SOUTH

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FISHERIES

ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST, AND PREFERENCE SURVEYS
ON
LAKE OAHE, SOUTH DAKOTA, 2011

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

Annual Report
No. 12-05

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ON
LAKE OAHE, SOUTH DAKOTA, 2011

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Annual Report

Dingell-Johnson Project --F-21-R-44
Job Numbers--- 2102 and 2109
Date ---March 2012

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PREFACE

Information collected during 2011 is summarized in this report. Copies of this report and references to the data can be made with permission from the authors or the Director of the Division of Wildlife, South Dakota Department of Game, Fish, and Parks, 523 E. Capitol, Pierre, SD 57501.

The authors would like to thank the following individuals from the South Dakota Department of Game, Fish and Parks who helped with data collection, data entry, manuscript preparation, and report editing: John Aberle, Brian Beel, Linsey Coit, Layne Duvall, Nick Emme, Josh Gerber, Doug Jones, Dan Jost, Jason Jungwirth, Nicholas Johnson, Darla Kusser, Emily Moses, Mallory Peterson, Nate Satre, Keith Swartz and Pete Weinzirl.

The collection and analysis of data for these surveys was funded, in part, by Federal Aid in Sport Fish Restoration, (D-J) project F-21-R-44, Statewide Fish Management Surveys. Some of these data have been presented previously in segments F-21-23 through 43.

EXECUTIVE SUMMARY

In 2011 the upper Missouri River basin received record rainfall resulting in three of the six wettest months on record documented this spring (April, May and June). This, combined with the above average snow pack in the Rocky Mountains and on the high plains, resulted in record flows throughout the entire Missouri River system during the summer of 2011. Thus, hydrological conditions present in the Missouri River in 2011 created sampling conditions never before witnessed. As such, care must be taken when interpreting biological data collected from the Missouri River impoundments in 2011.

This report includes data collected from annual fish population surveys and angler use and harvest surveys collected during 2011 on Lake Oahe, South Dakota. Fish population data and angler use and harvest survey data from previous years are referenced in this report. Results of these surveys are used to evaluate progress towards strategic plan objectives as outlined in the Missouri River Fisheries Program Strategic Plan.

Walleye, channel catfish and yellow perch comprised 41%, 21%, and 11% of the fish caught in the 2011 coolwater gill net survey, respectively. Twenty-three species were captured in the coolwater gill net survey samples in 2011. Mean CPUE for all species collected in 2011 were near ranges previously observed. Emerald shiners were the most abundant species captured during the August seining survey. Also abundant in 2011 were white bass, black crappie and yellow perch. Age-0 gizzard shad, first collected in the annual seining survey in 2001, were the most abundant species in seining survey catches since 2003. However, catches of shad have been declining since 2006. Since 2009, no gizzard shad have been captured during the seining survey.

Mean walleye gillnet catch per unit effort (CPUE) in 2011 was similar to previous years in the middle and upper zones. However, walleye CPUE was dramatically higher in the lower zone compared to the previous four years and overall CPUE was higher than the five year average. In 2011, stock-quality sized fish were well above the five year average; however, the quality-preferred and preferred-memorable size classes had declined. Although relative weight (*Wr*) has generally increased since 2007, it is slightly lower in 2011 than previous years. Length at capture for age-1 through age-3 walleye was less than the five year average in 2011. However, length at capture was higher for all age-5 and older fish. Additionally, walleye growth varied among zones and mean length at time of capture was generally higher in the lower zone of Lake Oahe. Mean annual incremental growth for age 1-2, 2-3, 3-4 and 4-5 walleye slowed in 2011.

Estimated fishing pressure for the South Dakota portion of Lake Oahe for 2011 was 1,320,814 h, the highest estimated since 1998 and approximately 15% higher than 2010. The highest estimated fishing pressure for the April-October period occurred in 1996 at 1,968,525 h. An estimated 1,816,970 fish were caught in Lake Oahe during the May-October 2011 survey; up 84% from 2010 at 989,299 fish. Walleye was the most caught species with an estimated 1,274,276 fish caught in 2011. Of the estimated 694,689 fish harvested from Lake Oahe during the May-October 2011 daytime period, 595,511 (86%) were walleye.

In 2011, resident anglers represented 75% of the parties interviewed on Lake Oahe. Of the nonresidents, four states represented the majority of home states and included Nebraska, Minnesota, Iowa and North Dakota. In 2011, the majority of anglers traveled >200 miles (one way) to fish Lake Oahe. Although high, this number is lower than the previous four years, and below the five year average.

Overall satisfaction on Lake Oahe during the May-October period of 2011 was at 88%, not including neutral or no opinion (Table 39). Median satisfaction rating for angling parties that harvested 0 to 1.9 walleye per person was “moderately satisfied”, while for parties harvesting two to four walleyes per person, median rating was “highly satisfied” (Table 40).

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INTRODUCTION

Lake Oahe is one of the largest and most economically important fisheries in the State of South Dakota with angler's averaging 161,000 trips annually over the last ten years (Longhenry et al. 2011). Anglers often travel more than 200 miles, one way, to take advantage of the fishing opportunities in Lake Oahe. The Lake Oahe fishery had an estimated direct economic impact of over $25 million for the April-October 1998 daylight period (US Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 1998). Approximately 264,668 trips occurred during the May-October 2011 daylight period on Lake Oahe, for an estimated economic input of ~$20.9 million (economic impact multiplier taken from U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2007).

Due to the importance of the Lake Oahe fishery to the State of South Dakota, these resources must be effectively managed to produce optimal recreational benefits. A prerequisite to the development of effective management strategies is the annual acquisition and analysis of data describing fish communities and population parameters, angler preference, use and harvest, and angler satisfaction data. These surveys provide essential information used in the evaluation of accomplishments towards objectives of the South Dakota Department of Game, Fish and Parks (SDGF&P) Missouri River Program Strategic Plan (SDGF&P 1994) and more specifically, the Lake Oahe Strategic Plan (LOSP). This report also evaluates fisheries management activities (regulations and stocking) and effects of environmental variables (water levels, weather, etc.) on Lake Oahe fisheries.

OBJECTIVES

The objectives of the annual fish population and associated surveys (Federal Aid Code 2102) are to provide information on:

1. Species composition and relative abundance
2. Population size structure
3. Sport fish condition
4. Age, growth, and recruitment

5. Survival and mortality rates
6. Fish reproduction
7. Effects of regulations
8. Success of stocking and other management activities
9. Effects of sport fish harvest on fish population status

Emphasis is given to selected species that may be important from a sport or prey perspective. Common and scientific names of fishes collected or observed during these surveys are listed in the Appendix 1.

The objectives of the angler use, harvest, and preference surveys (Federal Aid Code 2109) are to:

1. Estimate recreational angling pressure
2. Estimate fish harvest, by species
3. Estimate fish harvest rates and catch rates, by species
4. Provide statistics on mean angler party size, mean length of angler day, and angler residency
5. Provide estimates of the annual direct economic impact of Lake Oahe's fishery
6. Document effects of walleye regulations on the sport fishery and the walleye population
7. Document angler attitudes, preferences, and level of satisfaction

STUDY AREA

Lake Oahe is a mainstem Missouri River storage reservoir located in north-central South Dakota, downstream from Lake Sakakawea and upstream of Lake Sharpe. Historical, biological, chemical, and physical parameters have been discussed in South Dakota Game, Fish and Parks reports (Warnick 1987). Additionally, select physical characteristics and fisheries management classifications for Lake Oahe in South Dakota can be found in Michaletz et al. (1986) and reproduced in Table 1. Lake Oahe has been separated into three zones that include approximately four sampling locations within each zone (Figure 1) with the exception of the lower zone which was split in half for angler use and harvest surveys. Lake Oahe water elevation during August, the month the standard gill net and seining surveys are conducted, fluctuates frequently (Figure 2), but has remained above 1610 msl since 2009.

Table 1. Physical characteristics and management classification of Lake Oahe, South Dakota.

Oahe Dam closed in:	1958	***Reservoir length:**	372 km
Elevation at full pool:	1617 msl.	***Shoreline length:**	3,620 km
Surface area (SD portion):	110,660 ha	**Shoreline development index:**	26.4
Water volume:	2.9x10^3 L	**Drainage area:**	630,639 km^2
***+Coldwater habitat**	47,755 ha	***Average depth:**	18.3 m
Trophic status:	Oligo/meso	***Maximum depth:**	62.5 m
Bottom composition:	Sand, gravel, clay, and shale	**Morpho-edaphic index:**	28.4
Management classification:	Cold, cool, and warmwater permanent	**Water source:**	Missouri River and tributaries

*Denotes values for water elevation at full pool.
+Denotes upper surface area of water ≤15^oC in August.

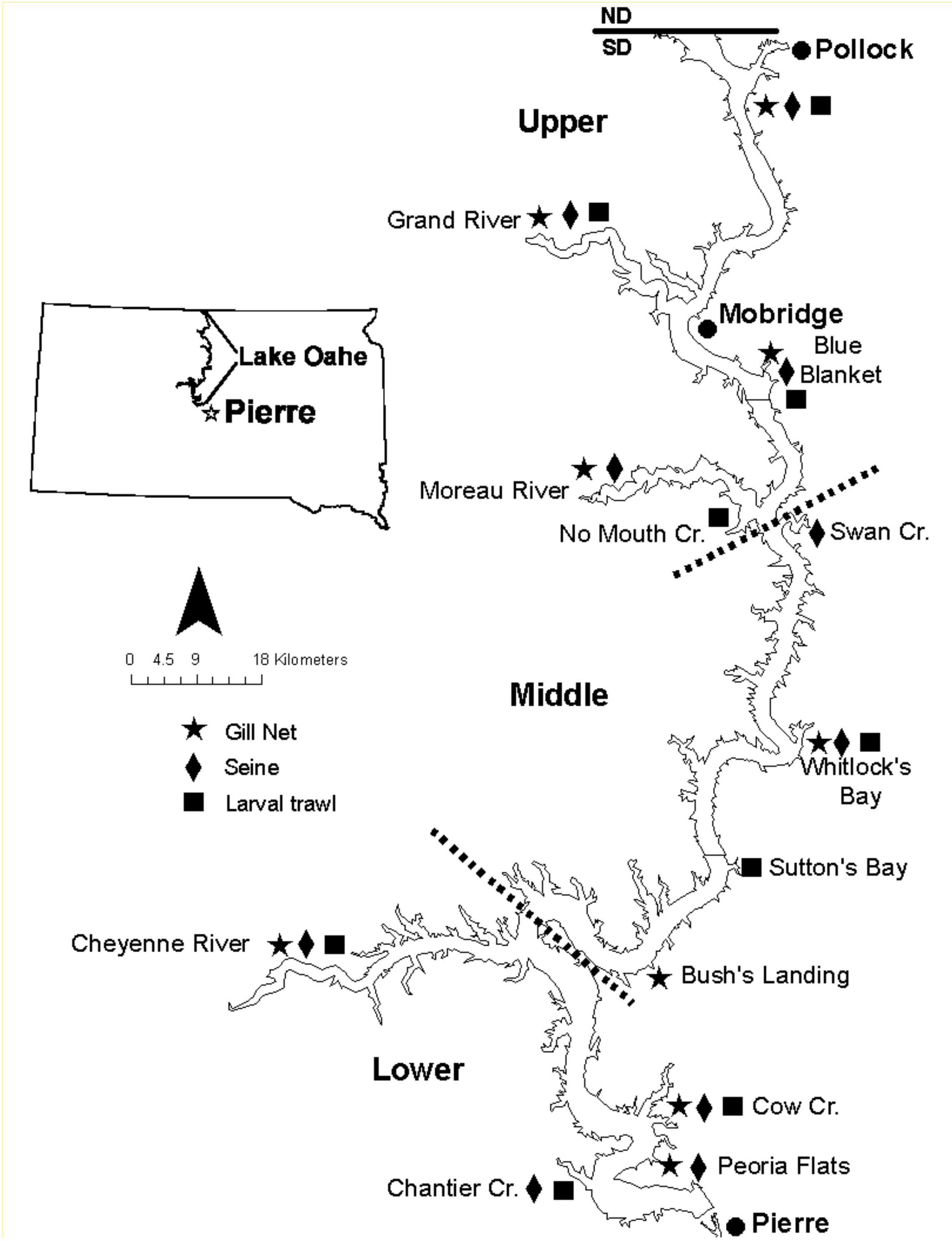

Figure 1. 2011 reservoir zones and fish population sampling locations on Lake Oahe, South Dakota.

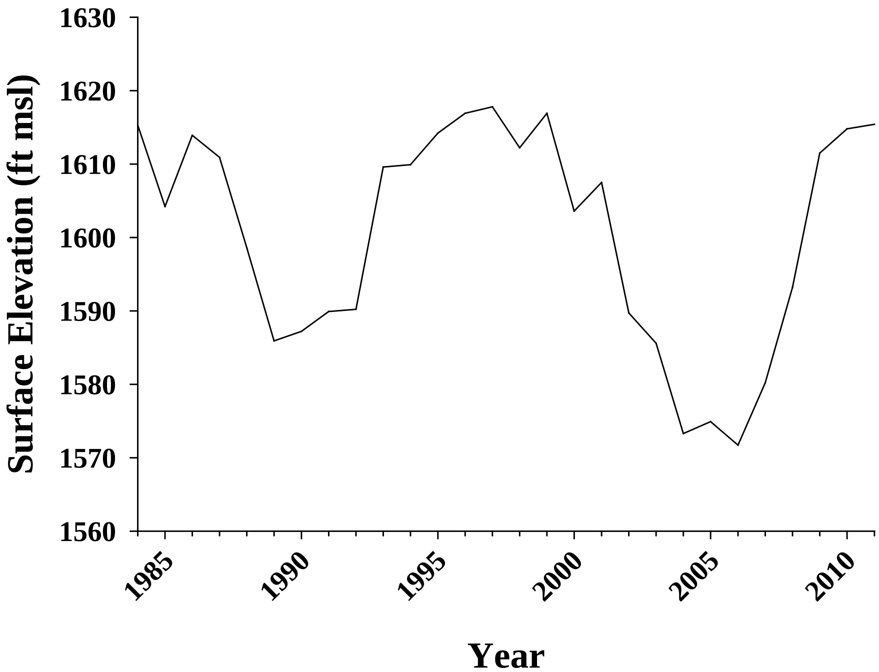

Figure 2. Average August elevation of Lake Oahe for the 1984-2011 period.

REGULATION HISTORY

Walleye harvest regulations for Lake Oahe have differed from standard statewide regulations since 1990. At that time, a 356 mm (14 in) minimum length limit was placed on Lakes Oahe, Sharpe, and Francis Case from April through June and the daily limit was four fish (Table). In 1999, the harvest regulations were amended to where only one fish in the daily limit could be 457 mm (18 in) or longer and the April through June minimum length limit was removed. The objective of this regulation change was to concentrate harvest on abundant walleye less than 381 mm (15 in) and reduce harvest of larger walleye in the population in order to maintain a quality fishery.

Due to rapid declines in rainbow smelt in the late 1990's, the daily walleye bag limit on Lake Oahe was increased from four to 14 fish in 2001. The objective of this regulation was to maximize harvest to reduce walleye abundance and subsequent predation pressure on rainbow smelt. At that time, walleye less than 381 mm (15 in) were in high abundance (Lott et al. 2002), so bag limits were changed to concentrate harvest on these smaller individuals where, at most, four fish could be 381 mm (14 fish daily limit).

The daily limit was reduced to ten fish for 2002 and 2003 and six fish for 2004 and 2005 due to decreases in walleye abundance (catch per gill-net night). Additionally, a decrease in angler satisfaction was associated with anglers unable to attain high daily limits, as hourly catch rates declined (Lott et al. 2004). The daily limit was thus reduced to the statewide daily limit of four fish beginning 1-January, 2006, while the possession limit of 12 fish was reduced to align with the statewide possession limit of eight fish on 1-January, 2007.

Table 2. History of harvest regulations for walleye on Lake Oahe, South Dakota, 1968 through 2011.

Species	Period	Daily limit	Possession limit	Length restrictions
Walleye, sauger, and hybrids, in combination	1968-1983	8	16	None
	1984-1989	6	12	None
	1990-1998	4	8	• April-June 14 inch minimum length
	1999-2000	4	8	• At most one equal to or longer than 18 inches
	2001	14	42	• At most four equal to or longer than 15 inches • At most one equal to or longer than 18 inches
	2002-2003	10	30	• At most four equal to or longer than 15 inches • At most one equal to or longer than 18 inches
	2004-2005	6	18	• At most four equal to or longer than 15 inches • At most one equal to or longer than 20 inches
	2006	4	12	• At most one equal to or longer than 20 inches
	2007-2011	4	8	• At most one equal to or longer than 20 inches

SAMPLING METHODS

FISH POPULATION SURVEYS

Data Collection

A suite of gears were used to collect fish throughout the summer of 2011 in Lake Oahe (Table 3). The standard coolwater fish population survey consists of setting three standard gill nets overnight (approximately 20 h). Gill nets were placed on the bottom in each depth zone (where possible), for a total of six or nine nets at each station (depending on water levels) (Figure). A standard gill net of multifilament nylon was 91.4 m (300 ft) long by 1.8 m (6 ft) deep, with 15.2 m (50 ft) panels of the following bar mesh sizes: 12.7 mm (1/2 in), 19.1 mm (3/4 in), 25.4 mm (1 in), 31.8 mm (1 1/4 in), 38.1 mm (1 1/2 in), and 50.8 mm (2 in).

All walleye collected during the standard coolwater gill net survey were measured for total length (mm) and weighed (g). Attempts were made to remove sagittal otoliths from ten fish within each ten mm length class for walleye, sauger, and hybrids captured at each sampling station (Figure). When possible, representative samples (at least 50 individuals per sampling station) of all other species were measured and weighed. Due to low catch rates and fluctuating water levels, deep water gill nets have been analyzed independently from standard gill nets.

A nylon, 6.4 mm (1/4 in) mesh bag seine, measuring 30.5 m (100 ft) long by 2.4 m (eight ft) deep with a 1.8 m (six ft) by 1.8 m (six ft) bag, was used to collect age-0 fishes and small littoral species. A quarter-arc seine haul was accomplished using methods described in Martin et al. (1981). Four seine hauls were made at each sampling station (Figure). All fish collected with seines were identified, counted and classified as age-0 or other.

Data Analysis

Relative abundance of fish species is expressed as mean catch per unit effort (CPUE) for gill net (No./net night) and seine (No./haul) catches. Standard error values were calculated for gill net and seining CPUE as a measure of sample variance. Age and growth analyses were conducted for ten walleye in each ten mm length class.

Otoliths from walleye and sauger less than 300 mm were viewed submersed in water in a black dish with an overhead light source and aged whole. For fish greater than 300 mm, otoliths were cracked through the focus and charred using a propane torch prior to age interpretation. Growth was expressed as mean length at age at time of capture. Incremental growth rates were estimated by subtracting the mean length of fish from a year class at the time of capture from the mean length at capture of the same year class the previous year. Age distributions were developed by assigning ages to all walleye captured during the survey, based on length at capture information. Mean age-0 walleye gill net CPUE was correlated with mean age-1 walleye CPUE to determine if age-0 CPUE was an adequate early indicator of recruitment.

Proportional size distribution (PSD; Anderson and Weithman 1978; Willis et al 1991) was calculated for channel catfish, smallmouth bass, white bass, walleye and yellow perch (Gabelhouse 1984; Table 4). Relative weight (*Wr;* Anderson 1980) was calculated using standard-weight (*Ws*) equations developed for walleye (Murphy et al. 1990), yellow perch (Willis et al. 1991), channel catfish (Brown et al. 1995), and white bass (Brown and Murphy 1991). Proportional size distribution and *Wr* were calculated using the WinFin software package developed by Francis (2000).

Acoustic surveys have been conducted over several years with a variety of equipment and processing techniques. Equipment specification used during the 2003 - 2005 surveys can be found in Nelson-Stastny (2001). Processing methods were not recorded for the 2003-2005 surveys. The 2007 data was collected by staff from the SDGF&P and data analysis was contracted with Hydroacoustics Technology Inc. Seattle, Washington (HTI project report 2444).

Data from 2008-2011 were collected with Biosonics equipment. Acoustic data were processed using EchoView™ Ver. 4.9 (Myriax Software Pty Ltd.) independently for each year and for above and below the thermocline. Based on visual inspection of the acoustic data, files were processed using echo integration techniques or fish trace counting. Higher density files were analyzed using echo integration because echograms could not be processed using fish trace counting due to overlapping fish traces. All files for each year were analyzed using the same technique.

Separation of age classes was based on size ranges determined from fish collected in historic mid-water trawl surveys. Fish lengths were converted to expected target strength using the empirical formula from Love (1977). The bottom line and thermocline depth line were identified for each file. Bottom lines were adjusted as needed to account for submerged structures along the bottom. Thermocline depths were chosen by creating a fixed depth line in the echogram that was: 1) near the depth region of the thermocline in the nearest available temperature profile and 2) separated the vertically stratified fish targets visually identified in the echogram. Each echogram was horizontally subdivided into 100 m intervals for the analysis.

For echo integration in 2009, 2010 and 2011, the expected mean target strength below the thermocline was -44.4 dB. Since the species composition above the thermocline is unknown, the expected mean target strength for above the thermocline was left as the default value (-40 dB). The estimates of year class densities were calculated by averaging the back scattering cross section for each transect, converting to target strength and computing length using the empirical formula from Love (1977). Back scattering cross section for individual echoes was converted into target strength by:

$$TS = 10\text{Log}\ (\sigma_{bs})$$

where TS = target strength (dB), σ_{bs} = back scattering cross section. Target strength to length was calculated from Love's equation:

$$TS = 19.1\ \text{Log}\ (L) - 0.9(F) - 62$$

where TS = target strength (dB), L = fish length (cm) and F = acoustic frequency. The proportion of each age/size class was then calculated (number of echoes in size class "X" / total number of echoes) for each transect. The proportions of each age class were multiplied by the estimated overall density to derive densities for each individual age class. For trace counting, the single target detection parameters used are provided in Table 7.

Table 3. Sampling times, depths, and gears for annual fish population surveys on Lake Oahe, South Dakota.

Survey	Time	Survey gear	Sampling specifics
Gill nets	August	Standard gill net *Deepwater gill nets	Three shallow (0-9 m) three middle (9-18 m), and three deep (18-27 m) at standardized locations
Shoreline seining	August	30.5-m by 2.4-m bag seine, 6.4-mm mesh	Four quarter-arc pulls at each station
Larval trawling	May-June	1-m x 2-m limnetic trawls, 0.5-mm mesh	Two trawls/week for four consecutive weeks, of 5-minute duration, at each station

* Number of deep water gill net sites varies with water levels.

Table 4. Minimum lengths (mm) of length-class designations used when calculating proportional stock density and relative stock density values for fish population survey samples (Gabelhouse 1984).

Species	**Length class**				
	Stock	**Quality**	**Preferred**	**Memorable**	**Trophy**
Channel catfish	280	410	610	710	910
Walleye	250	380	510	630	760
White bass	150	230	300	380	460
Yellow perch	130	200	250	300	380

Table 5. Analysis techniques used for hydro-acoustics data processing.

Year	**Location**	**Analysis technique**
2008	Above thermocline	Trace counting
	Below thermocline	Trace counting
2009	Above thermocline	Echo integration
	Below thermocline	Trace counting
2010	Above thermocline	Trace counting
	Below thermocline	Echo integration
2011	Above thermocline	Echo integration
	Below thermocline	Echo integration

Table 6. Rainbow smelt age classes used for size classification of hydroacoustic assesment.

Age class	**Size range**	**Target strength range**
Age 0	21-79 mm	-57.9 - -46.9 dB
Age 1+	80-180 mm	-46.8 - -40.1 dB
>180mm	>180 mm	> -40.0 dB

Table 7. Single target detection parameters used in the trace counting analysis.

Single target detection parameter	**Value used**
Target strength threshold	-60 dB
Pulse length determination level	6 dB
Minimum normalized pulse length	0.80
Maximum normalized pulse length	1.5
Beam compensation model	BioSonics
Maximum beam compensation	4.0 dB
Max. standard deviation of major axis	0.600
Max. standard deviation of minor axis	0.600

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

Data Collection

Angler use and sport fish harvest surveys conducted on Lake Oahe are patterned after a study designed by Schmidt (1975) for Lake Sharpe. Sampling includes aerial boat and shore angler counts to estimate fishing pressure, and angler interviews at lake access areas to estimate harvest rates, catch rates, release rates, mean party size, mean angler day length, target species, and angler state of residency. Flight dates and interview dates were selected using a stratified random design based on the assumption of different levels of fishing pressure for weekdays and weekend days/holidays. Lake access areas for angler interviews were also assigned using a stratified random design, with probabilities of assignment differing by access area and month. For a more detailed description of aerial count, angler interview, and data expansion techniques see Stone et al. (1994).

Sampling was conducted from 1-May, 2011 through 31-October, 2011, for the sunrise to sunset period. Angler satisfaction and attitude questions were included in angler interviews in 2011. In addition to asking anglers how satisfied they were with their fishing trip, considering all factors, anglers were asked questions “Where they launched there boat on there previous fishing trip” and “At what depth they caught walleye”.

Data Analysis

Pressure count and angler interview data were entered and analyzed using the Creel Application Software (CAS) package (Soupir and Brown 2002) and 80% confidence intervals were calculated for estimates of fishing pressure and harvest.

RESULTS AND DISCUSSION

FISH POPULATION SURVEYS

Species Composition and Relative Abundance

Catch per unit effort has historically been used as an index of population abundance or density. However, changes in fish behavior can also affect CPUE of gill nets (Hubert 1996). Because Lake Oahe is a storage reservoir, the elevation of the reservoir surface, and therefore the surface area and volume of the reservoir, change over time and are not the same each August when the coolwater gill net survey is conducted. For example, the average August surface elevation decreased from 1603.5 FT MSL in 2000 to 1571.6 FT MSL in 2006 and increased to 1613 in 2009. Therefore, caution should be used when inferring density or abundance of fish species captured in the standard gill net survey from CPUE compared temporally.

Walleye, channel catfish and yellow perch comprised 41%, 21%, and 11% of the fish caught in the 2011 coolwater gill net survey, respectively (Table 8). Twenty-three species were captured in the coolwater gill net survey samples in 2011 (Table 9). Mean CPUE for all species collected in 2011 were near ranges previously observed. Walleye were in the upper range compared to the previous four years and more comparable to the CPUE measured in the 1990's (Wickstrom et al. 1993; Johnson et al. 1999; Lott et al. 2007; Adams et al. 2009, Longhenry et al. 2011).

Emerald shiners were the most abundant species captured during the August seining survey, with a mean CPUE of 60.3 fish/haul (Table 10). Also abundant in 2011 were white bass (42.1 CPUE), black crappie (21.0 CPUE) and yellow perch (20.0 CPUE). Age-0 gizzard shad, first collected in the annual seining survey in 2001, have been the most abundant species in seining survey catches since 2003. However, catches of shad have been declining since 2006. Since 2009, no gizzard shad have been captured during the seining survey.

In 2011, walleye were the most abundant fish species captured in the deepwater gill net survey with a mean CPUE of 26 walleye/net night (Table 11). This is the highest CPUE of walleye documented since the deepwater netting was started in 2007.

Freshwater drum (1.9 CPUE) and northern pike (1.1 CPUE) were also detected at densities much higher than previously documented (Table 11).

Population Parameters for Walleye

The increased water elevation of Lake Oahe in 2009 likely influenced the walleye abundance index (CPUE) estimates for the various reservoir zones (Longhenry et al. 2010). Water levels rose at rates faster than ever recorded during 2009 and the lake was above normal operating level most of the summer and fall. Changes in surface area, volume, and flow may also influence catch rates of other species in the standard fish population surveys so caution should be used when interpreting results. In 2011, water levels once again increased and Lake Oahe reached the highest elevation recorded with maximum pool cresting at 1619.7 msl in June and maintained near record full pool through July. Thus, caution must be taken when interpreting standard surveys and making comparisons temporally.

Unlike previous years, walleye CPUE in the standard gill net survey was similar in the upper and middle zones of Lake Oahe (Figure 3). The CPUE in the lower zone, which typically supports high gill net catches for walleye during the August gill net survey, was higher than the previous four years. With high catches of walleye in each zone, the lake wide walleye CPUE was higher than in previous years.

In 2011, walleye gill net CPUE for the entire reservoir increased from the previous four years and was above the five year average (Table 11). In 2011, stock-quality sized fish were well above the five year average; however, the quality-preferred and preferred-memorable size classes had declined (Table 12). Walleye PSD for the total Lake Oahe sample in 2011 was 29 (Table 13). This is slightly below the desired range of 30 to 60, which represents a balanced population (Anderson and Weithman 1978). However, this can be attributed to increased recruitment in 2008 and 2009 and an abundance of smaller fish. The PSD-P value of eight fell below the lakewide objective of ten from the Lake Oahe Strategic Plan. The high abundance of stock length walleye in the population played a key role in the decrease in 2011 stock distribution index values.

Although relative weight (*Wr*) has generally increased since 2007, it is slightly lower in 2011 than previous years (Table 14). The objective for mean relative weight for

Lake Oahe walleye is 90-100 and in 2011, this objective was not met. Length at capture for age-1 through age-3 walleye was less than the five year average in 2011 (Table 15). However, length at capture was higher for all age-5 and older fish. Additionally, walleye growth varied among zones (Table 16) and mean length at time of capture was generally higher in the lower zone of Lake Oahe. Mean annual incremental growth for age 1-2 , 2-3, 3-4 and 4-5 walleye slowed in 2011 (Table 17) and could be possibly attributed to colder water temperatures. The age 1-2 fish exhibited the largest reduction in length added, with approximately half the growth compared to previous years (Table 17). Sixteen year classes were represented in 2010 (Table 18). The 2009 (age-2) year class comprised 70% of the 2011 gill net sample and was the largest year class for the second year in a row. Additionally, the 2008 year class is large and in 2011, 86% of the walleye sample were age-3 or younger.

Currently, 254-381 mm TL (10-15 in) walleye make up the highest percentage of the population in 2011 (Figure 4). Numbers of fish above 508 mm (20 in) are currently higher than the 2000 to 2001 period, but remain below those recorded in the late 1990's. The lower zone continues to produce more walleye above preferred length when compared with the middle and upper zones (Figure 5). Numbers of fish below 254 mm were again lower in the lower part of Lake Oahe suggesting poor recruitment in this zone. In previous years, walleye production in the lower zone of Lake Oahe has been low while growth is generally faster than the other two zones of the reservoir (Longhenry et al. 2010).

<u>Population Parameters for Rainbow Smelt</u>

The high water flows through the entire Missouri River system in 2011 had substantial impacts on the rainbow smelt population so we recommend using caution when interpreting these data. Estimates of age-0 rainbow smelt in 2011 were the third highest recorded in the past 12 years with a total of 128 million age-0 rainbow smelt estimated at the time of the survey (Table 19). However, preliminary hydro-acoustics transects suggest much higher numbers in early July, but decreasing throughout the summer months due to entrainment (M. Fincel and K. Edwards unpublished data). Additionally, high discharge through Oahe Dam were witnessed through September and it is likely that entrainment reduced the number of rainbow smelt in Oahe after our standard surveys were conducted (M. Fincel and K. Edwards unpublished data).

At the time of the standard population survey, Lake Oahe had similar numbers of adult rainbow smelt ($\geq$ Age-1) compared to 2010 (Table 19); however, this number is reduced compared to the mid 2000's. Additionally, warm water prey fish abundance is higher than 2010 though much reduced compared to the mid 2000's. This decline in warm water prey fish is likely a function of the absence of gizzard shad in Lake Oahe following the winters of 2008 and 2009. All age classes of rainbow smelt were observed in high concentrations in zone two (Table 20). A relatively high proportion of adults to juveniles was observed in the lower and upper zones and may suggest poor recruitment in those zones (Table 20). Conversely, a high juvenile to adult ratio was observed in the middle zone which may suggest conditions in this zone that contribute to better recruitment, comparatively.

Table 8. Relative species composition, expressed as percent of total catch by number, of fish species collected during August standard gill net survey during 2007 through 2011.

Species	Year				
	2007	2008	2009	2010	2011
Channel catfish	36	41	29	29	21
Walleye	30	27	21	24	41
Gizzard shad	6	4	0	0	0
Freshwater drum	4	4	3	3	2
River carpsucker	1	2	2	1	1
Yellow perch	7	6	26	32	11
Common carp	2	3	5	4	2
Goldeye	3	2	0	1	2
White bass	2	2	1	1	6
Other	9	8	13	14	13

Table 9. Mean catch per unit effort (CPUE; No./net-night) and standard error values (SE) for selected fish species collected with standard coolwater gill nets in 2007-2011. Trace (T) indicates values less than 0.05.

Species	**Year**									
	2007		**2008**		**2009**		**2010**		**2011**	
	CPUE	**SE**	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**
Bigmouth buffalo	0.2	0.1	0.4	0.1	T	--	0.2	0.1	0.4	0.3
Black bullhead	0.0	---	0.0	---	T	--	0.0	0.0	0.2	0.2
Bluegill	0.1	---	0.1	0.0	0.5	0.3	0.2	0.1	0.2	0.2
Channel catfish	18.8	1.5	28.0	2.3	16.2	1.7	14.7	1.3	2.8	0.8
Chinook salmon	0.0	---	T	---	T	--	0.0	0.0	T	--
Common carp	1.1	0.2	2.0	0.3	3.0	0.4	2.7	0.3	1.5	0.2
Freshwater drum	1.8	0.2	2.0	0.5	1.5	0.3	2.3	0.3	0.6	0.2
Gizzard shad	3.3	1.3	2.0	0.7	0.2	0.1	0.1	0.0	0.0	0.0
Goldeye	1.3	0.3	1.2	0.3	0.1	0.1	0.5	0.2	1.4	0.3
Lake herring	0.0	---	0.0	---	T	--	T	--	0.06	0.03
Northern pike	0.1	T	0.1	0.0	0.5	0.1	1.5	0.3	2.0	0.3
Paddlefish	T	T	T	---	0.0	0.0	0.0	0.0	0.0	0.0
Rainbow smelt	0.0	---	0.4	0.2	0.3	0.1	T	--	0.0	0.0
River carpsucker	0.7	0.2	1.0	0.2	1.0	0.3	1.1	0.3	0.5	0.2
Sauger	1.4	0.3	1.0	0.2	0.9	0.2	0.6	0.2	0.3	0.08
Shorthead redhorse	0.2	0.1	0.1	0.1	0.2	0.1	0.6	0.2	0.5	0.2
Shortnose gar	0.0	---	0.2	0.1	0.1	0.1	T	--	0.0	0.0
Smallmouth bass	1.9	0.8	1.0	0.5	2.3	0.5	4.2	0.7	0.1	0.05
Smallmouth buffalo	0.1	T	0.2	0.1	0.3	0.1	0.2	0.1	0.1	0.8
Spottail shiner	0.3	0.1	0.1	0.0	0.2	0.1	0.0	0.0	0.7	0.05
Walleye	15.6	2.2	14.0	2.0	12.1	1.9	18.4	1.9	20.6	1.8
White bass	1.1	0.3	1.0	0.4	0.6	0.2	1.1	0.2	3.1	0.7
White crappie	0.3	0.3	0.2	0.1	1.6	0.7	1.4	0.3	0.5	0.2
White sucker	T	T	0.1	0.1	0.4	0.1	0.6	0.2	0.4	0.1
Yellow perch	3.5	0.7	3.0	1.0	14.6	3.5	24.0	4.5	6.4	0.8

Table 10. Mean catch per unit effort (CPUE; No./haul) and standard error (SE) values for fish species collected during the standard August seining survey, 2007-2011. Catches are for age-0 fishes except where noted. Trace (T) indicates values less than 0.05.

Species	Year									
	2007		2008		2009		2010		2011	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0.0	--	0.0	--	0.0	--	0.1	0.1	0.0	--
Black crappie	0.0	--	T	--	9.1	9.1	3.9	2.4	21.0	20.6
Bluntnose minnow	0.0	--	0.0	--	0.7	0.7	0.0	--	0.0	--
Brassy minnow*	0.3	0.2	T	--	0.1	0.1	0.7	0.4	0.3	0.3
Channel catfish	4.1	2.8	2.0	1.8	0.0	--	0.0	0.0	T	--
Common carp	0.4	0.3	1.0	0.5	0.6	0.4	0.2	0.1	0.5	0.3
Emerald shiner*	21.4	8.3	12.0	8.1	14.6	6.1	7.9	3.6	60.3	45.9
Fathead minnow*	0.0	--	0.0	--	0.1	0.1	20.9	14.2	0.3	0.2
Freshwater drum	2.0	0.6	0.3	0.1	0.0	--	0.1	0.1	2.2	1.4
Gizzard shad	118	56.1	76.0	31.0	22.0	13.7	0.0	--	0.0	--
Goldeye	0.6	0.4	0.5	0.2	0.0	--	0.0	--	0.0	--
Johnny darter*	0.1	0.1	T	--	0.4	0.2	1.1	0.4	1.0	0.3
Lake herring	0.0	--	0.2	0.2	0.1	--	0.0	0.0	0.0	0.0
Largemouth bass	0.0	--	0.5	0.3	0.0	--	0.3	0.2	T	--
Northern pike	0.0	--	0.1	0.1	0.4	0.2	0.0	--	T	--
River carpsucker	1.1	0.4	1.0	0.5	2.3	1.7	0.8	0.5	0.3	0.2
Silvery minnow	0.0	--	0.0	--	0.0	--	0.1	0.1	0.0	--
Smallmouth bass	4.1	1.1	37.0	14.0	8.3	2.3	7.9	2.0	10.4	2.3
Smallmouth buffalo	0.0	--	0.0	--	4.8	1.9	T	--	0.0	--
Spottail shiner*	5.1	1.6	2.0	0.5	6.3	3.4	12.7	5.3	3.0	1.5
Walleye	0.1	T	0.2	0.1	1.3	0.7	0.2	0.1	0.2	0.2
White bass	15.2	4.1	20.0	4.7	135.0	56.9	38.9	17.5	42.1	19.5
White crappie	3.3	1.5	15	5.1	13.5	6.3	28.9	27.0	10.1	6.3
White sucker	0.1	T	1.0	0.4	2.4	2.3	0.3	0.2	T	--
Yellow perch	5.0	2.1	35	17.0	393.0	217.0	44.8	27.1	20.0	7.6

* Includes all ages.

Table 11. Mean catch per unit effort (CPUE; No./net) and standard error (SE) values for all fish species collected during the standard August deep water gill net survey, 2007-2011. Trace (T) indicates values less than 0.1.

Species	**Year**									
	2007		**2008**		**2009**		**2010**		**2011**	
	CPUE	**SE**	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**
Bigmouth buffalo	0	0	0.1	0.1	0	0	0	0	0	0
Burbot	0.1	0.1	0	0	0	0	0	0	0	0
Channel catfish	8.5	1.5	14.7	3.7	3.9	1.0	9.8	3.0	4.2	0.6
Chinook salmon	0.3	0.2	1.3	0.5	0.3	0.1	0.7	0.3	0.1	0.1
Common carp	0.4	0.2	0.2	0.1	0.1	0.1	0.7	0.4	0.3	0.1
Freshwater drum	0.1	0.1	0	0	0	0	0	0	1.9	0.6
Gizzard shad	0	0	0.1	0.1	0	0	0	0	0	0
Goldeye	0.2	0.2	0	0	0	0	0.5	0.4	0.5	0.1
Lake herring	10.7	2.8	10.8	2.5	6.8	1.9	7.9	2.2	1.3	0.6
Northern pike	0	0	0	0	T	--	0	0	1.1	0.4
Rainbow smelt	1.1	0.4	1.3	0.6	10	3	8.7	2.9	T	--
River carpsucker	0.1	0.1	0	0	0	0	0	0	0	0
Sauger	0.2	0.1	0.2	0.1	0.1	0.1	0	0	0.1	0.1
Smallmouth bass	0	0	0	0	0	0	0.3	0.2	T	--
Walleye	4.6	1.5	8	2.6	2.2	0.7	5.4	1.5	26	4.6
White bass	0.3	0.3	0	0	0	0	0.1	0.1	T	0
White crappie	0	0	0	0	0	0	0	0	0.1	0.1
White sucker	0	0	0	0	0.2	0.1	1	0.3	T	--
Yellow perch	0.8	0.3	1.7	0.9	0.5	0.3	9.5	2.7	1.7	0.6

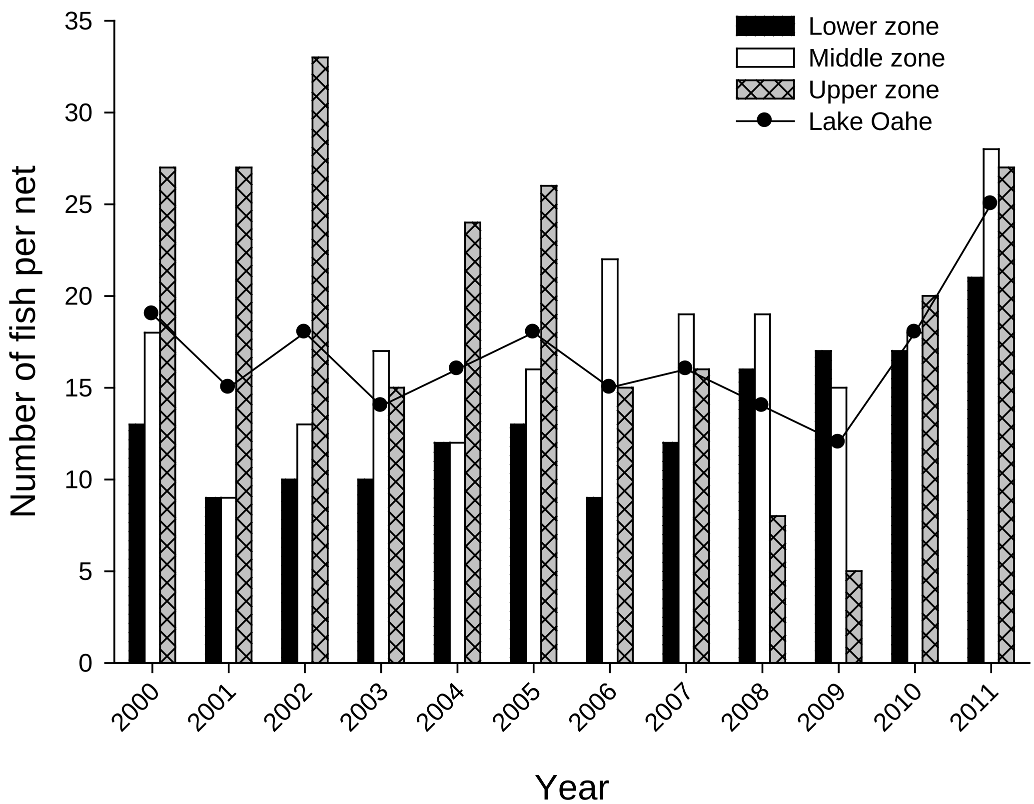

Figure 3. Mean walleye catch per unit effort (No./net-night) in the coolwater gill net survey for lower, middle, and upper zones of Lake Oahe, South Dakota, 2000-2011.

Table 12. Mean walleye catch per unit effort (No./net-night) in the standard coolwater gill net survey, by year and length group, for 2007-2011.

Year	Length group				
	Substock	**Stock-quality**	**Quality-preferred**	**Preferred-memorable**	**Total**
2007	2	4	7	2	16
2008	1	7	5	2	14
2009	2	10	8	2	12
2010	6	8	3	2	18
2011	4	23	2	1	30

Table 13. Walleye proportional size distributions (PSD, PSD-P,PSD-M), by reservoir zone, for fish collected during the standard coolwater gill net, 2007-2011.

Year	Zone											
	Lower			**Middle**			**Upper**			**Total**		
	PSD	**PSD-P**	**PSD-M**	**PSD**	**PSD -P**	**PSD-M**	**PSD**	**PSD -P**	**PSD-M**	**PSD**	**PSD -P**	**PSD-M**
2007	77	27	2	35	5	0	70	4	0	62	11	1
2008	68	18	2	29	6	0	58	13	0	49	12	1
2009	90	24	3	55	8	1	72	9	0	76	19	2
2010	43	18	1	33	7	0	40	8	1	39	12	0
2011	51	15	1	17	4	0	19	5	1	29	8	1

Table 14. Mean walleye relative weight (*Wr*) values, by length group, 2007-2011. N is number of stock-length fish in a sample.

Year	Length group							
	Stock-quality		**Quality-preferred**		**Preferred**		**Total sample**	
	Wr	**N**	***Wr***	**N**	***Wr***	**N**	***Wr***	**N**
2007	87	255	86	343	87	70	87	673
2008	88	366	88	274	84	80	87	769
2009	90	138	93	326	90	80	91	556
2010	87	407	90	182	89	78	88	659
2011	83	729	89	229	87	79	84	1045

Table 15. Mean length-at age at time of capture (mm) for walleye collected in the standard August coolwater gill net survey, 2007-2011.

Year		**Length at age at capture (mm)**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2007	**Mean**	242	367	420	459	477	488	516	526	516	526	617	527
	N	137	265	57	59	29	91	13	16	5	5	3	6
	SE	2.5	1.6	4.0	4.2	6.3	4.8	13.5	17.1	26	15.0	53	14.2
2008	**Mean**	251	349	431	478	512	517	532	555	561	544	564	600
	N	79	307	171	16	24	33	48	10	10	4	4	6
	SE	3.0	1.6	2.2	7.5	8.0	7.7	5.6	16.3	17.2	26.4	28.4	35.7
2009	**Mean**	248	363	431	487	513	542	543	532	574	617	524	558
	N	83	124	208	86	2	7	12	31	6	9	2	3
	SE	3.8	2.6	1.9	3.4	33.0	8.8	17.7	8.5	15.7	17.7	22.0	5.8
2010	**Mean**	248	339	433	488	516	494	602	596	555	557	514	570
	N	439	177	81	93	58	4	2	4	5	2	1	1
	SE	2.2	3.0	3.6	3.3	7.3	22.7	13	28.7	17.6	56	---	---
2011	**Mean**	196	303	400	478	514	547	534	564	559	619	596	581
	N	45	1007	116	44	50	29	1	3	4	3	2	2
	SE	4	2	5	6	7	8	--	16	26	29	25	21
Five year Average		237	344	423	478	506	518	545	555	553	573	563	567

Table 16. Mean length (TL; mm) at time of capture, by reservoir zone, for walleye collected in the coolwater gill net survey from 2009 through 2011. N is sample size and SE is standard error.

Zone	Age	2009			2010			2011		
		Length	N	SE	Length	N	SE	Length	N	SE
Lower	**1**	290	17	6	295	137	2	170	5	44
	2	384	20	5	391	21	8	351	246	3
	3	435	125	2	450	20	8	436	29	6
	4	489	64	4	495	50	4	499	22	4
	5	--	--	--	526	30	6	508	36	8
	6	539	4	15	530	2	24	543	18	10
	7	553	9	23	589	1	--	534	1	--
	8	541	23	9	638	2	31	558	2	26
	9	592	2	45	547	3	20	566	3	35
	10	616	7	23	603	1	--	--	--	--
	11	524	2	22	514	1	--	571	1	--
	12	558	3	6	570	1	--	--	--	--
Middle	**1**	236	52	4	239	158	3	211	5	7
	2	355	86	3	345	69	4	303	400	3
	3	420	69	3	428	29	4	399	41	8
	4	468	12	9	493	18	8	466	15	9
	5	546	1	--	523	9	14	534	8	13
	6	546	3	10	--	--	--	565	8	18
	7	519	1	--	615	1	--	--	--	--
	8	496	6	22	556	2	26	577	1	--
	9	566	4	14	608	1	--	--	--	--
	10	622	2	16	491	1	--	562	1	--
	11	--	--	--	--	--	--	--	--	--
	12	--	--	--	--	--	--	560	1	--
Upper	**1**	241	14	7	215	149	3	198	31	3
	2	378	18	5	325	79	4	270	363	3
	3	441	14	8	434	27	7	379	47	7
	4	493	10	10	480	17	7	450	8	20
	5	480	1	--	495	10	35	519	6	17
	6	--	--	--	458	2	5	521	4	18
	7	--	--	--	--	--	--	--	--	--
	8	--	--	--	--	--	--	--	--	--
	9	--	--	--	527	1	--	536	1	--
	10	--	--	--	--	--	--	647	2	13
	11	--	--	--	--	--	--	620	1	--
	12	--	--	--	--	--	--	602	1	--

Table 17. Mean annual growth (length) increment estimates for walleye collected in the coolwater gill net, for the 2006-2007, 2007-2008, 2008-2009, 2009-2010 and 2010-2011 periods.

Year	Growth increment added during period (mm)								
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
2006 -2007	111	65	32	16	9	32	2	--	--
2007-2008	107	64	58	53	40	44	39	35	28
2008 -2009	112	82	56	35	30	26	0	19	56
2009 -2010	91	70	57	29	-19	60	53	23	-17
2010 -2011	55	61	45	26	31	40	-38	-37	64

Table 18. Age distribution of walleye in 2006 through 2011, with standard coolwater gill net sets, as determined by aging otoliths.

	Age												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2006	25	267	125	105	56	148	20	28	10	7	5	17	9
2007	49	173	289	61	68	33	101	14	18	5	5	3	19
2008	12	68	317	176	16	22	35	48	10	10	3	5	5
2009	50	86	133	214	87	2	7	12	31	6	9	2	3
2010	1	575	184	77	86	50	4	2	4	5	2	1	1
2011	12	36	647	102	41	47	29	1	3	4	3	2	2

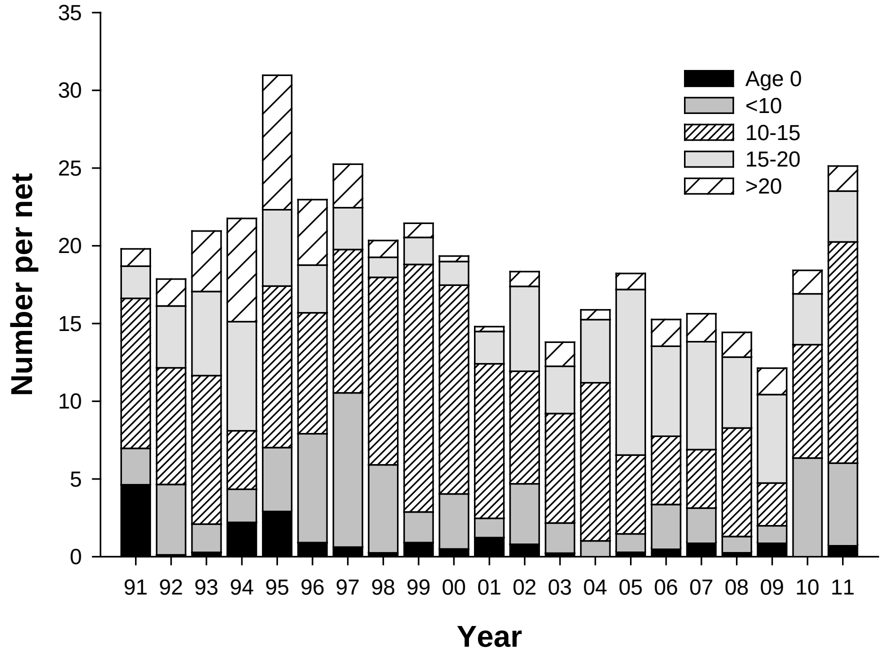

Figure 4. Length structure, in terms of catch per unit effort (CPUE), of walleye sampled in the standard coolwater gill net survey, 1991-2011.

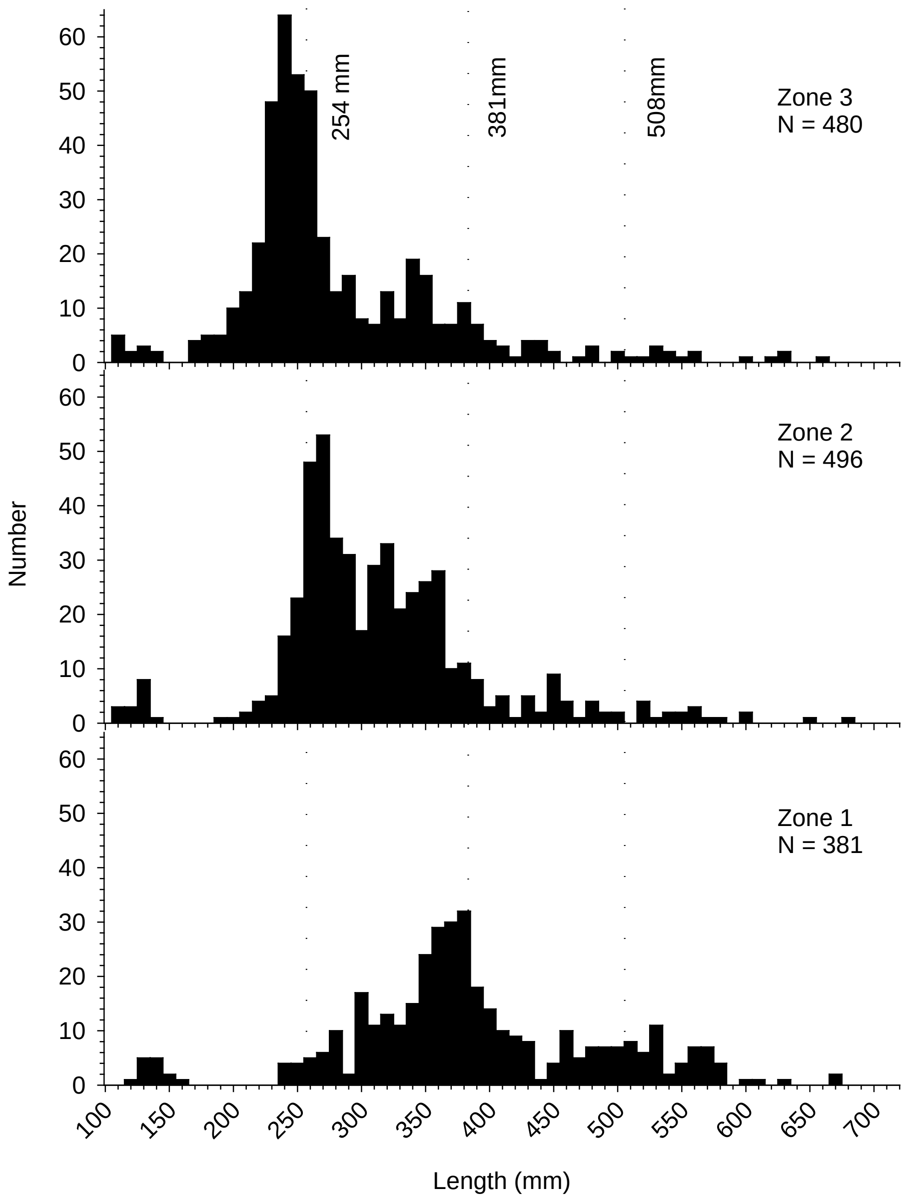

Figure 5. Length frequencies of walleye collected by zone, for fish collected during the standard coolwater gill net survey in 2011.

Table 19. Summary of 2000-2011 annual hydracoustic estimates of rainbow smelt.

Year	Age-0 smelt	≥ Age-1 smelt	Warmwater prey fish
2000	22,355,394	9,124,186	61,137,676
2001	301,694	0	46,481,942
2002	55,697,926	17,915,654	17,915,6654
2003	174,416,958	91,197,100	254,207,372
2004	23,027,641	113,632,146	584,760,961
2005	130,187,588	44,748,275	357,869,701
2006	58,876,298	116,948,745	254,966,028
*2007	44,475,598	65,110,154	143,385,687
**2008	17,081,481	22,313,083	38,246,299
2009	5,208,281	3,766,315	5,982,974
**2010	26,269,734	36,532,586	1,390,758
2011	128,129,398	31,371,181	3,381,414

* indicates year with HTI equipment and Erickson processing methods.

** Indicates year with Biosonics equipment and Echoview Software

Table 20. Summary of 2011 annual hydracoustic estimates of rainbow smelt by zone.

Zone	Age-0 smelt	≥ Age-1 smelt	Warmwater prey fish
1	15,351,572.63	9,960,254.36	3,871,281.36
2	108,327,474.07	18,284,698.16	6,800,942.02
3	4,450,351.40	3,126,229.01	4,450,351.40
total	128,129,398.10	31,371,181.54	15,122,574.78

ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

Angler Use

Estimated fishing pressure for the South Dakota portion of Lake Oahe for 2011 was 1,320,814 h; the highest estimated since 1998 and approximately 15% higher than 2010 (Table 21). The highest estimated fishing pressure for the April-October period occurred in 1996 at 1,968,525 h and 338,880 angler trips. In 2011, estimated fishing pressure and number of trips were 77% and 88% of the 1996 levels, respectively. Estimated fishing pressure peaked in July during the 2011 season, at 523,458 h or 40% of the fishing pressure for the months of April through October (Table 22). Approximately 79% of the fishing pressure in the April through October period occurred during the months of May, June, and July, which is higher than 70% in the same period in 2010 (Longhenry et al. 2010).

In 2011, angling pressure was the highest in the middle zone of Lake Oahe at 45% of the total estimated pressure, followed by the upper and lower zones at 30% and 25%, respectively (Table 22). The percentage of the total estimated fishing pressure taking place in the lower zone remained the same from 2010 to 2011 at 25%, but decreased for the upper zone going from 35% down to 30% (Longhenry et al 2010). Estimated fishing pressure, from vessel, has increased every year since 2007 and reached 1,279,595 h (Table 23). Conversely, shore fishing pressure has remained relatively constant during the same time period.

Estimated fishing pressure, calculated using full pool surface area, was 11.9 h per hectare for the May-October period in 2011 (Table 24). By zone, fishing pressure by hectare was highest in the middle zone, followed by the upper and lower zones at 17.5 h/ha, 11.3 h/ha and 7.9 h/ha, respectively. In 2011, fishing pressure by hectare was over twice as high in the middle zone compare to 1999, 2000, 2003 and 2004 (Table 24). Estimates for angler h per hectare for the 2006 through 2011 period ranged from 5.6 h/ha to 11.9 h/ha (Table 24).

Catch, Harvest and Release Estimates

Of the estimated 694,689 fish harvested from Lake Oahe during the May-October 2011 daytime period, 595,511 (86%) were walleye (Table 25). Smallmouth bass, channel catfish and northern pike were harvested at 4%, 4% and 3%, of the 2011 total harvest respectively. The walleye harvest during June and July (433,372 walleye) made up 73% of the total walleye harvest during the May-October period in 2011 (Table 25). An estimated 1,816,970 fish were caught in Lake Oahe during the 2011 survey (Table 26); up 84% from 2010 at 989,299 fish (Longhenry et al. 2011). Walleye was the most caught species with an estimated 1,274,276 fish (approximately 70%) caught in 2011. Smallmouth bass, northern pike and yellow perch followed walleye in terms of total estimated catch in 2011 (Table 26). As with fishing pressure, catch and harvest was highest in the months of June and July. The total catch estimate for June and July 2011 was 1,321,246 fish or 73% of the total for the May-October period. This approximately doubled the June and July catch estimates in 2010 (663,441 fish).

Similar to 2010, estimated walleye harvest in 2011 was highest in the middle zone of Lake Oahe, at 280,705 fish, followed by the upper and lower zones at 171,789 and 143,017 fish, respectively (Table 27; Longhenry et al. 2011). This is a return to a long term pattern such as 2008 when 36,663 and 122,679 walleye were harvested in the lower and upper zones, respectively (Adams et. al 2009). The majority of white bass and yellow perch harvest took place in the upper zone at approximately 65% for both species. With high entrainment during the summer months of 2011, and boating closures along the face of the dam, the Chinook salmon harvest was considerably lower than 2010 at 582 fish caught (Longhenry et al. 2011). Of these, 66% (383) were harvested from the lower zone of Oahe (Table 27).

Estimated walleye catch and the percentage of walleye caught that were harvested have varied greatly among years (Table 28). The percentage of fish caught that were harvested ranged from 23% to 41% during the 1997-2000 period due to the walleye population being dominated by fish less than 380 mm in length and high angler catch rates of walleye allowing anglers to be very selective in the fish they kept (Lott et al. 2002). The high increase in percentage of fish caught that were kept in 2001 was the result of liberal limits implemented that year. The percentage of walleye caught that were harvested decreased from 81% in 2001 to 65% in 2010. In 2011, catch rates were high and likely increased the release rates on Lake Oahe; thus, the percent harvest was 31%, the lowest since 1998 (Table 28).

Length frequency histograms of walleye harvested by anglers for all of Lake Oahe (Figure 6) suggest anglers generally begin harvesting walleyes at approximately 300 mm in length but prefer to harvest fish longer than 350 mm. Walleye < 300 mm were well represented in the population in all portions of Lake Oahe but were not harvested by anglers. The mean length of walleye harvested during the April-October 2009 period of 434 mm (17 inches) illustrates the increase in quality of the Lake Oahe fishery since the early 2000's. Unlike previous years, average size of harvested walleye generally remained the same between zones with the average size of walleye harvest of 419 mm, 415 mm and 419 mm average in the upper, middle and lower zones, respectively (Figure 7, 8, and 9). Smallmouth bass are typically an incidental catch by anglers and harvested by generalist anglers (Longhenry et al. 2011). In 2011, harvest of smallmouth bass was consistent across a range of sizes (Figure 10); however, the mean length of bass harvested decreased from 357 mm in 2010 to 352 mm in 2011.

Hourly Catch, Harvest, and Release Rates

Walleye catch rates exceeding 0.3 fish/angler-h are generally considered excellent (Colby et al. 1979), and mean angler catch rates for walleye on Lake Oahe have exceeded this number (1.42 fish/angler-h in 2011; Table 29, 30) since the annual surveys were initiated in 1991 (Stone et al. 1994, Table 29). Walleye catch rates were highest from 1997 through 2001 with peak catch rates of 1.18 walleye per hour occurring during 1998. Additionally, anglers actively fishing for walleye witnessed a 3.29 fish/angler-h catch rate in 2011, much higher than previous years (Longhenry et al. 2011; Table 31).

Catch rates for smallmouth bass, white bass, northern pike and channel catfish vary greatly among years (Table 29). Anglers actively fishing for smallmouth bass in 2011 had a catch rate of 4.36 fish/angler-h down slightly from 5.68 in 2010 (Table 31). Again, likely due to lake closures and downstream entrainment, Chinook salmon catch rates were trace in 2011, as a whole, and decreased to 0.11 fish/angler-h for those individuals targeting Chinook salmon (Table 31). This is vastly below the 2005 through

2009 period (Adams et al 2009, Longhenry et al. 2011). Release rate, appeared to parallel catch rates for walleye and all fish combined in 2011, where high catch rates accompanied high release rates (Table 32).

The percentage of anglers harvesting four walleye decreased from 16% in 2009 to 11% in 2010, but rose dramatically in 2011 to 31% (Table 33; Longhenry et al. 2011). In 2011, the percentage of angling parties catching zero walleye per trip was almost twice as high in the lower zone (21%) compared to the middle (11%) and upper (13%) zones. However, the number of anglers catching zero walleye per trip dropped in each zone from 2010 to 2011 (Longhenry et al. 2011). Additionally, the number of parties that caught more than ten fish per tip increased from 2% in 2010 to 26% in 2011 (Table 33).

Angler Demographics and Economic Input

In 2011, resident anglers represented 75% of the parties interviewed on Lake Oahe (Table 34). More non-resident anglers were interviewed in the upper zone (28%) followed by the middle (25%) and lower zones (22%). From 2008 to 2011, the percentage of non-resident angler contacts within each zone has remained similar (Longhenry et al. 2011; Table 3). Four states, Nebraska (27%), Minnesota (18%), Iowa (17%) and North Dakota (14%) made up 76% of the non-resident anglers that visited Lake Oahe (Table 35).

Visiting resident anglers fishing Lake Oahe have a tendency to fish the zone closest to their county of residency. For upper Lake Oahe, many anglers are from the northern tier of counties or along US Highway 12. Anglers fishing middle Lake Oahe tend to reside near US Highway 212 and anglers fishing lower Lake Oahe tend to live near US Highway 14. These three highways cross South Dakota in an east-west pattern. A large percentage (18%) of resident angler contacts for Lake Oahe in 2011 was from Hughes County (Table 36). The majority of resident anglers fishing lower Lake Oahe were from Hughes County (Figure 11). In middle Lake Oahe, the majority of resident anglers were from Hughes, Potter and Minnehaha counties (Figure 12). Resident anglers from Walworth and Brown counties were the majority of anglers fishing in upper Lake Oahe (Figure 13). Overall for Lake Oahe in 2011, the highest percentages of resident angler contacts for a county were Hughes (18%), Brown (11%), Walworth (10%), Minnehaha (8%), and Pennington (7%; Figure 14).

Lake Oahe is largely known as a destination fishery, as such, many anglers travel far distances for the angling opportunities provided by Lake Oahe. In 2011, the majority of anglers traveled >200 miles (one way) to fish Lake Oahe (Table 37). Although high, this number is lower than the previous four years, and below the five year average (41.8). In 2011, most anglers on Lake Oahe were targeting walleye (87%) with "anything" being the second most sought after species (9%; Table 38). In 2011, likely due to boating closures along Oahe Dam and entrainment of fish, anglers targeting Chinook salmon (2%) dropped appreciably from 2010 (8%) and 2009 (10%). For the May-October 2011 daytime period, the Lake Oahe fishery had a direct economic impact of 20.9 million dollars based on 264,688 trips at a value of $79 per trip (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2007). This is an increase from $17.7 million in 2010 and $16.5 million in 2009 (Longhenry et al. 2011).

Angler Satisfaction and Attitudes

Anglers' attitudes about fishing, their preferences concerning management issues and their level of satisfaction are important components in managing South Dakota fisheries. Historically, fisheries managers have primarily focused on understanding biological aspects of fish populations and monitoring sport fish harvest and use. However, biologists have now realized the necessity and value of understanding angler attitudes, levels of satisfaction, and preferences. Consequently, more attitude, preference and satisfaction data have been collected in recent years (Longhenry et al 2011). Angler assessment of the fishing experience is important to the success of a fishery. Angler responses help evaluate if current management practices and regulations are providing a fishery that meets angler needs and expectations.

Overall satisfaction on Lake Oahe during the May-October period of 2011 was at 88%, not including neutral or no opinion (Table 39), which is well above the Lake Oahe Strategic Plan objective of 70%. Trip satisfaction generally increases with the percentage of daily limits attained by anglers. Median satisfaction rating for angling parties that harvested 0 to 1.9 walleye per person was "moderately satisfied", while for parties harvesting two to four walleyes per person, median rating was “highly satisfied” (Table 40).

Research suggests that walleyes angled from deep water experience high mortality due to stress experienced during the rapid pressure change and subsequent recovery period (Talmage and Staples 2011). To examine the potential for deep water angling mortality in Lake Oahe, the following question was asked during the creel interviews “What was the average depth you caught your walleye today?” Answers could be recorded in depths of 0-9, 10-19, 20-29, 30-39 and above forty feet. In 2011, the majority of anglers caught walleye between 10-19 feet and close to 90% of the total walleyes angled were from 10-29 ft (Table 41).

Table 21. Angler use and harvest estimates for surveys conducted 1995-2011. All surveys were conducted during the April-October daylight period, except where noted.

Year	Fishing pressure (h)	Angler trips	Estimated fish harvest	Estimated walleye harvest	Reference
1995	1,695,945	292,404	464,735	367,693	Johnson et al. (1996)
1996	1,968,525	338,880	533,062	438,355	Johnson et al. (1997)
1997	1,617,024	287,011	538,596	475,638	Johnson et al. (1998)
1998	1,781,032	309,744	563,009	484,234	Johnson et al. (1999)
1999	847,359	158,904	328,184	280,305	Lott et al. (2000)
2000	539,188	109,665	267,642	225,041	Lott et al. (2001)
2001	1,014,591	206,638	694,200	627,435	Lott et al. (2002)
2002	856,059	174,706	465,422	381,390	Lott et al. (2003)
2003	651,557	123,168	233,114	179,002	Lott et al.(2004)
2004	660,973	136,565	277,717	221,405	Lott et al. (2006)
2005	460,334	94,760	204,257	162,780	Lott et al. (2007)
2006	620,272	128,044	233,680	204,335	Lott et al. (2007b)
2007	652,828	132,624	246,430	211,111	Adams et al. (2008)
2008	897,434	192,345	371,089	328,558	Adams et al. (2009)
2009	1,046,564	209,347	335,384	291,885	Longhenry et al. (2010)
2010	1,126,597	224,870	356,573	271,164	Longhenry et al. (2011)
*2011	1,320,814	264,668	694,060	582,461	This Report

*2011 survey period was May-Oct.

Table 22. Estimated fishing pressure (angler hours), by month and zone, with 80% confidence intervals (CI), for the May-October 2011 daylight period.

Zone	Month						
	May	**June**	**July**	**August**	**Sept.**	**Oct.**	**Total**
Lower	13,664	77,669	125,334	80,454	18,305	12,261	327,688
80% CI	6,295	27,841	30,264	26,383	4,377	3,864	49,607
Middle	4,608	216,748	275,146	58,444	28,879	10,556	594,380
80% CI	2,032	108,338	140,019	17,791	6,769	5,216	178,146
Upper	41,926	158,898	122,979	34,276	25,982	14,684	398,745
80% CI	15,630	61,491	42,009	11,671	7,270	5,502	77,521
Total	60,198	453,315	523,458	173,174	73,166	37,502	1,320,814
80% CI	16,972	127,645	149,284	33,894	10,855	8,509	200,515

Table 23. Estimated fishing pressure, expressed as angler-hours (h) and hours per hectare (h/ha), by type of fishing, with 80% confidence intervals (CI), for the standard April-October daylight survey period from 2007 through 2011.

Type of fishing	Year				
	2007	**2008**	**2009**	**2010**	**2011***
Boat (h)	617,134	855,753	1,009,924	1,083,102	1,279,595
80% CI	89,990	102,263	143,611	158,790	198,748
h/ha	5.6	7.7	9.1	9.8	11.6
Shore (h)	35,693	41,680	36,640	43,495	41,219
80% CI	6,201	6,368	5,761	5,784	6,259
h/ha	0.3	0.4	0.3	0.4	0.4
Combined (h)	652,828	897,434	1,046,564	1,126,597	1,320,814
80% CI	89,789	102,968	143,899	158,168	200,515
h/ha	5.9	8.1	9.5	10.2	11.9

*2011 survey period was May-Oct.

Table 24. Estimated fishing pressure, expressed as angler-hours (h) and hour per hectare (h/ha), by reservoir zone, for standard creel surveys conducted during the April-October daylight period from 1995 through 2011, except where noted.

Year	Zone							
	Lower		Middle		Upper		Total	
	H	h/ha	h	h/ha	h	h/ha	H	h/ha
1995	520,102	16.7	509,497	20.5	666,346	22.2	1,695,495	19.7
1996	688,936	22.0	579,200	23.4	700,389	23.3	1,968,525	22.9
1997	508,565	12.6	548,942	14.3	559,517	21.4	1,617,024	15.4
1998	760,797	18.8	522,740	13.6	497,495	19.0	1,781,032	17.0
1999	455,434	11.3	196,425	5.1	195,500	7.5	847,359	8.1
2000	233,013	5.8	170,320	4.4	135,855	5.2	539,188	5.1
2001	396,097	9.5	350,503	10.3	267,991	7.6	1,014,591	9.2
2002	216,608	5.2	320,535	9.5	318,915	9.1	856,059	7.7
2003	164,804	4.0	280,712	8.3	206,041	5.9	651,557	5.9
2004	161,693	3.9	296,194	8.7	203,086	5.8	660,973	5.9
2005	107,385	2.6	238,202	7.0	114,747	3.3	460,334	4.2
2006	146,218	3.5	307,479	9.1	166,575	4.7	620,272	5.6
2007	177,447	4.3	338,569	10.0	136,810	3.9	652,828	5.9
2008	195,497	4.7	397,962	11.7	303,974	8.6	897,434	8.1
2009	318,711	7.7	427,974	12.6	299,879	8.5	1,046,564	9.5
2010	283,277	6.8	444,681	13.1	398,640	11.3	1,126,597	10.2
***2011**	327,688	7.9	594,380	17.5	398,745	11.3	1,320,814	11.9
Zone size (ha)	41,598		33,890		35,172		110,660	

*2011 survey period was May-Oct.

Table 25. Estimated number of fish harvested, by species and month, with 80% confidence intervals (CI), for the May-October 2011 daylight period.

Species	**Month**						
	May	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Total**
Walleye	15,565	172,877	260,495	86,572	36,090	23,912	595,511
80% CI	5,669	49,963	47,189	18,956	5,958	6,216	72,032
Channel catfish	9,413	6,752	4,251	2,586	1,009	175	24,186
80% CI	3,781	2,093	1,123	866	525	158	4,581
White bass	3,855	3,308	901	590	594	261	9,508
80% CI	193	2,256	276	257	311	210	2,326
Smallmouth bass	950	10,653	7,565	6,234	2,684	1,088	29,173
80% CI	492	3,128	2,013	2,477	795	562	4,601
Yellow perch	491	3,331	2,234	404	633	216	7,249
80% CI	299	1,232	1,056	176	454	265	1,741
Northern pike	4,586	7,940	5,688	1,305	983	443	20,943
80% CI	1,579	2,353	1,289	430	492	230	3,189
Chinook salmon	18	29	197	0	125	214	582
80% CI	27	46	142	0	67	162	232
Other*	1,487	3,258	1,905	386	245	191	7,537
Total	36,365	208,148	283,236	98,077	42,363	26,500	694,689
80% CI	9,137	88,040	50,748	21,756	6,594	6,628	80,843

*Other includes black crappie, common carp, freshwater drum, goldeye, sauger, and white crappie.

Table 26. Estimated number of fish released, by species and month, for the May-October 2011 daylight period.

Species	Month						
	May	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Total**
Walleye	40,515	348,499	592,164	177,051	76,651	39,397	1,274,276
80% CI	13,041	116,580	116,935	43,682	13,152	12,742	172,273
Channel catfish	462	3,098	31,702	19,429	1,227	273	56,191
80% CI	199	1,021	10,126	10,943	224	101	14,947
White bass	1,114	10,777	4,611	2,752	4,933	3,328	27,514
80% CI	451	4,103	1,729	1,254	2,584	1,412	5,502
Smallmouth bass	2,898	45,555	64,045	36,570	13,671	12,092	174,831
80% CI	239	14,279	12,129	10,417	3,189	4,483	22,132
Northern pike	9,369	39,487	51,181	12,106	5,412	2,817	120,370
80% CI	4,443	10,932	10,225	3,350	1,425	864	16,056
Yellow perch	3,233	42,274	38,468	8,772	3,841	780	97,367
80% CI	1,904	14,342	8,615	2,468	1,184	415	17,065
Chinook salmon	0	0	74	146	150	0	369
80% CI	0	0	84	0	85	0	120
Other*	1,917	23,130	26,181	10,593	3,751	475	66,052
Total	59,508	512,820	808,426	267,419	109,636	59,162	1,816,970
80% CI	16,841	156,712	149,513	62,158	17,692	18,023	227,277

*Other includes black crappie, bluegill, burbot, common carp, freshwater drum, goldeye, sauger, smallmouth buffalo, white crappie, and white sucker.

Table 27. Estimated number of fish harvested, for selected species, by zone, with 80% confidence intervals (CI), for the May-October 2011 daylight period.

Species	Zone			
	Lower	**Middle**	**Upper**	**Total**
Walleye	143,017	280,705	171,789	595,511
80% CI	23,231	58,147	35,608	72,033
Channel catfish	6,925	7,068	10,193	24,186
80% CI	2,332	1,581	3,382	4,581
White bass	1,200	2,092	6,216	9,508
80% CI	376	2,190	688	2,326
Smallmouth bass	12,536	12,299	4,338	29,173
80% CI	3,006	3,305	1,101	4,601
Yellow perch	279	2,236	4,734	7,249
80% CI	114	758	1,563	1,741
Northern pike	7,060	6,471	7,412	20,943
80% CI	1,658	2,191	1,620	3,190
Chinook salmon	383	136	63	582
80% CI	219	74	20	232
Other	1,042	1,265	5,230	7,537
Total	172,442	312,272	209,975	694,689
80% CI	26,777	65,268	39,481	80,843

Table 28. Estimated number of walleye caught, harvested, and released during the April-October daylight period, by year1994 through 2011, except where noted.

Year	Caught	Harvested	Released	Percent harvested
1994	423,527	288,182	135,345	68%
1995	583,671	367,693	215,978	63%
1996	675,269	438,355	236,914	65%
1997	1,152,050	475,638	676,412	41%
1998	2,103,666	484,234	1,619,432	23%
1999	816,394	280,305	536,089	34%
2000	602,288	225,041	377,247	37%
2001	777,640	627,435	150,205	81%
2002	499,881	381,390	118,491	76%
2003	272,461	179,002	93,459	66%
2004	351,255	221,405	129,849	63%
2005	213,334	162,780	50,554	76%
2006	311,931	204,334	107,594	66%
2007	415,398	211,111	204,287	51%
2008	586,890	328,557	258,333	56%
2009	438,631	291,885	146,746	67%
2010	419,471	271,164	148,307	65%
***2011**	1,869,788	595,511	1,274,276	31%

*2011 survey period was May-Oct

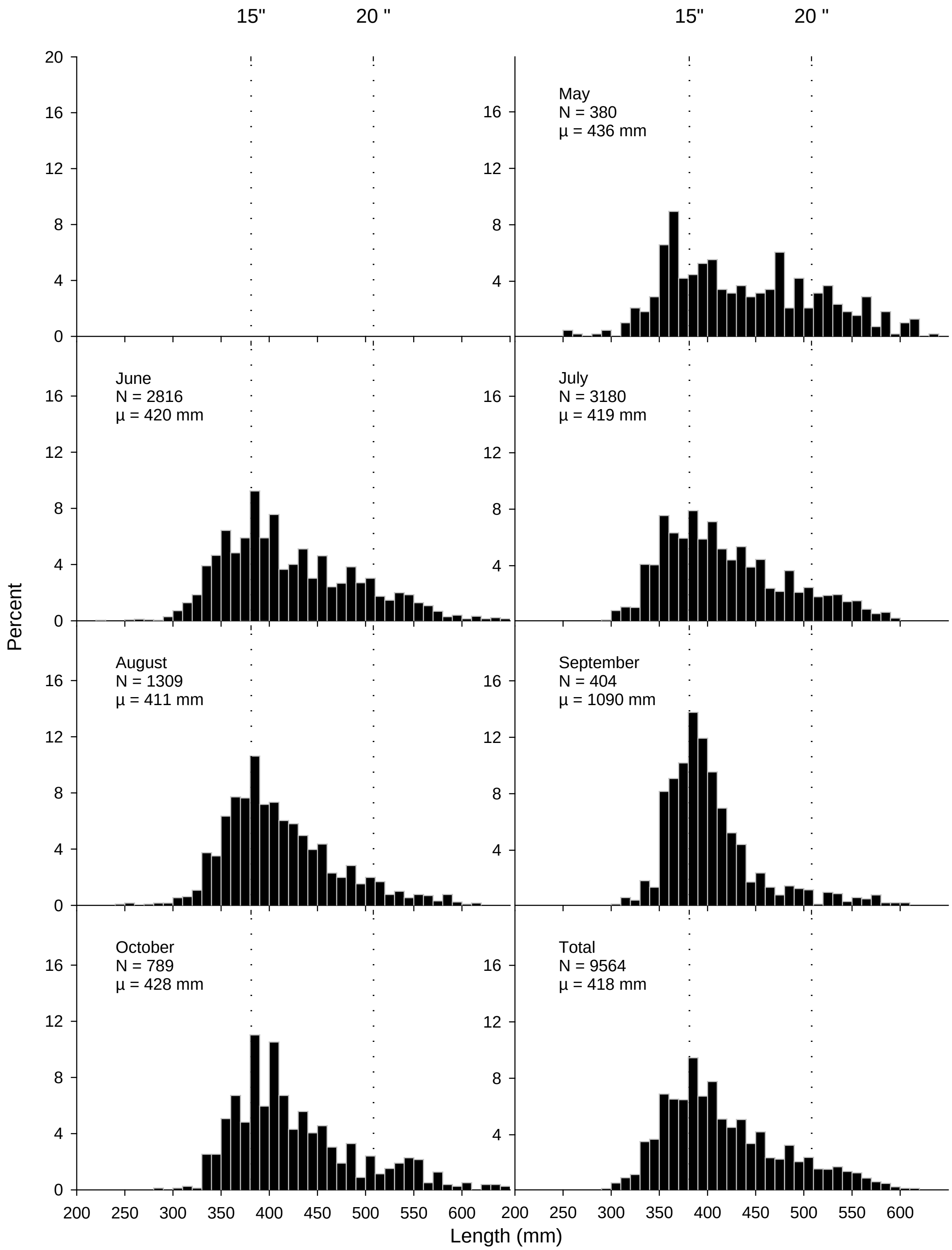

Figure 6. Length frequency distribution of walleye harvested by anglers during the May-October 2011 daylight period. N= sample size, µ = mean length.

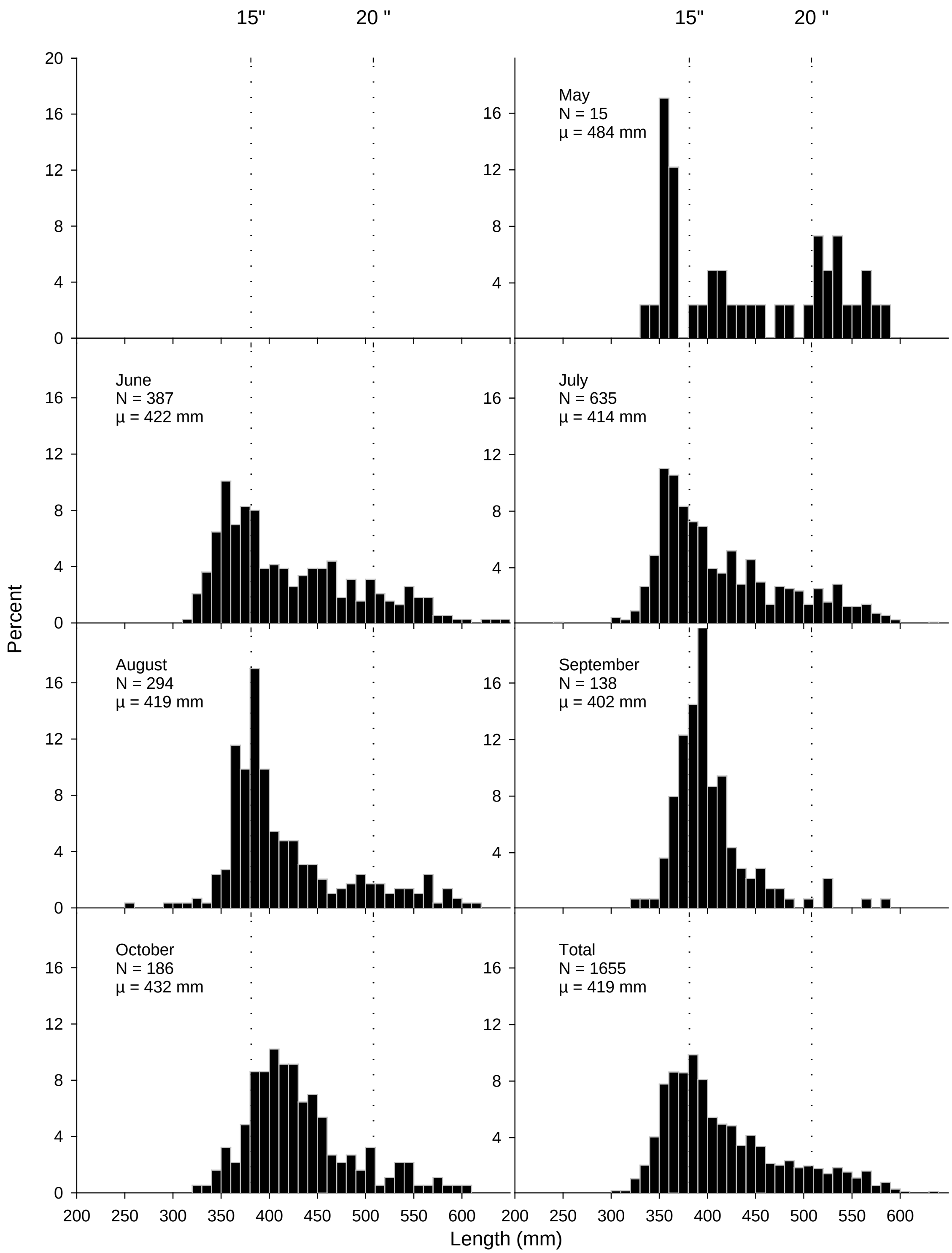

Figure 7. Length frequency distribution of walleye harvested by anglers fishing lower Lake Oahe, South Dakota, during the May-October 2011 daylight period. N= sample size, μ = mean length.

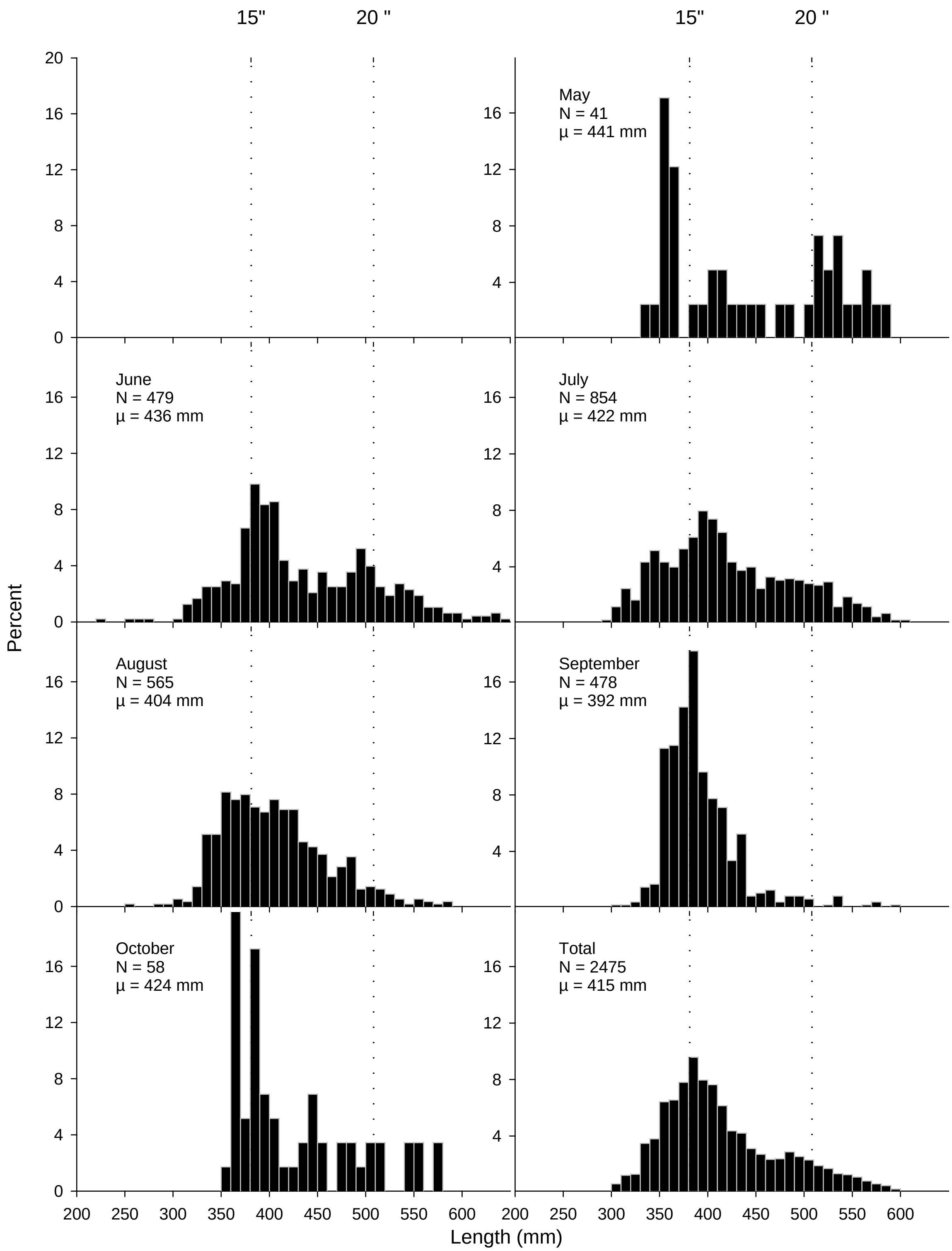

Figure 8. Length frequency distribution of walleye harvested by anglers fishing middle Lake Oahe, South Dakota, during the May-October 2011 daylight period. N= sample size, µ = mean length.

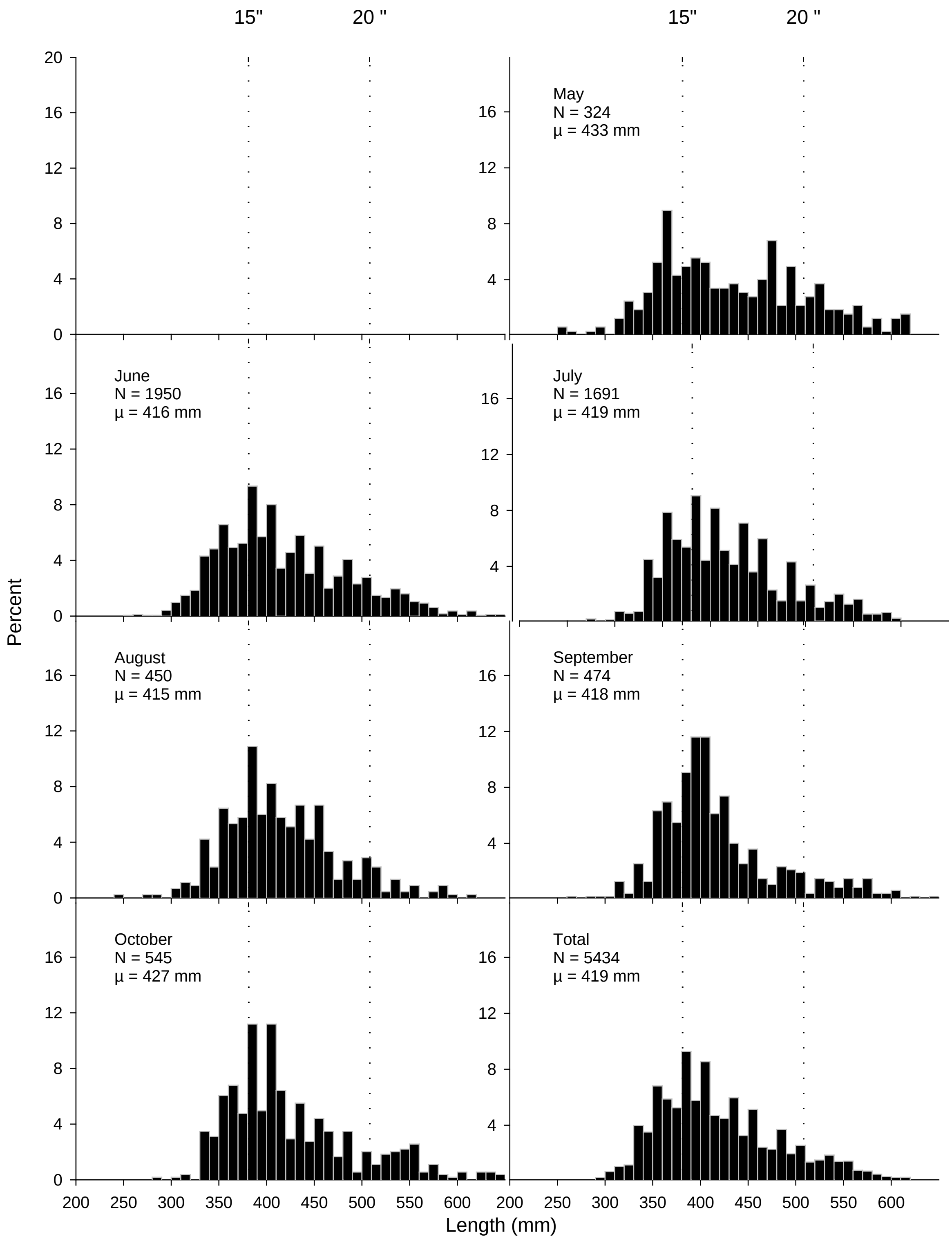

Figure 9. Length frequency distribution of walleye harvested by anglers fishing upper Lake Oahe, South Dakota, during the May-October 2011 daylight period. N= sample size, µ = mean length.

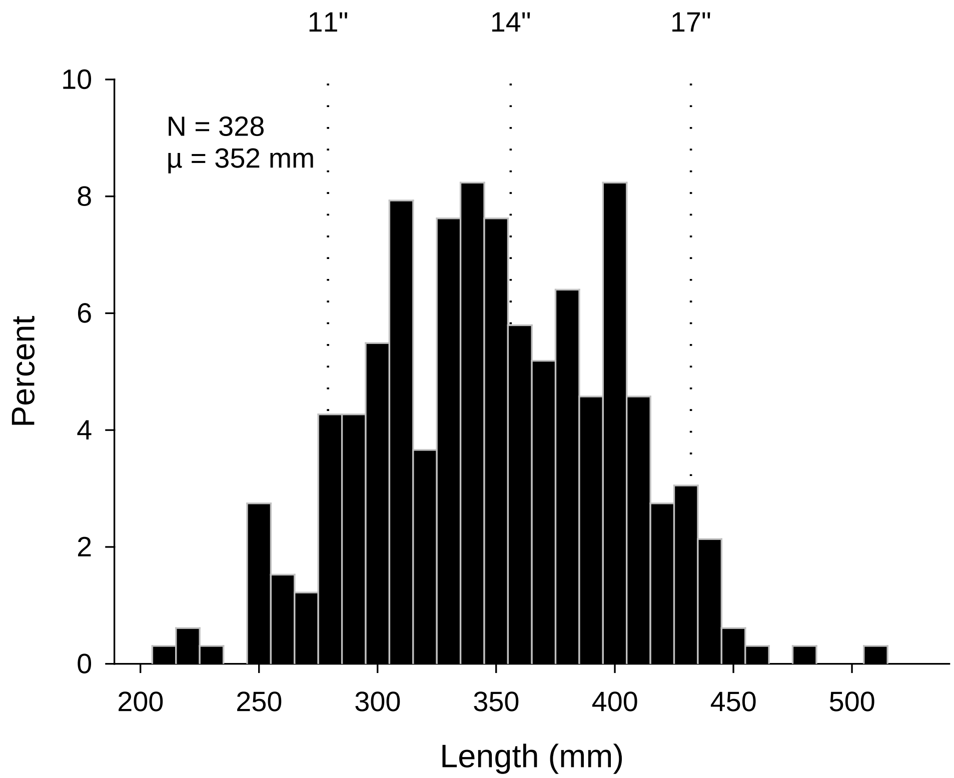

Figure 10. Length frequency distribution of smallmouth bass harvested by anglers fishing during the May-October 2011 daylight period. N= sample size, μ = mean length.

Table 29. Estimated hourly catch rates for walleye, smallmouth bass, white bass, channel catfish, and all fish combined, by year, for all anglers, for the April-October daylight survey period 1995 through 2011, except where noted.

Year	Catch rate (fish/angler-h)				
	Walleye	**Smallmouth bass**	**White bass**	**Channel catfish**	**All fish**
1995	0.34	0.01	0.04	0.01	0.57
1996	0.34	0.02	0.03	0.01	0.50
1997	0.71	0.04	0.05	0.02	0.92
1998	1.18	0.06	0.13	0.02	1.45
1999	0.96	0.04	0.13	0.03	1.22
2000	1.11	0.05	0.20	0.03	1.00
2001	0.77	0.02	0.12	0.06	1.00
2002	0.58	0.03	0.27	0.09	1.02
2003	0.42	0.02	0.19	0.07	0.74
2004	0.53	0.02	0.18	0.06	0.85
2005	0.46	0.02	0.14	0.06	0.73
2006	0.50	0.03	0.03	0.08	0.73
2007	0.64	0.09	0.05	0.05	0.88
2008	0.65	0.08	0.02	0.05	0.85
2009	0.42	0.07	0.03	0.05	0.64
2010	0.37	0.17	0.02	0.05	0.88
2011	1.42	0.15	0.03	0.06	1.90

*2011 survey period was May-Oct

Table 30. Estimated hourly catch, harvest, and release rates, by species, for all anglers interviewed during the May-October 2011 daylight survey period. Confidence intervals (CI) are indicated in parenthesis and trace (T) indicates <0.01.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	1.42 (0.31)	0.45 (0.11)	0.96 (0.22)
Channel catfish	0.06 (0.02)	0.02 (0.00)	0.04 (0.01)
White bass	0.03 (0.01)	0.01 (0.00)	0.02 (0.00)
Smallmouth bass	0.15 (0.04)	0.02 (0.01)	0.13 (0.04)
Northern pike	0.11 (0.03)	0.02 (0.00)	0.09 (0.02)
Yellow perch	0.08 (0.02)	0.01 (0.00)	0.07 (0.02)
Chinook salmon	T (0.00)	T (0.00)	T (0.00)
Total	1.90 (0.39)	0.53 (0.12)	1.38 (0.30)

* Other includes black crappie, bluegill, burbot, common carp, freshwater drum, goldeye, sauger, smallmouth buffalo, white crappie and white sucker.

Table 31. Estimated hourly catch, harvest, and release rates, by species, for anglers specifically fishing for the species listed during for the May-October 2011 daylight period. Confidence intervals (CI) are indicated in parenthesis.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	3.29 (0.39)	1.11 (0.14)	2.18 (0.31)
Smallmouth bass	4.36 (0.55)	0.32 (0.21)	4.04 (0.35)
Channel catfish	1.39 (0.03)	1.39 (0.03)	0.00 (0.00)
White bass	---	---	---
Chinook salmon	0.11 (0.07)	0.11 (0.07)	T (0.00)
Northern pike	0.64 (0.38)	0.07 (0.12)	0.57 (0.42)

Table 32. Estimated hourly catch, harvest, and release rates (fish/angler-h), for walleye and all species combined, with 80% confidence intervals (CI), by month, for the May-October 2011 daylight survey period. Trace (T) indicates values >0.0 but <0.01.

Month	**Walleye**			**All fish combined**		
	Catch rate	**Harvest rate**	**Release rate**	**Catch rate**	**Harvest rate**	**Release rate**
May	0.93 (0.45)	0.26 (0.14)	0.67 (0.31)	1.59 (0.74)	0.60 (0.27)	0.99 (0.46)
June	1.15 (0.52)	0.38 (0.20)	0.77 (0.35)	1.59 (0.69)	0.46 (0.23)	1.13 (0.50)
July	1.63 (0.59)	0.50 (0.18)	1.13 (0.42)	2.09 (0.71)	0.54 (0.20)	1.54 (0.56)
August	1.52 (0.89)	0.50 (0.26)	1.02 (0.63)	2.11 (0.90)	0.57 (0.29)	1.54 (0.88)
September	1.54 (0.36)	0.49 (0.13)	1.05 (0.24)	2.08 (0.50)	0.58 (0.15)	1.50 (0.35)
October	1.69 (0.75)	0.64 (0.31)	1.05 (0.46)	2.28 (1.02)	0.71 (0.35)	1.58 (0.70)
Total	1.42 (0.31)	0.45 (0.11)	0.96 (0.22)	1.90 (0.39)	0.52 (0.12)	1.38 (0.30)

Table 33. Percentage of angling parties catching and harvesting the specified number of walleye and sauger per person per party, by reservoir zone during the April-October 2010 and May – October 2011 daylight survey periods.

Number/trip	**Catch per trip**							
	2010				**2011**			
	Lower	**Middle**	**Upper**	**Total**	**Lower**	**Middle**	**Upper**	**Total**
0	61	27	20	33	21	11	13	15
0.1-0.9	13	16	14	14	15	5	6	5
1.0-1.9	11	16	17	15	7	5	9	7
2.0-2.9	5	10	10	9	6	6	8	7
3.0-3.9	3	9	8	7	5	4	7	6
4.0-4.9	3	9	9	8	10	6	7	8
5.0-5.9	1	4	7	5	5	4	8	6
6.0-6.9	1	3	5	3	5	5	7	6
7.0-7.9	--	2	3	2	4	4	7	5
8.0-8.9	0	1	1	1	2	4	5	4
9.0-9.9	0	1	1	1	2	6	4	4
≥10	1	2	4	2	18	40	19	26

Number/trip	**Harvest per trip**							
	2010				**2011**			
	Lower	**Middle**	**Upper**	**Total**	**Lower**	**Middle**	**Upper**	**Total**
0	65	33	28	39	29	18	20	22
0.1-0.9	12	15	14	14	6	8	10	8
1.0-1.9	10	17	22	17	12	12	16	13
2.0-2.9	5	11	13	10	12	13	15	13
3.0-3.9	3	10	9	8	10	14	14	12
4.0	4	14	13	11	32	35	25	31

Table 34. Percentage of total angler contacts for resident and non-resident (states combined) anglers fishing Lake Oahe during the April-October daylight period, 2008-2011. N is the number of parties interviewed, except where noted.

Zone		Year			
		2008	2009	2010	2011*
Lower	N	612	797	760	933
	Residents (%)	76	78	79	78
	Non-residents (%)	24	22	21	22
Middle	N	1,050	659	1,161	982
	Residents (%)	70	74	75	75
	Non-residents (%)	30	26	25	25
Upper	N	566	377	1,179	1,081
	Residents (%)	81	80	75	72
	Non-residents (%)	19	20	25	28
Total	N	2,228	1,833	3100	2,996
	Residents (%)	74	77	76	75
	Non-residents (%)	26	23	24	25

*2011 survey period was May-Oct

Table 35. Percentage of total non-resident angler contacts for the states listed, for anglers fishing during the April-October daylight survey period, 2007-2011, except where noted.

State	Percent by Year				
	2007	2008	2009	2010	2011*
Iowa	21	19	14	18	17
Nebraska	33	29	33	27	27
North Dakota	9	12	14	11	14
Colorado	7	6	7	3	4
Minnesota	13	17	18	21	18
Wisconsin	2	2	2	3	4
Wyoming	2	3	4	3	5
Other*	13	12	8	13	11

*2011 survey period was May-Oct

**Other includes Alabama, Alaska, Arkansas, Arizona, California, Connecticut, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Kansas, Michigan, Mississippi, Missouri, Montana, Nevada, New Jersey, New Mexico, North Carolina, Oklahoma, Ohio, Ontario Canada, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah and Washington.

Table 36. Percentage of total angler contacts on Lake Oahe by residents of the counties listed, during the May-October daylight survey period, 2008-2011, except where noted.

County	Major city	Percent by Year			
		2008	2009	2010	2011*
Beadle	Huron	4	4	3	3
Brown	Aberdeen	9	9	12	11
Campbell	Pollock	2	3	2	2
Codington	Watertown	2	3	4	3
Davison	Mitchell	2	2	1	2
Hughes	Pierre	20	22	15	18
Minnehaha	Sioux Falls	10	8	7	8
Pennington	Rapid City	7	8	6	7
Potter	Gettysburg	5	4	5	4
Stanley	Fort Pierre	4	4	3	3
Sully	Onida	2	<0.5	1	2
Walworth	Mobridge	11	7	11	10
Other		22	26	30	27

*2011 survey period was May-Oct

Table 37. Percentage of anglers driving the specified distances, one way, to fish during the April-October daylight survey period, 2006-2011, except where noted.

Distance (miles)	Percent by Year					
	2006	2007	2008	2009	2010	2011*
<25	23	21	21	22	18	20
25-49	11	11	9	8	9	9
50-99	9	5	5	4	6	10
100-199	22	20	20	22	25	18
≥200	35	43	45	44	42	40

*2011 survey period was May-Oct

Table 38. Target species of anglers fishing during the May-October daylight survey period, expressed as percent of total, 2007 - 2011. T (trace) indicates values > 0.0 but < 0.5, except where noted.

Target species	Percent by Year				
	2007	**2008**	**2009**	**2010**	**2011***
Walleye	79	83	75	80	87
Anything	7	7	10	8	9
Chinook salmon	11	7	10	8	2
Northern pike	2	2	2	3	T
White bass	0	T	0	T	0
Channel catfish	T	T	T	1	T
Smallmouth bass	T	1	1	1	1

*2011 survey period was May-Oct

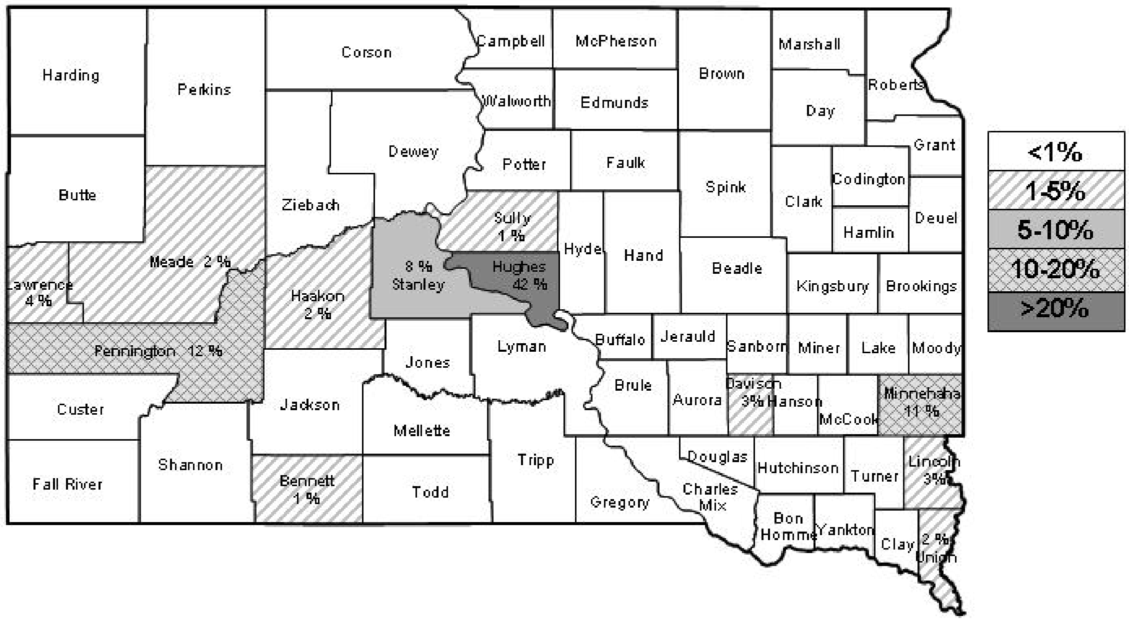

Figure 11. County of residency for South Dakota residents fishing lower Lake Oahe during the May-October 2011 daylight survey period.

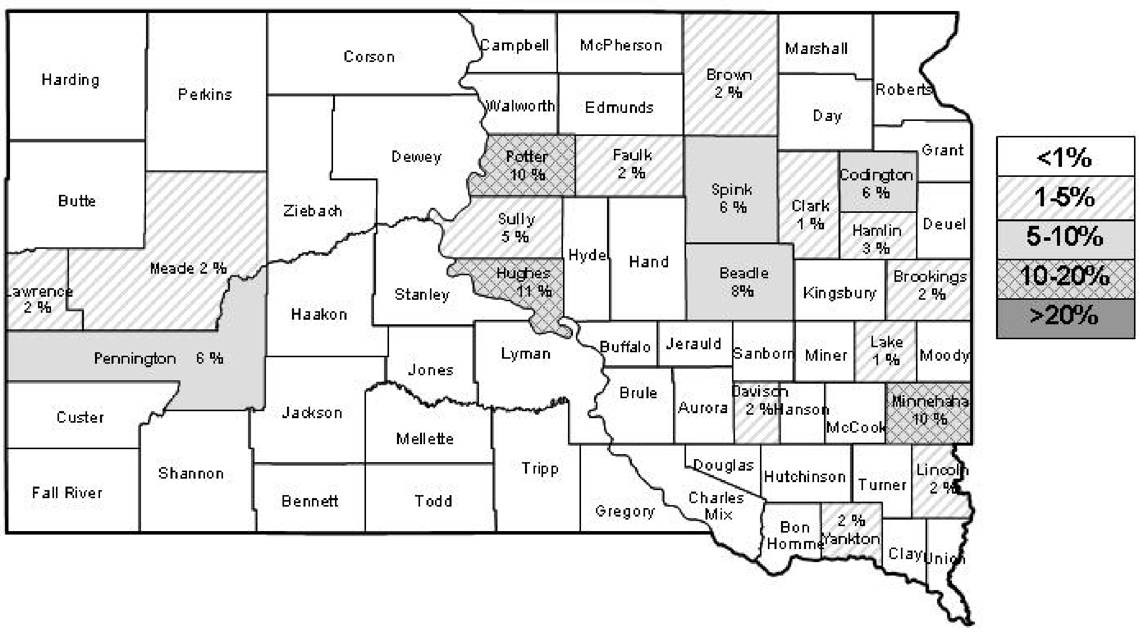

Figure 12. County of residency for South Dakota residents fishing middle Lake Oahe during the May-October 2011 daylight survey period.

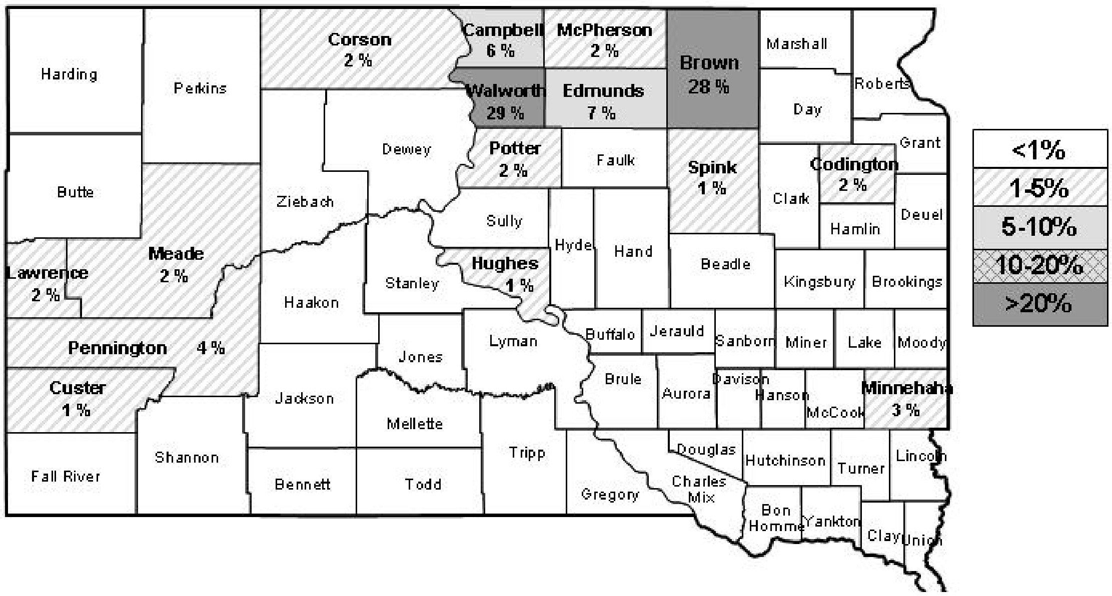

Figure 13. County of residency for South Dakota residents fishing upper Lake Oahe during the May-October 2011 daylight survey period.

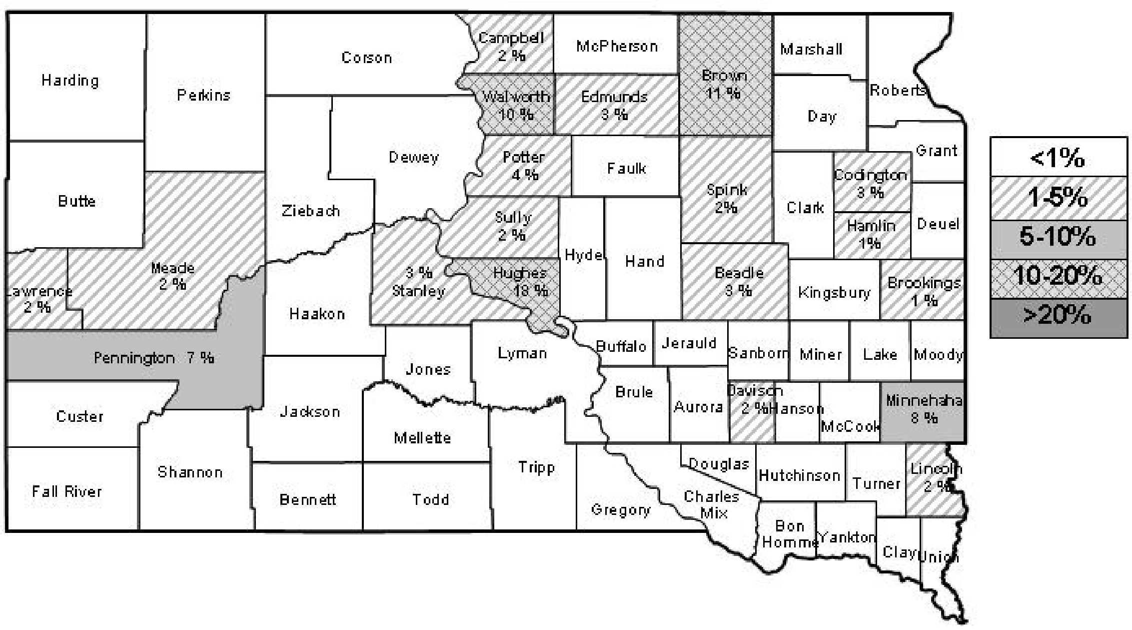

Figure 14. County of residency for South Dakota residents fishing Lake Oahe during the May-October 2011 daylight survey period.

Table 39. Responses of anglers who were asked the following question during the May-October 2011 daylight survey period: “Considering all factors, how satisfied are you with your fishing trip today?” 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral/no opinion (N.O.), 5 = slightly dissatisfied, 6 = moderately dissatisfied, and 7 = very dissatisfied. N is sample size and does include “neutral/no opinion” responses.

	Satisfaction rating								
Month	**Satisfied**			**Neutral/N.O.**	**Dissatisfied**			**N**	**Median**
	1	**2**	**3**	**4**	**5**	**6**	**7**		
May	69	55	26	18	17	5	3	193	2
June	459	215	80	49	30	14	12	859	1
July	510	224	63	37	29	8	2	873	1
August	289	94	52	21	26	4	2	488	1
September	207	58	30	12	20	7	6	340	1
October	159	34	31	7	9	2	4	246	1
Total	1693	680	282	144	131	40	29		
Percent		88		5		7			

Table 40. Responses of anglers who were asked the following question during the May-October 2011 daylight survey period: "Considering all factors, how satisfied are you with your fishing trip today?" compared to the number of walleye harvested per person per trip. 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral/no opinion (N.O.), 5 = slightly dissatisfied, 6 = moderately dissatisfied and 7 = very dissatisfied. N is sample size.

Walleye/ angler	**Satisfaction rating**							**N**	**Median**
	Satisfied			**Neutral/N.O.**	**Dissatisfied**				
	1	**2**	**3**	**4**	**5**	**6**	**7**		
0	224	164	93	61	73	21	20	656	2
0-0.9	75	69	48	19	22	4	2	239	2
1.0-1.9	150	129	61	26	21	8	4	399	2
2.0-2.9	221	113	38	14	8	3	2	399	1
3.0-3.9	262	86	17	10	5	2	1	383	1
4.0 (limit)	748	118	25	12	1	2	0	906	1
Percent		88		5		7			

Table 41. Percentage of responses to the following question in 2011, "What was the average depth you caught your walleye today?" N is the number of respondents.

Depth	**%**	**N**
0-9	4	29
10-19	64	485
20-29	25	188
30-39	4	31
≥40	2	17
Total		750

LAKE OAHE FISH MORTALITY AND LABORATORY RESULTS

In April 2011, dead and dying common carp were observed during the Grand River walleye spawning operation. A whole carp was collected and sent to Washington Animal Disease Diagnostic Laboratory (WADDL) for testing. Results revealed hemorrhaging in multiple tissues. Additionally, tests for viral hemorrhagic septicemia virus (VHSV) came back negative (Appendix 2). A fungal infection found on one specimen was consistent with *Saprolegnia spp*. It is likely local environmental stressors (e.g., water temperature, turbidity, etc.) could have stressed the fish and fungal infection was secondary to this stress.

In late April 2011, anglers reported observing Chinook salmon near the face of Oahe Dam that appeared under "stress". A "stressed" salmon was brought into the Region 2 District Office for diagnosis and preliminary inspection of the fish revealed dense mats of gray-brown material adhered to the ventral skin from the vent anterior to the tail. These mats were up to two cm deep and several ulcerations were present on the tail fin. The fish had little body fat and an empty gastrointestinal tract. Two additional salmon were collected and sent to South Dakota State University (SDSU) Animal and Disease Research & Diagnostic Laboratory in Brookings. Results suggest severe fungal dermatitis with local invasions of subcutaneous and muscle by the fungus (Appendix 3). It is likely these fungal infections were induced by some form of environmental stressor (e.g., extended winter, water temp, ice cover, etc.). Personal communication with Jim Riis, Reservoir Program Coordinator, indicated a similar situation occurred with salmon in the late 1990's after an especially harsh winter. No samples were sent off for testing from the 1990's event.

In September 2011, reports of dead lake herring near Bush's Landing on Lake Oahe approximately 101 river km (i.e., 63 miles) upstream of Oahe Dam; North 44°46.809; West 100°31.809 were investigated. It appeared the die-off was contained to an area from the Cheyenne River Arm to Sutton Bay on Lake Oahe (i.e., 40 km; 25 mile stretch). Within this reach, four randomly selected 400 m shoreline counts were conducted. The average number of adult LAH on shore per 400 m beach section was 121.7 adult herring. This is likely an underestimate as fish that have washed ashore can be buried by shoreline material or removed by scavengers. Four live lake herring were collected and sent to SDSU Animal and Disease Research & Diagnostic Laboratory. *Aeromonas hydrophilia* is a ubiquitous, opportunistic bacterium that was likely able to establish after the lake herring were stressed by an environmental factor (Appendix 4).

FISHERY STATUS AND 2012 OUTLOOK

The Lake Oahe walleye population has improved dramatically compared to previous years (1997 through 2001). Walleye condition has remained stable throughout the previous five year period with values between 84 and 91. In 2011, walleye relative abundance was the third highest documented since 1991, with increases in each zones compared to recent years. The desired range for Lake Oahe walleye PSD is 30-60; however, through recent years, walleye recruitment seems to be increasing in all zones (including the lower zone) which led to lower PSD and PSD-P values in all zones in 2011.

It appears that the conditions favoring high yellow perch recruitment has diminished with lowering seine catches since it peaked in 2009. In 2011, emerald shiners and white bass made up the majority of the seine catch. Like 2010, no gizzard shad were caught in 2011 and it appears that gizzard shad abundance is at the lowest level since the establishment of shad in 2002. Since reproduction of gizzard shad was first documented in Lake Oahe in 2001, the species had become an important part of the prey fish community. Gizzard shad are still present in Lake Oahe; however, currently they do not exist at levels that can be detected in standard surveys. Lake Oahe is located near the northern boundary of the gizzard shad range, so permanence of this prey fish species in Lake Oahe is unknown.

In 2011, estimated fishing pressure and number of angler trips was the highest it has been since 1998, but remained lower than the late 1990s. Even with changes in the Lake Oahe fishery over the past decade, the direct economic impact of Lake Oahe remains immense at 20.9 million dollars. Anglers spent an estimated 1,320,814 hours fishing on Lake Oahe in 2011 and harvested 582,461 walleyes for an hourly catch rate of 0.44 fish per hour. Harvest rates for Chinook salmon in 2011 fell below the goal of 0.10 fish/hour for the third time in four years, likely due to boating closures along Oahe Dam and entrainment of salmon through the summer months. The Chinook salmon program on Lake Oahe has become a major contributor to the overall fishery in recent years. Hopefully, with continued salmon research and management, an increase in catch and harvest will facilitate the Chinook salmon program to gain additional angler support compared to previous years.

MANAGEMENT RECOMMENDATIONS

1. Develop a new Lake Oahe Strategic Plan which includes:
   - Reviewing adequacy of current management plan and objectives
   - Developing management objectives for channel catfish
   - Removing rainbow trout from the list of management species in Lake Oahe
2. Expand efforts to understand / improve prey fish dynamics in Lake Oahe
   - Expand efforts to document characteristics of gizzard shad population structure and dynamics
   - Implement and evaluate gizzard shad stocking programs in Lake Oahe
   - Implement and evaluate deep water gillnets targeting cold water prey fish
   - Continue to refine hydro-acoustics estimates of rainbow smelt
3. Expand efforts to understand the coldwater fishery in Lake Oahe
   - Work to develop age structure and growth estimates for the rainbow smelt and lake herring populations
   - Continue to stock Chinook salmon and evaluate the relative contribution of various stocking locations / stocking sizes to the fishery
   - Evaluate effects of predation on stocked Chinook salmon
4. Continue to monitor Lake Oahe sport fish
   - Continue to conduct annual creel and angler harvest surveys
   - Continue to conduct annual fish population surveys
   - Evaluate northern pike growth, mortality and recruitment
   - Evaluate yellow perch growth, mortality and recruitment

LITERATURE CITED

Adams, G., K. Edwards, R. Hanten and K. Potter. 2008. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2007. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 08-07, Pierre.

Adams, G., K. Edwards, R. Hanten and K. Potter. 2009. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2008. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 09-06, Pierre.

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

Anderson, R.O. 1980. Proportional stock density (PSD) and relative weight(*Wr*): interpretive indices for fish populations and communities. Pages 27-33 *in* S. Gloss and B. Shupp, editors. Practical fisheries management: more with less in the 1980's. New York Chapter American Fisheries Society, Ithaca.

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

Brown, M.L., F. Jaramillo, Jr., D.M.Gatlim III, and B.R. Murphy. 1995 A revised standard weights (*Ws*) equation for channel catfish. Journal of Freshwater Ecology 10:295-302.

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

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

Gabelhouse, D.W., Jr. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Hubert, W.A. 1996. Passive capture techniques. Pages 157192 *in* B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd Edition. American Fisheries Society, Bethesda, Maryland.

Johnson, B., J. Lott, W. Nelson-Stastny, and J. Riis. 1996. Annual fish population and sport fish harvest surveys on Lake Oahe, South Dakota 1995. South Dakota Department of Game, Fish and Parks, Wildlife Division Report No. 96-12, Pierre.

Johnson, B., J. Lott, W. Nelson-Stastny, and J. Riis. 1997. Annual fish population and sport fish harvest surveys on Lake Oahe, South Dakota 1996. South Dakota Department of Game, Fish and Parks, Wildlife Division Report No. 97-15, Pierre.

Johnson, B., J. Lott, W. Nelson-Stastny, and J. Riis. 1998. Annual fish population and sport fish harvest surveys on Lake Oahe, South Dakota 1997. South Dakota Department of Game, Fish and Parks, Wildlife Division Report No. 98-8, Pierre.

Johnson, B., R. Hanten, J. Lott, and W. Nelson-Stastny. 1999. Annual fish population and sport fish harvest surveys on Lake Oahe, South Dakota 1998. South Dakota Department of Game, Fish and Parks, Wildlife Division Report No. 99-21, Pierre.

Longhenry, C., K. Edwards, R. Hanten, and K. Potter. 2010. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2010. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 11-08, Pierre

Longhenry, C., K. Edwards, R. Hanten, and K. Potter. 2011. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2010. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 11-06, Pierre

Lott, J., R. Hanten, B. Johnson, and W. Nelson-Stastny. 2000. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 1999. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 00-11, Pierre.

Lott, J., R. Hanten, B. Johnson, and W. Nelson-Stastny. 2001. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2000. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 01-14, Pierre.

Lott, J, B. Johnson, and W. Nelson-Stastny. 2002. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2001. South

Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 02-19, Pierre.

Lott, J, B. Johnson, W. Nelson-Stastny, and K. Potter. 2003. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2002. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 03-15, Pierre.

Lott, J, B. Johnson, W. Nelson-Stastny, and K. Potter. 2004. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2003. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 04-22, Pierre.

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

Lott, J, J. Erickson, R. Hanten, and K. Potter. 2007 Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2005. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 07-26 Pierre.

Lott, J., J. Erickson, R. Hanten, and K. Potter. 2007b. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota, 2006. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 07-27 Pierre.

Love, R.H. 1977. Target strength of an individual fish at any aspect. Journal of the Acoustical Society of America 62:1397-1403.

Martin, D.B., L.J. Mengel, J.F. Novotny, and C.H. Walburg. 1981. Spring and summer water levels in a Missouri River reservoir: effects of age-0 fish and zooplankton. Transactions of the American Fisheries Society, 110: 70-381.

Michaletz, P., B. Johnson, J. Riis, C. Stone, D. Unkenholz, and D. Warnick. 1986. Annual fisheries surveys on the Missouri River reservoirs, 1981-1985. South Dakota Department of Game, Fish and Parks, Wildlife Division Progress Report 86-11, Pierre.

Murphy, B.R., M.L. Brown, and T.A. Springer. 1990. Evaluation of the relative weight (*Wr*) index, with new applications to walleye. North American Journal of Fisheries Management 10:85-97.

Nelson-Statsny, W. 2001. Estimates of abundance, biomass, and distribution of rainbow smelt and other pelagic fish in Lake Oahe using hydroacoustic techniques, 1996-1999. South Dakota Department of Game, Fish and Parks, Wildlife Division, Special Report No. 01-06, Pierre

Schmidt, B.R. 1975. Results and evaluation of an aerial creel survey technique on Lake Sharpe, South Dakota. Masters Thesis, South Dakota State University, Brookings.

Soupir, C., and M. Brown. 2002. Comprehensive evaluation and modification of the South Dakota angler creel program. South Dakota Department of Game, Fish and Parks, Wildlife Division Completion report, Pierre.

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

Stone, C., J. Riis, and B. Johnson. 1994. Angler use and sport fishing harvest survey on Lake's Francis Case, Sharpe, and Oahe, South Dakota, 1992 and 1993. South Dakota Department of Game, Fish and Parks, Wildlife Division Report No. 94-9, Pierre.

Talmage, P.J. and D.F. Staples. 2011. Mortality of walleye angled from deep waters of Rainy Lake, Minnesota. North American Journal of Fisheries Management. 826-831.

United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, Bureau of Census 2007. 2006 National Survey of Fishing , Hunting, and Wildlife-associated Recreation. United States Government Printing Office, Washington, D.C.

United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, Bureau of Census 1999. 1998 National Survey of Fishing , Hunting, and Wildlife-associated Recreation. United States Government Printing Office, Washington, D.C.

Warnick, D. 1987. The introduction of selected fish species into the Missouri River system, 1984-85. South Dakota Department of Game, Fish and Parks, Wildlife Division Report No. 87-10, Pierre.

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

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

APPENDICES

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

Common name	Scientific name
Bigmouth buffalo	*Ictiobus cyprinellus*
Black bullhead	*Ictalurus melas*
Black crappie	*Pomoxis nigromaculatus*
Bluntnose minnow	*Pimephales notatus*
Brassy minnow	*Hybognathus hankinsoni*
Burbot	*Lota lota*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Common carp	*Cyprinus carpio*
Emerald shiner	*Notropis atherinoides*
Fathead minnow	*Pimephales promelas*
Flathead chub	*Platygobio gracilis*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Goldeye	*Hiodon alosoides*
Golden shiner	*Notemigonus crysoleucas*
Johnny darter	*Etheostoma nigrum*
Lake herring	*Coregonus artedi*
Largemouth bass	*Micropterus salmoides*
Northern pike	*Esox Lucius*
Paddlefish	*Polyodon spathula*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhynchus mykiss*
River carpsucker	*Carpiodes carpio*
Red shiner	*Cyprinella lutrensis*
Sauger	*Sander canadense*
Shorthead redhorse	*Moxostoma macrolepidotum*
Shortnose gar	*Lepisosteus platostomus*
Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Silvery minnow	*Hybognathus nuchalis*
Smallmouth bass	*Micropterus dolomieu*
Smallmouth buffalo	*Ictiobus bubalus*
Spottail shiner	*Notropis hudsonius*
Suckermouth minnow	*Phenacobius mirabilis*
Walleye	*Sander vitreus*
White bass	*Morone chrysops*
White crappie	*Pomoxis annularis*
White sucker	*Catostomus commersonii*
Yellow perch	*Perca flavescens*

Appendix 2. Diagnostic laboratory report of common carp collected from Lake Oahe May, 2011.

WASHINGTON ANIMAL DISEASE DIAGNOSTIC LABORATORY
P.O. Box 647034
Pullman, WA 99164-7034
Phone: (509) 335-9696
Fax: (509) 335-7424

Veterinarian:	Brian Fletcher	Owner:	Fish & Parks SD Game
Clinic:	SD Game, Fish & Parks	Animal:	
Address:	4725 Jackson Blvd	Species:	Carp
		Breed:	
	Rapid City, SD 57703	Age:	
Phone:	(605) 394-4100	Sex:	Not Reported

HISTOPATHOLOGY REPORT **07/07/11** **WADDL #2011-5582**
Report authorized by: Kevin Snekvik, Senior Pathologist **Received: 05/10/11**

Heart: The epicardium overlying the atrium, and to a less extent the ventricle, is multifocally expanded by low to moderate numbers of inflammatory cells, edema fluid and extravasated erythrocytes. The inflammatory cells consist of eosinophilic granular cells with fewer macrophages, lymphocytes and rare rodlet cells. The macrophages frequently contain intracytoplasmic, light brown-yellow material (presumptive lipofuscin). Similar accumulations of inflammatory cells multifocally expand the septa of the atrium; the affected septa are in turn lined by reactive endothelial cells and rare plump macrophages. The solid and spongy myocardium of the ventricle is normal.

Gill: In multiple sections, there is diffuse congestion with extensive multifocal to coalescing areas of hemorrhage that expand the connective tissue of the primary lamellae and radiate into the secondary lamellae. Occasionally, similar areas of hemorrhage are also present in the gill arch. Accumulations of fibrin or necrosis are not associated with the hemorrhage. Scattered regions of secondary lamellae are lined by piled, hyperplastic epithelial cells that fill the interlamellar trough. These areas of hyperplasia affect less than 30% of the examined gill.

Spleen: Scattered within the red pulp and white pulp, there are slightly increased numbers of lipogranulomas which consist of densely packed aggregates of macrophages and fewer melanophages. There is moderate congestion of the red pulp.

Liver: The portal regions are infiltrated by low numbers of lymphocytes that frequently surround the bile ductules. The gall bladder is normal.

Posterior kidney: Rare tubules contain small, lightly basophilic concretions (nephrocalcinosis). Free within the lumen of occasional collecting ducts and rare renal tubules, there are low numbers of myxosporidial organisms that consist of multinucleated extrasporogonic stages that are 7-15 um in diameter. In the collecting ducts the myxosporidial organisms are also rarely attached to the apical surface of the epithelium.

Page 1 of 2

Undetermined sample: One sample within the container is composed completely of a fungal mat. The mat consists of interwoven hyphae separated by variable amounts of granular eosinophilic cellular debris, small shards of refractile material that moderately polarizes light, extruded erythrocyte nuclei, and loosely sprinkled melanin granules. The fungal hyphae stain variably basophilic on H&E sections and have parallel to moderately irregular, non-septate walls that are approximately 20um in diameter and branch at acute angles. Zoosporangia are associated with the hyphae as well as low to moderate numbers of small, round, 2-4 um diameter structures that cluster amongst the cellular debris and along the hyphae (presumptive zoospores).

The following tissues are normal: stomach and pancreas

HISTOLOGIC DIAGNOSES:

1. Branchial hemorrhage, acute, multifocal to locally extensive, gill
2. Epicarditis, granulocytic to pleocellular, subacute, multifocal, mild to moderate with mild multifocal myocarditis (atrium), heart
3. Splenic congestion, acute, diffuse, moderate, spleen
4. Branchial epithelial hyperplasia, chronic, multifocal, mild, gill
5. Portal hepatitis, lymphocytic, chronic, multifocal, minimal, liver
6. Nephrocalcinosis, chronic, multifocal, minimal, posterior kidney
7. Renal myxosporidiosis, multifocal, minimal, posterior kidney
8. Presumptive *Saprolegnia* infection, undetermined tissue

COMMENTS: All testing is complete on this case of mortally of wild common carp in Lake Oahe. Histopathology reveled hemorrhage in multiple tissues. Given that this could be the histological presentation for infection by viral hemorrhagic septicemia virus (VHSV), paraffin embedded tissue (spleen and posterior kidney) was submitted for PCR evaluation for VHSV. VHSV was not detected by PCR. No lesions suggestive infection by spring viremia of carp virus are present in the examined sections. The epithelial hyperplasia in the gills, portal hepatitis, nephrocalcinosis and renal myxosporidiosis are all mild to minimal changes, are incidental findings in wild populations, and are considered clinically insignificant to the mortality event. The fungal infection noted in one of the samples is morphologically consistent with a *Saprolegnia* sp. The extent of the fungal infection is not determined by histopathology, but if covering a significant portion of skin could contribute to mortality. Otherwise, local environmental stressors (water temperature, turbidity, etc.,) could have stressed the fish and the fungal infection is secondary to this stress. Viral culture of fresh tissues submitted to WADDL are negative a cytopathic effect, further suggesting that the mortality was not due to a primary viral infection.

WORK PENDING: None

Dr. Kevin Snekvik/KRS/krs/dlo
4177, 3033, 6492, 7355, 7389
Phone contact: Phone report of histopathology results given to Brian Fletcher.

Washington Animal Disease Diagnostic Lab

P.O. Box 647034
Pullman, WA 99164-7034
Telephone : (509) 335-9696
Fax : (509) 335-7424

Dr. Brian Fletcher
SD Game, Fish & Parks
4725 Jackson Blvd

Rapid City, SD 57703

Case#: 2011-5582
Report Date: 07/07/11

Submittal Date: 05/10/11	Species: Carp	Age:
Owner: SD Game, Fish & Parks		Sex:

Final Report:

Aquaculture- Reported on 07/07/11 Authorized by Kevin Snekvik, Section Head

Aquatic histopathology SOP: Not yet posted

Animal	Specimen	Result
	Container of Tissue(s)	Reported separately

Previously reported results:

Aquaculture- Last reported on 06/09/11 Authorized by Kevin Snekvik, Section Head

Aquatic Diagnostic Viral Iso. SOP: 938.10.09.20

Animal	Specimen	Result	Isolate
1-Carp 3F k/s Lake Oahe	Tissue Pool	Negative	

Aquatic Diagnostic Viral Iso. test comment: no virus isolated on CHSE-214, EPC, FHM or BF-2 cell lines after a two week primary cultivation followed by a two week sub-cultivation.

Molecular Diagnostics- Last reported on 05/17/11 Authorized by Daniel Bradway, Lab Manager

PCR for VHS SOP: Not yet posted

Animal	Specimen	Result
blcok #6	Tissue Block Embedded	Not detected

Washington Animal Disease Diagnostic Lab

PCR for VHS test comment: Viral haemorrhagic septicaemia virus PCR performed using Blue Book primers and ATCC positive control. Validation of this assay at WADDL is not complete.

Appendix 3. Diagnostic laboratory report for Chinook salmon, May 4, 2011.

ANIMAL DISEASE RESEARCH & DIAGNOSTIC LABORATORY
Veterinary and Biomedical Sciences Department
South Dakota State University
Box 2175, North Campus Drive - Brookings, SD 57007-1396

SDSU

Phone: (605) 688-5171
Fax: (605) 688-6003

Accounting: (605) 688-5392
http://sdstate.edu/vs

FAX: (605) 223-7717

GAME FISH AND PARKS
20641 SD HWY 1806
FORT PIERRE, SD 57532

Date: 06/08/11

Case: **11-6915**
Accession Date: **05/04/11**
Owner: **GAME FISH AND PARKS**
Owner Address: **FORT PIERRE, SD 57532**

Species: FISH SPECIES
Wt: lbs
Age:

Case Coordinator:____

Regg D. Neiger, DVM, PhD

TEST REPORT

COPY

cc SD AIB - 411 S FORT - - PIERRE , SD 57501 -
GAME FISH and PARKS FISH - 523 E CAPITOL AVE - JOHN LOTT FISHERIES PROG - PIERRE , SD 57501 -
FLETCHER, BRIAN - SD GAME FISH AND PARKS - 4725 JACKSON BLVD - RAPID CITY , SD 57702 -
ADAMS, GENO - SD GAME FISH AND PARKS - - PIERRE , SD 57501 -

Diagnostic Findings

ADDENDUM #1 June 08, 2011 gam

Virus isolation of the kidney and spleen was negative.

SUMMARY May 13, 2011 gam

Specimen: 2 dead, 5-pound, Chinook Salmon from Lake Oahe, SD

Laboratory findings included:
1) Severe fungal dermatitis with local invasion of subcutaneous and muscle by the fungus. Bacterial cultures supported a diagnosis of secondary bacteremia.
2) Emaciation with lack of body fat and empty gastrointestinal tract.
3) Virus isolation has been initiated, and positive results will be forwarded.

Pathology

GROSS PATHOLOGY May 13, 2011 gam

These 2 dead, Chinook Salmon had a large mat of gray-brown material adhered to the ventral skin from the vent anterior to the jaw. There were also some multifocal ulcerations on the tail fin. This mat was almost 2 cm deep in places. The fish also had limited body fat and empty gastrointestinal tract. There was hyperemia of the swim bladder, and 1 liver had large hemorrhages present in the parenchyma. The subcutaneous tissue and muscle subjacent to the skin with the mat was edematous. One fish had 2 ulcers in the stomach.

HISTOPATHOLOGY May 13, 2011 gam

There was severe diffuse dermatitis and cellulitis of the skin and subcutaneous tissues of the ventral portion of both fish. The skin lesion was characterized by a large mat of fungal hyphae adhered to the skin surface of the fish. There was an assortment of bacteria and necrotic debris mixed in the fungal mat. There was multifocal epidermal ulceration which, in places, extended to the stratum compactum. The dermis subjacent to the stratum compactum had multifocal necrosis with fungal hyphae, inflammation, and hemorrhage present multifocally. The skeletal muscle subjacent to the skin lesion was necrotic. In areas, this muscle also had some fungal hyphae present. The skeletal muscle of the lateral aspects of the fish had multifocal necrosis, which was much milder than that found subjacent to the ventral skin lesion. The gills had moderate autolysis present making it difficult to interpret; however, there appeared to be mild to moderate, hydropic degeneration of the laminar epithelial cells as well as some accumulation of inflammatory cells within lamina. One of 2 livers had some large focal hemorrhagic areas. There was some moderate cytoplasmic vacuolization of hepatocytes. There were no lesions in the head kidney, trunk kidney, brain, spleen, or heart. Gastrointestinal tissue was difficult to interpret due to autolysis; however, there did not appear to be major lesions present.

Virology

FISH VIRUS ISOLATION **Verified on: 06/07/11**

Animal ID	Specimen	Isolate	Level	Result
CHINOOK SALMON	KIDNEY			NO ISOLATE
CHINOOK SALMON	SPLEEN			NO ISOLATE

Bacteriology

AEROBIC CULTURE **Verified on: 05/10/11**

Animal ID	Specimen	Isolate	Level	Result
CHINOOK SALMON	KIDNEY	PSEUDOMONAS SP.		ISOLATED
**: SIMILAR COLONY TYPE COMPATIBLE WITH PSEUDOMONAS SP. ISOLATED FROM SPLEEN AND GILLS -- DLM 5/10/11				
CHINOOK SALMON	SPLEEN	AEROMONAS HYDROPHILIA		ISOLATED
**: SIMILAR COLONY TYPE COMPATIBLE WITH AEROMONAS HYDROPHILA ISOLATED FROM KIDNEY -- DLM 5/10/11				
CHINOOK SALMON	GILLS			NO PATHOGEN ISOLATED

MYCOLOGY NON-SPEC FLUORESCENCE TEST **Verified on: 05/05/11**

Animal ID	Specimen	Isolate	Level	Result
CHINOOK SALMON	SKIN			POSITIVE

*** End of Report ***

Appendix 4. Diagnostic laboratory report for lake herring collected on September 7, 2011.

ANIMAL DISEASE RESEARCH & DIAGNOSTIC LABORATORY
Veterinary and Biomedical Sciences Department
South Dakota State University
Box 2175, North Campus Drive • Brookings, SD 57007-1396
SDSU
Phone: (605) 688-5171
Fax: (605) 688-6003
Accounting: (605) 688-5392
http://sdstate.edu/vs

BRIAN FLETCHER
GAME FISH AND PARKS
4725 JACKSON BLVD
RAPID CITY, SD 57702

FAX: (605) 394-1872
Date: 09/14/11

Case: **11-13768**
Accession Date: **09/07/11**
Owner: **GAME FISH AND PARKS**
Owner Address: **FORT PIERRE, SD 57532**

Species: FISH SPECIES
Wt: lbs
Age:

Case Coordinator: ____________
Regg D. Neiger, DVM, PhD

TEST REPORT

COPY

GAME FISH and PARKS FISH - 523 E CAPITOL AVE - JOHN LOTT FISHERIES PROG - PIERRE , SD 57501 - FLETCHER, BRIAN - SD GAME FISH AND PARKS - 4725 JACKSON BLVD - RAPID CITY , SD 57702 -

Diagnostic Findings

SENT
SEP 14 2011

SUMMARY
September 14, 2011 gam

Specimen: 4 dead, adult, Lake Herring fish from near Bush's Landing on Lake Oahe

Laboratory findings included gross and microscopic lesions consistent with bacteremia and Edwardsiella tarda isolated from affected tissues. Aeromonas hydrophila was also isolated from the gills and may have contributed to the problem.

PCR examination of a pool of kidney and spleen was negative for VHS virus. Virus isolation is negative to date. Positive results will be forwarded.

Pathology

GROSS PATHOLOGY
September 12, 2011 nn

These dead mature lake herring had multifocal hemorrhages of the dermis and around the eyes. These vary from just a few in a couple of the fish and to many in one. All fish had empty gastrointestinal tracts. Skin scrapings, gill clips and fecal wet mounts showed no significant anomalies.

HISTOPATHOLOGY
September 12, 2011 nn

There is some mild multifocal interstitial necrosis in the kidney of a couple of the fish. There is also some mild multifocal inflammation and some necrosis in the spleens. One fish had moderate amounts of skeletal muscle fibrolysis, the other fish mild to no muscle lesions. The intestine was autolytic. There are no lesions in the testes, ovaries, brains, livers or gills.

Virology

Results are Pending for VIRUS ISOLATION

Bacteriology

AEROBIC CULTURE **Verified on: 09/14/11**

Animal ID	Specimen	Isolate	Level	Result
	GILLS	AEROMONAS HYDROPHILIA		ISOLATED
	GILLS	AEROMONAS HYDROPHILIA		ISOLATED
POST KIDNEY	KIDNEY	EDWARDSIELLA SP.		ISOLATED
HEAD KIDNEY	KIDNEY			SEE COMMENTS
	LIVER			SEE COMMENTS
**: EDWARDSIELLA TARDA ISOLATED FROM POST KIDNEY, SIMILAR COLONY TYPE ON ALL OTHER TISSUES. DLM 9/14/11				

Molecular Diagnostics

PCR VIRAL HEM SEPT VIRUS **Verified on: 09/09/11**

Animal ID	Spec #	Specimen	Test	Result
POOL OF KIDNEY AND SPLEEN	6	POOL-TISSUE	PCR VIRAL HEM SEPT VIRUS	NEG
POOL OF OVARIES AND TESTES	7	POOL-TISSUE	PCR VIRAL HEM SEPT VIRUS	NEG

PCR: FLAVOBACTERIUM PSYCHROPHILUM **Verified on: 09/09/11**

Animal ID	Spec #	Specimen	Test	Result
POOL OF KIDNEY AND SPLEEN	6	POOL-TISSUE	PCR: FLAVOBACTERIUM PSYCHROPHI	NEG
POOL OF OVARIES AND TESTES	7	POOL-TISSUE	PCR: FLAVOBACTERIUM PSYCHROPHI	NEG

*** End of Report ***