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ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS ON LEWIS AND CLARK LAKE AND THE LOWER MISSOURI RIVER, SOUTH DAKOTA, 2009

South Dakota
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ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS ON LEWIS AND CLARK LAKE AND THE LOWER MISSOURI RIVER, SOUTH DAKOTA, 2009

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American Creek Fisheries Station
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PREFACE

Information collected from Lewis and Clark Lake during 2009 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 and angler use and harvest surveys conducted on the Lewis and Clark reservoir system, and the Missouri River below Gavins Point Dam in 2009. Trends in fish population structure and angler use and harvest are reported and compared with previous year's surveys. These surveys are used to determine the relative health of the fishery, to evaluate management strategies and objectives outlined in the Missouri River Program strategic plan, and to guide management recommendations to improve the current fishery.

Walleye, sauger, freshwater drum, and channel catfish were the most abundant species sampled with gill nets in 2009. Walleye and sauger catch per unit effort (CPUE) were among the highest levels observed in recent years (10.7 and 8.3/gill net, respectively). Six mature year classes of walleye were present (2002-2007) and seven (2001-2007) were present for sauger. Size structure for walleye and sauger populations met or exceeded management objectives. Proportional size distribution of walleye was within the management objective range of 30-60, and PSD-P matched the management objective of 10. Sauger PSD was slightly above the management objective and PSD-P was well above the objective. Gill net CPUE's were also above the management objectives of 4.0 and 6.0 fish/net night for walleye and sauger, respectively.

Channel catfish continue to be relatively abundant during the fall gill net survey (4.3/gill net) and exceeded the CPUE objective of 3/gill net. Channel catfish size structure indices were better than average in 2009, and surpassed the set objective levels for PSD and PSD-P. Creel survey results show 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. PSD was within 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.

Nineteen species of fish were sampled during the seining survey on Lewis and Clark Lake in 2009. Total catch rates increased this year and were well above the long-term average for the first time since 2001. This can be attributed to high catches of age-0 gizzard shad at select sampling locations. Catches of emerald shiners were up from last year, they were the second most abundant fish caught in seines. Another notable change since 2008 was the increase in age-0 white bass CPUE from 4.6 to 59.6 per seine haul.

Anglers spent an estimated 372,382 hours fishing the Lewis and Clark system and the Missouri River downstream of Gavins Point Dam during the April-October 2009 daylight period. Total fish harvest was estimated at 117,750, including 27,722 walleye. The majority of walleye harvest came from the Lewis and Clark system (20,996), at a catch rate of 0.126 fish/angler-hour. White bass, channel catfish and sauger were commonly harvested in the Lewis and Clark system, as were freshwater drum below Gavins Point Dam. Anglers from South Dakota and 17 other states generated a local economic impact estimated at about $8.14 million.

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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 size distribution
Q ..... quality length
RM ..... river mile
PSD-M ..... proportional size distribution for memorable-length fish
PSD-P ..... proportional size distribution for preferred-length fish
S ..... stock length
SD ..... South Dakota
s ..... survival
spp. ..... species (multiple)
TL ..... total length
W_r ..... relative weight
W_s ..... standard weight
-z ..... instantaneous mortality rate

ANNUAL FISH POPULATION AND ANGLER USE AND SPORTFISH HARVEST SURVEYS ON LEWIS AND CLARK LAKE AND THE LOWER MISSOURI RIVER, SOUTH DAKOTA, 2009

INTRODUCTION

Lewis and Clark Lake was formed by the construction of Gavins Point Dam, which was completed in 1955. Lewis and Clark Lake is the lowermost of four Missouri River reservoirs in South Dakota that was impounded under the authority of the Pick-Sloan Act. The main purposes of dam construction along the Missouri River were to lessen flooding in the lower basin, provide flows for navigation in the un-impounded portion of the river, provide irrigation, and generate power. Recreation was a small part of the original purpose of the Missouri River reservoirs, but became the largest financial contributor to the State of South Dakota. Based on the average $79/trip estimate for resident and nonresident anglers combined (U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census 2006), 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. 2009, Adams et al. 2009, 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. 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.

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

The purpose of this report is to provide a summary of the data collected from Lewis and Clark Lake and the Missouri River downstream from Gavins Point Dam during 2009, and to provide management recommendations to enhance or conserve the recreational sport fisheries contained therein.

MANAGEMENT OBJECTIVES

Reservoir-wide Objectives and Strategies

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

Species Specific/Lake Specific Objectives

<u>Walleye</u>

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

<u>Sauger</u>

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

Channel catfish

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

Largemouth and smallmouth bass

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

Sampling Objectives (Federal Aid Code 2102)

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

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

STUDY AREA

Lewis and Clark Lake is the lowermost reservoir of the Missouri River system. Stretching 110 km from Fort Randall Dam to Gavins Point Dam, the Lewis and Clark Lake system contains reservoir, delta and riverine habitats (Figure 1). The upstream river reach (referred to as the Missouri River) is approximately 60-km long and extends from Springfield, SD, upstream to Fort Randall Dam. Normal pool elevation for Lewis and Clark Lake is 1,208 feet above mean sea level. Reservoir surface area is 12,707 ha at normal pool, with a storage capacity of 6.06 million cubic meters. Maximum depth is 13.7 m with a mean depth of 5.0 m. There is approximately 144 km of shoreline surrounding the lake when it is at normal pool elevation. The Lewis and Clark Lake watershed drains 41,440 square kilometers, with the area above Gavins Point Dam draining 682,410 square kilometers.

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

The angler use and harvest survey encompassed the entire Lewis and Clark reservoir system, and extended downstream to the confluence of the Missouri River and Big Sioux River near the Iowa, Nebraska border. For the purposes of the angler harvest and use survey, the survey area was divided into five zones (Figure 1). Zone 1 included the Fort Randall Dam tailwater, downstream to the head of the first island below the spillway boat ramp (river mile 880 to 878). Zone 2 was the upper Missouri River, and extended downstream from zone 1 to the mouth of Bazile Creek (river mile 878 to 838). Zone 3 was Lewis and Clark Lake, and extended from zone 2 to Gavins Point Dam (river mile 838 to 810). Zone 4 was the Gavins Point Dam tailwater, and extended from Gavins Point Dam downstream to the end of the recreation area on the south bank (river mile 811 to 810). Zone 5 extended from zone 4, downstream to the confluence of the Missouri River and Big Sioux River (river mile 810 to 735). A complete list of access sites by zone appears in Appendix 3.

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.

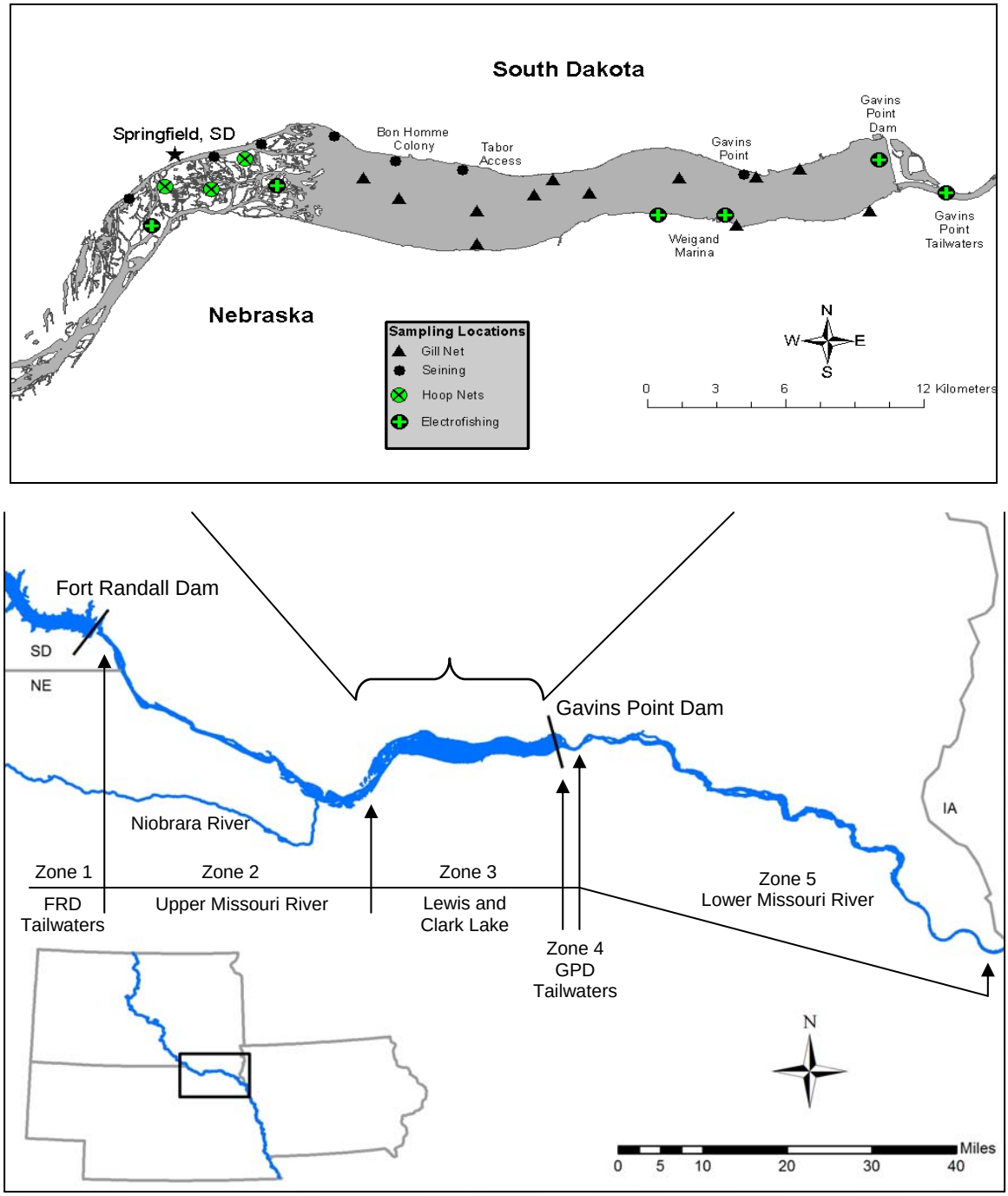

Figure 1. The Missouri River from Fort Randall Dam, downstream to the point where it leaves South Dakota entirely, showing select sampling locations in Lewis and Clark Lake, and zones used during the angler use and harvest survey.

METHODS

Fish Population Surveys

Fish populations in the Lewis and Clark Lake system were sampled with gill nets, hoop nets, shoreline seines, and daytime and nighttime electrofishing during 2009. 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, 2009. GPDT = Gavin's Point Dam tailwater, FRDT = Fort Randall Dam tailwater, Age-0 = age-0 walleye and sauger.

Area	**Lewis and Clark Lake**					**Delta**				**GPDT**	**FRDT**
Method	**Gill Net**	**Electrofish**			**Seine**	**Electrofish**		**Seine**	**Hoop Net**	**Electrofish**	
Target	All	SMB	FCF	Age-0	All	LMB	SMB	All	CCF	SMB	SMB
Effort	12 net nights	50 min	121 min	120 min	8 hauls	70 min	80 min	18 hauls	100 net nights	58 min	60 min

Lewis and Clark Lake

Experimental multifilament gill nets were used to sample Lewis and Clark Lake on September 22 and 23, 2009. 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).

A bag seine was used to target age-0 fishes and adult prey species (e.g., shiner spp., cyprinid spp.) in Lewis and Clark Lake. Seine dimensions were 30.5 m long by 2.4 m deep and composed of 6.4-mm bar measure nylon mesh, with bag dimensions of 1.8 m by 1.8 m. The quarter-arc haul method was used as described by Hayes et al. (1996). Seine collections took place between July 20 and 21, 2009. Two seine hauls were made at each of the following sites: Sand Creek (RM 828), Charlie Creek (RM 825), Bon Homme colony (RM 822), and Gavins Point (RM 815). All fish collected were identified and enumerated.

Smallmouth bass were sampled by nighttime electrofishing near Gavins Point Dam on May 21, 2009, 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 50 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 23 and 30, 2009, 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 seven runs totaling 121 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).

Fall night electrofishing was initiated in 2008 at twelve randomly chosen locations as a new method to index age-0 walleye and sauger recruitment in the reservoir. These sites were resampled October 6, 2009 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 10 minutes at each site. Collected fish were identified and measured.

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 21, 2009. 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). One to five hauls were made at six sites throughout the Niobrara River delta (18 total hauls). All fish collected were identified and counted.

Smallmouth bass were sampled by daytime electrofishing from the Gavins Point Dam tailwater area on May 20, 2009, 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 58 minutes. All smallmouth bass were measured for total length (mm), and weight (g), and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Smallmouth bass were collected by night electrofishing from the Fort Randall Dam tailwater area on October 12, 2009, 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 daytime electrofishing in the Running Water area of the Niobrara delta, Missouri River, near Springfield, South Dakota on May 19, 2009, 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 80 minutes. Smallmouth bass were measured for total length (mm), and weight (g), and scales were collected from below the lateral line near the distal end of the pectoral fin for age analysis (DeVries and Frie 1996).

Largemouth bass were collected by daytime electrofishing near Springfield, South Dakota on May 18, 2009, 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 19 and 21, 2009. Twenty-five nets were baited with cheese and remained in the water for two consecutive nights. Hoop net diameter and mesh size varied. Nineteen nets had a diameter of 508 mm with two different mesh sizes; 25 mm (N=10) and 38 mm (N=9). Six other nets had larger diameters ranging from 891-960 mm and mesh sizes ranging from 19-32 mm. Nets were reset and remained in the water for two additional nights for a total of 100 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 size distribution (PSD; Anderson 1980; Gablehouse 1984; Guy et al 2007). Species specific length categories are listed in Table 2.

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

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

Condition was assessed through relative weight calculations by dividing the weight of a fish by a length-specific standard weight for that species (Wege and Anderson 1978). Standard weight equations used for walleye (Murphy et al. 1990), sauger (Guy et al.

1990), smallmouth bass (Kolander et al 1993), largemouth bass (Henson 1991) channel catfish (Brown et al. 1995), and flathead catfish (Bister et al. 2000) are listed in Appendix 2.

Age and growth information was obtained from otoliths, scales, and pectoral fin rays (DeVries and Frie 1996). Aging structures were removed from all walleye, sauger, channel catfish, flathead catfish, largemouth bass, and smallmouth bass and ages were estimated based on enumeration of annuli. Age distributions were developed for the entire sample (i.e., fish without estimated ages were assigned an age with an age-length key). Scale ages were determined by counting 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), allowed to dry and were then cracked through the focus. One otolith from each fish was sanded with a precision rotary tool using the rotating disc sander attachment to clarify annuli and subsequently viewed under a microscope. Pectoral spines were allowed to dry, then sectioned using a low speed diamond blade saw and viewed under a microscope (Sneed 1951; Ashley and Garling 1980). Back-calculated lengths were also estimated for channel and flathead catfish aged with pectoral fin rays. Age distributions were generated with 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.

Angler Use and Harvest Surveys

An angler use and harvest survey was conducted on the Missouri River from the Fort Randall Dam tailwaters, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border. This survey was conducted in collaboration with the Nebraska Game and Parks Commission. South Dakota Game, Fish and Parks conducted surveys on zones 1 - Fort Randall Dam tailwaters, 2 - the upper Missouri River, 4 - Gavins Point Dam tailwaters, and 5 - the lower Missouri River (Figure 1). Nebraska conducted the survey on zone 3 - Lewis and Clark Lake (Figure 1). A random, stratified roving creel survey design was used to gather data from anglers (Malvestuto, 1996). Data collection was conducted throughout the daylight hours. Due to manpower constraints, five 8-h workdays were sampled each week for South Dakota surveys. At an absolute minimum, each zone was scheduled for at least two weekend/holiday and two weekday shifts each month. When the opportunity presented itself, more sampling was randomly scheduled, at times providing three weekdays and/or three weekend shifts sampled in a month for

certain zones. Nebraska GPC surveyed Lewis and Clark Lake 15 days/month, including 10 weekdays and five weekend days, randomly selected.

Instantaneous pressure counts were conducted with vehicles in zones 1, 2, 3 and 4, and by airplane in zone 5. Pressure counts were made on the same day that interviews were obtained (flights were occasionally cancelled due to weather and rescheduled on randomly selected days). One count per day was scheduled (random time) for zones 2, 3 and 5. Counts in zone 5 (actual number of boats and anglers) were done from a plane because of the large geographic area and long distance between boat ramps. Counts in zones 2 and 3 (number of trailers at each boat ramp and number of visible shore anglers) took ~0.75 h and ~2.0 h, respectively. Counts (actual number of boats and anglers) in the tailrace zones (1 and 4) were every two hours, randomly starting either at shift start time or one hour after start time.

Data collected from angler interviews and pressure counts for each zone were entered and analyzed using the Creel Application Software (CAS) package (Soupir and Brown 2002). Estimates of angler hours, mean party size, mean trip length; catch, harvest, and release by species; and catch, harvest, and release rates by species were computed for each zone. Estimates from each zone were summed to determine the total catch, harvest, and release by species, and the total fishing pressure for the entire surveyed reach.

RESULTS AND DISCUSSION

Lewis and Clark Lake

Seines

Nineteen species were sampled in 2009. Catch per unit effort, or number of fish per seine haul was above the long-term average for the first time since 2001 (Figure 2). This can be attributed to high catches of age-0 gizzard shad at select sampling locations. Emerald shiner CPUE also increased from 6.8 in 2008 to a more typical catch rate of 85.6 per seine haul (Table 3). Age-0 gizzard shad and emerald shiners were the most common species. A notable change from 2008 was the increase in age-0 white bass CPUE from 4.6 to 59.6 per seine haul, this can also be attributed to high catches at select locations. CPUE of walleye was 1.5 per seine haul, unchanged from 2008. One central stoneroller and two common shiners were collected with seines in Lewis and Clark Lake in 2009, two species that are not commonly sampled in the reservoir. Otherwise, species composition and abundance was relatively similar to the 2008 sample.

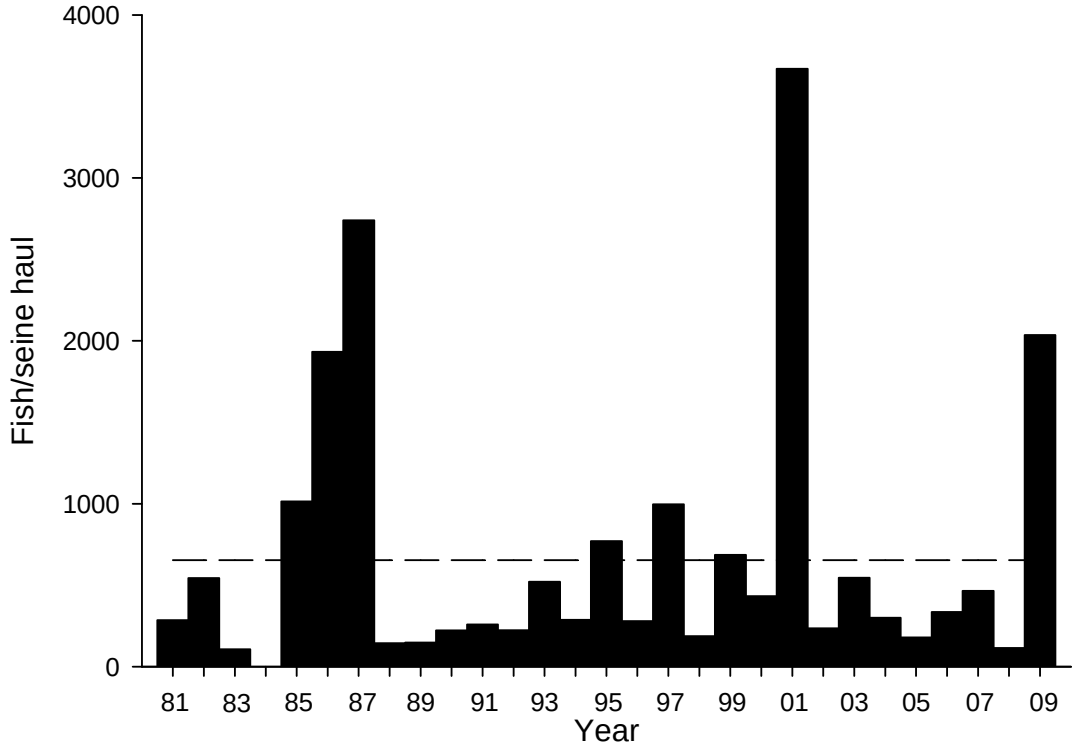

Figure 2. Mean number of fish captured per seine haul from Lewis and Clark Lake, South Dakota, 1981-2009. Dotted line represents long-term mean catch per haul.

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

Newly formed delta habitats have been shown to affect fish habitat utilization (Graeb 2006) and species richness and diversity. Kaemingk et al. (2007) showed species richness was greater in the Niobrara River delta (N=37 species) compared to Lewis and Clark Lake (N=23). Thirteen species were found exclusively in the delta area, while no species were found exclusively in the reservoir area. These findings, along with decreases in species richness since dam closure due to the absence of certain species 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 darters, redhorse species, 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 2004-2009, including age-0 and adults. Standard error (SE) is included 2004-2009. *total number sampled.

Species	1956*	2004	2005	2006	2007	2008	2009
Bigmouth buffalo	91	--	--	--	0.1 (0.1)	0.1 (0.1)	--
Black bullhead	4	--	--	--	--	--	--
Black crappie	191	--	--	--	0.1 (0.1)	--	0.1 (0.1)
Bluegill	15	0.9 (0.3)	--	1.1 (1.0)	0.9 (0.4)	--	1.6 (1.6)
Bluntnose minnow	--	--	0.9 (0.6)	--	--	--	--
Central stoneroller	--	--	--	--	--	--	0.1 (0.1)
Channel catfish	1	--	--	--	0.4 (0.3)	--	0.3 (0.2)
Common carp	1951	--	--	--	0.1 (0.1)	0.3 (0.3)	--
Common shiner	--	--	--	--	--	--	0.3 (0.3)
Creek chub	--	0.9 (0.9)	--	--	--	--	--
Emerald shiner*	34	206.8 (64)	65.4 (15.5)	91.9 (39.9)	374.5 (237)	6.8 (0.8)	85.6 (47.8)
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)	1.1 (0.7)
Gizzard shad	132	10.6 (6.9)	93.3 (29.5)	200.3 (103.0)	74.0 (37.5)	69.4 (9.0)	1876.5 (1873.2)
Green sunfish	1	--	--	--	--	--	--
Hybopsis sp.	--	0.9 (0.7)	--	--	--	--	--
Johnny darter*	--	4.1 (3.3)	1.8 (1.2)	0.8 (0.4)	0.5 (0.4)	1.3 (1.1)	2.3 (2.0)
Largemouth bass	63	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)	1.0 (1.0)
Redfin shiner	48	--	--	--	--	--	--
River carpsucker	575	0.4 (0.2)	--	0.1 (0.1)	0.3 (0.3)	0.3 (0.3)	0.3 (0.2)
Sauger	21	0.6 (0.4)	0.1 (0.1)	0.1 (0.1)	--	--	0.4 (0.2)
Shorthead redhorse	33	0.1 (0.1)	--	--	1.5 (0.8)	0.8 (0.4)	1.0 (0.8)
Shortnose gar	9	--	--	--	0.5 (0.5)	--	0.1 (0.1)
Silverstripe shiner	4	--	--	--	--	--	--
Smallmouth bass	--	2.5 (0.9)	1.0 (0.3)	4.3 (1.2)	1.0 (0.7)	0.1 (0.1)	1.0 (0.5)
Smallmouth buffalo	164	--	--	--	--	--	--
Spotfin shiner*	--	2.4 (1.2)	3.5 (2.0)	0.1 (0.1)	--	1.3 (1.3)	1.9 (1.5)
Spottail shiner*	--	19.3 (13.7)	1.1 (0.7)	2.0 (1.2)	--	1.8 (0.8)	0.6 (0.2)
Walleye	--	1.5 (0.7)	0.8 (0.4)	0.8 (0.4)	0.3 (0.2)	1.5 (1.1)	1.5 (0.4)
Western silvery	1843	--	--	--	--	--	--
White bass	--	40.1 (18.9)	5.9 (2.3)	25.4 (9.6)	11.6 (9.2)	4.6 (1.7)	59.6 (44.1)
White crappie	196	--	--	--	0.3 (0.2)	--	--
Yellow perch	92	3.4 (2.5)	0.1 (0.1)	--	1.9 (1.7)	--	--

Gill Nets

Twelve species were captured with gill nets in 2009, down from fifteen species in 2008 (Table 4). Walleye were the most abundant species sampled in gill nets representing 31 percent of the total fish captured (Figure 3). Sauger, freshwater drum, and channel catfish were the second, third, and fourth most abundant species sampled, respectively. Most species showed slight decreases in abundance since the 2008 sample, except for freshwater drum whose CPUE increased from 3.6 per net night in 2008, to 6.4 fish per net night in 2009 (Table 4). Although walleye CPUE fell from 14.0 in 2008 to 10.7 in 2009, this is still a high relative abundance compared to previous years, and nearly double the 25-year average (Table 4).

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 17 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 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 impoundment and reservoir formation. Delta development 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, 2003-2009. Standard error (SE) is included (no standard errors are listed for 1956 sampling).

Species	1956	1983	2003	2004	2005	2006	2007	2008	2009
Bigmouth buffalo	8.2	--	--	0.1 (0.1)	--	--	--	0.2 (0.2)	0.1 (0.1)
Black bullhead	0.1	--	--	--	--	--	--	--	--
Black crappie	--	--	--	--	--	--	0.3 (0.2)	--	--
Blue catfish	0.1	--	--	--	--	--	--	--	--
Blue sucker	0.3	--	--	--	--	--	--	--	--
Channel catfish	5.8	3.0 (1.3)	2.4 (0.5)	2.6 (0.6)	7.0 (2.2)	2.5 (0.6)	8.2 (2.0)	5.5 (2.2)	4.3 (1.2)
Common carp	25.6	0.8 (0.3)	0.2 (0.1)	0.3 (0.1)	1.1 (0.3)	0.1 (0.1)	0.8 (0.2)	0.7 (0.4)	0.7 (0.3)
Emerald shiner	--	--	--	0.2 (0.1)	--	--	--	--	--
Flathead catfish	--	--	--	--	--	0.1 (0.1)	--	--	--
Freshwater drum	0.8	9.5 (5.3)	5.9 (1.3)	4.5 (1.1)	3.0 (0.8)	5.5 (1.5)	4.2 (1.0)	3.6 (1.1)	6.4 (1.5)
Gizzard shad	2.8	24.4 (23.1)	2.1 (0.7)	3.3 (1.1)	10.6 (5.7)	1.3 (0.9)	3.8 (1.2)	11.9 (6.3)	1.8 (0.8)
Goldeye	3.1	--	--	--	0.2(0.1)	--	--	--	--
Paddlefish	--	--	--	--	--	--	--	0.3 (0.1)	--
Pallid sturgeon	--	--	0.1 (0.1)	--	--	--	--	--	--
River carpsucker	3.1	3.0 (2.5)	0.3 (0.2)	1.8 (0.6)	0.3 (0.1)	1.4 (0.7)	1.1 (0.5)	2.2 (1.2)	0.4 (0.2)
Rock bass	--	--	--	--	--	0.1 (0.1)	--	--	--
Sauger	0.9	14.9 (1.4)	8.0 (1.7)	4.5 (0.8)	4.7 (1.2)	4.7 (0.7)	6.4 (1.8)	9.6 (2.1)	8.3 (1.4)
Shorthead redhorse	1.0	--	0.5 (0.3)	0.3 (0.2)	2.3 (0.9)	0.8 (0.4)	1.6 (0.7)	2.3 (0.8)	1.3 (0.5)
Shortnose gar	1.7	--	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	3.3	--	--	--	--	--	--	--	--
Smallmouth buffalo	0.5	--	0.1 (0.1)	0.1 (0.1)	--	0.1 (0.1)	0.2 (0.1)	0.1 (0.1)	0.1 (0.1)
Spottail shiner	--	--	0.1 (0.1)	--	--	0.1 (0.1)	--	--	--
Walleye	--	13.1 (1.8)	10.6 (1.0)	4.3 (0.9)	9.1 (2.4)	4.5 (0.6)	9 (2.1)	14.0 (3.3)	10.7 (1.7)
White bass	--	0.1 (0.1)	0.2 (0.1)	0.2 (0.1)	--	0.1 (0.1)	--	2.3 (0.8)	0.3 (0.2)
White crappie	0.6	1.9 (1.7)	0.9 (0.6)	0.1 (0.1)	--	0.2 (0.1)	0.1 (0.1)	0.3 (0.1)	0.4 (0.3)
Yellow perch	0.3	0.2 (0.1)	0.1 (0.1)	--	--	--	--	0.1 (0.1)	--

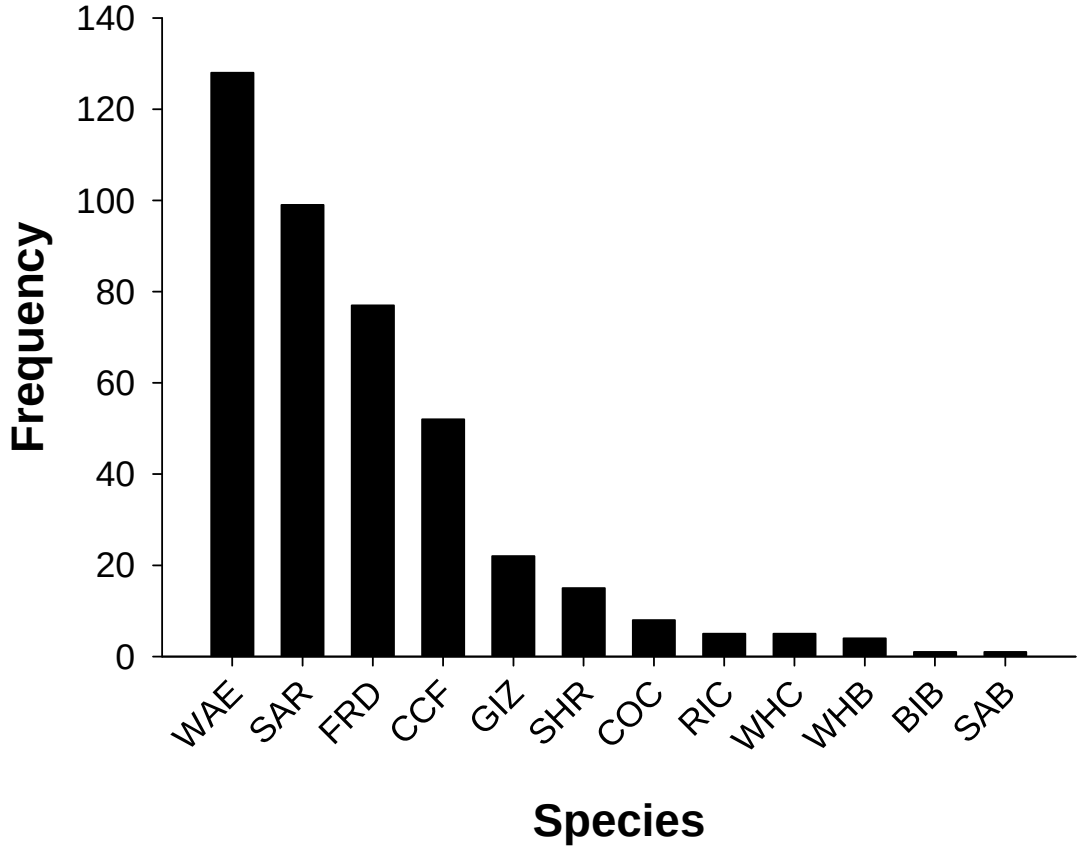

Figure 3. Number of each species collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2009. Abbreviations used are defined in Appendix 1.

Walleye population parameters

A total of 128 walleye were sampled during the standard September gill net survey resulting in a CPUE of 10.7 walleye per gill net (Table 4). Relative abundance (gill net CPUE) has fluctuated over the past 20 years but overall has undergone an increasing trend. Although CPUE fell slightly from 2008, the 2009 sample was still one of the highest CPUE in recent years. CPUE of harvestable size walleye (381 mm or 15 inches) was 5.3, indicating that about half of the walleye population is available for angler harvest, similar to last year (Table 5, Figure 4).

Walleye size structure is quantified with proportional size distribution (PSD; Anderson 1980; Gablehouse 1984; Guy et al 2007). Walleye PSD was 54, and within the desired range of 30 – 60 (Anderson and Weithman 1978), and PSD-P met the objective of 10 (Table 6).

Lewis and Clark Lake walleye 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. Mean relative weights for all size classes were reduced from 2008 but were comparable to previous years (Table 9).

Walleye recruitment in Lewis and Clark Lake is currently indexed with gill net CPUE of age-0 walleye. In 2009, only four age-0 walleye were sampled (CPUE = 0.3), indicating a small year class was produced. Lott et al. (2006) suggested that age-0 CPUE could be used as an indicator of year class strength because correlation analysis of age-0 CPUE and age-1 CPUE during the following year provided a strong correlation ($r = 0.8$, $p < 0.01$). This relationship in Lewis and Clark Lake is not as strong ($r = 0.56$, $p < 0.01$), but provides a rough index to recruitment. Fall night electrofishing was instituted in 2008 and continued in 2009 at 12 randomly selected sites in the lake portion of the reservoir to provide another 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. CPUE of age-0 walleye collected by night electrofishing dropped from 76.5/hour in 2008 to 24.5/hour in 2009. This could be related to cooler water temperatures and less than ideal sampling conditions, but it also suggests that 2009 produced a below average year class of walleye.

Mean age of walleye sampled in 2009 (2.5) was down for the fourth consecutive year. Strong year classes were formed in 2007 and 2008 and have contributed to the decrease in mean age. Despite this decrease in mean age, all age classes out to age-7 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, 2002-2009. Standard error (SE) is included in parenthesis.

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

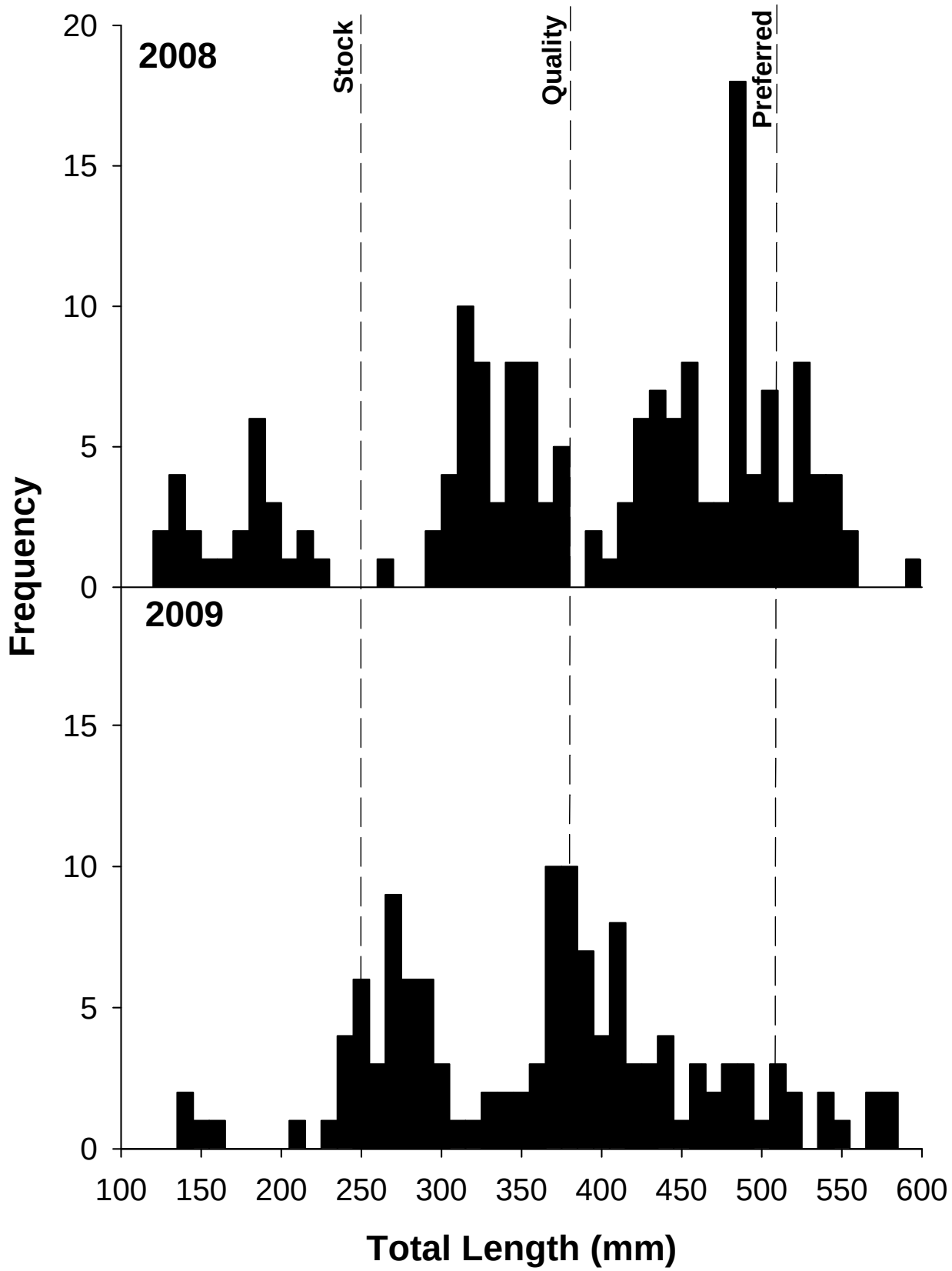

Figure 4. Length frequency of walleye collected during the standard gill net survey on Lewis and Clark Lake, South Dakota, 2008 and 2009.

Table 6. Walleye proportional size distribution (PSD) and proportional size distribution of preferred and memorable-length fish (PSD-P and PSD-M) collected in standard gill net surveys, Lewis and Clark Lake, South Dakota, 2002-2009.

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

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 2006-2009, 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	--
Mean of means		163	318	411	455	497	509	492	513	520	528	525	510	543

Table 8. Mean annual growth increments for walleye collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2006-2009.

Year	Growth increment added during period (mm)							
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**
2006-2007	195	99	71	69	43	1	32	--
2007-2008	150	89	74	21	21	--	--	15
2008-2009	107	64	--	22	6	--	54	--
Mean	151	84	73	37	23	1	43	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, 2002-2009. Sample size (N) and standard error (SE) are also presented.

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

Table 10. Age distribution of walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009, as determined from scales (2002 – 2005) and otoliths (2006 – 2009). Mean age excludes age-0 fish.

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

Table 11. Catch curve estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (-Z) for walleye collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009. Age range is the range of ages used to calculate catch curve statistics. Scales (2002-2006) and otoliths (2006-2009) were used to estimate ages.

Years	S	A	-Z	R^2	Age range
2002-2003	0.45	0.55	0.807	0.85	2-5
2003-2004	0.44	0.56	0.818	0.98	2-5
2004-2005	0.37	0.63	0.982	0.84	3-5
2005-2006	0.48	0.52	0.737	0.94	3-6
2006-2007	0.54	0.46	0.614	0.99	3-5
2007-2008	0.52	0.49	0.663	0.91	3-6
2008-2009	0.55	0.46	0.606	0.98	2-6
2002-2009	0.55	0.45	0.599	0.98	2-9

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 2009, 99 sauger were sampled during the gill net survey with a CPUE of 8.3 fish/net night (Table 4). Mean gill net CPUE for sauger 381-mm (15 inches) and longer decreased slightly from 2008 to 2.4 fish/net night, but is still comparable to catches from recent years (Table 5).

Sauger PSD (61) and PSD-P (36) were reduced in 2009, compared to 93 and 51, respectively, during the 2008 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 sampled age-0 sauger are under stock length, while age-1 sauger are predominately greater than quality length. This happened in 2008 causing the stock-to-quality length category to be relatively void of fish, resulting in high PSDs. In 2009 a large number of fish fell in the stock-to quality length category which drove the PSD down (Figure 5).

Sauger generally grow slower than walleye (Malison et al. 1990); however, growth rates of Lewis and Clark Lake sauger are typically similar to walleye growth rates (Table 13, Table 14). Sauger growth in 2009 was below normal, with only single digit growth occurring in older year classes (Table 14). This reduced growth could be related to a small sample size, as the estimated growth increments for fish age 2-3 and 3-4 were based on seven and three fish, respectively (Table 13).

Sauger relative weights for Lewis and Clark Lake are generally between 77 and 85 (Table 15). In 2009, sauger relative weights were within this range for all size groups indicating sufficient prey availability. Wickstrom (2006) suggested that diet overlap with walleye combined with insufficient quantity and quality of prey items could be a possible explanation for moderate relative weights of sauger in Lewis and Clark Lake during most years.

Similar to walleye, sauger recruitment is indexed with age-0 CPUE from the September gill net survey. In 2009, age-0 CPUE was 1.3, indicating low to moderate recruitment, less than 2008 (CPUE = 2.5) which formed a strong year class of age-1 sauger (CPUE = 3.1) in 2009 (Table 16). Fall night electrofishing showed an even greater decrease in age-0 CPUE from 34.5/hour in 2008 to 3.5/hour in 2009. However, CPUE from fall night electrofishing should only be used as a crude index to abundance (Hansen et al. 2004). Mean age of sauger (2.0 years) fell slightly from previous years. Age-1 sauger were the most prevalent sampled age class in 2009 comprising 45% of the total sample, excluding age-0 fish.

Annual survival for 2008-2009 pooled sauger data was 51% (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 2002-2009 pooled catch curve provided an estimated survival of 53%, 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, leading to listing as a ‘species of concern’ in some areas (McMahon and Gardner 2001; Pegg et al. 1996). The sauger population in Lewis and Clark Lake appears to be one of the most stable in their range. Niobrara River delta habitat is expanding annually, increasing the amount of habitat resembling the pre-dam Missouri River with increases in channel braiding, backwater area and turbidity. This expanding habitat should help enhance the current sauger population in Lewis and Clark Lake. However, the loss of pure sauger from this stretch of Missouri River due to high levels of natural hybridization with walleye (Graeb 2006) could greatly impact this sauger fishery.

Table 12. Sauger proportional size distribution (PSD) and proportional size distribution for preferred and memorable-length fish (PSD-P and PSD-M) collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009.

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

Table 13. Mean length at age of capture, as determined by ages estimated from otolith analysis, for sauger collected in the standard September gill net survey 2006-2009, Lewis and Clark Lake, South Dakota. Sample size (N) and standard error (SE) are also presented.

		Length at age of capture (mm)											
Year		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2006	**Mean**	--	315	378	426	479	478	481	443	--	--	--	--
	N	0	15	25	2	8	3	1	1	--	--	--	--
	SE	--	4.6	4.0	32.0	10.4	20.6	--	--	--	--	--	--
2007	**Mean**	198	313	402	432	500	--	480	--	--	--	--	--
	N	33	8	17	16	2	0	1	--	--	--	--	--
	SE	3.0	7.3	3.7	7.8	5.0	--	--	--	--	--	--	--
2008	**Mean**	174	336	437	463	482	502	496	490	--	--	--	466
	N	30	40	12	12	10	4	2	3	0	0	0	1
	SE	2.7	12.7	26.1	69	97.6	174	325	41.8	--	--	--	--
2009	**Mean**	145	277	380	441	469	444	482	470	490	--	--	--
	N	16	37	31	7	3	1	2	1	1	--	--	--
	SE	2.8	3.3	5.0	14.8	30.9	--	54.0	--	--	--	--	--
Mean of means		172	310	399	441	483	475	485	468	490	--	--	466

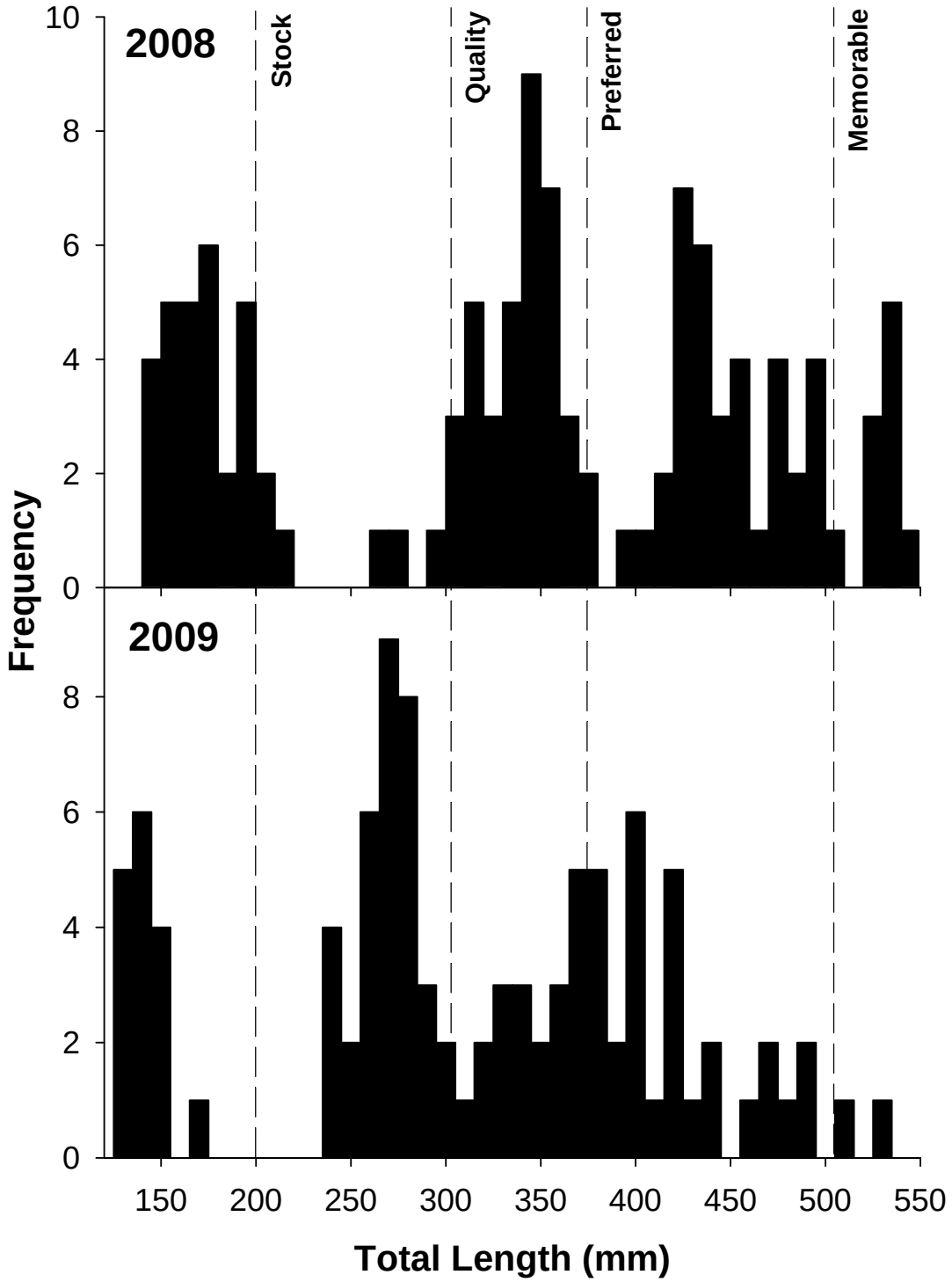

Figure 5. Length frequency of sauger collected during the standard gill net surveys from Lewis and Clark Lake, South Dakota, 2008 and 2009.

Table 14. Mean annual growth increments for sauger collected in the standard September gill net survey, Lewis and Clark Lake, South Dakota, for 2006-2009.

Year	Growth increment added during period (mm)							
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**
2006-2007	--	87	54	74	--	2	--	
2007-2008	138	125	61	50	2	--	10	
2008-2009	103	44	4	6	--	--	--	
Mean	121	85.3	39.7	43.3	2	2	10	--

Table 15. Mean relative weight of sauger, by length categories, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

Table 16. Age distribution of sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009. Scales (2002-2005) and otoliths (2006-2009) were used to estimate ages. Mean age excludes age-0 fish.

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

Table 17. Catch curve estimates of annual survival (S), annual mortality (A), and instantaneous mortality rates (-Z) for sauger collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009. Age range is the range of ages used to calculate catch curve statistics. Scales (2002-2006) and otoliths (2006-2009) were used to estimate ages.

Years	S	A	-Z	R^2	Age range
2002-2003	0.71	0.29	0.342	0.83	2-5
2003-2004	0.47	0.53	0.748	0.95	3-5
2004-2005	0.31	0.70	1.188	0.98	3-5
2005-2006	0.58	0.42	0.544	0.88	2-5
2006-2007	0.48	0.52	0.738	0.99	2-4
2007-2008	0.66	0.34	0.419	0.89	1-4
2008-2009	0.51	0.49	0.678	0.98	2-5
2002-2009	0.53	0.47	0.630	0.97	2-7

Channel catfish population parameters

A total of 52 channel catfish were sampled with lengths ranging from 210-769 mm. Mean gill net CPUE for channel catfish decreased from 5.5 fish/net-night in 2008 to 4.3 fish/net night in 2009 (Table 4). However, size structure of sampled fish increased from 2008 to 2009 (Figure 6, Table 18). Channel catfish PSD for the 2009 Gill net sample was 56 and PSD-P was 18 compared with 29 and 8, respectively, during the 2008 sampling. Channel catfish in Lewis and Clark Lake exhibit fast growth compared with the other South Dakota Missouri River Reservoirs. Lewis and Clark channel catfish typically reach 400 mm during their 4th growing season, while Lake Francis Case and Lake Oahe channel catfish reach 400 mm during their 7th

and 8th growing seasons, respectively (Adams et al. 2008; Longhenry 2009). In 2009, mean Wr for quality-preferred length channel catfish was 94 (Table 19), above the normal range of 85 to 90.

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. Previous analyses of the age distribution reveal that most year classes beyond 3 or 4 are present during most years, indicating stable recruitment patterns (Longhenry 2009). Aging structures were not removed from channel catfish sampled with gill nets in 2009, but are scheduled to be collected in 2010.

Table 18. Channel catfish proportional size distribution (PSD) and proportional size distribution for preferred and memorable length fish (PSD-P and PSD-M), collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009.

Year	PSD	PSD-P	PSD-M	Sample Size
2002	70	3	0	39
2003	62	24	7	29
2004	52	0	0	31
2005	64	11	0	84
2006	85	46	8	31
2007	66	16	2	98
2008	29	8	3	66
2009	56	18	8	52

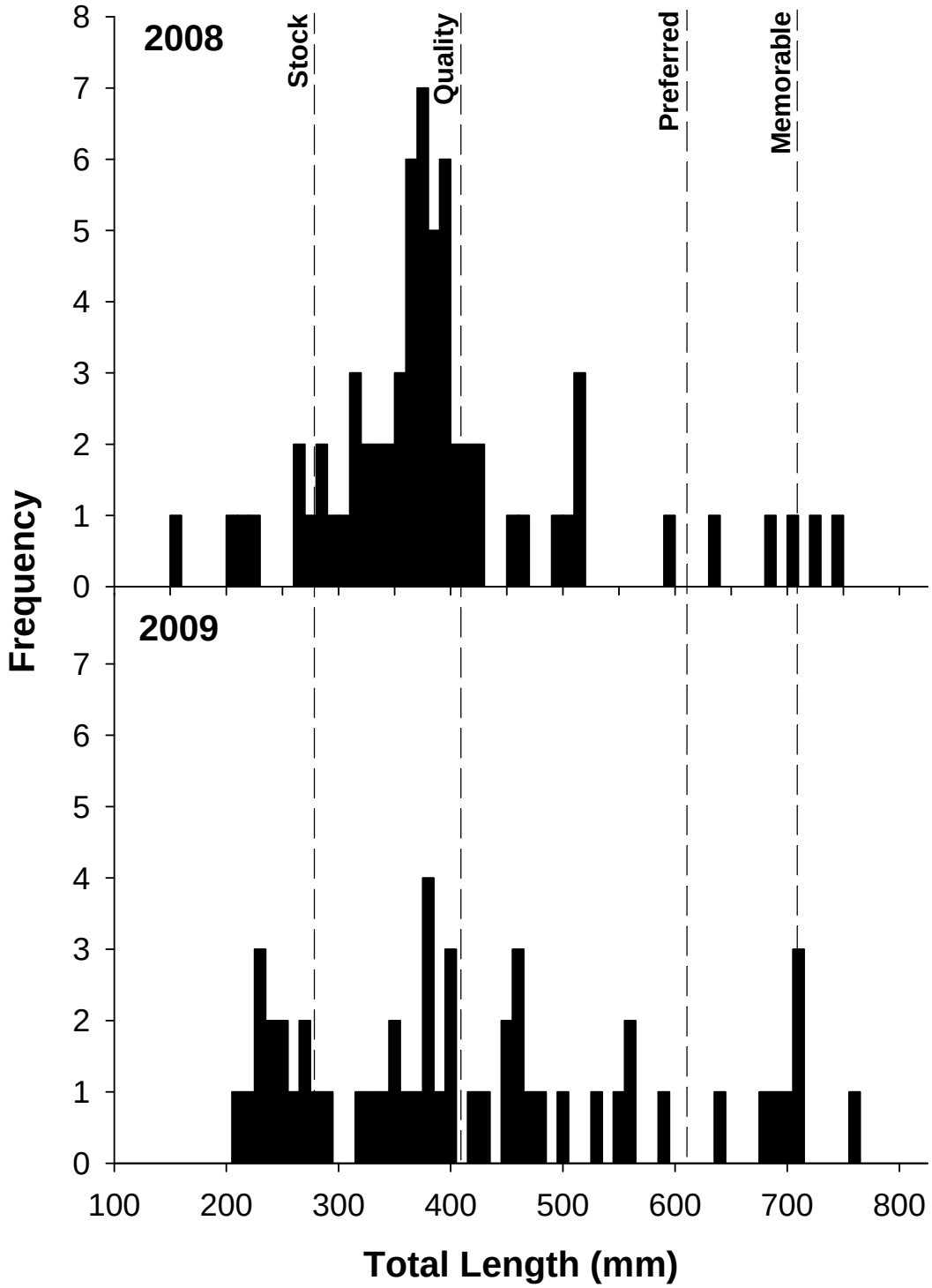

Figure 6. Length frequency for channel catfish collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2008 and 2009.

Table 19. Relative weight of channel catfish, by incremental stock density indices, collected in standard gill net surveys from Lewis and Clark Lake, South Dakota, 2002-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

Electrofishing

Smallmouth bass population parameters

Smallmouth bass CPUE has been highly variable during the past eight years, ranging from 25/h in 2003 to 79/h in 2008 to 43/hr in 2009 (Table 20). Smallmouth bass size structure is known to be underestimated with electrofishing (Beamesderfer and Rieman 1988; Milewski and Willis 1991). Nonetheless, smallmouth bass in 2009 were more evenly distributed across age and size classes than previous years, resulting in a PSD of 39 (Figure 7, Table 20). 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 indicate that over 75% of the smallmouth bass harvested in 2009 were above quality length, and trophy-class fish were also harvested ($\geq$ 510 mm).

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 21, Table 22). Wr of stock-quality smallmouth was high at 97, while Wr of quality-preferred smallmouth was in the normal range at 86.

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, 2002-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

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 2009.

Year class	Age	N	Annulus						
			1	2	3	4	5	6	7
2007	2	13	95	192					
2006	3	16	80	162	256				
2005	4	5	92	181	277	338			
2004	5	1	79	156	252	335	368		
2003	6	1	81	146	277	329	391	401	
2002	7	1	94	215	294	368	393	418	443
Sample mean			87	176	271	343	384	410	443
Standard error			3	10	8	9	8	8	0
Length increment			89	96	71	42	25	33	

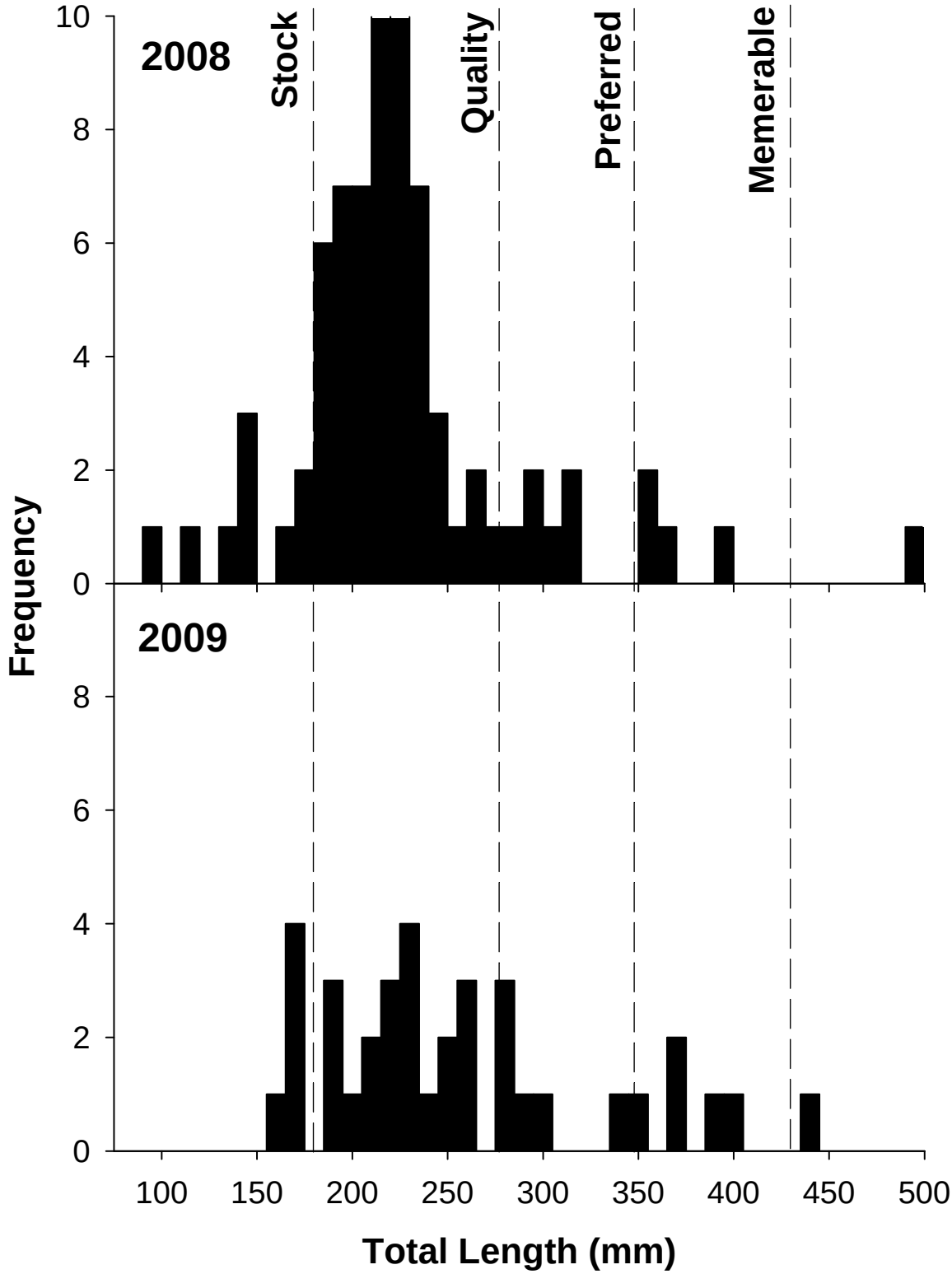

Figure 7. Length frequency for smallmouth bass sampled by nighttime electrofishing near Gavins Point Dam in Lewis and Clark Lake, South Dakota, 2008 and 2009.

Table 22. Age distribution of smallmouth bass collected by electrofishing Lewis and Clark Lake near Gavins Point Dam, 2002-2009, as determined from scales.

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

Flathead catfish population parameters

Low amperage daytime electrofishing along riprap areas in Lewis and Clark Lake collected 56 flathead catfish in 2009 with a CPUE of 25/hour (Table 23). The 2009 survey resulted in lower catch rates than the previous two years. Size structure appeared to improve with the capture of preferred and memorable sized fish. However, 75 percent of the total catch was still smaller than stock length (Figure 8). PSD for the 2009 sample was 64 and PSD-P was 14. Nearly all fish between 350mm and 580mm in length were taken to South Dakota State University for use in a research project, and spines were not collected from these fish. As a result, accurate growth estimates could not be calculated for the population in 2009. Flathead catfish growth in previous years as determined from back-calculating lengths from pectoral spine annuli, was relatively slow, taking five years to surpass stock length (350 mm; Adams 2007, Knecht et al. 2008, Longhenry 2009). Relative weight values for both stock-quality and quality-preferred length fish were both near 90.

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, 2002-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

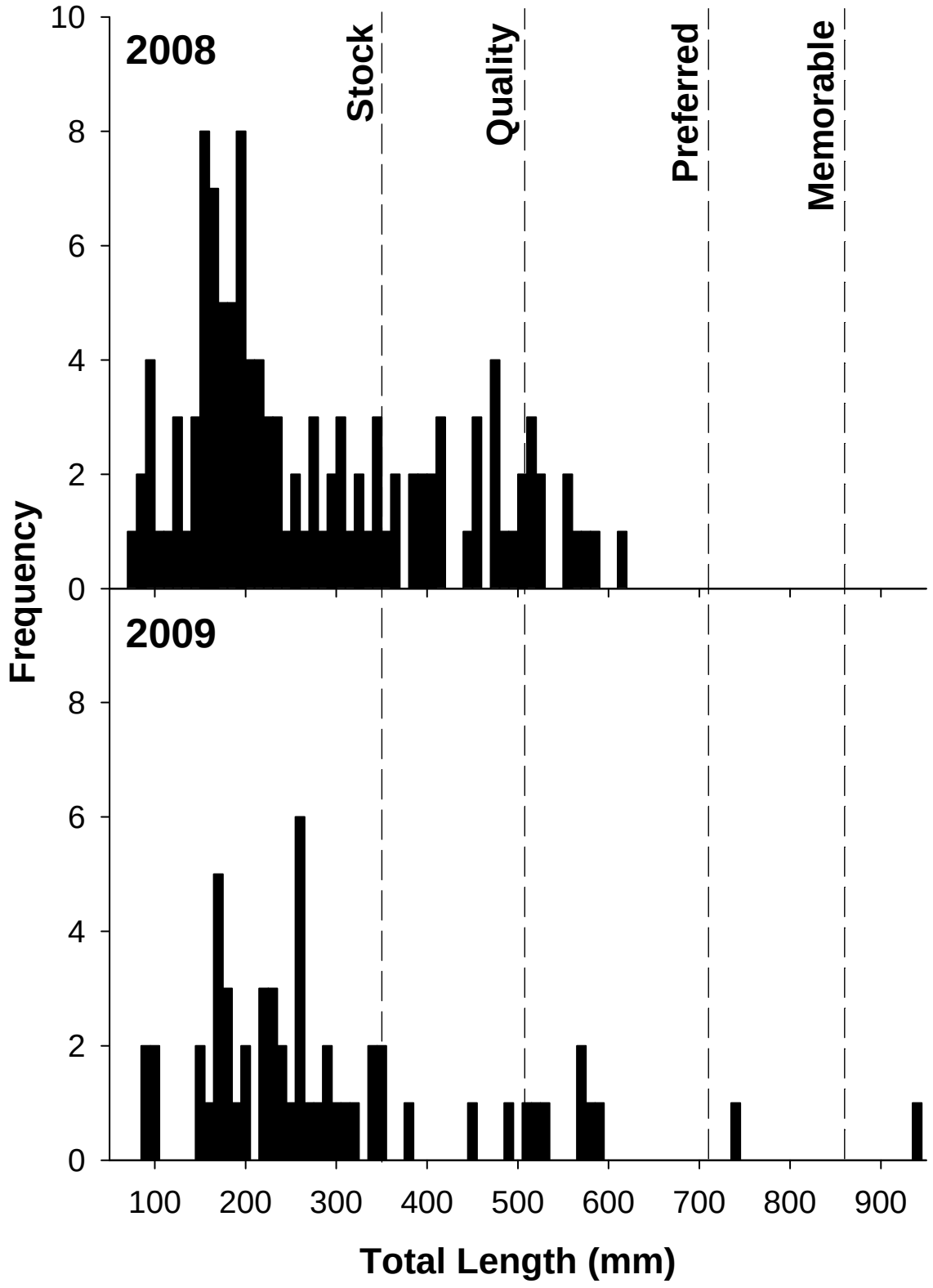

Figure 8. Length frequency of flathead catfish sampled by electrofishing Lewis and Clark Lake during June 2008 and 2009.

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 90 largemouth bass were sampled with a CPUE of 81/h, one of the highest CPUE on record (Table 24). 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 2009 largemouth bass sample had a quality size structure (PSD = 85 and PSD-P = 36), with fish ranging in size from 57-437 mm total length (Figure 9). The growth characteristics of this population (Table 25) is faster than the state average, and is similar to the upper quartile for largemouth bass populations reported by Willis et al. (2001). The age distribution (Table 26) shows a relatively even number of fish in each age class out to 8, however, because of the annual variability in CPUE, few inferences can be made about recruitment patterns.

Table 24. 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, 2003-2009. 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

Table 25. 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 2009. Ages were determined from scales.

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

Table 26. Age distribution of largemouth bass sampled by electrofishing in the Springfield area of the Niobrara Delta, 2003-2009, 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

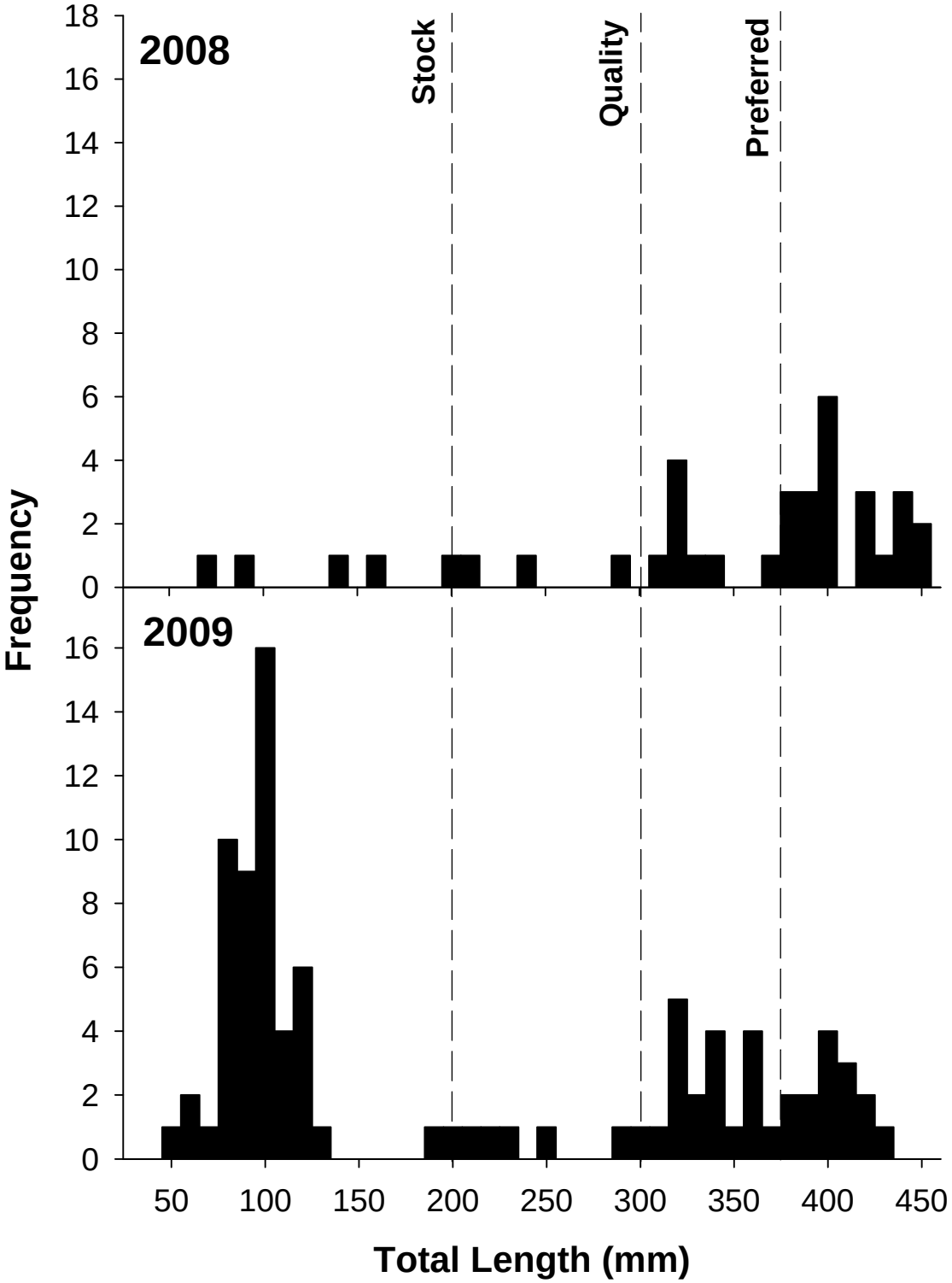

Figure 9. Length frequency of largemouth bass sampled by electrofishing in the Niobrara delta near Springfield, South Dakota during May 2009.

Smallmouth bass population parameters

Niobrara Delta near Running Water

Smallmouth bass have been sampled occasionally in the Niobrara delta area near Springfield, SD. In 2009, preliminary sampling was initiated in an effort to index smallmouth bass in the Running Water area of the delta. A total of 21 smallmouth bass were collected with a CPUE of 16/h. Total lengths ranged from 163-456 mm. PSD (65) was slightly above the management objectives for smallmouth bass due to a lack of age-1 fish in the sample (Table 27). PSD-P was 25, also above management objectives, and PSD-M was 5. Relative weights were calculated for these fish by length category; Wr S-Q 94 (SE 2.1), Wr Q-P 95 (SE 2.1), and Wr P-M 92 (SE1.7). Six age classes were collected in 2009 (Table 27). It is hard to make any assumptions about this population based on such a small sample size. The future success of smallmouth bass surveys in the delta will be dependent on water level fluctuations and access to certain habitats for sampling.

Table 27. Mean back-calculated total lengths (mm) for each age class of smallmouth bass sampled by daytime electrofishing in the Running Water area of the Niobrara delta, May 2009. Ages were determined from scales.

Year class	Age	N	Annulus								
			1	2	3	4	5	6	7	8	9
2007	2	1	86	161							
2006	3	13	87	202	274						
2005	4	2	74	133	228	307					
2004	5	1	80	198	297	354	379				
2003	6	3	88	131	253	337	371	390			
2000	9	1	99	194	283	347	399	415	440	449	456
Sample mean			86	170	267	336	383	403	440	449	456
Standard error			3	13	12	10	8	12	0	0	0
Length increment			84	97	69	47	20	38	9	7	

Gavins Point Dam Tailwaters

A total of 95 smallmouth bass were sampled in the Gavins Point Dam tailwater area with lengths ranging from 91-436 mm (Figure 10). Mean CPUE for smallmouth bass was 97 fish/h; one of the highest on record, and up from 76 fish/h in 2008 (Table 28). Smallmouth bass PSD, PSD-P and PSD-M increased from 2008 to 2009. Relative weights for stock-quality and quality-preferred length smallmouth bass in 2009 were within the normal range for this population (Table 28).

Six age classes (1-6) were sampled in 2009 (Table 29, Table 30), up from three in 2008. There is evidence that larger (older) fish are less susceptible to the sampling methods used, and this could have contributed to their under-representation in the 2008 sample (Beamesderfer and Rieman 1988; Milewski and Willis 1991).

Table 28. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass sampled by spring electrofishing the Missouri River below Gavins Point Dam, 2002-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

Table 29. 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 2009. Ages were determined from scales.

Year class	**Age**	**N**	**Annulus**					
			1	**2**	**3**	**4**	**5**	**6**
2008	1	15	110					
2007	2	49	107	198				
2006	3	23	96	201	281			
2005	4	4	106	225	303	325		
2004	5	3	85	163	259	354	387	
2003	6	1	104	237	335	363	398	433
Sample mean			101	205	295	348	393	433
Standard error			4	13	16	12	5	0
Length increment			104	90	53	45	40	

Table 30. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May, 2002-2009, as determined from scales.

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

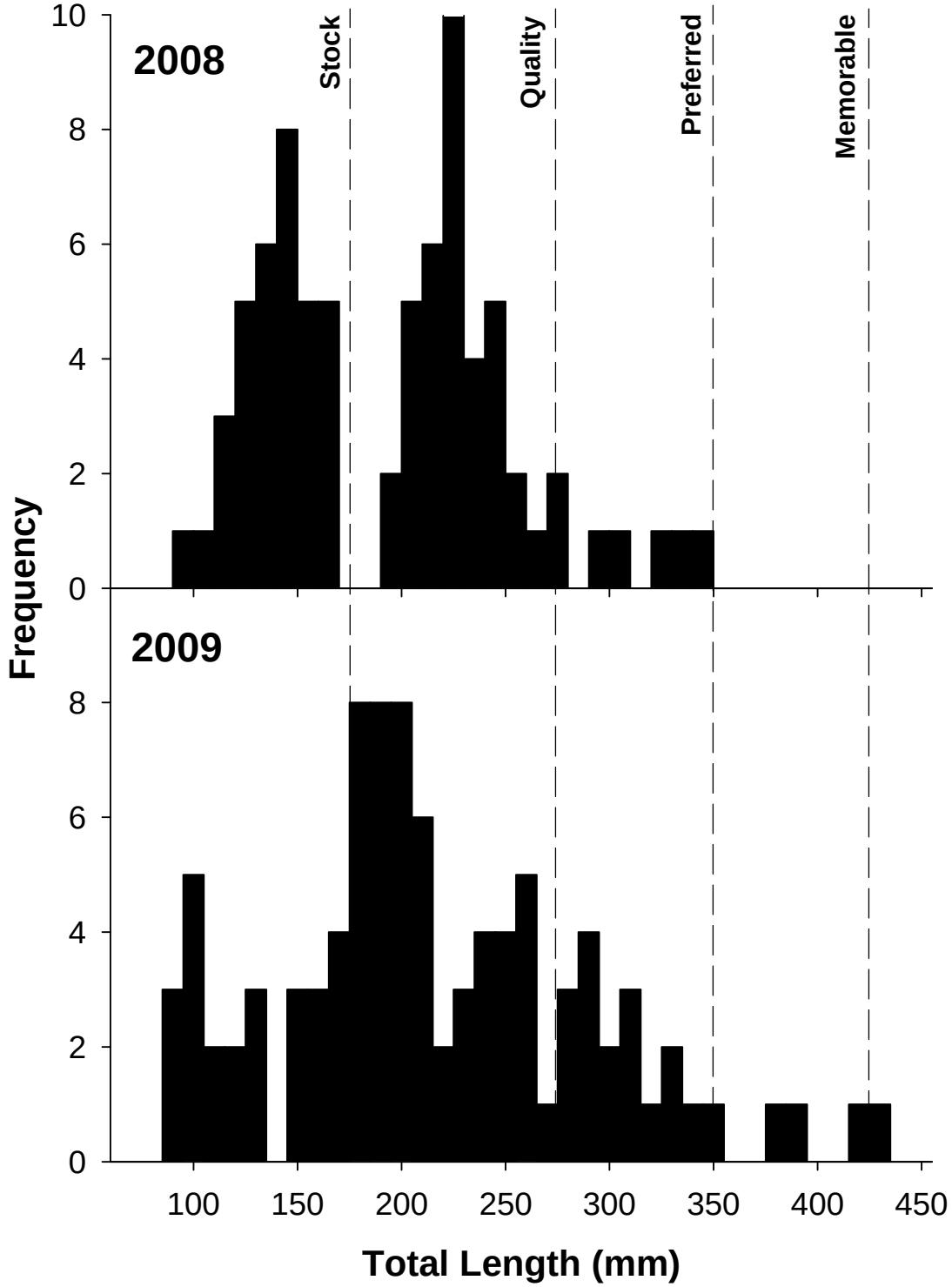

Figure 10. Length frequency of smallmouth bass sampled by electrofishing the Missouri River below Gavins Point Dam in May 2008 and 2009.

Fort Randall Dam Tailwaters

A total of 39 smallmouth bass were sampled during a cumulative 60 minutes of night electrofishing. Lengths ranged from 53 to 333 mm with two thirds of the sample longer than stock length (180 mm) but no fish above preferred length (350 mm; Figure 11). Size structure indices were lower than previous years (Table 31). Growth rates of smallmouth bass in the Fort Randall Tailrace reach (Table 32) 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 102 for the stock-quality size class and 91 for quality-preferred. 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 33). 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 mortality of the population.

Table 31. Catch per unit effort (CPUE), proportional size distribution (PSD), proportional size distribution for preferred and memorable-length fish (PSD-P, PSD-M), and relative weight of stock-quality (S-Q), quality-preferred (Q-P), and preferred-length (P) smallmouth bass sampled by fall nighttime electrofishing the Missouri River below Fort Randall Dam, 2002-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

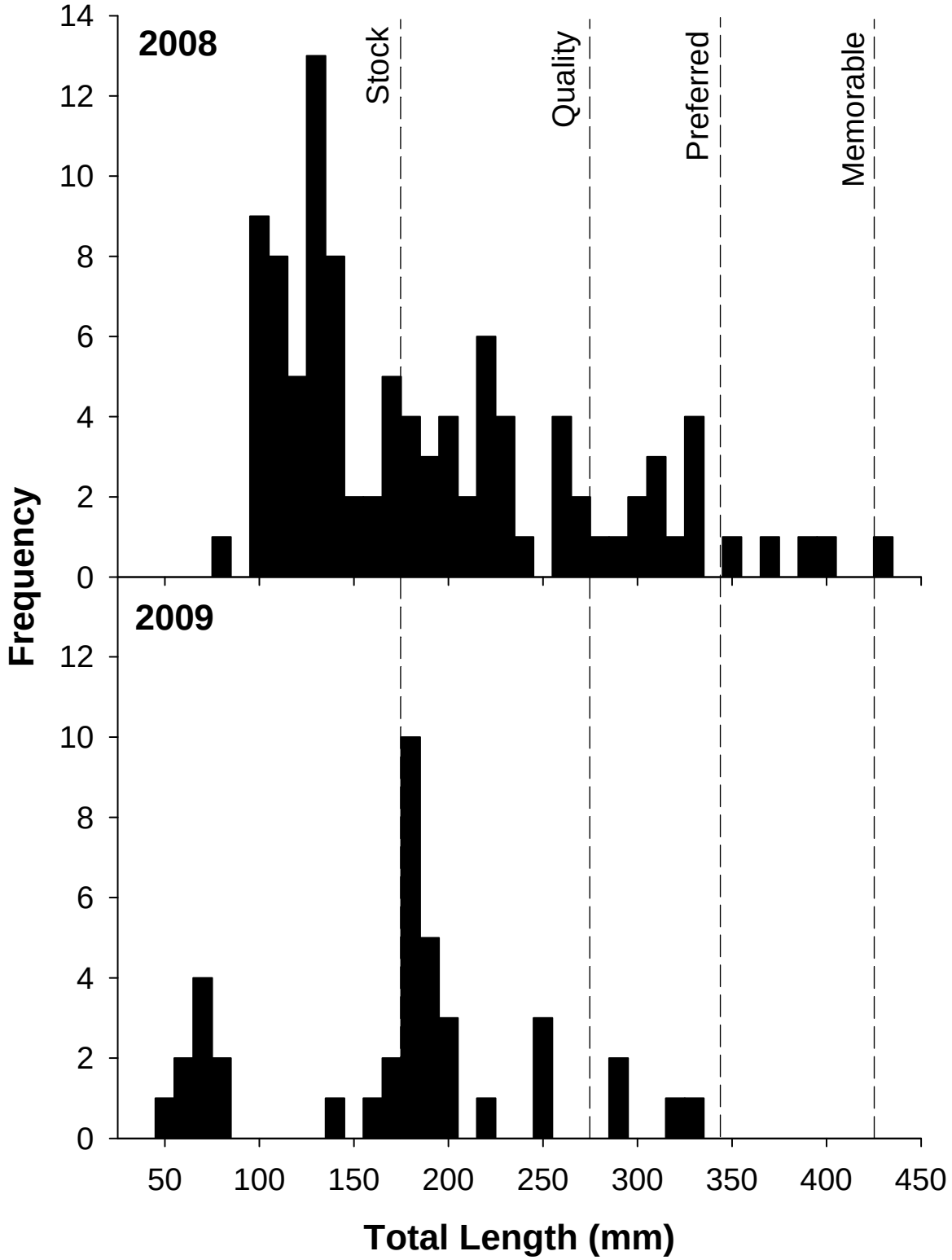

Figure 11. Length frequency of smallmouth bass sampled by nighttime electrofishing the Missouri River below Fort Randall Dam in October 2009.

Table 32. 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 2009. Ages were determined from scales.

Year class	Age	N	Annulus			
			1	2	3	4
2007	2	16	93	181		
2006	3	11	89	143	219	
2005	4	2	88	156	232	291
Sample mean			90	160	226	291
Standard error			1	11	6	0
Length increment			70	65	65	

Table 33. Age distribution of smallmouth bass sampled by electrofishing the Missouri River below Fort Randall Dam, 2002-2009, as determined from scales.

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

Hoop Nets

Channel catfish population parameters

A total of 197 channel catfish were sampled with hoop nets in the Missouri River and Niobrara delta near Springfield, SD in 2009 (Table 34). This was a significant increase in sample size from 2008 (N=17). Sampling effort increased in 2009 to 100 net-nights (Table 35), but increases in sample size and CPUE are likely a result of changes in gear placement, habitat conditions, and access within the delta. The sampled channel catfish population in the Missouri River and Niobrara delta was dominated by smaller fish below stock length (<280 mm). However, fish above quality, preferred, and memorable lengths were also observed (Figure 12; Table 35). All age classes were observed to age six, with a few older fish also sampled (Tables 36, 37).

Table 34. Total annual hoop net catches (CPUE) of channel catfish from the Missouri River and Niobrara delta near Springfield, SD, 2002-2004 and 2006-2009. Standard error (SE) is also included.

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

Table 35. Proportional size distribution (PSD), proportional size distribution for preferred and memorable length fish (PSD-P, PSD-M), and mean relative weight (standard error) for stock-quality (S-Q), quality-preferred (Q-P), and preferred-memorable length (P-M) channel catfish sampled with hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 2002-2004 and 2006-2009. Sample size (N = number of fish in the respective category) and standard error (SE) are also included.

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

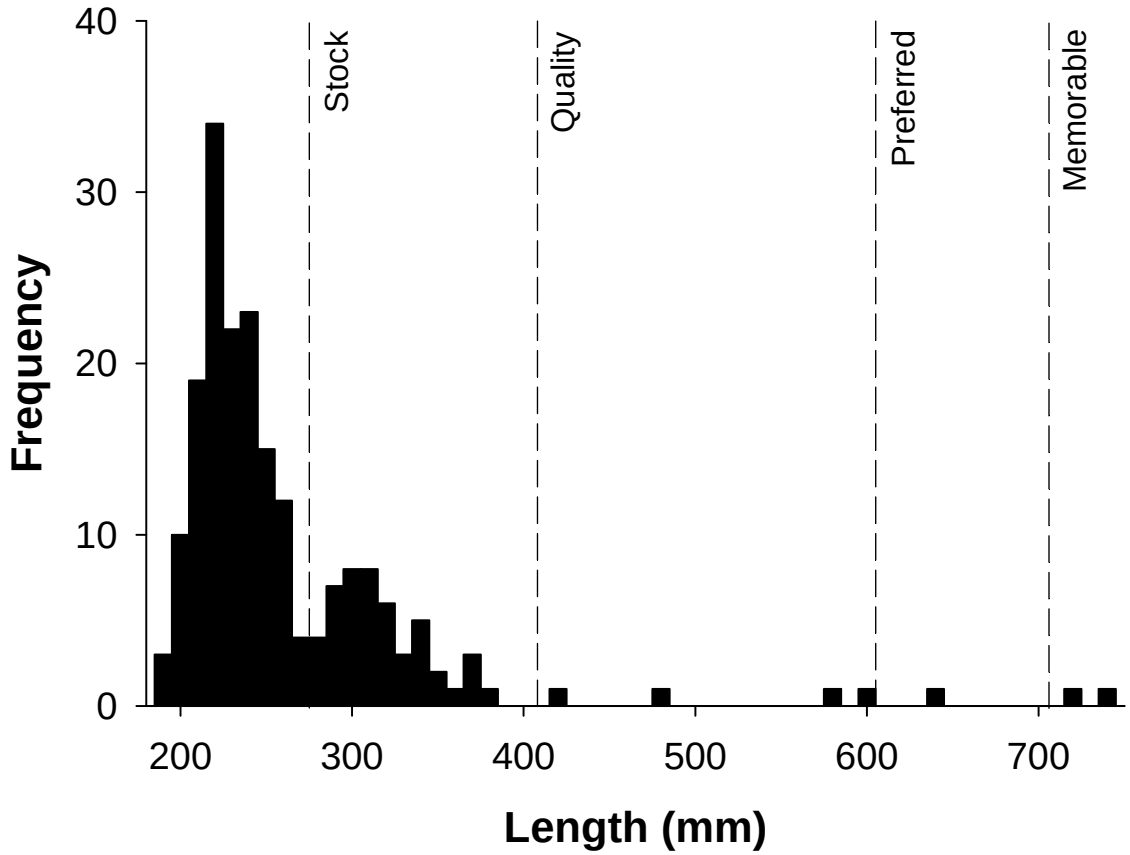

Figure 12. Length frequency for channel catfish collected in hoop nets from the Missouri River and Niobrara delta near Springfield, SD 2009.

Table 36. 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, 2009.

Year class	Age	N	Annulus												
			1	2	3	4	5	6	7	8	9	10	11	12	13
2008	1	26	166												
2007	2	117	84	181											
2006	3	27	96	177	252										
2005	4	18	83	136	221	301									
2004	5	3	98	166	256	332	361								
2003	6	1	75	90	181	206	266	291							
1999	10	3	119	177	261	343	425	477	514	551	592	622			
1998	11	1	118	177	218	294	347	371	412	453	482	517	559		
1996	13	1	95	195	250	320	355	471	486	511	541	556	686	701	721
Sample mean (mm)			104	163	234	299	351	402	470	505	538	565	622	701	721
Standard error			9	12	11	20	25	44	30	28	32	31	64	--	--
Length increment			59	72	65	51	52	68	34	34	27	57	79	20	

Table 37. Age distribution of channel catfish sampled in hoop nets from the Missouri River and Niobrara delta near Springfield, SD, 2002, 2004, and 2006-2009, as determined from pectoral spines.

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

Seines

A total of 10 fish species were captured with seines in the Niobrara delta near Springfield, South Dakota during June, 2009 (Table 38). All species had been previously sampled in the Lewis and Clark reservoir system, although northern pike and grass pickerel had not been collected for several years. The most abundant species was the spotfin shiner, followed by the red 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 2009, high water was a factor and the only place that a seine could successfully be used was on sandbars without vegetation.

Table 38. Catch per unit effort (fish/seine haul) for July seining surveys in the Missouri River near Springfield, South Dakota, 2004-2009, includes both age-0 and adults. Trace (T) indicates a value is less than 0.05. Standard error (SE) is in parenthesis.

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

Angler Use and Sportfish Harvest Survey

Fishing Pressure

The angler use and sportfish harvest survey was divided into five zones along the Missouri River; zone 1, the Fort Randall Dam tailwaters (FRDT), zone 2, the upper Missouri River (UMR) stretching from the FRDT downstream to Bazile Creek, zone 3, Lewis and Clark Lake (L&C), extending from Bazile Creek downstream to Gavins Point Dam, zone 4, the Gavins Point Dam tailwaters (GPDT), and zone 5, the lower Missouri River (LMR) extending from the GPDT downstream to the confluence with the Big Sioux River near the Iowa, Nebraska Border.

Estimated fishing pressure ranged from 29,585 to 127,903 angler hours among zones (Table 39). Anglers spent an estimated 372,382 hours fishing the entire surveyed reach during the April through October, 2009 daylight creel survey period (Table 39), or about 16 angler hours per hectare (Table 40). The Lewis and Clark reservoir system (zones 1-3) accounted for an estimated 166,239 angler-hours during the 2009 survey period. Angler effort was highest in the Gavins Point Dam tailwaters with the greatest number of angler hours and also the greatest number of angler h/ha (Table 40). Lewis and Clark Lake had the second highest overall angler hours (Table 39). Peak fishing pressure occurred in May, June, and July (Table 39). The Lewis and Clark angler use and harvest survey has not been carried out on an annual basis, so trends in pressure and harvest can be hard to identify. The 2009 survey showed increased fishing pressure in zones 1 and 2 compared to the 2005 survey; zone 3, Lewis and Clark Lake, had the lowest estimated pressure since the 1994 survey (Table 41).

Table 39. Estimated total fishing pressure (angler hours), by month and zone, on the Missouri River from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included.

Zone	April	May	June	July	August	September	October	Total
FRDT	2,741	9,293	6,545	4,816	3,064	2,518	609	29,585
	(1,197)	(2,502)	(725)	(979)	(510)	(1,691)	(93)	(3,508)
UMR	3,573	11,055	7,646	16,270	8,343	2,013	606	49,507
	(1,166)	(3,026)	(3,701)	(5,506)	(1,871)	(1,209)	(313)	(7,719)
L&C	4,963	21,164	20,568	10,674	9,985	9,565	10,228	87,147
	(672)	(3,046)	(2,312)	(920)	(1,070)	(901)	(1,071)	(4,362)
GPDT	9,523	25,315	19,327	24,163	14,225	8,966	26,385	127,903
	(1,713)	(7,334)	(4,852)	(4,704)	(3,742)	(1,890)	(6,064)	(12,520)
LMR	6,173	13,315	11,161	13,048	17,976	13,361	3,205	78,239
	(555)	(3,990)	(3,158)	(2,275)	(4,063)	(3,305)	(517)	(7,686)
Total	26,973	80,142	65,247	68,971	53,593	36,423	41,033	372,382
	(1,187)	(3,083)	(2,924)	(3,198)	(2,547)	(2,185)	(4,874)	(16,834)

Table 40. Estimated total angler hours for boat anglers, shore anglers, bowfishing, and all combined, by zone, for the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

		Boat			Shore			Bowfishing			Combined		
Zone	Area (hectares)	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha	Total angler hours	%	No. h/ha
FRDT	172	17,591	7	102.3	11,994	9	69.7	0	0	0	29,585	8	172.0
UMR	4,369	42,327	18	9.7	7,180	5	1.6	0	0	0	49,507	13	11.3
L&C	12,143	71,160	30	5.9	15,987	12	1.3	unk			87,147	23	7.2
GPDT	61	44,365	19	727.3	81,382	62	1334.1	2,156	59	35	127,903	34	2096.8
LMR	6,523	61,030	26	9.4	15,704	12	2.4	1,506	41	0	78,239	21	12.0
Total	23,268	236,473	100	10.2	132,247	100	5.7	3,662	100	0	372,382	100	16.0

Table 41. Estimated hours of fishing pressure, by zone and year, April-September, on the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border.

Year	FRDT	UMR	L&C	GPDT	LMR	Reference
1984	41,499	40,888	19,874	79,743	--	Stone 1985
1994	35,222	36,332	50,278	92,002	--	Wickstrom 1995
1995 [1]	30,533	60,697	100,313	92,123	--	Wickstrom 1996
2000 [2]	55,121	93,611	100,297	147,545	62,176	Mestl et al. 2001
2001	36,201	57,331	156,685 [3]	81,093	--	Wickstrom et al. 2002
2005	24,228	38,009	102,791	--	--	Wickstrom and Schuckman 2006
2009 [4]	29,585	49,507	87,147	127,903	78,239	--

1 – Surveys conducted May - September.
2 – Survey conducted April – December.
3 – Some of the survey area was in the UMR zone in previous years.
4 – Surveys conducted April - October.

Fish Harvest and Release

Anglers fishing the Missouri River from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009, harvested an estimated 117,750 fish, all species and fishing methods combined, including an estimated walleye harvest of 27,722 (Table 42). Some anglers were opportunistic in regards to keeping fish for consumption, as twenty-six different species were observed in the angler harvest in 2009. Walleye made up the majority of the overall harvest (23.5%). Species also common in the angler harvest included freshwater drum (17.1%), white bass (16.4 %), channel catfish (11.2 %), sauger (6.2%), and smallmouth bass (5.5%; Table 42). Other species harvested, including bluegill,

largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common carp, grass carp, and asian carp species made up approximately 20% of the estimated total fish harvest (Table 42).

Table 42. Estimated total fish harvest, by zone, for anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included – SE could not be calculated for totals.

Zone	WAE	SAR	CCF	SMB	LMB	WHB	BLG	FRD	Other*	Total
FRDT	3,803 (685)	151 (69)	526 (62)	430 (124)	26 (22)	3,323 (2,654)	0 --	616 (393)	6,498 --	15,373 (3,716)
UMR	3,173 (561)	2,281 (869)	1,811 (809)	253 (186)	50 (58)	31 (43)	0 --	279 (163)	380 --	8,259 (1,792)
L&C	14,020 (1,219)	898 (186)	2,621 (375)	557 (204)	217 (53)	6,287 (968)	527 (237)	462 (127)	2,287 --	27,876 (1,994)
GPDT	5,093 (895)	2,771 (972)	7,569 (2,042)	1,645 (383)	128 (119)	9,533 (3,779)	654 (186)	16,646 (5,334)	9,582 --	53,622 (9,666)
LMR	1,633 (566)	1,178 (123)	611 (262)	3,534 (713)	0 --	116 --	0 --	2,071 (683)	3,478 --	12,620 (4,069)
Total	27,722 --	7,279 --	13,138 --	6,419 --	421 --	19,290 --	1,181 --	20,074 --	22,225 --	117,750 --

* Other includes brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

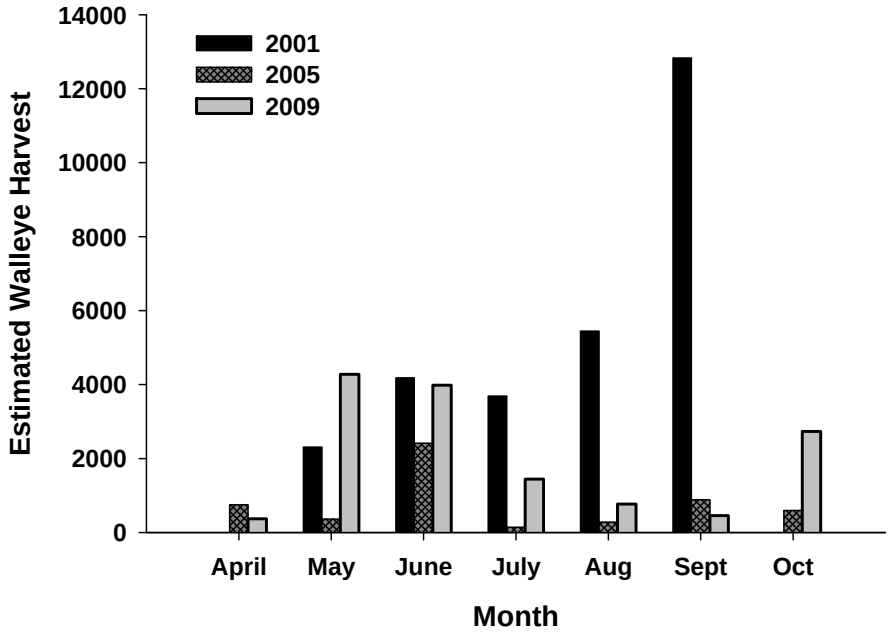

Figure 13. Estimated total walleye harvest by month, for anglers fishing Lewis and Clark Lake, 2001, 2005, and 2009. April and October were not surveyed in 2001.

The majority of the walleye harvest for the entire surveyed area occurred in the Lewis and Clark reservoir system (zones 1-3; estimated 20,996). This harvest estimate was more than double that of the previous survey, conducted in 2005, but about average compared to walleye harvest estimates from all previous surveys combined. See appendix 4 for a summary of angler use and harvest information from 1984 to present.

At the Fort Randall Dam tailwaters (zone 1), anglers harvested 15,373 fish; walleye and white bass each made up about 25% of the total angler harvest (Table 43). The highest harvest of walleye in the tailwaters, about two thirds of the total, occurred during May and July (Table 43).

For the upper Missouri River (zone 2), anglers harvested 8,259 fish, most commonly walleye, sauger, and channel catfish. Walleye made up 38% of the total angler harvest while sauger and channel catfish accounted for 28% and 22% of the total harvest, respectively (Table 44). Most harvest occurred in the spring and summer and fishing pressure decreased in the fall (Table 44).

At Lewis and Clark Lake (zone 3) anglers harvested 27,876 fish. Walleye made up 50.3% of the estimated total fish harvest, with over half of the Lewis and Clark walleye harvest occurring during May and June, and significant harvest also occurring in October (Table 45, Figure 13). In the 2005 survey, walleye harvest on Lewis and Clark Lake peaked in June, while in 2001 harvest peaked in September (Figure 13). White bass were also an important part of the Lewis and Clark Lake fishery (22.6% of total harvest) as were channel catfish (9.4%) (Table 45). Although extremely high walleye harvest was recorded in 2001 at Lewis and Clark Lake, harvest in 2009 was still above average compared to estimates from 1994 to present (Figure 14).

The Gavins Point Dam tailwaters (zone 4) received the highest fishing pressure of all the zones (Tables 39-41) and anglers harvested and estimated 53,623 fish. Freshwater drum made up about a third of all harvest, followed by white bass (18%), channel catfish (14%) and walleye/sauger combined (15%; Table 46). The highest harvests occurred in June and October (Table 46). Anglers at the Gavins tailwaters also harvested more species in the “other” category than other zones, which includes bluegill, largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Harvested fish in the “other” category made up 19% of the total estimated harvest (Table 46).

Anglers on the lower Missouri River (zone 5) harvested an estimated 12,620 fish. Smallmouth bass and freshwater drum were both important in the angler harvest, accounting for 28% and 16% of the total harvest, respectively (Table 47). Walleye and sauger combined accounted for about 22% of total harvest (Table 47). The greatest harvests occurred in the months of May and July.

Table 43. Estimated total fish harvest, by month, for anglers fishing the Fort Randall Dam tailwaters, April-October, 2009. Standard error (SE) is included.

Month	WAE		SAR		CCF		SMB		WHB		FRD		Other*		Total	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	309	154	93	0	0	0	15	0	0	0	0	0	5,641	108	6,058	263
	(203)	(101)	(61)	--	--	--	(10)	--	--	--	--	--	--	--	(281)	(109)
May	1,009	708	17	0	14	14	82	143	2,343	1,086	34	498	603	556	4,102	3,004
	(523)	(297)	(23)	--	(4)	(22)	(95)	(116)	(2,642)	(970)	(33)	(375)	--	--	(3,582)	(2,236)
June	601	1,258	10	57	10	38	63	167	411	962	398	762	157	215	1,648	3,458
	(269)	(519)	(7)	(39)	(15)	--	(37)	(74)	(242)	(462)	(391)	(269)	--	--	(848)	(1,192)
July	1,080	423	33	0	213	41	89	56	310	477	35	1,180	56	175	1,817	2,353
	(261)	(113)	(21)	--	(50)	(33)	(63)	(34)	(66)	(320)	(14)	(326)	--	--	(375)	(494)
Aug.	631	124	0	0	37	100	25	260	87	297	0	188	25	1,101	804	2,069
	(58)	(101)	--	--	(33)	(71)	(19)	(203)	(20)	(16)	--	(48)	--	--	(97)	(434)
Sept.	117	54	0	0	13	69	36	308	78	13	16	195	20	795	279	1,434
	(92)	(47)	--	--	(8)	(36)	(20)	(273)	(43)	(15)	(13)	(96)	--	--	(150)	(668)
Oct.	57	13	0	0	240	127	120	40	93	22	133	22	22	130	665	354
	(56)	--	--	--	--	(74)	--	--	--	(19)	--	(19)	--	--	(84)	(100)
Total	3,803	2,735	151	57	526	388	430	974	3,323	2,855	616	2,845	6,524	3,081	15,373	12,935
	(685)	(627)	(69)	(39)	(62)	(116)	(124)	(368)	(2,654)	(1,121)	(393)	(576)	--	--	(3,716)	(2,706)

* Other includes bluegill, largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

Table 44. Estimated total fish harvest, by month, for anglers fishing the upper Missouri River, from the Fort Randall Dam tailwaters to Springfield, SD, April-October, 2009. Standard error (SE) is included.

Month	WAE		SAR		CCF		SMB		WHB		FRD		Other*		Total	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	520	3,089	72	144	166	0	29	29	0	0	0	0	0	419	787	3,681
	(55)	(58)	(39)	(78)	(158)	--	(16)	(14)	--	--	--	--	--	--	(192)	(124)
May	796	4,287	1,206	1,285	334	215	143	700	0	0	0	0	251	694	2,729	7,181
	(312)	(1,197)	(782)	(633)	(198)	(90)	(171)	(459)	--	--	--	--	--	--	(1,239)	(1,973)
June	244	1,626	215	411	653	159	50	3,776	0	25	0	25	118	796	1,280	6,819
	(101)	(823)	(90)	(186)	(548)	(125)	(58)	(2,033)	--	(30)	--	(29)	--	--	(636)	(3,207)
July	837	3,450	434	467	502	852	31	1,673	31	185	279	379	62	841	2,175	7,848
	(378)	(1,287)	(330)	(355)	(537)	(370)	(43)	(625)	(43)	(80)	(163)	(106)	--	--	(1,066)	(2,770)
Aug.	777	3,581	354	407	157	991	0	1,350	0	170	0	306	0	423	1,288	7,227
	(247)	(1,169)	(159)	(472)	(26)	(296)	--	(1,096)	--	(76)	--	(94)	--	--	(312)	(937)
Sept.	0	662	0	0	0	0	0	331	0	0	0	0	0	0	0	994
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	3,173	16,696	2,281	2,714	1,811	2,218	253	7,859	31	381	279	710	430	3,172	8,259	33,750
	(561)	(2,267)	(869)	(889)	(809)	(499)	(186)	(2,437)	(43)	(114)	(163)	(145)	--	--	(1,792)	(4,769)

* Other includes bluegill, largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

Table 45. Estimated total fish harvest, by month, for anglers fishing Lewis and Clark Lake, April-October, 2009. Standard error (SE) is included.

Month	WAE		SAR		CCF		SMB		WHB		FRD		Other*		Total	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	369 (132)	412 (213)	24 (15)	0 --	214 (89)	27 (20)	285 (197)	58 (34)	54 (27)	3 (2)	0 --	4 (3)	741 --	601 --	1,687 (392)	1,105 (294)
May	4,278 (742)	7,428 (1,433)	525 (169)	307 (116)	344 (76)	7 (5)	7 (5)	783 (380)	206 (63)	2,556 (468)	82 (38)	1,273 (256)	424 --	987 --	5,866 (1,008)	13,341 (2,284)
June	3,982 (810)	7,833 (1,996)	58 (19)	22 (13)	356 (108)	216 (96)	22 (13)	0 --	1,483 (455)	2,121 (516)	143 (76)	1,885 (482)	358 --	674 --	6,402 (1,091)	12,751 (2,266)
July	1,443 (329)	3,108 (691)	59 (38)	24 (12)	601 (246)	133 (72)	53 (27)	248 (113)	1,845 (656)	3,033 (1,017)	94 (62)	601 (182)	387 --	401 --	4,482 (1,007)	7,548 (1,755)
Aug.	765 (263)	1,360 (339)	6 (4)	9 (7)	271 (99)	215 (64)	68 (31)	129 (38)	587 (261)	962 (292)	22 (11)	446 (129)	390 --	424 --	2,109 (388)	3,545 (624)
Sept.	454 (94)	1,246 (350)	19 (11)	0 --	807 (212)	328 (89)	109 (32)	332 (119)	1,794 (472)	2,119 (515)	122 (69)	353 (88)	457 --	719 --	3,762 (559)	5,097 (940)
Oct.	2,730 (277)	2,512 (445)	207 (60)	54 (20)	30 (10)	38 (21)	13 (7)	182 (56)	317 (71)	673 (113)	0 --	307 (61)	271 --	247 --	3,568 (374)	4013 (500)
Total	14,020 (1,219)	23,899 (2,644)	898 (186)	415 (119)	2,621 (375)	963 (165)	557 (204)	1,732 (421)	6,287 (968)	11,468 (1,372)	462 (127)	4,869 (599)	3,028 --	4,053 --	27,876 (1,994)	47,400 (3,878)

* Other includes bluegill, largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

Table 46. Estimated total fish harvest, by month, for anglers fishing the Gavins Point Dam tailwaters, April-October, 2009. Standard error (SE) is included.

Month	WAE		SAR		CCF		SMB		WHB		FRD		Other*		Total	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	758 (235)	1,561 (396)	1,721 (919)	506 (373)	332 (321)	700 (148)	161 (90)	238 (67)	31 (45)	157 (174)	0 --	283 (101)	503 --	165 --	3,505 (917)	3,612 (1,162)
May	1,290 (407)	3,317 (1,403)	327 (90)	322 (182)	856 (198)	1,386 (451)	457 (136)	888 (87)	360 (49)	745 (262)	5,439 (4,201)	5,739 (2,902)	724 --	4,284 --	9,453 (4,595)	16,680 (6,196)
June	621 (371)	1,915 (749)	0 --	37 (15)	1,264 (812)	1,070 (392)	113 (43)	490 (145)	489 (288)	193 (80)	7,777 (3,125)	5,446 (1,397)	382 --	1,702 --	10,647 (3,493)	10,852 (1,938)
July	475 (198)	909 (718)	288 (111)	331 (194)	1,501 (445)	1,641 (990)	468 (233)	372 (98)	717 (611)	1,962 (1,339)	1,811 (879)	1,668 (442)	4,253 --	1,653 --	9,512 (5,172)	8,537 (2,950)
Aug.	194 (85)	380 (210)	0 --	0 --	1,875 (1,202)	2,470 (1,400)	34 (18)	145 (62)	771 (967)	979 (476)	921 (460)	1,921 (696)	656 --	1,722 --	4,450 (2,031)	7,618 (2,461)
Sept.	426 (151)	378 (177)	0 --	37 (27)	1,581 (1,311)	1,548 (1,021)	364 (250)	418 (160)	1,392 (155)	1,797 (1,134)	667 (238)	550 (181)	202 --	1,190 --	4,632 (1,471)	5,918 (1,928)
Oct.	1,329 (611)	3,732 (2,626)	437 (284)	678 (671)	160 (80)	333 (188)	49 (44)	83 (71)	5,772 (3,586)	7,033 (3,089)	31 (35)	376 (199)	3,645 --	39,259 --	11,423 (5,123)	51,494 (11,689)
Total	5,093 (895)	12,193 (3,189)	2,771 (972)	1,911 (813)	7,569 (2,042)	9,148 (2,097)	1,645 (383)	2,634 (277)	9,533 (3,779)	12,867 (3,599)	16,646 (5,334)	15,982 (3,337)	10,366 --	49,976 --	53,623 (9,666)	104,711 (14,093)

* Other includes bluegill, largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

Table 47. Estimated total fish harvest, by month, for anglers fishing the lower Missouri River from the Gavins Point Dam tailwaters downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included.

Month	WAE		SAR		CCF		SMB		WHB		FRD		Other*		Total	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	148	262	0	0	175	0	0	1,120	0	0	87	110	175	110	585	1,602
	--	(108)	--	--	(262)	--	--	(221)	--	--	(131)	(74)	--	--	(655)	(383)
May	384	848	347	0	89	251	2,005	6,296	0	0	393	1,778	393	911	3,611	10,083
	(158)	(126)	(108)	--	--	--	--	(2,020)	--	--	(661)	(73)	--	--	(1,346)	(2,280)
June	243	1,372	0	505	347	347	477	428	116	58	73	1,877	73	7,749	1,328	12,336
	(4)	(67)	--	--	--	--	(108)	(196)	--	--	(108)	(108)	--	--	(325)	(1,044)
July	0	733	733	244	0	978	232	696	0	0	0	232	2,804	3,884	3,770	6,767
	--	--	--	--	--	--	(167)	(502)	--	--	--	(167)	--	--	(3,672)	(3,139)
Aug.	793	793	0	0	0	4,510	819	5,621	0	0	0	0	0	206	1,612	11,131
	(542)	(542)	--	--	--	(3,780)	(684)	(3,792)	--	--	--	--	--	--	(843)	(5,758)
Sept.	0	1,518	0	0	0	0	0	0	0	0	1,518	0	0	0	1,518	1,518
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oct.	65	0	98	0	0	0	0	130	0	0	0	65	33	195	195	391
	(40)	--	(60)	--	--	--	--	(179)	--	--	--	(90)	--	--	(119)	(407)
Total	1,633	5,527	1,178	750	611	6,085	3,534	14,291	116	58	2,071	4,062	3,478	13,055	12,620	43,827
	(566)	(570)	(123)	--	(262)	(3,780)	(713)	(4,339)	--	--	(683)	(242)	--	--	(4,069)	(7,043)

* Other includes bluegill, largemouth bass, brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

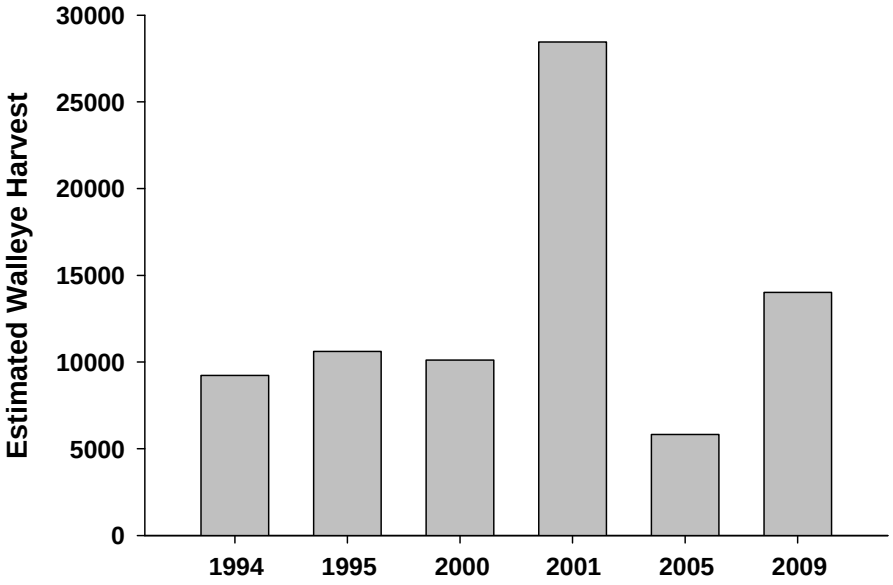

Figure 14. Estimated walleye harvest by year for anglers fishing Lewis and Clark Lake (Zone 3). Surveys were conducted April-September except in 1995 surveys were from May-September, and in 2009 from April-October.

Length frequencies of angler-harvested walleye and catfish were developed for all zones (Figures 15-19). From Fort Randall Dam downstream to the Nebraska state line, there is a minimum length-limit of 381 mm for walleye, except for the months of July and August. Anglers did harvest some fish under 381 mm during those months (Figure 15). From the Nebraska state line downstream to Gavins Point Dam, the 381 mm minimum length limit is in effect for walleye year-round. No illegal walleye were measured in the upper Missouri River (Figure 16) but creel clerks did measure one illegal walleye harvested in Lewis and Clark Lake (300 mm; Figure 17). Below Gavins Point Dam there is no minimum length-limit for walleye, and anglers harvested fish ranging from 220-600 mm (Figures 18, 19). Mean total length of harvested walleye exceeded 400 mm at all five zones. Anglers at Lewis and Clark Lake harvested the most large walleye (over 600 mm) than other zones (Figure 17). Channel catfish of a preferred size (>610 mm) were harvested in most zones, with large catfish over 700 mm harvested in zones 2, 3, and 4. The greatest harvest of large catfish (>700 mm) occurred in Lewis and Clark Lake (Figure 17).

Nearly 13% of anglers harvested a limit of walleye at Lewis and Clark Lake, higher than any of the other zones (Table 48) Greater percentages of angling parties at Lewis and Clark Lake also harvested some number of channel catfish and white bass compared to other zones (Tables 49, 50).

Table 48. Percentage of anglers that harvested specific numbers of walleye per completed trip, by zone, from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

Harvest Per Angler	FRDT	UMR	L&C	GPDT	LMR
0	58.1	77.7	21.9	85.8	90.0
0.1-0.9	14.5	10.1	23.2	6.8	5.6
1.0-1.9	16.1	7.2	13.4	4.9	3.3
2.0-2.9	5.4	3.6	18.0	1.2	1.1
3.0-3.9	3.8	1.4	10.9	0.9	
4.0	2.2		12.7	0.5	

Table 49. Percentage of anglers that harvested specific numbers of channel catfish per completed trip, by zone, from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

Harvest Per Angler	FRDT	UMR	L&C	GPDT	LMR
0	93.5	87.8	26.3	85.8	96.7
0.1-.9	4.3	4.3	29.3	5.9	
1.0-1.9	1.1	4.3	10.5	4.2	1.1
2.0-2.9		2.2	18.0	1.4	1.1
3.0-3.9	0.5	0.7	0.8	0.7	1.1
4.0-4.9			11.3	0.5	
5.0-5.9		0.7	3.8	0.9	
6.0-6.9				0.2	
7.0-7.9					
8.0-8.9					
9.0-9.9	0.5				
10.0-10.9				0.3	
11.0-11.9				0.2	

Table 50. Percentage of anglers that harvested specific numbers of white bass per completed trip, by zone, from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

Harvest Per Angler	FRDT	UMR	L&C	GPDT	LMR
0	81.7	99.3	65.7	91.2	98.9
0.1-.9	7.0	0.7	12.7	4.0	1.1
1.0-1.9	6.5		7.2	2.3	
2.0-2.9	2.7		4.7	0.7	
3.0-3.9	0.5		2.8	0.5	
4.0-4.9			1.9	0.2	
5.0-5.9	0.5		0.6	0.2	
6.0-6.9			1.3	0.2	
7.0-7.9				0.7	
8.0-8.9	0.5				
9.0-9.9					
10.0-10.9			0.4		
11.0-11.9	0.5			0.2	
12.0-12.9			0.6		
13.0-13.9			0.6		
14.0-14.9					
15.0-15.9			0.4		
19.0-19.9			0.6		
20.0-20.9			0.4		

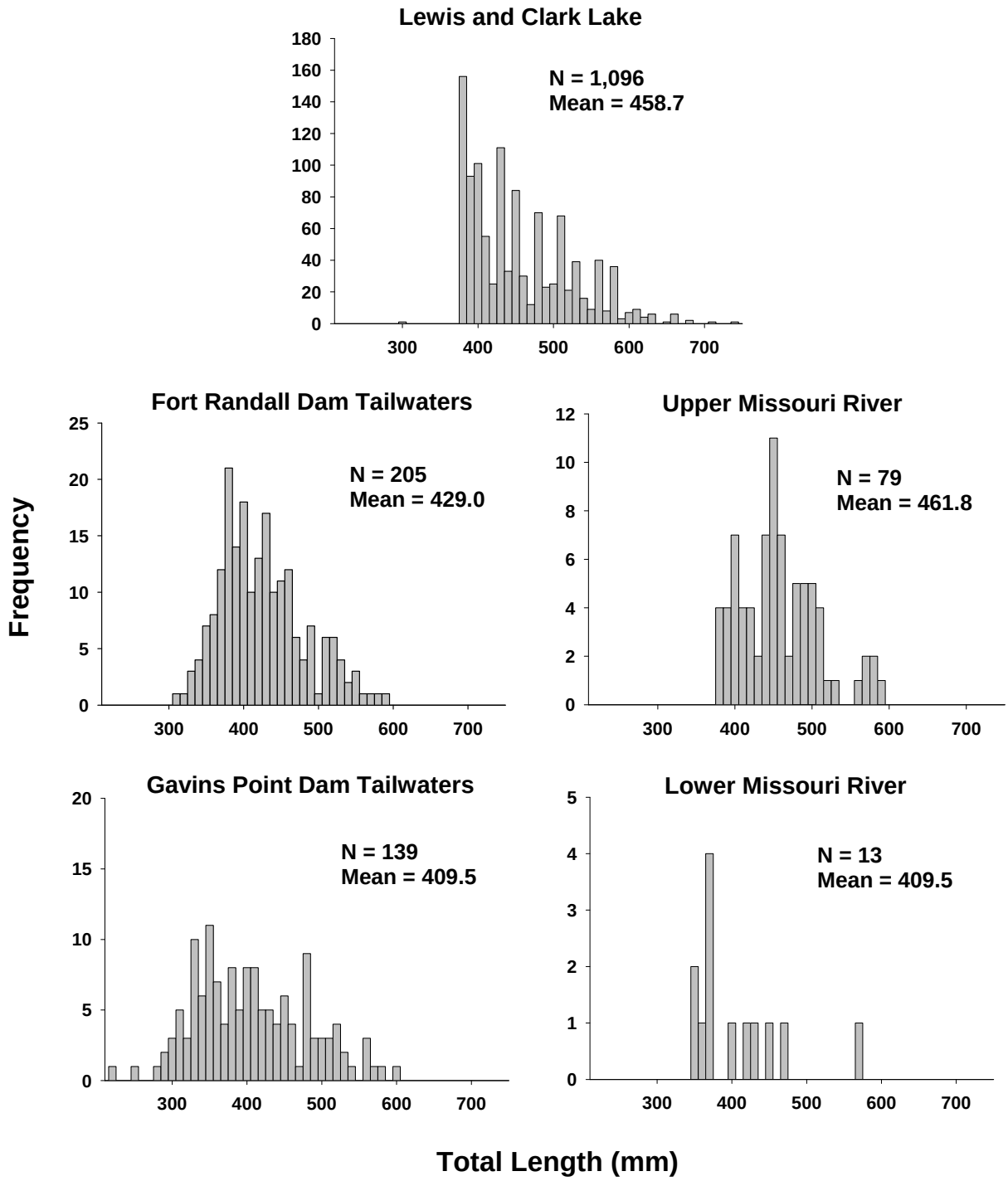

Figure 15. Length frequencies of angler-harvested walleye from zones 1-5, April-October, 2009. Please note the alternate scaling on the Y-Axis.

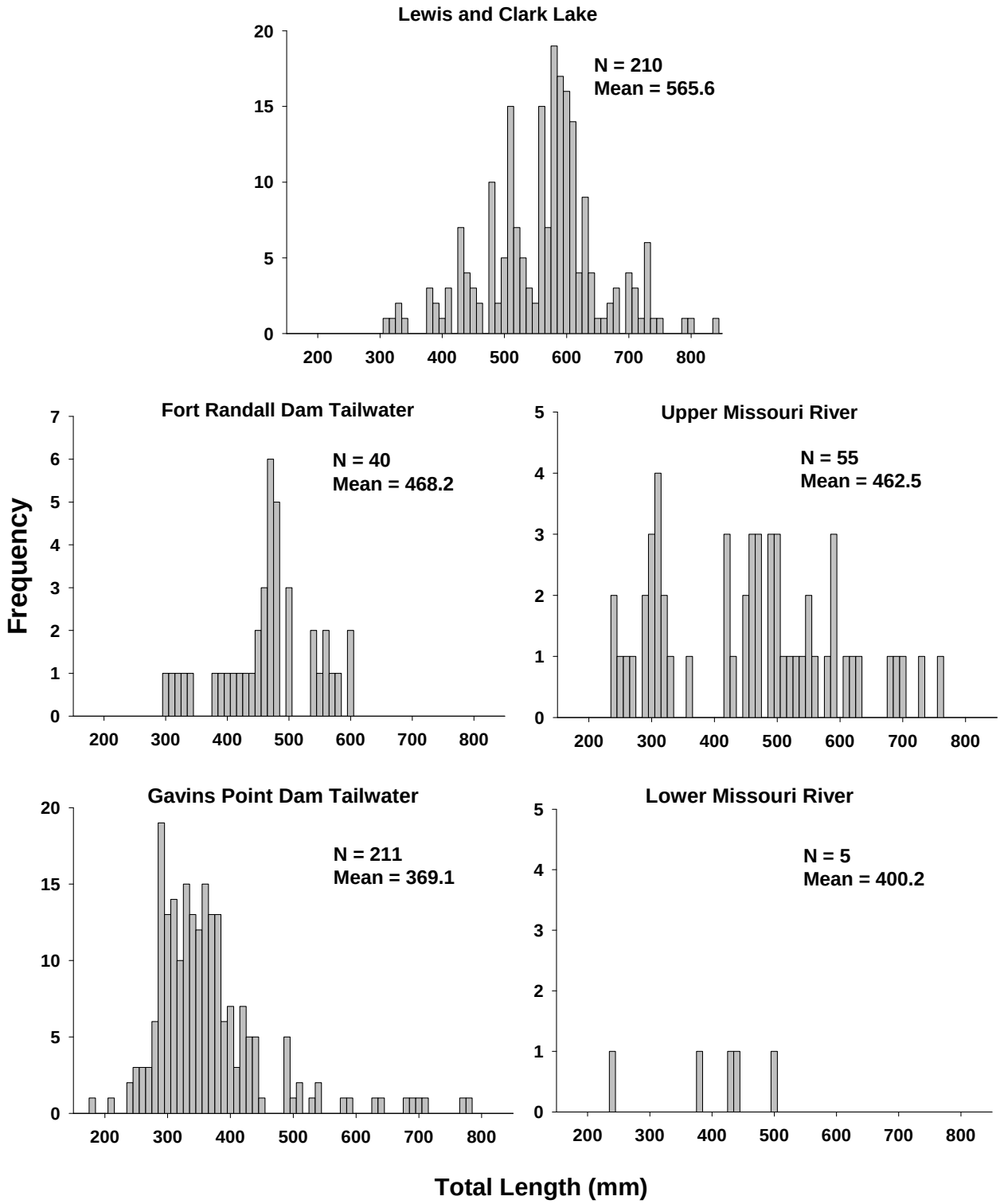

Figure 16. Length frequencies of angler-harvested catfish from zones 1-5, April-October, 2009. Please note the alternate scaling on the Y-Axis.

Catch and release, either mandated by length-limit regulations or voluntary, has become an important part of the Missouri River sport fishery. The estimated number of fish caught and released on the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009, was 242,623. Release estimates exceeded the number of fish harvested for every species except sauger (Tables 42, 51). The estimate of released fish is based on an angler's ability to recall what they released, and therefore may be biased up or down. Estimates of the number of released sauger may also be biased by an anglers ability to correctly identify the species. It is possible that some released sauger were reported by anglers as released walleye. However, this data is useful for analyzing trends over time and estimating catch rates. The overall estimate of the number of fish caught in the surveyed area by anglers in 2009 (harvested plus released fish) was 360,372.

Table 51. Estimated number of fish caught and released, by zone, for anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included.

Zone	WAE	SAR	CCF	SMB	LMB	WHB	BLG	FRD	Other*	Total
FRDT	2,735 (627)	57 (39)	388 (116)	974 (368)	149 --	2,855 (1,121)	598 --	2,845 (576)	2,334 --	12,935 (2,706)
UMR	16,696 (2,267)	2,714 (889)	2,218 (499)	7,859 (2,437)	515 (196)	381 (114)	0 --	710 (145)	2,657 --	33,750 (4,769)
L&C	23,899 (2,644)	415 (119)	963 (165)	1,732 (421)	682 (135)	11,468 (1,372)	636 (145)	4,869 (599)	2,736 --	47,400 (3,878)
GPDT	12,193 (3,189)	1,911 (813)	9,148 (2,097)	2,634 (277)	167 (78)	12,867 (3,599)	1,490 (585)	15,982 (3,337)	48,319 --	104,711 (14,093)
LMR	5,527 (570)	750 --	6,085 (3,780)	14,291 (4,339)	12 (18)	58 --	363 (541)	4,062 (242)	12,679 --	43,827 (7,043)
Total	61,050 (3,816)	5,847 (496)	18,802 (1,673)	27,490 (2,507)	1,525 (126)	27,629 (2,763)	3,087 (246)	28,468 (2,666)	68,725 --	242,623 (15,273)

***** Other includes brown trout, paddlefish, flathead catfish, northern pike, crappie species, rock bass, green sunfish, goldeye, big and smallmouth buffalo, river carpsucker, bullhead species, yellow perch, shorthead redhorse, common, grass and asian carp species. Standard error could not be calculated.

Harvest, Release, and Catch Rates

The mean overall harvest rates for anglers fishing the Missouri River from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009, ranged from 0.161 fish/angler-hour to 0.520 fish/angler-hour (Table 52). The highest estimated overall catch rates occurred in the Gavins Point Dam tailwaters in October and the Fort Randall Dam tailwaters in April. The highest estimated overall harvest rate occurred at the FRDT in April (2.21 fish/angler-hour; Table 52). This high harvest rate is due in part to a brown trout fishery that is established in the tailwater every spring thru hatchery stockings.

On Lewis and Clark Lake, mean angler harvest rate was estimated at 0.345 fish/angler-hour. The overall catch rate (estimated harvest rate plus the estimated release rate of 0.570 fish/angler-hour) was 0.915 fish/angler-hour. The highest overall catch rate and harvest rate occurred in July. September had the second highest harvest rate and June had the second highest catch rate

(Table 54). For the Lewis and Clark Reservoir system (zones 1-3) the overall harvest rate was 0.31 fish/h and the overall catch rate was 0.876 fish/h, well above the reservoir-wide management objective of 0.5 fish/h.

The estimated mean walleye harvest rate for Lewis and Clark Lake was 0.163 fish/angler-hour, the highest of all the zones surveyed (Table 53). The overall catch rate (estimated harvest rate plus the estimated release rate of 0.271 fish/angler-hour) was 0.434 fish/angler-hour. This value is higher than 0.30 fish/angler-hour, which is considered by most biologists to be characteristic of high quality walleye fisheries (Colby et al. 1979). For the reservoir system (zones 1-3), overall walleye harvest rates were 0.126 fish/h and exceeded the reservoir-wide management goal of 0.1 fish/h. Walleye harvest rates exceeded sauger harvest rates at all zones, but were most comparable at zones 2 and 5, the zones with primarily riverine habitat (Tables 53, 54). Reservoir-wide (zones 1-3) harvest rates for sauger were 0.02 fish/h, short of the management goal of 0.1 fish/h. Release rates may be underestimated for sauger based on angler misidentification.

Table 52. Estimated harvest and release rates for all species combined by month and zone for anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included.

Month	FRDT		UMR		L&C		GPDT		LMR	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	2.210 (0.000)	0.096 (0.000)	0.220 (0.122)	1.030 (0.341)	0.266 (0.077)	0.234 (0.144)	0.368 (0.159)	0.379 (0.164)	0.095 (0.124)	0.260 (0.066)
May	0.441 (0.483)	0.323 (0.313)	0.247 (0.169)	0.650 (0.282)	0.293 (0.067)	0.659 (0.179)	0.373 (0.271)	0.659 (0.407)	0.271 (0.195)	0.757 (0.209)
June	0.252 (0.155)	0.528 (0.213)	0.167 (0.151)	0.892 (1.168)	0.326 (0.077)	0.642 (0.166)	0.551 (0.324)	0.561 (0.214)	0.119 (0.060)	1.105 (0.363)
July	0.377 (0.073)	0.489 (0.065)	0.134 (0.089)	0.482 (0.292)	0.520 (0.265)	0.787 (0.320)	0.394 (0.231)	0.353 (0.159)	0.289 (0.253)	0.519 (0.176)
August	0.263 (0.073)	0.675 (0.245)	0.154 (0.037)	0.866 (0.830)	0.226 (0.071)	0.390 (0.113)	0.313 (0.174)	0.536 (0.283)	0.090 (0.070)	0.619 (0.425)
September	0.111 (0.128)	0.569 (0.000)	0.000 --	0.494 (0.000)	0.422 (0.108)	0.527 (0.186)	0.517 (0.222)	0.660 (0.286)	0.114 (0.000)	0.114 (0.000)
October	1.092 (0.148)	0.582 (0.189)	0.000 --	0.000 --	0.388 (0.064)	0.398 (0.070)	0.433 (0.278)	1.952 (0.861)	0.061 (0.020)	0.122 (0.164)
Combined	0.520 (0.120)	0.437 (0.115)	0.167 (0.053)	0.682 (0.242)	0.345 (0.117)	0.570 (0.184)	0.419 (0.105)	0.819 (0.173)	0.161 (0.058)	0.560 (0.111)

Table 53. Estimated harvest and release rates for walleye by month and zone for anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included.

Month	FRDT		UMR		L&C		GPDT		LMR	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	0.113 (0.089)	0.056 (0.044)	0.145 (0.051)	0.865 (0.284)	0.057 (0.026)	0.113 (0.118)	0.080 (0.034)	0.164 (0.064)	0.024 (0.002)	0.043 (0.018)
May	0.109 (0.058)	0.076 (0.051)	0.072 (0.056)	0.388 (0.235)	0.189 (0.047)	0.348 (0.113)	0.051 (0.028)	0.131 (0.088)	0.029 (0.015)	0.064 (0.021)
June	0.092 (0.049)	0.192 (0.103)	0.032 (0.021)	0.213 (0.219)	0.182 (0.052)	0.354 (0.133)	0.032 (0.021)	0.099 (0.044)	0.022 (0.006)	0.123 (0.035)
July	0.224 (0.062)	0.088 (0.027)	0.051 (0.036)	0.212 (0.139)	0.168 (0.082)	0.361 (0.160)	0.020 (0.012)	0.038 (0.032)	0.000 --	0.056 (0.010)
August	0.206 (0.054)	0.040 (0.038)	0.093 (0.013)	0.429 (0.182)	0.080 (0.059)	0.121 (0.051)	0.014 (0.006)	0.027 (0.013)	0.044 (0.032)	0.044 (0.032)
September	0.046 (0.062)	0.022 (0.034)	0.000 --	0.329 (0.000)	0.048 (0.021)	0.097 (0.045)	0.048 (0.013)	0.042 (0.021)	0.000 --	0.114 (0.000)
October	0.093 (0.093)	0.022 (0.003)	0.000 --	0.000 --	0.309 (0.055)	0.233 (0.073)	0.050 (0.030)	0.141 (0.110)	0.020 (0.007)	0.000 --
Combined	0.129 (0.028)	0.092 (0.029)	0.064 (0.019)	0.337 (0.093)	0.163 (0.053)	0.271 (0.111)	0.040 (0.009)	0.095 (0.029)	0.021 (0.008)	0.071 (0.010)

Table 54. Estimated harvest and release rates for sauger by month and zone for anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009. Standard error (SE) is included.

Month	FRDT		UMR		L&C		GPDT		LMR	
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release
April	0.034 (0.027)	0.000 --	0.020 (0.013)	0.040 (0.026)	0.003 (0.002)	0.000 --	0.181 (0.111)	0.053 (0.044)	0.000 --	0.000 --
May	0.002 (0.003)	0.000 --	0.109 (0.077)	0.116 (0.065)	0.021 (0.012)	0.014 (0.010)	0.013 (0.006)	0.013 (0.008)	0.026 (0.011)	0.000 --
June	0.001 (0.001)	0.009 (0.006)	0.028 (0.018)	0.054 (0.036)	0.004 (0.003)	0.000 --	0.000 --	0.002 (0.001)	0.000 --	0.045 (0.000)
July	0.007 (0.005)	0.000 --	0.027 (0.025)	0.029 (0.028)	0.009 (0.011)	0.003 (0.003)	0.012 (0.000)	0.014 (0.009)	0.056 (0.000)	0.019 (0.000)
August	0.000 --	0.000 --	0.042 (0.026)	0.049 (0.067)	0.000 --	0.0004 (0.001)	0.000 --	0.000 --	0.000 --	0.000 --
September	0.000 --	0.000 --	0.000 --	0.000 --	0.002 (0.002)	0.000 --	0.000 --	0.004 (0.003)	0.000 --	0.000 --
October	0.000 --	0.000 --	0.000 --	0.000 --	0.025 (0.014)	0.005 (0.004)	0.017 (0.008)	0.026 (0.026)	0.030 (0.019)	0.000 --
Combined	0.005 (0.002)	0.002 (0.001)	0.046 (0.020)	0.055 (0.022)	0.011 (0.009)	0.004 (0.005)	0.022 (0.008)	0.015 (0.007)	0.015 (0.002)	0.010 (0.001)

Angler Demographics and Economics

Over 47% of anglers fishing the Missouri River from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009 were not South Dakota residents. The majority of this surveyed reach is a Nebraska border water, so it is not surprising to see about 36% of all surveyed anglers coming from that state. At the Upper Missouri River (zone 2) and the Gavins Point Dam tailwaters (zone 4), the majority of anglers were Nebraska residents (Table 55). Non-resident anglers traveled from 17 different states to fish the surveyed stretch, about 7.4% of all anglers came from Iowa, and 1.95% came from Minnesota (Table 55). The majority of anglers fishing the surveyed reach came from southeastern South Dakota and Northeastern Nebraska; about 24% of all surveyed anglers resided in Yankton County, South Dakota (Figure 20). Excluding Lewis and Clark Lake, nearly one third of surveyed anglers drove less than 25 miles to fish the surveyed reach, 6 percent drove over 200 miles (Table 56).

Non-residents comprised about 42% of all anglers at Lewis and Clark Lake, with the majority coming from Nebraska (29.3% of all anglers). Non-residents from Iowa and Minnesota made up 8.7% and 3.0% of all anglers at Lewis and Clark, respectively (Table 55). Non-resident anglers traveled from nine different states to fish Lewis and Clark Lake. Previous surveys have shown Lewis and Clark Lake to be a popular destination for non-resident anglers, who often make up a greater proportion of the total anglers compared to other Missouri River Reservoirs in the state (Adams et al. 2009; Adams et al. 2009; Sorensen and Knecht 2009). Surveys in 2001 and 2005 showed 33% and 47.4% of Lewis and Clark Lake anglers to be non-residents, respectively (Wickstrom et al. 2002; Wickstrom and Schuckman 2006). The high percentage of non-resident anglers utilizing Lewis and Clark Lake is likely a result of its position as the lowermost reservoir on the Missouri River, and as a Nebraska border water. Lewis and Clark Lake is the closest Missouri River reservoir to major population centers such as Sioux City, IA and Omaha, NE.

Table 55. State residency of surveyed anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009, by number and percent of the total.

	Zone											
	FRDT		UMR		L&C		GPDT		LMR		Total	
State	N	%	N	%	N	%	N	%	N	%	N	%
California	--	--	--	--	--	--	1	0.2	--	--	1	0.04
Idaho	1	0.5	--	--	4	0.3	--	--	--	--	5	0.20
Illinois	--	--	--	--	--	--	1	0.2	--	--	1	0.04
Iowa	19	10.1	6	4.3	127	8.7	28	4.8	2	2.2	182	7.39
Kansas	--	--	--	--	4	0.3	1	0.2	--	--	5	0.20
Massachusetts	--	--	--	--	--	--	1	0.2	--	--	1	0.04
Michigan	--	--	--	--	--	--	1	0.2	--	--	1	0.04
Minnesota	3	1.6	--	--	44	3.0	1	0.2	--	--	48	1.95
Mississippi	--	--	--	--	--	--	1	0.2	--	--	1	0.04
Missouri	2	1.1	--	--	2	0.1	1	0.2	--	--	5	0.20
Montana	--	--	--	--	2	0.1	--	--	1	1.1	3	0.12
Nebraska	44	23.4	121	87.1	428	29.3	296	51.1	11	11.8	900	36.54
New Mexico	2	1.1	--	--	--	--	--	--	--	--	2	0.08
Ohio	--	--	--	--	--	--	1	0.2	--	--	1	0.04
Oklahoma	--	--	--	--	2	0.1	--	--	--	--	2	0.08
Oregon	--	--	1	0.7	--	--	--	--	--	--	1	0.04
South Dakota	117	62.2	11	7.9	852	58.1	246	42.5	77	84.9	1303	52.90
Utah	--	--	--	--	1	0.1	--	--	--	--	1	0.04
Total	188	100	139	100	1466	100	579	100	91	100	2463	100

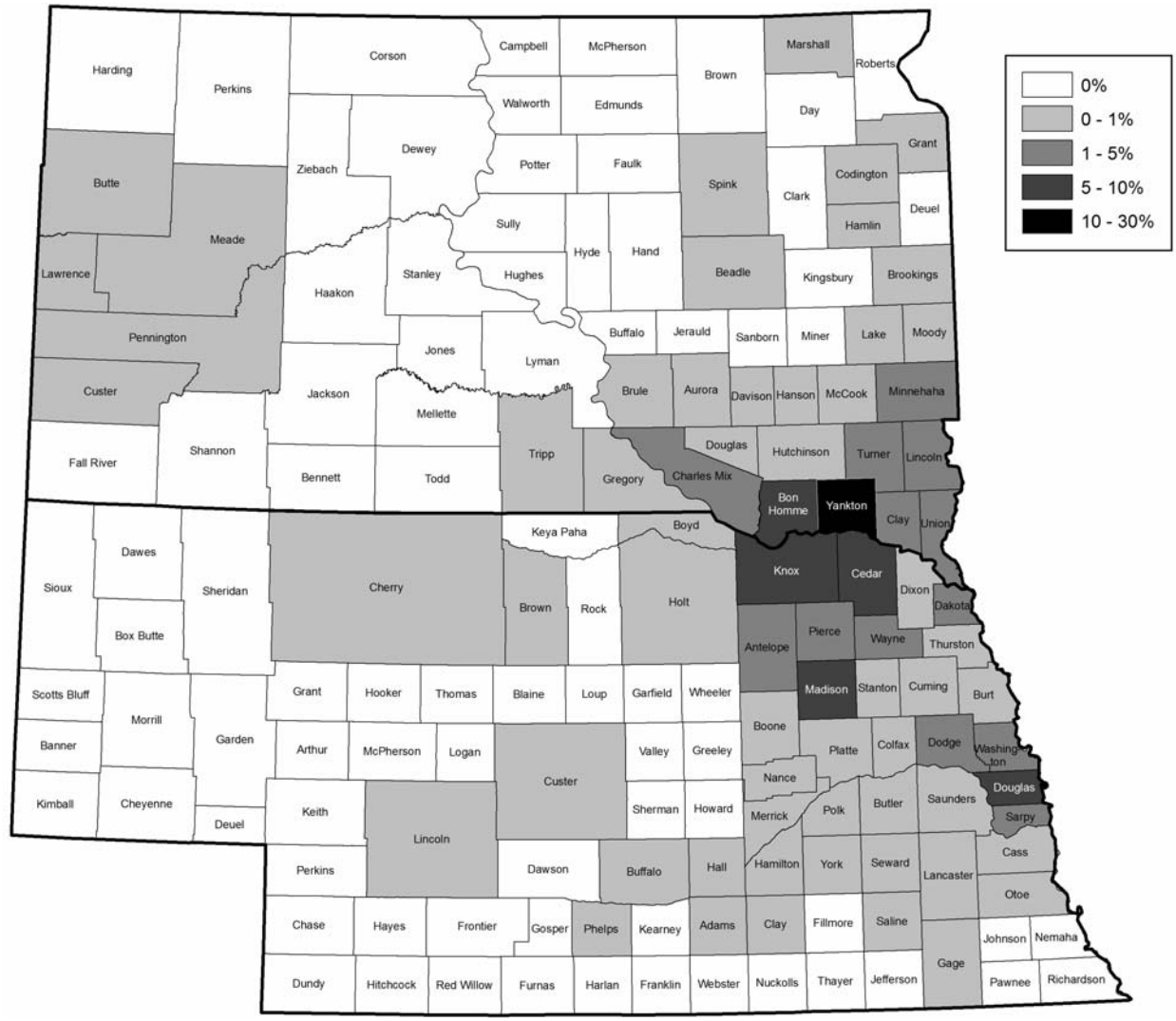

Figure 17. Percentage of overall angler contacts on the Missouri River, April-October, 2009, from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, by residence of listed Counties in South Dakota and Nebraska.

Table 56. Percentage of anglers traveling specified distances, one way, to fish the Missouri River, from Fort Randall Dam downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

Distance Traveled (miles)	Zone 1 FRDT	Zone 2 UMR	Zone 3 L&C	Zone 4 GPDT	Zone 5 LMR	Total
<25	34	14		26	75	30
25-50	19	26	data	33	14	27
51-100	17	24	not	21	10	20
101-200	19	29	collected	16	1	17
201+	11	6		4	0	6

Mean completed trip length (boat and shore anglers combined) for the entire surveyed reach from April-October, 2009 during the daylight period, was 3.88 hours. Mean completed trip length on Lewis and Clark Lake was 5.19 hours, the longest trip length of all the zones surveyed (Table 57). Angling parties averaged approximately two members in size (Table 57). The number of angler days can be estimated by dividing the estimated pressure (angler-hours) at each zone, by the mean completed trip length for each zone. Estimates show 103,081 angler days for the entire sampled reach, including an estimated 36,181 days within the Lewis and Clark reservoir system (Table 57). 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 2006), the direct economic impact by anglers on the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, was $8.14 million. The Lewis and Clark reservoir system had an estimated economic impact of $2.86 million.

Table 57. Mean party size, completed trip length, pressure, and angler days by zone, for anglers fishing the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

Zone	Mean Party Size	Number Surveyed	Mean Completed Trip Length (h)	Total Angler Hours	Boating Hours	Total Angler Days	Boat Days
FRDT	2.03	186	3.67	29,585	17,591	8,061	4,793
UMR	2.07	139	4.37	49,507	42,327	11,329	9,686
L&C	2	1,466	5.19	87,147	71,160	16,791	13,711
GPDT	2.05	577	3.79	127,903	44,365	33,747	11,706
LMR	1.81	90	2.36	78,239	61,030	33,152	25,860
Mean	1.99	2,458	3.88	372,381	236,473	103,081	65,756

The surveyed reach provides many diverse fishing opportunities. Overall, the majority of interviewed anglers were specifically targeting walleye and sauger (48.2%, Table 60). Anglers not specifically targeting a fish species (fishing for “anything”) came in second overall (30.3%), but angling parties were also interviewed that were specifically targeting a dozen other species

including catfish, bass, brown trout, paddlefish, freshwater drum, and others (Table 58). At Lewis and Clark Lake, more anglers targeted walleye/sauger than at other zones (60.8%). Catfish were also popular at Lewis and Clark Lake, and were specifically targeted by almost 10% of interviewed anglers, while 22.6% of anglers were fishing for anything (Table 58).

Table 58. Percentage of anglers fishing for a preferred fish species in the Missouri River from Fort Randall Dam, downstream to the confluence with the Big Sioux River near the Iowa, Nebraska border, April-October, 2009.

	Zone											
	FRDT		UMR		L&C		GPDT		LMR		Total	
Species	N	%	N	%	N	%	N	%	N	%	N	%
Walleye/Sauger	89	47.3	60	42.6	891	60.8	127	21.8	23	24.5	1,190	48.2
Catfish Species	11	5.9	22	15.6	137	9.4	54	9.3	10	10.6	234	9.5
Paddlefish	--	--	--	--	--	--	116	19.9	6	6.4	122	4.9
Smallmouth Bass	--	--	22	15.6	21	1.4	2	0.3	7	7.5	52	2.1
Largemouth Bass	--	--	1	0.7	24	1.6	--	--	1	1.1	26	1.1
Brown Trout	8	4.3	--	--	--	--	--	--	--	--	8	0.3
White Bass	1	0.5	--	--	23	1.6	4	0.7	--	--	28	1.1
Carp/Buffalo Spp.	--	--	1	0.7	--	--	9	1.6	--	--	10	0.4
Northern Pike	--	--	--	--	4	0.3	1	0.2	1	1.1	6	0.2
Crappie	--	--	--	--	33	2.3	1	0.2	--	--	34	1.4
Bluegill	--	--	--	--	2	0.1	--	--	--	--	2	0.1
Freshwater Drum	--	--	--	--	--	--	10	1.7	--	--	10	0.4
Anything	79	42.0	35	24.8	331	22.6	258	44.3	46	48.9	749	30.3
Total	188	100	141	100	1,466	100	582	100	94	100	2,471	100

Angler Trip Satisfaction

Angler attitudes about fishing and their preferences concerning management options are important components of a fishery. Historically, fisheries biologists have primarily focused efforts on understanding biological aspects of fish populations and monitoring sport fish harvest and use. Recently, biologists have realized the necessity and value of understanding angler attitudes, level of satisfaction, and preferences. Consequently, more attitude, preference, and satisfaction data has been collected in recent years. The angler use and harvest survey was a joint effort between South Dakota Game, Fish and Parks, and the Nebraska Game and Parks Commission. Although much of the data collected by both agencies was complementary, interview questions regarding angler trip satisfaction were not conducted on Lewis and Clark Lake.

How anglers feel about their fishing experience is important when evaluating the success of fishery management efforts. Angler responses help evaluate if current management practices and regulations are providing a fishery that meets angler needs and expectations. Of the anglers that were surveyed, 81.9% expressed some degree of satisfaction with their angling experience (Table 59). This exceeds the Missouri River Fisheries Program management objective of 70%

(SDGFP unpublished document). Many factors contribute to angler satisfaction, fish catch and harvest appeared to play minor roles. Thirty-eight percent of all surveyed angling parties did not harvest any fish, and yet 78% of those angling parties expressed some degree of satisfaction with their trip (Table 60). Over 70% of angling parties expressed some degree of satisfaction regardless of the number of fish caught (Table 61).

Table 59. Response of anglers fishing the Missouri River April-October, 2009 from Fort Randall Dam downstream to the Nebraska, Iowa border, excluding Lewis and Clark Lake, to the question: "Considering all factors, how satisfied were you with your fishing trip today?" 1 = Very Satisfied, 2 = Moderately Satisfied, 3 = Slightly Satisfied, 4 = Neutral or No Opinion, 5 = Slightly Dissatisfied, 6 = Moderately Dissatisfied, and 7 = Very Dissatisfied.

	Satisfied	→		Neutral	←		Dissatisfied		
Month	1	2	3	4	5	6	7	Total	Median
April	31	30	12	4	5	12	2	96	2
May	48	69	29	5	6	9	1	167	2
June	43	59	26	11	17	13	3	172	2
July	28	89	37	5	14	8	7	188	2
August	34	80	14	0	16	8	0	152	2
September	16	36	12	2	7	12	3	88	2
October	78	31	7	1	4	2	1	124	1
Total	278	393	137	28	69	64	17	987	2
Percent	28.2	39.9	13.9	2.8	7.0	6.5	1.7	100	--
Combined	81.9			2.8	15.2			100	--

Table 60. Response of angling parties to the question "Considering all factors, how satisfied are you with your fishing trip today?" by number of total fish harvested from Fort Randall Dam downstream to the Nebraska, Iowa border, excluding Lewis and Clark Lake, April-October, 2009.

Number of fish harvested/angling party	Satisfied		Dissatisfied		Neutral/No-Opinion		Total	
	#	%	#	%	#	%	#	%
0	220	78.0	53	18.8	9	3.2	282	38.0
1	79	84.0	12	12.8	3	3.2	94	12.7
2	72	87.8	9	11.0	1	1.2	82	11.1
3	43	87.8	3	6.1	3	6.1	49	6.6
4	42	93.3	2	4.4	1	2.2	45	6.1
5	36	92.3	3	7.7	0	0.0	39	5.3
6	26	89.7	1	3.4	2	6.9	29	3.9
7	21	80.8	4	15.4	1	3.8	26	3.5
8	17	100.0	0	0.0	0	0.0	17	2.3
9	11	84.6	2	15.4	0	0.0	13	1.8
10-15	45	100.0	0	0.0	0	0.0	45	6.1
>15	20	95.2	0	0.0	1	4.8	21	2.8
Total	632	85.2	89	12.0	21	2.8	742	100.0

Table 61. Response of angling parties to the question "Considering all factors, how satisfied are you with your fishing trip today?" by number of total fish caught from Fort Randall Dam downstream to the Nebraska, Iowa border, excluding Lewis and Clark Lake, April-October, 2009.

Number of fish caught/angling party	Satisfied		Dissatisfied		Neutral/No-Opinion		Total	
	#	%	#	%	#	%	#	%
0	--	--	--	--	--	--	--	--
1	83	79.0	18	17.1	4	3.8	105	14.2
2	57	74.0	19	24.7	1	1.3	77	10.4
3	49	87.5	6	10.7	1	1.8	56	7.5
4	45	84.9	6	11.3	2	3.8	53	7.1
5	38	88.4	3	7.0	2	4.7	43	5.8
6	22	71.0	6	19.4	3	9.7	31	4.2
7	28	80.0	5	14.3	2	5.7	35	4.7
8	24	80.0	5	16.7	1	3.3	30	4.0
9	31	88.6	4	11.4	0	0.0	35	4.7
10-15	98	90.7	7	6.5	3	2.8	108	14.6
16-25	97	92.4	7	6.7	1	1.0	105	14.2
>25	60	93.8	3	4.7	1	1.6	64	8.6
Total	632	85.2	89	12.0	21	2.8	742	100.0

Angler Responses to Questions Relating to Aquatic Nuisance Species

Aquatic nuisance species have the potential to cause great ecological and economic harm to our public waters. The appearance of zebra mussels and Asian carp species below Gavins Point Dam has prompted South Dakota Game, Fish and Parks to try and inform and educate anglers about the presence of these invasives, and hopefully limit their spread upstream. Questions relating to aquatic nuisance species were asked in the 2009 angler use and harvest survey to gauge angler knowledge. South Dakota anglers were slightly more aware of the presence of zebra mussels and Asian carp below Gavins Point Dam than non-resident anglers fishing the surveyed reach (Table 62). However, a large number of anglers were unaware of the presence of either nuisance species. More education and outreach must be accomplished so that all anglers understand the negative impacts of these species, and so they can help prevent their spread to other waters.

Table 62. Response of anglers fishing the Missouri River April-October, 2009 from Fort Randall Dam downstream to the Nebraska, Iowa border, but excluding Lewis and Clark Lake, to the questions: "Are you aware that zebra mussels are present below Gavins Point Dam?" and "Are you aware that Asian carp are present below Gavins Point Dam?"

State	Are you aware that Zebra Mussels are present below Gavins Point Dam?				Are you aware that Asian carp are present below Gavins Point Dam?			
	Yes	%	No	%	Yes	%	No	%
SD	136	61	88	39	175	78	48	22
NE	131	57	98	43	156	69	71	31
All Interviewed Anglers	289	59	204	41	356	73	135	27

RARE FISH OBSERVATIONS

No state threatened or endangered fishes were observed during fish population survey sampling activities on Lewis and Clark Lake or the Missouri River upstream and downstream of Lewis and Clark Lake during 2009.

FISHERY STATUS

The results from the 2009 standard sampling indicate that most of the sport fish populations in Lewis and Clark Lake continue to remain abundant. This is especially true for the walleye and sauger populations which are near the highest levels recorded for the last 10 years. Additionally, the two species have quality size structures with half of the sampled walleye and a third of the sampled sauger 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 2009 (Table 63). Five mature year classes of walleye were present (2002-2006) and six (2001-2006) for sauger. Proportional size distribution and PSD-P were within the management objective range for walleye. For sauger, PSD was slightly above the management objective range of 30-60, and PSD-P was higher than the management objective of 10. Gill net CPUE's were also above the management objectives of 4.0 and 6.0 fish/net night for walleye and sauger respectively. Estimated total harvest and harvest rate (number of fish per hour) for walleye were well above the objective of 10,000 and 0.1 fish/hour. Sauger however, did not meet harvest or harvest rate objectives.

Channel catfish continue to be relatively abundant during the fall gill net survey (4.3/gill net) and exceeded the CPUE objective of 3/gill net (Table 63). Channel catfish size structure indices were within the set objective levels for PSD, and greater than objective levels for PSD-P (Table 63). Although channel catfish are popular with some anglers in the Lewis and Clark reservoir system, this fishery is underutilized on the other Missouri River reservoirs in South Dakota.

Largemouth and smallmouth bass CPUE continues to be well above the management objective of 10 fish/h, while PSD was within the management objective range of 30 to 60 for smallmouth and above the 30 to 60 range for largemouth (Table 63). However, size structure parameters are based on low sample sizes. Gilliland (1985) suggested that a sample size of 50 was insufficient for largemouth bass, while a sample size of 150 mirrored that of 500 when analyzing size structure. With sample sizes generally below 100, an increase in sampling effort for largemouth bass and smallmouth bass in Lewis and Clark Lake may be necessary in the future for better representation of population structure.

Currently, objectives in the Missouri River Fisheries strategic plan address angler days and harvest rates for all waters in the Missouri River system in South Dakota. The Lewis and Clark Lake strategic plan also contains objectives for angler days and fish harvest rates, verifying the importance of these metrics to fisheries management. The most accurate method of evaluating these objectives is with angler use and harvest surveys. It is important to conduct these surveys at least every four years, and more frequently if possible. Lewis and Clark Lake may not annually provide as many angler days as other Missouri River reservoirs, but it is an important fishery for the people of southeast South Dakota, Nebraska and other surrounding states.

Table 63. 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 the Lewis and Clark Reservoir system, 2009. Bold values were not within the objective range.

Species and Objectives	CPUE	PSD	RSP-P	Harvest	Harvest rate
Walleye	10.7 / gill	54	10	20,996	0.126
Objectives	≥4 / gill net	30-60	≥10	10,000	0.1 / hour
Sauger	8.3 / gill net	**61**	36	**3,330**	**0.020**
Objectives	≥6 / gill net	30-60	≥10	5,000	0.1 / hour
Channel Catfish	4.3 / gill net	56	18		
Objectives	≥3 / gill net	30-60	≥10		
Largemouth Bass	81 / hour	**85**	36		
Objectives	≥10 / hour	30-60	≥20		
Smallmouth Bass	43 / hour	39	**19**		
Objectives	≥10 / hour	30-60	≥20		

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

Presently, fish population trends seem stable in the Lewis and Clark Reservoir system with many population structural index values similar or higher than those of previous surveys. However, water levels and flow regimes in this system and their effects on fish populations are relatively unknown. Combined with the changing nature of the system due to expansion of the Niobrara River delta and overall increases in the rate of sediment deposition, the fishery present in Lewis and Clark Lake and the upstream Missouri River stretch will likely exhibit more variability in population structure and fish habitat use in the future.

MANAGEMENT RECOMMENDATIONS

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

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

- Determine alternate sampling methods or increase effort for smallmouth/largemouth bass sampling. The sample sizes for both black bass species is consistently small and needs to be addressed.

- 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, largemouth, and smallmouth bass.

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

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APPENDICES

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

Common name	Scientific name	Abbreviation
Bigmouth buffalo	*Ictiobus cyprinellus*	BIB
Black bullhead	*Ameiurus melas*	BLB
Black crappie	*Pomoxis nigromaculatus*	BLC
Bluegill	*Lepomis macrochirus*	BLG
Blue sucker	*Cycleptus elongatus*	BSR
Bluntnose minnow	*Pimephales notatus*	BLM
Brassy minnow	*Hybognathus hankinsoni*	BRM
Buffalo spp.	*Ictiobus spp.*	--
Channel catfish	*Ictalurus punctatus*	CCF
Common carp	*Cyprinus carpio*	COC
Common shiner	*Notropis cornutus*	COS
Creek chub	*Semotilus atromaculatus*	CRC
Emerald shiner	*Notropis atherinoides*	EMS
Fathead minnow	*Pimephales promelas*	FHM
Flathead catfish	*Pylodictis olivaris*	FHC
Flathead chub	*Platygobio gracilis*	FLC
Freshwater drum	*Aplodinotus grunniens*	FRD
Gizzard shad	*Dorosoma cepedianum*	GZD
Golden shiner	*Notemigonus crysoleucas*	GOS
Goldeye	*Hiodon alosoides*	GOE
Grass pickerel	*Esox americanus vermiculatus*	GRP
Green sunfish	*Lepomis cyanellus*	GRS
Johnny darter	*Etheostoma nigrum*	JOD
Largemouth bass	*Micropterus salmoides*	LMB
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. Access sites surveyed during the angler use and sportfish harvest survey, April-October, 2009.

Zone		State	Site	River Mile
1	Fort Randall Dam tailwaters	SD	Fort Randall	881.1
			Randall Creek	881.7
2	Upper Missouri River	SD	Running Water	843
		NE	Sunshine Bottom	868.2
			Verdel	853
			Bazile Creek	840.8
			Ferry Landing	843
			Niobrara Ramp	844.9
			Niobrara Bridge	846
3	Lewis and Clark Lake	SD	Bottom Road	837
			Springfield	834
			Sand Creek	831
			Snatch Creek	829.6
			Navratlis Cove	828
			Charley Creek	826.5
			Tabor	821.9
			Gavins Point	816.5
			Midway	814.9
			Yankton Marina	813.4
		NE	Miller Creek	822.9
			Bloomfield	821.4
			Weigand Marina	818
			South Shore	813.4
4	Gavins Point Dam tailwaters	SD	North Shore	810.5
		NE	South Shore	810.5
5	Lower Missouri River	SD	Myron Grove	787
			Clay County Access	780.5
			Bolton	756.7
			Rosenbaum	749
			Riverside Park	806
		NE	Brooky Bottom	785
			Ponca State Park	753.5
			Mulberry Bend	776
			St. Helena	798.8

Appendix 4. Select information from previous angler harvest and use surveys; L&C System represents zones 1, 2, and 3 combined. GPDT = Gavins Point Dam tailwater, LMR = Lower Missouri River from GPDT to the confluence with the Big Sioux River near the Iowa, Nebraska border. Survey dates differed; 1984, 1994, 2001, and 2005 were conducted April-September, 1995 was conducted May-September, and 2000 was conducted April-December.

	1984			1994			1995		
	L&C System	GPDT	LMR	L&C System	GPDT	LMR	L&C System	GPDT	LMR
WAE Harvest	12167	6554	x	16915	6550	x	22772	7182	x
WAE Release			x	41856	44419	x	27029	15199	x
WAE Caught			x	58771	50969	x	49801	22385	x
CCF Harvest	9002	2138	x	10073	8917	x	5525	3885	x
CCF Release			x	1876	3043	x	1371	2932	x
CCF Caught			x	11949	11960	x	6896	6817	x
Overall Harvest	33412	45101	x	39302	81450	x	47994	36328	x
Overall Release			x	64462	126842	x	63101	51649	x
Overall Caught			x	103764	208292	x	111095	87977	x
Pressure (angler-h)	106818	79743	x	121932	92002	x	191543	92123	x
Boat Hours	85603	40581	x	101318	46391	x	165736	44806	x
Mean Trip Length	4.1	4.2	x	3.5	3.3	x	3.4	2.8	x
Boating Days	20879	9662		28948	14058	x	48746	16002	x
WAE Harvest Rate	0.12	0.08	x	0.139	0.071	x	0.119	0.078	x
WAE Catch Rate			x	0.482	0.554	x	0.26	0.243	x
CCF Harvest Rate	0.08	0.03		0.083	0.097	x	0.029	0.042	x
CCF Catch Rate				0.098	0.13	x	0.036	0.074	x
Overall Harvest Rate	0.31	0.4	x	0.322	0.885	x	0.251	0.394	x
Overall Catch Rate			x	0.851	2.264	x	0.58	0.955	x

Appendix 4 continued.

	2000			2001			2005		
	L&C System	GPDT	LMR	L&C System	GPDT	LMR	L&C System	GPDT	LMR
WAE Harvest	22883	4820	1973	34617	1396	x	9001	x	x
WAE Release	52158	14474	3288	29829	5600	x	11330	x	x
WAE Caught	75041	19294	5261	64446	6996	x	20331	x	x
CCF Harvest	20490	10473	5538	18672	4706	x	12282	x	x
CCF Release	21260	20233	18006	13740	6147	x	5381	x	x
CCF Caught	41750	30706	23544	32412	10853	x	17663	x	x
Overall Harvest	81022	63454	14944	67338	26097	x	35972	x	x
Overall Release	141439	122412	32718	91321	49764	x	46431	x	x
Overall Caught	222459	185866	47663	158659	75861	x	82403	x	x
Pressure (angler-h)	249029	147545	62176	250219	81093	x	165028	x	x
Boat Hours	x	x	x	215457	27119	x	130698	x	x
Mean Trip Length	reported 5.9 combined		x	3.76	3.32	x	4.41	x	x
Boating Days	n/a	n/a	n/a	57303	8168	x	29612	x	x
WAE Harvest Rate	0.092	0.033	0.032	0.138	0.017	x	0.055	x	x
WAE Catch Rate	0.301	0.131	0.085	0.258	0.086	x	0.123	x	x
CCF Harvest Rate	0.082	0.071	0.089	0.075	0.058	x	0.074	x	x
CCF Catch Rate	0.168	0.208	0.379	0.130	0.134	x	0.107	x	x
Overall Harvest Rate	0.325	0.430	0.240	0.269	0.322	x	0.218	x	x
Overall Catch Rate	0.893	1.260	0.767	0.634	0.935	x	0.499	x	x