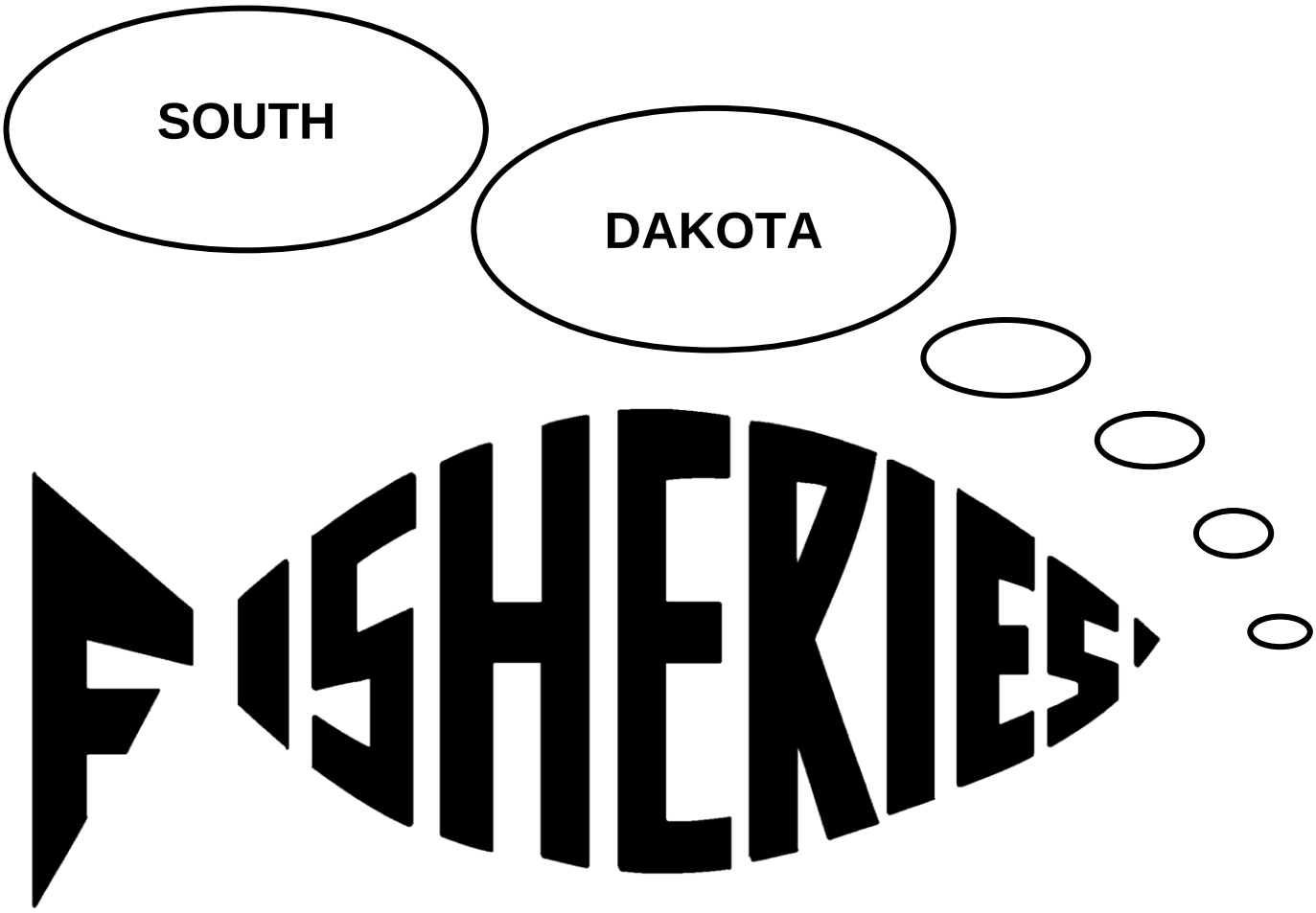

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE OAHE, SOUTH DAKOTA, 2014

South Dakota
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Game, Fish and Parks
Wildlife Division
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Pierre, South Dakota 57501-3182

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ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE OAHE, SOUTH DAKOTA, 2014

By

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Annual Report

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PREFACE

Information collected during 2014 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: J. Aberle, B. Beel, A. Carlson, L. Collett, E. Felts, K. Graham, M. Greiner, L. Johnson, D. Jones, D. Jost, J. Jungwirth, R. Novak, W. Radigan, J. Schweiss, J. Simpson, J. Tostenson, and F. Turner.

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-47, Statewide Fish Management Surveys. Some of these data have been presented previously in F-21 segments 23 through 46.

EXECUTIVE SUMMARY

This report includes data collected from annual fish population surveys and angler use and harvest surveys collected during 2014 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 Management Area Strategic Plan.

Walleye comprised 32% and channel catfish comprised 40% of the fish caught in the 2014 coolwater gill net survey. Eighteen species were collected in the coolwater gill net survey in 2014, and mean catch per unit effort (CPUE) for most species was lower than previous years, but similar to CPUE in 2013. White bass were the most abundant species captured during the August seining survey in 2014. Black crappie and yellow perch were also abundant in seine catches.

In 2012 and 2013, an intensive gizzard shad stocking program was implemented where adult pre-spawn gizzard shad were stocked in select bays of Lake Oahe in an attempt to create a short term localized prey resource for Lake Oahe sportfish. In 2014, the stocking program was reduced, and only a small number of pre-spawn adults were stocked in Spring and Cow Creek. No gizzard shad were captured in standard shoreline seining or gill net surveys.

Mean CPUE of walleye captured in gill nets in 2014 was lower than previous years (14.1 walleye/net), and lower than the ten year average (16.9 walleye/net). In 2014, the number of stock-quality sized fish was slightly higher than the five year average; however, the numbers of quality-preferred and preferred-memorable size walleye was lower than the previous five years. Walleye condition, as measured by relative weight (*Wr*), increased from 2013 to 2014. Length-at-age-at-capture for age-1 and 2 walleye captured in 2014 was similar to the five year mean. Length-at-age-at-capture was smaller in 2014 compared to the five-year average for fish ages 3-8. This is particularly apparent in the 2009 (age-5) year class. Mean annual incremental growth for age-5 walleye was still considerably slower in 2014 compared to 5 year average.

Estimated fishing pressure for the South Dakota portion of Lake Oahe for 2014 was 771,419 h. Angling pressure was lower than that observed in 2012 and 2013, but similar to the 10 year average (754,715 h). An estimated 932,381 walleye were caught in Lake Oahe during the May-July 2014 survey. Of those, 369,929 walleye were harvested, which was slightly greater than the 10 year average of 334,534 walleye.

In 2014, resident anglers represented 77% of the parties interviewed on Lake Oahe. Four states represented the majority of non-resident anglers and included Nebraska, Minnesota, Iowa and North Dakota. In 2014, 40% of anglers traveled >200 miles (one way) and 62% of anglers traveled >100 miles (one way) to fish Lake Oahe. This number is similar to the five year average for Lake Oahe.

Overall satisfaction on Lake Oahe during the May-July period of 2014 was at 82%, not including responses of “neutral” or “no opinion”. Median satisfaction rating for angling parties that harvested zero to two walleye per person was “moderately satisfied”, while for parties harvesting two to four walleye per person, median rating was “very satisfied”.

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INTRODUCTION

Lake Oahe is the largest and one of the most economically important fisheries in the state of South Dakota averaging 150,039 angler trips annually over the last ten years. 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 163,586 trips occurred during the May-July 2014 daylight period on Lake Oahe, for an estimated economic input of ~$11 million (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2011).

Because the Lake Oahe fishery is an important resource to the state of South Dakota, it must be effectively managed to produce optimal recreational benefits. A prerequisite to the development of effective management strategies is the acquisition and analysis of data describing fish assemblages and population characteristics, angler preferences, use and harvest, and angler satisfaction data. These surveys provide information used to evaluate progress towards objectives of the South Dakota Department of Game, Fish and Parks Missouri River Fisheries Management Area Strategic Plan and more specifically, the Lake Oahe Strategic Plan.

STUDY AREA

Lake Oahe is a mainstem Missouri River storage reservoir located in north-central South Dakota. Lake Oahe is a large reservoir with a surface area of 110,660 ha, 3,620 km of shoreline and mean and maximum depths of 18.3 and 62.5 m, respectively (Table 1; Michaletz et al. 1986, Warnick 1987). Lake Oahe has been separated into three zones for survey purposes. Each zone includes approximately three sampling locations (Figure 1).

Because Lake Oahe is a storage reservoir, elevation, surface area, and volume change over time (Figure 2). Consequently, sampled habitats are not the same each August when coolwater gill net surveys are conducted. Additionally, Lake Oahe water elevation fluctuations can have dramatic effects on aquatic habitat, lake productivity, water temperatures, water residency time and many other physical variables. Drastic changes in water elevation likely influence year-to-year variation of survey efficiency and precision.

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
Substrate 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 $\leq 15^oC$ in August.

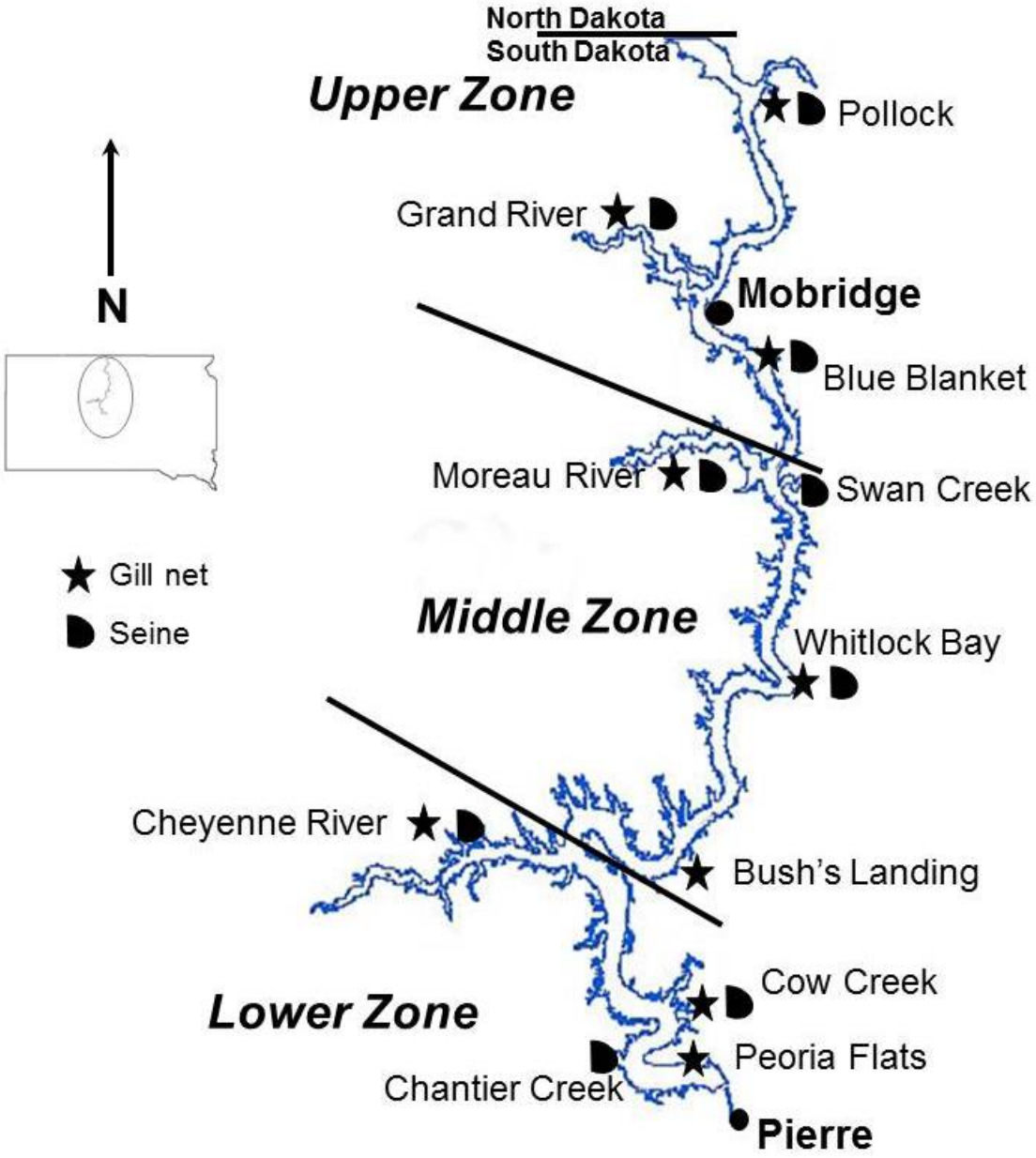

Figure 1. Reservoir zones and fish population sampling locations on Lake Oahe, South Dakota.

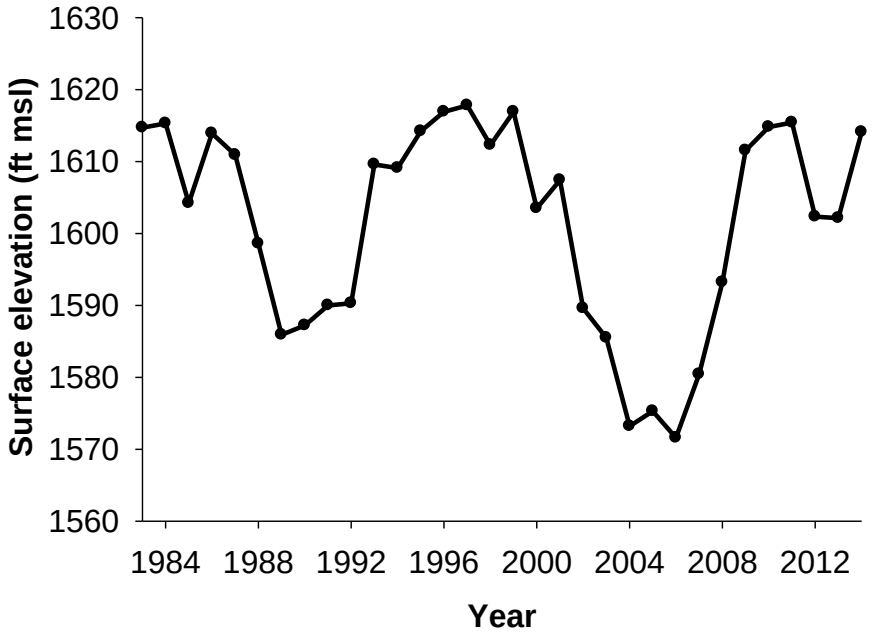

Figure 2. Average August elevation of Lake Oahe 1983-2014

REGULATION HISTORY

Walleye harvest regulations for Lake Oahe have differed from standard statewide regulations since 1990. Initially, a 356-mm (14-in) minimum length limit was placed on Lakes Oahe, Sharpe and Francis Case from April through June with a daily limit of four fish (Table 2). In 1999, the harvest regulations were amended so 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 to maintain a quality fishery with a high size structure.

The daily walleye bag limit on Lake Oahe was increased from four to 14 fish in 2001 of which, at most, four fish could be 381-mm (15-in) and one fish could be over 457-mm (18-in). The objective of this regulation was two-fold: to reduce predation on rainbow smelt which saw rapid population declines in the late 1990's and to reduce the high abundance of walleye less than 381-mm (15-in; Lott et al. 2002).

Following liberalization of the Lake Oahe walleye regulations, a decrease in angler satisfaction was associated with anglers unable to attain high daily limits (Lott et al. 2004). Thus, the daily limit was reduced to ten fish in 2002 and six fish in 2004. In an effort to standardize regulations statewide, the daily limit was reduced to four walleye with only one fish allowed over 508-mm (20-in) in 2006, and the possession limit of 12 fish was reduced to eight fish in 2007.

In 2011, the Missouri River experienced a massive flood that moved much of the Lake Oahe prey fish biomass through Oahe Dam. Following this high entrainment event, prey fish populations plummeted resulting in poor condition and high natural mortality of Lake Oahe walleye (Fincel et al. 2013). At the same time, a massive 2009 walleye year class was attaining a size sought by anglers. Thus, the population was made up of fewer large fish of poor condition and many small fish (less than 381-mm) of mediocre condition. This change in population size structure spurred a change to the 2013 walleye regulations in an effort to take advantage of the exceptionally large 2009 year class. This regulation permitted the harvest of four additional walleye less than 381-mm (15-in) complimentary to the state-wide limit of four walleye, of which, one may be over 508-mm (20-in). The 2013 regulation for four additional walleye on Lake Oahe was removed in 2014, and fishing limits returned to the state-wide limit of four walleye.

Table 2. History of harvest regulations for walleye on Lake Oahe, South Dakota, 1968-2014.

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 356-mm minimum length (14-in)
	1999-2000	4	8	• At most one equal to or longer than 457-mm (18-in)
	2001	14	42	• At most four equal to or longer than 381-mm (15-in) • At most one equal to or longer than 457-mm (18-in)
	2002-2003	10	30	• At most four equal to or longer than 381-mm (15-in) • At most one equal to or longer than 457-mm (18-in)
	2004-2005	6	18	• At most four equal to or longer than 381-mm (15-in) • At most one equal to or longer than 508-mm (20-in)
	2006	4	12	• At most one equal to or longer than 508-mm (20-in)
	2007-2012	4	8	• At most one equal to or longer than 508-mm (20-in)
	2013	8	24	• At most four equal to or longer than 381-mm (15-in) • At most one equal to or longer than 508-mm (20-in)
	2014	4	8	• At most one equal to or longer than 508-mm (20-in)

SAMPLING METHODS

Fish Population Surveys

Data Collection

A suite of gears was used to collect fish throughout the summer of 2014 in Lake Oahe. The standard coolwater fish population survey consists of setting three standard gill nets overnight (approximately 20 h) in two depth zones (0- to 10-m and 10- to 20-m). Gill nets were placed on the bottom in each depth zone (where possible), for a total of six nets at each station. A standard gill net of multifilament nylon was 10.7-m long by 1.8-m deep with 15.2-m panels of the following bar mesh sizes: 12.7-mm, 19.1-mm, 25.4-mm, 31.8-mm, 38.1-mm, 50.8-mm, and 63.5-mm.

All walleye collected during the standard coolwater gill net survey were measured for total length (mm) and weighed (g). Sagittal otoliths were removed from ten fish (maximum) within each 25-mm length class for walleye, sauger and hybrids captured at each sampling station. When possible, representative samples (at least 50 individuals per sampling station) of all other species were measured and weighed.

Age was estimated using whole otoliths from walleye and sauger less than 300-mm. Otoliths were viewed under a thin layer of glycerol in a black dish with an overhead light source. For fish greater than 300-mm, otoliths were cracked through the focus and charred prior to age-estimation. Otoliths were read independently by at least two experienced readers.

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

Acoustic surveys have been conducted since the late 1980's to monitor cold water species that are less susceptible to coolwater gillnet surveys, primarily rainbow smelt. Equipment specification used during the 2003 -2005 surveys can be found in Nelson-Statsny (2001). Data from 2008-2014 were collected with a Biosonics DT-X digital Echosounder and a split-beam transducer.

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 (SE) values were calculated for gill net and seining CPUE as a measure of sample variance.

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.

Proportional size distribution (PSD; Anderson and Weithman 1978) was calculated for walleye and channel catfish (Gabelhouse 1984; Appendix 2). Relative weight (W_r; Anderson 1980) was calculated using standard-weight (W_s) equations

developed for walleye (Murphy et al. 1990) and channel catfish (Brown et al. 1995). Proportional size distribution and W_r were calculated using the WinFin software package developed by Francis (2000).

Acoustic data were processed using EchoView™ Ver. 4.9 (Myriax Software Pty Ltd.) independently for each year, both 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.

Separation of rainbow smelt age classes was based on size ranges determined from fish collected in historic mid-water trawl surveys (Table 3). 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, and targets enumerated. Age-0 and age-1 lake herring abundance has only been quantified since 2013.

For echo integration from 2009 through 2014, 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.

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 counts of boat and shore anglers 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 (Stone et al. 1994).

Sampling was conducted from 1-May, 2014 through 31-July, 2014, for the sunrise to sunset period. The Lake Oahe angler survey was reduced from a May-October creel to a May-July creel due to budget restrictions and lack of manpower. Angler satisfaction and attitude questions were included in angler interviews in 2014. In addition to asking anglers how satisfied they were with their fishing trip, anglers were asked questions pertaining to an ongoing walleye tagging research project, questions regarding Aquatic Invasive Species and opinions on stocking Atlantic salmon into Lake Oahe. A complete list of satisfaction, attitude and preference questions asked in conjunction with the 2014 angler use and harvest survey appears in (Appendix 3) and will be summarized in respective reports.

Data Analysis

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

Table 3. Rainbow smelt and lake herring age and size classes used for size classification of hydro-acoustic assessment.

Age Class	Size Range	Target Strength Range
Age-0 rainbow smelt	21-79 mm	-58.2 to -47.2 dB
Age-0 lake herring	100-159 mm	-44.9 to -41.1
Age-1+ rainbow smelt	80-180 mm	-47.1 to -40.4 dB
Age-1 lake herring	180 - 269 mm	-40.3 to -37.1 dB
Other Large	> 270 mm	> -37 dB

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 (Hubert 1996) and lake volume can also affect CPUE of gill nets. Therefore, some caution should be used when inferring density or abundance of fish species captured in the standard gill net survey from CPUE compared temporally. Eighteen species were captured in the coolwater gill net survey samples in 2014 (Table 4). Walleye comprised 32% and channel catfish comprised 40% of all fish caught in the 2014 coolwater gill net survey (Table 5). Mean CPUE for all species in 2014 was similar to 2013 (Table 4).

White bass were the most abundant species captured during the 2014 August seine survey, with a mean CPUE of 569 fish/haul ± 214.4 (SE; Table 6). Also abundant in 2014 were black crappie and yellow perch with CPUE of 282.8 ± 157.4 and 270.4 ± 145, respectively. Age-0 gizzard shad were the most abundant species in seine survey catches from 2003 to 2009; however, catches began declining in 2006 and no gizzard shad were captured from 2010 through 2011. In 2012 and 2013, an intensive gizzard shad stocking program was completed and age-0 gizzard shad were once again captured in shoreline seining surveys in 2012 and 2013 (Table 6). We transferred 152 and 174 pre-spawn adult gizzard shad to Cow Creek and Spring Creek, respectively. No age-0 gizzard shad were collected during the standard seining survey in 2014.

Population Characteristics of Walleye

Mean CPUE of walleye captured in gillnets in 2014 was slightly lower than CPUE in 2013 and lower than the 10-year average (16.9 walleye/net night; Figure 3). Similar to previous years, the lower end of Lake Oahe had lower walleye CPUE (11.8) compared to the upper (16.9) and middle (13.7) zones (Figure 3). Walleye PSD in 2014 was slightly higher than in 2013 (Table 7). Walleye PSD-P in 2014 was the same as 2013 across all zones of Lake Oahe (Table 7).

Relative weight of walleye increased from 80 in 2013 to 86 in 2014 (Table 8). Relative weight was slightly higher in the middle zone (88) compared to the lower (87) and upper (85) zones. Relative weight was similar for stock-quality (87) size fish and quality-preferred (86) size fish. Relative weight of preferred size fish was the lowest of the three size categories (78). Length-at-age-at-capture was generally smaller in 2014 compared to the five-year average (Table 9). Only age-1 and age-10 walleye were longer than the five year average. It appears the 2009 and 2010 walleye year classes are still growing substantially slower when compared to the 5-year average growth rate. In 2014, the average length of walleye from the 2010 year class was 74 mm below the 5-year average, and the average length of a walleye from the 2009 year class was 107 mm below the 5-year average. Walleye growth varied among zones, and mean length-at-time-of-capture was greater in the upper zone of Lake Oahe (Table 10).

Mean annual incremental growth of walleye in 2014 was similar to the five year mean (Table 11). All ages of walleye showed an increase in growth compared to the previous year. Ten year classes were represented in 2014 with strong age-5 and age-3 year classes (2009 and 2011 year classes, respectively; Table 12). Additionally, age-0

walleye abundance was the 2nd highest since 2009, suggesting the potential for another strong year class produced in 2014 (Fincel et al. 2014). Age-5 walleye (2009 year class) represented 48% of the 2014 gill net sample and was the largest year class for the fifth consecutive year. Age-3 walleye represent 16% of the 2014 gill net sample.

Similar to 2011, 2012 and 2013, 254- to 381-mm TL (10- to 15-in) walleye composed the highest percentage of the population in 2014 (Figure 4). Catch per unit effort of walleye larger than 508-mm (20-in) was the lowest since 2005. The middle zone produced the most walleye greater than preferred length (Figure 5). Numbers of walleye below 254-mm were similar in the lower and middle zones of Lake Oahe.

Population Characteristics of Channel Catfish

Channel catfish in Lake Oahe were more abundant but exhibited a slightly smaller size structure in 2014 than 2013 (Figure 6). Catch per unit effort of channel catfish increased from 16.6 in 2013 to 17.6 in 2014. Proportional size distribution of channel catfish decreased from 49 in 2013 to 41 in 2014. Channel catfish condition (*Wr*) increased slightly from 81 in 2013 to 85 in 2014 (Table 13).

Hydro-acoustic Surveys

Population Characteristics of Rainbow Smelt

The 2014 annual hydro-acoustics survey estimated the lowest number of age-0 (0) and second lowest estimate of age-1+ (18,510,701) rainbow smelt since 2005 (Table 14). Pelagic warm water prey fish abundance in 2014 (i.e., the number of fish above thermocline in the open water; 167,203,899 fish) was similar to the ten year average (168,762,037). The hydro-acoustics survey also documented a large number of age-0 lake herring in 2014 (Table 15). Years when rainbow smelt abundance is low and age-0 and age-1 lake herring is high may provide sufficient prey for sportfish in Lake Oahe. Size ranges of age-0 and age-1 lake herring are similar to the size range of rainbow smelt, and may provide a suitable alternative in years of low rainbow smelt abundance (Figure 7).

Table 4. 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 2010-2014. Trace (T) indicates values less than 0.05.

Species	Year									
	2010		2011		2012		2013		2014	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0.2	0.1	T	--	0	--	0.1	--	0.1	0.1
Black bullhead	0	--	T	--	0	--	T	--	0	--
Black crappie	0	--	0	--	0	--	0	--	T	--
Bluegill	0.2	0.1	T	--	T	--	0	--	0	--
Channel catfish	14.7	1.3	12.7	1.3	16.3	1.6	16.6	1.8	17.6	1.8
Chinook salmon	0	--	T	--	0	--	0	--	0	--
Common carp	2.7	0.3	1.5	0.2	1.1	0.2	1.9	0.3	1.8	0.3
Freshwater drum	2.3	0.3	1.5	0.3	0.8	0.1	0.9	0.2	1.2	0.2
Gizzard shad	0	--	0	--	0.1	0.1	T	--	0	--
Goldeye	0.5	0.2	1.4	0.3	1.1	0.3	1.1	0.2	0.7	0.2
Lake herring	T	--	0.1	0.1	0	--	0	--	0	--
Northern pike	1.5	0.3	2.0	0.3	1.7	0.2	0.6	0.1	0.4	0.1
Rainbow smelt	T	--	0	--	0	--	0	--	0	--
River carpsucker	1.1	0.3	0.5	0.2	1.1	0.2	0.6	0.2	0.9	0.3
Sauger	0.6	0.2	0.3	0.1	0.3	0.1	0.1	0.1	0.2	0.1
Shorthead redhorse	0.6	0.2	0.6	0.2	0.8	0.3	1.1	0.3	1.0	0.4
Shortnose gar	T	--	T	--	0.3	0.2	0	--	T	--
Smallmouth bass	4.2	0.7	1.6	0.3	1.7	0.5	1.4	0.4	1.4	0.3
Smallmouth buffalo	0.2	0.1	0.1	0.1	0.3	0.1	0.2	0.1	0.2	0.1
Spottail shiner	0	--	0.1	0.1	0	--	0	--	0	--
Walleye	18.4	1.9	25.1	2.0	20.4	1.6	15.7	1.6	14.1	1.7
White bass	1.1	0.2	3.8	0.7	1.4	0.3	1.5	0.3	1.5	0.6
White crappie	1.4	0.3	2.7	1.7	0.7	0.2	0.5	0.2	0.2	0.1
White sucker	0.6	0.2	0.4	0.1	0.2	0.1	0.1	0.1	0.6	0.2
Yellow perch	24.0	4.5	7.2	0.8	0.3	0.1	0.9	0.2	2.5	0.8

Table 5. Relative species composition, expressed as percent of total catch of all fish species collected during the August standard coolwater gill net survey from 2010-2014.

Species	Year				
	2010	**2011**	**2012**	**2013**	**2014**
Channel catfish	29	21	33	38	40
Walleye	24	41	42	36	32
Freshwater drum	3	2	2	2	3
River carpsucker	1	1	2	1	2
Yellow perch	32	11	1	2	6
Common carp	4	2	2	4	4
Goldeye	1	2	2	2	2
White bass	1	6	3	4	3
***Other species**	14	13	13	9	8

*Other species include bigmouth buffalo, black bullhead, black crappie, bluegill, Chinook salmon, gizzard shad, lake herring, northern pike, rainbow smelt, sauger, shorthead redhorse, shortnose gar, smallmouth bass, smallmouth buffalo, spottail shiner, white crappie and white sucker.

Table 6. Mean catch per unit effort (CPUE; No./haul) and standard error (SE) values for fish species collected during the standard August seine survey, 2010-2014. Catches are for age-0 fishes, except where noted. Trace (T) indicates values less than 0.05.

Species	Year									
	2010		2011		2012		2013		2014	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0.1	0.1	0.0	--	0.0	--	6.0	3.4	2.8	1.1
Black crappie	3.9	2.4	21.0	20.6	21.3	20.6	0.1	0.1	282.8	157.4
Brassy minnow*	0.7	0.4	0.3	0.3	0.0	--	0.3	0.2	0.1	0.1
Channel catfish	0.0	--	T	--	0.0	--	T	--	0.0	--
Common carp	0.2	0.1	0.5	0.3	0.1	0.1	0.3	0.2	0.1	0.1
Emerald shiner*	7.9	3.6	60.3	45.9	14.3	6.3	64.0	27.1	74.9	33.0
Fathead minnow*	20.9	14.2	0.3	0.2	0.1	0.1	T	--	1.2	0.5
Freshwater drum	0.1	0.1	2.2	1.4	1.6	0.6	7.4	4.0	T	--
Gizzard shad	0.0	--	0.0	--	2.5	2.5	0.3	0.2	0.0	--
Goldeye	0.0	--	0.0	--	0.0	--	0.5	0.5	0.1	0.1
Johnny darter*	1.1	0.4	1.0	0.3	0.3	0.2	0.3	0.2	0.1	0.1
Lake herring	0.0	0.0	0.0	--	0.0	--	0.0	--	T	--
Largemouth bass	0.3	0.2	T	--	0.0	--	0.1	0.1	0.1	0.1
Northern pike	0.0	--	T	--	0.0	--	0.0	--	0.2	0.1
River carpsucker	0.8	0.5	0.3	0.2	0.1	0.1	2.2	1.6	3.9	3.0
Silvery minnow	0.1	0.1	0.0	--	0.0	--	0.0	--	0.0	--
Smallmouth bass	7.9	2.0	10.4	2.3	5.6	1.8	32.6	9.6	14.8	3.8
Smallmouth buffalo	T	--	0.0	--	T	--	6.7	4.3	4.6	1.4
Spottail shiner*	12.7	5.3	3.0	1.5	1.8	0.7	0.4	0.2	1.5	0.6
Walleye	0.2	0.1	0.2	0.2	0.3	0.2	1.0	0.7	4.2	2.4
White bass	38.9	17.5	42.1	19.5	15.1	9.7	70.1	28.3	569.0	214.4
White crappie	28.9	27.0	10.1	6.3	7.2	4.7	25.4	15.2	21.1	10.9
White sucker	0.3	0.2	T	--	0.1	0.1	4.0	1.7	1.1	0.6
Yellow perch	44.8	27.1	20.0	7.6	8.6	7.3	39.4	22.0	270.4	145.0

* Includes all ages.

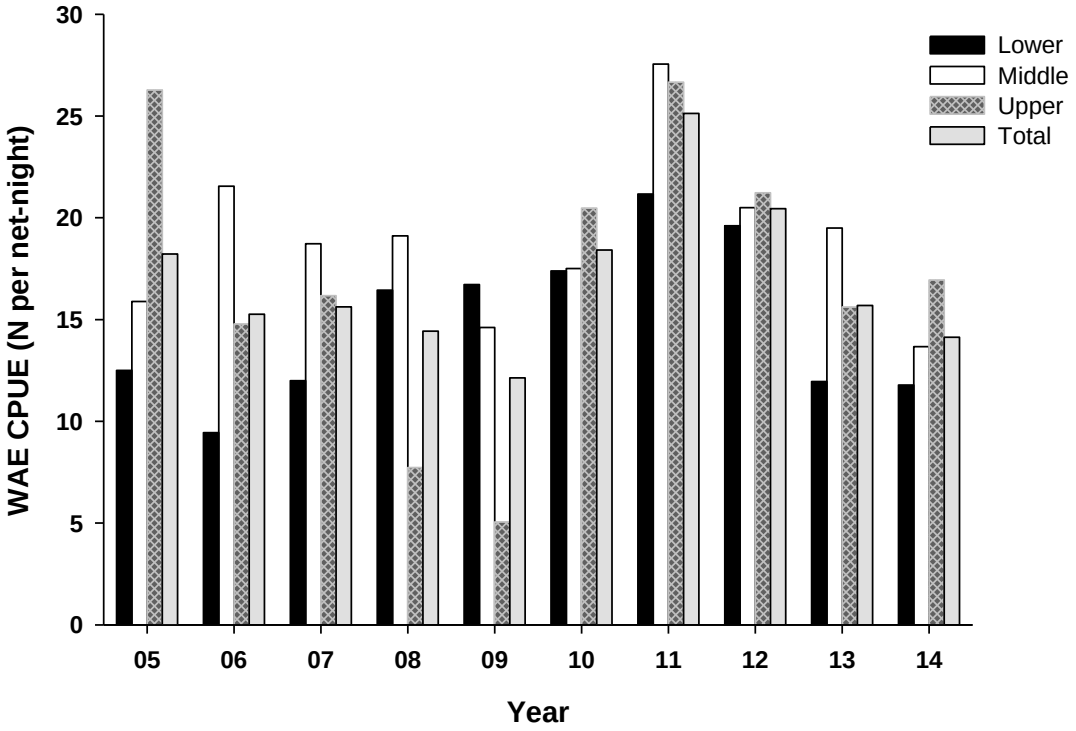

Figure 3. Mean walleye catch per unit effort (CPUE; No./net-night) in the coolwater gill net survey for lower, middle and upper zones of Lake Oahe, South Dakota, 2005-2014.

Table 7. Proportional size distribution of walleye (PSD, PSD-Preferred, PSD-Memorable) by reservoir zone, for fish collected during the standard coolwater gill net survey, 2010-2014.

Year	Zone											
	Lower			Middle			Upper			Total		
	PSD	-P	-M	PSD	-P	-M	PSD	-P	-M	PSD	-P	-M
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
2012	32	7	1	14	4	1	8	3	0	18	4	1
2013	21	2	0	8	1	1	5	2	0	10	2	1
2014	19	1	1	19	2	0	24	0	0	22	2	0
Mean	33	9	1	18	4	0	19	4	0	24	6	1

Table 8. Mean relative weight (W_r) of walleye by length group and reservoir zone from 2010-2014. N is the number of fish in a length group.

Zone/Year	Length group							
	Stock-quality		Quality-preferred		Preferred		Total sample	
	W_r	N	W_r	N	W_r	N	W_r	N
Lower								
2010	89	173	92	91	91	55	90	308
2011	86	173	91	90	90	54	88	358
20 12	77	222	76	72	72	22	76	326
2013	75	148	76	36	71	4	75	188
2014	87	149	87	34	75	2	87	185
Middle								
2010	87	134	89	54	87	14	87	202
2011	81	349	84	57	81	18	81	424
2012	76	271	75	32	68	13	76	316
2013	82	260	78	22	65	4	81	286
2014	88	168	86	37	77	4	88	209
Upper								
2010	83	89	87	48	85	12	85	149
2011	84	205	89	41	83	15	85	261
2012	83	301	76	18	72	9	82	328
2013	83	237	81	8	75	4	83	218
2014	85	168	84	62	81	4	85	234
Lake Wide								
2010	87	407	90	182	89	78	88	659
2011	83	729	89	229	87	79	84	1,045
2012	79	794	76	132	71	41	78	970
2013	81	633	77	66	69	12	80	711
2014	87	485	86	133	78	10	86	628

Table 9. Mean length-at-age at time of capture (mm), sample size (N) and standard error (SE) for walleye collected in the standard August coolwater gill net survey on Lake Oahe, from 2010-2014.

Year		Length at age at capture (mm)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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
2012	**Mean**	215	258	338	444	526	525	540	550	582	---	637	---
	N	69	52	426	21	7	21	7	1	3	0	2	0
	SE	3.1	3.1	2.3	11.1	20.5	12.6	22.9	---	28.3	---	37	---
2013	**Mean**	205	264	291	342	451	517	561	521	606	---	648	703
	N	41	108	36	344	12	4	1	1	1	0	1	1
	SE	1.7	2.3	4.3	2.2	21.2	21.7	---	---	---	---	---	---
2014	**Mean**	228	291	326	346	368	395	554	521	---	681	---	---
	N	77	72	89	36	255	1	5	4	---	1	---	---
	SE	3.3	3.9	3.6	7.5	2.6	---	24.5	18.9	---	---	---	---
Five year mean		218	291	358	420	475	496	558	550	576	619	599	618

Table 10. Mean length-at-time of capture (TL; mm) by reservoir zone, for walleye collected in the coolwater gill net survey from 2012-2014. N is sample size and SE is standard error.

Zone	Age	2012			2013			2014		
		Length	N	SE	Length	N	SE	Length	N	SE
Lower	**1**	230	15	5	210	11	2	196	13	3
	2	257	7	6	274	41	4	273	18	10
	3	358	156	4	298	12	8	314	31	6
	4	468	8	12	355	124	4	318	14	10
	5	490	4	36	538	1	--	363	107	4
	6	511	12	44	496	3	8	--	--	--
	7	553	2	45	560	1	--	466	1	--
	8	--	--	--	521	1	--	471	1	--
	9	557	2	24	--	--	--	--	--	--
	10	--	--	--	--	--	--	--	--	--
	11	674	1	--	--	--	--	--	--	--
	12	--	--	--	--	--	--	--	--	--
Middle	**1**	212	28	6	198	14	2	235	22	6
	2	238	15	5	258	51	3	275	16	6
	3	338	120	4	290	13	7	325	38	5
	4	473	6	14	337	126	4	369	12	13
	5	588	2	13	467	4	11	365	79	5
	6	559	5	12	--	--	--	--	--	--
	7	554	3	31	--	--	--	616	1	--
	8	--	--	--	--	--	--	531	2	18
	9	631	1	--	606	1	--	--	--	--
	10	--	--	--	--	--	--	681	1	--
	11	--	--	--	648	1	--	--	--	--
	12	--	--	--	703	1	--	--	--	--
Upper	**1**	209	26	3	208	16	3	234	42	4
	2	269	30	3	259	16	5	307	38	4
	3	317	150	3	286	11	6	349	20	8
	4	392	7	14	332	94	3	359	10	12
	5	551	1	--	430	7	33	380	69	5
	6	523	4	54	580	1	--	395	1	--
	7	506	2	67	--	--	--	563	3	6
	8	550	1	--	--	--	--	552	1	--
	9	--	--	--	--	--	--	--	--	--
	10	--	--	--	--	--	--	--	--	--
	11	600	1	--	--	--	--	--	--	--
	12	--	--	--	--	--	--	--	--	--

Table 11. Mean annual growth (mm/y) increment estimates for walleye collected in the coolwater gill net survey for the 2009-2010, 2010-2011, 2011-2012, 2012-2013 and 2013-2014 periods.

Year	Growth increment added (mm/y)								
	1-2	**2-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**	**8-9**	**9-10**
2009 -2010	91	70	57	29	--	60	53	23	--
2010 -2011	55	61	45	26	31	40	--	--	64
2011-2012	62	35	44	48	11	--	16	18	--
2012-2013	49	33	4	7	--	36	--	56	---
2013-2014	86	62	55	26	--	37	--	---	75
Five year mean	69	52	41	27	21	43	61	32	51

Table 12. Age distribution of walleye captured in standard coolwater gill net survey from 2010-2014 on Lake Oahe, as determined using sagittal otoliths for age-estimation.

	Age												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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
2012	14	76	84	852	23	8	26	7	2	4	0	2	0
2013	25	45	141	59	553	13	4	1	1	1	0	1	1
2014	28	89	90	124	51	369	1	5	4	0	1	0	0

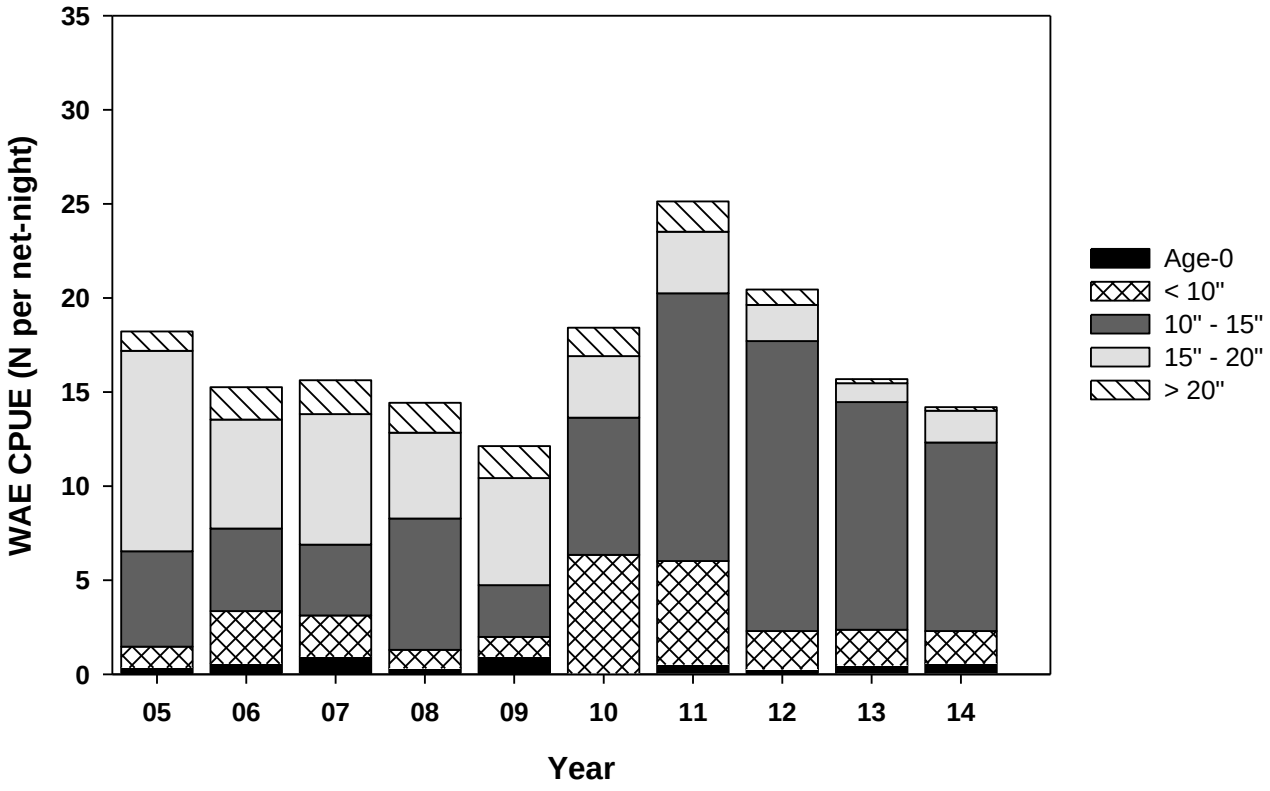

Figure 4. Incremental CPUE for walleye by year, as sampled by the standard coolwater gill net survey from 2005-2014 on Lake Oahe, South Dakota.

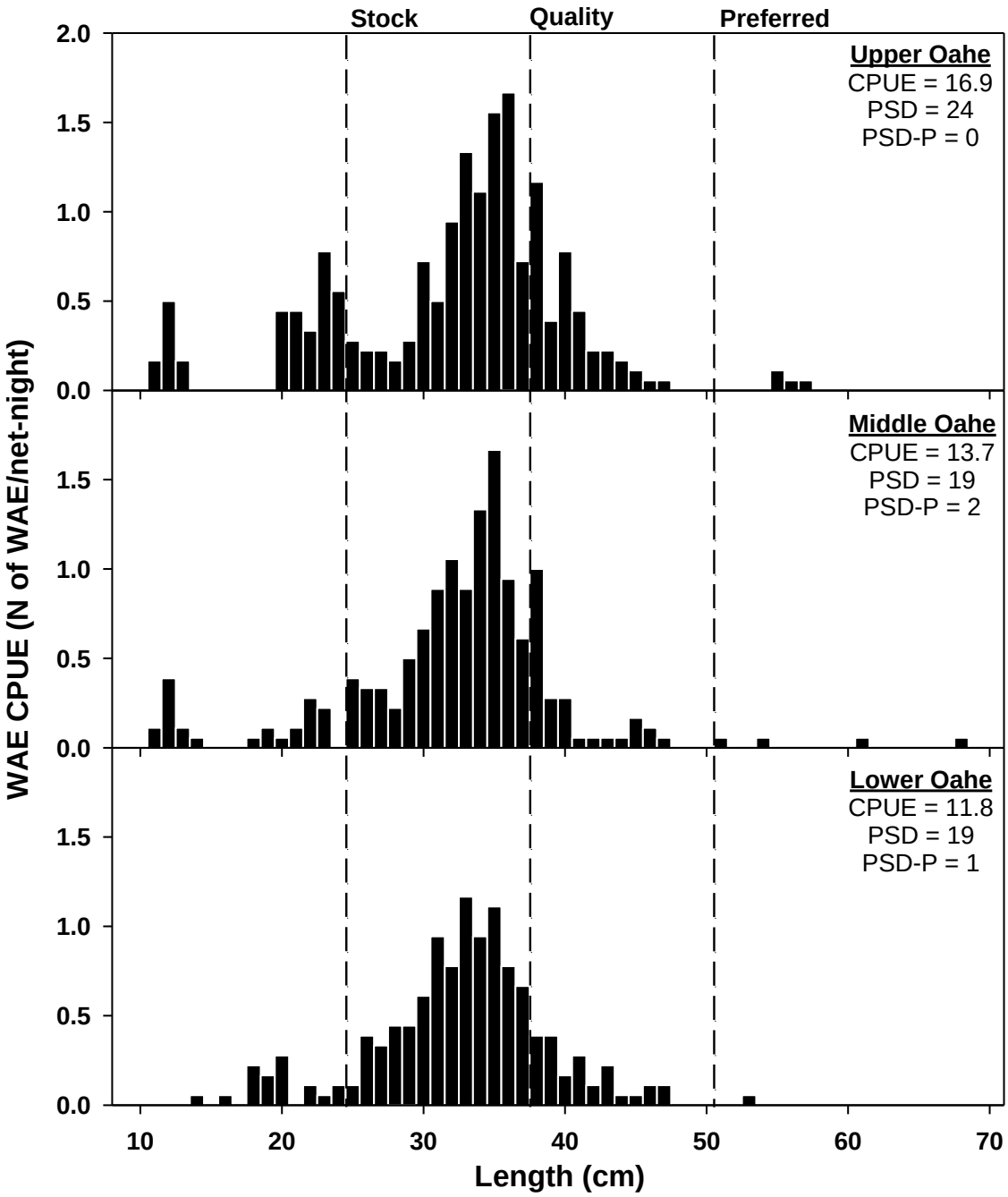

Figure 5. Length-frequency distribution of walleye by zone, collected during the standard coolwater gill net survey in 2014.

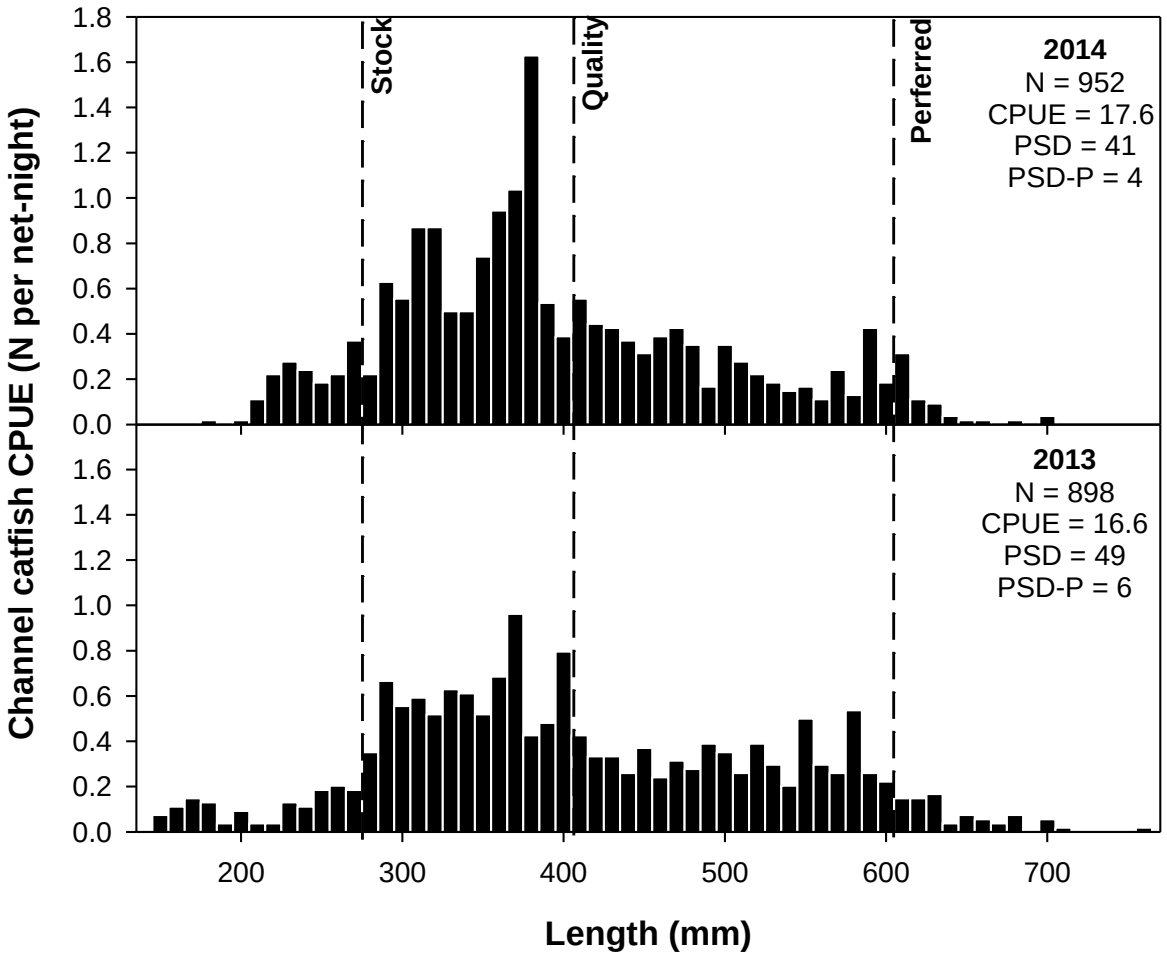

Figure 6. Length-frequency distribution of channel catfish collected during the standard coolwater gill net survey in 2013 and 2014. N is the number of channel catfish sampled.

Table 13. Proportional size distribution (PSD), preferred (PSD-P) and memorable length (PSD-M) for channel catfish and mean relative weight (W_r) values for 2010-2014 for Lake Oahe, South Dakota. Mean W_r values are for stock-length fish and longer.

Year	PSD	PSD-P	PSD-M	W_r	Sample size
2010	63	5	1	84	175
2011	48	6	0	87	406
2012	55	7	0	81	335
2013	49	6	0	81	579
2014	41	4	0	85	534

Table 14. Summary of annual hydro-acoustic estimates of age-0 rainbow smelt, age-1+ rainbow smelt, age-0 lake herring, age-1 lake herring and warm-water prey fish from 2005-2014 in Lake Oahe. Lake herring numbers were not quantified prior to 2013.

Year	Age-0 Rainbow smelt	Age-1+ Rainbow smelt	Age-0 Lake herring	Age-1 Lake herring	Warmwater prey fish
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	136,155,095	146,470,914	--	--	499,538,318
2009	71,819,867	32,392,760	--	--	126,578,403
2010	175,337,044	221,476,199	--	--	41,221,525
2011	761,017,172	270,541,766	--	--	67,879,345
2012	157,179,851	107,584,173	--	--	8,854,785
2013	9,479,735	2,030,291	1,184,967	809,638	20,122,679
2014	0	18,510,701	23,150,206	--	167,203,899

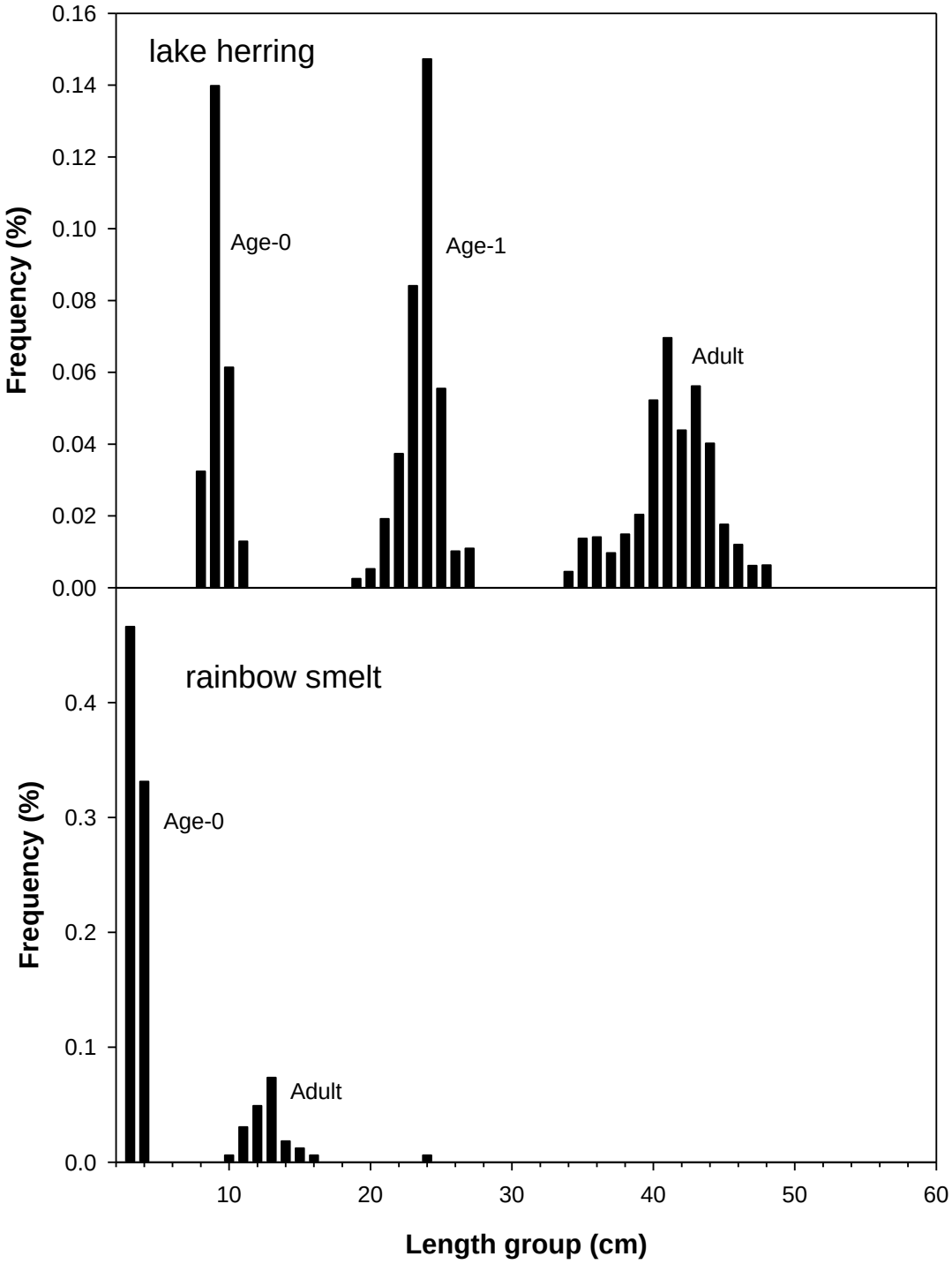

Figure 7. Length-frequency distribution of lake herring (top; N = 397) and rainbow smelt (bottom; N = 228) captured during annual deepwater gill net surveys on Lake Oahe, South Dakota in 2014.

Angler Use, Sportfish Harvest and Preference Surveys

Angler Use

Estimated fishing pressure for the South Dakota portion of Lake Oahe for the May-July daylight period was 771,419 h in 2014 (Table 15). Estimated fishing pressure peaked in June during the 2014 season, at 410,540 h or 53% of the total fishing pressure throughout the months of May to July (Table 16).

Estimated boat fishing pressure decreased in 2014 to 741,698 h, the lowest amount of pressure over the last five years (Table 17). Shore fishing also decreased substantially from 2013 with only 29,721 h of effort expended in 2013. Estimated fishing pressure, calculated using full pool surface area was 7.0 angler-h/ha for the May-July period in 2014 (Table 17). Fishing pressure decreased from upstream to downstream in 2014, unlike in 2012 and 2013 where pressure was highest in the lower zone. The upper zone had the highest pressure (8.2 angler-h/ha), the middle zone had intermediate pressure (7.7 angler-h/ha) and the lower zone had the least pressure (5.3 angler-h/ha).

Catch, Harvest and Release Estimates

Of the estimated 423,944 fish harvested from Lake Oahe during the May-July 2014 daytime period, 369,929 (87%) were walleye (Table 18). Smallmouth bass, northern pike and channel catfish were the next most common species harvested but each individual species made up less than 5% of the harvest. Similar to 2013, the majority of the walleye harvest in 2014 (46%) took place on the upper zone (Table 20; Fincel et al. 2014). The number of fish harvested in 2014 peaked in June at 208,319 fish (Table 19).

Estimated walleye catch and the percentage of walleye caught that were harvested have varied greatly among years (Table 22). Over the past 10 years, on average, anglers harvested 52% of walleye that were caught. The lowest percentage of walleye harvested out of total catch occurred in 2012 with only 27% of walleye kept and 2011 with only 31% of walleye kept (Table 22). In 2011 and 2012, catch rates were high and likely increased the release rates on Lake Oahe. Percent of walleye harvested has increased slightly from 2012, but has still remained low throughout 2013 and 2014 (44% and 40%, respectively). Total number of walleye harvested on Lake Oahe in 2014 (369,929) was similar to the 10 year average of 334,535 walleye harvested.

Anglers generally begin harvesting walleye at approximately 300-mm in length, but tend to harvest fish longer than 350-mm (Figure 8). Average length of walleye harvested was approximately 377-mm (14.8-in). As seen in previous years, anglers in the lower zone harvested larger fish than anglers in the middle and upper zones (Figure 9; Figure 10; Figure 11).

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 over the last 10 years (average of 0.96 fish/angler-h; Table 23). In 2011, 2012, 2013 and 2014, walleye catch rates were the highest on record since the initiation of the creel survey in the mid 1980's (Stone et al. 1994). Additionally, catch rates for anglers actively fishing for walleye were 3.57 fish/angler-h in 2014, slightly higher than 2013 (3.38 fish/angler-h in 2013; Table 24). Catch, harvest and release rates for all fish species were higher in June compared to May and July (Table 25).

The percentage of anglers catching zero walleye increased from 8% in 2013 to 13% in 2014 (Table 26). The percent of anglers harvesting zero walleye also increased from 2013 to 2104 (Table 26). The percent of anglers harvesting a limit (four fish) of walleye decreased from 67% in 2013 to 56% in 2014. Overall, catch and harvest per angler in 2014 was lower than in 2013 (Table 26).

Angler Demographics and Economic Input

Lake Oahe is one of the largest and most economically important fisheries in the state of South Dakota, with anglers averaging 150,039 trips annually over the last ten years. Anglers often travel more than 200 miles (one-way) to take advantage of the fishing opportunities in Lake Oahe. Approximately 163,586 trips occurred during the May-July 2014 daylight period on Lake Oahe, for an estimated economic input of $11 million in local revenues. This is down considerably from $12.6 in 2013, $13.2 in 2012 and $13.6 in 2011.

In 2014, resident anglers represented 77% of the parties interviewed on Lake Oahe and were approximately equal across zones (Table 27). However, Lake Oahe has long been recognized as a destination walleye fishery and 2014 was no exception, with 62% of anglers traveling ≥ 100 miles (one-way) to fish on Lake Oahe (Table 28). Non-residents represent a substantial proportion of Lake Oahe anglers and in 2014, non-resident anglers were predominantly from Nebraska (23%), Minnesota (26%), North Dakota (13%) and Iowa (12%; Table 29). Of the anglers fishing Lake Oahe, 83% targeted walleye, which was slightly lower compared to the previous four years (Table 30). Anglers targeting Chinook salmon remained low in 2014 (<0.5%) compared to pre-flood angling effort (4% in 2010).

The most common counties for resident angler contacts were Hughes (15%), Brown (13%) and Walworth Counties (10%; Table 31). Visiting resident anglers fishing Lake Oahe have a tendency to fish the zone closest to their county of residence. On upper Lake Oahe, many anglers were from the northern counties bordering Lake Oahe 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 (Figure 12; Figure 13; Figure 14).

Angler Satisfaction and Attitudes

Attitudes of anglers 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 now realize 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). Assessment of angler satisfaction is important to the success of a fishery. Angler responses help evaluate whether current management practices and regulations are providing a fishery that meets angler needs and expectations.

Overall satisfaction on Lake Oahe during the May-July period of 2014 was 82%, not including responses of “neutral” or “no opinion”, which is above the Lake Oahe Strategic Plan objective of 70% (Table 33). Trip satisfaction generally increased with the

percent of daily limits attained by anglers. Median satisfaction rating for angling parties that harvested zero, and between 1 and 2.9 walleye per person was "moderately satisfied" and 64% of anglers that harvested greater than three walleye per person were "very satisfied" (Table 33).

Anglers were asked two additional sets of questions on the angler preference and satisfaction survey (see Appendix 3). The majority of anglers that were asked if they had ever fished for salmon on Lake Oahe said "No" (59%; Table 34). Anglers that fished for salmon on Lake Oahe in the past responded to being "very in favor" or "very opposed" to stocking Atlantic salmon in Lake Oahe more than anglers that have never fished for salmon (Table 35). Anglers that have never fished for salmon on Lake Oahe had higher response rates of "neutral/no opinion" when asked about stocking Atlantic salmon (Table 35). The staff at the Fort Pierre district office asked this question to gauge interest and public approval for stocking Atlantic salmon into Lake Oahe. Within the next 4-5 years, SDGFP hopes to stock Atlantic salmon to increase catch rates and return-to-angler for salmon species in Lake Oahe. When asked "Have you removed or opened your boat's plugs to drain the water today?" most anglers (75%) said "Yes" (Table 36). Most anglers (89%) were catching and releasing fish in water less than 30 feet deep in Lake Oahe (Table 37). Anglers in the lower and upper zones of Lake Oahe tended to fish in water less than 30 feet deep a high percentage of the time (92% and 96%, respectively), whereas anglers in the middle zone fished in water greater than 30 feet deep more often than the upper and lower zones (Table 37).

Table 15. Angler use and harvest estimates for surveys conducted from 2005-2014. All surveys were conducted during the May-July daylight period.

Year	Fishing pressure (h)	Angler trips	Estimated fish harvest	Estimated walleye harvest	Reference
2005	393,875	77,022	187,703	152,328	Lott et al. (2007)
2006	541,432	107,080	218,521	195,869	Lott et al. (2007b)
2007	531,751	103,706	204,646	177,671	Adams et al. (2008)
2008	718,557	144,416	315,469	290,089	Adams et al. (2009)
2009	872,900	166,223	294,637	259,668	Longhenry et al. (2010)
2010	800,728	149,998	242,562	194,977	Longhenry et al. (2011)
2011	1,036,972	203,613	502,945	438,322	Fincel et al. (2012)
2012	949,690	196,507	602,703	536994	Fincel et al. (2013)
2013	929,830	188,238	802,968	729,501	Fincel et al. (2014)
2014	771,419	163,586	423,944	369,929	This Report

Table 16. Estimated fishing pressure (angler hours) by month and zone with 80% confidence intervals (CI) for the May-July 2014 daylight period.

Zone	Month			
	May	**June**	**July**	**Total**
Lower	38,429	106,909	75,754	221,091
80% CI	21,256	32,815	29,086	48,730
Middle	32,943	159,164	68,788	260,894
80% CI	19,473	40,301	30,285	54,042
Upper	60,788	144,468	84,178	289,433
80% CI	34,925	42,581	32,304	63,847
Total	132,160	410,540	228,719	771,419
80% CI	45,285	67,187	52,979	96,807

Table 17. 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 May-July daylight survey period from 2010-2014.

Type of fishing	Year				
	2010	**2011**	**2012**	**2013**	**2014**
Boat (h)	766,139	1,004,064	899,910	874,930	741,698
80% CI	150,194	195,407	98,153	153,293	95,186
h/ha	6.9	9.1	8.1	7.9	6.7
Shore (h)	22,725	32,907	50,797	54,900	29,721
80% CI	4,058	5,911	8,290	9,453	4,528
h/ha	0.2	0.3	0.5	0.5	0.3
Combined (h)	800,728	1,036,972	950,707	929,829	771,419
80% CI	150,215	197,148	128,904	155,572	96,807
h/ha	7.2	9.4	8.6	8.4	7.0

Table 18. Estimated fishing pressure, expressed as angler-hours (h) and hour per hectare (h/ha) by reservoir zone, for standard creel surveys conducted during the May-July daylight period from 2005-2014.

Year	Zone							
	Lower		Middle		Upper		Total	
	H	h/ha	h	h/ha	h	h/ha	H	h/ha
2005	79,095	1.9	204,828	6.0	92,262	2.6	376,185	3.4
2006	115,855	2.8	272,057	8.0	140,136	4.0	528,048	4.7
2007	139,038	3.3	277,018	8.2	105,984	3.0	522,040	4.7
2008	118,402	2.8	313,844	9.3	238,469	6.8	670,715	6.1
2009	233,504	5.6	357,274	10.5	258,471	7.3	849,249	7.7
2010	182,271	4.4	311,733	9.2	294,860	8.4	788,864	7.1
2011	216,667	5.2	496,502	14.7	323,803	9.2	1,036,972	9.4
2012	389,772	9.4	301,819	8.9	259,117	7.4	950,708	8.6
2013	355,563	8.5	282,387	8.3	291,879	8.3	929,829	8.4
2014	221,092	5.3	260,895	7.7	289,434	8.2	771,421	7.0
Zone size (ha)	41,598		33,890		35,172		110,660	

Table 19. Estimated number of fish harvested, by species and month, with 80% confidence intervals (CI) for the May-July 2014 daylight period.

Species	Month			
	May	**June**	**July**	**Total**
Walleye	65,045	208,319	96,565	369,929
80% CI	27,653	40,870	25,374	55,488
Channel catfish	1,480	12,453	6,219	20,152
80% CI	263	6,827	3,297	7,586
White bass	784	1,245	401	2,430
80% CI	145	482	248	561
Smallmouth bass	3,032	14,074	3,033	20,139
80% CI	1,473	4,869	1,259	5,240
Yellow perch	58	155	361	573
80% CI	--	169	244	597
Northern pike	2,666	2,896	1,119	6,681
80% CI	771	1,042	484	1,384
Chinook salmon	0	122	0	122
80% CI	--	--	--	--
Other*	636	2,613	669	3,918
Total	73,701	241,877	108,367	423,944
80% CI	29,066	46,549	27,669	61,459

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

Table 20. Estimated number of fish harvested for selected species, by zone with 80% confidence intervals (CI) for the May-July 2014 daylight period.

Species	Zone			
	Lower	Middle	Upper	Total
Walleye	70,560	128,025	171,334	369,929
80% CI	18,271	27,899	44,348	55,488
Channel catfish	6,013	7,939	6,200	20,152
80% CI	1,925	6,648	3,106	7,586
White bass	1,133	358	940	2,430
80% CI	350	212	384	561
Smallmouth bass	4,795	11,729	3,615	20,139
80% CI	1,300	5,010	822	5,240
Yellow perch	58	76	439	573
80% CI	--	64	290	597
Northern pike	2,251	2,560	1,869	6,681
80% CI	858	908	596	1,384
Chinook salmon	122	0	0	122
80% CI	--	--	--	--
Other*	1,255	597	2,076	3,918
Total	86,187	151,284	186,473	423,944
80% CI	21,411	33,968	46,529	61,459

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

Table 21. Estimated number of fish released by species and month, with 80% confidence intervals (CI) for the May-July daylight period in 2014.

Species	Month			
	May	June	July	Total
Walleye	104,084	329,632	128,735	562,451
80% CI	52,531	73,614	32,771	96,190
Channel catfish	3,569	16,163	27,446	47,177
80% CI	1,612	4,139	9,130	10,153
White bass	1,882	6,375	3,947	12,203
80% CI	567	3,170	1,487	3,547
Smallmouth bass	6,439	34,392	12,452	53,283
80% CI	2,192	13,131	4,345	13,995
Northern pike	6,800	12,838	5,924	25,563
80% CI	2,547	3,769	1,774	4,883
Yellow perch	160	778	374	1,312
80% CI	70	710	216	746
Chinook salmon	8	0	0	8
80% CI	12	--	--	12
Other*	2,702	12,558	9,866	25,127
Total	125,644	412,736	188,744	727,124
80% CI	59,642	85,545	46,830	114,316

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

Table 22. Estimated number of walleye caught, harvested or released during the May-July daylight period by year from 2005-2014.

Year	Caught	Harvested	Released	Percent harvested
2005	200,253	152,328	47,925	77%
2006	299,535	195,869	103,665	65%
2007	370,611	177,671	192,938	48%
2008	517,362	290,089	227,275	56%
2009	399,179	259,668	139,512	65%
2010	289,346	197,039	92,308	68%
2011	1,398,454	438,322	960,133	31%
2012	1,973,850	537,862	1,435,988	27%
2013	1,645,921	729,501	916,420	44%
2014	932,381	369,929	562,451	40%

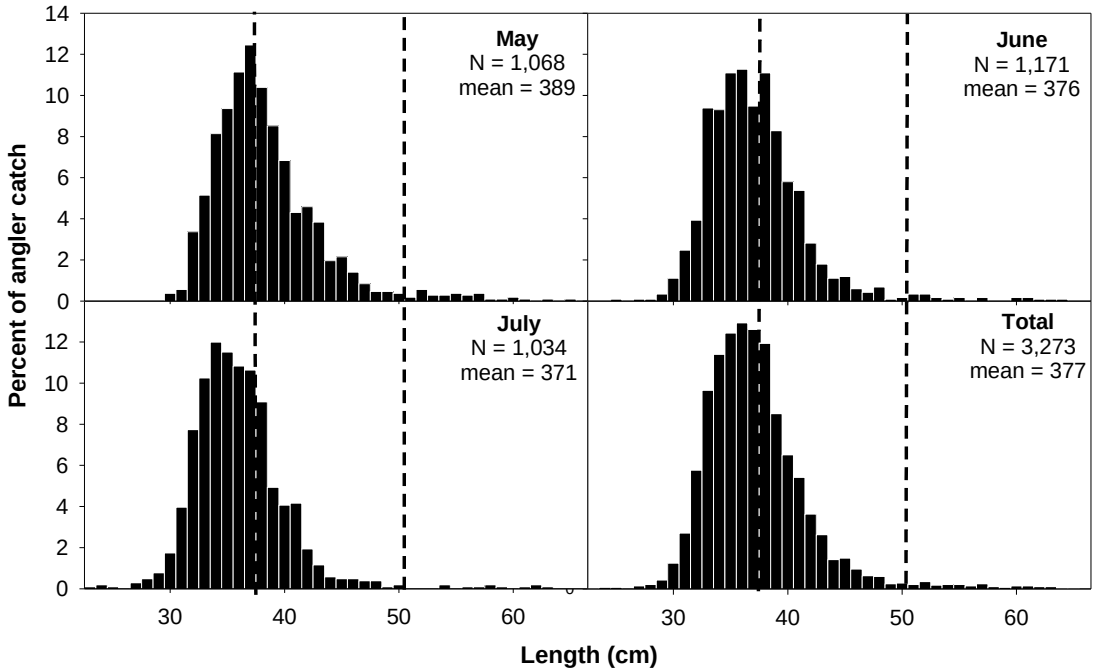

Figure 8. Length-frequency distribution of walleye harvested by anglers during the May-July 2014 daylight period on Lake Oahe, South Dakota. Vertical lines represent 15 and 20 inches. N is sample size.

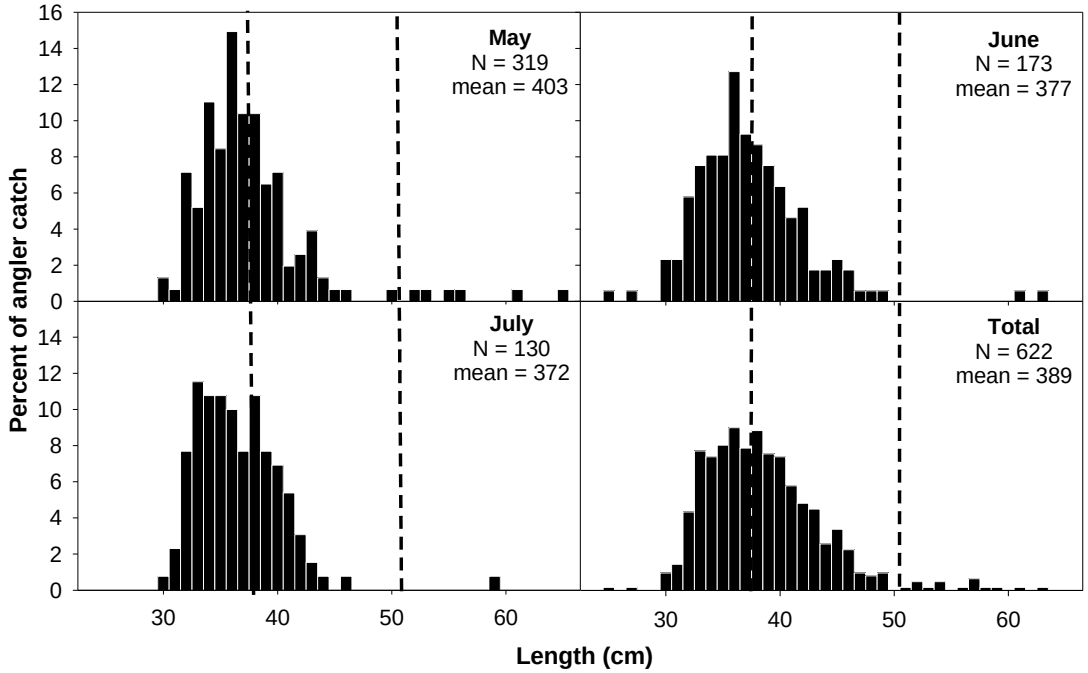

Figure 9. Length-frequency distribution of walleye harvested by anglers fishing lower Lake Oahe, South Dakota during the May-July 2014 daylight period. Vertical lines represent 15 and 20 inches. N is sample size.

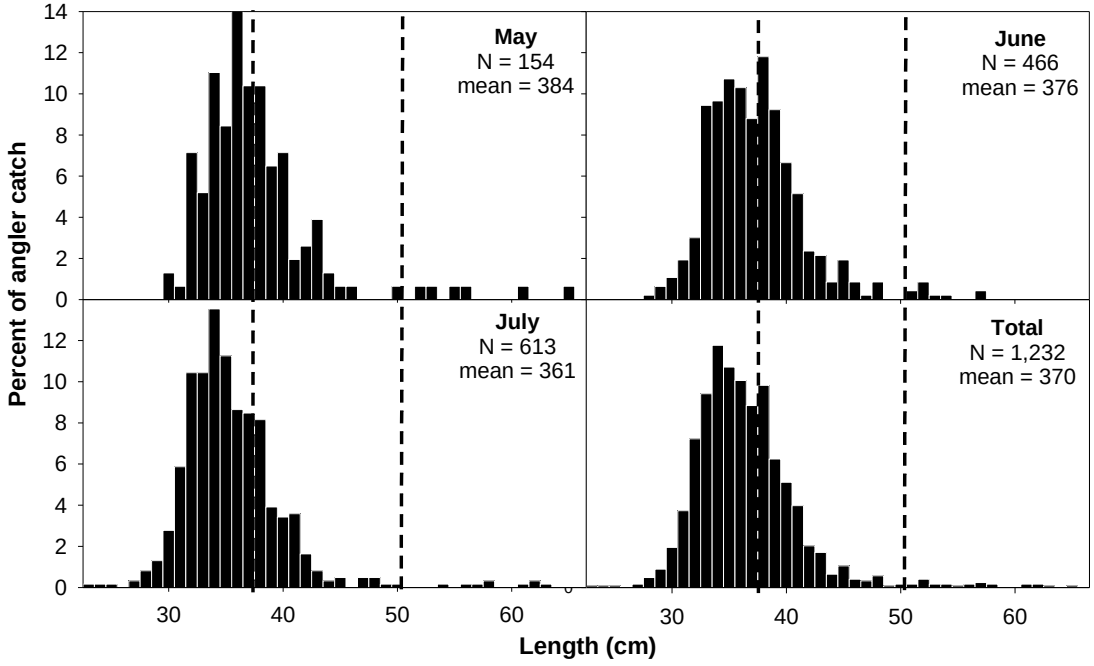

Figure 10. Length-frequency distribution of walleye harvested by anglers fishing middle Lake Oahe, South Dakota during the May-July 2014 daylight period. Vertical lines represent 15 and 20 inches. N is sample size.

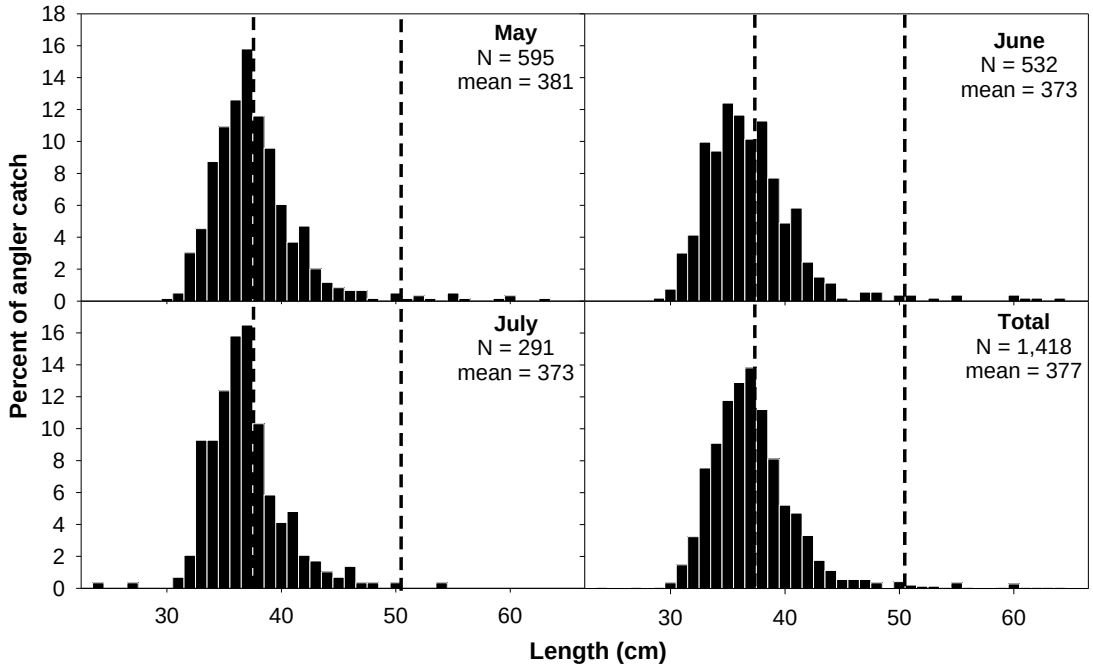

Figure 11. Length-frequency distribution of walleye harvested by anglers fishing upper Lake Oahe, South Dakota during the May-July 2014 daylight period. Vertical lines represent 15 and 20 inches. N is sample size.

Table 23. Estimated hourly catch rates for walleye, smallmouth bass, white bass, channel catfish and all fish combined, by year, for all anglers for the May-July daylight period from 2005-2014.

Year	Catch rate (fish/angler-h)				
	Walleye	Smallmouth bass	White bass	Channel catfish	All fish
2005	0.51	0.01	0.16	0.04	0.76
2006	0.55	0.03	0.03	0.08	0.77
2007	0.69	0.08	0.06	0.05	0.95
2008	0.72	0.08	0.03	0.02	0.88
2009	0.46	0.07	0.03	0.04	0.66
2010	0.36	0.13	0.02	0.05	0.85
2011	1.35	0.12	0.02	0.05	1.77
2012	2.07	0.20	0.02	0.03	2.53
2013	1.77	0.11	0.04	0.09	2.16
2014	1.21	0.10	0.02	0.09	1.49

Table 24. Estimated hourly catch, harvest and release rates, by species for species-specific anglers during the May-July 2014 daylight period.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	3.57	1.39	2.18
Smallmouth Bass	3.26	0.69	2.56
Channel Catfish	2.30	2.30	0.0
Chinook Salmon	0.0	0.0	0.0
Northern Pike	0.49	0.23	0.26

Table 25. Estimated hourly catch, harvest and release rates (fish/angler-h) for walleye and all species combined, by month for the May-July 2014 daylight survey period.

Month	Walleye			All fish combined		
	Catch rate	Harvest rate	Release rate	Catch Rate	Harvest rate	Release rate
May	1.28	0.49	0.79	1.51	0.56	0.95
June	1.31	0.51	0.80	1.59	0.59	1.00
July	0.98	0.42	0.56	1.30	0.47	0.83
Total	1.21	0.48	0.73	1.49	0.55	0.94

Table 26. Percentage of angling parties that caught (top panel) or harvested (bottom panel) a specified number of walleye and sauger per angler in each reservoir zone during the May-July 2013 and 2014 daylight period.

Number/ person	Catch per trip							
	2013				2014			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	6	8	11	8	19	13	9	13
≥ 0.1	94	92	89	92	81	87	91	87
≥ 1	87	85	83	85	73	80	85	80
≥ 2	81	78	76	78	57	72	75	70
≥ 3	76	72	70	73	49	66	68	63
≥ 4	70	66	66	67	43	57	62	56
≥ 5	64	59	59	61	38	51	53	49
≥ 6	60	54	54	56	29	44	43	40
≥ 7	56	49	48	51	22	35	35	32
≥ 8	52	44	44	47	18	29	29	26
≥ 9	47	41	39	43	13	23	25	21
≥10	43	38	34	39	11	19	21	18

Number/ person	Harvest per trip							
	2013				2014			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	12	13	17	14	35	23	18	24
≥ 0.1	88	87	83	86	65	77	82	76
≥ 1	80	79	77	79	54	69	76	68
≥ 2	71	68	68	69	40	55	63	55
≥ 3	63	57	56	59	28	43	52	43
≥ 4	54	47	46	49	18	29	39	30
≥ 5	42	38	38	39	**Daily limit of 4**			
≥ 6	33	28	32	30				
≥ 7	27	21	25	24				
8	20	15	19	18				

Table 27. Percent of total angler contacts for resident and non-resident anglers fishing Lake Oahe during the May-July daylight period from 2010-2014. N is the number of parties interviewed.

Zone		Year				
		2010	**2011**	**2012**	**2013**	**2014**
Lower	**N**	433	615	580	504	277
	Residents (%)	75	77	75	66	73
	Non-residents (%)	25	23	25	34	27
Middle	**N**	769	581	652	448	463
	Residents (%)	73	74	75	74	78
	Non-residents (%)	27	26	25	26	22
Upper	**N**	809	729	823	457	457
	Residents (%)	73	70	72	67	78
	Non-residents (%)	27	30	28	33	22
Total	**N**	2,011	1,925	2,055	1,409	1,197
	Residents (%)	73	74	74	69	77
	Non-residents (%)	27	26	26	31	23

Table 28. Percent of anglers that drove a specific distance, one way, to fish during the May-July daylight survey period from 2010-2014.

Distance (miles)	Percent by year				
	2010	**2011**	**2012**	**2013**	**2014**
<25	13	18	19	18	21
25-49	10	11	6	9	8
50-99	6	10	8	12	9
100-199	26	17	24	21	22
≥200	35	44	43	40	40

Table 29. Percent of non-resident angler contacts by state during the May-July daylight survey period from 2010-2014.

State	Percent by year				
	2010	**2011**	**2012**	**2013**	**2014**
Iowa	18	16	23	19	12
Nebraska	27	27	39	28	23
North Dakota	11	14	2	12	13
Colorado	3	4	6	3	6
Minnesota	21	19	10	18	26
Wisconsin	2	4	2	3	2
Wyoming	3	5	1	5	6
Other**	15	11	17	12	12

**Other includes Alaska, Arkansas, Arizona, California, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Michigan, Mississippi, Missouri, Montana, Nevada, New Mexico, New York, North Carolina, Oklahoma, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, and non-USA residents.

Table 30. Percent of anglers targeting a specific species on Lake Oahe during the May-July daylight survey period from 2010-2014. Trace (T) indicates values >0 but <0.5.

Target species	Percent by year				
	2010	**2011**	**2012**	**2013**	**2014**
Walleye	88	86	90	90	83
Anything	6	11	8	7	13
Chinook salmon	4	1	1	T	T
Northern pike	T	1	T	1	2
White bass	T	0	0	0	0
Channel catfish	1	T	T	1	T
Smallmouth bass	1	1	T	T	2

Table 31. Percent of resident angler contacts on Lake Oahe by county of residence during the May-July daylight survey period from 2010-2014.

County	Major city	Percent by year				
		2010	2011	2012	2013	2014
Beadle	Huron	3	2	4	3	4
Brown	Aberdeen	14	12	14	12	13
Campbell	Pollock	2	2	3	3	4
Codington	Watertown	4	3	4	1	2
Davison	Mitchell	2	2	2	2	2
Hughes	Pierre	15	22	13	14	15
Minnehaha	Sioux Falls	8	9	7	8	6
Pennington	Rapid City	6	7	8	9	7
Potter	Gettysburg	5	4	4	6	6
Stanley	Fort Pierre	2	3	4	3	1
Sully	Oneida	2	2	2	2	2
Walworth	Mobridge	11	10	11	11	10
Other		26	22	24	26	28

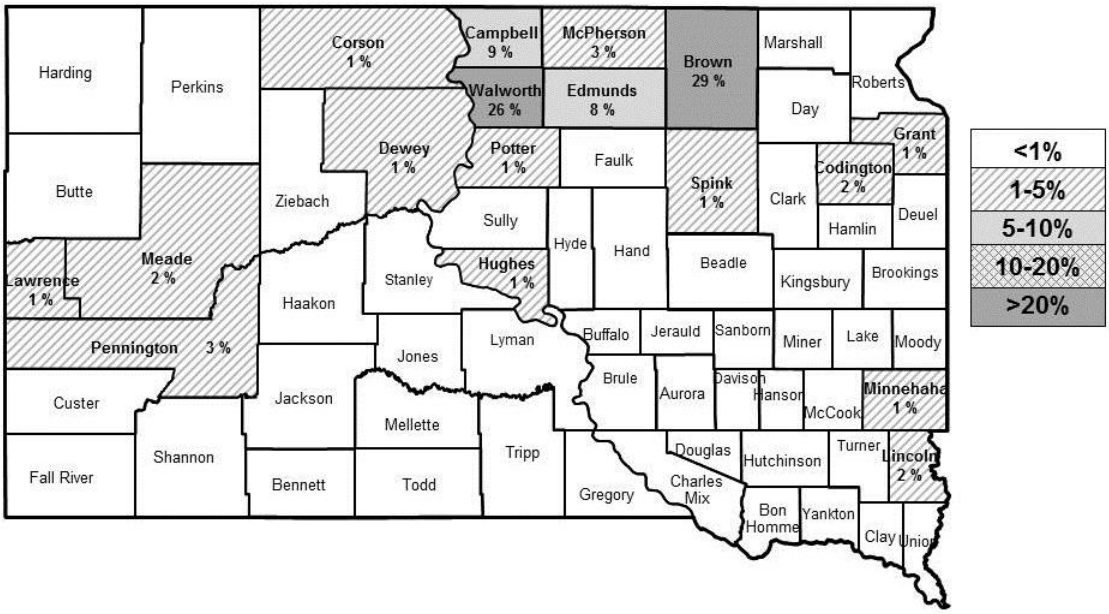

Figure 12. County of residence for South Dakota residents fishing upper Lake Oahe during the May-July 2014 daylight survey period.

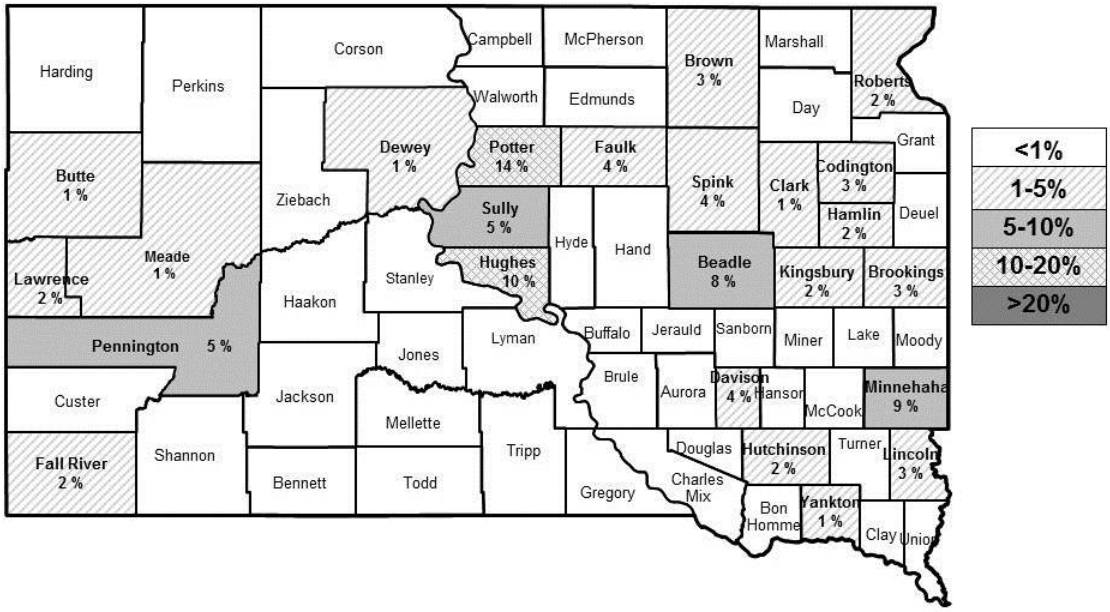

Figure 13. County of residence for South Dakota residents fishing middle Lake Oahe during the May-July 2014 daylight survey period.

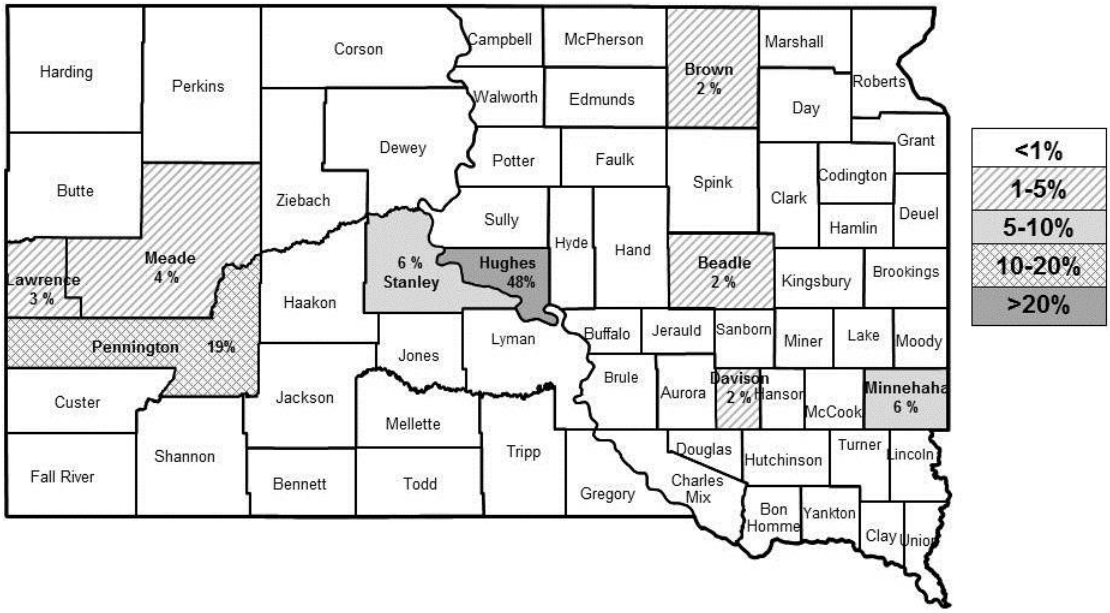

Figure 14. County of residence for South Dakota residents fishing lower Lake Oahe during the May-July 2014 daylight survey period.

Table 32. Responses of anglers who were asked the following question during the May-July 2014 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.

Month	Satisfaction rating							N	Median
	Satisfied			Neutral/N.O.	Dissatisfied				
	1	2	3	4	5	6	7		
May	102	53	15	23	11	4	6	214	2
June	104	54	37	12	13	4	10	234	2
July	107	44	27	14	14	4	7	217	2
Total	313	151	79	49	38	12	23	665	2
Percent	82%			7%	11%				

Table 33. Responses of anglers who were asked the following question during the May-July 2014 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	58	43	34	21	17	4	10	187	2
0.1-0.9	13	9	7	8	3	1	5	46	3
1.0-1.9	28	16	9	6	10	5	2	76	2
2.0-2.9	26	19	5	5	5	0	3	63	2
3.0-3.9	46	24	10	1	1	2	0	84	1
4 (limit)	137	39	13	8	2	0	3	202	1
Percent	82%			7%	11%				

Table 34. Percentage of responses to the following question: "Have you ever fished for salmon on Lake Oahe?" N is the number of responses.

	May	N	June	N	July	N	Overall	N
Yes	41%	88	36%	84	45%	98	41%	270
No	59%	125	64%	150	55%	119	59%	394

Table 35. Percentage of responses of anglers that responded to the following questions: "How strongly do you favor or oppose SD GFP stocking Atlantic salmon, along with Chinook salmon, in attempt to improve salmon fishing on Lake Oahe?" that also answered "Have you ever fished for salmon on Lake Oahe?"

"Have you ever fished for salmon on Lake Oahe?"	**NO**	**N**	**YES**	**N**
Very favor	27%	106	36%	98
Moderately favor	11%	42	12%	33
Slightly favor	6%	22	8%	21
Neutral/no opinion	45%	178	29%	77
Slightly oppose	1%	4	2%	6
Moderately oppose	3%	11	1%	3
Very oppose	7%	29	12%	32

Table 36. Responses of anglers that were asked, "Have you removed or opened your boat's plugs to drain the water today?"

	May		June		July		Overall	
Location	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**
Yes	**73%**	98	**76%**	134	**75%**	126	**75%**	358
Open at ramp	47%	63	53%	93	56%	94	52%	250
Open at fish cleaning station	13%	18	13%	22	11%	18	12%	58
Open at another location	13%	17	11%	19	8%	14	10%	50
No	**27%**	37	**24%**	42	**25%**	41	**25%**	120

Table 37. Estimated release of walleye and sauger, combined, from Lake Oahe anglers during May, June, and July, 2014, and within lower, middle, and upper zones from water depths of less than 30 feet and greater than 30 feet.

	May	%	June	%	July	%	Overall	%
Overall release	104,084		329,632		128,735		562,451	
Released < 30 feet	89,777	86%	306,254	93%	110,544	86%	499,259	89%
Released > 30 feet	14,307	14%	23,378	7%	18,191	14%	63,192	11%

	Lower	%	Middle	%	Upper	%	Overall	%
Overall release	104,084		329,632		128,735		562,451	
Released < 30 feet	95,995	92%	260,092	79%	123,611	96%	499,259	89%
Released > 30 feet	8,089	8%	69,540	21%	5,124	4%	63,192	11%

ONGOING AND COOPERATIVE RESEARCH PROJECTS

The Missouri River Fisheries staff has also been conducting field work on a number of collaborative projects. During the 2014 sampling season, we deployed trap nets and electrofished on Lake Oahe to capture walleye for a collaborative tagging project between South Dakota State University (SDSU), SDGFP and North Dakota Game and Fish. A PhD student from SDSU (E. Felts) is collecting information on natural and fishing mortality, movement and effects from the 2011 flood. The anticipated completion date of this project is May 2017. Staff have also collected data for a joint project with SDSU to evaluate our current survey gear and compare it to American Fisheries Society standard gear. During 2013 and 2014, we deployed paired gill net sets using SD GFP standard multi-filament gill nets as well as an American Fisheries Society standard mono-filament gill net. A master's student at SDSU (B. Smith) is comparing net catches to determine effectiveness of each of these gears. The anticipated completion date for this project is spring of 2015. Andrew Carlson of SDSU completed his MS project (Spring 2015) determining natal origin and post-flood movement of walleye in Lake Oahe. South Dakota GFP also has an in-house research project examining returns of Chinook salmon stocked at various locations throughout Lake Oahe. Chinook salmon were stocked at four different locations throughout Lake Oahe during the spring and fall of 2014 and 2015, and continue through 2017. Biologists will examine tag return rates from different stocking locations to determine the highest rate of return to anglers.

FISHERY STATUS AND 2015 OUTLOOK

The Missouri River flood of 2011 produced conditions that lead to a reduction in rainbow smelt abundance by downstream entrainment through Oahe Dam. Although not novel, this occurrence is particularly problematic as rainbow smelt are the primary food source for walleye. Hence, Lake Oahe experienced a decline in walleye condition immediately following the high entrainment of 2011. Rainbow smelt exhibit boom-bust cycles in Lake Oahe and numbers will likely begin to recover in the coming years.

Despite low rainbow smelt abundance, warm-water prey fish abundance and age-0 lake herring abundance was high in 2014. The resurgence of these species is likely contributing to an increase in walleye condition in 2014. Relative weight (*Wr*) values are similar (although slightly lower) to pre-flood conditions. It appears as though the walleye population has begun to rebound from the effects of the 2011 flood. This is particularly notable as surveys reflect growth and condition in August, long before the end of the growing season for walleye (and other sport fish). Similar to 2013, ancillary data suggest an above average lake herring spawn in 2014 with reports of lake herring in walleye and Chinook salmon diets and informal collections made throughout the summer. Lake herring are particularly hard to monitor, so formal determinations on changes in relative abundance are unknown.

No age-0 gizzard shad were collected in 2014. The last major stocking effort was conducted in spring of 2013. Lake Oahe was ice-covered for a majority of the winter of 2013-2014, which likely caused substantial over-winter mortality in the gizzard shad population. In the mid-2000's, gizzard shad became an important prey fish to many Lake Oahe sport fish. However, Lake Oahe is located near the northern boundary of the gizzard shad range, so permanence of this prey fish in Lake Oahe is doubtful.

The abundant 2009 year class (age-5) of walleye have reached sizes desirable to anglers (> 15-in) during 2014, and will likely be a major contributor to catches in 2015. Growth of the 2009 year class is still slower than overall average growth rates in Lake Oahe, but abundance is high. The 2011 year class (age-3) is also relatively abundant. This recent increased reproductive effort should result in future angler catches made up of predominantly younger fish. It is likely walleye catch rates will remain good through 2015, however there may continue to be a decrease from previous years due to increased prey abundance and average walleye abundance. Angler catches will likely be dominated by walleye from 14- to 16-in.

MANAGEMENT RECOMMENDATIONS

1. Develop a new Lake Oahe Strategic Plan which includes:
   - Review adequacy of current management plan and objectives
   - Examine methods to buffer prey fish crashes
2. Expand efforts to understand / improve prey fish dynamics in Lake Oahe
   - Expand efforts to document characteristics of gizzard shad population structure and dynamics
   - Continue to 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 and lake herring
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 angler returns of Chinook salmon
   - Evaluate interest in and efficacy of stocking other salmonid species in Lake Oahe to utilize coolwater habitat and provide an additional fishery
4. Continue to monitor Lake Oahe sport fish and prey fish, in particular examining:
   - Northern pike growth, mortality and recruitment
   - Yellow perch growth, mortality and recruitment
   - Lake herring growth, mortality and recruitment

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APPENDICES

Appendix 1. Common and scientific names of common fishes of South Dakota.

Common name	Scientific name
Bigmouth buffalo	*Ictiobus cyprinellus*
Black bullhead	*Ameiurus 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 canadensis*
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. Minimum lengths (mm) of length-class designations used when calculating proportional size distribution 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

Appendix 3. Angler satisfaction, preference and attitude questions asked as part of the May-July 2014 angler use and harvest survey on Lake Oahe, South Dakota. Question series A and B were asked in an alternating order as part of the survey.

Question Series A:

Trip Satisfaction:

#1. 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 *(neither satisfied or dissatisfied)*
5 = Slightly dissatisfied
6 = Moderately dissatisfied
7 = Very dissatisfied

Salmon Questions:

#2. Have you ever fished for salmon on Lake Oahe? YES or NO

#3. How strongly do you favor or oppose GFP stocking Atlantic salmon, along with Chinook salmon, in an attempt to improve salmon fishing on Lake Oahe?

1 = Very in-favor
2 = Moderately in-favor
3 = Slightly in-favor
4 = Neutral/ No opinion
5 = Slightly oppose
6 = Moderately oppose
7 = Very oppose

Question Series B:

Angler caught walleye tag questions:

#1. How many tagged walleye have you caught in 2014?

#2. Of these, how many were reported to SD GFP to date for 2014?

Depth of fishing/Angler induced mortality

#3. How many WAE/SAR were caught and released today from water shallower than 30 feet?

Risk of anglers spreading aquatic nuisance species:

#4. Have you removed or opened your boat's plugs to drain the water today?

YES, NO, Open at fish clean station, or Open at other location