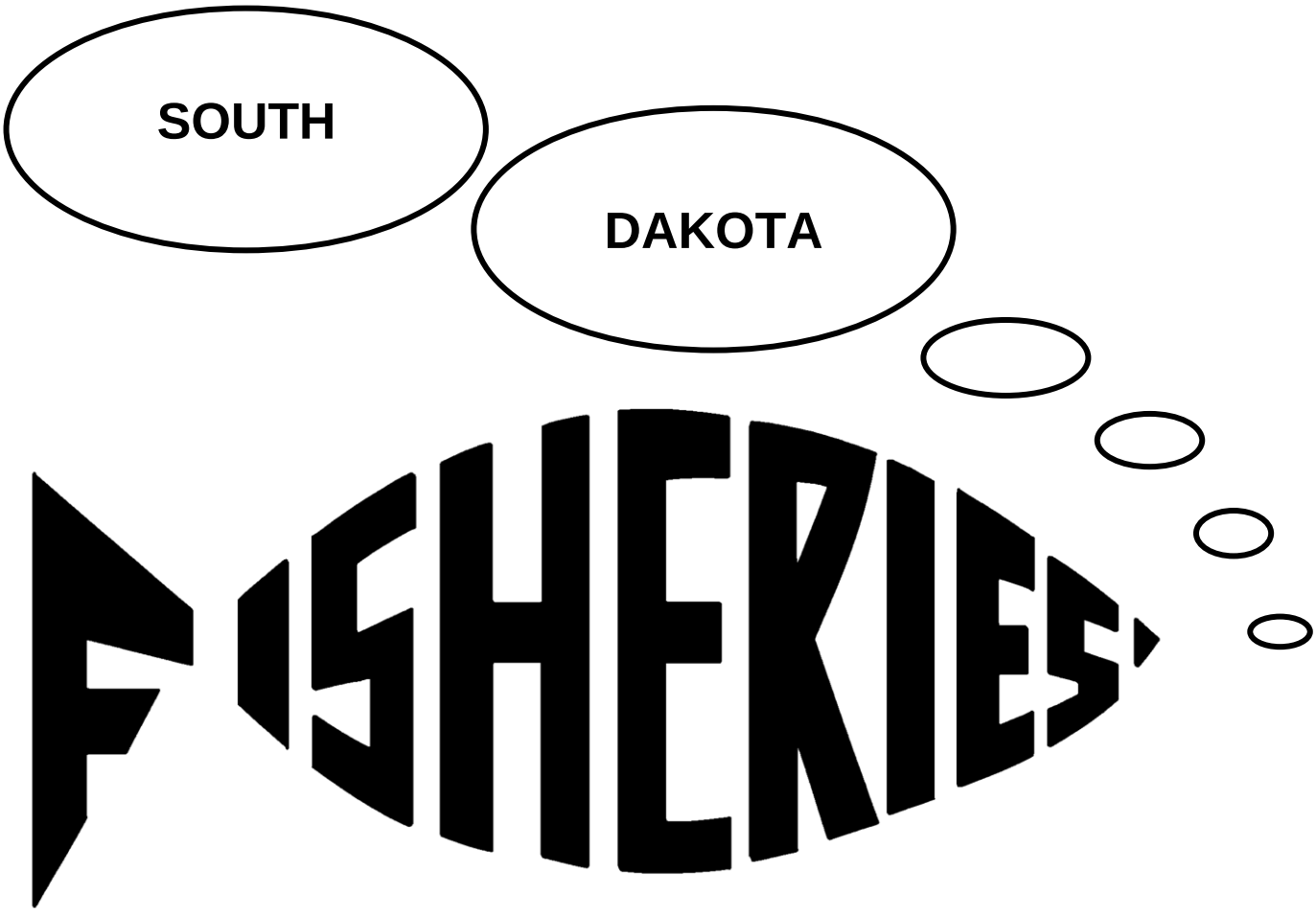

ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE OAHE, SOUTH DAKOTA, 2015

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

Annual Report
No. 16-03

ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE OAHE, SOUTH DAKOTA, 2015

By

Kyle Potter, Hilary Meyer, Robert Hanten, Mike Greiner, Mark Fincel and Mike Smith
Ft. Pierre District Office
South Dakota Dept. of Game, Fish, and Parks

Annual Report

Dingell-Johnson Project ----------F-21-R-48
Job Numbers---------- 2102 and 2109
Date ---------- April 2016

PREFACE

Information collected during 2015 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, C. Anderson, C. Burback, L. Collett, E. Felts, D. Jones, D. Jost, J. Jungwirth, N. Kludt, C. Kruse, A. McGuigan, W. Radigan, B. Schwery, G. Tibbs, 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-48, Statewide Fish Management Surveys. Some of these data have been presented previously in F-21 segments 23 through 47.

EXECUTIVE SUMMARY

This report includes data from annual fish population surveys and angler use and harvest surveys collected during 2015 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 objectives outlined in the Missouri River Fisheries Management Area Strategic Plan.

Walleye comprised 26% and channel catfish comprised 40% of the fish caught in the 2015 coolwater gill net survey. Twenty species were collected in the coolwater gill net survey, and mean catch per unit effort (CPUE) for most species was similar to 2014 except walleye, which was lower than in 2014. Black and white crappie were the most abundant species captured during the August seining survey. Yellow perch and emerald shiners were also abundant in seine catches. Overall, seine catches were above the long term mean and were the 4th highest since the beginning of the survey. No gizzard shad were captured in standard shoreline seining or gill net surveys.

Mean walleye abundance, as indexed by catch per unit effort (CPUE) was lower (8.7 walleye/net night) than the ten year average (16.0 walleye/net night) and has continually declined since 2011 when 25.1 walleye/net night were collected. Upper zone walleye CPUE remained similar to the 10-year mean of 15.1 walleye/net night. Proportional size distribution (PSD) was higher than the five year average but PSD-Preferred (510-629-mm) was lower. Approximately 80% of the walleye collected by gill nets were less than 381-mm (15-in). Walleye condition had improved from the low in 2012, but a decline was seen in 2015 for all sizes of walleye except preferred size fish and larger. Growth of walleye aged -1, -2, and-3 improved to rates greater than the five year mean. Incremental growth for all age classes increased as well, indicating better prey availability for walleye in Lake Oahe.

Estimated fishing pressure for the South Dakota portion of Lake Oahe was 738,360 h. Angling pressure was lower than the 10 year average (778,617 h). An estimated 571,664 walleye were caught in Lake Oahe during the May-July 2015 period. Anglers harvested 56% of walleye caught or 308,513 fish, which was lower than the 10 year average of 350,446 walleye.

Resident anglers represented 76% of the parties interviewed on Lake Oahe. Four states represented the majority of non-resident anglers which included Minnesota, Nebraska, Iowa and North Dakota. In 2015, 33% of anglers traveled more than 200 miles (one way) and 52% of anglers traveled more than 100 miles (one way) to fish Lake Oahe. Anglers generated an estimated ~$10 million of economic input to local communities during the May-July period.

Overall angler satisfaction on Lake Oahe from May-July 2015 was 83%. Median satisfaction rating for angling parties that harvested zero to three walleye per person was “moderately satisfied”, while parties harvesting three to four walleye per person had a median rating of “very satisfied”. Anglers that were not “very satisfied” were asked what would improve their satisfaction rating. “Catch more fish” was the most frequently (57%) given response, with “improve weather” and “catch larger fish” as the next most popular responses given by anglers.

TABLE OF CONTENTS

PREFACE ... **iii**

EXECUTIVE SUMMARY ... **iv**

LIST OF TABLES ... **vi**

LIST OF FIGURES ... **ix**

LIST OF APPENDICES ... **x**

INTRODUCTION ... **1**

STUDY AREA ... **2**

REGULATION HISTORY ... **6**

SAMPLING METHODS ... **8**

Fish Population Surveys ... 8
Data Collection ... 8
Data Analysis ... 9
Angler Use, Sportfish Harvest and Preference Surveys ... 10
Data Collection ... 10
Data Analysis ... 10

RESULTS AND DISCUSSION ... **11**

Fish Population Surveys ... 11
Species Composition and Relative Abundance ... 11
Population Characteristics of Walleye ... 11
Population Characteristics of Channel Catfish ... 12
Hydro-acoustic and Suspended Gill Net Surveys ... 12

Angler Use, Sportfish Harvest and Preference Surveys ... **27**

Angler Use ... 27
Catch, Harvest and Release Estimates ... 27
Hourly Catch, Harvest, and Release Rates ... 27
Angler Demographics and Economic Input ... 28
Angler Satisfaction and Attitudes ... 28

ONGOING AND COOPERATIVE RESEARCH PROJECTS ... **47**

FISHERY STATUS AND 2016 OUTLOOK ... **47**

MANAGEMENT RECOMMENDATIONS ... **48**

LITERATURE CITED ... **49**

APPENDICES ... **52**

LIST OF TABLES

Table 1. Physical characteristics and management classification of Lake Oahe, South Dakota. 3
Table 2. History of harvest regulations for walleye on Lake Oahe, South Dakota, 1968-2015. 7
Table 3. Rainbow smelt and lake herring age and size classes used for size classification of hydro-acoustic assessment on Lake Oahe, South Dakota. 10
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 2011-2015 on Lake Oahe, South Dakota. Trace (T) indicates values less than 0.05. 13
Table 5. Relative species composition, expressed as percent of total catch of all fish species collected during the standard coolwater gill net survey on Lake Oahe, South Dakota from 2011-2015. 14
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 on Lake Oahe, South Dakota, 2011-2015. Catches are for age-0 fishes, except where noted. Trace (T) indicates values less than 0.05. 15
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 on Lake Oahe, South Dakota, 2011-2015. 16
Table 8. Mean relative weight (W_r) of walleye by length group and reservoir zone on Lake Oahe, South Dakota from 2011-2015. N is the number of fish in a length group. 17
Table 9. Mean length-at-age at time of capture (mm), sample size (N) and standard error (SE) for walleye collected in the standard coolwater gill net survey on Lake Oahe, South Dakota from 2011-2015. 18
Table 10. Mean length-at-time of capture (mm) by reservoir zone, for walleye collected in the coolwater gill net survey on Lake Oahe, South Dakota from 2013-2015. N is sample size and SE is standard error. 19
Table 11. Mean annual growth increment (mm/y) estimates for walleye collected in the coolwater gill net survey on Lake Oahe, South Dakota for the 2010-2011, 2011-2012, 2012-2013, 2013-2014 and 2014-2015 periods. 20
Table 12. Age distribution of walleye captured in standard coolwater gill net survey from 2011-2015 on Lake Oahe, South Dakota as determined using sagittal otoliths for age-estimation. 20
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 2011-2015 for Lake Oahe, South Dakota. Mean W_r values are for stock-length fish and longer. 23
Table 14. Mean catch per unit effort (CPUE; No./net night) and standard error values (SE) for selected fish species collected with suspended deepwater small mesh gill nets in 2012-2015 from Lake Oahe, South Dakota. 24
Table 15. Angler use and harvest estimates for surveys conducted from 2006-2015. All surveys were conducted during the May-July daylight period on Lake Oahe, South Dakota. 30

Table 16. Estimated fishing pressure (angler-h) by month and zone with 80% confidence intervals (CI) during the May-July 2015 daylight period on Lake Oahe, South Dakota..... 31
Table 17. Estimated fishing pressure, expressed as angler-h and hours per hectare (h/ha) by type of fishing with 80% confidence intervals (CI), during the May-July daylight period from 2011-2015 on Lake Oahe, South Dakota. 31
Table 18. Estimated fishing pressure, expressed as angler-h and hour per hectare (h/ha) by reservoir zone, for standard creel surveys conducted during the May-July daylight period from 2006-2015 on Lake Oahe, South Dakota. 32
Table 19. Estimated number of fish harvested, by species and month, with 80% confidence intervals (CI) during the May-July 2015 daylight period on Lake Oahe, South Dakota..... 33
Table 20. Estimated number of fish harvested for selected species, by zone with 80% confidence intervals (CI) during the May-July 2015 daylight period on Lake Oahe, South Dakota..... 34
Table 21. Estimated number of fish released by species and month, with 80% confidence intervals (CI) during the May-July daylight period in 2015 on Lake Oahe, South Dakota..... 35
Table 22. Estimated number of walleye caught, harvested or released during the May-July daylight period by year from 2006-2015 on Lake Oahe, South Dakota..... 36
Table 23. Estimated hourly catch rates (fish/angler-h) for walleye, smallmouth bass, white bass, channel catfish and all fish combined, by year, for all anglers during the May-July daylight period on Lake Oahe, South Dakota from 2006-2015.. 38
Table 24. Estimated hourly catch, harvest and release rates (fish/angler-h), by species for species-specific anglers during the May-July 2015 daylight period on Lake Oahe, South Dakota..... 39
Table 25. Estimated hourly catch, harvest and release rates (fish/angler-h) for walleye and all species combined, by month during the May-July 2015 daylight period on Lake Oahe, South Dakota..... 39
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 zone during the May-July 2014 and 2015 daylight period on Lake Oahe, South Dakota. 40
Table 27. Percent of total angler contacts for resident and non-resident anglers fishing Lake Oahe, South Dakota during the May-July daylight period from 2011-2015. N is the number of parties interviewed..... 41
Table 28. Percent of anglers that drove a specific distance, one way, to fish Lake Oahe, South Dakota during the May-July daylight period from 2011-2015. 41
Table 29. Percent of non-resident angler contacts, by state during the May-July daylight period from 2011-2015, on Lake Oahe, South Dakota. 42
Table 30. Percent of anglers targeting a specific species on Lake Oahe, South Dakota during the May-July daylight period from 2011-2015. Trace (T) indicates values >0.0 but <0.5. 42
Table 31. Percent of resident angler contacts on Lake Oahe, South Dakota by county of residence during the May-July daylight period from 2011-2015..... 43

Table 32. Responses of anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight 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 includes “neutral/no opinion” responses. 45
Table 33. Responses of anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight 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..... 45
Table 34. Responses of anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight period: “What would help increase your satisfaction level to “very satisfied”?” after being asked their overall satisfaction rating (Table 32)..... 46
Table 35. Response of all anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight period: “Are you aware of the new regulations for boat plug removal and live bait transport?” 46

LIST OF FIGURES

Figure 1. Reservoir zones and fish population sampling locations on Lake Oahe, South Dakota. 4
Figure 2. Average August surface elevation (feet above mean sea level; ft msl) on Lake Oahe, South Dakota, 1983-2015. 5
Figure 3. Mean walleye catch per unit effort (CPUE; No./net night) in the coolwater gill net survey for lower, middle and upper zones, and lake-wide average, of Lake Oahe, South Dakota, 2006-2015. 16
Figure 4. Incremental catch per unit effort (CPUE; No./net night) for walleye by year, as sampled by the standard coolwater gill net survey from 2006-2015 on Lake Oahe, South Dakota. 21
Figure 5. Length-frequency distribution of walleye by zone, collected during the standard coolwater gill net survey on Lake Oahe, South Dakota in 2015. 22
Figure 6. Length-frequency distribution of channel catfish collected during the standard coolwater gill net survey on Lake Oahe, South Dakota in 2014 and 2015. N is the number of channel catfish sampled. 23
Figure 7. Length-frequency distribution of lake herring, displayed as percent of catch, collected during suspended deepwater gill net surveys in 2012 through 2015 on Lake Oahe, South Dakota. Vertical bars represent age-0, age-1 and age-2+ size class cut-offs. Catch per unit effort (CPUE) is No./net night, and N is the number of lake herring sampled. 25
Figure 8. Length-frequency distribution of rainbow smelt, displayed as percent of catch, collected during suspended deepwater gill net surveys from 2012 through 2015 on Lake Oahe, South Dakota. Catch per unit effort (CPUE) is No./net night, and N is the number of rainbow smelt sampled. 26
Figure 9. Length-frequency distribution of walleye harvested by anglers during the May-July 2015 daylight period on Lake Oahe, South Dakota. Vertical lines represent 15 and 20 in. and N is sample size. 36
Figure 10. Length-frequency distribution of walleye harvested by anglers fishing lower Lake Oahe, South Dakota during the May-July 2015 daylight period. Vertical lines represent 15 and 20 in. and N is sample size. 37
Figure 11. Length-frequency distribution of walleye harvested by anglers fishing middle Lake Oahe, South Dakota during the May-July 2015 daylight period. Vertical lines represent 15 and 20 in. and N is sample size. 37
Figure 12. Length-frequency distribution of walleye harvested by anglers fishing upper Lake Oahe, South Dakota during the May-July 2015 daylight period. Vertical lines represent 15 and 20 in. and N is sample size. 38
Figure 13. County of residence for South Dakota residents fishing upper Lake Oahe, South Dakota during the May-July 2015 daylight period. 43
Figure 14. County of residence for South Dakota residents fishing middle Lake Oahe, South Dakota during the May-July 2015 daylight period. 44
Figure 15. County of residence for South Dakota residents fishing lower Lake Oahe, South Dakota during the May-July 2015 daylight period. 44

LIST OF APPENDICES

Appendix 1. Common and scientific names of common fishes of South Dakota. 52
Appendix 2. Minimum lengths (mm) of length-class designations used when calculating proportional size distribution values for fish population survey samples (Gabelhouse 1984)..... 53
Appendix 3. Angler satisfaction, preference and attitude questions asked as part of the May-July 2015 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. 54

INTRODUCTION

Lake Oahe is the largest and one of the most economically important fisheries in the state of South Dakota averaging 157,464 angler trips during the May-July day-light period, 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 151,269 trips occurred during the May-July 2015 daylight period on Lake Oahe, for an estimated economic input of ~$10 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.

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.

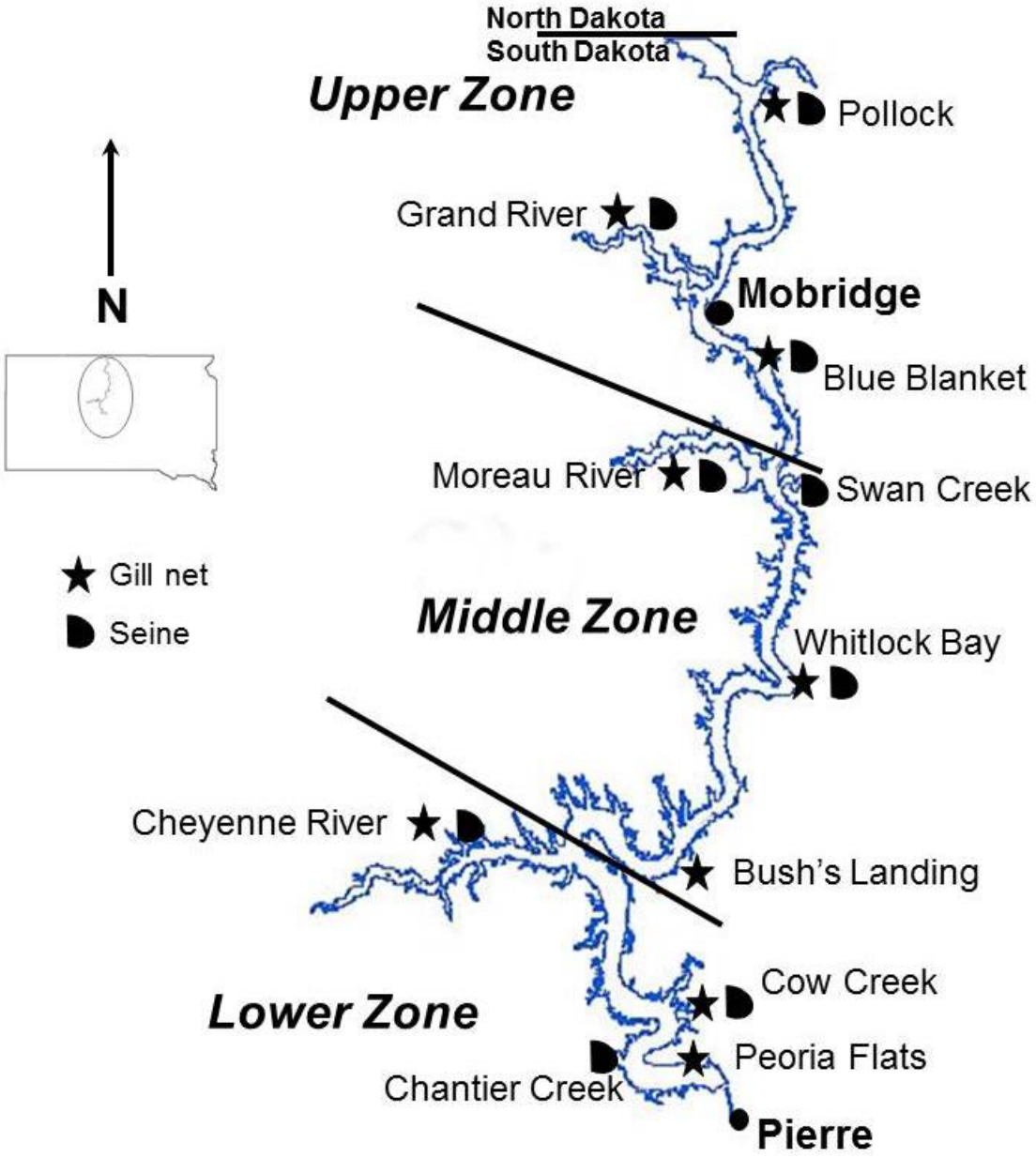

Figure 1. Reservoir zones and fish population sampling locations on Lake Oahe, South Dakota.

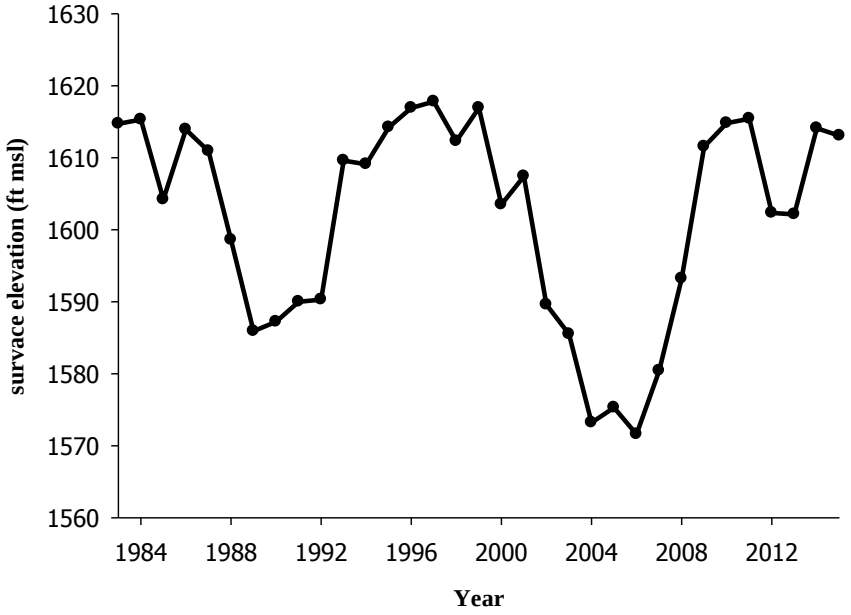

Figure 2. Average August surface elevation (feet above mean sea level; ft msl) on Lake Oahe, South Dakota, 1983-2015.

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 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 attained 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 below average condition. In reaction to the change in population size structure a change to the 2013 walleye regulations was made 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, 1968-2015.

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)
	2014-2015	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 2015 in Lake Oahe. The standard coolwater fish population survey consisted 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 107-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 at each sampling station. When possible, representative samples (up to 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 and counted.

Hydro-acoustic surveys have been conducted since the late 1980's to monitor cold water species that are less susceptible to gill net surveys. Equipment specification used during the 2003 -2005 surveys can be found in Nelson-Statsny (2001). Data from 2008-2015 were collected with a Biosonics DT-X digital Echosounder and a split-beam transducer.

Beginning in 2012, a suspended deep water gill net survey was introduced and paired with the hydro-acoustic survey. Hydro-acoustic transects were completed, and targets were visually located on the echogram. An approximate depth where targets were located was noted and two overnight net sets were deployed within a few days in the identified zone. Suspended deep water gill nets were 38.1 m long and 7.3 m deep and consisted of 7.6 m length of the following multifilament meshes in the following order: 19.1-mm, 9.5-mm, 12.7-mm, 15.9-mm, and 25.4-mm. Nets were hung with sufficient flotation to allow for neutral buoyancy while in the water column. Netting effort has varied between years depending upon staffing, weather conditions, and locations of transects.

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 at time of capture from the mean length at capture of the same year class one year prior. 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 PSD and W_r were calculated using WinFin software (Francis 2000).

Delineation of rainbow smelt age classes was accomplished by assigning fish to an age class based on target strengths determined from fish collected in historic mid-water trawl surveys (Table 3). The bottom line and thermocline depth line were identified for each file. Thermocline depths were created by assigning 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) vertically stratified fish targets were visually separated. Each echogram was horizontally subdivided into 100-m intervals for analysis, and targets enumerated.

For single target detection, the expected mean target strength below the thermocline was -44.4 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. Acoustic data were processed using Sonar 5 Professional, Version 6.0.3 (Balk and Lindem 2015; Lindem Data Acquisition A/S). New methodology was used to analyze hydro-acoustics data collected in 2015; therefore, estimates were not compared to previous years.

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 through 31-July, 2015, for the sunrise to sunset period. Angler satisfaction and attitude questions were included in angler interviews in 2015. In addition to asking anglers how satisfied they were with their fishing trip, anglers were asked what factor would increase their satisfaction level to "very satisfied". Anglers were also asked questions pertaining to an ongoing walleye tagging research project and a question regarding new Aquatic Invasive Species (AIS) regulations. A complete list of satisfaction, attitude and preference questions asked in conjunction with the 2015 angler use and harvest survey appears in (Appendix 3).

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 on Lake Oahe, South Dakota.

Age Class	Size Range	Target Strength Range
Age-0 rainbow smelt	21-79 mm	-58.2 to -47.2 dB
Age-0 lake herring	80-110 mm	-44.9 to -41.1
Age-1+ rainbow smelt	100-180 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

Twenty species were captured in the coolwater gill net survey samples in 2015 (Table 4). Walleye comprised 26% and channel catfish comprised 40% of all fish caught in the 2015 coolwater gill net survey (Table 5). Mean CPUE for fish species in 2015 was similar to 2014, with a decrease in catches of channel catfish and walleye (Table 4). 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 affect CPUE estimates. Therefore, caution should be used when inferring density or abundance of fish species based on temporal comparisons of CPUE.

Black and white crappie were the most abundant species captured during the 2015 August seine survey, with a mean CPUE of 165 fish/haul and 113 fish/haul, respectively (Table 6). Also abundant in 2015 were yellow perch and emerald shiner with CPUE of 110 and 77 fish/haul, 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 in 2010 and 2011.As a result, an intensive gizzard shad stocking program was implemented from 2012 to 2015. Adult gizzard shad were collected from Lake Sharpe (Hipple Lake) and stocked into various embayments within Lake Oahe with 326 and 168 stocked in 2014 and 2015, respectively. Age-0 gizzard shad were captured in shoreline seining surveys in 2012 and 2013 (Table 6). No age-0 gizzard shad were collected during the standard seining survey in 2014 and 2015.

Population Characteristics of Walleye

Mean CPUE of walleye captured in gillnets was lower than the 10-year average of 16.0 walleye/net night (Figure 3). The CPUE in the lower zone (5.5 walleye/net night) and middle zone (5.4 walleye/net night) was lower than the upper zone (15.1 walleye/net night; Figure 3). Walleye PSD in 2015 increased from 2014 and 2013 (Table 7). Walleye PSD-P increased slightly in the lower and middle zones (Table 7).

Relative weight (W_r) of walleye fluctuates as a function of changes in prey abundance. All zones within Lake Oahe saw a slight decrease in W_r from 2014 to 2015 (Table 8). The greatest increase was the W_r of preferred and greater size fish (91). However, there was a low sample size (n = 5) of preferred and greater size fish during the survey, with no preferred and greater walleye collected in the upper zone. Length-at-age-at-capture has improved, and is similar to the five-year mean for age-1 to age-3 walleye. Walleye age-4 and older were generally smaller when compared to the five-year mean (Table 9). Walleye growth varies by zone, where age-3 fish grow faster in the middle (374-mm) and upper (362-mm) zones when compared to the lower zone (343 mm). Age-6 walleye showed a slightly greater mean length-at-age in the lower zone (454-mm) compared to the middle (451-mm) and upper (401-mm) zones (Table 10).

Mean annual incremental growth of walleye was greater than the five year mean (Table 11). All ages of walleye showed an increase in growth compared to the previous year. The strong 2009 year class was still present in gill net catches, comprising 14% of the overall walleye catch. The 2014 year class appears to comprise a large percentage

(38%) of the gill net catch. All year classes from age-0 to age-6 were present in our gear, and the oldest fish collected was age-10 (Table 12).

Lake wide gill net CPUE of walleye has decreased annually from 2011 to 2015 (Figure 3). The proportion of the walleye in the 254- to 380-mm (10 to 15 inch) length group has also decreased from 2014 to 2015 (Figure 4). Catch rates of larger (greater than 508-mm; 20-inches) walleye have also decreased from 2011 to 2015. The number of stock-quality size fish captured in gill nets was greatest in the upper zone (Figure 5).

Population Characteristics of Channel Catfish

Similar to previous years, channel catfish comprised 40% of the gill net catch (Table 5). Catch per unit effort of channel catfish decreased slightly from 17.6 fish/net night in 2014 to 13.0 fish/net night in 2015 (Table 4). Eight age-0 channel catfish were collected by shoreline seining in 2015 (0.2 fish /haul) indicating a reproducing population (Table 6). A wide range of sizes of channel catfish were collected in 2015 by gill nets, with fish ranging from 220 to 735 mm (Figure 6). Relative weight, PSD, PSD-P, and PSD-M has remained similar to the past five years (Table 13).

Hydro-acoustic and Suspended Gill Net Surveys

The 2015 annual hydro-acoustic survey estimated 24,890,873 age-0 rainbow smelt and 18,868,034 age-1+ rainbow smelt. The hydro-acoustic survey also documented a large number (13,899,525) of age-0 and age-1 (5,605,178) lake herring in 2015. 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. 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).

Suspended deep water gill net CPUE has varied between years and species. In 2012, walleye and lake herring comprised the majority of fish captured (20 and 15 fish/net night, respectively; Table 14). Lake herring and rainbow smelt had the highest CPUE in 2015 (278 and 119 fish/net night, respectively). Size distribution of lake herring shifted between years, with fish captured from a large year-class produced in 2014 recruiting to the age-1 size class in 2015 (Figure 7). Lake herring ranged in size from 80 to 490 mm in the years of 2012 to 2015. Rainbow smelt CPUE in suspended deep water gill nets was the highest in 2015 (119 fish/net night; Table 14). No rainbow smelt were captured in 2014. The size distribution of rainbow smelt ranged from 80 to 220 mm in 2015, with a large percentage in the 110 and 120 mm length groups (Figure 8).

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 2011-2015 on Lake Oahe, South Dakota. Trace (T) indicates values less than 0.05.

Species	Year									
	2011		2012		2013		2014		2015	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	T	--	0	--	0.1	--	0.1	0.1	0	--
Black bullhead	T	--	0	--	T	--	0	--	0	--
Black crappie	0	--	0	--	0	--	T	--	T	--
Bluegill	T	--	T	--	0	--	0	--	0	--
Channel catfish	12.7	1.3	16.3	1.6	16.6	1.8	17.6	1.8	13.5	1.3
Chinook salmon	T	--	0	--	0	--	0	--	T	--
Common carp	1.5	0.2	1.1	0.2	1.9	0.3	1.8	0.3	1.1	0.3
Freshwater drum	1.5	0.3	0.8	0.1	0.9	0.2	1.2	0.2	0.7	0.1
Gizzard shad	0	--	0.1	0.1	T	--	0	--	0	--
Goldeye	1.4	0.3	1.1	0.3	1.1	0.2	0.7	0.2	0.8	0.1
Lake herring	0.1	0.1	0	--	0	--	0	--	T	--
Northern pike	2.0	0.3	1.7	0.2	0.6	0.1	0.4	0.1	0.6	0.1
Rainbow smelt	0	--	0	--	0	--	0	--	0	--
River carpsucker	0.5	0.2	1.1	0.2	0.6	0.2	0.9	0.3	0.4	0.1
Sauger	0.3	0.1	0.3	0.1	0.1	0.1	0.2	0.1	T	--
Shorthead redhorse	0.6	0.2	0.8	0.3	1.1	0.3	1.0	0.4	0.6	0.2
Shortnose gar	T	--	0.3	0.2	0	--	T	--	T	--
Smallmouth bass	1.6	0.3	1.7	0.5	1.4	0.4	1.4	0.3	2.0	0.5
Smallmouth buffalo	0.1	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.5	0.2
Spottail shiner	0.1	0.1	0	--	0	--	0	--	T	--
Walleye	25.1	2.0	20.4	1.6	15.7	1.6	14.1	1.7	8.6	1.1
White bass	3.8	0.7	1.4	0.3	1.5	0.3	1.5	0.6	1.0	0.4
White crappie	2.7	1.7	0.7	0.2	0.5	0.2	0.2	0.1	0.2	0.1
White sucker	0.4	0.1	0.2	0.1	0.1	0.1	0.6	0.2	0.2	0.1
Yellow perch	7.2	0.8	0.3	0.1	0.9	0.2	2.5	0.8	3.3	0.5

Table 5. Relative species composition, expressed as percent of total catch of all fish species collected during the standard coolwater gill net survey on Lake Oahe, South Dakota from 2011-2015.

Species	Year				
	2011	**2012**	**2013**	**2014**	**2015**
Channel catfish	21	32	38	40	40
Walleye	41	41	36	32	26
Smallmouth bass	3	3	3	3	6
Freshwater drum	2	2	2	3	2
River carpsucker	1	2	1	2	1
Yellow perch	11	4	2	6	10
Common carp	2	2	4	4	3
Goldeye	2	2	2	2	2
White bass	6	3	4	3	3
***Other species**	10	9	6	6	7

*Other species include bigmouth buffalo, black bullhead, black crappie, bluegill, Chinook salmon, gizzard shad, lake herring, northern pike, sauger, shorthead redhorse, shortnose gar, 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 on Lake Oahe, South Dakota, 2011-2015. Catches are for age-0 fishes, except where noted. Trace (T) indicates values less than 0.05.

Species	Year									
	2011		2012		2013		2014		2015	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Bigmouth buffalo	0.0	--	0.0	--	6.0	3.4	2.8	1.1	0.3	0.1
Black crappie	21.0	20.6	21.3	20.6	0.1	0.1	282.8	157.4	165.2	86.5
Brassy minnow*	0.3	0.3	0.0	--	0.3	0.2	0.1	0.1	0.1	0.1
Channel catfish	T	--	0.0	--	T	--	0.0	--	0.2	0.1
Common carp	0.5	0.3	0.1	0.1	0.3	0.2	0.1	0.1	0.0	--
Emerald shiner*	60.3	45.9	14.3	6.3	64.0	27.1	74.9	33.0	76.8	36.7
Fathead minnow*	0.3	0.2	0.1	0.1	T	--	1.2	0.5	0.8	0.3
Freshwater drum	2.2	1.4	1.6	0.6	7.4	4.0	T	--	0.7	0.5
Gizzard shad	0.0	--	2.5	2.5	0.3	0.2	0.0	--	0.0	--
Goldeye	0.0	--	0.0	--	0.5	0.5	0.1	0.1	0.6	0.4
Johnny darter*	1.0	0.3	0.3	0.2	0.3	0.2	0.1	0.1	0.1	0.1
Lake herring	0.0	--	0.0	--	0.0	--	T	--	0.1	0.1
Largemouth bass	T	--	0.0	--	0.1	0.1	0.1	0.1	0.5	0.4
Northern pike	T	--	0.0	--	0.0	--	0.2	0.1	0.0	--
River carpsucker	0.3	0.2	0.1	0.1	2.2	1.6	3.9	3.0	0.1	0.1
Silvery minnow	0.0	--	0.0	--	0.0	--	0.0	--	0.0	--
Smallmouth bass	10.4	2.3	5.6	1.8	32.6	9.6	14.8	3.8	7.4	1.4
Smallmouth buffalo	0.0	--	T	--	6.7	4.3	4.6	1.4	8.2	6.9
Spottail shiner*	3.0	1.5	1.8	0.7	0.4	0.2	1.5	0.6	1.5	0.6
Walleye	0.2	0.2	0.3	0.2	1.0	0.7	4.2	2.4	0.4	0.3
White bass	42.1	19.5	15.1	9.7	70.1	28.3	569.0	214.4	12.5	8.5
White crappie	10.1	6.3	7.2	4.7	25.4	15.2	21.1	10.9	113.2	73.7
White sucker	T	--	0.1	0.1	4.0	1.7	1.1	0.6	0.1	0.1
Yellow perch	20.0	7.6	8.6	7.3	39.4	22.0	270.4	145.0	109.6	46.8
OVERALL	346.8	57.8	192.2	32.0	332.6	55.4	2,029.5	338.3	498.2	195.8

* Includes all ages.

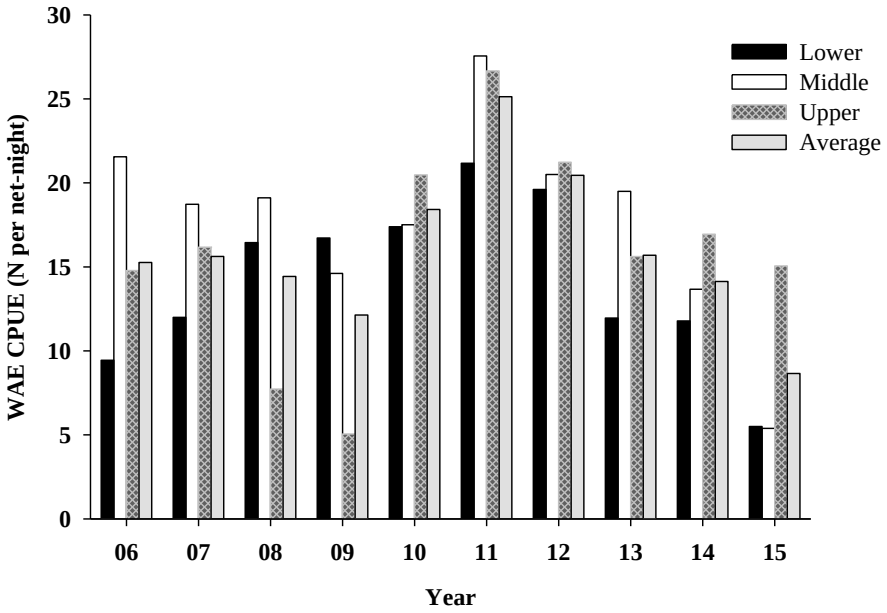

Figure 3. Mean walleye catch per unit effort (CPUE; No./net night) in the coolwater gill net survey for lower, middle and upper zones, and lake-wide average, of Lake Oahe, South Dakota, 2006-2015.

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 on Lake Oahe, South Dakota, 2011-2015.

Year	Zone											
	Lower			Middle			Upper			Lake-Wide Average		
	PSD	-P	-M	PSD	-P	-M	PSD	-P	-M	PSD	-P	-M
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
2015	59	3	0	59	6	0	24	0	0	39	2	0
Mean	36	6	1	23	3	0	16	2	0	24	4	1

Table 8. Mean relative weight (W_r) of walleye by length group and reservoir zone on Lake Oahe, South Dakota from 2011-2015. 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								
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
2015	76	28	84	37	91	2	81	67
Middle								
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
2015	76	21	78	27	91	3	78	51
Upper								
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
2015	83	111	82	41	--	0	83	152
Lake Wide								
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
2015	81	160	82	105	91	5	82	270

Table 9. Mean length-at-age at time of capture (mm), sample size (N) and standard error (SE) for walleye collected in the standard coolwater gill net survey on Lake Oahe, South Dakota from 2011-2015.

Year		Length at age at capture (mm)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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	---	---	---	---
2015	**Mean**	212	308	360	395	424	434	---	530	---	623	---	---
	N	125	71	55	40	14	61	0	1	0	1	0	0
	SE	2.3	3.1	3.0	4.8	10.9	5.4	---	---	---	---	---	---
Five year mean		211	285	343	401	457	484	547	537	582	641	627	642

Table 10. Mean length-at-time of capture (mm) by reservoir zone, for walleye collected in the coolwater gill net survey on Lake Oahe, South Dakota from 2013-2015. N is sample size and SE is standard error.

Zone	Age	2013			2014			2015		
		Length	N	SE	Length	N	SE	Length	N	SE
Lower	**1**	210	11	2	196	13	3	209	20	6
	2	274	41	4	273	18	10	282	15	9
	3	298	12	8	314	31	6	343	10	13
	4	355	124	4	318	14	10	391	13	10
	5	538	1	--	363	107	4	459	5	8
	6	496	3	8	--	--	--	454	26	8
	7	560	1	--	466	1	--	--	--	--
	8	521	1	--	471	1	--	--	--	--
	9	--	--	--	--	--	--	--	--	--
	10	--	--	--	--	--	--	--	--	--
	11	--	--	--	--	--	--	--	--	--
	12	--	--	--	--	--	--	--	--	--
Middle	**1**	198	14	2	235	22	6	211	33	5
	2	258	51	3	275	16	6	297	13	6
	3	290	13	7	325	38	5	374	6	6
	4	337	126	4	369	12	13	405	12	10
	5	467	4	11	365	79	5	423	3	29
	6	--	--	--	--	--	--	451	13	12
	7	--	--	--	616	1	--	--	--	--
	8	--	--	--	531	2	18	530	1	--
	9	606	1	--	--	--	--	--	--	--
	10	--	--	--	681	1	--	623	1	--
	11	648	1	--	--	--	--	--	--	--
	12	703	1	--	--	--	--	--	--	--
Upper	**1**	208	16	3	234	42	4	214	72	3
	2	259	16	5	307	38	4	321	43	2
	3	286	11	6	349	20	8	362	39	2
	4	332	94	3	359	10	12	389	15	5
	5	430	7	33	380	69	5	395	6	13
	6	580	1	--	395	1	--	401	22	4
	7	--	--	--	563	3	6	--	--	--
	8	--	--	--	552	1	--	--	--	--
	9	--	--	--	--	--	--	--	--	--
	10	--	--	--	--	--	--	--	--	--
	11	--	--	--	--	--	--	--	--	--
	12	--	--	--	--	--	--	--	--	--

Table 11. Mean annual growth increment (mm/y) estimates for walleye collected in the coolwater gill net survey on Lake Oahe, South Dakota for the 2010-2011, 2011-2012, 2012-2013, 2013-2014 and 2014-2015 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**
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
2014-2015	80	69	69	78	66	---	---	---	---
Five year mean	66	52	43	37	36	38	16	37	70

Table 12. Age distribution of walleye captured in standard coolwater gill net survey from 2011-2015 on Lake Oahe, South Dakota as determined using sagittal otoliths for age-estimation.

	Age												
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
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
2015	8	178	76	76	48	15	63	0	1	0	1	0	0

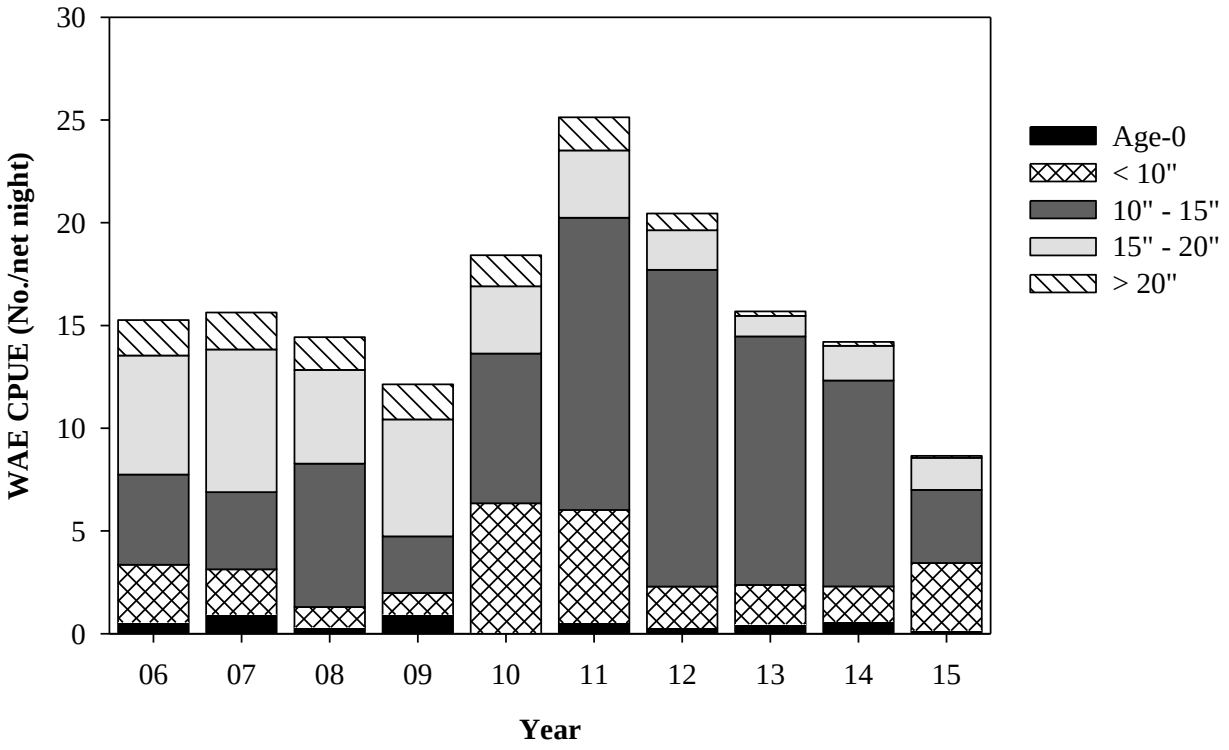

Figure 4. Incremental catch per unit effort (CPUE; No./net night) for walleye by year, as sampled by the standard coolwater gill net survey from 2006-2015 on Lake Oahe, South Dakota.

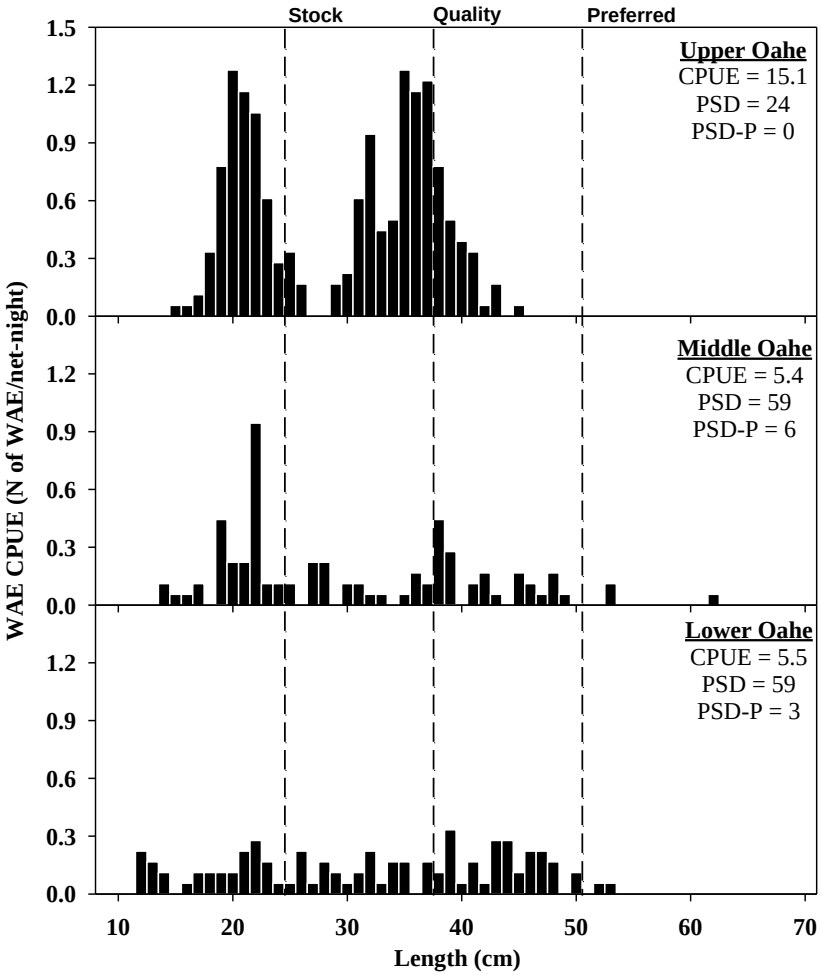

Figure 5. Length-frequency distribution of walleye by zone, collected during the standard coolwater gill net survey on Lake Oahe, South Dakota in 2015.

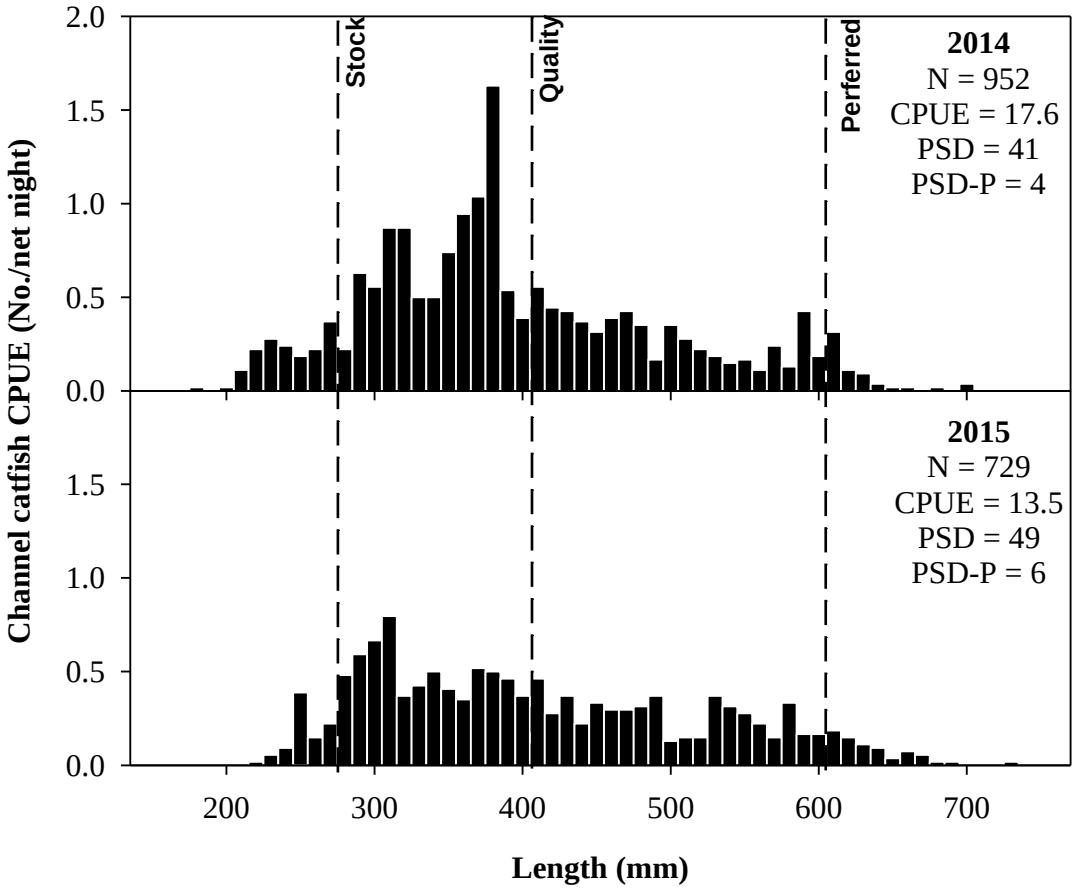

Figure 6. Length-frequency distribution of channel catfish collected during the standard coolwater gill net survey on Lake Oahe, South Dakota in 2014 and 2015. N is the number of channel catfish sampled.

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 2011-2015 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
2011	48	6	0	87	406
2012	55	7	0	81	335
2013	49	6	0	81	579
2014	41	4	0	85	534
2015	49	6	0	81	548

Table 14. Mean catch per unit effort (CPUE; No./net night) and standard error values (SE) for selected fish species collected with suspended deepwater small mesh gill nets in 2012-2015 from Lake Oahe, South Dakota.

Species	Year							
	2012		2013		2014		2015	
	CPUE	SE	CPUE	SE	CPUE	SE	CPUE	SE
Channel catfish	0.4	0.2	0.2	0.2	0.0	--	0.0	--
Chinook salmon	0.1	0.1	0.1	0.1	0.4	0.3	0.2	0.1
Lake herring	14.9	4.5	1.6	1.0	156.4	66.8	278.3	88.0
Northern pike	0.4	0.2	0.1	0.1	0.0	--	0.2	0.1
Rainbow smelt	1.8	0.7	1.2	1.1	0.0	--	119.4	49.2
Walleye	19.5	4.0	0.2	0.2	0.8	0.3	1.8	1.0
White bass	0.0	--	0.0	--	0.0	--	0.1	0.1
Effort- 2 net-nights per locations:	***Effort = 8*** Whitlock Bay Bushes Chantier Oahe Dam		***Effort = 14*** Whitlock Bay Sutton Bay Bushes Little Bend Chantier Oahe Dam		***Effort = 8*** LeBeau Whitlock Bay Little Bend Cow Creek		***Effort = 10*** LeBeau Whitlock Bay Bloody Run Pike Haven Chantier	

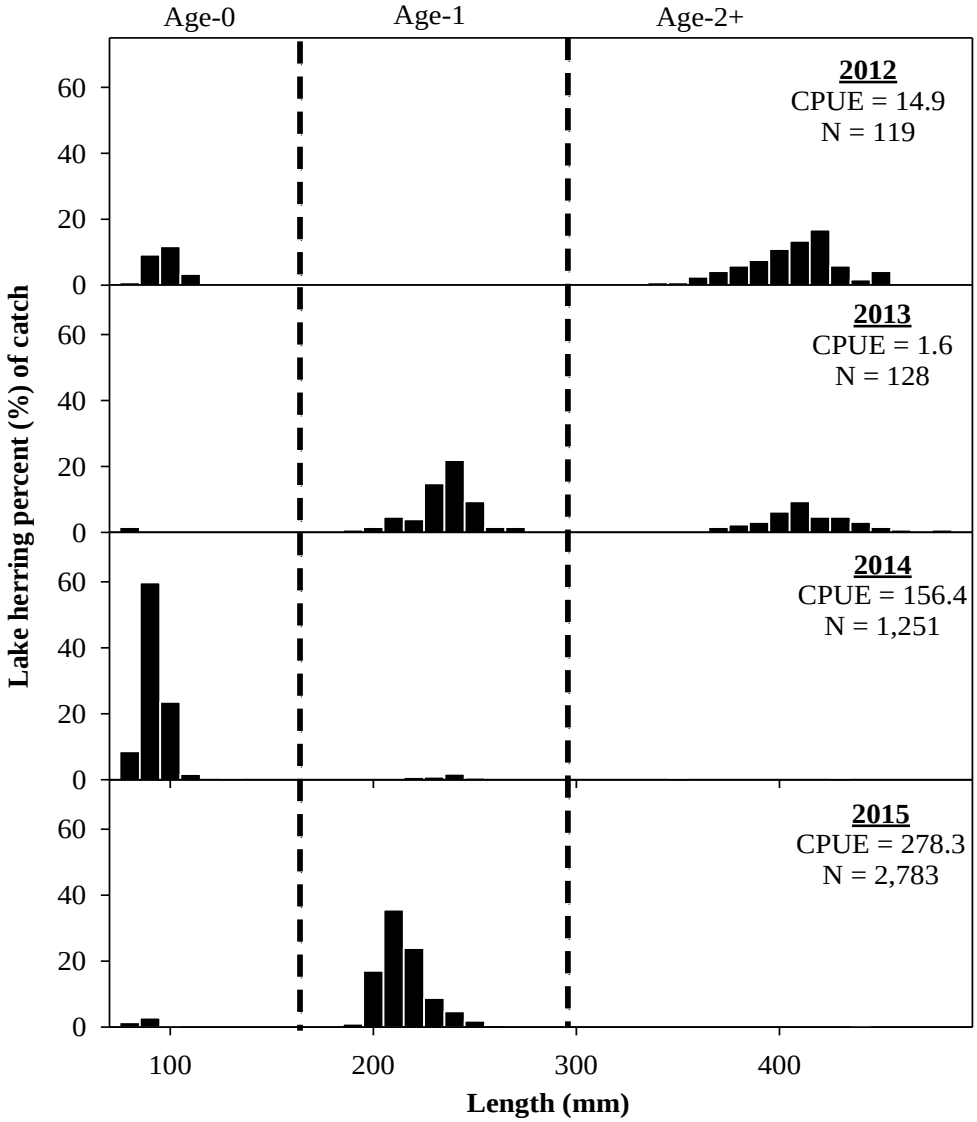

Figure 7. Length-frequency distribution of lake herring, displayed as percent of catch, collected during suspended deepwater gill net surveys in 2012 through 2015 on Lake Oahe, South Dakota. Vertical bars represent age-0, age-1 and age-2+ size class cut-offs. Catch per unit effort (CPUE) is No./net night, and N is the number of lake herring sampled.

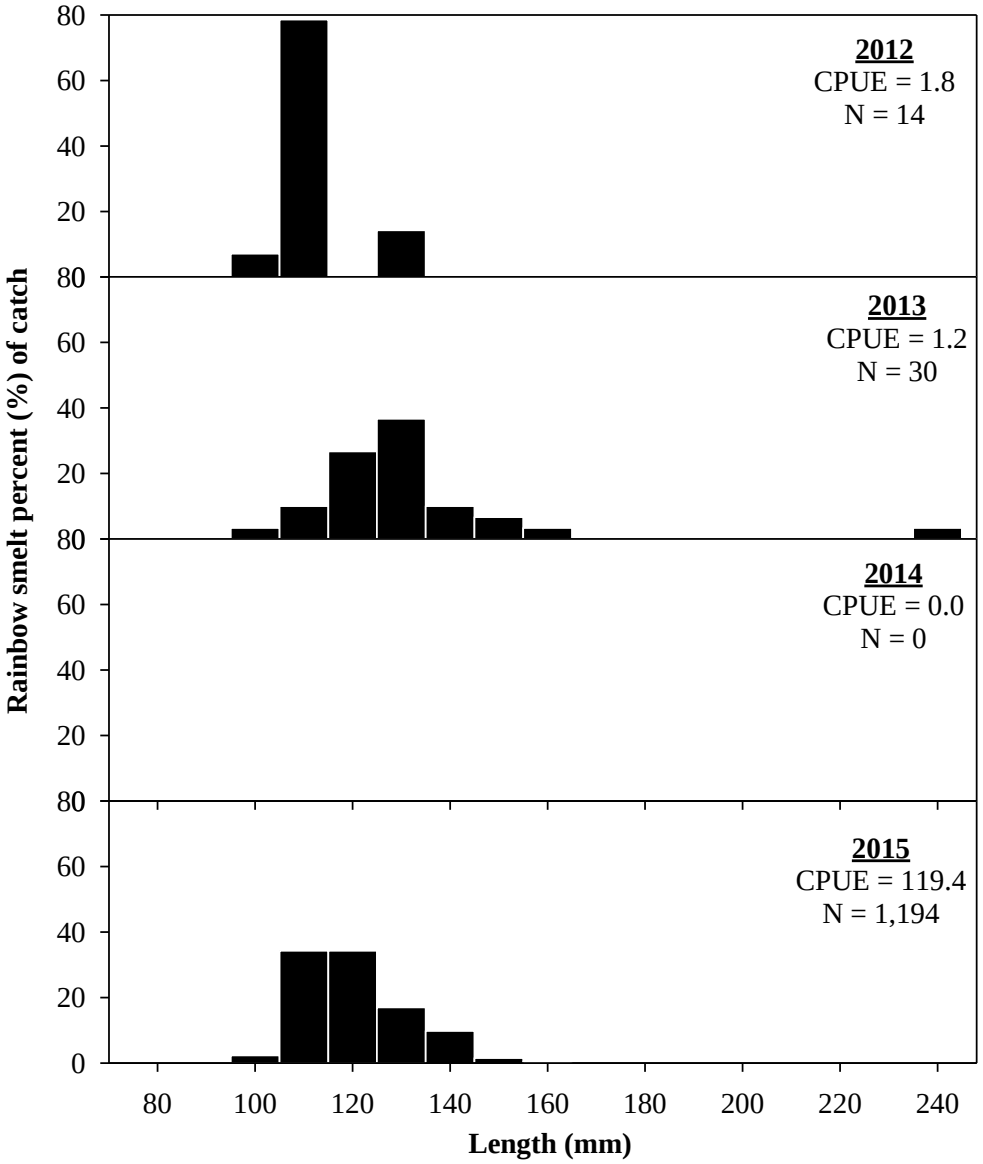

Figure 8. Length-frequency distribution of rainbow smelt, displayed as percent of catch, collected during suspended deepwater gill net surveys from 2012 through 2015 on Lake Oahe, South Dakota. Catch per unit effort (CPUE) is No./net night, and N is the number of rainbow smelt sampled.

Angler Use, Sportfish Harvest and Preference Surveys

Angler Use

Anglers fished an estimated 151,269 angler-days on the South Dakota portion of Lake Oahe during May-July of 2015, which is slightly lower than the 10 year average of 157,464 angler-days (Table 15). Estimated lake-wide fishing pressure was highest during June (344,588 angler-h), accounting for 47% of the total fishing pressure during the May-July period (Table 16). Angler use was the highest during June for the upper and middle zones while angler use was highest in the lower zone during July (Table 16). Total fishing pressure in the middle and upper zones were similar during the May-July period (Table 18). The majority (96%) of anglers on the South Dakota portion of Lake Oahe are fishing by boat during the months of May-July (Table 17). The middle and upper zones had similar angler use in 2015 at 7.8 and 7.7 angler-h/ha, respectively. Estimated angling pressure in the lower zone during 2015 (4.7 angler-h/ha) was the lowest since 2010 (Table 18).

Catch, Harvest and Release Estimates

Of the estimated 358,533 fish harvested from Lake Oahe during the May-July 2015 daytime period, 308,513 (86%) were walleye (Table 15). Smallmouth bass, channel catfish, northern pike, and white bass were also harvested, to a lesser extent (Table 20). Approximately 53% of walleye harvest occurred in June (Table 19). Walleye harvest was similar in the upper and middle zones (39% and 37% of total walleye harvest, respectively) and was lowest in the lower zone (Table 20).Walleye compromised the majority of fish released (263,151 fish) followed by smallmouth bass (70,151 fish). The months of June and July had similar numbers of total fish released (Table 21). Anglers harvested 54% of the 571,664 walleye caught in 2015, similar to the 10-year average of 53% of walleye harvested that were caught (Table 22).

Anglers generally begin harvesting walleye at approximately 300-mm (11.8-in) in length, however, the majority of the harvest occurs when fish reach 350-mm (13.7-in) or greater (Figure 9). The average length of walleye harvested by anglers increased from 2014, and was 402-mm (15.8-in). Mean length of harvested walleyes was similar across all three zones (Figure 10; Figure 11; Figure 12).

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 0.94 fish/angler-h; Table 23). Although walleye catch rate (0.77 fish/angler-h) exceeded the standard set by Colby et al. (1979) it was lower than the long-term average (Table 23). During 2015, catch rates for smallmouth bass (0.12 fish/angler-h), white bass (0.02 fish/angler-h), channel catfish (0.09 fish/angler-h), and all fish combined (1.15 fish/angler-h) were near the 10 year mean for these species (Table 23). Additionally, catch rates for anglers actively fishing for walleye were 1.86 fish/angler-h, representing a sharp decrease from 2014 when anglers caught 3.57 fish/angler-h (Table 24). Catch and harvest rates for walleye were the highest in June (0.87 fish caught/angler-h and 0.48 fish harvested/angler-h), followed closely by July (0.81 fish caught/angler-h and 0.39 fish harvested/angler-h; Table 25).

The percentage of angling parties catching zero walleye was similar between years (13% in 2014 to 14% in 2015; Table 26). Twenty-two percent of angling parties fishing the lower zone in 2015 caught zero walleye compared to 13% of anglers in the middle zone and 11% in the upper zone. The percent of angling parties harvesting a daily limit (four fish/person) decreased slightly from 30% in 2014 to 26% in 2015. A greater percent of parties harvested a daily limit in the upper zone (31%) than in the lower zone (20%; 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 157,464 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 151,269 trips occurred during the May-July 2015 daylight period on Lake Oahe, for an estimated economic input of $10.1 million in local revenues. This is down from $11.0 million in 2014 and $12.6 million in 2013.

Resident anglers represented 76% of the parties interviewed on Lake Oahe, which was similar to previous years (Table 27). The lower zone had a slightly higher proportion of resident anglers than the upper and middle zones (Table 27). Lake Oahe continues to be recognized as a destination walleye fishery and 2015 was no exception, with 52% of anglers traveling ≥ 100 miles (one-way) to fish. However, this number has been declining since 2011 (Table 28). Non-resident anglers were predominantly from Minnesota (31%), Nebraska (20%), Iowa (15%), and North Dakota (10%) with non-residents from 34 other states and Canadian Providences interviewed during the survey (Table 29). Walleye were the most sought after species for the last five years, with 90% of anglers targeting walleye in 2015 (Table 30). The proportion of anglers targeting Chinook salmon remained low in 2015 at <0.5%.

Anglers from Hughes (19%) and Brown (17%) counties were the most common resident angler contacts in 2015 (Table 31). Resident anglers fishing Lake Oahe have a tendency to fish the zone closest to their county of residence.

Angler Satisfaction and Attitudes

Overall satisfaction on Lake Oahe during the May-July period was 83% which is above the Lake Oahe Strategic Plan objective of 70% (Table 32). Median satisfaction was highest (trip rating of "very satisfied") during the month of June. Trip satisfaction generally increased with the percent of daily limits attained by anglers (Table 33). Median satisfaction rating for angling parties that harvested less than three walleye per person was "moderately satisfied".

If an angler responded to trip satisfaction as anything less than "very satisfied", creel clerks then asked the respondent what it would take to increase their ranking to "very satisfied." This question was intended to assess motivations of anglers (e.g. catch motivated, harvest motivated, trophy angler, etc.; see appendix 3 for full list of responses). Of the anglers that rated their satisfaction as "moderately satisfied" or below, 57% of parties indicated that catching more fish would increase their satisfaction rating. "Improve weather" and "catch larger fish" were the next most common responses to improve an angler's satisfaction rating (Table 34).

In May 2015, regulations to pull all boat and live-well plugs were promulgated to restrict the movement of water between South Dakota waterbodies. During the May to July period, anglers were asked if they were aware of these new regulations. Ninety-seven percent of anglers interviewed were aware of new regulations (Table 35).

Table 15. Angler use and harvest estimates for surveys conducted from 2006-2015. All surveys were conducted during the May-July daylight period on Lake Oahe, South Dakota.

Year	Fishing pressure (h)	Angler trips	Estimated fish harvest	Estimated walleye harvest	Reference
2006	541,432	107,080	218,521	195,869	Lott et al. (2007)
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	Meyer et al. (2015)
2015	738,360	151,269	358,533	308,513	This Report

Table 16. Estimated fishing pressure (angler-h) by month and zone with 80% confidence intervals (CI) during the May-July 2015 daylight period on Lake Oahe, South Dakota.

Zone	Month			
	May	**June**	**July**	**Total**
Lower	22,857	72,368	102,276	197,500
80% CI	7,051	34,819	43,987	56,541
Middle	34,759	149,907	85,708	270,373
80% CI	22,152	64,016	41,597	79,492
Upper	94,005	122,314	54,167	270,486
80% CI	37,214	22,623	25,542	50,488
Total	151,621	344,588	242,151	738,360
80% CI	43,878	76,303	65,708	109,841

Table 17. Estimated fishing pressure, expressed as angler-h and hours per hectare (h/ha) by type of fishing with 80% confidence intervals (CI), during the May-July daylight period from 2011-2015 on Lake Oahe, South Dakota.

Type of fishing	Year				
	2011	**2012**	**2013**	**2014**	**2015**
Boat (h)	1,004,064	899,910	874,930	741,698	709,521
80% CI	195,407	98,153	153,293	95,186	110,177
h/ha	9.1	8.1	7.9	6.7	6.4
Shore (h)	32,907	50,797	54,900	29,721	28,839
80% CI	5,911	8,290	9,453	4,528	4,281
h/ha	0.3	0.5	0.5	0.3	0.3
Combined (h)	1,036,972	950,707	929,829	771,419	738,360
80% CI	197,148	128,904	155,572	96,807	109,841
h/ha	9.4	8.6	8.4	7.0	6.7

Table 18. Estimated fishing pressure, expressed as angler-h and hour per hectare (h/ha) by reservoir zone, for standard creel surveys conducted during the May-July daylight period from 2006-2015 on Lake Oahe, South Dakota.

Year	Zone							
	Lower		Middle		Upper		Total	
	h	h/ha	h	h/ha	h	h/ha	h	h/ha
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
2015	197,500	4.7	270,373	7.8	270,486	7.7	738,360	6.7
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) during the May-July 2015 daylight period on Lake Oahe, South Dakota.

Species	Month			
	May	June	July	Total
Walleye	50,499	163,909	94,106	308,513
80% CI	19,902	37,050	26,993	49,974
Channel catfish	4,257	2,713	5,746	12,716
80% CI	1,169	1,156	4,745	5,022
White bass	1,114	1,493	548	3,156
80% CI	664	583	335	945
Smallmouth bass	4,233	11,404	4,067	19,704
80% CI	2,465	3,791	1,732	4,842
Yellow perch	226	769	458	1,453
80% CI	40	724	341	440
Northern pike	1,078	1,505	851	3,433
80% CI	302	510	366	697
Chinook salmon	0	0	95	95
80% CI	--	--	82	82
Other*	5,540	3,267	655	9,463
Total	66,947	185,060	106,526	358,533
80% CI	22,746	42,059	30,806	56,880

*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) during the May-July 2015 daylight period on Lake Oahe, South Dakota.

Species	Zone			
	Lower	Middle	Upper	Total
Walleye	73,269	114,222	121,022	308,513
80% CI	24,434	37,135	22,834	49,974
Channel catfish	4,022	5,308	3,386	12,716
80% CI	1,998	4,595	344	5,022
White bass	1,423	639	1,093	3,156
80% CI	767	257	438	945
Smallmouth bass	5,854	10,519	3,331	19,704
80% CI	2,689	3,620	1,762	4,842
Yellow perch	478	615	360	1,453
80% CI	359	188	170	440
Northern pike	1,061	1,261	1,112	3,433
80% CI	384	506	286	697
Chinook salmon	95	0	0	95
80% CI	82	--	--	82
Other*	898	1,054	7,511	9,463
Total	87,100	133,618	137,815	358,533
80% CI	28,190	42,718	24,815	56,880

* 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) during the May-July daylight period in 2015 on Lake Oahe, South Dakota.

Species	Month			
	May	June	July	Total
Walleye	26,525	134,239	102,386	263,151
80% CI	13,545	30,155	29,918	44,586
Channel catfish	2,199	10,940	42,123	55,262
80% CI	657	3,849	15,675	16,154
White bass	3,619	6,191	2,728	12,538
80% CI	1,564	2,234	1,320	3,030
Smallmouth bass	8,258	32,088	29,805	70,151
80% CI	2,964	10,555	9,989	14,832
Northern pike	4,012	15,042	12,475	31,530
80% CI	1,539	3,997	3,754	5,695
Yellow perch	1,496	4,653	5,190	11,339
80% CI	61	2,314	1,768	2,913
Chinook salmon	0	0	0	0
80% CI	--	--	--	--
Other*	4,958	20,790	18,181	43,926
Total	51,067	223,943	212,888	487,897
80% CI	20,854	50,772	59,942	81,275

* Other includes bigmouth buffalo, black crappie, common carp, freshwater drum, goldeye, sauger, shortnose gar, white crappie, and white sucker.

Table 22. Estimated number of walleye caught, harvested or released during the May-July daylight period by year from 2006-2015 on Lake Oahe, South Dakota.

Year	Caught	Harvested	Released	Percent harvested
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%
2015	571,664	308,513	263,151	54%

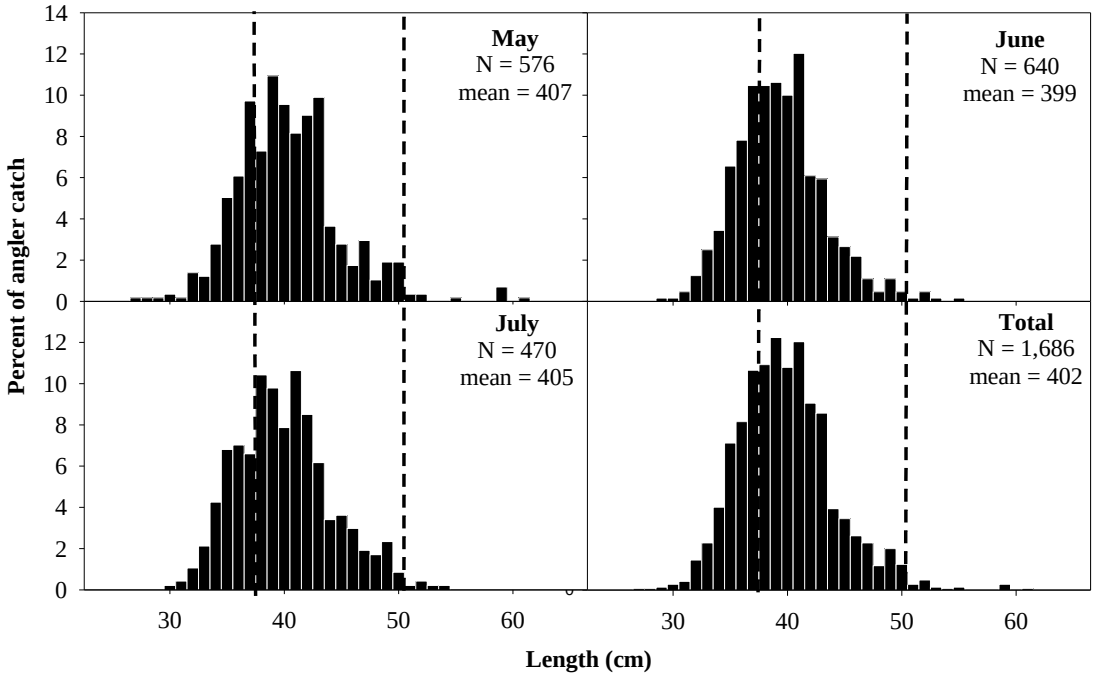

Figure 9. Length-frequency distribution of walleye harvested by anglers during the May-July 2015 daylight period on Lake Oahe, South Dakota. Vertical lines represent 15 and 20 in. and N is sample size.

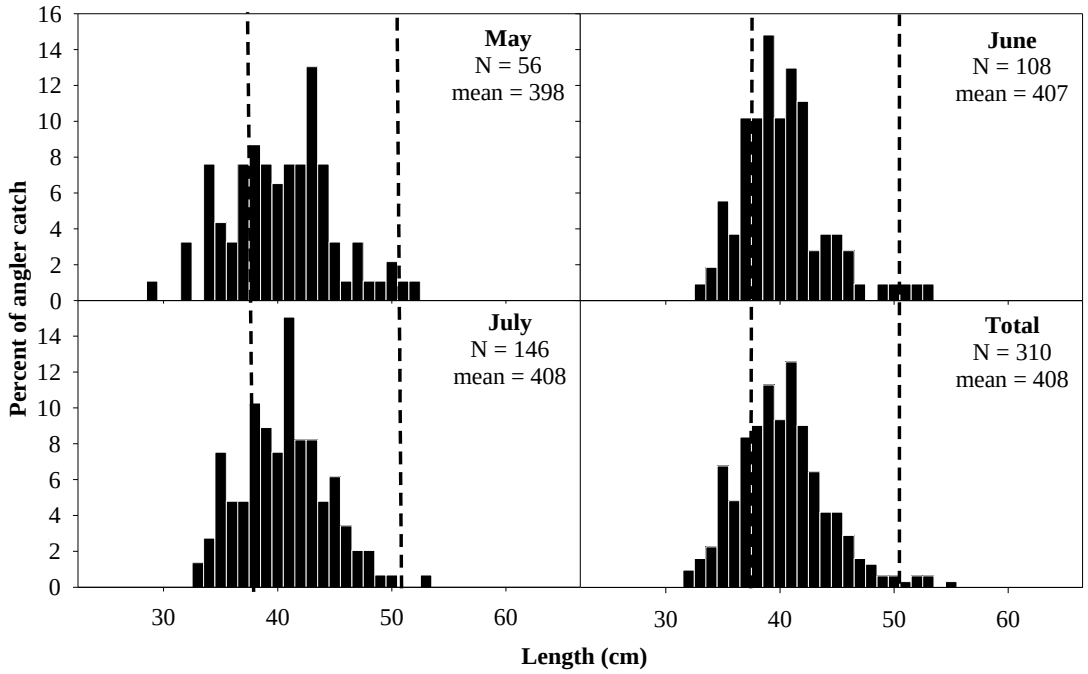

Figure 10. Length-frequency distribution of walleye harvested by anglers fishing lower Lake Oahe, South Dakota during the May-July 2015 daylight period. Vertical lines represent 15 and 20 in. and N is sample size.

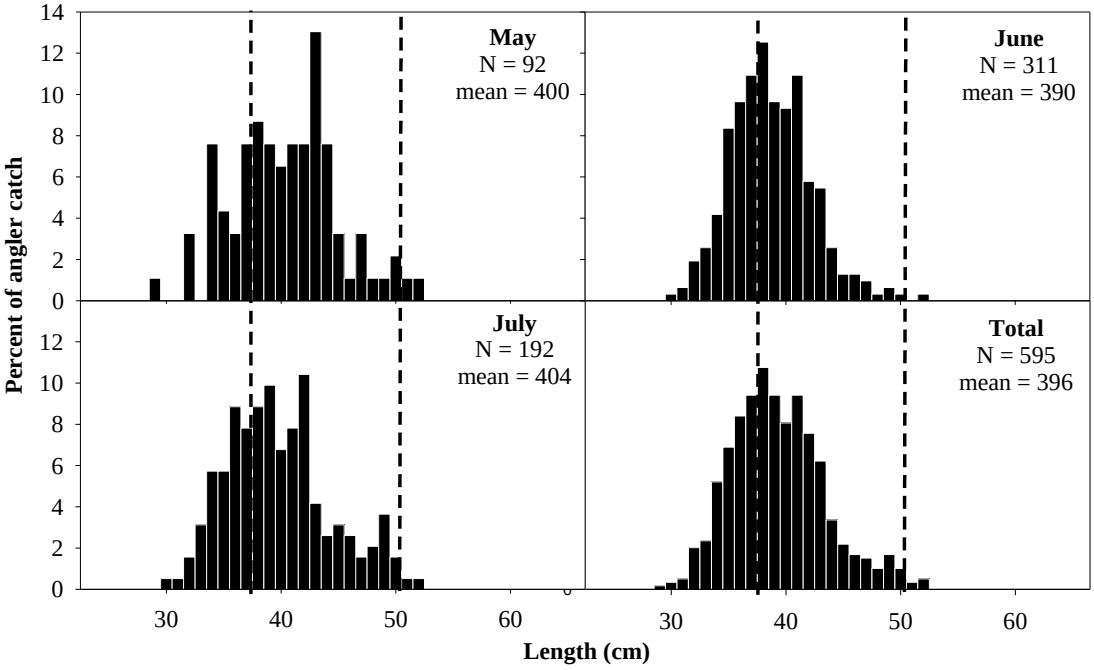

Figure 11. Length-frequency distribution of walleye harvested by anglers fishing middle Lake Oahe, South Dakota during the May-July 2015 daylight period. Vertical lines represent 15 and 20 in. and N is sample size.

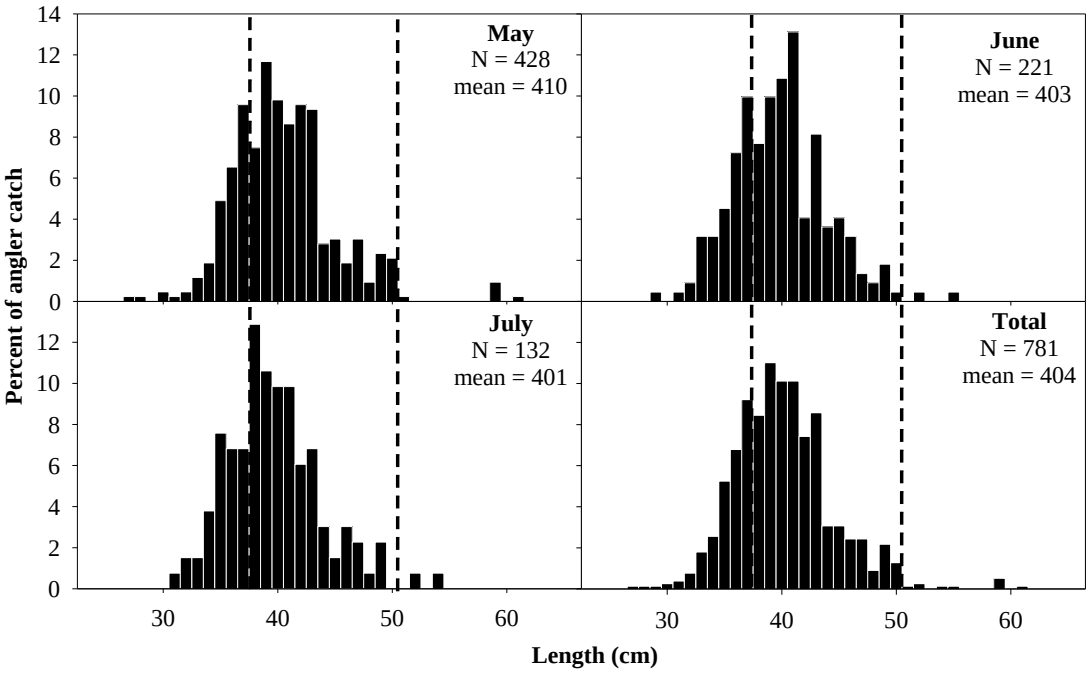

Figure 12. Length-frequency distribution of walleye harvested by anglers fishing upper Lake Oahe, South Dakota during the May-July 2015 daylight period. Vertical lines represent 15 and 20 in. and N is sample size.

Table 23. Estimated hourly catch rates (fish/angler-h) for walleye, smallmouth bass, white bass, channel catfish and all fish combined, by year, for all anglers during the May-July daylight period on Lake Oahe, South Dakota from 2006-2015.

Year	Catch rate (fish/angler-h)				
	Walleye	Smallmouth bass	White bass	Channel catfish	All fish
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
2015	0.77	0.12	0.02	0.09	1.15

Table 24. Estimated hourly catch, harvest and release rates (fish/angler-h), by species for species-specific anglers during the May-July 2015 daylight period on Lake Oahe, South Dakota.

Species	Catch rate (fish/angler-h)	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)
Walleye	1.86	1.10	0.76
Smallmouth bass	1.97	0.08	1.89
Channel catfish	13.30	11.75	1.56
Chinook salmon	0.00	0.00	0.00
Northern pike	0.19	0.03	0.16

Table 25. Estimated hourly catch, harvest and release rates (fish/angler-h) for walleye and all species combined, by month during the May-July 2015 daylight period on Lake Oahe, South Dakota.

Month	Walleye			All fish combined		
	Catch rate	Harvest rate	Release rate	Catch Rate	Harvest rate	Release rate
May	0.51	0.33	0.18	0.78	0.44	0.34
June	0.87	0.48	0.39	1.19	0.54	0.65
July	0.81	0.39	0.42	1.32	0.44	0.88
Total	0.77	0.42	0.35	1.15	0.49	0.66

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 zone during the May-July 2014 and 2015 daylight period on Lake Oahe, South Dakota.

Number/ Person	Catch per trip							
	2014				2015			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	19	13	9	13	22	13	11	14
≥ 0.1	81	87	91	87	78	87	89	86
≥ 1	73	80	85	80	69	79	82	78
≥ 2	57	72	75	70	57	68	70	67
≥ 3	49	66	68	63	48	55	60	55
≥ 4	43	57	62	56	37	48	52	47
≥ 5	38	51	53	49	28	31	39	34
≥ 6	29	44	43	40	18	23	28	24
≥ 7	22	35	35	32	13	16	19	17
≥ 8	18	29	29	26	10	13	14	13
≥ 9	13	23	25	21	9	10	11	10
≥10	11	19	21	18	7	8	9	8

Number/ Person	Harvest per trip							
	2014				2015			
	Lower	Middle	Upper	Total	Lower	Middle	Upper	Total
0	35	23	18	24	34	20	20	23
≥ 0.1	65	77	82	76	66	80	80	77
≥ 1	54	69	76	68	55	71	74	69
≥ 2	40	55	63	55	41	56	58	54
≥ 3	28	43	52	43	29	38	43	38
4 (limit)	18	29	39	30	20	24	31	26

Table 27. Percent of total angler contacts for resident and non-resident anglers fishing Lake Oahe, South Dakota during the May-July daylight period from 2011-2015. N is the number of parties interviewed.

Zone		Year				
		2011	**2012**	**2013**	**2014**	**2015**
Lower	**N**	615	580	504	277	327
	Residents (%)	77	75	66	73	80
	Non-residents (%)	23	25	34	27	20
Middle	**N**	581	652	448	463	613
	Residents (%)	74	75	74	78	74
	Non-residents (%)	26	25	26	22	26
Upper	**N**	729	823	457	457	610
	Residents (%)	70	72	67	78	75
	Non-residents (%)	30	28	33	22	25
Total	**N**	1,925	2,055	1,409	1,197	1,550
	Residents (%)	74	74	69	77	76
	Non-residents (%)	26	26	31	23	24

Table 28. Percent of anglers that drove a specific distance, one way, to fish Lake Oahe, South Dakota during the May-July daylight period from 2011-2015.

Distance (miles)	Percent by year				
	2011	**2012**	**2013**	**2014**	**2015**
<25	18	19	18	21	18
25-49	11	6	9	8	13
50-99	10	8	12	9	17
100-199	17	24	21	22	19
≥200	44	43	40	40	33

Table 29. Percent of non-resident angler contacts, by state during the May-July daylight period from 2011-2015, on Lake Oahe, South Dakota.

State	Percent by year				
	2011	2012	2013	2014	2015
Iowa	16	23	19	12	15
Nebraska	27	39	28	23	20
North Dakota	14	2	12	13	10
Colorado	4	6	3	6	4
Minnesota	19	10	18	26	31
Wisconsin	4	2	3	2	2
Wyoming	5	1	5	6	2
Other**	11	17	12	12	16

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

Table 30. Percent of anglers targeting a specific species on Lake Oahe, South Dakota during the May-July daylight period from 2011-2015. Trace (T) indicates values >0.0 but <0.5.

Target species	Percent by year				
	2011	2012	2013	2014	2015
Walleye	86	90	90	83	90
Anything	11	8	7	13	8
Chinook salmon	1	1	T	T	T
Northern pike	1	T	1	2	1
White bass	0	0	0	0	T
Channel catfish	T	T	1	T	T
Smallmouth bass	1	T	T	2	1

Table 31. Percent of resident angler contacts on Lake Oahe, South Dakota by county of residence during the May-July daylight period from 2011-2015.

County	Major city	Percent by year				
		2011	2012	2013	2014	2015
Beadle	Huron	2	4	3	4	3
Brown	Aberdeen	12	14	12	13	17
Campbell	Pollock	2	3	3	4	2
Codington	Watertown	3	4	1	2	3
Davison	Mitchell	2	2	2	2	1
Hughes	Pierre	22	13	14	15	19
Minnehaha	Sioux Falls	9	7	8	6	6
Pennington	Rapid City	7	8	9	7	7
Potter	Gettysburg	4	4	6	6	4
Stanley	Fort Pierre	3	4	3	1	2
Sully	Onida	2	2	2	2	2
Walworth	Mobridge	10	11	11	10	8
Other		22	24	26	28	26

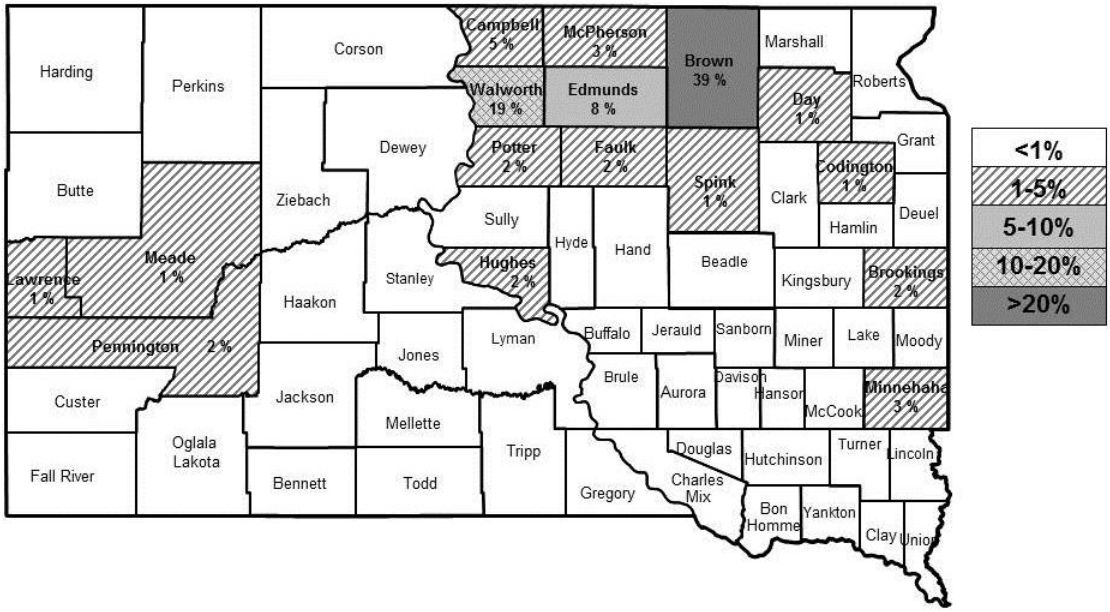

Figure 13. County of residence for South Dakota residents fishing upper Lake Oahe, South Dakota during the May-July 2015 daylight period.

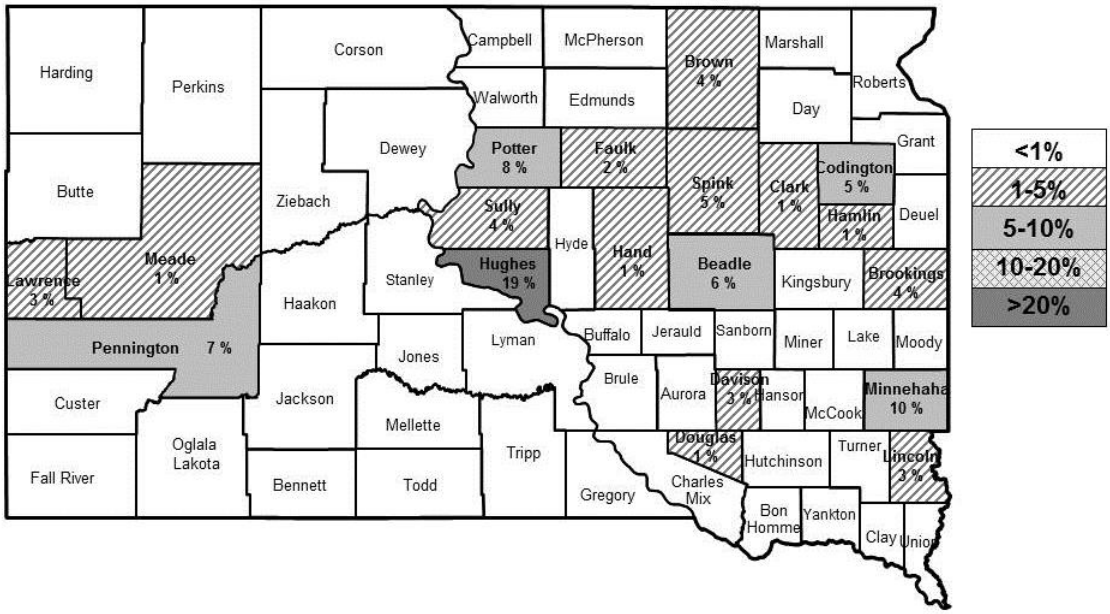

Figure 14. County of residence for South Dakota residents fishing middle Lake Oahe, South Dakota during the May-July 2015 daylight period.

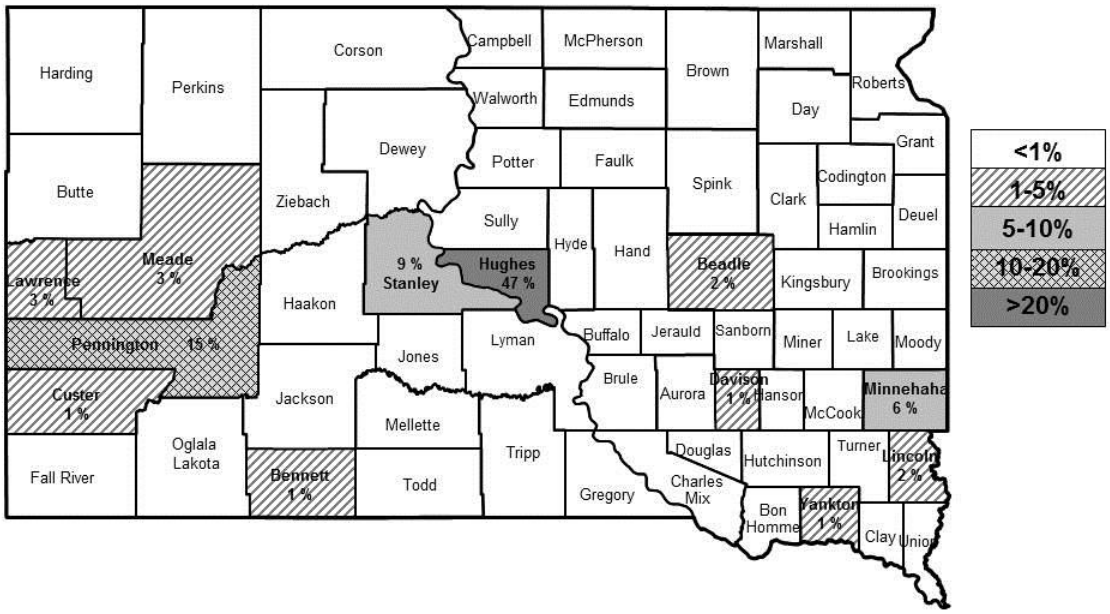

Figure 15. County of residence for South Dakota residents fishing lower Lake Oahe, South Dakota during the May-July 2015 daylight period.

Table 32. Responses of anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight 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 includes "neutral/no opinion" responses.

Month	Satisfaction rating							N	Median
	Satisfied			Neutral/N.O.	Dissatisfied				
	1	2	3	4	5	6	7		
May	77	62	24	18	12	18	9	220	2
June	218	83	26	7	11	6	10	361	1
July	107	64	41	16	10	16	10	264	2
Total	402	209	91	41	33	40	29	845	2
Percent	83%			5%	12%				

Table 33. Responses of anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight 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	57	41	28	18	13	18	18	193	2
0.1-0.9	22	18	8	6	4	9	10	77	2
1.0-1.9	32	38	19	8	12	9	1	119	2
2.0-2.9	61	35	17	6	3	3	0	125	2
3.0-3.9	57	30	9	3	1	1	0	101	1
4 (limit)	168	45	10	0	0	0	0	223	1
Percent	83%			5%	12%				

Table 34. Responses of anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight period: "What would help increase your satisfaction level to "very satisfied"?" after being asked their overall satisfaction rating (Table 32).

Improvement sought	Percent "very satisfied"	N	Percent	N
Very Satisfied – no improvement	48%	402	-	441
Catch more fish			57%	251
Harvest more fish			<1%	1
Improve weather			17%	76
Catch larger fish			17%	73
Improve time			2%	7
Less competition			<1%	1
Other			7%	32

Table 35. Response of all anglers fishing Lake Oahe, South Dakota who were asked the following question during the May-July 2015 daylight period: "Are you aware of the new regulations for boat plug removal and live bait transport?"

Response	Percent	N
Yes	97%	685
No	3%	18

ONGOING AND COOPERATIVE RESEARCH PROJECTS

The Missouri River Fisheries staff have been collaborating on a number of projects. During the 2015 sampling season, trap nets and boat electrofishing were employed 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 of the 2011 flood on walleyes in Lake Oahe. The anticipated completion date of this project is June 2017. Additional projects include a PhD student from SDSU (N. Kludt) using hydro-acoustics to assess rainbow smelt and lake herring population dynamics in Lake Oahe. We are also 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 2013 and 2014 and spring of 2015, and tagged fish will be collected through 2019. Biologists will examine tag returns from different stocking locations to determine the highest rate of return to anglers and Whitlock spawning station.

FISHERY STATUS AND 2016 OUTLOOK

The Missouri River flood of 2011 resulted in steep declines in rainbow smelt abundance as a result of 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 rainbow smelt entrainment of 2011.

Walleye W_r has improved from a low in 2012, but declined from 2014 to 2015. The abundance of age-1 lake herring appears to have improved the condition of larger walleye that are present in the population. Lake herring may have led to increased weights of Chinook salmon with a new state record caught in 2015. Walleye growth rates have improved since 2012, and current growth rates are greater than the five-year average. Walleye abundance has continued to decline since 2011, which may allow for future increases in rainbow smelt abundance. The large 2009 (age-6) year-class of walleye has shown a decline in abundance, but is now at? a size attractive to anglers (~ 17-in) with improved growth. The 2014 year-class of walleye appears to be abundant and should provide recreational opportunities in the future.

No age-0 gizzard shad were collected in 2014 and 2015. 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 for 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.

Angler catches in 2016 will be dominated by small (<15-inches) walleye owing to a substantial proportion (80%) of the walleye population currently in that size range.

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
   - 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
     Continue to monitor Lake Oahe sport fish and prey fish

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.

Balk, H. and Lindem, T. 2015. Sonar4 and Sonar5-Pro post processing systems, Operator manual version 6.0.3, 464p. Lindem Data Acquisition A/S, Oslo, Norway.

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.

Fincel, M.J., K. Edwards, R. Hanten, M. Smith and K. Potter. 2012. 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, Annual report 12-05, Pierre.

Fincel, M.J., K. Potter, R. Hanten, H. Meyer and M. Smith. 2013. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2012. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 13-07, Pierre.

Fincel, M.J., R. Hanten, H. Meyer, K. Potter and M. Smith. 2014. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2013. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 14-02, Pierre.

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.

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, 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. 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, R. Hanten and K. Potter. 2007. 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.

Meyer, H., R. Hanten, K. Potter, M. Fincel, and M. Smith. 2015. Annual fish population and angler use, harvest and preference surveys on Lake Oahe, South Dakota 2014. South Dakota Department of Game, Fish and Parks, Wildlife Division, Annual report 15-04, Pierre.

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 hydro-acoustic 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. Master's 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.

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.
U.S. Department of the Interior, U.S. Fish and Wildlife Service and U.S. Department of Commerce, Census bureau. 2011. 2011 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.

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 2015 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

2. What would help increase your satisfaction level to "very satisfied"?
   a. More fish caught
   b. Larger fish caught
   c. Improve time
   d. More fish harvested
   e. Improve weather
   f. Less competition
   g. Other:_____

Question Series B:

Angler caught tagged walleye questions:

#1. How many tagged walleye have you caught in 2015?

#2. Of these, how many were reported to SD GFP to date for 2015?

Aquatic nuisance species regulation awareness:

Are you aware of the new regulations for boat plug removal and live bait transport?

YES or NO