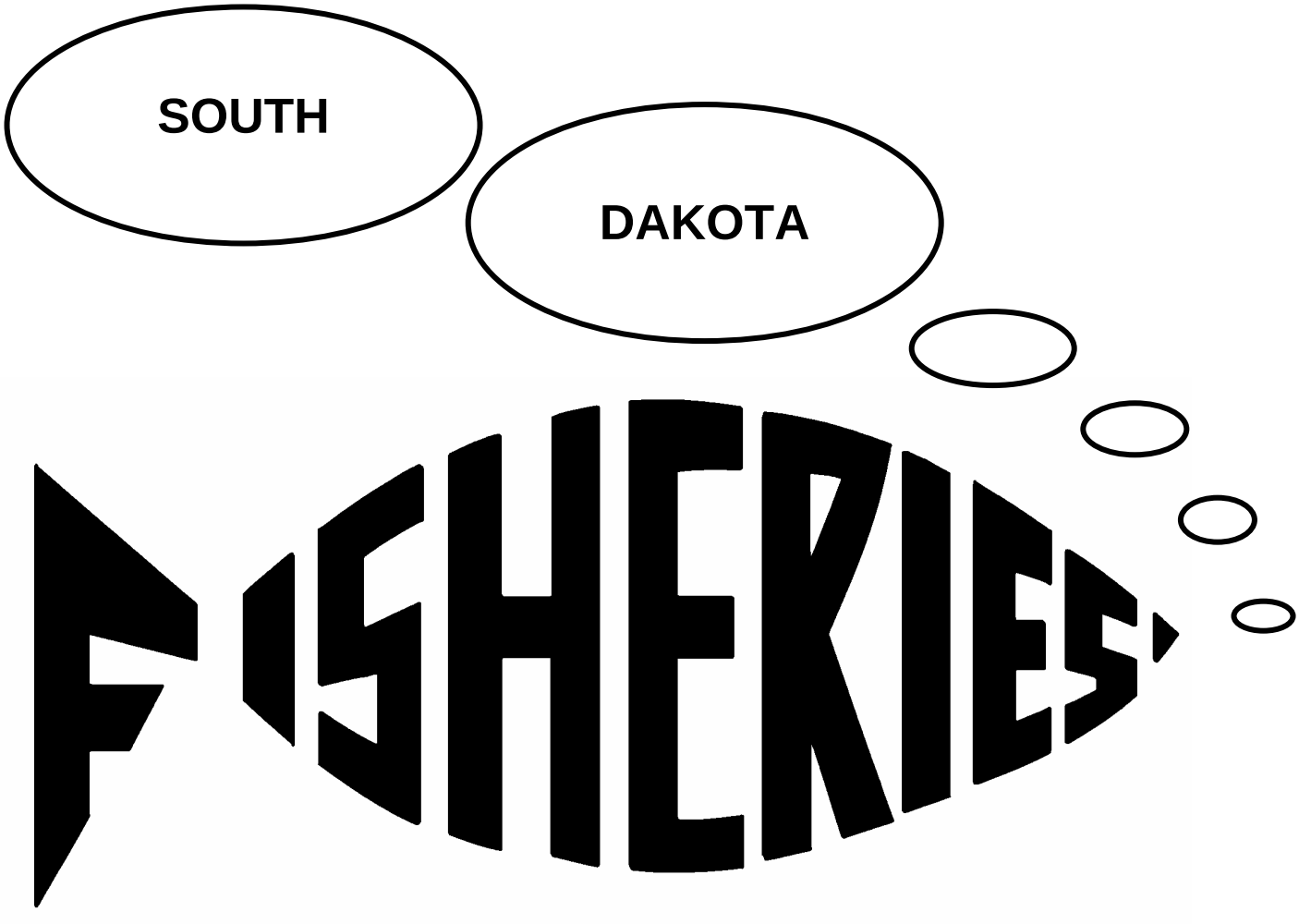


# ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE OAHE, SOUTH DAKOTA 2006

**South Dakota Department of Game, Fish and Parks**
**Wildlife Division**
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**Annual Report No. 07-27**

# ANNUAL FISH POPULATION
# AND
# ANGLER USE, HARVEST AND PREFERENCE SURVEYS
# ON
# LAKE OAHE, SOUTH DAKOTA, 2006

By

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## PREFACE

Information collected during 2006 is summarized in this report. Copies of this report and references to the data can be made with permission from the authors or the Director of the Division of Wildlife, South Dakota Department of Game, Fish, and Parks, 523 E. Capitol, Pierre, SD 57501.

The authors would like to thank the following individuals from the South Dakota Department of Game, Fish and Parks who helped with data collection, data entry, manuscript preparation, and report editing: John Aberle, Brian Beel, Dalton Decker, Marlin Fallon, Jackie Forester, Torey Garrett, Bret Graves, Robert Hanten, Harrold Hoffman, Dan Jost, Jason Jungwirth, Kim Kayler, Darla Kusser, Brad Richards, Jim Riis, Aaron Rumpca, Justin Sarvis, Sylvester Schied, Jason Sorensen, Jason Stahl, and Thomas Trimble.

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# EXECUTIVE SUMMARY

This report includes results of angler use and harvest and fish population surveys conducted during 2006 on Lake Oahe, South Dakota and references information collected during previous years. Discussion focuses on species that may be important from a sport perspective or as prey.

Age-0 gizzard shad were the most abundant species captured during the August seining survey, with a mean CPUE of 191 fish/haul. Age-0 gizzard shad were first collected in the annual seining survey in 2001 and have been the most abundant species in seining survey catches since 2003.

Channel catfish and walleye comprised 31% and 28% of the fish caught in the 2006 coolwater gill net survey, respectively. Channel catfish CPUE, for the 2002-2006 period, was similar among years with values ranging from 15.6 in 2003 to 20.7 in 2004 Walleye gill net CPUE for the entire reservoir in 2006 was similar to other years in the 2000-2006 period and significantly lower than from 1997 to 1999.

The relative stock density of preferred-length fish (RSD-P) management objective for walleye from the Lake Oahe Strategic Plan, of ≥10 for the total Oahe sample, was met in 2006 for the first year since 1997. While relative weight (*Wr*) values have generally been increasing since 2003, *Wr* values are still considerably lower than during the early and mid-1990's. Mean length at capture for age-1 through age-5 walleye was significantly higher in 2006 than during all years in the 2002-2005 period.

Age frequency distributions illustrate the continued presence of year classes produced in 1999, 2001, and 2005 in the 2006 Lake Oahe walleye population. Walleye production in 2006 appears to be low, based on an age-0 CPUE of 0.5 fish/net-night. Mean CPUE for age-1 fish (2005 year class) in the total Oahe sample was 4.9 fish/net-night, indicating moderate-to-high recruitment in 2005, primarily in the middle zone of the reservoir.

Estimated fishing pressure for the South Dakota portion of Lake Oahe for 2006, at 620,273 h, was similar to estimates for 2003 and 2004 and higher than the 2005 estimate. Estimated fishing pressure peaked in June and July 2006, at 430,232 hours, 69% of the fishing pressure for the months of April through October, a value similar to 2005 . As with fishing pressure, catch and harvest was highest in the months of June and July. The total catch estimate for June and July 2006, was 343,619 fish, 77% of the 442,659 caught during the April-October period.

Of the estimated 232,117 fish harvested from Oahe during the April-October 2006 daytime period, 201,554 (87%) were walleye. The walleye harvest during June and July comprised 76% (153,745) of the total walleye harvest during the April-October period in 2006. The mean hourly catch rate for walleye in 2006 was at 0.5 fish/angler-h, a value similar to 2004 and 2005 estimates.

Use of the Chinook salmon fishery in Lake Oahe was higher in 2006 than in recent years, in association with increases in angler catch rates for salmon. Mean catch rate of Chinook salmon by anglers specifically fishing for salmon were the same in 2005 and 2006, at 0.34 fish/angler-h. The percentage of angler parties interviewed that were specifically fishing for Chinook salmon increased to 13% in 2006, from values between 2% and 4% during the 2002-2005 period. Chinook salmon were not stocked during 2001 and 2002 as part of a program to decrease predator abundance and set the stage for an increase in smelt abundance.

Approximately 61% of angling parties interviewed during 2006 expressed some level of satisfaction with their fishing trip, a value lower than the Lake Oahe plan objective of 70%. For the April-October 2006 daytime period, the Lake Oahe fishery had a direct economic impact of 8.2 million dollars based on 134,258 trips at value of $61.00 per trip.

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## INTRODUCTION

Lake Oahe is an extremely important fisheries resource for the State of South Dakota, annually supporting between 87,000 and 339,000 angler trips during the 1991-2003 period (Lott et al. 2007). The Lake Oahe fishery had an estimated direct economic impact of over $25 million for the April-October 1998 daylight period, based on information provided by the United States Census Bureau (1998). Approximately 134,258 trips occurred during the April-October 2006 daylight period on Lake Oahe, for an estimated economic input of $8.2 million (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2003). Because of the importance of Lake Oahe fisheries resources to the State of South Dakota, these resources must be effectively managed to produce optimal recreational benefits. A prerequisite to the development of effective management strategies is the annual acquisition and analysis of data describing fish community and population parameters, angler use and harvest of these populations, and angler preference and satisfaction data. These surveys provide essential information used in the evaluation of accomplishments towards objectives of the South Dakota Department of Game, Fish and Parks (SDGF&P) Missouri River Program Strategic Plan (SDGF&P 1994) and more specifically, the Lake Oahe Strategic Plan (LOSP). This report also evaluates fisheries management activities (regulations and stocking) and effects of environmental variables (water levels, weather, etc.) on Lake Oahe fisheries.

## OBJECTIVES

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

1. species composition and relative abundance
2. population size structure
3. individual fish condition
4. age, growth, and recruitment
5. survival and mortality rates
6. fish reproduction
7. effects of regulations
8. success of stocking and other management activities
9. effects of sport fish harvest on fish population status

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

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

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

## STUDY AREA

Lake Oahe is a mainstem Missouri River storage reservoir located in north-central South Dakota, downstream from Lake Sakakawea and upstream of Lake Sharpe. Historical, biological, chemical, and physical parameters have been discussed in North Central Reservoir Investigation reports (June 1974; Selgeby and Jones 1974) and South Dakota Game, Fish and Parks reports (Warnick 1987). Table 1 presents selected physical characteristics and a fisheries-management classification for Lake Oahe in South Dakota (Michaletz et al. 1986). Sampling locations for the various surveys discussed in this report appear in Figure 1 and average elevation of Lake Oahe during August, the month the standard gill net and seining surveys are conducted, is provided in Figure 2.

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

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

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

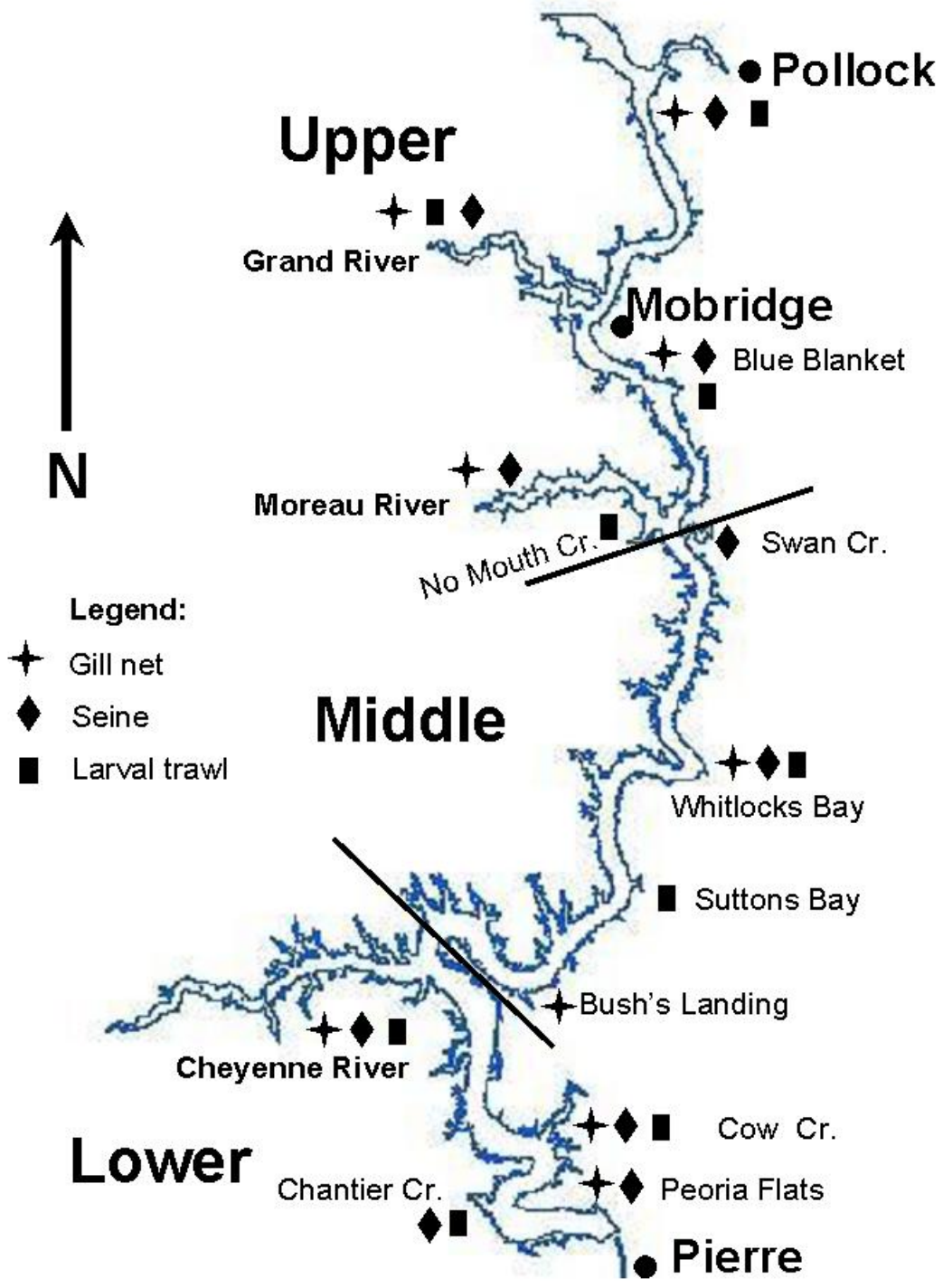


Figure 1. Reservoir zones for fish population and angler use and harvest surveys on Lake Oahe, South Dakota, for 2006. Specific fish population sampling stations are also listed.

## REGULATION HISTORY

Fish population and angler use and harvest survey data is essential when evaluating special management regulations. Walleye harvest regulations for Lake Oahe have differed from standard statewide regulations since 1990, when an April through June 14-inch minimum length limit was placed in effect on Lakes Oahe, Sharpe, and Francis Case and the daily limit was reduced from six to four fish (Table 2). A stipulation that at most one fish in the daily limit could be 18 inches or longer was also added to the walleye regulation package in 1999, and the April-June 14-inch minimum length limit was removed. The objectives of regulation changes for 1999 were to concentrate harvest on abundant walleye less than 381-mm (15 inches) in length, produced from 1994 through 1996, and to reduce harvest of larger walleye in the population, to maintain the quality of the fishery. The daily walleye limit was increased from four fish to 14 fish in 2001, with the objective of maximizing walleye harvest to reduce walleye abundance and precipitate an increase in rainbow smelt abundance by reducing predatory pressure on rainbow smelt.

Table 2. History of harvest regulations for walleye on Lake Oahe, South Dakota, 1968 through 2006.

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

The stipulation that at most four fish could be 381-mm (15 inches) or longer in the daily limit of 14 was aimed at concentrating harvest on walleye < 381-mm, which were in high abundance (Lott et al. 2002). The daily limit was reduced to 10 fish for 2002 and 2003 and six fish for 2004 and 2005 due to decreases in the walleye abundance index (catch per gill-net night) and in angler satisfaction. A decrease in percentage of anglers satisfied with their trip was associated with anglers not being able to realistically attain high daily limits, as hourly catch rates declined (Lott et al. 2002, 2003, 2004). The daily limit was reduced to the statewide daily limit of four fish beginning January 1, 2006 with a possession limit of 12 fish.

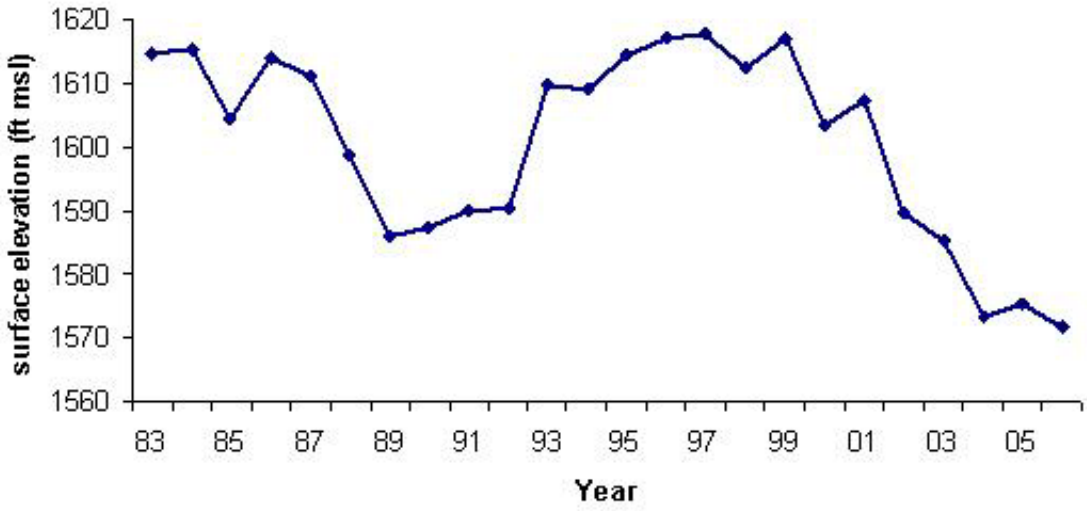


Figure 2. Average August elevation of Lake Oahe for the 1983-2006 period, as determined by the U.S. Army Corps of Engineers.

# SAMPLING METHODS

## FISH POPULATION SURVEYS

Data Collection

Gill nets, seines, larval trawls, and hydroacoustics were used to sample fish populations in Lake Oahe in 2006. Dates and depths of fish population surveys are presented in Table 3.

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

| Survey | Time | Survey gear | Sampling specifics |
|---|---|---|---|
| Coolwater gill net | August | Standard gill net | Three shallow (0-9 m) and three deep (9-18 m), at standardized locations, at each station |
| Shoreline seining | August | 30.5-m by 2.4-m bag seine, 6.4-mm mesh | Four quarter-arc pulls at each station |
| Larval trawling | May-June | 1-m x 2-m limnetic trawls, 0.5-mm mesh | Two paired trawl hauls/week for four consecutive weeks, of 5-minutes duration, at each station |
| Hydroacostics | August | Hydroacoustic equipment and midwater trawl | 20 transects covering the South Dakota portion of Lake Oahe |

The standard coolwater fish population survey consists of setting three standard gill nets, overnight (approximately 20 h), on the bottom, in each depth zone (where possible), for a total of six nets at each station (Table 3, Figure 1). A standard gill net of multifilament nylon was 91.4-m (300-ft) long x 1.8-m (6-ft) deep, with 15.2-m (50-ft) panels of the following bar mesh sizes: 12.7 mm (1/2 in), 19.1 mm (3/4 in), 25.4 mm (1 in), 31.8 mm (1 1/4 in), 38.1 mm (1 1/2 in), and 50.8 mm (2 in).

All walleye collected during the coolwater gill net survey were measured for total length (TL; mm) and weighed (g). Attempts were made to remove sagittal otoliths from all walleye, sauger, and hybrids captured, at each sampling station (Figure 1). A representative sample of at least 50 individuals per sampling station was measured and weighed for all other species, where possible.

A nylon, 6.4-mm (1/4-in) mesh bag seine, measuring 30.5-m (100-ft) long x 2.4-m (8-ft) deep, with a 1.8-m (6-ft) x 1.8-m (6-ft) bag, was used to collect age-0 fishes and small littoral species. A quarter-arc seine haul was accomplished using methods described in Martin et al. (1981). Four seine hauls were made at each sampling station (Figure 1). All fish collected with seines were identified, counted, and classified as age-0 or other. A seining station at Chantier Creek was added in 2001 because of concerns about the decreasing efficiency of seining at Peoria Flats, in association with low water levels (Figure 1).

Larval fish densities were estimated for Lake Oahe by sampling with paired limnetic larval trawls. Each trawl had a mesh size of 0.5 mm (bar measure), a 1-m x 2-m opening and was equipped with a flow meter. Trawling was performed at night. Each trawl haul lasted approximately five minutes. Two paired trawl hauls were made at each sampling station during each sampling event (Figure 1). Eight stations throughout Lake Oahe were sampled weekly during late May and early June of 2006. Pollock was not sampled during the 2004-2006 period due to low water conditions. All samples were preserved in 10% formalin and later identified and enumerated.

Hydroacoustic sampling transects are not listed in Figure 1 but 20 standard transects are sampled each year from the face of Oahe Dam to the North Dakota/South Dakota border. Specific locations of hydroacoustic transects are presented in Nelson-Stastny (2001) as are standard sampling and analysis procedures for this survey.

Data Analysis

Relative abundance of fish species was expressed as mean catch per unit effort (CPUE) for gill net (No./net night), and seine (No./haul) catches. Walleye CPUE for coolwater gill net samples was tested for differences within years and among areas within Lake Oahe (Figure 1) using a one-way analysis of variance (ANOVA) and the Least Squares Means (LSD) procedure (SYSTAT 1998; Sokal and Rohlf 1981). Walleye gill net CPUE was also tested within incremental length groups (Gablehouse 1984) among years using an ANOVA and LSD. Channel catfish CPUE was tested for differences among years using a one-way ANOVA and LSD. Standard error values about means were calculated for gill net and seining CPUE, as a measure of sample variance.

Age and growth analyses were conducted for walleye. Walleye otoliths from fish less than 300-mm were viewed and aged whole while submersed in water in a black dish with an overhead light source. For walleye greater than 300-mm, otoliths were cracked through the focus and charred using a propane torch prior to age interpretation to make annuli easier to distinguish. Growth was expressed as mean length at age at time of capture in August. Incremental growth rates were estimated by subtracting the mean length of fish from a year class at the time of capture in August from the mean length at capture of the same year class the previous year. Age distributions for gill-net catches were developed by assigning ages to all walleye captured during the survey, based on length-at-age-at-time-of-capture information. Walleye length at age at time of capture was tested for differences among years and reservoir zones using a one-way ANOVA and LSD. Correlation analysis of mean age-0 walleye gill net CPUE vs. mean age-1 walleye CPUE the following year, was conducted to determine if age-0 CPUE was an adequate early indicator of recruitment.

Proportional stock density (PSD; Anderson and Weithman 1978) and relative stock density (RSD) values were calculated for channel catfish, smallmouth bass, white bass, walleye and yellow perch (Gabelhouse 1984). Stock Density Index values were tested for differences among years using Chi-square analysis (Conover 1980). Length categories used to calculate PSD and RSD values are listed in Table 4.

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

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

Relative weight values (*Wr;* Anderson 1980) were calculated using standard-weight (*Ws*) equations developed for walleye (Murphy et al. 1990), yellow perch (Willis et al. 1991), channel catfish (Brown et al. 1995), and white bass (Brown and Murphy 1991). Calculated values for yellow perch and white bass are presented in Appendix 2, while values for walleye and channel catfish are presented in the results and discussion section of this report. Relative weight values for walleye were tested for differences among length-class designations using one-way ANOVA (SYSTAT 1998). Mean *Wr* for stock-length fish was reported when no significant differences were detected among length classes ($P<0.05$). All statistical tests were performed using a significance level of 0.05, unless otherwise stated. Proportional stock density, RSD, and *Wr* values were calculated using the WinFin software package developed by Francis (2000).

## ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

### Data Collection

Angler use and sport fish harvest surveys conducted on Lake Oahe are patterned after a study designed by Schmidt (1975) for Lake Sharpe. Sampling includes aerial boat and shore angler counts to estimate fishing pressure, and angler interviews at lake access areas to estimate harvest rates, catch rates, release rates, mean party size, mean angler day length, target species, and angler state of residency. Flight dates and interview dates were selected using a stratified random design based on the assumption of different levels of fishing pressure for weekdays, and weekend days and 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.

Sampling was conducted from April 1, 2006 through October 31, 2006, for the sunrise to sunset period. Creel zones are the same as fish population survey zones identified in Figure 1. Aerial pressure counts were made during all months. For a more detailed description of aerial count, angler interview, and data expansion techniques see Stone et al. (1994).

Angler satisfaction and attitude questions were included in angler interviews in 2006. Besides asking anglers how satisfied they were with their fishing trip, considering all factors, anglers were asked where they were staying on this trip and how often they use the fish cleaning stations when fishing the Missouri River system. A complete list of satisfaction, attitude and preference questions asked in conjunction with the 2006 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 (CAS) package (Soupir and Brown 2002) and 80% confidence intervals were calculated for estimates of fishing pressure and harvest.

# RESULTS AND DISCUSSION

## FISH POPULATION SURVEYS

Species Composition and Relative Abundance

Catch per unit effort has historically been used as an index of population abundance or density (Hubert 1996). However, changes in fish behavior can also affect CPUE of gill nets (Hubert 1996). Because Lake Oahe is a storage reservoir, the elevation of the reservoir surface, and therefore the surface area and volume of the reservoir, change over time and are not the same each August when the coolwater gill net survey is conducted. As an example, the average August surface elevation decreased from 1603.5 FT MSL in 2000 to 1571.6 FT MSL in 2006. The corresponding decreases in surface area and volume of Lake Oahe from 2000 to 2006 were 43,195 ha and 1.23 x $10^{10}$ $m^3$. Percent decreases in surface area and volume were 37% and 57%, respectively. Therefore, caution should be used when inferring density or abundance of fish species captured in the standard gill net survey from CPUE.

Channel catfish and walleye comprised 31% and 28% of the fish caught in the 2006 coolwater gill net survey, respectively (Table 5). Goldeye, yellow perch, freshwater drum, and gizzard shad were well represented in the net catch with each species comprising approximately 5-7% of the total sample. Twenty-two species comprised the coolwater survey gill net sample in both 2005 and 2006. Lake herring and rainbow smelt was caught in 2005, while bluegill and orange-spotted sunfish were captured in 2006 (Table 6). Channel catfish and walleye were the most abundant species in gill net catches, with mean CPUE values of 16.9 and 15.3 fish/net-night, respectively. Channel catfish CPUE, for the 2002-2006 period, was similar among years with values ranging from 15.6 in 2003 to 20.7 in 2004. Other species commonly captured in gill nets in 2006 included goldeye, gizzard shad, yellow perch, freshwater drum, and common carp, listed in order of decreasing mean CPUE (Table 6). White bass experienced a die off in the summer of 2005, but white bass CPUE has remained within the range of values seen before and has increase slightly from 0.4 fish/net night in 2005 to 1.1 fish/net-night in 2006 (Lott et al. 2007). Mean CPUE for all species collected in 2006 were within the ranges previously observed (Michaletz et al. 1986; Riis et al. 1988; Stone et al. 1989; Johnson et al. 1990; Wickstrom et al. 1991; Johnson et al. 1992; Wickstrom et al. 1993; Lott et al. 1994; Johnson et al. 1995, 1997, 1999; Lott et al. 2000, 2002, 2004, 2007).

Table 5. Relative species composition, by percent of total catch, of fish species collected during August standard gill net survey on Lake Oahe, South Dakota, during 2002 through 2006. Trace (T) for values < 0.5 %.

| Species | Year | | | | |
|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2005 | 2006 |
| Channel catfish | 37.3 | 35.1 | 41.8 | 33.5 | 31.0 |
| Walleye | 35.8 | 31.0 | 32.1 | 29.9 | 28.1 |
| Gizzard shad | T | 3.7 | 5.5 | 18.0 | 7.0 |
| Freshwater drum | 2.0 | 3.5 | 4.2 | 3.6 | 5.4 |
| River carpsucker | 2.5 | 2.9 | 3.4 | 3.5 | 1.2 |
| Yellow perch | 4.3 | 5.5 | 3.3 | 2.9 | 6.6 |
| Common carp | 2.1 | 2.4 | 2.4 | 2.3 | 4.4 |
| Goldeye | 2.1 | 4.7 | 2.3 | 2.2 | 7.1 |
| White bass | 6.0 | 6.7 | 1.7 | 0.7 | 2.0 |
| Other | 7.7 | 4.4 | 3.4 | 3.6 | 7.2 |

Table 6. Mean catch per unit effort (CPUE; No./net-night) and standard error values (SE) for fish species collected with standard coolwater gill net sets in Lake Oahe, South Dakota, 2002-2006. Trace (T) indicates values less that 0.05.

| Species | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
| | CPUE | SE | CPUE | SE | CPUE | SE | CPUE | SE | CPUE | SE |
| | | | | | | | | | | |
| Bigmouth buffalo | 0.1 | T | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Burbot | 0.0 | --- | 0.0 | --- | T | T | 0.0 | --- | 0.0 | --- |
| Black bullhead | 0.0 | --- | T | --- | 0.1 | 0.1 | T | --- | T | --- |
| Channel catfish | 19.1 | 2.3 | 15.6 | 1.4 | 20.7 | 1.7 | 20.5 | 1.8 | 16.9 | 2.4 |
| Chinook salmon | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Common carp | 1.1 | 0.2 | 1.1 | 0.2 | 1.2 | 0.2 | 1.4 | 0.2 | 2.4 | 0.4 |
| Freshwater drum | 1.0 | 0.2 | 1.6 | 0.3 | 2.1 | 0.3 | 2.2 | 0.5 | 2.9 | 0.5 |
| Gizzard shad | 0.2 | 0.1 | 1.6 | 0.5 | 1.7 | 0.6 | 11.0 | 2.5 | 3.8 | 1.5 |
| Goldeye | 1.1 | 0.5 | 2.1 | 0.5 | 0.9 | 0.2 | 1.3 | 0.3 | 3.9 | 0.8 |
| Lake herring | 0.1 | T | 0.0 | --- | 0.0 | --- | 0.1 | 0.1 | 0.0 | --- |
| Northern pike | 0.2 | 0.1 | 0.2 | 0.1 | 0.1 | T | T | --- | 0.1 | T |
| Rainbow smelt | 0.1 | 0.1 | T | --- | T | T | T | --- | 0.0 | --- |
| River carpsucker | 1.3 | 0.3 | 1.3 | 0.2 | 1.1 | 0.2 | 2.1 | 0.6 | 0.6 | 0.1 |
| Sauger | 0.2 | 0.1 | 0.1 | T | 0.3 | 0.1 | 0.3 | 0.1 | 1.4 | 0.4 |
| Shorthead redhorse | 1.7 | 0.5 | 0.7 | 0.2 | 0.4 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 |
| Shortnose gar | 0.1 | 0.1 | T | --- | 0.1 | T | T | --- | T | T |
| Shovelnose sturgeon | T | T | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Smallmouth bass | 0.5 | 0.1 | 0.3 | 0.1 | 0.1 | T | 0.9 | 0.4 | 1.0 | 0.5 |
| Smallmouth buffalo | 0.2 | 0.1 | 0.1 | T | T | T | 0.1 | --- | T | T |
| Spottail shiner | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | --- | 0.5 | 0.2 |
| Walleye | 18.3 | 2.4 | 13.8 | 1.5 | 15.9 | 1.5 | 18.2 | 2.1 | 15.3 | 1.9 |
| White bass | 3.1 | 0.7 | 3.0 | 0.8 | 1.6 | 0.3 | 0.4 | 0.1 | 1.1 | 0.3 |
| White crappie | 0.2 | 0.1 | 0.1 | T | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.1 |
| White sucker | 0.4 | 0.1 | T | --- | 0.1 | T | T | -- | T | T |
| Yellow perch | 2.2 | 0.5 | 2.4 | 0.7 | 2.7 | 0.7 | 1.7 | 0.4 | 3.6 | 0.9 |
| | | | | | | | | | | |

Age-0 gizzard shad were the most abundant species captured during the August seining survey, with a mean CPUE of 191 fish/haul (Table 7). Age-0 gizzard shad were first collected in the annual seining survey in 2001 and have been the most abundant species in seining survey catches since 2003. Other species commonly sampled during the 2006 seining survey included emerald shiners, white bass, yellow perch, and spottail shiner, in order of decreasing mean CPUE.

Table 7. Mean catch per unit effort (CPUE; No./haul) and standard error (SE) values for fish species collected during the standard August seining survey on Lake Oahe, South Dakota. Catches are for age-0 fishes except where noted. Trace (T) indicates values less than 0.05.

| Species | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
| | CPUE | SE | CPUE | SE | CPUE | SE | CPUE | SE | CPUE | SE |
| | | | | | | | | | | |
| Bigmouth buffalo | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.1 | T |
| Black crappie | 0.1 | 0.1 | 0.0 | --- | 0.0 | --- | 0.0 | --- | T | --- |
| Bluntnose minnow | 0.0 | --- | 0.0 | --- | 1.1 | 0.7 | 0.0 | --- | 0.4 | 0.4 |
| Brassy minnow* | 0.0 | --- | 0.0 | --- | 0.5 | 0.3 | T | T | 0.1 | T |
| Channel catfish | 0.1 | 0.1 | 0.1 | T | 0.1 | 0.1 | 2.0 | 1.2 | 0.1 | 0.1 |
| Common carp | 1.9 | 1.9 | 0.1 | T | 0.0 | -- | 1.6 | 0.6 | 0.3 | 0.2 |
| Emerald shiner* | 50.0 | 20.8 | 35.0 | 3.6 | 43.8 | 22.1 | 23.3 | 15.3 | 26.1 | 6.4 |
| Fathead minnow* | 0.0 | --- | 1.2 | 0.3 | 0.0 | --- | 0.2 | 0.1 | 0.0 | --- |
| Flathead chub | 0.1 | 0.1 | 0.0 | --- | 0.0 | --- | 0.0 | --- | 6.8 | 3.9 |
| Freshwater drum | 21.6 | 14.1 | 2.9 | 0.5 | 2.7 | 1.0 | 5.1 | 1.4 | 3.8 | 1.1 |
| Gizzard shad | 46.2 | 27.3 | 322.2 | 41.1 | 500.0 | 173.0 | 83.8 | 33.6 | 191.0 | 41.8 |
| Golden shiner | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Goldeye | 0.0 | --- | T | T | 0.3 | 0.2 | 1.0 | 0.9 | 0.0 | --- |
| Johnny darter* | 0.1 | T | 0.5 | 0.1 | 0.3 | 0.1 | 0.1 | T | 0.1 | T |
| Lake herring | 0.0 | --- | 0.0 | --- | 0.1 | T | 0.0 | --- | 0.0 | --- |
| Largemouth bass | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Northern pike | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| River carpsucker | 0.1 | 0.1 | 0.2 | T | 0.2 | 0.2 | 4.2 | 3.0 | 4.8 | 3.5 |
| Red shiner* | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Shorthead redhorse | 0.0 | --- | 0.1 | T | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Silvery minnow | 2.1 | 1.9 | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Smallmouth bass | 0.9 | 0.3 | 0.2 | T | 1.6 | 0.7 | 2.7 | 0.6 | 3.5 | 0.9 |
| Smallmouth buffalo | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Spottail shiner* | 14.5 | 5.9 | 24.5 | 2.5 | 9.3 | 4.2 | 1.8 | 0.6 | 10.4 | 3.2 |
| Suckermouth minnow* | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- | 0.0 | --- |
| Walleye | T | T | 0.1 | T | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 | 0.1 |
| White bass | 21.0 | 7.3 | 46.3 | 7.9 | 15.2 | 5.1 | 4.1 | 0.9 | 21.6 | 5.3 |
| White crappie | 0.1 | 0.1 | 0.1 | T | T | T | 0.0 | --- | 0.1 | 0.1 |
| White sucker | 0.0 | --- | 0.5 | 0.1 | 0.1 | T | 0.1 | 0.1 | 0.1 | 0.1 |
| Yellow perch | 0.5 | 0.3 | 4.2 | 0.8 | 1.4 | 0.7 | 2.1 | 0.9 | 11.4 | 6.8 |
| | | | | | | | | | | |

* Includes all ages.

Population Parameters for Walleye

Walleye CPUE in the standard gill net survey was significantly higher in middle Lake Oahe than in lower Lake Oahe during 2006 (Table 8). During many years in the 1997-2006 period, the upper zone had a significantly higher CPUE then the lower and middle zones, except for 1998, 2003, 2005 and 2006. During 1998, CPUE in all zones were similar. The middle zone was similar to the upper zone in 2003, while during 2005, the middle zone was similar to the upper and lower zones.

One factor that may be impacting walleye abundance index (CPUE) estimates for the various reservoir zones is the low surface water elevation of Lake Oahe in 2006. The upper end of the South Dakota portion of the reservoir, near Pollock, SD, resembled a river more than a lake during August 2006 sampling efforts. Changes in surface area, volume, and flow may greatly influence catch rates of walleye and other species in standard fish population surveys. An example of this is the mean CPUE of sauger in the standard coolwater gill net survey. Mean sauger CPUE increased from 0.3. fish/net-night in 2005 to 1.4 fish/net-night in 2006 (Table 6), possibly because changes in the Missouri River system caused downstream movement of these fish from the Missouri River above Lake Oahe to Lake Oahe.

Table 8. Mean walleye catch per unit effort (No./net-night) in the coolwater gill net survey for lower, middle, and upper zones of Lake Oahe, South Dakota, 1997-2006. Values within a year with no letters in common are significantly different at the *P*<0.05 level of significance. Comparisons were only made among zones, within years.

| Year | Zone | | | |
|---|---|---|---|---|
| | Lower | Middle | Upper | Total |
| 1997 | 21.5a | 22.1a | 31.6b | 25.2a |
| 1998 | 23.4a | 19.3a | 21.1a | 20.3ab |
| 1999 | 17.4a | 17.9a | 29.3b | 21.4ac |
| 2000 | 13.1a | 17.6a | 27.4b | 19.3bcd |
| 2001 | 8.9a | 9.1a | 26.6b | 14.8d |
| 2002 | 9.7a | 12.5a | 32.8b | 18.3bcde |
| 2003 | 9.7a | 16.6b | 14.9b | 13.8e |
| 2004 | 11.7a | 11.7a | 24.2b | 15.9bde |
| 2005 | 12.5a | 15.9ab | 26.3b | 18.2de |
| 2006 | 9.4a | 21.6b | 14.8ab | 15.3de |

Walleye gill net CPUE for the entire reservoir in 2006 was similar to other years in the 2000-2006 period and significantly lower than from 1997 to 1999 (Table 9). While overall CPUE of walleye has been similar the last seven years, differences in CPUE of the various incremental length groups exist. Substock walleye CPUE was significantly lower during the 2004-2006 period when compared to the 1997-2000 period and 2002. Stock-to-quality-length walleye CPUE was also lower during the 2005-2006 period when compared to the 1997-2004 period, while walleye CPUE for the preferred-length fish during 2006 was similar to 1997, but higher than all years in the 1998-2005 period (Table 9).

Walleye population size structure, as quantified with stock density indices, differed significantly among years in the 1997-2006 period (Table 10). Proportional stock density values for lower and upper Lake Oahe, for 2005 and 2006, were not significantly different, while PSD for middle Lake

Oahe and for the total sample decreased from 2005 to 2006 (Table 10). Relative stock density of preferred-length fish for 2005 and 2006 was higher for lower Oahe than the other two zones or the overall sample. Higher PSD and RSD-P values for lower Lake Oahe when compared to the other two zones is partially related to lower recruitment in that zone (Lott et al. 2004). Walleye PSD for the total Oahe sample in 2006, at 60, was at the upper end of the desired range of 30-60, signifying a balanced population (Anderson and Weithman 1978). The RSD-P objective from the LOSP of ≥10 for the total Oahe sample was met in 2006 for the first year since 1997.

Table 9. Mean walleye catch per unit effort (No./net-night) in the standard coolwater gill net survey, by year and length group, for 1997-2006, for Lake Oahe, South Dakota. Values within length groups, among years, with no letters in common, are significantly different at the $P<0.05$ level of significance. Comparisons were only made within length groups among years.

| Year | Length group | | | | |
|---|---|---|---|---|---|
| | Substock | Stock-quality | Quality-preferred | Preferred- | Total |
| 1997 | 10.5a | 9.2a | 2.7a | 2.8a | 25.2a |
| 1998 | 5.9b | 12.1a | 1.3b | 1.1b | 20.3ab |
| 1999 | 2.9ce | 15.9bc | 1.7b | 0.9b | 21.4ac |
| 2000 | 4.0bc | 13.4ac | 1.5b | 0.4c | 19.3bcd |
| 2001 | 2.5cd | 9.9d | 2.1bc | 0.3cd | 14.8d |
| 2002 | 4.7be | 7.2d | 5.5d | 1.0cd | 18.3bcde |
| 2003 | 2.2cd | 7.0d | 3.0ace | 1.6bd | 13.8e |
| 2004 | 1.0f | 10.2a | 4.1ade | 0.6bd | 15.9bde |
| 2005 | 1.4f | 5.1e | 10.7f | 1.0b | 18.2de |
| 2006 | 2.4df | 5.1e | 6.0d | 1.7a | 15.3de |

Table 10. Walleye proportional stock density (PSD) and relative stock density of preferred-length (RSD-P) and memorable-length (RSD-M) fish, by reservoir zone, for fish collected during the standard coolwater gill net survey on Lake Oahe, South Dakota, 1997-2006

| Year | Zone | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lower | | | Middle | | | Upper | | | Total | | |
| | PSD | RSD-P | RSD-M | PSD | RSD-P | RSD-M | PSD | RSD-P | RSD-M | PSD | RSD-P | RSD-M |
| 1997 | 49 | 11 | 1 | 22 | 10 | 2 | 35 | 10 | 0 | 35 | 10 | 1 |
| 1998 | 27 | 9 | 1 | 13 | 2 | 0 | 4 | 2 | 0 | 16 | 5 | 1 |
| 1999 | 26 | 4 | 1 | 20 | 6 | 2 | 3 | 1 | 0 | 15 | 3 | 1 |
| 2000 | 19 | 0 | 0 | 11 | 2 | 1 | 12 | 0 | 0 | 14 | 1 | 0 |
| 2001 | 30 | 4 | 1 | 20 | 3 | 2 | 16 | 0 | 0 | 20 | 2 | 1 |
| 2002 | 58 | 1 | 0 | 44 | 3 | 1 | 47 | 0 | 0 | 49 | 1 | 0 |
| 2003 | 57 | 12 | 1 | 31 | 4 | 0 | 38 | 1 | 0 | 40 | 5 | 0 |
| 2004 | 67 | 13 | 1 | 31 | 2 | 0 | 20 | 1 | 0 | 34 | 4 | 0 |
| 2005 | 97 | 18 | 0 | 52 | 3 | 0 | 65 | 2 | 0 | 70 | 6 | 0 |
| 2006 | 92 | 32 | 0 | 34 | 4 | 0 | 56 | 5 | 0 | 60 | 13 | 1 |

Walleye *Wr* values for quality-to-preferred and preferred-length walleye in lower Lake Oahe were higher than in middle or upper Oahe in 2006 (Table 11). While *Wr* values during the 1997-2006 period have generally been increasing since 2003, *Wr* values are still considerably lower than during the early and mid-1990's (Johnson et al. 1995). The objective range for mean *Wr* values for Lake Oahe walleye is 90-100 (LOSP 1994). While mean *Wr* values are not currently within the objective range, condition has improved since 2002 (Table 11).

Table 11. Mean walleye relative weight (*Wr*) values, by length group and reservoir zone, for Lake Oahe, South Dakota, 1997-2006. N is number of stock-length fish in a sample. Within length groups, values with the same letter code are not significantly different at the $P<0.05$ level of significance.

| Zone/Year | Length group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Stock-quality | | Quality-preferred | | Preferred | | Total sample | |
| | *Wr* | N | *Wr* | N | *Wr* | N | *Wr* | N |
| **Lower** | | | | | | | | |
| 1997 | 88a | 177 | 88ab | 131 | 87ab | 36 | 88a | 344 |
| 1998 | 81b | 255 | 81cd | 66 | 80c | 30 | 81b | 351 |
| 1999 | 79c | 220 | 80c | 67 | 71d | 11 | 79c | 298 |
| 2000 | 77d | 171 | 78c | 39 | 68cd | 1 | 77c | 211 |
| 2001 | 83ef | 105 | 84de | 39 | 81bce | 6 | 84d | 150 |
| 2002 | 82be | 61 | 81ce | 81 | 84acde | 2 | 82b | 144 |
| 2003 | 85ef | 64 | 86ae | 68 | 85ace | 18 | 85e | 150 |
| 2004 | 85ef | 70 | 87ae | 112 | 89ae | 27 | 87e | 209 |
| 2005 | 81bcdef | 7 | 90b | 176 | 87ae | 41 | 89a | 224 |
| 2006 | 80bef | 9 | 93f | 95 | 88a | 65 | 91f | 169 |
| **Middle** | | | | | | | | |
| 1997 | 79a | 200 | 78ac | 33 | 81a | 25 | 79a | 258 |
| 1998 | 76b | 182 | 79bc | 23 | 75ab | 5 | 77b | 210 |
| 1999 | 81ac | 223 | 80bc | 39 | 72b | 17 | 80ac | 279 |
| 2000 | 75b | 240 | 75a | 24 | 68b | 4 | 75b | 268 |
| 2001 | 81cd | 103 | 83c | 21 | 76ab | 5 | 81d | 129 |
| 2002 | 82cd | 104 | 81bc | 75 | 83ac | 6 | 82cd | 185 |
| 2003 | 82dg | 148 | 85c | 69 | 79a | 9 | 83d | 226 |
| 2004 | 88e | 130 | 90d | 55 | 84ac | 4 | 89e | 189 |
| 2005 | 86f | 105 | 88de | 108 | 82ab | 6 | 87f | 220 |
| 2006 | 84g | 172 | 87e | 94 | 87c | 17 | 85f | 283 |
| **Upper** | | | | | | | | |
| 1997 | 80a | 175 | 79a | 51 | 82a | 26 | 80ad | 252 |
| 1998 | 80ad | 247 | 80abegh | 3 | 76bc | 6 | 79ad | 256 |
| 1999 | 83b | 428 | 83b | 11 | 77abc | 4 | 83b | 443 |
| 2000 | 80a | 316 | 75cg | 43 | 73abc | 1 | 79a | 360 |
| 2001 | 87c | 334 | 85dh | 62 | -- | -- | 87cf | 396 |
| 2002 | 79ad | 217 | 78a | 196 | -- | -- | 79d | 413 |
| 2003 | 79d | 132 | 75ce | 70 | 68c | 2 | 78e | 204 |
| 2004 | 87c | 325 | 85bd | 78 | 82ab | 3 | 87c | 406 |
| 2005 | 88c | 162 | 88f | 286 | 84a | 8 | 88f | 456 |
| 2006 | 86e | 95 | 84bd | 136 | 83a | 11 | 85g | 242 |
| **Total** | | | | | | | | |
| 1997 | 82a | 552 | 84a | 215 | 84a | 87 | 83a | 854 |
| 1998 | 79b | 684 | 81cd | 92 | 79b | 41 | 79b | 817 |
| 1999 | 81cd | 871 | 80cd | 117 | 72c | 32 | 81c | 1020 |
| 2000 | 78e | 727 | 76b | 106 | 69c | 6 | 78d | 839 |
| 2001 | 85f | 542 | 85a | 122 | 78ab | 11 | 85e | 675 |
| 2002 | 81c | 382 | 80c | 352 | 83abd | 8 | 80cf | 742 |
| 2003 | 81ad | 344 | 82d | 207 | 82abd | 29 | 82ag | 580 |
| 2004 | 87g | 525 | 87e | 245 | 88d | 34 | 87h | 804 |
| 2005 | 87hi | 274 | 88g | 570 | 86ad | 55 | 88hi | 900 |
| 2006 | 85ej | 276 | 88f | 325 | 87d | 93 | 86ej | 694 |

Otoliths were first used as an aging structure for walleye in Lake Oahe in 2002. Scales were not used as an aging structure after 2003 because of higher aging precision for otoliths than scales (Erickson 1983; Marwitz and Hubert 1995; Isermann et al. 2003) and because scales may result in under-aging fish longer than 400-mm on Lake Oahe (Lott et al. 2004).

Mean walleye length-at-age-at-time-of-capture values for 2002-2006 are presented in Table 12. Mean length at capture for ages through age-5 was significantly higher in 2006 than during the 2002-2005 period (Table 12). In 2006, walleye from age 0 to age 16 where collected during the Lake Oahe August gill net survey. The time period from one August gill-net survey to the following August survey is considered a growth period. Higher mean lengths of fish collected during 2006 are the result of faster growth of all year classes produced after a time period of slower growth from approximately 1998-2002 (Lott et al. 2002).

Table 12. Mean length-at age time of capture (mm) for walleye collected in the standard August coolwater gill net survey, 2002-2006, on Lake Oahe, South Dakota.

| Year | | Length at age at capture (mm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **2002** | **Mean** | 227 | 322 | 373 | 393 | 412 | 412 | 435 | 450 | | | | |
| | **N** | 97 | 87 | 121 | 45 | 58 | 45 | 65 | 5 | | | | |
| | **SE** | 2 | 3 | 2 | 5 | 5 | 6 | 7 | 24 | | | | |
| **2003** | **Mean** | 229 | 284 | 371 | 409 | 424 | 451 | 441 | 454 | 496 | | | |
| | **N** | 77 | 295 | 60 | 87 | 26 | 28 | 44 | 69 | 7 | | | |
| | **SE** | 2 | 2 | 6 | 4 | 8 | 9 | 8 | 7 | 37 | | | |
| **2004** | **Mean** | 243 | 320 | 359 | 406 | 440 | 468 | 470 | 485 | 492 | 522 | 605 | 580 |
| | **N** | 61 | 144 | 347 | 57 | 51 | 15 | 22 | 28 | 29 | 14 | 2 | 1 |
| | **SE** | 4 | 3 | 2 | 6 | 6 | 15 | 9 | 11 | 12 | 17 | 25 | -- |
| **2005** | **Mean** | 234 | 348 | 403 | 424 | 441 | 492 | 484 | 492 | 514 | 525 | 450 | 435 |
| | **N** | 91 | 185 | 115 | 399 | 48 | 43 | 24 | 5 | 12 | 25 | 3 | 1 |
| | **SE** | 3 | 2 | 3 | 2 | 6 | 9 | 11 | 15 | 15 | 12 | 35 | -- |
| **2006** | **Mean** | 256 | 355 | 427 | 461 | 479 | 484 | 524 | 528 | 550 | 549 | 540 | 544 |
| | **N** | 203 | 123 | 102 | 102 | 146 | 20 | 28 | 10 | 7 | 5 | 17 | 8 |
| | **SE** | 2 | 2 | 3 | 3 | 3 | 12 | 8 | 17 | 20 | 27 | 20 | 22 |
| **Mean of means** | | 238 | 326 | 387 | 419 | 439 | 461 | 471 | 482 | 513 | 532 | 532 | 520 |

While differences existed in walleye length at age at capture among years, differences also existed within years among reservoir zones and among years within reservoir zones. A general trend exists where mean length at age at capture, in August, decreases from lower to upper Lake Oahe. Length at capture of age-1 to age-6 walleye in the 2006 gill net survey was higher for walleye collected from lower Lake Oahe than walleye collected from middle and upper Lake Oahe (Table 13). Growth increments of walleye from age 1 to age 2 have continued to increase from 57-mm additional growth for the 2002-2003 period to 121-mm for the 2005-2006 period (Table 14). Comparing additional growth from the 2002-2003 growth period to the 2005-2006 period, growth increments continue to increase through the age-4-to-age-5 group. Growth increments for age-5-to-age-6 period and for the age-6-to-age-7 period were similar for the 2002-2003 and the

2005-2006 samples (Table 14). Another way to analyze incremental growth is by comparing new length added during a growth period to initial length at the beginning of the growth period. This is illustrated in Figure 3. Comparisons of 2004-2005 and 2005-2006 growth period data in Figure 3 illustrates the fact that larger walleye were adding more length during the 2005-2006 period than during the 2004-2005 period.

Table 13. Mean length (TL; mm) at time of capture, by reservoir zone, for walleye collected in the coolwater gill net survey from 2004 through 2006, in Lake Oahe, South Dakota. N is sample size and SE is standard error.

| Zone | Age | 2004 | | | 2005 | | | 2006 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Length | N | SE | Length | N | SE | Length | N | SE |
| **Lower** | **1** | 281 | 13 | 4.5 | -- | -- | -- | 289 | 7 | 7.8 |
| | **2** | 359 | 42 | 3.7 | 391 | 12 | 3.8 | 386 | 9 | 6.8 |
| | **3** | 401 | 71 | 3.8 | 438 | 21 | 3.8 | 456 | 25 | 4.8 |
| | **4** | 437 | 11 | 12.9 | 463 | 58 | 3.2 | 487 | 20 | 7.9 |
| | **5** | 484 | 13 | 6.7 | 493 | 10 | 11.7 | 502 | 49 | 4.2 |
| | **6** | 481 | 6 | 29.3 | 531 | 13 | 11.2 | 530 | 8 | 13.3 |
| | **7** | 477 | 10 | 12.1 | 478 | 5 | 8.9 | 529 | 17 | 10.3 |
| | **8** | 509 | 19 | 11.7 | 512 | 1 | -- | 537 | 8 | 20.7 |
| | **9** | 521 | 14 | 16.8 | 511 | 2 | 45.5 | 562 | 6 | 19.3 |
| | **10** | 544 | 7 | 21.1 | 553 | 7 | 15.5 | 549 | 5 | 27.1 |
| | **11** | 605 | 2 | 24.5 | 520 | 1 | -- | 566 | 11 | 19.9 |
| | **12** | -- | -- | -- | -- | -- | -- | 552 | 2 | 49.5 |
| **Middle** | **1** | 232 | 22 | 5.8 | 224 | 68 | 2.5 | 245 | 126 | 2.8 |
| | **2** | 309 | 59 | 4.4 | 341 | 83 | 2.6 | 351 | 77 | 2.6 |
| | **3** | 367 | 90 | 2.5 | 403 | 44 | 3.4 | 422 | 33 | 4.6 |
| | **4** | 426 | 12 | 12.3 | 425 | 67 | 3.6 | 454 | 20 | 6.8 |
| | **5** | 461 | 5 | 10.6 | 445 | 1 | -- | 487 | 34 | 5.5 |
| | **6** | 471 | 5 | 22.1 | 502 | 5 | 11.6 | 508 | 1 | -- |
| | **7** | 478 | 6 | 17.2 | 544 | 3 | 53.1 | 525 | 7 | 20.6 |
| | **8** | 448 | 2 | 7.5 | 520 | 1 | -- | 491 | 1 | -- |
| | **9** | 484 | 7 | 13.7 | 500 | 4 | 19.2 | 478 | 1 | -- |
| | **10** | 516 | 3 | 56.5 | 504 | 3 | 13.4 | --- | -- | -- |
| | **11** | -- | -- | -- | -- | -- | -- | 591 | 2 | 69.5 |
| | **12** | 580 | 1 | -- | -- | -- | -- | 544 | 5 | 32.7 |
| **Upper** | **1** | 233 | 26 | 3.0 | 262 | 23 | 3.3 | 271 | 70 | 2.9 |
| | **2** | 296 | 43 | 4.0 | 348 | 90 | 3.0 | 357 | 37 | 2.5 |
| | **3** | 340 | 186 | 1.7 | 388 | 50 | 3.6 | 414 | 44 | 3.3 |
| | **4** | 389 | 34 | 5.8 | 415 | 274 | 2.2 | 436 | 15 | 8.6 |
| | **5** | 420 | 33 | 5.3 | 427 | 37 | 4.4 | 446 | 63 | 4.7 |
| | **6** | 447 | 4 | 29.6 | 470 | 25 | 11.3 | 448 | 11 | 9.2 |
| | **7** | 449 | 6 | 20.9 | 475 | 16 | 11.2 | 503 | 4 | 21.3 |
| | **8** | 431 | 7 | 10.6 | 476 | 3 | 19.5 | 494 | 1 | -- |
| | **9** | 447 | 8 | 19.4 | 524 | 6 | 26.5 | --- | -- | -- |
| | **10** | 488 | 4 | 18.6 | 516 | 15 | 17.7 | --- | -- | -- |
| | **11** | -- | -- | -- | 415 | 2 | 8.0 | 442 | 4 | 8.9 |
| | **12** | -- | -- | -- | 435 | 1 | -- | 527 | 1 | -- |

Table 14. Mean annual growth (length) increment estimates for walleye collected in the coolwater gill net survey on Lake Oahe, South Dakota, for the 2002-2003, 2003-2004, 2004-2005, and 2005-2006 periods.

| Year | Growth increment added during period (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 |
| 2002-2003 | 57 | 49 | 36 | 31 | 39 | 29 | 19 | 46 | -- |
| 2003-2004 | 91 | 75 | 35 | 31 | 44 | 19 | 44 | 38 | 26 |
| 2004-2005 | 105 | 83 | 65 | 35 | 52 | 16 | 22 | 29 | 33 |
| 2005-2006 | 121 | 79 | 58 | 55 | 43 | 32 | 44 | 58 | 35 |

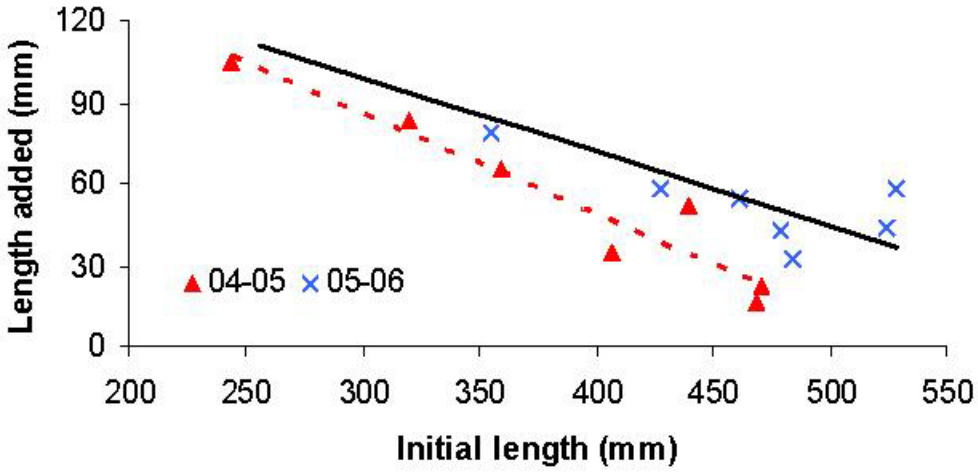


Figure 3. Mean length added by walleye in an age group during a growth period plotted against mean initial-length-at-age-values for the beginning of the growth period, for walleye collected from Lake Oahe, South Dakota during annual August gill net surveys. Trendlines for the 04-05 (dashed line) and 05-06 (solid line) growth periods are included.

Age frequency distributions illustrate the continued presence of year classes produced in 1999 2001, and 2005 in the 2006 Lake Oahe walleye population (Table 15). Walleye production in 2006 appears to be low, based on an age-0 CPUE of 0.5 fish/net-night (Table 15). Approximately 32% of walleye captured during the 2006 gill net survey were from the 2005 year class and almost all these fish were captured in middle Oahe. Mean CPUE for age-1 fish (2005 year class) in the total Oahe sample was 4.9 fish/net-night, but for middle Oahe, mean CPUE of age-1 fish was 10.4 fish/net-night. Walleye from the 2001, 2003, and 2004 year classes were also well represented in gill net catches, accounting for 46% of the total gill net catch, as a group (Table 15). Age-0 walleye were only present in gill net samples from lower Oahe during one year in the 2002-2006 period, signifying low reproduction of walleye in this portion of the reservoir.

Table 15. Age distribution of walleye collected from Lake Oahe, South Dakota, with standard coolwater gill net sets, by reservoir zone, as determined by aging otoliths. Mean age excludes age-0 fish. Year refers to walleye year class, CPUE is catch per unit effort (No./net-night), and T (trace) indicates values <0.05.

| 2002 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Year** | **02** | **01** | **00** | **99** | **98** | **97** | **96** | **95** | **94** | **93** | **92** | **91** | **90** |
| **Low** | 0 | 32 | 7 | 49 | 30 | 25 | 23 | 5 | 2 | 0 | 0 | 0 | 0 |
| **Mid** | 0 | 31 | 39 | 44 | 49 | 31 | 16 | 11 | 1 | 1 | 0 | 0 | 0 |
| **Up** | 3 | 128 | 135 | 137 | 48 | 44 | 23 | 25 | 5 | 0 | 0 | 0 | 0 |
| **Total** | 3 | 193 | 176 | 227 | 136 | 104 | 63 | 38 | 8 | 1 | 0 | 0 | 0 |
| **CPUE** | 0.1 | 3.5 | 3.3 | 4.2 | 2.5 | 1.9 | 1.2 | 0.7 | 0.1 | T | 0.0 | 0.0 | 0.0 |

| 2003 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Year** | **03** | **02** | **01** | **00** | **99** | **98** | **97** | **96** | **95** | **94** | **93** | **92** | **91** |
| **Low** | 5 | 27 | 53 | 15 | 19 | 7 | 10 | 13 | 22 | 3 | 1 | 0 | 0 |
| **Mid** | 1 | 31 | 176 | 18 | 31 | 9 | 8 | 11 | 14 | 0 | 0 | 1 | 0 |
| **Up** | 7 | 21 | 102 | 25 | 36 | 10 | 10 | 20 | 34 | 4 | 0 | 0 | 0 |
| **Total** | 13 | 85 | 321 | 61 | 87 | 26 | 28 | 44 | 70 | 7 | 1 | 1 | 0 |
| **CPUE** | 0.2 | 1.6 | 6.0 | 1.1 | 1.6 | 0.5 | 0.5 | 0.8 | 1.3 | 0.1 | T | T | 0.0 |

| 2004 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Year** | **04** | **03** | **02** | **01** | **00** | **99** | **98** | **97** | **96** | **95** | **94** | **93** | **92** |
| **Low** | 0 | 15 | 44 | 74 | 11 | 13 | 5 | 11 | 17 | 14 | 6 | 2 | 0 |
| **Mid** | 0 | 22 | 61 | 92 | 11 | 4 | 5 | 5 | 2 | 6 | 3 | 0 | 1 |
| **Up** | 0 | 27 | 50 | 258 | 42 | 33 | 4 | 5 | 7 | 6 | 3 | 0 | 0 |
| **Total** | 0 | 63 | 171 | 411 | 62 | 52 | 15 | 23 | 28 | 29 | 14 | 2 | 1 |
| **CPUE** | 0.0 | 1.2 | 3.2 | 7.6 | 1.1 | 0.9 | 0.3 | 0.4 | 0.5 | 0.5 | 0.2 | 0.0 | 0.0 |

| 2005 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Year** | **05** | **04** | **03** | **02** | **01** | **00** | **99** | **98** | **97** | **96** | **95** | **94** | **93** |
| **Low** | 0 | 1 | 26 | 33 | 100 | 12 | 18 | 10 | 1 | 7 | 12 | 1 | 0 |
| **Mid** | 7 | 68 | 82 | 42 | 66 | 1 | 5 | 2 | 1 | 4 | 3 | 0 | 0 |
| **Up** | 10 | 22 | 78 | 41 | 233 | 35 | 20 | 11 | 3 | 1 | 9 | 2 | 1 |
| **Total** | 17 | 91 | 185 | 115 | 399 | 48 | 43 | 23 | 5 | 12 | 25 | 3 | 1 |
| **CPUE** | **0.3** | **1.7** | **3.5** | **2.2** | **7.5** | **0.9** | **0.8** | **0.4** | **0.1** | **0.2** | **0.5** | **0.1** | **T** |

| 2006 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **Year** | **06** | **05** | **04** | **03** | **02** | **01** | **00** | **99** | **98** | **97** | **96** | **95** | **94** |
| **Low** | 0 | 7 | 10 | 26 | 20 | 49 | 8 | 17 | 8 | 6 | 5 | 11 | 2 |
| **Mid** | 16 | 187 | 79 | 34 | 20 | 34 | 1 | 7 | 1 | 1 | 0 | 2 | 5 |
| **Up** | 11 | 71 | 32 | 45 | 15 | 65 | 11 | 4 | 1 | 0 | 0 | 5 | 1 |
| **Total** | 25 | 267 | 125 | 105 | 56 | 148 | 20 | 28 | 10 | 7 | 5 | 17 | 9 |
| **CPUE** | **0.5** | **4.9** | **2.3** | **2.0** | **1.0** | **2.8** | **0.4** | **0.5** | **0.2** | **0.1** | **0.1** | **0.3** | **0.2** |

Lott et al (2006) quantified the terms low, moderate and high recruitment for Lake Oahe walleye based on mean gill net CPUE values for age-1 fish. Based on patterns in walleye recruitment as indicated by age-1 walleye CPUE, mean CPUE values of > 5 for age-1 fish will be considered "high" recruitment, values between 2 and 5 will be considered "moderate" recruitment, and values < 2 will be considered "low" recruitment.

Age-0 walleye CPUE in the standard August Oahe gill net survey has been used as an early indicator of the strength of year classes (Lott et al. 2006), as illustrated by the *r* value of 0.8 for the correlation of mean age-0 CPUE vs. mean age-1 CPUE displayed in Figure 4. However, the 2005 year class, as age-0 fish, was indicative of low-to-moderate recruitment, but the age-1 mean CPUE, a more reliable indicator of recruitment, suggests the 2005 to be of moderate-to-high strength (CPUE=4.9 fish/net-night).

With this in mind, walleye high levels of recruitment occurred from 1989 through 1991 and in 1994 and 1995 (Figure 4 and Figure 5), while recruitment in 1996, 1997, 1999, 2001, and 2005 was moderate. The majority of preferred-length walleye in the 2006 population (Table 15) would have been produced during the period of moderate recruitment from 1999 through 2001 (Figure 5). Walleye recruitment during the 2002-2004 period appears to be low based on gill net CPUE at age 1 (Figure 5).

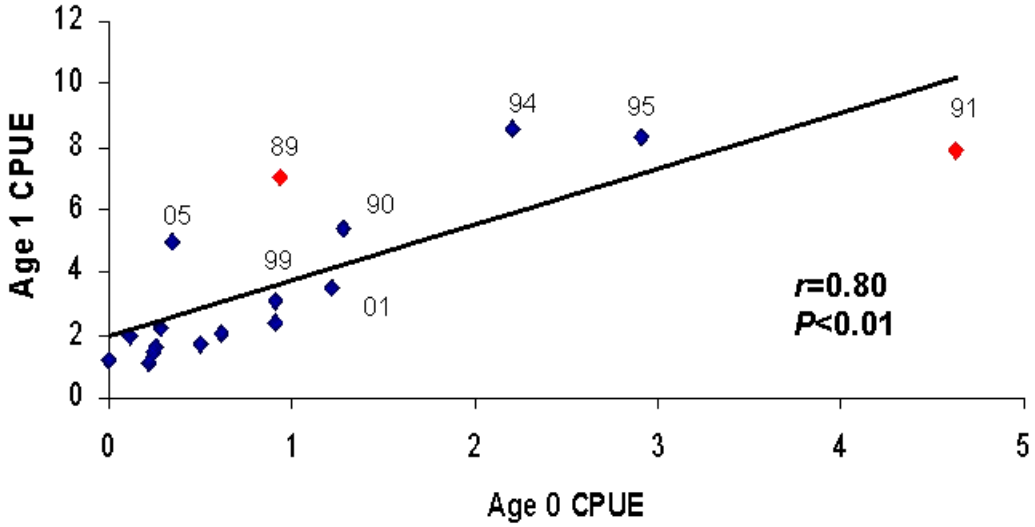


Figure 4. Mean walleye gill net catch per unit effort (CPUE; No./net-night) at age-0 vs. age 1, for year classes produced during the 1989-2005 period. Labels on points refer to year class and were only used for the eight largest year classes produced.

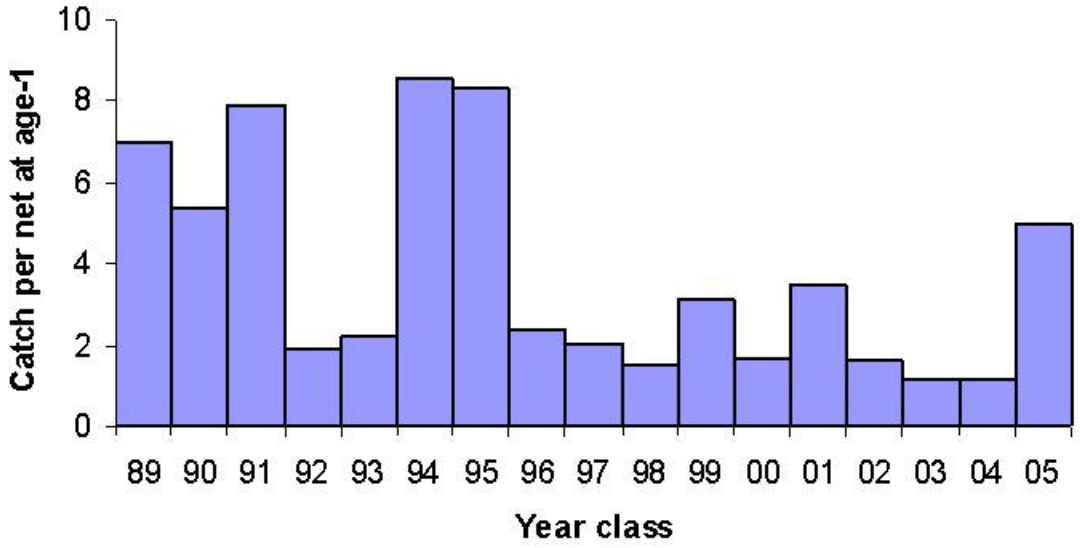


Figure 5. Mean walleye catch per unit effort (CPUE; No./net-night) of fish from designated year classes at the point of recruitment at age 1, for the 1989-2006 standard coolwater gill net surveys conducted during August on Lake Oahe, South Dakota.

Walleye population CPUE by incremental length group is presented in Figure 6. As previously stated, high recruitment of the 1989-1991 and 1994-1995 year classes fueled the high abundance of walleye documented during the mid 1990's. High mortality of walleye ≥ 510 mm in length and slow growth of fish from years of moderate and high recruitment from 1994 through 1996 (Lott et al. 2002) resulted in a reduction in population size structure by 1998 (Table 10). Recruitment has generally been lower since the 1994-1996 period (Figure 5).and growth has increased (Table 12; Lott et al. 2004), resulting in higher PSD and RSD-P values since the 1998-2000 period, especially in 2005 and 2006 (Table 10).

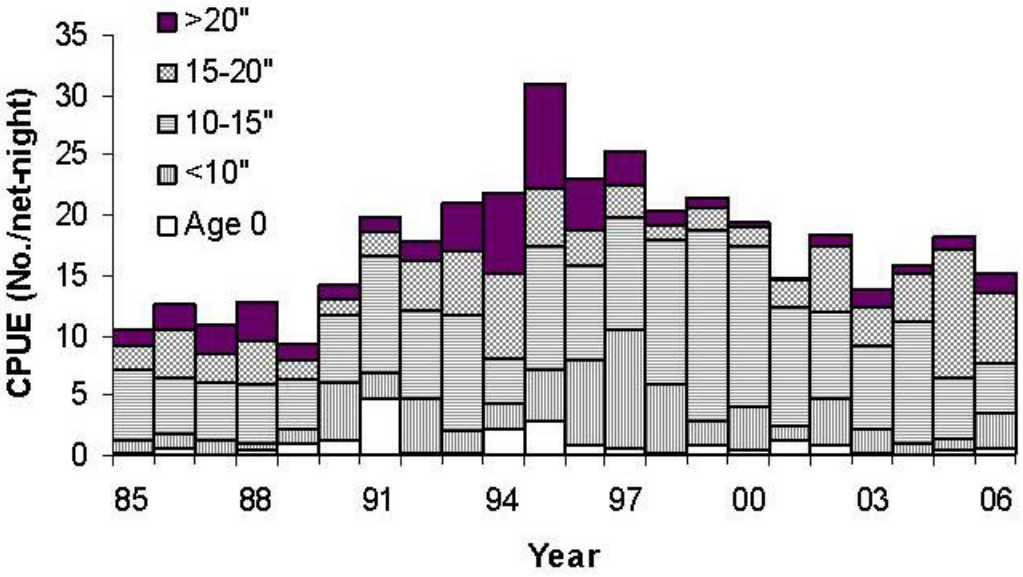


Figure 6. Length structure, in terms of catch per unit effort (CPUE), of Lake Oahe walleye sampled in the standard coolwater gill net survey, 1985-2006.

Length frequency distributions for gill net catches in 2006, in terms of CPUE, illustrate the current status of the Lake Oahe walleye population (Figure 7). The walleye abundance index (CPUE) was highest for middle Oahe in 2006, mostly because of a high number of age-1 fish in the sample (2005 year class). The abundance index was lowest for lower Oahe, where very few fish in the gill net sample were <380 mm in length (Figure 7), and intermediate in upper Oahe, where some recruitment occurs annually. Higher PSD and RSD-P values for lower Lake Oahe than for the middle and upper zones is a function of lower recruitment and faster growth (Lott et al. 2006) in this zone, when compared with middle and upper Oahe.

Length frequency histograms for the total Oahe sample for 2003 through 2006 (Figure 8) support the fact that natural production of walleye was absent in all areas of Oahe during 2004, but some natural production was documented during other years in the 2003-2006 period, though not in all zones all years. A low (0.3 fish/net night) amount of natural production occurred in lower Oahe in 2003 (Figure 9). The fish in the 120-mm length group in the 2005 lower Oahe sample was actually an age-1 fish, meaning natural production was not documented in lower Oahe from 2004 through 2006. Natural production of walleye was highest in middle Oahe in 2005 and 2006, as indicated by fish on the length frequency histograms between 90 mm and 160 mm (Figure 10) As in middle Oahe, natural production of walleye was documented in upper Oahe during all years in the 2003-2006 period except 2004 (Figure 11). As previously discussed, the decrease in CPUE of walleye in upper Oahe from 2005 to 2006 may not reflect actual changes in abundance. With the presence of recruitment in 2003, 2005, and 2006 and the fact angler harvest have been relatively low in recent years, changes in fish distribution or activity may be likely causes for low walleye CPUE in upper Oahe in 2006.

Examination of Figure 8 through Figure 11 illustrates the higher percentage of walleye ≥ 504 mm in lower Oahe, when compared to the middle and upper zones. Relative Stock Density of Preferred-length fish in 2006 was 2 in upper Oahe, 4 in middle Oahe and 32 in lower Oahe. While walleye ≥ 504 mm comprised 38% of the fish in the lower Oahe August 2006 gill net sample, lower abundance of walleye and lower catch rates for this zone, may mean the “one walleye ≥ 20 inches” regulation may not substantially impact an anglers ability to harvest walleye from lower Oahe in 2007.

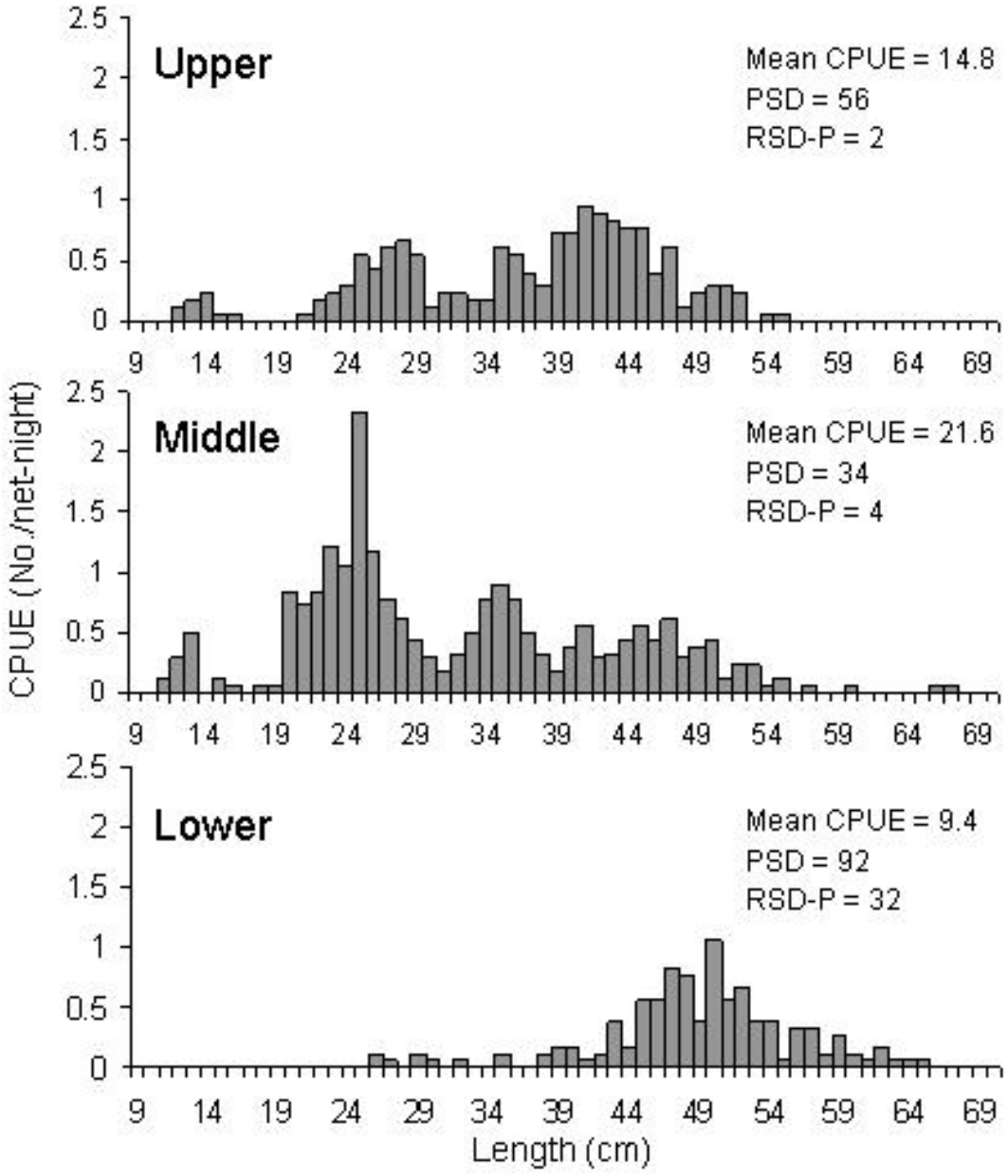


Figure 7. Length frequencies of walleye collected, in terms of catch per unit effort (CPUE), by zone, for fish collected during the standard coolwater gill net survey in 2006.

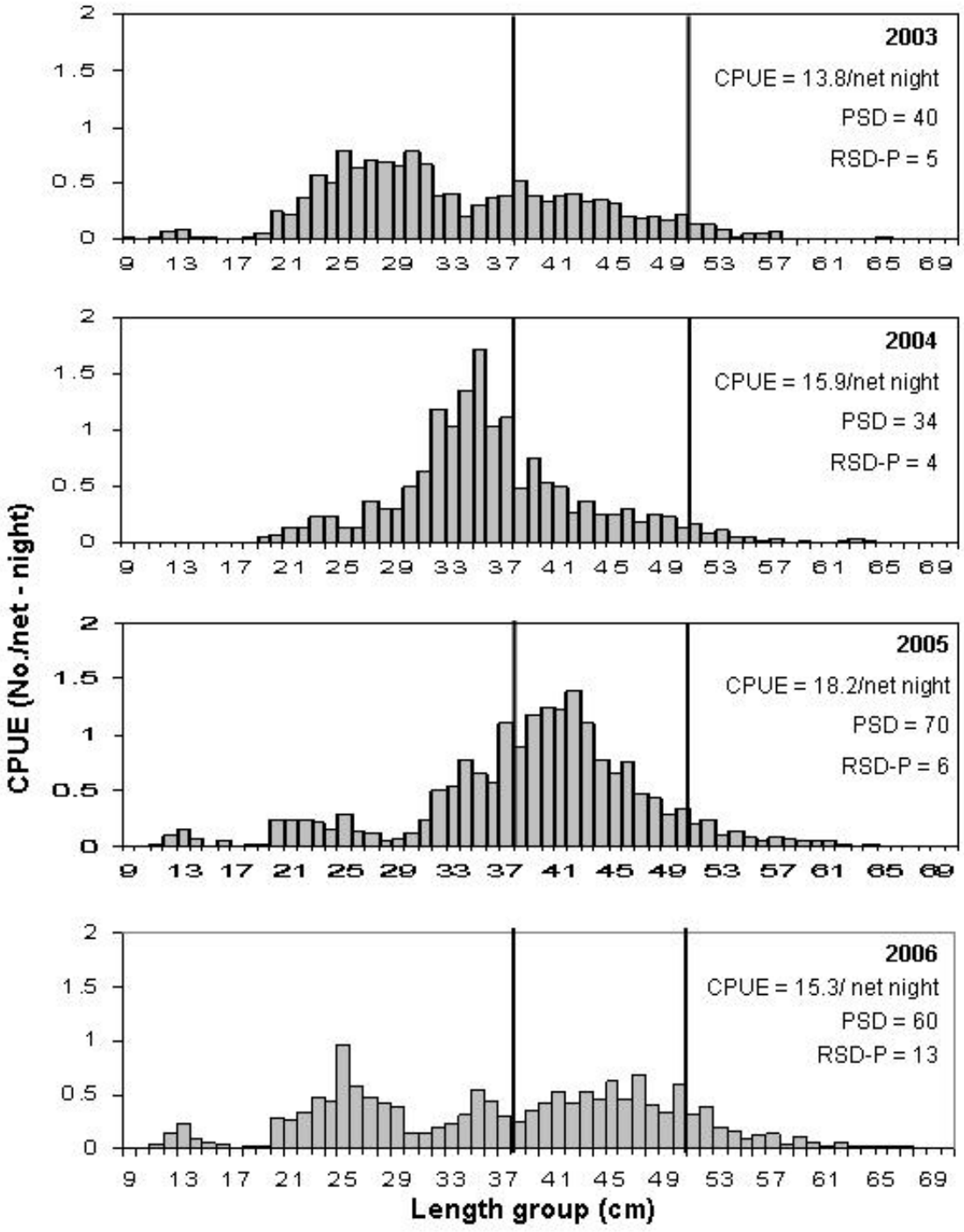


Figure 8. Overall Length frequency, by catch per unit effort, of walleye collected in standard gill-net sets in Lake Oahe, South Dakota, during August 2003 through 2006. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

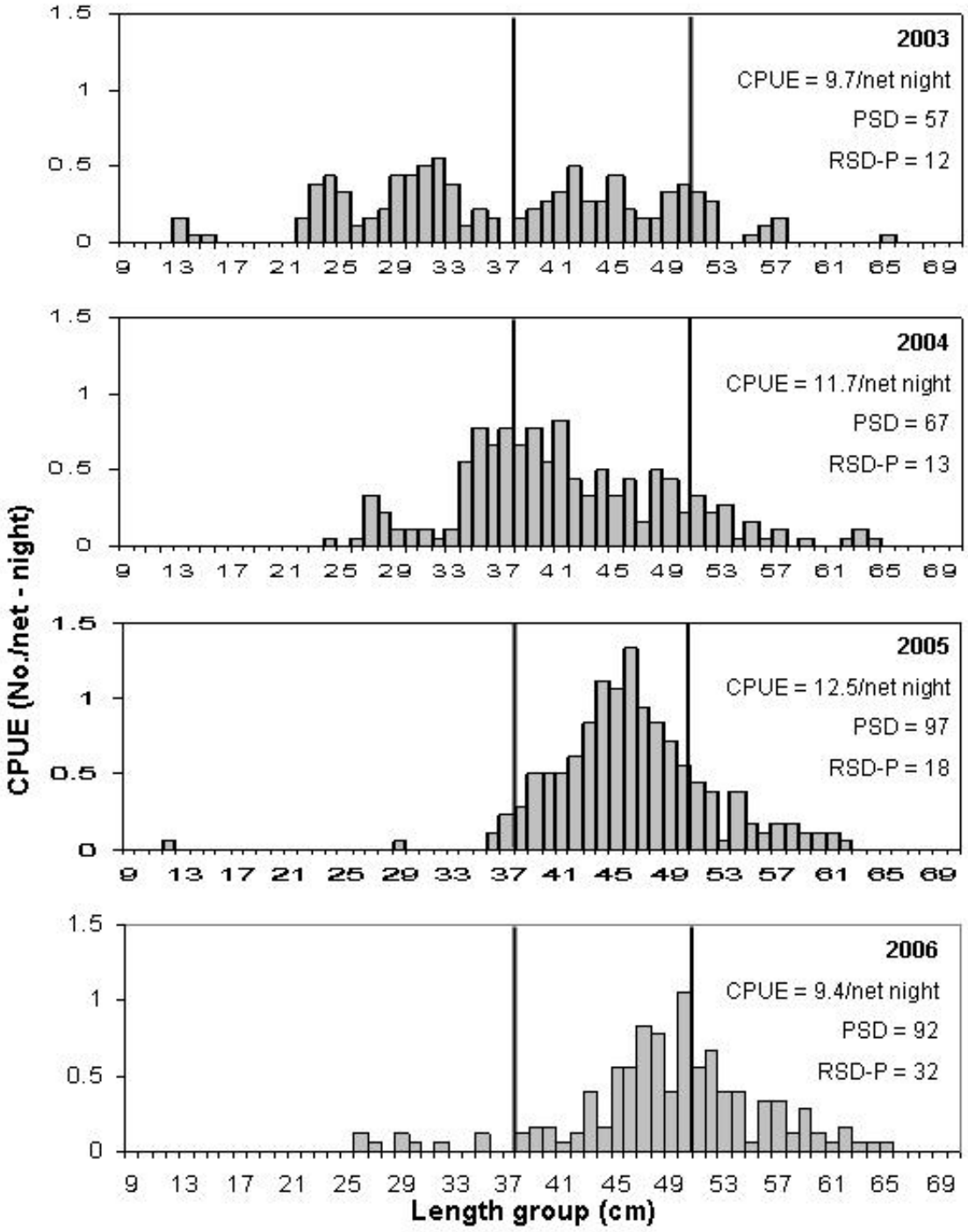


Figure 9. Lower zone of Lake Oahe, South Dakota, length frequency by catch per unit effort, of walleye collected in standard gill-net sets during August 2003 through 2006. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

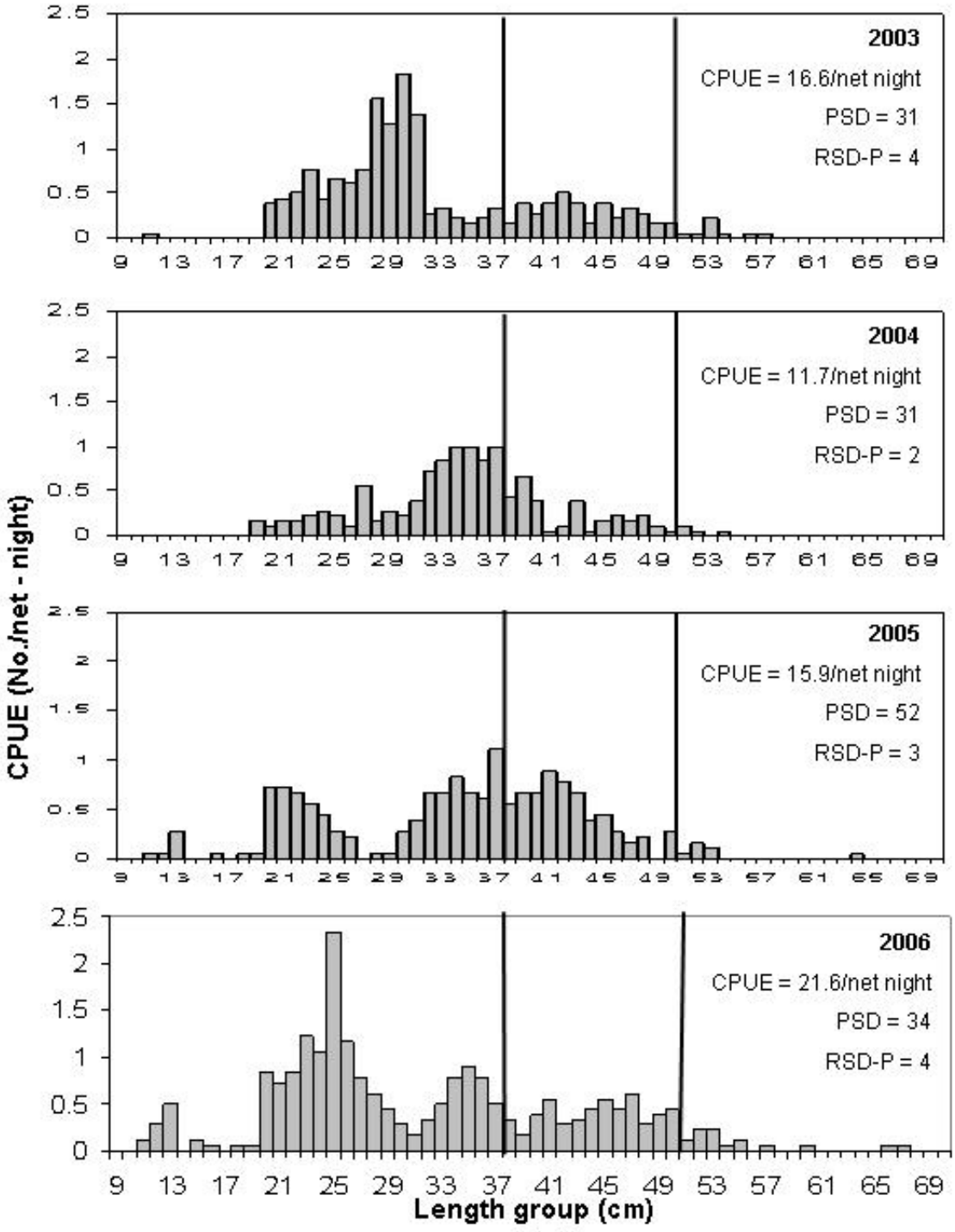


Figure 10. Middle zone of Lake Oahe, South Dakota, length frequency, by catch per unit effort, of walleye collected in standard gill-net sets during August 2003 through 2006. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

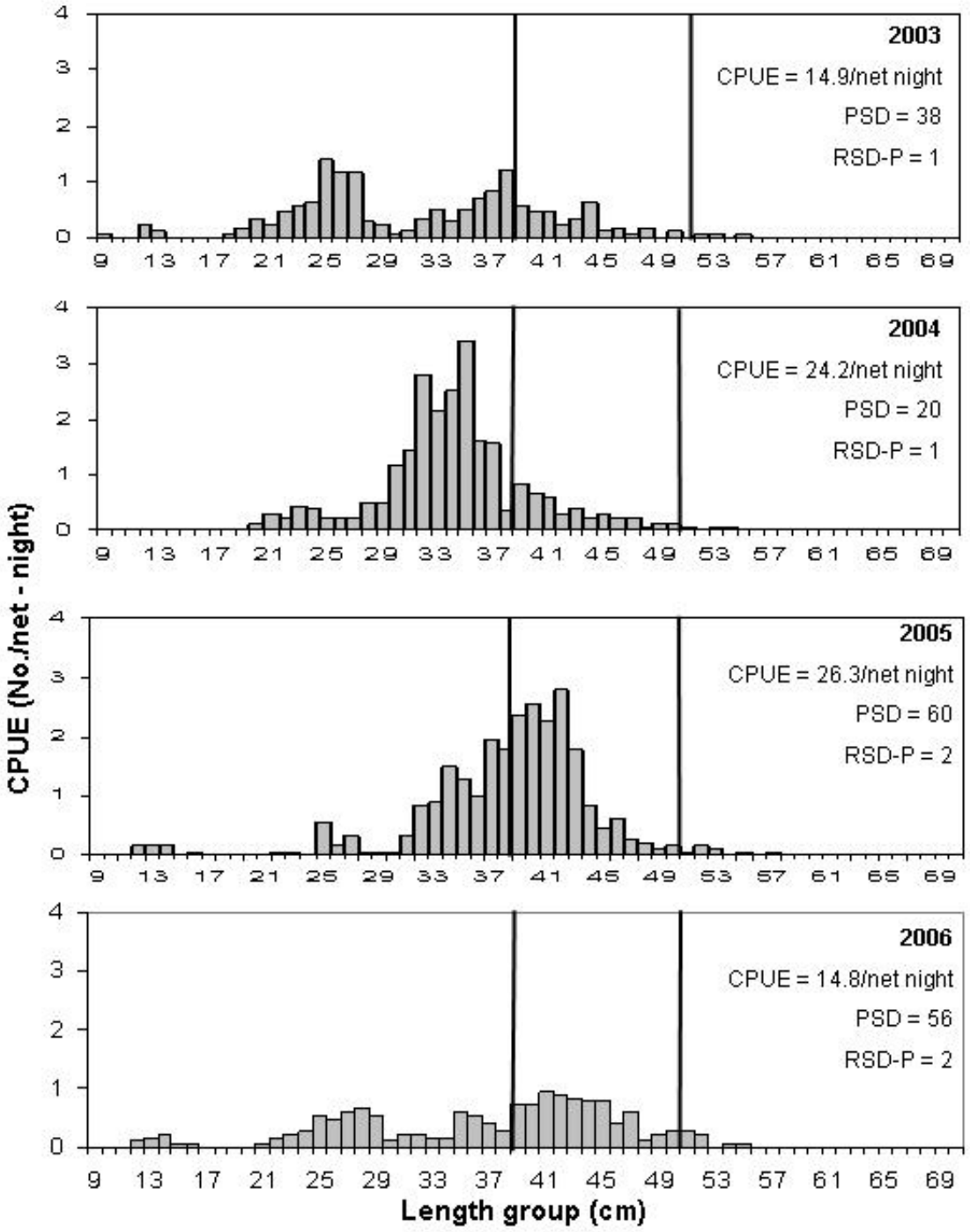


Figure 11. Upper zone of Lake Oahe, South Dakota, length frequency, by catch per unit effort, of walleye collected in standard gill-net sets during August 2003 through 2006. Vertical lines represent the 15-inch and 20-inch classifications. Catch per unit effort (CPUE), PSD and RSD-P are presented for each year.

Population Parameters for Channel Catfish

Proportional stock density for the overall Lake Oahe 2006 gill net sample of channel catfish, at 44, was similar to the 2005 value and within the range of values generated for other years in the 1997-2006 period (Table 16). Relative weight in 2006 was similar to 2004 and 2005 and significantly higher than during the 2000-2003 period (Table 16). Structural and condition indices for the Lake Oahe channel catfish population have generally varied little among years due to slow growth, consistent recruitment, and low exploitation (Lott et al. 2003, 2004). Channel catfish growth rates have slowed considerably since the impoundment of Lake Oahe (Starostka and Nelson 1974; Lott et al. 2003). Quality length for channel catfish is 410 mm, or approximately 16 inches. Therefore, 44% of the channel catfish sampled in the standard gill net survey in 2006 were longer than 16 inches (Figure 12) but angler use and harvest of this species remains low. Mean CPUE of channel catfish in the 2006 standard gill net survey, at 16.9, was the highest of all species sampled (Table 6) and similar to other channel catfish CPUE during the 2002-2006 period. Age and growth analysis for channel catfish is scheduled in association with the 2007 standard Lake Oahe gill net survey.

Table 16. Channel catfish proportional stock density (PSD), relative stock density fo preferred- and memorable-length (RSD-P and RSD-M) fish, and mean relative weight (*Wr*) values for 1997-2006 for Lake Oahe, South Dakota. Mean Wr values for 2002-2006 are for stock-length fish only.

| Year | PSD | RSD-P | RSD-M | *Wr* | Sample size |
|---|---|---|---|---|---|
| 1997 | 56 | 4 | 0 | 83 | 411 |
| 1998 | 54 | 2 | 0 | 78 | 391 |
| 1999 | 51 | 1 | 0 | 79 | 428 |
| 2000 | 52 | 1 | 0 | 77 | 452 |
| 2001 | 44 | 1 | 0 | 77 | 493 |
| 2002 | 42 | 0 | 0 | 78 | 533 |
| 2003 | 46 | 2 | 0 | 76 | 424 |
| 2004 | 31 | 0 | 0 | 81 | 399 |
| 2005 | 43 | 1 | 0 | 80 | 481 |
| 2006 | 44 | 0 | 0 | 79 | 461 |

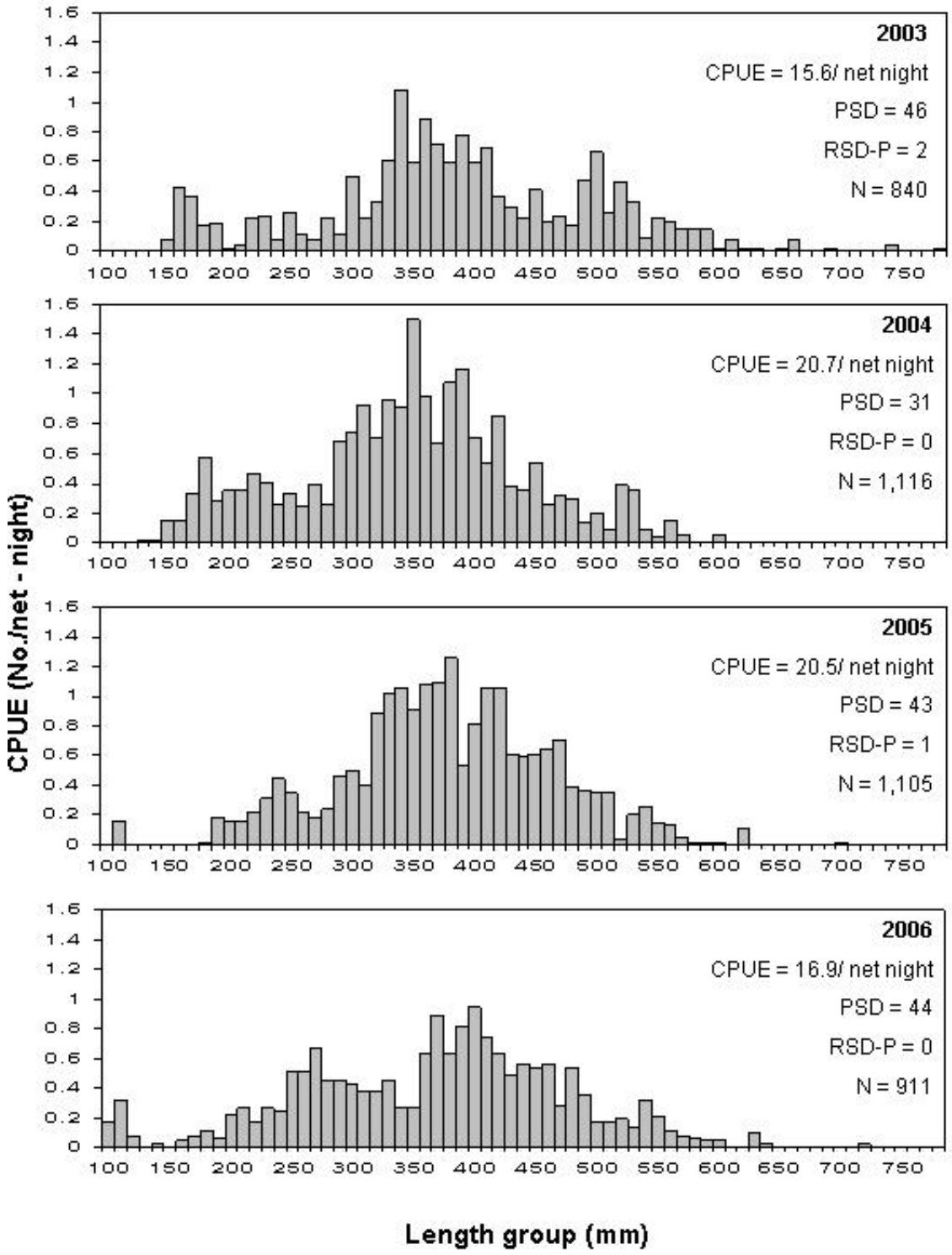


Figure 12. Length frequency of channel catfish, in terms of catch per unit effort (CPUE), collected during the standard coolwater gill net survey in 2003 through 2006. N is number of channel catfish sampled.

Population Parameters for Rainbow Smelt

Mean peak larval rainbow smelt density for 2006, at 25.9 fish/100 $m^3$, was lower than the 2005 value but substantially higher than values for the 1999-2002 period (Table 17). While peak densities from the three-week trawling period are used in analysis, and variance among samples can be high, there is definitely a trend of increasing larval rainbow smelt density since 2002.

Table 17. Mean peak larval densities (No./100 $m^3$) of rainbow smelt, by reservoir zone, in Lake Oahe, South Dakota, during late May and early June, 1995-2006. Trace (T) indicates values <0.05.

| Year | Zone | | | |
|---|---|---|---|---|
| | Lower | Middle | Upper | Total |
| 1995 | 165.9 | 39.7 | 131.2 | 112.3 |
| 1996 | 9.2 | 11.4 | 58.1 | 26.2 |
| 1997 | 31.7 | 8.6 | 0.1 | 13.5 |
| 1998 | 9.3 | 2.1 | 0.0 | 3.8 |
| 1999 | 1.0 | T | 0.0 | 0.4 |
| 2000 | 9.3 | 0.3 | 0.1 | 3.3 |
| 2001 | 2.5 | T | 0.0 | 0.8 |
| 2002 | 4.7 | 2.8 | 6.7 | 4.7 |
| 2003 | 12.3 | 20.8 | 1.1 | 11.4 |
| 2004 | 51.6 | 41.4 | 15.4 | 36.1 |
| 2005 | 95.2 | 43.9 | 52.7 | 63.9 |
| 2006 | 21.2 | 37.1 | 19.0 | 25.9 |

Hydroacoustic surveys from 1996-1999, presented in Nelson Stastny (2001) show the decline in rainbow smelt abundance and biomass that is mirrored in declines in larval smelt production during the same period. Hydroacoustic survey estimates of rainbow smelt biomass and abundance from 2000-2006, presented in Erickson et al. (*In* prep, Table 18) illustrate the low point in rainbow smelt abundance that began in 1999 and continued through 2002. Since 2002, rainbow smelt abundance and biomass estimates for Lake Oahe have increased, but are still significantly lower than during 1996 (Nelson-Stastny 2001). Changes in rainbow smelt abundance and biomass follow a similar pattern to walleye *Wr* values during the 1996-2006 period, with lows for *Wr* typically occurring in 2000 (Table 11)

Table 18. Hydroacoustic estimates of the number of rainbow smelt and other fish from Lake Oahe, South Dakota surveys, 2000-2006

| Year | Zone | Smelt ≥ age-1 | Smelt age-0 | Other fish* |
|---|---|---|---|---|
| 2000 | 1 | 336,120 | 9,025,143 | 17,866,330 |
| | 2 | 8,788,066 | 11,801,987 | 24,952,703 |
| | 3 | 0 | 1,528,264 | 18,318,643 |
| | **Total** | **9,124,186** | **22,355,394** | **61,137,676** |
| 2001 | 1 | 0 | 173,093 | 6,239,870 |
| | 2 | 0 | 128,556 | 26,227,342 |
| | 3 | 0 | 0 | 14,014,730 |
| | **Total** | **0** | **301,649** | **46,481,942** |
| 2002 | 1 | 6,746,892 | 21,654,739 | 6,746,892 |
| | 2 | 11,168,762 | 34,043,187 | 11,168,762 |
| | 3 | 0 | 0 | 0 |
| | **Total** | **17,915,654** | **55,697,926** | **17,915,654** |
| 2003 | 1 | 49,944,953 | 97,729,928 | 95,805,322 |
| | 2 | 41,252,147 | 76,687,030 | 76,811,349 |
| | 3 | 0 | 0 | 72,590,701 |
| | **Total** | **91,197,100** | **174,416,958** | **245,207,372** |
| 2004 | 1 | 75,830,260 | 18,176,115 | 105,383,296 |
| | 2 | 37,801,886 | 4,851,526 | 97,649,770 |
| | 3 | 0 | 0 | 381,727,895 |
| | **Total** | **113,632,146** | **23,027,641** | **584,760,961** |
| 2005 | 1 | 28,295,289 | 107,642,452 | 92,659,837 |
| | 2 | 16,452,986 | 22,545,136 | 131,607,192 |
| | 3 | 0 | 0 | 133,602,672 |
| | **Total** | **44,748,275** | **130,187,588** | **357,869,701** |
| 2006 | 1 | 77,589,686 | 42,515,230 | 58,100,747 |
| | 2 | 39,359,059 | 16,361,068 | 118,117,674 |
| | 3 | 0 | 0 | 78,747,607 |
| | **Total** | **116,948,745** | **58,876,298** | **254,966,028** |

* Other fish include: channel catfish, common carp, freshwater drum, gizzard shad, spottail shiner, walleye, white bass, white crappie and yellow perch.

## ANGLER USE, SPORTFISH HARVEST, AND PREFERENCE SURVEYS

Angler Use

Angler survey clerks interviewed 1,971 parties during the April-October 2006 daytime angler use and harvest survey. The estimated fishing pressure for the South Dakota portion of Lake Oahe for 2006, at 620,273 h, was similar to estimates for 2003 and 2004 and higher than the 2005 estimate (Table 19). While estimated fishing pressure for the April-October 2006 daytime period was higher than for 2005, it was still among the lowest estimates generated since annual April-October surveys were initiated in 1993. Estimated pressure was lowest in 2000, at 539,188 h. The highest estimated fishing pressure for the April-October period occurred in 1996 at 1,968,525 hours and 338,880 angler trips. In 2006, estimated pressure was 32% of the 1996 level and estimated trips was 40% of the 1996 level.

Table 19. Angler use and harvest estimates for surveys conducted on Lake Oahe, South Dakota. All surveys were conducted during the April-October daylight period, except where noted.

| Year | Fishing pressure (h) | Angler trips | Estimated fish harvest | Estimated walleye harvest | Reference |
|---|---|---|---|---|---|
| 1981* | 671,393 | 124,332 | 278,127 | 221,594 | Riis (1982) |
| 1982** | 1,276,990 | 228,034 | 342,682 | 286,633 | Riis (1983) |
| 1983** | 784,658 | 142,665 | 141,475 | 95,797 | Riis (1984) |
| 1986 | 1,031,176 | 190,658 | 313,199 | 256,737 | Riis and Stone (1989) |
| 1991*** | 903,777 | 238,795 | 193,593 | 178,492 | Fielder et al. (1992) |
| 1992*** | 1,051,330 | 210,266 | 267,746 | 216,426 | Stone et al. (1994) |
| 1993 | 1,299,344 | 236,244 | 318,381 | 269,392 | Stone et al. (1994) |
| 1994 | 1,189,267 | 212,597 | 341,391 | 288,182 | Johnson et al. (1995) |
| 1995 | 1,695,945 | 292,404 | 464,735 | 367,693 | Johnson et al. (1996) |
| 1996 | 1,968,525 | 338,880 | 533,062 | 438,355 | Johnson et al. (1997) |
| 1997 | 1,617,024 | 287,011 | 538,596 | 475,638 | Johnson et al. (1998) |
| 1998 | 1,781,032 | 309,744 | 563,009 | 484,234 | Johnson et al. (1999) |
| 1999 | 847,359 | 158,904 | 328,184 | 280,305 | Lott et al. (2000) |
| 2000 | 539,188 | 109,665 | 267,642 | 225,041 | Lott et al. (2001) |
| 2001 | 1,014,591 | 206,638 | 702,899 | 632,770 | Lott et al. (2002) |
| 2002 | 856,059 | 174,706 | 474,168 | 383,367 | Lott et al. (2003) |
| 2003 | 651,557 | 121,107 | 249,166 | 181,528 | Lott et al.(2004) |
| 2004 | 660,973 | 132,726 | 286,885 | 223,782 | Lott et al. (2006) |
| 2005 | 460,334 | 87,433 | 210,953 | 164,428 | Lott et al. (2007) |
| 2006 | 620,273 | 134,258 | 232,117 | 201,554 | This study |

* July-September
** April-September
*** May-October

Estimated fishing pressure peaked in June and July 2006, at 430,232 hours, 69% of the fishing pressure for the months of April through October (Table 20), a value similar to 2005 (Lott et al. 2007). Angling pressure was the highest in the middle zone of Oahe at 50% of the total estimated pressure, followed by the upper and lower zones at 26% and 24%, respectively

Table 20. Estimated fishing pressure (angler hours), by month and zone, with 80% confidence intervals (CI), for the April-October 2006 daylight period on Lake Oahe, South Dakota.

| Zone | Month | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | April | May | June | July | August | Sept. | Oct. | Total |
| **Lower** | 6,161 | 7,540 | 34,366 | 73,948 | 12,543 | 5,842 | 5,818 | 146,218 |
| **80% CI** | 2,488 | 3,043 | 12,235 | 27,534 | 4,438 | 5,735 | 3,150 | 31,397 |
| **Middle** | 4,040 | 49,476 | 120,219 | 102,362 | 13,359 | 5,338 | 12,685 | 307,479 |
| **80% CI** | 2,707 | 25,051 | 44,433 | 42,126 | 6,069 | 2,840 | 9,401 | 67,209 |
| **Upper** | 5,414 | 40,799 | 54,812 | 44,525 | 3,611 | 5,798 | 11,637 | 166,575 |
| **80% CI** | 1,892 | 17,407 | 26,053 | 16,769 | 1,851 | 6,197 | 5,481 | 36,584 |
| **Total** | 15,614 | 97,795 | 209,397 | 220,835 | 29,513 | 16,978 | 30,414 | 620,273 |
| **80% CI** | 4,135 | 30,657 | 52,941 | 53,046 | 7,743 | 8,908 | 11,329 | 82,712 |

Estimated fishing pressure, using full pool surface area in calculations, was 5.6 h per hectare for the April-October period in 2006 (Table 21). Estimates for angler hours per hectare for the 2002 through 2006 period ranged from 4.2 h/ha to 7.7 h/ha. The majority of the pressure on Lake Oahe is by boat, with 97% of estimated angler hours for the April-October 2006 period being attributed to boat anglers (Table 21). Estimated fishing pressure was highest in the middle zone of Oahe in 2006, at an average of 9.1 h/ha, followed by the upper and lower zones at 4.7 and 3.5 h/ha, respectively (Table 22).

Table 21. Estimated fishing pressure, expressed as angler-hours (h) and hours per hectare (h/ha), by type of fishing, with 80% confidence intervals (CI), for the standard April-October daylight survey period, on Lake Oahe, South Dakota, from 2002 through 2006. Estimates were generated using aerial counts of fishing pressure.

| Type of fishing | Year | | | | |
|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2005 | 2006 |
| **Boat (h)** | 827,891 | 613,954 | 634,135 | 437,908 | 600,294 |
| **80% CI** | 95,760 | 87,024 | 69,714 | 58,305 | 82,555 |
| **h/ha** | 7.5 | 5.5 | 5.7 | 4.0 | 5.4 |
| **Shore (h)** | 28,169 | 5,257 | 26,838 | 22,426 | 19,978 |
| **80% CI** | 3,605 | 6,740 | 3,316 | 3,139 | 3,649 |
| **h/ha** | 0.3 | T | 0.2 | 0.2 | 0.2 |
| **Combined (h)** | 856,059 | 651,557 | 660,973 | 460,334 | 620,273 |
| **80% CI** | 96,514 | 87,880 | 70,301 | 59,283 | 82,712 |
| **h/ha** | 7.7 | 5.9 | 6.0 | 4.2 | 5.6 |

Table 22. Estimated fishing pressure, expressed as angler-hours (h) and hour per hectare (h/ha), by reservoir zone, for standard creel surveys conducted during the April-October daylight period, on Lake Oahe, South Dakota, from 1994 through 2006.

| Year | Zone | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Lower | | Middle | | Upper | | Total | |
| | h | h/ha | h | h/ha | h | h/ha | h | h/ha |
| **1994** | 328,203 | 7.8 | 333,602 | 9.9 | 527,462 | 15.1 | 1,189,267 | 10.7 |
| **1995** | 520,102 | 16.7 | 509,497 | 20.5 | 666,346 | 22.2 | 1,695,495 | 19.7 |
| **1996** | 688,936 | 22.0 | 579,200 | 23.4 | 700,389 | 23.3 | 1,968,525 | 22.9 |
| **1997** | 508,565 | 12.6 | 548,942 | 14.3 | 559,517 | 21.4 | 1,617,024 | 15.4 |
| **1998** | 760,797 | 18.8 | 522,740 | 13.6 | 497,495 | 19.0 | 1,781,032 | 17.0 |
| **1999** | 455,434 | 11.3 | 196,425 | 5.1 | 195,500 | 7.5 | 847,359 | 8.1 |
| **2000** | 233,013 | 5.8 | 170,320 | 4.4 | 135,855 | 5.2 | 539,188 | 5.1 |
| **2001** | 396,097 | 9.5 | 350,504 | 10.3 | 267,990 | 7.6 | 1,014,591 | 9.2 |
| **2002** | 216,608 | 5.2 | 320,535 | 9.5 | 318,915 | 9.1 | 856,058 | 7.7 |
| **2003** | 164,804 | 3.9 | 280,712 | 8.3 | 206,042 | 5.9 | 651,558 | 5.8 |
| **2004** | 161,693 | 3.8 | 296,194 | 8.8 | 203,086 | 5.8 | 660,973 | 6.0 |
| **2005** | 107,385 | 2.6 | 238,202 | 7.0 | 114,747 | 3.3 | 460,334 | 4.2 |
| **2006** | 146,218 | 3.5 | 307,479 | 9.1 | 166,575 | 4.7 | 620,273 | 5.6 |
| **Zone size (ha)** | 41,598 | | 33,890 | | 35,172 | | 110,660 | |

Catch, Harvest and Release Estimates

Of the estimated 232,117 fish harvested from Oahe during the April-October 2006 daytime period, 201,554 (87%) were walleye. Channel catfish (6%) and Chinook salmon (3%) had the second and third highest harvest estimates for the 2006 survey period. The walleye harvest during June and July made up 76% (153,745) of the total walleye harvest during the April-October period in 2006 (Table 23).

Table 23. Estimated number of fish harvested, by species and month, with 80% confidence intervals (CI), for the April-October 2006 daylight period, on Lake Oahe, South Dakota.

| Species | Month | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | April | May | June | July | Aug. | Sept. | Oct. | Total |
| **Walleye** | 533 | 39,346 | 89,839 | 63,906 | 4,390 | 1,203 | 2,321 | 201,554 |
| **80% CI** | 203 | 14,314 | 26,490 | 17,836 | 1,527 | 761 | 1,038 | 35,053 |
| **Channel catfish** | 959 | 2,317 | 3,689 | 4,649 | 1,401 | 568 | 425 | 14,008 |
| **80% CI** | 429 | 1,346 | 1,960 | 2,167 | 570 | 581 | 115 | 3,348 |
| **White bass** | 286 | 1,202 | 2,104 | 528 | 177 | 70 | 92 | 4,459 |
| **80% CI** | 164 | 551 | 756 | 259 | -- | 9 | 47 | 986 |
| **Smallmouth bass** | 0 | 313 | 1,053 | 639 | 566 | 4 | 219 | 2,795 |
| **80% CI** | -- | 166 | 474 | 321 | 111 | 0 | 200 | 639 |
| **Northern pike** | 68 | 46 | 160 | 15 | 143 | 13 | 57 | 501 |
| **80% CI** | 54 | 8 | 118 | 21 | -- | 0 | 58 | 144 |
| **Chinook salmon** | 611 | 190 | 3,047 | 777 | 386 | 618 | 1,272 | 6,901 |
| **80% CI** | 249 | 114 | 1,811 | 130 | 209 | 430 | 567 | 1,981 |
| **Other*** | 0 | 256 | 893 | 618 | 66 | 0 | 82 | 1,899 |
| **Total** | 2,457 | 43,670 | 100,785 | 71,132 | 7,129 | 2,477 | 4,468 | 232,117 |
| **80% CI** | 695 | 15,227 | 28,704 | 18,653 | 1,971 | 1,410 | 1,650 | 37,588 |

*Other includes common carp, goldeye, river carpsucker, yellow perch, white crappie, black crappie, sauger and freshwater drum.

An estimated 442,659 fish were caught in Lake Oahe during the 2006 standard survey period (Table 23, Table 24 and Figure 13). An estimated 309,603 (69% of all fish) walleye were caught, the top species for catch, and 65% of them harvested. An estimated 210,542 fish were released back into Lake Oahe (Table 24). Channel catfish (47,286), white bass (19,768), and smallmouth bass (19,232) followed walleye in terms of total estimated catch in 2006 (Figure 13). Approximately 52% of the fish caught were harvested in 2006. As with fishing pressure, catch and harvest was highest in the months of June and July. The total catch estimate for June and July 2006, was 343,619 fish, 77% of the 442,659 caught during the April-October period.

Table 24. Estimated number of fish released, by species and month, for the April-October 2006 daylight period, on Lake Oahe, South Dakota.

| Species | Month | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | April | May | June | July | Aug. | Sept. | Oct. | Total |
| **Walleye** | 242 | 10,182 | 54,876 | 39,061 | 1,135 | 344 | 2,210 | 108,049 |
| **Channel catfish** | 500 | 728 | 7,972 | 20,272 | 3,018 | 334 | 454 | 33,278 |
| **White bass** | 237 | 3,805 | 7,765 | 2,409 | 457 | 98 | 539 | 15,309 |
| **Smallmouth bass** | 91 | 2,190 | 5,305 | 4,495 | 768 | 1,736 | 1,852 | 16,437 |
| **Northern pike** | 189 | 20 | 42 | 133 | 30 | 25 | 197 | 637 |
| **Chinook salmon** | 0 | 34 | 361 | 86 | 22 | 0 | 77 | 580 |
| **Other*** | 47 | 2,203 | 16,333 | 12,592 | 3,534 | 566 | 976 | 36,252 |
| **Total** | 1,306 | 19,162 | 92,654 | 79,048 | 8,964 | 3,103 | 6,305 | 210,542 |

*Other includes goldeye, white sucker, common carp, yellow perch, white crappie, black crappie, sauger, river carpsucker, rainbow trout, burbot, and freshwater drum.

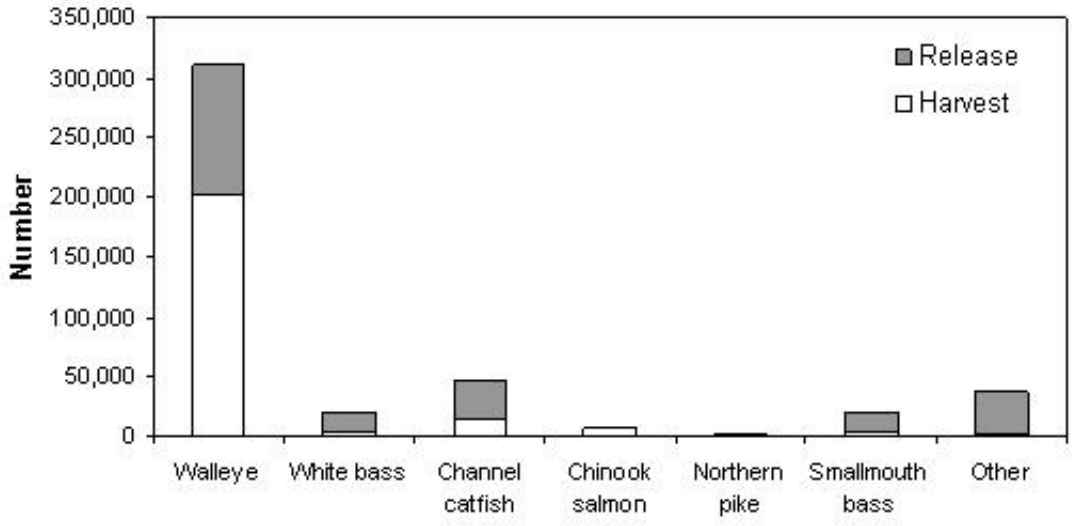


Figure 13. Estimated number of fish harvested and released, for selected species, for the April-October 2006 daylight period, on Lake Oahe, South Dakota. Other includes goldeye, common carp, river carpsucker, white sucker, rainbow trout, white crappie, black crappie, yellow perch, sauger, and freshwater drum.

Estimated walleye harvest in 2006 was the highest in the middle zone of Oahe, at 121,052 fish, followed by the upper and lower zones at 66,366 and 14,136 fish, respectively (Table 25). The highest harvest of channel catfish (63% of total), white bass (52% of total) and northern pike (42% of total) occurred in the upper zone of the reservoir in 2006 (Table 25).

Table 25. Estimated number of fish harvested, for selected species, by zone, with 80% confidence intervals (CI), for the April-October 2006 daylight period, on Lake Oahe, South Dakota.

| Species | Zone | | | |
|---|---|---|---|---|
| | Lower | Middle | Upper | Total |
| **Walleye** | 14,136 | 121,052 | 66,366 | 201,554 |
| **80% CI** | 5,392 | 29,676 | 17,859 | 35,053 |
| **Channel catfish** | 1,308 | 3,838 | 8,863 | 14,008 |
| **80% CI** | 580 | 1,930 | 2,674 | 3,348 |
| **White bass** | 969 | 1,166 | 2,324 | 4,459 |
| **80% CI** | 411 | 513 | 735 | 986 |
| **Chinook salmon** | 4,977 | 1,503 | 421 | 6,901 |
| **80% CI** | 1,844 | 567 | 448 | 1,981 |
| **Smallmouth bass** | 757 | 1,857 | 182 | 2,795 |
| **80% CI** | 313 | 547 | 106 | 639 |
| **Northern pike** | 124 | 167 | 210 | 501 |
| **80% CI** | 61 | 21 | 129 | 144 |
| **Total** | 22,622 | 130,965 | 78,530 | 232,117 |
| **80% CI** | 6,640 | 31,292 | 19,738 | 37,588 |

Estimated walleye catch and the percentage of walleye caught that were harvested have varied greatly among years (Table 26). The percentage of fish caught that were harvested ranged from 23% to 41% during the 1997-2000 period because the walleye population was dominated by fish less than 380 mm in length and angler catch rates of walleye were high, allowing anglers to be very selective in the fish they kept (Lott et al. 2002). The high increase in percentage of fish caught that were kept in 2001 was the result of liberal limits implemented that year. The percentage of walleye caught that were harvested decreased from 81% in 2001 to 65% in 2006. Reasons for the reduction in percentage caught that were harvested from 2001 to 2006 include reductions in the daily limit from 14 fish to 4 fish during this time period (Table 2), and changes in sizes of walleye caught and hourly catch rates of walleye. Estimated walleye catch was the

highest in 1998, at over 2 million walleyes caught, while the percentage harvested was the lowest, at 23%. In 2006, with 309,603 walleyes caught, estimated catch was only 15% of the 1998 estimated catch, but harvest was 42% of the 1998 estimate (Table 26).

Table 26. Estimated number of walleye caught, harvested, and released during the April-October daylight period, by reservoir zone and year, for Lake Oahe, South Dakota, 1994 through 2006.

| Year | Caught | Harvested | Released | Percent harvested |
|---|---|---|---|---|
| **1994** | 423,527 | 288,182 | 135,345 | 68% |
| **1995** | 583,671 | 367,693 | 215,978 | 63% |
| **1996** | 675,269 | 438,355 | 236,914 | 65% |
| **1997** | 1,152,050 | 475,638 | 676,412 | 41% |
| **1998** | 2,103,666 | 484,234 | 1,619,432 | 23% |
| **1999** | 816,394 | 280,305 | 536,089 | 34% |
| **2000** | 602,288 | 225,041 | 377,247 | 37% |
| **2001** | 783,598 | 632,770 | 150,828 | 81% |
| **2002** | 501,958 | 383,367 | 118,591 | 76% |
| **2003** | 275,883 | 181,528 | 94,355 | 66% |
| **2004** | 354,368 | 223,782 | 130,586 | 63% |
| **2005** | 215,164 | 164,428 | 50,735 | 76% |
| **2006** | 309,603 | 201,554 | 108,049 | 65% |

Length frequency histograms of walleye harvested by anglers for all of Lake Oahe (Figure 14) show that anglers generally begin harvesting walleyes at approximately 300 mm in length but prefer to harvest fish longer than 350 mm. Walleye < 300 mm were well represented in the population in upper and middle Oahe (Figure 10 and Figure 11) but were not harvested by anglers, and walleye between 300 and 350 mm were mostly harvested in middle Oahe and only during July and August (Figure 16) However, most of the walleye between 300 and 350 mm were harvested from middle Oahe, where fish < 300 mm are well represented in the population. The mean length of walleye harvested during the April-October 2006 period, of 428 mm (17 inches) illustrates the increase in quality of the Lake Oahe fishery since the early 2000s. As one moves up the reservoir from lower Oahe to upper Oahe average size of harvested walleye decreases from 483 mm for lower Oahe to 415 mm in upper Oahe (Figure 14 to Figure 17). Examining Figures 14-17, one would determine that anglers begin to harvest walleyes at or near the 300 mm (12 inches). Smallmouth bass are typically an incidental catch by anglers and harvested by generalist anglers. Two peaks in the harvest frequency of smallmouth bass existed for 2006; one at 290 mm and the other at 380 mm, with the mean length of smallmouth bass harvested in 2006 being 352 mm (Figure 18).

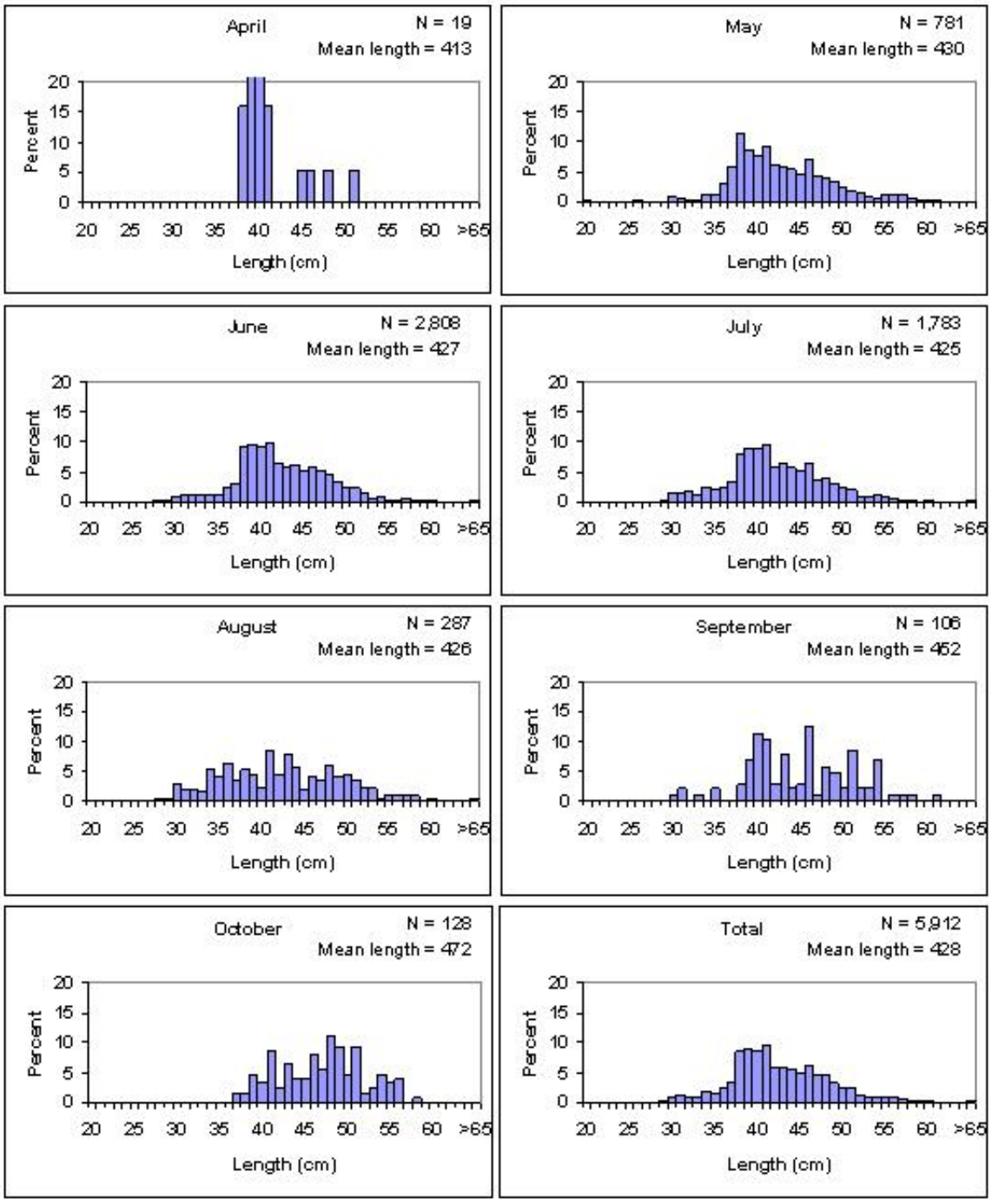


Figure 14. Length frequency distribution of walleye harvested by anglers fishing Lake Oahe, South Dakota, during the May-September 2006 daylight period.

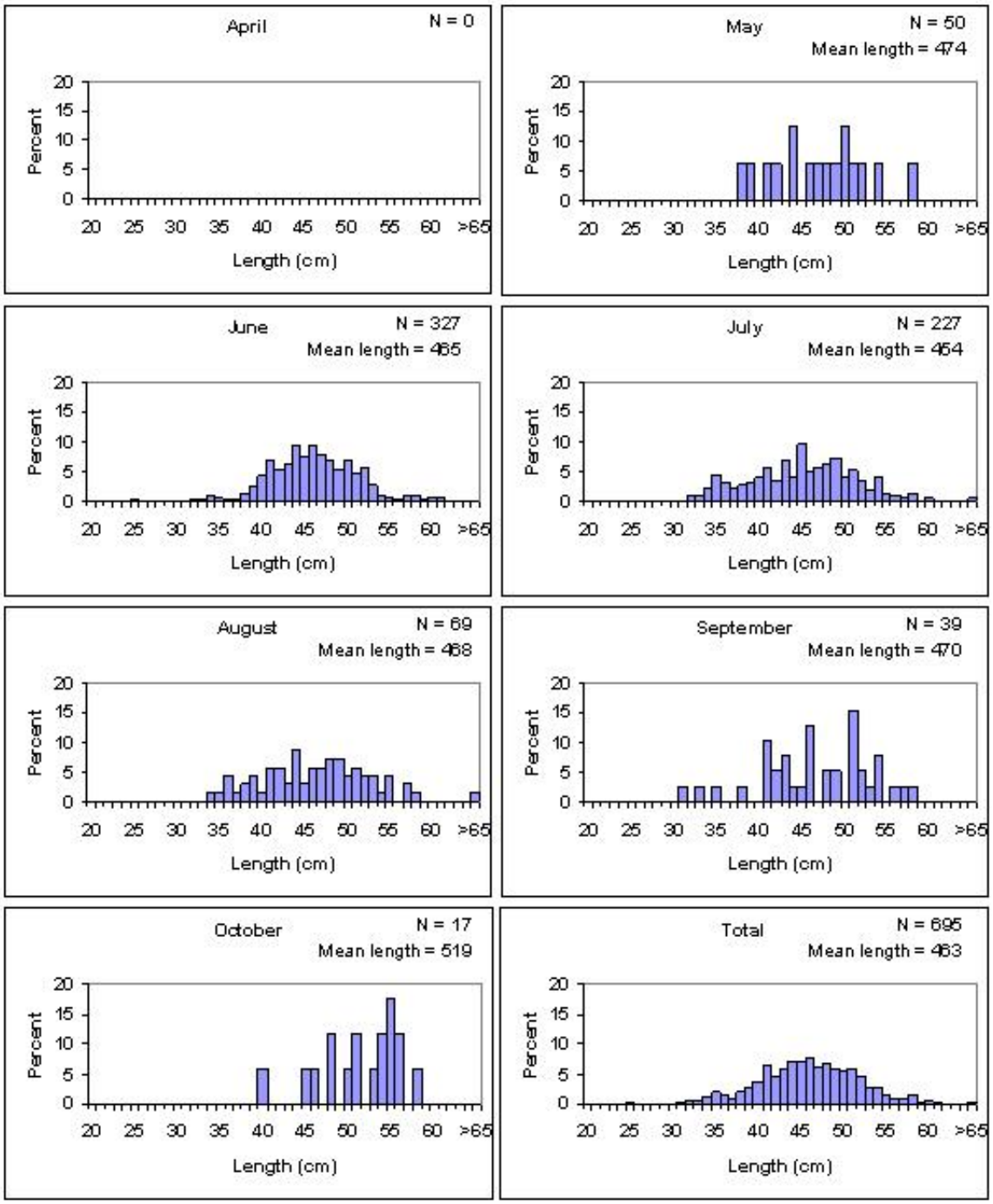


Figure 15. Length frequency distribution of walleye harvested by anglers fishing lower Lake Oahe, South Dakota, during the May-September 2006 daylight period.

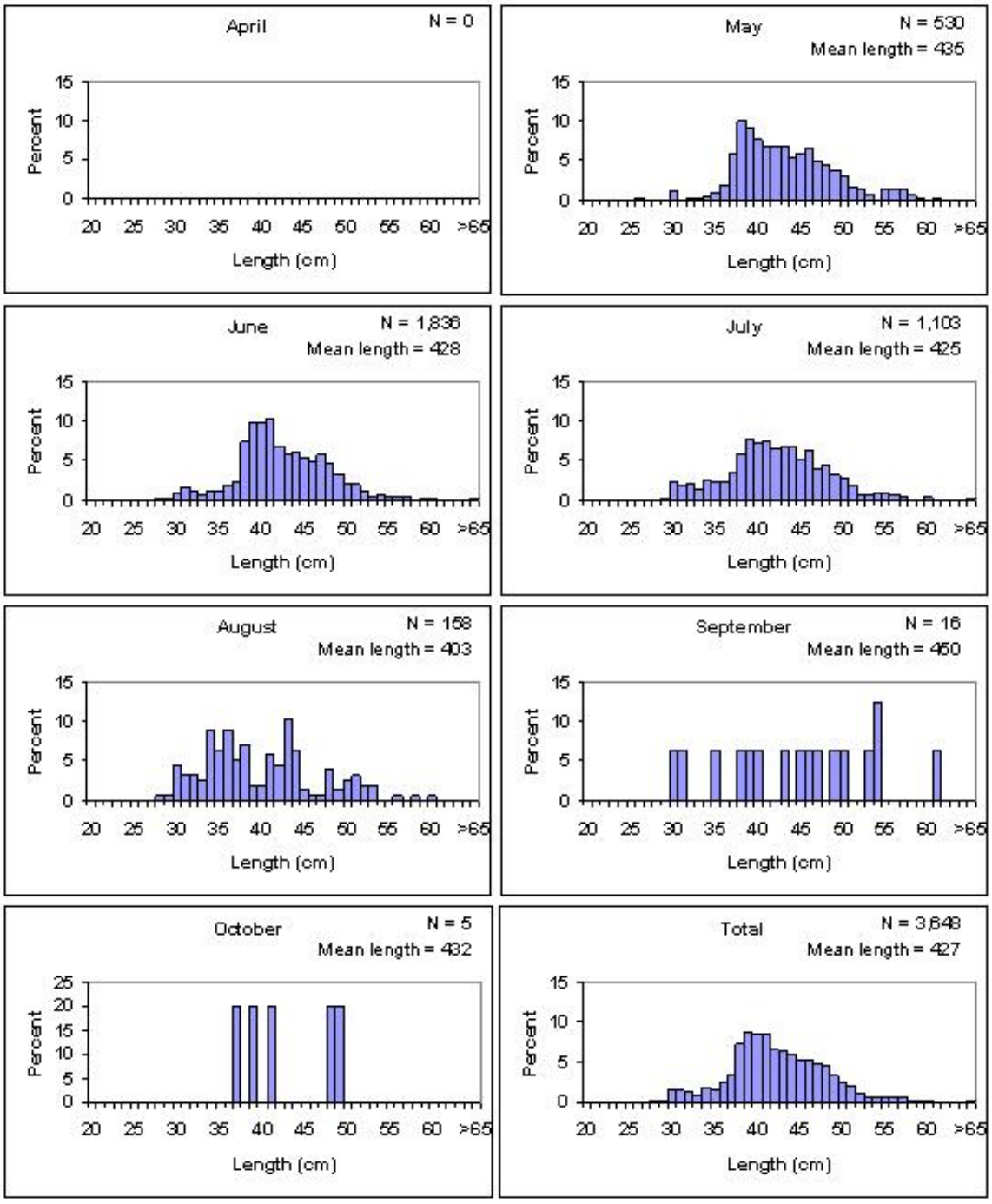


Figure 16. Length frequency distribution of walleye harvested by anglers fishing middle Lake Oahe, South Dakota, during the May-September 2006 daylight period.

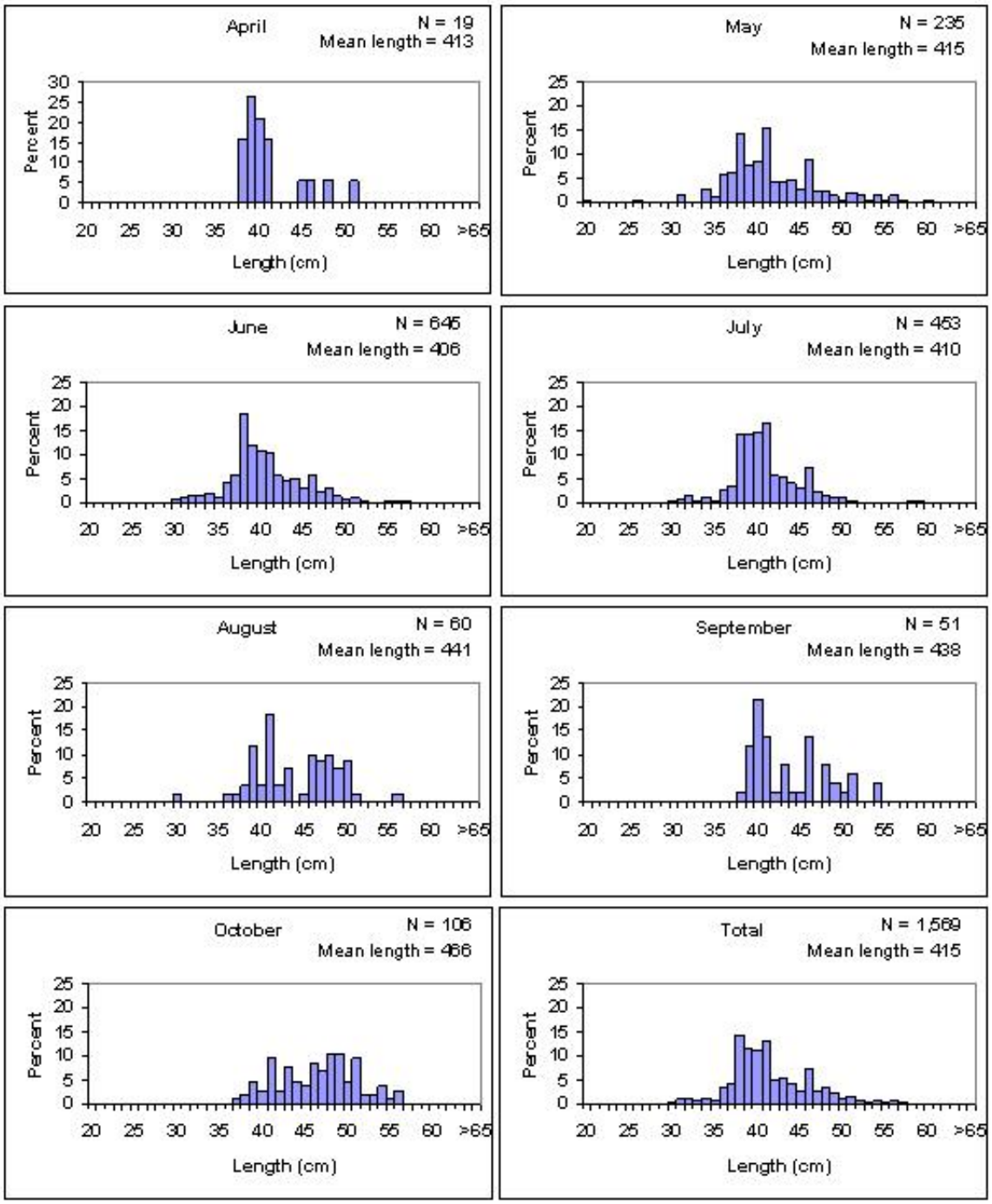


Figure 17. Length frequency distribution of walleye harvested by anglers fishing upper Lake Oahe, South Dakota, during the May-September 2006 daylight period.

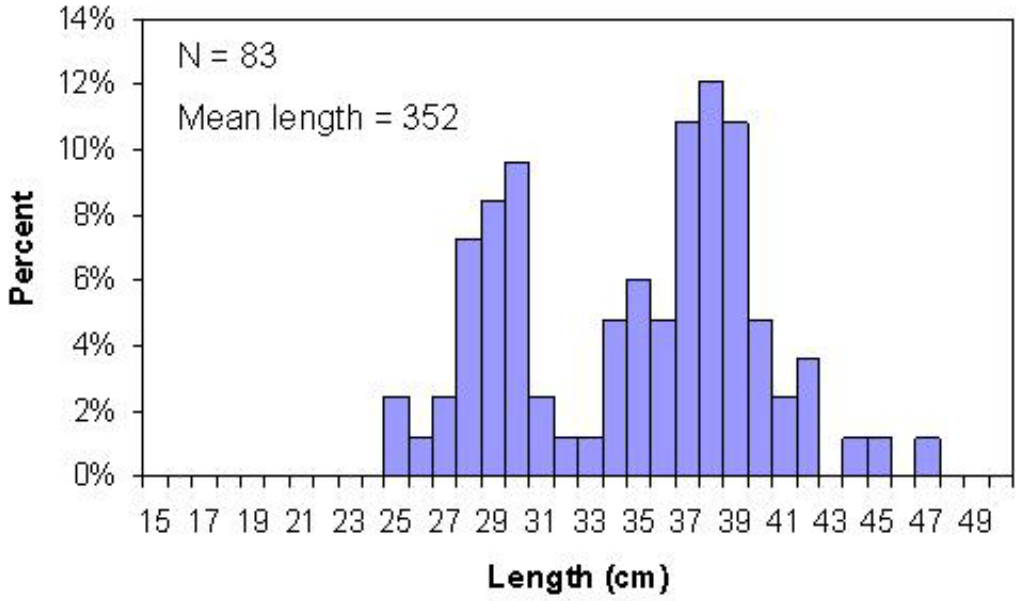


Figure 18. Length frequency distribution of smallmouth bass harvested by anglers fishing Lake Oahe, South Dakota, during the April-October 2006 daylight period.

Hourly Catch, Harvest, and Release Rates

The mean hourly catch rate for walleye in 2006, at 0.5 fish/angler-h comprised the majority of the total hourly catch rate for all species of 0.71 fish/angler-h (Table 27) and almost the entire hourly harvest rate. Anglers specifically fishing for a certain species dramatically increased the catch rates for the species they are fishing for (Table 28). Anglers actively fishing for smallmouth bass had the greatest increase in catch rates (2.47 fish/angler-h) over the sample of all anglers (0.03 fish/angler-h, Table 27) with majority of the fish they caught being released. Anglers specifically fishing for channel catfish in 2006 caught an estimated 1.12 fish/angler-h, compared to the sampler of all anglers, where the catch rate was 0.08 fish/angler-h. Mean catch rate of Chinook salmon by anglers specifically fishing for salmon were the same in 2005 and 2006, at 0.34 fish/angler-h (Lott et al. 2007, Table 28). Walleye catch rates exceeding 0.3 fish/angler-h are generally considered excellent (Colby et al. 1979). For Lake Oahe, mean catch rate for walleye has exceeded 0.3 fish/angler-h since annual surveys were initiated in 1991 (Stone et al. 1994, Table 29).

Table 27. Estimated hourly catch, harvest, and release rates, by species, for all anglers interviewed on Lake Oahe, South Dakota, during the April-October 2006 daylight survey period. Trace (T) indicates values >0.0 but <0.01.

| Species | Catch rate (fish/angler-h) | Harvest rate (fish/angler-h) | Release rate (fish/angler-h) |
|---|---|---|---|
| **Walleye** | 0.50 | 0.33 | 0.17 |
| **Channel catfish** | 0.08 | 0.02 | 0.06 |
| **White bass** | 0.03 | 0.01 | 0.02 |
| **Smallmouth bass** | 0.03 | T | 0.03 |
| **Northern pike** | T | T | T |
| **Yellow perch** | 0.03 | T | 0.03 |
| **Chinook salmon** | 0.01 | T | T |
| **Other*** | 0.03 | 0.01 | 0.02 |
| **Total** | 0.71 | 0.37 | 0.34 |

*Other includes goldeye, white sucker, common carp, white crappie, black crappie, river carpsucker, rainbow trout, sauger and freshwater drum.

Table 28. Estimated hourly catch, harvest, and release rates, by species, for anglers specifically fishing for the species listed, on Lake Oahe, South Dakota during for the April-October 2006 daylight period. Trace (T) indicates values >0.0 but <0.01.

| Species | Catch rate (fish/angler-h) | Harvest rate (fish/angler-h) | Release rate (fish/angler-h) |
|---|---|---|---|
| **Walleye** | 0.77 | 0.53 | 0.24 |
| **Smallmouth bass** | 2.47 | 0.04 | 2.43 |
| **Channel catfish** | 1.12 | 0.98 | 0.14 |
| **Chinook salmon** | 0.34 | 0.32 | 0.02 |
| **Northern pike** | 0.16 | 0.15 | 0.01 |

Catch rates for walleye, smallmouth bass, white bass, and channel catfish vary greatly among years (Table 29). Walleye catch rates were highest during 1997 through 2001 with 1998 being the highest at 1.18 walleye per hour. White bass catch rates were 0.12 fish/angler-h or higher during all years in the 1998-2005 period. However, a die-off of white bass (Lott et al. 2007) occurred during July of 2005 that may be responsible for the decrease in mean white bass catch per angler-h for 2006 (Table 29). Catch rates, for all species combined in 2006, peaked during the months of June and July (Table 30), the same months fishing pressure was the highest (Table 20). Walleye catch rates also peaked in June and July 2006, with harvest rates being the greatest in June (0.43 walleye per hour, Table 30).

In 2005 and 2006, 79% and 85% of angling parties harvested an average of less than four walleyes per angler, respectively (Table 31). Correspondingly, 21% and 15% of angling parties in 2005 and 2006 harvested four or more walleye per angler. The percentage of angling parties catching zero walleye per trip varied greatly among reservoir zones in 2006. Sixty four percent of parties fishing the lower zone in 2006 caught zero walleyes, while only 20% and 32% of anglers fishing middle and upper Oahe caught zero walleyes, respectively (Table 31).

Table 29. Estimated hourly catch rates for walleye, smallmouth bass, white bass, channel catfish, and all fish combined, by year, for all anglers, for the April-October daylight survey period on Lake Oahe, South Dakota, 1994 through 2006.

| Year | Catch rate (fish/angler-h) | | | | |
|---|---|---|---|---|---|
| | Walleye | Smallmouth bass | White Bass | Channel catfish | All fish |
| 1994 | 0.36 | 0.02 | 0.02 | 0.01 | 0.51 |
| 1995 | 0.34 | 0.01 | 0.04 | 0.01 | 0.57 |
| 1996 | 0.34 | 0.02 | 0.03 | 0.01 | 0.50 |
| 1997 | 0.71 | 0.04 | 0.05 | 0.02 | 0.92 |
| 1998 | 1.18 | 0.06 | 0.13 | 0.02 | 1.45 |
| 1999 | 0.96 | 0.04 | 0.13 | 0.03 | 1.22 |
| 2000 | 1.11 | 0.05 | 0.20 | 0.03 | 1.00 |
| 2001 | 0.77 | 0.03 | 0.12 | 0.06 | 1.01 |
| 2002 | 0.59 | 0.03 | 0.28 | 0.09 | 1.03 |
| 2003 | 0.42 | 0.02 | 0.20 | 0.08 | 0.77 |
| 2004 | 0.54 | 0.02 | 0.19 | 0.07 | 0.87 |
| 2005 | 0.47 | 0.02 | 0.14 | 0.07 | 0.74 |
| 2006 | 0.50 | 0.03 | 0.03 | 0.08 | 0.71 |

Table 30. Estimated hourly catch, harvest, and release rates (fish/angler-h), for walleye and all species combined, by month, for the April-October 2006 daylight survey period, on Lake Oahe, South Dakota.

| Month | Walleye | | | All fish combined | | |
|---|---|---|---|---|---|---|
| | Catch rate | Harvest rate | Release rate | Catch rate | Harvest rate | Release rate |
| **April** | 0.05 | 0.03 | 0.02 | 0.24 | 0.16 | 0.08 |
| **May** | 0.51 | 0.40 | 0.11 | 0.64 | 0.45 | 0.19 |
| **June** | 0.69 | 0.43 | 0.26 | 0.92 | 0.48 | 0.44 |
| **July** | 0.47 | 0.29 | 0.18 | 0.68 | 0.32 | 0.36 |
| **August** | 0.19 | 0.15 | 0.04 | 0.55 | 0.24 | 0.31 |
| **September** | 0.09 | 0.07 | 0.02 | 0.33 | 0.15 | 0.18 |
| **October** | 0.15 | 0.08 | 0.07 | 0.36 | 0.15 | 0.21 |
| **Total** | 0.50 | 0.33 | 0.17 | 0.71 | 0.37 | 0.34 |

Table 31. Percentage of angling parties catching and harvesting the specified number of walleye and sauger (combined) on an angling trip, by reservoir zone, for Lake Oahe, South Dakota, during the April-October 2005 and 2006 daylight survey periods.

| Number /trip | Catch per trip | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2005 | | | | 2006 | | | |
| | Lower | Middle | Upper | Total | Lower | Middle | Upper | Total |
| **0** | 51 | 17 | 41 | 35 | 64 | 20 | 32 | 37 |
| **0.1-0.9** | 13 | 11 | 6 | 10 | 12 | 11 | 8 | 11 |
| **1.0-1.9** | 12 | 14 | 11 | 12 | 10 | 13 | 12 | 12 |
| **2.0-2.9** | 8 | 11 | 8 | 9 | 7 | 13 | 9 | 10 |
| **3.0-3.9** | 5 | 10 | 5 | 7 | 3 | 5 | 10 | 6 |
| **4.0-4.9** | 5 | 9 | 5 | 7 | 2 | 11 | 13 | 9 |
| **5.0-5.9** | 2 | 7 | 4 | 5 | 1 | 10 | 7 | 6 |
| **6.0-6.9** | 2 | 8 | 8 | 6 | 1 | 5 | 3 | 3 |
| **7.0-7.9** | 1 | 4 | 2 | 3 | 0 | 3 | 2 | 2 |
| **8.0-8.9** | T | 3 | 3 | 2 | 0 | 2 | 1 | 1 |
| **9.0-9.9** | T | 2 | 2 | 1 | 0 | 2 | 1 | 1 |
| **≥10** | 1 | 4 | 5 | 3 | 0 | 5 | 2 | 2 |

| Number /trip | Harvest per trip | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2005 | | | | | | | |
| | Lower | Middle | Upper | Total | Lower | Middle | Upper | Total |
| **0** | 54 | 22 | 47 | 39 | 67 | 26 | 36 | 41 |
| **0.1-0.9** | 11 | 10 | 5 | 9 | 11 | 10 | 8 | 10 |
| **1.0-1.9** | 12 | 15 | 12 | 13 | 9 | 16 | 13 | 13 |
| **2.0-2.9** | 7 | 13 | 8 | 10 | 7 | 15 | 12 | 12 |
| **3.0-3.9** | 5 | 11 | 5 | 8 | 3 | 12 | 12 | 9 |
| **4.0-4.9** | 8 | 12 | 6 | 9 | 3 | 21 | 19 | 15 |
| **5.0-5.9** | 2 | 9 | 4 | 5 | **Daily limit of 4** | | | |
| **6.0** | 1 | 8 | 13 | 7 | | | | |

Angler Demographics and Economic Impacts

Average party size was 2.2 anglers/party and average trip length was 4.6 h, during the April-October 2006 period. Resident anglers averaged 77% of the parties interviewed on Oahe in 2006 (Table 32). In the lower and upper zones of Oahe, 80% of angling parties interviewed were comprised of resident anglers. The middle zone was higher with non-resident anglers at 28 % (72% resident). From 2003 to 2006, the percentage of non-resident angler contacts for middle Oahe were similar among years, while percentages of angler contacts for upper and lower Oahe changed slightly among years.

For the April-October 2006 daytime period, the Lake Oahe fishery had a direct economic impact of 8.2 million dollars based on 134,258 trips at value of $61.00 per trip (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2003).

Three states, Nebraska (32%), Iowa (15%), and Minnesota (18%) had 65% of the non-resident anglers that visited Lake Oahe (Table 33). Nebraska, Iowa, and Minnesota have been the top three, or near, visiting states making up the majority of the out of state visitors to Lake Oahe.

Table 32. Percentage of total angler contacts for resident and non-resident (states combined) anglers fishing Lake Oahe during the April-October daylight period, 2003-2006. N is the number of parties interviewed.

| Zone | | Year | | | |
|---|---|---|---|---|---|
| | | 2003 | 2004 | 2005 | 2006 |
| **Lower** | **N** | 595 | 595 | 591 | 612 |
| | **Residents (%)** | 75 | 83 | 78 | 80 |
| | **Non-residents (%)** | 25 | 17 | 22 | 20 |
| **Middle** | **N** | 797 | 670 | 696 | 862 |
| | **Residents (%)** | 71 | 71 | 73 | 72 |
| | **Non-residents (%)** | 29 | 29 | 27 | 28 |
| **Upper** | **N** | 620 | 471 | 488 | 495 |
| | **Residents (%)** | 76 | 82 | 80 | 80 |
| | **Non-residents (%)** | 24 | 18 | 20 | 20 |
| **Total** | **N** | 2,012 | 1,736 | 1,778 | 1,969 |
| | **Residents (%)** | 74 | 78 | 77 | 77 |
| | **Non-residents (%)** | 26 | 22 | 23 | 23 |

Table 33. Percentage of total non-resident angler contacts for the states listed, for anglers fishing Lake Oahe, South Dakota, during the April-October daylight survey period, 2001-2006.

| State | Percent by Year | | | | | |
|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| **Iowa** | 16 | 18 | 17 | 16 | 16 | 15 |
| **Nebraska** | 13 | 14 | 24 | 39 | 33 | 32 |
| **North Dakota** | 15 | 14 | 8 | 8 | 8 | 7 |
| **Colorado** | 4 | 5 | 5 | 8 | 4 | 7 |
| **Minnesota** | 32 | 30 | 25 | 14 | 23 | 18 |
| **Wisconsin** | 7 | 5 | 6 | 3 | 3 | 6 |
| **Wyoming** | 1 | 2 | 2 | 6 | 1 | 2 |
| **Other*** | 12 | 12 | 13 | 6 | 12 | 16 |

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

County of residence data for South Dakota resident anglers that fished Lake Oahe in 2006 are depicted in Figure 19 through Figure 22. The majority (51%) of resident angler contacts for lower Oahe in 2006 were Hughes and Stanley county residents (Figure 19). No one county dominated resident angler contacts for middle Lake Oahe, though anglers from Hughes, Minnehaha, Beadle, Potter, Codington, and Pennington Counties were well represented (Figure 20).
Anglers from Walworth County comprised 49% of resident angler contacts in upper Oahe with Brown County residents accounting for 21% of the total resident angler contacts in this zone (Figure 21). For the total Oahe sample in 2006, the highest percentage of resident angler contacts for one county was for Hughes County, at 19%, followed by Walworth and Minnehaha Counties at 13% and 9%, respectively (Figure 22).

Not surprisingly, the counties with the highest percentage of resident angler contacts are also areas either close to Lake Oahe or supporting major population centers (Table 34). High percentages of total resident angler contacts for Hughes and Walworth Counties are due to the close proximity of Pierre and Mobridge to Lake Oahe, while the percentage of Minnehaha and Pennington County residents in the sample of total resident angler contacts is due to the large populations of Sioux Falls and Rapid City, respectively. Approximately 35% of angling parties contacted during the standard April-October angler survey traveled in excess of 200 miles, one way, to fish Lake Oahe (Table 35), a value lower than other years in the 2001-2006 period.

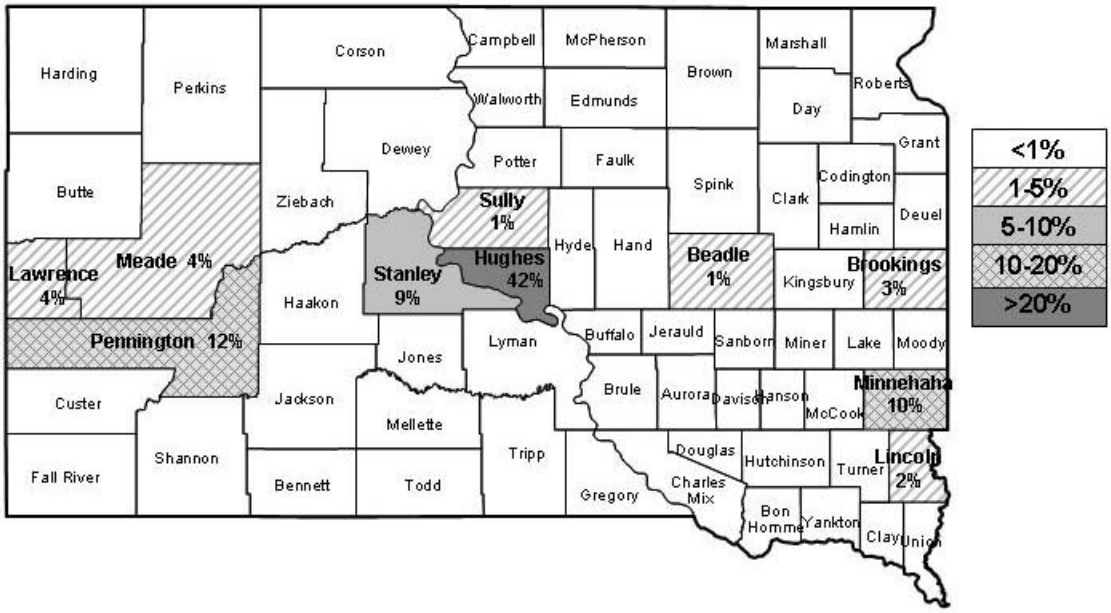


Figure 19. County of residency for South Dakota residents fishing lower Lake Oahe during the April-October 2006 daylight survey period.

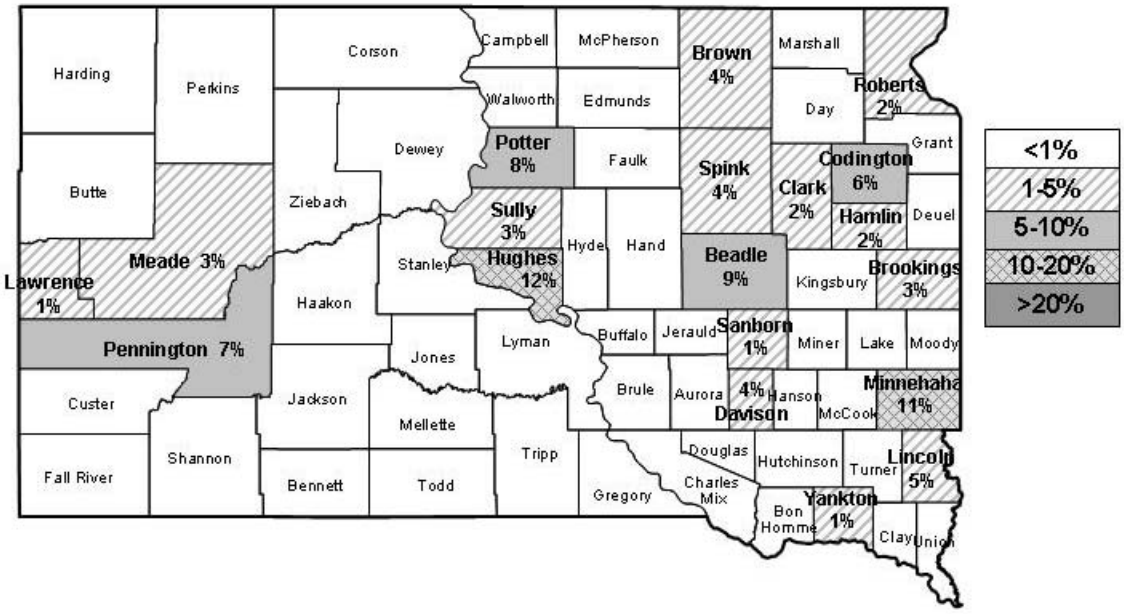


Figure 20. County of residency for South Dakota residents fishing middle Lake Oahe during the April-October 2006 daylight survey period.

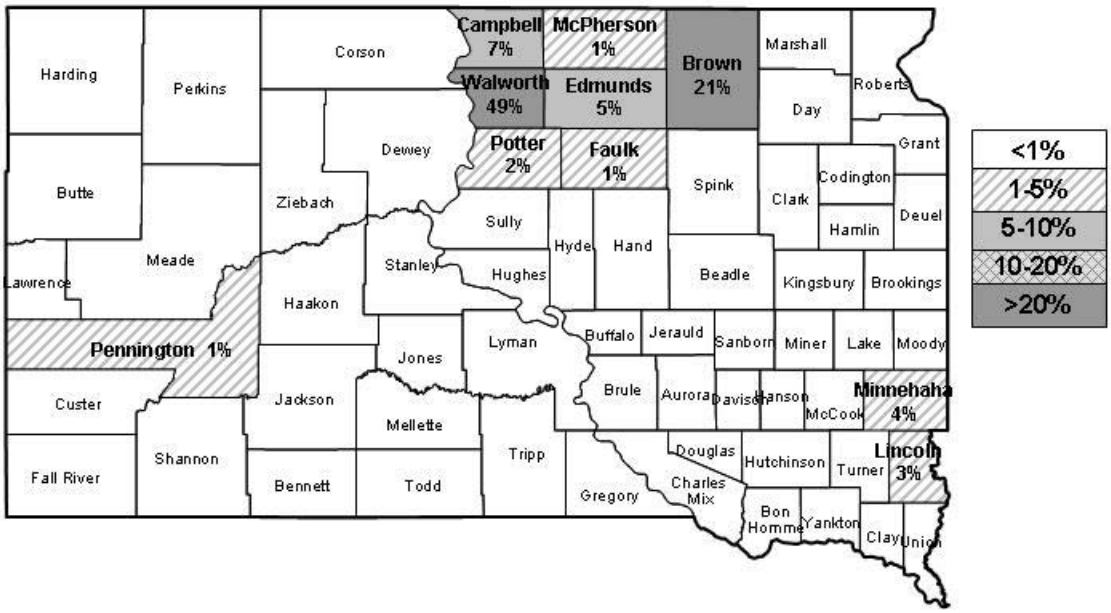


Figure 21. County of residency for South Dakota residents fishing upper Lake Oahe during the April-October 2006 daylight survey period.

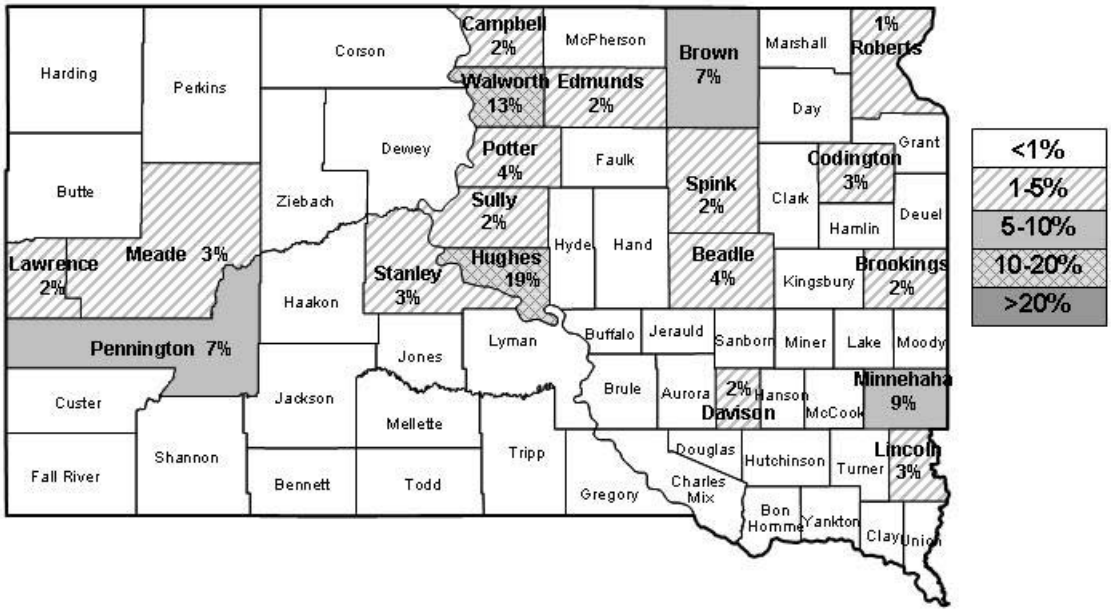


Figure 22. County of residency for South Dakota residents fishing Lake Oahe during the April-October 2006 daylight survey period.

Table 34. Percentage of total angler contacts on Lake Oahe by residents of the counties listed, for anglers fishing Lake Oahe, South Dakota, during the April-October daylight survey period, 2003-2006.

| County | Major city | Percent by Year | | | |
|---|---|---|---|---|---|
| | | 2003 | 2004 | 2005 | 2006 |
| **Beadlle** | Huron | 4 | 3 | 5 | 4 |
| **Brown** | Aberdeen | 8 | 9 | 9 | 7 |
| **Campbell** | Pollock | 7 | 3 | 2 | 2 |
| **Codington** | Watertown | 3 | 2 | 4 | 3 |
| **Davison** | Mitchell | 2 | 2 | 2 | 2 |
| **Hughes** | Pierre | 17 | 25 | 17 | 19 |
| **Minnehaha** | Sioux Falls | 8 | 9 | 9 | 9 |
| **Pennington** | Rapid City | 7 | 6 | 7 | 7 |
| **Potter** | Gettysburg | 6 | 4 | 5 | 4 |
| **Stanley** | Fort Pierre | 2 | 2 | 3 | 3 |
| **Sully** | Onida | 2 | 2 | 1 | 2 |
| **Walworth** | Mobridge | 13 | 16 | 13 | 13 |
| **Other** | | 21 | 17 | 23 | 25 |

Table 35. Percentage of anglers driving the specified distances, one way, to fish Lake Oahe, South Dakota, during the April-October daylight survey period, 2001-2006.

| Distance (miles) | Percent by Year | | | | | |
|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| **<25** | 29 | 24 | 25 | 27 | 22 | 23 |
| **25-49** | 2 | 7 | 8 | 11 | 10 | 11 |
| **50-99** | 10 | 12 | 4 | 5 | 4 | 9 |
| **100-199** | 18 | 14 | 19 | 18 | 22 | 22 |
| **≥200** | 41 | 43 | 44 | 39 | 42 | 35 |

The majority of anglers fishing Lake Oahe were targeting walleye (75%) during the April-October period in 2006, while 9% of parties were not fishing for a particular species (Table 36). The percentage of angler parties interviewed that were specifically fishing for Chinook salmon increased to 13% in 2006, from values between 1% and 6% during the 2002-2005 period..

Table 36. Target species of anglers fishing Lake Oahe, South Dakota, during the April-October daylight survey period, expressed as percent of total, 2002 - 2006. T (trace) indicates values > 0.0 but < 0.5.

| Target species | Percent by Year | | | | |
|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2005 | 2006 |
| **Walleye** | 78 | 75 | 82 | 78 | 75 |
| **Anything** | 14 | 15 | 13 | 12 | 9 |
| **Chinook salmon** | 4 | 5 | 1 | 6 | 13 |
| **Northern pike** | 4 | 4 | 2 | 2 | 2 |
| **White bass** | T | 0 | T | T | 0 |
| **Channel catfish** | T | 1 | 1 | 1 | 1 |
| **Smallmouth bass** | T | T | 1 | T | T |

Angler Satisfaction and Attitudes

Anglers' attitudes about fishing, their preferences concerning management issues and their level of satisfaction are important components of the total fishery survey. Historically, fisheries managers have primarily focused on understanding biological aspects of fish populations and monitoring sport fish harvest and use. Recently, biologists have realized the necessity and value of understanding angler attitudes, levels of satisfaction, and preferences. Consequently, more attitude, preference and satisfaction data have been collected during recent years. The following results build on angler preference and attitude survey data collected previously for the Lake Oahe fishery.

How anglers feel about their fishing experience is important to the success of a fishery. Angler responses help evaluate if current management practices and regulations are providing a fishery that meets angler needs and expectations.

The overall satisfaction of anglers interviewed during 2006 was "slightly satisfied. Overall satisfaction on Lake Oahe during the April-October period of 2006 was at 61% (Table 37), a value lower than the Lake Oahe plan objective of 70%. Trip satisfaction generally increases with the percentage of the daily limit attained by anglers. Median satisfaction rating for angling parties that harvested 2.0 to 3.9 walleye per person was "moderately satisfied", while for parties harvesting a daily limit of four walleyes per person, median rating was "highly satisfied" (Table 38).

Table 37. Responses of Lake Oahe anglers who were asked the following question during the April-October 2006 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

| Month | Satisfaction rating | | | | | | | | N | Median |
|---|---|---|---|---|---|---|---|---|---|---|
| | Satisfied | | | Neutral | Dissatisfied | | | N.O. | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| **April** | 15 | 32 | 22 | 19 | 14 | 21 | 3 | 1 | 126 | 3 |
| **May** | 73 | 46 | 35 | 31 | 28 | 21 | 6 | 5 | 240 | 3 |
| **June** | 244 | 129 | 80 | 87 | 45 | 29 | 29 | 2 | 643 | 2 |
| **July** | 116 | 96 | 76 | 57 | 54 | 50 | 32 | 6 | 481 | 3 |
| **August** | 23 | 22 | 24 | 27 | 29 | 17 | 14 | 1 | 156 | 4 |
| **September** | 25 | 30 | 35 | 26 | 17 | 25 | 7 | 7 | 165 | 3 |
| **October** | 37 | 17 | 15 | 18 | 28 | 10 | 6 | 6 | 132 | 3 |
| **Total** | 533 | 372 | 287 | 265 | 215 | 173 | 97 | 25 | 1,942 | 3 |
| **Percent** | | 61 | | 14 | | 25 | | | | |

Table 38. Responses of Lake Oahe anglers who were asked the following question during the April-October 2006 daylight survey period: "Considering all factors, how satisfied are you with your fishing trip today?" compared to the average number of walleye harvested per trip. 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

| Walleye/ angler | Satisfaction rating | | | | | | | | N | Median |
|---|---|---|---|---|---|---|---|---|---|---|
| | Satisfied | | | Neutral | Dissatisfied | | | N.O. | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| **0** | 113 | 146 | 121 | 121 | 105 | 110 | 76 | 20 | 792 | 4 |
| **0-0.9** | 13 | 23 | 29 | 37 | 34 | 36 | 16 | 4 | 188 | 4 |
| **1.0-1.9** | 41 | 41 | 52 | 50 | 46 | 18 | 2 | 1 | 250 | 3 |
| **2.0-2.9** | 70 | 50 | 43 | 35 | 24 | 4 | 2 | 0 | 228 | 2 |
| **3.0-3.9** | 90 | 40 | 25 | 18 | 5 | 4 | 0 | 0 | 182 | 2 |
| **4.0 (limit)** | 204 | 70 | 17 | 4 | 1 | 1 | 0 | 0 | 297 | 1 |
| **Percent** | | 61 | | 14 | | 25 | | | | |

When the percentage of angling parties expressing some degree of satisfaction is plotted against the average harvest per angler, in terms of percent of the daily limit attained, a significant positive correlation exists (Figure 23). Anglers often set their expectations for their ability to harvest fish based on the daily limit currently in effect. Examination of Figure 23 indicates that for Lake Oahe, during the 1996-2006 time period, average harvest per angler needed to exceed 40% of the daily limit for the percentage of anglers expressing some degree of satisfaction with their trip to equal or exceed the 70% plan objective. When the daily limit was 10 fish per day in 2002 and 2003, but hourly walleye catch rates were 0.59 and 0.42 fish/angler-h, respectively (Table 29), the ability of anglers to harvest at least 40% of the daily limit was low, resulting in a low percentage of anglers expressing some degree of satisfaction with their trip.

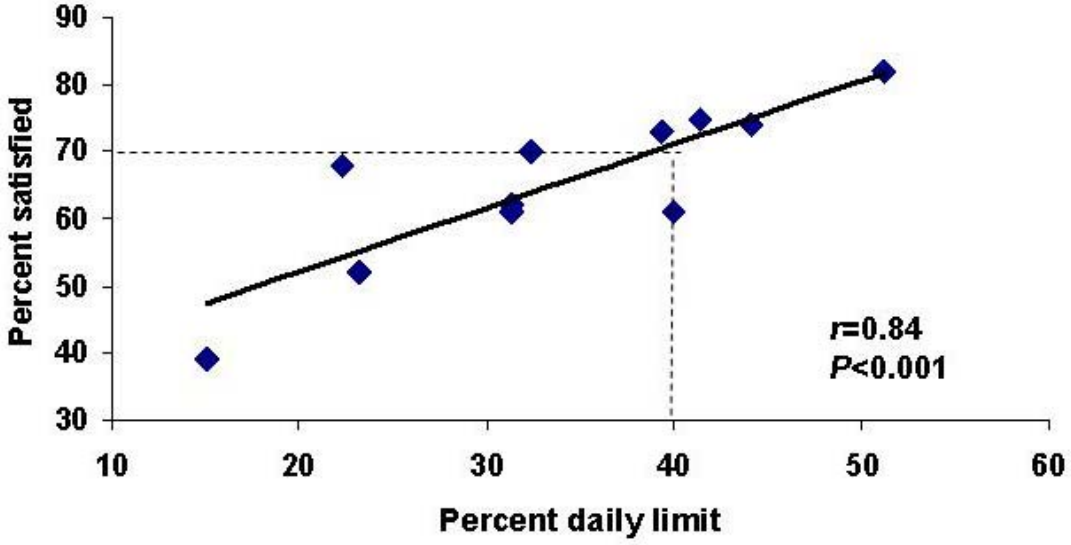


Figure 23. Angler percent satisfied against harvest per trip, as percent daily limit. Years included in analysis 1996 to 2006.

In addition to the question on angler satisfaction, anglers were asked one of two questions, regarding their fishing trip. Anglers were either asked where they were staying on their current fishing trip or how often they used fish cleaning stations equipped with grinders to clean their fish (Appendix 3).

Approximately 34% of angling parties interviewed during the April-October 2006 survey period were staying at home, while 14% were staying at a private residence not their home (Table 39). For anglers not staying at a private residence, the highest percentage stayed at private campgrounds (22%), followed by motels (16%), and State parks (9%).

Almost half (49%) of angling parties interviewed stated they used fish cleaning stations equipped with grinders all the time, while 23% stated they used them most of the time (Table 40). Only 10% of respondents stated they never use fish cleaning stations equipped with grinders.

Table 39. Percentage of anglers interviewed during the April-October 2006 daytime survey on Lake Oahe that indicated where they are staying.

| Place of stay | Percent | N |
|---|---|---|
| Home | 34 | 342 |
| Private residence | 14 | 133 |
| Private campground | 22 | 223 |
| Motel | 16 | 159 |
| State park | 9 | 93 |
| Unknown | 5 | 46 |

Table 40. Responses of anglers fishing Lake Oahe during the April-October 2006 daytime period that use state owned fish cleaning stations.

| Use of fish cleaning stations | Percent | N |
|---|---|---|
| Always | 49 | 474 |
| Most of time | 23 | 220 |
| Sometimes | 9 | 91 |
| Rarely | 7 | 66 |
| Never | 10 | 96 |
| Unknown | 2 | 26 |

## OAHE DAM SALMON SURVEY

The Oahe Dam (i.e. West Shore) salmon survey was conducted from 1993 to 2000 during June-August daylight periods. The creel survey was suspended from 2001 to 2005 due to reduced abundance of salmon available to anglers that included a two-year period (2001 and 2002) when no salmon were stocked. The salmon creel was reinitiated in July 2006. The average size of salmon harvested during July of 2006 was the largest since 1993 and harvest rates were similar to the mid 1990's when salmon fishing pressure was high (Table 41.). Strong correlations of large average size and increased catch rates of Lake Oahe Chinook salmon have been shown to be the driving factors that increase salmon angling pressure (Lott et. al. 2001). Large average size and increased catch rates likely caused the upsurge in salmon fishing pressure in 2006. Salmon anglers harvested 87% of the fish they caught (Table 42). The Chinook salmon program is a put, grow, and take fishery with high harvest rates and a daily limit of 5 fish with no size limit. However anglers are encouraged to release small salmon when water temperatures are below 21 C to maintain salmon stocks.

Table 41. Results of the 3-month salmon angler use and harvest survey near the face of the Oahe dam, 1993-2000 and July of 2006.

| Statistics | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2006 |
| Fishing pres. (h) | 37,194 | 38,437 | 45,836 | 55,212 | 27,486 | 27,561 | 15,027 | 15,570 | 9,510 |
| Harvest | 2,778 | 4,346 | 7,402 | 8,588 | 2,709 | 1,697 | 1,441 | 1,203 | 1,081 |
| Ave. weight (g) | 3,007 | 2,313 | 2,381 | 2,220 | 2,161 | 2,207 | 1,771 | 1,960 | 2,858 |
| Harvest rate (fish/h) | 0.075 | 0.113 | 0.161 | 0.156 | 0.099 | 0.062 | 0.096 | 0.077 | 0.114 |
| Catch rate (fish/h) | | | | | | | | | 0.130 |

**Column in gray is the month of July creel.**

Table 42. Estimated number of salmon caught, harvested, and released during the July daylight period, for salmon anglers fishing near Oahe Dam on Lake Oahe, South Dakota, 2006.

| Year | Caught | Harvested | Released | Percent harvested |
|---|---|---|---|---|
| **2006** | 1,237 | 1,081 | 156 | 87 |

Biological data from 90 coded-wire tagged (CWT) Chinook salmon were collected from anglers throughout 2006, to provide information on age, growth, hatchery rearing test groups, and stocking and rearing history (Table 43). Approximately 63% of the CWT salmon collected from angler-caught fish were age-3. Mean weight of age-3 fish was 3,639 g, or approximately 8 pounds.

Table 43. Age composition, length, and weight of coded-wire-tagged Chinook salmon caught by anglers in 2006.

| Age | Brood year | Number | Mean length (mm) | Range | Mean weight (g) | Range |
|---|---|---|---|---|---|---|
| **1** | **2005** | | | | | |
| **2** | **2004** | 27 | 517 | 381-966 | 1,043 | 590-1,500 |
| **3** | **2003** | 57 | 717 | 610-838 | 3,639 | 1,364-6,810 |
| **4** | **2002** | 6 | ---- | ------- | 4,860 | 3,182-6,051 |

Salmon Angler Satisfaction and Demographics

During the July Oahe Dam angler use and harvest survey, the overall median angler trip rating was "slightly satisfied" (median=3; Table 44). A median trip rating of slightly satisfied was surprising with good catch rates (0.11 fish/hour) and increased average size of salmon harvested (2,858 g; Table 41). A breakdown of the angler satisfaction rating was completed for groups that harvested no salmon (Table 45) and those groups that harvested at least 1 salmon per trip (Table 46). Anglers that did not harvest a salmon gave a neutral satisfaction rating (median=4) with only 27% of the anglers giving a satisfied rating. Salmon anglers that harvested at least one salmon gave a satisfied rating (median=3) with 75% of the anglers satisfied with there fishing trip. The angling satisfaction question is worded, "Considering all factors, how would you rate your fishing trip today?" The "all factors" leaves the response open to additional factors over and above whether a fish was harvested or not. For example, a low satisfaction trip rating could be related to no salmon harvested, hot July temperatures and biting flies. These were some of the factors that likely reduced angler satisfaction when no fish were harvested.

During the July 2006 daylight period, 21% of the salmon angling trips were by nonresidents and 79% were by residents (Table 47). For all anglers interviewed, approximately 1/3 of the anglers traveled less than 25 miles. Sixty-seven percent of the anglers traveled in excess of 100 miles, one way, and 42% of the anglers traveled in excess of 200 miles, one way (Table 48) to fish salmon.

Table 44. Responses of Lake Oahe salmon anglers who were asked the following question during the July 2006 daylight survey period: "Considering all factors, how satisfied are you with your fishing trip today?" 1 = very satisfied, 2 = moderately satisfied, 3 = s slightly satisfied, 4 = neutral, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

| Month | Satisfaction rating | | | | | | | | N | Median |
|---|---|---|---|---|---|---|---|---|---|---|
| | Satisfied | | | Neutral | Dissatisfied | | | N.O. | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| **July** | 7 | 19 | 18 | 18 | 7 | 7 | 9 | 0 | 85 | 3 |
| **Percent** | | 52 | | 18 | | 27 | | | | |

Table 45. Responses of Lake Oahe salmon anglers that harvested no salmon, who were asked the following question during the July 2006 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

| Month | Satisfaction rating | | | | | | | | N | Median |
|---|---|---|---|---|---|---|---|---|---|---|
| | Satisfied | | | Neutral | Dissatisfied | | | N.O. | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| **July** | 2 | 4 | 5 | 11 | 6 | 4 | 9 | 0 | 41 | 4 |
| **Percent** | | 27 | | 27 | | 46 | | | | |

Table 46. Responses of Lake Oahe salmon anglers, that harvested >1 salmon, who were asked the following question during the July 2006 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, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and 8 = no opinion (N.O.). N is sample size and does not include "no opinion" responses.

| Month | Satisfaction rating | | | | | | | | N | Median |
|---|---|---|---|---|---|---|---|---|---|---|
| | Satisfied | | | Neutral | Dissatisfied | | | N.O. | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| **July** | 5 | 15 | 13 | 7 | 1 | 3 | 0 | 0 | 44 | 3 |
| **Percent** | | 75 | | 16 | | 9 | | | | |

Table 47. Percentage of total non-resident angler contacts for the states listed, for anglers interviewed as part of the Oahe Dam salmon angler use and harvest survey on Lake Oahe, South Dakota, during July 2006.

| State | Number | Percent |
|---|---|---|
| **Residents** | 67 | 79 |
| **Nonresidents** | 18 | 21 |
| **Total** | 85 | 100 |

*Nonresidents includes California, Iowa, Nebraska, North Dakota and Wyoming.

Table 48. Percentage of anglers driving the specified distances, one way, to fish salmon on Lake Oahe, South Dakota, during July daylight survey period, 2006.

| Distance (miles) | Percent by year |
|---|---|
| | 2006 |
| **<25** | 32 |
| **25-49** | 1 |
| **50-99** | 0 |
| **100-199** | 25 |
| **≥200** | 42 |

2005 and 2006 Chinook Salmon Stomach Contents

In 2005, a coldwater netting strata, 18-27m, was added to the Oahe adult fish population survey depending on depth availability. The sample locations with the coldwater netting strata included Peoria Flats, Cow Creek, Bush's Landing and Whitlocks Bay. In 2005, salmon stomach contents were examined at one location and in 2006 Chinook salmon stomachs were examined at four locations. Two of the four Chinook salmon stomachs examined in 2005 contained multiple gizzard shad (Table 49). In 2006, 4 of the 6 Chinook salmon stomachs checked contained at least one rainbow smelt.

Table 49. Chinook salmon collected and stomach contents identified during adult fish population survey, August 2005 and 2006.

| Year | Location | Length | Weight | Stomach contents |
|---|---|---|---|---|
| 2005 | Bush's | | | 8 Age-0 Gizzard Shad |
| 2005 | Bush's | | | 12 Age-0 Gizzard Shad |
| 2005 | Bush's | | | Empty |
| 2005 | Bush's | | | Empty |
| 2006 | PEO | 469 | 2866 | Empty |
| 2006 | COC | 530 | 1511 | 9 RBS |
| 2006 | COC | 285 | 231 | 14 RBS |
| 2006 | BUS | 777 | 4867 | 1 RBS |
| 2006 | BUS | 729 | 3840 | 1 RBS |
| 2006 | WHB | 793 | 5119 | Empty |
| 2006 | WHB | 529 | 1297 | Empty |

## FISHERY STATUS AND 2007 OUTLOOK

The Lake Oahe walleye population is currently in better balance with available prey resources than it was during the 1997-2002 period. Walleye condition, as indexed by *Wr*, has been gradually increasing since 2000 and is nearing the objective range of 90-100 (Table 11). Natural production of gizzard shad has annually occurred since at least 2001, with shad being the most abundant species in seine catches since 2003 (Table 7). Rainbow smelt abundance and biomass was higher in 2005-2006 than during 2000 and 2001(Table 18) and the addition of gizzard shad has increased the diversity of prey resources available to predators. Mean length at capture of age-5 walleyes in August was significantly higher in 2006 than during the 2002-2005 period (Table 12).

Natural recruitment of walleye in Lake Oahe generally occurs annually in upper and middle Oahe, while recruitment in lower Oahe is rare. From the mid 1980's through 1998, small walleye fingerlings were stocked in lower and middle Oahe to supplement natural reproduction. Riis (1983) first documented the trend of low walleye recruitment in lower Oahe and stocking efforts were aimed at increasing walleye abundance and population stability. Stocking was ceased after 1999 because large year classes produced in all areas of Lake Oahe in 1994 and 1995 were beginning to dominate the population (Figure 5) and prey resources were becoming limited (Lott et al. 2001, 2002). Current walleye abundance index values (Table 8), stock density indices values (Table 10), walleye harvest estimated (Table 25), and catch and harvest per trip frequencies (Table 31), for lower Oahe, all point to the need to increase the stability of walleye recruitment in lower Oahe. Mean hourly catch rates of walleye by anglers for the 2006 angler survey, for lower, middle, and upper Oahe were 0.11, 0.66, and 0.54 fish/angler-h, respectively. An hourly catch rater of only 0.11 walleye/angler-h will not generate the level of angler use expected from lower Oahe.

Recruitment in middle and upper Oahe has been sufficient to maintain walleye abundance index values and hourly angler catch rates of walleye within the desired ranges. The 2005 walleye year class, produced mostly in middle Oahe, has the potential to result in a moderate-to-high level of recruitment for the population. Age-0 gill net CPUE of 0.5 fish/net-night for the 2005 year class was indicative of low recruitment (Table 15 and Figure 4), possibly because many fish in the year class were too small to be effectively collected during August as age-0 fish. While CPUE at age-0 may show some indication of future year class strength, CPUE at age-1 is still a better indicator of year class strength.

Estimated angler hours and walleye harvest for the April-October 2006 period was relatively low when compared with other years in the 1991-2006 period (Table 19). Hourly catch rates of walleye are excellent and the average length of a walleye harvested in 2006 was approximately 17 inches, indicating a quality fishery. However, other quality fisheries have developed in South Dakota that may be drawing angler trips that once would have been spent on Lake Oahe.

Angler use of the Chinook salmon fishery in 2006 increased from 2005 and the hourly catch rate of salmon by salmon anglers, at 0.34 fish/angler-h, should help angler use of this fish population to continue to increase, after a period of low use associated with no stockings being made in 2001 or 2002. Angler use and harvest survey efforts for the salmon fishery should be increased if manpower is available, to better document the contribution of this fishery to the overall Lake Oahe fishery.

# MANAGEMENT RECOMMENDATIONS

1. Develop a new Lake Oahe Strategic Plan by June 2008 which includes:
    - Reviewing adequacy of current management plan and objectives
    - Developing management objectives for channel catfish and gizzard shad
    - Removing rainbow trout from the list of management species in Lake Oahe
2. Expand efforts to document characteristics of gizzard shad population structure and dynamics and role in the Lake Oahe predator-prey system
3. Investigate possible reasons for low walleye recruitment in lower Lake Oahe and investigate possible stocking options to supplement natural reproduction.
4. Continue to conduct annual creel and angler harvest surveys.
5. Continue to conduct annual fish population surveys.
6. Incorporate all rainbow smelt surveys into the annual Lake Oahe report and work to develop age structure and growth estimates for the rainbow smelt population..
7. Continue to stock Chinook salmon and evaluate the contribution of stocked salmon to the fishery.
8. Re-establish the Oahe Dam salmon creel to evaluate stocking strategies and attainment of management objectives for the salmon fishery.

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# APPENDICES

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

| Common name | Scientific name |
|---|---|
| Bigmouth buffalo | *Ictiobus cyprinellus* |
| Black bullhead | *Ictalurus melas* |
| Black crappie | *Pomoxis nigromaculatus* |
| Brassy minnow | *Hybognathus hankinsoni* |
| 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* |
| Johnny darter | *Etheostoma nigrum* |
| Lake herring | *Coregonus artedii* |
| Largemouth bass | *Micropterus salmoides* |
| Northern pike | *Esox Lucius* |
| Rainbow smelt | *Osmerus mordax* |
| Rainbow trout | *Oncorhynchus mykiss* |
| River carpsucker | *Carpiodes carpio* |
| Red shiner | *Cyprinella lutrensis* |
| Sauger | *Sander canadense* |
| Shorthead redhorse | *Moxostoma macrolepidotum* |
| Shortnose gar | *Lepisosteus platostomus* |
| Shovelnose sturgeon | *Scaphirynchus platorynchus* |
| Smallmouth bass | *Micropterus dolomieu* |
| Smallmouth buffalo | *Ictiobus bubalus* |
| Spottail shiner | *Notropis hudsonius* |
| Walleye | *Sander vitreus* |
| White bass | *Morone chrysops* |
| White crappie | *Pomoxis annularis* |
| White sucker | *Catostomus commersoni* |
| Yellow perch | *Perca flavescens* |

Appendix 2. White bass and yellow perch proportional stock density (PSD) relative stock density of preferred-length (RSD-P) fish and memorable-length (RSD-M) fish, and mean relative weight (*Wr*) values, for 1997-2006, for fish collected in the standard August gill net survey, on Lake Oahe, South Dakota. Mean *Wr* values for 2002-2006 are for stock-length fish only.

**White bass**

| Year | PSD | RSD-P | RSD-M | *Wr* | Sample size |
|---|---|---|---|---|---|
| 1997 | 100 | 59 | 3 | 93 | 186 |
| 1998 | 95 | 62 | 2 | 89 | 188 |
| 1999 | 100 | 82 | 2 | 89 | 170 |
| 2000 | 99 | 86 | 1 | 85 | 121 |
| 2001 | 100 | 91 | 3 | 92 | 149 |
| 2002 | 68 | 65 | 5 | 88 | 140 |
| 2003 | 100 | 38 | 1 | 93 | 127 |
| 2004 | 90 | 67 | 2 | 93 | 88 |
| 2005 | 100 | 67 | 33 | 100 | 11 |
| 2006 | 100 | 78 | 17 | 99 | 18 |

**Yellow perch**

| Year | PSD | RSD-P | RSD-M | *Wr* | Sample size |
|---|---|---|---|---|---|
| 1997 | 33 | 0 | 0 | 91 | 296 |
| 1998 | 58 | 1 | 0 | 83 | 103 |
| 1999 | 57 | 6 | 0 | 89 | 63 |
| 2000 | 44 | 5 | 0 | 86 | 63 |
| 2001 | 55 | 6 | 0 | 90 | 65 |
| 2002 | 40 | 14 | 0 | 80 | 35 |
| 2003 | 26 | 3 | 0 | 84 | 63 |
| 2004 | 30 | 5 | 0 | 82 | 43 |
| 2005 | 13 | 1 | 0 | 87 | 49 |
| 2006 | 10 | 0 | 0 | 81 | 63 |

Appendix 3. Angler satisfaction, preference, and attitude questions asked as part of the April-October 2006 angler use and harvest survey on Lake Oahe, South Dakota.

**Trip Satisfaction:**

Considering all factors, how satisfied are you with your fishing trip today?

1 = Very satisfied
2 = Moderately satisfied
3 = Slightly satisfied
4 = Neutral *(neither satisfied or dissatisfied)*
**5 = Slightly dissatisfied**

6 = Moderately dissatisfied
7 = Very dissatisfied
8 = No opinion

**Facility Use Questions:**

1. Where are you staying on this trip: (circle)

State Park Motel Private Camp Private Residence Home

2. When fishing the Missouri River system, how often do you use fish cleaning stations equipped with grinders and running water to clean the fish you keep? (circle)

Always Most of the time Sometimes Rarely Never