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ANNUAL FISH POPULATION SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2008

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ANNUAL FISH POPULATION SURVEYS OF LEWIS AND CLARK LAKE, SOUTH DAKOTA, 2008

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PREFACE

Information collected from Lewis and Clark Lake during 2008 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 the 2008 fish population surveys on Lewis and Clark Lake, and the Missouri River from Lewis and Clark Lake upstream to Fort Randall Dam. Trends in fish population structure are reported and compared with previous year's surveys. These results are used to determine the relative health of the fishery and make management recommendations to improve the current fishery.

Fourteen species of age-0 and prey fish were sampled during the seining survey on Lewis and Clark Lake in 2008. Total catch rates were well below the long term average for the lake. Age-0 gizzard shad were the most abundant species sampled, while emerald shiners showed a drastic decrease from previous years.

Walleye, gizzard shad, sauger, and channel catfish were the most abundant species sampled with gill nets in 2008. Walleye and sauger Catch per Unit effort (CPUE) were at the highest levels observed in the last 10 years (14 and 10/gill net, respectively). Four mature year classes of walleye were present (2002-2005) and five (2001-2005) for sauger. Size structure was also excellent for walleye and sauger. Proportional stock density was above the management objective range of 30-60, and RSD-P was higher than the management objective of 10 for both species. Gill-net CPUE's were also above the management objectives of 4.0 and 6 fish/net night for walleye and sauger, respectively.

Channel catfish continue to be relatively abundant during the fall gill-net survey (6/gill net) and exceeded the CPUE objective of 3/gill net. Channel catfish size structure indices were just below the set objective levels for PSD and RSD-P. Channel catfish continue to be one of the most underutilized resources in the Missouri River system in South Dakota.

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, however, size structure parameters are based on low sample sizes.

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. Stability in water management during the current drought period may be related to current population trend stability; 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 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.

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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 stock density
Q ..... quality length
RM ..... river mile
RSD-M ..... relative stock density for memorable length fish
RSD-P ..... relative stock density 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 SURVEY OF LEWIS AND CLARK LAKE, 2008

INTRODUCTION

Lewis and Clark Lake was formed by the construction of Gavins Point Dam, which was completed in 1955. Lewis and Clark Lake is one 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 was 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 $61/trip estimate (U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census 2003), reservoir fisheries contribute over 25 million dollars annually to the economy of South Dakota. The four reservoirs produce over 350,000 angler days annually (Lott et al. 2006, Lott et al. 2007, Sorensen and Knecht 2008), with Lewis and Clark Lake contributing over 30,000 angler days in 2005. Lewis and Clark Lake had an estimated economic impact of $2.51 million in 2005.

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 alternative habitat that was 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 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 2008, and to provide management recommendations to enhance or conserve the recreational sport fisheries contained therein.

MANAGEMENT OBJECTIVES

Reservoir-wide Objective 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 an RSD-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 an RSD-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 an RSD-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 an RSD-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 Reservoir is divided 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 first sandbars of the Niobrara Delta (river km 1,330). 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.

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 12,000 square miles 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.

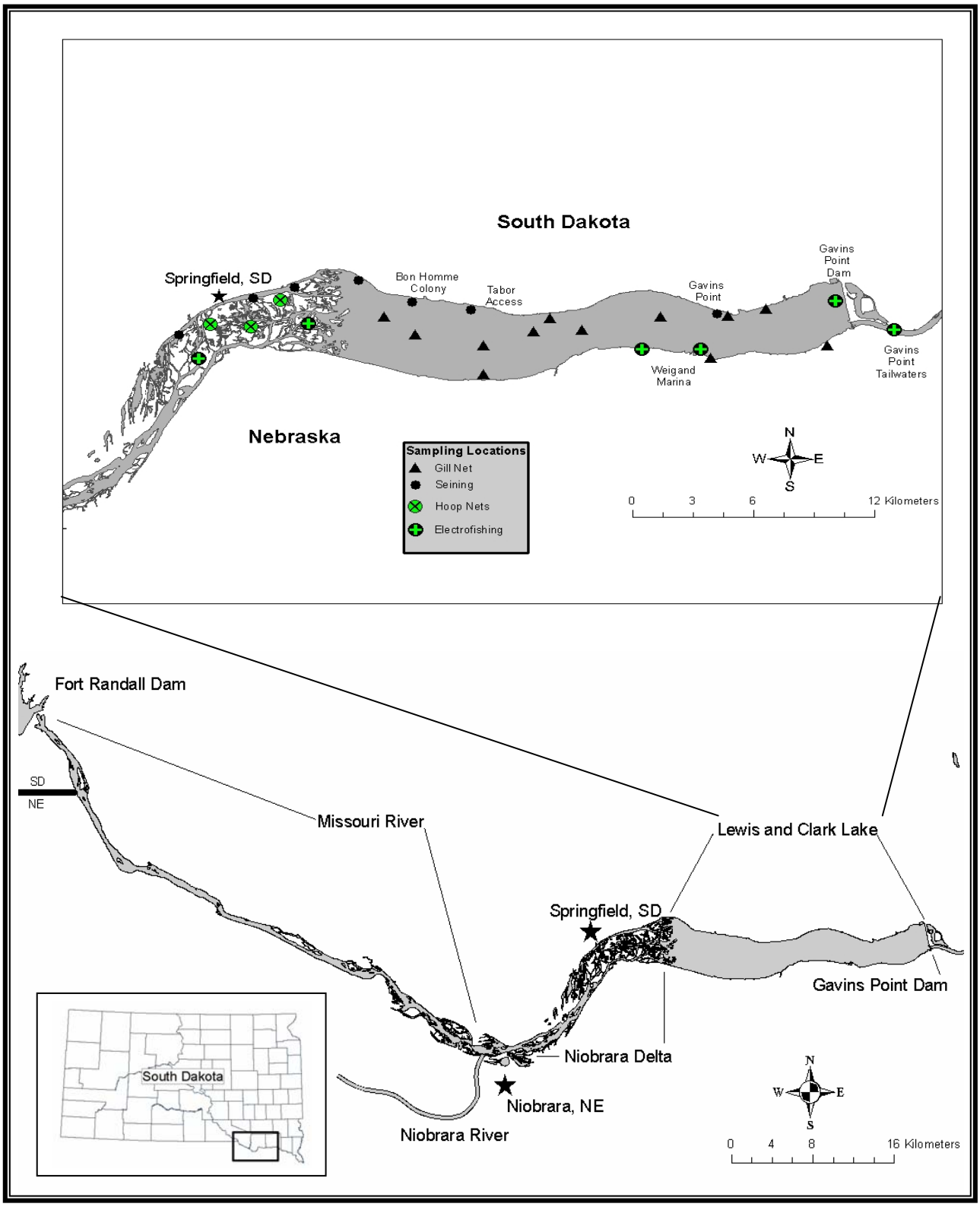

Figure 1. Lewis and Clark Reservoir system, Fort Randall Dam to Gavins Point Dam, South Dakota.

METHODS

Fish populations in the Lewis and Clark Lake system were sampled with gill nets, hoop nets, shoreline seines, and daytime and nighttime electrofishing during 2008. 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, 2008. GTW = Gavin's Point Dam tailwater, FRTW = Fort Randall Dam tailwater, SMB = smallmouth bass, FCF = flathead catfish, LMB = largemouth bass, and CCF = channel catfish.

Area	**Lewis and Clark Lake**				**Delta**			**GTW**	**FRTW**
Method	**Gill net**	**Electrofish**		**Seine**	**Electrofish**	**Seine**	**Hoop net**	**Electrofish**	
Target	All	SMB	FCF	All	LMB	All	CCF	SMB	SMB
Effort	12 net nights	72 min	147 min	8 hauls	70 min	28 hauls	76 net nights	60 min	60 min

Lewis and Clark Lake

Experimental multifilament gill nets were used to sample Lewis and Clark Lake on September 15 and 16, 2008. 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) and coordinates are listed in appendix 3.

Total length (mm) and weight (g) were recorded for all species captured. Otoliths were collected from walleye, sauger, white bass and crappie spp. (Tesch 1971), and pectoral spines were collected from channel catfish for age analysis (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). Two seine hauls were made on July 21, 2007, at each of the following sites: Sand Creek (RM 828), Charlie Creek (RM 825), Bon Homme colony (RM 822), and Gavins Point (RM815). All fish collected were identified and enumerated.

Smallmouth bass were sampled by nighttime electrofishing near Gavins Point Dam on May 20, 2008, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using one dipper and one boat operator consisted of four runs totaling 72 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 rip-rap areas in Lewis and Clark Lake on June 17 and 24, 2008, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 460 volts, 2 amps and 15 pulses/second. Electrofishing effort using one dipper and one boat operator consisted of eight runs totaling 147 minutes. All flathead catfish were measured for total length (mm), and weight (g), and a pectoral spine was collected for age analysis (Sneed 1951; Ashley and Garling 1980).

Missouri River

A seine was 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 on July 22, 2008. Seine dimensions were 9.1m long by 1.2 m deep with 6.6-mm bar measure. The quarter-arc haul method was used as described by Hayes et al. (1996). Two to four hauls were made at 9 sites throughout the Niobrara River delta. All fish collected were identified and counted.

Smallmouth bass were sampled by daytime electrofishing from the Gavins Point Dam tail water area on May 20, 2007, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using one dipper 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 also collected by electrofishing from the Fort Randall Dam tail water area on October 7, 2008, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using one dipper 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).

Largemouth bass were collected by electrofishing near Springfield, South Dakota on May 27, 2008, with a boom-mounted electrofishing boat utilizing pulsed DC settings of 185 volts, 6-8 amps and 60 pulses/second. Electrofishing effort using one dipper and one boat operator consisted of four runs totaling 70 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 20 and 22, 2007. Hoop net diameter was 508 mm with two different mesh sizes of 25 mm and 38 mm. Twenty nets were baited with cheese and remained in the water for two consecutive nights. Nets were reset and remained in the water for two additional nights for a total of 76 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 Lewis and Clark Lake and Missouri River 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 stock density (PSD; Anderson 1976) and relative stock density (RSD; Wege and Anderson 1978). 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 (Gablehouse 1984), largemouth bass (Gablehouse 1984) 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 annual marks and back-calculations were made using WinFin 4.4 (Francis 2003a) and Winfin Analysis 2.3 (Francis 2003b) computer software. Length 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), then allowed to dry and were 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 WinFin 2.3 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.

RESULTS AND DISCUSSION

Lewis and Clark Lake

Seines

Catch per unit effort, or number of fish per seine haul for 2008 was below the long-term average for the seventh consecutive year (Figure 2). Fourteen species were sampled in 2008. Age-0 gizzard shad and freshwater drum were the most common species and CPUE of walleye was 1.5 per seine haul. The most notable change since 2007 was the decrease of emerald shiners from 374.5 to 6.8 per seine haul (Table 3). Otherwise, composition and abundance was relatively similar to the 2007 sample.

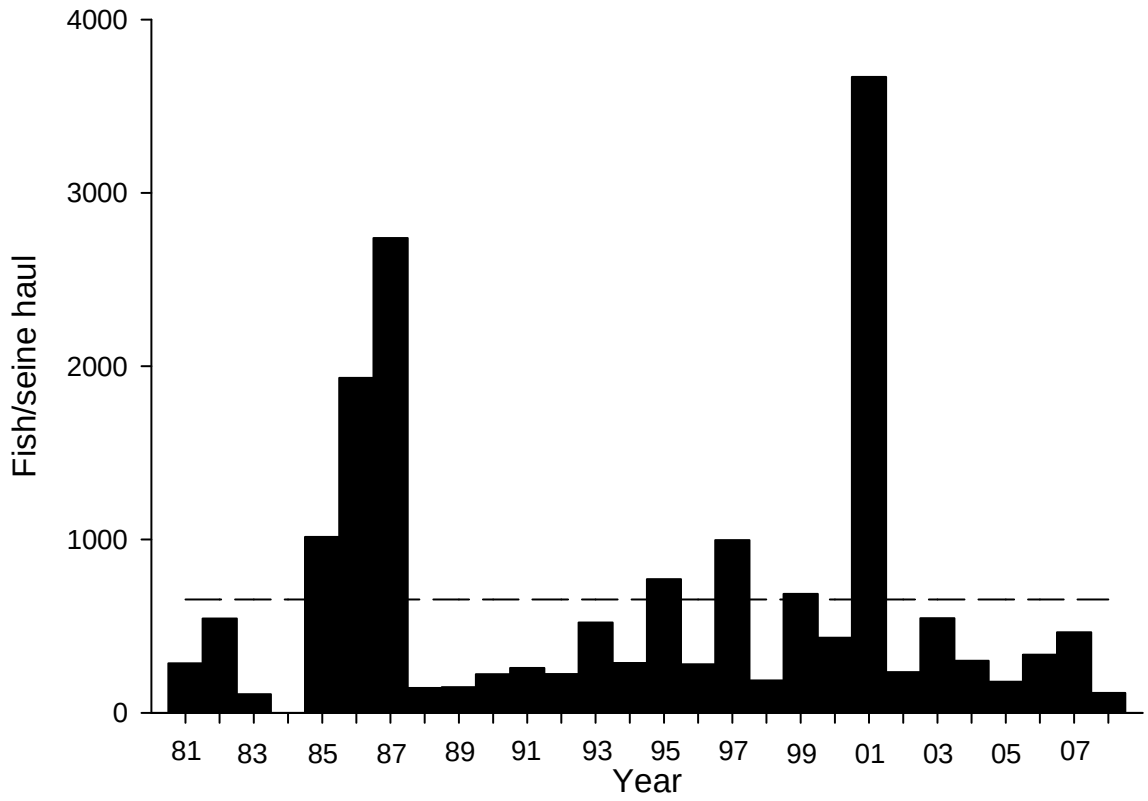

Figure 2. Mean number of fish captured per seine haul from Lewis and Clark Lake, South Dakota, 1981-2008. Dotted line represents long-term mean catch per haul.

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). Kaemingk et al. (2007) looked at species richness and diversity in the Niobrara River delta. 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 since dam closure with certain species absent from current surveys, imply that delta habitat may function more similarly to the historic Missouri River than current reservoir habitats. Delta habitats could provide improved habitat diversity resulting in positive effects on aquatic systems and fish communities.

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 darter spp., redhorse spp., and river carpsucker. Additionally, fluvial habitats can inhibit proper deployment of seining gear as can woody debris and vegetation.

Table 3. Catch per unit effort (fish/seine haul) for seining surveys at Lewis and Clark Lake, South Dakota, 1956 and 2003-2008. Standard error (SE) is included.

Species	1956a	2003	2004	2005	2006	2007	2008
Bigmouth buffalo	91	--	--	--	--	0.1 (0.1)	0.1 (0.1)
Black bullhead	4	--	--	--	--	--	--
Black crappie	191	--	--	--	--	0.1 (0.1)	--
Bluegill	15	--	0.9 (0.3)	--	1.1 (1.0)	0.9 (0.4)	--
Bluntnose minnow	--	--	--	0.9 (0.6)	--	--	--
Brassy minnow*	--	0.6 (0.2)	--	--	--	--	--
Channel catfish	1	--	--	--	--	0.4 (0.3)	--
Common carp	1951	0.1 (0.1)	--	--	--	0.1 (0.1)	0.3 (0.3)
Common shiner	--	5.8 (4.5)	--	--	--	--	--
Creek chub	--	--	0.9 (0.9)	--	--	--	--
Emerald shiner*	34	412 (221.7)	206.8 (64)	65.4 (15.5)	91.9 (39.9)	374.5 (237)	6.8 (0.8)
Fathead minnow	24	--	--	--	--	--	--
Flathead catfish	--	--	--	--	--	0.1 (0.1)	--
Freshwater drum	--	--	5.3 (2.6)	4.8 (1.7)	8.3 (4.4)	13.3 (7.9)	21.9 (12.4)
Gizzard shad	132	76.5 (53.2)	10.6 (6.9)	93.3 (29.5)	200.3 (103.0)	74.0 (37.5)	69.4 (9.0)
Green sunfish	1	--	--	--	--	--	--
Hybopsis sp.	--	--	0.9 (0.7)	--	--	--	--
Johnny darter*	--	1.0 (0.7)	4.1 (3.3)	1.8 (1.2)	0.8 (0.4)	0.5 (0.4)	1.3 (1.1)
Largemouth bass	63	0.4 (0.4)	0.5 (0.3)	0.3 (0.2)	0.6 (0.5)	0.4 (0.3)	--
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)
Redfin shiner	48	--	--	--	--	--	--
River carpsucker	575	0.3 (0.2)	0.4 (0.2)	--	0.1 (0.1)	0.3 (0.3)	0.3 (0.3)
Sauger	21	0.1 (0.1)	0.6 (0.4)	0.1 (0.1)	0.1 (0.1)	--	--
Shorthead redhorse	33	--	0.1 (0.1)	--	--	1.5 (0.8)	0.8 (0.4)
Shortnose gar	9	0.1 (0.1)	--	--	--	0.5 (0.5)	--
Silverstripe shiner	4	--	--	--	--	--	--
Smallmouth bass	--	1.5 (0.7)	2.5 (0.9)	1.0 (0.3)	4.3 (1.2)	1.0 (0.7)	0.1 (0.1)
Smallmouth buffalo	164	--	--	--	--	--	--
Spotfin shiner*	--	11.9 (8.5)	2.4 (1.2)	3.5 (2.0)	0.1 (0.1)	--	1.3 (1.3)
Spottail shiner*	--	12.4 (11.4)	19.3 (13.7)	1.1 (0.7)	2.0 (1.2)	--	1.8 (0.8)
Walleye	--	1.4 (0.6)	1.5 (0.7)	0.8 (0.4)	0.8 (0.4)	0.3 (0.2)	1.5 (1.1)
Western silvery	1843	--	--	--	--	--	--
White bass	--	19.6 (16.2)	40.1 (18.9)	5.9 (2.3)	25.4 (9.6)	11.6 (9.2)	4.6 (1.7)
White crappie	196	0.1 (0.1)	--	--	--	0.3 (0.2)	--
Yellow perch	92	0.6 (0.6)	3.4 (2.5)	0.1 (0.1)	--	1.9 (1.7)	--

*includes both age-0 and adults. a-total number sampled

Gill Nets

Fifteen species were captured with gillnets in 2008, up from twelve species in 2007 (Table 4). Walleye were the most abundant species sampled in gill nets representing 26 percent of the total fish captured (Figure 3). Gizzard shad, sauger, and channel catfish were the second, third, and fourth most abundant species sampled, respectively. Gizzard shad, walleye, and white bass showed increases in abundance since the 2007 sample, while all other species were sampled at similar relative abundances to the 2007 gill-net sample.

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 12 species sampled during fall netting (Table 4; Shields 1957). Channel catfish, common carp and goldeye 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 absent from gill-net samples. In 1983, ten species were sampled with gizzard shad, sauger, and walleye being the most abundant species sampled.

River species (e.g., blue sucker, sturgeon spp.) have been negatively impacted to the greatest extent by reservoir formation. Delta formation in Lewis and Clark Lake has led to 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, 2002-2007. Standard error (SE) is included (no standard errors are listed for 1956 sampling).

Species	1956	1983	2002	2003	2004	2005	2006	2007	2008
Bigmouth buffalo	--	--	--	--	0.1 (0.1)	--	--	--	0.2 (0.2)
Black crappie	--	--	--	--	--	--	--	0.3 (0.2)	--
Blue sucker	0.3	--	--	--	--	--	--	--	--
Channel catfish	6.3	3.0 (1.3)	3.3 (0.9)	2.4 (0.5)	2.6 (0.6)	7.0 (2.2)	2.5 (0.6)	8.2 (2.0)	5.5 (2.2)
Common carp	9.3	0.8 (0.3)	0.5 (0.2)	0.2 (0.1)	0.3 (0.1)	1.1 (0.3)	0.1 (0.1)	0.8 (0.2)	0.7 (0.4)
Emerald shiner	--	--	--	--	0.2 (0.1)	--	--	--	--
Flathead catfish	--	--	--	--	--	--	0.1 (0.1)	--	--
Freshwater drum	0.8	9.5 (5.3)	5.0 (1.4)	5.9 (1.3)	4.5 (1.1)	3.0 (0.8)	5.5 (1.5)	4.2 (1.0)	3.6 (1.1)
Gizzard shad	2.8	24.4 (23.1)	5.5 (2.1)	2.1 (0.7)	3.3 (1.1)	10.6 (5.7)	1.3 (0.9)	3.8 (1.2)	11.9 (6.3)
Goldeye	5.3	--	--	--	--	0.2(0.1)	--	--	--
Paddlefish	--	--	0.1 (0.1)	--	--	--	--	--	0.3 (0.1)
Pallid sturgeon	--	--	0.1 (0.1)	0.1 (0.1)	--	--	--	--	--
River carpsucker	2.0	3.0 (2.5)	1.6 (0.8)	0.3 (0.2)	1.8 (0.6)	0.3 (0.1)	1.4 (0.7)	1.1 (0.5)	2.2 (1.2)
Rock bass	--	--	--	--	--	--	0.1 (0.1)	--	--
Sauger	1.5	14.9 (1.4)	8.9 (1.1)	8.0 (1.7)	4.5 (0.8)	4.7 (1.2)	4.7 (0.7)	6.4 (1.8)	9.6 (2.1)
Shorthead redhorse	0.8	--	0.8 (0.6)	0.5 (0.3)	0.3 (0.2)	2.3 (0.9)	0.8 (0.4)	1.6 (0.7)	2.3 (0.8)
Shortnose gar	2.0	--	0.3 (0.2)	0.4 (0.3)	0.1 (0.1)	0.6 (0.3)	0.1 (0.1)	0.2 (0.1)	0.3 (0.1)
Shovelnose sturgeon	1.5	--	--	--	--	--	--	--	--
Smallmouth buffalo	--	--	--	0.1 (0.1)	0.1 (0.1)	--	0.1 (0.1)	0.2 (0.1)	0.1 (0.1)
Spottail shiner	--	--	--	0.1 (0.1)	--	--	0.1 (0.1)	--	--
Walleye	--	13.1 (1.8)	8.3 (1.3)	10.6 (1.0)	4.3 (0.9)	9.1 (2.4)	4.5 (0.6)	9 (2.1)	14.0 (3.3)
White bass	--	0.1 (0.1)	0.3 (0.2)	0.2 (0.1)	0.2 (0.1)	--	0.1 (0.1)	--	2.3 (0.8)
White crappie	0.5	1.9 (1.7)	1.8 (1.2)	0.9 (0.6)	0.1 (0.1)	--	0.2 (0.1)	0.1 (0.1)	0.3 (0.1)
Yellow perch	0.2	0.2 (0.1)	--	0.1 (0.1)	--	--	--	--	0.1 (0.1)

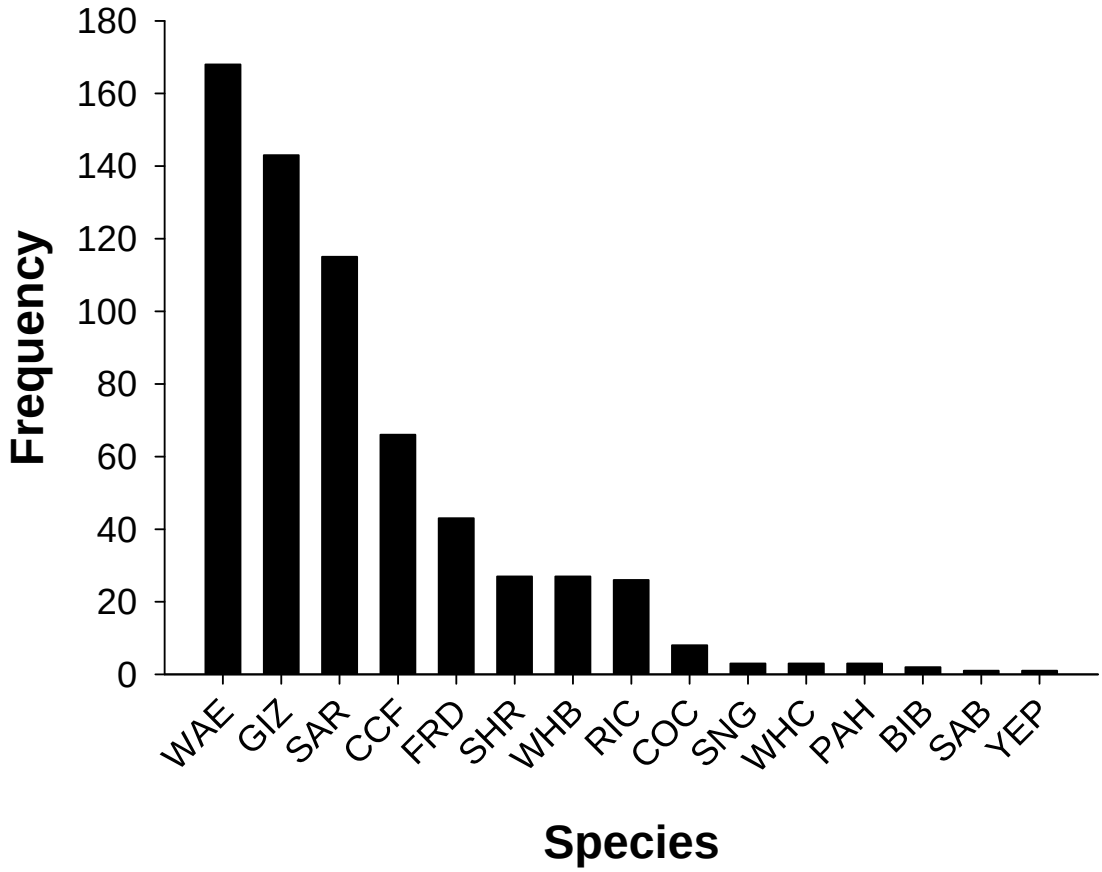

Figure 3. Number of each species collected during the standard gill-net survey on Lewis and Clark Lake, South Dakota, 2008. Abbreviations used are defined in Appendix 1.

Walleye population parameters

A total of 168 walleyes were sampled during the standard September gill-net survey resulting in a CPUE of 14 walleye per gill net (Table 4). This is the highest recorded catch rate of walleyes in Lewis and Clark Lake. Relative abundance (gill-net CPUE) has fluctuated over the past 20 years but overall has undergone an increasing trend. Additionally, CPUE of harvestable size walleye (381 mm or 15 inches) was 7.6 indicating that over half of the walleye population is available for angler harvest (Table 5, Figure 4).

Walleye size structure is quantified with proportional stock density (PSD; Anderson and Weithman 1978) and relative stock density indices (RSD; Gabelhouse 1984). Walleye PSD was 64, and is just above the desired range of 30 – 60 (Anderson and Weithman 1978) (Table 6), while RSD-P (16) was greater than the objective of 10 or more.

Lewis and Clark Lake walleyes exhibit fast growth, consistently attaining mean lengths in excess of 381 mm during the third growing season (Table 7, Table 8). The 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. Additionally, mean relative weight for all size classes was near 90, indicating that there was sufficient prey available in 2008 (Table 9).

Walleye recruitment in Lewis and Clark Lake is currently indexed with gill-net CPUE of age-0 walleyes. In 2008, 25 age-0 walleye were sampled (CPUE = 2.1), indicating a moderate 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 in the lake portion of the reservoir could provide a useful index of age-0 and age-1 walleye abundance (Serns 1982, 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. Use of this sampling method should be considered for indexing age-0 walleye in the future on Lewis and Clark Lake.

Mean age of walleyes sampled in 2008 (2.7) was down for the third consecutive year. A strong year class was formed in 2007 and has contributed to the decrease in mean age. Despite this decrease in mean age, all age classes out to 6 were present in the sample (Table 10). Annual survival for 2007-2008 pooled walleye data as estimated from catch curve analysis (Ricker 1975) was 0.52 (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, 2002-2008. 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)

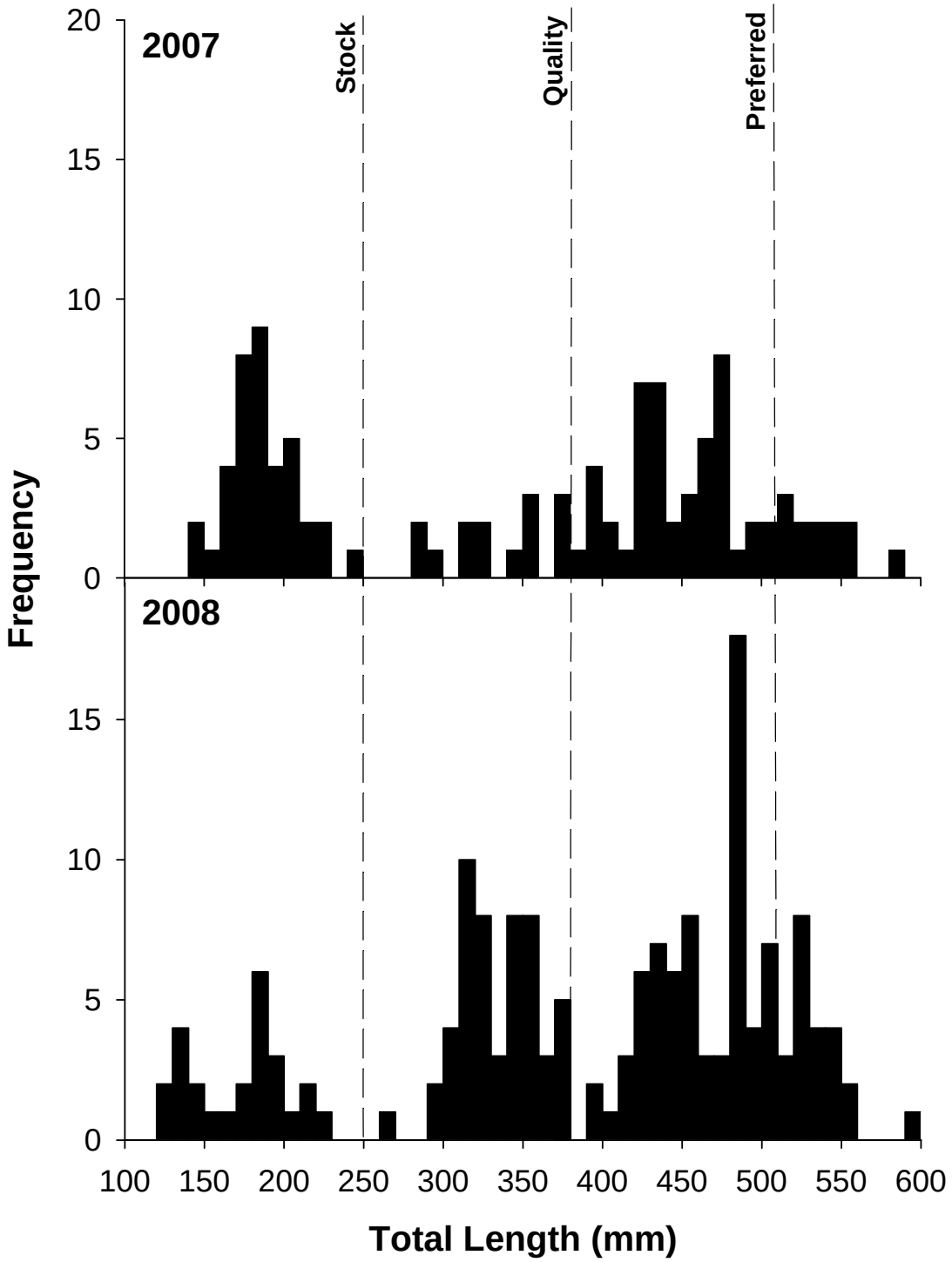

Figure 4. Length frequency of walleye collected during the standard gill-net survey on Lewis and Clark Lake, South Dakota, 2007 and 2008.

Table 6. Walleye proportional stock density (PSD) and relative stock density of preferred and memorable-length fish (RSD-P and RSD-M) collected in standard gill-net surveys, Lewis and Clark Lake, South Dakota, 2002-2008.

Year	PSD	RSD-P	RSD-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

Table 7. Mean length at age at capture, as determined by ages estimated from otoliths analysis, for walleyes collected in the standard September gill-net survey 2006-2008, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented.

Year		Length at age at capture (mm)											
		0	1	2	3	4	5	6	7	8	9	10	11
2006	Mean	144	320	397	440	473	494	473	--	--	--	--	517
	N	2	10	14	13	9	3	1	--	--	--	--	1
	SE	6.0	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	14.0	14.2	42.5	50.0	--	--		
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	6.0	5.5	9.4	17.3	29.2	--	--	--	--	10.0
Mean of means		167	331	415	467	490	513	487	496	520	535	525	507

Table 8. Mean annual growth increments for walleye collected in the standard September gill-net survey, Lewis and Clark Lake, South Dakota, for 2006-2008.

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	-25	-8	15
Mean	172	94	72	45	32	-12	12	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, 2002-2008. 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	8 (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

Table 10. Age distribution of walleye collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2002-2008, as determined from scales (2002 – 2005) and otoliths (2006 – 2008). 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

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, 2001-2008. Age range is the range of ages used to calculate catch curve statistics. Scales (2001-2006) and otoliths (2006-2008) 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
2002-2008	0.54	0.46	0.620	0.98	2-8

Sauger population parameters

Sauger are an important component of the Lewis and Clark fishery and are commonly sampled at higher relative densities than walleye. In 2008, 115 sauger were sampled during the gill-net survey with a CPUE of 9.6 fish/net night (Table 4). Mean gill-net CPUE for sauger 381-mm (15 inches) and longer has increased to 3.8 fish/net night, and is similar to levels recorded in 2003 (Table 5).

Sauger PSD for 2008 was 93 and RSD-P was 51, compared to 69 and 59, respectively, during the 2007 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. Sauger PSD for Lewis and Clark Lake is consistently above this range due to the growth characteristics of the sauger population. Often, the majority of the age-0 sauger sampled are under stock length, while age-1 sauger are predominately greater than quality length (Figure 5). Commonly, this causes the stock-to-quality length category to be relatively void of fish, resulting in high PSDs.

Sauger generally grow slower than walleye (Malison et al. 1990); however, growth rates of Lewis and Clark Lake sauger are similar to walleyes growth rates (Table 13, Table 14). Increased sauger growth may be due to an increase in habitat resembling the historic Missouri River due to delta formation in Lewis and Clark Lake, which would favor sauger over walleye.

Sauger relative weights for Lewis and Clark Lake are generally between 77 and 85 (15). In 2008, sauger relative weights were in the high end of 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 in the September gill-net survey. In 2008, age-0 CPUE was 2.5, indicating moderate to high recruitment similar to 2007 (CPUE = 2.75), which formed a strong year class of age-1 sauger (CPUE = 3.4) in 2008 (Table 16). Mean age of sauger (2.4 years) remained similar to 2006 and 2007. Age-1 sauger were the most prevalent sampled age class in 2008 comprising 50% of the total sample excluding age-0 fish.

Annual survival for 2007-2008 pooled sauger data was 66% (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 2002-2008 pooled catch curve provided an estimated survival of 54%, which is likely a more precise 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 in some areas leading to listing as a 'species of concern' (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. 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 stock density (PSD) and relative stock density for preferred and memorable-length fish (RSD-P and RSD-M) collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2002-2008.

Year	PSD	RSD-P	RSD-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

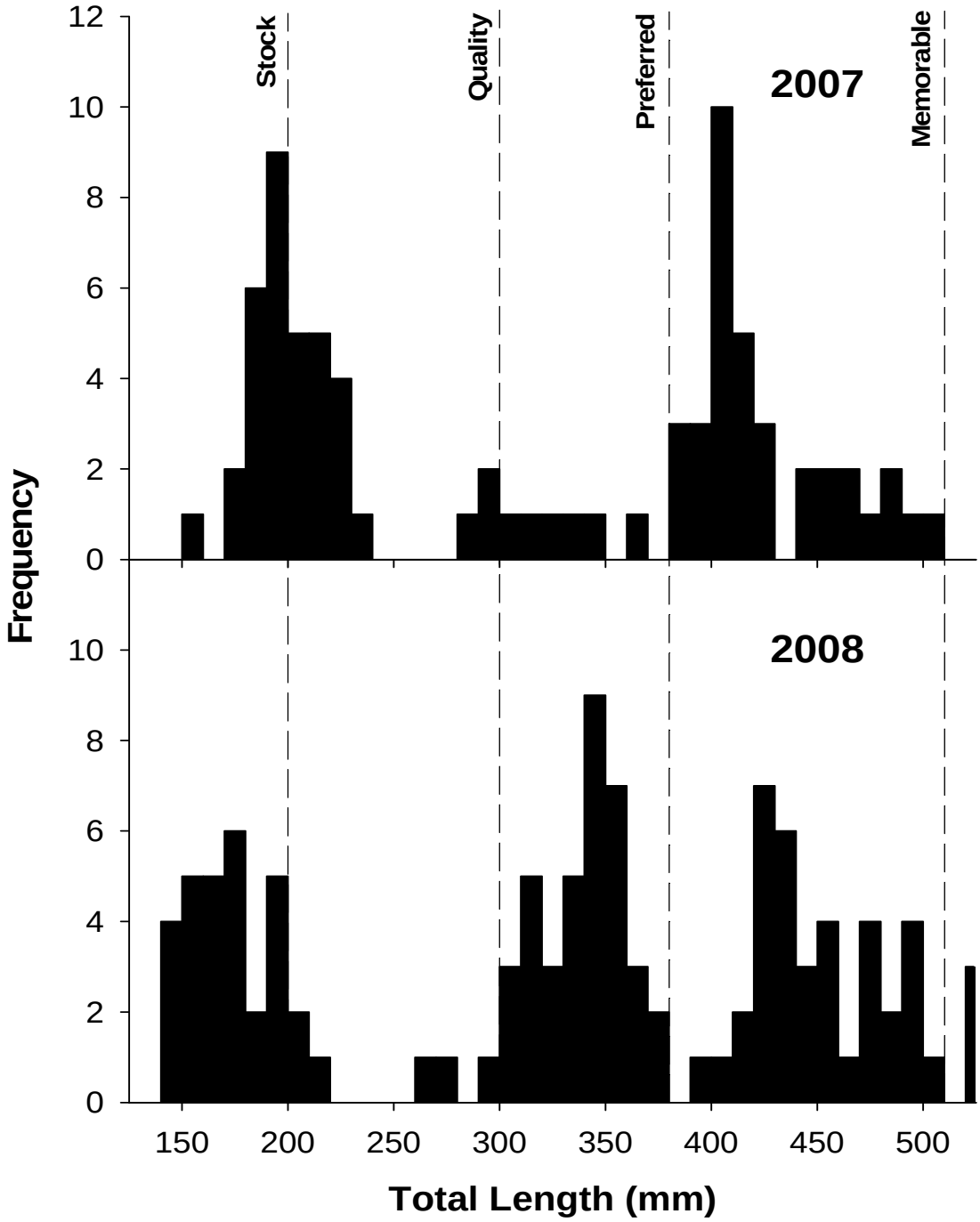

Figure 5. Length frequency of sauger collected during the standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2007 and 2008.

Table 13. Mean length at age at capture, as determined by ages estimated from otoliths analysis, for sauger collected in the standard September gill-net survey 2006-2008, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented.

Year		Length at age at capture (mm)											
		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	69.0	97.6	174.0	325.0	41.8	--	--	--	--
Mean of means		186	321	406	440	487	490	486	466	--	--	--	466

Table 14. Mean annual growth increments for sauger collected in the standard September gill-net survey, Lewis and Clark Lake, South Dakota, for 2006-2008.

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	
Mean	138	106	57	62	2	2	10	0

Table 15. Mean relative weight of sauger, by length categories, collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2002-2008. 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

Table 16. Age distribution of sauger collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2002-2008. Scales (2002-2005) and otoliths (2006-2008) 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

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, 2001-2008. Age range is the range of ages used to calculate catch curve statistics. Scales (2001-2006) and otoliths (2006-2008) 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
2002-2008	0.54	0.46	0.619	0.94	2-7

Channel catfish population parameters

A total of 66 channel catfish were sampled with lengths ranging from 158-748 mm. Mean gill-net CPUE for channel catfish decreased from 8.2 fish/net-night in 2007 to 5.5 fish/net night in 2008 (Table 4). Size structure of sampled fish also decreased from 2007 to 2008 (Figure 6, Table 18). Channel catfish PSD for the 2008 gill-net sample was 29 and RSD-P was 8 compared with 66 and 16, respectively, during the 2007 sampling. Channel catfish in Lewis and Clark Lake exhibit fast growth (Table 19) 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 (Adams et al. 2008; Sorensen and Knecht 2007). In 2008, mean Wr for quality-to-preferred-length channel catfish was 86 (Table 20), and within the normal range of 85 to 90.

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

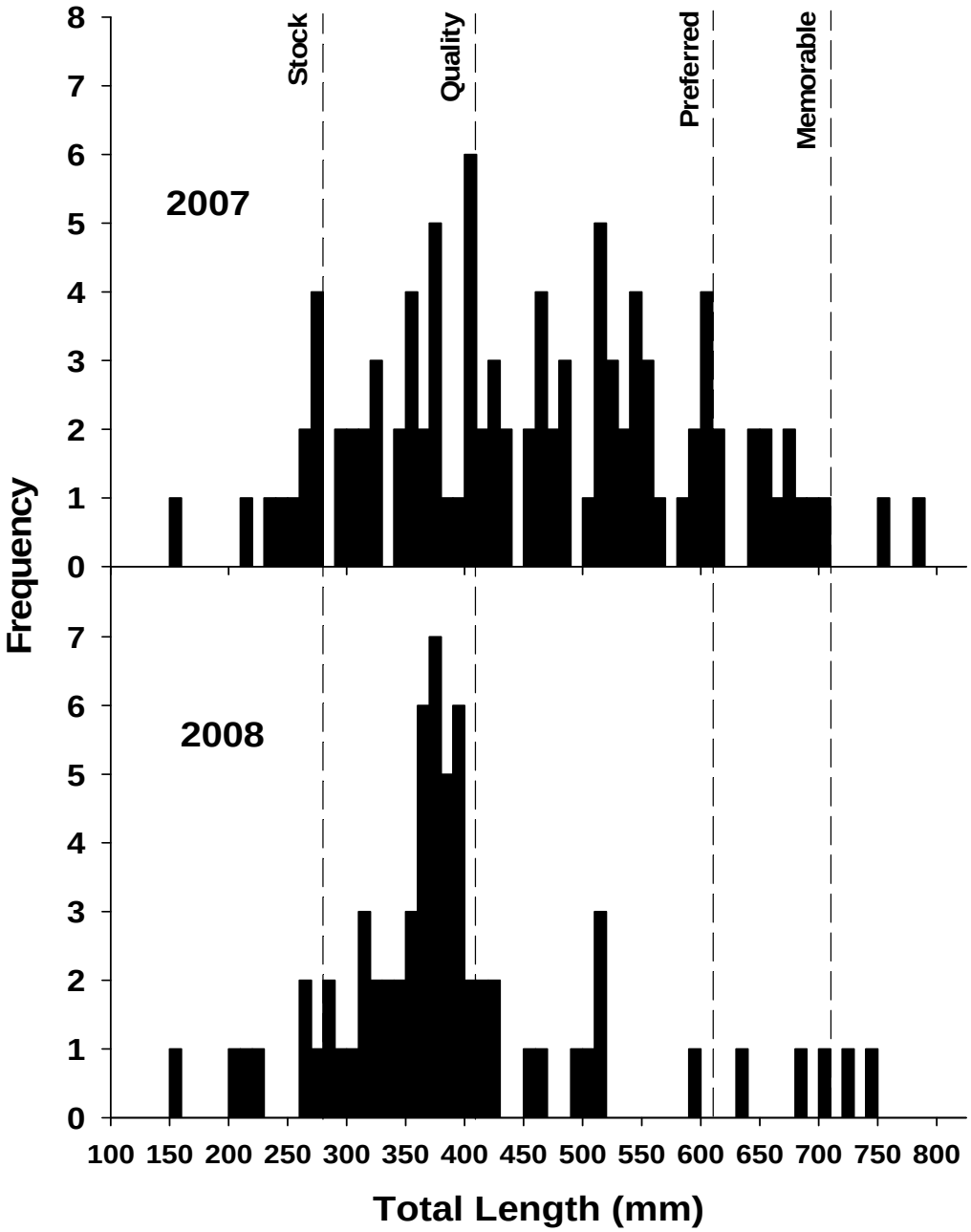

Figure 6. Length frequency for channel catfish collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2007 and 2008.

Table 18. Channel catfish proportional stock density (PSD) and relative stock density for preferred and memorable length fish (RSD-P and RSD-M), collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2002-2008.

Year	PSD	RSD-P	RSD-M	Sample Size
2002	74	9	3	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

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, 2008. 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
2007	1	2	74									
2006	2	13	80	180								
2005	3	32	85	162	296							
2004	4	7	86	163	273	368						
2003	5	2	100	209	256	433	482					
2002	6	2	100	165	228	318	394	441				
2001	7	1	117	255	378	443	501	537	573			
2000	8	1	89	238	330	382	427	453	473	492		
1999	9	0	.	.	.	.	.	.	.	.	.	
1998	10	1	96	168	307	419	485	550	550	583	603	623
Sample mean			95	192	304	387	452	487	530	548	590	615
Standard error			4	11	16	17	17	18	20	25	21	24
Length increment			97	113	83	65	35	43	18	42	26	17

Table 20. Relative weight of channel catfish, by incremental stock density indices, collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2002-2008. 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

Table 21. Age distribution, of channel catfish collected in standard gill-net surveys from Lewis and Clark Lake, South Dakota, 2003-2008. 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**	**Mean**
2003	0	0	1	9	0	4	3	1	3	1	2	1	2	1	1	0	0	6.5
2005	0	0	7	10	13	23	5	5	5	8	4	3	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	7.6
2007	1	7	18	13	9	10	8	5	4	9	3	6	2	0	0	0	1	5.3
2008	0	2	13	32	7	2	2	1	1	0	1	0	2	0	3	0	0	4.0

Electrofishing

Smallmouth bass population parameters

Smallmouth bass CPUE has been highly variable during the past 7 years, ranging from 25/h in 2003 to 79/h in 2008 (Table 22). Although based on small sample sizes, size structure has decreased during this time as well. In 2008, a large proportion of the sample was in the stock-quality length group resulting in a PSD of 17 (Figure 7, Table 22). Smallmouth bass size structure is known to be underestimated with 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, in 2007, 15% of the smallmouth bass sampled were above quality length, while creel survey results indicate that 60% of the smallmouth bass caught in 2006 were above quality length (Jeff Schuckman, Nebraska Game and Parks Commission, personal communication).

Growth appears to be higher than the state average, however this is based on a sample with few individuals from year classes older than 2 (Table 23, Table 24). Wr of stock-quality and quality-preferred smallmouth were in the normal range, at 88 and 93, respectively.

Table 22. Catch per unit effort (CPUE), proportional stock density (PSD), relative stock density for preferred and memorable-length fish (RSD-P, RSD-M), and mean relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass collected by electrofishing Gavins Point Dam face, Lewis and Clark Lake, 2002-2008. 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**	**RSD-P**	**RSD-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

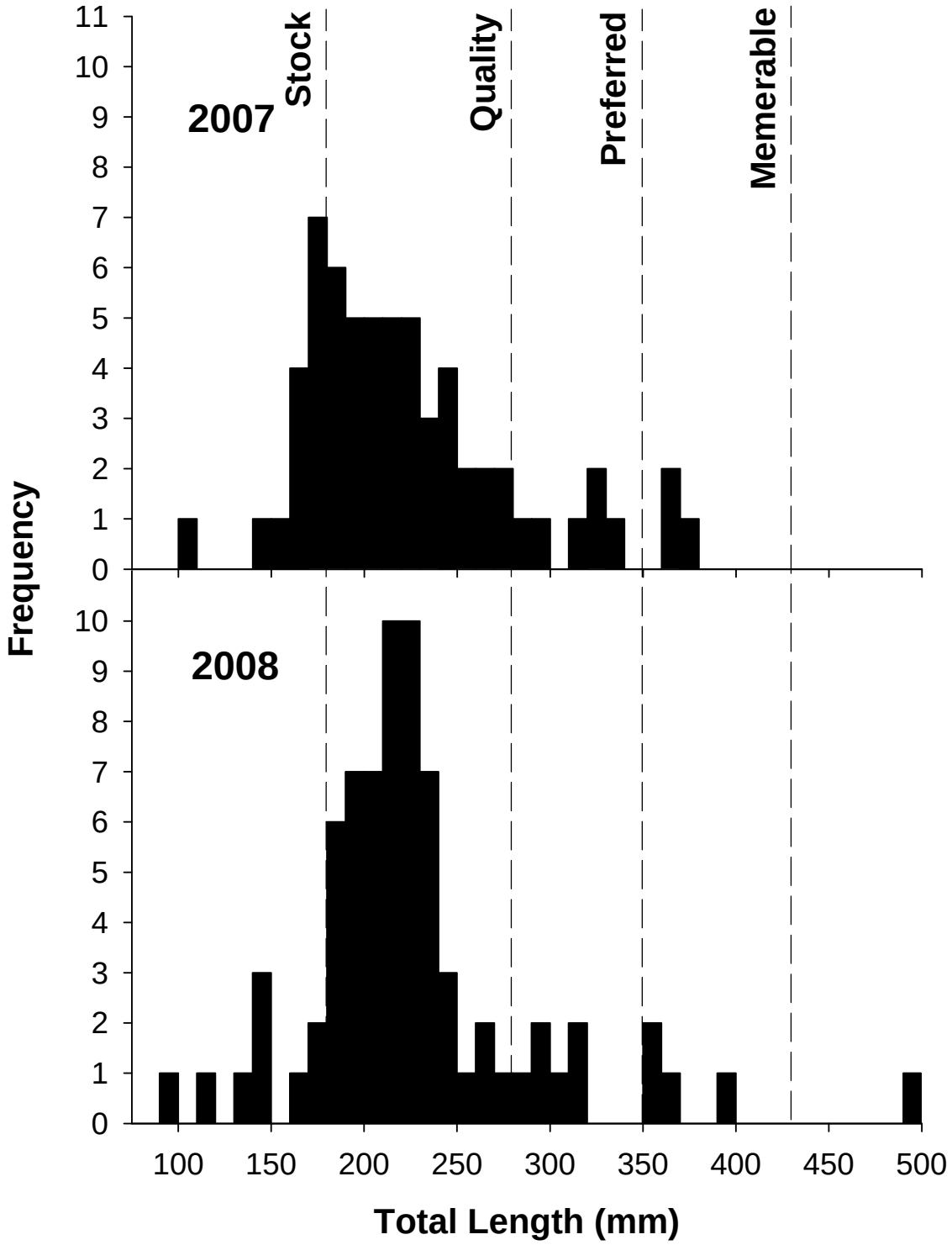

Figure 7. Length frequency for smallmouth bass sampled by nighttime electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, 2007 and 2008.

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 2008.

Year class	Age	N	Annulus							
			1	2	3	4	5	6	7	8
2007	1	3	112							
2006	2	56	92	209						
2005	3	12	97	179	290					
2004	4	1	99	247	320	394				
2003	5	0								
2002	6	0								
2001	7	0								
200	8	1	120	232	367	419	455	473	484	494
Sample mean			104	217	326	407	455	473	484	494
Standard error			5	15	23	13	--	--	--	--
Length increment			113	109	81	48	18	11	10	

Table 24. Age distribution of smallmouth bass collected by electrofishing Lewis and Clark Lake near Gavins Point Dam, 2002-2008, as determined from scales.

Year	Age								
	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

Flathead catfish population parameters

Low amperage daytime electrofishing along riprap areas in Lewis and Clark Lake produced 119 flathead catfish in 2008 with a CPUE of 52/hour electrofishing (Table 25). The 2008 and 2007 surveys both resulted in higher catch rates than previous years, however size structure remains small (Figure 8). PSD for the 2008 sample was 30 and RSD-P was 0. Additionally, 70 percent of the total catch was smaller than stock length.

Flathead catfish growth, as determined from back-calculating lengths from pectoral spine annuli, is relatively slow, taking 5 years to reach stock length (350 mm) (Table 26). Although this estimate is slower than what Wickstrom (2006) reported, it is similar to values reported by Adams (2007), either indicating changes in growth characteristics over time or discrepancies in aging analysis. Relative weight values for both stock-quality and quality-preferred length fish were both above 90. Visual inspection of the age distribution (Table 27) indicates that flathead recruitment has remained relatively consistent over the past few years.

Table 25. Catch per unit effort (CPUE), proportional stock density, relative stock density for preferred and memorable length fish (RSD-P, RSD-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, 2002-2008. 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**	**RSD-P**	**RSD-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

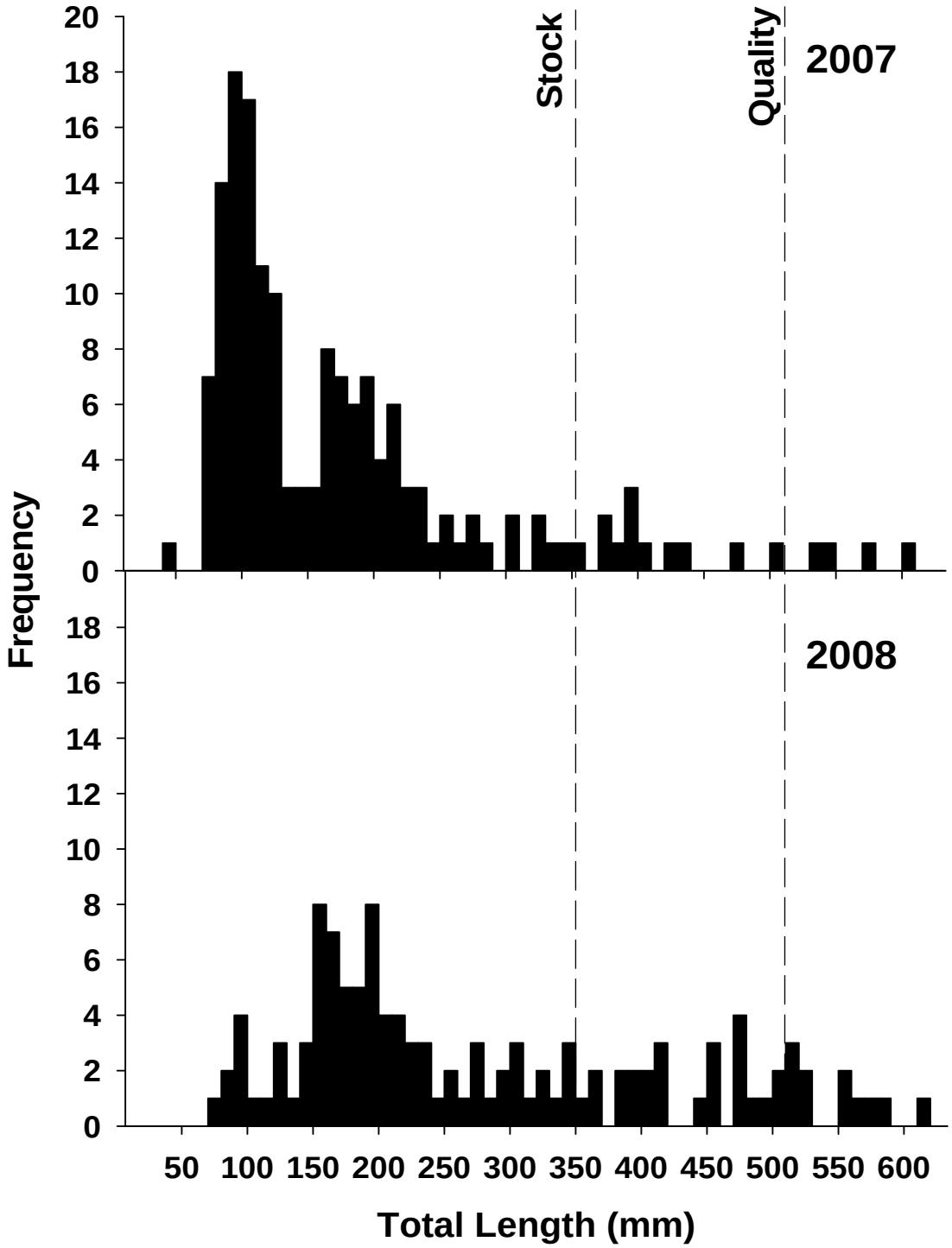

Figure 8. Length frequency of flathead catfish sampled by electrofishing Lewis and Clark Lake during June 2007 and 2008.

Table 26. 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 2008. Ages were determined from pectoral spines.

Year class	Age	N	Annulus												
			1	2	3	4	5	6	7	8	9	10	11	12	13
2007	1	12	105												
2006	2	43	90	179											
2005	3	17	90	158	251										
2004	4	13	118	219	304	362									
2003	5	8	107	171	239	306	369								
2002	6	4	107	207	249	300	337	384							
2001	7	4	120	211	277	340	389	447	480						
2000	8	3	114	201	288	332	369	424	473	511					
1999	9	6	93	159	229	309	352	384	422	452	477				
1998	10	5	126	234	308	376	423	444	467	490	505	523			
1997	11	1	88	152	205	257	327	409	479	491	508	584	619		
1996	12	1	100	177	262	355	417	463	471	479	486	502	510	525	
1995	13	2	92	174	263	330	383	420	442	467	488	510	528	544	565
Sample mean			104	187	261	327	374	422	462	482	493	530	552	534	565
Standard error			4	8	9	11	11	10	8	8	6	19	34	9	--
Length increment			83	74	66	47	48	40	20	11	37	23	-18	31	

Table 27. Age distribution of flathead catfish sampled by electrofishing Lewis and Clark Lake during 2002-2008, as determined from pectoral spines.

Year	Age													
	1	2	3	4	5	6	7	8	9	10	11	12	13	Mean
2002	7	12	13	36	17	1	5	2	0	1	0	0	0	3.9
2003	6	10	9	7	11	9	1	2	2	1	0	1	0	4.3
2004	0	3	21	10	3	8	4	2	2	0	0	0	0	4.4
2005	9	10	7	10	1	4	4	0	1	0	0	0	0	3.4
2006	7	7	4	7	4	0	3	1	1	0	0	0	0	3.5
2007	63	12	7	5	4	1	2	4	0	0	0	0	0	2.0
2008	12	43	17	13	8	4	4	3	6	5	1	1	2	4.1

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 37 largemouth bass were sampled with a CPUE of 31/h (Table 28). 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 2008 largemouth bass sample had a quality size structure (PSD = 88 and RSD-P = 66), with fish ranging in size from 73-456 mm total length (Figure 9). The growth characteristics of this population (Table 29) is faster than the state average, and is similar to the upper quartile for largemouth bass population reported by Willis et al. (2001). The age distribution (Table 30) shows a relatively even number of fish in each age class out to 7, however, this is based on a small sample and few inferences can be made about recruitment patterns.

Table 28. Catch per unit effort (CPUE), proportional stock density (PSD), relative stock density for preferred and memorable-length fish (RSD-P, RSD-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, 2003-2008. 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**	**RSD-P**	**RSD-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

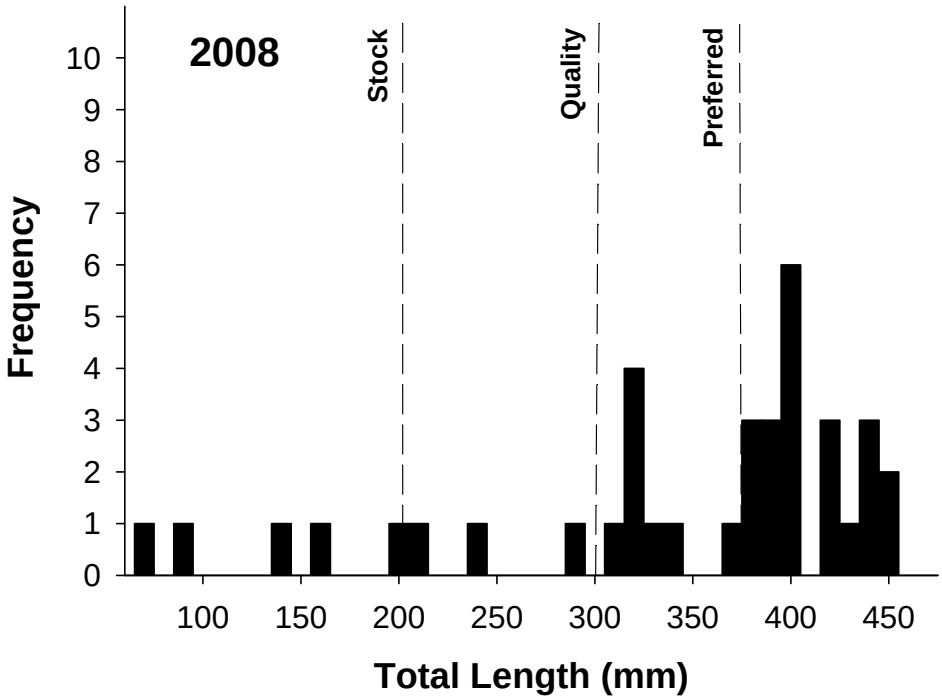

Figure 9. Length frequency of largemouth bass sampled by electrofishing in the Niobrara delta near Springfield, South Dakota during May 2008.

Table 29. 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 2008. Ages were determined from scales.

Year class	Age	N	Annulus								
			1	2	3	4	5	6	7	8	9
2007	1	3	101								
2006	2	4	93	206							
2005	3	5	90	204	314						
2004	4	4	92	205	296	347					
2003	5	3	93	205	288	351	383				
2002	6	7	88	194	288	342	380	404			
2001	7	8	97	195	283	344	386	410	422		
2000	8										
1999	9	3	87	168	265	337	378	402	424	441	452
Sample mean			92	197	289	344	382	405	423	441	452
Standard error			2	5	7	2	2	2	1	--	--
Length increment			104	92	55	38	23	18	18	11	

Table 30. Age distribution of largemouth bass sampled by electrofishing in the Springfield area of the Niobrara Delta, 2002-2008, 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

Smallmouth bass population parameters

Gavins Point Dam Tailwaters

A total of 76 smallmouth bass were sampled in the Gavins Point Dam tailwater area with lengths ranging from 93-348 mm (Figure 10). Mean CPUE for smallmouth bass was 76 fish/h; up from 56 fish/h in 2007 (Table 31). Smallmouth bass PSD and RSD-P decreased from 2007 to 2008. Relative weights for stock-quality and quality-preferred-length smallmouth bass in 2008 were within the normal range for this population (Table 31).

Three age classes (1-3) were sampled in 2008 (Table 29, Table 30), down from 7 in 2007, however, it is likely that larger (older) fish are less susceptible to the sampling methods used and are under represented in this sample (Beamesderfer and Rieman 1988; Milewski and Willis 1991).

Table 31. Catch per unit effort (CPUE), proportional stock density (PSD), relative stock density for preferred and memorable-length fish (RSD-P, RSD-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, 2002-2008. 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**	**RSD-P**	**RSD-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

Table 32. 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 2008. Ages were determined from scales.

Year class	**Age**	**N**	**Annulus**		
			1	**2**	**3**
2007	1	32	139		
2006	2	38	101	222	
2005	3	6	95	200	305
Sample mean			112	211	305
Standard error			14	11	--
Length increment			99	94	

Table 33. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May, 2002-2008, 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

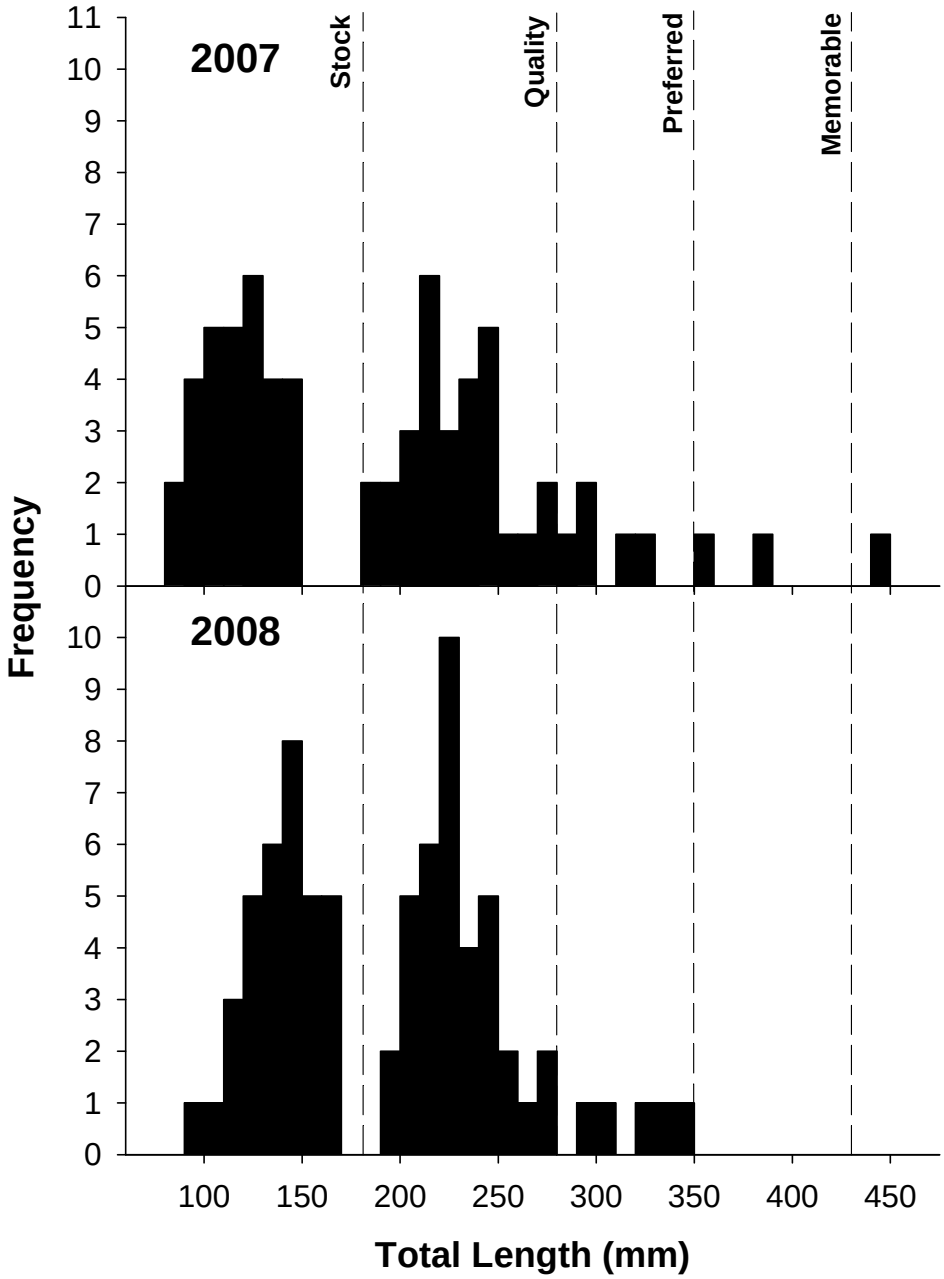

Figure 10. Length frequency of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May 2007 and 2008.

Fort Randall Dam Tailwaters

A total of 100 smallmouth bass were sampled during a cumulative 60 minutes of electrofishing. Lengths ranged from 80 to 439 mm with 53 percent of the sample shorter than stock length (180 mm) (Figure 11). Size structure indices were similar to previous years (Table 34). Growth rates of smallmouth bass in the Fort Randall Tailrace reach (Table 35) 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). Average relative weights were higher than 100 for all size classes. Average relative weights are typically above 95 for this population indicating adequate prey is available. However, these values are generated from a fall sample, while the other smallmouth bass surveys on the Lewis and Clark Lake take place in the spring, so limited comparisons can be made between sub-populations.

Similar to the other smallmouth surveys, age distribution of the Fort Randall Tailrace smallmouth was dominated by fish less than 3 years of age (Table 36). In most Fort Randall Tailwater surveys, age classes up to 4 are present indicating consistent recruitment. Electrofishing for smallmouth bass typically underestimates size structure and age structure (Beamesderfer and Rieman 1988; Milewski and Willis 1991) thus mortality estimates would likely overestimate the actual mortalty of the population.

Table 34. Catch per unit effort (CPUE), proportional stock density (PSD), relative stock density for preferred and memorable-length fish (RSD-P, RSD-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 Fort Randall Dam, 2002-2008. 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**	**RSD-P**	**RSD-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

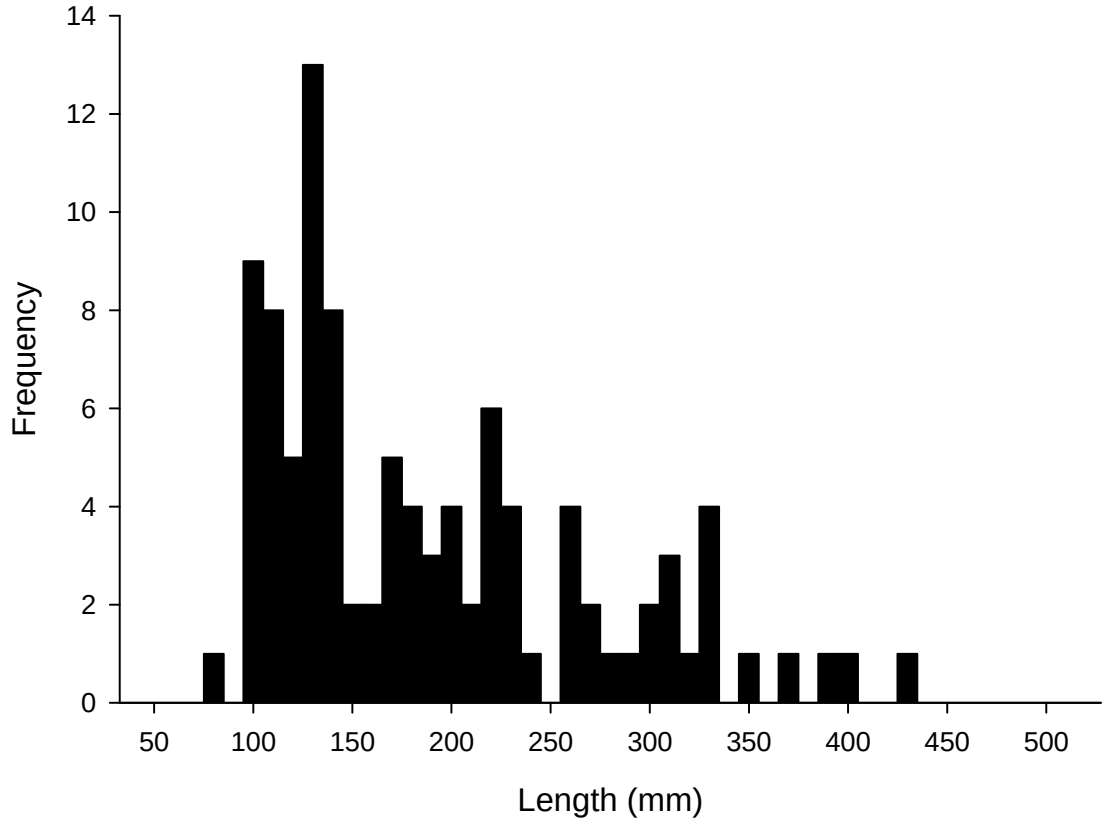

Figure 11. Length frequency of smallmouth bass sampled by electrofishing the Missouri River below Fort Randall Dam in October 2008.

Table 35. 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 2008. Ages were determined from scales.

Year class	Age	N	Annulus				
			1	2	3	4	5
2007	1	50	88				
2006	2	30	87	156			
2005	3	13	85	159	254		
2004	4	2	80	153	222	288	
2003	5	2	99	183	260	345	392
Sample mean			88	163	245	317	392
Standard error			3	7	12	29	--
Length increment			75	82	71	76	

Table 36. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Fort Randall Dam, 2002-2008, 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

Hoop Nets

Channel catfish population parameters

A total of 17 channel catfish were sampled with hoop nets in the Niobrara delta in 2008 Table 37). Only 2 of these fish were longer than stock length and little can be inferred about population dynamics with such a small sample size (Table38). Growth and age data are represented in Table 39 and 40. Future efforts should be directed at increasing sample size with other gears or sampling other locations.

Table 37. Total annual hoop net catches (CPUE) of channel catfish from the Missouri River near Springfield, SD, 2001-2004 and 2006-2007. 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)

Table 38. Proportional stock density (PSD), relative stock density for preferred and memorable length fish (RSD-P, RSD-M), and mean relative weight (standard error) for stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) channel catfish sampled with hoop nets from the Missouri River near Springfield, SD, 2001-2004 and 2006-2007. 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**	**RSD-P**	**RSD-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	79 (1.4)	2	99 (--)	1
2008	0	0	0	96.5 (0.0)	2	--	0	--	0

Table 39. Mean back-calculated total lengths (mm) for each age class of channel catfish sampled during the hoop net survey in the Niobrara delta, South Dakota, 2008.

Year class	**Age**	**N**	**Annulus**		
			1	**2**	**3**
2007	1	1	74		
2006	2	12	71	172	
2005	3	4	68	147	223
Sample mean			71	159	223
Standard error			2	12	--
Length increment			89	63	

Table 40. Age distribution of channel catfish sampled in hoop nets from the Missouri River, 2002, 2004, and 2006-2008, 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

Seines

A total of 17 species of age-0 fishes and adult prey species were captured with seines in the Niobrara Delta near Springfield, South Dakota during July, 2008 (Table 41). All species have been previously sampled in Lewis and Clark Lake. The most abundant species was the river carpsucker followed by the spotfin shiner. Water level fluctuations within the delta can greatly influence seining efficiency. For example, high water levels inundate terrestrial vegetation, which makes seining nearly impossible. In 2008, high water was a factor and the only place that a seine could successfully be used was on sandbars without vegetation.

Table 41. Catch per unit effort (fish/seine haul) for July seining surveys in the Missouri River near Springfield, South Dakota, 2003-2008. Trace (T) indicates a value is less than 0.05. Standard error (SE) is in parenthesis. *includes both age-0 and adults.

Species	2003	2004	2005	2006	2007	2008
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*	1.3 (0.4)	4.0 (2.9)	0.9 (0.2)	0.6 (0.4)	1.1 (1.0)	0.4 (0.3)
Freshwater drum	--	--	--	--	--	0.1 (0.1)
Gizzard shad	--	T	3.1 (2.5)	0.6 (0.3)	13 (0.9)	T
Green sunfish	--	--	--	--	--	T
Johnny darter*	0.1 (0.1)	--	--	--	T	0.1 (0.1)
Largemouth bass	0.8 (0.4)	0.4 (0.2)	0.8 (0.3)	T	--	0.3 (0.2)
Rock bass	--	T	--	--	--	--
Red shiner*	--	--	0.1 (0.1)	--	26 (0.9)	--
River carpsucker	0.1 (0.1)	T	0.4 (0.2)	0.1 (0.1)	5 (1.0)	5.7 (3.0)
Sauger	--	--	--	--	T	0.1 (0.1)
Shorthead redhorse	--	--	--	--	--	T
Smallmouth bass	0.4 (0.2)	0.1 (0.1)	0.4 (0.2)	--	T	--
Smallmouth Buffalo	--	--	--	--	--	T
Spotfin shiner	0.7 (0.3)	0.3 (0.1)	0.4 (0.2)	--	--	1.4 (0.6)
Spottail shiner*	--	--	--	--	--	0.1 (0.1)
Walleye	0.2 (0.1)	T	0.2 (0.1)	--	--	0.1 (0.1)
White bass	--	T	0.2 (0.1)	--	T	--
White crappie	0.1 (0.1)	--	0.2 (0.1)	--	T	--
Yellow perch	--	T	--	--	--	--

RARE FISH OBSERVATIONS

No state threatened or endangered fishes were observed during sampling activities for fish population surveys on Lewis and Clark Lake or the Missouri River upstream and downstream of Lewis and Clark Lake during 2008.

FISHERY STATUS

The results from the 2008 standard sampling indicate that most of the sport fish populations in Lewis and Clark Lake have seen increases in abundance in recent years. This is especially true for the walleye and sauger populations which are at the highest levels in more than 10 years. Additionally, the two species have quality size structures with nearly half of both species longer than the 15 inch minimum length limit in place on the reservoir.

Most species specific management objectives were met for both walleye and sauger in 2008 (Table 42). Four mature year classes of walleye were present (2002-2005) and five (2001-2005) for sauger. Proportional stock density was above the management objective range of 30-60, and RSD-P was higher than the management objective of 10 for both species. Gill-net CPUE's were also above the management objectives of 4.0 and 6 fish/net night for walleye and sauger respectively.

Channel catfish continue to be relatively abundant during the fall gill-net survey (6/gill net) and exceeded the CPUE objective of 3/gill net (Table 42). Channel catfish size structure indices were just below the set objective levels for PSD and RSD-P (Table 27). Channel catfish continue to be one of the most underutilized resources in the Missouri River system in South Dakota.

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 the 30 to 60 range (Table 42), 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 50, an increase in sampling effort may be necessary in the future for largemouth bass and smallmouth bass in Lewis and Clark Lake for better representation of population structure.

Currently, an objective in the Missouri River Fisheries program strategic plan addresses 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 are with angler use and harvest surveys. While Lewis and Clark Lake does not annually provide as many angler days or

harvest as other Missouri River reservoirs, it is an important fishery for the people of southeast South Dakota as well as the surrounding states. With management objectives dealing with creel data, annual creel surveys should be performed on Lewis and Clark Lake.

Table 42. Catch per unit effort (CPUE), proportional stock density (PSD, relative stock density – preferred (RSD-P) and species specific management objectives for walleye, sauger, channel catfish, largemouth and smallmouth bass, in Lewis and Clark Lake, 2008. Bold values indicate failure to meet objective.

Species/Obj	CPUE	PSD	RSP-P	Harvest	Harvest rate
Walleye	14 / gill net	**64**	16		
Objectives	≥4 / gill net	30-60	≥10	10,000	0.1 / hour
Sauger	9 / gill net	**93**	51		
Objectives	≥6 / gill net	30-60	≥10	5,000	0.1 / hour
Channel Catfish	6 / gill net	**29**	**8**		
Objectives	≥3 / gill net	30-60	≥10		
Largemouth Bass	31 / hour	**88**	66		
Objectives	≥10 / hour	30-60	≥10		
Smallmouth Bass	79 / hour	**17**	**8**		
Objectives	≥10 / hour	30-60	≥10		

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 yet 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 locations and utilization of various habitats will undoubtedly change as well. Increases in habitat diversity through delta formation may promote greater species diversity than reservoir and riverine habitats and provide increased habitat for various native species.

MANAGEMENT RECOMMENDATIONS

- Conduct an angler use and harvest survey in 2009. This will allow managers to determine if management objectives are being met and the extent to which the fishery is being utilized.

- 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.

- 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.

- 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 habitat that was lost due to 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 delta 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
Green sunfish	*Lepomis cyanellus*	GRS
Johnny darter	*Etheostoma nigrum*	JOD
Largemouth bass	*Micropterus salmoides*	LMB
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*	WTB
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. GPS location and effort of all sampling sites on Lewis and Clark Reservoir in 2008.

Target	Gear	Site	Location	Month	Start/small mesh northing	Start/small mesh easting	Stop/large mesh northing	Stop/large mesh easting	Effort
SMB	Electrofishing	1	Gavins Dam	May	4745466.95	623796.59	4745933.63	623801.79	20 min
SMB	Electrofishing	2	Gavins Dam	May	4745949.53	623791.42	4746518.13	623697.90	20 min
SMB	Electrofishing	3	Gavins Dam	May	4746532.25	623687.56	4747156.18	623556.23	20 min
SMB	Electrofishing	4	Gavins Dam	May	4747563.95	623267.07	4747530.10	622940.26	12 min
SMB	Electrofishing	1	Gavins Tailrace	May	4744874.41	625910.29	4744699.64	626722.93	20 min
SMB	Electrofishing	2	Gavins Tailrace	May	4744710.64	626964.34	4745027.75	627805.65	20 min
SMB	Electrofishing	3	Gavins Tailrace	May	4745126.21	627909.50	4745624.45	628360.18	20 min
LMB	Electrofishing	1	Springfield	May	4744551.45	590704.63	4744120.98	590382.65	20 min
LMB	Electrofishing	2	Springfield	May	4744192.14	590309.16	4744621.44	590640.47	20 min
LMB	Electrofishing	3	Springfield	May	4742739.75	589742.48	4742531.60	589635.59	20 min
LMB	Electrofishing	4	Springfield	May	4743158.87	590231.93	4743023.86	590324.75	10 min
FHC	Electrofishing	1	Weigand Marina	Jun	4743437.70	617130.24	4743764.99	616542.30	20 min
FHC	Electrofishing	2	Weigand Marina	Jun	4743800.34	616518.46	4743889.40	616288.04	20 min
FHC	Electrofishing	3	Weigand Marina	Jun	4743913.78	616249.48	4743827.23	615639.20	20 min
FHC	Electrofishing	4	Weigand Marina	Jun	4743887.95	615137.83	4743961.39	614897.17	20 min
FHC	Electrofishing	5	Midway Marina	Jun	474656.70	620603.39	4746756.43	620873.53	--
Any	Seine small	1	Delta	Jul	4745249.31	590971.84	--	--	4 pulls
Any	Seine small	2	Delta	Jul	4744813.97	590670.73	--	--	4 pulls
Any	Seine small	3	Delta	Jul	4742463.10	590774.49	--	--	4 pulls
Any	Seine small	4	Delta	Jul	4740772.30	590236.62	--	--	4 pulls
Any	Seine small	5	Delta	Jul	4743887.81	592397.25	--	--	2 pulls
Any	Seine small	6	Delta	Jul	4744844.77	591958.74	--	--	3 pulls
Any	Seine small	7	Delta	Jul	4746440.76	592567.23	--	--	3 pulls

Appendix 3. Continued.

Target	Gear	Site	Location	Month	Start/small mesh northing	Start/small mesh easting	Stop/large mesh northing	Stop/large mesh easting	Effort
Any	Seine small	8	Delta	Jul	4745799.96	591564.63	--	--	4 pulls
Any	Seine small	9	Delta	Jul	4745510.59	591220.44	--	--	2 pulls
Any	Seine large	1-a	Lake	Jul	4745892.02	618412.01	--	--	1 Pull
Any	Seine large	1-b	Lake	Jul	4746050.74	618424.18	--	--	1 Pull
Any	Seine large	2-a	Lake	Jul	4746104.13	606450.11	--	--	1 Pull
Any	Seine large	2-b	Lake	Jul	4746033.47	606619.97	--	--	1 Pull
Any	Seine large	3-a	Lake	Jul	4746736.42	602813.37	--	--	1 Pull
Any	Seine large	3-b	Lake	Jul	4746690.63	603058.62	--	--	1 Pull
Any	Seine large	4-a	Lake	Jul	4748299.31	597789.81	--	--	1 Pull
Any	Seine large	4-b	Lake	Jul	4748314.38	597861.64	--	--	1 Pull
CCF	Hoop net	1	Delta	Aug	4744275.27	589936.90	--	--	2 Day
CCF	Hoop net	2	Delta	Aug	4743586.29	590192.31	--	--	2 Day
CCF	Hoop net	3	Delta	Aug	4742756.98	590739.92	--	--	2 Day
CCF	Hoop net	4	Delta	Aug	4742191.59	590515.81	--	--	2 Day
CCF	Hoop net	5	Delta	Aug	4741687.07	590434.29	--	--	2 Day
CCF	Hoop net	6	Delta	Aug	4740291.07	589839.34	--	--	2 Day
CCF	Hoop net	7	Delta	Aug	4739582.81	589942.02	--	--	2 Day
CCF	Hoop net	8	Delta	Aug	4739384.21	589881.44	--	--	2 Day
CCF	Hoop net	9	Delta	Aug	4738121.83	589201.94	--	--	2 Day
CCF	Hoop net	10	Delta	Aug	4737171.01	587719.90	--	--	2 Day
CCF	Hoop net	11	Delta	Aug	4737177.48	588180.62	--	--	2 Day
CCF	Hoop net	12	Delta	Aug	4740595.51	590657.41	--	--	2 Day
CCF	Hoop net	13	Delta	Aug	4742134.50	591784.43	--	--	2 Day
CCF	Hoop net	14	Delta	Aug	4743031.95	591708.01	--	--	2 Day

Appendix 3. Continued.

Target	Gear	Site	Location	Month	Start/small mesh northing	Start/small mesh easting	Stop/large mesh northing	Stop/large mesh easting	Effort
CCF	Hoop net	15	Delta	Aug	4744156.50	592971.06	--	--	2 Day
CCF	Hoop net	16	Delta	Aug	4744940.80	591832.95	--	--	2 Day
CCF	Hoop net	17	Delta	Aug	4746824.19	593603.82	--	--	2 Day
CCF	Hoop net	18	Delta	Aug	4746367.46	592477.49	--	--	2 Day
CCF	Hoop net	19	Delta	Aug	4745490.66	591469.68	--	--	2 Day
Any	Gill net	1	Lake	Sep	4744360.25	622680.05	4744426.07	622761.75	1 day
Any	Gill net	2	Lake	Sep	4746193.44	619714.52	4746190.23	619804.01	1 day
Any	Gill net	3	Lake	Sep	4745861.78	617830.33	4745826.99	617921.24	1 day
Any	Gill net	4	Lake	Sep	4743589.53	617088.19	4743525.35	617168.65	1 day
Any	Gill net	5	Lake	Sep	4745874.13	614753.46	4745874.73	614860.85	1 day
Any	Gill net	6	Lake	Sep	4745091.55	610703.10	4745073.03	610811.69	1 day
Any	Gill net	7	Lake	Sep	4745735.08	609099.23	4745744.35	609206.66	1 day
Any	Gill net	8	Lake	Sep	4744957.24	608177.71	4744960.18	608294.64	1 day
Any	Gill net	9	Lake	Sep	4742729.97	605801.04	4742671.53	605875.18	1 day
Any	Gill net	10	Lake	Sep	4744271.76	605512.52	4744233.84	605604.30	1 day
Any	Gill net	11	Lake	Sep	4744746.96	602536.64	4744777.08	602438.86	1 day
Any	Gill net	12	Lake	Sep	4745902.42	601096.11	4745880.18	601204.71	1 day
SMB	Electrofishing	1	Fort Randall Tailrace	Oct	4762183.62	539650.26	4761339.82	539916.18	20 min
SMB	Electrofishing	2	Fort Randall Tailrace	Oct	4761299.40	539930.84	4760357.10	540261.25	20 min
SMB	Electrofishing	3	Fort Randall Tailrace	Oct	4760184.74	540362.02	4759198.87	541042.64	20 min
WAE -age-0	Electrofishing	1	Lake	Oct	4746376.85	623715.96	4746791.02	623650.21	10 min
WAE -age-0	Electrofishing	2	Lake	Oct	4747114.01	613885.08	4747119.13	614229.51	10 min
WAE -age-0	Electrofishing	3	Lake	Oct	4744069.47	613906.54	4744008.28	614313.61	10 min
WAE -age-0	Electrofishing	4	Lake	Oct	4746716.28	611870.53	4746883.55	612152.71	10 min

Appendix 3. Continued.

Target	Gear	Site	Location	Month	Start/small mesh northing	Start/small mesh easting	Stop/large mesh northing	Stop/large mesh easting	Effort
WAE -age-0	Electrofishing	5	Lake	Oct	4745869.99	608436.46	4745923.95	608759.57	10 min
WAE -age-0	Electrofishing	6	Lake	Oct	4746340.96	605267.77	4746276.20	605668.52	10 min
WAE -age-0	Electrofishing	7	Lake	Oct	4742376.02	603762.69	4742258.58	604114.45	10 min
WAE -age-0	Electrofishing	8	Lake	Oct	4746618.87	603239.40	4746607.66	603564.36	10 min
WAE -age-0	Electrofishing	9	Lake	Oct	4748001.43	599577.10	4747765.80	599928.02	10 min
WAE -age-0	Electrofishing	10	Lake	Oct	4746846.93	621335.56	4747010.53	621623.74	10 min
WAE -age-0	Electrofishing	11	Lake	Oct	4743788.70	620991.30	4743757.36	621377.33	10 min
WAE -age-0	Electrofishing	12	Lake	Oct	4743553.06	617779.96	4743589.44	618163.94	10 min