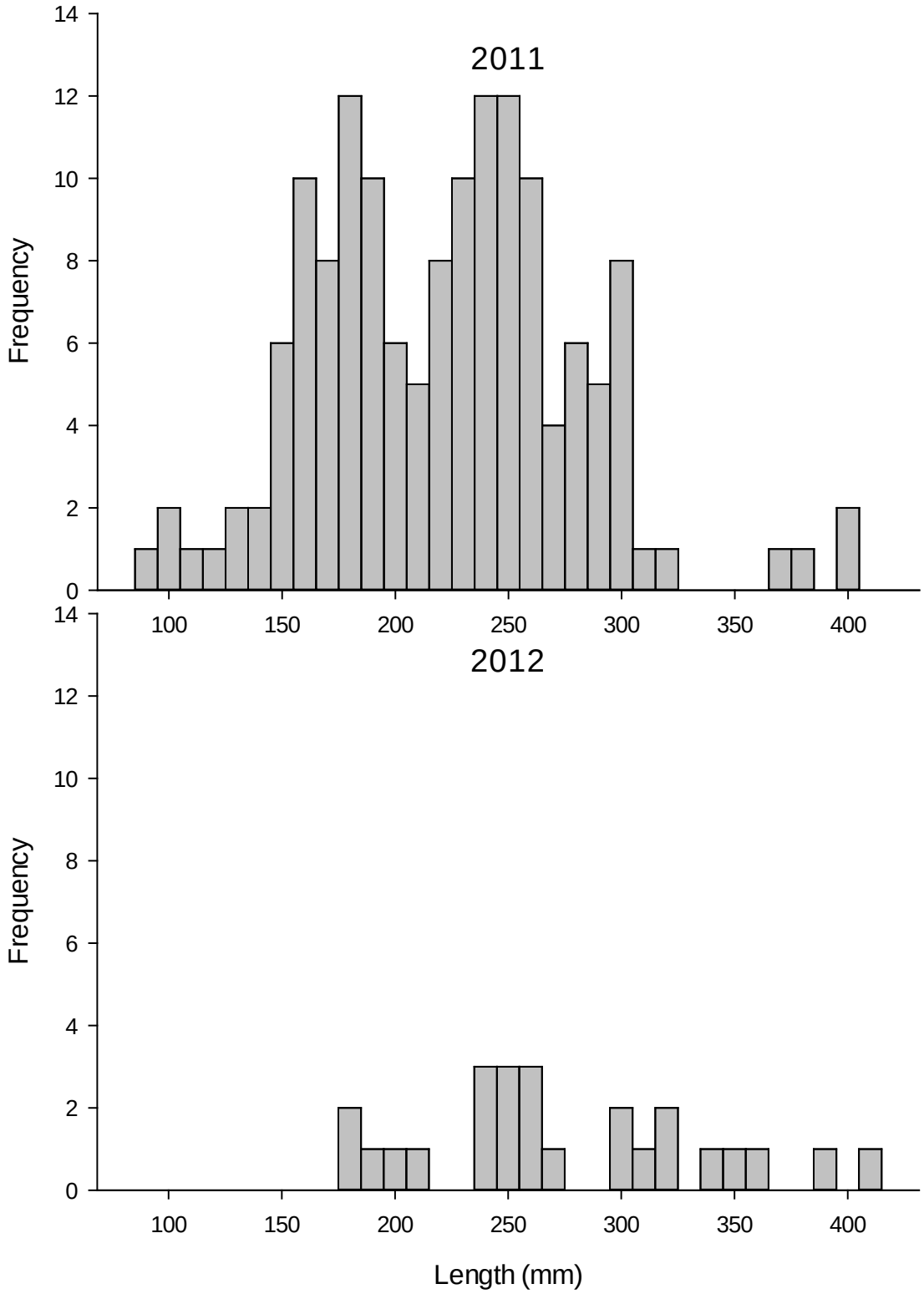

Figure 6. Length frequency for Smallmouth Bass sampled by nighttime electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, 2011 and 2012.

Table 22. Age distribution of Smallmouth Bass collected by electrofishing Lewis and Clark Lake near Gavins Point Dam, 2003-2012, as determined from scales.

	Age								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
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
2011	5	60	64	14	1	3	0	0	2.8
2012	0	4	13	6	0	0	0	0	3.1

Flathead Catfish population parameters

Low amperage daytime electrofishing along riprap areas in Lewis and Clark Lake provided a CPUE of 39 and 28 for Flathead Catfish in 2012 and 2011, respectively (Table 23). Catch rates in the 2012 survey increased from 2011. Preferred and memorable-sized fish were absent from the 2012 survey, with a majority of the total catch smaller than stock length (Figure 7). PSD for the 2012 sample was 16 (Table 23), below the balanced range of 30-60.

Flathead Catfish growth was determined by back-calculating lengths from pectoral spine annuli. Similar to previous years, growth was relatively slow, taking 5-6 years to surpass stock length (Table 24 and Table 25)(350 mm; Adams 2007, Knecht et al. 2008, Longhenry 2009). Relative weight values for stock-quality length fish was above the typical range, while quality-preferred length fish was below the typical range, however, both estimates are based on relatively few samples (Table 23).

Table 23. 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, 2003-2012. 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	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
2011	28 (3.6)	42	6	3	94 (1.0)	18	90 (1.7)	11	--	0
2012	39 (11.0)	16	0	0	93 (0.9)	16	74 (12.3)	3	--	0

Table 24. Age distribution of Flathead Catfish sampled by electrofishing Lewis and Clark Lake during 2003-2012 as determined from basal recess (2002- 2010a) and articulating process (2010b, 2011 and 2012) sections of pectoral spines. * mean age includes older fish not included in table.

	Age															
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Mean**
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
2009	26	14	3	4	0	0	0	2	1	0	0	0	0	0	0	2.8*
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
2011	5	8	6	4	5	5	2	2	3	1	0	3	3	2	0	6.4*
2012	1	42	16	6	3	6	2	2	2	4	1	1	2	1	0	4.0

Table 25. 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, June 2011 and 2012. Ages were determined from pectoral spines sectioned at the articulating process. Ages beyond 10 are excluded; however, sample mean, standard error, and length increment are calculated from the complete sample.

Year			Annulus (2011)									
class	**Age**	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2010	1	5	125									
2009	2	7	119	194								
2008	3	6	107	174	244							
2007	4	3	110	169	214	282						
2006	5	5	145	239	312	353	389					
2005	6	5	104	177	244	312	355	402				
2004	7	1	149	237	301	380	428	460	476			
2003	8	2	145	195	259	320	358	388	413	427		
2002	9	3	150	238	315	361	400	432	465	487	511	
2001	10	1	175	236	298	337	376	398	420	454	487	515
1999	12	3	145	196	265	324	363	391	432	453	478	499
1998	13	3	132	225	300	370	405	430	454	474	496	523
1997	14	2	187	281	349	401	423	447	467	486	503	526
1994	17	1	69	128	252	376	474	546	592	618	644	677
1992	19	1	137	208	261	332	379	409	421	432	450	486
1991	20	1	89	166	238	267	315	344	392	415	439	451
Sample mean (mm)			131	204	275	340	389	423	453	472	501	525
Standard error			8	10	10	11	12	16	18	20	22	27
Length increment			74	71	64	49	34	31	18	29	24	21

Year			Annulus (2012)									
class	**Age**	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2011	1	1	116									
2010	2	42	101	178								
2009	3	16	90	159	223							
2008	4	6	102	182	254	293						
2007	5	3	101	191	248	299	337					
2006	6	6	89	155	203	266	311	343				
2005	7	2	93	154	216	310	359	385	407			
2004	8	2	118	178	242	311	367	397	419	434		
2003	9	2	104	182	246	290	353	399	438	457	472	
2002	10	4	98	163	231	277	321	351	389	412	433	450
2001	11	1	85	147	227	313	362	417	448	479	491	510
2000	12	1	105	200	241	316	384	418	506	547	588	615
1999	13	2	97	177	250	311	350	372	394	416	432	454
1998	14	1	94	184	237	269	300	338	354	375	417	444
Sample mean (mm)			100	173	235	296	344	380	419	446	472	494
Standard error			3	4	4	6	8	10	16	21	26	32
Length increment			73	62	61	49	36	39	26	27	22	31

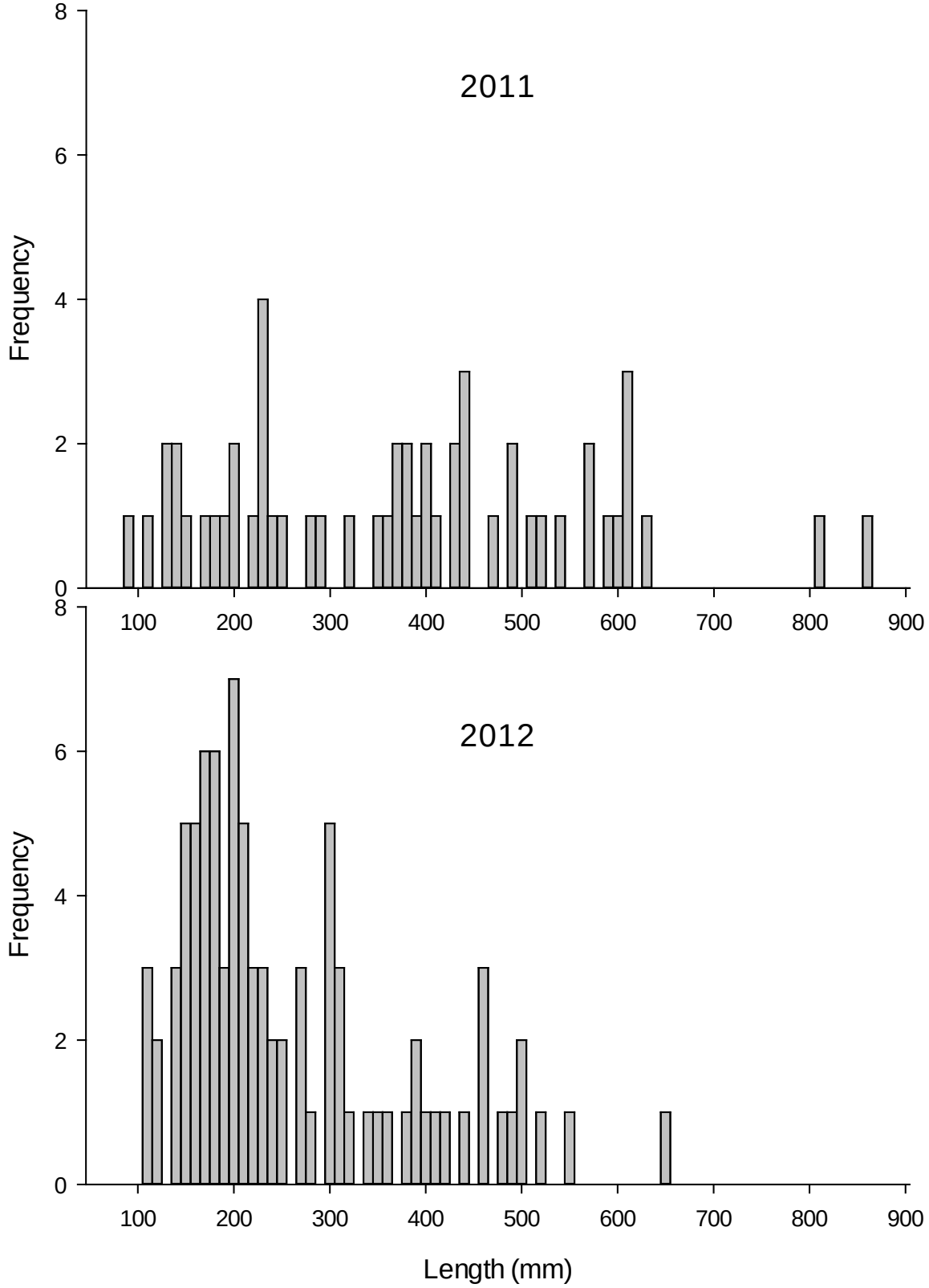

Figure 7. Length frequency of Flathead Catfish sampled by electrofishing Lewis and Clark Lake during June 2011 and 2012.

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 8 Largemouth Bass were sampled with a CPUE of 6/h (Table 26). Relative abundance in 2012 was considerably lower than previous years likely related to habitat modification from the 2011 flood. Some common sampling locations were impossible to get a boat into and others had modified substrate and vegetation characteristic from before the flood. If this survey is to be continued, effort will be needed to find new/additional sampling locations that are accessible and have suitable habitat for Largemouth Bass.

Table 26. 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, 2003-2012. 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
2011	15 (3.6)	77	64	0	114 (2.8)	5	116 (4.4)	3	109 (5.7)	14
2012	6 (6)	75	38	0	118 (1.1)	2	120 (4.0)	3	107 (7.9)	3

Table 27. 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 2011 and 2012. Ages were determined from scales.

Year class	Age	N	Annulus (2011)							
			1	2	3	4	5	6	7	8
2009	2	2	98	202						
2008	3	2	85	160	256					
2007	4	3	102	220	295	330				
2006	5	3	107	184	266	339	388			
2005	6	4	80	181	294	345	394	423		
2004	7	2	100	209	266	326	379	405	418	
2003	8	4	94	204	280	353	410	432	446	458
Sample mean			95	194	276	339	393	420	432	458
Standard error			4	8	7	5	7	8	14	0
Length increment			99	82	63	54	28	12	26	
Year class	Age	N	Annulus (2012)							
			1	2	3	4	5	6	7	8
2009	3	3	109	232	292					
2008	4	2	97	221	319	368				
2007	5	2	94	193	313	365	410			
Sample mean			100	215	308	366	410			
Standard error			5	12	8	1	0			
Length increment			115	93	58	44				

Table 28. Age distribution of Largemouth Bass sampled by electrofishing in the Springfield area of the Niobrara Delta, 2003-2012, 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
2011	0	2	2	3	3	4	2	4	0	0	0	0	5.4
2012	0	3	2	2	0	0	0	0	0	0	0	0	2.9

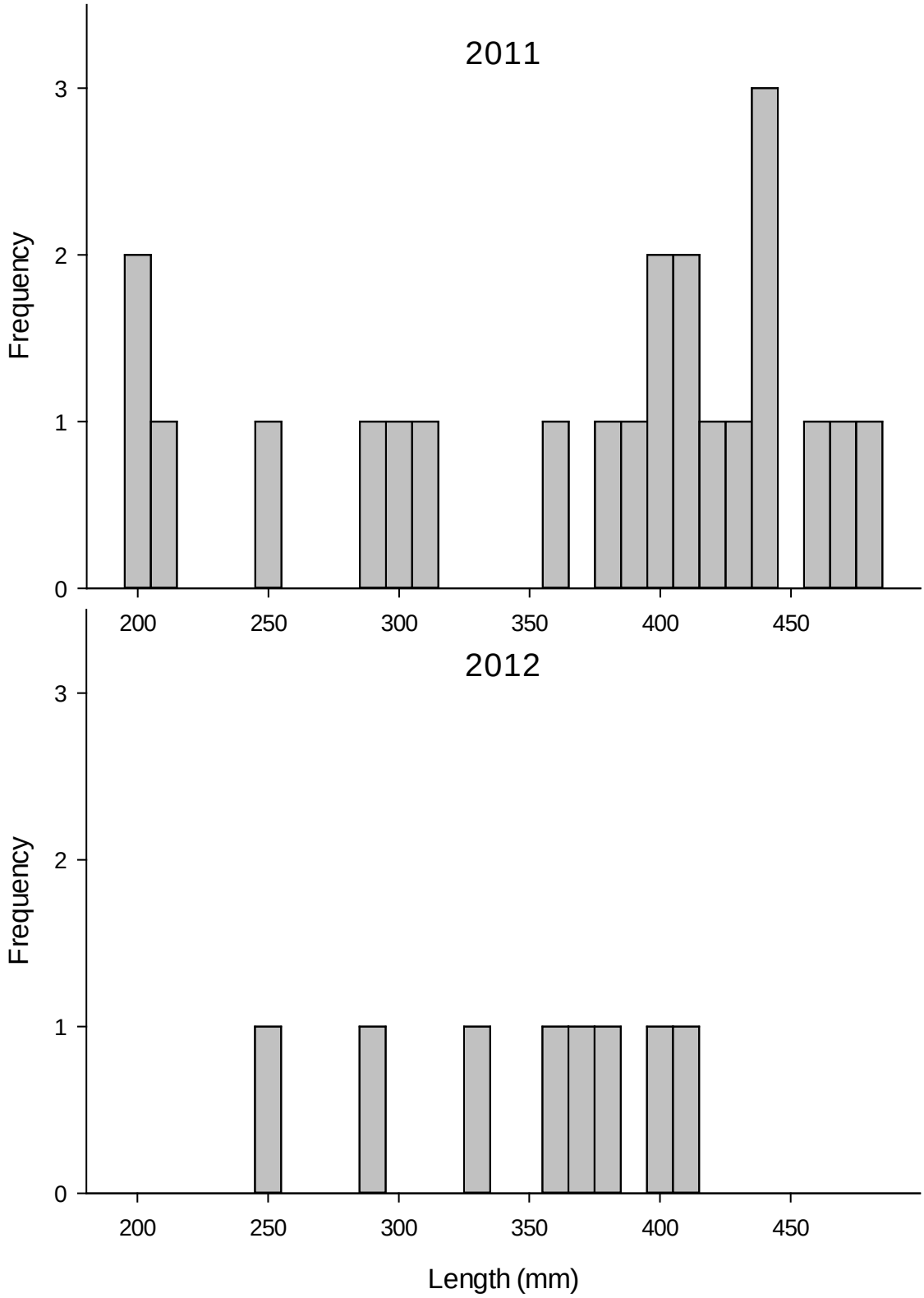

Figure 8. Length frequency of Largemouth Bass sampled by electrofishing in the Niobrara delta near Springfield, South Dakota during May 2011 and 2012.

Smallmouth Bass population parameters

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 9). Mean CPUE for Smallmouth Bass was 59 and 30 fish/h 2011 and 2012 respectively, significantly lower than 2010 (Table 29). Smallmouth Bass PSD, PSD-P and PSD-M increased from 2010. Relative weights decreased for all length categories in 2011, but increased slightly for all length categories in 2012, and remained within the normal range for this population (Table 33).

Four age classes (1-3 and 5) were sampled in 2012 (Table 30; Table 31). 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 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) Smallmouth Bass sampled by spring electrofishing the Missouri River below Gavins Point Dam, 2003-2012. 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	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
2011	59 (11.1)	28	12	0	89 (0.5)	73	88 (3.0)	17	91 (1.4)	12
2012	30 (11.4)	35	30	5	91 (1.3)	13	95 (--)	1	99 (3.7)	5

Table 30. 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 2011 and 2012. Ages were determined from scales.

Year class	Age	N	Annulus (2011)				
			1	2	3	4	5
2010	1	7	132				
2009	2	54	107	205			
2008	3	39	107	193	276		
2007	4	13	114	216	292	349	
2006	5	2	107	199	292	365	407
Sample mean			113	203	287	357	407
Standard error			5	5	5	8	0
Length increment			90	84	70	50	--
Year class	**Age**	**N**	**Annulus (2012)**				
			1	**2**	**3**	**4**	**5**
2011	1	1	101				
2010	2	18	104	181			
2009	3	7	108	204	289		
2008	4	0					
2007	5	4	115	222	306	359	392
Sample mean			107	202	298	359	392
Standard error			3	12	9	0	0
Length increment			95	95	61	33	

Table 31. Age distribution of Smallmouth Bass sampled by electrofishing the Missouri River below Gavins Point Dam in May, 2003-2012, as determined from scales.

Year	Age							
	1	2	3	4	5	6	7	Mean
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
2011	7	54	39	13	2	0	0	2.6
2012	1	18	7	0	4	0	0	2.6

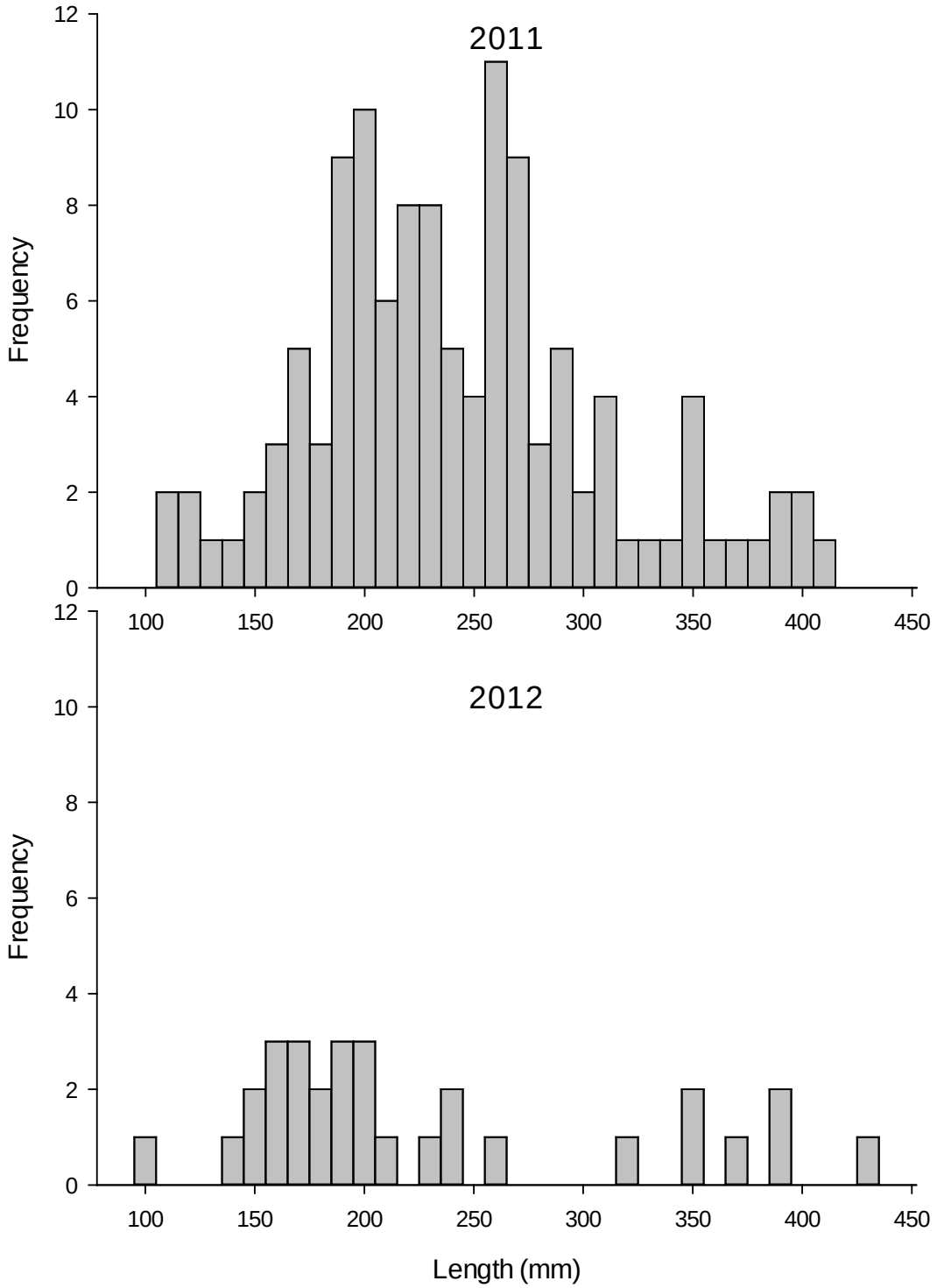

Figure 9. Length frequency of Smallmouth Bass sampled by electrofishing the Missouri River below Gavins Point Dam in May 2011 and 2012.

Fort Randall Dam Tailwaters

Smallmouth Bass sampling in the Fort Randall Dam tailwaters is conducted in the fall while other Smallmouth Bass sampling on the reservoir system occurs in the spring. A total of 15 and 257 were sampled during 60 minutes of night electrofishing in both 2011 and 2012, respectively (Table 32). Lengths ranged from 104 to 363 mm with about 41% of the sample longer than stock length (180 mm; Figure 10). Growth rates of Smallmouth Bass in the Fort Randall Tailrace reach (Table 33) are similar to those estimated for the Gavins Point Dam Tailrace and Lewis and Clark Lake, and to the state and Missouri River reservoir averages (Willis et al. 2001). Relative weights were at or near 100 for all size classes excluding the 2012 P-M length category; however this low *Wr* is the result of one fish (Table 32).

Similar to the other Smallmouth Bass surveys, age distribution of the Fort Randall Tailrace Smallmouth Bass was dominated by fish three years of age or less (Table 38; Table 39). In most Fort Randall Tailwater surveys, age classes up to four are present indicating consistent recruitment. In 2012, fish out to age four were sampled and the mean age dropped to 1.8 years (Table 34).

Table 32. 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, 2003-2012 (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**
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	0	0	102 (0.4)	22	91 (0.0)	2	--	0
2010a	51 (25.0)	24	5	0	100 (0.4)	16	99 (3.9)	4	88 (--)	1
2010b	48 (22.5)	44	13	0	112 (1.4)	18	109 (0.6)	10	107 (0.3)	4
2011	15 (4.6)	100	41	1	--	0	118 (3.5)	5	116 (1.5)	6
2012	257 (52.6)	25	2	0	98 (0.6)	33	98 (2.6)	10	80 (--)	1

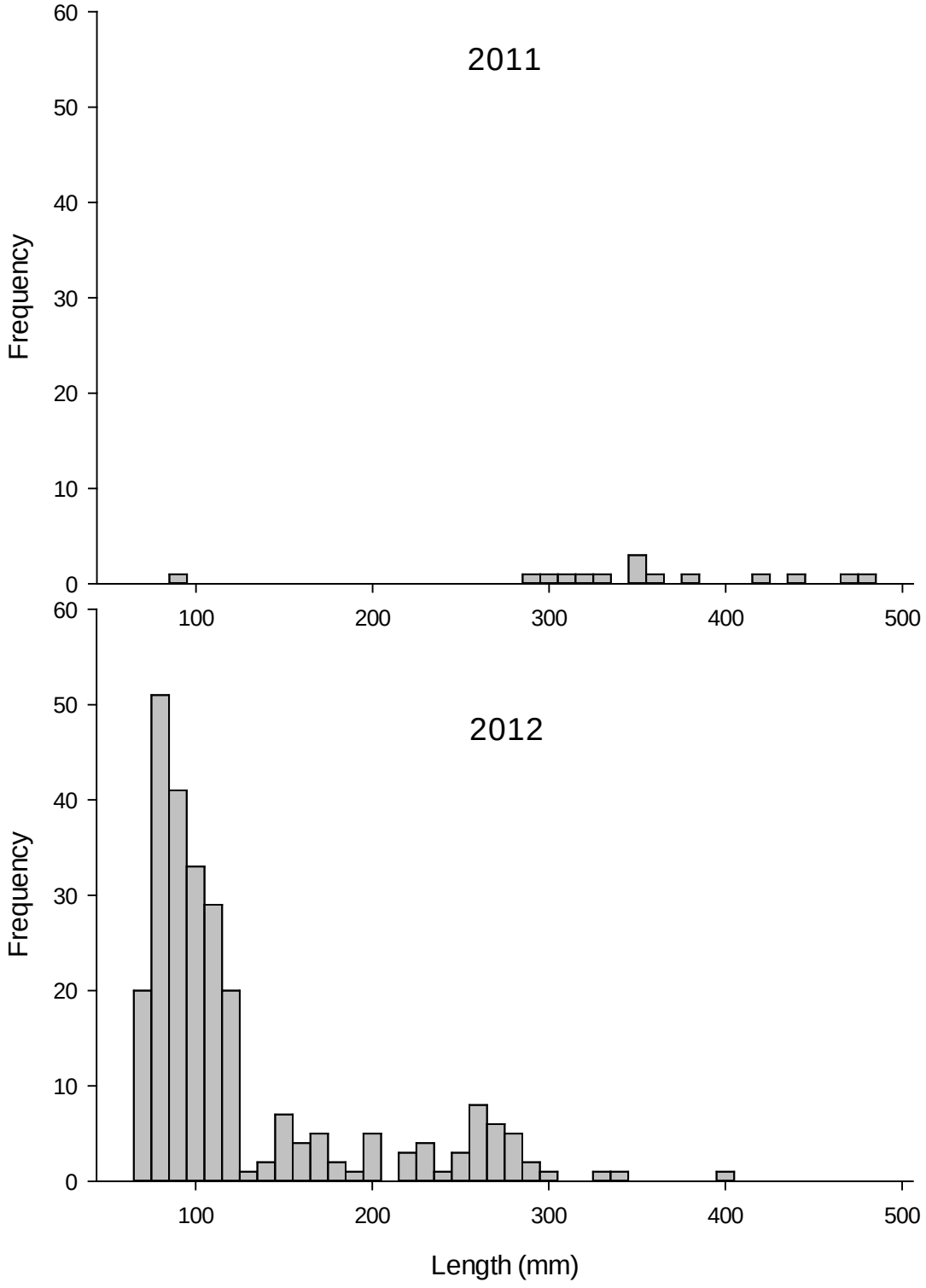

Figure 10. Length frequency of Smallmouth Bass sampled by nighttime electrofishing the Missouri River below Fort Randall Dam in October 2011, and 2012.

Table 33. 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 2011 and 2012. Ages were determined from scales.

Year class	Age	N	Annulus (2011)				
			1	2	3	4	5
2011	0	1					
2009	2	3	93	197			
2008	3	6	102	184	296		
2007	4	1	121	221	360	402	
2006	5	2	101	212	311	377	435
Sample mean			104	204	322	389	435
Standard error			6	8	19	12	0
Length increment			99	118	67	46	
Year class	Age	N	Annulus (2012)				
			1	2	3	4	5
2012	0	201					
2011	1	19	92				
2010	2	33	91	182			
2009	3	4	95	179	258		
2008	4	1	84	200	312	382	
Sample mean			90	187	285	382	
Standard error			2	6	27	0	
Length increment			97	98	96		

Table 34. Age distribution of Smallmouth Bass sampled by fall electrofishing the Missouri River below Fort Randall Dam, 2003-2012 (2010a = June sample; 2010b = October sample), as determined from scales. Mean age excludes age-0 fish.

Year	**Age**									
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
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
2011	1	0	3	6	1	2	0	0	0	3.2
2012	201	19	33	4	1	0	0	0	0	1.8

Hoop Nets

Channel Catfish population parameters

A total of 140 and 417 Channel Catfish were sampled with hoop nets in the Missouri River and Niobrara delta near Springfield, SD during August 2011 and 2012, respectively (Table 35). This was an increase in CPUE from recent years. The Channel Catfish sample dominated by smaller fish below quality length (<410 mm), with approximately half of the sample less than stock length (Figure 11; Table 36). Fish from nine different age classes were sampled, out to age thirteen. Most fish were two to four years old although a few of older fish were sampled in 2011 which increased the average age to 4.0 years. In 2012 the average age was 2.4 years (Table 37; Table 38).

Table 35. Total annual hoop net catches (CPUE) of Channel Catfish from the Missouri River and Niobrara delta near Springfield, SD, 2003-2004 and 2006-2012. Standard error (SE) is also included.

Year	Number of fish	Net-nights	CPUE	Mean length
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)
2011	140	70	2.0 (0.6)	363 (9.0)
2012	417	94	4.4 (2.2)	287 (2.8)

Table 36. 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, 2003-2004 and 2006-2012. 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**
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
2011	36	4	1	111 (1.3)	88	100 (1.4)	21	101 (--)	2
2012	7	2	0	83 (0.1)	179	81 (1.9)	11	73 (2.2)	3

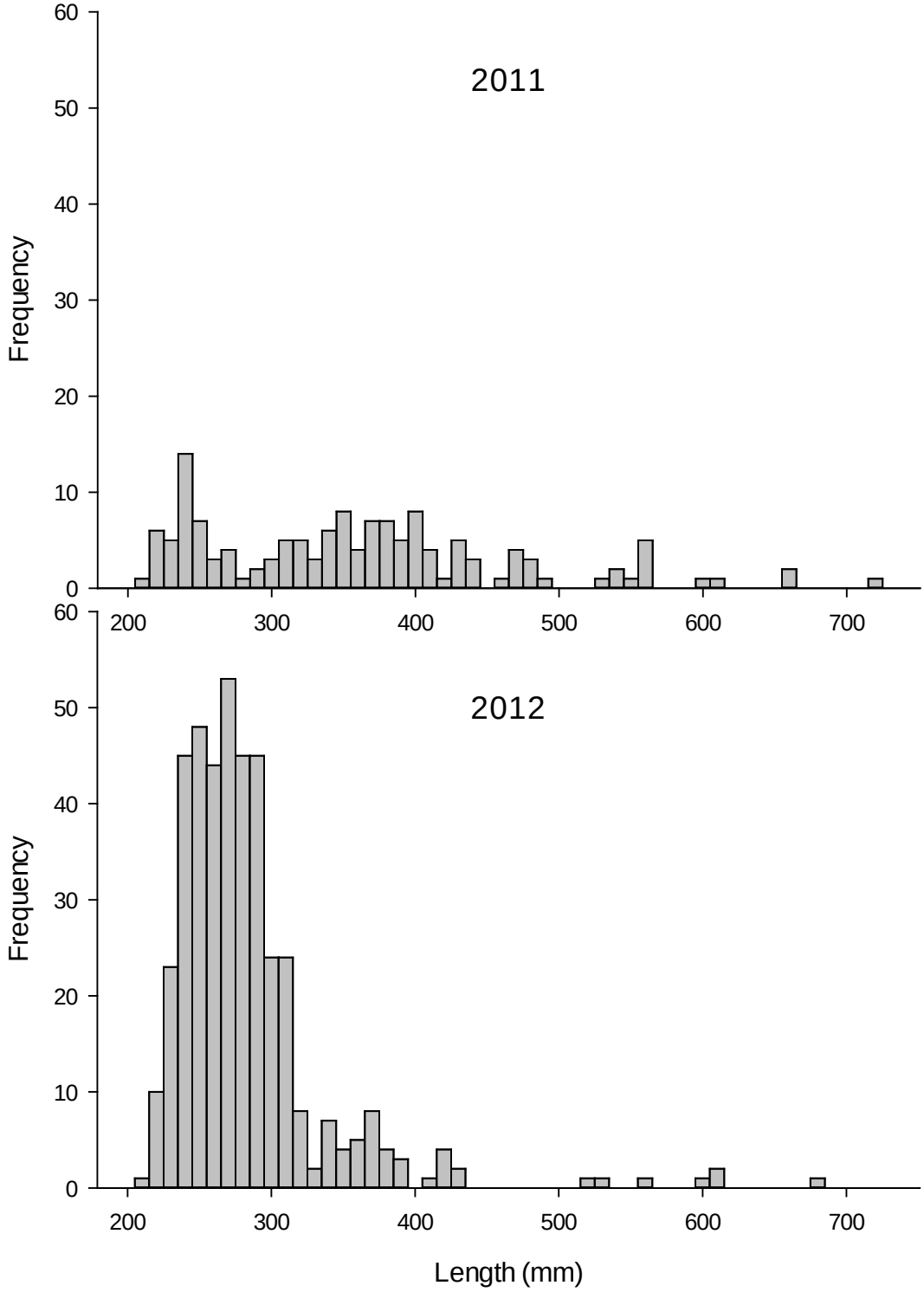

Figure 11. Length frequency for Channel Catfish collected in hoop nets from the Missouri River and Niobrara delta near Springfield, SD in August 2011 and 2012.

Table 37. 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, 2012.

Year class	Age	N	Annulus 1	2	3	4	5	6	7	8	9	10	11		
2011	1	5	188												
2010	2	344	121	233											
2009	3	45	98	195	301										
2008	4	17	98	193	269	344									
2007	5	1	109	198	277	344	389								
2005	7	2	126	202	279	348	404	459	513						
2004	8	2	140	242	352	423	470	502	556	596					
2001	11	2	146	251	347	405	435	464	487	502	517	532	555		
1999	13	1	162	250	352	411	455	499	528	557	572	586	601		
Sample mean (mm)			132	221	311	379	431	481	521	552	544	559	578	645	660
Standard error			10	9	14	15	15	11	14	27	27	27	23	0	0
Length increment			89	90	68	51	50	40	31	-7	15	19	67	15	

Table 38. Age distribution of Channel Catfish sampled in hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 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
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	11	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
2012	5	34	45	17	1	0	2	2	0	0	2	0	1	0	2.4

Seines

Water level fluctuations within the delta can greatly influence seining efficiency. The 2011 flood influenced seine efficiency whereby little habitat was suitable for seining in 2011, while there was ample habitat in 2012. The most abundant species in 2012 was River Carpsucker followed by Bluegill, Emerald Shiner, Largemouth Bass, Shorthead Redhorse and Smallmouth Bass. (Table 39). Sand shiners were sampled in the Niobrara delta for the first time in 2012.

Table 39. Catch per unit effort (fish/seine haul) for July seining surveys in the Missouri River near Springfield, South Dakota, 2007-2012, includes both age-0 and adults. Trace (T) indicates a value is less than 0.05. Standard error (SE) is in parenthesis.

Species	2007	2008	2009	2011	2012
Bigmouth Buffalo	--	0.1 (0.1)	--	--	--
Black Crappie	--	0.1 (0.1)	--	0.1 (0.1)	T
Bluegill	T	T	--		1.3 (0.9)
Bluntnose Minnow	--	0.1 (0.1)	--	0.2 (0.1)	0.1 (0.1)
Common Carp	--	--	--	0.7 (0.6)	--
Emerald Shiner	1.1 (1.0)	0.4 (0.3)	0.1 (0.1)	--	0.5 (0.3)
Freshwater Drum	--	0.1 (0.1)	--	--	--
Gizzard Shad	13 (0.9)	T	--	--	--
Grass Pickerel	--	--	0.1 (0.1)	0.5 (0.5)	--
Green Sunfish	--	T	--	--	--
Johnny Darter	T	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	T
Largemouth Bass	--	0.3 (0.2)	0.8 (0.5)	2.0 (1.3)	0.4 (0.2)
Northern Pike	--	--	0.1 (0.1)	0.3 (0.2)	1.1 (0.9)
Red Shiner	26 (0.9)	--	1.6 (1.1)	1.2 (0.6)	--
River Carpsucker	5 (1.0)	5.7 (3.0)	0.2 (0.2)	0.1 (0.1)	20.7 (6.2)
Sauger	T	0.1 (0.1)	--	0.1 (0.1)	--
Sand Shiner	--	--	--	--	0.3 (0.3)
Shorthead Redhorse	--	T	--	--	0.4 (0.1)
Smallmouth Bass	T	--	0.2 (0.2)	0.1 (0.1)	0.4 (0.2)
Smallmouth Buffalo	--	T	--	--	--
Spotfin Shiner	--	1.4 (0.6)	3.6 (1.3)	--	0.1 (0.1)
Spottail Shiner	--	0.1 (0.1)	--	--	
Walleye	--	0.1 (0.1)	--	--	T
White Bass	T	--	0.1 (0.1)	--	T
White Crappie	T	--	--	--	--
Yellow Perch	--	--	--	0.4 (0.2)	0.2 (0.2)

RARE FISH OBSERVATIONS

One Shovelnose Sturgeon was collected during the 2011 gill net survey on Lewis and Clark Lake. 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 standard sampling indicate that some of the sport fish populations in Lewis and Clark Lake continue to remain abundant while others have declined. Walleye and Sauger abundance dropped in 2011 and 2012 below the long-term average. Consecutive years of low reproduction likely contributed to reduced abundance. Channel Catfish and Smallmouth Bass remained abundant in 2012.

Some species specific management objectives were met for both Walleye and Sauger in 2012, while others were not (Table 40). Eight mature year classes of Walleye were present and three for Sauger. Proportional size distribution was above the management objective range for Walleye while PSD-P was below set objective. Sauger PSD was above the management objective range of 30-60, and PSD-P was higher than the management objective (Table 40). Relative abundance fell below the management objectives of 6.0 fish/net night for Sauger while Walleye CPUE was above the management objective of 4.0/net.

Channel Catfish continue to be abundant during the fall gill net survey (5.8/gill net) and exceeded the CPUE objective of 3.0/gill net in 2012 (Table 40). Channel Catfish size structure indices were above objective range for PSD, and greater than objective minimum for PSD-P (Table 40).

Smallmouth Bass CPUE continues to be above the management objective of 10.0 fish/h, while Largemouth Bass was below (6.0 fish/h). Proportional size distribution was below the management objective range of 30 to 60 for Smallmouth Bass and above the 30 to 60 range for Largemouth Bass (Table 40). 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 will provided similar results to a sample size of 500 and provides a representative sample. 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.

Table 40. 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, 2012. Bold values were not within the objective range.

Species and Objectives	CPUE	PSD	PSP-P	Harvest	Harvest rate
Walleye	4.8 / gill net	**83**	**6**		
Objectives	≥4.0 / gill net	30-60	≥10	10,000	0.1 / h
Sauger	**2.9 / gill net**	**95**	76		
Objectives	≥6.0 / gill net	30-60	≥10	5,000	0.1 / h
Channel	5.8 / gill net	**67**	12		
Objectives	≥3 / gill net	30-60	≥10		
Largemouth	**6 / h electrofishing**	**75**	38		
Objectives	≥10 / h electrofishing	30-60	≥20		
Smallmouth	25 / h electrofishing	**23**	**3**		
Objectives	≥10 / h electrofishing	30-60	≥20		

MANAGEMENT RECOMMENDATIONS

- Develop a new Lewis and Clark management plan under the current statewide umbrella plan and the Missouri River management unit.

- Develop a plan for identifying recruitment bottlenecks for Walleye and Sauger in Lewis and Clark Lake.

- 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 and 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.

- 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, and 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
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*	FCF
Flathead Chub	*Platygobio gracilis*	FLC
Freshwater Drum	*Aplodinotus grunniens*	FRD
Gizzard Shad	*Dorosoma cepedianum*	GIS
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
Rock Bass	*Ambloplites rupestris*	ROB
Sauger	*Sander canadense*	SAR
Sand Shiner	*Notropis stramineus*	SAS
Shorthead Redhorse	*Moxostoma macrolepidotum*	SHR

Appendix 1. continued

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	$Log_{10}(Ws)= 3.180*Log_{10}(TL)-5.453$